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Government of India

VOLUME II
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INDIA TRANSPORT REPORT

MOVING INDIA TO 2032

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NATIONAL TRANSPORT DEVELOPMENT POLICY COMMITTEE

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Government of India
National Transport Development
Policy Committee
भारत सरकार
राष्ट्रीय परिवहन विकास नीति समिति

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January 31, 2014

Dear Hon'ble Prime Minister

I have great pleasure in submitting to you the Report of the National Transport Development Policy Committee.

I regret very much the great delay in submission of this report. Covering all the transport sectors in detail, while also addressing the various cross cutting issues, entailed a large amount of technical work, which proved to be time consuming. Much of the sectoral work was accomplished through the appointment of corresponding working groups. We also examined international best practice to inform our work; consulted state governments and other stakeholders; and commissioned research studies and papers on specific topics.

Projecting transport requirements and policy over a twenty year horizon is a complex task. This was made more difficult in the current circumstances of an economic slowdown. In our projections we have, however, assumed that the pace of overall economic growth will return to its potential in the coming years and ensuing decades. Transport investment is a response to emerging demand, but it is also an economic growth driver in itself. Transport planning and provision therefore must be seen as central to the growth planning process. That all modes of the country's transport network are under severe pressure is clearly evident. It will be difficult to achieve the kind of growth envisaged if adequate transport investment is not made in an efficient and timely manner.

We find that there has been an accelerating shift of traffic from the railways in favour of roads, partly in response to the stepped up allocation of resources to the roads sector. A massive effort is now required to carry out a similar enhancement of investment in the railways, which will also involve very significant modernization and reorganization, and will also lead to greater environmental sustainability.

The next two decades will witness very significant changes in energy prices, in the discovery and application of new technologies, demographic shifts, and in consumer requirements and tastes in transport. Any projections and policy recommendations made now are almost certain to need modification over time. We have therefore emphasized the importance of institution building for transport governance and of the need for capacity building in the human resources area to raise the level of skills and professional knowledge in the sector, and for research and development. We have also placed special emphasis on institution building and measures for the promotion of safety in all transport modes, and for protection of the environment.

A particular focus of the report is highlighting the need to achieve much greater transportation integration with the South and South East Asia regions. In a world characterized by rapidly increasing economic linkages between countries our region stands out as being among the least integrated. This must be repaired.

Our vision is that a well-developed and competent institutional system for planning, management and execution of transport should be in place as soon as possible, as it blends investment in and delivery of transport services by the public, private and joint sectors alike. The Report abstracts from current methodologies to solve today's problems, while forging a coherent strategy for the transport sector as a whole and for each of the modes of travel.

To meet the needs of India in the 21st century, radical structural change is necessary along with a new strategy for investment.

I would like to acknowledge the generous help and time given by all Members of the NTDPC, the staff of the secretariat, and many other colleagues.

With warm regards,

Yours sincerely,

(Rakesh Mohan)

Dr. Manmohan Singh,
Prime Minister of India
South Block,
New Delhi.

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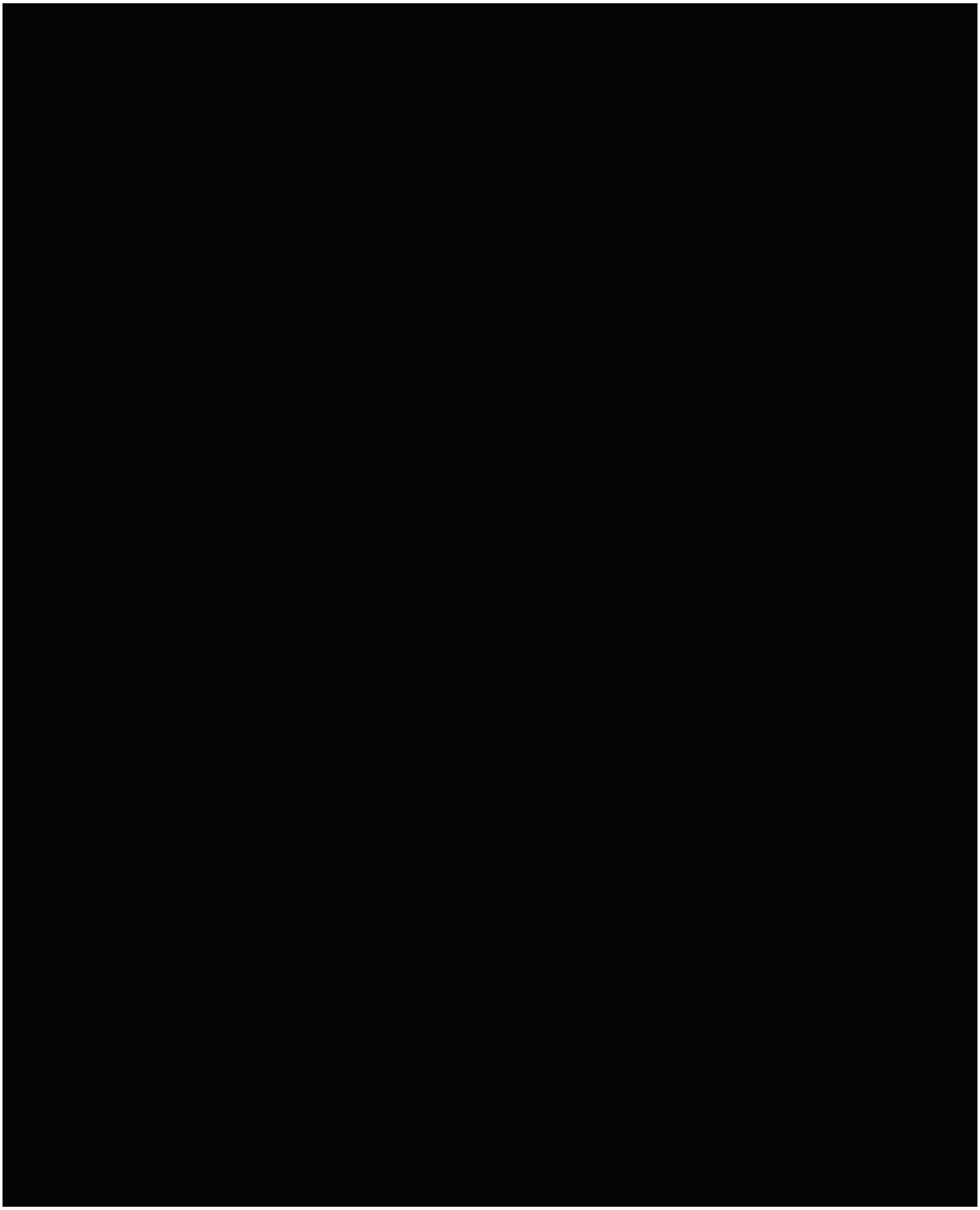

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PREFACE

The Government of India set up a High Level National Transport Development Policy Committee (NTDPC) on February 11, 2010. The main objective of setting up this Committee was to develop long term national transport policy (with a twenty year horizon) which facilitates overall growth and efficiency in the economy, while minimising energy use and effects on climate change. A somewhat similar Committee constituted by the Government to look at long term transport policy was the National Transport Policy Committee under the chairmanship of Shri B.D Pande, a former Cabinet Secretary. That committee submitted its report to the Government in May, 1980. This was followed up by the Steering Committee on Perspective Planning for Transport Development in 1988.

The Constitution of the NTDPC and its terms of reference are at Annex P.1.

At the outset, I would like to express my deepest appreciation to the Prime Minister and Shri Montek Singh Ahluwalia, Deputy Chairman, Planning Commission for having the vision to constitute the NTDPC and then providing it with all the support that was essential for its functioning throughout its long tenure. The Committee was initially given a tenure of 18 months. Because of the complexity of the task and volume of work, its tenure had to be repeatedly extended and we are grateful to the Government for having the patience and understanding to allow us to complete our work to our satisfaction.

I would also like to express my gratitude to the Member Secretary of the Planning Commission and the team of officers and staff from both the Administration as well as Transport Divisions, from whom the Committee received utmost cooperation in the initial days of its life while setting up the secretariat, conducting meetings and appointing officials and staff. Smt. Vini Mahajan, Joint Secretary, Prime Minister's Office provided excellent guidance and support in the setting up of the Committee.

This is the third Committee on infrastructure issues which I have had the privilege to be associated with. The first was the Expert Group on Commercialisation of Infrastructure Projects which issued the *India Infrastructure Report* in June 1996. The second was the Expert Group on Indian Railways which issued the *Indian Railways Report* in July, 2001. The work involved in the current report has been the most complex by far and has involved a very large number of institutions and individuals in its preparation. I would like to record my personal gratitude to all the institutions and experts who have contributed to the preparation of this report.

The work of the Committee was greatly facilitated by the generous provision of excellent office facilities and infrastructure support provided by the Infrastructure Development Finance Company (IDFC) in their New Delhi offices. A very special word of thanks for this generous gesture goes to Shri Deepak Parekh, Chairman of the IDFC at the inception of the NTDPC, and Dr. Rajiv Lall, then CEO & MD, and now Executive Chairman.

The Committee held 21 meetings over the period of almost 4 years of its existence, mostly on Saturdays. A list of the dates on which the meetings were held and the venue are given below.

1. March 15, 2010, Planning Commission
2. May 18, 2010, Planning Commission
3. June 26, 2010, Planning Commission
4. July 31, 2010, Rail Bhavan
5. August 21, 2010, Rail Bhavan
6. October 28, 2010, Metro Bhavan
7. January 8, 2011, Rajiv Gandhi Bhavan
8. February 12, 2011, Planning Commission
9. March 26, 2011, Rail Bhavan
10. May 14, 2011, Rail Bhavan
11. June 11, 2011, Rail Bhavan
12. June 18, 2011, Rail Bhavan
13. November 19, 2011, Rail Bhavan
14. March 31, 2012, Rail Bhavan
15. July 7, 2012, Rail Bhavan
16. July 28, 2012, Rail Bhavan
17. January 5, 2013, Rail Bhavan
18. February 23, 2013, Planning Commission
19. July 15, 2013, Rail Bhavan
20. August 19, 2013, Rail Bhavan
21. November 30, 2013, Rail Bhavan

The NTDPC is grateful to the respective Chairmen, Railway Board, for hosting most of the meetings of the Committee.

We are also grateful to the Government of South Africa for having graciously hosted the Committee, during their visit to South Africa between March 19-28, 2012. The team benefited from the deliberations and interaction with the Deputy Minister of Transport as well as from their field visits.

INTERIM REPORT OF THE NTDPC

In view of the length of time that it has taken us to prepare the Final Report of NTDPC, Shri Montek Singh Ahluwalia, Deputy Chairman, Planning Commission, requested the NTDPC to submit an Interim Report so that could be used in the preparation of the 12th Five Year Plan. A number of NTDPC Members contributed to its preparation, which was coordinated by Shri B.N. Puri, Member Secretary. Shri Rishab Sethi contributed significantly to its preparation. The Report was submitted in April, 2012 (http://planningcommission.nic.in/sectors/NTDPC/Interim%20Report_NTDPC_2012.pdf).

I am grateful to all members of the NTDPC and their delegates for actively participating and contributing to the work of the Committee throughout the lengthy period of its existence.
We received consistent support from all the ex-officio members, the Chairmen, Railway Board and all the Secretaries of the various ministries represented. Advisor to Deputy Chairman, Planning Commission, Shri Gajendra Haldea withdrew from membership of the Committee in its late stages due to his official pre-occupations. We benefitted from his contribution in the earlier stages.

I would like to record a particular debt of gratitude to what emerged as the core group of independent members: Shri K.L. Thapar, Shri S. Sundar, Shri D.P. Gupta, Professor Dinesh Mohan, Shri M. Ravindra and Shri Cyrus Guzder along with Shri Vivek Sahai, who held my hand and provided constant encouragement throughout the period. Each of them are recognized experts in the area of transportation and they gave very generously of their time to guide me with great deal of patience throughout this period. NTDPC also benefitted from the consistent support of the institutions with which they are affiliated: in particular, the Asian Institute of Transport Development (AITD), The Energy and Resources Institute (TERI), and the Transport Research and Injury Prevention Programme (TRIPP) of the Indian Institute of Technology, Delhi. This report could not have been compiled without their generosity and lifelong dedication to the development of efficient transport in India.

The compilation of this report has been a very complex operation since we have had the task of, on the one hand, preparing detailed sectoral reports on each of the transport sectors, and on the other, addressing each of the cross-cutting themes needed to be addressed across the transport sectors in a consistent fashion, while keeping in focus an integrated view of the whole transport sector. As will be appreciated while going through individual sector chapters, each sector by itself is extremely complicated with its own laws, regulations and peculiarities, and which had to be captured in each case. Addressing the cross cutting issues involved wider consultation, both domestically and internationally. The work of the NTDPC has therefore involved the participation and existence of a great many people, all of whom have contributed generously, and largely on a *pro bono* basis.

WORKING GROUPS

The Committee was provided with a broad terms of reference to begin with. Considerable discussion took place in the first three meetings on how we should organize the work of the Committee. Should it be organised on a sectoral basis or on cross cutting themes? We concluded that it was necessary to look at each sector in depth, while simultaneously initiating work on various cross cutting themes that were identified. Hence, initially, the Committee appointed the five sectoral Working Groups:

i. Railways
ii. Roads
iii. Civil Aviation
iv. Ports and Shipping
v. Urban Transport

Subsequently, as the discussions proceeded, the NTDPC decided to appoint an additional set of two special Working Groups on specific issues.

A presentation given by the Ministry of Coal gave rise to the understanding that the future growth of the country, being highly dependent on corresponding growth in energy production, would need a coordinated approach for significant transport investment to ensure timely and efficient transportation of coal and other key energy related commodities. Hence, it was decided to appoint an additional Working Group on "*Integrated Strategy for Bulk Transport of Energy and Related Commodities in India*".

Second, as discussions proceeded, it became clear that because of the isolation of the North East from the rest of the country, which arose at the time of independence and partition, it would be necessary to take an integrated view of the transport needs of the North Eastern region. Hence, it was also decided to constitute a full Working Group on "Improvement and Development of Transport Infrastructure in the North East".

Each of the Working Groups appointed their own respective sub-groups to facilitate their work.
The composition and terms of reference of these Working Groups and Sub-Groups are given at Annex P.2 and Annex P.3.

I am grateful to the Chairmen of the Railway Board and respective Secretaries of sectoral Ministries for agreeing to chair the sectoral Working Groups and for taking personal interest in the deliberations and preparation of the Working Group reports. As would be seen from the composition of these Working Groups and various sub groups formed by them, all the Ministries and associated organisations contributed generously to the work of these groups.

1. **The Working Group Report on Railways** was prepared under the direction of Shri S. S. Khurana, Shri Vivek Sahai and Shri Vinay Mittal, former Chairmen, Railway Board. Shri Ranjan Jain, former Advisor (Infrastructure), Shri Sushant Mishra, then Executive Director, Shri Girish Pillai, Advisor (Infrastructure) and Shri Mukul Mathur, Executive Director, Railway Board were particularly instrumental in preparing the Report of the Working Group. Sushant Mishra and Ranjan Jain had earlier been associated with the preparation of the Indian Railways Report in 2001, and also with the Sam Pitroda report on "Modernization of Indian Railways" more recently. The continuity of their association with developments in thinking on railways reform helped greatly in the preparation of this report. The Report was submitted to the Government on August 9, 2012.
(http://planningcommission.nic.in/sectors/NTDPC/Working%20Group%20Reports/Railways/Report%20of%20Working%20Group%20on%20Railways_Submitted%20to%20the%20Govt%20on%20Aug%209th,%202012.pdf)

2. **The Working Group Report on Roads** was prepared under the direction of Shri Brahm Dutt, Shri R.S Gujral and Shri A.K. Upadhyay, former Secretaries, Ministry of Road Transport & Highways. . Shri Arvind Kumar contributed to the drafting of the report. The report was submitted to the Government on July 4, 2012.
(http://planningcommission.nic.in/sectors/NTDPC/Working%20Group%20Reports/Roads/Report%20of%20Working%20Group%20on%20Roads_Submitted%20to%20the%20Govt%20on%20July%204th,%202012.pdf)

3. **The Working Group Report on Ports and Shipping** was prepared under the guidance of Shri K. Mohandas and Shri Pradeep Kumar Sinha, former Secretaries, Ministry of Ports and Shipping. Shri Arvind Kumar and Shri M.M. Hasija contributed to the drafting of the report. The report was submitted to the Government on September 25, 2012.
[http://planningcommission.nic.in/sectors/index.php?sectors=National%20Transport%20Development%20Policy%20Committee%20(NTDPC)]

4. **The Working Group Report on Civil Aviation** was prepared under the guidance of Shri M.M. Nambiar andDr S N A Zaidi, former Secretaries Ministry of Civil Aviation. Shri M. Kannan, was primarily responsible for drafting of the report. The report was submitted to the Government on July 4, 2012.
(http://planningcommission.nic.in/sectors/NTDPC/Working%20Group%20Reports/Civil%20Aviation/Report%20of%20Working%20Group%20on%20Civil%20Aviation_Submitted%20to%20the%20Govt%20on%20July%204th,%202012.pdf)

5. **The Working Group Report on Urban Transport** was prepared under the direction of Dr. Sudhir Krishna, Secretary, Ministry of Urban Development and his predecessors Shri M. Ramachandran and Shri Navin Kumar. Shri S K Lohia contributed greatly to the preparation of the report. The report was submitted to the Government on July 4, 2012.
(http://planningcommission.nic.in/sectors/NTDPC/Working%20Group%20Reports/Urban%20Transport/Report%20of%20Working%20Group%20on%20Urban%20Transport_Submitted%20to%20the%20Govt%20on%20July%204th,%202012.pdf)

6. **The Working Group Report on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India** was prepared under the guidance of Shri P. Uma Shankar, former Secretary, Ministry of Power. Dr. Anupam Khanna and Shri Daljit Singh of the NTDPC were mainly instrumental in the drafting of the report. The report was submitted to the government on June 24, 2013.
(http://planningcommission.nic.in/sectors/NTDPC/Working%20Group%20Reports/Bulk%20Transport%20of%20Energy/WG%20Report%20on%20Bulk%20Transport%20of%20Energy%20.pdf)

7. **The Working Group Report on Improvement and Development of Transport Infrastructure in the North East** was prepared under the direction of Shri Vivek Sahai, former Chairman, Railway Board. Smt. Jayashree Mukherjee, Joint Secretary, Ministry of Development of North Eastern Region (DoNER) was responsible for drafting of the report. Smt. Bunty Prasad, Ms. Jayati Chandra, former Secretaries, Ministry of DoNER, were very generous in their support of this work. This report was submitted to the government on July 4, 2012.
(http://planningcommission.nic.in/sectors/NTDPC/Working%20Group%20Reports/NER/Report%20of%20Working%20Group%20on%20North%20East_Submitted%20to%20the%20Govt%20on%20July%204th,%202012.pdf)

8. **Information and Communication Technology (ICT)**: Efficiency in the transport sector is undergoing significant transformation with the introduction of ICT in this sector. Moreover, development in seamless transfer across modes is being enabled by the new applications of ICT. Accordingly, we requested Shri T.V. Mohandas Pai, Member, NTDPC and former CFO of Infosys to help the NTDPC in developing an approach to ICT in transport. He readily agreed and oversaw the work on ICT in Transport which was led by Shri C.N. Raghupathy, with assistance from Shri Deepankar Khashnabish and Shri Kripakaran of Infosys and Shri Daljit Singh of NTDPC. Our grateful thanks to all of them.

As would be seen from the composition of these Working Groups and their Sub-Groups, a whole host of experts, officials and institutions were involved in the work of these Working Groups and the subsequent preparation of their reports, which finally culminated in the sectoral chapters in Volume III of this Report. I would like to express my deep appreciation of all the contributions made all concerned.

I want to record a particular debt of gratitude to Shri P. Uma Shankar, former Secretary, Ministry of Power who chaired the Working Group on "Integrated Strategy for Bulk Transport of Energy and Related Commodities in India" despite the fact that his portfolio was not, prima facie, connected with transport. As will be evident from the Working Group Report, and from chapter 8 of this Report, a great deal of data collection and modelling had to be undertaken to accomplish this task. This would not have been possible without the special support of Shri Uma Shankar.

I am similarly indebted to Shri Vivek Sahai who agreed to chair the Working Group on the North East after stepping down as Chairman, Railway Board. Given his long experience in the Railways, he then became part of the "core group" and gave generously of his time and advice.

SPECIAL STUDIES

In organising its work, the NTDPC also decided to commission a few special studies on issues that were cross cutting across sectors.

1. **Fiscal Issues and Allocative Efficiency:** This study was assigned to the National Council for Applied Economic Research (NCAER). We are very grateful to Shri Suman Bery, former Director General and Dr Shekhar Shah, Director General of NCAER, for agreeing to undertake this work and providing enough latitude to the researchers for completing the task while responding to our repeated requests for revisions and data collection. Very detailed work was carried out both in modelling and data collection by Dr. Rajesh Chadha and Dr. Sourabh Pal. They cheerfully and patiently accepted our many comments and went through various drafts as requested by us. Shri B.N. Puri, assisted by Dr. Krishna Dev, Geeta Garg and Honey Gupta, guided and contributed towards finalisation of the report. The study was submitted to the Government on January 4, 2013. (http://planningcommission.nic.in/sectors/NTDPC/Study%20Reports/NCAER/Study%20on%20Fiscal%20Issues%20and%20Allocative%20Efficiency_Submitted%20to%20the%20Govt%20on.pdf)

   I would also like to record my appreciation to Dr. Sudipto Mundle (then at National Institute of Public Finance and Policy (NIPFP), now Member, 14th Finance Commission) for reviewing the report and providing us with very useful comments.

2. **Life Cycle Analysis Study of Transport modes:** There is increasing concern on the differential environmental impact of different transport modes. It is found, often, that some erroneous conclusions are drawn because a comprehensive evaluation is not taken of full life cycle impacts involved in construction and operation of different modes. This study was entrusted to The Energy Research Institute (TERI). We are very grateful to the very innovative work done by Dr. Akshima Ghate with able assistance provided by Ms Raina Singh, Ms Tarika Sinha and Shri Apoorv Vij. She was also assisted by an Advisory Committee consisting of Shri S Sundar, Shri D P Gupta, Shri M Ravindra, Prof. Dinesh Mohan, Shri B N Puri (all Members of NTDPC), Dr Anupam Khanna (NTDPC), Shri S K Mishra (Railways), Shri Arvind Kumar (MoRTH) and Shri S D Sharma (DMRC). Shri S. Sundar provided overall direction at TERI. Our grateful thanks to all who have contributed their time in the preparation of this report. The study was submitted to the Government on January 4, 2013.
   (http://planningcommission.nic.in/sectors/NTDPC/Study%20Reports/TERI/Study_Life%20Cycle%20Analysis%20of%20Transport%20Modes_Submitted%20to%20the%20Govt%20on%20Jan%204,%202013/LCA_Final%20Report%20Vol%20I.pdf)
   (http://planningcommission.nic.in/sectors/NTDPC/Study%20Reports/TERI/Study_Life%20Cycle%20Analysis%20of%20Transport%20Modes_Submitted%20to%20the%20Govt%20on%20Jan%204,%202013/LCA_Final%20Report%20Vol%20II.pdf)
3. Regulatory Framework for Transportation: This study was entrusted to Dr Rajat Kathuria (then Professor, International Management Institute) and now Director, ICRIER. He prepared a detailed paper on the subject which was discussed at vari-

ous times in the NTDPC Secretariat and by the NTDPC. This work was condensed to the chapter now appearing in the report (chapter 6, Regulatory Issues: An Overall Approach). Shri S. Sundar and Ms Jessica Seddon very kindly gave their time to review the study in its various stages.

4. **Institutional Development for Long Term Transport Policy in India:** This study was entrusted to the Indian Institute of Human Settlements (IIHS) under the supervision of Jessica Seddon, then Head of Research at the IIHS. The key issue that engaged the attention of NTDPC, which is a recurrent theme of the report, is the development of institutional capacity in the country to integrate transport strategy and planning over time. As economic conditions over time and there are new technological developments, it is essential that the country develops adequate institutions that can adapt the extant transport strategy on a continuing basis. In preparing the study, Jessica was assisted by H.S. Sudhira and research assistance from Aruna Raman, Amogh Arakali, M.T. Vishnu, Arindam Jana and Anushree Dey. In view of the importance of this study for the development of transport strategy in India, it was discussed with selected members of NTDPC and other experts in various meetings. Shri K.C. Sivaramakrishnan, Shri Anil Baijal (former Secretaries of Ministry of Urban Development) and Shri V K Shunglu, a former Comptroller & Auditor General of India, kindly agreed to review the material prepared and to participate in the discussions with us. The final chapter on this issue (chapter 5, Institutions for Transport System Governance) owes much to the sage advice received from the collective wisdom embodied in these respected senior administrators.

I want to record a special debt of gratitude to Jessica Seddon for assisting us in reviewing a number of chapters far beyond the one that she was primarily responsible for her study on institutional development for transport system governance. She gave us very significant assistance in reviewing various drafts related to urban transport, regulation, capacity development, and safety. She has done this despite her own very heavy load of work, reflecting her longstanding association with transport policy in India.

TECHNICAL ASSISTANCE FROM THE WORLD BANK

The Committee was concerned that it should reflect best practices that are now developing across the world in the transportation area. In order to incorporate these developments in the work of the NTDPC, the Committee requested the Secretary, Department of Economic Affairs, Ministry of Finance to facilitate Technical Assistance (TA) from the World Bank. The TA was coordinated for the World Bank by Shri Ben Eijbergen, Lead Transport Specialist in South Asia Region and Shri Arnab Bandopadhyay, Sr. Transport Engineer from the Delhi office of the World Bank. I am grateful to Dr Roberto Zagha, Director of the World Bank in India for enabling and facilitating the commissioning of this Technical Assistance. The anchors of the different sectors were:

• Railways	Paul Amos
• Roads	Clell Harral
• Ports and shipping	Marten van den Bossche
• Urban Transport	Ken Gwilliam

Overall, 24 papers were submitted to the NTDPC and each paper was discussed with select Members of NTDPC and other experts in the NTDPC secretariat. The papers were then revised after the Secretariat provided its comments to the World Bank. Two international workshops were also held in New Delhi on Feb 6-8, 2012 and June 15, 2012 to discuss the papers with a wide variety of stakeholders, representatives of government ministries and selected invited practitioners from other emerging market countries. The papers were submitted to the government on August 9, 2012. A list of the papers is at Annex P.4, along with the programmes of the two international conferences.

The World Bank team also helped in organising the South Africa visit of the NTDPC in March, 2012. The programme of that visit is at Annex P.5.

I would also like to express my deepest appreciation to the World Bank for providing the services of Shri Bhaskar Naidu, Statistical Officer, Development Data Group of the World Bank, who developed the macro model which is the basis of the overall investment projections made in chapter 3 of this report. Bhaskar Naidu had made a similar contribution in the preparation in the Indian Infrastructure Report in 1996. He has since made such modelling efforts for a host of other countries in the world. He developed and simulated the model innumerable times over the last three years during the preparation of this report. Continuous revisions had to be made with changing economic conditions in India, and revisions of data during this period. He has given his time far beyond the call of duty which is deeply appreciated and acknowledged.

ASIAN DEVELOPMENT BANK

The NTDPC has placed considerable emphasis on promoting international transport connectivity between India and rest of the South Asia region and beyond to South East Asia. We requested the Asian Development Bank through the Department of Economic Affairs, Ministry of Finance to provide us assistance in this regard in view of the considerable work done by the ADB on international transport connectivity in South East Asia. We thank Mr. Hun Kim, Country Director, ADB for his support. Ms Kavita Iyengar drafted the final chapter after several much lengthier drafts with great deal of dedication, knowledge and interest. She has had to do much of this during her own time in addition to her normal duties at the ADB. Critical inputs were provided to her by Cuong Minh Nguyen and assistance from Elizabeth Tan at ADB, Manila. I am deeply grateful to Kavita for all the work she has put in into this enterprise and I do hope that this work will indeed result in new initiatives promoting international connectivity within the South Asia region.

CONSULTATIONS WITH STATE GOVERNMENTS

Responsibilities for the transport sector are shared between central and state governments in different ways. It was therefore felt essential to hold consultations with state governments. Initially, a questionnaire was sent to all state governments in order to elicit their views on various issues of relevance to them. Subsequently, a series of meetings were organized as follows:

1. October 8-9, 2012 at Patna, with state governments of Bihar, Chhattisgarh, Jharkhand, Orissa and West Bengal (invited, but not able to attend)

2. February 4-5, 2013 at Mumbai, with state governments of Goa, Gujarat, Madhya Pradesh, Maharashtra and Union Territories of Daman & Diu and Dadra & Nagar Haveli.

3. May 27, 2013 at Chandigarh, with state governments of Haryana, Himachal Pradesh, Jammu & Kashmir, Punjab and Union Territory of Chandigarh.

4. August 1, 2013 at Jaipur, with state governments of NCT of Delhi, Rajasthan, Uttarakhand and Uttar Pradesh.

5. August 26, 2013 at Bengaluru, with state governments of Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and Union Territories of Andaman and Nicobar Islands, Puducherry and Lakshadweep.

Annex P.6 lists the participants in each of the above meetings. Annex P.7 gives in brief the issues highlighted in those meetings and the way forward suggested.

The NTDPC is very grateful to the state governments of Bihar, Maharashtra, Rajasthan and Karnataka and of the Union Territory of Chandigarh for hosting these meetings. In addition, the Working Group on Improvement and Development of Transport Infrastructure in the North East held consultations with state governments at Guwahati, Assam. We are grateful to the State Government of Assam for hosting these meetings.

PREPARATION OF THE FINAL REPORT

The preparation of this complex report has been a truly cooperative effort. However, I would like to acknowledge the specific contributions made by the many individuals who gave generously their time through various drafts and revisions of each of the chapters.

Chapter 2 Trends in Growth and Development of Transport
Shri B.N. Puri was primarily responsible for the preparation of this chapter. He received able assistance from Shri Honey Gupta and Ms Geeta Garg from the NTDPC Secretariat. Dr. Somik Lall also contributed to this chapter in the initial stages.

Chapter 3 Macroeconomic Growth Backdrop: Transport Investments Requirements: 2012-2032
I am deeply indebted to Shri Bala Bhaskar Naidu for developing and simulating the macro-economic model on which this is based. Dr. Somik Lall, Dr. Krishna Dev and Shri Amod Jain, and Shri Muneesh Kapur, Advisor, IMF also contributed to the preparation of this chapter.

Chapter 4 Integrated Transport: Strategy and Logistics
This chapter was prepared by Shri B.N. Puri and Shri Rishab Sethi with consistent advice from Shri K.L. Thapar and Shri Cyrus Guzder. We also received useful inputs from Shri Pritam Banerjee of DHL. Dr. Krishna Dev provided further assistance.

Chapter 5 Institutions for Transport System Governance
Ms Jessica Seddon was primarily responsible for the preparation of this chapter with advice and contributions from Shri B.N. Puri, Shri S. Sundar and Shri K.L. Thapar.

Chapter 6 Regulatory Issues: An Overall Approach
This chapter was prepared by Dr. Rajat Kathuria. Ms Jessica Seddon and Shri S. Sundar contributed significantly to the development of this chapter.

Chapter 7 Energy and Environment
We received generous assistance from the International Council on Clean Transportation (ICCT) based in Washington D.C. Shri Gaurav Bansal, Dr. Anoop Bandivadekar, Dr. Alan Lloyd and Mr. Michael Walsh contributed to the work embodied in this chapter. We are grateful to the ICCT for providing this assistance. We are also grateful to Dr Sarath Guttikunda for his contribution to this chapter. The chapter was pre-

pared under the direction of Shri S. Sundar by Ms Akshima T Ghate of TERI and Shri Gaurav Bansal

Chapter 8 Transportation of Energy Commodities
This chapter was prepared by Shri Daljit Singh under the direction of Dr Anupam Khanna.

Chapter 9 Fiscal Issues
The work embodied in this chapter was done by Dr Rajesh Chadha and Dr. Sourabh Pal. Shri B.N. Puri, assisted by Shri Honey Gupta and Ms Geeta Garg, steered the drafting of chapter.

Chapter 10 Potential of Information and Communication Technology to Enhance Transport Efficiency
This chapter is based on the work done by Shri C.N. Raghupathy, Shri Dipankar Khashnabhish, Shri Kripakaran, under the direction of Shri T.V. Mohandas Pai. Shri BN Puri, along with Shri Daljit Singh contributed tremendously to the final drafting of this chapter.

Chapter 11 Research and Human Resource Development

Chapter 12 Safety
These chapters were primarily prepared by Professor Dinesh Mohan, with review and advice from Shri K.L. Thapar and Ms Jessica Seddon.

Chapter 13 Promoting International Transport Connectivity between India and South and South East Asia Region
The primary work for this chapter was done by Ms Kavita Iyengar of the Asian Development Bank. She received critical inputs from Mr. Cuong Minh Nguyen and assistance from Ms Elizabeth Tan at ADB, Manila. We are also grateful to Shri Shyam Saran, former Foreign Secretary, Shri Ashok Kantha, Secretary (East), Ministry of External Affairs and Ms Renu Pall, Joint Secretary, Ministry of External Affairs, for their valuable inputs to this chapter.

SECTORAL CHAPTERS

1. Railways
A great deal of work, discussion and deliberation went into the preparation of this chapter. Very significant contributions were made by Shri M. Ravindra, Shri Vivek Sahai, Shri K.L. Thapar, Shri S. Sundar, Shri B.N. Puri, Shri Cherian Thomas, Shri Ranjan Jain, Shri S.K. Mishra and Dr. Krishna Dev. Shri Sourabh Anand and Ms Jyoti Gujral of the IDFC did the excellent final drafting of this chapter.

2. Roads and Road Transport
This chapter was primarily prepared by Shri D.P. Gupta, with contributions from Shri B.N.Puri. Shri Rishab Sethi, and Dr. Krishna Dev. Ms Shruti Jain provided valuable assistance.

3. Civil Aviation
The primary work on which this chapter is based was done by Shri M. Kannan and Shri Rishab Sethi. Shri B.N. Puri, Shri K.L. Thapar and Shri Cyrus Guzder made valuable contributions. Ms Vidya Satchit provided assistance in the initial stages.

4. Ports and Shipping
We received significant assistance in the preparation of this chapter from Shri Rahul Chaudhary and Shri Thomas Netzer from McKinsey and Co. in its initial stages. The final draft is greatly due to the intensive work put in by Shri B.N. Puri, Shri Honey Gupta and Ms Geeta Garg. Advice received from Shri S. Sundar and Shri Bharat Sheth has been of great value in the preparation of this chapter. Shri M.M. Hasija, Shri Ajit Khot and Shri Anil Devli also provided useful comments.

5. Urban Transport
This chapter has been prepared primarily by Shri Shubaghato Dasgupta with very significant contributions from Professor Dinesh Mohan, Shri S. Sundar, Ms Jessica Seddon, Shri S.K. Lohia and Shri B.I. Singhal.

6. Transport Development in the North East
This chapter has been prepared by Shri Vivek Sahai, Shri B.N. Puri, Ms. Jayashree Mukherjee, and Shri Honey Gupta. Ms Shruti Jain provided valuable assistance.

Each of the chapters went through extensive debate and discussion at the meetings of the NTDPC and in other meetings held in the NTDPC Secretariat throughout 2013. Each chapter was circulated to all the Committee Members for comments and then revised on the basis of comments received.

SECRETARIAT OF THE NTDPC

As may be seen from the description of work undertaken by the NTDPC, a great deal of background work has gone into preparation of this final report, which required coordination at all stages. We operated with a relatively lean Secretariat, all members of which have contributed to the work of the NTDPC far beyond the call of normal duty. Dr Anupam Khanna, was Principal Advisor and Dr. Somik B Lall was Senior Consultant in the NTDPC Secretariat in the initial period of the Committee's work until mid-2011. Dr. Anupam Khanna continued to assist the Committee through his work on Transportation of Energy Commodities; and Dr. Somik Lall continued to assist in the preparation of chapter 3. Shri Daljit Singh joined the NTDPC Secretariat in mid-2011 and has contributed significantly to the overall work of the Committee since then, though particularly in the work on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, and on Information and Communication Technology (ICT). Shri Shubaghato Dasgupta has been a Consultant in the Secretariat concentrating essentially on all the work connected with the urban transport.

We have been fortunate to get the assistance of a number of Research Assistants during the tenure of the Committee. Shri Amod Jain worked in the Secretariat as an Associate on leave from McKinsey and Co., from the inception of the NTDPC until mid-2011. He contributed very significantly to the preparation of the basic data that was used in the macro-economic model used in chapter 3 of volume II. He also prepared a large number of Boxes that have been used in the report. Shri Rishab Sethi has been with the NTDPC since early 2011 and has contributed very significantly to the work on Roads, Civil Aviation and Integrated Transport Strategy and Logistics. Shri Honey Gupta has been with the Secretariat since mid-2012 and has contributed a great deal to the work connected with Ports and Shipping, Fiscal Issues and the North East. Ms Shruti Jain and Ms Geeta Garg worked in the Secretariat from mid-2010 until mid-2013. They provided research assistance on a wide variety of work carried out in the Secretariat.

Shri R.K.Sharma, Administrative & Accounts Officer (AAO) shouldered much of the administrative burden of the NTDPC as AAO. He has worked to keep all our accounts and other administrative actions consistent with government procedures and conventions. He has been instrumental in taking away a good deal of the administrative burden from the Chairman and the Member Secretary. Ms Asha Jhulka worked as PS to the Member Secretary and helped a great deal in organising the large number of meetings that had to be set up during the tenure of the Committee.

I would like to convey the appreciation of the NTDPC to CRIS personnel, Shri GK Maishi, GM, Ms Seema Vadhera, Manager, and Shri Rahul Gupta, Sr. Software Engineer who have maintained the website of NTDPC since its inception.

Shri Vinod Tejpal, Shri Shatrudhan and Shri Brajesh Tiwari have been with the NTDPC Secretariat almost throughout its existence as office support staff. They have worked far beyond the call of duty at all times with a very cheerful countenance and efficiency.

A special word of appreciation goes to Shri K. Raghuraman, my PS, who has been a rock of support throughout the existence of the NTDPC. He has helped me to keep track of all the work of the NTDPC through this whole long period. This has not been easy since I have spent significant time in the United States throughout the tenure of the Committee: first as Professor at Yale University, and later as Executive Director at the International Monetary Fund (IMF). His loyalty, sincerity, devotion to work and efficiency would serve as an example to all.

During the existence of the NTDPC, I have functioned four months at a time during September-December 2010, 2011, 2012 as Professor in Yale University in United States. I was also then appointed as Executive Director in the International Monetary Fund effective November, 2012. During these periods, I have also received significant assistance from colleagues in these institutions. At Yale, I received assistance from Shri Rahul Ahluwalia and Shri Ashraf Virk who helped me in preparing a number of the Boxes that appear in Sectoral reports and which have been extracted from the papers submitted to NTDPC as part of the World Bank technical assistance. Ms. Carla Mills provided excellent administrative assistance. My grateful thanks to all of them for being generous with their assistance.

At the IMF, I received assistance from Shri Ravi Sundararajan in the compilation of the final draft chapters by conducting consistency checks, drafting and introducing uniformity in the formatting of different chapters. It would not have been possible to finish this task without his very efficient assistance.

In addition, my colleagues, Shri K.V. Eapen, Dr. Janak Raj, Shri Muneesh Kapur and Dr. Manoj Govil provided excellent support so that I could also discharge my duties as Executive Director effectively, while also providing useful comments on various chapters in this Report. Shri Davinder Sandhu, formerly of the Prime Minister's Office also provided useful comments. Shri S. Gopavajhala provided very able administrative assistance all through.

Dr. Krishna Dev has been a Consultant in the NTDPC Secretariat throughout its existence. He has been a pillar of strength in much of the administrative work connected with the Committee and in assisting in the work of the Working Groups, the commissioning of the studies, the monitoring of the World Bank technical assistance and of the final report preparation. He has kept in order all the records of the Committee's work, the papers prepared, the reports prepared and the many versions that each chapter has undergone. He did all these extremely efficiently and quietly with a great degree of sincerity and devotion to work. I owe him a deep debt of gratitude for accomplishing all these tasks very cheerfully, while exhibiting great humility.

Shri B.N.Puri has worked as Member Secretary of the NTDPC from its inception. As Senior Consultant Planning Commission he was instrumental in setting up the Committee including drafting of its TOR. Shri Puri has been an anchor of Indian transport policy in the Planning Commission for a good portion of his career. He was associated with the original NTPC in 1980. He has therefore provided the continuity and institutional memory that is so necessary in the compilation of a report like this. The NTDPC has also benefited immensely from his knowledge of all the Ministries associated with transport and personnel at all levels. He has done a truly outstanding job of coordinating all the activities of the NTDPC throughout its existence. He has also shouldered the burden of coordinating the final preparation of all the chapters with a painstaking eye to detail, including cross-checking of all the data that are embodied in the Report. He has done all these in a very patient and quiet manner which is typical of his self-effacing personality. My sincerest appreciation goes to him for taking away much of the worry that would otherwise have fallen on me. The Indian transport sector owes a great deal to his devotion and continuity of work that he has exhibited throughout his career.

This Report has taken an inordinately long time in its preparation, much longer than any of the other Expert Group Reports that I have had the privilege of being associated with. This mainly reflects the enormous complexity of the task that the NTDPC confronted: the development of an integrated view across sectors; adequate in-depth treatment of each sector; the forging of broad agreement on various contentious issues; consultation and coordination with the government departments and ministries; and consultations with state governments. The rapidly changing macroeconomic conditions that have led to a significant economic slowdown in the last couple of years also led to repeated revisions in the macroeconomic modelling framework used to make projections in the Report.

I would like to conclude on a personal note. This is by far the most difficult task that I have undertaken during my relatively long policy advisory career, while simultaneously undertaking teaching and other advisory assignments in India and abroad, culminating in my appointment as Executive Director at the International Monetary Fund. I have been able to do all this because of the understanding displayed and unstinted support provided by all my colleagues in different institutions over all these 3 to 4 years.

Most of all, I am truly indebted to my wife Rasika, and children Tarini and Rasesh, who supported me all throughout and who have been most patient over this whole very difficult period.

It is my earnest hope, along with all my colleagues in the NTDPC, that this Report will generate active discussions leading to substantive change in how transportation policy is approached in India. The focus must be on the facilitation of all our people and businesses for their travel and freight needs.

1. NTDPC's APPROACH TO TRANSPORT POLICY


Bus, railway

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1. NTDPC's APPROACH TO TRANSPORT POLICY

We all use transport in our daily lives. Children travel to school, their parents commute to work and shop for their daily needs; people visit friends, and travel for entertainment purposes, sports and games…There are myriad reasons for travelling both short and long distances, out of necessity as well as for pleasure; for fulfilling personal needs and for business requirements. The transportation of both passengers and goods is thus an intrinsic part of our daily lives.

The production of goods and services needs efficient transport services to take them to where they are needed. Transport connects producers and consumers. Farmers need roads and transport to take their produce to market to serve the country's daily needs. The emerging standard for manufacturing and distribution, with complex supply chains, increasingly requires efficient and responsive logistics systems. Food supply has scaled up and requires timely, predictable freight to avoid wastage. Manufacturing operations are becoming increasingly complex, characterised by specialisation and outsourcing. Their supply chains now look more like networks and may be local, national or global. With transport becoming cheaper, faster and more efficient, it is not unusual for a product to contain components sourced from a multitude of locations spread locally within a country or globally, but subject to 'Just in Time' (JIT) inventory systems. Transport then has to be quick, reliable and predictable. Thus, people's livelihoods depend increasingly on the availability of low-cost and efficient transport, both for convenience in their daily lives and for efficient and competitive production of goods and services. Inadequate transport facilities impinge on higher productivity; higher transport costs increase transaction costs which reduce efficiency and competitiveness, thereby affecting the whole economy.

But we also need to think carefully about how we create the transport system that will best serve India in the coming decades. We need to do it cost-effectively—generating a transport system that is accessible and affordable to all. We must do it with close attention to passengers and shippers' needs. The system must be safe for both passengers and the transport of goods and responsive enough to meet evolving economic and social geography. High cost, inconvenient, unsafe and inadequate provision of transport impinges particularly on opportunities lost for the very large number of poor people, be they labouring in inaccessible farms or living in large cities with poor transport to work and play. Moreover, urban design affects peoples' accessibility to jobs and other needs: large distances generate demand for cheaper travel, which may not be sustainable.

We also must think about how to create an environmentally sustainable transport system, one that delivers mobility and freight movement with the least possible energy use and emissions. Transport currently accounts for 18 per cent of India's commercial energy use, and 55 per cent of the country's use of petroleum products. Given that 85 per cent of the crude oil refined in India in 2011-12 was imported, the trajectory of the transport sector has serious implications for the nation's energy security. Second, the transport sector is a leading contributor to climate-changing emissions such as carbon dioxide and dark particulate matter. Transport-related emissions are also a significant contributor to urban air pollution, which in turn affects public health and damages crop yields in downwind areas. Third, the increasing loss of lives and life changing injuries that are occurring in the transport system are unacceptable. The design of a safe transport system is an imperative need for the future.

To achieve a significant improvement in productivity and efficiency, it is imperative that future planning of India's transport network is aimed at the development of multi-modal transport, both within the country and for export-import trade

That all modes of the country's transport network are under severe pressure is clearly evident. As the country is poised for significant economic growth in the next two decades, it has become urgent to plan effectively the expansion of the existing network capacity, and the addition of new transport links and corridors. To achieve a significant improvement in productivity and efficiency, while introducing measures that reduce CO_2 emissions and unit costs, it is however imperative that future planning of the network should be aimed at a better integration of the various modes, so as to facilitate the development of multi-modal transport, both within the country and for our export-import trade. This will also call for heavy investments in transport infrastructure; a massive effort at building capacity in the human resources area to raise the level of skills and professional knowledge in the sector; and accelerating reform measures to ease and simplify the regime of taxes, levies and procedures that currently impede the smooth and rapid flow of transport across the country.

The National Transport Development Policy Committee (NTDPC) was constituted by the Government of India in 2010 to formulate a long-term transport policy to address just these issues. Prior to this, the government had carried out two similar exercises. The National Transport Policy Committee submitted its Report in 1980 and the Steering Committee on Perspective Planning for Transport Development in 1988. The latter Report, among other aspects, covered the entire spectrum of newly-emerging technologies for principal transport modes and suggested possible choices in the context of our economic and social milieu.

The present Report is devoted to setting the conditions for a coherent transport strategy for India in the long term: the horizon is 2032, two decades from the beginning of the country's 12th Five Year Plan to the end of its 15th, which shall also bring us to 85 years as an independent nation. Our vision is that a well-developed and competent institutional system for planning, management and execution of transport should be in place by the end of this period, if not earlier, as it blends investment in and delivery of transport services by the public, private and joint sectors alike. The Report abstracts from current methodologies to solve today's problems, while forging a coherent strategy for the transport sector as a whole and for each of the modes of travel.

This Report draws on the considerable work that has been carried out in the infrastructure sector over the past two decades or so, in India and elsewhere. In particular, it may be seen in some ways as a continuation of the thinking embedded in two previous reports connected with infrastructure and transport—*India Infrastructure Report 1996,* and *The Indian Railways Report 2001*. This Report represents new thinking on how to look at different transport sectors in an integrated fashion, and suggests mechanisms and measures for carrying this approach forward in a manner that reduces the resource costs involved. It also addresses a number of wider issues that affect all transport modes.

The India Infrastructure Report set the stage for the commercialisation of infrastructure as a whole. It facilitated introduction of the private sector in infrastructure, which had largely been in the public sector prior to the 1990s. The Indian telecom sector is now predominantly private, providing among the cheapest services in the world; considerable private investment has also been made in the production of power; the extent of public private projects in roads in India is on the cutting edge in the world despite the emergence of some problems. Thus, much has changed in infrastructure as a whole since the mid-1990s: it is appropriately seen much more as commercial enterprise than hitherto.

The Indian Railways Report served to focus attention on the need for much greater investment in the railways along with the emerging need for a significant reorganisation. This was seen as necessary to enable Indian Railways to undertake the capacity expansion and modernisation necessary for the rapidly growing Indian economy. It provided the rationale for the need for significant expansion of the railway system and focused on the means of raising adequate resources for the volume of investment projected. Although not much has changed in the railways over the past decade, there is now much greater debate and increasing focus on the need for reform, reorganisation and expansion. The initiation of the dedicated freight corridors (DFC) is one illustration of some significant change that has indeed been put into motion. The time is now ripe for a very new thrust for undertaking higher and more effective investment in modernising and enhancing the capacity of the Indian Railways system to serve the transportation needs of the country in the future.

NTDPC provides a renewed focus on significantly enhancing the priority that should be attached to the expansion, restructuring and reorganisation of Indian Railways so that its continuing loss in market share can be arrested and even reversed in the larger interest of the country.

Since the mid-1990s, spanning three Five Year Plans, much has changed in the Indian transport sector, but much has also remained the same. We do now have four-lane highways criss-crossing the country; the Golden Quadrilateral is essentially complete; and East-West and North-South highways are well-advanced. The experience of long-distance travel by road for both passengers and freight today is different from what it was in the 1990s and earlier. Civil aviation has been totally transformed with the initiation of a multiplicity of competing airlines and advent of low fares, guaranteed overnight inter-metro air express services, along with availability of frequent flights between the main urban centres.

There isn't however much substantive change in the railways; urban transport remains inadequate, infrequent, unreliable, unpleasant and unsafe; there are indeed new modern container handling private port terminals, and some new private ports in the state sector, but the overall structure has not changed much, and efficiency in the port sector continues to be relatively low compared with ports globally. The institutional structure for provision of transport is about the same. The changes that have occurred, significant as they are in themselves, have been on a piecemeal sporadic basis with little strategic intent.

Meanwhile, the economy has undergone significant transformation with 7-9 per cent growth being experienced over a decade until the recent slowdown. During this period, India ascended from its low income status to a middle income status quite successfully and without experiencing much restructuring pain.

The challenge confronting the country now is to take the next steps to achieving a sustainable middle income status and beyond over the next 20 years. To achieve this, economic growth over the next 20 years has to be at rates that are at least as high as those achieved in the last 20. But our aspirations are and must be even higher. And transport growth and development must be commensurate with this aspiration. We must aim for per capita income to at least double every 10 years so that real per capita income by 2032 is around four times what it is today. That is the example set for us by our Asian neighbours over the last two to four decades, both small and large. It would then reach around US$ 6,000 (at 2012-13 prices): similar to the present per capita income of China, and just above that of Thailand now.

Transport investment is a response to emerging demand, but it is also an economic growth driver in itself. Transport planning and planning therefore must be seen as central to the growth planning process

For this to happen, adequate transport provision in terms of quality, quantity and resource-efficiency is essential. If the required transport investment is not made, and in time, to satisfy both the burgeoning passenger and freight demands, the aspirational growth envisaged will simply not be achieved. *Transport investment is a response to emerging demand, but it is also an economic growth driver in itself. Transport planning and provision therefore must be seen as central to the growth planning process.*

Changing demographics and prosperity with growing incomes will increase the demand for transport infrastructure and its services on a continuous basis. Indian manufacturing growth has faltered in recent years. If this is not revived again to attain growth rates significantly higher than overall Gross Domestic Product (GDP) growth, as it was between 2005 and 2010, India's economic transformation to middle income status will be stymied. For Indian manufacturing to grow and be competitive globally, transport costs have to be minimised, both for inland and international transport. East Asian manufacturing capacity has become globally competitive on the basis of efficient transport provision and logistics expertise. Their manufacturing capacity is based largely on the sea coast with easy access to efficient and cheap international shipping. Much of Indian manufacturing is, however, based in inland locations across the country. Thus, our challenges are even greater in ensuring efficient and competitive transport facilities within the country so that manufacturing and other production is connected to ports that are competitive, and shipping that is cost competitive. The goals of inclusive development will be difficult to achieve without necessary spatial diversity and activity dispersion.

The agriculture sector will also undergo very significant transformation over the next two decades, and much of this transformation will be dependent on universal connectivity of all habitations in the country. High food inflation in recent years has resulted, in part, from supply bottlenecks related to fruits, vegetables, poultry, fish, meat, milk products and the like, whose demand will keep increasing with higher household incomes. The establishment of efficient supply chains is not feasible without connectivity. This is essential for the spread of income and employment opportunities in rural areas, particularly the less connected ones.

Adequate investment in transport is therefore essential for achieving higher Indian economic growth over the next 20 years and beyond. Hence this Report.

WHAT IS DIFFERENT IN THIS REPORT?

Much of the thinking on transport in India has been project-centric, done within single-mode silos. The focus has been on stepping up investments to address specific problems, usually well after logistic and transport dislocations have begun to appear. Even the Five Year Plans are essentially a collection of projects that are not necessarily connected. The Plans lack an overall coherent strategy to develop transport networks within and across modes designed to leverage transport investments for achieving economic growth. The visions of the National Highway Development Project (NHDP) and the Prime Minister's Gram Sadak Yojana (PMGSY) are exceptions in this regard. By its very nature, transport as a system connects cities, towns and villages within and across countries; and people as consumers and producers to manufacturers, wholesalers and retailers, and vice versa, once again within and across countries. The 'system' is also composed of various elements: the infrastructure itself, the norms for access and use of the infrastructure (which significantly affect infrastructure's capacity to support flows of goods and people), and the vehicles that move on the infrastructure. *So, a key requirement for thinking on transport strategy is that it must be system based.* In other words, it must cut across modes of transport, administrative geographies, and integrate capital investment with regulatory and policy development.

> We need to develop human resource capacity and responsive institutions that observe, analyse and act on developments as they occur while remaining embedded within overall strategies that are articulated

Whereas this Report also addresses sectoral issues in detail, its focus is on cross-cutting themes underlying transport strategy and resulting investment programmes (Volume II, Chapters 3 and 4). *It is less focused on specific solutions than on developing human resource capacity and responsive institutions that observe, analyse and act on developments as they occur while remaining embedded within overall strategies that are articulated* (Volume II, Chapters 5 and 11). We have been dismayed to find a significant lack of expertise within the whole transport system from policy making agencies to executing ones. Hence, the Report provides a sharp focus on research and human resource development in all segments of the transport sector, and overall.

The Report projects India's requirement for transport over the next 20 years to 2032 and what transport investments need to be made on a phased basis to get us there (Volume II, Chapter 3). We are however fully aware that today's projections at some point will indeed be wrong, as conditions change beyond what may be expected or projected today. Transport needs are determined by economic growth as it occurs, by the emerging pace and pattern of urbanisation, by developments in differential sectoral growth, shifts in consumer and producer preferences, and by changes in demographics and technology. But these trends will themselves be impacted by emerging developments in energy availability and prices, and new technologies. So, the economic and regulatory framework underlying transport must be price-responsive. Within a 20-year framework, it is quite possible that radically new transportation technologies may develop or alternative energy sources like solar energy may well become available, cost-competitive and viable. We can recall that there was no internet just 20 years ago; it is now ubiquitous in our daily lives, and has transformed the whole logistics business and other segments of transport services. *Thus, the country must have planning capacity in transport that, on the one hand, develops coherent medium and long-term strategies, but on the other, is also able to respond on an ongoing basis to changes that occur over time.* When significant transport investment has to be made, it must be done with considerable forethought.

Transport infrastructure lasts a long time. For example, the basic Indian Railways network was laid out in the latter part of the 19th century. It has determined much of the spatial distribution of economic activities in India over the last 100 or more years. Within cities, the specific layout of suburban rail networks, as in Mumbai, and of underground metro systems in cities such as London, Paris, New York and Tokyo, have determined the spatial pattern of growth and activity of these cities over a long period. On a different plane, large coordinated investments in mega ports and airports in Amsterdam/Rotterdam, Singapore, Dubai, Hong Kong have enabled these countries to become globally competitive despite their small size and lack of domestic resources. Indeed, transport investments have been among the key drivers of economic growth in these countries. Similarly, Japanese investment in the Shinkansen in the 1960s, along with coordinated investment in ports and airports in Tokyo/Yokohoma/Osaka, greatly influenced the concentration of economic activity in this region, and the Japanese economy's rapid growth in the 1960s and 1970s. In the United States, the interstate highway system planned in the late 1950s has determined the spatial pattern of the economic activity to a very significant extent.

Technology has always played a crucial role in human affairs. In the transport sector, because of the lumpy nature of the investments, it tends to change in cycles. These used to be long, but in the last 30 years, have grown much shorter. India needs to build this fact into its approach to transport policy.

This Report therefore abstracts from specific problems today, but puts them in the context of India's long-term development trajectory. It makes long-term projections and provides guidance on broad magnitudes of needed transport investment. But it accepts that these projections are only indicative and, being made today, will need to be reviewed as new developments occur in the future. It therefore pays particular attention to building institutional and informational foundations that both signal the onset of specific challenges and help in the provision of a range of options for differential needs of the multitude of producers and consumers in the country. As technologies, prices and incomes undergo specific changes over the next 20 years, the absence of such institutional foundations will run the risk of 'lock in' if current choices dominate and restrain adaptation in later periods.

Consistent with this long-term view, in formulating a transport strategy for India, it is also imperative that this be undertaken within the larger context of connectivity within South Asia and between South Asia and South East Asia. NTDPC has taken a conscious view that much greater attention should be paid to the development of these links across our borders (Volume II, Chapter 13). This focus has been absent in the formulation of national transport strategy so far.

As political and diplomatic conditions improve in the region, consideration will need to be given to promote connectivity of countries with one another through a dense web of transport links, encompassing road, rail, waterways, and air. A corollary to this is the need to develop modern, efficient and convenient cross-border transport linkages, in particular, by rail and road. Many of our border areas have been left deliberately underdeveloped because of an outdated notion of security which looks upon borders as walls separating India from a hostile neighbourhood, rather than as connectors bringing peoples and economies together. Transport linkages across our border regions must be developed in tandem with 'backward linkages', i.e., links with the Indian heartland. If the latter fall behind the former, there is a danger of further alienating our border regions and the people inhabiting them. *Consequently, NTDPC has further focused specially on the transport needs of the North East Region (NER) which has otherwise suffered from relative transport isolation within the region itself, connectivity with the rest of India and cross-border with all the countries surrounding the North East* (Volume III, Chapter 6). The route dispersal guidelines formulated by the Ministry of Civil

Many of our border areas have been left deliberately underdeveloped because of an outdated notion of security that looks at borders as walls separating India from a hostile neighbour rather than connectors bringing peoples and economies together

Aviation to promote viable air services to remote areas such as the North East, the Andaman Islands, Lakshadweep and Ladakh, have not met their objectives, while the mechanism of cross-subsidisation with passenger air fares has only created undesirable market distortions. NTDPC has made a recommendation on an alternative model of direct subsidy with viability gap funding, which can be managed, as required, to meet national strategic objectives.

NTDPC's view on focusing on international connectivity is similar to that adopted within Europe to facilitate achievement of the common market, and in South East Asia for similar proportion of trade within that region. Equal emphasis has to be given to the development of physical networks as to the soft institutional mechanisms necessary for seamless transfer of goods and services across borders. The current lack of intra-regional trade within South Asia and between South Asia to South East Asia stands out, making South Asia the least integrated region in the world. This must be corrected through the development of transport linkages in all modes.

This NTDPC vision is also consistent with that taken by the Government of India as articulated in its Look East Policy. The government has taken various initiatives to forge closer and deeper economic integration with Eastern and South Eastern neighbours so that trade with these countries can increase at a rate consistent with the expected growth of the East and South East Asia region as a whole.

THE GROWTH CHALLENGE

This Report builds on the macroeconomic growth framework pioneered in the *India Infrastructure Report 1996*. Building on the very significant growth departure of the Indian economy recorded since the turn of 1980s and accelerated in the 2000s, overall economic growth projected over the next 20 years is to rise from the expected 7 per cent in the 12th Plan to 9 per cent per annum in subsequent periods until 2032. Whereas such growth projections were regarded as reasonable until just two years ago, the significant downturn in 2012-14 has raised scepticism regarding the reality of projections at this level. Whereas we have indeed tempered growth expectations during the 12th Five Year Plan period until 2016-17, we believe that there is little reason to doubt the feasibility of achieving the kind of growth projected for the next

20 years, reflecting the record of the last 30 years, and particularly that of the last 10. The achievement of such growth will indeed need very significant policy reform in a range of activities. That such reform has been carried out on a relatively continuous basis since the early 1980s, intensifying in the 1990s and accentuated in the infrastructure sector since the mid-1990s, gives us confidence in the potential ability of the country's policy making system to rise to the challenges of the future. In principle, therefore, Indian institutional capacity for governance and reform has exhibited considerable resilience. Thus, we should not let the current climate of scepticism cloud our vision for the long-term future. We have therefore retained high growth projections between 8.5 to 9 per cent during the 13th, 14th and 15th Five Year Plans covering the period 2017-32 (Volume II, Chapter 3). As this Report emphasises, however, the institutional development and reform needed to get to the next steps in the ladder towards achieving middle income status will be of a much higher order than that achieved in the past.

Total investment in transport was about 2.6 per cent of of GDP during the 11th Five Year Plan. This needs to rise to about 3.3 per cent in the 12th Plan, and then stabilise at about 3.7 per cent during the rest of the period till 2032

The basic macroeconomic reason for this optimism is maintenance of the relatively high levels of gross domestic savings which had reached almost 37 per cent of GDP in 2007-08. Despite the slowdown in economic growth, gross domestic savings have remained in excess of 30 per cent, while suffering a decline particularly in public sector and household financial savings. Just as India was able to achieve a correction in public sector savings from negative levels in 2000-01 to significantly positive ones from 2003-04, one can be optimistic about a similar turnaround over the next few years with the exercise of appropriate fiscal responsibility, and restraint in yielding to pressures promoting the subsidy culture, particularly in the provision of infrastructure services. In principle therefore, resource availability, both domestic and international, for maintaining the kind of high growth envisaged should not be a constraint.

INVESTMENT REQUIREMENTS

To achieve the kind of growth as projected over the next 20 years, the overall required investment rate would need to increase gradually to around 40 per cent from the current 35 per cent of GDP over the period. The key ingredient for achieving such growth would be restoration of industrial growth to 10 per cent plus over the next three to four Five Year Plans. There is a symbiotic relationship between efficient transport provision and industrial growth. Thus, the high growth projected will not be possible without enhanced infrastructure spending, and the enhanced infrastructure spending will be infructuous if manufacturing growth does not accelerate significantly.

Our macroeconomic exercise suggests that it is feasible for total investments in infrastructure to increase from the 11th Plan average of about 5.8 per cent of GDP to 6.9 per cent in the 12th Plan and then to around 8 per cent in the subsequent Plan periods upto 2031-32 (on national accounts basis)[1]. In absolute terms, this implies that the annual level of investment in infrastructure would need to increase from the current Rs 6 trillion ($100 billion) to about Rs 30 trillion ($570 billion) by 2032 at constant 2012-13 prices. Total infrastructure investment is projected to rise from about Rs 25 trillion ($ 425 billion) in the 11th Plan to Rs 40 trillion ($ 745 billion) in the 12th Plan and further to Rs 70 trillion ($1.25 trillion), Rs 100 trillion ($1.9 trillion) and Rs 155 trillion ($2.9 trillion) in the 13th, 14th and 15th Plans respectively (all at 2012-13 prices).

Of this, about 75-85 per cent of total infrastructure investment would have to be domestically financed, while the rest of about 15-25 per cent could come from external sources, assuming that 30-40 per cent of total capital inflows go into the financing of infrastructure.

Total investment in transport, both public and private, was of the order of about 2.6 per cent on average during the 11th Five Year Plan. NTDPC projects that to achieve the kind of growth envisaged overall, this investment in transport would need to increase to about 3.3 per cent of GDP in the 12th Plan, and then stabilise at about 3.7 per cent of GDP during the rest of the period until 2032[2].

In absolute terms, this implies an increase in total transport investment from about Rs 10.4 trillion ($190 billion) in the 11th Plan to about Rs 19 trillion ($350 billion) in the 12th Plan and Rs 30, 45 and 70 trillion ($ 575, 850 and 1300 billion) respectively in the 13th, 14th and 15th Plans. In this scenario, both public and private sector investment in transport will need to increase as a proportion of GDP. It is estimated that public sector investment in transport was about 1.8 per cent of GDP in the 11th Plan. This is projected to increase to 2.0 per cent in the 12th Plan and then remain stable at 2.1 to 2.2 per cent till the 15th Plan. We are projecting a somewhat higher pace of increase in private sector investment from less than 1 per cent of GDP in the 11th Plan period to about 1.3 per cent in the 12th Plan and around 1.5 to 1.6 per cent of GDP in the following Plan periods until 2032. In absolute terms, this implies very significant increases in pri-

1. About 1-1.5 per cent of GDP can be added to make these projections comparable to the Planning Commission definitions of infrastructure investments.
2. Here again, about 0.5-0.7 per cent of GDP can be added to be comparable with Planning Commission investment concepts.

vate investment in transport. In terms of feasibility of such projections, this would imply that about 5-7 per cent of the total flow of resources to the organised private sector should be utilised for transport investment.

These are clearly very large numbers, even if we look at the more immediate future of the next 5-10 years. Broadly speaking, a major step up in transport investment is required in the current 12th Plan and further in the 13th Plan ending in 2022, in both the public and private sectors. The expectations from the private sector are ambitious, perhaps without equal in the rest of the world. If they do not fructify, the government needs to put contingency plans in place, so that public sector resource mobilisation and execution can substitute for any shortfalls in private sector investment. In any case, as indicated, public sector investment itself has to increase significantly and there can be no expectation of its reductions in transport. In general, it is much easier for the private sector to invest in rolling stock. Private investment in fixed infrastructure is more difficult to organise.

The increase in public sector investment is primarily due to the increased investment proposed in the railways. Overall, a greater effort will need to be made to strengthen and commercialise all public sector entities that invest and manage public sector transport infrastructure at both the central and state levels. The railways in particular will need very significant organisational and accounting reform (Volume III, Chapter 1) if the kind of capacity and quality expansion envisaged is to be achieved. *NTDPC* is proposing a *significant increase in investment in railways from about 0.4 per cent of GDP over the last two decades to around 0.8 per cent in the 12th Plan and then rising to around to 1.1 to 1.2 per cent of GDP in the subsequent three Plan periods. The investment should primarily be on productive capacity enhancement of the system. This would then bring investment in railways at par with that in roads and bridges which increased from about 0.4 per cent of GDP in 2000-01 to about 1.2 per cent by 2011-12. This is manifested on the ground by the progress achieved in the National Highway Development Project (NHDP) and the Pradhan Mantri Gram Sadak Yojana (PMGSY).*

The much enhanced level of investment in roads over the past decade or so relative to previous periods demonstrates that it is possible to achieve such an enhancement in a short period of time. *NTDPC is of the view that it is now time to shift this focus to the railways.*

Where will all these resources come from? In public sector investment, we have projected that 70 per cent of total public sector transport investment may be expected to come from the Budget, with the remaining 30 per cent coming from Internal and Extra Budgetary Resources (IEBR). As for the 1.3 to 1.6 per cent of GDP expected to be invested by the private sector in transport over the next 20 years, up to about a third could come from foreign sources. Whereas foreign equity financing of private sector transport investment could possibly be comparable to that of the domestic private sector, domestic debt financing will have to be significantly higher than foreign debt financing, if private investment in transport is to be sustainable. This is reasonable since most cash flows in the domestic transport sector are in domestic currency, although in sectors such as ports and airports, foreign borrowings are naturally hedged. What these projections illustrate is that if we account for the sustainability of the Indian balance of payments over the long term, the extent of external borrowing for the transport sector would be somewhat limited to about 0.25 to 0.30 per cent of GDP overall, leaving the rest of debt required to be raised in domestic markets. It is therefore of utmost importance that much greater efforts are made to invigorate the pension and insurance sectors for greater domestic long-term savings to flow into these funds which would then be the natural source for funding transport and other infrastructure investment. It is these contractual savings that are made for the long term and are hence particularly suited for investment in transport infrastructure assets, that can then provide stable returns on a sustained long-term basis.

About 75-85 per cent of total infrastructure investment would have to be domestically financed, and the rest from external sources, assuming that 30-40 per cent of total capital inflows go into financing of infrastructure

The generation of this level of funds from both domestic and foreign sources for both the public and private sectors in transport will be dependent on the economic sustainability of such investments. This requires the levy of user charges, levies and cesses, as appropriate, in all segments of the transport sector, so that its economic viability is seen as feasible and stable. *NTDPC therefore believes that economic pricing and adequate regulation are essential for sustainability of the transport system and hence for attracting the kind of resources that are needed for transport investment.*

These projections were made top down in a macroeconomic modelling framework. NTDPC also made bottom-up estimates for investment requirements in each of the sectoral transport sectors. One of the interesting findings of NTDPC is that the bottom-up aggregate and sectoral estimates provided by the respective Working Groups for the later two Plan periods (2022-32) turn out to be lower than the macroeconomic-consistent model projections of availability of resource flows for transport infrastructure. This is unusual since unconstrained bottom-up projections are usually far in excess of what is feasible. What these projections suggest is that we can be more ambitious in our transport planning in the 13th Plan and beyond. This outcome suggests that the many proposals in this Report that relate to:

- capacity development
- safety enhancement in all sectors
- use of information technology
- environmental projection through more stringent fuel standards, etc
- universal connectivity of all habitations through PMGSY
- connectivity with and within the North East; and
- international connectivity

have high probability of being financed. Furthermore, beyond the 13th Plan, we can also be more ambitious in implementing full connectivity with all-weather roads of all habitations in the country, and enhancement of their quality. More ambitious projects such as high-speed rail transport and mass rapid transit systems could also be examined more realistically for their economic viability and resource intensity in the period beyond the 2020s.

All projections suggest that overall economic growth could be stymied if appropriate strategic choices are not made now to facilitate significant capacity expansion of the Indian railway network

The given land resources of the country have to meet myriad requirements of its large population. The ever-increasing economic activities are putting great pressure on this scarce resource. Hence, there is an imperative need to have a closer look at the requirements of land for transport projects. Besides, it is equally essential to develop common user facilities at the terminals. In this scenario, it would be prudent to find strategies that minimise the time lag in acquiring land for such projects.

TRENDS IN TRANSPORT DEVELOPMENT

At present, India's transport networks are severely capacity constrained. During the last six decades, growth in total freight traffic has been broadly consistent with that of GDP, while that in passenger traffic has been much greater. It is now expected that with increasing complexity in the economy, rising incomes and hence greater demand for goods, both food and non-food, the elasticity of freight traffic may well be higher over the next couple of decades. On this basis, NTDPC has projected that freight traffic may increase from around 2,000 billion net tonne kms (btkm) in 2011-12 to between 10,500 to 13,000 btkm by 2032, an increase by a factor of about 5-6. The increase in total passenger traffic would be much higher and may well increase by a factor of about 15 over this period. There has been a veritable explosion in air traffic over the past 20 years: domestic passenger traffic increased from about 7.5 million in 1990-91 to about 60 million in 2011-12. These trends suggest that it will be much in excess of 400 million by 2031-32; and international passenger traffic may grow from around 40 million now to over 200 million over the same period. These numbers provide an idea of the key growth challenges facing investment in transport (Volume II, Chapter 2 and Volume III, Chapter 3).

A significant feature of developments in the Indian transport network has been the relative decline of railways and corresponding increase in that of roads for both passenger and freight transport. The share of railways in freight traffic fell from about 90 per cent in 1950-51 to about 40 per cent by the end of 1990s and further to just over 30 per cent by 2011-12. The fall in passenger transport was even greater with the railways share falling from about 70 per cent in 1950-51 to about 15 per cent in 1999-2000 and only about 10 per cent by 2011-12. With the kind of growth envisaged in both the economy and the consequent growth in transport, such a pattern of mode share in transport sector is not sustainable. Loss in the share of railways is a global phenomenon, but the decline in India is somewhat steeper than in other large economies. In view of the expected uncertainties related to the availability of future crude oil supplies, the attendant adverse implications for energy prices and the damaging environmental impact of fossil fuels, it is essential that an attempt be made to reverse this trend or at a minimum to arrest it. *This requires making strategic decisions in terms of the relative allocation of resources between rail and road, accompanying pricing and taxation policies and legal changes, which can then be used to nudge transport demand toward desired modal shares.*

The key issue therefore facing the country is the desired strategy for capacity expansion for the railways over the next 20 years. All projections for the growth in demand for both freight and long distance passenger services suggest that overall economic growth could be stymied if appropriate strategic choices are not made now to facilitate significant capacity expansion of the railways, as has been done in China over the past decade or so. Such an expansion would not take place in a business as usual scenario. *As indicated there would have to be significant allocation of public resources for investment in the railways which, however, will be difficult to implement without corresponding investment in capacity building and significant reorganisation of the railways system as a whole* (Volume III, Chapter 1).

Thus, a vision similar to that of NHDP should be laid down for the railways now, so that we may expect a much expanded and transformed railway network by 2032. If this is not done, the progressive achievement of NHDP itself will only accelerate the loss in the railways transport share, leading to overall economic inefficiency and a pattern of energy usage that could lead to greater pollution and environmental degradation.

Better understanding of relative energy usages and life-cycle energy costs of different transport modes would be very helpful in such decision making. This Report has made a beginning in this area (Volume II, Chapter 7). Urban transport faces a similar challenge arising from the increasing use of personalised motorised vehicles, lack of efficient public transport systems, and inadequate facilities that discourage walking and cycling.

India has experienced relatively higher rates of growth in its trade since the early 1990s. Going forward, the Government envisages an increase in India's share of world trade from the current 0.8 per cent to 1.5 per cent over the next 20 years. Such high growth in trade needs corresponding investment in ports in a timely manner. At present, there is no comprehensive and coherent strategy for the location of ports in the country or indeed for the overall investment programme of these ports, that is in its turn, linked with the corresponding investments in roads, railways, logistics and coastal shipping. Our specialised work on the transportation of energy commodities has also highlighted the need for such a strategic programme for port investment. Each of the world's major economies has a few mega ports which are then well-connected with the inland transport system through road, rail, inland waterways and coastal shipping. At present, India has no mega port comparable to the size of such ports in other countries. Consequently, at present, a good proportion of India's maritime trade is transhipped in Colombo or Singapore. *NTDPC is therefore recommending the establishment of four to six mega ports over the next 20 years with two to three on each coast.* The location of these ports would need harmonisation with plans for NHDP on the one hand and the Dedicated Freight Corridor (DFC) system being currently planned for the railways on the other so that there is efficient connectivity (Volume II, Chapter 8 and Volume III, Chapter 4).

These mega ports can be established either by transforming some of the existing major (or non-major) ports into mega ports, if feasible, by combining some major and minor ports, or by setting up totally new mega ports.

As such a strategic review is taken for investment in ports; NTDPC also recommends the adoption of the concept of landlord ports and corporatisation of the existing Port Trusts. This model can then transform the Port Trusts to statutory landlord port authorities through specific legislation, while the terminal operations of the Port Trusts would need to be corporatised as public sector corporations. Then, both private and corporatised public sector terminal operators would compete under the aegis of the landlord port authority. Such significant organisational, legislative and regulatory reforms would be necessary if we decide to set up mega ports as recommended, and if Indian trade is to be facilitated on an integrated logistical framework connected adequately with the hinterland road and rail infrastructure (Volume III, Chapter 4).

Four to six mega ports should be established over the next 20 years, with two or three on each coast. These mega ports could be built by transforming some of the existing ports, if feasible, or by setting up totally new ports

The civil aviation sector has already witnessed a major transformation over the past 20 years, and particularly over the last 10. The growth envisaged over the next 20 years will be an order of magnitude higher in terms of absolute growth. It is expected that more than 1,000 aircraft will have to be added to the current stock of domestic aircraft. A comparable increase will take place in international airline aircraft serving Indian airports. Total passenger throughput is currently around 150 million: this is expected to increase to over 1.1 billion by 2031-32. We therefore need a coherent strategy that recognises the intermodal linkages required along with the physical expansion of aircraft, airports, air traffic control systems. This challenge also needs to be turned into opportunity: the development of airport hubs, international competitive airlines, facilities for maintenance, repair and overhaul, and even aircraft manufacturing. NTDPC recommends that a holistic view be taken of this growth opportunity through a modernised regulatory framework that encourages such capacity enhancement (Volume III, Chapter 3).

To ensure that the creation of new capacity is dovetailed into the overall framework of a multi-modal transport network for the country, it is recommended that a National Master Plan for airport development over a 20-30-year timeframe is drawn up; and an Airport Approvals Commission is established within the Ministry of Civil Aviation, to review and clear the plans on an ongoing basis. A crucial component of airport development is to ensure the provision of adequate infrastructure to process the country's air exports and imports. This can be created rapidly and cost-effectively by the development of off-airport processing facilities, similar to inland ports and container depots, to supplement the expansion of on-airport cargo terminals, and will require the Customs to adopt a more liberal approach to recognising and manning such facilities (Volume III, Chapter 3).

India needs an efficient network with interchange points that receive short-haul smaller cargo for aggregation, provides longer-haul rail transport to ports and industries and the like, and vice versa

The Report emphasises that India must adopt a holistic approach in designing integrated transport networks. One of the weaknesses of the planning of transport infrastructure has been the mismatch at the interfaces of the various modes. For example, India needs an efficient network with interchange points that receive short-haul smaller cargo volumes from roads from the hinterland for aggregation, and then provides longer-haul rail transport of vehicle loads forward to ports, industries, and the like, and vice versa from ports/industries to rural/urban centres through disaggregation. Similarly, while the size of the container ships has substantially increased, the corresponding facilities for evacuation of the containers from the ports have not kept pace. Special attention also needs to be given to the development of coastal shipping and inland water transportation, which are also characterised by low energy intensity. It is, therefore, essential to plan in an integrated manner across the entire movement chain. To achieve this, we need governance structures and an organisational culture that supports transport networks with seamless inter-modal and hierarchical connectivity and skilled human resources to innovate, develop and manage such structures (Volume II, Chapter 4).

THE GOVERNANCE AND INSTITUTIONAL CHALLENGE

INSTITUTIONAL DEVELOPMENT FOR TRANSPORT GOVERNANCE

The current approach to transport planning is essentially piecemeal. Given the availability of overall transport projections as we have made, both in the macroeconomic context and in terms of transport demand expectation, a more integrated approach is desirable. The desired end state is an overlay of transportation networks allowing for efficient transport of passengers on the one hand, and of each commodity type on the other, as well as natural interchange points where networks intersect and where large quantities are broken down into smaller volumes for last mile transportation into urban centres. A vastly superior logistics infrastructure is thus essential to achieve such a transportation system. We need a modal mix that will make feasible an efficient, sustainable, economical, safe, reliable, environmentally friendly and regionally balanced transportation system.

Choices should be made between the priorities to be placed on different investments. Given the scenario of significantly expanding magnitudes in terms of transport demands across all categories, it will be crucial to influence the development of the transport network so that there is optimal movement of passengers and of freight by matching cargo category with transportation mode. This implies some judgement on the normative modal shares that are desired for rail, road, air, shipping and inland waterways traffic which we have attempted to some extent.

At present, this prioritisation and decision making is disjointed. For example, decisions on investments on highways and expressways on the one hand and potential DFCs and even possible high-speed trains are made in isolation of each other. Similarly, investments in ports are also not coordinated as closely as they should be with other investments in the overall transport network and developments in the overall economy. This is illustrated in great detail in the work that NTDPC has conducted in the transportation of energy commodities (Volume II, Chapter 8). As demonstrated there, the requirements of energy supplies, consistent with the overall economic growth envisaged, implies a corresponding growth in the demand for coal and hence of its transportation from domestic mines and increasingly from international sources over the next couple of decades. To ensure adequate energy supply over the next two decades, it is therefore essential to undertake corresponding investments in adequate port capacity, in the laying of pipelines, and in rail infrastructure that connect the sources of energy supplies to the points of consumption and power production across the country. At present, this is done on a piecemeal basis.

The main reasons for this state of affairs is that the institutional framework for formulation of transport policy, planning and coordination in India is very weak. We do not have any single agency at either the central or state levels for coordination of policy formulation for the transport sector as a whole. In fact, the constitution of NTDPC itself reflects the lack of such an agency to devise overall transport policy strategies. In the absence of such arrangements, the responsibility of investment coordination rests with the Planning Commission. In addition, the Planning Commission is also expected to coordinate policy formulation for the transport sector as a whole, along with all the other areas of economic policy. Given the increasing complexity of the economy, and in the transport sector itself, the Planning Commission, as constituted at present, simply does not have the technical capacity to accomplish this task in a competent manner.

It might have been expected that the individual transport ministries themselves would have such technical capacity to aid the Planning Commission, which could then perform the function of integrating the ideas and strategies put forward by the different transport related Ministries. In fact, the individual ministries themselves are bereft of technical capacity to perform this function. Moreover, there is no continuity in the leadership, which could otherwise enable them to take longer term views. By way of illustration, we may note that during the existence of NTDPC of about three and a half years, there have been at least three Secretaries to the Government in each of these ministries and in some cases four. Given the current Indian administrative governance system, senior officials, while being competent administrators, do not in general possess domain knowledge of the ministries to which they are appointed. They are essentially birds of passage. This is not to decry the individual abilities and qualities of any of the administrators in the system, but is much more a reflection of systemic flaws in the administrative governance of transport infrastructure in India, along with other economic areas. With such an administrative system, where there is no continuity or domain knowledge in the ministerial or bureaucratic leadership of key transport and related ministries, there can be little expectation of the emergence of organised and integrated thinking for long-term transport strategy and investment. This has to be corrected.

NTDPC therefore believes that it is of the utmost necessity to develop suitable institutional entities at both central and state levels, which are endowed with adequate expertise to perform such coordination on a continuous basis. Such coordinating entities can then take into account logistic and inter-modal issues that are now essential for formulating and implementing coordinated transport planning and policy (Volume II, Chapter 5).

India faces three main institutional challenges in developing the governance infrastructure to support a transport system that will meet its needs over the coming decades. First, India will have to shed the old version of directive planning to move to a new skill of facilitation, recognising that capital investment in transport infrastructure and regulation or policy are instruments to affect the transport system rather than decrees that determine its final shape. Ultimately, mobility for passengers and services for freight are the products of individual responses to existing infrastructure, policy structures and pricing. Similarly, the transport system is one of many contributors to an emerging economic and social geography that is also the product of millions of households' and businesses' decisions about investment, living, travel, investment and consumption. It is coordination of policy, regulation and fiscal arrangements that influence costing, pricing and supply of transport services made in response to emerging demands. We have consequently provided some pointers to the kind of overall approach required for regulation on the one hand, and fiscal structures that affect transportation on the other (Volume II, Chapters 6 and 9).

Transport governance in India is far more centralised than international practice. The changes that we are recommending are to re-align transport governance with the principles of subsidiarity in federal design

Second, progress has to be made in setting up institutional structures that integrate decision making across agencies that have historically focused on particular modes of transport and between elements of the system. Policies concerning physical infrastructure, its use, and investment in rolling stock have historically been undertaken in different parts of the federal system and agencies within each level of government. India's fragmentation of transport investment planning between modes of transport stands out in comparative context: *it is the only country among the 100 largest economies in the world that continues to maintain separate ministries for each mode of transport.* This fragmentation is deeply rooted in the Indian system and will be difficult to overcome. But NTDPC believes that the process has to be initiated to overcome these constraints and to ensure better governance in transport (Volume II, Chapter 5).

'Integration' does not mean centralised decision-making, but rather setting up of systems for information flow, knowledge generation, and continuous, interactive, dialogue between relevant organisations throughout the project cycle. NTDPC emphatically argues for a move towards decentralised coordination, enabled by information flow among agencies with clear responsibilities, and which moreover have adequate financial and human resources to carry out their mandates. NTDPC accordingly has provided a series of recommendations on how to strengthen capacity in the transport sector in all the sectors and at all levels of both government and executing agencies.

Third, India will have to reconsider the division of authority between levels of government. Transport governance in India is far more centralised than international practice, in part because of constitutional divisions of authority between levels of government; because of the power that fiscal centralisation awards to the Union government; and because of the allocation of and adaptation to scarce technical capacity that is currently available. The changes that NTDPC has recommended are to re-align transport governance with the principles of subsidiarity in federal design.

What are we then proposing for the institutional development in the transport sector?

The increased participation of the private sector in the provision of both transport infrastructure facilities and servivces accentuates the role of regulation through appropriate institutions and frameworks

First, *NTDPC proposes the immediate formation of a high level Office of Transport Strategy (OTS).* The OTS must have the resources to build a strong technical team, aggregate, manage and analyse transport data, and be able to assert itself as a compelling advocate of policies that leverage transport for development goals. The proposed OTS should be set up as an independent agency associated with the Planning Commission (possibly along the lines of the Independent Evaluation Office set up recently). The OTS mandate would be to build on the work of the NTDPC by providing ongoing technical support for sectoral investment programmes as they are accepted, evaluating alternatives for institutional reforms, setting up new entities as proposals are accepted, and updating the Committee's analysis in coming years. Strategic transport planning is not a one-time exercise, particularly in times of economic and political uncertainty. As a technical agency, it would effectively complete the triad of capabilities required for transport strategy: generation of sound policy options (OTS), review of consistency with social goals (government), and implementation (existing ministries and later the departments of the proposed Ministry of Transport). It would leave existing agencies to pursue their current mandates, but within a clearer strategic framework. An institutional structure will have to be developed so that the proposed OTS does not work in isolation, but has organic and continuous links with the implementing ministries/departments and the Planning Commission. It must also be given adequate powers so that its recommendations are implemented.

The OTS should be visibly technocratic. Its policy advisory functions should be backed by significant in-house expertise as well as research generated by centres of excellence and other transport research institutions recommended by the NTDPC (Volume II, Chapter 11). In order to emphasise the kind of agency that is being envisaged, it may be noted that a comparable institution, the Directorate General for Mobility and Transport in the European Commission has more than 2,000 professional staff; the unified US Department of Transportation has as many as 60,000 professional staff. We are clearly not proposing an agency of such size: this is only to make the point that an effective OTS for a country of the size, diversity and complexity of India requires very substantive technical capacity for transport oversight and generation of transport strategy on a continuous basis.

NTDPC also recommends that, given the federal nature of the country, it would be necessary also to set up state level Offices of Transport Strategy which have functions similar to the central OTS, and which would then have an on-going relationship with the central OTS. *Furthermore, the recommended Metropolitan Urban Transport Authorities (MUTA) should also perform OTS type functions at the city level.*

NTDPC recommends that consideration be given immediately to the actions that will be required to set up the national OTS within the 12th Plan period.

Second, after considerable discussion, NTDPC suggests the formation of a unified Ministry of Transport encompassing all transport sectors, as is the practice in all other large countries. We understand that this will not be easy, but it must be done in the medium to longer term. The current collection of ministries would then be subsumed within this unified Transport Ministry. The new unified Ministry of Transport must be carefully structured to create and maintain an incentive structure that encourages technical excellence, open-minded consideration of all available options, and consistent attention to transport system goals rather than particular means. The existing ministries should become departments focused on delivering effective transport infrastructure and services for each mode. Every country in the world and all of India's perceived peers, including China, have moved in this direction. Whereas it has often been observed that the Railways Ministry has been kept separate from the unified Transport Ministry, it is observed in recent times that the integration of railways into the larger Transport Ministry also takes place at a subsequent stage. That is usually coincident with the separation of railways operations into a corporatised entity somewhat removed from general government. Similar unification of transport functions can also take place at the state level.

REGULATION

The key new governance issue that has arisen in the last decade or two in the infrastructure sector as a whole, and correspondingly in transportation, is the increased participation of the private sector in the provision of both transport infrastructure facilities and services. This development accentuates the role of effective regulation through appropriate regulatory institutions and frameworks (Volume II, Chapter 6). Transport infrastructure facilities such as rights of way, railway track, airports, ports and roads involve heavy upfront investment and display significant economies of scale, and hence display monopolistic tendencies. Service provision (conveyance of passengers and freight in every mode) varies from being monopolistic, such as in the railways, to almost fully competitive such as in trucking and many inter-city bus services.

Transport services have long been the domain of the public sector in view of the public good characteristics of many segments of these services. Some services may be seen as 'open access services' such as most inter-city and urban roads, apart from limited access highways: it is difficult, if not impossible, to exclude people from such infrastructure facilities or to charge for using them, and nor is it desirable. They thus have public good characteristics. In effect, tax revenues collected from the citizens effectively entitle people to expect the provision of a minimum level of transport infrastructure on a free and open access basis. It is, however, possible to exclude people from most other transport services and hence to charge them for their usage in trains, buses, trucks, airlines and shipping for both passengers and freight. With technological change, it is possible to charge them without exclusion, even for open access services, for example, through fuel cesses or electronic charging. Thus, many parts of transport infrastructure and services are now often classified as private goods that can be made subject to user charges that are based on economic costs. Levy of the fuel cess on diesel and petrol is one example of almost perfect user charge for the use of roads and infrastructure even when there is open access: the consumption of fuel by a vehicle is directly proportional to its weight and the distance travelled by it.

Nonetheless, the transport sector is replete with examples of limited competition, market failure and monopolistic elements that then require economic regulation: most cities have just one airport; the number of ports in any region is limited; it is difficult to construct a limited access highway between two nodes; and it is unusual to have more than one railway track between two cities. Thus, whereas there could be adequate competition between service providers, if permitted, such as buses, trains, airlines and shipping, it is unlikely that there can be competition between transport infrastructure facilities. Furthermore, while it is possible to charge and even exclude people from various transport services, there is also need to ensure universal access to transport. Charging for every transport service should not mean that the poor are excluded from the transport service that they need.

NTDPC believes that there is demonstrable need for regulation of various parts of the transport network: to limit potential monopolistic power exercised by owners of networks through regulated pricing; to manage congestion and air pollution and also to enforce safety regulations. In brief, regulation is needed both to manage the consequences of negative externalities and also to achieve positive externalities through enhanced safety and inducing network effects. One of the main goals of regulation is to induce firms to produce the service at the lowest possible costs, to align prices with costs so that affordable accessibility is ensured to the users of transport services, while monopolistic providers are restrained from making supernormal profits. This has become much more important with the growing use of public-private partnership (PPP) contracts in transport and introduction of the private sector transport in general. New problems have also arisen in the enforcement of PPP contracts, since such contracts are of typically very long duration and economic conditions may well change over the period of the contract. It is also necessary to ensure that there is adequate competition in the bidding for such contracts since once the contract is awarded, the concessionaire effectively becomes a monopoly provider. All of these new developments in transport necessitate enhanced quality of governance and regulation.

> Regulation is needed both to manage the consequences of negative externalities and also achieve positive externalities inducing network effects. A key goal is to induce firms to produce the service at the lowest possible costs, to ensure affordability of access

Designing good regulatory institutions is complex since it is important to ensure that there is adequate technical expertise in the exercise of regulation that is seen to be both competent and fair. Furthermore, attributes such as independence, transparency, accountability, legitimacy and credibility are also essential as we establish these regulatory institutions. Besides, safety and social regulations to reduce health and environmental impacts are also necessary to be integrated in the overall regulatory approach. Since private investors are confronted with considerable uncertainty and risk in making investments in transport facilities, which provide them returns over the long term, it is essential that regulatory frameworks provide them with stable conditions and a predictable environment that enables them to make credible commitments. Independence implies shielding regulatory agencies from political pressure to the extent possible. Whereas it is appropriate for a government to issue broad policy guidelines and directives, the regulatory agency should be given functional autonomy in its day-to-day activities. The credibility of the regulator also implies that it needs to follow a transparent consultative process in decision making which is seen as fair and representative of the different, often competing, interests in the relevant sector. It is also useful to provide financial autonomy to the regulator to ensure its independence. So far, the government has not seen it fit to provide financial autonomy to most of the regulatory institutions that have been set up. They are generally supported by budgetary allocations through their respective administrative ministries, which can have adverse consequences for the exercise of functional autonomy. It will be desirable to find appropriate procedures that can indeed enable regulators in the transport sector to be financially autonomous.

The current proposal in the aviation sector to replace the Directorate-General of Civil Aviation with a Civil Aviation Authority (along the lines of the UK CAA) responsible for the operational regulation of airlines, with separate specialist divisions (covering air-worthiness, licensing, air-space management, etc.) is a step in this direction as it separates the regulatory function into an autonomous body, leaving the Ministry of Civil Aviation to focus on policy and establishing a more conducive environment, where the Government progressively withdraws from operations and encourages the states and the private sector to play a more active role in the development of the sector (Volume III, Chapter 3).

The multiplicity of state level transport-related taxes needs to be simplified and rationalised through a mechanism akin to that used to transform the complex state-level sales taxes to the state VAT system

As regulators have spread across infrastructure sectors, some questions have arisen regarding the overall institutional design for regulation: should regulation and dispute resolution institutions be created for each sector and sub-sector, or should certain functions be consolidated across sectors? The alternative to sector-specific regulation is the single umbrella transport regulator with specialised departments. After considerable discussion and thought, NTDPC has opted to continue with the current approach of setting up separate regulators for each sector. The argument is essentially that in the current stage of development, it is necessary for the regulator to develop sector-specific technical, economic and legal expertise in an environment which is still developing and changing rapidly. However, as we move towards a unified Transport Ministry as NTDPC has proposed, it may also become feasible at a later stage to combine the various sector-specific transport regulators into an overall unified transport regulator as well.

As the transport sector develops and exhibits greater competition in different sectors, through both greater private participation and technology changes, the role of the transport regulator in price regulation often reduces. This has been observed in the telecom sector where the Telecom Regulatory Authority of India (TRAI) initially focused on tariff regulation, but increasing competition made pricing relatively free. Similar developments could take place in the operations of the Tariff Authority for Major Ports (TAMP) as there is increasing competition between port terminals. Thus, as transport development takes place, the burden on sector-specific transport regulators could indeed reduce thereby making the possibility of a unified transport regulator more realistic.

As in other aspects of governance, NTDPC emphasises the need for adequate development of technical competence in all the regulatory institutions so that their decision making processes and outcomes are protected from undesirable politicisation. The experience so far has been mixed. It is important that the leadership of regulatory institutions be seen as knowledgeable and competent so that their decisions are respected and hence implemented. There has been a tendency to staff the leadership of these organisations with superannuating civil servants who may not necessarily possess adequate domain knowledge: this must be corrected.

FISCAL ISSUES

The key issue in transport governance that has not been analysed adequately, and which is linked to both government and its regulatory institutions, is the impact of the many fiscal levies on both the supply of and demand for transport services. *We have documented the very wide proliferation and complexity of fiscal levies affecting transport both at the central and state levels* (Volume II, Chapter 9). The distinction between some tax levies (such as fuel cess) and user charges is often not clear cut. Given this complexity, it is difficult to analyse the differential fiscal incidence on different modes.

We have, for example, argued for the use of tax levies and charges (e.g., for parking) for urban transport demand management to discourage the use of personalised motorised transport usage in large cities, while also using this mechanism for funding urban transport investment (Volume III, Chapter 5). As argued in that chapter, the levy of such charges would need the cooperation of central/state and metropolitan authorities, including the proposed MUTAs. NTDPC has therefore proposed that *the multiplicity of state level taxes be simplified and rationalised through a mechanism akin to that used for transforming the complex state-level sales taxes to the simplified state VAT system, which is now moving towards a comprehensive Goods and Services Tax (GST).*

As this is done, among the tasks that the proposed OTS can do is to keep track of the various taxes and user charges levied and collected by different levels of government, and other user charges regulated by the various regulators. In principle, the combined public and private revenue collected from both providers and users of transport services should collectively finance the provision of these services in the system. Thus, there is a close link between the fiscal system as it affects transport services and the user charge regime, including cesses, as it affects investment in transport infrastructure facilities, the service providers and the ultimate users of the services.

NTDPC therefore views the governance system, the regulatory system and the fiscal framework as components of the overall transport system. Successful operation of this system requires the combined efforts of all the stakeholders to be participants through organised methodologies of mutual consultation.

SAFETY

The existing rates of fatalities and the rate of increase in accidents in transportation in India are both unacceptably high. More than 150,000 people died in transportation-related accidents in 2011 in India or more than 450 a day, the vast majority of them in road accidents. It is estimated that, in addition to the deaths, at least 1,500 persons were probably disabled, 7,000 hospitalised and more than 40,000 sustained minor injuries every day in traffic-related accidents. The cost of road traffic crashes alone may be about 3 per cent of the GDP. With continuing growth in traffic in all modes, particularly on roads, and with increasing speeds, the graph of traffic accidents is inching up inexorably. The situation is therefore quite serious and unless policies and evidence-based counter measures are put in place urgently, the situation is likely to worsen (Volume II, Chapter 12).

There is little expertise, data or information available in India to address the transport safety problem in a scientific manner. The international professional consensus is that it is not very productive to focus on human error alone. Since each accident is a result of a combination of human, vehicular and environmental factors, a sophisticated systems approach is a must in addressing transport safety issues. This approach has not been internalised yet by any official organisation or institution dealing with safety in India. The predominant approach is still based on principles of finding fault with the individuals concerned and then acting accordingly.

Business as usual with regard to safety in transport cannot be tolerated any longer. It is imperative that we give much more importance to transportation safety in India, and this will only happen if the whole system is improved and strengthened on an urgent basis. Significant reduction in accident rates has been seen in all modes of transport in developed countries since the 1960s and 1970s. The reduction has not been due to any single factor, but due to a systemic approach resulting in a wide variety of improvements in designing the vehicles, operating environment infrastructure and enforcement of safety regulation and standards. Thus, it is indeed possible to arrest the continuing increase in accident rates in India, and then to reverse the current

> There is little expertise, data or information available in India to address the transport safety problem in a scientific manner. A sophisticated systems approach is a must, and this has not been internalised at all

trend. The entire traffic and transport system must be designed to account for the limitation in capabilities of users and operators. The requirements of a safe systems approach are:

- an institutional structure that creates a demand for scientific work in safety issues;
- legislation and regulation to promote safety;
- monitoring and measurement (generation of national databases);
- assuring and improving the quality of safety services provided through professionals, individual institutions and the use of specific technology and devices.

All countries that have been successful in reducing transport related injuries and deaths, have set up relatively large professional national safety agencies for each mode of transport. These agencies have different structures owing to different political and administrative systems in different countries, but are generally kept independent of the operating departments.

In the aviation sector, the best practice in this regard is exemplified by the fully autonomous Accident Investigation and Safety Boards in Australia and the UK, where this is an absolute separation from the regulatory agency, the Boards are staffed by acknowledged professional specialists and there is a statutory requirement to publish every report, so that preventive measures can be quickly fed back into the safety regulatory regime. The decision of the Ministry of Civil Aviation to set up such a body in India sets a worthwhile precedent for the other sectors to follow.

Demand for better knowledge and technologies in the transport sector can only be provided by public bodies: central and state governments, and local bodies like municipalities and transit authorities. It is the responsibility of the public sector to create long-term stable demand for safety work, with the understanding that progressive employment of trained professionals will be available on a continuous basis. If respectable professional jobs are available with promising and secure career paths in safety research and operations, talented professionals will gravitate to the field; this in turn will encourage educational training institutions to provide the necessary programmes.

Accordingly, NTDPC proposes that action should be initiated forthwith to establish National Safety Boards

Capacity building in transportation is an urgent necessity. One per cent of investment in each sector should be earmarked for institution and capacity building in transport, in both the public and private sectors

for road, railways, water/marine and air. These boards must be independent of the respective operational agencies; they should be headed by professionals at the highest levels and these boards should have adequate funding. The recommendations contained in the Report of the Sundar Committee on Roads and the Kakodkar Committee on Railways provide excellent guidelines for formulating the terms of reference for these boards. Furthermore, safety departments need to be set up within operating agencies at different levels for ensuring dayto-day compliance with safety standards, study effectiveness of the existing policies and standards, conducting safety audits, collecting relevant data, etc. The national safety agencies in each of the transport departments should also help in establishing multi-disciplinary safety research centres in independent academic and research institutions, and ensure adequate funding to achieve critical size and adequate levels of expertise.

As institutional development takes places in the area of safety in transportation, we can expect that safety concerns will get embedded in the design of both transport infrastructure facilities like roads, railway track, airports, ports and the like, as well as in the design of all vehicles. It is only if such motivated action is taken on an urgent basis that there can be any chance of reversing the current high growth in transportation accidents resulting in fatalities and severe injuries. This would constitute an important departure for the planning process since this issue has so far not been addressed in an organised manner. The task will be difficult in India in view of the extremely high growth that is expected in all sectors of transport.

NTDPC attaches the highest importance to this matter since it concerns the life and death of many of our citizens on a daily basis.

RESEARCH AND HUMAN RESOURCE DEVELOPMENT

This Report is distinguished by its emphasis on institution building for managing India's burgeoning transportation requirements over the next couple of decades and beyond. Consequently, future transport planning, policy making, regulation, execution, implementation and maintenance of transport systems will require a greatly enhanced number of transport professionals, researchers and educators to run the system. The kind of agencies suggested, the OTS at both the central and state levels, the MUTA at the city level, the various regulators, and the safety boards, will not be possible to set up unless there is an adequate supply of technocratic expertise at every level. At present, the country simply does not have even a fraction of the number of professionals required. Furthermore, the kind of capacity expansion proposed for each of the transport sectors—railways, roads, civil aviation, ports, urban transport and inland waterways—will also require very significant enhancement in the availability of high-quality engineers and associated personnel at all levels. In addition, the new concerns regarding energy and environmental sustainability will need to be integrated in our planning and execution activities, along with much greater concentration on safety issues.

India fares poorly in terms of knowledge output in the transport sector, in comparison with our peers such as China and Brazil. We do not have any institutes within government departments and operating agencies, university centres or stand alone institutions in any areas of transportation that compare favourably with such institutes in our peer countries. The few centres that exist are sub-critical in terms of resources expertise and size. We simply do not have appreciation of the size and sophistication of technical institutions that we need. This must change.

Thus, capacity building in transportation is a key necessity for urgent action so that we enhance the probability of successfully facing the emerging challenges in transport investment and operation over the next couple of decades. Capacity building comprises various challenges: building systems in research and development to update and upgrade capacity on a continuous basis; ensuring production of transport professionals in every sector; and consistent retraining and upgrading of existing personnel.

NTDPC has therefore recommended very significant institution building for transport research, development, education and training in all areas of transport activity (Volume II, Chapter 11). The effort necessary for setting up the structures of the institutions envisioned for the next two decades will be very substantial. The potential availability of adequate resources should not be an issue for this purpose. In comparison with the estimated magnitude of funds required for transport investment for the next 20 years, the resource needs for capacity building are relatively small. *NTDPC suggests that 1 per cent of investment in each sector be earmarked for institution building and capacity building in transport in both the public and private sectors. It is proposed that the Planning Commission may take up the various capacity building proposals made by NTDPC in mission mode and allocate enough resources for* *this activity on urgent basis, within the period of the 12th Plan.*

Accordingly, we have proposed a range of institutions to be set up for research and human resource development in the transport sector, each of substantial size: a standalone Indian Institute of Transport Research (IITR) is proposed which could be supplemented with various regional centres; centres of excellence in selected universities and engineering institutions; research institutions in each transport sector; and corresponding institutions at the state level. In addition to the standalone IITR, NTDPC has also proposed establishment of substantive research organisations in each of the transport sectors, railways, roads, civil aviation, ports and urban transport.

Correspondingly, NTDPC also recommends the setting up of an Indian Institute for Transportation Statistics (IITS) which should be responsible for coordinating and generating, where necessary, all the data required for the kind of transport strategy and planning that has been recommended in this report. IITS would be responsible for acquiring, preserving, managing, disseminating transport data, conducting statistical analysis and associated information for use by central, state and city transportation departments. The various research institutions proposed by the NTDPC would also need statistical support from such an institution.

One way of bringing about consistent technical upgradation of roads across the country is through the development of technical standards related to the quality of road surface, signage, pavement (sidewalks), and all other aspects of road design. Each level of road within the designated road hierarchy would then be uniform across the country, both for inter city roads and for urban roads. NTDPC therefore recommends the setting up of a high-quality roads standards institute which can then help in bringing up Indian roads to international-level quality (Volume III, Chapter 2).

Adequate financial and technical resources must be provided so that each of the institutions is of critical size and has the potential to develop expertise over the next 10 years. These institutions will require qualified professionals to staff them. Thus, there is need for adequate expansion of education in all transport related scientific and engineering disciplines across the country.

If we start such institution building, it will take 10 years or more to achieve significant results. Meanwhile, we must initiate a comprehensive programme for upgrading the technical quality and competence of existing personnel at all levels in the country. This must be done through a focused and sustained programme that covers all operating departments, institutions, corporations at both the central and state levels. The aim should be to sponsor 2-5 per cent of the staff in all such organisations for full-time education to the Masters level every year for the next 5-10 years. The organisations to be covered should include all the transport-related engineering organisations in the central government, state governments, public- and private-sector companies, and at the city level. *Once again, NTDPC recommends that this programme be initiated at both national and state levels within the 12th Plan period.*

While we build the necessary institutions, we must initiate a comprehensive programme for upgrading technical quality and competence of existing personnel in the transport sector at all levels in the country

Many will criticise NTDPC for the range and size of institutions recommended in this Report as being too large, too idealistic and unrealistic. In fact, the number, size and type of institutions being recommended is based on international comparisons, focusing on large countries with comparable levels of development. International experience suggests that it takes more than a decade to build viable quality institutions. We have had demonstrated successes in the past in the building of high quality technical institutions such as Indian Institute of Science (IISc), the Indian Institutes of Technology (IITs), Indian Space Research Organisation (ISRO), the National Aeronautical Laboratory (NAL), the Bhabha Atomic Research Centre (BARC) and others. *The vision that the NTDPC has offered for capacity building in the transport sector is therefore feasible to be achieved once we make up our minds and decide that such action is necessary to build an efficient, competitive, affordable and sustainable transport sector that is essential for the country's development in the future.* Moreover, if India is to emerge as a global power over time, it needs to invest significantly in human resource institutes to develop much greater soft power than at present.

THE ENERGY AND TECHNOLOGY CHALLENGE

A common theme running through this NTDPC Report is the need for upgrading Indian transport facilities in all their aspects and for modernisation across the board. Much of rolling stock in the Indian Railways is obsolete including both passenger coaches and freight wagons. As the volume of freight increases, and inter-modal transfers become the norm rather than the exception, rolling stock of freight will have to undergo a very significant transformation towards specialised wagons for specialised needs. It will be necessary to enable fast loading from ships as well as from domestic sources; similarly, container handling from ship to train and from train to truck will need to be made efficient at container freight stations. In the case of passenger rail coaches, as average speed increases with the transfer of freight trains to DFCs, the quality of passenger coaches will also need to be upgraded to increase passenger comfort. From the environmental point of view, the open toilet provision in Indian passenger trains is a disaster and a major health hazard[3]. Thus, a significant need is also for modernisation of toilets and other facilities on Indian trains. Existing open toilets also result in corrosion of coaches and tracks as well as resultant high costs in ensuring hygiene and cleanliness.

In urban transport, there is a great need for better technology for traffic management, for transport demand management, for encouraging public transport and non-motorised transport. Similarly, the improvement in the quality of buses for both energy efficiency and passenger comfort is necessary to wean away passengers from individual owned transport vehicles to public transport.

From the point of view of economy in energy usage, there is a clear and demonstrated need to reverse the increasing mode share of road transport in the country for both passengers and freight

In the case of roads, there is very little standardisation in the quality of roads, road signs and other road furniture across the country. Each of these requires the development of technical standards and their enforcement (Volume III, Chapter 2). NTDPC has accordingly emphasised the development of technology institutions across the board and training to address these and other problems related to the modernisation of transport in India.

This also includes the increasing use of information and communication technology (ICT) to integrate the different transport systems to reduce energy use and to improve customer satisfaction. Most of the technologies that can be used in all these areas are available off-the-shelf in the world. India is therefore in the fortunate situation that it can indeed pick and choose the technologies that are suitable for usage in India, given its income levels, climate and other economic conditions (Volume II, Chapter 10). The challenge facing us is to make intelligent choices which are commensurate with our needs, income levels and availability of resources at different times. Our challenges also are complicated by the expectation of consistently high growth which results in constantly changing income levels, demand patterns and increasing availability of resources.

We have documented that with the projected overall economic growth in the country over the next 20 years, it is quite likely that much higher magnitudes of resources will be available for investment in transport from around the early 2020s and beyond. Thus, some technologies that may not be appropriate to adopt today might indeed become feasible from the resource point of view 10 or more years from now.

The world is awash with new ideas in transportation such as driverless cars, electric cars, high-speed trains, monorails, information technology-based charging systems, increasingly sophisticated emissions control systems, and the like. What is important is that we develop mechanisms to make technology choices in an economic manner that is consistent with our current economic conditions and which are adapted to the fast growing changes that we expect in the economy in the coming years. At the same time, where economically feasible, we should not be afraid to also leapfrog technologies so that we use the best in class available globally. To do all this, we need professional competence and an institutional framework that is capable of making such choices on a continuous basis. Hence, in this area also, NTDPC, while providing some focused recommendations that can be adopted readily, has once again emphasised the development of institutions in the area of information and other technologies also. Modernisation needs to be done across the board and in a manner that it serves the needs of all travellers on an inclusive basis.

Energy usage in transportation has been growing at rates corresponding to the growth in transportation itself. With the expectation of continuing high economic growth, along with that in transportation, we can expect similar growth in the use of energy in the business as usual framework. The uncertainties in energy supply, particularly petroleum products in the coming years and decades poses particular challenges for India since much of its petroleum is imported. The increasing share of road transport in both passenger and freight has further accentuated the increasing dependence of India on petroleum and petroleum products. Furthermore, concerns connected with climate change have brought additional focus to these problems as the economy grows and demand for energy increases, including that used in transport. As cities grow, and the number of large cities increases, the pollution concerns relating to emissions from vehicles also assume greater importance in relation to the serious adverse effects on health that is now clearly documented. Attacking these problems needs to be done on an integrated basis using all the various means available.

3. The Prohibition of Employment as Manual Scavengers and their Rehabilitation Act, 2013 has been passed by the Parliament and came into force on 6 December 2013. The Act prohibits manual scavenging and envisages provision of new cleaning devices and protective gears for existing water flush toilets in railway coaches.

First, there is a clear demonstrated need from the point of view of economy in energy usage and associated positive results on climate change, to arrest and then reverse the increasing mode share of road transport in the country for both passengers and freight. The movement of bulk and over-dimensioned cargo should be considered for transportation through inland waterways and coastal shipping wherever possible. The advantages of this mode in terms of lower emissions and fuel consumption, even when compared with railways, should be fully harnessed. Similarly, within cities, while there will be an inexorable increase in ownership of private motorised vehicles, everything needs to be done to encourage the use of public transport and the use of facilities for non-motorised transport like walking and cycling. Nearly 98 per cent of energy needs of transportation are met through petroleum products, and almost half of the total consumption of petroleum products in India is on account of transport activities. Second, observing the improvement in air quality in many of the cities in developed countries, it is clear that technologies are available for reducing emissions made by motorised transport of every description. Tightening, and more importantly, enforcing vehicle emissions standards will drive further innovation in emissions control and even development of new industries, as it has in other settings around the world. Third, new technologies are also becoming available including information and communication technology for facilitating more efficient use of energy through greater integration of transport modes and logistics efficiency in freight transport. NTDPC has examined these issues in some detail and made appropriate recommendations across the Report. (Volume II, Chapters 4, 7, 10 and Volume III, Chapter 5).

With the increase in personal motorised vehicles, and also the expansion of public transport vehicles, the air quality in most cities from middle sized cities to the larger cities has been deteriorating over time in India. One estimate suggests that around 150,000 people died in India in 2005 as a result of ambient fine particulate matter. This number has most likely increased since. In 2002, the WHO calculated a respiratory disease mortality rate of 58 persons per 100,000 in India. This rate is now likely to be much in excess of 100 persons per 100,000. A substantial portion of CO_2 emissions in India are released by the transport sector. In a business as usual scenario, overall transport CO_2 emissions could increase four fold over the next 20 years. Because of the prevailing low income levels, many people walk or use bicycles for their daily travel needs in Indian cities. It is essential that facilities are put in place, through regulations and standards, to make these modes pleasant for all, including the physically challenged, so that these modal shares are, at a minimum, retained over time. This will do much to contain the continuing increase in vehicular pollution. Thus, India requires a combination of measures for urban planning, transport infrastructure development and stringent enforcement of emissions control to reduce fuel consumption and emissions.

We recommend that an auto fuel policy committee should be formed every five years on a regular basis so that we may ensure the air quality for our citizens on a much more firm basis in the years to come

We can observe that there has been considerable improvement in urban air quality in advanced countries such as the United States, Europe, Japan and South Korea over the last couple of decades. The days of consistent smog in large cities such as London, New York, Tokyo and others are gone. It is seldom that air quality in these cities now falls to levels that were seen on a regular basis in the 1950s and 1960s. It is therefore clear that it is possible to use technology to improve air quality even in the presence of rising vehicle ownership and use. The latest emission control technologies that are already available will have to be taken advantage of to leapfrog to tighter emission standards and reduce fuel consumption.

Vehicle emission standards have been tightened successively in India since the 1980s, both through new legislation and progressively through regulations concerned with vehicular emission. Similarly, fuel quality standards have also been tightened over time, but they remain well behind international best practices. Whereas the maximum sulphur content of 10 ppm in gasoline has already been mandated in Europe and Japan more than five years ago, the standard in India remains at 150 ppm countrywide and 50 ppm in selected cities. The diesel sulphur content remains higher than the gasoline sulphur content in most of the country and well behind international best practices.

The technology for improving fuel quality across the board is readily available and so is that for improving emission standards in vehicles. There is of a course a cost associated with enforcing such standards. Thus, compliance with such standards will take time and adequate resources should be made available for the purpose. *The NTDPC has provided its recommendations for reaching European fuel quality standards and emission standards by 2020* (Volume II, Chapter 7). At present, auto fuel policy committees are formed on a sporadic basis involving considerable delays in mandating newer standards.

NTDPC recommends that an auto fuel policy committee should be formed every five years on a regular basis so that we may ensure the air quality for our citizens on a much more firm basis in the years to come. The responsibility for fuel quality and emission standards is currently spread across different Ministries such as the Ministry of Petroleum and Natural Gas, the Ministry of Heavy Industries, the Ministry of Urban Development, the Ministry of Road Transport and Highways and state governments. Whereas the relevant responsibilities will remain dependent on the Allocation of Business Rules across Ministries, *NTDPC recommends the formation of the National Automobile Pollution and Fuel Authority (NAPFA) to assume responsibility on institutional basis for setting and enforcing vehicle emission and fuel quality standards in India.* This is a reiteration of the recommendation made in 2003 by the Mashelkar Auto Fuel Policy Committee.

> Through the use of Big Data, computing and analytics that match supply and demand for various services, information technology can help in more efficient energy usage, enhancing sustainability

What is also necessary is a National In-use Vehicle Testing programme to be established to ensure safety, road worthiness and emission performance of end use vehicles, covering all motor vehicle categories. A model Inspection and Certification (I&C) regime needs to be established in a phased manner through the establishment of a dense network of modern I&C centres, along with corresponding investments in the police force and Regional Transport Offices. This will require allocation of appropriate resources through state governments. Given the environmental challenge, these initiatives need to be taken up on an urgent basis in the interest of ensuring better health for all our citizens.

To examine the differential environmental costs related to different modes, we also commissioned a special study on the Life Cycle Analysis of transport modes. In general, environmental impact assessment exercises carried out to support decision making in the transport sector do not consider the full life cycle energy and CO_2 impact of transport modes but instead focus on the tail pipe impact only. It is however necessary that a more integrated approach is adopted while analysing impact. This is because different transport modes involve varying degrees of construction and maintenance activities. While some modes may be highly material- and energy-intensive, others may be comparatively less energy-intensive. Material and energy consumption at various stages of a transport project, i.e., construction, operation and maintenance, need to be examined in order to fully understand their impact on environment. Such an approach would help identify the stages of a transport system that has maximum impact and would also therefore enable identification of appropriate mitigation strategies. It is found for example that metro rail projects for urban areas have the highest environmental costs of all alternatives at the construction stage, but such high capacity public transportation systems do exhibit the least observed carbon emissions because they generate no emission at the tail pipe. A life cycle analysis evaluation however indicates that a metro system generates more CO_2 on a life cycle basis, compared to say, a bus traffic transport system which can also be high capacity. Introducing life cycle impact situations can therefore bring more detailed understanding of the overall impact of system or proposed infrastructure project and therefore help decision makers to make informed choices based on the economic, social and environmental goals set by the national, state or city governments (Volume II, Chapter 7). The establishment of the OTS proposed by the NTDPC and other transport research organisations can be expected to develop such analytical methodologies for making the choices that the country will be confronted with on a continuous basis in the years to come.

INFORMATION AND COMMUNICATION TECHNOLOGY

The increasing use of information and communication technology (ICT) in transportation systems has been transforming the organisation and management of transportation services and the quality of the interface between users and providers. The use of ICT can help in integrating different transport systems with other systems resulting in reduced energy use and increased customer satisfaction. Through the use of Big Data, computing and analytics that match supply of and demand for various services, utilities, ICT can help in more efficient use of energy, thus enhancing the sustainability of transport and other infrastructure (Volume II, Chapter 10). The increasing use of logistics systems in freight transportation has been almost entirely due to the availability of ICT over the last 20 years or so. The seamless transfer of both passengers and goods across modes can be made possible through the use of ICT. The introduction of smart cards, for example, can allow for paying for the usage of different modes by consumers in an integrated fashion without having to buy tickets from different transport service providers. Similarly, from the supply side, such systems integration can take place across service providers so that consumers are better able to plan journeys across different modes and different providers in a seamless fashion. This can be particularly useful in urban transport systems where it is not unusual for people to use buses, trams, taxis or trains for the same journey on a daily basis. Similarly, ICT can also enable more efficient and connected scheduling between different modes so that consumers do not have to wait while using different modes in the same journey.

Issuance of e-tickets by airlines has greatly facilitated the planning of journeys by travellers across the world through the use of laptops or other Information Technology (IT) devices from the convenience of homes. A whole industry of travel websites has arisen wherein one can book airlines, car rentals, hotel and the use of other services on a very convenient basis. Within India, e-ticketing by the Indian Railways has transformed the rail booking procedure from having to wait in long lines for physical booking at railway stations to the convenience of making reservations from within one's home. State road transport organisations and private bus companies have also begun to issue e-tickets. What has not happened is the possibility of integrating these different ticket issuing agencies through a single website or the integration of multi-modal journeys through the issuance of a single ticket.

On the freight side, global logistic providers such as Fedex, UPS, DHL have transformed the freight business beyond recognition over the last two decades. Through the extensive use of ICT, they have greatly simplified the procedure that needs to be complied with by the despatcher of goods and that by the receiver, both within and across countries. Such logistics providers undertake to find the most efficient transportation route within or across modes and within or across countries, including customs procedures, etc. Prior to such integration the freight industry was characterised by high degrees of fragmentation that involved a number of intermediaries such as transportation companies themselves, freight forwarders, customs clearing agents, and others, each of which had to be arranged by the despatcher on the one hand and the receiver on the other. The consolidation provided now by logistics companies could not have taken place without the increasing use of ICT.

With the expected expansion of trade that has been projected within our macroeconomic modelling framework, cargo traffic can be expected to increase at both Indian ports and airports. Many of our ports are already stretched to capacity with capacity utilisation already close to 100 per cent or higher. Low productivity, congestion and delays are often the norm at some of our ports. Whereas there is no doubt that it is essential to undertake investment in capacity expansion as proposed by NTDPC, greater use of ICT can certainly help productivity and efficiency at ports. Trade facilitation through ICT can be greatly enhanced to reduce transaction costs involved in the movement of goods through our ports and airports and made more efficient in terms of the time taken for customs processes and otherwise.

In the road sector, with the increasing use of tolled highways, many delays are being experienced by both passengers and freight transport, who have to negotiate their way through different toll gates across the country. Once again, as recommended by the Nandan Nilekani report, the use of ICT can facilitate the use of smart cards and electronic toll collection so that passengers and freight can move seamlessly across the country through different jurisdictions and different toll roads without high-cost delays at toll gates.

Smart cards and electronic toll collection can make sure that both passengers and freight can move seamlessly across India through different jurisdictions and different toll roads without high-cost delays at toll gates

In urban transport, apart from the use of cross-modal smart cards, ICT has already been used in different cities such as Singapore and London, among others, to introduce congestion pricing, to reduce the number of cars in the city and to encourage the people to use public transportation. The NTDPC approach to urban transport exhibits a similar orientation. The NTDPC, through its Report, emphasises greater coordination between modes for both passengers and freight transport; the increased use of ICT can indeed facilitate this.

This merely provides some examples for the use of ICT in transportation in the future. Many of these technologies are available elsewhere and some of which are already in use in India and others are in the process of being introduced in different places. Here also, what is needed is considerable capacity building of both professionals and institutions. *We have identified different initiatives in each of the sectoral chapters and also in Volume II, Chapter 10 (on Potential of Information and Communication Technology to Enhance Transport Efficiency) which are designed to enhance efficiency, utilisation and safety of the transport systems.*

All such initiatives will require a strong institutional foundation for development and implementation. The key functional areas of focus include setting standards for technology in transportation and of processes which facilitate implementation of these technologies; the initiation of training and research and development so that available technologies can be adapted and standardised for use in India; provision of policy advice for government and providers of transport services; and the provision of consulting in project management services for implementation of ICT in different areas. As the prospect of use of information technology in banking began to manifest itself in India in the mid to late 1990s, the RBI set up the Institute for Development and Research in Banking Technology (IDRBT) in Hyderabad for the purpose of research and development as well as consultancy in the application of technology to the banking and financial sector of the country. The IDRBT has been instrumental in setting the relevant IT and communication standards and protocols in banking and across the financial sector in India, which enables those financial institutions to communicate with each other. IDRBT also does research and runs academic programmes for Masters and Doctorate degrees. *In an analogous fashion, NTDPC recommends the establishment of the Indian Institute of Information Technology in Transportation (IIITT).* Its function would be similar to RITA (Research in Technology Administration) which coordinates the US Department of Transportation Research programmes. The IIITT would develop the overall ICT framework in the Indian transport sector and coordinate with other proposed central-level and state-level institutions as necessary. It would also collaborate with international institutions to develop new technologies, adapt available technologies for deployment in India and facilitate research, development and training for ICT for transport professionals. The successful application of ICT in each of the different segments of transportation will need adequate institutional development at all levels, details of which have been outlined in the relevant chapters in this Report.

We need very significant and integrated planning of key transport corridors and execution on a timely basis so that the potential and prospects of Indian economic growth are not jeopardised

TRANSPORTATION OF ENERGY COMMODITIES

Considerable stress has been laid in this Report on the growth in use of energy in transport over the coming years and its impact on the environment and on climate change. The NTDPC has also focused specifically on the impact of overall energy growth and its production on the transport system in the future (Volume II, Chapter 8). As is well known, the growth in demand for energy is essentially similar to that of overall economic growth. Thus, if the Indian economy grows by a factor of 4 over the next 20 years, the required production of energy will also have to increase by a similar proportion, in order to meet the increasing demand. Similarly, growth in the production of key commodities like steel will also be comparable or higher. Such growth will imply corresponding growth in the transportation of bulk commodities such as coal, iron ore and steel.

Coal already accounts for almost half the freight volume in Indian Railways and some of the current problems afflicting the power industry include the lack of adequate capacity in crucial links and corridors for the supply of coal to power stations consistent with the increase in power generation. The future poses profound challenges. Given the composition of energy resources in the country, coal is expected to remain the dominant fuel for the power sector, despite the various apprehensions that are being expressed globally on the environmental impact of coal use in energy projects. According to NTDPC projections, the production of domestic coal is expected to increase by about 2.5 times over the next two decades. At the same time, it is expected that imports will have to grow much faster by around five times over the same period. The intensity of steel use in the economy is expected to possibly go up by a factor of 8 resulting in a corresponding growth in the transport of raw materials, particularly iron ore for the production of steel. Similarly, the usage of Petroleum, Oils and Lubricants (POL) and natural gas will also grow by large volumes much of which will continue to be imported, but these, of course, will be carried out through pipelines and would not expected to have a significant impact on over-the-ground transport infrastructure.

These very large increases in the transport requirement of bulk commodities poses a great challenge because our transport system is barely able to cope with the traffic today: the trunk railway network is heavily congested; almost all the major rail routes over which coal and iron ore will be transported are operating at over 100 per cent capacity. The capacity utilisation of ports also averages over 85 per cent with some even over 100 per cent. International norms recommend capacity utilisation in ports below 70 per cent to avoid delays.

In recognition of these challenges facing the Indian economy and its transport system in particular, NTDPC emphasises the need for very significant and integrated planning of key transport corridors over the next 20 years and execution on a timely basis so that the potential and prospects of Indian economic growth are not jeopardised. The approach taken by NTDPC suggests the addition of appropriate port capacity for enabling integration for better investment in associated transport links along with similar coordination of links with the domestic sources of coal.

NTDPC conducted an elaborate technical exercise to make detailed projections of the optimal transport network that would enable efficient transport of domestic and imported coal to the expected location of power plants. As may be appreciated, many different solutions are possible for such an exercise. It is therefore necessary to build up institutional capacity that can enable adequate planning for these very segments of Indian transport systems, particularly railways, over the next 20 years. Once again, NTDPC recommends that the proposed OTS should be adequately equipped to carry out such exercise.

The result of our own work suggests that the key requirement is to concentrate investment in the railways for the transport of bulk commodities first on the feeder routes from the coal and iron ore mines located mostly in the tri-state area of Chhattisgarh, Odisha and Jharkhand for connecting them with the trunk routes. Second, among the DFCs, the highest priority may be given to the completion of the Eastern Freight Corridor. Third, adequate attention to be given to promoting coastal shipping from the coal producing areas on the eastern coast to avoid long over-the-land transportation of coal. Fourth, consistent with the NTDPC recommendation in the ports sector for the establishment of 4-6 mega ports, the increased imports of both petroleum and coal would suggest that the selection of sites for these mega ports should be significantly influenced by the transportation needs of these commodities. This is because mega ports provide very significant economies of scale which can dramatically reduce turnaround time. The need for mega ports is dictated by the fact that at present India is not able to receive large tankers and other cargo and container ships because of inadequate depth available even in its largest ports. The dredging and other engineering works required for creating the depth necessary is very resource intensive. Hence the need for investing in only select locations for mega ports.

As indicated, the planning for the transport of energy commodities which is essential for ensuring the projected high economic growth for the country requires considerable technical analysis and expertise. Furthermore, investment decisions will typically involve difficult choices involving trade-offs between different alternatives. The current system of decision making in different transport sectors such as railways, roads, ports, pipelines, coastal shipping on a segmented basis will not be adequate for the needs of the coming decades.

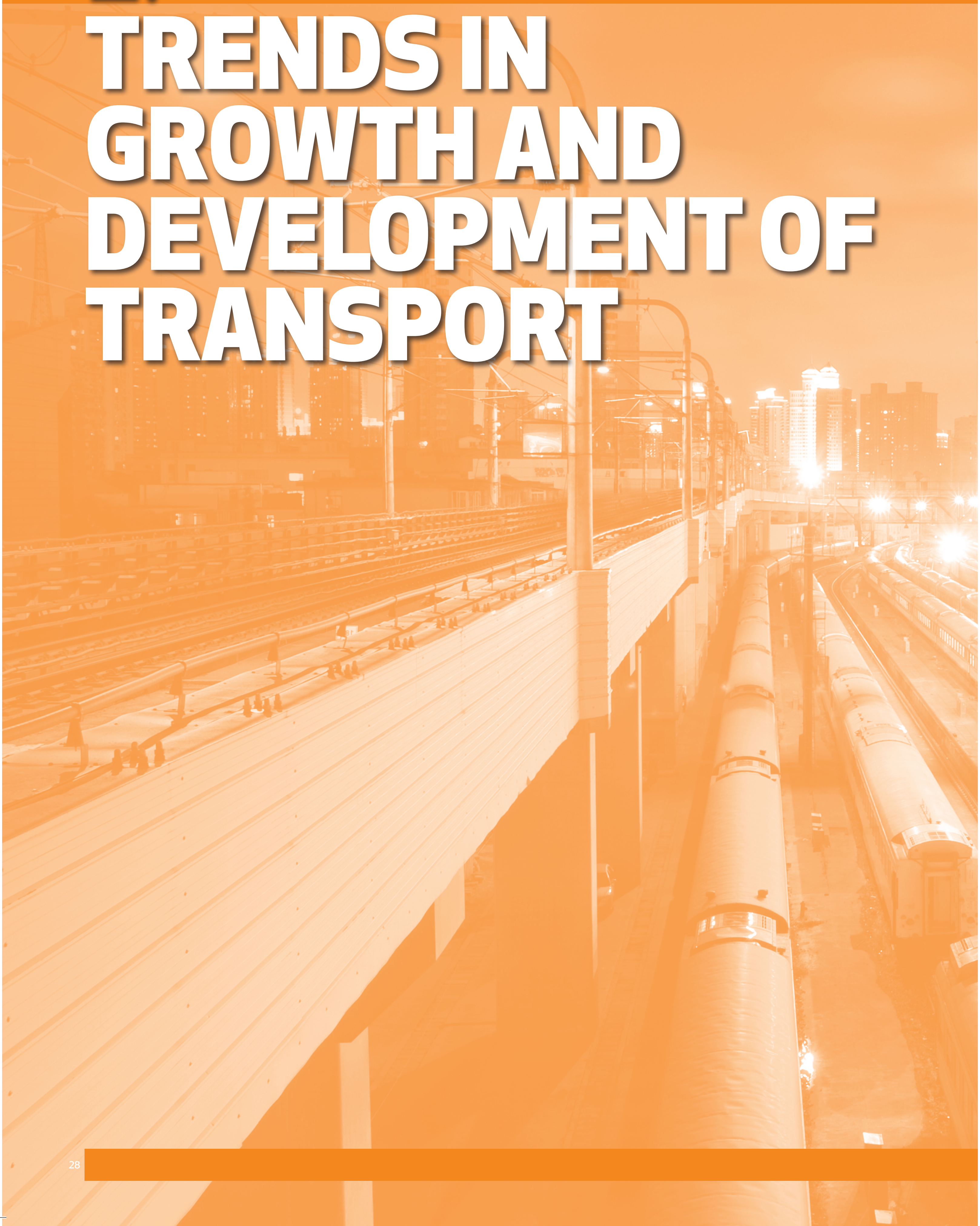
There has been an enormous increase in the movement of goods produced and distributed in the country. This has led to a growing need for transporting ever-increasing quantities and volumes. This explosion in scale has brought to the fore the critical importance of developing modern terminals—mineral depots, freight centres, dry ports, inland container depots, logistics parks, freight villages, industrial sidings, etc. Indeed, in many ways, the capacity on the transport columns is determined by the efficiency of these terminals.

The transport requirements of bulk commodities poses a great challenge. All major coal and iron ore train routes are operating at over 100 per cent capacity. Capacity utilisation of ports averages over 85 per cent

SUMMARY

This Report has emphasised the need for modernisation and expansion of all segments of the transport system and the building of capacity in all its aspects to accomplish this: institutions at national, state and local levels, each embedded with adequate technocratic capacity in both quality and quantity; the setting up or operation of existing regulatory authorities with adequate technical competence to mediate between the needs of producers and consumers, to promote competition and to regulate any consequences of monopoly power; setting up or strengthening research and development institutions on transport across the country; providing for education and nurturing of scientific talent for transport; rationalisation of fiscal regimes to remove distortions while raising revenue; and embedding safety concerns in all transport planning and its execution.

2. TRENDS IN GROWTH AND DEVELOPMENT OF TRANSPORT



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2. TRENDS IN GROWTH AND DEVELOPMENT OF TRANSPORT

Transport plays a very vital role in the development of a country's economy; in determining overall productivity, quality of life of citizens, access to goods and services and the pattern for distribution of economic activity.

In a country of continental size like India where resources and markets are dispersed across long distances, the provision of efficient, low cost, reliable and safe transport infrastructure and services assumes additional significance.

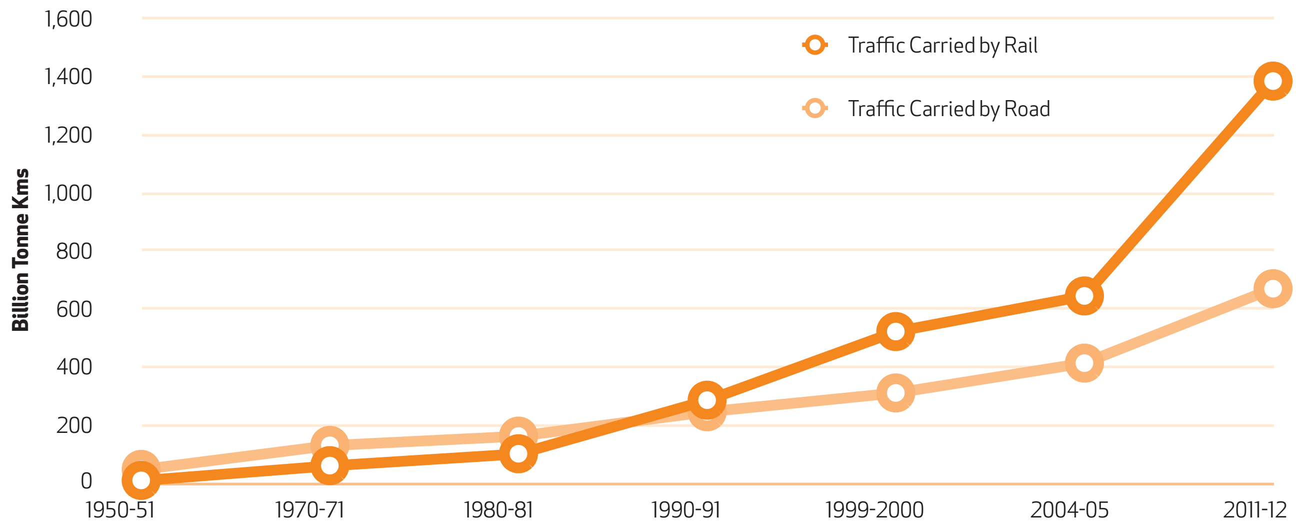
Historically, large-scale investments in transport have kicked off phases of accelerated development and have led to large declines in transport costs on a global basis. Falling transport costs created large home markets for producers, allowing them to exploit larger market sizes and shape the economic landscape. For instance, canal construction and the surge of the railways boosted early US development in the 19th century[1]. Research clearly indicates increasing returns to scale: higher levels of demand reduce cost, allowing more efficient sharing of facilities and services. Recent analytic work in economic geography also points out that for activities that benefit from increasing returns to scale, a fall in transport costs is accompanied by higher geographic concentration of economic activities. With high transport costs, large economies of scale will remain unexploited, and production inefficient. When transport costs fall, spatial differences in production and economic growth will increase, both within and between countries[2].

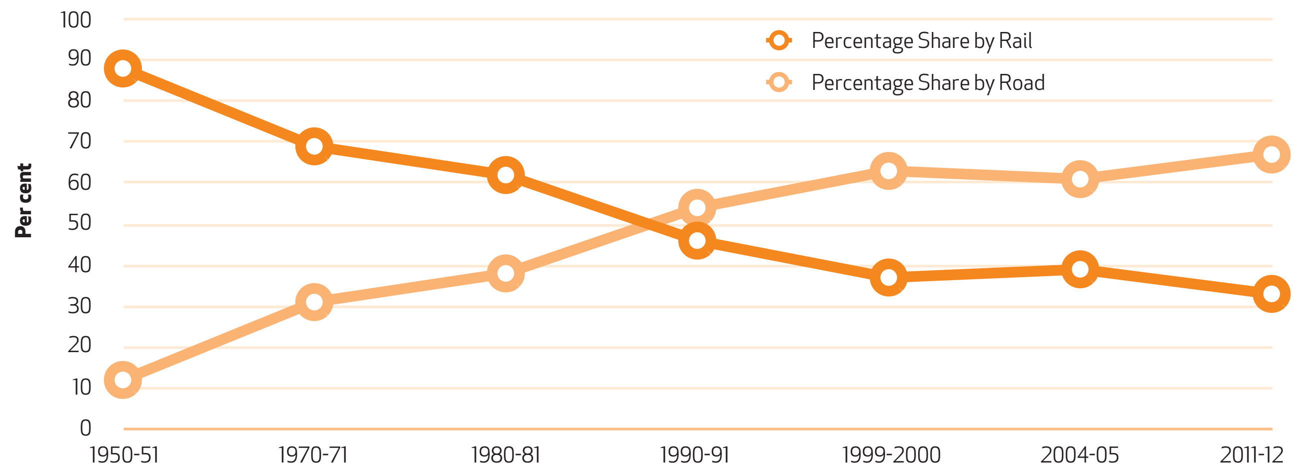
TRANSPORT DEMAND AND PROJECTIONS

The transport system in India comprises distinct modes such as rail, road transport, coastal shipping, civil aviation, inland water transport and pipelines. Rail and road dominate, carrying about 87 per cent of the total freight traffic in the country in 2007-08. Unfortunately, the rail-road mix in freight movement has developed rather sub-optimally over the years, as railways consistently lost out to roads, unable to install capacity or respond to market needs. The divide between the two modes became even more pronounced as roads expanded rapidly on the back of focused policy and investments, particularly during the last decade or so. The Total Transport System Study (TTSS) carried out by RITES for the Planning Commission in 2007-08 calculated that railways' share in total inter-regional freight traffic has come down from 89 per cent in 1951 to 65 per cent in 1978-79, 53 per cent in 1986-87 and 30 per cent in 2007-08. This consistent and unchecked fall in the share of railways through the years was estimated by RITES to have cost the Indian economy about Rs 385 billion (16 per cent of the total transport cost) in the year 2007-08[3].

1. The states of Illinois, Michigan and Ohio had marked increases in population, construction and manufacturing. Falling consumer prices of agricultural goods boosted the real income of the working population in rapidly growing cities. Price differences between Iowa and New York fell from 69 per cent to 19 per cent from 1870 to 1910. International trade relations in the first episode of globalisation were driven by the massive decrease in maritime transport costs following from the emergence of the steamboat (Source: World Development Report 2009 'Reshaping Economic Geography').
2. World Development Report 2009 'Reshaping Economic Geography'.
3. According to the Total Transport System Study (TTSS) by RITES, rail and road together carried about 1,287 BTKM (~87 per cent) of freight traffic (inter + intra regional) out of the total traffic of 1,482 BTKM carried by all modes in 2007-08.

Figure 2.1
Freight Traffic: Roads Overtake Rail





Source: Rail Year Book, Report of Steering Committee: Perspective Planning for Transport Development, August, 1988, Various Plan documents, Planning Commission and NTDPC research.

For passenger traffic as well, rail and road continue to be the dominant modes in India. The traffic carried by air and water transport is negligible, though on certain routes, the former carries considerable volumes which continue to increase. Over time, roads have emerged as the predominant mode for passenger transport. The share of road in passenger traffic (billion passenger kilometre or bpkm) in total passenger traffic carried by rail and road together has increased from 32 per cent in 1951 to about 90 per cent in 2011-12[4] (Figure 2.5).

FREIGHT TRAFFIC

Freight traffic carried by road and rail increased from 257 billion tonne km in 1980-81 to 2053 billion tonne km in 2011-12[5]. While the increase in freight movement is impressive, more striking is the changing modal composition. Rail had historically dominated freight traffic, carrying about 60 per cent of freight in the early 1980s (Figure 2.1), but it came down to about 50 per cent by the late 1980s. Later, with economic liberalisation, with higher growth, as the demand for freight transport grew faster, market forces rapidly pushed for road transport. The share of rail further dropped to about 37 per cent at the end of 1990s. While overall freight movement almost doubled in the 1990s, freight traffic on roads increased over 2.5 times. Roads accounted for about 67 per cent[6] of freight movement in 2011-12 (Figure 2.1).

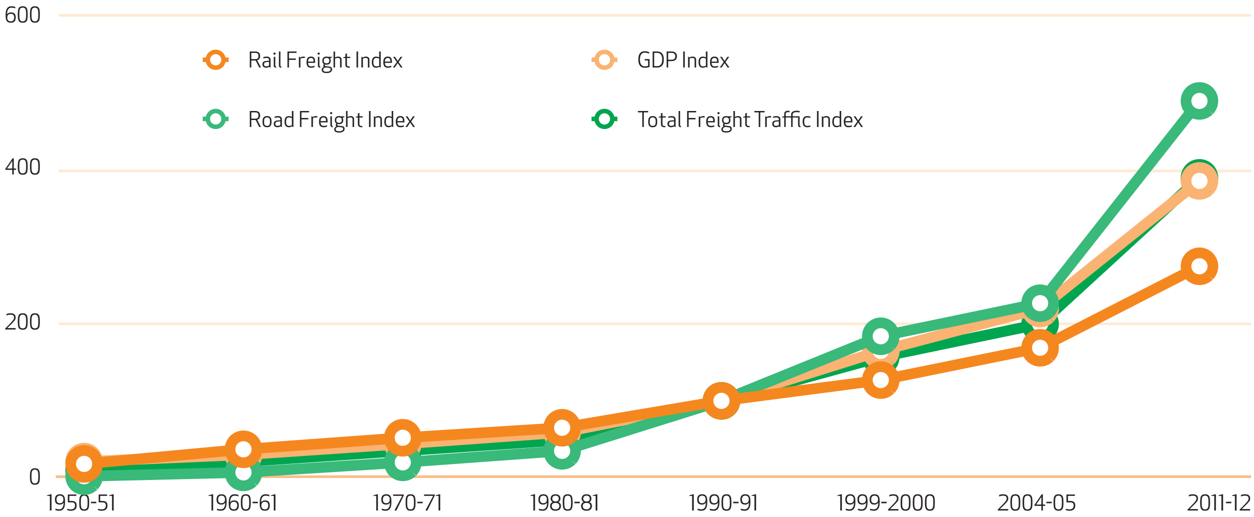
When analysing the performance of total freight traffic as well as traffic moved by rail and road with respect to GDP, it can be observed from Figure 2.2 that

4. NTDPC research (As far as NTDPC's analysis of freight and passenger traffic is concerned, it is confined only to the traffic carried by rail and road as these two modes together dominate the total freight and passenger traffic carried by all modes together).
5. Report of Steering Committee: Perspective Planning for Transport Development, August, 1988 and NTDPC research.
6. As per the McKinsey report on 'Building India-Transforming the Nation's Logistics Infrastructure', Roads in China and US account for 22 per cent and 27 per cent of freight movements, while rail contributes to about 47 and 48 per cent, respectively.

Figure 2. 2

Indices of Freight Traffic and Economic Trends

[GDP]



Note: The road and rail traffic as well as GDP figures have been indexed to the year 1990-91.

in the decades before and after economic reforms, total freight traffic grew at a pace broadly comparable to GDP growth. Road freight traffic which grew at a slower rate than GDP prior to 1991, increased at a higher rate subsequently. The trend for rail traffic was exactly the opposite.

While freight movements have increased exponentially following liberalisation, the cost of transporting freight has remained fairly stable. For instance, freight cost between Delhi and Mumbai was Rs 1.03 per tonne km in 2001, and Rs 1.21 in 2011 (Figure 2.3). Freight prices would have been around Rs 1.8 per tonne km in 2011 had the cost followed the same trajectory as the Wholesale Price Index (WPI). Research on published freight rates carried out by the NTDPC shows similar trends on most road segments.

While overall road transport costs are low (relative to international experience) and have been stable, there has been a rapid increase in transport costs across relatively short distances across metropolitan areas and between cores and suburbs of the largest metropolitan areas. For instance, freight rates between Delhi and Chandigarh (a distance of 260 km) increased from Rs 1.2 per tonne km in 2001 to Rs 2.7 in 2011. The price escalation would have been to about Rs 2 per tonne km had it traced the WPI. Prices are even higher for shorter distances between cores and suburbs of metropolitan areas.

A recent survey of truckers and transport providers shows that freight rates for short distances (less than 100 km) are on average as high as Rs 5.2 per tonne km between large cities and their immediate hinterland (Figure 2.4). India's metropolitan freight costs are twice the national average and almost three times what it costs to move products in countries such as China.

The relatively high and rising metropolitan transport costs are likely to pose serious economic challenges as these areas provide the highest potential for trade and population movements (see market access map in Figure 2.4). The 2011 census reports that 377 million people now live in India's 7,935 towns—an increase of 91 million people and 2,774 towns since 2001. In fact, data from the 2001 census tell us that urban demand is more likely to emerge at the fringes of existing cities with more than one million people.

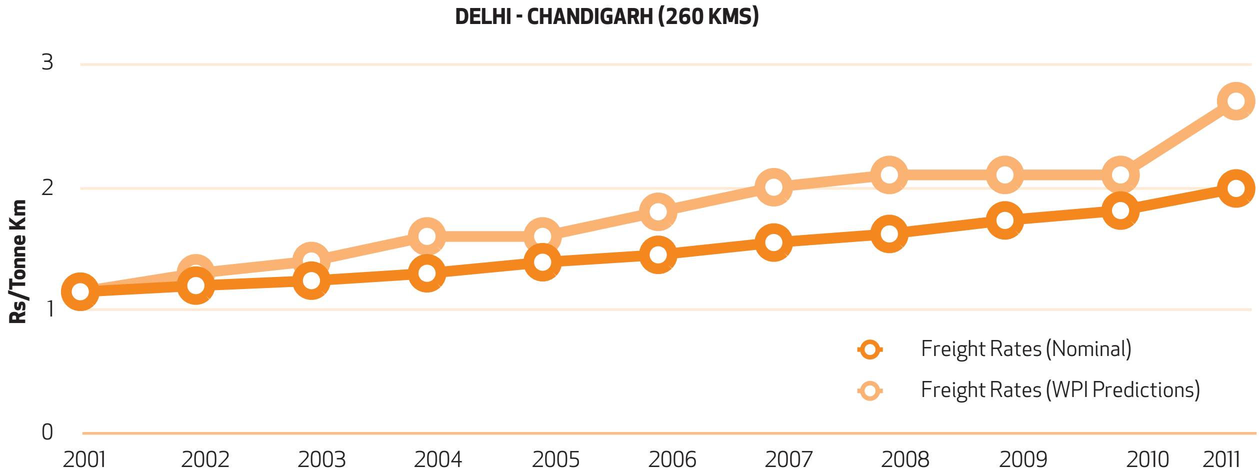
Also, 43 per cent of India's natural urban expansion—new towns—between 1991 and 2001 took place within 100 km of existing cities with a million or more people, and another 35 per cent between 100 and 200 km. While at this time, specific information on locations of the newly created 2,774 towns is not available, previous trends would point at metropolitan suburbanisation. Rising transport costs at this scale is likely to hamper economic efficiency.

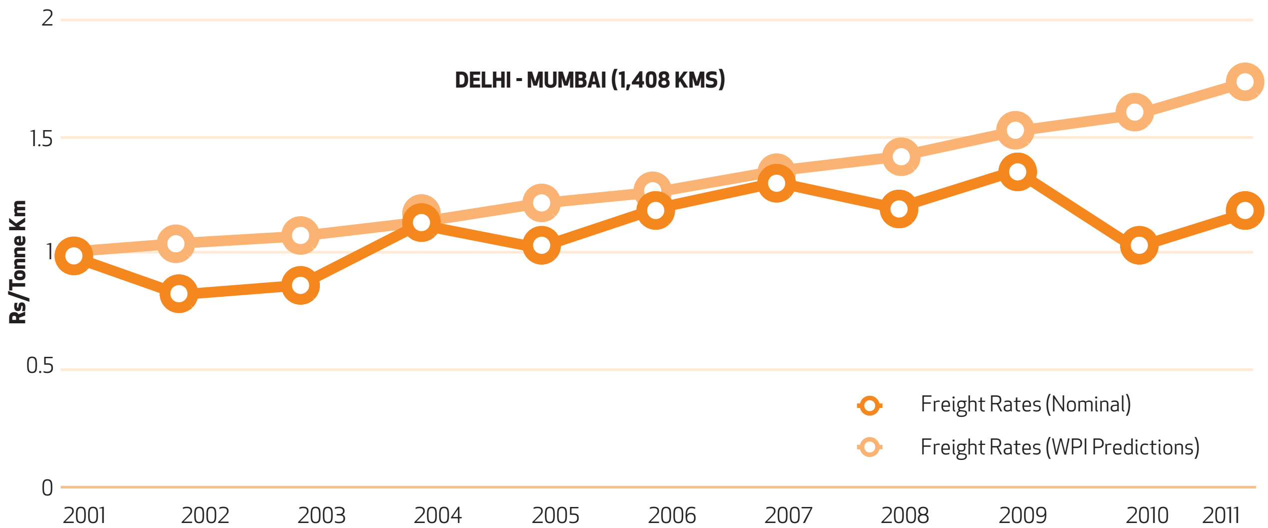
PASSENGER TRANSPORT

The demand for road-based transport services has dramatically accelerated following economic liberalization, and by 2011-12, roads provided for as high as about 90 per cent of the total passenger traffic, leaving a meager 10 per cent for rail[7] (Figure 2.5). This trend reflects the constraints experienced in capacity expansion of the railways. This sharp growth is expected to continue with increase in incomes and

7. Based on NTDPC research.

Figure 2.3
Cost of Transporting Freight by Road
[Rs/Tonne Km]





Source: Freight rate data compiled from The Economic Times, Wholesale Price Index (WPI) – Base Year – 2004-05, from Economic Survey 2011-12.

the changing spatial footprint of suburbanising cities. While robust estimates on the income and price sensitivity of road use and automobile demand are not readily available, a proxy using gasoline demand shows a high, long-run income elasticity (2.68) and a low price elasticity (-0.32) of gasoline demand. This implies that demand for gasoline will increase at twice the pace of income/GDP growth while being less sensitive to price increases[8]. Related research has also shown that automobile demand increases rapidly with city population and changes in incomes (follows an 'S' shape). Such a pattern can lead to a number of problems as India has several small but rapidly growing suburbs and towns where demand for vehicles will increase with city growth. Vehicular increase dominated by personalised modes that are not energy-efficient and environmentally benign will have implications for sustainable development.

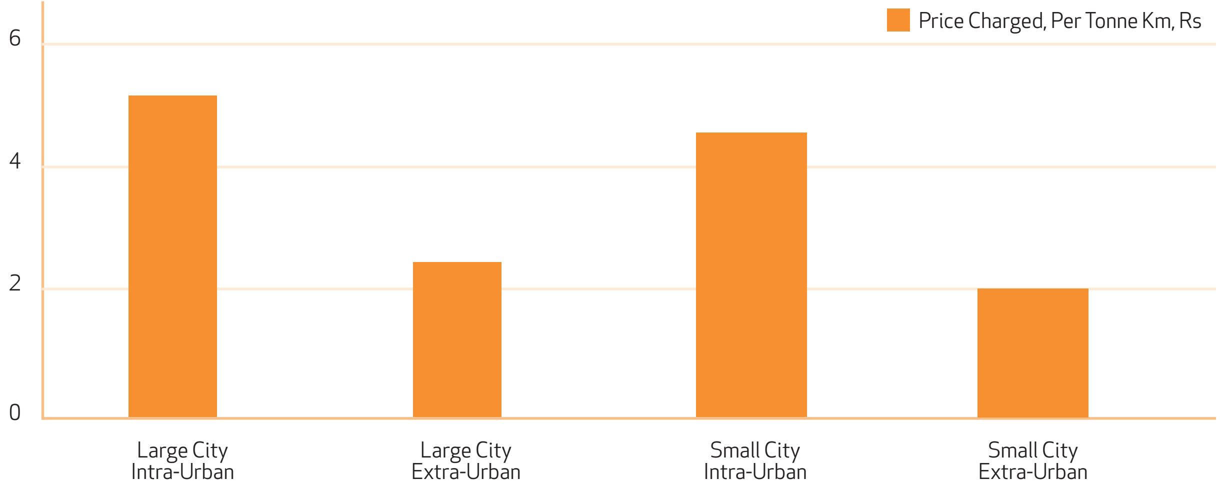
The performance of total passenger traffic as well the passenger traffic moved by rail and road with respect to GDP indicates that total passenger traffic grew at a slower pace than GDP before economic reforms in 1991, but subsequently surpassed the GDP growth rate (Figure 2.6). Thus, the movement of passenger traffic by rail and road shows similar trends as that of freight.

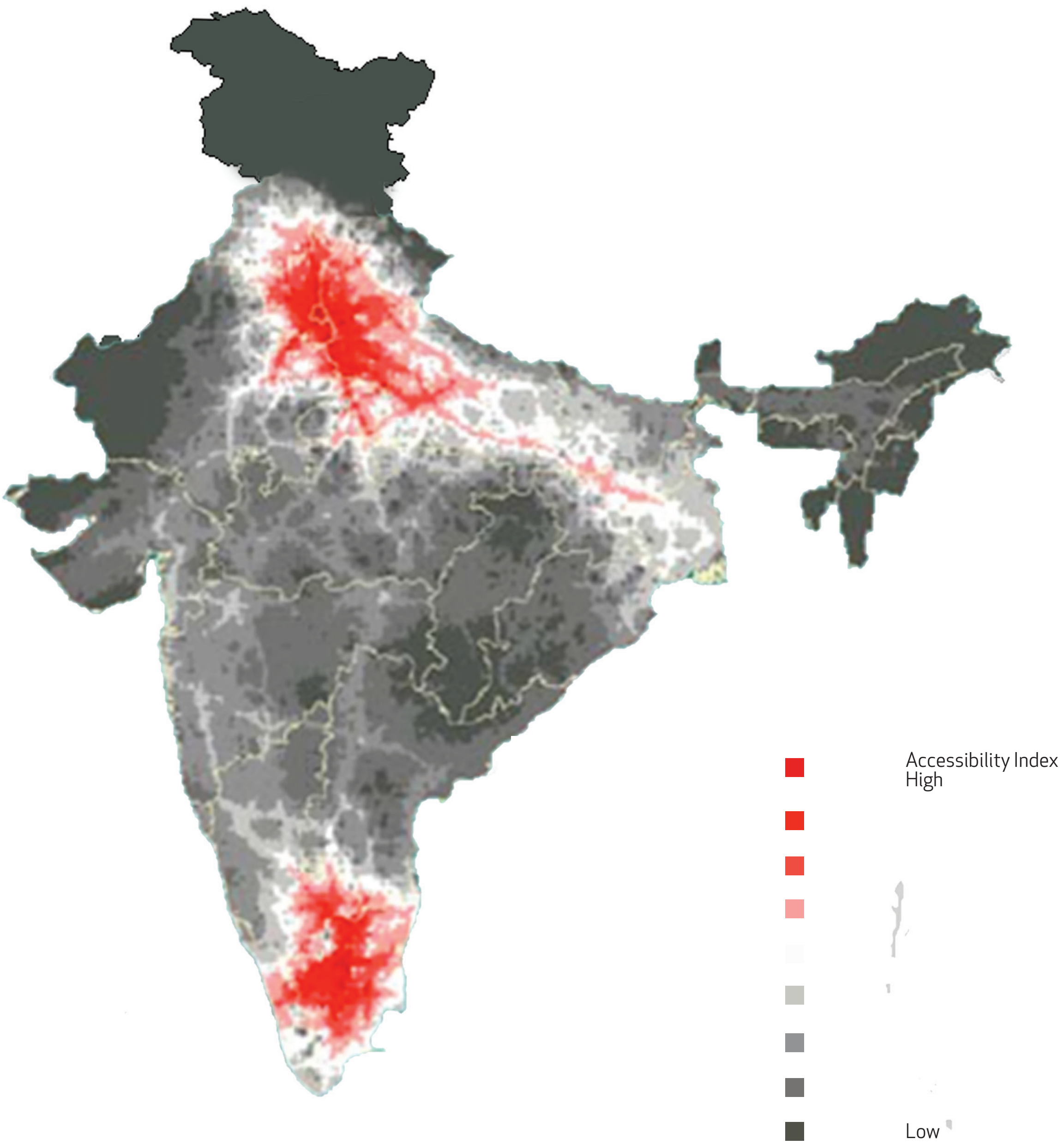
TRAFFIC IN 2032

The NTDPC has estimated transport demand for the terminal years of the 12th Five Year Plan (2016-17), 13th Plan (2021-22), 14th Plan (2026-27) and 15th Plan (2031-32). Elasticity of traffic demand with respect to GDP has been taken as the underlying approach for assessment of traffic projections. Elasticities for different time periods from 1950 onwards have been

8. Ramanathan (1999).

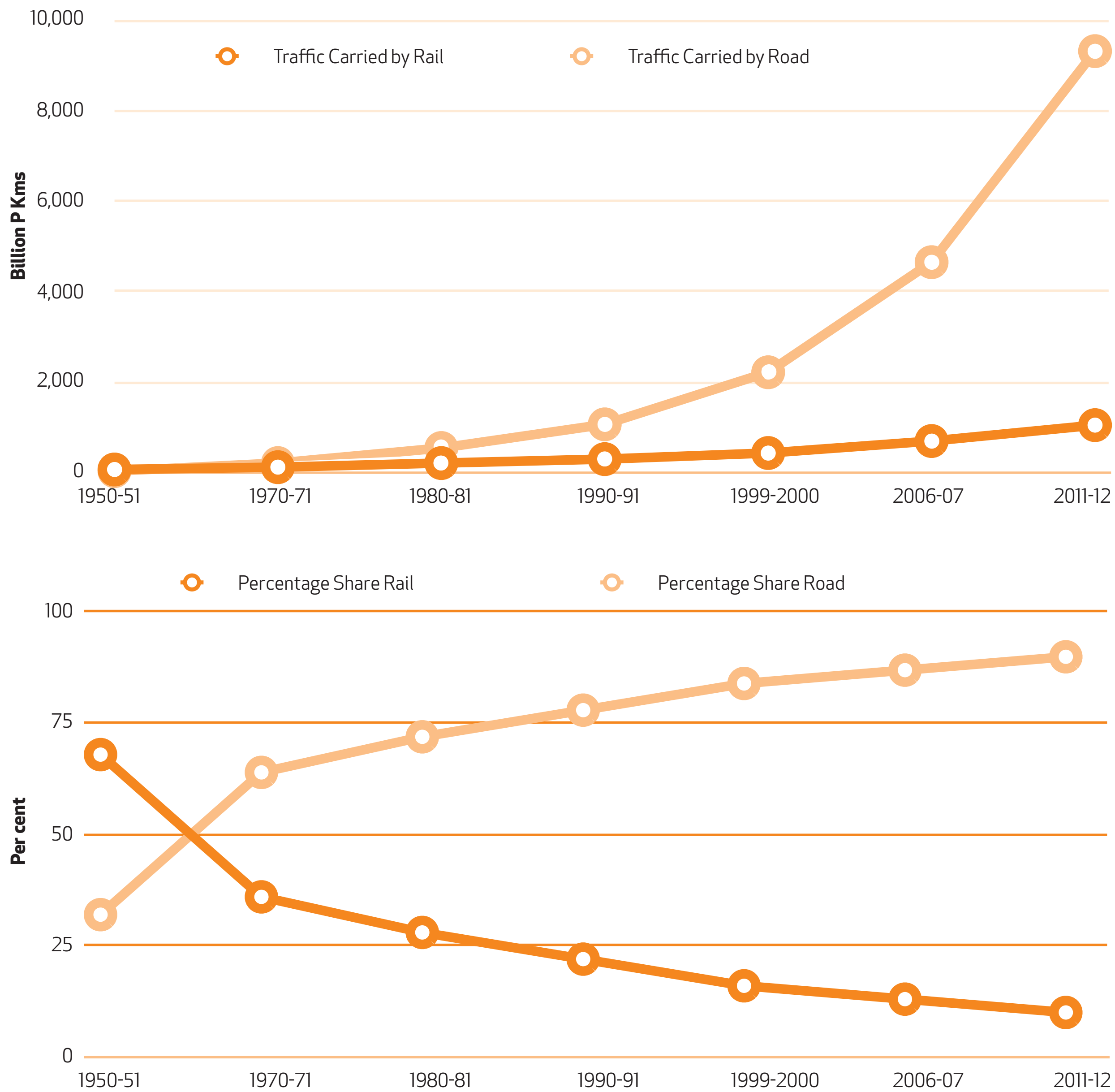
Figure 2. 4
High Transport Costs Between Large Cities and Suburbs





Source: Urbanisation Review, The World Bank (based on a survey of over 1,800 truckers and trucking companies).

Figure 2. 5
Passenger Traffic : Roads Dominate



Source: Rail Year Book, Report of Steering Committee: Perspective Planning for Transport Development, August, 1988, Planning Commission and NTDPC research.

calculated. Though transport demand depends upon a number of factors, GDP has been found to be the most dominant one for calculating elasticities for both freight and passenger traffic. On the basis of a general trend in the elasticities over different time periods, traffic projections have been made. Different GDP growth rates have been estimated for each Plan. The GDP growth rate estimates are as follows: 6.9 per cent for the 12th (2016-17)[9] Plan, 8 per cent for the 13th (2021-22) Plan, 8.5 per cent during 14th (2026-27) Plan and 9 per cent in the 15th (2031-32) Plan.

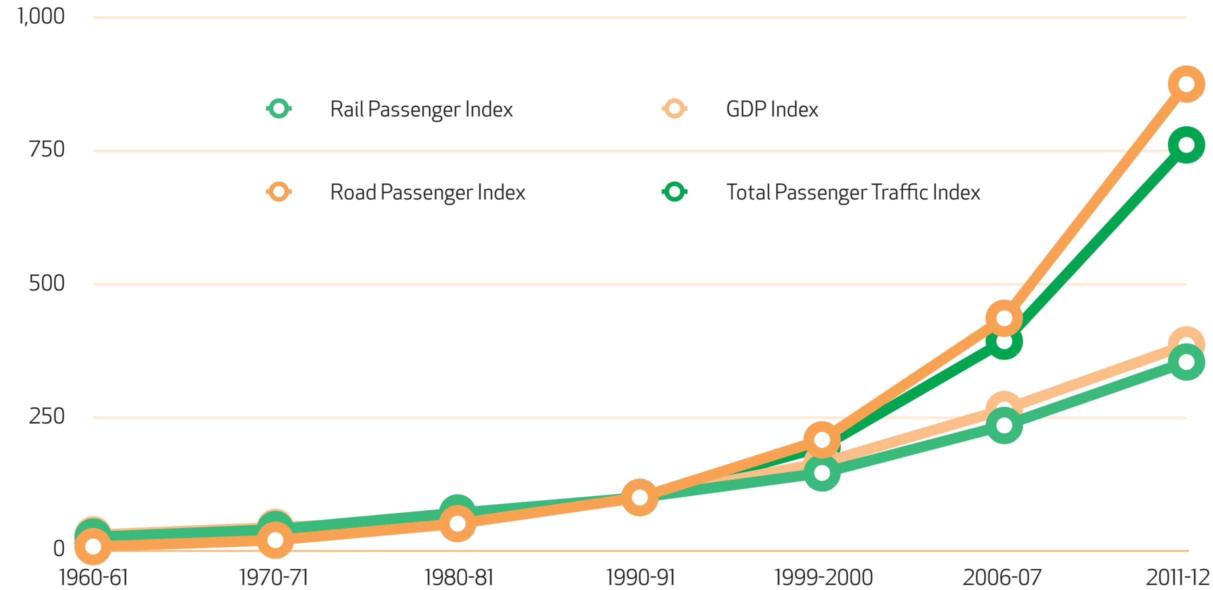
FREIGHT TRAFFIC

Elasticity of total freight with respect to GDP was calculated for different time periods from 1950-51 to 2004-05, which is considered as the base year (Table 2.1).

The total freight elasticity had been declining over time but may have increased in the recent period along with acceleration in economic growth. The overall elasticity for the period 1950-51 to 2004-05 is approximately 1.30. This appears reasonable as per *The Indian Railways Report 2001: Policy Imperatives for Reinvention and Growth (Expert Group on Indian Railways, July 2001)* which estimated Total Freight Traffic Elasticity at 1.25. The 12th Plan estimates road freight traffic at 1,337 billion net tonnes kilometer (BTKM) for the year 2012-13 using an elasticity of 1.2 and GDP growth rate at 8 per cent. It is discounted

9. 12th Five Year Plan Document, Planning Commission.

Figure 2. 6
Indices of Passenger Traffic and Economic Trends



Note: The road and rail traffic as well as GDP figures have been indexed to the year 1990-91.

Table 2. 1
Freight Elasticities with respect to GDP

YEARS	1950-51 TO 1970-71	1970-71 TO 1990-91	1990-91 TO 2004-05	1950-51 TO 2004-05	2004-05 TO 2011-12
Rail Freight Traffic Elasticity	1.43	0.8	0.64	0.9	0.9[A]
Road Freight Traffic Elasticity	3.13	1.98	1.05	2.0	1.4[E]
Total Freight Traffic Elasticity	1.77	1.29	0.87	1.3	1.2[E]

Source: NTDPC Research.
Note: The traffic figures for the years 1990-91 and 2011-12 are based on NTDPC research.
[A] Actual Elasticity.
[E] Estimated Elasticity.

back to provide the road freight traffic for the year 2011-12. The rail freight traffic estimated by the Planning Commission for 2011-12 stands at 640 BTKM. Accordingly, total freight traffic elasticity has been found to be 1. However, this appears to be low. It is expected that elasticity with respect to GDP will be about 1.2. An additional exercise assuming an elasticity of 1.1 has also been performed.

Based on this approach, rail and road freight traffic estimates for the 12th, 13th, 14th and 15th Plans have been projected for both elasticity figures (Tables 2.2 and 2.3). It is estimated that the modal share of rail and road in the total freight traffic will be 35:65 in the 12th Plan, 39:61 in the 13th, 45:55 in the 14th and 50:50 in the 15th Plan. With elasticity at 1.2, total freight traffic is expected to grow at 9.7 per cent per annum to reach over 13,000 BTKM in 2031-32 from about 2,000 BTKM in 2011-12. Rail and road freight traffic are expected to grow at about 12 per cent and 8 per cent per annum respectively to achieve a 50 per cent share each in the total freight traffic at the end of 15th Plan.

This assumes a significant change in transport strategy that tilts towards investment in railways as is assumed in this report. Such an increase in freight carried by rail will not take place without substantive expansion in rail freight capacity.

When the elasticity of total freight traffic with respect to GDP is assumed at 1.1, the total freight

Table 2. 2
Scenario 1: Freight Traffic Estimates with Elasticity 1.2, Base Year 2004-05

	RAIL		ROAD		TOTAL
YEARS	TRAFFIC (BTKM)	PER CENT SHARE	TRAFFIC (BTKM)	PER CENT SHARE	TOTAL TRAFFIC (BTKM)
1950-51	44	88	6	12	50
1970-71	127	69	57	31	184
1990-91	247	47	283	53	530
2004-05	411	39	643	61	1,054
2011-12	668	33	1,385[E]	67	2,053[E]
2016-17 (GDP = 6.9 per cent)*	1,070	35	1,987	65	3,056
2021-22 (GDP = 8 per cent)*	1,885	39	2,949	61	4,834
2026-27 (GDP = 8.5 per cent)*	3,535	45	4,321	55	7,856
2031-32 (GDP = 9 per cent)*	6,559	50	6,559	50	13,118

Source: Rail Year Book, Report of Steering Committee: Perspective Planning for Transport Development, August, 1988 and NTDPC Research.
Note: *NTDPC research.
[E] Estimated (based on NTDPC research).

Table 2. 3
Scenario 2: Freight Traffic Estimates with Elasticity 1.1, Base Year 2004-05

	RAIL		ROAD		TOTAL
YEARS	TRAFFIC (BTKM)	PER CENT SHARE	TRAFFIC (BTKM)	PER CENT SHARE	TOTAL TRAFFIC (BTKM)
1950-51	44	88	6	12	50
1970-71	127	69	57	31	184
1990-91	247	47	283	53	530
2004-05	411	39	643	61	1,054
2011-12	668	34	1,279[E]	66	1,947[E]
2016-17 (GDP = 6.9 per cent)*	982	35	1,824	65	2,807
2021-22 (GDP = 8 per cent)*	1,669	39	2,610	61	4,279
2026-27 (GDP = 8.5 per cent)*	3,011	45	3,680	55	6,691
2031-32 (GDP = 9 per cent)*	5,363	50	5,363	50	10,726

Source: Rail Year Book, Report of Steering Committee: Perspective Planning for Transport Development, August, 1988 and NTDPC Research.
Note: *NTDPC Research.
[E] Estimated (based on NTDPC research).

Table 2. 4

Passenger Traffic Elasticities with Respect to GDP

YEARS	1950-51 TO 1970-71	1970-71 TO 1990-91	1990-91 TO 2006-07	1950-51 TO 2006-07	2006-07 TO 2011-12
Rail Passenger Elasticity	0.75	1.12	0.87	0.92	1.1[A]
Road Passenger Elasticity	2.64	2.01	1.54	2.0	1.9[E]
Total Passenger Elasticity	1.64	1.75	1.42	1.59	1.8[E]

Source: NTDPC Research.
Note: [A] Actual (from 12th Five Year Plan document).
[E] Estimated (based on NTDPC research).

Table 2. 5

Passenger Traffic Estimates with Base Year 2006-07

YEARS	RAIL		ROAD		TOTAL
	TRAFFIC (BTKM)	PER CENT SHARE	TRAFFIC (BTKM)	PER CENT SHARE	TOTAL TRAFFIC (BTKM)
1950-51	67	68	31	32	98
1970-71	118	36	210	64	328
1990-91	296	22	1,671	78	1363
2006-07	695	13	4,657	87	5,352
2011-12	1,047	10	9,329	90	10,375
2016-17 (GDP = 6.9 Per cent)*	1,509	8	17,272	92	18,780
2021-22 (GDP = 8 Per cent)*	2,300	6	35,043	94	37,343
2026-27 (GDP = 8.5 Per cent)*	3,596	4	74,079	96	77,675
2031-32 (GDP = 9 Per cent)*	5,765	3	163,109	97	168,875

Source: Rail Year Book, Report of Steering Committee: Perspective Planning for Transport Development, August,1988 and NTDPC Research.
Note: *NTDPC Research.
[E] Estimated (based on NTDPC research).
Passenger Traffic includes only Bus Traffic.

traffic is expected to grow at 8.9 per cent per annum to climb to 10,726 BTKM in 2031-32 from 1,947 BTKM in 2011-12. Rail and road freight traffic are expected to grow at about 11 per cent and 7 per cent per annum respectively to achieve a 50 per cent share each in the total freight traffic at the end of 15th Plan.

PASSENGER TRAFFIC

In order to forecast passenger traffic for 2016-17, 2021-22, 2026-27 and 2031-32, elasticity of rail, road and total passenger traffic with respect to GDP was calculated for different time periods from 1950-51 to 2006-07, which is the base year (Table 2.4). The long-term rail passenger elasticity for the period analysed is 0.92. However, between the 10th and 11th Five Year Plans (2006-07 to 2011-12) this increased to 1.1. On the basis of this trend as well as 12th Plan estimates, an elasticity of 1.1 for rail passenger traffic appears reasonable.

Long-term elasticity of road passenger traffic with respect to GDP is approximately 2.0. The 12th Plan estimate of the same appears to be very low. Thus,

Table 2. 6
Comparative Overview of Originating Inter-Regional Freight Traffic

YEAR	TOTAL ORIGINATING INTER-REGIONAL TRAFFIC	MODE-WISE TRAFFIC AND PERCENTAGE SHARE IN TOTAL TRAFFIC					
		RAILWAYS	HIGHWAYS	COASTAL SHIPPING	AIRLINES	PIPELINES	INLAND WATER TRANSPORT
1950-51	82	73 (89)	9 (11)	NA	NA	NA	NA
1978-78	283	185 (65)	96 (34)	3 (1)	NA	NA	NA
1986-87	485	255 (53)	224 (46)	6 (1)	NA	NA	NA
2007-08	2,555	769 (30.08)	1,559 (61.01)	59 (2.31)	0.3 (0.01)	114 (4.44)	55 (2.15)

Source: Total Transport System Study by RITES.
Note: Figures in parentheses indicate percentage modal share.

Table 2. 7
Comparative Overview of Inter-Regional Transport Output

YEAR	TOTAL INTER-REGIONAL TRAFFIC (BTKM)	BTKM							
		RAILWAYS		HIGHWAYS		COASTAL SHIPPING		AIRWAYS	
		TRAFFIC	AVERAGE LEAD (KM)	TRAFFIC	AVERAGE LEAD (KM)	TRAFFIC	AVERAGE LEAD (KM)	TRAFFIC	AVERAGE LEAD (KM)
1978-78	189	150 (79.2)	810	34 (17.8)	353	6 (3)	1,807	NA	NA
1986-87	299	199 (66.5)	778	91 (30.5)	406	9 (3)	1,655	NA	NA
2007-08	1,300	508 (39.1)	661	706 (54.3)	453	86 (6.6)	1,450	0.29 (0.02)	1,027

Source: Total Transport System Study by RITES.
Note: Figures in parentheses indicate percentage modal share.

on the basis of NTDPC research, an elasticity of 1.9 with respect to GDP has been utilised for forecasting (Table 2.5).

Total passenger traffic is expected to grow at about 15 per cent per annum to reach 168,875 bpkm in 2031-32 from 10,375 bpkm in 2011-12. Growth in rail passenger traffic is expected to be around 9 per cent per annum, and for road traffic, 15.4 per cent.

With these assumptions, it can be seen that total passenger traffic could increase by a factor of almost 16 over the next 20 years. The comparable increase in the last 10 years or so was by a factor of about 7 or 8. Overall, these projections provide an idea of the challenge facing overall transport investment in the country, if India is to achieve sustainable and continuous growth in the next two decades.

THE RITES STUDY

RITES has carried out three studies—in 1978-79, 1986-87 and 2007-08, to forecast transport demand. In the first two studies, RITES took into account only the inter-regional freight traffic, while the study conducted in 2007-08 also assessed intra-regional traffic[10]. It has estimated traffic in all modes including rail, road, coastal shipping, airways, inland water transport (IWT) and pipelines.

RITES identified 52 commodity groups and derived the total traffic on the basis of originating tonnage and their average leads. Table 2.6 shows the operational performance of different modes of transport in terms of originating inter-regional (long and medium lead) traffic between 1950-51 and 2007-08.

Out of the total originating freight traffic of 2,555 million tonnes during 2007-08, the shares of railways and road transport were around 30 and 61 per cent respectively. The balance 9 per cent was handled by the remaining four modes. Since 1986-87, while overall freight traffic grew over five times, rail traffic has grown three times, road traffic about seven times and coastal shipping over 10 times.

10. Intra-regional traffic means traffic within a district.

Table 2. 8
Inter and Intra Regional Traffic
[Btkm]

YEAR	INTER-REGIONAL TRAFFIC			INTRA-REGIONAL TRAFFIC			TOTAL TRAFFIC (INTER-REGIONAL +INTRA-REGIONAL)		
	RAIL	ROAD	TOTAL	RAIL	ROAD	TOTAL	RAIL	ROAD	TOTAL
1978-79	150 (81.6)	34 (18.4)	184	-	-	-	-	-	-
1986-87	199 (68.6)	91 (32.4)	290	-	-	-	-	-	-
2007-08	508 (41.8)	706 (58.2	1,214	5 (7.4)	67 (92.6)	73	514 (40)	773 (60)	1,287

Source: Total Transport System Study by RITES Ltd.
Note: Figures in parentheses indicate percentage modal share.

Table 2. 9
Average Freight Traffic Leads
[Km]

YEARS	RAIL	ROAD
1978-78	810	353
1986-87	778	406
2007-08	661	453

Source: Total Transport System Study by RITES Ltd.

The total as well as mode-wise inter-regional traffic in terms of net tonne km, and the mode-wise average leads during the last three Total Transport System Studies conducted by RITES are shown in Table 2.7.

In terms of BTKM, the shares of rail and road are around 36 per cent and 50 per cent respectively. The other four modes make up the remaining 14 per cent. Since rail and road constitute 86 per cent of the total traffic in terms of BTKM, the estimates presented in Table 2.8 focus essentially on these two modes and include the inter-regional as well as intra-regional traffic. The share of road in the inter-regional freight traffic increased from 18 per cent in 1978-79 to approximately 58 per cent in 2007-08 while the share of rail declined from about 82 per cent in 1978-79 to about 42 per cent in 2007-08. As for intra-regional traffic, majority of freight traffic is carried by road: 93 per cent was the road share in 2007-08.

AVERAGE LEADS

The average lead of freight traffic moved by rail and road are presented in Table 2.9. The average lead of freight traffic by rail has declined over time while it has increased for road. However, the average lead by rail is still higher than that of road; rail transport is preferred for long haulage.

RAIL-ROAD COMMODITY SHARE

RITES identified nine major commodities: coal, food grains, iron and steel, fertilisers, cement and cement structures, POL, iron ore, limestone and dolomite, and miscellaneous/other commodities—which constitute 63 per cent of the total volume of 52 commodities carried by all four modes—rail, road, coastal shipping, airways.

The shares of rail and road transport in movement of these commodities are about 47 and 50 per cent respectively. Of the nine major commodities, coal, iron ore, limestone and dolomite, and fertilisers are predominantly carried by rail, while cement is carried almost equally between the two modes. Road transport reflects a comparatively higher share in movement of POL, iron and steel, and foodgrains. As analysed by RITES, the average leads for the move-

Table 2.10
Commodity-Wise Modal Performance During Base Year [2007-08]
[Million Tonnes]

COMMODITY	RAIL	ROAD	COASTAL SHIPPING	AIRWAYS	TOTAL
Coal	332 (80)	68 (16.4)	15 (3.6)	0 (0)	415
Food Grains	38 (23.8)	123 (76.9)	0 (0)	0 (0)	160
Iron and Steel	27 (20.2)	107 (79.9)	0 (0)	0 (0)	134
Iron Ore	122 (78.7)	23 (14.8)	10 (6.5)	0 (0)	155
POL Products (Liquid)	35 (18.4)	128 (67.4)	26 (13.7)	0 (0)	190
Limestone and Dolomite	14 (70)	6 (30)	0 (0)	0 (0)	20
Cement	79 (50)	76 (48.1)	3 (1.9)	0 (0)	158
Fertilisers	36 (65.5)	18 (32.7)	0 (0)	0 (0)	55
Miscellaneous/ Others	22 (9.7)	202 (88.9)	3.2 (1.4)	0.3 (0.13)	227
Total of 9 Commodities	705 (46.6)	751 (49.6)	57 (3.8)	0.3 (0.02)	1,514
Total of 52 Commodities	769 (32.2)	1,559 (65.3)	59 (2.5)	0.3 (0.01)	2,387

Source: Total Transport System Study by RITES.
Note: Figures in parentheses indicate percentage modal share.

Table 2.11
Freight Traffic Projection
[Btkm]

YEARS	TOTAL INTER-REGIONAL TRAFFIC FOR RAIL & ROAD (BTKM)
2007-08 (Base Year)	1,214
2012-13	1,924
2017-18	2,952
2022-23	4,316
2025-26	5,345

Source: Total Transport System Study by RITES.

ment of POL, iron and steel, and cement by road are 272 km, 525 km and 358 km respectively, while corresponding leads by rail are much higher, at 658 km, 936 km and 557 km.

This trend indicates that over time, commodities that were historically moved by rail over long distances are now being moved by road as the average lead of road has increased over time, and railways have probably been affected by capacity constraints.

Table 2.11 shows the projections of total inter-regional freight traffic made by RITES for rail and road for the years 2012-13, 2017-18, 2022-23 and 2025-26.

Total inter-regional freight traffic carried by rail and road for the year 2025-26 has been estimated

Table 2.12
Share of Transport in Public Sector Expenditure: Five-Year Plans
[Per cent]

S. No.	SECTOR	1ST - 6TH PLAN (1951-85)	7TH PLAN (1985-90)	8TH PLAN (1992-97)	9TH PLAN (1997-2002)	10TH PLAN (2002-07)	11TH PLAN (2007-12)
		EXPENDITURE					
1	Railways	46.4	56.1	49.1	38.2	35.7	29.7
2	Roads	28.5	21.5	24.4	39.9	45.6	39.9
3	Road Transport	7.6	7.3	5.9	5.0	2.4	2.3
4	Ports	6.3	5.1	3.5	4.2	1.4	3.0
5	Shipping	4.7	2.4	5.0	2.5	1.3	1.3
7	Light House and Light Ships	0.1	-	NEG	NEG	NEG	0.02
6	Inland Water Transport (IWT)	0.4	0.6	0.2	0.3	0.2	0.4
8	Civil Aviation	6.1	6.6	11.4	5.8	3.6	7.9
7	Pradhan Mantri Gram Sadak Yojana (PMGSY)	-	-	-	4.1	7.5	13.4
8	Other Transport Sector	-	0.2	0.4	-	2.1	2.1
9	**Total Transport Sector** (At Current Prices in Rs Billion)	**255 (100.0)**	**295 (100.0)**	**656 (100.0)**	**1,196 (100.0)**	**2,422 (100.0)**	**6,472 (100.0)**
10	**Total Public Sector Expenditure** (At Current Prices in Rs Billion)	**1,797**	**2,187**	**4,855**	**8,140**	**16,185**	**37,510**
11	Transport Sector as Per cent Of Total Public Sector Expenditure	14.2	13.5	13.5	14.7	14.5	17.3

Source: Planning Commission.
Note: The total transport sector expenditure does not include expenditure on urban transport.
Neg: Negligible.

at 5,345 BTKM. The compound annual growth rate (CAGR) during the period 2007-08 to 2025-26 is 8.58 per cent and if these projections are extrapolated to 2031-32, the total freight traffic is estimated at 8,756 BTKM. This is lower than the Committee's estimates as these exclude intra-regional freight traffic. According to the NTDPC, total freight traffic (Inter + Intra Regional) with an elasticity of 1.2 is 15,289 BTKM in 2031-32, and 12,356 BTKM when the elasticity is 1.1.

PUBLIC SECTOR INVESTMENT

Public action has been and is likely to continue to be the dominant force in development of transport infrastructure and facilities. The transport sector has received special attention in India's planning process and public investment has increased over the various Plans.

However, with expanding investment requirements, public resources alone are not adequate. This necessitates private sector participation, a decision that is expected to not only augment the resources available for the transport sector but also to improve service delivery and efficiency.

It is not that private players have not been involved in transport. The private sector has always provided the bulk of trucking transportation; it now also has a majority share of passenger road transport services, international and coastal shipping and all non-motorised transport. More recently, it has become a dominant player in providing air transport services. The private sector, during the last 10-15 years, has also made its presence felt in areas like ports, roads (national highways) and airports. Its contribution in the provision of transport infrastructure, particularly rail and waterways, though, has been rather limited and needs to be encouraged.

However, despite the emerging role of the private sector, the State has to continue playing the role of both provider and facilitator through appropriate policy interventions, regulations and supporting investment. Table 2.12 presents Plan-wise expenditure in various sectors of transport.

Table 2.13

Investment in Infrastructure During 10TH and 11TH Plans

[Rs Billion at Current Prices]

PARTICULARS	10TH PLAN	11TH PLAN	12TH PLAN*
GDP at Market Prices	165,988	336,045	681,632
Public Investment	6,511 (78.3)	15,368 (63.3)	28,908 (51.8)
Private Investment	1,860 (21.7)	8,875 (36.7)	26,838 (48.2)
Total Investment	**8,371**	**24,243**	**55,746**
Investment as Percentage of GDP			
Public Investment	3.92	4.57	4.24
Private Investment	1.12	2.64	3.94
Total Investment	5.04	7.21	8.18

Source: 12th Five Year Plan Document (2007-2012), Planning Commission.
Note: Figures in parenthesis are percentage shares.

From the very beginning, the planners realised the significance of the development of the transportation sector in both promoting economic development, and fulfilling the aspirations of the people. During the 1st Five Year Plan, agricultural production, irrigation and power were the main focus areas. Despite this, about 22 per cent of the total expenditure was incurred on the transport sector. The expenditure share was the highest in the 2nd Plan at about 23.5 per cent. However, over the years, the percentage has declined. It hovered around 12.8 to 13.5 per cent from the 6th to the 8th Plans. During the 10th and 11th Plans, infrastructure, including transport, received special attention with the share of transport in total expenditure increasing from 14.5 in the 10th Plan to 17.3 per cent in the 11th.

Railways and roads constitute the major chunk in the total transport spending. Analysis reveals that spending on railways saw a cyclical movement from the 1st to the 7th Plan, followed by a decline from the 8th Plan onwards. The railways share increased from 50 per cent in the 1st Plan to a peak of 67 per cent in the 3rd, with a drastic fall in the 4th and 5th Plan onwards, followed by a rise till the 7th. From the 8th Plan onwards, the share has constantly declined while expenditure on highways increased. The railways share stood at a dismal low of about 30 per cent in the 11th Plan.

Roads saw a major impetus in spending to reach a significant 42 per cent in the 11th Plan, from a meagre 22 per cent in the 2nd Plan. Railways capacity in both freight and passenger traffic has not increased enough simply due to inadequate investment. Meanwhile, the capacity of the national highway system has grown considerably with the initiation of the National Highway Development Project (NHDP). Further, the explosion in airline capacity is providing increasing competition to the upper-class railway segment.

The share of modes other than railways and roads, which was around 15 per cent of total expenditure on transport in the first three Plans, escalated to 30 per cent in the 4th and 5th Plans, only to settle down at about 28 per cent in the 10th plan and 11th Plan.

THRUST ON INFRASTRUCTURE

The infrastructure sector in India is currently at an inflexion point. The Government has shown an increasing commitment to accelerate infrastructure development, as indicated by augmented spending during the 11th Plan (2007 to 2012) and now in the 12th (2012-2017).

The total investment in infrastructure sectors is estimated to be Rs 55,746 billion[11] in the 12th Plan, which is roughly 8.2 per cent of GDP, as compared to about 7 per cent during the 11th Plan period. Table 2.13 reveals that the contribution of the private sector in total investments towards infrastructure development has progressively increased over the Plans.

Public sector investment showed a growth of 344 per cent between the 10th and the 12th Plans. But private investment grew by 1,343 per cent. The total investment increased by about 566 per cent, at current pric-

11. This is roughly $930 billion at current exchange rates.

Table 2.14

Infrastructure Investment Mix Between Public and The Private Sector, 10TH and 11TH Plan Periods

[Rs Billion at Current Prices]

PARTICULARS	10TH PLAN	11TH PLAN	12TH PLAN*
Roads and Bridges	1,393	4,531	9,145
• Public Sector	1,274 (91.4)	3,606 (79.6)	6,105 (66.8)
• Private Sector	119 (8.6)	925 (20.4)	3,040 (33.2)
Ports	206	445	1,978
• Public Sector	33 (16.1)	82 (18.5)	262 (13.5)
• Private Sector	173 (83.9)	363 (81.5)	1,715 (86.8)
Airports	68	363	877
• Public Sector	42 (61.9)	129 (35.5)	175 (19.9)
• Private Sector	26 (38.1)	234 (64.5)	702 (80.1)
Railways (including MRTS)	944	2,429	6,434
• Public Sector	938 (99.3)	2,284 (94.0)	4,908 (76.2)
• Private Sector	6 (0.7)	145 (6.0)	1,526 (23.8)
Total Infrastructure Investment	**8,372**	**24,243**	**55,746**
Public Investment	6,511 (77.8)	15,368 (63.3)	28,908 (51.8)
Private Investment	1,860 (22.2)	8,875 (36.7)	26,838 (48.2)
Total Transport Sector Investment (Per cent Share in Infrastructure)	**2,609 (31.3)**	**7,769 (32.6)**	**18,434 (33.8)**
Public Investment	2,285 (87.6)	6,101 (78.5)	11,450 (62.1)
Private Investment	324 (12.4)	1,668 (21.5)	6,984 (37.9)

Source: 12th Five Year Plan Document (2007-2012), Planning Commission.
Note: Figures in parentheses are percentage shares.
*The 10th Plan numbers have been arrived at by dividing the 10th Plan numbers at 2006-07 prices in the following ratio—Public Sector: Divided by 1.0965 and Private Sector: Divided by 1.0856.

es. A large part of this growth can be attributed to the increasing private participation. In sectors like roads, ports and airports, where traditionally the public sector has been almost exclusively responsible for their development, the private sector is rapidly becoming a reliable partner. As a result of investments made during the last 60 years of planned development, the transport sector has expanded manifold in terms of capacity and spread (Annex). A total expenditure of Rs 14,793 billion towards the sector is projected in the 12th Plan. Table 2.15 gives the sectoral break-up.

TRANSPORT DEVELOPMENT IN INDIA

RAILWAYS

The Indian Railways had a modest beginning in 1853 when the first train journeyed from Mumbai to Thane, covering a distance of 34 km. In the next 50 years, the railway network expanded rapidly, and by 1900, the total length of the network (route kilometres) increased to 39,835 km. The rate of growth declined during the next 50 years, reaching 53,596 km in 1950-51. In the next 60 years, since the beginning of the Plan era, the route length increased to

Table 2.15
Proposed Public Expenditure on Transport, 12TH Plan [2012-17]
[Rs Billion]

S. NO.	SECTOR	CENTRE			STATES	TOTAL OUTLAYS
		GBS	IEBR	TOTAL		
1	Roads and Road Transport*	2,713	648	**3,361**	6,524	**9,885**
2	Railways	1,942	2,250	**4,192**	-	**4,192**
3	Ports and Shipping	70	220	**290**	43	**333**
4	Civil Aviation	170	162	**332**	51	**383**
Total		**4,894**	**3,280**	**8,175**	**6,618**	**14,793**

Source: 12th Five Year Plan Document, Planning Commission.
Notes: * Includes Rural Roads (Rs 1,265 billion).
1) GBS - Gross Budgetary Support.
IEBR - Internal and Extra Budgetary Resources.
2) The State Outlays for 12th Five Year Plan have been estimated on the basis of their shares in the sectoral outlays in 11th Plan.
3) The proposed expenditure on Urban Transport are not included.

Table 2.16
Gauge-Wise Indian Railways Network
[Per cent Shares]

GAUGE	ROUTE KM	RUNNING TRACK KM	TOTAL TRACK KM
Broad Gauge (1676 mm)	86.62	89.96	90.99
Metre Gauge (1000 mm)	9.83	7.49	6.78
Narrow Gauge (762 mm and 610 mm)	3.56	2.56	2.23
Total (km)	**64,600**	**89,801**	**115,062**

Source: Indian Railways Year Book, 2011-12.
Note: 'Route kilometre' is a unit of distance, measuring the distance by rail between two points on the railway network whereas 'Running track km' is the sum of all running lines (counting each line of doubled, tripled, etc. lines separately) between two points.

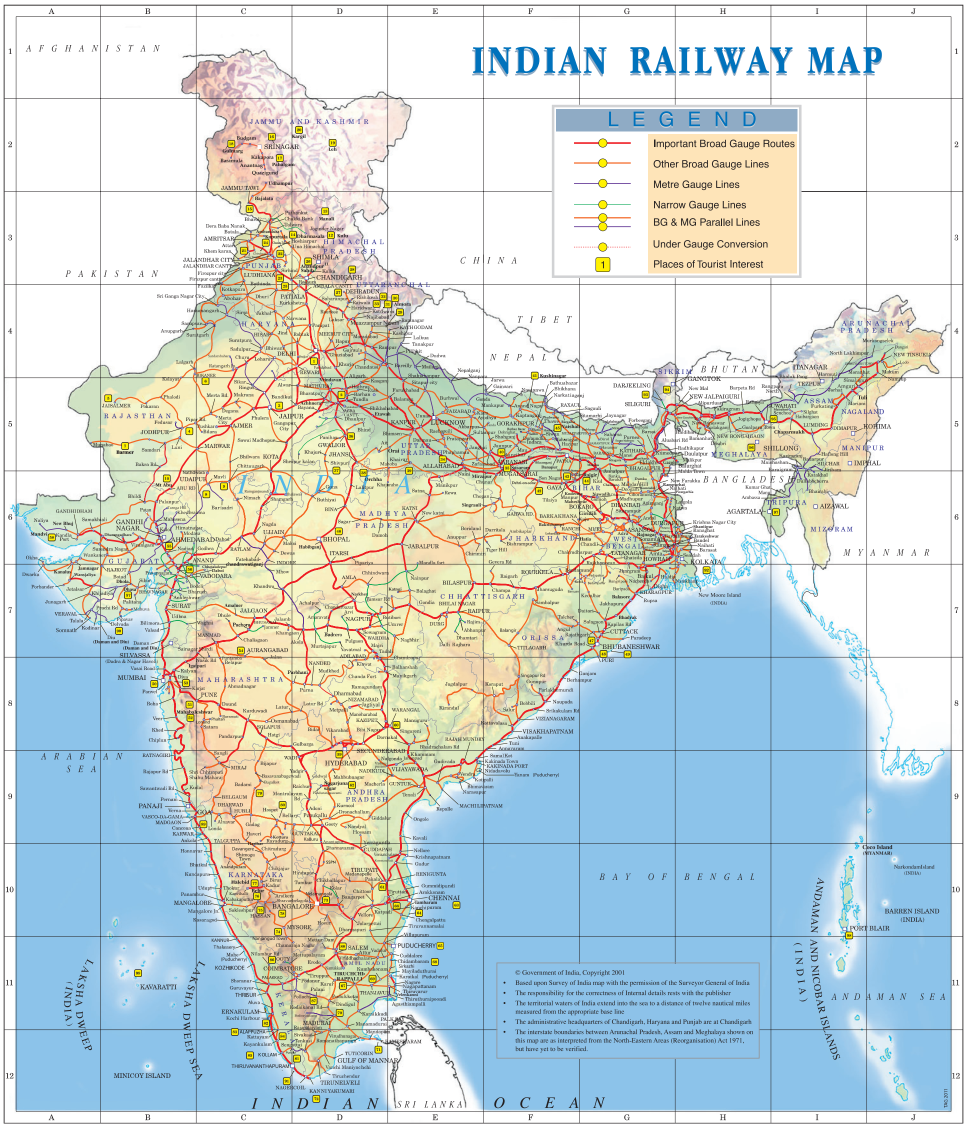
64,600 km by 2011-12 an overall growth of about 20.53 per cent.

Today, Indian Railways (IR) occupies a unique and crucial place in the country's transport infrastructure. IR, managed directly by the Ministry of Railways, is the third largest railway network in the world under a single management with 7,500 railway stations, 9,549 locomotives, 55,339 passenger coaches, 2,39,321 freight cars and 64,600 route km. IR operates 12,000 passenger trains every day and 7,000 freight trains. It transports 2.8 million tonnes of freight traffic and 25 million passengers every day.

GAUGE

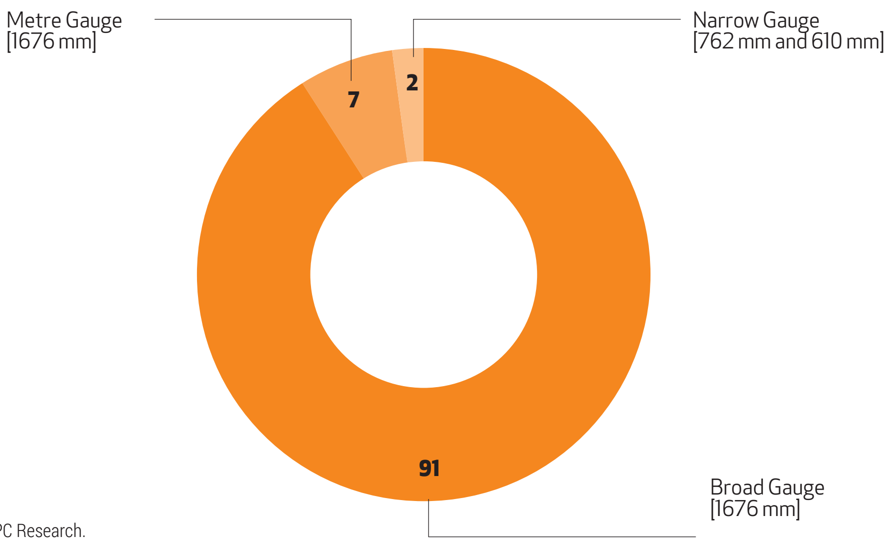
Indian railways run on three gauges, though it is proposed to make the entire network single gauge. The size of the network (gauge-wise) as on 31 March 2012 is shown in Table 2.16. Currently, broad gauge (BG) contributes about 91 per cent of total track km, while it forms about 86.62 per cent of total route km. The rest of the network, barring hill/heritage railways, is progressively getting converted to BG. The BG network accounts for 97.9 per cent of passenger and almost 100 per cent of the freight traffic. Almost all double/multiple track sections and electrified routes are broad gauge. Meter and narrow gauges

Figure 2.7
Indian Railways Network



Source: Ministry of Railways.

Figure 2.8
Percentage Gauge Share in Total Track Kilometres



Source: NTDPC Research.

Table 2.17
Distribution of Route Kilometres by Railway Zone

ZONES	ROUTE KILOMETRES
Northern, New Delhi	6,990
North Western, Jaipur	5,502
Southern, Chennai	4,994
South Central,Secunderabad	5,810
Western, Mumbai	6,440
Balance (12 zones)	34,864
Total Route Km	**64,600**

Source: Indian Railways Year Book, 2011-12.

are mostly single line and non-electrified. Between 1950-51 and 2010-11, traffic density (million gtkm per running track km) increased from 4.29 to 23.17 on BG.

INDIAN RAILWAY ZONES

Whether it is a remote village or developed metropolis, Indian Railways serves and connects rail users in every part of the country. IR is administered through 17 zonal railways. However, almost half of the route kilometres fall under five railway zones while the rest 12 together constitute 54 per cent (Table 2.17). The newly included zone (Metro Railway, Kolkata) comprises only 25 km, while the Northern Zone has the highest coverage of 6,990 km.

The zonal railways are further divided into smaller operating units called divisions. There are 68 operating divisions at present.

TRACTION

The Indian railways run mainly on electric and diesel traction. Steam traction was almost phased out by the late 1990s. The shift from steam to diesel for passenger transport started in early 1960s, whereas the transition for freight movement had begun in mid-1950s. Diesel traction reached its highest share (56 per cent) for passenger movement in 2000-01, while in case of freight, it comprised 62 per cent in 1980-81.

Gradually, electric traction was introduced, particularly on high density routes. The share of electric traction, which was 2 per cent for passengers (loco) and 5 per cent for passenger (EMU), and 1 per cent for freight in 1950-51, increased to 38.2 per cent, 13.3 per cent and 63.5 per cent respectively in 2011-12 (Figures 2.9 and 2.10).

ROLLING STOCK

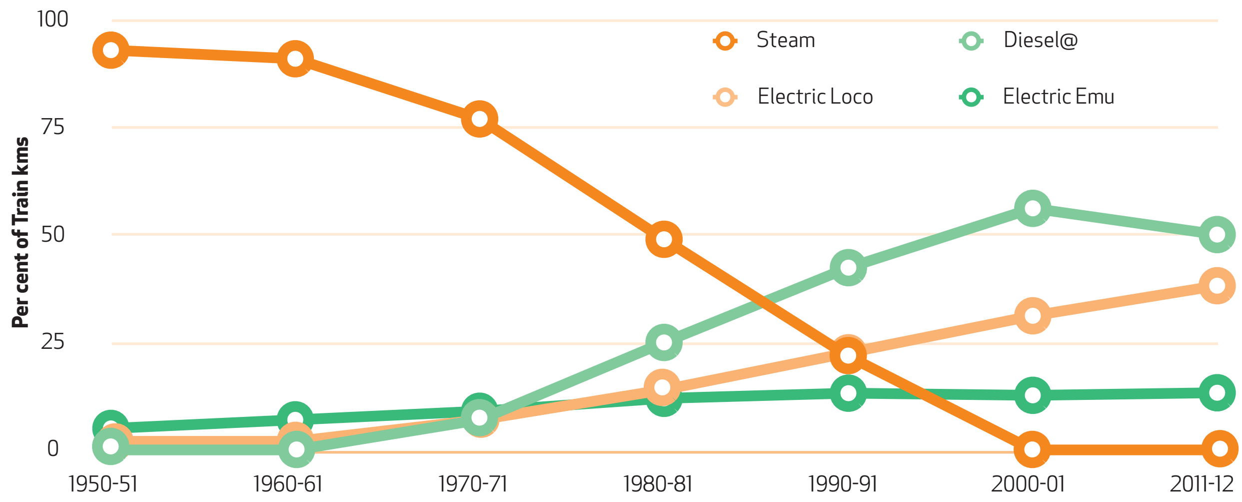
Over the years, there has been improvement in design and capacity of locomotives, wagons and coaches through introduction of new technology. While the number of wagons has come down, total capacity has gone up. Similarly, seating capacity per coach has risen (Figure 2.11).

Passenger traffic increased by about 1,460 per cent, from 67 billion in 1950-51 to 1,047 bpkm in 2011-12. Freight traffic grew by about 1,400 per cent, from 44 to 668 BTKM during the same period[12]. During the 11th Plan period, CAGR for freight traffic was about 6.8 per cent as against the long-term CAGR of 4.6 per cent. However, the achievement of the railways in freight movement would have been more impressive had it not faced capacity constraints. In the 12th Plan, the rate of growth is anticipated to be about 11.5 per cent.[13].

The bulk of freight traffic is accounted for by 11 commodities. These include coal, foodgrains, iron and steel, iron ore, cement, POL, fertilisers, limestone and dolomite, stone (including gypsum) other than marble, salt and sugar. These commodities together accounted for 91.1 per cent of total freight traffic in 2011-12.

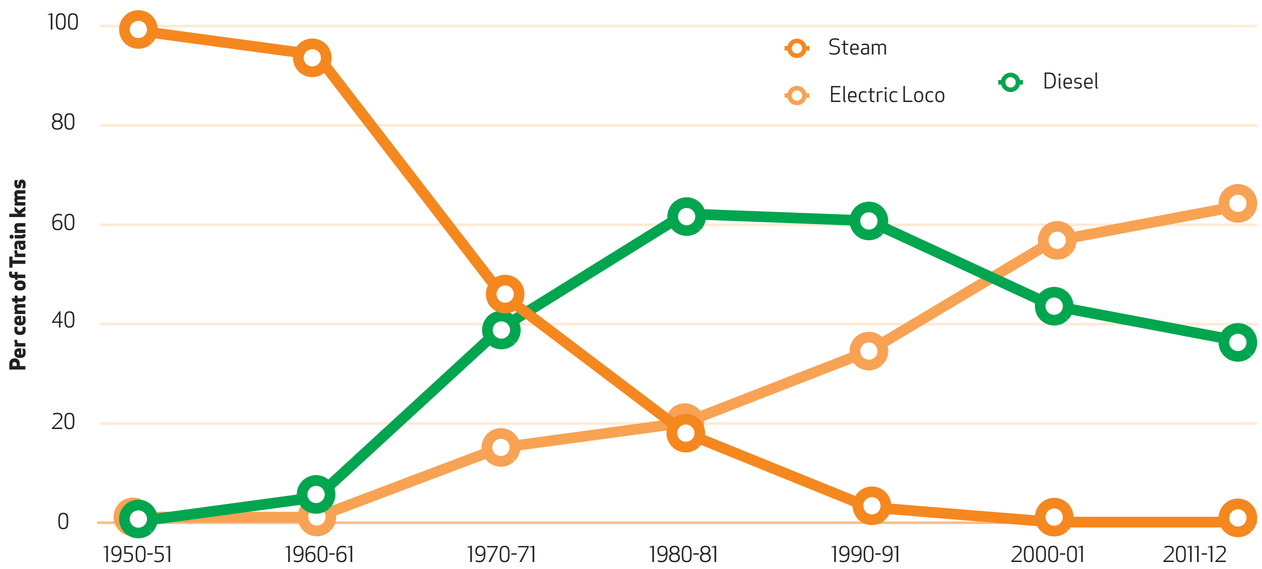
12. Indian Railways Year Book 2011-12, Draft 12th Five-Year Plan, Planning Commission.
13. NTDPC Research.

Figure 2. 9
Percentage of Passenger Movement Kilometres by Traction Mode



Source: Indian Railways Year Book, 2011-12.
Note: @ Includes DHMU & DEMU.

Figure 2. 10
Percentage of Freight Movement Kilometres by Traction Mode



Source: Indian Railways Year Book, 2011-12.

RECENT INITIATIVES FOR CAPACITY AUGMENTATION

Two important developments that have taken place in recent years need special mention. These are:

- Special Railways Safety Fund (SRSF) in the 9th Plan to be utilised to rehabilitate the railway network and other assets.
- Dedicated Freight Corridors (DFCs), which have been envisaged to augment rail freight transportation capacity, particularly on the Eastern and Western Corridors. The existing trunk routes of Howrah-Delhi on the Eastern Corridor and Mumbai-Delhi on the Western Corridor are currently saturated with line capacity utilisation varying between 115 per cent and 150 per cent [14].

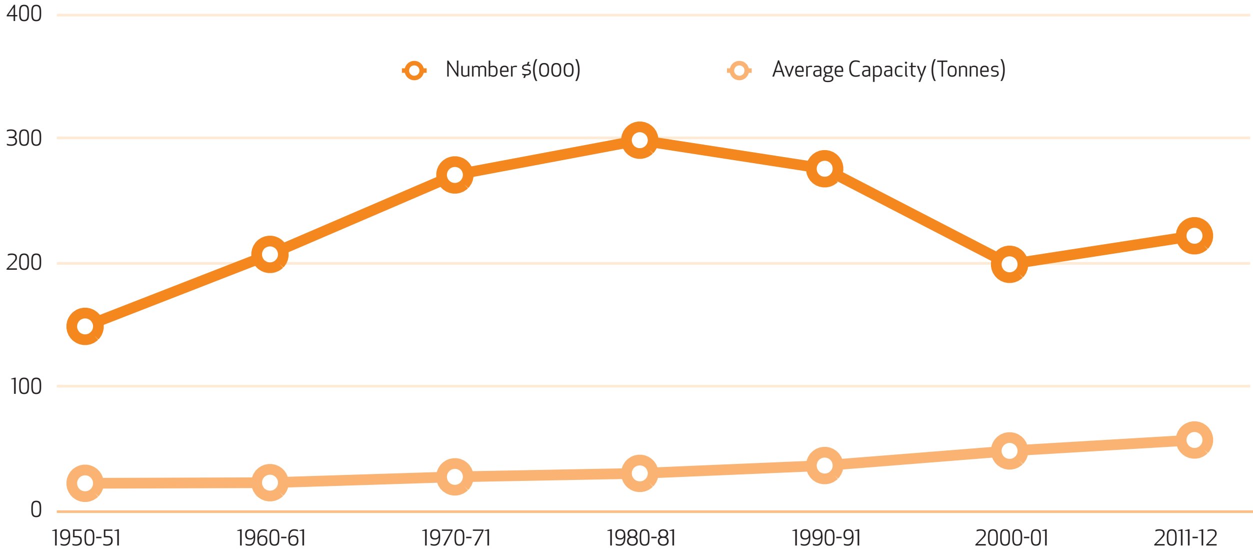
While the former initiative helped the railways meet increased traffic demand in the short and medium terms, a DFC is expected to ensure that long run traffic demand is met adequately and efficiently. Railways need several such DFCs.

ROADS AND ROAD TRANSPORT

Along with railways, road transport caters to the bulk of domestic transport demand. In some areas, this is the only means of transport. Public investment over six decades has produced a massive road network. The total road length increased from about 400,000 km to 4.7 million km between 1951 and 2011. Surfaced roads increased from 157,000 km to around

14. Source: Dedicated Freight Corridor Corporation of India Ltd (DFCCIL).

Figure 2.11
Carrying Capacity Per Wagon on Broad Gauge



Source: Indian Railways Year Book, 2010-11.
Note: $: Excludes departmental service wagons and brake vans.

2.5 million km. Road density in India is now nearly 1.42 km per sq km, which compares favourably with many countries. The share of the surfaced road length in the total road length also reflects healthy improvement. Surfaced road length accounted for 54 per cent of total road length in 2011, compared with 39 per cent in 1951 (Figure 2.12).

The Indian road network can be divided into three main categories:

- National Highways, with an aggregate length of 70,934 km in 2010-11 and which constitute about 1.5 per cent of network, carrying about 40 per cent of road-based traffic;
- State Highways and other Public Works Department (PWD) roads which constitute the secondary system of road transportation, with an aggregate length of about 1.2 million km, about 25 per cent of the total road network;
- The rural road network, almost 60 per cent of the total network.

The development of roads got a big boost with the launching of the NHDP and the Pradhan Mantri Gram Sadak Yojana (PMGSY). While NHDP aimed at primarily strengthening and widening high-density corridors of National Highways, PMGSY was designed to improve the accessibility of habitations in rural areas. The development of National Highways and rural roads received special attention of the planners. However, similar attention was not assigned to State Highways and Major District Roads.

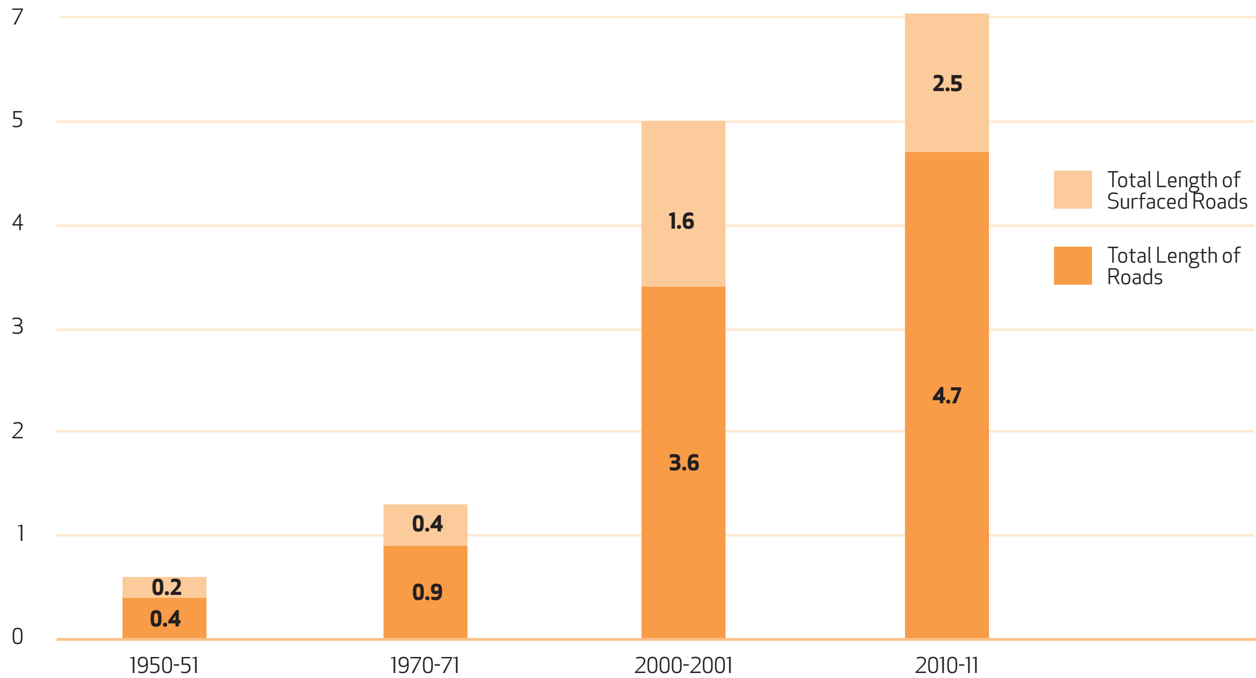
Table 2.18 presents the growth of the road network, category-wise.

The length of National Highways (NH) reported a CAGR of 2.2 per cent between 1951 and 2011. NHDP has contributed largely towards improving the capacity and road quality of NHs. The length of NHs with two lanes increased from 25,395 km in 1996 to 41,518 km in 2012, and those with four lanes and above from 1,170 km to 17,774 km. During the same period, the combined network of State Highways and other PWD roads posted a sevenfold expansion in length with a CAGR of 3.2 per cent.

The highest CAGR of 4.4 per cent from 1951 to 2011 was registered by rural roads comprising Panchayati roads, and roads constructed under the Jawahar Rozgar Yojana (JRY) and PMGSY. Till the advent of PMGSY, rural roads were being constructed under various programmes. These included Minimum Needs Programmes, state sector programmes, National Rural Employment Programme (NREP), Rural Landless Employment Guarantee Programme (RLEGP) and JRY. After assessing the requirement of connectivity to habitations, the PMGSY was launched in December 2000 with the objective of providing connectivity in phases, depending upon the population of a habitation. In the first phase, habitations with a minimum population of 1,000 in plain areas and 500 in tribal, hilly and desert areas were taken up. The second phase envisages providing all-weather road connectivity to habitations with populations of 500 in plain areas and 250 in tribal and hilly areas. As a result of PMGSY and other non-PMGSY programmes, the accessibility to habitations has improved considerably (Table 2.19).

Despite the steady growth rate, the development of the rural road network has not been balanced. While certain states provide 100 per cent connectivity, some

Figure 2.12
Total Road Length vis-à-vis Surfaced Road Length
[Million Km]



Source: Basic Road Statistics of India 2008-09, 2009-10 & 2010-11.

Table 2.18
Growth of Road Network

ROAD NETWORK BY CATEGORIES (IN KM): 1951 TO 2011							
ROAD CATEGORY	**1951**	**1961**	**1971**	**1981**	**1991**	**2001**	**2011**
National Highways	19,811	23,798	23,838	31,671	33,650	57,737	70,934*
Per cent Share	**5.0**	**4.5**	**2.6**	**2.1**	**1.4**	**1.7**	**1.5**
State Highways and Other PWD Roads	173,273	257,125	333,598	516,254	636,746	868,101	1,169,225
Per cent Share	**43.4**	**49.0**	**36.5**	**34.8**	**27.4**	**25.7**	**24.9**
Rural Roads	206,408	197,194	354,530	628,865	1,260,430	1,972,016	2,749,805
Per cent Share	**51.7**	**37.6**	**38.7**	**42.3**	**54.2**	**58.5**	**58.6**
Urban Roads	--	46,361	72,120	123,120	186,799	252,001	411,840
Per cent Share	**0.0**	**8.8**	**7.9**	**8.3**	**8.0**	**7.5**	**8.8**
Project Roads	--	--	130,893	185,511	209,737	223,665	288,539
Per cent Share	**0.0**	**0.0**	**14.3**	**12.5**	**9.0**	**6.6**	**6.2**
Total	**399,492**	**524,478**	**914,979**	**1,485,421**	**2,327,362**	**3,373,520**	**4,690,343**

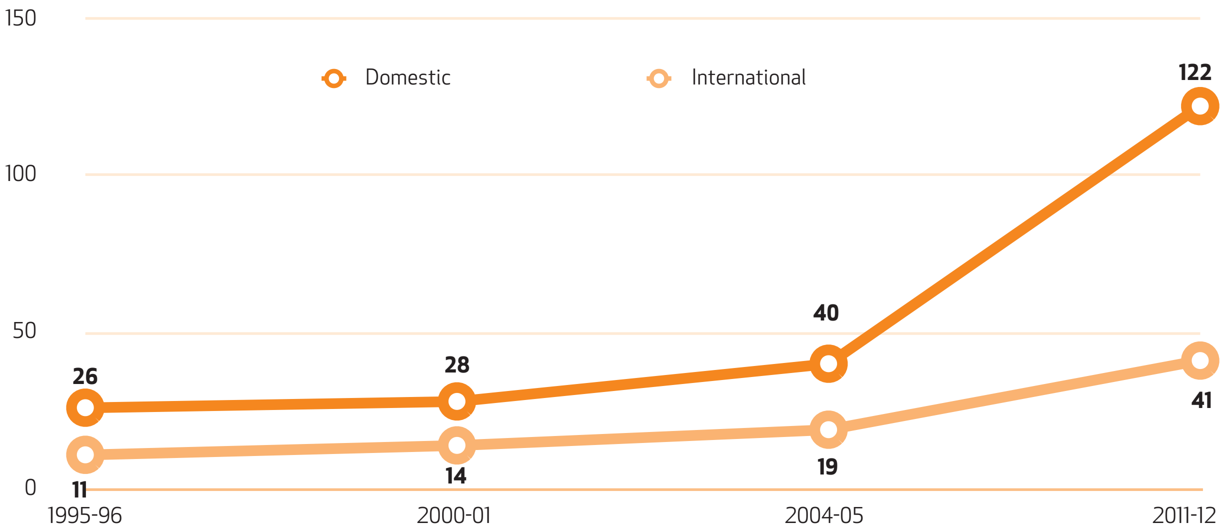
Source: Basic Road Statistics of India 2008-09, 2009-10 & 2010-11.
Note: *76,818 kilometres as on 31st March 2012.

Table 2.19
Village Connectivity to All-Weather Roads

PARTICULARS	1950-51	1960-61	1970-71	1980-81	1990-91	2000-01	2010-11
Per cent Villages with 1000+ Population Connected with All- Weather Roads	32	36	40	46	73	90	95
Overall Per cent Village Connectivity	20	22	25	28	44	54	68

Source: Working Group Report on Rural Roads for 12th Five Year Plan and NTDPC Research.

Figure 2.13
Passenger Throughput at Indian Airports
[Millions]



Source: Report of the Working Group on Civil Aviation, NTDPC and AAI.

others still have a large number of habitations with poor accessibility.

Both freight and passenger traffic continue to increase. While in 1950-51, freight and passenger traffic was 6 BTKM and 31 bpkm respectively, freight traffic increased to 1,385 BTKM while passenger traffic reached 9,329 bpkm in 2011-12[15]. Percentage share of road freight has increased from 12 per cent in 1950-51 to 67 per cent in 2011-12 and passenger traffic from 32 per cent to 90 per cent.

CIVIL AVIATION

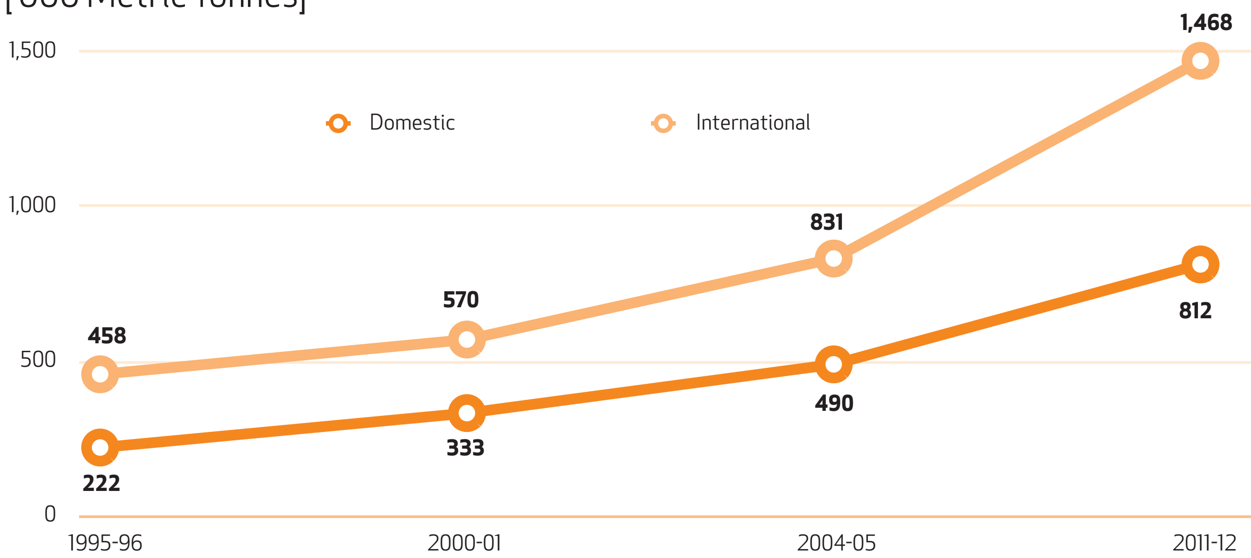
Civil aviation arrived in India in 1911 when an aircraft flew from Allahabad to Naini, covering a short distance of 10 km. The two World Wars provided a stimulus to the sector. A number of airlines were established after World War II. However, significant development started only in 1953 when Indian Airlines and Air India were set up.

The annual growth in domestic passenger traffic from 1960-61 to 1985-86 was around 10 per cent per annum. The 7th Plan (1985-90) observed that 'domestic traffic has registered an average increase of 10 per cent and by all indications this trend is likely to continue, unless otherwise restrained'. Efforts were made to peg the growth rate, since the sector is heavy on fuel consumption and foreign exchange. In fact, the last decade of the 20th century witnessed stagnant growth.

The Air Corporations Act, 1953, was repealed in 1994, paving the way for entry of private airlines. A large number entered the market, and some

15. NTDPC Research.

Figure 2.14
Cargo Throughput at Indian Airports
['000 Metric Tonnes]



Source: Report of the Working Group on Civil Aviation, NTDPC.

perished. The overall seat capacity increased dramatically, which led to a fall in fares, which further stimulated the growth of air traffic. The private sector also contributed towards provision of airport infrastructure facilities. In the last five years, the private sector has invested about Rs 300 billion (at 2011-12 prices) in airport modernisation, mainly in development of greenfield airports at Hyderabad and Bengaluru, and modernisation of Delhi and Mumbai airports.

In the last decade, the sector has grown at a phenomenal pace, and India has emerged as the world's ninth largest civil aviation market. There has been enhanced national and international connectivity with 74 foreign airlines operating to/from various destinations. The number of scheduled aircraft departures per day for domestic and international segments has increased from 503 and 79 respectively in 2001-02 to 1,538 and 236 in 2012[16]. In 2001-02, there were only five Indian airlines in operation with 132 aircraft. By 2010-11, the number of scheduled operators had increased to 13 with a total fleet size of 340. India has also witnessed significant growth in the number of non-scheduled airline operators, from 36 in 2000 to 146 in 2012. The number of aircraft with non-scheduled operators increased from 106 in 2000 to 409 in 2010. Similar expansion has been witnessed in airport infrastructure; the number of operational airports increased from 50 in 2000 to 84 in 2012.

Passenger throughput at Indian airports during 2011-2012 was 162.3 million (Figure 2.13), of which 121.51 million or about 75 per cent were domestic passengers and the rest international. The percentage of domestic passengers to the total passenger throughput has gone up from about 67 per cent in 2000-01 to about 75 per cent in 2011-12, implying faster growth of domestic compared to international passenger throughput. In the last 11 years, the domestic segment has grown at a Compound Annual Growth Rate (CAGR) of about 14.3 per cent vis-à-vis 10.2 per cent for the international segment.

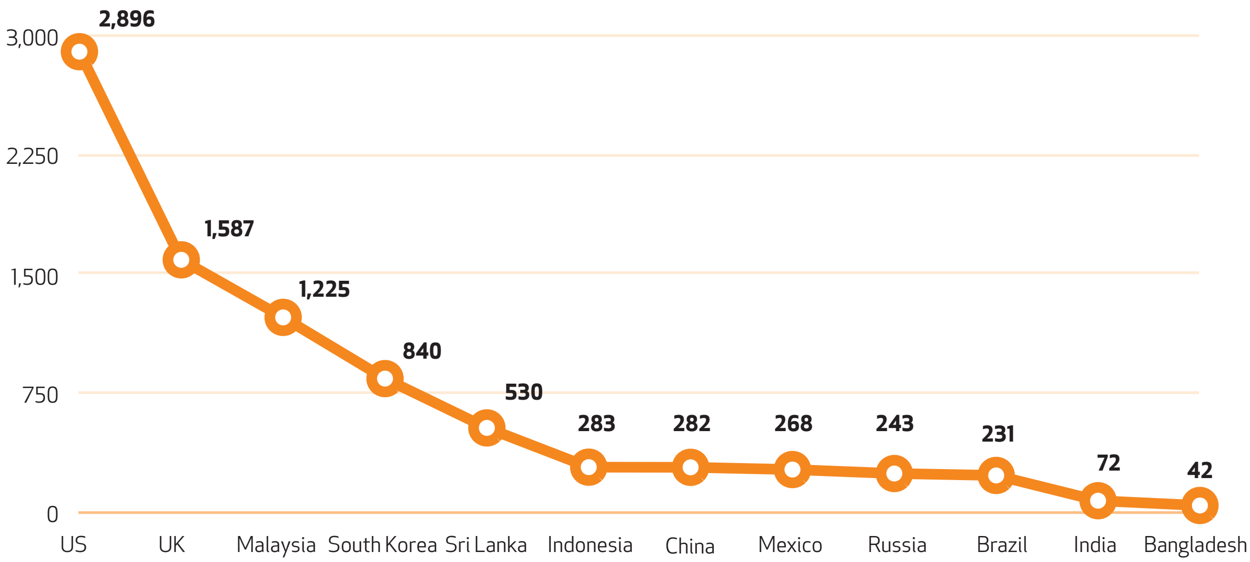
Cargo throughput at Indian airports during 2011-12 was 2.28 million metric tonnes. The Indian government adopted an 'Open Skies' policy for air cargo traffic in the early 1990s, under which Indian and foreign carriers were allowed to operate scheduled and non-scheduled cargo services to/from any airport in India. As a result, international air cargo traffic increased from about 0.9 million metric tonnes (MMT) in 2000-01 to 2.28 MMT in 2011-12. Total freight traffic handled by Indian airports has increased at a CAGR of about 9.2 per cent in the last 11 years to reach 2.28 MMT by 2012. Domestic cargo, buoyed by increasing domestic trade, has grown at a pace of 8.4 per cent, while international cargo grew at nearly 9. In spite of this high growth, India continues to be a small player in the international arena. The air traffic density (1,000 passengers per million urban population[17]) in India is very low at 72. China (282) is four times higher, Brazil (231) three times, Malaysia (1,225) 17 times, US (2,896) 40 times and Sri Lanka (530) more than seven times higher. China's domestic traffic is five times that of India's. Moreover, India has an aircraft for every 2.89 million people in comparison to 1.14 million in China. In terms of freight carriers, out of 15,750 freight carriers globally, India

16. Air Transport Statistics, 2001-02 and ICAO ATR form as furnished by all airlines.
17. Achieving the Trillion Dollar Dream: Background Paper, India Infrastructure Summit 2011, FICCI.

Figure 2.15

Comparison of Air Traffic Density Across Select Countries

[1,000 Passengers Per Million Urban Population]



Source: Working Group Report on Civil Aviation, NTDPC.
Note: Traffic data pertains to 2010 for India and 2008-09 for other economies.

Table 2. 20

Composition of Traffic at Major Ports

[Per cent]

YEAR	POL	IRON ORE	CONTAINER
1960-61	28	16	--
1990-91	42	21	13
2011-12	31	11	21

Source: Basic Ports Statistics of India, 2011-12.

has just 13 scheduled and 149 non-scheduled operators.

These data—as also the traffic densities of countries such as China and Indonesia—indicate the kind of growth that can be expected as Indian incomes rise in the next couple of decades and beyond.

PORTS, SHIPPING AND IWT

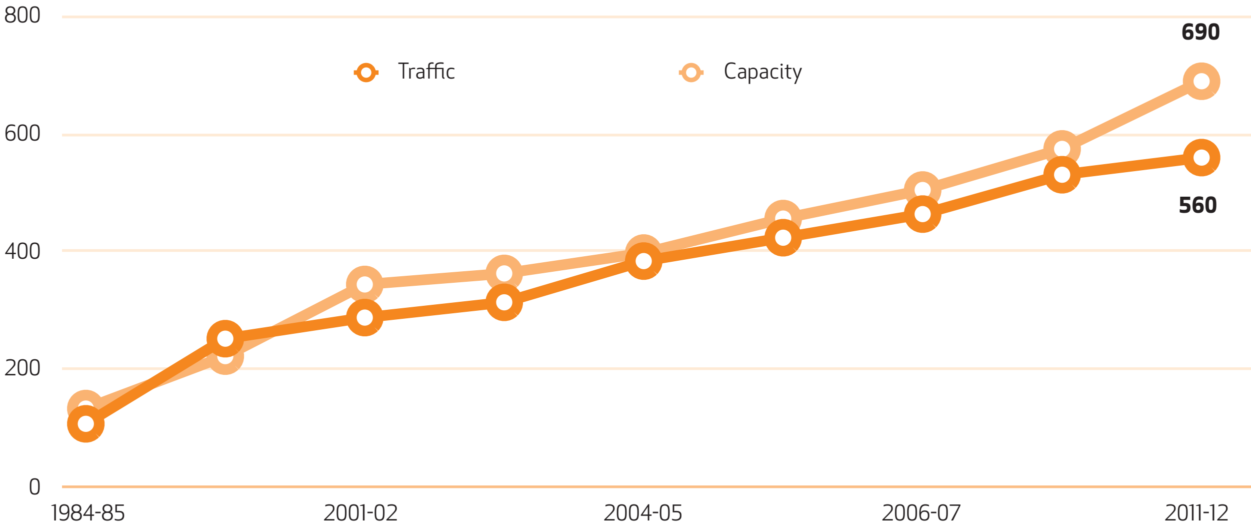
Global economic integration relies heavily upon efficient maritime transport due to its unparalleled physical capacity and ability to carry freight over long distances and at low costs. Seaborne trade represents more than 80 per cent of international trade. As high as about 95 per cent of India's trade volume (around 70 per cent in terms of value) is moved by sea. India's maritime sector comprises ports, shipping, shipbuilding and ship repair, as well as inland water transport systems.

The Indian peninsula is also strategically located between the Atlantic Ocean in the west and the Pacific Ocean in the east, with a 7,517 km-long coastline. But in spite of its significance and low cost of operation, the share of water transport in domestic freight traffic is just about 6 per cent[18] compared to that of other large economies such as China (47 per cent), USA (12.4 per cent) and Japan (34 per cent)[19].

PORTS

Today, India has 12 Major Ports and 200 notified Non-Major Ports along the coastline and islands.

Figure 2.16
Growth in Capacity and Traffic at Major Ports
[Million Tonnes]



Source: Basic Ports Statistics of India, 2011-12.

Major Ports are administered by the Union Government under the Major Port Trusts Act of 1963, with one exception, Ennore Port, which is administered under the provisions of the Companies Act, 1956. Non-Major Ports are administered by nine maritime states and three union territories within their respective coastlines.

In keeping with the general policy of economic liberalisation, the port sector was opened to private sector participation in 1997 through an amendment in the Major Port Trusts Act. Accordingly, a regulatory body known as Tariff Authority for Major Ports (TAMP) was introduced for regulating both vessel-related and cargo-related tariffs. TAMP was also made responsible for regulating rates for lease of properties in respect of Major Port Trusts and private operators.

TRAFFIC In 1950-51, there were six Major Ports in India: Kolkata, Mumbai, Chennai, Cochin, Mormugao (Goa) and Vishakhapatnam. Subsequently, Kandla, New Mangalore, Paradip, Haldia and Tuticorin were declared Major Ports. In 1989, another major port, Jawaharlal Nehru Port Trust (JNPT), Mumbai came into existence, followed by Ennore in 2001.

During 2011-12, total cargo handled by Major and Non-Major ports was 914 million tonnes with the 13 Major Ports handling nearly 61 per cent of it—560 million tonnes.

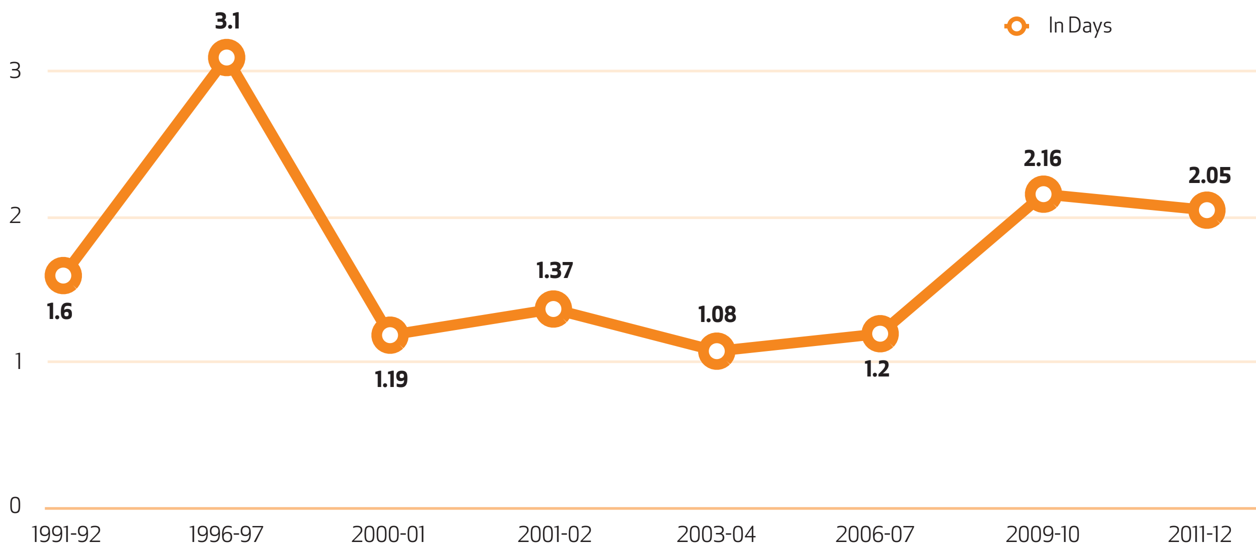
Between 1960-61 and 1990-91, total traffic grew at a CAGR of 4.9 per cent, with traffic at Major and Non-Major Ports growing at 5.2 per cent and 2.4 per cent respectively. The period from 1990-91 to 2011-12 witnessed an overall traffic CAGR of 8.6 per cent with traffic at the Major Ports and Non-Major Ports growing at 6.4 per cent and at about 18 per cent respectively. The increased throughput of Non-Major Ports has been the effect, to a large extent, of capacity saturation at the Major Ports. Encouraging initiatives by many maritime states for the development of Non-Major Ports through the participation of the private sector also contributed to this shift.

The increase in quantity of cargo handled at Non-Major Ports from 2000-01 to 2011-12 was mainly driven by traffic growth in Gujarat, Andhra Pradesh, Goa and Maharashtra. In 2000-01, Gujarat accounted for more than 80 per cent of the total traffic handled at the Non-Major Ports and continued to hold more than 73 per cent share in 2011-12, followed by Andhra Pradesh (13 per cent), Maharashtra (5.6 per cent), Goa (4.1 per cent), Odisha (1.4 per cent) and Tamil Nadu (0.3 per cent). The remaining 2.4 per cent was handled by all the other maritime states/union territories (UTs).

COMPOSITION OF TRAFFIC The composition of cargo traffic at Major Ports has changed significantly over the years (Table 2.20). The cargo composition at Non-Major ports did not show any pronounced shift with POL and its products being the single largest commodity with about 55 per cent and about 44 per cent in 2001-02 and 2011-12 respectively.

CAPACITY Over the years, cargo handling capacity of Major Ports has steadily increased. However, traffic demand clearly outpaced capacity additions, resulting in port congestion. In 1984-85, total capacity utilisation was 81 per cent which increased to 95 per cent in 1990-91, indicating high stress on the available port infrastructure. Capacity utilisation remained very high during the 1990s. Due to recent capacity addi-

Figure 2. 17
Average Pre-Berthing Detention for All Major Ports



Source: Basic Ports Statistics of India, 2011-12.

Table 2. 21
Break-Up of Traffic and Capacity at Indian Ports at The End of 12TH Plan
[Million Tonnes]

PARTICULARS	END OF 11TH PLAN 2011-12	END OF 12TH PLAN 2016-17
Traffic	914	1,278
Capacity	1,147	1,662

Source: Working Group Report on Ports and Shipping, NTDPC.

tions, utilisation at Major Ports came down to about 80 per cent in 2011-12. Similarly, Non-Major Ports, which had a capacity utilisation of 81 per cent in 2006-07, saw a decline to about 64.5 per cent in 2011-12.

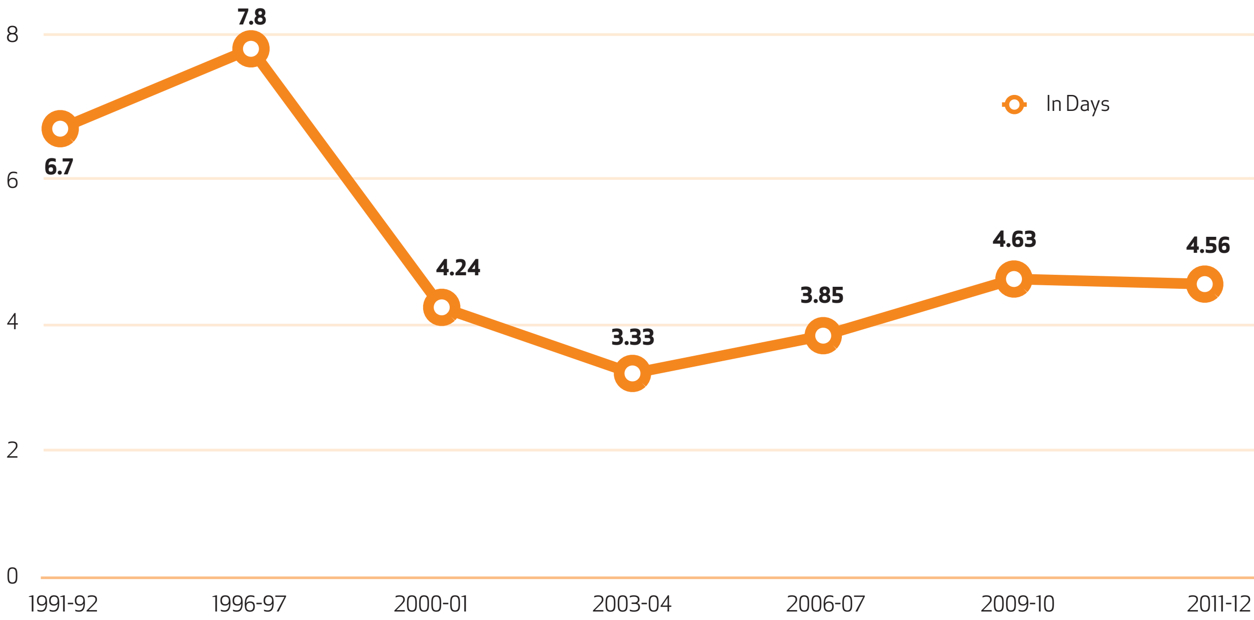
Despite this, capacity utilisation at both Major and Non-Major Ports have been way above the identified optimum capacity utilisation of 70 per cent, implying that the cargo evacuation facilities are under great strain.

EFFICIENCY PARAMETERS The performance of Indian ports has generally deteriorated over the years except for a brief period from the late 1990s to the mid 2000s.

- Average pre-berthing detention (PBD) of vessels rose from 1.6 days in 1991-92 to 3.1 days in 1996-97, then saw a decline till 2004-05, reaching an encouraging level of around one day. However, port efficiency subsequently saw a dip as the detention time again started increasing and then gradually declined to 2.05 days in 2011-12.
- Average turn round time (TRT) increased from 6.7 days in 1991-92 to 7.8 days in 1996-97, after which it declined till 2003-04 when it was 3.3 days. It then increased gradually to 4.63 days in 2009-10. However, in 2011-12, average TRT dropped to 4.56 days.

The gap between the growth in traffic and growth of port capacity is apparently widening. Port traffic is expected to grow by about 40 per cent, from 914 million tonnes at the end of 11th Plan to 1,278 million tonnes by the end of the 12th Plan. Rapid upscaling

Figure 2.18
Average Turnaround Time for Major Ports



Source: Basic Ports Statistics of India, 2011-12.

of port capacities, particularly in terms of deeper drafts for bigger vessels, modern cargo handling facilities, swift cargo evacuation, and commensurate financing shall be required in the 12th. An expansion in total capacity by about 7.7 per cent by the end of the 12th Plan from 2011-12 levels is suggested.

SHIPPING

India has one of the largest merchant shipping fleets among developing countries and is ranked 16th in the world in terms of gross tonnage under its flag. However, the share of coastal shipping in India's domestic transport is miniscule, despite the various benefits it offers. Coastal shipping provides an energy-efficient, environment-friendly and economical mode of transport, and is a crucial component for the development of domestic industry and trade. It has been estimated by the Working Group on the 12th Plan that the potential cost of carriage by coastal shipping is Rs 0.25 per tonne km, as compared to Rs 1.20 by road and Rs 0.60 by rail. However, the cost efficiency is not realised due to insignificant volumes and inefficiencies of first/last mile connectivity.

INDIAN SHIPPING TONNAGE The Indian shipping fleet, which possessed 94 ships with a total tonnage of about 0.37 million GT in 1950-51, at the beginning of the 1st Plan, grew significantly till the end of the 6th Plan, registering a CAGR of 4.6 per cent and 9 per cent for Indian fleet and Indian tonnage respectively. However, in subsequent years, there have been fluctuations in growth, with number of ships and total tonnage declining and then again showing improvement in the post-liberalisation period. In 1992, the shipping fleet possessed 441 ships with a total tonnage of 6.3 million GT which increased to 1,154 ships and 10.4 million GT in 2012, indicating a CAGR of 4.9 per cent and 2.6 per cent respectively.

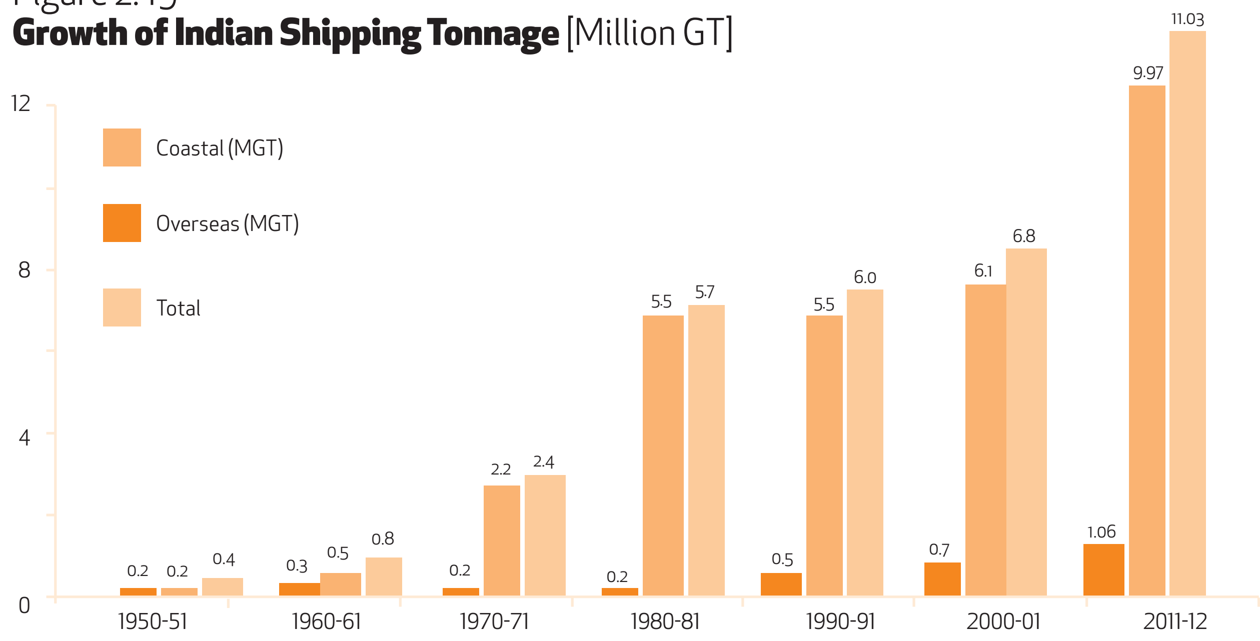
In 1950, the share of coastal shipping tonnage in the total tonnage was as high as 57 per cent, but it showed a steep decline to reach a mere 8.7 per cent in 1990. In 2012, the share of coastal shipping tonnage increased marginally over the previous year to 10.4 per cent, while overseas tonnage constituted 89.6 per cent.

The average tonnage per vessel for coastal shipping in 1950 was 2,900 GT. This increased slightly to 3,220 GT by 1990, but it declined considerably to just 1,390 GT by 2012. In the case of overseas shipping, the average tonnage per vessel, which was 7,260 GT in 1950, increased significantly to 21,500 GT in 1990, and further to 26.700 GT in 2012.

However, the share of the Indian fleet in the carriage of the country's overseas trade has declined steeply in the last seven years. In 1990, the Indian fleet's share was as high as 35.5 per cent of the overseas trade, and the balance was carried by foreign vessels. But by 2011-12, the Indian flag share was only 10.9 per cent.

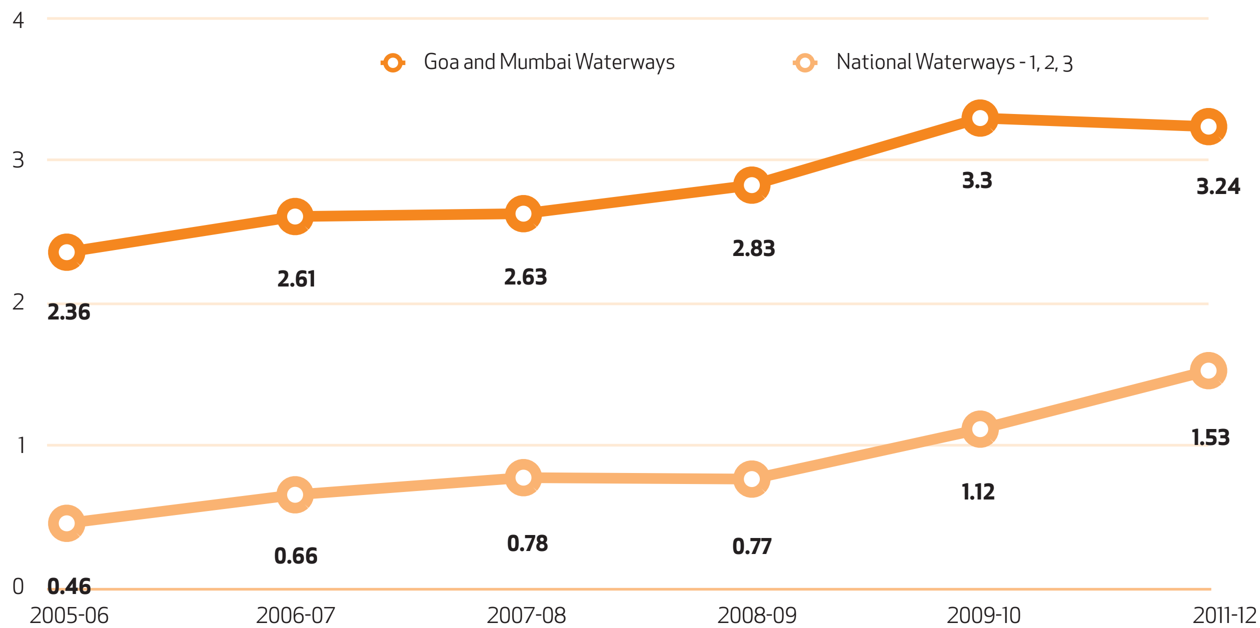
AGE STRUCTURE OF INDIAN TONNAGE In 1993, the age of around 12 per cent of the Indian fleet was below five years, 49 per cent between six and 15 years, and only 15 per cent above 20 years. But by 2012, about 39 per cent of the fleet was above 20 years of age, and only 25.6 per cent below five years. In 2011, 50 per cent of the world tonnage was less than nine years of age.

Figure 2.19
Growth of Indian Shipping Tonnage [Million GT]



Source: Indian Shipping Statistics, 2012.

Figure 2.20
Cargo Movement on Goa and Mumbai Waterways vis-à-vis National Waterways [Btkm]



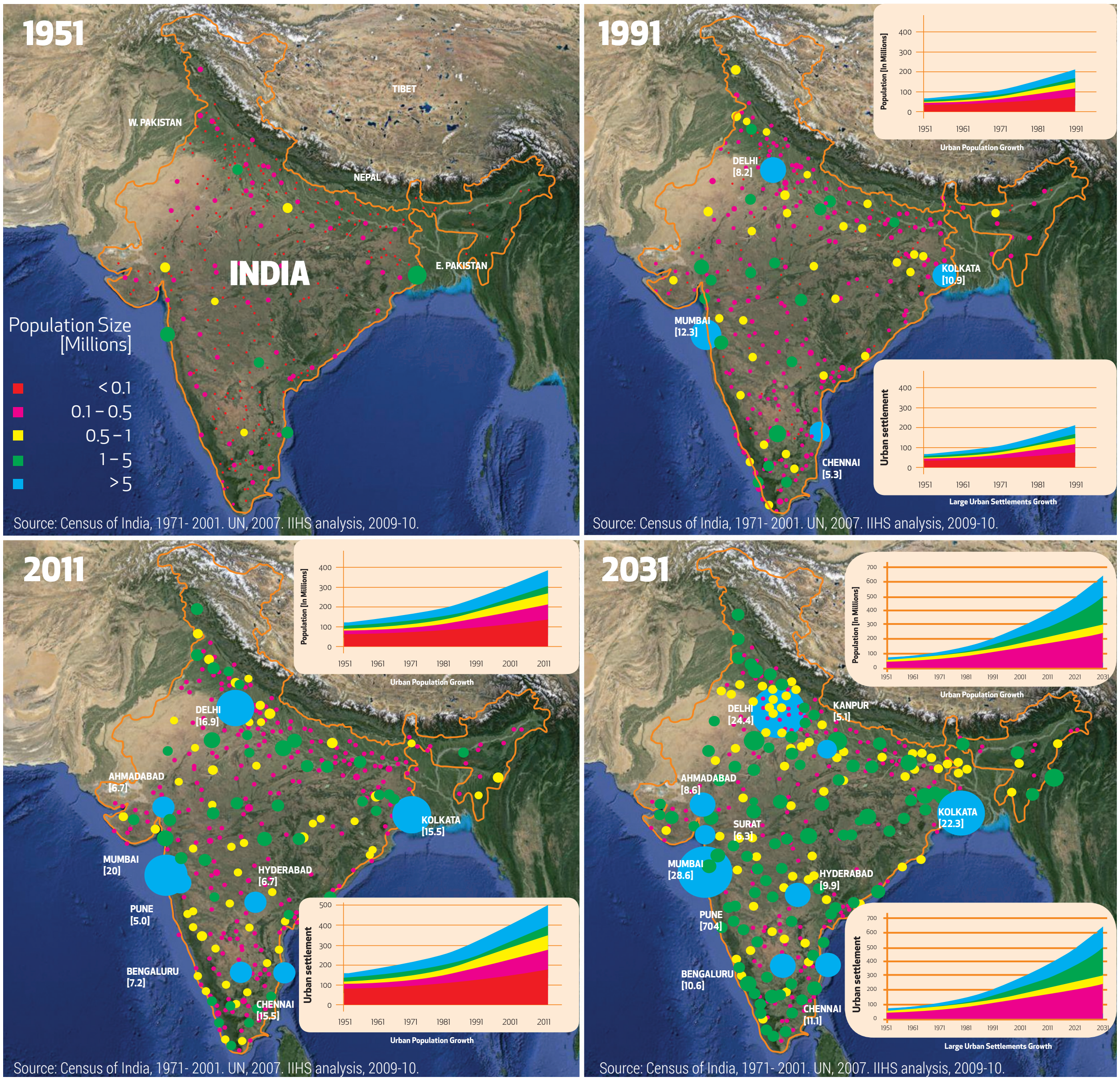
Source: Working Group on Ports and Shipping, NTDPC.

INLAND WATER TRANSPORT (IWT)

Inland waterways in India are underdeveloped as a mode of transportation, despite their inherent advantages of fuel efficiency, environment friendliness, hinterland connectivity to less-developed rural regions, and its capacity to shift large volumes of cargo from congested roads. Development of IWT can substantially reduce accidents as well as address the growing carbon footprint. India has 14,500 km of navigable waterways, including rivers, backwaters and canals. A significant proportion of this, stretching over 5,200 km of rivers and 485 km of canals, are suitable for mechanised transportation.

IWT did not receive adequate focus till the 6th Plan when the National Transport Policy Committee (1980) recommended setting up of the Inland Waterways Authority of India (IWAI). The Authority, set up in 1986, was charged with the responsibility of

Figure 2. 21
Geographical Dispersion of Urban Growth Areas and Projections for 2031



Source: IIHS, Urban India Conference, November 2011.

the development of National Waterways and provided the much required boost to IWT.

At present, there are five National Waterways, NW1—River Ganga (1,620 km), NW2—River Brahmaputra (891 km), NW3—West Coast Canal (205 km), NW4—Kakinada to Puducherry Canal System along with Rover Godavari and River Krishna (1,095 km), and NW5—the Brahmani and Mahanadi delta along with the East Coast Canal (623 km). River Barak is likely to be declared as the sixth NW. Besides National Waterways, several other waterways are extensively used for IWT; this includes Goa Waterways for transportation of iron ore for export, and Mumbai Waterways for coal, steel, etc.

CARGO MOVEMENT The total cargo traffic handled by IWT rose from 1.5 BTKM in 1999-2000 to 2.82 BTKM in 2005-06, a CAGR of 11.1 per cent. Traffic further increased to 4.77 BTKM in 2011-12. Bulk of this traffic is moved through Goa and Mumbai Waterways which together contributed as high as about 84 per cent of the total IWT traffic in 2005-06. The combined share of the two waterways showed a modest decline to around 68 per cent in 2011-12. Meanwhile, cargo movement on National Waterways 1, 2 and 3 exhibited a high CAGR of about 22 per cent, from 0.46 btkm in 2005-06 to 1.53 btkm in 2011-12. Waterways in the North East are potential sources to focus on; this will also facilitate establishing strategic linkages in the region.

URBAN TRANSPORT

The development of cities largely depends upon their physical, social, and institutional infrastruc-

Table 2. 22

Trends in Urban Population Concentration

CENSUS YEARS	NO. OF TOWNS BY SIZE CLASS							PERCENTAGE OF URBAN POPULATION BY SIZE CLASS						
	I	II	III	IV	V	VI		I	II	III	IV	V	VI	VI
1901	24	43	130	391	744	479		26.0	11.2	15.6	20.8	20.1	6.1	6.1
1911	23	40	135	364	707	485		27.4	10.5	16.4	19.7	19.3	6.5	6.5
1921	29	45	145	370	734	571		29.7	10.3	15.9	18.2	18.6	7.0	7.0
1931	35	56	183	434	800	509		31.2	11.6	16.8	18.0	17.1	5.2	5.2
1941	49	74	242	498	920	407		38.2	11.4	16.3	15.7	15.0	3.1	3.1
1951	76	91	327	608	1124	569		44.6	9.9	15.7	13.6	12.9	3.1	3.1
1961	102	129	437	719	711	172		51.4	11.2	16.9	12.7	6.8	0.7	0.7
1971	148	173	558	827	623	147		57.2	10.9	16.0	10.9	4.4	0.4	0.4
1981	218	270	743	1,059	758	253		60.3	11.6	14.3	9.5	3.5	0.5	0.5
1991	200	345	947	1,167	740	197		65.2	10.9	13.1	7.7	2.6	0.3	0.3
2001	293	401	1,151	1,344	888	191		68.6	9.67	12.2	6.8	2.3	0.2	0.2
2011*	495	NA	NA	NA	NA	NA		58.9	NA	NA	NA	NA	NA	NA

Class I: Greater than 1,00,000 population
Class II: 50,000 – 100,000 population
Class III: 20,000 – 50,000 population
Class IV: 10,000 – 20,000 population
Class V: 5,000 – 10,000 population
Class VI: less than 5000 population

Source: Various Census Reports.
Note: * Provisional.

ture. In this context, the importance of urban transportation is paramount. However, this has been a victim of ignorance, neglect and confusion. As far as the public transport system is concerned, dedicated city bus services operate in only a few cities.

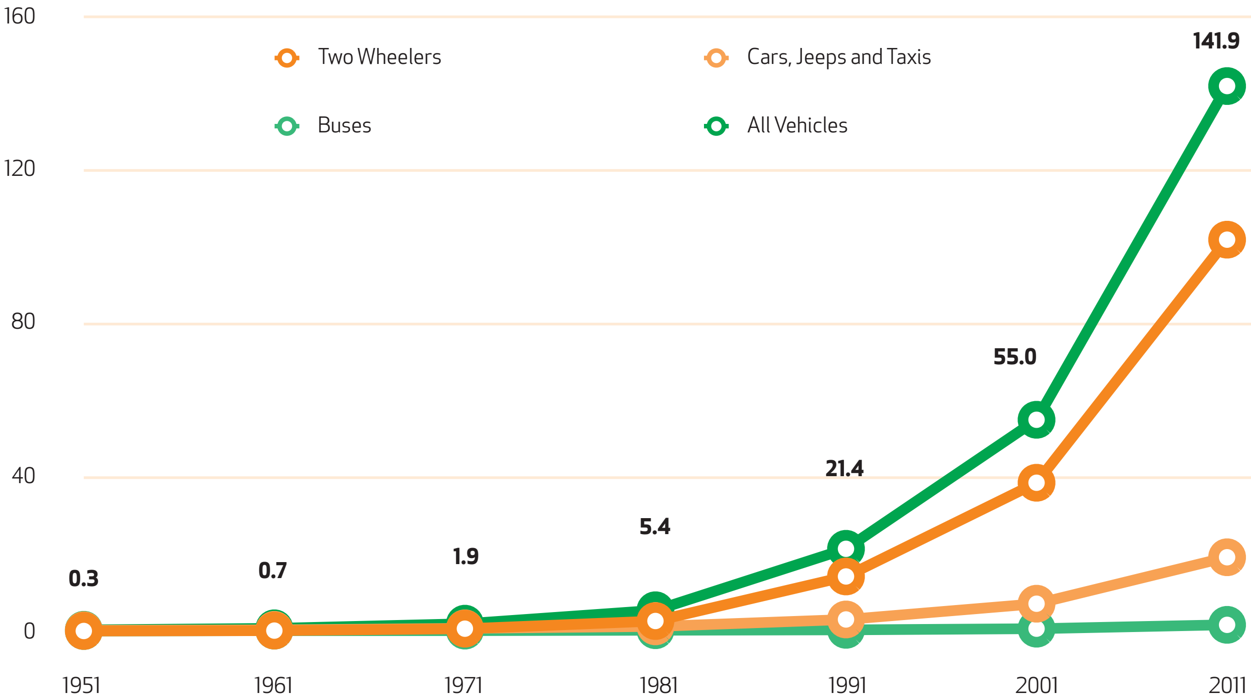
India has been slow to urbanise. As of 2011, 32 per cent of India's population is conservatively classified as 'urban'. This is much lower than in other major developing countries for example, 45 per cent in China, 54 per cent in Indonesia, 78 per cent in Mexico, and 87 per cent in Brazil. However, all these countries have much higher per capita incomes.

Still, India's urban population concentration in larger Class 1 (100,000+) and million-plus cities has been steadily increasing, leading to greater challenges in urban transport. As presented in Table 2.22, the percentage of the urban population living in Class I towns has steadily increased from 26 per cent in 1901 to 69 per cent in 2001.

According to the 2011 census, a total of 468 Class I urban agglomerations/cities are believed to constitute more than 70 per cent of the urban population. Given that the issues of urban transport and private vehicle use are essentially concentrated in larger cities, this is an important base trend for projecting urban transport requirements.

Cities have witnessed increasing usage of private vehicles because they are yet to develop adequate public transport systems to meet increased travel requirements. Since 1991, the total number of registered motor vehicles has gone up from 21.4 million to 141.8 million, a more than sixfold increase. Two-wheeler private transport has gone up from 14.2 million to 101.8 million, a rise of more than 13 times (Figure 2.22).

Figure 2. 22
Growth of Registered Vehicles In India
[Millions]



Source: Road Transport Yearbook (2009-10 and 2010-11), MoRT&H, Government of India.

Among the 53 million-plus cities as on March 31, 2011, Delhi had the largest number of registered motor vehicles (7.2 million), followed by Bengaluru (3.8 million), Chennai (3.5 million), Hyderabad (3 million) and Pune (2.1 million). The five largest cities accounted for 49.3 per cent of the total registered motor vehicles of these 53 cities. Delhi's registered motor vehicle population exceeded the combined vehicle population in Chennai, Kolkata, Lucknow and Mumbai.

Over the last decade or so, the vehicle ownership rate (number of vehicles per 1,000 people) in metropolitan cities has seen a significant rise. Five cities have rates in excess of 500 as per the Road Transport Yearbook 2009-10 and 2010-11. Nearly 28 per cent (39.7 million) of the total vehicles in the country (141.8 million), are in million-plus cities alone. In 2011, with nearly 17 million vehicles, four big cities—Delhi, Bengaluru, Chennai and Hyderabad—alone constituted 12.3 per cent. Delhi, which has around 1.4 per cent of the Indian population, accounts for nearly 5 per cent of all motor vehicles. According to the statistics provided by the Ministry of Road Transport and Highways, the annual growth rate of motor vehicle population in India has been around 10 per cent during the last decade.

Analysis of data on vehicles registered in India reveals that the share of buses has declined to 1.1 per cent of all registered vehicles in 2011 from 11.1 per cent in 1951. The decline has been particularly rapid in the last decade from 2000 to 2011, when the growth in two wheelers and cars was significantly higher across metropolitan cities. As a case in point, the number of cars in Delhi increased at an annual rate of 9 per cent whereas number of buses grew at only 1 per cent during 2000-09.

RECENT INITIATIVES

Urban transport essentially is a state and local government responsibility. Except for the national capital, and a few metro rail projects—Kolkata, Delhi, Bengaluru, Jaipur, etc.—most urban transport systems and interventions are funded and owned by state governments. National intervention in the sector has been quite recent with a particular fillip provided through the JnNURM programme launched in 2005 and the National Urban Transport Policy announced in 2006.

The JnNURM programme attempted to improve the public transport system in larger cities through funding of public transport buses, development of comprehensive city mobility plans and supporting city transport infrastructure projects. As of December 2012, 15,388 buses at a cost of more than Rs 47 billion in 64 cities had been funded under the programme. This has led cities to develop new bus services. Bus rapid transit projects have been initiated in 10 large cities. Some cities have also used central funding to improve traffic management. However, in

In general, the importance of intermodal connectivity has not influenced the development of India's transport network enough. Examples are imports lying in ports due to inadequate trucking and rail capacities, and the serious lack of 'last mile connectivity'

the medium and long term, public transport in cities will have to remain a local body responsibility and new ways to develop self-financing and sustainable public transport systems have to be developed.

KEY ISSUES

The NTDPC has been charged with identifying a set of policy strategies for developing transport infrastructure over the next 20 years. The aim is to ensure that adoption of these strategies results in infrastructure that supports the desired pace of India's economic transition, social and economic development, and other goals as articulated in greater detail in subsequent chapters. Consequently, it is useful to conclude this chapter on the historical trends in Indian transport by drawing together the lessons apparent from the manner in which infrastructure has developed in the past. Though grounded in history, most of these lessons will continue to hold major import for the future of transport in India.

Rather than address modal-specific issues that are dealt in greater detail in relevant chapters later, the focus here is on overall planning, institutional arrangements, governance and execution issues that are universally applicable across sectors, and are critical contributors to a well-functioning transport system. The record of issues and lessons drawn below is essentially an upshot of a broader and deeper analysis of what went wrong rather than right. However, with every issue stemming from multiple causes, and with complex dynamics between the issues, there is some natural and unavoidable overlap.

INTERCONNECTED, HIERARCHICAL TRANSPORT NETWORK

The existing Indian transport network is a natural consequence of the somewhat disjointed executive decision making process that has been characteristic of our transport planning approach over the years. The result is a far-from-optimal modal mix. What is desirable is an integrated network that facilitates seamless transport of passengers and freight alike, across modes, while also allowing natural mapping of freight/commodity types with appropriate modes of transport. What is needed is an efficient network with interchange points that receive short-haul smaller cargo volume from roads from the hinterland for aggregation and then provide longer-haul rail transport of vehicle loads forward to ports, industries and the like and vice versa from ports into urban centres through disaggregation. Similarly, movement of medium- and long-haul coal should necessarily be through more suitable rail rather than road. This puts things in perspective when the need to match cargo category with right transport mode is emphasised.

Clear and stable network standards reduce operational uncertainty and transaction costs, and raise the productive efficiencies of transport services deployed on the network. Similarly, networks that span various geographies—local, regional, national and international—should also be mutually coherent. It is of little use having efficient cars built for smooth roads and stringent fuel standards in a city, when they must also contend with vicious pavement and poor fuel outside city limits.

Having noted the broad existing deficiency of the Indian transport network and certain desirable traits, a greater inquiry into what has gone wrong in the evolution of India's transport system is useful. Network enhancements have been all too frequently driven by political rather than business or even social welfare considerations, resulting in haphazard and inefficient route expansion. Underused and uneconomic railway spurs in favoured political constituencies have diverted much needed resources from capacity augmentation projects on key trunk rail routes. These have often been misleadingly motivated on 'equity' rather than socio-economic basis. These are honourable and essential considerations for inclusive growth. However, a much more efficient overall transport network could have resulted if holistic planning led to universal connectivity via roads that link villages to bigger towns that are in turn are situated on economically viable railway lines.

So far, little emphasis seems to have been paid to the idea that throughput of a network is only as strong as its weaker links. Capacity augmentation has sometimes only resulted in pushing bottlenecks to elsewhere in the network. New road and rail links have been attached to existing highways and rail routes without increasing capacity on the existing trunk infrastructure. In cities, flyovers and road widening programmes result in urban highways that carry vast flows of traffic capably, but also create choked intersections where highways meet other urban roads. Moreover, encouraging fast intra-city traffic also results in safety hazards.

Perhaps the biggest example of the lack of holistic planning is seen in the volume of goods and passengers that have been wrested away from the railways by road-based alternatives. Given the better economic and environmental value proposition of the railways, this decline in market share has not been the result of direct policy action. If anything, responsibility may be assigned to policy inaction over the years, as rail capacity has not been installed fast enough to keep pace with the growing economy and its structural changes. Whereas the unprecedented policy focus towards expansion of the national highway system during the last decade was on the right track, a more holistic network approach that would consider road and rail networks concurrently would have been more helpful.

In general, the importance of intermodal connectivity has not influenced the development of India's transport network to the degree it should have. Imports languish at ports for want of adequate trucking and rail capacities to assist in their removal to the hinterland. The oft-quoted 'last mile connectivity' issue is one manifestation of this problem. And the usability of mass rapid transit systems is reduced when the walk along vehicle-friendly streets from home, office, school or shopping centre to metro station or bus stop is inconvenient, arduous or dangerous.

Conscious choices will need to be made on the priorities to be placed on investments across transport modes. This calls for some judgment on the normative modal shares desired. Any transport network strategy will have to be necessarily embedded in the planning process at all levels, so that naturally sensible plans result for prioritising allocation and spending of limited resources. The fundamental idea is synchronisation and not modal competition, as the desired end state would be an integrated system where transport modes efficiently complement one another, resulting in reduced overall cost of transport.

Fortunately for India, a significant part of the logistics network is still to be built. So the country can make up for past inadequacies and use the opportunity to shape its future transport infrastructure network to an increasingly desirable state.

BOTTOM LINE India must adopt a holistic approach in designing integrated transport networks. Hierarchical connectivity, intermodal access and fit-for-purpose network standards should be emphasised. Network expansions and capacity enhancements must be assessed for their impact on the existing network, and within and across networks. With substantial logistics infrastructure yet to be built, India can still make amends to reach a more desirable and efficient state for its transport system.

India has been creating transport infrastructure to service existing markets. As a general rule, investments have been reactionary rather than anticipatory

CAUSALITY AND TIMELINESS

It is frequently noted that the demand for transport services is 'derived' from the demand for other goods and services. The demand for food in cities creates need for trucking services to haul in grain from the hinterland. However, the derived nature of the demand for transport does not mean that the causal relationship is one-way. Causality flows the other way too: the creation of transport infrastructure and services opens up new vistas and opportunities, and creates and strengthens markets for other goods and services.

As noted at the beginning of this chapter, American railway and canal investments gave rise to entire cities and revitalised life in others. The Interstate highway network that criss-crosses America was an infrastructure idea conceived for other purposes and well before its time had come. These roads are now the pulsing arteries that knit together a vast country and effortlessly support the logistics of the world's largest economy. Closer home, the Western DFC and the piggybacking Delhi-Mumbai industrial corridor will give rise to new industrial areas, inland ports, logistics parks, and rewire the economic landscape—from agricultural to industrial—of a catchment area that is expected to extend 100 km on either side of the corridor. Similarly, the construction or improvement of a rural road can significantly change the educational, healthcare and economic opportunities available to the village's inhabitants. The ambitious PMGSY launched in 2000 to provide all-weather access to unconnected habitations in rural areas has achieved considerable success.

However, we have largely tended to see only one side of the coin, creating transport infrastructure to service existing markets, perhaps allowing for a measure of growth. As a general rule, infrastructure investment has been reactionary rather than anticipatory. Roads have been widened when existing lanes are stretched to capacity. New ports have been built when ships wait at sea for days to berth at existing ones. Mass rapid transit arrived after population and economic growth had slowed intra-city movement to a crawl. Roads receive maintenance after they are already flooded or potholed. The point here is that India's approach to transport infrastructure has been narrowly focused on fixing problems at the margin rather than on defining and executing a grand comprehensive vision for the future where transport clears and paves new routes to opportunity and prosperity.

Infrastructure should be programmed in anticipation of future demand. It is frequently easier, cheaper and faster to do so than post hoc construction that increases capacity in the margins. Maintenance should be pre-emptive, not rehabilitative, and the system capable of dynamic responses to changing situations

Causality's cousin is timeliness. It is true that India has devoted less effort than it should have to maintenance relative to new construction. Rehabilitation requires far more substantial financial resources than preventive measures do. Importantly, preventive maintenance also imposes lower indirect and opportunity costs since the citizenry and government are less likely to have to contend with catastrophic failure, or with the decommissioning of important links in the network for lengthy periods of time.

It is not just maintenance that benefits from timely action. Anticipatory construction can often be easier, cheaper and faster to accomplish than the reactive kind. If it is known with reasonable certitude that an Indian city will grow rapidly over the next generation, action to plan appropriate urban transport options should be taken well in advance. By forming a cornerstone element of a city's master development plan, attempts can be made to match pro-active plans for transport infrastructure consistent with planned land use. In contrast, the reactive Indian method forces new transport infrastructure to conform to sub-optimal alignments, demands the deployment of expensive tools to avoid inconveniencing or displacing people, and requires costly programmes to re-engineer existing ill-planned land use.

Of course, it is essential to acknowledge the dangers of excessive stargazing. In the absence of market signals, governments are notoriously bad at ultra-long-range planning exercises. There are no guarantees that pre-emptive construction of transport infrastructure will actually lead to a subsequent boom in economic activity, or that the anticipated motivating factors will actually materialise. There are several examples of infrastructure white elephants around the world that attest to this. Building it and hoping that they will come is also a recipe for unproductive and wasteful over-investment, as has been the Chinese experience in certain areas. Fixed infrastructure, once created, is essentially irreversible and can lock cities and countries into unsuitable or undesired growth straitjackets. Finally, it is almost certain that today's technologies will be superseded by better options and that hindsight will prove today's choices to be less than optimal.

However, these caveats should not serve to circumscribe or abandon the advance planning process. Instead, when set against the advantages noted above, they highlight the inherent difficulties of long-range planning, and underscore the importance of building human capital and institutions that can appropriately account for these pitfalls when devising long-term anticipatory transport infrastructure plans. It is essential to build into the planning process choices that need to be made as conditions change in the future.

BOTTOM LINE Both sides of the causality between demands for transport and for other goods and services should be considered in making the case for new infrastructure spending. Infrastructure should be programmed in anticipation of future demand. It is frequently easier, cheaper and faster to do this than post hoc construction that increases capacity at the margin. Once created, maintenance should be regular, timely and pre-emptive, rather than rehabilitative and this should become an integral part of the asset management system of each mode of transport. Allowance should also be made for allowing dynamic responses to changing situations.

REBALANCING AND CAPACITY

As mentioned before, certain issues which might otherwise need separate enunciation could still present some natural overlap with others. Rebalancing of the modal share of Indian Railways is one such conundrum that needs to be discussed along with the need for intermodal access and holistic planning. The share of railways in freight transport which forms the backbone of railway revenues (tonne km) is estimated to be about 33 per cent as against 67 per cent share of road transport. The railways' share of freight traffic is close to 50 per cent in large economies like US and China. Trunk rail routes which form just about 16 per cent of the network are dangerously oversaturated, with the bulk running at 80 per cent, and several in excess of 120 per cent of their design capacity. Other operating challenges for the railways are today typically characterised by deficient availability of rolling stock and the power to haul, mismatch between capable speeds of locomotive and the wagons, heavy terminal detention of rolling stock, and empty haulage of rakes due to scarce maintenance.

Indian Railways still has a huge throw forward of projects. The various initiatives envisaged such as for capacity augmentation, throughput enhancement, port connectivity works and upgradation of permanent way, are plagued by procedural delays; a majority of them are running behind schedule. A recent measure that allowed intensive asset utilisation through enhanced axle loading has only helped overstretch the current infrastructure, bringing into focus its long-term sustainability. Apart from difficulties arising from the current organisational structure of the railways, and political exigencies, the railways establishment has been less than agile in responding to the challenges arising from higher economic growth.

Attempts to harness private investment through Public-Private Partnership arrangements have not materialised as envisaged. Setting up of locomotive manufacturing facilities, and initiatives to recapture the road traffic such as development of multimodal parks and roll-on-roll-off facility to provide door-to-door multimodal service are in preliminary stages and yet to manifest any measurable advantage.

There is a pressing need for a strategic long-term decision in favour of investment in railways over the next 20 years for desired capacity augmentation and modernisation of the rolling stock while achieving a certain balance between the two dominant modes. Importantly, any effort for railways to reclaim their lost business share should be viewed as an attempt to enhance the productivity of the transport network itself and not as a competitive onslaught. The rebalancing should be based on closely coordinated investment decision making which should aim for a more efficient modal mix that provides for a sustainable, economical and regionally-balanced transportation system.

Infrastructure, and within it transport as a sub-category, has witnessed a high-funding priority in the last few years. Despite this, commensurate increases in the capacity of physical transport infrastructure have not yet fructified. Infrastructure is also often built for reasons other than to enhance capacity, such as to improve connectivity, for national security, nation-building, and so on. While this is important, another relevant dimension of infrastructure investment is that new transport infrastructure or capacity additions needed to meet growing demand, are often indivisible, entailing lumpy investment.

In such situations, capacity cannot be gradually increased pari passu with demand, but only in large amounts at considerable intervals. Because they are typically lumpy, these decisions to invest or otherwise can have a significant impact on the economy as opportunity loss in the short run, and in determining how the competitive environment evolves in the long run. Concurrently, mistakes in the form of overly aggressive or poorly sequenced capacity additions can result in excess capacity resulting in irreversible sunk investment as well as opportunity cost to the public exchequer.

At the present time, significant capacity constraints exist across sectors. The processing of cargo at India's ports is amongst the slowest in the world. The grim situation in the railways has already been discussed. Notwithstanding the NHDP-sponsored improvements in highway infrastructure, a truck travelling the 1,400 km between Delhi and Mumbai spends four days on the road, at an average operational speed of under 30 kmph. However, private participation in several major metro airports has dramatically improved aviation capacity.

The situation is less clear-cut with respect to urban transport. Capacity limitations vary from city to city, and from one transport mode to another. The absence of good data is also a problem. Rising car ownership and declining rates of walking and cycling have placed severe pressure on urban roads. Municipal bus services are often in short supply or entirely missing from urban areas where they are much needed. Private shared taxis, vans and other para-transit modes often effectively substitute for a more organised public transport system. This is interesting in that the capacity considerations have more to do with operational and service delivery issues rather than with the underlying physical infrastructure. For example, expensive investment in mass rapid transit projects in the larger cities is often made without adequate examination of much cheaper alternatives.

> Cargo processing at India's ports is among the slowest in the world. The situation in the railways is grim. A truck travelling 1,400 km between Delhi and Mumbai, spends four days on the road, at an average operational speed of 30 kmph

The immediate consequence of constrained capacity is delay. This translates into strangled economic activity, attended by pointless congestion and environmental pollution. Capacity shortages can also be self-reinforcing, and costly in themselves. Over-used fixed infrastructure is more prone to wear and tear, requires more diligent maintenance, and more frequent rehabilitation. These activities can intermittently remove some pieces of infrastructure from service, exacerbating the capacity problem.

Despite the recent government focus on transport investment, there is a disconnect between the funding applied and capacity improvements achieved. Easy answers may lie in the observation that execution has been wanting, with funding leakages, tardy construction, quality compromises and missed maintenance. There is undoubtedly some truth to each of these, but they explain only a part of the disconnect. The bigger and more direct answer lies with the fact that capacity augmentation, particularly where it was needed, has not received the needed investment. Whatever additions to infrastructure took place essentially helped increase the

Railways, though a more reliable and energy-efficient mode, have been losing out to roads for long want of capacity augmentation. Investment focus has largely been on new and sometimes unhelpful infrastructure creation

transport footprint, not necessarily resulting in capacity improvement.

The capacity of a transport network is the product of three factors: the installed physical infrastructure itself; the intensity of use of the infrastructure; and the topology or 'shape' of the network in the context of the demographic, economic and physical geography of the nation. The first item on the list is uncomplicated: more is better. However, the kind of 'more' that is installed is important. Track-kilometres can boost rail network capacity more than route-kilometres, as can lane additions when compared with new roads.

Intensity of use increases with operating, commissioning or permitting a higher frequency or speed of transport service on the fixed infrastructure, and from improvements in technology or operational management. For example, there has been only around 20 per cent growth in rail route kilometres over the past 60 years, to which we can add a significant amount of track doubling. With gauge standardisation, more trains, longer and heavier ones, and better signalling and scheduling, passenger and freight traffic has increased 1,400 and 1,300 per cent respectively over the same period. (But even this increase has not been enough to stem the slide of traffic mode share to road-based alternatives.) Similarly, the port sector has been able to achieve higher cargo throughputs both by building new infrastructure, and by achieving higher throughputs per berth-hour. On both fronts, however, there is substantial room for improvement.

Institutional factors also influence the intensity of use of physical infrastructure. Slow customs clearances can dramatically decrease capacity at ports. Internal borders can be just as unforgiving as international ones. By some estimates, the languid four-day sojourn of the Delhi-Mumbai truck is because considerable time is spent at inter-state borders having cargo inspected, permits verified, papers stamped and taxes collected.

Finally, the capacity of a network is contingent on the capacities of all the individual links and nodes within the network to process passengers and freight. For example, the capacity of an air link depends on the throughput of airports at both ends of the link. The capacity of a highway system is derived both from the trunk routes on the network, as well as the efficiency of junctions and bridges, and the capacity of feeder roads. And from the inter-modal network perspective, the capacity of shipping infrastructure also depends on rail and road links.

This is not to say that the capacities of all links and nodes within a network are equally important. Clearly, capacities on trunk routes are more meaningful for overall network capacity. Second, the gross capacity of a network is not concomitant with its size. The major lesson from this reasoning is that not enough funding and effort has been devoted to those critical pieces of infrastructure—such as trunk routes, junctions and intermodal nodes—that have maximal impact on capacity.

BOTTOM LINE India's transport networks are severely constrained for capacity. Railways in particular, despite being a more reliable and energy-efficient mode, have been losing out to roads for long want of capacity augmentation at various fronts. Increased funding has not translated into commensurate increases in the capacity of physical transport infrastructure, essentially due to greater investment focus on new and sometimes unhelpful infrastructure creation rather than on capacity augmentation.

FUNDING

Transport conforms to the classic characteristics of a public good to a large degree. Subject to capacity, it is non-rivalrous. On the flip side, positive consumption externalities mean that, conditional on a (usually subsidised) price, it is Pareto-inefficient to exclude any would-be consumers even if it is possible to do so. It naturally follows that government spending has historically accounted for the bulk of investment in transport.

ROADS

At the simplest level, roads provide basic accessibility to the rest of the world. No other piece of transport infrastructure can replace the street outside one's home. Consequently, it is sensible that sources for road funding are principally commitments from gross budgetary outlays, though these may stem from earmarked revenue streams, taxes and cesses, dedicated road funds, or special development programmes such as the PMGSY. The desirability of universal accessibility on developmental and nation-building grounds motivates budgetary funding for roads as a redistributive tool. However, to a significant degree, the benefits from road use accrue to private agents, be it from the transport of goods to market or the movement of people for work or leisure. As such, after accounting for all positive consumption externalities, this offers good economic support for more direct funding of road infrastructure from fuel taxes, vehicle registration fees, and the like.

AVIATION

Small numbers of people and quantities of valuable freight can be whisked across the world rapidly via air. Aviation has long featured a user-pays model. Passenger, fuel, service and luxury taxes are used to pay for the lion's share of fixed infrastructure and ancillary services like air navigation. In an increasingly globalised economy, however, spillover benefits from better air links with the rest of the world, and the importance of aviation in connecting remote locations both constitute excellent rationale for greater funding from the public purse.

PORTS

Finance for port infrastructure for Major Ports is essentially from their internal resources and user charges, though some budgetary support from the government helps in creating essential common infrastructure. In recent years, in the case of minor ports that are directly under the state governments, the infrastructure has been largely funded by the private sector. Though India has a long coastline, it has relatively few suitable natural harbours. The scarcity of options and the critical importance of ports in an increasingly globalised world indicate that future investment in ports requires a strategic approach that better accounts for the corresponding investment required for efficient hinterland connectivity. A progressive shift to the landlord model of port governance would help induce greater private capital, but significant investments, particularly in common infrastructure such as drafts and hinterland connectivity, will have to continue to be funded through public resources.

URBAN TRANSPORT

Urban transport suffers from having too many and too few parents. Barring central funding under a few dedicated schemes such as JnNURM, urban transport is largely a state prerogative, and is funded from state budgets and farebox collections that are not always earmarked. Some states have devolved responsibilities to local authorities; others generate master plans for all urban areas in state capitals. The lack of clear funding lines, and matched spending and revenue authorities, leaves some aspects of urban transport entirely neglected and others subject to unnecessary duplication.

RAILWAYS

The overwhelming historical dominance of the railways in fiscal affairs led to the unique distinction of the railways' financial statements being presented separately from those of the general government. This is an idea of the past. Railway plans have, since the late 1950s, been essentially financed by a mix of internal and gross budgetary resources, with GBS consistently growing from 34 per cent during the 1st Plan (1957-62) to 75 per cent by the 5th Plan, as share of internal resources declined proportionately. Beyond the 5th Plan, the financing pattern reversed, with greater allocation through internal resources, reaching close to 60 per cent by the 8th Plan, while market borrowings additionally contributed about 18 per cent. Since the 9th Plan, the GBS in railway Plan funding has again grown to dominate, as internal resources struggle to meet mounting operating expenses, a trend which needs to be reversed. The generation of internal resources is today seriously affected by the limitation of railways to rationalise fares and freights due to political constraints.

> India has allowed private participation in transport, sometimes even inviting full private funding. However, areas like the tendering process, land acquisition, project monitoring and service pricing need strengthening

Modern rail budgets further cloud matters. Important strategies for modernising the railways, such as statements of action on expanding capacity and skilling staff are lost amidst the detail of the announcements on new trains, stations and routes. The separate budget presents a curious situation. On the one hand, it is subject to extreme visibility and scrutiny. On the other, little or no progress has been achieved towards modernising the accounts to present a true picture of the multitude of subsidies that riddle the system, and the operational investment criteria. It has become difficult to compare spending on the railways with other government priorities, much less with funding for other transport modes.

The popular romantic view of the railways in India is that rail is somehow 'different'. The vast network is accessible physically and financially by nearly everyone and constitutes democracy itself. From this lens, Indian Railways is a nation-building social service that should not be held accountable to business criteria. This is fallacious. As things stand, the railways' funding model of cross-subsiding passenger fares from freight revenue is not sustainable. It has led to the steady erosion of freight traffic share to the roads, at substantial environmental cost. Shaky finances have left little for sustained programmes of capacity or safety enhancements, or improvements in service delivery, at substantial social cost.

THE LESSONS

While transport infrastructure should remain a priority for public finances, there is as much a need for boosting private investment to fill the gap. There has always been tension between the private and public funding of infrastructure projects. Indeed, new transport networks that initially accompanied the industrialisation process around the world were often a product of private enterprise. Private companies built much of the first railway, canal and urban transport networks around the world, including in India. However, many private infrastructure projects often had to be later bailed out by governments later.

For most of the 20th century, much of the transport infrastructure around the world was built in the public sector. However, beginning in the 1980s and 1990s, there was a new trend towards private investment in infrastructure. In the economic liberalisation of the past two decades, India has followed this trend and allowed private participation in air and maritime ports, and roads that are made 'private' through price excludability. Attempts are even being made to invite full private funding for mass rapid transit projects. However, there are areas such as the tendering process, land acquisition, project monitoring and service delivery pricing, that need further strengthening.

Better attempts must be made at establishing the true nature and extent of transport externalities, and the relative incidence of cost and benefit. Importantly, pricing of services must be depoliticised and set by independent regulatory authorities

Further, for most of the period in question in India, the government has been involved in service delivery. Strong economic arguments exist for the government to provide the underlying infrastructure network, but less for the public sector to be involved in the operation of transport services.

Free from competitive forces or the discipline of market pricing, public sector-supplied transport services have often been inefficient and wasteful. Natural price discovery through healthy market competition is typically known to result in greater operational efficiencies and improved service delivery, and this needs to be encouraged. At absolute levels, perhaps the most that can be said is that the private sector's resources must be harnessed even more than they have.

The big lesson to draw from the snapshots of funding models presented for each mode is that the sourcing of public funds can be improved substantially to provide a better match between incidence of costs and benefits. Conditional on externalities and redistributive goals, matching cost and benefit is a sound economic principle in ensuring that the price, quantity, and quality of infrastructure are optimised.

BOTTOM LINE Differential characteristics of the various transport modes warrant different funding models. Opportunities for improving the source of public funding exist for all modes, to better match costs and benefits for economic efficiency. Problems are especially rife in how the railways are funded. While retaining the role for the government in infrastructure funding, there is a logical need for stepping up private investment to both fill the investment gap and also allow increased flow of public investment in perhaps commercially unviable but economically and socially important investment decisions.

PRICING

The market for transport services is characterised by externalities, natural monopolies, bi-directional causality with the wider economy, and a necessary role for government as investor and regulator. 'Correct' pricing in the context of these market failures is difficult. Yet, given transport's large, unique, and both direct and indirect roles in the economy, setting good pricing policy is of the utmost importance. Good pricing is simple, clear, prevents market distortions, guides consumption and investment decisions appropriately, and is sustainable over the long run.

A complex web of subsidies, tariffs and taxation policies applies to transport in India. Adjusting the pricing of transportation is a standard tool for redistribution policy. Fuel is subsidised, ostensibly for agricultural relief, but has many unintended beneficiaries. More vehicle-kilometres are driven than they would be if fuel was priced at market. Demand has skyrocketed for diesel vehicles, with severe environmental implications, given the generally high-sulphur diesel fuel available in India.

Worse, the method and practice of setting the subsidy has become so beset by politics, that required adjustments are delayed until the fiscal implications become untenable, at which point they are made in large jumps, causing more pain at the pump as consumers struggle to adjust to hugely increased fuel outlays. Meanwhile, vehicle registration and parking fees are disconnected from the economic value of public resources that are used up. Freight tariffs cross-subsidise rail passenger fares, distorting both markets. Fare subsidies are available to a bewildering variety of passengers. Besides the child, senior citizen and military concessions found elsewhere, discounted rail travel is available to poor people, exam-takers, doctors and mountaineers.

Economic theory proposes that optimal economic efficiency occurs when costs and benefits are aligned and consequently considers cross-subsidisation to be a symptom of economic inefficiency that should be avoided. Such rate setting is accepted out of the belief that the social benefits created by such subsidisation outweigh the resulting economic inefficiency. Therefore, one cannot logically claim that cross-subsidies are uniformly good or bad. They are introduced to achieve certain economic, social and political ends. The argument against the application of a particular cross-subsidy is not an opposition to cross-subsidy per se, but rather on the judgment about the worthiness of those socio-political goals.

Taxes on aviation fuel and services are only loosely tied to economic fundamentals or any market characteristics that they are intended to correct. Indeed, aviation is taxed so highly that taxes and government charges comprise the major share of an airfare.

It is apparent that despite the important allocative role that prices play in transport markets, they are highly managed by government and are not informative for making market decisions. Better attempts must be made at establishing the true nature and extent of transport externalities, the relative incidence of cost and benefit, and how these fit in with the government's wider agenda. This understanding will result in sound economic reasoning for setting prices at particular levels. Importantly, pricing must be depoliticised and set by independent regulatory authorities. They should also be responsive to changing economic fundamentals in a timely fashion to minimise adjustment costs.

Beyond these basic changes, there is much room for pricing reform. Just as with airfares, dynamic pricing based on the time and date of travel and other market conditions could be suitable for the railways. Similar logic applies to higher pricing for car parking during busier times of the day. International experience suggests that the take-up of public transport is greatly enhanced when different transport modes within a city subscribe to a shared pricing structure and fare collection method. Further, consideration should be given to innovative pricing regimes such as congestion charges, even if these are not deemed immediately suitable for India.

BOTTOM LINE A complex web of subsidies, tariffs and taxation policies applies to transport in India. This results in distorted pricing that does not serve as an efficient allocative signal, and creates opportunities for wasteful leakages and rent-seeking. More sophisticated and less distortionary pricing can result in a powerful tool in the government's armoury to shape transport markets.

URBAN TRANSPORT

Urban transport in India presents a significant challenge as India's urban population will continue to grow in the foreseeable future, as will the number of large cities. Since independence, a slow, steady urbanisation of India's population has taken place. Hundreds of villages have become market towns and centres of agricultural commerce for their hinterlands. Several small towns of the 1950s and 1960s have become large enough to qualify as prosperous cities in their own right. Meanwhile, the great metropolitan cities of yesteryear have become greater yet: vast urban conurbations, usually spanning multiple municipal or state jurisdictions.

> In urban transport, we need a clear framework of supply-side measures and an equally important demand-side gradual approach of progressively introducing restraints on personalised modes of transport, while strengthening public transport

At 62 million people, India's urban population was around 17 per cent of the total in 1951. Growing at about 2.7 per cent each year—a full percentage point faster than the rural population—the share of urban population is now just over 30 per cent, at 380 million. In 1951, there were 76 cities with a population exceeding 100,000 and only five large enough to be home to more than one million people. By 2011, 53 cities had a population larger than a million. Urban travel requirements have escalated significantly, leading to rapid rise in private vehicle ownership, given the inadequate development of public transport. Over the last decade, the vehicle ownership rate in metropolitan cities has grown by over 100 per cent.

While gauging the magnitude of the growing urban populace that needs to be served for its specific urban transport requirement is important, it is more worthy from a policy standpoint to build an overarching philosophy that guides a practical and sensible direction of urban transport development that is sustainable, rather than purely advocating arbitrary capacity creation or widespread pursuit of popular, yet not always effective urban transport projects. In this context, a policy framework that suggests better utilisation and maintenance of the existing urban infrastructure, building on current strengths, and regulation enforcement is needed.

Walking as a natural and effective commuting habit needs to be encouraged through safer and convenient walkways, particularly around congested hotspots. Most modern cities of the world are great walking cities. A clear framework of supply side policy measures—such as one-way traffic system, infrastructure improvement, repair of footpaths and roads, reliable public transport and passenger information system—on one hand, and equally importantly, a demand side gradualist approach of progressively introducing restraints on private modes and inefficient road use through organised feeder services, congestion pricing, parking fee, fuel tax and so on, on the other hand, are desirable.

Most cities have not adequately catered to or fully absorbed the consequences of the surge in their size and population. In briefly recounting the litany of issues that blight our cities, and the resultant impact

India's unique and dated system of institutional governance has resulted in a transport sector that favours silo decisions with litle intermodal coordination, beset by unclear responsibilities, politicisation of investment and weak accountability.

on transport, it is useful to begin at the top of the pyramid with the absence of planned growth. Indian cities have lacked modern planning systems that make vital choices about where people of all incomes live, work and spend their leisure time. Planning is necessary to help link land use with urban flows.

A point that perhaps demands greater emphasis is the need to make better informed decisions while fostering specific public transport options so as to enable judicious use of limited resources. Provision of metros and other rail-based transit systems typically cost much higher as compared to other modes such as city bus/bus rapid transit system, and the current emphasis on it appears rather excessive. As a comparison, a total expenditure of about Rs 43 billion was budgeted for procurement of buses under the JnNURM in the 11th Plan, while a single Delhi airport metro line cost about Rs 57 billion. A careful analysis is needed for efficient resource allocation.

BOTTOM LINE A clear framework of supply side measures and equally important demand side gradual approach of progressively introducing restraints on personalised modes of transport, while strengthening public transport, is needed to meet the demands of the burgeoning urban population. It is however essential to make rational and customised decisions when choice for investment in one form of public transport system vis-à-vis another is considered, as opposed to 'one size fits all' kind of widespread replication of a particular model.

GOVERNANCE AND INSTITUTIONS

We should examine how existing governance structures have failed to yield the desired 'network of networks': one that is extensive, robust, economically viable in the first instance, and offers seamless intermodal and hierarchical connectivity.

India's transport networks are governed by a multitude of institutions at all levels. There is a preference for the now internationally rare model of mode-based governance. At the central level, separate government ministries hold decision authority over separate transport modes. Within the purview of these ministries, there is a non-standardised delineation of responsibilities over various functional areas, such as investment, regulation, operations, maintenance and so on. Independent decision making at these mode-based ministries and then across the various functional areas results in uncoordinated policy, replication, inefficiencies and waste. The blurring of administrative lines under the multitude of authorities makes accountability exceptionally difficult.

State-level institutional authority primarily extends to roads that are not national highways, minor ports and urban transport. Given the close links essential between urban transport, land use regulations, and city planning and development, it is in this sphere that the absence of strong and clear institutional authority is most keenly felt. For example, there is duplication of municipal bus services in many cities where several agencies have operational mandates from various authorities. Urban and rural roads and other infrastructure are often constructed and maintained under any number of authorities to varying standards, sometimes within the same municipal or local area. Wide variations in institutional arrangements, and subsequently in policies, from state to state, impose large and unnecessary transaction costs. Incomplete execution of central policy at the state level creates uncertainty and has similar effects.

At all levels, institutions that make investments in transport infrastructure, or monitor and regulate transport services, are vulnerable to the politicisation of their budgets and agendas. Conflicts of interest result when an institution is both regulator and service operator in a competitive environment. This further contributes to lower levels of private investment. In other instances, multiple overlapping regulatory authorities create both compliance uncertainty and opportunities for gaming the regulatory system.

BOTTOM LINE India's unique and dated system of institutional governance has resulted in a transport system that favours silo decisions, with the result that there is little intermodal coordination, and a system that is beset by unclear responsibilities, politicisation of investment, and weak accountability. The overall outcomes are characterised by inefficiency and waste.

SKILLS AND HUMAN RESOURCES

To develop a transport network commensurate with India's economic aspirations, three enabling factors must be in place: funding, institutions, and professionals with the necessary skills to staff these institutions. Indeed, the depth and variety of human resources is perhaps the single biggest limiting factor in delivering a transport system that is well-designed, efficient, safe, environmentally-friendly, harmonised with land use, economically sensible and financially viable. India urgently requires people adept at the following with respect to infrastructure development: planning, project identification and development, efficient and transparent contract procurement, administration, and operation and management.

There is an enormous shortage of skilled transport professionals at all levels, and across all disciplines and all institutions, including academia, government and construction. Shortages at the academic level are self-reinforcing. There are few courses, degrees and higher education institutes with a dedicated focus on transport planning, and on various aspects of related infrastructure delivery. As a result, there are few graduates who have the necessary skills to become research professionals and academics.

In government, most jobs relating to transport are staffed by a mix of rotating civil service officials, rather than by transport professionals who can have the opportunities to acquire the deep experience necessary to make decisions and implement plans over the long term. More jobs in government with defined career advancement will dramatically increase the popularity of transport-related higher education. Finally, construction skills are sorely lacking and many private contractors must rely on unskilled labour, the net result being with slow, inefficient and unsafe construction.
Amongst the major recommendations of this committee is that the severe shortage of skilled transport professionals must be addressed forthwith. Moreover, it will be essential for these professionals to acquire the expertise necessary to plan and engineer increasingly complex infrastructure. A common pitfall of expertise is, however, an inability to engage constructively with specialists in other fields. This is the case today when there is little inter-agency cooperation, knowledge sharing, data dissemination, and joint planning that is so essential in developing a complete transport system. Consequently, the cadre of experts must also be capable of taking a holistic view on transport infrastructure, and new institutional decision frameworks must be developed to aid inter-agency cooperation and action

With this background, the implications for an integrated transport policy is to address critical questions on capacity augmentation and the types and magnitudes of transport investments required to support rapid economic growth. The policy also needs to focus on suggesting growth directions and building the institutional and informational foundations that will help in meeting specific challenges as they emerge over time. This is particularly important as transport investments typically have long lives of 25 to 100 years.

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ANNEX

PROFILE OF TRANSPORT SECTOR								
ITEMS	**UNIT**	**1950-51**	**1960-61**	**1970-71**	**1980-81**	**1990-91**	**2000-01**	**2010-11**
RAILWAYS								
Route Length	Km	53,596	56,247	59,790	61,240	62,367	63,028	64,460
Electrified Route Length	Km	388	748	3,706	5,345	9,968	14,856	19,607
Throughput								
Freight Traffic (Total)	M. Tonnes	93	156	197	220	341	504	926
Net Tonne (Kms)	BT Km	44	88	127	159	243	316	627
Passengers Originating	Million	1,284	1,594	2,431	3,613	3,858	4,833	7,651
Passenger Kms	Million	66,517	77,665	118,120	208,558	296,544	457,022	978,508
Average Lead: Passenger Lead	Km	52	49	49	58	77	95	128
Average Lead: All Goods Traffic	Km	470	561	648	720	711	626	676
ROADS								
Total	000 Km	400	525	915	1,485	2,350	3,373	4,690
Of Which National Highways	000 Km	22	24	24	32	34	58	71
Percentage of Village with 1000+ Population Connected with All Weather Roads	Percent	32	36	40	46	73	90	95
Overall Village Connectivity	Percent	20	22	25	28	44	54	68
Surface Length	000 Km	156	234	398	684	1,113	1,573	2,524
ROAD TRANSPORT								
No. of Goods Vehicles	In '000	82	168	343	554	1,356	2,948	
No. of Passenger Buses	In '000	34	57	94	162	331	634	
MAJOR PORTS								
Traffic Handled	M. Tonnes	NA	NA	7	7	11	87	315
CIVIL AVIATION								
Total Fleet Strength								

Air India		NA	13	10	17	24	28	0
Indian Airlines		NA	88	73	4 9	56	42	0
NACIL								106
Private Airlines		NA	NA	NA	NA	NA	37	234
Number of Passengers Carried								
Air India	Million	NA	0.1	0.5	1.4	2.2	3.3	0
Indian Airlines		NA	0.8	2.1	5.4	7.9	6.0	0
NACIL								12.8
Passengers Handled at								
AAI Airports	Million	NA	NA	NA	10.7	17.7		59.6
Joint Venture International Airports		NA						83.8
Total at Indian Airports								143.4
Cargo handled at								
AAI Airports		NA	NA	NA	179	377		727
Joint Venture International Airports	'000 Tonnes							1,622
Total at Indian Airports								2,348
Revenue Tonne Kms	Million							
Air India		NA	NA	275	980	1,381	1,501	0
Indian Airlines		NA	83	161	420	669	775	0
NACIL								3,677
No. of Airports and Civil Enclaves	Numbers	NA	NA	NA	84	117		126
INLAND WATER TRANSPORT								
Length of Navigable Waterways	Km	14,544	14,544	14,544	14,544	14,544	14,544	14,544

3. MACROECONOMIC GROWTH BACKDROP: TRANSPORT INVESTMENT REQUIREMENTS 2012-2032


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3. MACROECONOMIC GROWTH BACKDROP: TRANSPORT INVESTMENT REQUIREMENTS 2012-2032

India reached a per capita GDP of Rs 75,000 ($1,550) and overall GDP of Rs 90 trillion ($1.9 trillion) in 2011-12, the terminal year of the 12th Five Year Plan. It took 60 years (at constant 2004-05 prices) to move from a per capita GDP of about Rs 8,200 in 1950-51 to about Rs 47,000 in 2011-12, and during this period, GDP grew by a factor of almost 20 from less than Rs 3 trillion to Rs 56 trillion.

If we double per capita GDP in each of the next two decades at an average growth rate of 7 per cent per year, India will move from the current per capita GDP of $1,550 to about $6,000 by 2031-32 (at 2011-12 prices); and GDP will increase from $1.9 trillion to $8.7 trillion (at 2011-12 prices). Thus, even if India grows at a growth rate in excess of 8 per cent per year over the next 20 years, India's GDP will be just over a half of the current US GDP of $16 trillion and per capita GDP will be only about 12 per cent of current US per capita GDP of $50,000. Apart from the challenge of achieving such a sustained growth rate over a long period, the pace of change in actual level of GDP will be of an order of magnitude different from our historical experience, and even of our more recent experience over the last couple of decades. With such an increase expected in GDP, the demand for transport services, from both passengers and freight, will grow commensurately. Thus, the task of making investments in transport also poses challenges that are vastly greater than anything experienced in the past.

Whereas this report is largely devoted to a consideration of policies that will be needed to facilitate the transport investment necessary for achieving consistent economic growth of such an order, it is important to also derive the corresponding broad orders of magnitude of the required investments. The challenge is to arrive at estimates of such investments that are adequate to achieve the aspirations for high growth, but which are also consistent with the expected and feasible movement of overall macroeconomic magnitudes. It is important to keep in mind the feasible and sustainable domestic resource balances along with developments in external balances that will be needed for the availability of adequate resources for transport.

In projecting transport investment requirements, we need to arrive at numbers consistent with India's evolving macro-economic situation

As can be seen from the exercises underlying the Five Year planning process, it is difficult enough to conduct such an exercise for a projected Five Year Plan perspective: doing such an exercise with a 20-year horizon is that much more complex and heroic. Moreover, with the pace of change having accelerated, along with the volatility experienced in the global economy in recent years, making 20-year projections is even more fraught with difficulty. Second, we are also aware that global changes in both technology, and in oil and commodity prices over time, can render such long-term estimates infructuous. Third, since in previous times, most of infrastructure and transport investment was in the public sector, the task of projecting resource availability and application was simpler. Now, with the increased level of participation of the private sector, and increased commercialisation in the public sector as well, projection of both demand and supply is also likely to be more price-sensitive. Thus, estimation of likely investment is more market-related and complex, relative to need-based estimates.

Finally, our task has been rendered even more difficult with the recent slowdown in the Indian economy, along with that in the global economy. Whereas we have taken account of the current slowdown, we have continued to assume a reasonably rapid recovery in the years to come. This is based on the expectation that Government will continue to take appropriate measures in both macroeconomic and structural policies so that India can return to a high growth path. We are aware that this may seem unreal at the present time. But we make no apologies for making this assumption: if the current aspirations of people in India are not to be dashed by the current economic slowdown, there is no choice for policy makers but to respond positively to the new challenges.

We are, therefore, very cognizant of all these dangers inherent in making such long-term estimates and hence this exercise has been undertaken with a sense of humility, trepidation and realism. We have made a best practice attempt in making these projections according to the best information available at the current time. The aim is to provide information on the broad shape of things to come so that expectations of the different players, both private and public, are influenced in the desired direction. It is hoped that all the players in this exercise government, public sector entities, suppliers of funds in the capital market, private sector entities in the transport sector, foreign investors and the general public will find this exercise of interest.

This report focuses on transport. The task is to arrive at reasonable targets for transport investment, which are consistent with the expectation of increased demands for transport that have been documented in Volume III, Chapter 2. Having experienced very significant economic growth over the past couple of decades, and particularly in the last 10 years, the overall needs and aspirations of the Indian public are now very high. These aspirations are also reflected in people's expectations with respect to transport developments. We have witnessed a revolution in air travel in the country over the past decade, as also in the ownership of private vehicles. Similarly, the demand from industry for efficient transportation of goods across modes has also grown tremendously. Moreover, with constantly increasing competition in the global economy, the future competitiveness of the Indian economy will be heavily dependent on efficiency in the transport sector. Thus, any estimates that are made with respect to perceptions of increased demand for transport over the next two decades are consistently very high, and usually higher than what may be feasible from the point of view of availability of resources. In projecting transport investment requirements in this challenging environment, however, we need to arrive at investment levels that are consistent with the evolving macroeconomic situation of the country.

This is what this chapter attempts to do.

Very heavy investment will have to be made overall in infrastructure, which includes transport, if the country is to maintain a sustained and sustainable high-growth path over the next 20 years and beyond. We need to respond to the binding constraint that infrastructure has posed on growth in India. The fastest growing countries in Asia, particularly China, have consistently invested around 8-10 per cent of their GDP in infrastructure, during their high-growth period.

The experience of countries in East Asia such as Japan, South Korea, Malaysia and Taiwan also illustrates that large investments in infrastructure, along with other supportive policies, have been associated with economic growth that has outpaced other world regions. Between 1975 and 2005, East Asia's GDP increased tenfold; South Asia's GDP increased fivefold; and all other regions' economies grew by factors of between two and three[1]. To sustain high rates of economic growth, it is essential for India to strengthen its infrastructure and derived services,

1. Difference in GDP (PPP) in constant 2000 dollars between 1975 and 2005.

Table 3.1

India: Gross Domestic Product, 2000-01 to 2011-12

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Current Prices (Per cent of GDP Share)												
Gdp at Factor Cost	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Agriculture & Allied Activities	23.1	23.0	20.7	20.8	19.0	18.8	18.3	18.3	17.8	17.7	18.0	17.5
Agriculture	19.5	19.4	17.3	17.5	16.0	15.8	15.3	15.6	15.2	15.2	15.6	15.2
Industry	26.1	25.2	26.2	26.0	27.9	28.1	28.8	29.0	28.3	27.8	27.6	26.7
Mining & Quarrying	2.3	2.2	2.7	2.4	2.9	2.8	2.7	2.7	2.6	2.6	2.7	2.4
Manufacturing	15.4	14.7	14.9	14.9	15.3	15.4	16.1	16.0	15.4	15.1	14.9	14.4
Electricity, Gas & Water Supply	2.4	2.3	2.4	2.3	2.1	2.0	1.9	1.8	1.7	1.9	1.8	1.7
Construction	6.0	6.0	6.2	6.4	7.7	7.9	8.2	8.5	8.5	8.2	8.2	8.2
Services	50.8	51.8	53.0	53.2	53.0	53.1	52.9	52.7	53.9	54.5	54.4	55.7
Trade, Hotel, Transport and Communications	22.2	22.6	23.2	23.8	24.5	25.0	25.3	25.1	24.7	24.3	24.4	25.2
Railways	1.1	1.0	1.0	1.0	1.0	0.9	0.9	1.0	0.9	0.9	0.8	0.7
Transport by Other Means	5.0	5.0	5.3	5.5	5.7	5.7	5.7	5.6	5.5	5.3	5.3	5.4
Communications	1.5	1.7	1.5	1.6	1.7	1.6	1.5	1.4	1.4	1.4	1.1	0.9
Storage	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Trade and Hotels	14.6	14.9	15.4	15.6	16.1	16.7	17.1	17.1	16.9	16.5	17.2	18.0
Finance, Insurance, Real Estate & Business Services	13.8	14.6	15.2	15.3	14.7	14.5	14.8	15.1	15.9	15.8	16.0	16.6
Community, Social & Personal Services	14.8	14.6	14.6	14.2	13.8	13.5	12.8	12.5	13.3	14.5	14.0	14.0
(2004-05 Prices) (Annual Per cent Change)												
GDP at Market Prices	4.0	4.9	3.9	7.9	7.8	9.3	9.3	9.8	3.9	8.5	10.5	6.3
GDP at Factor Cost	4.3	5.5	4.0	8.1	7.0	9.5	9.6	9.3	6.7	8.6	9.3	6.2
Agriculture & Allied Activities	0.0	6.0	-6.6	9.0	0.2	5.1	4.2	5.8	0.1	0.8	7.9	3.6
Agriculture	-0.6	6.5	-8.1	10.8	0.1	5.5	4.1	6.3	-0.3	0.4	8.8	3.9
Industry	6.0	2.6	7.2	7.3	9.8	9.7	12.2	9.7	4.4	9.2	9.2	3.5
Mining & Quarrying	2.3	1.9	8.4	2.7	7.9	1.3	7.5	3.7	2.1	5.9	4.9	-0.6
Manufacturing	7.3	2.3	6.9	6.3	7.4	10.1	14.3	10.3	4.3	11.3	9.7	2.7
Electricity, Gas & Water Supply	2.2	1.8	4.7	4.6	7.9	7.1	9.3	8.3	4.6	6.2	5.2	6.5
Construction	6.1	4.0	8.3	12.4	16.3	12.8	10.3	10.8	5.3	6.7	10.2	5.6
Services	5.4	6.9	7.0	8.1	8.1	10.9	10.1	10.3	10.0	10.5	9.8	8.2
Trade, Hotel, Transport and Communications	6.4	8.6	8.5	11.1	9.7	12.0	11.6	10.9	7.5	10.4	12.3	7.0
Railways	4.1	7.0	5.6	5.9	7.3	7.5	11.1	9.8	7.7	8.8	5.9	7.5
Transport by Other Means	7.7	4.1	10.2	12.0	12.1	9.3	9.0	8.7	5.3	7.3	8.2	8.6
Communications	25.0	19.4	23.2	25.8	21.0	23.5	24.3	24.1	25.1	31.5	25.4	8.3
Storage	6.1	0.6	-6.7	5.1	13.6	4.7	10.9	3.4	14.1	19.3	2.2	9.4
Trade and Hotels	5.2	9.6	6.9	10.1	7.7	12.2	11.1	10.1	5.7	7.9	11.5	6.2
Finance, Insurance, Real Estate & Business Services	4.5	7.1	7.7	5.8	8.7	12.6	14.0	12.0	12.0	9.7	10.1	11.7
Community, Social & Personal Services	4.6	4.1	3.9	5.4	4.9	7.1	2.8	6.9	12.5	11.7	4.3	6.0

(Contd...)

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Memo Items												
Population (Million)	1,019	1,040	1,056	1,072	1,089	1,106	1,122	1,138	1,154	1,170	1,186	1,202
Current Prices (Rs Billion)												
GDP at Market Prices	21,687	23,483	25,307	28,379	32,422	36,934	42,947	49,871	56,301	64,778	77,953	89,749
GDP at Factor Cost	19,920	21,677	23,382	26,222	29,715	40,168	39,533	45,821	53,036	61,089	72,670	83,535
Constant (2004-05) Prices (Rs Billion)												
GDP at Market Prices	25,540	26,803	27,850	30,063	32,422	35,432	38,715	42,509	44,164	47,908	52,961	56,314
GDP at Factor Cost	23,428	24,721	25,707	27,778	29,715	32,531	35,644	38,966	41,587	45,161	49,370	52,436
Current Prices (US$ Billion)												
GDP at Market Prices	475	492	523	618	722	834	948	1,239	1,226	1,366	1,711	1,873
GDP at Factor Cost	436	455	483	571	661	874	873	1,139	1,155	1,288	1,595	1,743
Per Capita GDPmp (Rupees in Current Prices)	21,282	22,580	23,965	26,473	29,772	33,394	38,277	43,823	48,787	55,366	65,728	74,667
Per Capita GDPmp (Ruees in 2004-05 Prices)	5,064	25,772	26,373	28,043	29,772	32,037	34,505	37,355	38,270	40,947	44,655	46,850
Exchange Rate (Rs/US$) (Per cent Change)	5.4	4.4	1.5	-5.0	-2.2	-1.5	2.3	-11.1	14.1	3.3	-3.9	5.2
Population (Per cent Change)	1.8	2.1	1.5	1.5	1.6	1.6	1.4	1.4	1.4	1.4	1.4	1.3
Per Capita GDPmp (Current Prices, Per cent Change)	5.9	6.1	6.1	10.5	12.5	12.2	14.6	14.5	11.3	13.5	18.7	13.6
Per Capita GDPmp (2004-05 Prices, Per cent Change)	2.1	2.8	2.3	6.3	6.2	7.6	7.7	8.3	2.5	7.0	9.1	4.9

Source: Government Of India, Central Statistical Office, National Account Statistics.

such as roads and highways, energy production, telecommunications, etc. The Indian government is already engaged in providing or facilitating investment in such infrastructure from both public and private sources. The 11th Five Year Plan (2007-2012) proposed an investment of about Rs 27,750 billion (at 2011-12 prices) ($500 billion) in infrastructure sectors including electric power, roads, railways, ports, airports, telecommunications, irrigation, drinking water, sanitation, storage and warehousing, and based on currently available data, 95 per cent of projected investments are likely to have been realised (High Level Committee on Financing Infrastructure (HLCFI, 2012[2])). Going forward, the HLCFI has projected investments of about Rs 51,500 billion, (at 2011-12 prices) ($1 trillion) for the 12th Five Year Plan period (2012-17) accounting for an average investment of 9.15 per cent of GDP at market prices compared with 7.2 per cent during the 11th Plan period[3]. The key sectors are electricity, roads and bridges, telecommunications and railways, respectively accounting for 34 per cent, 18 per cent, 17 per cent, and 11 per cent of total infrastructure investment.

Thus, there is broad consensus among policy makers that infrastructure investments are important ingredients for accelerating economic growth, poverty alleviation, and environmental sustainability but these benefits accrue only when the supply of infrastructure services responds to effective demand and does so efficiently. Policy makers in India, as in many other parts of the world, are facing a major challenge to develop mechanisms for efficient and responsive delivery of infrastructure services. However, the jury is out on how much infrastructure is needed to maximise growth and how long it takes before the benefits of these investments are realised. Implementing large infrastructure programmes requires considerable resources, and identifying ways to close the gap between infrastructure needs and realistic financing options is a recurrent challenge.

2. Interim Report of the High Level Committee on Financing Infrastructure, Planning Commission, August 2012
3. These estimates are for gross investment in infrastructure and differ from the gross domestic capital formation (GDCF) concept in National Accounts. The difference in the two concepts may amount to between 1 and 1.5 per cent of GDP

This chapter addresses this issue by identifying *how much* India should be spending on infrastructure, particularly transport infrastructure, given competing needs for public spending, and in the light of fiscal constraints and macro stability objectives. The chapter also addresses how these investments will be financed and how much of financing needs can be met domestically and what would be a sustainable level of financing from external savings.

The approach taken here is fairly straightforward: relying on first principles, the analytical framework allows policy makers to think through alternative financing options. It would have been ideal to develop a general equilibrium model that explicitly incorporates public investment costs, and identify an optimal (growth maximising) level of infrastructure spending[4]. However, such an approach would have needed estimation of detailed parameters of elasticity of growth with respect to infrastructure sectors and across regions, a time and data-intensive exercise beyond the scope of this Committee's mandate.

Our analytical framework makes it possible to develop broad magnitudes of infrastructure and transport investment that are compatible with the country's prospects for economic growth over the next 20 years. Although we base the estimations on a macro-consistency framework so that the sums are kept consistent, the approach taken here is subjective in fact aspirational with the assumption that growth can take place if both macro and sectoral policy constraints are relaxed. In essence, this is a top down approach. A similar approach was adopted in the work related to the *India Infrastructure Report, 1996*.

The main objective of this approach is to place the required infrastructure investment, particularly in transport, within the broad macroeconomic context and trends. A simple macroeconomic model, RMSM-X, is used to capture the main variables such as savings, investments and sectoral outputs, giving particular attention to the balance of payments both current and capital accounts. An advantage of the RMSM-X model is that it allows the introduction of multiple economic agents in a consistent flow-of-funds framework to explore alternative policy options. The RMSM-X model relies on the fundamental accounting identity of standard national income accounts, and includes detailed information such as investment and consumption disaggregated into public and private components. In this framework, the economy can grow while ensuring adherence to the various standard macroeconomic identities.

Even though the projections provided here are point estimates, they should be interpreted as ranges in each case as the projections are mainly intended to give an idea of the broad magnitudes derived from the growth scenario modeled in this framework. A number of simulations could be analysed, but these would be difficult to discuss and present. Thus, only a preferred scenario is being discussed in this Report, which has been picked following consultations with a broad range of stakeholders in government and in the private sector.

The model is calibrated using data from the National Accounts spanning the 1980s through 2012. This makes it possible to suggest a plausible macroeconomic framework for the next two decades (spanning the 12th, 13th, 14th and 15th 5 Year Plans). By building projections on GDP growth, current account balance, and financing needs, among others, it is possible to assess the feasible magnitude of infrastructure and transport investments, which can help shape the expectations of different actors of infrastructure policy: the government, suppliers of funds in the capital market, local companies planning to invest in the infrastructure sector, foreign investors, and the general public. These estimates give an idea of the possible demand on the capital market in India in terms of equity and debt, providing pointers for capital market reforms and institutional development that would be necessary if such magnitudes of funds are to be mobilised.

> While infrastructure investments are vital for faster economic growth, poverty alleviation and environmental sustainability, these benefits accrue only when the supply responds to effective demand and does so efficiently

The broad magnitudes from this macro approach are complemented with a 'bottom up' approach aggregating the investment requirements from estimates in each sector. The focus of this approach, provided at the end of the chapter, is limited to the transport sectors. These sectoral estimates are also judgmental, based on what sectoral experts are projecting in terms of needs in each sector. They are somewhat normative since they reflect current perceptions of what should be invested to provide reasonable quality and quantity of services for satisfying the people's perceived needs.

In practice, the two approaches provide considerably different results and this chapter does not attempt to reconcile these approaches. On the other hand, the macro-model-based projections provide a sense of what is feasible in the aggregate. The bottom-up estimates are slightly in excess or comparable to the macro-consistent projections during the 12th and 13th Plans. Interestingly, however, the bottom-up esti-

4. Examples of the general equilibrium approach include Rioja (2001) for Brazil, Peru and Mexico, and Cavalcanti Ferreira and Gonçalves do Nascimento (2005) and Estache and Munoz (2007) for Senegal and Uganda

mates for the 14th and 15th Plans, from 2022 to 2032, seem to underestimate both what the investment needs may be during that period, and what may be feasible from the macro point of view. This suggests that people might find it difficult to envision numbers that are of an order of magnitude higher beyond 10 years in the future. This exercise therefore provides a degree of optimism with regard to the feasibility of improving and expanding Indian transport infrastructure over the next couple of decades. For example, rural roads are still not of a quality that makes them passable in all weather conditions. The projections in this report suggesting higher levels of feasible investments in roads than projected by our Working Group indicate that it will be feasible to upgrade significantly the quality of our road infrastructure once the basics are done in the next decade or so.

PROJECTING ECONOMIC GROWTH: 2012-2032

Given the domestic slowdown and the expectation of sluggish global economic growth in the near term, we have projected a 7 per cent annual real GDP growth for 20012-17, following which the economy is expected to grow at an average of 8.5 per cent per year till 2032

What are the prospects for India's economic growth over the next two decades? What growth targets are feasible? India has emerged as a dynamic economic power over the last three decades, recording GDP growth of about 6.3 per cent between 1980-81 and 2012-13[5]. This has been accompanied by dramatic progress in poverty reduction, with the national poverty head count ratio dropping from 45 per cent in 1993-94 to 22 per cent in 2011-12[6] . Exports of goods and services have surged from 5 per cent of GDP in 1990 to 24 per cent in 2012 and contrary to popular perceptions, ICT services accounted for just 18 per cent of total exports. Manufactured goods, constituting 87.6 per cent of merchandise exports, earned $240 billion in 2012, almost five times as much as ICT services' exports of around $52 billion[7]. The economy is also transforming structurally as the contribution of agriculture to GDP has dropped from 34 per cent to 15 per cent over the past 25 years; services have moved up from 41 per cent to 56 per cent of GDP (Tables 3. 1 and 3. 4). Much of this progress has been stimulated by the dismantling of the Licence Raj which included rescinding licensing requirements, overhauling public enterprises, scrapping quantitative import restrictions, reductions in trade tariffs and liberalisation of rules for foreign direct investment (FDI). However, growth of the manufacturing sector has, perhaps, not been as high as might have been expected.

Whereas expectations of double-digit growth rates had built up in the mid to late 2000s, these expectations have now been tempered since 2008 as the global economy slowed and so did India: The GDP growth rate dropped to 3.9 per cent in 2008-09; it picked up to 8.5 per cent and 10.5 per cent in 2009-10 and 2010-11 respectively but slipped again to 6.3 per cent in 2011-12 and 5 per cent in 2012-13 (Table 3. 1). It is quite likely that the current global economic slowdown and India's fiscal problems and other domestic factors are dragging down the economy and corrections are likely to take place in the medium term. Thus, taking into account the current domestic slowdown and the expectation that the global economy is likely to exhibit sluggish growth in the near-term, we have used a projection of 7 per cent annual real GDP growth for the 12th Plan period (2012-2017), following which the economy is expected to experience an average growth of 8.5 per centup to 2032. It is important to stress here that such growth is not possible without robust industrial growth and in fact, the government is planning to develop strategies aimed at increasing the share of manufacturing to 25 per cent of GDP[8]. We do need to note that this is not going to be easy, since manufacturing growth has fallen to less than 3 per cent during 2011-13.

These projections for GDP growth are used to project India's infrastructure requirements over the next 20 years. Such growth will not be feasible if corresponding infrastructure investments of the projected magnitude are not made. In the data given in this chapter, all economic variables are at current prices through 2011-2012 and external transactions are at the prevailing exchange rates for each year. Our projections for 2012-13 to 2031-32 are in real terms, made at constant 2012-13 prices and at a constant exchange rate of $1 = Rs 54.4 (average exchange rate in 2012-13).

ENHANCING INVESTMENT EFFICIENCY

With the economic reforms of 1991, the Indian government implemented a series of policy initiatives to deregulate and liberalise the economy to enhance competitiveness and productivity and achieve higher growth. Encouraging private and foreign participation in the economy led to higher competition, enhanced trade, provided free access to foreign investment and technology, and opened capital markets.

5. In terms of GDP/capita which bears more directly on potential welfare, GDP/capita growth rose steadily from a 10-year average of 3.2 per cent per year in the 1980s (1980-81 to 1989-90) to 3.7 per cent in the 1990s (1990-91 to 1999-2000) and 5.3 per cent in the 2000s (2000-01 to 2009-10), almost reaching the 'miracle rates' seen in East Asia before the Asian financial crisis.
6. Planning Commission (2013)
7. In 2012-13, India's exports consisted of engineering goods (22 per cent), petroleum products (14 per cent), gems and jewellery (14 per cent), chemicals (13 per cent), and textiles and other manufactures (22 per cent), making up a total of 85 per cent of all merchandise exports , establishing it as an exporter of mainly manufactures.
8. Government of India, National Manufacturing Policy, 2011

Table 3. 2

India: Gross Domestic Expenditure, 2000-01 to 2012-13

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Current Prices (Per cent of GDP)												
GDP at Market Prices	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Gross Domestic Capital Formation	23.5	25.1	24.5	25.3	32.5	34.3	35.9	38.0	35.5	36.3	37.0	35.4
Gross Fixed Capital Formation	22.8	25.1	23.8	24.6	28.7	30.3	31.3	32.9	32.3	31.7	31.7	30.6
Public	6.3	6.3	6.1	6.3	6.9	7.3	7.9	8.0	8.5	8.4	7.8	7.4
Private	16.6	18.8	17.7	18.3	21.8	23.0	23.4	24.9	23.8	23.3	24.0	23.2
Change in Stocks	0.7	-0.1	0.7	0.7	2.5	2.8	3.4	4.0	1.9	2.8	3.1	2.1
Public	0.4	0.4	-0.2	-0.1	0.5	0.6	0.4	0.8	0.9	0.8	0.6	0.5
Private	0.3	-0.4	1.0	1.0	2.0	2.2	3.0	3.2	1.0	2.0	2.5	1.6
Valuables	..	..	..	..	1.3	1.1	1.2	1.1	1.3	1.8	2.1	2.7
Exports of Goods & Services	12.8	12.4	14.0	14.7	17.6	19.3	21.1	20.4	23.6	20.0	21.9	23.9
Imports of Goods & Services	13.7	13.2	15.0	15.4	19.3	22.0	24.2	24.4	28.7	25.4	26.3	30.3
Total Consumption	77.5	77.6	75.9	73.9	70.1	69.2	68.0	67.2	68.6	69.1	67.2	68.0
Private Consumption	64.9	65.2	64.0	62.4	59.1	58.3	57.7	57.0	57.7	57.2	55.8	56.3
Government Consumption	12.6	12.4	11.9	11.4	10.9	10.9	10.3	10.3	10.9	11.9	11.4	11.6
(2004-05 Prices) (Annual Per cent Change)												
GDP at Market Prices	4.0	4.9	3.9	7.9	7.8	9.3	9.3	9.8	3.9	8.5	10.5	6.3
Gross Domestic Capital Formation	-6.7	11.5	3.0	10.5	36.2	16.3	15.3	17.2	-1.6	12.7	16.2	1.5
Gross Fixed Capital Formation	-1.4	15.3	-0.4	10.6	24.0	16.2	13.8	16.2	3.5	7.7	14.0	4.4
Public	1.9	3.6	1.3	10.8	5.1	16.4	18.3	12.5	12.0	5.6	4.9	2.5
Private	-0.8	8.9	8.7	14.7	23.5	16.1	12.4	17.4	0.8	8.4	17.2	5.0
Exports of Goods & Services	18.2	4.3	21.1	9.6	27.2	26.1	20.4	5.9	14.6	-4.7	19.7	15.3
Imports of Goods & Services	4.6	2.9	12.0	13.9	22.2	32.6	21.5	10.2	22.7	-2.1	15.8	21.5
Total Consumption	3.1	5.3	2.4	5.4	5.0	8.7	7.7	9.4	7.7	8.4	8.1	8.1
Private Consumption	3.4	6.0	2.9	5.9	5.2	8.6	8.5	9.4	7.2	7.4	8.6	8.0
Government Consumption	1.4	2.4	-0.2	2.8	4.0	8.9	3.8	9.6	10.4	13.9	5.9	8.6
ICOR	7.0	5.0	6.7	3.2	3.4	3.5	3.7	3.7	10.0	4.5	4.0	5.2
Memo Items (Deflators, 2004-05=100)												
Gross Domestic Product at Market Prices	84.9	87.6	90.9	94.4	100.0	104.2	110.9	117.3	127.5	135.2	147.2	159.4
Gross Domestic Capital Formation	83.8	86.7	88.6	93.0	100.0	103.5	109.2	114.7	123.0	128.3	135.4	147.3
Exports of Goods & Services	86.0	86.2	87.1	93.3	100.0	99.3	104.8	111.4	126.8	130.0	143.0	155.4
Imports of Goods & Services	76.3	77.4	84.5	85.3	100.0	98.0	103.2	109.7	118.4	123.5	132.7	145.0
Total Consumption	88.2	90.9	93.6	96.9	100.0	103.4	109.8	115.2	123.3	131.8	142.7	153.6

Source: Government of India, Central Statistical Office, National Account Statistics.

Table 3. 3
Key Economic Ratios (2000-2011)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
INDIA												
Gross Capital Formation (Per cent of GDP)	24.2	25.7	25.0	26.2	32.5	34.3	35.9	38.0	35.5	36.1	35.8	36.6
Gross Domestic Savings (Per cent of GDP)	22.6	24.2	23.5	24.6	30.7	31.5	32.7	34.0	30.5	30.8	31.7	31.1
GDP Growth (Annual Per cent)	4.0	4.9	3.9	7.9	7.8	9.3	9.3	9.8	3.9	8.2	9.6	6.9
Exports of Goods and Services (Per cent of GDP)	12.8	12.4	14.1	14.7	17.6	19.3	21.1	20.4	23.6	20.1	22.8	24.6
Imports of Goods and Services (Per cent of GDP)	13.7	13.3	15.0	15.4	19.3	22.0	24.2	24.5	28.7	25.5	26.9	29.9
Current Account Balance (Per cent of GDP)	-1.0	0.3	1.4	1.4	0.1	-1.2	-1.0	-0.7	-2.5	-1.9	-3.1	..
Central Government Debt, Total (Per cent of GDP)	54.3	58.2	61.6	61.2	61.5	61.2	59.1	56.5	56.1	54.5	47.3	..
External Debt Stocks (Per cent of Exports of Goods, Services and Income)	161.9	151.6	143.3	134.7	102.3	75.6	79.2	80.7	70.8	93.3	80.8	74.8
Total Debt Service (Per cent of Exports of Goods, Services and Income)	17.6	17.9	20.9	29.2	14.5	14.9	8.6	15.6	9.7	6.0	6.8	6.5
ICOR	6.8	4.9	6.6	3.2	3.3	3.5	3.7	3.7	9.9	4.4	3.9	5.5
CHINA												
Gross Capital Formation (Per cent of GDP)	35.1	36.3	37.9	41.2	43.3	42.1	43.0	41.7	44.1	48.2	48.2	48.5
Gross Domestic Savings (Per cent of GDP)	37.5	38.4	40.4	43.4	45.8	47.6	50.7	50.5	51.8	52.7	52.1	52.5
GDP Growth (Annual Per cent)	8.4	8.3	9.1	10.0	10.1	11.3	12.7	14.2	9.6	9.2	10.4	9.3
Exports of Goods and Services (Per cent of GDP)	23.3	22.6	25.1	29.6	34.0	37.1	39.1	38.4	35.0	26.7	30.6	31.4
Imports of Goods and Services (Per cent of GDP)	20.9	20.5	22.6	27.4	31.4	31.6	31.4	29.6	27.3	22.3	26.7	27.3
Current Account Balance (Per cent of GDP)	1.7	1.3	2.4	2.6	3.6	5.9	8.6	10.1	9.3	4.9	4.0	2.8
Central Government Debt, Total (Per cent of GDP)	..	..	..	..	..	..	..	..	..	..	..	..
External Debt Stocks (Per cent of Exports of Goods, Services and Income)	49.9	59.6	49.6	41.2	36.2	35.0	31.4	27.9	23.7	32.4	31.2	32.0
Total Debt Service (Per cent of Exports of Goods, Services and Income)	9.1	8.1	8.3	7.5	3.4	3.4	2.7	2.4	2.1	2.9	3.6	3.6
ICOR	4.3	4.2	4.0	3.7	3.9	3.6	3.2	2.9	4.3	4.5	4.4	5.0
KOREA, REP.												
Gross Capital Formation (Per cent of GDP)	30.6	29.2	29.2	29.9	29.9	29.7	29.6	29.4	31.2	26.3	29.5	29.5
Gross Domestic Savings (Per cent of GDP)	33.4	31.4	30.7	32.2	34.1	32.4	31.0	30.9	30.0	30.0	32.1	31.5
GDP Growth (Annual Per cent)	8.5	4.0	7.2	2.8	4.6	4.0	5.2	5.1	2.3	0.3	0.3	3.6
Exports of Goods and Services (Per cent of GDP)	38.6	35.7	33.1	35.4	40.9	39.3	39.7	41.9	53.0	49.7	52.3	56.2
Imports of Goods and Services (Per cent of GDP)	35.7	33.5	31.7	33.1	36.7	36.6	38.3	40.4	54.2	46.0	49.7	54.1
Current Account Balance (Per cent of GDP)	2.8	1.7	1.3	2.4	4.5	2.2	1.5	2.1	0.3	3.9	2.9	2.4
Central Government Debt, Total (Per cent of GDP)	..	..	..	..	..	..	..	..	..	..	..	..
External Debt Stocks (Per cent of Exports of Goods, Services and Income)	..	..	..	..	..	..	..	..	..	..	..	..
Total Debt Service (Per cent of Exports of Goods, Services and Income)	..	..	..	..	..	..	..	..	..	..	..	..
ICOR	3.5	7.7	4.1	10.5	6.4	7.4	5.5	5.6	12.2	85.5	3.8	7.0

(Contd...)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
INDONESIA												
Gross Capital Formation (Per cent of GDP)	22.3	22.5	21.4	25.6	24.1	25.1	25.4	24.9	27.8	31.0	32.6	32.8
Gross Domestic Savings (Per cent of GDP)	32.8	30.8	27.7	32.9	28.7	29.2	30.8	29.0	28.9	33.8	34.3	34.2
GDP Growth (Annual Per cent)	4.9	3.6	4.5	4.8	5.0	5.7	5.5	6.4	6.0	4.6	6.2	6.5
Exports of Goods and Services (Per cent of GDP)	41.0	39.0	32.7	30.5	32.2	34.1	31.0	29.4	29.8	24.2	24.6	26.3
Imports of Goods and Services (Per cent of GDP)	30.5	30.8	26.4	23.1	27.5	29.9	25.6	25.4	28.8	21.4	22.9	24.9
Current Account Balance (Per cent of GDP)	4.8	4.3	4.0	3.5	0.6	0.1	3.0	2.4	0.0	2.0	0.7	0.2
Central Government Debt, Total (Per cent of GDP)	..	..	32.2	29.7	56.6	47.3	39.0	35.2	33.1	28.4	26.1	..
External Debt Stocks (Per cent of Exports of Goods, Services and Income)	196.6	204.0	190.8	189.9	162.1	146.2	120.9	116.1	104.4	139.7	115.7	99.1
Total Debt Service (Per cent of Exports of Goods, Services and Income)	22.8	23.9	25.1	26.2	24.2	20.9	25.2	18.8	14.1	19.4	17.4	14.5
ICOR	4.0	6.1	5.2	4.5	4.5	4.0	4.4	3.7	3.7	5.1	3.8	3.8
MALAYSIA												
Gross Capital Formation (Per cent of GDP)	26.9	24.4	24.8	22.8	23.1	22.4	22.7	23.4	21.5	17.8	23.2	23.6
Gross Domestic Savings (Per cent of GDP)	46.1	41.8	42.0	42.5	43.4	44.3	44.5	43.3	43.8	38.1	40.3	39.5
GDP Growth (Annual Per cent)	8.9	0.5	5.4	5.8	6.8	5.3	5.6	6.3	4.8	-1.5	7.2	5.1
Exports of Goods and Services (Per cent of GDP)	119.8	110.4	108.3	106.9	115.4	112.9	112.2	106.2	99.5	91.4	93.8	91.6
Imports of Goods and Services (Per cent of GDP)	100.6	93.0	91.1	87.3	95.0	91.0	90.4	86.3	77.2	71.1	76.6	75.7
Current Account Balance (Per cent of GDP)	9.1	7.9	7.1	12.1	12.1	13.9	16.1	15.4	16.9	15.7	11.1	11.0
Central Government Debt, Total (Per cent of GDP)	..	..	43.1	45.1	45.7	42.1	40.6	40.1	39.8	50.8	51.2	..
External Debt Stocks (Per cent of Exports of Goods, Services and Income)	36.7	43.3	43.8	39.9	35.2	31.2	29.1	29.1	28.0	35.3	34.9	33.8
Total Debt Service (Per cent of Exports of Goods, Services and Income)	5.6	6.0	7.2	7.9	6.2	5.6	4.0	4.8	3.7	6.1	5.5	3.9
ICOR	2.5	51.9	4.5	4.3	3.4	4.3	3.8	3.5	4.7	-14.2	2.6	4.6
THAILAND												
Gross Capital Formation (Per cent of GDP)	22.8	24.1	23.8	25.0	26.8	31.4	28.3	26.4	29.1	21.2	25.9	26.6
Gross Domestic Savings (Per cent of GDP)	31.5	30.6	30.5	31.8	31.7	30.3	31.8	34.8	31.7	31.8	33.4	31.2
GDP Growth (Annual Per cent)	4.8	2.2	5.3	7.1	6.3	4.6	5.1	5.0	2.5	-2.3	7.8	0.1
Exports of Goods and Services (Per cent of GDP)	66.8	65.9	64.2	65.7	70.7	73.6	73.7	73.4	76.4	68.4	71.3	76.9
Imports of Goods and Services (Per cent of GDP)	58.1	59.4	57.5	58.9	65.8	74.7	70.2	65.0	73.9	57.8	63.9	72.4
Current Account Balance (Per cent of GDP)	7.6	4.4	3.7	3.4	1.7	-4.3	1.1	6.4	0.8	8.3	4.1	..
Central Government Debt, Total (Per cent of GDP)	..	..	..	28.9	26.1	27.3	26.1	24.5	24.0	28.6	28.8	30.2
External Debt Stocks (Per cent of Exports of Goods, Services and Income)	92.8	84.1	70.1	52.7	42.3	35.3	29.5	24.3	23.4	32.9	34.4	29.1
Total Debt Service (Per cent of Exports of Goods, Services and Income)	16.3	25.4	23.2	15.7	11.1	13.8	9.5	11.9	7.8	6.5	4.7	3.8
ICOR	4.5	10.5	4.3	3.2	3.9	5.6	5.5	5.1	9.9	-11.2	2.6	..

Source: The World Bank, World Development Indicators.

While the ensuing capital accumulation expanded the magnitude of resources available to the Indian economy, these reforms, if effective, should also have enhanced the efficiency of resource utilisation. Has this taken place?

Consider here the incremental capital output ratio (ICOR) as a measure of resource utilisation reflecting the extent to which additional investments translate into output. In the 1980s, the average level of domestic investment (or gross capital formation) was in the region of 23 to 24 per cent of GDP. This was accompanied by an average rate of GDP growth of 5 to 5.5 per cent, resulting in an ICOR of around 4.2. Gross capital formation picked up in the 1990s and beyond, increasing from 23 per cent of GDP in 1994-95 to 35.5 per cent in 2011-12, with a peak of 38 per cent in 2007-08 (Table 3.2). Such levels of gross capital formation (gross domestic investment) of more than 30 per cent of GDP were also observed during the high growth years of other Asian countries, and as such, these numbers for India portend well for its medium and long-run growth prospects. The overall ICOR for the economy dropped to around 3.6 between 2003 and 2007, albeit preceded by some rather high ICORs (around 6) in the early part of the previous decade. Reflecting the current growth slowdown, the ICOR has slipped again. International experience suggests that ICORs around 3.5 reflect 'good practice' efficiency levels, as seen in China and South Korea (Republic of Korea) during periods of rapid industrial expansion and urbanisation. In China, the ICOR fell from 5.0 in the 1970s to 4.3 through the 1990s and down to 3.5 between 2005 and 2008 (Table 3.3). These are periods when China industrialised and urbanised rapidly. In the Republic of Korea, ICORs were between 3 and 3.5 in the 1970s and 1980s periods of 'big push' industrialisation and rapid economic development. If India is able to restore the kind of investment levels that prevailed in the latter part of the last decade, levels of around 35 per cent plus, and ICORs remain between 3.5 and 4.5, it would be feasible for the country to achieve a sustained annual growth rate of 8-9 per cent, which would mean a 7-8 per cent annual growth in per capita incomes, a doubling in each of the coming two decades (Table 3.4).

INDICATORS FOR OPTIMISM

The current slowdown is such that many observers would be critical of our optimism on the restoration of a robust economic growth rate. When the National Transport Development Policy Committee (NTDPC) began work in mid-2010, a sustained growth rate of over 9 per cent was thought to be feasible and likely. The subsequent developments in the global economy and difficulties encountered domestically have tempered this optimism. Consequently, the targets for the 12th Five Year Plan were also revised downward, and we have made further downward revision in our own projection to about 7 per cent average annual real growth in the 12th Plan period. In view of only 5 per cent real growth (factor cost) in the first year of the 12th Plan, even achieving this lower projection of 7 per cent will not be easy. The issue then is whether the country can go back to rates in excess of 8 per cent in subsequent Plan periods?

We need to recognise that it is only a handful of countries that have been able to escape the 'middle income' trap. Given our high levels of poverty, it is essential that we do so. A key source of optimism is that whereas overall savings have fallen from a level of 35 per cent plus in 2007-08 to around 30 per cent now, household savings have remained resilient at around 22 per cent. It is both the overall public sector (mainly government) and the corporate private sector whose savings have fallen. The key issue is restoration of the fiscal health of the central government. If, as is now planned, the overall fiscal deficit of the central government be brought back down to less than 3 per cent and state governments can maintain theirs at around 2 per cent, within the next two to three years, public savings can be restored to the levels achieved previously in 2007-08. If that is achieved, the current draft on private savings will fall and greater resources will then become available to the private sector for investment. The second imperative is restoration of inflation to the 4-5 per cent level achieved in the last decade. Fiscal correction will help in this regard. Nominal interest rates can then come down and corporate profitability can also be restored, so that private corporate sector savings also increase to the levels achieved in 2005-10.

These objectives are clearly in the realm of feasibility. Gross domestic savings and investment can then be restored to the 35-40 per cent levels necessary to achieve sustained growth of 8-9 per cent over the next two decades.

In addition to these changes in the realm of macroeconomic policy, it is also necessary to considerably enhance the efficiency of government functioning with respect to infrastructure, for investment by both the public and by the private sectors, including through public-private partnerships (PPP). The recent administrative actions taken by the central government to streamline regulatory and permitting processes through, for example, the formation of the Cabinet Committee on Investment (CCI), are encouraging. But these have to be followed up down the line to ensure that infrastructure investment does take place in a timely fashion. Much work has been done in making the bidding and allocation process for PPP projects efficient and transparent. This needs to be continued as expertise is built up.

Similar actions are necessary at the state level. In addition to lagging regions catching up, rapid urbanisation can further increase investment efficiency as higher

Table 3. 4a

India: Gross Domestic Product, 2012-13 to 2031-32

	2012-13	2013-14	2014-15	2015-16	2016-17	FIVE YEAR PLANS (ANNUAL AVERAGE) FY13-FY17 12TH PLAN	FY18-FY22 13TH PLAN	FY23-FY27 14TH PLAN	FY28-FY32 15TH PLAN
(Rs Billion 2012-13 Prices)									
GDP at Market Prices	100,262	107,221	114,951	123,774	133,481	115,938	169,153	252,143	384,748
GDP at Factor Cost	94,631	100,822	107,956	116,094	124,509	108,803	157,302	233,297	354,921
Agriculture and Allied	16,135	16,724	17,351	18,020	18,722	17,391	21,082	25,650	31,207
Industry	24,917	26,491	28,265	30,421	32,894	28,597	42,368	65,245	103,171
Construction	7,845	8,434	9,066	9,837	10,722	9,181	14,194	22,345	35,176
Electricity, Gas and Water	1,643	1,758	1,898	2,060	2,245	1,921	2,972	4,816	7,934
Mining and Quarrying	2,184	2,326	2,489	2,675	2,889	2,513	3,770	5,800	8,924
Manufacturing	13,245	13,974	14,812	15,849	17,037	14,983	21,432	32,284	51,137
Services	53,579	57,607	62,339	67,654	72,893	62,814	93,852	142,402	220,543
Trade, Hotel, Transport and Communications	23,911	25,901	28,139	30,671	33,432	28,411	43,936	68,878	110,015
Finance, Insurance, Real Estate & Business Services	16,275	17,618	19,115	20,836	22,711	19,311	29,846	46,790	74,735
Community, Social & Personal Services	13,393	14,089	15,085	16,147	16,750	15,093	20,070	26,735	35,792
(US$ Billion 2012-13 Prices)									
GDP at Market Prices	1,843	1,971	2,113	2,275	2,453	2,131	3,109	4,634	7,071
GDP at Factor Cost	1,739	1,853	1,984	2,134	2,288	2,000	2,891	4,288	6,523
Agriculture and Allied	297	307	319	331	344	320	387	471	574
Industry	458	487	519	559	605	526	779	1,199	1,896
Construction	144	155	167	181	197	169	261	411	647
Electricity, Gas and Water	30	32	35	38	41	35	55	89	146
Mining and Quarrying	40	43	46	49	53	46	69	107	164
Manufacturing	243	257	272	291	313	275	394	593	940
Services	985	1,059	1,146	1,243	1,340	1,154	1,725	2,617	4,053
Trade, Hotel, Transport and Communications	439	476	517	564	614	522	808	1,266	2,022
Finance, Insurance, Real Estate & Business Services	299	324	351	383	417	355	549	860	1,374
Community, Social & Personal Services	246	259	277	297	308	277	369	491	658
Memo Items									
Population (Million)	1,217	1,233	1,248	1,262	1,276	1,247	1,317	1,378	1,429
Per Capita GDPmp (Rs 2012-13 Prices)	82,370	86,987	92,093	98,088	104,637	92,965	128,469	183,011	269,330
Per Capita GDPmp (US $ 2012-13 Prices)	1,514	1,599	1,693	1,803	1,923	1,709	2,361	3,364	4,950
Per Capita GDPmp (Rs 2012-13 Prices), Eop	82,370	86,987	92,093	98,088	104,637	104,637	146,276	210,769	314,080
PerCapita GDPmp (US $ 2012-13 Prices), Eop	1,514	1,599	1,693	1,803	1,923	1,923	2,688	3,874	5,773
Exchange Rate	54.4	54.4	54.4	54.4	54.4	54.4	54.4	54.4	54.4

Sources: Government of India, Central Statistical Office, National Account Statistics and NTDPC Projections.

For manufacturing to grow rapidly, tranport investment is critical. And higher investment in transport will require higher manufacturing growth. The relationship is symbiotic

densities of people and economic activities generate economies of scale and agglomeration. In fact, there was an increase of 90 million people living in urban areas between the census periods of 2001 and 2011.

However, lack of systematic land valuation and rules for land use transformation, lack of coordination between land use and infrastructure planning, rising transport costs, and inability of utilities to expand basic infrastructure services are reducing the net benefits and efficiency gains from urbanisation[9]. Unless the policy distortions that currently bind cities and the urbanisation process are resolved, it will be challenging to enhance efficiency gains from India's once-in-a-lifetime spatial transformation. In addition to spatial transformation and convergence that can enhance efficiency, overall growth rates and efficiency also depend on sectoral performance and transformation.

SECTORAL TRANSFORMATION

Consider Tables 3.1 and 3.4, which provide an overview of sectoral growth rates, Table 3. 1 for the past decade or so and Table 3. 4 for the next two. The core issue here is whether India can realise 8-9 per cent GDP growth by enhancing specialisation and performance of sectors that are both labour intensive and which generate positive externalities. In this framework, the important issue is a turnaround of industry and manufacturing in particular, whose performance hinges on the availability and quality of core infrastructure such as transport and electricity. Thus, as infrastructure needs are endogenous to industrial performance, keeping up transport and overall infrastructure investment will help in stimulating industrial growth, which in turn will generate demand for additional infrastructure.

For overall GDP growth to achieve sustained high levels, Indian manufacturing growth has to be accelerated. Whereas this had indeed happened in the period 2005-08, manufacturing growth has since tapered off. The government has exhibited its concern on this issue through the appointment of the National Manufacturing Competitiveness Council (NMCC), with the stated objective of increasing the share of manufacturing to 25 per cent of GDP. We have therefore projected higher growth in manufacturing over the next 20 years than has been achieved over a similar period in the past. We have still been somewhat conservative in stepping up the rate of manufacturing growth. What is desirable is that it actually increases to double digit growth rates. However, for this to be achieved, manufacturing will need greater focused policy attention and action. For manufacturing to be competitive and to grow rapidly, transport investment is critical, both domestic and international, through more efficient railways, roads, ports and airports. Conversely, higher investment in transport will require higher manufacturing growth. Thus, the relationship between manufacturing and transport is symbiotic.

Keeping in mind an aspiration to enhance industrial (and manufacturing) growth but realising the various constraints that are likely to remain in the medium term, industry's share in GDP is projected to be 24.7 per cent during the 12th Plan between 2012-17, increasing to 26.8 per cent between 2027-32. Accompanying industrial expansion, manufacturing is projected to increase from 12.9 per cent of GDP in 2012-17 to 13.3 per cent in 2027-32. Growth rates of industry are projected at 6.4 per cent annually during 2012-17, increasing to 9.8 per cent during 2027-32. Similarly manufacturing growth rates are projected at 5.6 per cent (2012-17), increasing to 10 per cent by 2027-32. While India has not experienced 10 per cent growth in industry and manufacturing, on a sustained basis, as of now, if such a growth rate is achieved at any time, it will imply doubling of industry value added output in seven years. The growth of other industrial sectors such as construction, utilities, and mining are also projected to grow around 9.5 per cent annually from 2018 onwards, albeit rather slower growth during 2012-17 (Construction 7.7 per cent; electricity, gas and water (utilities) 7.5 per cent; mining 5.8 per cent). Correspondingly, the services sector is projected to grow at its current rapid pace of around 8.5-9.5 per cent over the next 20 years (Table 3.4).

Growth in agriculture is being projected to be between 3.4 and 4 per cent per year over the next two decades. This would be seen by some as being excessively optimistic since the past record over 50 years suggests that it is difficult for agriculture to grow at much more than 3 per cent on a sustained basis. The basis of our optimism is that the demand for food other than cereals vegetables, fruit, milk, other dairy products, fish poultry, meat has higher elasticity with respect to income. This has already been manifested in the relatively higher inflation rates experienced by these commodities over the past few years. Thus, demand for these commodities can be expected to be buoyant in the coming years, and there will have to be supply response. For this to be achieved too, major policy changes are required. Transport investment in rural connectivity and in logistics will also be essential if such growth in agriculture is to be achieved.

9. Urbanization beyond Municipal Boundaries: Nurturing Metropolitan Economies and Connecting Peri-Urban Areas in India, World Bank (2013)

Table 3. 4b

India: Gross Domestic Product, 2012-13 to 2031-32

	2012-13	2013-14	2014-15	2015-16	2016-17	FIVE YEAR PLANS (ANNUAL AVERAGE) FY13-FY17 12TH PLAN	FY18-FY22 13TH PLAN	FY23-FY27 14TH PLAN	FY28-FY32 15TH PLAN
(Per cent Share)									
GDP at Factor Cost	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Agriculture and Allied	17.1	16.6	16.1	15.5	15.0	16.0	13.4	11.0	8.8
Industry	26.3	26.3	26.2	26.2	26.4	26.3	26.9	28.0	29.1
Construction	8.3	8.4	8.4	8.5	8.6	8.4	9.0	9.6	9.9
Electricity, Gas and Water	1.7	1.7	1.8	1.8	1.8	1.8	1.9	2.1	2.2
Mining and Quarrying	2.3	2.3	2.3	2.3	2.3	2.3	2.4	2.5	2.5
Manufacturing	14.0	13.9	13.7	13.7	13.7	13.8	13.6	13.8	14.4
Services	56.6	57.1	57.7	58.3	58.5	57.7	59.7	61.0	62.1
Trade, Hotel, Transport and Communications	25.3	25.7	26.1	26.4	26.9	26.1	27.9	29.5	31.0
Finance, Insurance, Real Estate & Business Services	17.2	17.5	17.7	17.9	18.2	17.7	19.0	20.1	21.1
Community, Social & Personal Services	14.2	14.0	14.0	13.9	13.5	13.9	12.8	11.5	10.1
(2012-13 Prices) (Average Annual Per cent Change)									
GDP at Market Prices	3.3	6.9	7.2	7.7	7.8	6.6	8.0	8.5	9.0
GDP at Factor Cost	5.0	6.9	7.2	7.7	7.8	6.9	8.0	8.5	9.0
Agriculture and Allied	1.8	3.7	3.8	3.9	3.9	3.4	4.0	4.0	4.0
Industry	3.2	6.3	6.7	7.6	8.1	6.4	8.6	9.3	9.8
Construction	5.9	7.5	7.5	8.5	9.0	7.7	9.5	9.5	9.5
Electricity, Gas and Water	4.9	7.0	8.0	8.5	9.0	7.5	9.5	10.5	10.5
Mining and Quarrying	0.4	6.5	7.0	7.5	8.0	5.8	9.0	9.0	9.0
Manufacturing	1.9	5.5	6.0	7.0	7.5	5.6	7.7	9.0	10.0
Services	6.8	8.2	8.4	8.7	8.8	8.2	8.7	8.9	9.4
Trade, Hotel, Transport and Communications	5.4	8.3	8.6	9.0	9.0	8.1	9.3	9.5	10.0
Finance, Insurance, Real Estate & Business Services	8.7	8.3	8.5	9.0	9.0	8.7	9.3	9.5	10.0
Community, Social & Personal Services	7.5	8.0	8.0	8.0	8.0	7.9	7.0	7.0	7.0
Memo Items (Annual Per cent Change)									
Population	1.3	1.3	1.3	1.1	1.1	1.2	1.0	0.8	0.7
Per Capita GDPmp (2012-13 Prices)	2.0	5.6	5.9	6.5	6.7	5.3	6.9	7.6	8.3

Sources: Government of India, Central Statistical Office, National Account Statistics and NTDPC Projections.

Tapping domestic savings is going to be an important part of a financing strategy, but not enough in itself. External savings, reflected in the current account, would be necessary to supplement domestic savings

FINANCING GROWTH

In the modeling framework employed in this chapter, GDP is expected to grow between 7 and 9 per cent over the next 20 years resulting in the economy more than doubling twice over this period. We are also projecting gross capital formation to increase gradually from its current 36.4 per cent of GDP (2007-12) to around 42 per cent in the next 20 years (Tables 3.2 and 3.5).

What are the implications of such a growth scenario? Can such investment levels be financed? And how? The acceleration of industrial growth implies higher investment needs for the following sectors: power, telecommunications, transportation, urban infrastructure, ports and airports. Tapping domestic savings is going to be an important part of a financing strategy but it is unlikely to be enough in itself. External savings, mirrored in current account deficits, would be necessary to supplement domestic savings. What would be the overall level of infrastructure investment required? How much external capital inflows can be expected? How much can domestic savings be expected to increase? These questions are answered next.

MOBILISING DOMESTIC SAVINGS

Understanding the way savings are constituted can help in projecting the increase in infrastructure investment that India requires. While tapping both domestic and foreign savings is going to be important, more clarity is needed on the potential contribution of these sources. Recent international research shows that strong investment periods in the power sector have been accompanied by an increase in domestic savings, and foreign sources, on the other hand, tend to prevail during periods of rapid investment in roads[10]. We first consider the performance and outlook for domestic savings.

The gross domestic saving rate has risen significantly since the late 1990s, but has fallen since 2008, though it is still above 30 per cent of GDP (Table 3.6). In fact, India's gross domestic savings rate in the recent past is comparable to Indonesia, Thailand and Korea, albeit much lower than that of China, Malaysia and Singapore (Table 3.3). In our projections, we assume that domestic savings will be restored and then rise over the over the next two decades, to be around 40 per cent of GDP by 2027-32 (Table 3.7). There has been a tendency to over-emphasise the importance of foreign savings in stimulating infrastructure investments in India, but the reality is that it is domestic savings that have largely financed Indian investment, including that in infrastructure and transport[11]. To get a better understanding of how domestic savings can be tapped, we consider each of its three components in turn: household savings, private corporate savings, and public sector savings.

HOUSEHOLD SAVINGS

For the household sector, we observe that savings increased from 19.7 per cent in 1998-2002 to about 23.4 per cent of GDP in 2008-2012. We project household savings to be the bedrock of domestic savings, reaching around 28 per cent over the next 20 years (Table 3.7). As already noted, despite an overall fall in gross domestic saving, household savings have remained relatively stable. Household net financial savings increased from about 6 to 7 per cent in the early 1980s to 10 per cent in the late 1990s, stabilising at this level thereafter (Table 3.6). In the future, we do not expect to see dramatic increases in net financial savings even though households will continue to increase gross savings, deeper financial markets and intermediation will translate into higher level of borrowings. Taking this perspective, we are projecting net financial savings to increase, albeit at a slower pace, reaching 13 per cent of GDP by 2028-2032 (Table 3.7). Bank deposits continue to account for the predominant share of gross financial assets, with their share increasing sharply in the second half of 2000s in contrast to the declining trend in the previous years; A trend that augurs well for infrastructure investments is the increasing share of contractual savings in life insurance funds, and provident and pension funds. Although these have not been very buoyant in the recent past, we can expect greater mobilisation of household financial savings in insurance, pension and provident funds, as incomes continue to increase. Life insurance funds accounted for over 3 per cent of GDP during 2007-12, up from about 1 per cent during the early 1990s[12]. Provident and pension funds were another 1.6 per cent of GDP during this period. This provides clear signals of the financial deepening of the economy and the formalisation of household sector savings in financial instruments. Going forward, however, the increasing penetration of insurance activity could increase the share of life insurance in total financial savings of households. We can expect much deeper penetration of insurance and pension products in the years to come: we have projected their share to go up from the current around 4 per cent of GDP to 5 per cent. With

10. Walsh et al (2011)
11. Chapter 1 in Mohan (2011)

Table 3. 5a

India: Gross Domestic Expenditure, 2012-13 to 2031-32

	2012-13	2013-14	2014-15	2015-16	2016-17	FIVE YEAR PLANS (ANNUAL AVERAGE) FY13-FY17 12TH PLAN	FY18-FY22 13TH PLAN	FY23-FY27 14TH PLAN	FY28-FY32 15TH PLAN
(Rs Billion 2012-13 Prices)									
Gross Domestic Product	100,262	107,221	114,951	123,774	133,481	115,938	169,153	252,143	384,748
Gross Domestic Capital Formation	35,373	38,600	42,172	46,401	50,738	42,657	65,725	103,700	166,526
Public	9,525	10,186	10,920	11,759	12,681	11,014	16,915	25,214	38,475
Private	25,848	28,414	31,251	34,642	38,057	31,643	48,810	78,486	128,051
Total Consumption	72,039	75,210	79,401	84,120	89,560	80,066	111,251	159,542	234,734
Public	13,052	13,410	13,796	14,850	16,008	14,223	18,724	27,666	42,168
Private	58,987	61,800	65,605	69,270	73,551	65,843	92,527	131,876	192,566
Exports of Goods & Services	24,877	27,455	30,333	33,561	37,160	30,677	51,173	86,519	148,044
Imports of Goods & Services	32,026	34,043	36,954	40,308	43,977	37,462	58,996	97,618	164,556
Memo Items									
Gross Fixed Investment	29,359	32,038	35,002	38,513	42,113	35,405	54,552	86,071	138,216
Change in Stocks	3,184	3,474	3,795	4,176	4,566	3,839	5,915	9,333	14,987
Valuables	2,830	3,088	3,374	3,712	4,059	3,413	5,258	8,296	13,322
(US$ Billion 2012-13 Prices)									
Gross Domestic Product	1,843	1,971	2,113	2,275	2,453	2,131	3,109	4,634	7,071
Gross Domestic Capital Formation	650	709	775	853	933	784	1,208	1,906	3,061
Public	175	187	201	216	233	202	311	463	707
Private	475	522	574	637	699	582	897	1,443	2,353
Total Consumption	1,324	1,382	1,459	1,546	1,646	1,472	2,045	2,932	4,314
Public	240	246	254	273	294	261	344	508	775
Private	1,084	1,136	1,206	1,273	1,352	1,210	1,701	2,424	3,539
Exports of Goods & Services	457	505	557	617	683	564	941	1,590	2,721
Imports of Goods & Services	589	626	679	741	808	689	1,084	1,794	3,024
Memo Items	-	-	-	-	-	-	-	-	-
Gross Fixed Investment	540	589	643	708	774	651	1,003	1,582	2,540
Change in Stocks	59	64	70	77	84	71	109	172	275
Valuables	52	57	62	68	75	63	97	152	245

Sources: Government of India, Central Statistical Office, National Account Statistics and NTDPC Projections.

We expect much deeper penetration of insurance and pension products in the coming years, and projected their share to go up from the current 4 per cent to 5 per cent of GDP. With rising incomes, it is quite possible that this projection is on the lower side

rising incomes and greater penetration of financial institutions, it is quite possible that this projection is on the lower side. (Box 3.1)

While one would think that an increase in financial savings would be accompanied by a move away from savings in physical assets the trends indicate that savings in both financial and physical assets will grow hand in hand. Savings in physical assets have increased from 9.7 per cent of GDP in the period 1998-2002 to 12.3 per cent of GDP during 2008-2012. The household sector's preference for savings in the form of physical assets since 2000-01 could be attributed partly to the robust economic growth as well as rising availability of credit to meet financing needs of the household sector. An important reason for this increase is that households are borrowing more for investments in durable assets such as housing which is among the few inflation-resilient long-term investment options and part of a diversified savings portfolio for households. On the back of rapid economic growth in the early 2000s, there has also been considerable expansion in consumer finance and developer finance for housing (and other assets) in recent years and we expect savings in physical assets to continue growing. Our projections suggest that this asset class will account for 12.5 per cent of GDP during the 12th Plan period and then increase to more than 14 per cent through 2032.

One striking feature is that the percentage of shares and debentures in gross financial assets of households has remained quite small (less than 10 per cent on an average), even though it increased sharply during the (early) 1990s, spurred by the reforms in the capital market[13]. Subsequently, the share of shares and debentures started declining largely reflecting stockmarket conditions impacted by irregularities and the downturn in industrial activity and was at less than 3 per cent in the first half of 2000s. 'Shares & debentures' did pick up again during 2005-06 to 2007-08, largely coinciding with a high-growth phase and buoyant stockmarket trends, but then dropped in 2008-09 in the face of knock-on effects of the global financial crisis. Household investment in the stockmarket has remained subdued, with net investment in recent years being zero or even negative.

PRIVATE CORPORATE SECTOR SAVINGS

The private corporate sector has remained vibrant and has benefitted from increasing consumption and investment demand arising out of consistently high economic growth. With robust sales growth, improved productivity, and lower interest rates during 2000-2010, corporates recorded good growth in profits which translated into higher private corporate sector saving. The savings of the private corporate sector thus increased rapidly from 3.9 per cent of GDP during the 9th Five Year Plan period (1997-2002) to 7.8 per cent of GDP during the 11th Plan period (2007-12). In view of the broader global economic slowdown and the current sluggishness of the Indian economy, we project that corporate savings will be around their current levels around 7.5 per cent of GDP during the 12th Plan period and then increase gradually to 9.5per cent by 2027-2032, although they have dipped in the last couple of years (Tables 3.6 and 3.7).

What is important to consider is that corporate savings had grown significantly from the low levels of 3.8 per cent in 1994-95, driven by marketisation of the economy and the entry of the private sector into areas that were historically reserved for the public sector. The corporate sector also benefitted from softening of the interest rate structure during 2003-08 accompanied by low inflation. We can expect the corporate sector to keep growing as a proportion of GDP: this would also help in increasing private corporate sector savings as a proportion of GDP.

The emphasis being placed by Government on the contribution of the private sector in infrastructure through public-private partnerships and otherwise will be difficult to realise if corporate profitability and hence corporate savings are not restored to what they were during most of the 11th Plan period. This needs the practice of both better macroeconomic and microeconomic policies. Fiscal correction is essential to redirect private household savings to the corporate sector and to reduce inflation. For nominal interest rates to come down, so that corporate profitability is restored, it is essential that inflation rates come down to the 4-5 per cent level that had been achieved during 1998-2008. This will also enable banks to give positive real deposit rates to depositors in order to increase bank deposits and hence restore financial savings. Furthermore, the World Bank's index of 'Ease of Doing Business' indicates high barriers to entry in India. Thus, regulatory policies, permitting processes, environmental clearances and the like, all have to be improved to restore corporate profitability. Finally, the role of efficient transport

12. Database on Indian Economy, Reserve Bank of India, http://dbie.rbi.org.in/DBIE/dbie.rbi?site=home , accessed 1 November, 2013
13. Report of the Sub Group on Household Sector Saving: 12th Five Year Plan (2012-13 to 2016-17), Planning Commission, 2011

Box 3.1

Pension Funds Can and Should Invest More in Infrastructure

[The Economist, October 26TH, 2013, Print Edition]

IT MIGHT seem like a marriage made in heaven. Infrastructure projects take a long time to build but then deliver cash flows over an extended period. Pension funds have liabilities that stretch over several decades. Why not get the latter to finance the former?

But the couple have barely survived the first date, let alone made it to the altar. A new report from the OECD, a think-tank, estimates that global pension funds have just 0.9 per cent of their portfolios in pure infrastructure plays.

In part, that is due to the OECD's decision to define infrastructure assets as unlisted debt and equity; pension funds have significant exposure to the listed shares and bonds of power companies and the like. From the point of view of public policy, however, the OECD's definition is the correct one. The utility shares owned by pension funds are those of companies that were privatised in the 1980s and 1990s; the infrastructure they operate was the result of government spending in previous decades.

At the moment, public finances are very tight. Although governments would like to see more infrastructure get built (thanks, not least to the Keynesian stimulus that might result), they would rather not bear the whole burden. The difficult bit about infrastructure projects, apart from the original decision to commission them, is the cost of construction. That is where governments would like pension funds, and the rest of the private sector, to open their wallets.

What's stopping them? Risk is clearly an important factor. Pension funds want reliable cash flows that can be used to pay retirees, not the uncertainties that are associated with greenfield projects. As the OECD report points out, there is a 'lack of objective high-quality data on infrastructure investments.' This makes it difficult for funds to calculate how infrastructure would fit into their portfolios: for example, whether its returns would be closely correlated with other assets, such as equities. Another problem is that small pension funds may lack the expertise to get directly involved in such large projects; they have to invest via an infrastructure fund, and pay a management fee for the privilege.

The biggest infrastructure investors so far have been the giant Australian and Canadian pension funds, which can benefit from economies of scale. Britain is trying to achieve the same effect by setting up a Pensions Investment Platform which will pool infrastructure investments; the hope is for a £20 billion ($32 billion) fund within ten years. However, the scheme has been slow to get going—one person involved described it as like 'herding cats'—and even if it is successful it will not be sufficient to fund Britain's highest-profile project, a proposed high-speed rail line from London to Manchester.

A new report from Llewellyn Consulting and the Pensions Insurance Corporation points to other problems for pension funds, including the lack of political certainty. Capital spending is often the first item to be cut when governments run into budget difficulties and tough decisions are put off to suit electoral cycles (expansion of airport capacity near London is a notable example). The report suggests one possible solution: that the government should borrow a separate sum to finance infrastructure spending with the stated intention of selling assets to the likes of pension funds after a number of years. Such debt could be recorded separately in the National Accounts, an idea that was suggested to the British government by one of the report's sponsors back in 2009.

An alternative option would be a national investment bank, along the lines of the European Investment Bank. It would borrow from the market and use its capital to guarantee the equity portion of infrastructure projects. That would allow pension funds to buy the more secure debt elements of the project's funding.

The Olympics showed that Britain can build projects on time when the country puts its mind to it. A similar effort is required now. The need is clear. More than half of companies surveyed by the Confederation of British Industry compared Britain unfavourably with other EU countries on this issue. Among the G7 countries, only Italy is regarded as having worse infrastructure. And there is no shortage of potential funding Britain's pension assets are equal to 112 per cent of GDP. Surely someone can put the two together.

infrastructure is essential for corporate efficiency, competitiveness and profitability.

In summary, the role of the private sector in infrastructure and transport investment will be difficult to achieve at the magnitudes expected unless corporate profitability is restored. It would then become possible for private corporate savings to increase and be invested as equity in the infrastructure sector, in addition to increasing investment in manufacturing and services.

PUBLIC SECTOR SAVINGS

An important development that has taken place since the late 2000s is the deterioration in public sector savings. From being around 5 per cent of GDP in 2007-08, this savings class has fallen to 1.3 per cent of GDP in 2011-12 (Table 3.6). And the main culprit here is public/government administration, where savings were (-) 2.0 per cent of GDP in 2011-12[14]. The combined (Centre and states) fiscal deficit during the 11th Plan averaged 7.3 per cent of GDP; of this, the GFD of the Centre was 5.1 per cent of GDP and the states was 2.3 per cent. The average revenue deficit of the Centre was 3.7 per cent of GDP, while the states had a marginal surplus (0.1 per cent of GDP) on the revenue account. While the revenue account of the states as a whole has improved substantially, the Centre's revenue deficit continues to be an area of concern. The attainment of higher gross domestic savings is therefore crucially dependent on increases in public sector savings. Continuing macro-economic stabilisation and reduction in fiscal deficit is essential if gross domestic savings are to increase further.

The 13th Finance Commission made the case that the fiscal deficit of the Central Government should be brought down to 3 per cent of GDP by 2013-14 and maintained at that level in subsequent years, and the Centre's revenue deficit should be progressively reduced and eliminated, followed by the emergence of revenue surplus by 2014-15. For the consolidated position of the state governments, the Commission's recommendation translates into a fiscal deficit target of 2.4 per cent of GDP in 2013-14 and 2014-15. In view of the fiscal slippage in the aftermath of the 2008 crisis and based on recommendations of the Kelkar panel, the Finance Ministry has now proposed a revised path for fiscal consolidation for the Central Government, wherein by 2016-17, the fiscal deficit will be brought down to 3 per cent and the revenue deficit to 1.5 per cent.

Improved fiscal management by itself can help in increasing domestic savings by 3 per cent of GDP. In this context, the tax-GDP ratio for the Central Government had increased sharply during the 2000 to 11.9 per cent in 2007-08, although it has declined since then to 9.9 per cent in 2011-12. On the other hand, interest payments-GDP ratio for the Central Government has decreased from 4.4 per cent in 2003-04 to 3.0 per cent in 2011-12. It is therefore not unrealistic to project an improvement in both the gross fiscal deficit of the Central Government and in its revenue deficit.

Within the public sector, savings of public sector undertakings (PSU) have been positive and stable on an average ranging between 3 per cent and 4 per cent of GDP over the past 15 years. Going forward, we project savings of these PSUs to increase gradually to around 4.7 per cent of GDP by 2027-32 (Table 3.7).

DOMESTIC SAVINGS: SUMMARY

The plausible projections of savings enhancement made above in each of the three main segments, the household sector, the private corporate sector, and the public sector, yield a good possibility of gross domestic savings increasing from a projected 32.7 per cent in 2012-17 to about 40 per cent of GDP by 2027-32. We may note that the gross domestic savings level had reached 36.8 per cent in 2007-08. Implications of these projections are (Table 3.7):

- That the household sector continues to contribute to long-term formal financial savings instruments in the future. Overall, we are projecting household savings to increase from about 23 per cent in 2012-17 to 28 per cent in 2027-32.
- The expansion of the private corporate sector continues over the next decade along with a continued increase in its share of domestic savings. We are projecting private corporate sector savings to increase from 7.4 per cent in 2012-17 to about 9.6 per cent in 2027-32.
- A sustained improvement in performance of the public sector so that the current drag of public sector savings deficit is reduced. We are projecting overall public sector savings to increase from around 2.2 per cent of GDP in 2012-17 to about 3.4 per cent in 2027-32.

From the point of view of infrastructure investment, a continuing increase in contractual savings in life insurance, provident fund and pension funds from the current level of about 4 per cent of GDP to over 5 per cent by 2027-32 is very important. These projections may be on the conservative side. This kind of expansion in such savings is essential to increase the stock of long-term savings which are most suitable for investment in infrastructure, which typically has long payback periods. With increas-

14 A sharp but temporary decline in public sector savings occurred in 2008-09 largely on account of the Sixth Pay Commission arrear payouts and fiscal stimulus measures. (Report of the Sub-Group on Household Sector Saving during the 12th Five Year Plan (2012-13 to 2016-17 (2011))

Table 3. 5b

India: Gross Domestic Expenditure, 2012-13 to 2031-32

	2012-13	2013-14	2014-15	2015-16	2016-17	FIVE YEAR PLANS (ANNUAL AVERAGE)			
						FY13-FY17	FY18-FY22	FY23-FY27	FY28-FY32
						12TH PLAN	13TH PLAN	14TH PLAN	15TH PLAN
Current Prices (Per cent of GDP)									
Gross Domestic Product	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Gross Domestic Capital Formation	35.3	36.0	36.7	37.5	38.0	36.8	38.9	41.1	43.3
Public	9.5	9.5	9.5	9.5	9.5	9.5	10.0	10.0	10.0
Private	25.8	26.5	27.2	28.0	28.5	27.3	28.9	31.1	33.3
Total Consumption	71.9	70.1	69.1	68.0	67.1	69.1	65.8	63.3	61.0
Public	13.0	12.5	12.0	12.0	12.0	12.3	11.1	11.0	11.0
Private	58.8	57.6	57.1	56.0	55.1	56.8	54.7	52.3	50.1
Exports of Goods & Services	24.8	25.6	26.4	27.1	27.8	26.5	30.3	34.3	38.5
Imports of Goods & Services	31.9	31.8	32.1	32.6	32.9	32.3	34.9	38.7	42.8
Memo Items									
Gross Fixed Investment	29.3	29.9	30.4	31.1	31.5	30.5	32.2	34.1	35.9
Change in Stocks	3.2	3.2	3.3	3.4	3.4	3.3	3.5	3.7	3.9
Valuables	2.8	2.9	2.9	3.0	3.0	2.9	3.1	3.3	3.5
(2004-05 Prices) (Annual Per cent Change)									
Gross Domestic Product	3.3	6.9	7.2	7.7	7.8	6.6	8.0	8.5	9.0
Gross Domestic Capital Formation	2.8	9.1	9.3	10.0	9.3	8.1	9.3	9.8	9.4
Public	24.9	6.9	7.2	7.7	7.8	10.7	9.1	8.5	9.0
Private	-3.5	9.9	10.0	10.9	9.9	7.3	9.3	10.3	9.5
Total Consumption	4.0	4.5	5.6	6.0	6.5	5.3	7.2	7.5	8.7
Public	25.2	2.7	2.9	7.6	7.8	9.0	6.1	8.5	9.0
Private	10.2	4.8	6.2	5.6	6.2	6.6	7.4	7.3	8.6
Exports of Goods & Services	-0.2	10.4	10.5	10.6	10.7	8.3	10.9	11.2	11.4
Imports of Goods & Services	1.6	6.3	8.5	9.1	9.1	6.9	10.2	10.6	11.1
Memo Items									
Gross Fixed Investment	-1.2	9.1	9.3	10.0	9.3	7.2	9.3	9.8	9.4
Change in Stocks	55.4	9.1	9.3	10.0	9.3	17.4	9.3	9.8	9.4
Valuables	7.7	9.1	9.3	10.0	9.3	9.1	9.3	9.8	9.4
ICOR - Gross Capital Formation	10.7	5.1	5.0	4.8	4.8	6.1	4.8	4.0	4.0

Sources: Government of India, Central Statistical Office, National Account Statistics and NTDPC Projections.

Table 3. 6

India: Gross Domestic Savings, 2000-01 to 2011-12

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Per cent of GDP												
Gross Domestic Savings	23.8	24.9	25.9	29.0	32.4	33.4	34.6	36.8	32.0	33.7	34.0	30.8
Household Sector	21.4	23.2	22.3	23.2	23.6	23.5	23.2	22.4	23.6	25.2	23.5	22.3
Financial Saving	9.9	10.5	10.0	11.0	10.1	11.4	11.3	11.6	10.1	12.0	10.4	8.0
Financial Savings (Gross)	11.4	12.2	12.8	13.7	13.8	15.8	17.9	15.4	13.0	16.0	13.4	10.8
Currency	0.7	1.2	1.1	1.5	1.1	1.4	1.6	1.6	1.6	1.5	1.8	1.2
Bank Deposits	4.4	4.8	4.8	5.5	5.4	7.2	10.0	7.8	7.4	6.1	5.7	5.5
Non- Banking Deposits	0.1	(0.0)	0.5	0.1	0.0	0.0	0.1	0.0	0.3	0.3	0.1	0.2
Life Insurance Fund	1.6	1.8	2.1	1.8	2.1	2.3	2.7	3.4	2.7	4.0	2.8	2.5
Provident and Pension Fund	2.3	1.9	1.8	1.7	1.7	1.7	1.7	1.4	1.3	2.0	1.8	1.7
Claims on Government	1.8	2.2	2.2	3.1	3.3	2.4	0.4	(0.6)	(0.5)	0.7	0.5	(0.2)
Shares & Debentures	0.5	0.4	0.3	0.3	0.3	0.9	1.2	1.5	(0.0)	0.7	0.0	(0.1)
Units of UTI	(0.0)	(0.1)	(0.1)	(0.3)	(0.1)	(0.0)	(0.0)	(0.0)	(0.0)	-	-	-
Trade Debt(Net)	0.0	(0.0)	-	(0.0)	(0.0)	(0.0)	0.2	0.3	0.2	(0.0)	0.1	0.1
Financial Liabilities	1.5	1.6	2.8	2.7	3.7	5.0	6.6	3.8	2.9	3.1	3.6	2.8
Savings in Physical Assets	11.5	12.7	12.3	12.1	13.4	11.7	11.9	10.8	13.5	13.2	13.1	14.3
Private Corportate Sector	3.7	3.3	3.9	4.6	6.6	7.5	7.9	9.4	7.4	8.4	7.9	7.2
Joint Stock Companies	3.5	3.0	3.4	4.0	6.0	7.0	7.4	8.9	7.0	7.9	7.5	6.8
Cooperative Banks & Societies	0.2	0.3	0.5	0.6	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4
Public Sector	(1.3)	(1.6)	(0.3)	1.3	2.3	2.4	3.6	5.0	1.0	0.2	2.6	1.3
Public Authorities	(4.2)	(4.9)	(4.2)	(2.8)	(1.8)	(1.6)	(0.5)	1.1	(2.4)	(2.7)	(0.3)	(1.7)
Government Administration	(5.0)	(5.5)	(4.7)	(3.3)	(2.3)	(2.1)	(1.0)	0.5	(2.8)	(3.1)	(0.6)	(2.0)
Departmental (Comm.) Enterprises	0.8	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.4	0.4	0.3	0.4
Non-Departmental Enterprises	2.8	3.4	3.9	4.1	4.1	4.0	4.0	3.9	3.3	2.8	2.9	3.0
Memo Item												
GDP at Market Prices (Rs Billion at Current Prices)	21,687	23,483	25,307	28,379	32,422	36,934	42,947	49,871	56,301	64,778	77,953	89,749

Source: Government of India, Central Statistical Office, National Account Statistics and Reserve Bank of India.

ing incomes and longer life expectancy, the demand for such savings instruments can also be expected to increase substantially in the coming years. At present, such savings are much easier to make by employees working within the organised sector. It is quite likely that there is considerable latent demand for contractual savings by workers in the unorganised sector across the whole economy. This is also reflected in the consistently high level of savings that are collected through the various government-run small savings schemes, mostly through the post office. The very strong implication of these projections is that if the domestic savings are to be enhanced to the level envisaged, major reforms must be instituted towards further deepening and widening of the life insurance, provident and pension funds in the country. The much delayed approval of the Pension Fund Regulatory and Development Authority Act finally setting up the Pension Fund Regulatory and Development Authority (PFRDA) on a statutory basis is a good sign for the future development of the pension fund industry.

It is vital for infrastructure investment that these savings instruments are available to the widest array of savers throughout the country. Better availability of

Box 3. 2

How to Finance Infrastructure? Macroeconomic Lessons and Emerging Markets Case Studies

How emerging countries have managed rapid economic growth along with supporting infrastructure, contributes to the discussion on the available options for India's current infrastructure investment planning. Examples from Brazil, China, Korea and Chile provide alternatives for financing infrastructure.

As previously established, rapid economic growth is accompanied with increases in infrastructure investment. Specifically, booms in power capacity tend to be financed domestically, while investment in roads usually is financed with the help of foreign capital.

Fiscal and financial conditions, as well as savings, usually improve during periods where infrastructure investment is growing. Therefore, focusing on the way countries finance their infrastructure improvements can be helpful to planning the increase in infrastructure investment that India requires.

There are several options to improve infrastructure financing, depending on the country characteristics. However, it is not clear if increases should be financed domestically or externally. In general, domestic savings increase during strong investment periods in the power sector. Foreign sources on the other hand, tend to prevail during periods of rapid investment in roads.

How are these increases financed? It seems that public finances do not decline during periods of rapid investment. Higher growth due to infrastructure booms leads to higher central government revenues; however it appears that spending totals are not significantly higher.

Another characteristic of high infrastructure investment periods is the financial deepening, both in terms of bank credit and bond finance. Therefore, infrastructure finance could be increased within a growing financial system instead of crowding out other sources of finance.

Country experiences also include the development of the private sector investment in infrastructure. Chile and Korea developed local bond markets to support relatively long-term issuances by infrastructure companies. Chile developed the pension system. With a market for local currency-denominated long-term securities, the country minimised the need for bank finance. In Korea, the main private sources are foreign and individual investors; however, in previous stages banks also purchased infrastructure debt. Further, in China and Brazil, bank loans have been instrumental. In China, public banks have supplied long-term financing, while in Brazil, the Brazilian Development Bank (BNDES), is the major source of finance.

Walsh, J. and others (2011)

safe and high-return contractual savings instruments is likely to result in an overall enhancement of the household savings level. At the same time, getting public sector savings in order should be of high priority.

At present, households are quite simply not investing in the stockmarket, either directly or indirectly through mutual funds. If private sector investment in infrastructure is to increase by the magnitudes envisaged, vehicles need to be found for household financial savings to be invested in infrastructure companies through the stockmarket. This also implies better and credible governance in private sector infrastructure companies that inspire confidence in investors.

MOBILISING EXTERNAL SAVINGS

Mobilising external savings will be important to augment domestic savings to finance India's gross domestic investment, particularly in infrastructure (See Box 3.1 for lessons from emerging economies). Over the next 20 years, Gross Domestic Investment (GDI) has been projected to increase from an average of around 36.2 per cent of GDP during the 11th Plan period (2007-12) to around 43 per cent during the 15th Plan period (2027-32) (Table 3.5). At the same time, domestic savings are projected to increase from their current 30-32 per cent of GDP to 40.9 per cent by 2027-2032 (Table 3.7). Hence, external capital inflows will remain important in the financing of investment in

Table 3. 7

India: Gross Domestic Savings, 2012-13 to 2031-32

	2012-13	2013-14	2014-15	2015-16	2016-17	FIVE YEAR PLANS (ANNUAL AVERAGE) FY13-FY17 12TH PLAN	FY18-FY22 13TH PLAN	FY23-FY27 14TH PLAN	FY28-FY32 15TH PLAN
Per cent of GDP									
Gross Domestic Savings	29.6	31.3	32.5	33.6	34.5	32.5	35.9	38.6	40.9
Household Sector	21.4	22.7	22.8	23.3	23.6	22.8	24.5	26.3	27.9
Financial Saving	7.7	8.2	11.0	11.0	11.0	9.9	11.4	12.3	13.0
Financial Savings (gross)	10.4	11.0	14.5	15.1	15.5	13.5	16.1	17.3	18.3
Currency	1.2	1.2	1.4	1.5	1.5	1.4	1.6	1.7	1.8
Bank Deposits	5.3	5.6	7.2	7.5	7.7	6.8	8.0	8.6	9.1
Non- Banking Deposits	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Life Insurance Fund	2.4	2.5	2.5	2.6	2.7	2.6	2.8	3.0	3.2
Provident and Pension Fund	1.6	1.7	1.5	1.6	1.6	1.6	1.7	1.8	1.9
Claims on Government	(0.2)	(0.2)	1.0	1.0	1.1	0.6	1.1	1.2	1.3
Shares & Debentures	(0.1)	(0.1)	0.7	0.7	0.7	0.4	0.8	0.8	0.9
Units of UTI	-	-	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Trade Debt(Net)	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Financial Liabilities	2.7	2.8	3.5	4.0	4.5	3.6	4.6	5.0	5.3
Saving in Physical Assets	13.7	14.6	11.8	12.3	12.6	12.9	13.1	14.0	14.9
Private Corporate Sector	6.9	7.3	7.0	7.6	8.1	7.4	8.5	9.1	9.6
Joint Stock Companies	6.5	6.9	6.5	7.1	7.6	7.0	7.9	8.5	9.0
Cooperative Banks & Societies	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.6	0.6
Public Sector	1.3	1.3	2.7	2.8	2.8	2.2	3.0	3.2	3.4
Public Authorities	(1.6)	(1.7)	(1.1)	(1.1)	(1.1)	(1.3)	(1.2)	(1.2)	(1.3)
Government Administration	(2.0)	(2.1)	(1.5)	(1.6)	(1.6)	(1.7)	(1.7)	(1.8)	(1.9)
Departmental (comm.) Enterprises	0.3	0.4	0.5	0.5	0.5	0.5	0.5	0.6	0.6
Non-Departmental Enterprises	2.9	3.0	3.7	3.9	4.0	3.5	4.1	4.4	4.7
Memo Item									
Gross Domestic Product at Market Prices - (Rs Billion 2012-13 prices)	100,262	107,221	114,951	123,774	133,481	115,938	169,153	252,143	384,748

Sources: Government of India, Central Statistical Office, National Account Statistics and NTDPC Projections.

India. And historically, expansion in economic activity, particularly during the 2nd, 3rd, 6th, and 7th Plans have been associated with higher financing through external sources as reflected in larger current account deficits. In the more recent period (since 2008-09), however, the higher recourse to foreign savings has been associated with a slowing economy.

In recent years, there has been a great deal of stress laid on mobilising external savings for transport investment, and for infrastructure as a whole. The objective in this section is to estimate the maximum feasible level of external savings that can be mobilised to finance overall investment in India, and hence for infrastructure and transport. What is of importance is that such external capital inflows should be sustainable. Net capital inflows that are absorbed by the economy as a whole are identically equal to the current account deficit (CAD). Thus, considerations for sustainability include the

Table 3. 8a

India: Balance of Payments: Summary, 2000-01 to 2011-12

	2000-01	NTDPC	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
US$ Billion												
Current Account Balance	-2.7	3.4	6.3	14.1	-2.5	-9.9	-9.6	-15.7	-27.9	-38.2	-45.9	-78.3
Exports of Goods and Services	61.7	61.8	74.5	93.2	128.5	162.8	202.7	256.5	295.0	276.0	383.3	450.7
Exports of Goods, F.O.B.	45.5	44.7	53.8	66.3	85.2	105.2	128.9	166.2	189.0	182.4	250.5	309.8
Exports of Services	16.3	17.1	20.8	26.9	43.2	40.6	73.8	90.3	106.0	96.0	132.9	140.9
Imports of Goods and Services	72.5	70.1	81.6	96.7	146.7	191.5	235.0	309.1	360.6	359.1	465.1	576.4
Imports of Goods, C.I.F.	57.9	56.3	64.5	80.0	118.9	157.1	190.7	257.6	308.5	300.6	381.1	499.5
Imports of Services	14.6	13.8	17.1	16.7	27.8	34.5	44.3	51.5	52.0	60.0	84.1	76.9
Net Factor Income	-5.0	-4.2	-3.4	-4.5	-5.0	-5.9	-7.3	-5.1	-7.1	-8.0	-17.3	-16.0
Private Transfers (Net)	12.9	15.4	16.4	21.6	20.5	24.5	29.8	41.7	44.6	51.8	53.1	63.5
Official Transfers (Net)	0.3	0.5	0.5	0.6	0.3	0.2	0.3	0.2	0.2	0.3	0.0	0.0
Foreign Investment	5.9	6.7	4.2	13.7	13.0	15.5	14.8	43.3	8.3	50.4	39.7	39.2
Foreign Direct Investment	3.3	4.7	3.2	2.4	3.7	3.0	7.7	15.4	22.4	18.0	9.4	22.1
Portfolio Investment	2.6	2.0	0.9	11.4	9.3	12.5	7.1	27.4	-14.0	32.4	30.3	17.2
External Assistance, net	0.4	1.1	-3.1	-2.9	1.9	1.7	1.8	2.1	2.4	2.9	4.9	2.3
Commercial Borrowings, Net	4.3	-1.6	-1.7	-2.9	5.2	2.5	16.1	22.6	7.9	2.0	12.5	10.3
Short-Term Credit (Supplier's Credit)	0.6	-0.8	1.0	1.4	3.8	3.7	6.6	15.9	-2.0	7.6	11.0	6.7
Bank Capital	-2.0	2.9	10.4	6.0	3.9	1.4	1.9	11.8	-3.2	2.1	5.0	16.2
Rupee Debt Service	-0.6	-0.5	-0.5	-0.4	-0.4	-0.6	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1
Other Capital	0.3	0.8	0.6	1.7	0.7	1.2	4.2	11.0	-5.9	-13.2	-11.0	-6.9
Erros and Omissons	-0.3	-0.2	-0.2	0.6	0.6	-0.5	1.0	1.3	0.4	0.0	-3.0	-2.4
Overall Balance	5.9	11.8	17.0	31.4	26.2	15.1	36.6	92.2	-20.1	13.4	13.1	-12.8
Reserves (Increase –/ Decrease +)	-5.9	-11.8	-17.0	-31.4	-26.2	-15.1	-36.6	-92.2	20.1	-13.4	-13.1	12.8
Foreign Exchange Reserves	42.9	54.7	76.1	113.0	141.5	151.6	199.2	309.7	252.0	279.1	304.8	294.4
Foreign Currency Assets, end of period	39.6	51.0	71.9	107.4	135.6	145.1	191.9	299.2	241.4	254.7	274.3	260.1
(Per cent of GDP)												
Exports of Goods and Services	13.0	12.6	14.3	15.1	17.8	19.5	21.4	20.7	24.1	20.2	22.4	24.1
Imports of Goods and Services	15.3	14.2	15.6	15.7	20.3	0.0	24.8	24.9	29.4	26.3	27.2	30.8
Private Transfers (Net)	2.7	3.1	3.1	3.5	2.8	2.9	3.1	3.4	3.6	3.8	3.1	3.4
Foreign Investment	1.2	1.4	0.8	2.2	1.8	1.9	1.6	3.5	0.7	3.7	2.3	2.1
Foreign Direct Investment	0.7	1.0	0.6	0.4	0.5	0.4	0.8	1.2	1.8	1.3	0.5	1.2
Portfolio Investment	0.5	0.4	0.2	1.8	1.3	1.5	0.7	2.2	-1.1	2.4	1.8	0.9
Commercial Borrowings	0.9	-0.3	-0.3	-0.5	0.7	0.3	1.7	1.8	0.6	0.1	0.7	0.6

(Contd...)

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
(Per cent Change in US$ Terms)												
Exports of Goods and Services	15.9	0.2	20.5	25.0	37.9	26.7	24.5	26.6	15.0	-6.4	38.9	17.6
Exports of Goods, F.O.B.	21.1	-1.6	20.3	23.3	28.5	23.4	22.6	28.9	13.7	-3.5	37.3	23.7
Exports of Services	3.6	5.4	21.1	29.4	61.0	-6.1	81.7	22.4	17.3	-9.4	38.4	6.0
Imports of Goods and Services	8.1	-3.3	16.4	18.6	51.7	30.5	22.8	31.6	16.6	-0.4	29.5	23.9
Imports of Goods, C.I.F.	4.6	-2.8	14.5	24.1	48.6	32.1	21.4	35.1	19.8	-2.6	26.7	31.1
Imports of Services	25.2	-5.2	23.9	-2.3	66.4	24.0	28.5	16.2	1.1	15.3	40.0	-8.5
Reserves (as Months of G&S Imports)	7.1	9.4	11.2	14.0	11.6	9.5	10.2	12.0	8.4	9.3	7.9	6.1

Source: Reserve Bank of India, Hand Book of Statistics.

magnitude of CAD that would be regarded as safe and sustainable by financial markets. We examine this issue by first focusing on feasible development in the current account, and then in the capital account.

THE CURRENT ACCOUNT

India's exports have grown at a healthy pace, significantly faster than world exports since 2002, reflecting the resilience of India's exports linked to a strategic trade policy that is aimed at diversifying trade in terms of commodities as well as destinations. This has helped in mitigating the adverse effects of global shocks[15]. Exports of goods and services as a share of GDP increased from 11.8 per cent during 1998-2002, reaching 22.1 per cent during 2008-12 (Table 3.8). In terms of products, the share of engineering goods and petroleum products in the export basket has increased while the share of labour-intensive goods has declined. Except for 2008-09 and 2009-10, which were crisis years for global trade, Indian exports of goods and services have been growing at rates in excess of 20-25 per cent since 2002. However, in view of the current slowdown in exports, and the very slow recovery of the global economy and a higher base, we are projecting a much lower growth rate of less than 9 per cent in exports of goods and services over the 12th Plan period, and then accelerating to around 11-12 per cent annually over the following three Plan periods. (These projections are in constant 2012-13 US dollars) (Table 3.9).

Whereas the current account deficit had been contained at prudent levels right through the 1990s and upto 2009-10, there has been an expansion of this deficit in the last couple of years, reaching 4.8 per cent of GDP in 2012-13. In projecting exports and imports for the future, we have gradually tapered off this deficit during the remaining years of the 12th Plan to reach 2.6 per cent of GDP by 2016-17. We have then kept the current account deficit at around 2.5 per cent, which is what we believe to be a prudent sustainable level. The growth projections of GDP and of exports then determine the growth projections of imports of goods and services.

With these assumptions, exports of goods and services are projected to grow to about 38 per cent of GDP by 2027-32, the 15th Plan period. By way of comparison, the current exports of goods and services from China amount to about 31 per cent of GDP. In absolute terms, exports of goods and services are projected to increase from $450 billion in 2011-12 to about $680 billion in 2016-17, and annual averages of $930 billion, $1.6 trillion, and $2.7 trillion during the 13th, 14th and 15th Plans respectively. In terms of only goods exports, this implies growth from $310 billion in 2011-12 to $480 billion in 2016-17, and annual averages of $680 billion, $1.2 trillion and $2.1 trillion during the 13th, 14th and 15th Plans. The corresponding projections of imports of goods and services can then be seen, keeping the CAD at around 2.5 per cent of GDP throughout the period after the 12th Plan, and the projections average annually $1.0 trillion, $1.8 trillion and $3.0 trillion during the 13th, 14th and 15th Plan respectively (Tables 3.9a & 3.9b).

Such projections of exports and imports of goods and services will not be feasible without the corresponding growth in investment in all aspects of transport, logistics and ports. The various sectoral chapters outline the kind of investments envisaged. Furthermore, the special attention given to the transport of energy commodities coal, iron ore and petroleum in Chapter 8 provides a specific focus on the need for coordination between investment strategies for the power, coal, railways and ports sectors.

15. Report of the Sub Group on Inflow of Foreign Savings: 12th Five Year Plan (2012-13 to 2016-17), Planning Commission, 2011

Table 3. 8b

India: Balance of Payments: Current Account, 2000-01 to 2011-12

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
US$ Billion												
Exports of goods, f.o.b.	45.5	44.7	53.8	66.3	85.2	105.2	128.9	166.2	189.0	182.4	250.5	309.8
Primary Products	7.1	7.2	8.7	9.9	13.6	16.4	19.7	27.6	25.3	26.4	32.8	45.6
Petroleum Products	1.9	2.1	2.6	3.6	7.0	11.6	18.6	28.4	27.5	28.2	41.5	55.6
Manufactured Goods	34.3	33.4	40.2	48.5	60.7	54.3	84.9	103.0	123.1	115.2	158.0	186.8
Other Goods	2.1	2.1	2.2	4.3	3.9	11%	5.6	7.3	13.0	12.7	18.1	21.8
Exports of Services	16.3	17.1	20.8	26.9	43.2	57.7	73.8	90.3	106.0	96.0	132.9	140.9
Travel	3.5	3.1	3.3	5.0	6.7	7.9	9.1	11.3	10.9	11.9	15.3	18.5
Transportation,	2.0	2.2	2.5	3.2	4.7	6.3	8.0	10.0	11.3	11.2	14.3	18.2
Software Services	6.3	7.6	9.6	12.8	17.7	23.6	31.3	40.3	46.3	49.7	55.5	67.6
Business Services	..	..	..	..	5.2	9.3	14.5	16.8	18.6	11.3	24.0	25.9
Financial Services	..	..	..	..	0.5	1.2	3.1	3.2	4.4	3.7	6.5	6.0
Other Services	4.4	4.3	5.3	5.8	8.5	9.4	7.7	8.7	14.4	8.3	17.3	4.7
Imports of Goods, C.I.F.	57.9	56.3	64.5	80.0	118.9	157.1	190.7	257.6	308.5	300.6	381.1	499.5
Petroleum, Crude and Products	15.7	14.0	17.6	20.6	29.8	44.0	56.9	79.6	93.7	87.1	106.0	154.9
Capital Goods	8.9	9.9	13.5	18.3	25.1	37.7	47.1	70.1	71.8	65.9	78.5	99.4
Mainly Export Related Goods	8.1	8.3	10.3	12.7	17.1	18.6	17.9	20.8	31.9	31.3	53.6	54.5
Consumption Goods	1.4	2.0	2.4	3.1	3.1	2.8	4.3	4.6	5.0	9.0	8.9	11.6
Other goods	23.8	22.1	20.6	25.4	43.7	54.0	64.5	82.5	106.1	107.4	134.1	179.2
Imports of Services	14.6	13.8	17.1	16.7	27.8	34.5	44.3	51.5	52.0	60.0	84.1	76.9
Travel	2.8	3.0	3.3	3.6	5.2	6.6	6.7	9.3	9.4	9.3	11.1	13.8
Transportation,	3.6	3.5	3.3	2.3	4.5	8.3	8.1	11.5	12.8	11.9	13.9	16.4
Software Services	0.6	0.7	0.7	0.5	0.8	1.3	2.3	3.4	2.6	1.5	2.2	8.1
Business Services	..	..	..	..	7.3	7.7	15.9	16.6	15.3	18.0	27.8	26.8
Financial Services	..	..	..	..	0.8	1.0	3.0	3.1	3.0	4.6	7.5	8.0
Other Services	..	..	..	..	0.7	0.3	0.8	0.9	1.1	1.4	1.2	1.6
Net Factor Income	-5.0	-4.2	-3.4	-4.5	-5.0	-5.9	-7.3	-5.1	-7.1	-8.0	-17.3	-16.0
Factor Receipts	2.7	3.4	3.5	3.9	4.6	6.4	9.3	14.3	14.3	13.0	9.1	10.1
Factor Payments	7.7	7.6	7.0	8.4	9.6	12.3	16.6	19.3	21.4	21.1	26.4	26.1
of which: Interest payments	4.2	4.4	4.2	5.5	4.4	4.5	5.0	7.3	7.3	5.5	5.4	7.0
of which: Other factor payments	3.5	3.2	2.7	2.9	5.1	7.7	11.7	12.0	14.1	15.5	21.0	19.1
Private Transfers (Net)	12.9	15.4	16.4	21.6	20.5	24.5	29.8	41.7	44.6	51.8	53.1	63.5
Private Transfers Receipts	13.1	15.8	17.2	22.2	21.1	25.0	30.8	43.5	46.9	53.6	55.6	66.1
Private Transfers Payments	0.2	0.4	0.8	0.6	0.6	0.5	1.0	1.8	2.3	1.8	2.5	2.7
Official Transfers (Net)	0.3	0.5	0.5	0.6	0.3	0.2	0.3	0.2	0.2	0.3	0.0	0.0
Official Transfers Receipts	0.3	0.5	0.5	0.6	0.6	0.7	0.6	0.8	0.6	0.7	0.6	0.6
Official Transfers Payments	0.0	0.0	0.0	0.0	0.4	0.5	0.4	0.5	0.4	0.5	0.6	0.6
Current Account Balance	-2.7	3.4	6.3	14.1	-2.5	-9.9	-9.6	-15.7	-27.9	-38.2	-45.9	-78.3

Source: Reserve Bank of India, Hand Book of Statistics.

Table 3. 8c

India: Balance of Payments: Capital Account, 2000-01 TO 2011-12

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
US$ Billion												
Capital Account	8.8	8.6	10.8	16.7	28.0	25.5	45.2	106.6	7.4	51.6	62.0	67.8
Receipts	54.1	43.3	46.4	75.9	98.5	144.4	233.3	438.4	315.8	345.8	499.4	478.8
Payments	45.3	34.7	35.5	59.1	70.5	70.5	188.1	331.8	308.4	294.1	437.4	411.1
Foreign Investment	5.9	6.7	4.2	13.7	13.0	15.5	14.8	43.3	8.3	50.4	39.7	39.2
Inbound	17.7	15.5	14.0	32.7	46.9	77.3	133.2	271.1	171.7	198.7	289.4	234.6
Outbound	11.9	8.8	9.8	18.9	33.9	61.8	118.5	227.8	163.3	148.3	249.8	195.4
Foreign Direct Investment	3.3	4.7	3.2	2.4	3.7	3.0	7.7	15.4	22.4	18.0	9.4	22.1
FDI in India	4.0	6.1	5.0	4.3	6.0	8.9	22.7	34.2	41.7	33.1	25.9	33.0
FDI Abroad	0.8	1.4	1.8	1.9	2.3	5.9	15.0	18.8	19.4	15.1	16.5	10.9
Portfolio Investment	2.6	2.0	0.9	11.4	9.3	12.5	7.1	27.4	(14.0)	32.4	30.3	17.2
Inflow	13.6	9.3	8.8	28.2	40.8	68.1	109.6	233.8	128.7	160.2	254.0	185.6
Outflow	11.0	7.3	7.9	16.9	31.6	55.6	102.6	206.4	142.7	127.8	223.7	168.4
External Assistance, Net	0.4	1.1	(3.1)	(2.9)	1.9	1.7	1.8	2.1	2.4	2.9	4.9	2.3
Disbursements	2.9	3.4	2.9	3.4	3.8	3.6	3.8	4.2	5.2	5.9	7.9	5.6
Repayments	2.5	2.2	6.0	6.2	1.9	1.9	2.0	2.1	2.8	3.0	2.9	3.4
Commercial Borrowings, Net	4.3	(1.6)	(1.7)	(2.9)	5.2	2.5	16.1	22.6	7.9	2.0	12.5	10.3
Disbursements	9.6	2.7	3.5	5.2	9.1	14.3	20.9	30.3	15.2	15.0	24.1	32.6
Repayments	5.3	4.3	5.2	8.2	3.9	11.8	4.8	7.7	7.4	13.0	11.6	22.2
Short-Term Credit (Supplier's Credit)	0.6	(0.8)	1.0	1.4	3.8	3.7	6.6	15.9	(2.0)	7.6	11.0	6.7
Disbursements	11.2	5.6	5.2	11.1	17.4	21.5	30.0	47.7	41.8	53.3	75.7	102.8
Repayments	10.7	6.4	4.2	9.7	13.6	17.8	23.4	31.7	43.8	45.7	64.7	96.1
Bank Capital	(2.0)	2.9	10.4	6.0	3.9	1.4	1.9	11.8	(3.2)	2.1	5.0	16.2
of which: NRI Deposits (Net)	2.3	2.8	3.0	3.6	(1.0)	2.8	4.3	0.2	4.3	2.9	3.2	11.9
Disbursements	9.7	13.9	19.0	19.2	14.6	21.7	37.2	55.8	65.2	61.5	92.3	89.9
of which: NRI Deposits	9.0	11.4	10.2	14.3	8.1	17.8	19.9	29.4	37.1	41.4	49.3	64.3
Repayments	11.7	11.0	8.5	13.2	10.7	20.3	35.3	44.1	68.5	59.4	87.4	73.7
of which: NRI Deposits	6.7	8.7	7.2	10.6	9.0	15.0	15.6	29.2	32.9	38.4	46.0	52.4
Rupee Debt Service	(0.6)	(0.5)	(0.5)	(0.4)	(0.4)	(0.6)	(0.2)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)
Other Capital	0.3	0.8	0.6	1.7	0.7	1.2	4.2	11.0	(5.9)	(13.2)	(11.0)	(6.9)
Disbursements	2.9	2.3	1.8	4.3	6.7	5.9	8.2	29.2	16.7	11.5	9.9	13.3
Repayments	2.6	1.5	1.3	2.6	6.1	4.7	4.0	18.3	22.6	24.6	20.9	20.2
Errors and Omissions	(0.3)	(0.2)	(0.2)	0.6	0.6	(0.5)	1.0	1.3	0.4	(0.0)	(3.0)	(2.4)
Overall Balance	5.9	11.8	17.0	31.4	26.2	15.1	36.6	92.2	(20.1)	13.4	13.1	(12.8)
Foreign Exchange Reserves	42.9	54.7	76.1	113.0	141.5	151.6	199.2	309.7	252.0	279.1	304.8	294.4
Foreign Currency Assets	39.6	51.0	71.9	107.4	135.6	145.1	191.9	299.2	241.4	254.7	274.3	260.1
Gold	2.7	3.0	3.5	4.2	4.5	5.8	6.8	10.0	9.6	18.0	23.0	27.0
SDRs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	4.6	4.5
Reserve Trench Position in IMF	0.6	0.6	0.7	1.3	1.4	0.8	0.5	0.4	1.0	1.4	2.9	2.8

Source: Reserve Bank of India, Hand Book of Statistics.

Table 3. 8d

India: Balance of Payments: Capital Account, 2000-01 to 2011-12

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Per cent of GDP												
Capital Account	1.9	1.7	2.1	2.7	3.9	3.1	4.8	8.6	0.6	3.8	3.6	3.6
Receipts	11.4	8.8	8.9	12.3	13.7	17.3	24.6	35.4	25.8	25.3	29.2	25.6
Payments	9.5	7.0	6.8	9.6	9.8	8.5	19.8	26.8	25.2	21.5	25.6	21.9
Foreign Investment	1.2	1.4	0.8	2.2	1.8	1.9	1.6	3.5	0.7	3.7	2.3	2.1
Inbound	3.7	3.1	2.7	5.3	6.5	9.3	14.0	21.9	14.0	14.5	16.9	12.5
Outbound	2.5	1.8	1.9	3.1	4.7	7.4	12.5	18.4	13.3	10.9	14.6	10.4
Foreign Direct Investment	0.7	1.0	0.6	0.4	0.5	0.4	0.8	1.2	1.8	1.3	0.5	1.2
FDI in India	0.8	1.2	1.0	0.7	0.8	1.1	2.4	2.8	3.4	2.4	1.5	1.8
FDI Abroad	0.2	0.3	0.3	0.3	0.3	0.7	1.6	1.5	1.6	1.1	1.0	0.6
Portfolio Investment	0.5	0.4	0.2	1.8	1.3	1.5	0.7	2.2	(1.1)	2.4	1.8	0.9
Inflow	2.9	1.9	1.7	4.6	5.7	8.2	11.6	18.9	10.5	11.7	14.8	9.9
Outflow	2.3	1.5	1.5	2.7	4.4	6.7	10.8	16.7	11.6	9.4	13.1	9.0
External Assistance, Net	0.1	0.2	(0.6)	(0.5)	0.3	0.2	0.2	0.2	0.2	0.2	0.3	0.1
Disbursements	0.6	0.7	0.6	0.5	0.5	0.4	0.4	0.3	0.4	0.4	0.5	0.3
Repayments	0.5	0.5	1.1	1.0	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Commercial Borrowings, Net	0.9	(0.3)	(0.3)	(0.5)	0.7	0.3	1.7	1.8	0.6	0.1	0.7	0.6
Disbursements	2.0	0.5	0.7	0.8	1.3	1.7	2.2	2.4	1.2	1.1	1.4	1.7
Repayments	1.1	0.9	1.0	1.3	0.5	1.4	0.5	0.6	0.6	1.0	0.7	1.2
Short-Term Credit (Supplier's Credit)	0.1	(0.2)	0.2	0.2	0.5	0.4	0.7	1.3	(0.2)	0.6	0.6	0.4
Disbursements	2.4	1.1	1.0	1.8	2.4	2.6	3.2	3.8	3.4	3.9	4.4	5.5
Repayments	2.3	1.3	0.8	1.6	1.9	2.1	2.5	2.6	3.6	3.3	3.8	5.1
Bank Capital	(0.4)	0.6	2.0	1.0	0.5	0.2	0.2	0.9	(0.3)	0.2	0.3	0.9
Of Which: NRI Deposits (Net)	0.5	0.6	0.6	0.6	(0.1)	0.3	0.5	0.0	0.3	0.2	0.2	0.6
Disbursements	2.1	2.8	3.6	3.1	2.0	2.6	3.9	4.5	5.3	4.5	5.4	4.8
Of Which: NRI Deposits	1.9	2.3	2.0	2.3	1.1	2.1	2.1	2.4	3.0	3.0	2.9	3.4
Repayments	2.5	2.2	1.6	2.1	1.5	2.4	3.7	3.6	5.6	4.3	5.1	3.9
Of Which: NRI Deposits	1.4	1.8	1.4	1.7	1.3	1.8	1.6	2.4	2.7	2.8	2.7	2.8
Rupee Debt Service	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Other Capital	0.1	0.2	0.1	0.3	0.1	0.1	0.4	0.9	(0.5)	(1.0)	(0.6)	(0.4)
Disbursements	0.6	0.5	0.4	0.7	0.9	0.7	0.9	2.4	1.4	0.8	0.6	0.7
Repayments	0.5	0.3	0.2	0.4	0.8	0.6	0.4	1.5	1.8	1.8	1.2	1.1
Errors and Omissions	(0.1)	(0.0)	(0.0)	0.1	0.1	(0.1)	0.1	0.1	0.0	(0.0)	(0.2)	(0.1)

(Contd...)

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Per cent of GDP												
Overall Balance	1.2	2.4	3.2	5.1	3.6	1.8	3.9	7.4	(1.6)	1.0	0.8	(0.7)
Foreign Exchange Reserves	9.0	11.1	14.6	18.3	19.6	18.2	21.0	25.0	20.6	20.4	17.8	15.7
Foreign Currency Assets	8.3	10.4	13.7	17.4	18.8	17.4	20.2	24.1	19.7	18.6	16.0	13.9
Gold	0.6	0.6	0.7	0.7	0.6	0.7	0.7	0.8	0.8	1.3	1.3	1.4
SDRs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.2
Reserve trench position in IMF	0.1	0.1	0.1	0.2	0.2	0.1	0.0	0.0	0.1	0.1	0.2	0.2
GDP (US$ BILLION)	474.7	492.4	522.9	617.6	721.6	834.2	948.4	1239.3	1226.1	1366.2	1711.0	1872.9

Source: Reserve Bank of India, Hand Book of Statistics.

What is also noteworthy in the developments expected in the current account is the increase in factor payments expected over time as a consequence of the debt and equity flows needed as external savings for financing the projected investments. From the existing factor payment of about $26 billion in 2011-12, including interest and other payments, this may be expected to rise to about $60 billion by 2016-17, and then increasing to about $80 billion, $130 billion and $220 billion annually during the 13th, 14th and 15th Plan. As a proportion of GDP, factor payments amount to around 1.8 per cent of GDP: this would increase to about 3 per cent of GDP by the 15th Plan (Table 3.9b). These projections attempt to quantify the servicing of debt and equity flows that have been projected.

THE CAPITAL ACCOUNT

In arriving at feasible estimates of the external savings that can be projected for financing investment in India, the key issue that has to be considered is the sustainability of external capital flows. There has been an increasing tendency to focus on external flows for the financing of infrastructure and transport investment in recent years. Our approach is to estimate the level of feasible capital flows while aiming to keep the current account deficit at around 2.5 per cent of GDP after the 12th Plan period. Owing to the expanded CAD in 2010-13, the average CAD will be higher than this during the 12th Plan period at around 3.6 per cent of GDP, tapering from 4.8 per cent in 2012-13 to 2.6 per cent in 2016-17. This can be achieved by keeping the CAD broadly stable at around $80 billion through the rest of this Plan period, and in the next Plan period (2017-22). We have then kept the CAD constant in the region of 2.5 per cent of GDP in subsequent Plan periods, which is what we consider prudent. The volatility of capital flows experienced in the first half of 2013, along with the corresponding pressure on the exchange rate illustrate the difficulties that can arise as a consequence of expansion of the CAD and corresponding external debt flows.

In estimating the total capital flows needed, we have also kept under consideration the need to keep foreign exchange reserves at prudent levels that are necessary for ensuring financial stability and to deal with situations that may arise from volatility in capital flows. We have therefore aimed to keep the foreign exchange reserves in the region of six months of imports of goods and services. With trade projected to grow faster than GDP, this implies stepping up reserves from just under 16 per cent of GDP in 2011-12 to about 19, 20 and 22 per cent in the 13th, 14th and 15th Plans. To put things in context, the foreign exchange reserves of China amounted to $3.4 trillion at end-2012, about 18 months of imports of goods and services and 41 per cent of GDP. This criterion implies that net capital flows have to be in excess of CAD by the required additions to reserves. Incidentally, the expansion in reserves is also necessary for the required expansion of base money, the Reserve Bank of India's balance sheet, that is necessary to fuel the monetary expansion consistent with projected GDP growth.

Consequently, while keeping the CAD at around 2.5 per cent of GDP, net capital flows will need to be in excess of 4 per cent of GDP through the whole period considered, nearing 4.5-5.0 per cent during the 15th Plan period (Table 3.9).

During the last two decades, there has been a process of continued phased liberalisation of the capital account. Consequently, the share of FDI as a proportion of GDP has gone up from 0.2 per cent of GDP in 1993-94 to 1.0 per cent in 2005-06 and further to 1.2 per cent during 2010-11. Net FDI flows are accordingly projected to keep increasing from 1.5 per cent of GDP ($32 billion) during the 12th Plan to 1.7 per cent ($50 billion and $80 billion) during the 13th Plan and 14th Plan respectively and just under 2 per cent ($130 billion) in the 15th Plan period. There has been a substantial rise in the outward FDI by Indian companies since 2006-07 due to liberalisation

Table 3. 9a

India: Balance of Payments: Summary, 2012-13 to 2031-32

	2012-13	2013-14	2014-15	2015-16	2016-17	FIVE YEAR PLANS (Annual Average) FY13-FY17	FY18-FY22	FY23-FY27	FY28-FY32
						12TH PLAN	13TH PLAN	14TH PLAN	15TH PLAN
US$ Billion									
Current Account Balance	(87)	(77)	(75)	(73)	(69)	(76)	(77)	(115)	(177)
Exports of Goods and Services	452	499	552	610	676	558	930	1,573	2,692
Exports of Goods, F.O.B.	307	343	384	429	481	389	683	1,206	2,137
Exports of Services	146	156	168	181	195	169	247	367	555
Imports of Goods and Services	582	619	672	733	800	681	1,073	1,775	2,992
Imports of Goods, C.I.F.	502	533	579	632	690	587	926	1,535	2,592
Imports of Services	81	86	93	101	110	94	146	240	400
Net Factor Income	(22)	(26)	(31)	(35)	(39)	(30)	(55)	(92)	(152)
Private Transfers (Net)	64	69	77	85	94	78	120	179	275
Official Transfers (Net)	0	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Foreign Investment	47	51	54	59	63	55	83	124	203
Foreign Direct Investment	20	31	33	36	39	32	52	78	133
Portfolio Investment	27	19	21	23	24	23	31	46	70
Commercial Borrowings	21	43	48	48	38	40	48	76	126
Overall Balance	4	22	33	38	37	23	56	86	151
Foreign Exchange Reserves	293	315	348	386	422	353	586	943	1,557
Memo Items									
(Per cent of GDP)									
Exports of Goods and Services	24.5	25.3	26.1	26.8	27.5	26.2	29.9	33.9	38.1
Imports of Goods and Services	31.6	31.4	31.8	32.2	32.6	32.0	34.5	38.3	42.3
Private Transfers (Net)	3.5	3.5	3.6	3.7	3.8	3.7	3.8	3.9	3.9
Current Account Balance	(4.7)	(3.9)	(3.5)	(3.2)	(2.8)	(3.6)	(2.5)	(2.5)	(2.5)
Foreign Investment	2.5	2.6	2.6	2.6	2.6	2.6	2.7	2.7	2.9
Foreign Direct Investment	1.1	1.6	1.6	1.6	1.6	1.5	1.7	1.7	1.9
Portfolio Investment	1.4	1.0	1.0	1.0	1.0	1.1	1.0	1.0	1.0
Commercial Borrowings, Net	1.1	2.2	2.3	2.1	1.6	1.9	1.5	1.6	1.8
(Per cent change in US$ terms)									
Exports of Goods and Services	0.4	10.4	10.5	10.6	10.7	8.5	10.9	11.2	11.4
Exports of Goods, F.O.B.	(1.0)	11.9	11.9	11.9	11.9	9.3	12.0	12.1	12.1
Exports of Services	3.4	7.2	7.4	7.8	7.9	6.7	8.0	8.4	8.8
Imports of Goods and Services	1.0	6.3	8.6	9.1	9.1	6.8	10.2	10.7	11.1
Imports of Goods, C.I.F.	0.4	6.4	8.6	9.1	9.1	6.7	10.2	10.7	11.1
Imports of Services	5.0	5.9	8.2	8.7	8.8	7.3	10.0	10.4	11.1
Reserves (as Months of G&S Imports)	6.0	6.1	6.2	6.3	6.3	6.2	6.6	6.4	6.2
GDPmp (US$ Billion)	1,843	1,971	2,113	2,275	2,453	2,131	3,109	4,634	7,071

Source: Reserve Bank of India, Hand Book of Statistics and NTDPC Estimates.

Table 3. 9b

India: Balance of Payments: Current Account, 2012-13 to 2031-32

	2012-13	2013-14	2014-15	2015-16	2016-17	FIVE YEAR PLANS (ANNUAL AVERAGE) FY13-FY17 12TH PLAN	FY18-FY22 13TH PLAN	FY23-FY27 14TH PLAN	FY28-FY32 15TH PLAN
US$ Billion									
Exports of Goods, F.O.B.	307	343	384	429	481	389	683	1,206	2,137
Petroleum Products	60	66	73	80	88	73	118	190	306
Manufactured Goods	191	215	243	275	311	247	455	839	1,545
Other Goods	56	62	68	74	82	68	110	177	285
Exports of Services	146	156	168	181	195	169	247	367	555
Imports of Goods, C.I.F.	502	533	579	632	690	587	926	1,535	2,592
POL and Other Energy	169	179	194	211	230	197	307	503	839
Capital Goods	96	104	114	127	140	116	191	331	581
Mainly Export Related	38	41	44	48	52	44	69	114	190
Other Imports	198	210	227	247	269	230	359	588	982
Imports of Services	81	86	93	101	110	94	146	240	400
Net Factor Income	(22)	(26)	(31)	(35)	(39)	(30)	(55)	(92)	(152)
Factor Receipts	13	12	13	15	17	14	24	40	68
Factor Payments	34	39	44	50	56	45	79	132	219
Of which: Interest payments	10	12	14	17	20	15	29	50	83
Of which: Other factor payments	25	27	30	32	35	30	49	83	136
Private Transfers (Net)	64	69	77	85	94	78	120	179	275
Private Transfers Receipts	67	72	79	88	97	81	123	183	280
Private Transfers Payments	3	3	3	3	3	3	3	4	5
Official Transfers (Net)	0	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Official Transfers Receipts	1	1	1	1	1	1	1	1	1
Official Transfers Payments	1	1	1	1	1	1	1	1	1
Current Account Balance	(87)	(77)	(75)	(73)	(69)	(76)	(77)	(115)	(177)

Source: Reserve Bank of India, Hand Book of Statistics and NTDPC projections.

of outward investment policies and efforts by Indian companies to compete better in the global economy. This trend may be expected to continue. The projections given here are in terms of net FDI; hence the implication is that incoming FDI will have to be significantly higher than the net projected to take account of the outward FDI from India (Table 3.9c and 3.9d).

The Indian capital market has picked up in terms of investments by 'Foreign Institutional Investors' (FII). Excluding 2008-09 (the crisis year), the average net FII inflows during 11th Plan worked out to over $26 billion. A glance at the record of FII inflows suggests high volatility in these flows, which are very dependent on perceptions of developments in the Indian economy, along with changing conditions in global financial markets. What may also be observed is that net flows are a fraction of gross inflows, since there is a constant churning of portfolio investments. Projections made are only for net FII flows.

Table 3. 9c

India: Balance of Payments: Capital Account, 2012-13 to 2031-32

	2012-13	2013-14	2014-15	2015-16	2016-17	FIVE YEAR PLANS (ANNUAL AVERAGE) FY13-FY17 12TH PLAN	FY18-FY22 13TH PLAN	FY23-FY27 14TH PLAN	FY28-FY32 15TH PLAN
US$ Billion									
Capital Account Balance	72	99	107	111	105	99	134	201	328
Foreign Investment	47	51	54	59	63	55	83	124	203
Direct Investment	20	31	33	36	39	32	52	78	133
Portfolio Investment	27	19	21	23	24	23	31	46	70
Commercial Borrowing	21	43	48	48	38	40	48	76	126
Disbursements	43	63	73	79	82	68	123	194	303
Repayments	22	20	25	31	44	28	75	118	177
Change in Reserves (- Increase/+ Decrease)	4	(22)	(33)	(38)	(37)	(23)	(56)	(86)	(151)
Total External Debt	360	408	461	513	556	460	702	1,026	1,544
External Debt Service	37	37	45	55	71	49	112	176	271
Short-term debt	78	79	84	88	95	85	125	199	359
Foreign Exchange Reserves	293	315	348	386	422	353	586	943	1,557
Foreign Exchange Reserves (as Months of G & S Imports)	6.0	6.1	6.2	6.3	6.3	6.2	6.6	6.4	6.2
Foreign Exchange Reserves (Percentage of GDP)	15.9	16.0	16.5	16.9	17.2	16.6	18.8	20.3	22.0
Memo Item									
GDP (US$ Billion)	1,843	1,971	2,113	2,275	2,453	2,131	3,109	4,634	7,071

Source: Reserve Bank of India, Hand Book of Statistics and NTDPC projections.

Net portfolio investment is seen to be about 1.1 per cent of GDP in 2012-17 and then projected to stay at about 1.0 per cent of GDP during the subsequent Plan periods. Some would find such a foreign investment profile to be too conservative. Even with such a profile, the servicing of the accumulated stock of foreign equity capital, including both FDI and portfolio investment, would rise to 1.5-1.6 per cent of GDP by 2012-17 and increase by 0.1 percentage points in each of the subsequent Plan periods.

How do we project overall foreign equity and debt flows? In general, foreign equity flows are deemed better than debt flows from the point of view of financial stability. On the other hand, from the point of view of infrastructure and transport investments, it is felt necessary to attract long-term debt flows. In order to keep a reality check, we have observed the current overall debt-equity ratios in the Indian corporate sector. This comes to about 70:100, or say, about 2:3. We have therefore projected the debt flow/equity flow ratios in overall capital flows at roughly this ratio through the period projected (Table 3.9c).

In fact, infrastructure projects actually tend to have higher debt-equity ratios. Moreover, one of the advantages of receiving foreign equity inflows is that it is then easier to leverage foreign debt inflows at more favourable rates. However, the existing high level of Indian foreign debt of approximately $390 billion (March 2013) reduces the degree of flexibility in receiving larger inflows of new foreign debt flows in the near term future. Thus, the recent expansion of debt flows will need to be restrained for the rest of the 12th Plan period. The projections suggest that as a consequence of this recent increase in debt, repayment levels will increase during the 13th Plan period, thus reducing net flows even if gross flows are adequate. As may be appreciated, these projections are difficult to make. Whereas our projections are suggesting a roughly 3:2 ratio between equity and debt flows, there may be some room for

Table 3. 9d

India: Balance of Payments: Capital Account, 2012-13 to 2031-32

	2012-13	2013-14	2014-15	2015-16	2016-17	FIVE YEAR PLANS (ANNUAL AVERAGE) FY13-FY17 12TH PLAN	FY18-FY22 13TH PLAN	FY23-FY27 14TH PLAN	FY28-FY32 15TH PLAN
Per cent of GDP									
Capital Account Balance	3.9	5.0	5.1	4.9	4.3	4.6	4.3	4.3	4.6
Foreign Investment	2.5	2.6	2.6	2.6	2.6	2.6	2.7	2.7	2.9
Direct Investment	1.1	1.6	1.6	1.6	1.6	1.5	1.7	1.7	1.9
Portfolio Investment	1.4	1.0	1.0	1.0	1.0	1.1	1.0	1.0	1.0
Commercial Borrowing (Net)	1.1	2.2	2.3	2.1	1.6	1.9	1.5	1.6	1.8
Disbursements	2.3	3.2	3.4	3.5	3.4	3.2	4.0	4.2	4.3
Repayments	1.2	1.0	1.2	1.4	1.8	1.3	2.4	2.5	2.5
Change in Reserves (- Increase/+ Decrease)	(0.2)	(1.1)	(1.5)	(1.7)	(1.5)	(1.1)	(1.8)	(1.9)	(2.1)
Total External Debt	19.5	20.7	21.8	22.6	22.7	21.6	22.6	22.1	21.8
External Debt Service	2.0	1.9	2.1	2.4	2.9	2.3	3.6	3.8	3.8
Short-Term Debt	4.2	4.0	4.0	3.8	3.9	4.0	4.0	4.3	5.1
Foreign Exchange Reserves	15.9	16.0	16.5	16.9	17.2	16.6	18.8	20.3	22.0
Memo Item									
GDP (US$ Billion)	1,843	1,971	2,113	2,275	2,453	2,131	3,109	4,634	7,071

Source: Reserve Bank of India, Hand Book of Statistics and NTDPC projections.

adjusting this composition to increase the share of debt flows. From the point of view of infrastructure and transport projects, which typically have higher leverage ratios, the composition of external capital flows may need to be tweaked somewhat in favour of debt, while keeping in mind the implications for interest payments and debt repayments. We have not attempted to change our projections in this direction.

The debt repayments for external commercial borrowing are expected to rise from the current $28 billion to about $75 billion during the 13th Plan, rising to about $180 billion annually during the 15th Plan. Consequently, substantial increases in gross external commercial borrowing will have to take place if the projected level of net debt flows are to materialise. The projections suggest that gross external commercial borrowing (including private non-guaranteed) will have to increase from about $33 billion in 2011-12 to average annual gross inflows of about $70 billion in the 12th Plan and $120 billion in the 13th Plan and rising to $300 billion in the 15th Plan. Furthermore, the external commercial borrowing policy should be tilted towards encouraging long-term debt flows to infrastructure. If external commercial borrowings continue to be controlled during this period, these are the kind of magnitudes which would have to be permitted so that appropriate capital inflows take place to fuel the increasing needs for overall investment.

With most of new debt being expected to be private non-guaranteed, these projections are crucially dependent on continuing improvement in India's sovereign credit rating, and of its corporate entities, both public and private, investing in the infrastructure and transport sector, along with its financial institutions internationally. In order to facilitate good credit ratings, and to provide adequate cushion in the face of rising capital inflows, imports levels and debt servicing requirements, our projections have provided for a cover of foreign exchange reserves at about 6 months of imports. The reserves are thus projected to rise from approximately *$290 billion (March 2013) to an average of $350 billion in the 12th Plan to $590 billion in the 13th Plan and rising to $1.5 trillion by the 15th Plan*. Sudden unforeseen shocks occurring internationally or within the domestic economy should then not have significant effects on the international confidence. It is also important to understand that with rising exposure of the domestic economy to trade and to foreign debt and equity, large volatility in the domestic currency would cause considerable difficulty to domestic firms, particularly in infrastructure sectors, to service their external obligations. A relatively high level of reserves should then help in maintaining a stable real exchange rate. In order to provide this continuing accretion to reserves, capital inflows have therefore to be somewhat higher than the current account deficit at any given time.

The mobilisation of such external capital inflows will be crucial for infrastructure and transport investment. As emphasised earlier, the maintenance of good credit ratings will be essential to impart confidence to would-be investors. The substantial and ambitious trade expansion projected would form the basis of market confidence in India's ability to service such external liabilities of both equity and debt. **A key lesson of this exercise is that continuing expansion of trade, both imports and exports, is crucial for the financing of growing domestic investment in India, and particularly that of infrastructure.** Finally, sustaining a current account deficit of much higher than 2.5 per cent of GDP is unlikely to be viable in the foreseeable future. This provides the maximum feasible limit on the volume of foreign savings that can be prudently absorbed, although, keeping in mind the need for adding to reserves, net capital flows will need to be at around 4.5 per cent of GDP (Table 3.9d).

As mentioned in the beginning, these projections of external capital inflows have been made on a judgemental basis on what the markets would be willing to lend to and invest in India based on the fundamentals of the economy. **The debt service ratio** according to these projections **would range between about 3 to 6 per cent as a proportion of current receipts over the next 20 years**. Exports as a percentage of GDP would rise from current 28 per cent of GDP to about 40 per cent, while imports would rise from the current 30 per cent to about 42 per cent. The implications of these projections is that export expansion and an open regime for equity flows, especially foreign direct investment will be essential to mobilise the volume of capital inflows projected.

Within these overall projections for external capital ,inflows the volume flowing into the infrastructure sectors will depend on how hospitable the regulatory regimes are in each sector for foreign investment. As in the other sectors, external commercial debt would tend to be closely associated with foreign investment. In sectors such as power and telecommunications, foreign equity inflows would tend to be associated with suppliers' credits as well as credits from official export credit agencies such as US EXIM Bank, the Japanese EXIM Bank and others. Since the repayment for both equity and debt associated with infra¬structure projects would have a longer duration, the payment burden arising from such capital inflows would be stretched out over time if the proportion of such inflows going into infra¬structure can be maintained at a high level. In our projections for the financing of infrastructure

Since infrastructure projects typically have higher leverage ratios, the composition of external capital flows may need to be tweaked somewhat in favour of debt, while keepiing in mind implcations of repayment issues

investment requirements, we have assumed that a total of about 40 per cent of external capital in¬flows would flow to the infrastructure sector.

Even somewhat conservative projections of the current account deficit at about 2.5 per cent of GDP by 2031-32, and optimistic assumptions of trade expansion, yield quite large volumes of capital inflows. Total net capital inflows are projected to rise from the current **$90 billion (2012-13) to about $110 billion by the end of the 12th Five Year Plan,** $135 billion, $200 billion, $330 billion, annually in the 13th, 14th and 15th Plans, divided between debt and foreign equity with the latter being preferably somewhat higher.

With these projections, the stock of total debt would rise to about **$550 billion by 2016-17, $700 billion average during the 13th Plan and $1.5 trillion by the 15th Plan period.** Debt service payments would rise to about **$130 billion by 2021-22 and $300 billion by 2031-32 (Tables 3.10, 3.11, 3.12).** Such magnitude of flows, both inflows and out flows, are not feasible to maintain without healthy and sustained overall economic growth of the kind that has been projected and prudent macroeconomic and financial policies. And this will only be possible if there is no further widening of the current account deficit.

Capital flows should tend to be higher in those infrastructure areas where the cash flow already forms a natural hedge and it is denominated in US dollars. Some of these areas are ports, airports, airlines, and telecommunications.

There are some problems for certain areas where infrastructure investment does not receive such high cash flows. These areas are more likely to be rupee-denominated, for example roads and the power sector. Another problem relates to the volume of infrastructure financing which depends on how long it takes to receive returns on investments. In many cases, the returns occur over very long periods of time (from 30 to 100 years), whereas financing returns are usually needed in a much shorter time. Another problem related to the Indian financial system is that it does not have much long-term debt available. These problems could be partially solved if international capital markets feel that the country has a sustainable current account, with a small possibility of widening it. Moreover, as already emphasised, growth of pensions and other long-term contractual savings is crucial for development of long-term debt markets in the country.

Thinking about the rules for foreign equity investment in India, most of the investments do not require approval of the Indian government. Infrastructure companies have also tapped external credit markets. About a third of external commercial borrowings (ECBs) in the 11th Plan were for infrastructure, particularly air transport (aircraft), telecom, and power equipment. There was very little external commercial borrowing for the transport sectors, except for aircraft acquisition.

For the future, a judicious balance is envisaged between debt and non-debt-creating inflows. Both kinds of inflows need to be serviced. In principle, the returns on equity ought to be higher than those on debt. But the returns on equity are performance-related, and therefore better for financial stability than those on debt. More over, a portion of the returns on FDI tends to be continually reinvested. Such retained earnings finance new investment but also need to be serviced in future years. The simulations have taken account of this. FDI is, by its nature, less mobile: once invested, it is not usually expected to be disinvested for a long period of time, if ever.

Capital flows should tend to be higher in those transport infrastructure sectors where the cash flow already forms a natural hedge and is denominated in US dollars. Some of these areas are ports, airports, airlines, and telecommunications

The debt projections have assumed average debt terms of seven years maturity and returns of 150 basis points above LIBOR. The net debt inflow is limited by the debt service targets mentioned above.

INVESTMENT IN INFRASTRUCTURE AND TRANSPORT REQUIRED FOR ECONOMIC GROWTH

Achieving a high sustained rate of economic growth requires corresponding investments in infrastructure, including all aspects of transportation. As argued earlier, industrial growth will need to be accelerated in particular, which place higher demands on the provision of power, transportation and logistics. The continued expansion of trade requires corresponding investment in ports, airports and all forms of domestic transport linkages as well.

Broad magnitudes of the trends expected in the demand for transport have been indicated in Chapter 2. In this section, we obtain broad orders of magnitude of infrastructure investment, and transport investment in particular, that will be consistent with growth in macroeconomic magnitudes, while maintaining appropriate domestic and external alances.

INFRASTRUCTURE INVESTMENT: A HISTORICAL PERSPECTIVE:

In order to estimate the infrastructure requirements over the next 20 years, it is useful to look at its investment history since the 1990s. The key infrastructure categories are electricity, gas and water supply (EGW) and transport, storage and communication (TSC). For a more detailed break-up, TSC is sub-divided into railways, other transport (roads, ports, airports, aviation, trucks, buses etc.), storage and communication. Urban infrastructure is not isolated as a separate category in the National Accounts; therefore, a part of this will be included in water supply (including sanitation) and urban transport will be incorporated in 'other transport'.

The estimates for infrastructure investment provided in this chapter are based on National Accounts estimates for gross domestic capital formation (GDCF). These estimates are typically lower than those usually made for infrastructure investment by the Planning Commission and other agencies[16]. For example, expenditures made for buying land in the process of making infrastructure investments are not included in GDCF since such expenditures are regarded as transfer payments in the GDP context. Nonetheless, such expenditures are real expenditures from the point of view of the investor, public or private. Apart from land, there are also other definitional differences. In addition, with the increase in the number of PPP projects in recent years, the statistical system is yet to fully devise procedures to cover these investments on a systemic basis. It is therefore likely that GDCF estimates according to National Accounts may be underestimated for recent year Whereas it is difficult to arrive at precise estimates, such underestimation could be of the order of 1 to 1.5 per cent of GDP.

As a proportion of GDP, total GDCF in infrastructure (National Accounts basis) ranged from about 3.9 per cent to 4.4 per cent, averaging 4.1 per cent of GDP during the 1990s. In the 2000s, the average was about 5.0 per cent. Currently, total investment in infrastructure is around 5.3 per cent. The absolute amount of investment on infrastructure in 1993-94 was about Rs 420 billion ($13.2 billion). The corresponding figure for 2001-02, the last year of the 9th Plan, was about Rs 1,070 billion ($22 billion), Rs 2,150 billion ($47 billion) at the end of the 10th Plan in 2006-07, and Rs 4,900 billion ($102 billion) in 2011-12 at the end of the 11th Plan, all in current prices (Table 3.13). Thus, there has

16. Planning Commission (2011a)

Table 3.10

India: External Debt Summary, 2000-01 to 2011-12

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
US$ Billion												
Multilateral	31.1	31.9	30.0	29.3	31.7	32.6	35.3	39.5	39.5	42.9	48.5	50.5
Government Borrowing	27.4	28.3	27.3	26.8	29.2	30.0	32.5	36.2	35.7	37.8	42.6	43.7
Concessional	19.1	19.7	21.6	22.7	24.0	23.7	24.9	26.9	25.1	25.7	27.0	27.2
Non-Concessional	8.3	8.6	5.7	4.2	5.2	8.4	7.6	9.3	10.6	12.1	15.6	16.5
Non-Government Borrowing	3.7	3.6	2.7	2.5	2.5	2.6	2.8	3.3	3.8	5.0	5.9	6.8
Concessional	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non - Concessional	3.7	3.6	2.7	2.5	2.5	2.6	2.8	3.3	3.8	5.0	5.9	6.8
Bilateral	16.0	15.3	16.8	17.3	17.0	15.8	16.1	19.7	20.6	22.6	25.7	26.8
Government Borrowing	12.2	11.5	12.7	13.0	13.1	12.2	12.3	14.9	14.7	15.9	18.0	18.0
Concessional	11.9	11.4	12.5	12.9	13.1	12.2	12.3	14.9	14.7	15.9	18.0	18.0
Non-Concessional	0.3	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-Government Borrowing	3.8	3.8	4.1	4.3	3.9	3.5	3.7	4.9	6.0	6.7	7.7	8.8
Concessional	1.2	1.4	1.7	2.0	1.7	1.6	0.4	0.4	0.6	0.7	0.9	1.3
Non-Concessional	2.6	2.4	2.5	2.3	2.2	2.0	3.3	4.4	5.3	6.0	6.8	7.4
International Monetary Fund	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.1	1.0	6.0	6.3	6.2
Trade Credit	5.9	5.4	5.0	4.7	5.0	5.4	7.2	10.3	14.5	16.8	18.6	19.9
Commercial Borrowings	24.4	23.3	22.5	22.0	26.4	26.5	41.4	62.3	62.5	70.7	88.6	104.4
NRI Deposits	16.6	17.2	23.2	31.2	32.7	36.3	41.2	43.7	41.6	47.9	51.7	58.6
Rupee Debt	3.7	3.0	2.8	2.7	2.3	2.1	2.0	2.0	1.5	1.7	1.6	1.4
Total Long-Term Debt	97.7	96.1	100.2	108.2	116.3	119.6	144.2	178.7	181.2	208.6	240.9	280.7
Short-Term Debt	3.6	2.7	4.7	4.4	17.7	19.5	28.1	47.0	49.4	52.3	65.0	65.1
Gross Total Debt	101.3	98.8	104.9	112.7	134.0	139.1	172.4	224.4	224.5	260.9	305.9	345.8
Memo Items												
Concessional Debt as Per cent of Total Debt	35.4	35.9	36.8	35.8	30.7	28.4	23.0	19.7	18.7	16.8	15.5	15.6
Short Term Debt as Per cent of Total Debt	3.6	2.8	4.5	3.9	13.2	14.0	16.3	20.4	19.3	20.0	21.2	22.6
Debt Stock-GDP Ratio	22.5	21.1	20.3	18.0	18.1	16.8	17.5	18.0	20.3	18.3	17.8	20.0
Short Term Debt as Per cent of Foreign Reserves	8.5	5.0	6.1	3.9	12.5	12.9	14.1	15.2	19.6	18.8	21.3	22.1
Debt Service Ratio (Per cent)	16.6	13.7	16.0	16.1	5.9	10.1	4.7	4.8	4.4	5.8	4.3	6.0
Foreign Exchange Reserves	42.9	54.7	76.1	113.0	141.5	151.6	199.2	309.7	252.0	279.1	304.8	294.4
GDPmp (US$ Billion)	475	492	523	618	722	834	948	1239	1226	1366	1711	1873

Source: Reserve Bank of India, Handbook of Statistics.

Table 3.11
India: External Debt Service, 2001-02 TO 2011-12

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
US$ Billion											
Multilateral	2.2	5.9	4.6	1.3	1.5	1.9	2.1	2.0	2.1	2.3	2.5
Principal	1.4	5.1	4.1	0.9	1.1	1.1	1.3	1.4	1.6	1.9	2.0
Interest	0.8	0.8	0.5	0.4	0.5	0.7	0.8	0.6	0.5	0.5	0.5
Bilateral	1.5	1.6	2.9	2.0	1.5	1.4	1.6	1.9	2.0	2.1	2.3
Principal	1.1	1.2	2.5	1.5	1.2	1.0	1.1	1.3	1.4	1.5	1.6
Interest	0.4	0.5	0.4	0.4	0.3	0.4	0.5	0.6	0.6	0.5	0.7
IMF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Principal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Export Credit	1.2	1.4	1.1	0.7	1.3	1.0	2.0	1.7	2.0	2.1	3.2
Principal	0.9	1.2	0.9	0.6	1.1	0.6	1.3	1.2	1.4	1.7	2.7
Interest	0.3	0.2	0.2	0.1	0.2	0.4	0.6	0.6	0.7	0.5	0.5
Commercial Borrowings	3.9	4.4	8.6	3.4	13.1	5.0	7.3	8.3	12.1	10.7	21.1
Principal	2.8	3.6	6.7	2.6	10.4	3.0	4.5	5.2	9.8	7.8	16.6
Interest	1.1	0.8	1.8	0.8	2.7	2.0	2.8	3.2	2.3	2.9	4.5
NRI Deposits	1.8	1.4	1.6	1.4	1.5	2.0	1.8	1.5	1.6	1.7	2.3
Interest	1.8	1.4	1.6	1.4	1.5	2.0	1.8	1.5	1.6	1.7	2.3
Rupee Debt	0.5	0.5	0.4	0.4	0.6	0.2	0.1	0.1	0.1	0.1	0.1
Principal	0.5	0.5	0.4	0.4	0.6	0.2	0.1	0.1	0.1	0.1	0.1
Total Debt Service	11.1	15.2	19.2	9.2	19.6	11.4	14.9	15.6	19.9	19.1	31.5
Principal	6.8	11.5	14.6	6.1	14.3	5.9	8.3	9.1	14.2	13.0	23.0
Interest	4.3	3.7	4.6	3.0	5.2	5.5	6.6	6.5	5.7	6.1	8.5
Memo Items											
Current Receipts	81.0	95.2	119.2	154.1	194.2	242.8	314.3	356.2	345.1	448.1	528.4
Debt Service Ratio	13.7	16.0	16.1	5.9	10.1	4.7	4.8	4.4	5.8	4.3	6.0
Interest Current Receipts	5.4	3.9	3.8	2.0	2.7	2.3	2.1	1.8	1.7	1.4	1.6

Source: Ministry of Finance, India's External Debt - A Status Report 2011-12.

been substantial growth in absolute terms. As a proportion of GDP also, GDCF in infrastructure has increased from 4.2-4.3 per cent in the 8th and 9th Plans to around 5.8 per cent of GDP in the 11th Plan, although as mentioned earlier, there is reasonable likelihood that private investment in infrastructure has been underestimated in PPP projects during the 11th Plan. Looking at different infrastructure sectors, investment in electricity, gas and water supply has been relatively stable at around 1.5 to 1.7 per cent during the 9th and 10th Plans, rising to about 2.1 per cent during the 11th Plan. Investment in transport has increased significantly from about 1.5 to 1.6 per cent in the 1990s to around 2.5 to 2.6 per cent in the 11th Plan period. Within transport, what has increased is investment in roads and bridges, from about 0.4 per cent of GDP in 2000-01 to about 1.2 per cent by 2011-12. This is manifested by the National Highway Development Project (NHDP) and the Pradhan Mantri Gram Sadak Yojana (PMGSY) (Prime Minister's Rural Roads Programme). Over the same period, investment in railways has been stagnant at around 0.4 per cent of

Table 3.12
India: External Debt Summary, 2012-13 to 2031-32

	2012-13	2013-14	2014-15	2015-16	2016-17	FIVE YEAR PLANS (ANNUAL AVERAGE)			
						FY13-FY17	FY18-FY22	FY23-FY27	FY28-FY32
						12TH PLAN	13TH PLAN	14TH PLAN	15TH PLAN
US$ Billion									
A. Disbursements									
Public & Publicly Guaranteed	17.9	23.1	28.0	32.7	32.6	26.9	32.0	31.5	31.5
2. Private Creditors	7.5	12.3	17.1	22.0	22.0	16.2	22.0	22.0	22.0
a. Bonds	5.0	10.0	15.0	20.0	20.0	14.0	20.0	20.0	20.0
b. Commercial	2.5	2.2	2.1	2.0	2.0	2.2	2.0	2.0	2.0
c. Other Private	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-
Private Non-Guaranteed	35.0	50.5	50.3	53.3	53.2	48.5	90.2	154.3	236.7
Total From Long-Term Loans	52.9	73.6	78.4	86.0	85.8	75.3	122.2	185.8	268.2
IMF Purchases	-	-	-	-	-	-	-	-	-
Net Short-Term Capital	-	0.7	5.4	3.5	7.3	3.4	11.2	17.3	44.4
Total Disbursements (LT+IMF+ST)	52.9	74.3	83.7	89.5	93.0	78.7	133.4	203.1	312.6
B. External Debt									
Public & Publicly Guaranteed	112.9	123.5	137.2	155.4	168.4	139.5	188.9	196.9	197.4
2. Private Creditors	32.3	38.0	46.9	60.6	69.6	49.5	81.1	81.3	81.0
a. Bonds	16.8	21.6	29.7	45.2	56.4	33.9	68.8	70.0	70.0
b. Commercial	15.5	16.4	17.1	15.4	13.1	15.5	12.2	11.2	11.0
c. Other Private	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
Private Non-Guaranteed	163.1	200.1	234.0	264.4	286.4	229.6	382.3	623.4	982.4
Total from Long-Term Loans	276.0	323.6	371.2	419.8	454.8	369.1	571.2	820.3	1,179.8
Use of IMF Credit	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
Net Short-Term Capital	78.1	78.7	84.1	87.6	94.8	84.6	124.5	199.3	358.6
Total DOD (LT+IMF+ST)	360.1	408.5	461.4	513.5	555.7	459.8	701.8	1,025.7	1,544.5
Memo Items (Per cent)									
Disbursements/GDP	2.9	3.8	4.0	3.9	3.8	3.7	4.3	4.4	4.4
External Debt/GDP	19.5	20.7	21.8	22.6	22.7	21.6	22.6	22.1	21.8
External Debt/Current Receipts	67.7	70.0	71.6	72.0	70.4	70.5	65.1	57.1	50.8
Short-Term Debt/External Debt	21.7	19.3	18.2	17.1	17.1	18.4	17.7	19.4	23.2
Concessional Debt/Total Debt	15.4	14.4	13.3	12.5	12.0	13.3	10.4	8.0	5.6
Short-Term Debt/Reserves	28.8	26.8	25.8	24.1	23.7	25.6	22.1	21.6	23.4
GDPmp (US$ Billion)	1,843	1,971	2,113	2,275	2,453	2,131	3,109	4,634	7,071
Current Receipts (US$ Billion)	532	584	644	713	790	653	1,077	1,797	3,039
Reserves (US$ billion)	271	293	326	364	401	331	564	921	1,535

Source: The World Bank Debt Reporting System and NTDPC Projections.

Table 3.13a

India: Investments in Infrastructure, 2000-01 to 2011-12

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
(RUPEES BILLION IN CURRENT PRICES)												
Infrastructure - Total	981	1,071	1,096	1,232	1,489	1,867	2,149	2,586	3,574	4,031	4,516	4,891
Electricity, Gas, Water Supply	365	402	390	507	533	674	837	982	1,182	1,360	1,730	1,892
Railways	54	68	91	109	131	154	183	222	297	318	312	312
Other Transport	222	195	281	303	368	428	378	501	692	700	734	1,002
Roads and Bridges	78	169	170	219	280	354	499	544	671	789	921	1,057
Storage	13	15	14	14	-3	7	8	10	18	21	25	37
Communications	249	221	150	80	180	251	244	327	714	843	794	590
Infrastructure - Public Sector	720	806	743	944	977	1,246	1,588	1,910	2,292	2,544	2,680	2,890
Electricity, Gas, Water Supply	319	332	311	447	452	590	758	861	1,030	1,145	1,344	1,477
Railways	55	70	89	108	131	154	183	222	297	318	312	312
Other Transport	38	27	35	32	34	59	83	200	168	157	139	130
Roads and Bridges	78	169	170	219	280	354	499	544	671	789	808	923
Storage	13	14	14	13	-5	0	1	0	0	3	7	11
Communications	218	194	125	125	84	89	64	82	127	133	70	36
Infrastructure - Private Sector	262	265	352	288	512	621	560	676	1,282	1,486	1,836	2,001
Electricity, Gas, Water Supply	47	71	79	60	81	83	79	120	152	215	386	415
Railways	-1	-2	2	1	0	0	0	0	0	0	0	0
Other Transport	184	168	246	271	334	369	295	301	524	543	595	872
Roads and Bridges	0	0	0	0	0	0	0	0	0	0	113	134
Storage	0	1	1	1	1	7	7	9	18	18	18	26
Communications	31	27	25	-45	96	162	180	245	587	711	724	554
(US$ BILLION IN CURRENT PRICES)												
Infrastructure - Total	21.5	22.4	22.6	26.8	33.1	42.2	47.5	64.3	77.8	85.0	99.1	102.1
Electricity, Gas, Water Supply	8.0	8.4	8.1	11.0	11.9	15.2	18.5	24.4	25.7	28.7	37.9	39.5
Railways	1.2	1.4	1.9	2.4	2.9	3.5	4.0	5.5	6.5	6.7	6.8	6.5
Other Transport	4.9	4.1	5.8	6.6	8.2	9.7	8.3	12.5	15.1	14.8	16.1	20.9
Roads and Bridges	1.7	3.5	3.5	4.8	6.2	8.0	11.0	13.5	14.6	16.6	20.2	22.1
Storage	0.3	0.3	0.3	0.3	-0.1	0.1	0.2	0.2	0.4	0.4	0.5	0.8
Communications	5.5	4.6	3.1	1.8	4.0	5.7	5.4	8.1	15.6	17.8	17.4	12.3
Infrastructure - Public Sector	15.8	16.9	15.4	20.5	21.7	28.2	35.1	47.5	49.9	53.7	58.8	60.3
Electricity, Gas, Water Supply	7.0	7.0	6.4	9.7	10.1	13.3	16.7	21.4	22.4	24.1	29.5	30.8
Railways	1.2	1.5	1.8	2.4	2.9	3.5	4.0	5.5	6.5	6.7	6.8	6.5
Other Transport	0.8	0.6	0.7	0.7	0.8	1.3	1.8	5.0	3.7	3.3	3.0	2.7
Roads and Bridges	1.7	3.5	3.5	4.8	6.2	8.0	11.0	13.5	14.6	16.6	17.7	19.3
Storage	0.3	0.3	0.3	0.3	-0.1	0.0	0.0	0.0	0.0	0.1	0.2	0.2
Communications	4.8	4.1	2.6	2.7	1.9	2.0	1.4	2.0	2.8	2.8	1.5	0.8

(Contd...)

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Infrastructure - Private Sector	5.7	5.6	7.3	6.3	11.4	14.0	12.4	16.8	27.9	31.3	40.3	41.8
Electricity, Gas, Water Supply	1.0	1.5	1.6	1.3	1.8	1.9	1.7	3.0	3.3	4.5	8.5	8.7
Railways	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Transport	4.0	3.5	5.1	5.9	7.4	8.3	6.5	7.5	11.4	11.5	13.1	18.2
Roads and Bridges	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	2.8
Storage	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.4	0.4	0.4	0.5
Communications	0.7	0.6	0.5	-1.0	2.1	3.7	4.0	6.1	12.8	15.0	15.9	11.6

Source: Government of India, Central Statistical Office, National Account Statistics.

GDP. It is then not surprising that, as documented in chapter 2, there has been a continuing shift of both freight and passenger traffic from the railways to roads (Table 3.13).

As a proportion of total GDCF, investment in infrastructure has varied between 14 and 19 per cent since the 2000s. In some other fast-growing middle-income countries, this proportion is near 20-25 per cent. This suggests that investment in infrastructure needs to be accelerated so that high sustainable overall growth can be achieved.

Looking at other features of infrastructure investment, the key systemic change is in the increasing share of private investment, as has been promoted by policy. Overall, the share of private sector investment has increased from around 12-18 per cent in the 8th Plan to about 40 per cent in the last years of the 11th Plan, with a corresponding fall in the public sector share. The most dramatic change is in the communication sector, as might be expected, with the private sector share increasing from zero in the early 1990s to almost 90 per cent towards the end of the 11th Plan. There is also a significant increase in the transport sector, in both roads and bridges and other transport, though not in railways. It seems, however, that the National Accounts may not adequately capture all the investments in roads through PPP, and in ports and airports.

PROJECTING INFRASTRUCTURE AND TRANSPORT INVESTMENT REQUIREMENTS 2012-2032

Stepping up infrastructure investments is key for accelerating industrial development and economic growth in India. Based on the macro consistent projections, we are projecting infrastructure investments to increase from the 11th Plan average level of 5.8 per cent of GDP (2007-12) to 6.9 per cent in the 12th Plan and then 8.0 per cent for the remaining period from 2018 through 2032. Infrastructure investments of around 8 per cent of GDP are needed for economic transformation, and lessons from South East and East Asian countries show similar patterns. In these countries, gross domestic investment rates increased to over 30 per cent of GDP, and rates of infrastructure investment rose to levels of 7 to 8per centof GDP. Gross domestic investment levels in India have been over 35 per cent of GDP during the 11th Plan period despite the slowdown in recent years, similar to recently fast-growing South East and East Asian countries. During the 15th Plan period (2027-32), we are projecting that gross domestic investment (gross domestic capital formation) to increase to 42 per cent of GDP. Once the country reaches a per capita GDP of about $6,000 (2012-13 prices) and the basic infrastructure is in place, we can envisage some tapering down of gross domestic capital formation rates, as we may expect in China now, including those for infrastructure and transport (Table 3.14).

SECTORAL PROJECTIONS:

Within infrastructure, we are projecting a significant enhancement in the investment in transport (railways, roads and bridges, and other transport) from around 2.7 per cent of GDP during the 11th Plan, with a step jump to 3.2 per cent in the 12th Plan and 3.7 per cent in the subsequent three Plan periods. Total investment in transport can then be seen to range between 45 to 50 per cent of total infrastructure investment (Table 3.15).

It is difficult to project the sectoral composition of investment in infrastructure on any systematic basis, and the different sectors within the transport sector. The only guidance available is some continuation of past trends and the use of judgement in some inter se changes in sectoral shares as may be desirable from the policy viewpoint. For example, as shown earlier, we have been underinvesting in Indian Railways relative to the roads sector. That it is feasible to enhance investment in a particular sector from a policy point of view is demonstrated by the increase in investment in roads from 0.2 per cent of GDP in the early 1990s to more than 1 per cent in

Table 3.13b
India: Investments in Infrastructure, 2000-01 to 2011-12

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Per cent of GDP												
Infrastructure - Total	4.5	4.6	4.3	4.3	4.6	5.1	5.0	5.2	6.3	6.2	5.8	5.4
Electricity, Gas, Water Supply	1.7	1.7	1.5	1.8	1.6	1.8	1.9	2.0	2.1	2.1	2.2	2.1
Railways	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.4	0.3
Other Transport	1.0	0.8	1.1	1.1	1.1	1.2	0.9	1.0	1.2	1.1	0.9	1.1
Roads and Bridges	0.4	0.7	0.7	0.8	0.9	1.0	1.2	1.1	1.2	1.2	1.2	1.2
Storage	0.1	0.1	0.1	0.0	(0.0)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Communications	1.1	0.9	0.6	0.3	0.6	0.7	0.6	0.7	1.3	1.3	1.0	0.7
Infrastructure - Public Sector	3.3	3.4	2.9	3.3	3.0	3.4	3.7	3.8	4.1	3.9	3.4	3.2
Electricity, Gas, Water Supply	1.5	1.4	1.2	1.6	1.4	1.6	1.8	1.7	1.8	1.8	1.7	1.6
Railways	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.4	0.3
Other Transport	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.4	0.3	0.2	0.2	0.1
Roads and Bridges	0.4	0.7	0.7	0.8	0.9	1.0	1.2	1.1	1.2	1.2	1.0	1.0
Storage	0.1	0.1	0.1	0.0	(0.0)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Communications	1.0	0.8	0.5	0.4	0.3	0.2	0.1	0.2	0.2	0.2	0.1	0.0
(PER CENT OF GROSS DOMESTIC CAPITAL FORMATION)												
Infrastructure - Total	19.2	18.2	17.7	17.2	14.1	16.4	13.9	13.6	17.9	17.1	15.7	15.4
Electricity, Gas, Water Supply	7.2	6.8	6.3	7.1	5.1	5.9	5.4	5.2	5.9	5.8	6.0	5.9
Railways	1.1	1.2	1.5	1.5	1.2	1.4	1.2	1.2	1.5	1.4	1.1	1.0
Other Transport	4.4	3.3	4.5	4.2	3.5	3.8	2.5	2.6	3.5	3.0	2.5	3.2
Roads and Bridges	1.5	2.9	2.7	3.0	2.7	3.1	3.2	2.9	3.4	3.4	3.2	3.3
Storage	0.3	0.3	0.2	0.2	(0.0)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Communications	4.9	3.8	2.4	1.1	1.7	2.2	1.6	1.7	3.6	3.6	2.8	1.9
Infrastructure - Public Sector	14.1	13.7	12.0	13.1	9.3	11.0	10.3	10.1	11.5	10.8	9.3	9.1
Electricity, Gas, Water Supply	6.2	5.6	5.0	6.2	4.3	5.2	4.9	4.5	5.1	4.9	4.7	4.6
Railways	1.1	1.2	1.4	1.5	1.2	1.4	1.2	1.2	1.5	1.4	1.1	1.0
Other Transport	0.7	0.5	0.6	0.4	0.3	0.5	0.5	1.1	0.8	0.7	0.5	0.4
Roads and Bridges	1.5	2.9	2.7	3.0	2.7	3.1	3.2	2.9	3.4	3.4	2.8	2.9
Storage	0.2	0.2	0.2	0.2	(0.0)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Communications	4.3	3.3	2.0	1.7	0.8	0.8	0.4	0.4	0.6	0.6	0.2	0.1
Infrastructure - Private Sector	5.1	4.5	5.7	4.0	4.9	5.5	3.6	3.6	6.4	6.3	6.4	6.3

(Contd...)

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Electricity, Gas, Water Supply	0.9	1.2	1.3	0.8	0.8	0.7	0.5	0.6	0.8	0.9	1.3	1.3
Railways	(0.0)	(0.0)	0.0	0.0	0.0	(0.0)	0.0	0.0	0.0	0.0	(0.0)	0.0
Other Transport	3.6	2.9	4.0	3.8	3.2	3.3	1.9	1.6	2.6	2.3	2.1	2.7
Roads and Bridges	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4
Storage	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.1	0.1
Communications	0.6	0.5	0.4	(0.6)	0.9	1.4	1.2	1.3	2.9	3.0	2.5	1.7
MEMO ITEMS (RS BILLION AT CURRENT PRICES)												
GDPmp	21,687	23,483	25,307	28,379	32,422	36,934	42,947	49,871	56,301	64,778	77,953	89,749
Gross Domestic Capital Formation	5,104	5,883	6,193	7,181	10,522	11,356	15,406	18,968	20,001	23,513	28,824	31,814

Source: Government of India, Central Statistical Office, National Account Statistics.

Table 3. 13c
India: Investments in Infrastructure, 2000-01 to 2011-12

(PUBLIC-PRIVATE SHARES (PER CENT) OF TOTAL INFRASTRUCTURE INVESTMENTS)												
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Infrastructure - Public Sector	73.3	75.3	67.8	76.6	65.6	66.8	73.9	73.9	64.1	63.1	59.3	59.1
Electricity, Gas, Water Supply	87.2	82.4	79.8	88.1	84.8	87.6	90.6	87.8	87.1	84.2	77.7	78.1
Railways	101.1	103.0	97.7	99.4	100.0	100.1	100.0	100.0	100.0	100.0	100.0	100.0
Other Transport	17.1	13.8	12.4	10.6	9.3	13.7	22.0	39.9	24.3	22.4	18.9	13.0
Roads and Bridges	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	87.7	87.4
Storage	96.3	95.3	96.3	91.2	135.0	0.9	13.9	1.6	0.6	14.5	28.0	29.5
Communications	87.5	87.8	83.5	155.7	46.8	35.5	26.2	25.0	17.8	15.7	8.8	6.1
INFRASTRUCTURE - PRIVATE SECTOR	26.7	24.7	32.2	23.4	34.4	33.2	26.1	26.1	35.9	36.9	40.7	40.9
Electricity, Gas, Water Supply	12.8	17.6	20.2	11.9	15.2	12.4	9.4	12.2	12.9	15.8	22.3	21.9
Railways	(1.1)	(3.0)	2.3	0.6	-	(0.1)	-	-	-	0.0	(0.0)	-
Other Transport	82.9	86.2	87.6	89.4	90.7	86.3	78.0	60.1	75.7	77.6	81.1	87.0
Roads and Bridges	-	-	-	-	-	-	-	-	-	-	12.3	12.6
Storage	3.7	4.7	3.7	8.8	(35.0)	99.1	86.1	98.4	99.4	85.5	72.0	70.5
Communications	12.5	12.2	16.5	(55.7)	53.2	64.5	73.8	75.0	82.2	84.3	91.2	93.9

Source: Government of India, Central Statistical Office, National Account Statistics.

Table 3.13d

India: Investments in Infrastructure, 2004-05 to 2011-12

	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
(RUPEES BILLION IN 2004-05 PRICES)								
Infrastructure - Total	1,489	1,802	1,980	2,286	3,005	3,239	3,472	3,585
Electricity, Gas, Water Supply	533	647	764	860	990	1,075	1,322	1,383
Railways	131	150	170	193	237	251	237	222
Other Transport	368	415	357	459	600	585	593	780
Roads and Bridges	280	343	459	476	555	634	697	737
Storage	(3)	6	8	8	14	15	17	24
Communications	180	240	224	289	609	678	605	438
Infrastructure - Public Sector	977	1,201	1,459	1,682	1,914	2,027	2,105	2,098
Electricity, Gas, Water Supply	452	566	692	756	869	903	1,024	1,079
Railways	131	150	170	193	237	251	237	222
Other Transport	34	56	78	183	145	128	108	97
Roads and Bridges	280	343	459	476	555	634	675	665
Storage	(5)	0	1	0	0	2	5	7
Communications	84	85	59	72	109	109	56	28
Infrastructure - Private Sector	512	601	521	604	1091	1239	1514	1656
Electricity, Gas, Water Supply	81	81	71	104	121	172	298	304
Railways	0	0	0	0	0	0	0	0
Other Transport	334	359	278	276	456	458	485	683
Roads and Bridges	0	0	0	0	0	0	22	73
Storage	1	6	6	8	14	13	12	17
Communications	96	155	165	217	501	569	549	410
(US$ BILLION IN 2004-05 PRICES)								
Infrastructure - Total	33.1	40.7	43.7	56.8	65.4	68.3	76.2	74.8
Electricity, Gas, Water Supply	11.9	14.6	16.9	21.4	21.6	22.7	29.0	28.9
Railways	2.9	3.4	3.8	4.8	5.2	5.3	5.2	4.6
Other Transport	8.2	9.4	7.9	11.4	13.1	12.3	13.0	16.3
Roads and Bridges	6.2	7.7	10.1	11.8	12.1	13.4	15.3	15.4
Storage	-0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.5
Communications	4.0	5.4	4.9	7.2	13.3	14.3	13.3	9.1
Infrastructure - Public Sector	21.7	27.1	32.2	41.8	41.7	42.8	46.2	43.8
Electricity, Gas, Water Supply	10.1	12.8	15.3	18.8	18.9	19.0	22.5	22.5
Railways	2.9	3.4	3.8	4.8	5.2	5.3	5.2	4.6
Other Transport	0.8	1.3	1.7	4.6	3.1	2.7	2.4	2.0
Roads and Bridges	6.2	7.7	10.1	11.8	12.1	13.4	14.8	13.9
Storage	-0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Communications	1.9	1.9	1.3	1.8	2.4	2.3	1.2	0.6
Infrastructure - Private Sector	11.4	13.6	11.5	15.0	23.8	26.1	33.2	34.6
Electricity, Gas, Water Supply	1.8	1.8	1.6	2.6	2.6	3.6	6.5	6.3

(Contd...)

	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Railways	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Transport	7.4	8.1	6.1	6.8	9.9	9.6	10.6	14.2
Roads and Bridges	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.5
Storage	0.0	0.1	0.1	0.2	0.3	0.3	0.3	0.4
Communications	2.1	3.5	3.6	5.4	10.9	12.0	12.1	8.6

Source: Government of India, Central Statistical Office, National Account Statistics.

recent years (Table 3.13). Finally, we also make use of the estimates derived by the different sectoral Working Groups of the NTDPC.

For the non-transport sectors, we have increased the share of the power sector slightly from about a third of total infrastructure investment in the 12th Plan to 35 per cent in view of the still many unmet needs of large sections of the population. The share of the telecom sector has correspondingly been brought down from about 22 per cent of total infrastructure investment in the 12th Plan to about 20 per cent in subsequent Plans (Table 3.14).

Coming to the transport sectors, there is a clear need for raising the share of Indian Railways in total infrastructure investment and within the transport sector as well. As noted, significant success has been achieved in ramping up investment in roads over the past 2 decades, and particularly since the year 2000. Thus, we are proposing a significant increase in investment in Railways from about 0.4 per cent of GDP in the last 2 decades to around 0.8 per cent in the 12th Plan and then rising to around 1.1 and 1.2 per cent of GDP in the following three Plan periods. (The estimates in the Railways chapter 1 Volume III suggest some tapering during the 15th Plan period). The initiative of the Dedicated Freight Corridor (DFC) and its continued expansion throughout the next two decades will require sustained investment in the Railways. Given the need for total renewal of rolling stock as well, this projected increase is absolutely essential if adequate transport facilities have to be provided in the next two decades. This projection would not accommodate investment in capital intensive projects such as the high speed rail transport that is sometimes proposed. For roads and bridges, we have kept up the investment at an enhanced level, around 1.2 per cent of GDP in the 12th Plan and 1.3 per cent of GDP thereafter over the subsequent three Plan periods. Thus, the scorching pace of growth over the past two decades has been slowed down. There is still considerable need for rural road connectivity in the country, with only about 54 per cent of unconnected habitations been provided with all weather roads in the recent past. We can also expect the graded construction of expressways over the 13th Plan and beyond (Table 3.15).

'Other transport' covers all the other transport sectors This includes all of road transport vehicles, ports, shipping, inland water transport, civil aviation and urban transport. We are projecting a slight acceleration in this category as investment in each of these categories can be expected to grow faster than in the past as incomes grow and urbanization proceeds apace. As detailed in the urban transport chapter, with accelerating urbanization, increased motorization and need for mass transit of all varieties, we can expect continuing increases in the investments in urban transport for urban roads, mass transit systems, buses and intermediate public transport. As the number of million plus and ten million plus cities increases, there will be increasing need for efficient urban transport.

Our macroeconomic projections suggest a continued expansion in trade both exports and imports. Total trade in goods and services is projected to grow from around 60 per cent of GDP in the 12th Plan to around 80 per cent in the 15th Plan (2027-32). It is trade in goods that is more transport intensive. In our projections, the share of goods in total trade in good and services is projected to increase from about 78 per cent in the 12th Plan to 83 per cent during the 15th Plan, while undergoing more than sevenfold increase in absolute terms. This will not be possible without significant growth in port capacity, domestic transport links through Railways DFCs and an expanded highway system, along with modernization of associated logistics system.

What do our projections suggest for the overall investment in transport over the next twenty years? First, we are projecting overall infrastructure investment to increase from about 5.8 per cent of GDP achieved in the Eleventh Plan to 6.9 per cent in the 12th Plan and to 8 per cent in the following three Plan periods. Within that, we are projecting transport investment to increase from about 2.7 per cent of GDP during the Eleventh Plan period to 3.2 per cent in the 12th Plan and 3.7 per cent thereafter. That

Table 3.14a

India: Investments in Infrastructure, 2012-13 TO 2031-32

	2012-13	2013-14	2014-15	2015-16	2016-17	FIVE YEAR PLANS (ANNUAL AVERAGE) FY13-FY17 12TH PLAN	FY18-FY22 13TH PLAN	FY23-FY27 14TH PLAN	FY28-FY32 15TH PLAN
(RUPEES BILLION IN 2012-13 PRICES)									
Infrastructure - Total	5,795	6,680	7,794	9,141	10,592	8,107	13,769	20,524	31,318
Electricity, Gas, Water Supply	1,905	2,144	2,529	2,971	3,471	2,604	4,736	7,060	10,773
Railways	501	590	805	990	1,201	928	1,861	3,026	4,617
Other Transport	902	1,072	1,150	1,362	1,602	1,391	2,199	3,278	5,002
Roads and Bridges	1,253	1,447	1,667	1,918	2,136	1,507	2,199	3,026	4,617
Storage	30	32	34	43	47	37	68	101	154
Communications	1,203	1,394	1,609	1,857	2,136	1,640	2,706	4,034	6,156
Infrastructure - Public Sector	3,459	3,861	4,521	5,217	5,887	4,603	7,535	11,050	16,700
Electricity, Gas, Water Supply	1,486	1,651	1,897	2,169	2,499	1,940	3,315	4,942	7,541
Railways	486	566	764	911	1,081	864	1,675	2,526	3,694
Other Transport	244	279	287	327	384	348	463	656	1,000
Roads and Bridges	1,003	1,086	1,250	1,439	1,495	1,122	1,539	2,118	3,232
Storage	0	0	0	0	0	0	1	1	2
Communications	241	279	322	371	427	328	541	807	1,231
Infrastructure - Private Sector	2,336	2,819	3,273	3,924	4,705	3,504	6,234	9,475	14,619
Electricity, Gas, Water Supply	419	493	632	802	972	664	1,421	2,118	3,232
Railways	15	24	40	79	120	63	186	499	923
Other Transport	659	793	862	1,035	1,217	1,044	1,735	2,622	4,001
Roads and Bridges	251	362	417	480	641	385	660	908	1,385
Storage	30	32	34	43	46	37	67	100	152
Communications	963	1,115	1,287	1,485	1,709	1,312	2,165	3,227	4,925
(US$ BILLION IN 2012-13 PRICES)									
Infrastructure - Total	107	123	143	168	195	149	253	377	576
Electricity, Gas, Water Supply	35	39	46	55	64	48	87	130	198
Railways	9	11	15	18	22	17	34	56	85
Other Transport	17	20	21	25	29	26	40	60	92
Roads and Bridges	23	27	31	35	39	28	40	56	85
Storage	1	1	1	1	1	1	1	2	3
Communications	22	26	30	34	39	30	50	74	113
Infrastructure - Public Sector	64	71	83	96	108	85	138	203	307
Electricity, Gas, Water Supply	27	30	35	40	46	36	61	91	139
Railways	9	10	14	17	20	16	31	46	68
Other Transport	4	5	5	6	7	6	9	12	18
Roads and Bridges	18	20	23	26	27	21	28	39	59
Storage	0	0	0	0	0	0	0	0	0
Communications	4	5	6	7	8	6	10	15	23

(Contd...)

	2012-13	2013-14	2014-15	2015-16	2016-17	FIVE YEAR PLANS (ANNUAL AVERAGE) FY13-FY17 12TH PLAN	FY18-FY22 13TH PLAN	FY23-FY27 14TH PLAN	FY28-FY32 15TH PLAN
Infrastructure - Private Sector	43	52	60	72	86	64	115	174	269
Electricity, Gas, Water Supply	8	9	12	15	18	12	26	39	59
Railways	0	0	1	1	2	1	3	9	17
Other Transport	12	15	16	19	22	19	32	48	74
Roads and Bridges	5	7	8	9	12	7	12	17	25
Storage	1	1	1	1	1	1	1	2	3
Communications	18	20	24	27	31	24	40	59	91

Sources: Central Statistical Office, National Account Statistics. Sectoral data for 2011-12 and for public sector 2010-11 and 2011-12 are NTDPC estimates.

implies that the share of transport in infrastructure investment would remain roughly constant at around 46 to 48 per cent.

In absolute terms, total investment in infrastructure is projected to rise from about Rs 25 trillion ($425 billion) in the 11th Plan to about Rs 40 trillion ($745 billion) in the 12th Plan. This is significantly lower than the $1 trillion that is generally discussed in the context of the 12th Plan. Even if we account for the difference in definitions between GDCF concept in National Accounts as used here, and the gross investment concept used by the Planning Commission, this estimate is not likely to be in a range much higher than about $850 billion. The corresponding estimates for total transport investment are projected to increase from about Rs 11 trillion ($200 billion) in the Eleventh Plan to about Rs19 trillion ($335 billion) in the 12th Plan. Once again, accounting for the difference in definitions, the actual projected investment could amount to about $400 billion. Investment in new roads or railway tracks would involve considerable land acquisition expenditures: this would not be included in the National Accounts GDCF estimates (Table 3.15).

Going further than the 12th Plan, our total infrastructure investment projections amount to about Rs 70 trillion ($1.25 trillion), Rs 100 trillion ($1.9 trillion) and Rs 155 trillion ($2.9 trillion) in the 13th, 14th and 15th Plans. The corresponding transport investments would be about Rs 30 trillion($600 billion), Rs 45 trillion ($850 billion) and Rs 70 trillion ($1.30 trillion) in the 13th, 14th and 15th Plans respectively. (All estimates in 2012-13 prices).

COMPARISON OF MODEL PROJECTIONS WITH WORKING GROUP ESTIMATES

The NTDPC also made bottom-up estimates for requirements in each infrastructure sector. Each Working Group (Railways, Roads, Ports and Shipping, Civil Aviation and Urban Infrastructure) made its own estimates for the investment required over the next four Five Year Plan periods until 2031-32. These estimates are provided in Table 3.16 along with the projections based on our macro-modelling exercise. It may be seen that the Working Group estimates are lower than the model projections beyond the 12th Plan period, except for the Railways, where they are lower in the 14th and 15th Plan periods.

What this suggests is that from a macroeconomic and resource flow feasibility perspective, we can be more ambitious in our planning for transport sector improvements from the 13th Plan period onwards. The focus after the 12th Plan can be on improving the quality of our transport infrastructure across the board better urban transport infrastructure, better buses, better railway coaches, more modern railway rolling stock for freight, higher quality ports, more international quality airports, better all-weather rural roads, state and district roads and the like.

The lower Railways Working Group estimates in the 14th and 15th Plan indicate that the substantive recommendations for stepping up railways investments are quite realistic from the overall resource availability perspective. The need for reorganisation of the Railways in order to deliver this magnitude of capacity and quality enhancement therefore becomes even more important.

Interestingly, the Roads Working Group investment estimates are significantly lower from the 13th Plan onwards. As mentioned earlier, this suggests that we can be more ambitious in our quest for providing connectivity to all habitations in the country through the PMGSY. Once basic connectivity is achieved, more focus can be given to improvement in the quality of all rural roads,

Table 3.14b

India: Investments in Infrastructure, 2012-13 to 2031-32

	2012-13	2013-14	2014-15	2015-16	2016-17	FIVE YEAR PLANS (ANNUAL AVERAGE)			
						FY13-FY17	FY18-FY22	FY23-FY27	FY28-FY32
						12TH PLAN	13TH PLAN	14TH PLAN	15TH PLAN
(PER CENT OF GDP)									
Infrastructure - Total	5.8	6.2	6.8	7.4	7.9	7.0	8.1	8.1	8.1
Electricity, Gas, Water Supply	1.9	2.0	2.2	2.4	2.6	2.2	2.8	2.8	2.8
Railways	0.5	0.6	0.7	0.8	0.9	0.8	1.1	1.2	1.2
Other Transport	0.9	1.0	1.0	1.1	1.2	1.2	1.3	1.3	1.3
Roads and Bridges	1.3	1.4	1.5	1.6	1.6	1.3	1.3	1.2	1.2
Storage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Communications	1.2	1.3	1.4	1.5	1.6	1.4	1.6	1.6	1.6
Infrastructure - Public Sector	3.5	3.6	3.9	4.2	4.4	4.0	4.5	4.4	4.3
Electricity, Gas, Water Supply	1.5	1.5	1.7	1.8	1.9	1.7	2.0	2.0	2.0
Railways	0.5	0.5	0.7	0.7	0.8	0.7	1.0	1.0	1.0
Other Transport	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Roads and Bridges	1.0	1.0	1.1	1.2	1.1	1.0	0.9	0.8	0.8
Storage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Communications	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Infrastructure - Private Sector	2.3	2.6	2.8	3.2	3.5	3.0	3.7	3.8	3.8
Electricity, Gas, Water Supply	0.4	0.5	0.6	0.6	0.7	0.6	0.8	0.8	0.8
Railways	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2
Other Transport	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.0
Roads and Bridges	0.3	0.3	0.4	0.4	0.5	0.3	0.4	0.4	0.4
Storage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Communications	1.0	1.0	1.1	1.2	1.3	1.1	1.3	1.3	1.3
(PER CENT OF GDCF)									
Infrastructure - Total	16.4	17.3	18.5	19.7	20.9	19.0	20.9	19.8	18.8
Electricity, Gas, Water Supply	5.4	5.6	6.0	6.4	6.8	6.1	7.2	6.8	6.5
Railways	1.4	1.5	1.9	2.1	2.4	2.2	2.8	2.9	2.8
Other Transport	2.6	2.8	2.7	2.9	3.2	3.3	3.3	3.2	3.0
Roads and Bridges	3.5	3.8	4.0	4.1	4.2	3.5	3.3	2.9	2.8
Storage	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Communications	3.4	3.6	3.8	4.0	4.2	3.8	4.1	3.9	3.7
Infrastructure - Public Sector	9.8	10.0	10.7	11.2	11.6	10.8	11.5	10.7	10.0
Electricity, Gas, Water Supply	4.2	4.3	4.5	4.7	4.9	4.5	5.0	4.8	4.5
Railways	1.4	1.5	1.8	2.0	2.1	2.0	2.5	2.4	2.2
Other Transport	0.7	0.7	0.7	0.7	0.8	0.8	0.7	0.6	0.6
Roads and Bridges	2.8	2.8	3.0	3.1	2.9	2.6	2.3	2.0	1.9
Storage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Communications	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.7

(Contd...)

	2012-13	2013-14	2014-15	2015-16	2016-17	FIVE YEAR PLANS (ANNUAL AVERAGE) FY13-FY17 12TH PLAN	FY18-FY22 13TH PLAN	FY23-FY27 14TH PLAN	FY28-FY32 15TH PLAN
Infrastructure - Private Sector	6.6	7.3	7.8	8.5	9.3	8.2	9.5	9.1	8.8
Electricity, Gas, Water Supply	1.2	1.3	1.5	1.7	1.9	1.6	2.2	2.0	1.9
Railways	0.0	0.1	0.1	0.2	0.2	0.1	0.3	0.5	0.6
Other Transport	1.9	2.1	2.0	2.2	2.4	2.4	2.6	2.5	2.4
Roads and Bridges	0.7	0.9	1.0	1.0	1.3	0.9	1.0	0.9	0.8
Storage	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Communications	2.7	2.9	3.1	3.2	3.4	3.1	3.3	3.1	3.0
(PUBLIC-PRIVATE SHARES (PER CENT) OF TOTAL INFRASTRUCTURE INVESTMENTS)									
Infrastructure - Public Sector	59.7	57.8	58.0	57.1	55.6	57.4	55.7	54.7	54.3
Electricity, Gas, Water Supply	78.0	77.0	75.0	73.0	72.0	74.5	70.0	70.0	70.0
Railways	97.0	96.0	95.0	92.0	90.0	93.2	90.0	83.5	80.0
Other Transport	27.0	26.0	25.0	24.0	24.0	25.0	21.1	20.0	20.0
Roads and Bridges	80.0	75.0	75.0	75.0	70.0	74.5	70.0	70.0	70.0
Storage	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Communications	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Infrastructure - Private Sector	40.3	42.2	42.0	42.9	44.4	42.6	44.3	45.3	45.7
Electricity, Gas, Water Supply	22.0	23.0	25.0	27.0	28.0	25.5	30.0	30.0	30.0
Railways	3.0	4.0	5.0	8.0	10.0	6.8	10.0	16.5	20.0
Other Transport	73.0	74.0	75.0	76.0	76.0	75.0	78.9	80.0	80.0
Roads and Bridges	20.0	25.0	25.0	25.0	30.0	25.5	30.0	30.0	30.0
Storage	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0
Communications	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
Memo Items									
Gross Domestic Product at Market prices (Rs Billion)	100,262	107,221	114,951	123,774	133,481	115,938	169,153	252,143	384,748
Gross Domestic Capita Formation (Rs Billion)	35,373	38,600	42,172	46,401	50,738	42,657	65,725	103,700	166,526

Sources: Central Statistical Office, National Account Statistics.

so that more widespread all-weather connectivity is achieved. Second, state and district roads have not received the attention they deserve so far: this can clearly be enhanced from the 13th Plan onwards. For achieving both of these objectives, there is great need for enhancing the capabilities of state governments' executing agencies, as proposed in the chapter on Research Human Resource Development (Volume II, Chapter 11).

Third, as the current plans for NHDP near completion, greater attention can be given to the improvement in quality of the four-lane highways, and construction of expressways from the 13th Plan onwards.

Our projections for 'Other Transport' provide room for higher investment than projected by the Working Groups in ports, urban infrastructure, civil aviation, etc. We have not made specific projections for investment in logistics parks, other aspects of modern logistics (Volume II, Chapter 4) , information technology for transport (Volume II, Chapter 10), all aspects of safety (Volume II, Chapter 12), Research and Human Resource Development (Volume II, Chapter 11), international connectivity (Volume II, Chapter 13), and the proposals on enhancing connectivity with and in the North East (Volume III, Chapter 6).

Thus, our projections suggest that the recommendations given in this report on various aspects of transport sector development are quite realistic from the resource availability point of view. The more difficult issues relate to the organisational and institutional changes that are required to achieve the magnitude of investments projected.

Overall, we are projecting the share of private sector investment to increase from around 40 per cent in the 11th Plan to around 46 per cent in the 15th Plan (2027-32) with much of the increase taking place in the 12th and 13th Plans and then stabilising

We next look at how these projected investment estimates could be divided between the public and private sectors.

INCREASING PRIVATE SECTOR PARTICIPATION IN INFRASTRUCTURE AND TRANSPORT

Globally, throughout the 20th century, the bulk of investment in infrastructure in general and transport in particular, was carried out by the public sector: directly by governments at different levels, or indirectly through public sector enterprises. India was no different and, until the early 1990s, almost all investment in transport was done by the public sector except road transport services (eg. buses and trucks). This was essentially because transport services have been regarded as public goods and services and, moreover, transport infrastructure involves significant economies of scale and is also characterised by indivisibilities in provision.

As technologies changed in the 1990s, it became increasingly possible to introduce contestability, if not competition, in different infrastructure sectors, including various aspects of transport. In addition, as demands for transport have been rising and public fiscal resources have been strained, there have been growing incentives for governments in most countries to seek private sector investment in transport, and other aspects of infrastructure. Thus, beginning in the early to mid-1990s, public policy in India has increasingly encouraged private sector participation in infrastructure.

Taking infrastructure as a whole, the private sector share in infrastructure investment has grown from around 10-15 per cent in the late 1980s and early 1990s to almost 40 per cent in the last couple of years of the 12th Plan (i.e. during 2010-12) (Table 3.13). As may be expected, the largest transformation is in the telecom sector, with the private sector increasing from zero in the early 1990s to almost 90 per cent in recent years. Within the transport sector, most projects under the NHDP are in the PPP mode thus increasing the share of private sector in the roads sector significantly. Much of the investment in ports is also increasingly in the private sector, as port terminals in Major Ports are given out to the private sector to invest, and state governments encourage investment in Non-Major Ports on a full ownership basis. Similarly, the major airports of Delhi, Mumbai, Hyderabad, Bangalore and Kochi have been privatised and the policy increasingly is for the Airports Authority of India to also make investments in the PPP mode. Although much of urban transport necessarily remains in the public sector, attempts are being made to introduce the PPP concept in major urban transport projects as well. Thus, the share of the private sector in 'Other Transport' has increased from around 40-60 per cent in the early to mid-1990s to 80-90 per cent in the 2000s. Within the transport sector, it is the railways where private sector participation remains low; and is likely to remain low even if a greater effort is made to invite private sector participation.

In making projections for the future, we have kept in mind recent trends, current policy prescriptions, as well as international experience in private sector investment in transport. Overall, we are projecting the share of private sector investment to increase from around 40 per cent in the 11th Plan to around 46 per cent in the 15th Plan (2027-32) with much of the increase taking place in the 12th and 13th Plans and then stabilising (Table 3.14c).

We have projected the private sector share in roads to increase from less than 15 per cent in the latter years of the 11th Plan to around 25 per cent in the 12th Plan and then stabilising at around 30 per cent in subsequent Plans. It should be noted that these shares are much higher than almost any other country in the world. In the Railways, we are projecting the private sector share to go up to around 6-7 per cent in the 12th Plan and increasing gradually to as much as 20 per cent in the 14th and 15th Plans. In 'Other Transport', we have kept the private sector share at around 75-80 per cent throughout the whole period, not too different from current trends. A good proportion of private investment in 'Other Transport' consists of private investment in buses and trucks and other vehicles: hence the high share of the private sector in this category in the National Accounts. It is possible that as share of urban transport infrastructure increases, the share of the public sector may be higher than in these projections (Table 3.14c).

We may note parenthetically that these shares are relatively high by international standards. Except for the United States, most railway systems in the world are in the public sector, though there is often private sector investment in rolling stock. Similarly, private sector investment in roads is an exception rather than the rule in most countries. Most ports and airports are in the public sector, structured as landlord ports or airports, though much of terminal investment is done by private sector operators. Almost all road transport is, of course, in the private sector in most places. In view of such global experience and trends, the Indian thrust on private sector participation in transport is at the

Table 3.14c

India: Investments in Infrastructure, 2012-13 to 2031-32

	2012-13	2013-14	2014-15	2015-16	2016-17	FIVE YEAR PLANS (ANNUAL AVERAGE) FY13-FY17 12TH PLAN	FY18-FY22 13TH PLAN	FY23-FY27 14TH PLAN	FY28-FY32 15TH PLAN
(Public-Private Shares (Per cent) of Total Infrastructure Investments)									
Infrastructure - Public Sector	59.7	57.8	58.0	57.1	55.6	56.8	54.7	53.8	53.3
Electricity, Gas, Water Supply	78.0	77.0	75.0	73.0	72.0	74.5	70.0	70.0	70.0
Railways	97.0	96.0	95.0	92.0	90.0	93.2	90.0	83.5	80.0
Other Transport	27.0	26.0	25.0	24.0	24.0	25.0	21.1	20.0	20.0
Roads and Bridges	80.0	75.0	75.0	75.0	70.0	74.5	70.0	70.0	70.0
Storage	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Communications	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Infrastructure - Private Sector	40.3	42.2	42.0	42.9	44.4	43.2	45.3	46.2	46.7
Electricity, Gas, Water Supply	22.0	23.0	25.0	27.0	28.0	25.5	30.0	30.0	30.0
Railways	3.0	4.0	5.0	8.0	10.0	6.8	10.0	16.5	20.0
Other Transport	73.0	74.0	75.0	76.0	76.0	75.0	78.9	80.0	80.0
Roads and Bridges	20.0	25.0	25.0	25.0	30.0	25.5	30.0	30.0	30.0
Storage	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0
Communications	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
Memo Items									
Gross Domestic Product at Market Prices(Rs Billion)	100,262	107,221	114,951	123,774	133,481	115,938	169,153	252,143	384,748
Gross Domestic Capital Formation (Rs Billion)	35,373	38,600	42,172	46,401	50,738	42,657	65,725	103,700	166,526

Sources: Central Statistical Office, National Account Statistics.

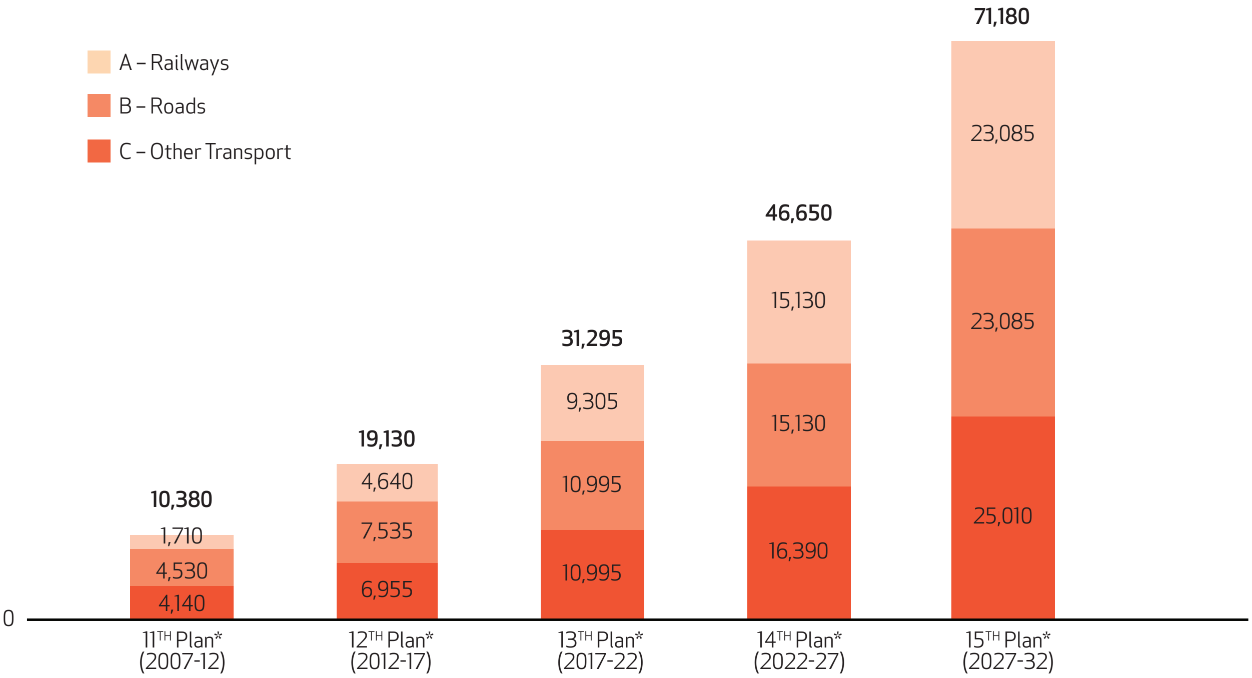
leading edge in the world. Consequently, there should be adequate awareness of the difficulties inherent in private sector participation, and there is likely to be need for vigilance at the policy, planning and project execution level on a consistent basis. Moreover, it is also likely that there will be need for innovation in each of these areas continuously, along with substantial capacity development at all levels in both the private and public sectors, as this report is emphasising.

As noted earlier, the projections of private sector investment in infrastructure as a whole, and in transport in particular, is at relatively optimistic proportions and levels. For this to be achieved, the regulatory environment governing all transport sectors will have to be such as to reduce perceived risk for private investors. In particular, the processes governing public private partnerships in transport infrastructure will have to be transparent and credible so that greater investment can flow through PPP arrangements.

TRANSPORT INVESTMENT REQUIREMENTS: 2012-32

What are the overall implications of these projections for infrastructure and transport investment? First, as a proportion of GDP, total investment in infrastructure (on a National Accounts basis) is set to increase from an average of 5.5 to 6 per cent during the 11th Plan (2007-12) to about 7 per cent in the 12th Plan and then stabilising at around 8 per cent in subsequent periods until the 15th Plan (2027-32). About 1 to 1.5 per cent of GDP can be added to make these projections comparable with the Planning Commission definitions of infrastructure investment.

Figure 3.1
Projection of Infrastructure and Transport Investments Required, 2012-13 Prices
[RS Billion]



	11TH PLAN* (2007-12)	12TH PLAN (2012-17)	13TH PLAN (2017-22)	14TH PLAN (2022-27)	15TH PLAN (2027-32)
TOTAL INFRASTRUCTURE (Rs. Billion**)**	22,500	40,535	68,800	1,03,000	1,56,600
US $ Billion	413	745	1,270	1,890	2,880
Per cent of GDP	5.8	7.0	8.1	8.1	8.1

* Actual

Total investment in transport is projected to increase from about 2.6 per cent average in the 11th Plan to 3.3 per cent in the 12th Plan, and stabilising at 3.7 per cent of GDP in the 13th, 14th and 15th Plans (2017-32). Here again, 0.5 to 0.7 per cent of GDP can be added to be comparable with the Planning Commission investment concepts.

In absolute terms, this implies an increase in total transport sector investment from about Rs 10.4 trillion (US $190 billion) in the 11th Plan to about Rs 19 trillion ($350 billion) in the 12th Plan, Rs 30, 45 and 70 trillion ($575, 850 and 1,300 billion) respectively in the 13th, 14th and 15th Plans (Table 3.15) (all in 2012-13 prices). In this scenario, both public and private sector investments in transport as a proportion of GDP will need to increase significantly.

PUBLIC SECTOR

Table 3.17 exhibits our assumptions regarding increasing private sector participation in railways and roads, while keeping it at around 75-80 per cent in 'Other Transport'. With these assumptions, and our strategy of increasing investment in the Railways, public sector investment in transport is envisaged to increase from an average of 1.8 per cent of GDP in the 11th Plan to around 2.0 per cent in the 12th Plan and then remaining stable at 2.1 to 2.2 per cent till the 15th Plan. In absolute numbers, this implies an increase in public sector investments in transport from an annual average of around Rs 1.3 trillion ($27-30 billion) in the latter years of the 11th Plan to Rs 2.3 trillion ($43 billion) in the 12th Plan, Rs 3.7 trillion ($70 billion) in the 13th Plan and rising to Rs 7.9 trillion ($145 billion) by the 15th Plan, all at constant 2012-13 prices (Table 3.14).

PRIVATE SECTOR

Consistent with current government policy, we have made relatively optimistic assumptions on increasing private sector participation in transport infrastructure. At 13 per cent, the National Accounts may underestimate the private sector contribution to investment in roads during the latter years of the 11th Plan. In fact, for the first three years (2007-10), it is estimated at zero. We have assumed it to be about 25 per cent for the 12th Plan and rising to

Table 3.16

Comparison of Model and Working Group Projections for Transport Investment

[Rs Billion – 2012-13 Prices]

	11TH PLAN* (2007-12)	12TH PLAN (2012-17)	13TH PLAN (2017-22)	14TH PLAN (2022-27)	15TH PLAN (2027-32)
I. RAILWAYS					
Working Group		5,190	9,190	12,040	8,900
Model	1,710	4,640	9,305	15,130	23,085
II. ROADS					
Working Group**		9,570	8,560	13,250	13,890
Model	4,530	7,535	10,995	15,130	23,085
III. OTHER TRANSPORT					
Working Group**					
Road Transport		53	61	70	81
Ports		574	613	848	1,181
Inland Water Transport		45	185	185	223
Civil Aviation		675	942	1,776	2,838
Urban Transport		2,340	3,340	4,360	7,200
TOTAL		3,687	5,141	7,239	11,523
Model	4,140	6,955	10,995	16,390	25,010
GRAND TOTAL					
Working Group		18,447	22,891	32,529	34,313
Model	10,380	19,130	31,295	46,650	71,180

*Actual from National Accounts
** Set up by NTDPC

30 per cent in the following three Plan periods. In the Railways, private sector contribution was effectively zero in the 11th Plan: we have assumed around 7 per cent for the 12th Plan, and then rising slowly to 20 per cent by the 15th Plan. 'Other Transport' includes all organised and unorganised private sector investment in buses, trucks etc: its share has been around 75-80 per cent for some years. We have assumed it to be 75 per cent in the 12th Plan, and then around 80 per cent for the following three Plan periods. Since urban infrastructure investment will rise in the coming years, which may inevitably be largely in the public sector, it is possible that this may be overestimating the private sector contribution in 'Other Transport'.

With these assumptions, we project private sector investment to rise from less than 1 per cent of GDP in the 11th Plan period to around 1.3 per cent in the 12th Plan and around 1.5 to 1.6 per cent in the following three Plan periods. In absolute terms, this implies an increase from an annual average of about Rs 700-900 billion ($16-18 billion) in the latter years of the 11th Plan to around an annual average of Rs 1.5 trillion ($27 billion) in the 12th Plan, rising to Rs 2.6 trillion ($50 billion) in the 13th Plan and as much as Rs 6.3 trillion ($110 billion) in the 15th Plan (all numbers in 2012-13 prices).

How do we evaluate these numbers from the point of view of broad feasibility? In the last two years of the 11th Plan (2010-12), the private sector was estimated to have invested an annual average of around Rs 700-900 billion (2012-13 prices) in transport. Our projection is for an average of Rs 1.5 trillion per year in the 12th Plan, about double that during 2010-12. An addition of about Rs 700-800 billion per year would therefore seem to be within the realms of possibility. Total resource flow to the private sector as a

Our expectations from the private sector are ambitious, and if they do not fructify, the government needs to put in place contingency plans, so that public sector resource mobilisation and execution can substitute for any shortfalls in private sector investment

whole was about Rs 14-15 trillion in 2012-13[17]. These estimates therefore imply that about 5-7 per cent of the total flow of resources to the organised private sector should be utilised for transport investment, These are clearly very large numbers, even if we look at the more immediate future of the next 5-10 years. Broadly speaking, a major step up in transport investment is required in the current 12th Plan and further in the 13th Plan ending in 2022, in both the public and private sectors. The expectations from the private sector are ambitious, and if they do not fructify, the government needs to put contingent plans in place, so that public sector resource mobilisation and execution can substitute for any shortfalls in private sector investment.

In any case, public sector investment in infrastructure cannot be expected to be reduced even as a proportion of GDP; if anything, it needs to be increased marginally. If such resources are to be available to the public sector for transport, these investments need to be commercially viable with the consistent application of user charges, transport taxes, and the like at all levels.

SOURCES OF FINANCING FOR TRANSPORT INVESTMENT

Having made the projections for the kind of transport investments that are required to fulfill the vision for transport envisioned in this report, it is now useful to get some sense of what the sources of such financing could be. This is not easy to do since there are no reliable estimates available of the pattern of financing in the transport sector overall. The sectors covered by transport are very varied, ranging from investments in trucks to those in aircraft, and from rural roads to airports. During the last five to 10 years, moreover, with the increasing share of private sector investment in infrastructure, and in different sectors in transport in particular, information on the financing pattern is even more difficult to compile since it involves analysis of all the different private firms involved in different areas of transport. Hence, this section provides only a very broad idea of what the sources of financing for transport investment could be. The projections made in this section indicate broadly where resources can come from, as between foreign and domestic sources; between budgetary and non-budgetary sources for the public sector; and between debt and equity for the private sector, both foreign and domestic.

FOREIGN FINANCING

It is first useful to see the possible extent of foreign financing of transport. We assume arbitrarily that about 40 per cent of total net capital flows to the country can flow to the infrastructure sector as a whole. Further, of total foreign capital flows to infrastructure, about 40 per cent could be invested in transport projects, which then amount to about 15-16 per cent of total capital flows. Table 3.9d exhibits detailed projections for the capital account, the key features of which are reproduced in Table 3.18. With the projected total equity and debt flows, the feasible foreign flows to the transport sector amount to about 0.65 to 0.70 per cent of GDP through the whole period 2012-2032. If we assume that a similar 15-16 per cent of both debt and equity flows are applied to the transport sector, equity flows amount to about 0.40 per cent to GDP throughout the period, and net foreign debt flows to about 0.25 to 0.30 per cent. Thus, in the 12th Plan period, these should amount to an average of about $8.5 billion of annual equity flows and about $6.5 billion in debt flows for investment in the transport sector. Table 3.18 projects the comparable figures in the 13th, 14th and 15th Plans on a consistent basis.

We may note that a more detailed calculation of these flows would need a better appreciation of the magnitudes of resources commanded by the various infrastructure companies in different transport sectors in the country, and then projecting them on a realistic basis. Particular account would need to be taken of the sustainability of foreign debt for these companies. Furthermore, we have provided approximate projections of net debt flows, but these would depend on the pattern of disbursements and repayments. The figures here therefore may be seen for illustrative purposes only, in terms of broad possible magnitudes.

PUBLIC SECTOR

We now look at the possible financing patterns for public and private sectors. An examination of the 11th and 12th Plan financing patterns for investment by the public sector in transport sector exhibit the following trends:

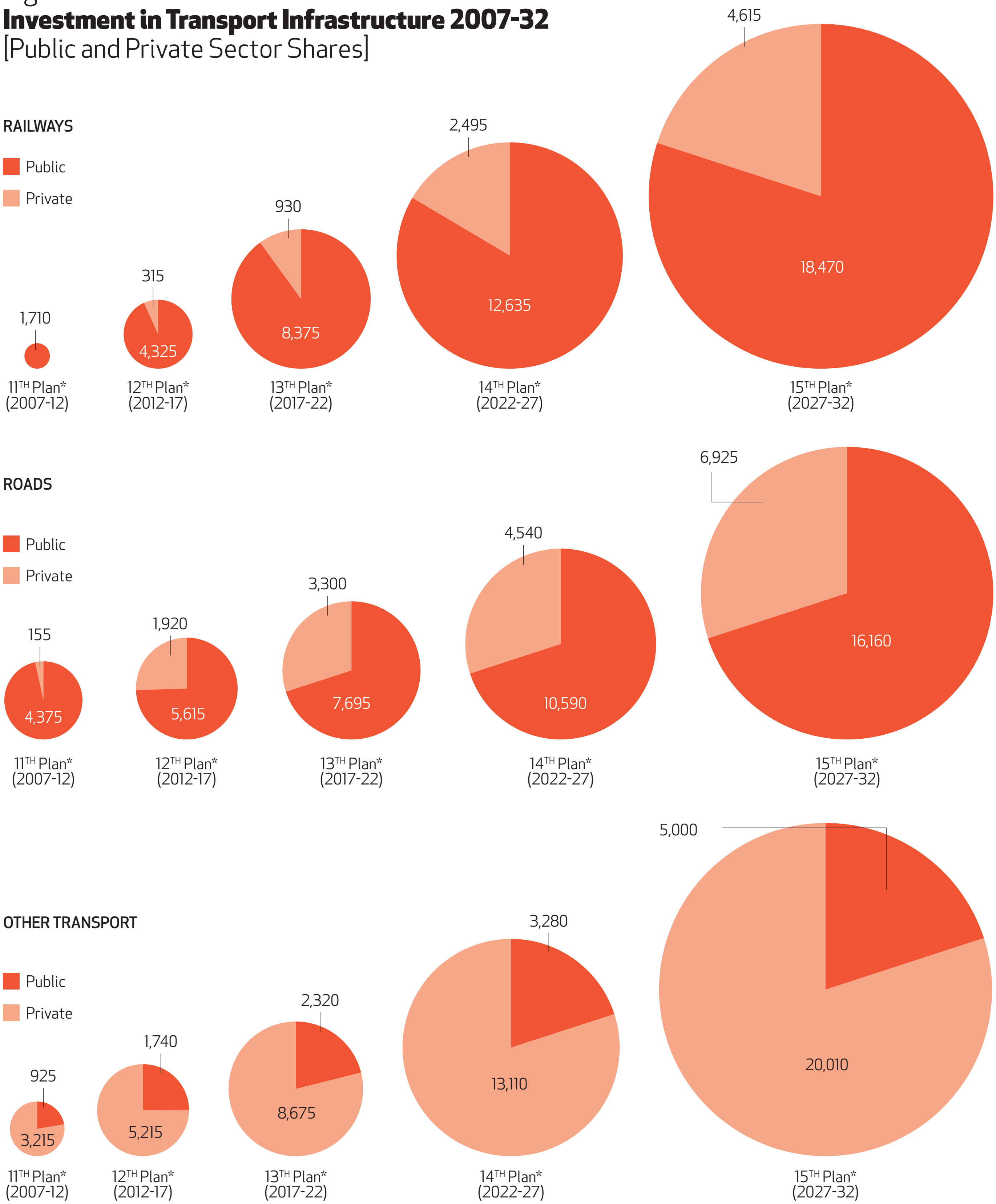
Central Government	
Budgetary support	40 per cent
Internal and Extra Budgetary Resource (IEBR)	30 per cent
State governments	
Budgetary support	30 per cent
Total 100 per cent	

17. Reserve Bank of India (2013)

Figure 3. 2

Investment in Transport Infrastructure 2007-32

[Public and Private Sector Shares]



	11TH PLAN* (2007-12)	12TH PLAN (2012-17)	13TH PLAN (2017-22)	14TH PLAN (2022-27)	15TH PLAN (2027-32)
TOTAL TRANSPORT (Rs Billion)	10,380	19,130	31,295	46,650	71,180
US $ Billion	190	350	575	850	1,308

*Actual from National Accounts

Table 3.18
Financing of Transport Investment: A Possible Projection
[Per cent of GDP]

	12TH PLAN (2012-17)	13TH PLAN (2017-22)	14TH PLAN (2022-27)	15TH PLAN (2027-32)
	I. INVESTMENT PROJECTIONS			
TOTAL INFRASTRUCTURE	**7.0**	**8.2**	**8.2**	**8.1**
As Per cent of GDCF	19.0	21.1	20.0	18.7
Public	4.0	4.5	4.5	4.3
Private	3.0	3.7	3.7	3.8
TRANSPORT INVESTMENT	3.3	3.7	3.7	3.7
Public	2.0	2.2	2.1	2.1
Private	1.3	1.5	1.6	1.6
	II. FINANCING			
A. FOREIGN				
Total Capital Flows	**4.6** (495)	**4.3** (670)	**4.3** (1005)	**4.6** (1640)
Equity	2.7 (275)	2.8 (415)	2.7 (620)	2.8 (1015)
Debt	1.9 (220)	1.5 (255)	1.6 (385)	1.8 (625)
FOREIGN FLOWS FOR TRANSPORT (APPROXIMATELY 15 PER CENT OF TOTAL FLOWS)	**0.70** (75)	**0.65** (100)	**0.65** (150)	**0.70** (235)
Equity	0.40 (42)	0.40 (60)	0.40 (90)	0.40 (140)
Debt	0.30 (33)	0.25 (40)	0.25 (60)	0.30 (95)
B. DOMESTIC	**2.60** (275)	**3.05** (475)	**3.05** (700)	**3.00** (1050)

Note: Figures in paranthesis are in US$ billion

We have therefore assumed that, overall, 70 per cent of total public sector transport investments will be expected to come from the Budget. And about 30 per cent from Internal and Extra Budgetary Resources (IEBR) including public sector borrowing, which includes foreign borrowings by public sector enterprises. Thus, of the 2.2 per cent of GDP projected for public sector investment in transport in the next four Plan periods, resources amounting to around 1.40 to 1.55 per cent of GDP would need to come from budgetary sources and about 0.70 per cent to 0.75 per cent of GDP from IEBR, including foreign borrowings. After examining the flows of official lending, we have made a rough estimation of about 0.10 per cent of GDP as foreign borrowing flowing to the public sector (Table 3.19).

PRIVATE SECTOR

Coming to private sector investments in transport, it is found that a substantial proportion of total funding could indeed come from foreign sources, if these projections are broadly reasonable. Thus, of the 1.3 to 1.6 per cent of GDP expected to be invested by the private sector in transport over the next 20 years, about 0.55 to 0.60 per cent, or about a third, could come from foreign sources. The proportion is somewhat higher in the 12th Plan because of the higher current account deficit that has already taken place. The implication of these projections are that the share of foreign equity financing of private sector transport investments could be comparable to that by the domestic private sector. Further, domestic debt financing would have to be significantly higher than sustainable foreign debt financing. This is reasonable since most cash flows in the domestic transport sector are in the domestic currency. In sectors such as ports and airports, however, foreign borrowings could be naturally hedged since a substantial part of their earnings are in foreign currency.

Consequently, of the domestic financing projected for transport investments in the private sector, the

Table 3.19
Financing of Transport Investment: Public and Private Sectors
[Per cent of GDP]

	12TH PLAN (2012-17)	13TH PLAN (2017-22)	14TH PLAN (2022-27)	15TH PLAN (2027-32)
PUBLIC SECTOR	**2.0**	**2.2**	**2.1**	**2.1**
Budget (70 Per cent)	1.40	1.55	1.50	1.50
IEBR (30 Per cent)	0.60	0.65	0.60	0.60
Foreign Debt	0.10	0.10	0.10	0.10
Private Sector				
FOREIGN	**0.60**	**0.55**	**0.55**	**0.60**
Equity	0.40	0.40	0.40	0.40
Debt	0.20	0.15	0.15	0.20
DOMESTIC	0.70	0.95	1.05	1.00
Equity	0.25	0.35	0.40	0.40
Debt	0.45	0.60	0.65	0.60
TOTAL	**1.30**	**1.50**	**1.60**	**1.60**
Equity	0.65	0.75	0.80	0.80
Debt	0.65	0.75	0.80	0.80
TOTAL TRANSPORT	**3.3**	**3.7**	**3.7**	**3.7**

debt equity ratio turns out to be in a range from about 2:1 to about 3:2 over the four Plan periods projected. What these projections illustrate is that if we account for the sustainability of the Indian balance of payments over the long term, the extent of external borrowing for the transport sector would be somewhat limited to about 0.25 to 0.30 per cent of GDP overall, leaving the rest of debt required to be raised in domestic markets. As emphasised earlier, it is of the utmost importance that much greater efforts are made to invigorate the pension and insurance sectors for greater long-term savings to flow into these funds. It is only if such long-term funds are available, can this kind of domestic borrowing become possible for investment by the private sector in transport.

OVERALL ASSESSMENT

Are these projections reasonable if translated into absolute amounts? (Table 3.20) During the 12th Plan, about Rs 8.2 trillion would need to be made available from the Budget, supplemented by about Rs 3.5 trillion from IEBR for public sector transport investment. This implies an average of about Rs 1.6 trillion per year from budgetary resources and about Rs 700 billion from IEBR per year during the 12th Plan. Looking at the private sector, there would need to be total investment of about Rs 7.45 trillion over the 12th Plan of which about Rs 4.1 trillion would come from domestic sources and about Rs 3.5 trillion from foreign sources. Domestic equity of about Rs 1.4 trillion would need to be raised during the 12th Plan period to be supplemented by about Rs 2.7 trillion in debt from domestic sources. Translated into annual average numbers, this comes to about Rs 280 billion per year in terms of equity and Rs 540 billion per year in terms of debt raised. Total bank credit disbursed to the transport sector over the last three years has been of the order of 0.5 per cent of GDP annually. If account is taken of other sources of borrowing, projections made for debt financing of the private sector would appear to be within the realms of feasibility. The comparable numbers for following Plans are provided in Tables 3.19 and 3.20.

The magnitudes of these numbers would seem to be reasonable. However, for such an investment programme to be successful, there is a great need for appropriate transport sector policies that can indeed attract such levels of both foreign and

Since a good deal of equity investment in most private sector companies arises from retained earnings, the business climate would have to be such that private investment in the infrastructure sector is adequately profitable on a consistent basis

domestic private investment. Since a good deal of equity investment in most private sector companies arises from retained earnings, the business climate would have to be such that private investment in infrastructure is adequately profitable on a consistent basis.

In summary, our projections suggest that with appropriate policies, it should be feasible to raise adequate financing for the transport investment projected from both domestic and foreign sources. Public sector investment will remain important, and around 70 per cent of public sector investment would need to come from Central and state budgetary sources. For success in raising adequate Internal and Extra Budgetary Resources (IEBR), it will be essential to follow consistent and appropriate policies for user charges wherever feasible in the transport sector. Innovative sources of budgetary financing will also need to be considered such as those proposed for Urban Transport (Volume III, Chapter 5). In the projections made in this section, it is probable that the expectation of foreign investment may be somewhat higher. So far, foreign firms have not yet shown much interest in such investments even though India has the largest PPP programme in roads; however, significant interest is available for investment in other transport infrastructure areas such as ports and airports. Potentially, foreign interest could also come in investment in rolling stock in the railways as and when permitted.

SUMMARY

This chapter has provided macroeconomic projections that could fulfill the infrastructure and transport requirements needed over the next two decades, taking into consideration assumptions about expected growth of the Indian economy. In addition, we provided a bottom-up approach to look at each sectoral investment need.

As stated at the beginning, there is a close relationship between economic growth and infrastructure investment, of which transport investment is a very significant component. When talking about economic growth, it is not possible to accelerate growth if transport investment is not accelerating correspondingly. Conversely, it will not be possible to find the resources required for infrastructure unless the country's economic growth accelerates.

The projections made in this chapter should be considered as indicators of the plausible magnitudes that can be invested in infrastructure and transport over the next two decades. Such investments could take place if the policy framework in each sector is made investor-friendly and transparent. We are aware that there will be leads and lags between different sectors over time. For instance, it is plausible that the power and telecommunications sectors could receive greater investment than suggested by our projections.

ACCELERATING GROWTH:

The Indian economy has been projected to accelerate its growth from the 11th Plan average of 8.0 per cent and the lower 12th Plan annual growth envisaged at around 7 per cent to 9.0 per cent subsequently upto 2031-32. To achieve such GDP growth, the investment rate would need to increase from the current 35 per cent of GDP to about 42 per cent in 2031-32. The economy would have to become more efficient to fulfill these expectations: the Incremental Capital Output Ratio (ICOR) would have to be around 4.2. Also, the rate of industrial growth would have to accelerate from an average of 7 per cent during the 11th Plan to approach 10 per cent per year over the next twenty years.

WHY TRADE NEEDS TO EXPAND:

The implication of such growth for the external sector of the economy is a high degree of continuing trade expansion over the next twenty years. This is because achieving the desired investment level would need significant mobilisation of external capital inflows to finance industrial and infrastructure investment requirements, and the equipment imports implied by such expansion. The sustainability of such economic growth would require continuing high growth in exports of goods and services, though declining from around 20-25 per cent recorded in the 11th Plan to about 10 per cent by 2016, and then growing at 10-11 per cent per year over the next 15 years. If this takes place, total exports should reach around \$3 trillion by 2031-32. At these levels, exports would comprise about 38 per cent by 2031-32, up from the current level of 24 per cent. With such consistent growth in exports, it would be feasible for India to sustain a current account deficit of about 2.5 per cent of GDP as assumed in our projections, which is required for the non-inflationary absorption of external capital inflows.

In order to keep the debt-service requirements at a sustainable level, the debt-equity ratio of net capital inflows would have to be less than one. Therefore, the implied net annual debt flows would increase from the current level of about \$20-40 billion to \$130 billion during 2027-32. As debt repayments also rise, this implies that annual gross debt flows will have to increase from around \$40-60 billion now to \$120 billion in the 13th Plan period and rising to \$300 billion by the 15th Plan. The annual net foreign investment inflow,

Table 3. 20
Financing of Transport Investment: Public and Private Sectors
[Rs Billion, 2012-13 Prices]

	12TH PLAN (2012-17)	13TH PLAN (2017-22)	14TH PLAN (2022-27)	15TH PLAN (2027-32)
PUBLIC SECTOR	**11,680**	**18,390**	**26,505**	**39,630**
Budget (70 Per cent)	8,176	12,957	18,932	28,307
IEBR (30 Per cent)	3,504	5,433	7,573	11,323
Foreign Debt	584	836	1,262	1,887
PRIVATE SECTOR				
FOREIGN	3,438	4,732	6,925	11,831
Equity	2,292	3,441	5,036	7,888
Debt	1,146	1,291	1,889	3,944
DOMESTIC	4,012	8,173	13,220	19,719
Equity	1,433	3,011	5,036	7,888
Debt	2,579	5,162	8,184	11,831
TOTAL	**7,450**	**12,905**	**20,145**	**31,550**
Equity	3,725	6,453	10,073	15,775
Debt	3,725	6,453	10,073	15,775
TOTAL TRANSPORT	19,130	31,295	46,650	71,180

including both foreign direct and portfolio inflows will represent an increase from the current $45 billion to $200 billion by 2027-32.

Such inflow of external capital requires an open foreign investment regime. On the debt side, there is a negative expectation about the official net debt flows: hence, most of the new debt flows would have to be commercial, which would be highly reliant on the maintenance of high credit ratings for India and its borrowing entities.

THE INVESTMENTS REQUIRED

The macro-economic exercise suggests that it is feasible for total investments in infrastructure to increase from the current level of 5.8 per cent of GDP to 8.0 per cent after the 12th Plan period, up to 2031-32. In absolute terms, this implies that the annual level of investment could increase from the current Rs 6 trillion ($100 billion) to about Rs 30 trillion ($570 billion) by 2031-32. If we can manage to steerabout 30-40 per centof the total capital inflows into the financing of infrastructure, we could expect about 15-25 per cent of the of the total requirements for infrastructure to be externally financed. The rest as much as 75-85 per cent will have to be domestically financed.

For investments in transport, the annual level of investment in railways, roads and bridges, and other transport, will increase from Rs 2.2 trillion ($45 billion) in 2011-12 to Rs 3.8 trillion ($70 billion) during the 12th Plan, Rs 6.3 trillion ($110 billion) in the 13th Plan and rising to about Rs 14 trillion ($250 billion) in the 15th Plan period. Of this, investments in Railways by itself will increase from Rs 300 billion ($6.5 billion) in 2011-12 to Rs 900 billion ($17 billion) during the 12th Plan, Rs 1.9 trillion ($ 33billion) in the 13th Plan, and rising to Rs 4.6 trillion ($85 billion) in the 15th Plan period, all in constant 2012-13 prices.

Public sector investment in infrastructure cannot be reduced from the current levels as a proportion of GDP. It should actually rise marginally: the projections for the next two decades show public sector investment in infrastructure should go up marginally

On the external capital front, there is a negative expectation about official net debt flows; hence, most of the new debt flows would have to be commercial, and thus, highly reliant on the maintenance of high credit ratings for India and the borrowing entities.

from 4 per cent of GDP during the 12th Plan period to 4.3 to 4.5 per cent of GDP in the next three Plans. This increase in public sector investment is primarily due to the increased investment proposed in the railways. Depending on private sector investment trends, there could also be a shift in sectoral composition of public sector infrastructure investments. Private sector investment is complementary to public sector investment rather than a substitute. This implies that public sector infrastructure investment will have to be increasingly commercially viable if public resources invested in infrastructure increase somewhat faster than GDP growth.

Thus, a greater effort will need to be made to strengthen and commercialise all public sector entities that invest in and manage public transport infrastructure at both the central and state levels. The Railways, in particular, need very significant organisational and accounting change (as detailed in Volume III, Chapter 1) if the kind of capacity and quality expansion envisaged is to be achieved. Similarly, urban transport entities ranging from bus transport companies, BRT and other MRT entities will have to be increasingly commercially viable.For this to happen, significant resources will have to be invested in capacity development across the board.

Most of the external capital inflow related to infrastructure, in terms of both equity and debt, is going into telecommunications and the power sector: The flow of external capital into the transport sector is, so far, not very large. Thus, the proportion of transport investments that can be expected to be externally financed is unlikely to be higher than 15 per cent: it could well be lower.
Thus, an important upshot of our exercise is that:

- Expectations of foreign financing of transport investment need to be realistic in terms of the attractiveness of this sector for foreign investment, in terms of both equity and debt.
- Special efforts will have to be made to influence the flow of domestic savings into the transport sectors.

Finally, high growth in trade and a stable domestic macroeconomic and financial environment is critical to India in order to attract the external capital inflows needed on a sustainable basis. Further, expecting a higher level of external capital inflows than those projected might be unrealistic and also destabilising. Therefore, the bulk of resources for overall infrastructure investment will have to originate from domestic savings.

The NTDPC also made bottom-up estimates for investment requirements in each infrastructure sector. The aggregate and sectoral estimates provided by the Working Groups, consisting of the relevant government ministry representatives and sectoral experts, turn out to be lower than the macroeconomic consistent model projections of availability of resource flows for transport infrastructure. We have not attempted to reconcile the two sets of estimates. But these projections suggest that we can be more ambitious in our transport planning in the 13th Plan and beyond.This outcome also suggests that the many proposals in this report that relate to

- Capacity development
- Safety enhancement in all sectors
- Use of information technology
- Environmental projection through more stringent fuel standards, etc
- Connectivity with and within the North East; and
- International connectivity

have a high probability of being financed.

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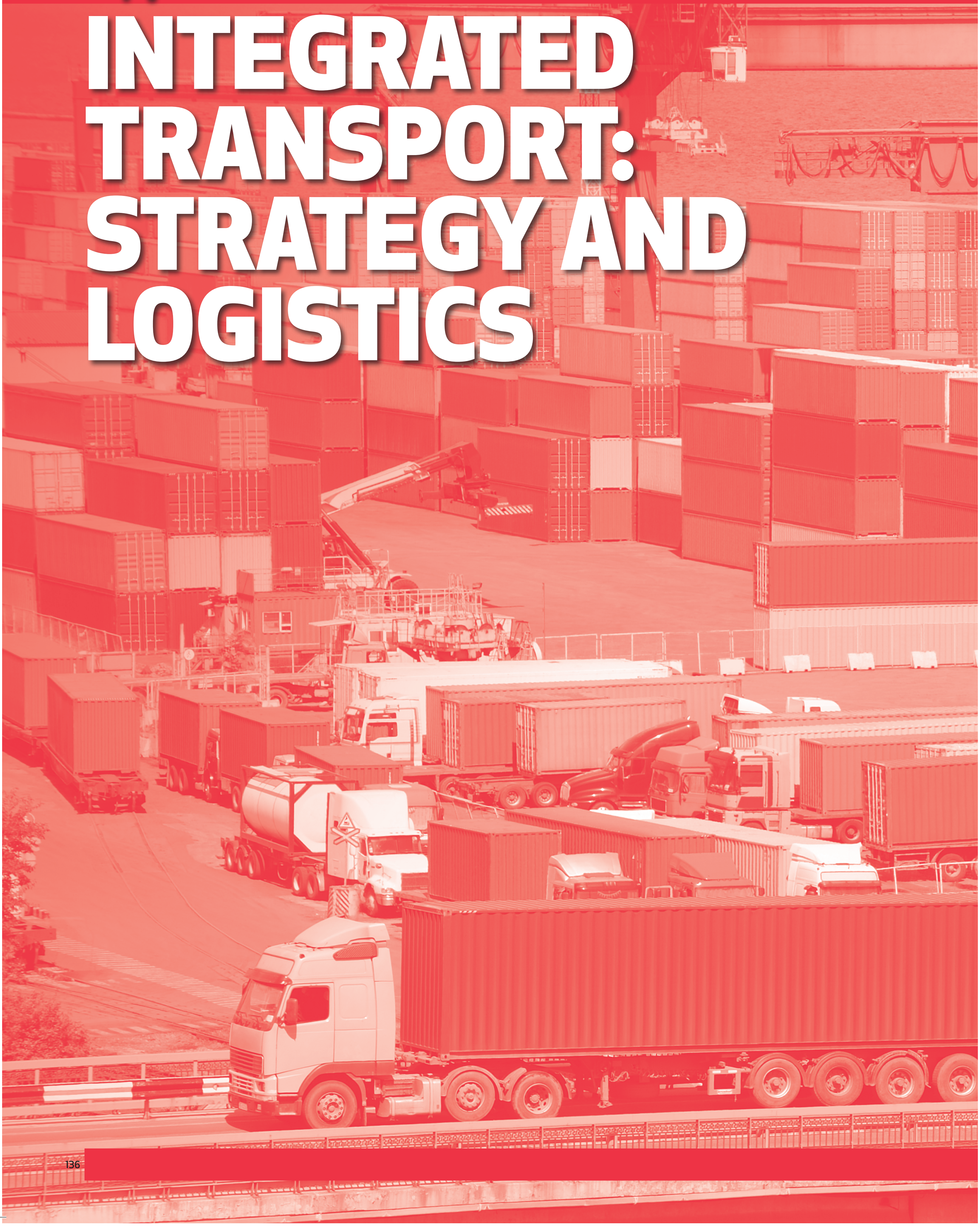
4. INTEGRATED TRANSPORT: STRATEGY AND LOGISTICS



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4. INTEGRATED TRANSPORT: STRATEGY AND LOGISTICS

The Committee aims to design a transport system—a network of networks—that permits the greatest choice at the lowest resource cost; one that is safe, efficient, effective, and is reflective of the net economic, social and environmental costs of service provision.

How do we get there? How does India deliver on a transportation system that meets the national purpose? What sets of strategies must be deployed? In this chapter, the Committee proposes an integrated approach to devising strategy for investment in transport infrastructure and service delivery. The approach is motivated by the view that transport—especially of a freighted good—is firmly integrated within the value proposition of the good; the contemporary supply chains and those of the future render them inseparable from any other production input. The perspective taken in this chapter is that it is modern transport practices that create and shape the market for many goods in today's globalised and integrated world. Consequently, this integrated approach to transport planning advocates considerations that go beyond ensuring the availability of a variety of transport modes and beyond accommodating easy intermodal transfers of passengers and freight, though these are important in their own right.

Instead, the integrated philosophy is about more than the simpler choices over intermodal transport that it is sometimes confused with. Choices within each transport mode—intra-modal or trans-modal choices—are also brought to the forefront of the planning exercise. The argument over the allocation of funds to road and rail is not limited to road and rail, but also includes deliberation on the minute detail of freight and passenger rail transport, to the economics of commercial and passenger vehicles on the roads, to the resource cost of freight transported via dedicated tractor-trailers versus generic bulk cargo trucks, to desired substitution from these modes to air and marine shipping, and to how all of these fit together. In short, the integrated approach to transport strategy considers the universe of transport modes, and in setting out choices between the modes, also considers choices to be made within the modes, and choices over the complementarity of modes. The philosophy emphasises both bottom-up as well as top-down thinking on transport to arrive at a desired complete and internally consistent strategy, and one that is best suited to deliver the holistic transport network described in Chapter 2, this volume.

This chapter is divided into two halves. The remainder of this section sets out the theoretical foundations of the integrated approach, together with some India-specific observations. The second half then provides an extended look at transport logistics in

Longer-term intergenerational transport infrastructure planning seeks to identify the deep secular, or structural, influences on the local and global economies in the early stages of their development, and tailor comprehensive development plans consistent with the resultant and desired traffic patterns.

India, and the benefit that this sector could draw from integrated transport planning. The purpose is both to consider the state of the industry domestically and around the world (an important topic for this Committee in its own right), and also to provide an illustration of the benefits that modern integrated transport strategy can bestow on the sector. The bulk of this second section is a discussion on the practical methods for planning efficient intermodal transport. Though the working example in this chapter is limited to the freight-carriage and logistics industries, there is no reason that similar thinking cannot be brought to bear on planning for all users of transport services.

THREE APPROACHES TO TRANSPORT STRATEGY

THE BOTTOM-UP APPROACH

For some politicians, policymakers, planners and administrators, identifying suitable transport investments will be motivated by an attempt to concentrate their spending focus over a defined period. For example, a civic agency or local government might reasonably proclaim 'bus rapid transit' (BRT) or 'rural connectivity' as their infrastructure development theme over the 12th Five Year Plan. Equally, political exigencies could favour the development of National Highways as the masthead road-building theme for one plan, and rural roads for another.

These 'bottom-up' investment themes certainly serve their purpose as short-term spending foci or as tools for communicating strategy, but they leave much to be desired in helping decide on the strategy itself. What are the macroscopic reasons for choosing one investment plan over another? What makes the various elements of an investment plan fit, such that, taken as a whole, the desired outcomes will be achieved? In effect, these bottom-up themes reflect project-centric, rather than network-centric, thinking. These projects are decision outputs, rather than the required inputs into the infrastructure investment decision framework. And even as outputs, they are not quite useful as they distract attention from what is really important: the outcomes. Will the transport system cater to projected traffic demand? What systematic reforms will be required to contribute to accessibility, mobility and connectedness? Will people and goods be able to move seamlessly from one transport mode to another? Will the system account for and be robust to structural, social, demographic, economic and environmental factors? In short, bottom-up, project-based thinking does not begin to answer the strategic questions on transport networks that governments and investment planners are really interested in.

However, the bottom-up approach is nonetheless the tool that is commonly used at present for determining many of the key ingredients that the strategy will ultimately rest on. As discussed later, these include traffic flows, projected demands for transport services and cost structures of alternative service delivery mechanisms for a given transport mode.

THE TOP-DOWN APPROACH

Other agencies and ministries might prefer a more top-down approach beginning with the identification of the important economic, geographic, demographic or industrial elements of the Indian or global socio-economic environment and the resultant impact on transport demand and supply. For example, an inescapable conclusion of the desired growth path for the Indian economy over the next 20 years is the requirement for more coal-fired thermal power plants[1]. This argues strongly in favour of improvements in the carrying capacity of railways for bulk coal and investment in ship-to-train connectivity to allow better movement of imported coal. This top-down perspective is considerably more macroscopic than the bottom-up view. However, even this 'bigger picture' is not quite big enough. The major shortcoming of this approach is that the successful identification of a macroscopic theme to motivate infrastructure development can be undone by shoddy project selection; or worse, by incomplete project selection. To continue the example above: suppose that the 'coal' motivator for a certain transport strategy is taken to hold support only for projects that boost rail capacity. Improvements in the intermodal connectivity at ports, which would be essential for efficient distribution of imported coal, are then neglected.

THE THIRD PERSPECTIVE: THE DRIVER OF INTEGRATED TRANSPORT PLANNING

The bottom-up and top-down approaches are better suited to planning for the short- and medium-terms. For long-term, intergenerational planning for transport infrastructure, a longer-term view on the local and global environment is necessary. In this worldview, strategies determined by booming economic sectors, modish financial ideas, latest technological developments, or 'hot' geographic regions are largely redundant. This perspective argues not so much for the picking of fair winds in one economic sector or transport mode, but for preparedness for wholesale changes to the national climate along all dimensions:

1. Chapter 8, Volume II on Transportation of Energy Commodities.

demographic, social, economic, technological and environmental. In short, it seeks to identify the deep secular, or structural, influences on the local and global economies in the early stages of their development, and to then tailor comprehensive infrastructure development plans consistent with the resultant and desired traffic patterns.

Returning to the example, this third perspective turns the concept of the drivers of transport strategy on its head. Coal, or even thermal power, is not the theme. Rather, the secular trends are the industrialisation and urbanisation of the Indian economy over the coming decades, and investment for the transport of coal to generate power is only one infrastructure idea that stems from these. Industrialisation and urbanisation have such far-reaching effects that a more expansive and crucially, internally consistent infrastructure investment plan is called for. The urbanisation driver will certainly provide justification for boosting investment in the rail transport of bulk goods such as coal, but it will also support the case for better urban roads and mass rapid transit. It may call for the rebalancing of long-distance rail services away from passenger services towards freight services[2]. Similarly, an explicit acknowledgment of the role that transport must play in the government's distribution and development policies a theme likely to persist in India for some time can prove more fruitful than an ad hoc 'system' of opaquely redistributive taxes and subsidies that distort the transportation markets.

Thinking about these long-term influences on the transport market also helps in devising much-needed prioritisation frameworks for transport investment. Together, these individual infrastructure ideas that are each grounded in urbanisation or distribution or another theme will provide complete investment plans—i.e., integrated strategies—that address the goal noted at the start of this chapter: infrastructure that supports the desired pace of India's socio-economic transition at the lowest resource cost.

The defining attributes of these 'third'-perspective themes which will guide integrated transport planning are their long-term and largely irreversible nature; their far-reaching, game-changing effects on the economy; their indifference to business cycles; and their relative immunity to financial and economic shocks. Note that these are characteristics of the driving forces that underpin the strategy, and not of the components of the resulting investment plans.

The challenges to using these long-term themes to motivate and shape infrastructure investment plans are several and severe. To define a fundamental driver requires the accurate and timely identification of structural trends that will persist for a substantial period. History is littered with bold predictions that never came to pass or were measurably less bold than their sponsors had anticipated. This is not unreasonable. Picking overarching new trends for the future is as much art as science, based as it is on divining relationships in patchy data, extrapolating from the same scant information set, and making assumptions about the future states of the world, all with fingers firmly crossed.

Picking overarching future trends is as much art as science, based on divining relationships in patchy data, and extrapolating from that scant information, with fingers firmly crossed.

To repeat a point made elsewhere in this report, there is important endogenity in devising long-term plans and the resulting infrastructure. Trends are vulnerable to the response they inspire. For example, the suburbanisation (as opposed to the urbanisation) of American cities was a major long-term trend observed in the post-war years, with important implications for transport infrastructure and policy. The policy response was to make it easier for people to commute from suburban homes to downtown city centres by building more and better roads, and pricing fuel below social costs. However, the resulting environmental pollution, sub-optimal landuse, increased commuting times, thinning of group social capital, and general urban degradation has meant that the factors supporting the suburbanisation theme have reversed, and many American cities have seen a rebirth in the vitality of the downtown. Against these challenges are indisputable benefits. Infrastructure development plans that are the outcome of integrated strategies are more likely to be complete, consistent and robust, as the next sub-section shows.

THE THEORY OF THE INTEGRATED APPROACH

The Committee has adopted the classical view that the demand for transport services is derived from the demand for other goods and services. This is to say that without the existence of goods that are produced and consumed in different locations, there is no requirement for transport[3]. There must be both functional complementarity in that viable demand and supply relationships exist, as well as spatial complementarity in that the demand and supply must originate at different geographical locations[4].

2. Note that the emphasis is on rebalancing away from passenger services and towards freight services; growth in passenger services can still be commensurate with the fundamental drivers of demand. The integrated approach yields this kind of useful prioritisation.
3. It is most convenient to frame this discussion in the context of the movement of freightable goods. Logically isomorphic constructions can be made for the movement of passengers, but at the cost of substantial linguistic calisthenics. For example, one may argue that services rendered by the employees of a firm are 'produced' at their residences, but 'consumed' at their workplaces, thereby giving rise to the necessity for the daily commute. To avoid these awkward constructions, and in keeping with logistics as the focal example in this chapter, the remainder of this discussion proceeds by considering the movement of goods only.
4. Rodrigue (2006).

For example, raw materials must be sourced from location A, manufacture takes place at B, packaging at C, distribution at D, consumption at E, and waste disposal at F. In this manner, transportation services supply the missing link that allow the match of the demand for and supply of a good.

The derived demands for transportation can be further decomposed into those that are direct and indirect, with the former referring to those for the transportation services themselves. However, the supply of transportation also generates the demand for other goods, such as for fuels that must be moved to the point of consumption, and for warehousing along various intermediate and terminal points of the supply chain. These second-order demands are the indirect consequences of the demand for the actual utility-providing good.

There must be both functional complementarity in that viable demand-supply relationships exist, as well as spatial complementarity in that demand and supply originate at diffrent geographical locations. Transportation services supply the missing link that allow the match of the demand for and supply of a good.

This classically obvious understanding of transport demand underpins much development of strategy and investment plans, and is fit-for-purpose. However, an alternative view that subsumes transportation into the supply-demand nexus—by rendering it an integral part of the manufacturing and consumption processes—provides useful theoretical basis for an integrated strategy for planning transport. This alternative view can be justified on the following grounds, and is especially pertinent when considering topics in logistics and freight movement[5].

The first argument reverses the link between the demand for a good and its transport. Under the traditional view, as noted earlier, the demand for a good gives rise to the demand for transport services. As scale expands, as more goods of a particular type and of several different types are transported, natural high-volume transit corridors develop between pairs of geographic nodes. Further, these nodes serve as hubs distributing to spokes, as warehousing junctions, and as interchanges allowing for the selection of the most efficient transport mode and gauge for each leg of the journey. As the transport system achieves scale economies and becomes more sophisticated, a definitive topography begins to take shape. Transport modes and processes are standardised—containerisation is a classic example—expanding supply chain capacities. In turn, these standardisations and efficiencies reduce costs, thereby making it feasible to transport other goods for which the freight was hitherto prohibitive. The net result is that it is the sophisticated freight and logistics network itself that creates the market for other goods, an upending of the traditional view.

The derived-demand perspective on transport essentially concludes that transportation costs are exogenous to manufacturing and consumption. A second argument against this view is that contemporary transport processes de-emphasise the costly maintenance of inventory in favour of tighter supply chains that synchronise raw material collection, manufacture, packaging, bundling and unbundling, distribution, and retail. Transportation thus becomes an intrinsic part of this modern system for supplying a market[6]. Specifically, this transportation is specialised enough to be called logistics, a term that has its origins in the military as the careful management of supply routes to a battlefield and associated processes. Firms that specialise in logistics are also beginning to blur the lines between transporter, transport arranger, and even manufacturer. These so-called third- and fourth-party logistics providers assume responsibility for the supply chain for a particular product to varying degrees. Fourth-party providers also then provide a host of auxiliary services that become an essential part of the product offering[7]. In this manner, transport is no longer an exogenous cost, and is no longer a service derived from the demand for another good, but is an embedded part of both that good's supply chain and its value proposition.

The third argument stems from the observation that an increasing number of logistics services are provided by integrated providers. Previously, separate agencies and enterprises would have been responsible for customs clearances, quarantine inspections, freight forwarding, trucking, shipping and final delivery, with delays and costs imposed by administrative and intermodal considerations. Industry consolidation, more flexible regulation, and technology have each combined to yield entities that anticipate and regulate the flows of freight. These integrators do not plan activities in response to a derived demand, but with respect to shaping and being shaped by customers' supply chain[8].

Fourth, just as the industry has consolidated, so has the infrastructure it requires. Massive logistics parks are modern-day marvels of technology and efficiency. Huge quantities of freight seamlessly

5. Rodrigue (2006) and Rodrigue (2011). This alternative view that argues against considering transportation as a derived demand is more difficult to motivate for passenger transport.
6. The advantages of such a demand-driven system are 'higher inventory turnovers, better customer service, as well as increased labour productivity and capacity utilisation which should transcribe in higher incomes, returns and lower operating expenses'. Ibid at 1455, citing Lee (2003).
7. For example, UPS, the second-largest parcel carrier in the United States, not only delivers Toshiba laptops throughout the country, but is also responsible for after-sales customer service, for collection of faulty product, and for its eventual return and repair.
8. Ibid.: 1456.

Box 4.1
Integrated Transport Networks

Historically, the coastal regions have benefited the most from economic growth and prosperity. The development levels invariably decline in areas further away from the coastline. Inadequate connections often make inland locations less competitive. Development of integrated transport networks would provide improved access to inland areas and spread the benefits of economic growth.

Development of growth centres away from the coastal areas is equally essential. Establishing dry ports in inland locations can stimulate this process. These ports would create the opportunity for the same economic stimulus seen at seaports. They would allow shippers to undertake consolidation and distribution activities as well as complete export/import procedures at inland locations that are at relatively short distances from farms and factories.

Source: Asian Institute of Transport Development: Regional Seminar on Intermodal Logistics, 2007.

interchange from plane to truck, or from ship to rail, or any combination of these. The seamless interchanges rely on efficient tracking, common or mutually intelligible software systems across the modes, and on standardised equipment such as the shipping container. The logistics parks are hubs of administrative services like customs and quarantine, and of purpose-built inventory control facilities. They also become home to businesses that require efficient access to a variety of transport modes, and to the staff and ancillary services that are required to support these. Once built, it is not necessarily the case that the throughput of these parks, a measure of the demand for transport, is determined solely by the demand for final goods, as would be the case if transport services were derived from these demands. For example, the industrial plants, new townships and logistics parks that are being built on the backbone of revitalised modern road and rail transport facilities, and known collectively as the Delhi-Mumbai Industrial Corridor are integrated demand-engines in their own right. The logistics parks and the transport links provide the scaffolding on which the entire set of other facilities rests.

The fifth and final argument against the transport-as-derived-demand view is perhaps the most pertinent and immediate. It is often noted that our world is shrinking and that transport has made it so. However, more nuanced conclusions can be drawn from this tautology. At one level, transport has ceased to matter because modern logistics has ensured that the focus can remain on identifying the most efficient supply chains[9]. 'When transport costs are high, manufacturers' main concern is to locate near their customers, even if this requires undesirably small plants or high operating costs. As transportation costs decline relative to other costs, manufacturers can relocate first domestically, and then internationally, to reduce other costs, which come to loom larger'[10]. In these most efficient supply chains, inventory costs are driven down by ensuring that parts and products are delivered to wherever they need to be at a guaranteed time: too early is almost as problematic as too late[11]. This is relevant for low- as well as high-value products[12]. In this regard, transportation systems are synonymous with inventory management systems, and are hence integrated within the manufacturing process, and especially in the management of production time and time-to-market. For many goods, it is no longer possible to separate out transportation from any other manufacturing input.

The five arguments noted above make a strong case for considering the demand for transport to be integrated with the demand for any other good. There are substantial endogeneities and feedback effects that challenge the derived-demand hypothesis. This has both positive and negative conclusions for transport planning. On the plus side, this implies that transport planning has more power to engineer and channel economic growth in a manner that is in the national interest than might appear at first glance. On the other hand, it places substantial onus and technical demands on the decision-making authorities to devise and deliver on plans. Whether the net repercussions are positive or negative, the major conclusion to be drawn from these observations is that transport planning must be necessarily integrated within and across modes.

9. 'It is better to assume that moving goods is essentially costless than to assume that moving goods is an important component of the production process.' Edward Glaeser and Janet Kohlase, cited in Levinson (2007: 8).
10. Ibid.: 14.
11. Alternatively, the certainty of delivery at a definitive time is almost as important as compressing the delivery time.
12. Zara, a brand of the Spanish company, Inditex, has grown to be the world's highest-grossing clothing retail chain on the back of its sophisticated logistics. The label is widely acknowledged to get a new item of fashion from conception to shopfloor within two weeks, against an industry average of six months. Besides its skilled staff and choice of manufacturing locations that are close to its largest markets, the biggest contributory cited in Zara's success is the sophistication of its supply chain.

Box 4. 2
Management Structure and Pricing of Services

All human endeavour involves choices and nowhere is this more true than in commercial activity. Transport is an integral part of economic and commercial activity. As such, it also requires choices to be made between different modes of transport, such as rail and road. However, the sum of individual choices, even while maximising the welfare of an individual or a firm, may not maximise social welfare.

Despite the comparative advantage of rail over road in terms of social costs, its share in both passenger and freight traffic has been declining over the years. The reasons for this decline can be broadly categorised into pricing policies and non-pricing attributes related to rail and road modes.

Of the two modes, rail is a state-owned monopoly subject to price regulation, while the road transport market is privatised and competitive for freight traffic. The prices of freight transport service by trucking are determined by free market forces. However, for passenger road transport, both public sector undertakings and private operators supply the service under a regime of price regulation.

The pricing systems prevailing in the two modes are totally different. Rail transport, in its pricing, covers all costs, including that of the fixed infrastructure, whereas road pricing does not reflect the full normative cost of ground infrastructure and its maintenance. Besides, the road and fuel taxes have little or no relation with the true resource cost of various inputs.

In road transport, the freight and passenger segments operate as independent entities, while in rail, there is no such distinction. This difference in structural characteristics has critical implications in pricing of the products in the two modes. In road transport, there is no element of cross-subsidisation between the two products, while railways indulge in it with great profligacy.

Source: Asian Institute of Transport Development, Environmental and Social Sustainability of Transport: Comparative Study of Rail and Road, 2002

INTERMODAL TRANSPORT SYSTEMS

Intermodal transport is the combination of at least two modes of transport in a single transport chain, ideally without a change of container for goods. With the multiplicity of modes, the cooperation and participation of several agents is required. On the demand side, owners, shippers, forwarders, shipping lines and logistics service providers each fulfil a particular set of service provisions, with terminal, rail, inland navigation, short-sea, road and intermodal transport operators involved in supplying the actual services. Terminal operators at ports, logistics parks, airports and other transhipment junctions are at heart of the intermodal system by transferring intermodal units between mainline transport networks and undertaking drayage.

The extra handling required of intermodal shipments adds to overall costs. However, these costs whether direct or indirect in the form of economic externalities are usually a small proportion of the gains to be made by transporting goods on modes to which they are best suited for particular segments of the journey. Intermodal transport systems demand flexibility, reliability, cost-effectiveness and extensive collection and dissemination of information. Against this, they offer cost savings, reduced congestion, air pollution, noise and fewer accidents through the use of dedicated and finely tuned systems.

It is important to note that, in itself, the intermodal principle is not about advocating a particular modal mix. Within the context of a regional or national economic environment and the prevailing social and financial circumstances, different modal mixes are likely to prove apposite. Thus, the principle petitions for the discovery of the optimal mix, with a view that the various components can be integrated into an origin-to-destination supply chain that improves overall efficiencies of the transport system. By improving the connections between all modes of transport and integrating them into a single system, intermodality allows better use to be made of rail, inland water transport and coastal shipping which, by themselves, are not readily amenable to origin-to-destination supply chains but are excellent for certain segments therein[13].

The inefficiencies of a transport system are manifested in higher prices, longer journeys, reduced reliability, lower availability of quality services, type restrictions, higher risks of damage or pilferage

13. Intermodality is, therefore, complementary to other transport policies such as liberalisation of transport markets, developing of national networks for a single mode, and the promotion of fair and efficient pricing. EC (2002).

Table 4.1
Break-Even Distances, Rail and Road

COMMODITY	BREAK-EVEN DISTANCE (KM)	COMMODITY	BREAK-EVEN DISTANCE (KM)
Food Grain	222	Cement	160
Fruit & Vegetables	313	Livestock	162
Coal & Other Minerals	188	Iron & Steel	173
Fertilisers	167	Containers	307
Sugar	372	Other	307
Petroleum	126		

Source: RITES (2007-08)

and more complex administrative procedures. Though multimodal systems seek to eliminate or dampen some of these outcomes through better modal mixes and efficient intermodal transfers, the good functioning of the system is determined by several critical enablers.

First, missing stretches of infrastructure within one mode or missing links between modes, however small they might be, can prevent seamless intermodal chains. They impose additional transfer and friction costs on operators. Inadequate access by rail, road or waterborne transport to existing transfer points can hamper the integration of these modes and transfer between modes.

Second, because the various component modes of an intermodal system are financed and managed separately, the responsibility for strengthening the links between them is unclear. Moreover, the existence of different forms of ownership and charges for the use of infrastructure and terminals does not enable transparent and coordinated infrastructure planning at local and regional levels. Intermodal transport is only as strong as the weakest link in the transport chain, a point made more forcefully in Chapter 2, Volume II, this report. The lack of standardisation and interoperability within and between modes poses significant problems. The wide variation of loading unit dimensions across modes, and the incompatibility of the transport equipment for road, rail, coastal and inland waterway traffic raises transfer and handling costs and necessitates cumbersome transhipment techniques. Simple standardisation technologies like pallets and shipping containers allow vehicles, vessels and wagons to be designed with complete agnosticism on the cargo carried. Further, the standardised handling equipment and the automation of handling procedures permit both easier and faster transhipment.

Unequal levels of performance and service quality mark the various component modes of an intermodal system. It is not much good if a coastal shipping system can deliver, and the road system remove, a certain defined quantity of cargo from a port, but the port's handling equipment can only process a small fraction of the required throughput. The differences arise from variations in the cost structures, but also from the industrial organisation, competition and liberalisation of a particular mode. Modes where operators are confronted with a high threshold for access to their infrastructure tend to generate monopolistic behaviour, resulting in a lack of customer-oriented operations and sub-optimal use of capacity. Next, because operators own their own fleets or even infrastructure, they often tend to subscribe to and promote only one mode of transport and disregard better options which may exist on other modes.

A final barrier to the efficient use of intermodal systems is the allocation of responsibility and liability. If the final receipt of an intermodal supply chain with many service providers is a damaged product, what is the appropriate measure for registering insurances and claims? The competitiveness of intermodal transport is also hampered by unequal administrative treatment and impermeable information. For example, transport documents are to a large extent still based on paper and differ according to specific modes—maritime, rail, road or air transport.

INTEGRATED TRANSPORT PLANNING IN PRACTICE: AN INDIAN PERSPECTIVE

As noted earlier, it is essential that an integrated transport strategy does not develop in mode-specific silos, and is tied to the agenda for national socio-economic development in an organised and sensible manner. The following discussion sequentially identifies the major steps in an integrated planning exercise, before focussing on general implementation issues and common pitfalls. As is true for this entire

Box 4. 3

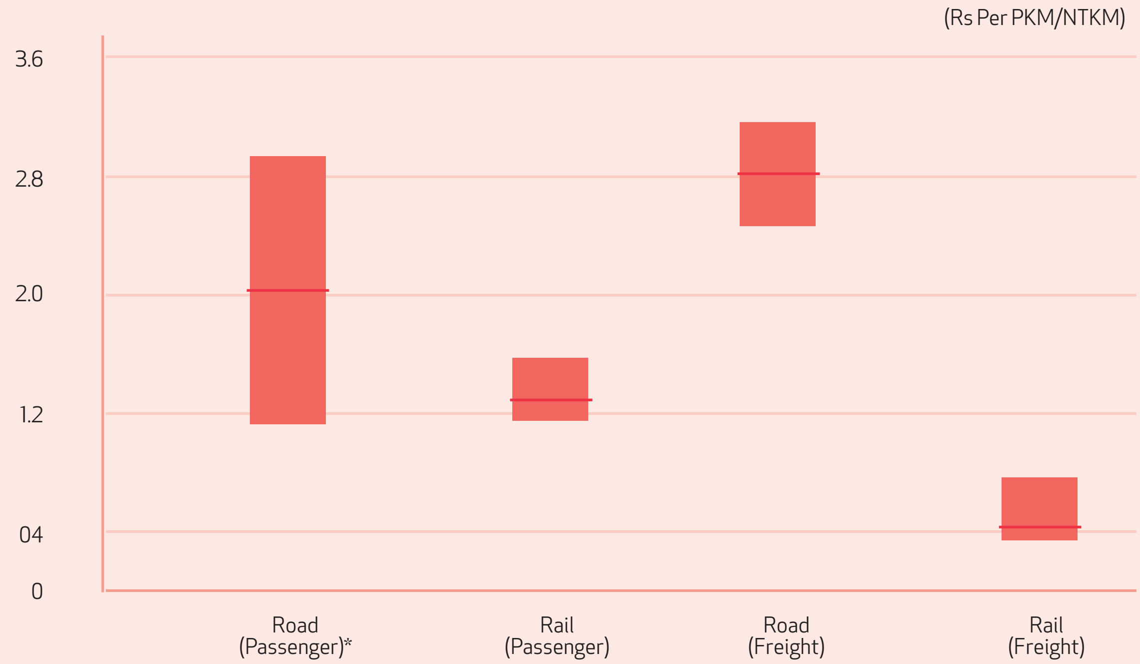
Comparative Study of Rail and Road Modes

The use of transportation is not wholly a benign activity. It causes strain on nature by consuming scarce resources, emitting harmful pollutants and generating undesirable wastes. Different modes of transport cause varying levels of stress and consequent damage. Hence, there is growing recognition that the transport systems and modal choices should factor in the cost of environmental degradation and social damage, as it would promote both overall sustainability and sustainable transport.

It was in this context that the Asian Institute of Transport Development (AITD) undertook an empirical comparative study of rail and road modes with a focus on social sustainability. The empirical model simulates effects of intermodal substitution. It estimates all inclusive costs—financial, environmental and health damage caused by line-haul operations and related development of ground infrastructure. The results of the study are graphically depicted below:

SOCIAL COSTS OF ROAD AND RAIL

* In terms of social costs, railways have a huge cost advantage over road transport. The advantage is



* The option of 'bus only' is considered for road passenger transports.

greater in freight traffic than in passenger traffic.

* Policy changes can induce shift of modal choice in favour of rail and in favour of public road transport over personalised transport.

Source: Asian Institute of Transport Development, Environmental and Social Sustainability of Transport: Comparative Study of Rail and Road, 2002

chapter, the focal example is the generalised movement of freighted goods and logistics.

TRAFFIC AND COSTS STUDIES

The first step is to identify past and expected changes in the pattern of traffic demand for various modes of transport[14]. These changes mainly occur due to two factors: the types of commodities that are moved through the system (themselves a function of the country's changing economic profile), and the costs at which the various modes of transport can accommodate the changing traffic patterns and volumes. The cost structures analysed should be resource costs, which are the sum total of the financial outlays by user and operator together with any external or shadow costs that are borne by society.

14. Puri (2012).

These studies on expected traffic flows and cost structures support the taking of a long-term view, which is especially important as transport infrastructure takes time to develop, and is also expected to be serviceable over long periods[15]. These detailed studies should be kept current so that the resulting investment plans are always validated in the face of the changing growth and cost environment. As noted by Puri, traffic flows and costs studies must be carried out with respect to major commodities, type of route, length of haul and keeping in view alternative technologies.

It is critically important to use identical methodologies for estimating unit transportation costs to ensure fair comparison and allocative efficiencies in earmarking financial resources. To do this requires the development and availability of suitable accounting systems at the constituent units and agencies engaged in the development and operation of transport infrastructure and services.

These traffic flows and cost studies within and across modes make possible optimal decisions on mode-specific investment. The Planning Commission has sponsored several such studies in the past, but these have not been carried out at regular intervals[16]. An important outcome of this research on traffic flows and resource costs has been to build granular knowledge of the break-even distances for the efficient cartage of various commodities by different modes of transport, and especially by road and rail. The break-even distances can then be used in identifying optimal investment plans. For example, the latest available data for India suggest that road is superior to rail for hauling foodgrain from origin to destination at leads of about 220 km. At larger distances, rail is the preferred mode for mainline haulage despite any delays at intermodal nodes where the grain must be transferred from or to trucks for initial lading or final delivery. (See Table 4. 1 for break-even distances for other commodities.)

In 2007-08, RITES carried out the latest attempt at determining traffic flows and unit resource costs for rail, road, airways and coastal shipping. It generated analyses on commodity-wise freight and passenger transport across the entire country, estimating both financial as well as economic costs[17]. The traffic data was used to estimate the actual modal mix, and the costs data to establish the optimal modal mix based on break-even distances[18]. The several thousand pages of detailed analysis of individual segments of track and road and waterway can be distilled, somewhat baldly, into the following observations:

- Though there is a growing preponderance of freight carried between geographic regions, intra-regional freight volumes are perhaps twice as large and inadequately catered for[19].
- The result of these traffic increases is severe congestion on key rail and road corridors, and the creation of bottlenecks on the network pertaining to a particular mode and at junctions where freight is transferred between modes.
- There is a discernible gap between the actual and optimal modal mixes. According to RITES, a switch from the actual to the optimal modal mix will result in a 3 per cent increase in freight throughput at a cost saving of around Rs 380 billion or 16 per cent of the total cost expended on transport in that year.
- Beyond the general observation that there are substantial efficiencies to be gained in a switch from road to rail, the study identifies that these switching benefits are largest for the following commodities: Miscellaneous (78 per cent)[20]; Iron and Steel (61 per cent); POL (61 per cent); Fruit and Vegetables (53 per cent) and Cement (36 per cent).
- Technical advances and solutions to achieving the optimal modal mix are readily available in the form of technologies such as higher-powered locomotives, high-speed coaches and wagons, and multi-axle road vehicles, besides many innovations in logistics management and operations software. However, these are patchily and inconsistently deployed.
- The operation and management of different modes of transport is characterised by a varying mix of institutional frameworks, acting independently of each other. As such, the various modes have been developed as isolated entities seeking to further idiosyncratic modal interests.
- A lack of data, and especially for traffic on the highways, is a major limiting factor in the development of good transport policy.

Before proceeding to a summary of the recommendations of the RITES study, it is crucially important to note that RITES determines the desired modal mix on the basis of break-even costs based on resource costs. Consequently, the 'optimal' modal mix is theoretical insofar as it is not reflective of the government's development priorities or other allocative and distributive goals. Further work will be required to first, continually

15. The study has previously also noted that infrastructure decisions are difficult to reverse in general, and even more so at short notice.
16. The Committee on Transport Policy and Co-ordination carried out the first study in the mid-1960s. This was followed by three studies by RITES in 1976-77, 1986-87 and 2007-08. Ibid.: 16.6.
17. The nine commodities considered were coal, foodgrain, iron and steel, iron ore, POL products in liquid form, limestone and dolomite, cement, fertilisers and miscellaneous/others. Together, these nine commodities comprise 63 per cent of the total volume of 2,387 million tonnes carried by all four modes across the entire universe of 52 commodities.
18. A break-even distance refers to the point of indifference between two mode choices, such that the prospective user of a transport service is indifferent between them.
19. The study noted that freight traffic increased threefold on the railways, by a factor of seven on the roads and by 10 times on coastal ships. Combined with an increase in the distances transported, overall freight increased four times.
20. RITES studied 52 commodity groups and the final miscellaneous category includes parcels and comprised about 3 per cent of the total volume of traffic carried across all modes in 2007-08.

Box 4. 4
The National Transport Policy Committee [1980]

The findings contained in the report of the National Transport Policy Committee of 1980 have naturally dated with respect to prices and technologies and the socio-economic agenda. Some recommendations, however, remain pertinent and perhaps more urgent than they were 33 years ago. This box summarises the thoughts of the Committee with respect to planning intermodal transport, and it is worthwhile beginning with the very last one:

For achieving the best intermodal mix, we suggest that appropriate investment decisions and use of pricing mechanism should have preference over regulatory measures and administrative controls.

The NTPC of 1980 was cognizant of the need to devise an investment strategy that was concomitant with the nation's development agenda of the day. In the late 1970s, the twin pillars of the agenda that the Committee focussed on were the employment potential and the energy intensity of the various modes of transport. To that end, the Committee studied the direct and indirect employment potential of different modes in substantial detail, before ultimately rejecting this as a basis for making decisions on intermodal transport. 'We hold the view that whatever importance employment generation may have in programmes of development, it has no role to play in determination of the intermodal mix in the transport system of the country. (Instead,) our policy aim should be to develop technologically as efficient a transport system as possible, so that production and hence employment generation programmes of other sectors are not jeopardised due to transport bottlenecks.'

The Committee placed heavier stock on the second pillar, arguing that the prevailing energy crisis in the country meant 'energy conservation should be given overriding consideration in determining the intermodal mix for the transport system'. They recommended achieving this by promoting modes that are more energy efficient and by selecting a modal mix that was compatible with India's energy resource endowment (i.e., coal, which favours rail).

Within the context of this development agenda, the Committee established the view that the central issue of transport policy is to allocate rationally and at minimum resource cost, the total available resources for investment between the various modes of transport. This is a view endorsed by the NTDPC.

The NTPC made a comparison of the costs of transporting units of freight traffic via road and rail to assess the relative advantages of these modes. The cost data and break-even points of 11 commodities were assessed, and for most of these, road proved more economical at distances below 300-350 km. The Committee also concluded that any increase in oil prices would only bias this break-even distance downward, and in favour of rail. Further, it was of the view that neither coastal shipping nor inland waterway transport had any important role to play in determining the optimal modal mix.

update the RITES results, and then to synthesise them with other goals of government policy in a non-distortionary fashion. On the basis of these observations, the authors of the RITES study recommend the following measures:

- An urgent increase in capacity is required for all modes, and especially in that of the railways. For freight, an equal focus to last-mile connectivity with ports and logistical parks as to dedicated freight corridors is essential.
- The development of domestic container traffic should be encouraged.
- The transport of several commodities can immediately shift to the more efficient mode (predominantly, rail) for the lion's share of the lead distance if multi-modal logistics parks aid intermodal transfer.
- The siting, profile and capacities of the multi-modal parks should be made conditional on a careful analysis of the patterns of traffic in the movement of commodities in the serviced hinterland.
- Recognising the important role that road transport will continue to play in the future, the study recommends further exploration of roll-on roll-off operations that deliver road-rail complementarity.
- Advanced research in mode-specific and mode-agnostic technology improvements is essential.
- The study presents a strong case for a Central

Box 4. 5

Ikea's Coffee Mugs and Tea-Lights

The Swedish firm Ikea has now become the world's largest furniture retailer. It also carries an extensive range of goods for the modern household, and its minimalist Scandinavian design sensibilities have become a de facto standard for interior design in many countries. Ikea is known for its focus on product design and on finely managing its supply chain with a relentless focus on cutting costs. It is the company that pioneered flat-pack designs for furniture. Every piece of furniture it sells is designed to be packed flat into the smallest space possible for shipping, lowering its distribution costs. (Separately, it has perhaps done more to promote Swedish cuisine than any other person or institution.)

One of the more prosaic products sold in its stores is the 50-cent coffee mug. The selling price of the 'Bang' mug is its great draw card, resulting in over 25 million mugs sold each year. However, it must still conform with Ikea's corporate policy on offering appealing product design and quality. Further, it should be profitable in its own right, rather than a loss-leader for the sales of other goods. The Bang mug has been re-designed three times with a view at making it more profitable. The first version fit 864 mugs on a standard shipping pallet. The subsequent redesign added a small lip to the mug making it sturdier and allowing around 1,200 to be packed onto a pallet. The third redesign shortened the mug making it stouter while adding a slightly different handle. The net result was the ability to pack an astonishing 2,204 mugs onto a standard pallet, the same space that had originally accommodated only 864 mugs. In a classic vindication of Ikea's 'Don't Ship Air' policy, overall shipping costs for the mug have reduced by 60 per cent, allowing Ikea to continue to profitably offer the mug at the same price for well over two decades. (It is perhaps relevant to add that while Ikea gets the supply chain right, by many accounts it fails to do the same on the distribution side. Tales of missed and delayed deliveries are legion.)

Another example of Ikea's decisions to avoid shipping 'air' can be seen in the overhaul of its logistics practices for transporting tea-light candles. Earlier, these candles were simply bundled randomly into a plastic bag, with bags being packed into cartons and cartons onto pallets. Efforts to re-arrange the candles with more care within the plastic bag yielded immediate payoffs with the volume of each bag reducing dramatically. This meant that about 40 per cent more candles could be transported within a standard shipping container. Perversely, this now yielded a container that was too heavy to comply with weight limitations on European flatbed trucks. Ikea solved this problem by deploying 'cluster supply' methods. Instead of the candles being directly shipped from manufacturer to Ikea warehouses, the firms were now encouraged to ship to suppliers of other Ikea products with lower weight-to-volume ratios, such as furniture. In effect, the furniture suppliers also became the receivers, packers and shippers of candle products by combining these with their own deliveries of (flat-pack) beds and couches.

Source: Material adapted from Chase et al. (2008) and EIA (2010).

Transport Co-ordinating Agency, responsible for planning, monitoring and selective regulation of policies related to the development of the integrated transport system.

RECOGNITION OF MODE-SPECIFIC CHARACTERISTICS

Marginal unit costs for transport on the various modes will reflect several mode-specific characteristics. Acknowledgment and exploitation of these characteristics ensures that each commodity is transported on the most suited mode at every stage of the journey. For example, fixed costs are higher in the railways and so exhibit more dramatic increasing returns to throughput. Road transport proves nimblest at carrying small loads over short distances to easily accessible as well as remote destinations at relatively low total costs.

Costs at constant speeds—discounting for required accelerations and decelerations, are lower for shipping than for other means of transport. Together with the absence of corridor congestion—coastal shipping capacities are only constrained by the availability of ships and the efficiency of ports—this implies that shipping can be more efficient than even rail along coastal routes, and especially for time-insensitive cargo, especially if the costs of transhipment at the ports are minimal.

To fully exploit a transport mode, its weaknesses must be accommodated. Rail and shipping both benefit from a more flexible and extensive road network

Box 4. 6
The Criticality of Logistics Costs

Transport and logistics costs most often pose a barrier at least as large, and frequently larger, than tariffs. In fact, trade is affected more by the cost of transport than by the tariffs. A 2008 WTO report, Trade in a Globalising World, explains that spending on shipping for world imports in 2004 was three times higher than spending on tariffs.

The logistics costs in India are estimated to account for 12-13 per cent of GDP. In the United States, these costs vary between 8.5-9 per cent of GDP. A reduction in logistics costs by one per cent would yield an annual saving of $5 billion for Indian economy.

If the logistics costs are brought down to the levels that prevail in the United States, this would result in about 4 per cent reduction in prices of Indian goods making them more competitive globally. At the same time, this reduction in costs would mean large reduction in inventories, and consequently in working capital.

Source: Asian Institute of Transport Development: Regional Seminar on Intermodal Logistics, 2007

Box 4. 7
Indicators of Performance of Logistics Services

The performance of logistics services can be gauged by the following indicators, that are somewhat specialised to the use of international maritime shipping for mainline transport. Analogous indicators can be easily drawn up for rail or road as the main transport mode in an intermodal chain.

1. Timeliness
   - Total time for trade-related procedures
   - Customs inspection clearance time
   - Technical control clearance time
   - Time for trade document procedures
   - Inland transport time
   - Verification of container security
   - Vessel turnaround times
   - Vessel waiting times to obtain berths
   - Time to resolve customs appeals
2. Cost
   - Total cost for trade-related procedures
   - Port- and terminal-related charges
   - Total cost for trade document procedures
   - Border control costs
   - Inland transport costs
   - Additional costs to verify container security
3. Complexity and risk
   - Total number of documents per trade transaction
   - Criteria for customs inspection
   - Percentage of containers inspected
   - Level of customs inspected
   - Damage or pilferage as percentage of values of container
   - Shutdown of port due to natural disaster and labour dispute (days)
   - Whether the port is a signatory to customer security initiative
   - Percentage of containers electronically scanned
   - Percentage of containers physically inspected
   - Speed of inland transport

Source: World Bank (2005) and Planning Commission (2010) that ensures last-mile and intermediate connectivity. The obvious limitation is that transfers between these modes must be efficient.

Finally, consideration of mode-specific characteristics must also reflect their differential environmental impacts, energy intensities and lifecycle costs[21]. The energy intensity of different transport modes is influenced by the terrain traversed, choice of locomotive power, efficiency of deployed engines and the care with which they are maintained, amongst many others. This important element of the decision process for deciding on the optimal modal mix thus needs to be carefully pieced together, again in the context of actual and planned traffic movements by commodity. Further, given the scarcity of energy, there is cause to weight this criterion more heavily in the decision-making exercise.

IDENTIFYING DISTORTIONS AND THE ROLE OF PRICE AS A RESTORATIVE MEASURE

The unit costs of freight transport are not indicative of the true marginal costs of transport, given the common observation that the transport sector in India is rife with market failures. As elsewhere, these market failures are the result of positive and negative externalities of transport demand and supply, of the networked nature of transport infrastructure which necessitates high upfront costs and so promotes monopolies, and due to characteristics that render transport at least a partial public good in the strict economic sense[22]. However, government policies have either not adequately addressed these market failures, or have presented solutions that have exacerbated the problems. Several examples of these distortions are discussed in the last section of Chapter 2, Volume II, of this report, and we only summarise these here:

- New capital works have generally been favoured over proper maintenance and repair. This has resulted in a mismatch between the actual and rated capacities of the mode.
- Network enhancements have been alltoofrequently driven by political rather than business or even social welfare considerations, resulting in haphazard and inefficient route expansion.
- Improved accessibility and transport links to remote or uneconomic locations have been based on decisions clouded by popular demand for a particular transport mode rather than by sound economics.
- Differing tax regimes across the states exacerbate inter-state border formalities and inefficient geographical arbitrage in production and distribution locations.

> To fully exploit a transport mode, its weaknesses must be accommodated. Rail and shipping both benefit from a more flexible and extensive road network that ensures last-mile and intermediate connectivity. And transfers between these modes must be efficient.

Finally, a complex web of subsidies, tariffs and taxation policies applies to transport in India[23]. Adjusting the pricing of transportation is a standard tool for redistribution policy. These highly managed prices are not informative for making market decisions and for influencing modechoice. Examples of the deleterious impact of these policies abound:

- More vehicle-kilometres are driven than they would be if motor fuels were priced at market
- Demand has skyrocketed for diesel vehicles, with severe environmental implications, given the generally high-sulphur diesel fuel available in India
- Freight tariffs cross-subsidise rail passenger fares, distorting both markets
- Taxes on aviation fuel and services are only loosely tied to economic fundamentals or any market characteristics that they are intended to correct

In short, prices are rarely indicative of the full marginal social costs incurred, thereby creating a role for the State to play a decisive role in determining the prices and the quantity and quality of transport infrastructure and services through appropriate policy measures. These policies and the resulting prices influence the selection of choice of mode of transport and the particular technologies deployed within a mode. However, this is not to say that the sound economic prescription is for the state to determine prices independently of the fundamentals that drive the transportation market. Instead, the main objective of transport policy may be restated as the creation of the appropriate technical and economic conditions so that each mode of transport is employed and priced within the system in a manner determined by its resource cost advantage.

OTHER POLICIES TO AID INTEGRATED TRANSPORT STRATEGY

India's transport network is best viewed as a 'network of networks' that can be classified based on (a) network standards and technology, (b) geographical hierarchy, and (c) mode choice. Each of these classifications yields useful insight into what makes a good network, and the policies required to support this.

21. Lifecycle costs are considered more fully in Chapter 7, Volume II.
22. Transport networks exhibit increasing returns to scale and cost structures comprising massively front-loaded construction expenditures and near-zero marginal costs, implying that natural monopolies are the most efficient market structures. (Air and maritime ports function as standalone nodes and, depending on market structure, may not always be best characterised by natural monopolies.)
23. See Chapter on Fiscal Issues (Chapter 9) in this volume.

Table 4. 2
The World's Top Trade Lanes

A: TOP TRADE LANES IN TERMS OF VALUE OF GOODS CARRIED, $ BILLION (AIR AND OCEAN) 2009			B: TOP TRADE LANES IN TERMS OF VALUE OF GOODS CARRIED, $ BILLION (AIR AND OCEAN) 2030		
1	China-USA	291	1	China-USA	594
2	China-Japan	208	2	China-Japan	337
3	Japan-USA	147	3	China-Korea	281
4	China-Korea	141	4	China-India	264
5	Germany-USA	119	5	China-Germany	201
6	Germany-UK	113	6	Japan-USA	190
7	China-Germany	102	7	China-Singapore	178
8	UK-USA	98	8	China-Indonesia	170
9	Japan-Korea	70	9	Germany-USA	167
10	UK-Netherlands	68	10	China-Malaysia	162
11	Korea-USA	66	11	China-West Africa	151
12	UK-France	63	12	Germany-UK	144
13	Hong Kong-USA	58	13	UK-USA	144
14	China-Singapore	56	14	China-Thailand	141
15	France-USA	55	15	China-Brazil	136
16	China-Australia	54	16	India-USA	125
17	Netherlands-USA	52	17	China-UK	121
18	Japan-Hong Kong	46	18	China-UAE	120
19	China-Netherlands	44	19	India-Netherlands	119
20	UK-Belgium	43	20	India-Singapore	116

Source: Calculations by DHL based on data from Roland Berger Consulting, and estimates of growth of bilateral trade.

Transport network standards apply in a physical sense, e.g., narrow, metre or broad gauge railway; and also as a matter of policy, e.g., trucking permits for carriage of freight in a state. Differential standards along various parts of a network must walk a fine line between being fit for the purpose at hand and supporting overall network functionality. For example, it is not feasible for all roads to be of a single uniform width. But equally, the standards that apply to rural roads, and State and National Highways, must agree for the smooth performance of the overall road network. Clear and stable network standards reduce operational uncertainty and transaction costs, and so raise the productive efficiencies of transport services that are deployed on the network. Transport standards can also include the use of new technologies such as common databases to track and trace shipments, or containers that aggregate and standardise the movement of diverse objects. Networks that span various geographies local, regional, national and international should be mutually coherent in terms of the specifications and standards employed.

Next, issues related to intermodal connectivity reign supreme and comprise a theme that is developed in much detail in the next section of this chapter. Each type of transport network and mode has strengths and weaknesses. Weaknesses are minimised and the usefulness of each transport mode maximised when it is possible to switch between modes seamlessly and at low cost. To note useful examples in the Indian context: rail efficiency and usefulness increases when coal can be transported via truck on good roads from pithead to railhead, and thence on a standardised gauge track to a power plant. Logistics on the best highway network can fall prey to interstate border formalities and idiosyncratic permit and tolling protocols that prevail on different parts of the network.

SUMMARY

To summarise, the prescription for achieving an integrated transport strategy as defined earlier proceeds as follows: (a) establish traffic flows and unit transportation costs across the various modes for the various commodities; (b) identify existing distortions in the market for transport; (c) identify other government development and distribution priorities and the role of transport in these matters;

(d) use these facts to arrive at the desired optimal modal mix; (e) install sufficient capacity and maintain both old and new infrastructure to ensure that no mismatch between actual and rated capacities; (f) use economically sensible pricing policies that are determined either by the market or by independent tariff-setting authorities to encourage a mode-choice driven by efficient markets; (g) install nodal infrastructure and promote technologies that reduce the costs of mode- and gauge-transfer.

LOGISTICS AND INTEGRATED TRANSPORT

Given a list of cities and the distances between these cities, what is the shortest route between them that would visit each city exactly once, before returning to the origin? This simple question, known as the 'travelling salesman' problem, is difficult enough to have withstood the combined assault of mathematicians and computers for the better part of a century. It is one of the six remaining 'Millennium Problems' with the solution carrying a prize of $1 million. It is also the fundamental problem that the modern logistics industry attempts to solve everyday: how does one ensure that the hundreds of components in a supply chain are exactly where they need to be at a specified time at the lowest possible cost? And though proof of the shortest route that the salesman must take remains a mathematical quandary in the general case, operations research has done exceptionally well in identifying heuristics and writing software to develop practical solutions to this fundamental problem of logistics.

These solutions have been so successful that the past three decades have seen massive overhauls in supply chains and business practices. As a rough approximation of the contemporary business standard, firms no longer give exceptional thought to locating their factories near customers or suppliers to simplify transport requirements and minimise costs. Instead, they seek to partner with desired suppliers and logistics providers the world over to manage product assembly, product quality, inventory and distribution. Modern logistics has redrawn the transport map of the world in favour of extremely high-volume land and sea transport corridors, and built enormous interchange complexes catering to varied transport modes and providing complex warehousing facilities for many industries and commodities.

The term 'logistics' is somewhat slippery to pin down exactly. Its origins lie in the French military practices of organising troop movements and maintaining

Logistics differs from transport insofar as the former is an elemental part of the production process, while the latter is merely a matter of distribution of material or finished product.

supply links with deployed battalions. In modern business practice, a leading industry body defines logistics as 'that part of the supply chain management that plans, implements, and controls the effective forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements'. Various other textbook definitions tinker with this at the margin, but the broad agreement is that logistics deals with the careful management in time and space of the movement of components and resources with respect to a larger business agenda.

The six operational objectives of a logistics system have been described as (a) rapid response based on anticipated need, and supported by flexible and robust technology and transport systems; (b) minimum variance to ensure certainty of delivery in time and space; (c) minimised inventory to reduce storage costs; (d) movement consolidation to reduce transport costs; (e) product quality; and (f) support for life-cycle activities such as returns, repairs and disposal.

As such, in the context of the movement of goods, logistics differs from transport insofar as the former is an elemental part of the production process, while the latter is 'merely' a matter of the distribution of raw material or finished product. In short, effective logistics can make a 'better' product, whether measured by quality or cost. Meanwhile, effective transport can only ensure that said raw material or product is actually made available at a desired location.

Logistics costs to the economy are variously estimated at around 9 per cent of GDP for the United States through to approximately 11 per cent for Japan, 12 per cent for France and Korea, and 18 per cent for China[27]. Cost estimates for India do not appear to be as robustly calculated, and various studies have provided a range of 12 to 15 per cent of GDP[28]. The high level of coordination required between the many fragmented and specialised participants in the logistics industry in India is sometimes cited as a cause for the relatively high proportion of logistics expenditure in GDP. In one panel study, it is noted that a 0.5 per cent decrease in logistics costs (relative to GDP) leads to a 2 per cent increase in trade and a 40 per cent increase in the range of products that are exported out of a country[29].

27. International Transport Forum (2012) and Sanyal (2006). China's relatively high share of logistics spend in GDP can be explained by the facts that (a) the share of the service sector in the economy is lower relative to India's (b) a large expanse of terrain is dominated by deserts and mountains; and (c) with the bulk of the population centres and growth centres located on the East Coast or in Eastern China, the nature of West to East flows (mainly bulk goods) is very different from that of East to West flows (mainly consumer goods). This requires the use of different trucking technologies and also results in many containers returning to their origins unladen. See Gupta et al. (2010).
28. Essential questions on whether firms choose to outsource logistics functions and warehousing will affect the accounting of logistics costs.
29. World Bank (2007).

Table 4. 3
Logistics Performance Index
[Top Ranked Countries]

THE TOP 10 PERFORMERS ON THE 2012 LPI						
	2012		2010		2007	
COUNTRY	LPI RANK	LPI SCORE	LPI RANK	LPI SCORE	LPI RANK	LPI SCORE
Singapore	1	4.13	2	4.09	1	4.19
Hong Kong, China	2	4.12	13	3.88	8	4.00
Finland	3	4.05	12	3.89	15	3.82
Germany	4	4.03	1	4.11	3	4.10
Netherlands	5	4.02	4	4.07	2	4.18
Denmark	6	4.02	16	3.85	13	3.86
Belgium	7	3.98	9	3.94	12	3.89
Japan	8	3.93	7	3.97	6	4.02
United States	9	3.93	15	3.86	14	3.84
United Kingdom	10	3.90	8	3.95	9	3.99

Source: Logistics Performance Index Results, 2012, The World Bank

That said, it should be noted that measuring logistics costs is fraught with difficulty and that international comparisons may not be entirely robust. Broadly, however, studies on logistics costs focus on the following areas: (a) customer service including parts and service support and the handling of returns; (b) transport costs and warehousing including storage and site selection; (c) inventory management including packaging and reverse logistics; (d) lot-quantity costs including materials handling and procurement; (e) order processing costs and (f) information systems costs including those related to communication, forecasting and planning[30]. These cost headlines also provide an excellent summary of the scale and scope of the modern logistics industry in shaping business practices.

The remainder of this section looks at the state of the logistics sectors in India and internationally. Briefly, these sections show that relative to international counterparts the Indian logistics sector demonstrates a lack of scale, scope, flexibility and dynamism, and exhibits a yawning urban-rural divide. The performance of the sector is hampered by restrictive regulation, poor mainline infrastructure, inefficient inter-modal transfers of freight, fragmented industrial organisation, and skill shortages amongst several other factors. The application of an integrated strategy for transport infrastructure development should ameliorate many of these deficiencies by creating a dynamic intermodal transport system. The final sub-section of the report identifies the components of this strategy and their expected effects.

THE INTERNATIONAL LOGISTICS LANDSCAPE

HIGHLIGHTS FROM THE STATE OF THE ART

The city of Louisville (population c. 750,000) in the state of Kentucky in the United States has two disproportionate claims to fame. It is home to the Kentucky Derby, country's most famous horse race, and perhaps its most watched two minutes of sporting activity each year. Its airport is also home to the WorldPort, the centralised sorting facility of the United Parcel Service of America (or UPS) that is the second largest provider of logistics services in the United States. Together with Federal Express's (FedEx) global sorting facility at Memphis, Tennessee, called the SuperHub, these two logistics giants deliver over seven billion packages every year, more than one for every person on the planet, for combined net revenues of around $100bn.

The sorting facilities at Louisville and Memphis are modern-day marvels[31]. Between 11pm and 4am every night, the WorldPort and the SuperHub transform into the two busiest airports in the world, with around 200 aircraft movements each. At peak times of the year,

30. Lambert et al. (2006).
31. The location of these processing facilities is not accidental. Both Louisville and Memphis airports are in central United States, about two hours' flying time from most major population centres. There is a ready pool of labour to staff these facilities, and the airports are largely free of adverse weather for much of the year.

Table 4. 4

Domestic Logistics Performance: Time and Cost

	EXPORT TIME AND COST						IMPORT TIME AND COST					
	PORT & AIRPORT SUPPLY CHAIN			LAND SUPPLY CHAIN			PORT & AIRPORT SUPPLY CHAIN			LAND SUPPLY CHAIN		
	DISTANCE (KM)	LEAD (DAYS)	COST ($)	DISTANCE (KM)	LEAD (DAYS)	COST ($)	DISTANCE (KM)	LEAD (DAYS)	COST ($)	DISTANCE (KM)	LEAD (DAYS)	COST ($)
Germany	150	1	1,500	868	5	1,784	150	1	1,500	483	4	1,145
US	206	2	680	346	3	745	126	2	603	273	3	729
South Korea	300	2	572	300	3	500	300	3	707	300	3	500
Brazil	150	2	612	83	3	439	150	2	274	150	5	750
Malaysia	73	3	285	172	2	298	84	2	285	105	2	298
China	162	3	454	215	3	645	133	4	353	171	3	637
South Africa	364	2	1,861	553	3	1,442	320	3	2,000	474	4	1,732
India	626	3	918	197	3	1,043	375	3	1,097	241	4	921

Source: Logistics Performance Index, World Bank (2012).

Table 4. 5

Domestic Logistics Performance: Procedures

	PERCENTAGE OF SHIPMENTS MEETING QUALITY CRITERIA	NUMBER OF IMPORT-CLEARANCE AGENCIES	NUMBER OF EXPORT-CLEARANCE AGENCIES	NUMBER OF FORMS: IMPORTS	NUMBER OF FORMS: EXPORTS	CLEARANCE TIME (DAYS) WITHOUT PHYSICAL INSPECTION	CLEARANCE TIME (DAYS) WITH PHYSICAL INSPECTION	PERCENTAGE OF IMPORTS PHYSICALLY INSPECTED	PERCENTAGE OF IMPORTS WITH MULTIPLE PHYSICAL INSPECTIONS
Germany	80	1	1	2	2	0	1	3	2
US	93	3	2	4	2	1	3	7	3
South Korea	97	1	1	2	1	1	1	3	1
Brazil	70	3	3	2	3	2	5	6	2
Malaysia	71	2	3	2	2	1	1	6	3
China	69	3	3	6	5	2	4	17	5
South Africa	89	2	2	2	2	1	2	5	2
India	59	3	3	6	5	2	4	35	16

Source: Logistics Performance Index, World Bank (2012).

airplanes takeoff and land every 45 seconds, each disgorging thousands of parcels containing documents, pharmaceuticals, internet shopping, human hearts, and thoroughbred cars and horses. Arriving planes are offloaded in around 20 to 30 minutes, before being refuelled and laden with cargo for a subsequent destination. The packages that these planes carry are sorted at the rate of around 400,000 per hour before being re-routed on dozens of kilometres of conveyor belts to their onward aircraft. In the time that they enter and leave the facility, any given package will be automatically scanned some 20 times. More than 99 per cent of these are delivered on time, regardless of weather, distance, or the size of package[32].

As measured by the number of aircraft in its fleet, FedEx may be considered the world's largest airline. This fleet of 684 jets serves nearly every country on the map almost every day of the week. It employs 290,000 people and maintains a fleet of 75,000 trucks for overland transportation and final delivery. US Customs and border protection agents are based at the SuperHub clearing cargo arriving from other countries.

As impressive as this nocturnal picture of packages, conveyor belts and aircraft that power global trade is, it remains only half the story. Over the past decade, both firms have dedicated increasing resources towards remodelling themselves as fourth-party logistics suppliers. UPS and FedEx will no longer just deliver packages for a firm, but they will also assemble a bespoke order, organise returns and refunds, and provide customer service. For example, all mobile phones imported into the United

32. Schactman (2012).

Box 4. 8
Integration of Logistics Services

One of the major weaknesses of transport infrastructure in our country has been the mismatch at the interfaces of the various modes. As a result, the system, despite upgradation in some segments, continues to operate at sub-optimal levels. For example, while size of the container ships has substantially increased, corresponding facilities for evacuation of the containers from the ports have not kept pace. It is, therefore, essential to plan in an integrated manner across the entire movement chain.

A recent development in the transport sector has been that of extending traditional service boundaries. For example, railways are combining with the port terminals to establish a unified movement chain. Ocean carriers are integrating into ports, inland terminals and landside transport links. At the same time, multimodal operators are increasingly integrating into the reverse of this chain. This vertical integration may lead to emergence of monopolies which are inherently inefficient. A regulatory oversight is therefore called for.

Source: Asian Institute of Transport Development: Regional Seminar on Intermodal Logistics, 2007.

States by Sprint, a major telecommunications provider, are carried by UPS aircraft from factories in Asia, stored at UPS facilities in Louisville before being assembled by UPS staff into orders for individual stores. Sprint has devolved the management of its supply chain almost completely to UPS, allowing it to focus on the core business of selling mobile phone service.

These massive logistics facilities have attracted other business to the area, businesses that have located nearby solely for immediate access to the most sophisticated logistics in the world. For example, some biotechnology firms market products with an extremely narrow range of tolerance on temperature, moisture and external contamination. The repeated scanning of each package ensures that both manufacturer and end-user are always aware of the integrity of the product and whether it was handled appropriately during transit or is no longer fit for use. Several of these firms have chosen to locate their entire production facilities in the vicinity of the WorldPort and the SuperHub so that they may rely on the bespoke logistics provided by UPS and FedEx. Because of the concentration of biotechnology firms in the region, the US Food and Drug Administration has also chosen to deploy a dedicated team to inspect local facilities. This reduces certification and compliance costs, causing other biotechnology firms to seek to relocate to this area.

Modern technology and operations research have played a similar role in improving efficiencies at the world's largest container ports. The standard shipping pallet and container are themselves humble technological marvels. Ships stacked with as many as 12,000 containers are offloaded and reloaded by giant automatic overhead cranes. The unloading and loading sequences, often undertaken simultaneously for greater speed, are determined by sophisticated software. The software guides automatic vehicles along routes selected for the greatest efficiency. The vehicles move containers from shipside cranes to another set of cranes which stack them depending upon when and how they are scheduled to be loaded onto trucks and trains for onward carriage. Meanwhile, the shipside cranes reload the ship in stacks seven-high with each placed precisely in a pre-determined location for easier unloading at the destination port. Each of these technologies helps to reduce the amount of time that ships spend in port, shortening the distribution cycle and reducing costs.

As with FedEx and UPS, the largest shipping lines such as AP Moeller-Maersk and CGA CGM are diversifying from merely providing transport services to also playing an active role in working with manufacturing companies in planning their supply chains and distribution networks. Business practices at terminals operated by these firms have resulted in substantially shorter transportation times even as vessel steaming speeds have generally slowed over the past decade to aid greater fuel efficiencies. These shorter—and crucially, more predictable—times have combined with newer technologies to allow goods to be made in regions with the greatest comparative advantages and subsequently permitted more extensive distribution channels.

THE STATE AND FUTURE OF THE GLOBAL INDUSTRY[33]

In a reflection of the integration of economies and production systems, global logistics expenditure is expected to near \$2.9 tn by 2015[34]. As Table 4.2 illustrates, no bilateral trade route with

33. A substantial portion of this survey is based on a paper provided by DHL India to the NTDPC.
34. Based on calculations by DHL on Datamonitor Global Logistics Industry data and trends in regional logistics expenditure. Does not include spending on bulk carrier and tanker shipments.

Box 4. 9

Load Exchanges

Load exchanges are popular in many countries. For example, in the United Kingdom, the Haulage Exchange allows couriers, truckers and other transporters to post details of available capacity or freight requirements. Details on sizes, dates and the nature of the goods to be shipped are also entered. Software automatically matches available capacities with loads awaiting shipment, alerting both trucker and shipper, and then allowing them to negotiate on the actual terms. The use of such exchanges reduces the incidence of empty return loads, lowers costs and increases revenues, decreases fuel use, and is an environmentally sound practice. The exchanges essentially serve as the marketplace by aggregating and disseminating information. More recently, some exchanges have expanded to include information on runs that are scheduled in advance, allowing firms booking space on the vehicles to better plan their transportation requirements in advance.

The exchanges also serve other functions that help rationalise the industry. By building cross-platform software systems, they make information dissemination easier, and encourage firms to collaborate profitably. The exchanges lower the barriers to entry to the market by making it possible for new firms to seek more customers, and to make runs with smaller loads. The exchange also serves as a de facto quality control over the member firms, which is a useful function in an industry with several new or small-scale participants. In the future, it is inevitable that the software systems for the exchanges will be updated to link with GPS and other tracking information sources, allowing for increased certainty over shipments.

Source: Company websites and EIA (2010).

India featured amongst the world's largest in 2009. By 2030, however, Indian trade routes with the United States, China, Netherlands (reflecting trade with the EU), and Singapore (reflecting trade with ASEAN region) are expected to be amongst the top 20 trade lanes in terms of value of goods shipped by air and ocean freight.

Another important conclusion to draw from Table 4.2 is that by 2030, Asia-related trade lanes are expected to account for almost 75 per cent of the value of goods traded on the top 20 busiest routes. Further, intra-Asian trade is expected to emerge as a major driver of international logistics revenues, accounting for a share 43 per cent of the value of goods shipped in the top 20 trade lanes. This suggests that India's external and internal logistics networks should be especially cognizant of the requirements of trade with other Asian countries in terms of the volumes, values and characteristics of goods traded. Air cargo is becoming increasingly a mode of choice for many exporters and importers, especially in trade routes characterised by geographically diverse supply chains. Global freight movement by air stood at 216 billion route tonne-kilometres (RTKM) in 2011, constituting a doubling over a decade, with a value of around $10.8 tn[35]. Exports that depend on critical imported intermediate components for their production, and are sensitive to changes in retail market sentiment are especially dependent on air cargo, as are products that are perishable and require time-sensitive, temperature-controlled environments. Important sectors like high-end textiles, electronics, engineering parts and components, and pharmaceuticals are dependent on air cargo for successful trade. The imported content of manufactures in these sectors is high, and exports too rely on quick access to offshore markets.

The air cargo industry comprises freight forwarders, dedicated cargo airlines, passenger airlines that supplement earnings by carrying belly cargo, and other arrangers of transport services. As compared to the express industry, generalised air cargo goods are delivered at lower speeds and lower prices by taking advantage of flexibility of resources such as by scheduling freight space on passenger aircraft as and when it becomes available. It is considered to be better suited to relatively low-value and high-volume products that must nevertheless be transported by air.

The express air industry on the other hand consists of dedicated providers of end-to-end air logistics services. The aim is to simplify and expedite the process of air transport by organising collections, usually arranging transport on its own aircraft, handling customs clearances as well as the payment of duties and taxes, as required. Value-added express services are also available, such as the ability to track shipments and by offering proof of final delivery. The

35. Estimated by DHL and based on Boeing World Air Cargo Forecast 2011 estimates of share of air cargo in total freight movement, and world merchandise trade figures available in the World Bank Development Indicators database.

In India, many more clearance forms are required to import a shipment than other countries, and a substantially higher share of all shiments are subject to at least one, and sometimes several, inspections. These bureaucratic hurdles need reduction.

express industry therefore requires access to airside facilities to meet the global standards of speed and reliability for goods that are typically higher-value and more time-sensitive than those shipped by generalised air cargo.

EVALUATING THE LOGISTICS INDUSTRY AROUND THE WORLD AND MAJOR GLOBAL ISSUES

The World Bank's Logistics Performance Index (LPI) contends that a country's logistics performance is strongly reflected in the reliability of its 'supply chains and the predictability of service delivery available to producers and exporters. Supply chains only as strong as their weakest links are becoming more and more complex, often spanning many countries while remaining critical to national competitiveness.' This publication, issued every two years since 2007, has become the standard tool for measuring the pervasiveness and resilience of these modern supply chains as measured by delivery time, cost, flexibility and reliability. It is intended to be a single indicator that evaluates the contributions that government services, investments and policies make to the extant state of the logistics industry. It measures the efficiency of the border clearance process in terms of its speed, simplicity and predictability; the quality of transport infrastructure; the ease of arranging competitively priced shipments; the competence and quality of logistics services; the ability to track and trace consignments; and the frequency with which shipments reach the consignee within the scheduled or expected delivery time.[36,37]

India ranked 46th in 2012, and the highest amongst a peer group of middle-income countries which include the Philippines, Indonesia and the Ukraine. (See Table 4.3 for the best performers.) Indeed, it ranks higher than Mexico and performs almost as well as Brazil and Thailand, leading the authors to conclude that India is amongst the most over-performing of the non-high-income countries. The LPI's cautions in interpretation, however, would seem to particularly apply to India. Being a large and diverse country it is unlikely that there is uniformly strong logistics performance across the nation. Instead, the results are more likely to be boosted by islands of excellence with most commerce originating and terminating at the metro cities.

Throughout, whether a country is high-, middle- or low-income, the low LPI score indicates that market participants are dissatisfied with the state of transport infrastructure, and especially with rail infrastructure. Within the South Asian region, however, roads and highways are considered the dominant limiting factor to better logistics performance. Relative to the satisfaction with infrastructure, logistics service providers are generally considered to deliver better performance, no matter which country they operate in.

Table 4.4 presents data on procedural issues such as customs and border control. The LPI notes that time taken in shipment can be especially reduced at the stage when goods are presented for import clearance. Delays at this stage are associated with red tape, excessive and opaque procedural requirements, and physical inspections. As shown in Table 4.5, at least some of India's logistics performance can be explained by the facts that many more clearance forms are required to import a shipment than in other countries, and a substantially higher share of all shipments is subject to at least one, and sometimes several, inspections. Low-income countries' export clearance protocols are long and complex vis-à-vis those for imports, and relative to those in other countries. The resulting long leads reduce the international competitiveness of exports from these countries.

On the whole, the best performing regions in logistics are the OECD countries (though there is marked variation between them), and the export-oriented developing countries of East Asia. The OECD countries exhibit streamlined processes to import and export container and other traffic with much standardisation of information and communications technologies. These standardisations encourage cross-border trust and result in faster processing times. Generally, supporting infrastructure like warehousing and cold storage and intermodal transfer facilities are quickly constructed and considered central to the building of the logistics network. Meanwhile, in fast-growing East Asia the rapid expansion of exports has resulted in huge increases in port and other transport infrastructure capacity. Against this, and as expected in transition economies, the supply and distribution chains in these counties are long with many intermediaries leading to operational inefficiencies, duplication and fragmentation, suggesting further room for improvement.

36. The LPI is constructed by statistically aggregating the opinions of logistics professionals from companies responsible for moving goods around the world.
37. Several countries have demonstrated massively better logistics industry performance over the past three editions of the LPI. For example, Morocco's ranking jumped from 113 in 2007 to 50 in 2012 on the strength of a rapidly implemented strategy that made use of the country's proximity to Europe, and by effectively harnessing private enterprise to focus on improving the procedural elements of intermodal freight transport. Meanwhile, the Index rankings have spurred South Africa, Indonesia and Malaysia into setting out national logistics strategies and reporting on the performances achieved.

Table 4. 6
Cargo Dwell-Times at Airports Around the World
[Hours]

AIRPORT	EXPORT DWELL TIME	IMPORT DWELL TIME
Singapore	6	4
Incheon	3	5
Dubai	3	4
Hong Kong	4	6
Delhi	36	129
Mumbai	48	96
Bengaluru	36	48

Source: Working Group Report on Air Cargo Logistics in India, Ministry of Civil Aviation.

THE EVOLUTION OF THE LOGISTICS INDUSTRY

In concluding this section, it is useful to provide a sketch of the evolution of the logistics industry. This is the path that governments, manufacturing firms and service providers in other countries have already beaten down, and a highly plausible one that Indian counterparts will follow as the economy develops and grows. Consequently, the following taxonomy of service provision may be helpful in understanding the extent and continuing evolution of the industry. Traditional logistics services providers arrange for transport and warehousing, with freight forwarders and courier companies being prime exemplars[38]. As experienced arrangers and coordinators of transport services, freight forwarders rationalise and organise the supply of ocean- and air-freight services on behalf of small and medium trading firms. Fragmented trading and transport industries as well as complex customs procedures and non-harmonised regulations mean that there is a continued need for mediation of type provided by freight forwarders, as is the case in India presently.

As transportation industries consolidate and modernise, as physical infrastructure is improved and expanded, and as regulatory processes are streamlined and harmonised to global standards, third-party logistics providers will supplement traditional logistics services in India. This has already happened in the developed economies. Third-party logistics providers (3PL) supplement the basic services with inventory management, packaging and labelling, product return and offer an end-to-end service. Manufacturing firms seek to outsource their logistics needs to these third-party providers to take advantage of their expertise and networks, or because they do notprocess sufficiently large volumes to justify dedicated logistics infrastructure, and to reduce the costs associated with arranging transport themselves. 3PL providers offer industry-custom supply chain solutions such as testing, inspection and reverse logistics. The end-to-end control over cargo is critical, and 3PL providers rely heavily on developing efficient processes, such as in backhaul management and route optimisation, and on harnessing technologies such as GPS and RFID[39].

With a $165 billion market, Europe is the largest regional market for 3PL, followed closely by Asia at $158 billion in second place. India is a relatively small market for 3PL, with an estimated size of $1.5 billion, or just 0.3 per cent of the world market. At around 10 per cent, 3PL penetration in India is far lower than in industrialised economies (Europe at 40 per cent; United States at 55 per cent; Japan at 90 per cent)[40]. At present, Indian firms tend to aggressively outsource domestic transportation and fleet management, given the high levels of asset specificity, and customs brokerage functions due to regulatory complexity. The practices in Indian industry reveal that warehousing, transportation, custom clearing and forwarding are the most frequently outsourced activities[41].

Finally, though a precise distinction is often unclear, some third-party logistics firms have transformed into the so-called fourth-party service providers by working closely with the manufacturing firm to devise integrated supply chain management solutions, providing consulting services to match supply with demand, and assisting with network and cost

38. The size of the freight forwarding industry in India was about $4 billion in 2006, and has since doubled to about $8 billion by 2011. It is expected to cross $13 billion by 2015. (DHL submission to the NTDPC.)
39. KPMG (2012).
40. Sahay and Mohan (2006).
41. Ibid.

Box 4.10

Modern Terminal Facilities

When one looks back over the development of the global economy, there are three major features that stand out. One is the increasing use of technology; the second is the increasing amount of capital employed in any economic endeavour; and the third, as a result of the first two, the enormous increase in the scale of goods produced and distributed.

This has led to an ever-increasing need to transport more and more quantities and volumes of goods. Indeed, in case of mineral traffic, it is figuratively akin to 'moving the mines'. This explosion in scale has brought to the fore the critical importance of facilities for loading and unloading of goods at either end of the transport networks. Indeed more often than not, the capacity at the terminals determines the capacity on the transport columns.

All over the world, goods sheds of yesteryears have given way to new facilities often called freight centres, logistics parks, dry ports, etc. These termini are designed to perform multitude of logistics services including even that of consolidation, packaging and distribution of goods. They also act as nodes for multimodal transport and are well endowed with transport connectivity.

These developments imply a need for significant investment in scaling up of facilities and technologies at the existing and new terminals across the movement chain. It is equally necessary to include logistics parks as an essential component of the emerging economic corridors. To give fillip to the related infrastructure, there is a convincing case for granting an industry status to the logistics and warehousing sector.

Source: Asian Institute of Transport Development: Journal of Transport infrastructure: Volume 16, 2009.

optimisation[42]. The firms complete the distribution channel for firms too, by not just delivering products to customers but by also providing installation, assembly and minor repairs.

GAPS IN THE INDIAN LOGISTICS SECTOR

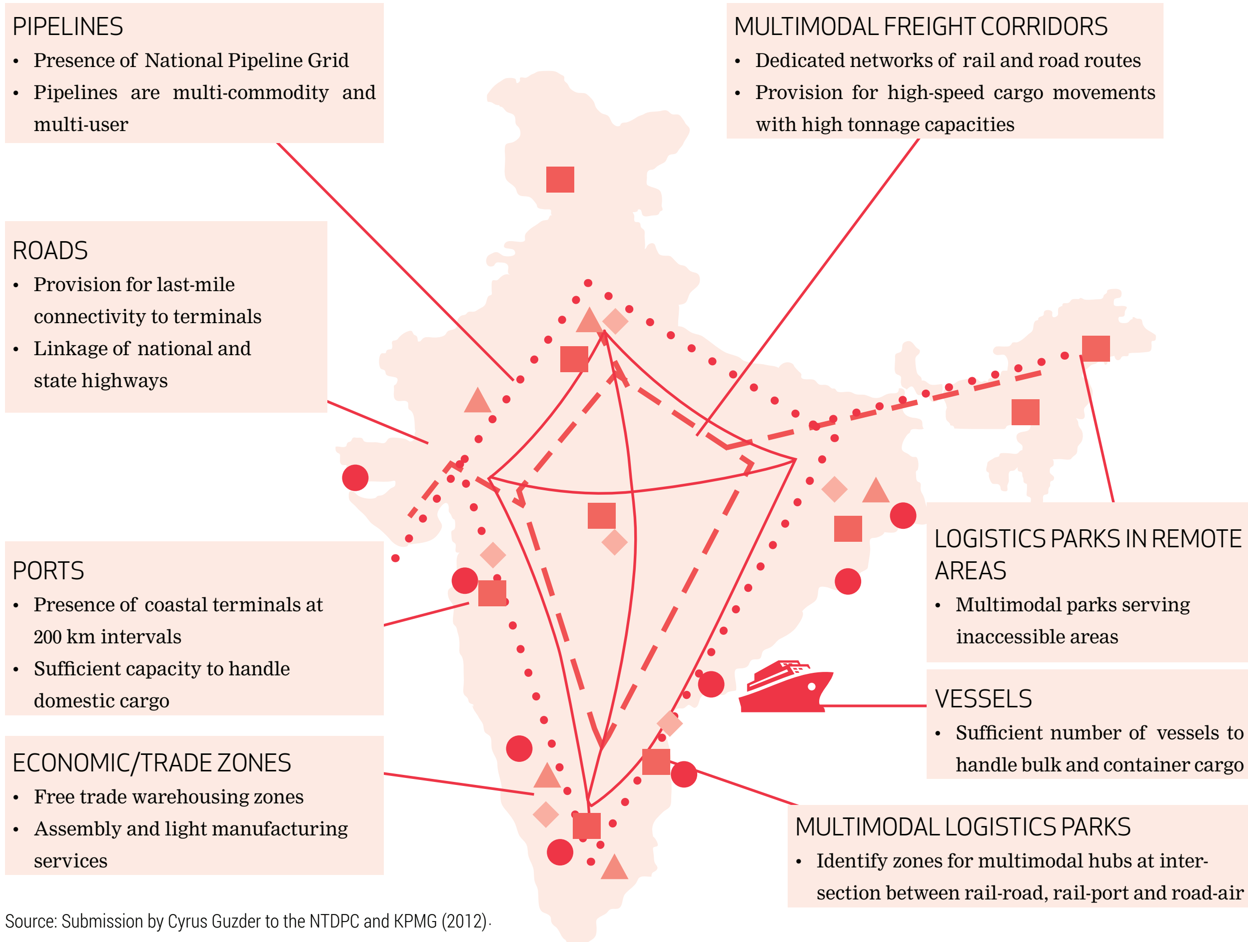
The current state of the logistics sector in India can be crudely characterised as largely unsophisticated, lacking in organisation, somewhat neglected by policy, and hamstrung by a shortage in skills. This is manifest in the observed inefficiencies of the sector. There are, however, significant pockets of excellence. For example, the automobile manufacturing industry and local service providers have developed transportation, inventory management and warehousing systems to rival those of the international gold standards. On the whole, a blunt appraisal of the sector's future reaches the inevitable conclusions that it is of both enormous potential and of critical importance to the nation's ambitions. This section explores the present structure of the industry as a prelude to the reforms proposed in next subsection. Detailed status reports on physical infrastructure in the form of roads, railways, ports and airports are available in Volume III of this report. Here, the focus is on industry trends, service provision and on gaps in those pieces of physical infrastructure that are dedicated for logistics purposes.

A common observation to be made of Indian logistics flows is that they are highly concentrated along certain corridors that link the largest metropolitan cities. This leads to the conclusion that transport and logistics infrastructure along these corridors should receive priority funding and development. However, it is tempered by observing that the causality is likely to run in the other direction as well. The infrastructure and availability of services along these corridors is already, though relatively, superior to that connecting with the more minor urban centers. This means that the observed concentration of traffic patterns is likely to be overstated with significant transhipment at the metropolitan cities for distribution into the wider hinterlands. This offers additional impetus for the founding of investment decisions on the basis of detailed origin-destination traffic studies as noted in the previous section.

Another common complaint related to logistics movements is the absence of last-mile links. Ports connect insufficiently well with the rail and road networks. The rail and road networks do not themselves offer efficient points of interchange for each to be harnessed to its best advantages, resulting in sub-optimal energy usages and higher costs as rail's last-mile disadvantages prove debilitating. On the whole, as noted in one study on Indian logistics, the country's exports are rendered less competitive due to higher transit times and reduced reliability, and imports priced higher at the shop front, with the overall burden amounting to 4.3 per cent of GDP every year[43].

42. KPMG (2012).
43. Gupta et al. (2010).

Figure 4.1
The Desired State of Indian Logistics Infrastructure



Source: Submission by Cyrus Guzder to the NTDPC and KPMG (2012).

With logistics services being primarily a private sector undertaking, the government's rle is largely restricted to deciding policy and providing infrastructure. Government may choose to provide this infrastructure of its own accord, in partnership with the private sector, or merely by enabling private investment. Meanwhile, as elaborated below, in nearly every sector related to logistics, the prevailing regulations are unclear, overlapping, or stifle needed efficiencies.

As for service provision by the private sector itself, logistics in India has been driven by the objective of reducing transportation costs that have been inordinately high due to regional concentration of manufacturing and warehousing, the geographic diversification of final distribution, as well as inefficiencies in infrastructure and accompanying technology. In turn, the regional concentrations have been motivated by the differential taxation and regulatory regimes of the states. Meanwhile, the reliability of services provided is considered to be low, with long fulfilment times and requiring a high degree of customer engagement, resulting in concomitant increases in the variable costs of freight transport.

THE DECLINING SHARE OF RAIL IN FREIGHT TRANSPORT

The abiding story of freight transport in India has been the steady and unceasing decline in the share of traffic carried by rail versus that transported by road. It is a well-known story (Chapter 2, Volume II). However, given that one of the most important recommendations of this report is the urgency of arresting this decline, the story is one that is worth repeating briefly. In 1951, around 90 per cent of India's freight traffic was carried by rail. Though the first decade of the new republic saw only a modest decline in rail's share, the next 20 years were less forgiving, and the gap had narrowed to a 60-40 split in favour of rail by 1981.

The decline has since accelerated. The liberalisation of the economy, the growth of markets in tier-II and tier-III cities, the expansion of trade, the dramatic increases in investment in the highway network, the subsidies extended to diesel fuel, and the discriminatory pricing of rail freight vis-à-vis passenger transport have all conspired to now leave rail with a roughly 30 per cent share of freight movement today. Other factors also contribute to the second-class treatment of freighted goods on Indian rails. The prioritisation of passenger traffic over freight means that the latter suffer elongated and uncertain travel times. As noted previously, the certitude of a pre-defined delivery schedule is almost as important in logistics as total transportation cost. Railways' inability to provide these guarantees results in substitution away to the higher cost but time-bound road-based alternatives.

In the absence of more flexible practice, customers usually engage point-to-point trucking services on a full-load basis. Further inefficiencies result when for short- to medium-haul distances, trucks are forced to return to base, empty.

Further, most rail terminals used for loading and unloading of freight are antiquated with limited options for accessing and evacuating cargo. There is reduced flexibility in carrying certain kinds of products[44]. The accommodation of freight on Indian railways has exhibited a marked preference for commodities that generate sufficient traffic to warrant dedicated full rakes. For higher value goods requiring transportation in lower volumes but to a more regimented schedule, Indian railways' container services have proved less attractive than they might have been.

The economic consequences are that goods are freighted inefficiently by road adding to their total cost, and reducing the competitiveness of exports. This does not include the generalised deleterious effects of distorted markets. The environmental consequences can be measured in terms of greenhouse gas emissions and energy usages that are higher than they need be, congestion and other effects.

INDIA'S TRUCKING INDUSTRY AND ROAD FREIGHT

The transportation of large volumes of freight Indian roads are typically done by an unorganised trucking industry. About 75 per cent of trucking firms own small fleets of less than five trucks, with only 11 per cent operating more than 20 trucks[45]. These trucks are usually all-purpose, used for transporting everything from agricultural produce to steel products to higher-value electrical items. Poor maintenance and low-quality spare parts rapidly reduce operational efficiency of trucks. Light trucks and double-axle trucks dominate the Indian trucking industry as narrow and badly maintained roads have traditionally been forgiving only of smaller and nimbler vehicles, and as regulations prohibiting the overloading of vehicles have been poorly enforced. The small vehicle sizes and rampant overloading mean that Indian trucking costs are amongst the lowest for bulk and heavy goods, but the cost for relatively lighter products—electronics, pharmaceuticals, chemicals, etc.—is substantially higher.

In the absence of more flexible practices, customers usually engage point-to-point trucking services on a full-load basis. Further inefficiencies sometimes result when for short- to medium-haul distances, trucks are forced to return to their base without a load. (See Box 4.9 for examples of how load exchanges can help eliminate empty backhauls.) There is relatively low penetration of tractor-trailer units, of flatbed trucks suitable for container carriage, and of specialised vehicles for refrigerated transport. On the whole, the industry is intensely competitive with low barriers to entry for either operator or driver, a high degree of substitutability, and significant bargaining power vested with the purchasers of trucking services. The capital required to enter the market is small, the licensing regime is not overly strict, and only basic skills and qualifications are requisite[46]. Service quality in terms of keeping to schedule and ensuring safety are not made priorities.

A few hundred logistics firms count amongst the larger fleet operators, offering an extensive network, limited transhipment at their own facilities, and limited value-added services like track-and-trace technologies. To varying degrees, these firms now offer warehousing and container rail transport, cold-chain logistics, and single-window cargo management solutions. Finally, a few industrial sectors, such as automobile manufacturing, have circumvented the limited trucking options available by operating their own fleets of dedicated transport or by working closely with more sophisticated logistics providers to develop their own supply chains and distribution strategies.

Once on the road, the rickety trucks face problems that are not limited to potholed roads or clogged highways which reduce their speeds to about a third of that achieved by developed-world counterparts. On a trans-national journey, they are stopped at multiple checkpoints for inspections, payments of tolls and taxes, octroi and so forth. It is well-acknowledged that many of these payments have no legal founding, and unjustly add to the transportation costs. The 11th Five Year Plan notes: 'Vehicles moving on interstate routes remain stationary about 40 per cent of the time in the process of being thus inspected. The World Bank has estimated that truck delays at checkpoints cost the Indian economy anywhere between

44. 'Special wagons are not easily available for carrying specialised products. For example, special types of steel required for automobile production have to be carried by trucks as the existing wagons do not offer the kind of protection that these high value products require. While customers are allowed to request for new wagon designs, the process of getting these wagon designs approved by railways is cumbersome.' Deloitte and ICC (2012).
45. CRISIL (2009).
46 KPMG (2010).

Rs 9 billion to Rs 23 billion'[47]. These delays result in Indian trucks being used, on average, for about 60,000 to 100,000 km per year, a figure that is less than a quarter of that in developed countries.

The high degree of competition within the trucking industry places pressures on the prices charged. Margins are then recovered by cutting costs, such as by hiring drivers with suspect licenses, overloading, compromises on maintenance, each of which contributes to a high incidence of accidents and mechanical failure. Regulations on licensing, overloading and vehicle roadworthiness are ineffectually enforced, contributing to rapid deteriorations in road quality, reduced speeds, driver fatigue and accidents[48].

The high degree of competition within the trucking industry places pressures on the prices charged. Margins are then recovered by cutting costs, such as by hiring drivers with suspect licenses, overloading, compromises on maintenance.

PORTS, COASTAL SHIPPING AND INLAND WATERWAYS

Container traffic at India's ports is the second largest but the fastest growing category of freight processed. In 2011-12, the major ports, which handle nearly all of India's container trade, loaded, unloaded or transhipped 120 million tonnes of container cargo[49]. Though container traffic has grown rapidly, the total quantities processed are still well short of international benchmarks. In processing larger quantities of container shipments, ports are hampered by many factors. First, inadequate drafts and port capacities prevent the largest container ships from calling at Indian ports[50]. Second, relatively little transhipment traffic is directed by shipping lines for processing at Indian ports. Third, poor road and rail connectivity to several ports hampers the efficient removal of all freight, but especially of containers. Fourth, the relatively small numbers and extent of inland container depots mean that much of the traffic must be cleared on-site upon landing at coastal ports. Clearance procedures for customs, security and bio-security, are slower and more involved than international standards, with physical inspections often called for, increasing cargo dwell-time at ports and raising costs. Fifth, limited availability and use of material handling equipment and the latest automation technologies at the ports also slows vessel turnaround times, reduces the certainty—and hence the usefulness—of time-bound freight movement, and also increases the time that ships must idle at sea before berths become available. Sixth, charges related to payments for container and port terminal operations, to port authorities, container freight station operators, and a host of other services are a part of the comprehensive cost burden borne by shippers to India. These costs tend to be relatively higher than comparator countries in Asia, especially when put in the context of the quality of services available. Each of these factors is explored more fully in the chapter on Ports and Shipping (Chapter 4, Volume III). Together with high prices for marine fuel (relative to that used for land-based transport which is subsidised), these factors combine to ensure less-than-desirable use of coastal shipping[51]. Finally, container traffic on inland waterways is negligible with neither barges nor docking facilities available on the major routes[52].

FREIGHT MOVEMENTS BY AIR

Indian airports currently handle 2.4 million tonnes of cargo, and are expected to handle about 7 million tonnes by 2020, representing a CAGR of 14.7 per cent[53]. Transhipment of air cargo through Indian airports is expected to become an important business. The transhipment share is assumed to become 5 per cent of total international air cargo volumes handled by Indian airports by 2015-16, and to increase by one percentage point each year thereafter over the next two decades[54].

Indian airports, including the new airports developed in Delhi, Bengaluru and Hyderabad, have not adopted the best practices for enabling express logistics. These best practices are marked by the availability of dedicated and exclusive handling facilities for express operators, including aircraft parking and transit bays adjacent to on-airport warehouses and the audited delegation of the handling processes to the express air cargo industry. In the absence of these dedicated facilities, the dwell-times for air cargo at Indian airports are substantially higher than in other countries. These high dwell-times are a direct consequence of the following infrastructural deficits: a shortage of landside truck docks, vehicle holding areas and air side operational space; insufficient entry gates; inefficient and insufficient handling equipment and trolleys; the absence of specialised storage and handling facilities for hazardous, radioactive, valuable or perishable cargo; poor quality roads that link airports to cities and the hinterland; an emphasis on physical checks on entry and exit of cargo from bonded areas at the expense of technological solutions; and finally, a lack of on-airport support services such as warehousing and packaging facilities.

47. Planning Commission (2010: 25).
48. Ibid.
49 Chapter on Ports and Shipping in Volume III of this report.
50 Recommendations for major ports in Chapter on Ports and Shipping in Volume III.
51. Present capacity estimates for container shipments along coastal routes are for around 14,000 containers per month, almost all of which is along the West Coast.
52. There is minimal traffic of around 200 containers per day on National Waterway 3 in Kerala. (See chapter on Ports and Shipping in this report.)
53. Ministry of Civil Aviation, Government of India.
54. Working Group Report on Air Cargo Logistics in India, Ministry of Civil Aviation.

Box 4.11
Freight Facilities at Hong Kong Airport

Hong Kong International Airport (HKIA) was the world's busiest cargo airport in 2012, just holding off Memphis from the top slot. In 2012, total cargo throughput was in excess of 4 million tonnes carried on 51,000 flights, or about 140 each day. (In comparison, the total international cargo throughput of all Indian airports was around 1.2 million tonnes in 2011-12.) With Hong Kong pressed for usable real estate, it is notable that the entire airport is situated on an island that is largely reclaimed from the sea.

The Asia Airfreight Terminal is designed to handle 1.5 mn tonnes of cargo per year on 8 hectares with a gross floor area of 17,000 square metres. It is equipped with a fully automated cargo handling system with special facilities for dangerous or radioactive cargo together with specially-trained staff, and for perishable goods required cold rooms or freezers. It boasts 97 workstations for build-up and break-down operations, together with transfer vehicles, scissor lifts and cargo hoists.

Several value-added services are available at the terminal including:

- Cargo security screening to ensure compliance of shipment with air carriage security regulations;
- Re-labelling and re-packaging of bulk shipments into smaller ones or vice versa;
- Scheduled release of empty unit load devices such as pallets and containers to allow freight forwarders to better plan logistics;
- Import shipments arranged at truck docks at pre-arranged times;
- Advanced pallet and container handling systems that automatically store and retrieve from nearly 5,000 bulk cargo positions and 1,750 built-up cargo positions;
- Collection and delivery of unit-load devices (such as pallets and containers) from throughout Hong Kong.

On more than 95 per cent of all occasions, the terminal achieves stringent standards on truck queuing time (less than 30 minutes), export cargo reception (less than 15 minutes), import cargo collection (less than 30 minutes), and release of empty containers and pallets (less than 30 minutes). It achieves all of these at a mishandling rate that is about 1 in 20,000 unit-load movements.

The AAT is not the only freight facility at HKIA. The DHL Central Asia hub is capable of processing up to 30,000 packages and 40,000 pieces of mail every hour on a total land area of 3.5 hectares. Hong Kong Air Cargo Terminals with a design capacity of 2.6 mn tonnes of cargo per year, occupy 17 hectares, with direct connections to other urban conurbations in the Pearl River Delta. Further, there are air mail centres run by Hong Kong Post, dedicated cargo terminals run by Cathay Pacific and other airlines, a marine cargo terminal that provides one-stop multimodal service links with 18 ports in the Pearl River Delta.

By 2030, HKIA expects to process nearly 9 million tonnes of cargo, and its latest master plan already argues for the construction of a third runway and expansion of the airport island.

Source: DGCA, Hong Kong Airport and facility websites

On the procedural front, the following regulatory shortfalls can be identified. The important agencies that regulate trade in food, drugs, chemicals, biological matter and textiles do not have dedicated facilities or laboratories at airports in most cases. Staffing at these agencies has not kept pace with the volumes and varieties of products now traded that must be inspected. Next, operators of cargo terminals must maintain separate licenses for handling areas that process inbound or outbound cargo, and for transhipment cargo. Customs clearances are not available around-the-clock or on demand, and the pricing model for these services imposes high threshold costs on air cargo operators, discouraging volume efficiencies.

WAREHOUSING

Until a decade ago, warehousing in India was synonymous with basic four-walled structures with sub-optimal sizes, inadequate ventilation and lighting, poor hygiene conditions, and marked by the absence of racking, inventory management, or technology solutions[55]. By one estimate, 433 million square feet of warehouse space existed in India in 2009. Of this,

55. KPMG (2010).

only 8 per cent was organised with nearly 30 per cent under direct public administration and 44 per cent under in-house private management.

These warehouses are of poor quality and inadequate for meeting the specialised needs of modern manufactured products and business processes. The large majority of publicly administered warehouses are used for long-term storage of food, and to fulfil shorter-term requirements for public distribution schemes for grain. The absence of cold-storage facilities, and especially ones that are integrated along the food supply chain, together with insufficient protection from pests, thefts and the elements results in an enormous amount of stored grain that is lost or spoiled. With a renewed focus on ensuring food security as the marquee development priority, India can ill-afford this continuing wastage. The absence of scale in the warehousing industry prohibits both the cost-effective adoption of new technologies resulting in lower productivity, and the provision of value-added services like specialised packaging and temperature-controlled environments at competitive prices. Further, the absence of enforceable and enforced quality standards and benchmarks in creating new facilities, hampers efficiency.

Finally, differential retail and consumption tax rates across the states prevent warehouses to be located optimally from a supply-chain perspective; instead, the warehouses often migrate to the lowest-tax jurisdictions. The mandates wielded by various regulatory authorities over warehousing are often in conflict, and the regulations themselves require clarification. For example, the rules related to the storage and handling of pharmaceutical products are governed by Schedule M of the Central Drugs and Cosmetics Act of 1945 (with amendments in 2010), while the norms that define compliance with these regulations are designed by state-level food and drug administrations. In most states, such norms insist on physical separation of inventory, not by product, but by client (i.e., by pharmaceutical producer or distributor), with separate security and personnel for every client. Essentially, this entails the setting up of several separate smaller warehouses within a larger warehouse. In turn, this results in some logically perverse outcomes: the same class of pharmaceuticals requiring the same temperature controls but manufactured by different firms must nevertheless be maintained in distinct storage areas; product-specific skills and management is discouraged and separate personnel must be maintained for the same class of products preventing scale economies from developing.

Differential retail and consumption tax rates across states prevent warehouses to be located optimally from a supply-chain perspective; instead warehouses often migrate to the lowest-tax jurisdiction.

THE FUTURE OF INDIAN LOGISTICS

India's growth ambitions require supportive logistics policies and service environments as essential enabling factors. In the near term, the driving factors for the anticipated growth in logistics can be found in forecasts of growth in international trade and interstate commerce (Chapters 2 and 3, Volume II). In the more distant future, the expected growth in logistics can be hung on the long-term secular themes defined in the first section of this chapter.

THE FUNDAMENTAL DRIVERS

Perhaps the most important amongst these is the country's changing demographic profile with the attendant urbanisation, industrialisation, and concentration of industry. It is anticipated that over 60 per cent of India's urban population will be concentrated in 20-25 urban clusters by 2030[56]. Urbanisation and clustering will also lead to the development of specialised industrial agglomerations and satellite cities to serve these clusters. The clusters will need dedicated freight corridors such as the Delhi-Mumbai Industrial Corridor currently under development with high-speed connectivity to key ports and urban centres. These corridors and access routes will help to keep the cost of supplying goods and services to these urban centres low or manageable. In pratical terms, establishing the desired logistics strategy to accommodate this urbanisation trend will involve (a) identification of existing, evolving and planned urban centres; (b) identification of sites for a clustering of warehousing and storage facilities to service these hubs; (c) creation of dedicated cargo routes for speedy access of supplies into local wholesale markets and (d) use of intra-city transportation for supply to retailers.

At the same time, the logistics industry and infrastructure will also have to keep pace with the increasing sophistication of manufacturing processes and outputs which will require their own dedicated logistics systems. Existing infrastructure will become obsolete as international standards are introduced in a competitive service-oriented environment. For example, existing, small 'godowns' will need to be replaced by larger, modern warehouses incorporating global standards such as taller designs, modular racking systems, palletisation and the usage of automation and information technology. The growth of specialised industries will necessitate value-added

56. KPMG (2012). The report of the Working Group on Logistics from the Planning Commission suggests the following 15 locations as suitable for situating logistics parks: Ludhiana, Rewari, Mumbai, Kolkata, Chennai, Bengaluru, Kishangarh, Ahmedabad, Hajira, Vadodara, Vapi, Durgapur, Nagpur, Hyderabad, Sriperumbudur.

services, such as cold chain warehousing, packaging and track-and-trace services. In short, the new profile of domestic and international trade will require commodity- and geography-specific storage and transportation assets. The non-availability of such required assets will hinder the investment potential of trade in other parts of the economy.

As noted earlier, India's logistics sector is currently constrained not only by insufficient or inadequate infrastructure, but perhaps even more so by the misuse of transportation modes for the wrong type of commodity and limits on the free use of transportation modes in others. At present, raw materials form the bulk of cargo movements in India (around 60 per cent), but have a relatively low value per unit of volume. These need to be moved from point-to-point over long distances. The movement of raw materials entails effective handling at logistics terminals and seamless multi-modal transportation, such as the movement of coal by coastal shipping, rail and road. For these goods, the importance of timely delivery is superseded by the requirements of ensuring low costs and secure shipments. On the other hand, capital goods and goods used for manufacturing have a moderate value per unit volume, and consumption is often concentrated in and around urban clusters. The goods are shipped over medium distances and transportation priorities are efficient, on-time delivery, together with the possibility of tracking shipments and the use of specialised vehicles or carriers. Finally, consumer goods account for a relatively small proportion of cargo volumes, but have a high value per unit of volume. These need to be moved over short distances and require high degrees of customisation in terms of transportation modes and in terms of storage and transportation assets based on the characteristics of the cargo. The timeliness and reliability of movements take precedence over maximisation of transport asset utilisation.

The desired 'end state' is an overlay of transport networks, with natural transition nodes where quantities are aggregated and disaggregated for more efficient transport on the best mode for a commodity a particular stage of the journey

The volumes for all of these classes of goods will grow, with the transport of bulk goods achieving such critical importance that it is addressed separately in Chapter 8, Volume II. The optimal movement of freight by matching of cargo category with transportation mode will be crucial in a scenario of expanding volumes across categories. Lopsided utilisation of transportation infrastructure such as road and rail, as is the case currently, stresses networks in addition to inflating costs and turnaround times. A need exists to incentivise optimal selection of modes to reduce congestion and enable smooth movement of cargo. The government also has a normative and prescriptive role to play; for example, by directing that bulk goods only be moved by rail, coastal shipping and inland waterways.

THE DESIRED END STATE

The desired 'end state' is an overlay of transportation networks, allowing for the efficient transportation of each commodity type as well as natural transition nodes where quantities are aggregated and disaggregated for more efficient transport on the best mode and gauge for a particular stage of the journey. A brief synopsis of this desired 'end state' is captured in Figure 4.1.

In practical terms, these desired outcomes are a reversal in the mode-share between rail and road, making inland water transport and coastal shipping more attractive, achieving seamless transfer between transport modes and gauges, and hubs for processing, storage, transhipment and onward distribution. Specifically, it is desirable to bring rail's mode-share of freight transport equal to that carried by road (50:50), to increase the share of liquid bulk cargo transported via the pipeline from 55 to 80 per cent (as is the international average), and to substantially increase the mode-share of coastal shipping and inland waterway transport from the currently discouraging share of 6 per cent. This rebalancing from road to rail and the more effective harnessing of the lesser-used transport modes—pipelines and water—can serve to reduce India's transport fuel requirement by 15 to 20 per cent and cut logistics expenditure by 0.5 to 2 per cent of GDP, together with providing non-financial benefits in the form of reduced air pollution and increased energy security.

In summary, the desired state of the logistics infrastructure in India can be encapsulated as follows. First, roads must provide for last-mile connectivity to rail-yards and maritime ports, and there should be good links to the national and state highway networks. Second, dedicated rail freight lines should parallel the corridors of the major movements of goods shipments across the country, and should be worthy of consideration as the premier mode of transport for all but the highest-value commodities above defined break-even distances. These lines should provide for high-speed cargo movements with high tonnage capacities. To support the efficacy of these corridors, roads should link readily with rail, and especially at specialised transhipment junctions or logistics parks. Meanwhile, major ports capable of servicing bulk carrier and container ships with the large beams and drafts that are commonly deployed on international routes should be located relatively evenly along India's coastline. The ports should also possess sufficient capacity to handle domestic cargo.

THE ROAD (AND RAIL) TO INTEGRATED INTERMODAL TRANSPORT

The first section of this chapter identified the theoretical underpinnings of an integrated logistics policy for freight transport, motivating this by the key observations that logistics are inseparable from the value proposition of a good. To achieve freight transport that is timely, reliable, and cost-effective, a set of policies and practices must be instituted to ensure that the most efficient transport mode is chosen for each commodity or class of product, and at each step of the journey to which it is best suited. This section details the policies and practices that will deliver the desired outcomes. There is natural overlap between the policies and practices that can be recommended to achieve multi-modal efficiencies for the carriage of freight, and those recommended for an individual transport mode. Here, only the former are set out, occasionally in abbreviated form, with the caveat that these must be read in conjunction with the extensive mode-specific documentation in Volume III.

ROADS AND TRUCKING

For a rebalancing of the multi-modal transport system in India, it is critical that the road sector become more efficient as well as less dominant. The focus should there be on maximising its advantages over other modes that lie in its extensive reach, its last-mile superiority, and its nimbleness and flexibility to deliver smaller volumes at higher frequencies to more destinations. In short, the structure of movement of freight over roads will best serve the country if its performance is maximised over short distances between urban centres, ports, airports, inland container depots and logistics parks, and the surrounding hinterland.

In the future, Indian trucking must become more adept at processing less-than-truckload (LTL) consignments, which are conventionally defined as those weighing-in at less than 10,000 pounds (or 4500 kg). The handling required to provide this service is greater than that needed for full truckload shipments[57]. To maintain the safety and integrity of different shipments, truck carriages will need to feature modern design elements including segregation, compartmentalisation and specialised locking systems. The driver of the vehicle must acquire trucking as well as inventory management skills. With multiple loads being loaded and unloaded at multiple origins and destinations, such trucking services place special demands on the service provider. They must develop route configuration systems as well as devise processes for handling and ensuring compliance for different kinds of shipments. LTL services are likely to prove a boon to small and medium manufacturing enterprises, which may not ship sufficient volumes on certain routes to justify full

> For a rebalancing of the multi-modal transport system, it is critical that the road sector become more efficient and less dominant. The structure of movement of freight over roads will best serve the country if its performance is maximised over short distances between urban centres and the surrounding hinterland.

truckload shipments. LTL services will also require substantial consolidation within the industry, as efficient service-provision can only be achieved with an extensive network, with a large and differentiated fleet of vehicles, and substantial investment in back-office management.

Though the government may choose to encourage this consolidation with a standard arsenal of industry tax holidays and other subsidies, it is preferable instead to resolve other regulatory hurdles and market failures such that the required consolidation may eventuate organically. These regulatory hurdles include simplifying the documentation required of truck movements, and reducing unjustifiable excise duties on multi-axle trucks[58]. It should also be noted that multi-axle vehicles cause less damage to roads than two-axle trucks. These vehicles offer cost reduction not merely in terms of lower line-haul costs per tonne-km but in terms of increased loading and unloading efficiency and in maximising transfer of loads between vehicles and modes. Since the benefits in terms of lower road damage do not accrue to the user, lower excise and differential taxation on multi-axle vehicles is justifiable. As noted earlier, prevailing road conditions, lax oversight on overloading, and the constrained liquidity of a fragmented trucking industry have each resulted in a preference for smaller all-purpose trucks, rather than for more sophisticated multi-axle vehicles.

It should also be noted that larger vehicles increase the costs associated with empty backhauls. This lack of demand has perhaps been the largest cause for domestic suppliers shying away from manufacturing this class of trucking vehicle. More recently, however, the situation is changing and some domestic manufacturers have begun to bring the more sophisticated vehicles to market.

Industry consolidation will also help as well as be influenced by another operational measure designed to improve efficiency: the use of the tractor-trailer. These trucks separate the payload from the propulsion mechanism, allowing a single tractor to pull multiple trailers. Fewer engine-units are required, and idling time for these during loading and unloading is reduced. System flexibility improves as a single tractor can be used to haul different types of specialised trailers or containers. Finally, there is better

57. DHL, in submission to NTDPC.
58. Goods vehicles with three or more axles are subject to a 12 per cent central excise, against a zero excise on smaller trucks.

Box 4.12
McKinsey's National Integrated Logistics Infrastructure Policy

McKinsey, the consultancy, have suggested a blueprint for India's national infrastructure policy through to 2020. The aims of this policy are threefold. First, it seeks to ensure an efficient logistics infrastructure that supports a balanced modal mix, furthers economic growth, and minimises environmental impacts. Second, the suggested policy is designed to engender better agency cooperation at the state and central levels, and between these levels. Finally, the policy seeks to provide logical impetus for the allocation and division of spending on infrastructure, skills development, and technologies.

Specifically, the suggested policy sets out the following measurable objectives by 2020:

1. To increase the share of rail in freight traffic to 45 per cent
2. To limit annual economic losses to $100 bn or to under 4 per cent of GDP
3. To reduce energy consumption by 1 per cent and greenhouse gases by 20 per cent relative to the current levels
4. To achieve on-time and on-budget delivery of projects
5. To achieve intermodal coordination

To these ends, the policy consists of the following 10 elements:

1. Accelerating the number and construction of rail DFCs. McKinsey suggest that the development of the two in-progress DFCs (between Delhi and Mumbai, and Ludhiana and Kolkata) should be expedited, with funding sourced from private enterprise as well as from the rail budget.
2. Strengthening coastal freight corridors. The policy aims to boost coastal shipping along both the East and West coasts by creating transhipment hubs, encouraging state-owned companies to use coastal shipping, and deploying new technologies for processing both bulk and break-bulk cargo.
3. Increase and accelerate the number of expressways of lengths between 100 km to 300 km to support the main NH network along heavily-trafficked routes.
4. Initiate a comprehensive last-mile road building programme to support rail and port infrastructure, and multi-modal logistics parks.
5. Initiate a last-mile rail programme to support mining and industrial activity and agricultural markets.
6. Develop 15 to 20 multimodal logistics parks at intermodal junctions, preferably where DFCs and National Highways intersect near major centres of population. These parks should be provided with land, utilities and facilities to ensure seamless transfer of goods between modes, together with office space, hotels, warehousing, etc.
7. Prioritise systematic investment in road maintenance to achieve the most from the existing asset base.
8. Encourage widespread adoption of automatic tolling by establishing technology standards, and a nationwide clearing house and payments system for operators.
9. Expand human resource capacities and skills-sets, including new colleges, certification standards, and licensing.
10. Enable better equipment, technologies and set common standards.

Source: McKinsey (2010).

operational flexibility in optimising routes, reducing fuel consumption, and reducing transit times, all of which lead to lower fuel and operating costs, reduced wear and tear of roads, as well as a lower carbon footprint per unit of freight carried.

For full deployment of tractor-trailer model, it is desirable that all state regulatory authorities permit the separate registrations of tractor and trailer units, and there does not appear to be any prohibition in the Motor Vehicles Act (2000). There is a need to develop a well-defined law applicable nationwide covering the differential legal obligations of the owners of tractor and trailer units. A national electronic register of trailer ownership, locations, payload and destination will add to the flexibility of the system, by allowing owners of tractor units to plan multiple routes in advance. Further down the line, fleet or load exchanges could be set up to bring transport suppliers and customers together.

The electronic collection of tolls under a single technological standard together with a clearing-house for the various toll operators to reconcile collections and dues will enormously reduce waiting times at toll plazas. The technologies can be readily adapted to collect taxes and fees as well. To incentivise the uptake of this technology, conforming vehicles should be given preferential access and clearance through toll plazas and other checkpoints, a facility that is only incompletely offered at present. Nationwide recognition of mechanisms for factory-sealed or customs-inspected containers can reduce the need for en-route physical inspections. The rollout of the smart-card based national electronic vehicle registration system (VAHAN) and the national smart-card based commercial driver's license (SARATHI) should be expedited and made compulsory for operators seeking one-time physical inspections of shipments and for operating tractor-trailer units.

RAIL

There are two initiatives with enormously far-reaching effects that will be most instrumental in reversing the decline of rail's mode-share in the transport of freight. First, the network of dedicated freight corridors (DFC), already commissioned and under construction, must be speedily completed. The corridors will do much to improve the speeds and reliabilities of both freight as well as passenger trains. The focus on freight will also allow the network to service the urban agglomerations and industrial belts where cheaper rail-freight service is most beneficial and most needed. It is critically important that work begins forthwith on the four corridors which have been identified but have yet to receive implementation go-aheads.

Below, this chapter argues for the sustained development of containerised cargo movements. To this end, the freight corridor designs must support efficiency measures such as double-stacking, and terminals and junctions designed for processing containers. The chapter on Railways (Chapter 1, Volume III) discusses the additions in physical capacity and network augmentations required in more detail. Here, we emphasise that mineral and feeder routes connecting mines, power stations, industrial centres and logistics parks to the DFCs will be critical to the success of the dedicated network.

Second, the large-scale cross-subsidisation of passenger services by the exorbitant charges on certain categories of freight is not justifiable as it deflects freight traffic which should be carried by the railways to road thus preventing the railways from carrying types of loads over distances that are in keeping with their comparative advantage. Instead, Indian Railways should set freight tariffs in accordance with market conditions, but subject to independent regulatory oversight in recognition of the monopoly of service. Cost-based commodity-specific pricing regimes may be instituted.

Once the financial viability of the freight network stabilises and upon completion of the DFCs, measures could be taken to increase the participation of private players for owning and moving rolling stock. Under this scenario, private agents own and lease wagons to end-customers, a practice widespread internationally but only incipient in India. The wagons

> Indian Railways should set frieght tariffs in acordance with market conditions, but subject to independent regulatory oversight. Cost-based commodity-specific pricing regimes should be instituted.

can be specialised for the movement of liquids, auto components or other commodities. The government may wish to introduce or strengthen regulations over service agreements and guarantees on the security of cargo from the service provider to reduce customers' financial risks over rail transport such as those covering delay, non-delivery or damage of goods in-transit.

Beyond these measures, the speed of freight on the network and unit transportation costs can both be improved by the induction of new high-power locomotives capable of hauling longer, heavier, trains and new wagons with higher payloads-to-tare ratios.

PORTS, COASTAL SHIPPING AND INLAND WATER TRANSPORTATION

Transportation by water is extraordinarily efficient. Fuel consumption for every tonne-km of freight shipped is only 15 per cent of that by road and 54 per cent of that by rail. Emissions, too, are lower as compared to rail or road transport. Coastal shipping is also more suited to handling bulky consignments. With efficient terminal infrastructure, networks, and vessels, coastal and inland carriage of goods by ship can be half as expensive as by rail and up to 80 per cent cheaper than by road.

It is desirable to increase the mode-share of water transport. To do so requires that the availability of sufficient terminal and vessel capacities, improved cargo handling efficiencies at terminals, an increase and regular maintenance of draft in harbours and IWT channels, and more skilled labour to participate in the sector. The required initiatives in physical infrastructure are thus as follows:

- Improved road and rail connectivity with the ports and to inland container depots, dry ports, and logistics parks. The use of shipping is especially vulnerable to poor hinterland connectivity, and natural dependencies exist with rail and road transport networks.
- Smaller new ports at regular intervals on the coast to increase the number of origin-destination pairs, and make coastal shipping more attractive for smaller cargo volumes.
- Increases in the number of vessels transporting bulk and container cargo on Indian coasts, with a range of capacities to suit cargo loads of varying sizes.
- Improved superstructure, through expansion of associated back-up container stack areas, transfer bays, rail transfer facilities for seamless

New airports may be considered, dedicated only to cargo flights. The economic zone around the terminals should facilitate acquisition of space to allow for truck docks, warehouses and temperature-controlled storage facilities, with service roads and entry gates linking the processing area.

rail evacuation, gate terminals for proper road evacuations, operational buildings, modern container handling equipment such as quay-side container handling gantry cranes, yard rubber-tyred gantries, reach stackers, terminal tractors, etc., in the terminal areas[59].

- Augmenting associated back-up value-add complementary facilities like CFSs, warehouses, assembly and packaging facilities, cargo consolidation areas, processing and distribution centres at off-dock locations to minimise port congestion and for easier inter-modal transfers.
- Dedicated berths for processing container and bulk cargoes, together with modernisation of associated material handling equipment.

On the policy front, the following initiatives should prove advantageous to the use of water transport:

- Co-loading of domestic and international cargo on coastal vessels. Such co-loading is already permissible on Indian-flagged vessels travelling wholly between Indian ports. The facility should be extended to foreign-flagged vessels that often carry considerable spare capacities on coastal routes and to vessels travelling between Indian and foreign ports.
- Centralisation of governance of inland waterway transport under a single agency.
- A standard policy on minimum drafts and regular dredging and maintenance to ensure compliance.
- Mandatory consultations between port authorities, metropolitan and civic agencies, and Indian railways in planning expanded port infrastructure to ensure better rail and road connectivity with the ports. This can be possibly be coordinated through a high-power group, headed by a minister or a secretary along with senior representation from Ministries of Shipping, Roads and Railways (Chapter 4, Volume III on Ports and Shipping).

A common IT platform for message exchange between shipping line, port authority, terminal operator, freight forwarder, and container freight station operator will help communications, planning and scheduling of both, ship arrival as well as clearance and onward despatch once cargo is landed. Inspection agencies supervising the imports of certain cargoes such as textiles and pharmaceuticals should be supplied with additional staff, with subsequent streamlining of processes to ensure time-definite clearance. Where appropriate, the agencies may choose to accept the clearance documentation issued by regulatory agencies in the country of export or by other credible third parties. Physical inspections should be made on the basis of official judgment and defined criteria in accordance with a formal Risk Management System rather than as a matter of course.

AIR CARGO AND FREIGHT

An important task in ensuring better processing of freight at India's airports is the setting up of dedicated terminals or private bonded facilities for air cargo at all metropolitan airports. Alternatively, consideration may be given to new airports that are dedicated only to cargo flights. These hubs are crucial to the development of the generalised logistics and express air service industries. The economic zone around the airport terminals should facilitate the acquisition of space to allow for truck docks, warehouses and temperature-controlled storage facilities and should be zoned as such. Service roads and entry gates linking to the processing area should be designed and constructed with a view towards anticipated volumes of trucks required to remove air cargo.

Delhi in the North; Navi Mumbai, Nagpur and Pune in the West, and Bengaluru and Hyderabad in the South are ideal locations for air cargo hubs given strong intermodal links, and demographic or geographic advantages. The establishment of these hubs will require investment in real estate, buildings, and in material handling equipment with provisions for stacking, palletisation and conveyor movement of containers. Data capture and piece-level control are critical in supply chain management, and bar coding and scanning systems, radio frequency identification tags, etc., are essential for updating track and trace systems.

Space limitations or advantages in intermodal connectivity may merit the situating of bonded facilities at off-airport sites. Procedures and systems should be overhauled such that cargo can be shifted to these bonded areas with customs processing occurring thereafter. These customs-free zones can be set up within the framework of existing laws governing SEZs (Special Economic Zones) by demarcating and recognising warehousing areas within or near airports. These changes will permit the easier movement of cargo to international destinations without customs examination and assessment in India. Further, it ought to reduce airport congestion and cater to increased scale in trade.

Customs clearances should be available at all times at the largest airports with the heaviest traffic volumes. The cost-recovery model used for setting fees

59. Planning Commission (2010).

for customs clearances should be abandoned in favour of a more rationalised fee structure, perhaps funded by a cargo services fee as is the case for passenger screening and clearance. Important regulatory agencies for inspecting shipments of food, pharmaceuticals, textiles and biological matter should have on-airport offices. Private laboratories should be certified and licensed to conduct mandated tests. The regulatory agencies and laboratories should be integrated into a common information technology system shared with customs, airports and cargo service providers. Finally, there does not appear to be a persuasive argument for persisting with a separate license for processing transhipment cargo.

PIPELINES

Pipelines are an important means of transport, as they do not require the return of 'empties' to the starting point and as such are ideal for unidirectional traffic. They are insensitive to surface conditions such as storms and inclement weather. Besides being environmentally friendly, operating costs are low and inflationary influences have a small impact on transport costs. Pipelines are highly under-used in India today with a mode-share in total cargo transport of less than 5 per cent and in liquid bulk cargo of around 55 per cent. This is lower than in many other countries.

Existing pipeline networks are localised in nature, with limited reach and absence of arrangements for multiple users. This adversely impacts recovery of investments and is reflected in the inadequacy and age of existing pipeline network. Possible initiatives in physical infrastructure are thus as follows:

- A National Pipeline Grid could be established along the lines of the National Electricity Grid. Disparate pipeline networks could be integrated to allow for efficient flow of products across long distances[60].
- New technologies permit upstream and downstream products to be transported in the same pipeline (such as crude oil, gasoline and naphtha). This can lead to further economies.

With the majority of pipelines under non-governmental ownership and administration, policy plays a bigger role than the provision of infrastructure. The following policies are likely to result in the desired boost for pipeline transport:

- Facilitate the investor in obtaining multiple permissions/clearances that are required for setting up pipelines.
- Fiscal and tax incentives for investing in pipelines could be introduced.

India will requitre about 25 logistics parks over the next 20 years. These should be situated close to population centres, at junctions of several transport modes, on the grounds of ports or airports, or in their immediate vicinity.

INTERMODAL TERMINALS AND LOGISTICS PARKS

In this discussion, the terms intermodal terminal, multi-modal transhipment hub, dry port, inland container depot and logistics park are all subsumed into the latter for brevity. However, it is recognised that each of these concepts is somewhat different in terms of the breadth of services provided and connecting infrastructure required. That said, each of these facilities encompasses the following functions in some measure:

1. To serve as a transhipment hub where quantities are aggregated and disaggregated;
2. As a waypoint to manage inventory, store goods and compile economically viable shipments; and
3. As a point of interchange between gauge and mode of transport.

'The use of large warehouses, shared equipment and manpower at these transhipment points lowers operating costs. Transportation costs can also be reduced with improved utilisation of transportation equipment with flow aggregation (over various modes), as additional distance is typically offset by scale benefits'[61]. Together with the ancillary activities and services such as inspections and certification, customs clearances, offices and hotels, logistics parks are enormously important cogs in processing domestic and international trade in a well-functioning economy.

India will require around 25 logistics parks over the next 20 years[62]. These should be situated close to population centres, at the junctions of several transport modes, and serve a large catchment area. A logistics park may be sited on the grounds of a coastal or inland port, or airport, or in the immediate vicinity of these facilities. To minimise the potential for administrative and procedural delays, it is ideal if the former approach is followed where possible. In some instances, it may be worthwhile to set up a new logistics park in conjunction with a new port or cargo airport or rail-freight handling facility. In either case, shorter processing and transhipment times may be expected, and the essential conveniences offered by ready and reliable freight transport are

60. For example, the linking of the Mathura-Jalandhar pipeline in the North with the Kandla-Bhatinda pipeline in the West; and the linking of the Barauni-Kanpur pipeline with that between Kanpur and Allahabad.
61. McKinsey (2010).
62. Essentially every major urban conurbation will require one, and some will require two. For example, the National Capital Region will be well-served by a logistics park that services freight travelling on National Highway 8 and the Western DFC; as well as by another serving freight travelling on National Highway 2 and the Eastern DFC.

The functional agenda and operational remit of every logistics park should be delineated separately. This should then be evaluated independently. Each park should aim to provide efficient and low-cost transhipment and client-oriented value-added services.

likely to encourage many time-sensitive businesses to locate in or near the park.

The guiding principles underpinning investment in logistics parks are the same for all other infrastructure spending as proposed in this report. Here, we only reiterate the important principle of network-centric thinking in planning infrastructure, and the major observations from the Indian experience that have thwarted this principle. As detailed in Chapter 2, these are (a) network enhancements have been driven by political rather than business or even social welfare considerations; (b) capacity augmentations that have often only resulted in pushing bottlenecks to elsewhere in the network; and (c) a generalised lack of intermodal thinking in planning infrastructure. When deciding on investment in logistics parks, the following 'good' practices may help in ensuring that these observations are not made in the future of parks constructed today.

First, logistics parks should possess sufficient space and be provided with room for future expansion, with the dimensions of the space determined, again, by estimates of traffic flows and patterns. The particular functional agenda and operational remit of each park should be delineated separately. This should then be evaluated independently to determine if sufficient market potential exists, if efficient intermodal terminal operations are possible at the chosen site, and if it links to transport networks that are of sufficient quality. Each park should aim to provide efficient and low-cost transhipment services and client-oriented value-added services. The hub potential of the park should be determined, whether in regional, national or international terms. The legal and operational restrictions on the functioning of the park should be identified in advance, and feasibility studies should pay particular attention to integration with urban master plans, regional development plans, land and building costs, and acceptance by existing users or neighbours of the designated site.

Logistics parks, by their inherent nature and particularly in current context, appear to be ideal candidates to be developed through suitable public private partnership (PPP) formats. The keywords that seem to characterise these parks today is bulky investments, huge land parcels, short project turnaround, efficient operations, tremendous commercial potential and innovation. These are best addressed and harnessed by the private sector. One of the serious constraints, however, is the availability of land and the fair price of acquisition, which is where the role and support of the public sector shall continue to remain important.

Where space proves to be problematic near urban centres, existing intersections of the highway and railway networks can be expanded by building terminals around the handling areas. These constructions are increasingly seen in Europe (e.g., at Basel/Weil and in Budapest which handle only containers, semi-trailer and swap-body traffic). The size of the terminals should further be determined by the number and length of transhipment tracks, the number and type of handling devices such as cranes and reachstackers, the types of semi-trailer, container and other traffic catered to, the storage required, and the desired opening hours and other preferences of customers.

Land use plans should be mandatory for new parks. A land use plan serves as a guiding document for the development and expansion of intermodal facilities and the lands where these facilities are located. Such plans are required in most developed countries with intermodal freight transportation systems. They should communicate the long-term goals of the operator, regulator and governing agency while strengthening future initiatives. Land use plans can be centralised to include location-specific goals that enable customers, stakeholders, municipalities and government agencies to understand the governing principles that the managing authority uses to manage land and water assets.

In seeking to provide efficient transhipment facilities and value-added services, the terminal building should offer good and safe working conditions for staff, safe drayage, high security against theft and terrorist attacks, and minimisation of environmental effects. The design of the park should be heavily influenced by expected traffic volumes and commodities processed, with consideration to specialised terminals for processing standardised cargo. Provision should be made for the short-term storage of cargo and the long-term storage of empty shipping units or rolling stock if required.

Other design principles that may be followed are as follows. Terminal designs can be modularised and standardised to limit investment costs[63]. All terminals and infrastructure along a particular high-density freight corridor should conform with a set of minimum design rules. The standards should be subject to regular benchmarking and quality certification processes, as well as more formal regulatory review if the standards are enshrined in law. Railway access to transhipment areas should be from both

63. The standardisation of the terminal buildings themselves is at the vanguard of the debate on the design of logistics parks. So far, there has been little progress outside Switzerland and Austria, though the idea is now under the EU's considered attention.

sides to reduce shunting effort and operational costs. Transhipment areas with loading tracks should be compatible with train lengths to reduce shunting requirements further. Terminal management systems for intermodal or railroad-only terminals consist of the following components and modules: train processing; road truck transhipment; regulatory compliance; crane work station and movement optimisation; mobile data captures, tracking and routing; storage and additional services; statistical analysis; and billing. For each of these systems, a single national standard should be decided on and deployed.

On the implementation front, the Working Group on Logistics recommends that the identification of locations for logistics parks should be undertaken by consulting companies such as RITES which should take into account the views of industry collectives[64]. Consortia of companies should be invited to undertake the establishment of the parks on the understanding the Central Government will provide road and rail connectivity and the State Government will assist in the acquisition of land as well as in the supply of utility services.

Planning Commission argues for a new central body with a charter and mandate that is dedicated to the development of the logistics industry, a view that the NTDPC endorses[65]. Pre-emptively called the Central Logistics Development Council (CLDC), its goal will be to serve as an advisory and recommendatory body that seeks to decrease logistics costs through integration of transport services. The Council should consist of representatives from the logistics industry, MoRTH, MoCA, Ministry of Railways, representatives of State governments, CII, financial institutions, insurance companies, and academic bodies. The CLDC will collect and disseminate information, conduct research, advise the government, with funding from the industry. The CLDC will also advise regulatory authorities or create guidelines for self-regulation of some elements of the logistics industry.

The CLDC would spearhead the development of logistics sector. The development process would particularly involve participation of, and coordination among multiple ministries/departments and organisations. It is therefore advisable that a Nodal Ministry be designated for CLDC. Since logistical hubs are already planned as a key ingredient to the ambitious Delhi-Mumbai Industrial Corridor, piggybacking on the high capacity Dedicated Railway Freight Corridor (DFC), the Ministry of Railways could possibly act as the Nodal Ministry. Alternatively, considering the logistics parks as purely trade facilitation and processing centres, the Ministry of Commerce (as in case of China) may be found equally suitable.

> The shipping container has become the dominant hold-all for break-bulk cargo. It has allowed new sourcing, manufacturing, and inventory management processes. Managers treat containers as 'warehouses in motion'.

UNITISATION OF CARGO: CONTAINERS AND PALLETS

Of all the technologies that have revolutionised the movement of global freight, few have had as much impact as the humble box. Until the arrival of the container, each vessel was laboriously loaded and unloaded by hand, a process that could take weeks. Longshoremen handled on each piece of cargo that went into a ship's hold, stuffing bags and opening crates. The inefficiencies of the system are obvious. Goods are prone to pilferage and spoilage from unprotected storage in the holds. Ship turnaround times go up several times with each article or each non-standard container requiring handling, and the idiosyncrasies hindering mechanisation of the process.

Since first being introduced in coastal shipping along the Eastern coast of the US in 1958, the shipping container has become the dominant hold-all for break-bulk cargo. Container dimensions have been standardised internationally, allowing ships, cranes, trucks, and storage areas to be constructed especially for handling these. Modern ships now carry a total of nearly 1.5 billion tonnes of cargo around the world in 560 million containers[66]. Some vessels boast capacities of 12,000 to 15,000 containers. Modern automated cranes can load and unload nearly 150 containers an hour, each container placed in the exact onboard space and ashore so as to maximise logistical efficiencies. The resulting decline in costs has created new markets for goods, and in a geographic reorganisation of global manufacturing. The decline in shipping times has allowed new sourcing, manufacturing and inventory management processes. Indeed, predictable shipments based on the container have allowed managers to treat containers like 'warehouses in motion. By precisely timing the arrival of components, manufacturers move items from containers directly onto assembly lines or store shelves, bypassing warehouses entirely'[67].

The containers themselves have been re-engineered to new purposes. Refrigerated containers ('reefers') are used for perishable products and containers lined with bladders are used to transport liquids. The versatility and standardisation of the shipping container—the key to its maritime success—has made it ubiquitous for overland freight transport as well. Flatbed trucks are designed to accommodate

64. Planning Commission (2010).
65. Ibid.
66. Curry (2013).
67. Ibid.

India must rapidly adopt the use of standardised containers and pallets for moving both overland and maritime freight. Associated handling equipment like forklifts, cranes and specialised flatbed rail wagons must become ubiquitous.

one or two containers for last-mile delivery or for longer hauls. Freight trains now increasingly move break-bulk (and some bulk) cargo in containers stacked singly or doubly on dedicated wagons. (The 'humble box' has even found a purpose in retirement as a ready-made low-cost housing solution.)

An equally humble technology that can lay claim to revolutionising freight movement is the pallet, a wooden construction of several planks nailed together. Instead of devising optimal methods for lifting and transporting different objects over short distances, the pallet 'unitises' these operations. Forklifts and warehouse cranes and trolleys can be engineered with the single purpose of moving a pallet, and with complete agnosticism about the characteristics of the payloads actually carried. Some goods never leave their resting place atop a pallet from the moment they exit a factory door until a customer selects them from the same pallet in a retail store. As Box 4.5 notes, companies have redesigned product lines to better suit the standard pallet. In many countries, companies lease pallets to industry, taking on the responsibilities of delivering and retrieving these.

India must rapidly adopt the use of standardised containers and pallets for moving both overland and maritime freight. Associated handling equipment such as forklifts, cranes, scanning and inspection equipment, tractor-trailer units, and specialised flatbed rail wagons must become ubiquitous technologies in use at ports, logistics parks, handling yards, and by road, rail and shipping service providers. The 'unitisation' of freight movement will result in enormous time and cost savings. Financial incentives should be set in place to retire old equipment and inaugurate new technologies. De facto standards for pallets and containers should be officially endorsed and implemented by all state-owned enterprises. It is important that there is no variation between domestic and global standards.

HUMAN RESOURCES AND SKILL DEVELOPMENT

As noted earlier, Indian logistics is slowly but inevitably moving away from the traditional model of transportation services and storage, characterised by small, independent, unorganised providers who focus on a particular transport mode. It is transforming into a new system wherein third-party logistics providers devise end-to-end transportation solutions for manufacturing firms, arranging transport across all modes, and providing value-added services like packaging and reverse logistics. Further down the road, it is likely that the nascent fourth-party logistics industry will grow further, with firms specialised in supply chain management and in matching supply and demand, further reducing costs and lead times.

The transformation of the industry is, however, dependent on the transformation of the skill sets possessed by the current corps of freight transport professionals, and on a substantial boost in their numbers. By one estimate, the 10-million-strong current corps of drivers, handlers, operators, managers and other freight service professionals will need to double by 2020. This includes a requirement for over five million drivers, 100,000 warehouse managers, and 70,000 coastal seafarers.

DRIVERS, HANDLERS AND EQUIPMENT OPERATORS

The drivers of the future will be required to not just be expert users of their increasingly sophisticated equipment, but to also be au fait with ancillary technologies such as route guidance systems, electronic data entry, and log book management. They will need to be fully aware of any special handling required by a given load of cargo. Further, they will need to fulfil their duties with precision and efficiency to play their role in a supply chain that is intolerant of delay or uncertainty. As such, their driving skills, including defensive driving, will need to be of the first order. They will also need to be trained in vehicle maintenance, freight loading and unloading, and be certified to prevailing safety standards. Their required skill sets will include reading, writing and communication, together with basic technological familiarity, basic knowledge of taxation, permit and license regimes, and the technical nous to manage specialised or hazardous goods in transit.

Truck drivers should be certified to a high, common standard across the country that takes into account these skill requirements. Training institutes should conduct courses in the operation of light and heavy goods vehicles, together with refresher courses and re-certification offerings on handling specialised or hazardous goods.

Meanwhile, a large corps of operators trained in latest material handling equipment technologies will also be required to load, unload and organise cargo. These operators include forklift and crane operators, drivers of haulage trucks at terminals, and so forth.

MANAGEMENT

This chapter has called for heavy investment in multimodal logistics parks. It is intended that these massive facilities will process a large amount of container and break-bulk cargo. Beginning at the top, park managers with extensive operational and managerial skills will be required. Training programmes for these managers should include specific courses on sourcing, contracting, multi-modal operations and tracking technologies. The managers will also need to be comfortable operating a facility at which many different activities take place, ranging from rail and road transport to customs processing and warehousing to retail and travel. The success of a logistics park will be determined to a large degree by the management team's successes in juggling the competing needs of many different service providers, and in finding efficient synergies wherever possible—these synergies are the charter responsibilities of the logistics park.

Service providers based in the logistics parks may choose to locate some of their senior supply chain management professionals there. Whether based at the parks or elsewhere, the supply chain professionals will need to manage contracts and relationships, select suppliers, understand information, financial and material flows. They will be required to have extensive knowledge on the construction and operation of new facilities such as warehouses and distribution centres. Further technical skills will be required for sophisticated demand and supply planning, and for matching the two to relatively low tolerances.

The major challenge that the industry will face in recruiting these managers will lie in legitimising and publicising the potential of a viable professional career in logistics. At present, 'skills gaps arise from the structure of the industry in India. Small sized entrepreneurs have limited intent or capability to scale and build manpower capabilities. The industry gaps in good management practices are deeply set, as the logistics industry itself has still not emerged as an attractive sector for professionals. [The gaps] in core technical skills arise from the unorganised and fragmented structure in the industry'[68].

As international borders come to be drawn in ever-lighter shades of grey for the sourcing of components and final assembly, an increasing number of firms will need to become masters at managing their supply chains. To do so, executives at these firms and their logistics advisors and providers must work together to manage flows of material and information while maintaining the integrity of both. They must create and monitor new plants, warehouses and distribution centres and also deal with the links in the supply chains. These supply chain management professionals will be required to have skills in managing information, generalised industry knowledge, customer relationship management, advanced planning and optimisation, and in demand planning.

The major challenge that the logistics industry faces in recruiting managers will lie in legitimising and publicising the potential of a viable career, since it has not emerged as an attractive sector for professionals.

There exist very few formal training institutions or professional certifications for use as credentials of competency. In conjunction with industry, government should design curricula at the master's level for combined training in operations research, supply chain management, cost accounting and planning, each with a focus on logistics. Besides the academic study of these subjects, the goal of the training programmes should be to develop the following practical skills: (a) the coordination and planning of logistics operations in support of business efficiency; (b) planning and management of product supply chains including forecasting skills and inventory management; (c) the acquisition, operation, and maintenance of material handling equipment; (d) facilities management; (e) knowledge of safety, labour, customs and transport documentation and regulations.

RECOMMENDATIONS

This section collates the major recommendations stemming from the discussion and analysis in this chapter. Again, the focus remains on identifying actionable remedies to existing problems relating to the planning and implementation of integrated transport strategies, with particular emphasis on the movement of freighted goods. Required investments in physical road, rail, aviation and shipping infrastructure are detailed in the respective sectoral chapters.

1. Government must adopt an integrated transport strategy guided by inter-generational drivers of patterns of transport demand. The characteristics of these drivers are their long-term and largely irreversible nature; their far-reaching, game-changing effects on the economy and so on transport; their indifference to business cycles; and their relative immunity to financial and economic shocks. The proposed Office of Transport Strategy should give proper consideration to determining and monitoring these long-term drivers such as urbanisation, demographic change and changes in the mix of industrial activity.

2. The overall aim of the integrated strategy should be to uncover an optimal modal mix.

68. NSDC (2009).

Rules and regulations governing the carriage of goods by road, rail, air, sea or any combination of these should ensure equal administrative treatment. All imports should have the same documentation requirements.

This desired mix should reflect the full resource costs of each transport mode for each type of commodity transported over various distances and terrains. It should also reflect the government's distributive and allocative agenda clearly. To this end, traffic and costs studies must be carried out periodically, with due regard for the specific characteristics of each transport mode and commodity. These studies can be organised and analysed for attendant interventions by the proposed Office of Transport Strategy to guide transport gradually towards a modal mix that is both, efficient and rational.

3. In itself, the intermodal principle is not about advocating a particular modal mix. Instead, it is highly likely that from the optimal modal mix, a persuasive case for intermodal transport will be made. The inefficiencies of an insufficiently intermodal transport system are manifest in higher prices, longer journeys, reduced reliability, lower availability of quality services, type restrictions, higher risks of damage or pilferage, and more complex administrative procedures. The critical enablers to address these inefficiencies and to yield an intermodal transport system are:
    a. Missing stretches of infrastructure within one mode or missing links between modes should be completed. From its studies on traffic flows, the Office for Transport Strategy should assume the important role of identifying the missing links. It should be provided with the mandate to direct central, state and local authorities responsible for implementing infrastructure to liaise with each other in constructing the missing links.
    b. With ministries individually responsible for the construction and upkeep of roads, railways, airports, ports and waterways, and other transport infrastructure, the allocation of responsibility for ensuring good intermodal links or for the construction of multi-purpose facilities is not clear. The Office for Transport Strategy should again pay special attention to these important links and facilities, and be provided with powers to direct authorities to attend to their construction.
    c. With multiple handling and transporting agencies in an intermodal chain, the allocation of liability is not clear. At present, rules governing liability are determined by the Multimodal Transport Act of 1993 (amended 2002), which in keeping with international guidelines maintains that the multimodal service provider has 'presumed fault'. The liability rules could be strengthened on the following fronts: limiting the jurisdiction over disputes to tribunals or courts with special knowledge of transport issues; clarifying the arbitration procedures including the setting up of a defined tribunal and appellate instead of leaving these important details unspecified as at present; and most importantly, by ensuring that the service provider is accountable for loss and compensations regardless of where in the transport chain the loss was deemed to occur.
    d. Rules and regulations governing the carriage of goods by road, air, sea, rail or any combination of these should be amended to ensure equal administrative treatment. For example, imports arriving by air or by sea should be subject to the same documentation requirements, as should inter-state movements of parcels by road or rail. It is recommended that an inter-ministerial panel examine the various acts governing the carriage of goods by the various modes with a view to harmonising registration and licensing of service providers, processes regulating the handling of goods, and documentation requirements.
    e. Information is generally impermeable with little interoperability of information and management systems that govern the movement of goods. An inter-ministerial group should agree on a common data standard, in consultation with industry, and provide for immediate collection and dissemination of the data to service provider APIs.
    f. There is insufficient unitisation of cargo in the form of the use of shipping containers and pallets. The Government should adopt the common standards on these shipping units and then ensure that goods transport on all modes can accommodate these units both on rolling stock as well as on fixed infrastructure.

4. Pricing for transport services and for associated inputs like fuels should be de-politicised and set by market or by independent regulatory authorities. Where prices are set by independent authorities, they should be responsive to changing economic fundamentals in a timely fashion to minimise adjustment costs. Good pricing is simple, clear, prevents market distortions, guides consumption and investment

decisions appropriately, and is sustainable over the long run. Pricing in the transport sector should conform closely to the cost of services and actual resources used in its production, having regard to scarcity values of these inputs.

5. Better attempts must be made at establishing the true nature and extent of transport externalities, the relative incidence of cost and benefit, and how these fit with the government's wider distributive and allocative agenda.

6. Subsidies should be limited to those areas where their retention on societal considerations is overwhelmingly justified. Wherever subsidies are retained, they must be made as explicit as possible so that they are clearly identifiable to ensure transparency. The instruments of pricing, taxation and subsidy should be used to develop an economically rational intermodal mix and to promote operational efficiencies. It is ideal if policies on these are not absorbed into the government's generalised toolkit for fulfilling its distributive and allocative agenda.

7. With respect to the movement of goods on road transport vehicles, the following recommendations are made:
   a. Growth and consolidation of the industry must be encouraged organically by reducing the documentation, administrative and state-border clearance burden required of truck movements and by reducing excise duties on multi-axle trucks.
   b. Provisions in the Motor Vehicles Act (1988, as amended) should be effectively implemented. Recommendations made by the Sundar Expert Committee reviewing the Act should be carefully considered. Provisions relating to the overloading of trucks, the unhindered movement of trucks with national permits, and those relating to the registration of tractors and trailers should be uniformly implemented and stringently enforced.
   c. Tolls should be electronically collected under a single technological standard together with a clearing-house for the various toll operators to reconcile collections and dues.
   d. Nationwide recognition of mechanisms for factory-sealed or customs-inspected containers will reduce the need for en-route physical inspections.
   e. Truck drivers should be certified to a high, common standard across the country that takes into account the skills such as reading, writing and communication, together with basic technological familiarity, basic knowledge of taxation, permit and license regimes, and the technical nous to manage specialised or hazardous goods in transit. Minimum standards should be formulated at the central level, with all state licensing authorities required to issue licenses in compliance with these.

The speed of freight on the railway network and unit transportation costs can be improved by inducting high-powered engines capable of hauling longer heavier trains, and new wagons with higher payload-to-fare ratios.

8. With respect to the movement of goods on rail, the following recommendations are made:
   a. The network of dedicated freight corridors must be speedily completed.
   b. Freight corridor designs must support efficiency measures such as double-stacking of containers, and terminals and junctions should be designed to process unitised cargo.
   c. The participation of private agents in owning and leasing wagons to end-customers and in packing and processing rail freight in unit loads should be encouraged by building rail lines to private facilities and by accommodating rakes originating and terminating at logistics parks (see below).
   d. The speed of freight on the network and unit transportation costs can both be improved by the induction of new high-power locomotives capable of hauling longer, heavier, trains and new wagons with higher payloads-to-tare ratios.

9. With respect to the movement of goods via sea, the following recommendations are made:
   a. Ports should provide due emphasis on improving superstructure, by expansions of associated back-up container stack areas, transfer bays, rail transfer facilities for seamless rail evacuation, gate terminals for proper road evacuations, operational buildings, modern container handling equipment such as quay-side container handling gantry cranes, yard rubber-tyred gantries, reach stackers, terminal tractors, etc., in the terminal areas.
   b. Smaller new ports should be constructed at regular intervals along the coast to increase the number of origin-destination pairs and to increase the attractiveness of coastal shipping.
   c. Restrictions on foreign-flagged vessels from plying coastal routes as part of their international operations should be relaxed to allow them to carry bulk/general cargo

A National Pipeline Grid can be built along the lines of the National Electricity Grid. Disparate pipeline networks can be integrated to allow efficient flow of products over long distances.

and transhipped exim containers, including empty containers to make use of the considerable spare capacity on these ships. This would enhance domestic mobility for India cargo. Stricter or absolute Cabotage could continue for import and export of crude, critical energy cargoes and defence equipment/parts.

d. A common IT platform should be developed for message exchange and tracking between the various private agents, marine and landside service providers, ports and government agencies.

e. Inspections agencies supervising the imports of certain cargoes should be supplied with additional staff, with subsequent streamlining of clearance processes.

f. Physical inspections should be made on the basis of official judgment and defined criteria in accordance with a formal Risk Management System.

10. With respect to the movement of goods via air, the following recommendations are made:

a. Dedicated terminals or private bonded facilities for air cargo should be set up at all metropolitan airports. Alternatively, consideration may be given to new airports that are dedicated only to cargo flights.

b. Customs clearances should be available at all times at the largest airports with the heaviest traffic volumes. Important regulatory agencies for inspecting shipments of food, pharmaceuticals, textiles and biological matter should have on-airport offices. Procedures and systems should be overhauled such that cargo can be shifted to off-airport bonded areas without prior clearance.

c. The regulatory agencies and laboratories should be integrated into a common information technology system shared with customs, airports and cargo service providers.

11. With respect to the movement of liquids and gases via pipeline, the following recommendations are made:

a. A National Pipeline Grid could be established along the lines of the National Electricity Grid. Disparate pipeline networks could be integrated to allow for efficient flow of products across long distances.

b. Facilitation in obtaining multiple permissions/clearances those are required for setting up pipelines would be helpful.

c. Fiscal and tax incentives for investing in pipelines could be introduced.

12. In recognition of the importance of warehousing and logistics parks to the logistics sector, the following recommendations are made:

a. Around 15 to 25 logistics parks should be established. These hubs should be located at major transportation hubs, including at the origin and destination points of DFCs, and at major industrial centres or near major urban conurbations. The parks should have sufficient space to serve as waypoints to manage inventory, provide storage, and should also have excellent links to the road and rail networks, and possibly to airports and ports depending on the local economy and geography.

b. The parks should have provision for ancillary activities and services such as inspections and certification, customs clearances, offices, hotels and others.

c. Logistics parks should possess sufficient space and be provided with room for future expansion, with the dimensions of the space determined, again, by estimates of traffic flows and patterns.

d. The hub potential of the park should be determined, whether in regional, national or international terms. The legal and operational restrictions on the functioning of the park should be identified in advance, and feasibility studies should pay particular attention to integration with urban master plans, regional development plans, land and building costs, and acceptance by existing users or neighbours of the designated site.

e. Land use plans should be mandatory for new parks and should communicate the long-term goals of the operator, regulator and sponsoring agency.

f. To provide efficient transhipment facilities and value-added services, the terminal building should offer good and safe working conditions for staff, safe drayage, high security against theft and terrorist attacks, and minimisation of environmental effects and impacts.

g. All terminals and infrastructure along a particular high-density freight corridor should conform to a set of minimum design rules.

h. Railway access to transhipment areas should be from both sides to reduce shunting effort and operational costs.

i. Terminal management systems for intermodal or rail-road only terminals consist of the following components and modules: train processing; road truck transhipment; regulatory compliance; crane work station and movement optimisation; mobile data captures, tracking and routing; storage and additional services; statistical analysis; and billing. For each of these systems, a single national standard should be decided on and deployed.

13. International standards on unit load devices such as containers and pallets should be adopted and infrastructure adapted to suit. Associated handling equipment such as forklifts, cranes, scanning and inspection equipment, tractor-trailer units, and specialised flatbed rail wagons must become ubiquitous technologies.

14. A new central body, the Central Logistics Development Council comprising of industry members, ministry representatives, and financial and academic institutions should be set up with the mandate of promoting the logistics industry. The body will collect information, advice on required infrastructure and changes to policy and regulation, propose standards on equipment, technology and manpower.

A Central Logistics Development Council, with industry and Ministry representatives, and financial and academic institutions, should be set up to promote the logistics industry.

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5. INSTITUTIONS FOR TRANSPORT SYSTEM GOVERNANCE

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5. INSTITUTIONS FOR TRANSPORT SYSTEM GOVERNANCE

India's transport system does not meet the country's current needs, much less the future requirements for goods and passenger transport as the country grows. The physical infrastructure is congested in nodes—ports, inland container depots, and urban streets—and inadequate in others such as rural roads.

Its quality varies widely. India may be the pre-eminent economy in South Asia, but it is also the one country in the region that does not yet have a deep-water seaport. Freight delays are an oft-cited constraint on the investment climate, one of the obvious handicaps for efforts to develop the manufacturing sector or leverage domestic energy resources for power generation, and a key contributor to India's relatively concentrated economic geography. The transport system is also energy-inefficient, with nearly 70 per cent of cargo moving by road rather than rail or inland waterways.

India's urban transport and mobility needs are changing quickly as its cities grow in population and geographic size. Transport choices about how to do so will set the tone for the energy efficiency and livability of India's cities. Public transport and non-motorised transport (bicycles and walking) continue to play an important role in urban mobility, but use of personal vehicles (two wheelers and cars) is increasing as incomes rise. India will need to invest strategically in public transport and pedestrian infrastructure to retain a sustainable mix of transport. Congestion in the denser city cores already appears to be motivating more businesses to locate in peri-urban areas, which in turn places greater stress on water, sanitation, and other infrastructure that is still in development. The cost per kilometer of short-distance shipping within urban areas can be multiples of long-distance rates.[1] Idling in traffic also increases air pollution that in turn affects human health, crop yields, and the climate. The World Health Organisation (WHO) declared diesel exhaust a carcinogen in 2012; and recent scientific research finds that black carbon, the dark particles found in particularly high concentrations in diesel exhaust, is second only to CO_2 in driving global warming.[2]

India's transport system must evolve rapidly to support growth over the coming decades. Although the near-term projections for India's growth have dropped to 5-6 per cent, the country should return to 8-10 per cent growth over the medium and long run, with a consequent increase in the circulation of goods, people, and raw energy supplies (Chapter 3 on Macroeconomic Growth Backdrop: Transport Investment Requirements 2012-2032). More than this 'committed usage,' India must also build up the transport system to sustain much higher growth in manufacturing that is necessary to generate employ-

1. World Bank (2012).
2. Bond, et al (2013).

ment for its expanding young workforce. The transport infrastructure is obviously also important for encouraging balanced regional growth in manufacturing-related employment.

The weaknesses of the transport system interact with other constraints on growth. Limited connectivity creates an artificial 'scarcity' of land; for example, driving up prices and affecting firm competitiveness. Improving transport also lowers the costs of trade between various regions, affecting the efficiency of the internal market and the prospect for income gains from specialisation in products where there is a regional comparative advantage.[3] Lowering the cost of trade also affects the returns from investments in human capital and, by implication, can reduce incentives for skilled workers in rural yet transport-linked areas to migrate.[4]

India needs to develop institutional capacity not only to achieve economic growth, but also to support goals such as energy security and environmental sustainability

The domestic and global fiscal resources for this upgrade are constrained. India will need to ensure maximum socio-economic return on high capital investment, both to ensure sustainable public investment as well as attract private finance. It will also need to build an institutional environment to ensure effective use of private finance and support public-private partnerships (PPPs) that increase the efficiency of infrastructure delivery. Private finance does not eliminate public financial support for infrastructure; it merely shifts the timing of commitments and the distribution of contributions across users and taxpayers. The real gains from PPPs come from sharing risk across parties with different abilities to mitigate them and from tapping into public and private comparative advantage in project management, innovation, and technology adoption.

In any case, finance is necessary but not sufficient. The country will also have to develop the institutional capacity to be more strategic in decision-making about investment in and regulation of transport infrastructure in order to not only achieve economic growth but also support other development goals such as energy security and environmental sustainability. 'Transport policy' will need to address the way that passengers and freight are transported, beyond simply meeting the demand for some form of mobility.

This report makes recommendations for national transport policy for the long term, with a perspective of about 20 years. In addition to making policy prescriptions for this long period, it is also making projections for the kind of investments that will be required in each sector. It also provides a set of recommendations for inter-modal transport and logistics arrangements (Volume II, Chapter 4 on Integrated Transport: Strategy and Logistics). All of these policy recommendations and investment projections are being made utilising the best information available at the present time (2013). The Committee is very cognizant of the fact that 20 years is a long-term horizon over which to make such prescriptions and quantitative projections. We have been witness, for example, to a complete revolution that has been brought about by information technology and the advent of the internet during the last 20 years. The world in 2013 is very different from what it looked like at the turn of the 1990s.

It is certain that we will witness many technological changes in transport in the coming 20 years that will make our current expectations obsolete. Moreover, we have also seen very large variations in the price of energy over the past two decades. No doubt, we will see similar variations over the next 20 years as well. The recent advent of shale oil and gas has materially altered the expectations with respect to energy prices that existed just five years ago. Similarly, concerns with climate change could become even more serious than they are today. Our work on the Transportation of Energy Commodities (see Volume II, Chapter 8) has been predicated on the continued large scale dependence on coal as the predominant energy source for the production of power in India. It is possible that in view of the climate change concerns related to expansion in the use of coal, there could be significant changes in power production strategy. We therefore believe that it is of utmost importance that India develops an institutional mechanism to adapt its overall transport strategy on a continuous basis.

This chapter on Institutions for Transport System Governance is devoted to suggesting such a mechanism so that the recommendations and projections of the NTDPC can be adapted to changing circumstances and conditions, be they related to technological developments, price changes or environmental concerns. For such institutional arrangements to work, it is essential that technical capacities are developed to make continuous technocratic arrangements and adaptations: hence this Committee's emphasis on institutional development for transport governance and the need for significant capacity development. This chapter lays out a framework for moving from the current approach to transport development as a collection of investment projects and sector-focused policy and regulation to system governance. To begin with, we define transport system governance as an institutional system for generating and regenerating policy and investment strategies. 'Good gov-

3. This effect is a well-known theoretical result; Donaldson (2013) shows empirical estimates of the income gains from lowering transport-related trade costs.
4. Michaels (2008) shows that the US Highway system increased the skill premium in rural areas with higher human capital endowments, and lowered in areas with lower levels of human capital, consistent with the Heckscher-Ohlin model of trade.

ernance' is an investment, policy, administrative, and regulatory framework that supports and motivates a supply response to emerging demand for mobility and freight services, and enables a strategic and proactive response to transport planning for policy goals including environmental sustainability, socio-economic inclusion, and energy security.

'Integrated Transport Governance' does not mean setting up new monoliths, but rather creation of circulatory systems for statistical information, user feedback, and constructive interaction between levels of government and agencies focused on particular modes of transport.

The remainder of the chapter focuses on the subset of transport governance issues concerned with integrating policies and investments across modes and levels of government. We look at the status quo in India's transport system in comparative international perspective. India's current structure of separate ministries for each mode of transport is an anomaly in global practice. Transport governance is also unusually centralised, compared to peer countries and there are limited institutional mechanisms for intergovernmental coordination in integrating networks and developing important nodes such as airports and ports. Local government, particularly urban local governments' limited role in regional transport decisions is also somewhat unusual. Most global cities of sizes comparable to India's metros and Tier One cities have far more autonomy to shape their transport infrastructure for development.

Next, we outline a reform agenda for system governance. There are changes needed over the next decade which will be essential foundations for the country's longer-run transport governance. All involve significant institutional restructuring with associated capacity-building needs that cannot be achieved overnight, but must begin now. A set of critical interventions could be initiated immediately to work toward this transformation and help guide transport investment and policy in the interim.

These interventions at each level of government include:

Union Government Moving toward a single 'Ministry of Transport' by building the infrastructure for intermodal coordination of investment, and more integrated assessment of investment and policies. We envision a more consolidated national transport governance under a newly created **Office of Transport Strategy (OTS)** that is primarily concerned with building the foundation for an integrated energy-efficient national infrastructure, reducing externalities from sub-national transport decisions, and leveraging transport as a contributor to national equity goals. Although the Union government may play a substantial role in financing transport infrastructure, incentives embedded in funding should limit themselves to these roles and, following the principle of subsidiarity, other transport responsibilities should be left to state and urban local governments.

The Office of Transport Strategy should build the foundation for an integrated national infrastructure, reduce externalities, and leverage transport for national equity goals.

State Increasing state-level authority over and capacity for integrated network planning, prioritisation and project implementation, particularly for airports, urban transport and roads other than National Highways. States may also be given greater authority (and central resources) to maintain National Highways. Greater decentralisation of transport planning, within guidelines for environmental impact, inclusion, and other national goals, is in keeping with the principle of subsidiarity. It could improve the transport system's responsiveness to socio-economic and technical change in three ways. First, in the classic theories of federalism, lower level governments are assumed to have an informational advantage in understanding and responding to varied subnational concerns. Second, competition between states for investment and skilled labour can create strong incentives for performance, and third, state-level authority allows for greater experimentation with new approaches and technologies. All of these mechanisms rely on sub-national governments having the ability to identify, analyse and respond to the socio-economic needs of their constituencies.

Metropolitan/Urban India may have as many as 70-80 or more cities with populations of more than one million by 2030. Their needs, and especially those of the six or seven 'megacities' that will be more populous and economically larger than many countries in the world, cannot be handled by national or even national-state collaboration. Unified Metropolitan Transport Authorities (UMTAs) with statutory authority, independent finances, and expert staff with access to relevant data need to be created quickly in India's largest cities, and over time, with State support, in the next tier of cities. The national government has required larger cities to develop transport plans as part of the terms for national funding of urban infrastructure policy and national policy urges cities and states to form integrated transport planning units, but the institutional basis for metropolitan transport investment, management, and regulation remains nascent. Effective integration of transport investment across modes and between infrastructure and its use requires regular access to the information and skills of an expert body, as well as a governance structure that motivates attention to regional needs and enables integration of transport

Our goal is governance that motivates all parts of the system to focus on increased mobility and freight capacity at the least possible economic and environmental cost.

with regional planning. We therefore join the High Power Expert Committee on Urban Infrastructure, numerous experts, and civil society in recommending full implementation of the 74th Amendment and creation of the metropolitan planning committees that it envisions. The UMTAs could ultimately be integrated with these metropolitan authorities. Two additional mechanisms could be formation of autonomous transport planning 'centres of excellence' undertaking education, research, and evidence-based advocacy in all cities of at least a million (see Volume III, Chapter 5 on Urban Transport). We also recommend allocating funding to support innovative experiments in 'passenger-facing' integration that reduce as many obstacles to multi-modal mobility as possible and thereby focus attention on the gaps in infrastructure and services. As in our recommendations for states, national funding to metropolitan agencies for urban transport should generally limit conditionalities to outcomes rather than approaches to urban transport.

However, all these initiatives will be empty shells unless India builds the human resource and organisational capacities to develop clear, feasible transport plans, implement them, and develop appropriate research strategies to monitor their progress. India must accelerate investment in training more transport planners and build systems for ongoing updating of skills. Human resource development must include not only an immediate push to fill the current gaps, but also a process for ongoing, continuous learning. India's transport planning institutions and their staff must be both motivated and able to experiment and learn from these efforts, adapt to new constraints, and take advantage of new technologies. Research that documents performance, identifies gaps, and develops solutions on an ongoing basis also plays a key part of sector governance. Such documentation and analysis of the relationships between public policies and outcomes is particularly important for coordinating efforts–and warning of undesirable side-effects of particular policies–in complex federal systems.

We conclude by summarising the institutional design rationale for the recommendations. Overall, the recommendations seek to reshape strategy, planning, and implementation across several dimensions: modes of transport investment, physical infrastructure and policies that affect the efficiency of use, and different national, regional, and local-scale systems. Our aim is to encourage governance that motivates all parts of the system to focus on the goal of increased mobility and freight capacity at the least possible economic and environmental cost. Projects and processes are a means, not an end.

DEFINING TRANSPORT SYSTEM GOVERNANCE

'Transport System Governance' is the combination of market, political, and administrative processes that define options for transport investment and use; prioritise among these options; implement the plans through law, regulation, community action and other means; and undertake research to measure the impacts of the transport investments and policies, and provide feedback for system improvement. The 'transport system' comprises various forms of physical infrastructure as well as the policies regulating access to and use of the facilities. Airports, container depots, ports, roads, rail, and inland waterways are part of the same network on which people and goods circulate; traffic laws, environmental regulation, competition regulation, and other policies create the incentives for investment in and operation of the airlines, buses, trucks, cars, ships, and trains that provide the flow. As 'governance,' it ideally includes various feedback loops: from market demand to investment, from political aggregation of preferences to policy choice, and from research to definition and evaluation of cost effective technology, policy, and investment options.

Any institutional strategy for transport governance must recognise that it is transport users' decentralised decision-making within the guidelines of policy and physical restrictions of infrastructure ultimately determine the extent and distribution of transport services available. Physical infrastructure and the policies governing its access and use create a framework for investment and location decisions as well as use of the network, but do not and cannot fully determine the quality of the system.

Government typically sets the terms of access to infrastructure in order to prevent monopolisation of fixed facilities (e.g. roads, railroad tracks, airports, ports) and to maintain incentives for service providers to minimise costs for high-quality service. It generally undertakes this role using a combination of three instruments: public sector development and management of fixed facilities; public-private partnerships with contractual provisions limiting the private partner's ability to restrict access to the facility; and regulation of private providers of fixed facilities. Maintaining competitive access to infrastructure facilities does not require public ownership, construction, or operation of infrastructure.

Governments also generally design and enforce safety regulations for services operating on the physical infrastructure (airlines, bus transport, etc). The market is unlikely to create sufficient incentives for safe operation, because passengers and freight users cannot readily observe many of the maintenance actions and technical decisions related to safety, nor is there likely to be sufficient competition to allow users to exercise choice to create market pressure for safety. This includes creating and enforcing norms for network use such as speed limits, and traffic rules–a classic coordination role (see Volume II, Chapter 12 on Safety).

Policy is important for ensuring that the transport system meets social goals such as environmental sustainability, energy efficiency, and social/economic inclusiveness. There is a range of instruments for achieving these goals, including direct siting and construction of physical infrastructure, subsidies for investments in physical infrastructure, subsidies to service providers, pricing policies, and specific purpose transfers to transport users, among others. Fiscal policies that affect the price of essential inputs for transport, such as fuel, may be designed for a variety of policy goals (such as revenue maximisation) but also affect the transport systems' impact through their influence on individuals' choices about forms of transport in which to invest.

While private investors have sited and built trunk infrastructure in the past (including, especially, railways in the 19th century, since access could be more readily controlled than for roads), governments typically undertake high-level design of the network as part of regional planning for economic development. While each of the components of a transport system could be built and operated privately (possibly under regulation to create competitive access), the public sector is more likely to internalise the externalities that each component creates for other parts of the system, the environment, and energy use. The government's roles in creating the physical network and regulating its use are intertwined, since both affect the potential flow rate of goods and passengers. Public sector institutions can also leverage their scale and relative consistency of structure to provide unique opportunities for accumulating knowledge, experience, and institutional memory over the long term.

The government's role in recognising and creating incentives to internalise externalities from transport investment is particularly important for urban infrastructure. There is a strong and long-lasting relationship between land use and transport as well as significant long-run environmental externalities of transport infrastructure when traffic densities are high. Freight and passenger links to surrounding regions determine the urban economy's contribution to national development. Transport also has social spillovers for equity, access to human-capital enhancing services (health and education), and labour market functioning. Gaps in the transport network can generate significant and long-lasting inequality by distorting firm location decisions and labour markets. Limited access to transport networks may motivate higher concentrations that may then be self-reinforcing, while congestion in economically vibrant areas may drive excessive dispersion. The government's role in providing finance for transport is especially important in rural areas where traffic and freight flows are not likely to be high enough to attract private investment.

Transport has strong social spillovers. Gaps in the trasnport network can generate significant and long-lasting inequality by distorting firm location decisions and labour markets.

Finally, much of the transport system's physical backbone is also publicly financed. Pure private investment would fall short of the optimal level of transport investment, given the positive externalities from transport development. Many parts of the transport system are also difficult to exclude people from, so would be difficult to finance based on user fees alone. Public finance, whether through broad taxes, carbon dioxide and fuel taxes, or other more focused benefit-linked means such as transport service taxes or user fees and land-based financing, is thus the only option.

In short, the public sector's role is to create an enabling environment for competitive public or private provision of energy-efficient, socially and economically inclusive mobility services.

The NTDPC is meant to provide a framework for institutional design and policy action. The market's role in transport system governance is in the background as a set of transactions and investment decisions that respond to policies that set the context for seeking profits and returns on investment.

Today's transport policy is important, particularly since the modal and spatial distribution of investment will affect the possibilities for freight and passenger flows for decades. However, tomorrow's policy is also important and India must begin to develop the institutional capacity to make these decisions without resorting to unusual arrangements such as the NTDPC. India's transport system will affect and be affected by a various 'known unknowns' in the coming decades:

- Variation over time and across regions in economic growth, driven by exogenous shocks (e.g. monsoon variability) and endogenous but spatially varying factors (e.g. state-level reforms).
- Urbanisation that could be concentrated in concentric rings around existing major metros or could agglomerate across a number of

Any institutional strategy for transport governance must recognise that transport users' decentralised decicion making within policy guidelines and physical restrictions of infrastructure ultimately determine the extent and distribution of transport services available

smaller urban areas. Transport investments will play a large role in shaping these patterns, but also have to anticipate and respond to the shifts.

- Electricity requirements and the means by which they are met: patterns of investment in transmission and generation that affect requirements for fuel transport, energy pricing and fuel choice (see Volume II, Chapter 8 on Transportation of Energy Commodities).
- Global energy prices and fiscal policy choices that in turn affect choices about shipping and mobility.
- Technology change that alters costs of transport at various scales, energy requirements for transport, and/or dematerialises communication (e.g. substituting video/voice for mobility; data transmission and decentralised production for freight shipping).

Our emphasis on the institutional system is distinct from the more common approach of stating a policy goal. The Urban Transport Working Group of the NTDPC, for example, argues that India's urban transport planning must move toward an overall approach of 'Comprehensive Mobility Planning,' aiming to increase accessibility ('the ability to reach desired goods, services and activities') rather than simply increase mobility and manage traffic. The planning regime should be capable of designing and implementing programmes to 'Avoid' (reduce demand for trips through IT investment, land use planning, and other means); 'Shift' (shift mobility from personal vehicles to more energy and space-efficient public and non-motorised transport); and 'Improve' (increase fuel efficiency, reduce emissions) in addition to the traditional functions of planning, siting, constructing, and maintaining urban transport infrastructure. These goals are hard to argue with, but the challenge is how to encode these systemic goals in specific departments' operational, tactical decision-making for the next decades, in ways that allow decision-makers to adjust the means of meeting them to administrative capacity, budget constraints, technology opportunities, demographic change, new information on environmental and social impacts as more data on these points emerge, and other local factors.

SUMMARY

India's transport system will affect and be affected by various 'known unknowns' in the coming decades, including variation over time and across regions in economic growth, urbanisation, energy use and energy markets, and technology change. 'Transport system governance' is the combination of market, political, and administrative processes that will enable the country to respond to these changes. The 'transport system' comprises various forms of physical infrastructure as well as the policies regulating access to and use of the facilities. As 'governance,' it ideally includes various feedback loops: from market demand to investment, from political aggregation of preferences to policy choice, and from research to definition and evaluation of cost effective technology, policy, and investment options. Any institutional strategy for transport governance must recognise that transport users' decentralised decision making within the guidelines of policy and physical restrictions of infrastructure ultimately determine the extent and distribution of transport services available.

The NTDPC is meant to provide this framework for institutional design and policy action. Policy is important for ensuring that the transport system meets social goals such as environmental sustainability, energy efficiency, and social/economic inclusiveness. The government typically sets the terms of access to infrastructure in order to prevent monopolisation of fixed facilities (e.g. roads, railroad tracks, airports, ports) and to maintain incentives for service providers to minimise costs for high quality service. Governments also generally design and enforce safety regulation for services operating on the physical infrastructure (airlines, bus transport, etc), including creating and enforcing norms for network use such as speed limits, and traffic rules–a classic coordination role. Finally, much of the transport system's physical backbone is also publicly financed. There is a range of instruments for achieving these goals: including direct siting and construction of physical infrastructure, subsidies for investments in physical infrastructure, subsidies to service providers, pricing policies, and specific purpose transfers to transport users, among others. Our emphasis on institutional design is distinct from the more common approach of stating a policy goal.

TRANSPORT SYSTEM GOVERNANCE IN INDIA: 2012

India's transport policy environment is fragmented between modes and level of government, with infrastructure investment planning, policy-making, regulatory oversight (to the extent that it exists), and financing strategies scattered across and within levels of government. The

Figure 5.1

Institutional Arrangement in Central Government

PARLIAMENT

Prime Minister and Central Cabinet

Committee on Infrastructure (under Secretariat of Planning Commission)

Program Planning	Prime Minister and Central Cabinet			Committee on Infrastructure (under Secretariat of Planning Commission)	
Nature of Assets Infra-Structure	National Highways	Ports	Railways	Inland Waterways	Civil Aviation/ Airports
Line Ministry/ Department	Ministry of Road Transport & Highways	Ministry of Shipping	Ministry of Railways	Ministry of Shipping	Ministry of Civil Aviation
Executing/ Implementing Agency	National Highways Authority of India (NHAI)	Major Port Trusts	Indian Railways and RVNL/CONCOR	Inland Waterways Authority of India	Airport Authority of India
Principal Governing Legislation	National Highways Act of 1956 and National Highways Authority of India Act of 1988	Indian Ports Act of 1908 and Major Port Trusts Act of 1963	Indian Railways Act, 1989	Inland Waterways Authority of India Act of 1985	Airport Authority of India Act of 1994
General financing Instruments	Central Road Fund, Tolls, Budgetary support, Market borrowings, Multilateral loans, PPP	Budgetary support, Internal accruals, PPP, Market borrowings, Loans from Govt of India	Internal Accruals, Budgetary support from Govt of India, IRFC borrowings, PPP, Multilateral loans	Budgetary support from Government of India, Domestic loans, Multilateral loans	Budgetary support from Govt of India, PPP, Market borrowings, Internal accruals

Notes: CONCOR=Container Corporation of India; IRFC=Indian Railways Finance Corporation; PPP=Public Private Partnership.

country is unique in having separate national ministries for each mode of transport. India's intergovernmental division of responsibilities is somewhat more centralised than in other geographically large federations, and the country lacks the governance infrastructure for intergovernmental coordination around the points where the pieces of the transport system link together. It also has an unusually complex urban policy environment, with limited metropolitan-level fiscal or administrative powers to coordinate transport infrastructure or policy in denser areas.

This arrangement handicaps intermodal planning and execution at all levels of government. Fragmentation has not led to obviously redundant investment, given the general need for more transport capacity across India, but it has led to system inefficiency. Ports do not always have infrastructure for evacuation of goods; rail networks do not link with road networks for last-mile delivery of goods; bus and metro systems in urban areas do not always exchange people. Highways built by one level of government are not always linked to district roads built and maintained by another. The lack of an insti1utionalised arena or even professional context for examining the interaction between investment and maintenance of the physical infrastructure; regulation of access; and policies affecting operators in shaping the supply of transport options also dulls the system's incentives and ability to respond to demand.

OVERVIEW

Annex 5.1 summarises the country's transport policy oversight across levels of government, focusing on the agencies involved in investment and operations of transport.

Figure 5.1 is a snapshot of the national government agencies involved in India's transport governance. The degree of fragmentation has evolved and generally increased over time. Oversight of rail and ports, at the time the major modes of transport, were initially combined under the Department of War Transport, carved out of the Department of Communications in 1942. Road planning was initially left

India's transport policy environment is fragmented, with infrastructure planning, policy making, and financing stragies scattered across and within levels of government

to another descendant of the Department of Communications, the Department of Posts and Air, but assigned to the Department of War Transport in 1944 'in view of the imperative need for close coordination of effort between the authorities concerned with Railway Development and those concerned with the development road communications and transport.'[5] The Ministry of Railways was carved out of the Department of War Transport soon after Independence, in 1951, in accordance with Section 27-A of the Indian Railways Act. The remainder of the Department became the Ministry of Transport & Communications, and some transport-related functions under other ministries (such as Maritime Shipping & Navigation under Commerce) were assigned to this ministry. Assignment of responsibility to departments was reorganised again in 1966, under a renamed but still integrated Ministry of Transport and Aviation.

Two Ministries (Rail and Transport) became three in 1967 when the Ministry of Transport and Aviation was bifurcated into the Ministry of Shipping and Transport and the Ministry of Tourism and Civil Aviation. There was a brief re-consolidation in 1985, with the creation of a new Ministry of Transport with the Ministry of Shipping and Transport absorbed as a Department, but this Department (Surface Transport) became a Ministry again in 1986. The Ministry of Surface Transport was later divided into two Ministries: Shipping, and Road Transport and Highways in 2000. These were merged in 2004 to be two departments of a single Ministry of Shipping, Road Transport, and HIghways, but subsequently re-divided and currently stand as a Ministry of Shipping with responsibility for Ports and a Ministry of Road Transport and Highways.

The Planning Commission's Transport Division (PCTD) currently functions as the main coordinating body on transport investment as part of its efforts to combine State Plan requests, the broad Plan vision as well as the recommendations of sector working groups and Mid-Year Reviews. Transport infrastructure investment, particularly decisions on programmatic approaches or financially large projects is also a subset of the work overseen by the Planning Commission Secretariat on Infrastructure and the Cabinet Committee on Infrastructure.

The Transport Division's stated mandate[6] includes:

- Addressing policy issues concerning railways, roads, road transport, shipping, ports, inland water transport and civil aviation for improving efficiency and making these sectors more responsive to the present and future requirements of the country.
- Addressing intermodal issues for improving coordination among different transport sectors and ensuring that each sector works according to its comparative advantage and efficiency.
- Organising Quarterly Performance Review Meetings for different transport sectors to monitor progress of transport sector projects according to Plan priorities and targets.
- Carrying out zero-based budgeting in consultation with various transport sector ministries to improve efficiency and utilisation of resources according to Plan priorities and objectives.
- Work relating to Parliamentary Committees for different transport sectors.
- Examining Five Year and Annual Plan proposals received from the states, Union Territories and North Eastern Council in respect of transport sectors.
- Discussions with the representatives of the state governments and Union Territories to review physical targets, programmes and outlays of Five Year and Annual Plans of states and Union Territories.
- Examining the proposals of state governments for provision of Additional Central Assistance.
- Participation in various workshops and seminars relating to the transport sector.
- Formulation, appraisal and monitoring of Five Year and Annual Plans.
- Mid-term review of Five Year Plans.
- Providing inputs for the Working Group Reports on the various transport sectors; preparing Steering Committee Report on Transport Sector.

The first two lines of the mandate imply long-range intermodal planning, but several practical features of the PCTD's context complicate the execution of this task. First, the Planning Commission's larger mandate focuses on capital investment. The policy frameworks for optimising use of the facilities are outside its purview, overseen by ministries, affected by fiscal policy, and enforced by regulatory bodies to the extent that they exist. Maintenance is under ministries' or state agencies non-Plan budgets. Second, most of the Planning Commission's work revolves around a five-year cycle for the Plan. Within this context, there is limited scope for gathering the data or building the technical team for longer-run projections and visioning.

5. As documented in the Organisational History of the Ministry of Shipping listed on its website: http://shipping.nic.in/index1.php?lang=1&level=1&sublinkid=42&lid=52, accessed February 13, 2013.
6. According to http://planningcommission.nic.in/sectors/index.php?sectors=infra, last accessed October 1, 2012.

Third, transport-related ministries (Annex 5.3) have significant scope to define their own policies for the modes of transport that they oversee, whether at the request of the Planning Commission or as independent initiatives. The Planning Commission delegated the first concerted study of urban transport, for example, to the Railways Ministry in the 1960s. The resulting report focused on rail-based solutions. The Ministry of Urban Development, which became the line ministry for urban transport in 1986 after the cabinet changed the Allocation of Business Rules, oversaw the most recent National Urban Transport Policy. It also drafted the Model Urban Transport Act for states. Jurisdictional disputes between the Ministry of Rail and Ministry of Urban Development, such as debates over specifications for the Delhi Metro, were resolved by a Group of Ministers and a Cabinet decision.

Similarly, the Ministry of Civil Aviation plays an important role in determining the location and capacity development of India's airports through the Airports Authority of India (AAI). The Ministry can and does dispute Planning Commission Infrastructure Division initiatives, for example in the case of proposed privatisation of Chennai and Kolkata airports. The Ministry of Shipping, under the rules of business, has responsibility for 'legislation and coordination of development of major and minor ports', as well as inland waterways and shipping policies. It also 'formulates the privatisation policy in the infrastructure areas of ports, shipping, and inland waterways'[7], and developed the Maritime Agenda 2010-20 as a statement of longer-run priorities. The Ministry of Road Transport and Highways (MoRTH) claims authority for 'planning, development and maintenance of National Highways in the country,' part of which has been delegated to the National Highways Authority of India (NHAI) established by a separate Act of Parliament in 1988 (operationalised in 1995).

Transportation planning on a regional (multi-state) scale currently takes place through ad hoc coordination between national ministries focused on particular modes of transport, and state level transport-related departments focused on the areas where their jurisdiction and the transport corridors overlap.

STATE AND LOCAL GOVERNMENTS

State governments play a larger role in constructing, maintaining, and regulating the road transport system and some ports than in other transport sectors. They are responsible for establishing the site, constructing, and maintaining roads other than the National Highways. The central government, however, has an important de facto role in state road planning through the Ministry of Road Transport and Highways' responsibility to 'extend technical and financial support to state governments for the development of state roads and roads of inter-state connectivity and economic importance.'[8]

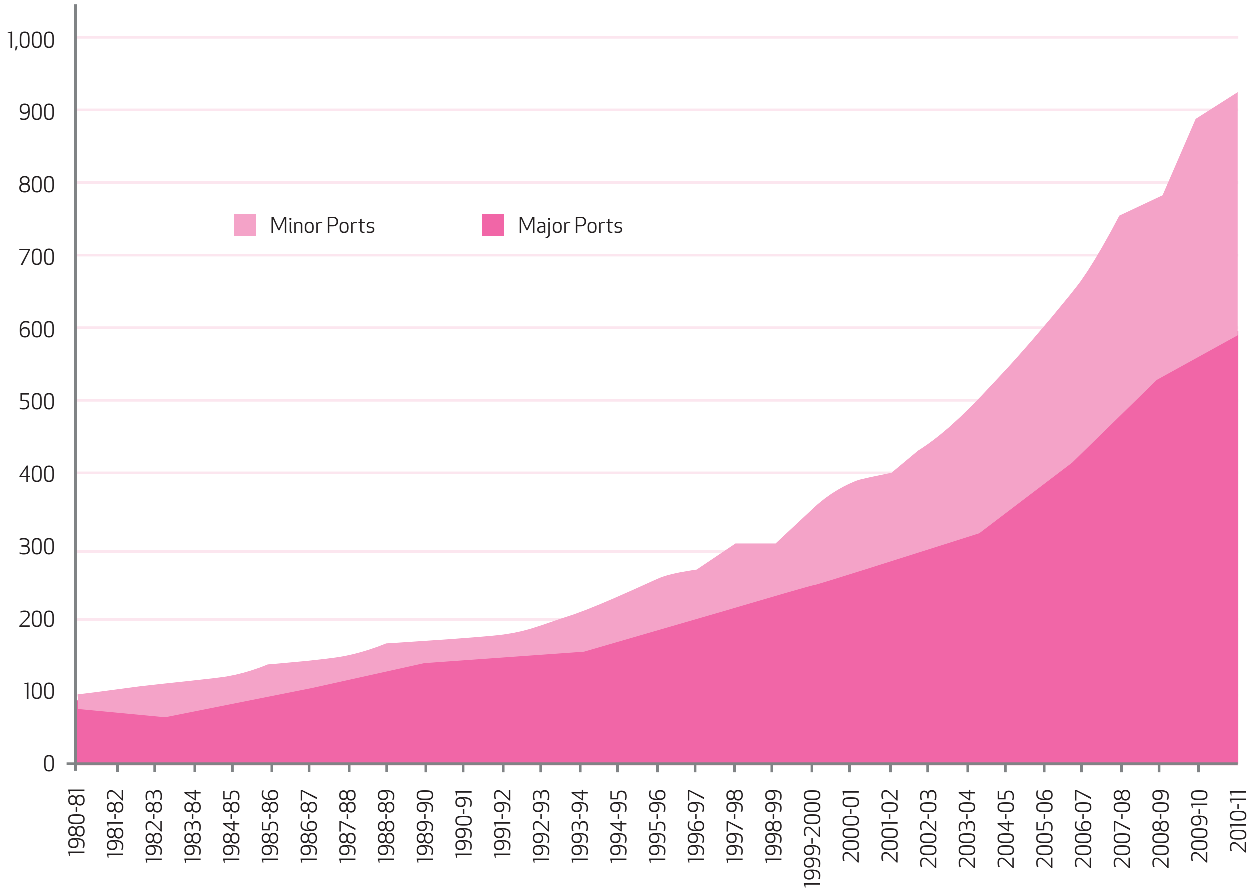
> India is unique in having separate ministries for each transport mode. It lacks the governance infrastructure for intergovernmental coordination around points where pieces of the transport system link together

State-level division of responsibility across different tiers of roads (rural, major district roads, highways), policy and implementation, sources of finance (public, private, intergovernmental transfer), and links between the agencies overseeing roads policies and those involved in land, buildings, or other infrastructure also vary. Punjab, for example, separates road planning from construction and maintenance, but does not have separate agencies for rural and district roads/highways. The state has a separate Roads and Bridges Development Board (RBDB) in addition to the Public Works Department. The two are closely linked--the RBDB is chaired by the Minister of Public Works and has the Secretary Public Works as Member Secretary--but the RBDB was established as a separate entity in 1998. It acts as 'a nodal agency to plan, and monitor all aspects relating to construction and improvement of roads and bridges in the state. This Board is responsible for planning and deployment of funds on state roads, fiscal management, project management, interdepartmental coordination and the other key areas.'[9] It is the nodal agency for rural roads under the Prime Minister's Rural Roads programme (PMGSY). The Public Works Department (PWD), on the other hand, is the 'premier agency of the state government for construction, upgradation and maintenance of roads, buildings and bridges in the state.'[10] In Andhra Pradesh, oversight over roads is divided between the Department of Transport, Roads and Buildings (secondary roads) and the Department of Panchayati Raj and Rural Development (rural roads). Within the Department of Transport, Roads, and Buildings, the Roads Development Corporation oversees higher-traffic and privately financed roads. Many of the northeastern states have a single public works department.

The individuals staffing these various entities generally come from the same pool of officers on transfer, however, and thus are likely to have similar attitudes, training, and levels of knowledge on international and national experience in transport. This may improve inter-agency coordination, but it detracts from the ability to pursue specialised goals. As discussed in subsequent sections, it will be important

7. Rules of business as recorded at http://shipping.gov.in/index1.php?lang=1&level=1&sublinkid=43&lid=53, accessed February 17, 2013.
8. Website of the Ministry of Road Transport and Highways
9. http://www.prbdb.gov.in/aboutus.htm
10. http://pwdpunjab.gov.in/

Figure 5. 2
Port Traffic
[Million Tonnes]



Source: Ministry of Shipping, Government of India, http://shipping.gov.in/
ICRA Rating Services - http://www.icra.in/Files/ticker/Indian%20Port%20Sector_Final_26Sep11.pdf

to develop a larger permanent professional staff in relevant state agencies.

The within-state division of authority for the second-tier roads appears to be in part a side effect of the response to new challenges of collaboration with the private sector in infrastructure development: state highway authorities were created to develop, implement, and maintain some sets of highways using private funding, while publicly funded roads remained with the public works or rural development departments. The 2004 enabling Act for Uttar Pradesh's Highway Authority, for example, divides jurisdiction by source of finance rather than road function: '19- (1) Subject to the rules made under this Act, it shall be the function of the Authority to develop, maintain and manage the state highways and any other highways vested in, or entrusted to it, by the state government in the manner that the authority becomes largely independent of government funding for the maintenance of the highways within three years from the date it is set up.'[11]

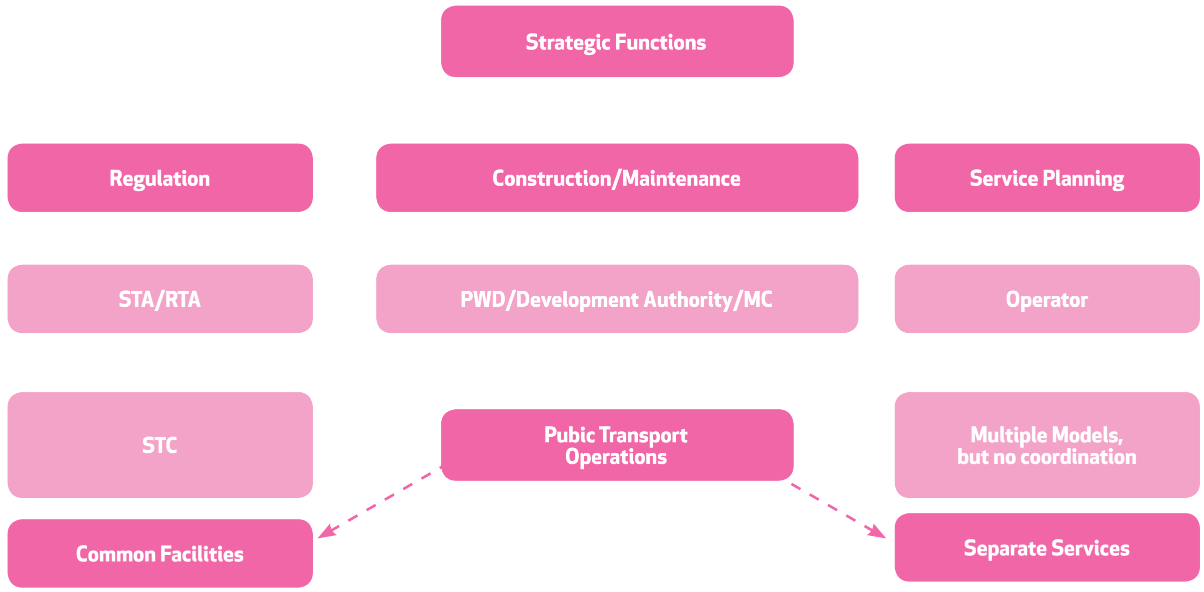
State Regional Transport Offices (RTOs) also issue licenses for private and commercial vehicles, including the common 'All India Permit' valid in states other than the place of issue. State Pollution Control Boards enforce the regionally varied emissions standards set by the national policy for vehicles.

The maritime states have also played a significant role in the development of India's overall port capacity through their investments in and policies toward minor ports. As Figure 5.2 shows, minor ports have accounted for an increasing fraction of India's port traffic over recent years, in part because these ports have been able to engage the private sector in various ways, including allowing the development of captive ports. States have also used their authority over tariffs at minor ports to attract both investment and business, with discounts for larger customers and tariff rates that attract private investment. Dubai Ports World, for example, began looking at larger investments in minor ports after the Tariff Authority for Major Ports reduced the national ports' tariffs to the point that operators started to lose money.

States' direct role in capital-intensive transport investments such as airports or large urban transport systems tends to be limited to being a minority partner with the national government and private

11. http://www.upsha.in/act.htm

Figure 5. 3
Institutional Structure for Transport in Indian Cities



Notes: STA: State Transport Authority
RTA: Regional Transport Authority
PWD: Public Works Department
Dev. Auth.: Development Authorities
MC: Municipal Corporations
STC: State Trading Corporation.

investors in joint ventures. State governments can propose airports, but they cannot independently develop these without central government permission. Their main influence is reactive, in their control over land acquisition for the projects and thus the location and pace of these projects. 'Airways aircraft and air navigation; provision of aerodromes; regulation and organisation of air traffic, and of aerodromes; provision for aeronautical education and training and regulation of such education and training provided by states and other agencies' is constitutionally a Union subject in India.

States have little formal influence on railway investment or operations. Connections between state-led transport systems (such as urban public transport) and airports are determined case by case. Indian Railways is divided into zones for investment planning, but these coincide with neither administrative regions (state or metropolitan) nor economic catchment areas relevant for transport system planning.

Rural local governments' role in transport is currently limited to contributions to the district rural roads plans and responsibility for maintenance of some rural roads. Both planning and maintenance are done under the oversight of a District Project Implementation Unit that reports to the state government. Working Groups on Rural Roads for the 11th and 12th Plans have proposed more extensive involvement of panchayat governments, although the Working Group for the 12th Plan notes, 'The objective of transferring full responsibilities for management of the rural roads network to PRIs [panchayati raj institutions] in most states is a long-term objective.'

URBAN TRANSPORT

'The present institutional framework to manage urban transport is quite fragmented and the responsibility is diffused. At the city level, several agencies are involved in the management of various components of urban transport. At the state level, urban transport is managed either by the Urban Development Department or by the Transport Ministry. At the Central Government level, urban transport is being managed by three Ministries, i.e. Urban Development, Railways and the Road transport and Highways. Laying down standards and norms for items such as roads is being done by the Indian Roads Congress.'(67) (NTDPC, Working Group On Urban Transport, 2012)

Urban transport planning is a 'constitutional and institutional orphan' according to the Report of the Working Group on Urban Transport (NTDPC, 2012). It takes place as a collective but not necessarily collaborative effort between national, state, and, to a lesser extent, city government agencies. The specific constellation of agencies involved in urban transport planning varies between states due to their role in defining the financial and human resources of local government institutions, and within states by city size. Figure 5.3 summarises the typical division of responsibilities: the state government plays a dominant role in regulation, state and local government share responsibility for road investment planning and implementation, and the local government undertakes maintenance. Public transport services are operated by a mix of state corporations (primarily focused on inter-city transport), municipal transport corporations (intra-city), and private providers of cabs, rickshaws, and mini-buses.

Transport governance for larger cities (million-plus) is more complex, in part due to the scale of operations but also because it often includes rail-based intra-city transport that national and state agencies are typically involved in.

Recent initiatives to encourage more integrated transport planning in India's larger cities expose the significant gaps in capacity to leverage urban transport for metropolitan development.

The Jawaharlal Nehru National Urban Renewal Mission (JNNURM) required all eligible cities[12] to create comprehensive mobility plans (CMPs) in order to access funding under the programme. These generated some attention to integrating transport planning and the funding does appear to have created an impetus and opportunity for strategy documents such as the Karnataka Urban Infrastructure Development and Finance Corporation (KUIDFC)'s Comprehensive Traffic and Transport Plan.

TERI's (2011) review of Comprehensive Mobility Plans (CMPs)[13] finds that the CMPs generally were not integrated with other city plans such as the Master Plan, and that the links between broad goals (if articulated) and specific projects were not made. Most of the CMPs mentioned the need for some kind of apex body, but did not mention details about how these would be formed. The Association of Municipalities and Development Authorities offered a similar critique in a 2010 review of the 35 CMPs then completed or underway. Chotani (2010) noted various gaps in the CMPs: lack of attention to mixed land use, slum and informal settlements and mobility needs, inattention to broad changes in city structure and links to the urban periphery, and lack of elaboration on legal and administrative issues in implementation. The report also noted that costing and funding were 'not on a rational approach,' cost benefit analyses were rare, and that road-widening projects were typically at the cost of space for pedestrians.[14]

Hidalgo et al (2011)'s interviews with '28 urban transport and planning experts in India, including Central, State and Municipal government officials, civil service officials, consultants, academics and representatives of NGOs'[15] found that some cities had gained new insight into transport planning and started to shift their thinking in line with moving people not vehicles. However, the authors' review of CMPs found that they were more often a list of projects rather than a plan based on a coherent strategy or enabling monitoring of the strategy. Municipalities did engage consultants and officials in preparing plans according to the guidelines released by the Union government, making an enormous quantity of data available and highlighting interaction of transport and land use planning. However, the preparation of CMPs was rushed, funding for advancing them very limited, the data collected were generally not managed for subsequent updating and use in ongoing decision-making. The paper also argued that many CMPs involved inadequate consultation in the rush to list projects for funding.

In a separate initiative, the Ministry of Urban Development's National Urban Transport Policy (2006) recommended that each city of more than a million residents form an Urban Metropolitan Transport Authority (UMTA). Only a few cities acted on the recommendation, and even then the UMTAs operate more like committees than planning secretariats. They are the equivalent of the National Development Committee without the kind of technical secretariat that the Planning Commission provides and its ability to generate options for consideration.

As of the 2011 Census, there are 53 cities of that size, but there are only 8-10 UMTAs existing in any form. There are six UMTAs/UMTA-like entities as of 2011, according to Agarwal and Chauhan (2011)[16]:

- The Greater Guwahati Transport Coordination Committee, set up in 1999 under the Chief Secretary.
- Delhi Transport Planning Group set up in 2001 under the Chief Minister. The Unified Traffic and Transportation Infrastructure Planning & Engineering Centre (UTTIPEC), set up in 2008 as part of the Delhi Development Authority (DDA), appears to have taken over UMTA-like responsibilities. Agarwal and Chauhan (2011) report that another statutory UMTA was under consideration as of 2011.
- Hyderabad UMTA set up in 2008 as part of the HMDA act. It includes the Chief Secretary as chairman, two transport experts, and heads of all transport agencies.
- Bangalore Metro Land Transport Authority, set up in 2007, discussed below
- Unified Mumbai Metropolitan Transport Authority, set up in 2008.
- Chennai UMTA, set up in December 2010 .[17]

Media reports indicate that discussions about formation of UMTAs are underway in Pune and Kochi, though the timeframe for implementation is not clear. Pimpri-Chinchwad, Raipur, Indore, and Mysore are also participating in the Sustainable Urban Trans-

12. 68 larger cities, state capitals, and others of historical/tourist/other importance.
13. TERI (2011)
14. M.L. Chotani (2010).
15. Hidalgo, , Pai, , Carrigan, , Bhatt, , and Owen (2011).
16. Agarwal, O.P., and Ishita Chauhan (2011).
17. The Act is available at http://www.thehindu.com/multimedia/archive/00287/Chennai_Unified_Met_287799a.pdf

Box 5.1
International Support for Integrated Urban Transport: Sustainable Urban Transport Project

The Government of India (GoI), in association with the Global Environment Facility (GEF), World Bank and United Nations Development Program (UNDP), initiated the Sustainable Urban Transport Project (SUTP) project in June 2007. The programme was started with the aim of developing integrated and comprehensive institutional and capacity development initiatives at the national, state and local government levels. The two main objectives of SUTP are:

- Strengthening capacity of GOI, Institute of Urban Transport (IUT), and participating states and cities in planning, financing, implementing, operating and managing sustainable urban transport systems;
- Assisting states and cities in preparing and implementing demonstration 'Green Transport' projects.

The project is being implemented by Ministry of Urban Development (MoUD), Government of India, through a Project Management Unit (PMU) at the national level. Project activities are under the overall guidance of a Steering Committee, under the chairmanship of Secretary Urban Development.[18]

SUTP implementation started in 2010, and is spread over four years and the project has three main components:

National Capacity Development Initiatives The primary objective of this component is to explore options and carry out preparatory work towards establishing and institutionalising the National Urban Transport Policy (NUTP). UNDP is directly supporting this component and the MoUD is tasked with implementation.[19]

Demonstration Projects The aim here is to implement demonstration projects in selected cities. These projects will then be sustainable transport solution-based models for other cities to replicate. The projects focus on four themes:

- Public transport development
- Non-motorised transport development
- Intelligent Transport System (ITS)
- Integrated land use, transport planning and Transit-Oriented Development (TOD).

The World Bank started with an initial list of about 30 cities, and narrowed this down to four demonstration cities: Pune and Pimpri-Chinchwad (Maharashtra), Naya Raipur (Chhattisgarh), Indore (Madhya Pradesh), and Mysore (Karnataka).[20] The World Bank supports this component. The MoUD and participating states and cities are tasked with jointly implementing these projects.[21]

Project Management This component aims to provide technical assistance to the MoUD to strengthen its project management capabilities and enable it to successfully manage the implementation of SUTP.

Role of State Governments The participating state governments, through their designated Implementing Agencies (PIAs), are responsible for implementation of their city demonstration projects. Each PIA has a Project Implementation Unit (PIU), which is led by a full-time project manager. The manager is responsible for day-to-day project implementation activities such as procurement, financial management, social and environmental management, as well as monitoring and evaluation.

port Project (SUTP) jointly funded by Government of India and the Global Environment Facility (GEF), which includes formation of a UMTA as part of the set of activities for 'pilot cities.' (Box 5.1).

Available information suggests that even the older UMTAs are in the early stages of institutional development. According to Agarwal and Chauhan (2011), the Guwahati initiative held one meeting and the orig-

18. https://www.pcmcindia.gov.in/sutp/
19. http://www.nayaraipur.com/SUTP/Pages/SUTP.aspx
20. http://www.dnaindia.com/bangalore/report_transport-mysore-makes-a-smart-move_1588173
21. http://www.nayaraipur.com/SUTP/Pages/SUTP.aspx

Urban transport planning remains fairly insulated from urban residents' inputs. Local economic and political stakeholders have neither a clear voice with which to share information, nor to advocate solutions

inal Delhi Transport Planning Group never met. Both were established by executive order, but did not gain traction once their political champions were moved. Mumbai's MTA was also created by executive order, but meets more regularly. The Hyderabad UMTA is reportedly the strongest: it has the power to approve projects and the Chief Secretary plays an active role in convening the various stakeholders. (More specific details of transport planning in Bangalore, Mumbai, and Chennai are discussed in Annexes to Volume III, Chapter 5, on Urban Transport).

State and urban governments appear to be creating, for the most part, committees or committee-like structures in their efforts to integrate transport planning across the many stakeholder agencies and departments. These committees may improve information flow and interagency negotiation, but do not address the deep need for the technical capacity required to evaluate technology options, assess and compare likely impacts of collections of projects, and otherwise generate integrated policy and investment packages to meet urban and regional development goals. Committees are also by definition evolving organisations with limited investment in maintaining knowledge bases or documenting organisational learning. They are no substitute for an organisation with a standing professional staff as well as a core, spatially referenced database on urban development.

Metropolitan planning, the backdrop for integrating transport investments for regional development, is similarly underdeveloped. Four of the 18 states with urban areas that should, according to the Constitution, have Metropolitan Planning Commissions[22] (MPCs) to integrate land use planning, regional development, and infrastructure among other tasks, do not have enabling legislation. Most of the enabled MPCs have not actually been set up.[23] No state has provided its MPCs with adequate sovereign authority to actually consolidate the draft development plan of the metropolitan areas and some of the statutes still contradict the 74th Amendment Act. (Planning Commission, 2011)

The state of urban transport planning varies across cities in India, but there are some common features. India's urban governance currently has fragmented authority, limited institutional support and capacity for creating a transport system that can be leveraged for urban planning, environment, and social goals (including, in particular, limited scope for coordination between land use planning and transport system development), and lack of channels for broad input from local citizens and businesses.

Transport planning and efforts to meet environmental goals are often disconnected. Some cities have implemented emission reduction plans by court order (e.g. Delhi's switch to CNG), and all have a formal legal framework for setting air quality norms and enforcing vehicle emissions standards. However, the level of actual enforcement varies, and there is no institutional mechanism for building environmental targets into broader plans for transport investment. Even if all fuel and vehicle-related norms were fully enforced, the fact of traffic and idling would continue to lead to higher than necessary emissions.

Transport development agencies do not currently face direct pressures to ensure that their investments reduce traffic sufficiently to meet air quality norms. Some cooperation occurs: for instance, the Karnataka State Transport Department has agreed to work with the Karnataka State Pollution Control Board (KSPCB) to use IT to track vehicle emissions and identify offenders so that fuel and engine norms can be enforced. However, there are no similar pacts to invest in comprehensive traffic management in the state. The Karnataka Traffic Police and the Karnataka Road Development Corporation (KRDC) have joined forces in the Bangalore Traffic Improvement Project (B-TRAC 2010), but the systems that the KRDC will implement are more concerned with managing the existing vehicles on the roads than substituting public transport for private vehicles or planning land use to reduce the need to move to obtain what one wants.

Finally, urban transport planning generally remains fairly insulated from urban residents' inputs. The ongoing efforts to integrate urban transport planning are driven in large part by state initiatives, where decision making is politically removed from the concerns of particular cities. Local political and economic stakeholders, who may have strong incentives to direct investment into transport infrastructure that supports their cities' integration with the region as well as efficient mobility within the city, have neither a clear voice with which to share information on mobility needs or advocate particular solutions. State governments may very well choose integration-enhancing infrastructure in the interests of the regional or state economy, but there is little scope for businesses or citizens' knowledge of the economy and its potential to be formally considered. There is also no forum to balance varying constituencies' preferences over investment in mobility and

22 'Metropolitan area means an area having a population of a million or more, comprised in one or more districts and consisting of two or more municipalities or panchayats or other contiguous area, specified by the Governor by public notification to be Metropolitan Area for the purposes of this Part'
23 Sivaramakrishnan, K.C., and Arundhati Maiti (2009). Updated by web search by MJ Vishnu, Research at IIHS.

The 74th Constitutional Amendment strengthened municipal governments in principle, but states have been slow to devolve the personnel, resources and powers to cities

goods transport. Debates over the prioritisation of investment in an expressway or an expansion of rail or bus-based urban transport, for example, happen in editorial pages if at all.

Unresolved inter-governmental allocation of powers over land use planning and urban administration affects the prospects for coordinated thinking about land use and infrastructure development. This is the case across India. The ongoing discussion about allocation of planning authority between the Bangalore Development Agency and the Bruhat Bengaluru Mahanagara Palike (BBMP) is a high-profile example of the unresolved institutional framework for urban planning in general, but it is not unique.[24] Planning Commission (2011) spells out the national impediments to 'urban strategic planning': urban planning without attention to regional development and the urban periphery, 'rigid master planning' that is not integrated with spatial planning including transportation and land use planning, utopian plans without basis in financial and operational realities, 'inadequate institutional clarity,' and lack of capacity and enabling tools such as GIS and GIS-enabled management information systems.

To some extent this fragmentation is a natural consequence of ad hoc efforts to invest in urban transport in the absence of a clear institutional 'home' as well as the rapid pace of some cities' growth and need to accommodate larger flows of goods and people. As we discuss below, it is also not unusual in comparative perspective.

This collectivity of institutions is expected to absorb and allocate up to Rs 1 trillion per year for the next 20 years in the service of urban India's circulatory system.[26] Questions about which levels of government (if any) will raise, direct, disburse, and use these resources are still open in political and bureaucratic terms. The 1992 74th Constitutional Amendment strengthened municipal governments in principle, but states have been slow to devolve the personnel, resources, and powers for urban planning, finance, infrastructure development, and other city administration to cities.

India's challenge will be to selectively improve policy coordination in order to address impacts that are necessarily interrelated through technology or individual decision-making. Land development choices and mobility needs, for example, are linked through peoples' living and working patterns–policy management can take place in silos, but one cannot help but affect the other. Most transport technologies produce emissions that damage health, agricultural yields, and affect the climate. Environmental policy and transport investment can ignore each other, but they cannot avoid affecting each other. As we discuss later, urban transport governance should recognise, address, and shape these relationships. It should not, however, substitute monolithic bureaucratised bottlenecks for the present fragmentation.

SUMMARY

The subsections discuss the role and responsibilities of various levels of government. National government agencies include the Prime Minister and Cabinet, the Planning Commission, as well as 5 Ministries, one for each mode of transport, and their sub-agencies. The Planning Commission's Transport Division (PCTD) currently functions as the main coordinating body on transport investment as part of its efforts to combine State Plan requests, the broad Plan vision as well as the recommendations of sector working groups and Mid-Year Reviews. Transport infrastructure investment, particularly decisions on programmatic approaches or financially large projects is also a subset of the work overseen by the Planning Commission Secretariat on Infrastructure and the Cabinet Committee on Infrastructure. Mode-specific industries oversee investment programmes and policy for the modes under their jurisdiction.

The Planning Commission is formally charged with undertaking long-range intermodal planning, but there is not currently any entity undertaking these exercises with data and required expertise. The policy frameworks for optimising use of the facilities are overseen by Ministries, affected by fiscal policy, and enforced by regulatory bodies to the extent that they exist. Maintenance is under Ministries' or state agencies non-Plan budgets. Second, most of the Planning Commission's work revolves around a five-year cycle for the Plan. Within this context, there is limited scope for gathering the data or building the technical team for longer-run projections and visioning. Transportation planning on a regional (multi-state) scale currently takes place through ad hoc coordination between national Ministries focused on particular modes of transport, and state level transport related departments focused on the areas where their jurisdiction and the transport corridors overlap.

24. The Bangalore Development Agency (BDA) is responsible for planning under the current statutory provisions of the State Act on Planning and related laws. However, this goes against the premise of the 74th Constitutional Amendment Act that suggests that these functions be vested with the urban local body, BBMP in this case. While both BBMP and BDA come under the umbrella of the Urban Development Department (UDD), Government of Karnataka, the BDA is currently dominant. As a para-statal, it is not answerable to BBMP. BBMP, on the other hand, follows the Zoning Regulations and Land-use Plan prepared by BDA in according building plan and other such approvals. Public representation by civil society as well as PILs in the High Court have called for shifting more powers and responsibilities to the BBMP.
25. lack of capacity and enabling tools such as GIS and GIS-enabled management information systems
26. According to estimates from the MoUD, HPEC (2011).

In the roads sector, financing and project selection are not always linked. Road policy and investment is often a key tension point in intergovernmental relations

State governments play a larger role in constructing, maintaining, and regulating the road transport system and some ports than in other transport sectors. Their direct role in capital-intensive transport investments such as airports or large urban transport systems tends to be limited to being a minority partner with the national government and private investors in joint ventures. They have little formal influence on railway investment or operations. Connections between state-led transport systems (such as urban public transport) and airports are determined case by case. Indian Railways is divided into zones for investment planning, but these coincide with neither administrative regions (state or metropolitan) nor economic catchment areas relevant for transport system planning. Rural local governments' role in transport is currently limited to contributions to the district rural roads plans and responsibility for maintenance of some rural roads.

Urban transport planning is a 'constitutional and institutional orphan' according to the Report of the Working Group on Urban Transport (NTDPC, 2012). It takes place as a collective but not necessarily collaborative effort between national, state, and, to a lesser extent, city government agencies. The specific constellation of agencies involved in urban transport planning varies between states due to their role in defining the financial and human resources of local government institutions, and within states by city size.

COMPARATIVE PERSPECTIVE

The division of different transport modes between ministries at the national level stands in stark contrast to international practice. Nearly all of the 100 largest economies, all of the OECD countries, and all of India's emerging market 'peers', the BRICS countries, have a Ministry of Transport or similar integrated equivalent rather than the collection of mode-specific ministries found in India. Some of these consolidated national agencies are also combined with the Ministry (or equivalent) of communication, a categorisation reminiscent of India's early post-independence structure. Iran, one of the remaining countries with separate ministries for different forms of transport merged its Ministry of Housing and Urban Development with its Ministry of Roads and Transportation to form a Ministry of Housing and Transport in 2011. While many of the public finance aspects of transportation, such as fuel taxation, design of appraisal for investments, and approvals for liabilities incurred in public-private partnerships remain under the Ministry of Finance or its equivalent, the trend is clearly toward consolidating planning for various modes of transport into one agency (Annex 5.2).
Railways seem to be one of the last modes of transport to be integrated into system-level planning, particularly in countries with significant histories of rail-based transport. In Brazil and Japan, this 'integration' took place through corporatisation, privatisation, and then policy formation by the integrated ministry. China, until recently, still had a Ministry of Transport and a Ministry of Railways. The Ministry of Urban-Rural Development also oversees some rural road infrastructure.

Many of these integrated national bodies adhere to visions focused on outcomes with inputs or investments (in principle) prioritised across modes to meet mobility or freight goals. The United States' Department of Transport (DOT), established in 1966, oversees road, rail, maritime, aviation, and other parts of the transport system. Its stated mission is to 'serve the United States by ensuring a fast, safe, efficient, accessible and convenient transportation system that meets our vital national interests and enhances the quality of life of the American people, today and into the future.' (http://www.dot.gov/). The United Kingdom's Department of Transport states: 'Our vision is for a transport system that is an engine for economic growth, but one that is also greener and safer and improves quality of life in our communities.' (http://www.dft.gov.uk/). The South Africa Department of Transport notes, 'Transport is the heartbeat of South Africa's economic growth and social development!' (http://www.transport.gov.za/)

Annex 5.2 shows the division of responsibilities between levels of government in several federations comparable to India. India certainly has a relatively more centralised system. Most federations retain some national government oversight of constructing and maintaining facilities for civil aviation, railways and ports, though few retain the level of national control over civil aviation that India has. South Africa's national Department of Transportation, for example, oversees national and international airports, but the provincial governments have jurisdiction over local airports. Brazilian states and even municipalities oversee some of its airports. Many of Brazil's airports are operated by a national government-owned company, Infraero, but it operates as a concessionaire to the sub-national governments and these governments are free to choose other service providers. Most of the United States' commercial airports are owned by state and local governments, although the national government often subsidises airport development and continues to

Box 5. 2

State and Federal Relations: Ebb and Flow of National Authority over Roads in the US

The United States' road network was based on state plans and administrations for much of its history. The national government did provide financial support: first in the form of land grants in the 1800s that states could then auction to finance transport or other improvement projects; later grant support for roads that the state could apply as it wished.[29]

The Eisenhower Interstate System was the first major national government entry into planning the road network. Even then, the Bureau of Public Roads (BPR), the predecessor organisation of the current Federal Highway Administration, consulted state highway agencies to determine possible routes in the initial planning process. The final network placement was approved by the BPR. Substantial funding for it was proportioned and dispatched to the state agencies under the Federal-Aid Highway Act of 1956 with the federal government paying for 90 per cent of the project.

Later, in the 1990's, with aims to expand the Interstate System and subsume it under the newly proposed National Highway System (NHS), the FHWA again provided state agencies as well as metropolitan planning organisations a substantial amount of planning power. This included the identification of key routes, elevating existing routes to Interstate status and the ability to choose new technologies such as Intelligent Transportation Systems (ITS). This was done as the FHWA recognised that the lower-level agencies would have a better knowledge of their key resources and that there should be a concordance between national, state and local transportation plans. However, state and local agencies do need to provide required evidence and justification for their proposals ensuring that accountability and participation would be extended to all levels.

The link between FHWA and the states also extends to sharing of transportation data, which has a large impact on planning for the future. The lack of transportation data in India could be remedied with such a system being put into place in state and local governments in the country.

The United States has continued the move back to a more decentralised approach by reducing restrictions on federal funding provided to states. The 'Moving Ahead for Progress in the 21st Century' (MAP-21) bill consolidated most of the federal transfers to states for specific aspects highways into a single, more flexible stream of funding. The US National Department of Transport describes state DOTs as 'the largest units of government that develop transportation plans and projects'[30]

http://www.fhwa.dot.gov/programadmin/interstate.cfm
http://www.fhwa.dot.gov/publications/publicroads/96spring/p96sp2.cfm
http://www.fhwa.dot.gov/planning/national_highway_system/dfitm.cfm
http://www.fhwa.dot.gov/legsregs/directives/fapg/cfr0470a.htm#470113

regulate the airports as well as oversee air traffic control and safety.

Similarly, planning for road networks is generally divided between levels of government by tier: higher-speed national interconnections under national highway programmes; state highways, sometimes including higher-traffic ring roads or links between urban and rural areas under state governments; and local government oversight of the lower-use local roads. Financing arrangements and decision-making about the location of road investments often cut across this general intergovernmental relationship: national governments sometimes give states specific funds for surface transport; state governments sometimes guide the location of national investments; national and state governments finance some local roads to ensure access to remote populations; and the balance of authority over roads varies over time (Box 5.2). Financing and project selection are also not always linked. Road policy and investment is often a key tension point in intergovernmental relations given the investment requirements well as the networks' economic and social importance.[27]

India's governance of regional transport corridors is also somewhat more centralised than international

27. Dilger, Robert (2012). 'Federalism Issues in Surface Transportation Policy: Past and Present,' Congressional Research Service Brief (United States).
29 The Federal Road-Aid Act of 1916 was limited to support for 'post roads,' which were mentioned in the Constitution as eligible for national support. States later accepted federal funding for other categories of roads in the 1921 and 1944 Federal Highway Acts, but project selection remained in the hands of state officials.
30. U.S. Department of Transportation (2009). A Guide to Transport Decision-making. Available online at http://www.fhwa.dot.gov/planning/publications/transportation_decision_making/decisionmaking.pdf, Accessed January 22, 2013.

While there is agreement on the 'ideal' in urban transport, 'best practice' seems to be elusive. India is not alone in having fragmented and sometimes contradictory systems in this area

practice for intergovernmental division of responsibility. In some cases, multi-state transport corridors are federal responsibilities, in which the Ministry of Transport or equivalent sets up a sub-agency or a less permanent working group or fund to facilitate inter-state, intermodal coordination. The Saint Lawrence Seaway Development Corporation under the US Department of Transportation, for example, was set up to oversee an important inland shipping route through the Great Lakes. Brazil's national Ministry of Transport has identified eight transportation corridors to be developed to connect inland agricultural areas to ports for export through multiple modes of transport.

In other cases, states or the equivalent first tier of subnational government cooperate to invest in or manage transport infrastructure across state lines, often in collaboration with the national government. The Port Authority of New York and New Jersey (PATH), which oversees bridges, tunnels, terminals, airports in the two-state region, is an example of the latter. It was established in 1921 after a dispute between the national Interstate Commerce Commission ordered New York and New Jersey to find a solution to their disputes over rail and port freight boundaries. The two states formed the authority by interstate compact under a Constitutional clause that permitted such agreements with Congressional consent.[28] The interstate agreements for some aspects of transport in the National Capital Region (NCR) of Delhi are in some ways similar.

The British Metropolitan Areas are another example of voluntary regional coordination for transport systems. These authorities were created (or allowed to continue in existence after the Local Government Reform of 1985) by agreement between the district authorities and were responsible to Boards of Management representing the districts, which had become the highest level of local government in the metropolitan areas after the reform of local government. The metropolitan area of Greater Manchester, one example of this form of organisation, consists of 10 District Councils; Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Stockport, Tameside, Trafford and Wigan. Each District Council has the primary responsibility for providing services in its area but contributes finance from local taxes and appoints local councillors to the Greater Manchester Integrated Transport Authority to represent its district. The Authority decides on public transport policy for the county. The Greater Manchester Integrated Transport(GMITA) has less strategic power than TfL (Discussed in Box 17 in Chapter on Urban Transport) and is restricted to public transport management.[31]

While there is substantial agreement on the 'ideal' in urban transport, 'best practice' seems to be elusive. Boarnet's (2011) summary of good practice describes aspirations succinctly: 'The intra-metropolitan systems should be governed at a metropolitan scale. Metropolitan transport institutions should have the authority to balance modes, link to land use, price the system, and adjust plans and infrastructure to fit local tastes and contexts and stages of urban development…Anything that empowers metropolitan-scale governance in user pricing (which within urban areas will include congestion pricing and marginal cost pricing of other externalities), land value-capture tax financing, and integrating land use plans and transport infrastructure should be encouraged. This implies that the governance structures at the metropolitan level should have sufficient tax, pricing, and planning authority to meet those objectives.'. Other general proposals for transport investment planning make similar points. Asian Development Bank (ADB) (2009) recommends integrating decision-making by creating a 'Sector Investment Organisation' for transport and other areas. This should be under the umbrella of 'Strategic Development Corporation' aka entity with regional planning authority.

However, India is not alone in having a fragmented and sometimes contradictory institutional setting for urban transport. The 'conventional wisdom is easy to state. But, as far as I know, it is not implemented anywhere in the world,' writes one researcher.[32] Nigeria, for example, has more than 100 agencies across three levels of government involved in providing urban transport infrastructure or services. Most develop and implement their policies and programmes in isolation.[33]

Coordinating bus and rail systems appears to be a common challenge for countries as diverse as Mexico, Hong Kong, Vietnam, and the Philippines. In each case, local governments either run buses or award concessions, while national governments plan rail.[34]

Colombia's efforts to simply override incumbent bus providers by offering redundant but better service offer another illustration of the challenges of operating without a comprehensive strategic authority. The national government sought to simply build a new, high-quality Bus Rapid Transport (BRT) system in parallel to a politically entrenched bus system, hoping that the new system would replace/co-opt the old one. De facto policy support for the BRT, however, has

28 PATH (2003).
31 Gwilliam (2011).
32 Frug, Gerald. (2007).
33 Gwilliam, Ken (2011).
34 Gwilliam, Ken (2011), Perkins, Steven, (2012).

been mixed, with the Secretary of Transport allowing the old buses to operate in parallel to the BRT (with additional flexibility in route). Older bus companies have been encouraged to bid for feeder routes, but the regulated routes in the traditional bus system have not been restructured to serve as feeders for the BRT. Gwilliam (2011) attributes the outcome to politics–that the older bus companies 'captured' their regulator--but regardless of the cause, the outcome of clashing systems within the public sector shows the importance of imposing 'peace' via a forward-looking 'referee' for urban transport.

Cities that have succeeded in developing integrated public transport systems still face the challenge of coordinating strategy across investment, maintenance, and regulation of different transport infrastructures. New York City, for example, has a city Department of Transport with 4,500 employees, a Metropolitan Transportation Authority (MTA) operating public transport, and the Port Authority of New York and New Jersey. The first runs subways, buses, and suburban rail to the east of the city, while the second runs the airports, suburban rail to the south, and connections between airports and the rest of the public transport system. A third entity, New Jersey Transit, also run trains and buses into New York and a fourth, the NYC Taxi and Limousine Commission licenses cabs. Transport infrastructure (tunnels, roads, bridges) is overseen by five agencies across two states. Transport for London (TfL) is a prominent example of an agency that has successfully created a seamless passenger experience across subways and buses in the London metropolitan area, but London's boroughs retain authority over a large part of the city's road construction and maintenance. TfL can and does propose integrated policies for reducing congestion and increasing safety on London's roads, host public consultations including on roads development, and develop model contracting and project management frameworks for the boroughs to use, but the boroughs are not legally required to collaborate.

China has moved toward integrating land use and transport infrastructure with a focus on mobility rather than specific modes, but local governments have not caught up with this direction. Most municipal governments oversee a geographic area larger than current built-up area, which has helped with strategic spatial development planning including transport investments, but the integration of decisions about modes of transport is weaker. Local governments still focus on accommodating cars rather than promoting alternatives. Urban bus and metro systems are managed by separate agencies with no formal mechanism for integration, and rail tends to be financially and politically dominant. Transfers between the two systems are often problematic and inconvenient. Some major cities, such as Kunming, still have no focal strategic planning institutions.

Cities that have succeeded in developing integrated public transport systems still face the challenge of coordinating strategy across different transport infrastructures

Conflicts between various interests in urban development are inevitable and being resolved on an ongoing basis even in some of the most 'advanced' systems. The Netherlands, for example, pioneered a zoning system that coordinated transport and land-use policy. In practice, local governments sometimes succumb to pressure from large employers and taxpayers to re-classify zones for transport-intensive uses. City and regional plans for land use and transport development in Zurich, Switzerland, were in conflict for about a decade in the 1980s and 1990s. (Perkins, 2012) The typical titles of case studies on urban transport make this clear: Wilkinson (2002) on South Africa asks, 'Integrated planning at the local level? The problematic intersection of integrated development planning and integrated transport planning in contemporary South Africa.' Low, Gleeson and Rush (2003) on Australia, call their study 'Making Believe: Institutional and Discursive Barriers to Sustainable Transport in Two Australian Cities.'

KEY CHALLENGES

This section discusses some of the key challenges that India's institutional environment creates for integrated transport governance. An integrated planning framework and more in-depth research and data collection could help quantify and avert two additional intra-modal challenges stemming from the intergovernmental division of responsibilities.

INTERMODAL COORDINATION OF INVESTMENT

The effects of ad hoc multi-agency coordination are apparent at various scales in India. Facility performance is affected. For example, traffic through Chennai port is growing quickly, but infrastructure projects to connect the port to road and rail networks have been stalled. This is a common occurrence whenever large new facilities such as ports and airports are constructed. Many issues have converged to affect shipping through the port.[35] First, environmental: some of the cargo, such as coal, is dusty, and Madras High Court banned handling of these cargoes. The national Supreme Court then appointed a committee with representatives from state and national environmental regulators, academics, and the relevant state and national top bureaucrats to resolve the issue. The committee has given a list of stringent pollution control measures that the port will have to complete before it is allowed to handle coal. Second, the State Public Works Department is behind schedule in linking the port to roads by wid-

35. As reported in Anand (2012).

The current division of responsibilities between levels of government affects the prospects of each transport mode to achieve its potential efficiency. This seems particularly important for India's road network and ports

ening near the gate and an elevated expressway to a Chennai suburb. The Ennore-Manali Road, a joint venture of the state government, two national ports, and the National Highways Authority of India, is also behind schedule. Third, bidders for the container terminal are waiting for security clearance from the Central government. The result: 'Every time a top government official visits the Chennai Port, new hope is kindled among stakeholders for the revival of connectivity projects…And often, such hope fades away soon after the visit.'[36]

On the larger urban scale, projects often need to be resolved by diplomacy. Informal coordination between the many agencies involved in Bangalore's transport worked well before the inauguration of the new International Airport at Devanahalli, when the state government constituted a High Level Task Force to Airport Connectivity, under the guidance of an Additional Chief Secretary to ensure there was better connectivity to the new international airport from city centre. Inter-agency agreements have also functioned well. The Bangalore Metrorail Corporation (BMC) and the Bangalore Metropolitan Transport Corporation (BMTC) signed an MoU for Common Day Metro-Bus transit passes in February 2011. BMTC introduced a metro feeder bus service in October 2011, when the first line of the Metro was inaugurated. Nevertheless, coordination by MOU does not resolve all of the challenges.

Ad hoc coordination creates an opening for the more politically powerful and/or better-financed transport organisations to disproportionately affect the transport system. The Delhi Metro Rail Corporation (DMRC), for example, reportedly forced the Delhi Transport Corporation to stop operations along some of its routes. It has also opposed proposals for new BRT lines to come up in the same corridors. Such overlapping routes, however, can help ease congestion in the longer run as well as cater to varying client bases.

Diplomacy is also a weak basis for resolving coordination problems that extend across state and national governments. This problem is particularly pronounced for rail-based public transport, which is currently divided among state and national oversight and, within the Union government, between the Ministry of Urban Development and Ministry of Railways. Land use and re-use of existing rights of ways and tracks are one challenge. The BMC and Indian Railways have sparred over land use for points where the two rail networks converge. The Metro's North-South Corridor is stalled because the South West Railways is asking for additional compensation for Railways land to be used by Metro.[37] There have been extended delays over transfer of land to Metro by Karnataka State Road Transport Corporation (KSRTC) and vice-versa for construction of Central Station at Majestic by Metro and Intermodal Bus Terminal at Peenya by KSRTC respectively. The matter appeared in at least two meetings of the Bangalore Metropolitan Land Transport Authority and has been finally resolved. The state government has now resorted to special purpose vehicles (SPVs) to ensure that various projects proposed under the comprehensive traffic management plan move forward.[38]

Intermodal fragmentation can also affect regional-scale projects. The Working Group on Roads for the NTDPC reports (NTDPC, 2012) that the Delhi-Mumbai Industrial Corridor Project (DMIC) has been 'persistently making requests to the Ministry of Road Transport & Highways to give special emphasis for development of road corridors necessary for…efficient hinterland dispersal traffic generated on account of the Dedicated Freight Corridor (DFC) and anticipated future demands on account of proposed development of [Investment Regions] and [Investment Areas]' approved by the Government. There has been limited coordination between ministries on developing plans for DFCs and the National Highways Development Programme, although both are important components of the national backbone for freight transport.

INVESTMENT PRIORITISATION WITHIN MODES

The current division of responsibilities between levels of government also affects the prospects for each mode of transport to achieve its potential overall efficiency. This appears to be particularly important for India's road network as well as its ports.

The returns on investment in a kilometer of road depend substantially on what that stretch of road is connected to. The impact of a National Highways project, for example, is affected by the quality of State Highways and Major District Roads that link to it; while the return on upgrading a Major District Road depend on the Highways and rural roads it connects. The funding streams for each tier of roads, however, are distinct and there is limited potential to transfer funding across primary, secondary, and rural networks based on the contribution of an improved kilometer to the network. State implementing agencies could, in principle, integrate decisions about invest-

36. N. Anand (2012).
37. http://articles.timesofindia.indiatimes.com/2012-04-18/Bengaluru/31361004_1_railway-land-swr-metro-workers. Accessed May 2, 2012
38. The Bengaluru Airport Rail Link Limited, another SPV under the Infrastructure Development Department was set to study the feasibility for high speed rail to airport, monorail/light rail as proposed in CTTP and then take on its construction similar to the relationship between BMC and the Metro. In a more recent move, the state government has established Hubli-Dharwad BRTS Company Limited (registered in the first week of May 2012) for taking up the BRTS between Hubli-Dharwad in northern Karnataka.

ment in second tier roads and rural roads funded by the PMGSY, but re-allocating funds between national and state highways would be nearly impossible even if the capacity to evaluate alternate uses of funds in a network perspective existed.

There does not appear to be a comprehensive study of the potential to increase the road network traffic capacity and flow rate through selected targeted investments in roads linking to national highways. However, it is clear that state roads are not always developed in the same timeframe as the national investments, nor do they meet quality standards. The Working Group on Roads for the NTPDC notes that most of the state highways and major district roads, which link state capitals and rural areas with National Highways are not capable of handling the extra traffic that would come from connection to a National Highway system: 65 per cent of the state highways have less than two-lane standards and many have narrow bridges and culverts as well as encroachments where roads pass through towns and villages. Nearly all (90 per cent) of the major district roads also have less than two-lane standards. (NTDPC, 2012b). Road conditions are in part a consequence of the Plan/non-Plan separation of maintenance and capital investment budgets, but inconsistent widths along the same road reflect inefficient allocation even within budgets for capital investment.

Some National Highways have also been a weak link in the network. Bihar's Chief Minister, for example, requested permission to take over development and maintenance of some stretches of National Highway so that these could be brought to the same quality as State Highways. The state unilaterally invested in maintenance from its own budget.[39]

The division of regulatory authority over India's major and minor ports affects the potential for competitive development of the overall ports system as well. The differences in regulatory oversight between the two sets of ports mean that the policy environment–labour laws, differential effort to attract private investment, tariffs and returns on investment allowed for private operators, affect private investment decisions in addition to the areas' natural potential as ports or their prospects for serving an unmet freight need. KPMG-CII (2008) notes this bifurcation of regulatory oversight as an important 'distortion in an emerging competitive market.'[40]

POLICY INFLUENCES ON CAPACITY OF THE PHYSICAL NETWORK

A transport network's performance depends on the policies governing access to and use of the network in addition to the physical infrastructure. This section provides some examples to illustrate the externalities that fiscal regimes and regulatory policy have on India's transport system. It is in no way a comprehensive inventory of all opportunities to improve the carrying capacity of India's physical transport infrastructure, but is meant to establish the existence of substitutability between investment and policy change and make the case for India to invest in building the institutional capacity to identify, quantify, and reduce these impacts faster.

> Checkpoints for collecting sub-national taxes and tolls, lack of access control for highways, and varied state and local traffic enforcement affect the capacity of India's road network

Checkpoints for collecting sub-national taxes and tolls, lack of access control for highways, and varied state and local traffic enforcement affect the capacity of India's road network, for example. One widely-cited study by IIM Calcutta and Transport Corporation of India estimated that delays at checkpoints led to time and fuel wastage of Rs 870 billion.[41] Deloitte (2012) reported similar findings in a study on the logistics in India.[42] While octroi checkpoints have been nearly entirely phased out along with the tax, tolls and checkpoints for overloading remain. The new category of federally-funded expressways include built-in access control, but states are otherwise in control of preventing incursions on National Highways and the enforcement is complicated by absence of physical barriers. Similarly, traffic control decisions and investments–designation of one-way streets, investments in curbs or dividers, signal timing–affect flow rate and as such can be seen as substitutes for investment in road length or width.

The regulatory and fiscal regimes for civil aviation, fuel, and industry services also affect the impact that investments in airports have on the overall transport system capacity. Landing rights, for example, affect airlines' decisions about routes to serve. The NTDPC Working Group on Civil Aviation considers the slots akin to a 'natural resource,' an essential input for provider decisions on par with spectrum for telecom services (NTDPC, 2012c). There is currently regulatory overlap in slot assignment, some inconsistencies in slot allocation processes across airports, and no provision to trade slots. The generally high, but state-varying price of aviation turbine fuel, may also affect route decisions. The Report of the NTDPC Working Group on Civil Aviation notes that ATF accounts for 40-50 per cent of airlines' operating costs. India's fiscal regime also discourages development of domestic maintenance options, affecting flight planning by forcing Indian carriers

39. Srivastava, Amitabh. (2012).
40. KPMG-CII (2008).
41. The document was not publicly available. IIM-Kolkata press release available online at http://iimcal.ac.in/iim-calcutta-study-indicates-huge-loss-countrys-economy-due-shoddy-road-checkpoint-system. Last accessed January 10, 2013.
42. Deloitte & Indian Chamber of Commerce (2012).

Fixation of economic levels of rail tariffs, for both freight and passengers, is a constant struggle in the current politicised system that distorts modal distribution of freight traffic

to take their aircraft to Dubai, Singapore, Malaysia, and other MRO centres. According to the Working Group (NTDPC, 2012c), Indian MRO players have to suffer an additional tax burden of nearly 40 per cent over foreign MROs due to import duties on equipment and spare parts, VAT, and service tax. Domestic MROs also find it difficult to bring experts into India for urgent repairs due to security and visa restrictions. Service aircraft are 40-50 per cent more expensive in India than in neighbouring countries. Spare parts are also not always kept in stock because customs, VAT, and octroi are high for third-party MROs.

Finally, the politics of railway pricing are an obvious factor in the modal distribution of freight traffic. Freight tariffs, kept high in order to cross-subsidise passenger traffic, may be lower at times than the costs of road transport, but they are not sufficiently lower to offset the inconvenience of shifting from rail to road for the last mile of transport. Fixation of economic levels of rail tariffs, for both freight and passengers, is a constant struggle in the current politicised system of fixing rail tariffs.

INDIA'S TRANSPORT GOVERNANCE - 2023

India's transport governance must move toward five significant changes over the next decade:

(i) Creating a consolidated Transport Ministry to focus on systemic performance;
(ii) Setting up an Office of Transport Strategy (OTS) to coordinate transport policies at the national level.
(iii) Clearly decentralising policy and planning authority, including urban transport, to the constitutionally recognised urban and metropolitan governments;
(iv) Building a comprehensive regulatory environment to govern transport flows, and
(v) Building an interdisciplinary cadre of transport experts.

This chapter focuses primarily on the first three challenges, leaving the other two to the chapters on Regulatory Issues and Research and Human Resource Development. Each of these is representative of broader institutional challenges beyond transport.

SET UP A UNIFIED MINISTRY OF TRANSPORT

CENTRAL GOVERNMENT

India needs to have a single unified ministry with a clear mandate to deliver a multi-modal transport system that contributes to the country's larger development goals including economic growth, expansion of employment, geographic expansion of opportunities, environmental sustainability, and energy security. The current collection of ministries creates a list of mandates to deliver particular types of transport infrastructure, with little incentive or ability to consider how these pieces interact as a circulatory system for moving goods and people.

Transport planning is too big a job for a dedicated 'Group of Ministers.' These are designed for coordination of existing plans and do not have the standing technical staff or information base to undertake integration of plans at the design phase. It is also too big a job to be left to the Planning Commission, as is the current de jure arrangement. As discussed earlier, the transport system involves much more than capital investment and strategies must be developed over a longer time horizon than the 5-10 year period that most of the Planning Commission's work focuses on. It is possible but unlikely for a particularly skilled individual from the Planning Commission or Prime Minister's Office (the two entities with a mandate for inter-ministerial coordination) to broker a set of productive exchanges and concessions. And in any case, this would be short-lived.

That said, the Transport Ministry must be carefully designed to create and maintain an incentive structure that encourages technical excellence, open-minded consideration of all available options, and consistent attention to transport system goals rather than particular means. Concentrating transport authority in one entity creates the potential for more coordinated–larger scale–failure as well as success. This objective implies two essential structural features:

- Explicit distribution of accountability between Ministers and the Ministers of State, with the Minister being responsible for systemic outcomes and 'first among equals.'
- Investment in an integrated monitoring and public reporting system that tracks system performance above and beyond achievements within particular modes. The common data repository would also support improved communication between departments.

The Transport Minister should be held responsible overall for the transport system's contribution to development goals articulated by the Government. The Ministry's consolidated data collection and reporting should be designed to monitor these goals and should measure system-wide performance on access, energy efficiency, cost, and other parameters.

It should also include a Secretary of 'Transport Affairs' or similar, and a professional staff, similar to the Department of Economic Affairs, to support this focus on system-wide performance and develop broad policy and investment frameworks for investments in particular modes.

The existing ministries should become Departments focused on delivering effective transport infrastructure and services for each mode. Each would be led by a Minister of State with support from a Secretary and a technical staff. Each of these Departments must have the technical ability and procedural standing to make a credible case for investment and policy in its mode of transport to meet the broader framework set at the Ministry level. This distribution of authority and technical expertise is important to maintain an ongoing, constructive discussion of various means for meeting transport development goals.

Day-to-day operations should be overseen by Divisions within these Departments, headed by Joint Secretaries. The number and structure of these divisions should be determined on the basis of transport needs, corporate structure, and technical requirements when the Transport Ministry is formed.

Nearly every other country in the world, and every one of India's perceived peers, has moved in this direction. Railway systems have also been included as part of this unified Transport Ministry or equivalent. China's integration of rail into the larger Transport Ministry is underway. Most of these integrated ministries retain the basic division of labour across departments focusing on different modes of transport, with additional 'integrative' sections looking at energy efficiency, innovation, and other cross-cutting functions. This may be for political feasibility, and international experience with integration should be reviewed in more detail after the concept of a single Transport Ministry is accepted in principle.

Consolidation of all or some parts of various ministries into a single Transport Ministry will be difficult in an era of coalition politics, but it must be done. As discussed earlier, the trend in transport governance in India in recent decades has been in the other direction, and any effort to consolidate has been overturned. Fragmentation of responsibility runs throughout the government. Each election brings some form of ministerial restructuring to create the requisite number of cabinet portfolios.

However, politics and the preference for the path of least resistance cannot continue to hold public sector transformation hostage. Other committees have also suggested similar consolidation: the High Powered Expert Committee on Urban Infrastructure, for example, called for merging the Ministry of Housing and Urban Poverty Alleviation and the Ministry of Urban Development. It is time to examine these various suggestions in aggregate and negotiate a comprehensive restructuring. The settlement should also include provisions that restrict the Government's ability to re-allocate business, as a way to prevent the problem from recurring.

Consolidation of all or some parts of various ministries into a single Transport Ministry will be difficult in an era of coalition politics, but it needs to be done. Unfortunately, the trend in recent decades has been in the other direction

STATE GOVERNMENTS

A similar process of integration of transport planning and policy into a single department must happen at the state level. Given states' relatively limited jurisdiction (mainly roads, urban transport, and ports), the main focus must be on integrating investment planning and policy across urban and rural areas, with particular emphasis on serving high-density peri-urban areas. The near-term priority is to develop the states' capacity and ability to articulate transport requirements, improve urban transport and its links to regional economic networks, and provide feedback for national transport investments.

Consolidating transport planning across modes takes time, even when there is some history of coordinated decision-making. Russia, for example, has re-consolidated all of its transport ministries, but is still said to have fragmented decision-making. Central planning involved intermodal coordination among a set of mode-specific industries before the 1990s. The government replaced this arrangement with a single integrated Transport Ministry for all modes except rail when it liberalised in 1990, but then re-divided this Ministry into separate ministries for each mode in 1996. This led to 'overlaps of responsibilities, policy incoherence and most significantly gaps in policy, notably with respect to sustainable development and intermodal containers.'[43] The government attempted to coordinate these Ministries by forming committees (more than 50 of them over four years, but ultimately decided to reunite the ministries in a new Ministry of Transport in 2000. Railways came under the Ministry in 2004 when railway operations were corporatised and re-established as a state-owned company. Simply re-labeling institutions, however, has not been enough. According to Perkins (2012):

'The earlier fragmentation of the sector is, however, still felt as many decisions on fiscal policy, funding and regulation are taken in other ministries or in

43. Perkins, Steven, (2012). 'Seamless Transport Policy: Institutional and Regulatory Aspects of Inter-Modal Coordination,' World Bank – International Transport Forum Working Paper, May 2012.

industry associations. The cultural change involved in transitioning from a fragmented model of modal ministries to an integrated ministry with separate corporatised transport service operators is bound to take time and meet resistance, so authority for policy making across the modes has to be identified clearly in government – either in a comprehensive transport ministry or a ministry or inter-ministerial authority for economic reform of some areas of policy are not to be captured by vested interests.'

Later in this chapter, we discuss some early investments in integration.

IMPLEMENT THE 74TH AMENDMENT, INCLUDING, IN PARTICULAR, THE METROPOLITAN PLANNING COMMITTEES

Metropolitan[44] governance is particularly important, given India's new trends leading to expansion around metropolitan cities, in which new employment and investment are increasingly locating on the outskirts of large cities.[45] Economically contiguous (or economically relevant) areas in Indian cities are nearly always much larger than the formal Urban Land Body (ULB) boundaries. If one uses the urban agglomeration index developed by Uchida and Nelson (2010), for example, India was 52 per cent urban as of the 2001 census, and it appears that the large 'near-urban' population is expanding. Some have estimated that as many as 200 million more people live in 'near-urban' conditions on the periphery of metropolitan areas or in large towns that other countries might classify as urban areas.[46]

> The new Metropolitan Urban Transport Authorities should be financially independent and have some authority over allocation of funding for urban transport projects, to ensure that they can exercise their statutory role in integrated planning across geographies and modes

Urban transport governance has several critical elements: expertise for generating feasible policy alternatives and evaluating them on technical merit, discussion fora for evaluating these options in light of multifaceted urban development goals (e.g. sustainability, equity, economic growth), credible authority for sanctioning plans as well as modifying them in light of new information, and the ability to implement the chosen plans efficiently. People need to be capable of generating sound policy options, politics need to hold them accountable for contributions to urban development, and finance has to flow once decisions are taken.

India will need to invest in the people and information systems for urban transport planning as well as delegate the financial authority to act on these strategies. We recommend establishing urban transport as a state responsibility in general, with devolution of authority to metropolitan governments of larger cities. Unified Metropolitan Transport Authorities (UMTAs) must be made independent and given the technical capacity and access to financial resources for effective, responsive metropolitan transport planning.

State governments or their sub-agencies, the Development Authorities, are currently the only platform for such institutional investments, and some of the nascent UMTAs act as subsidiaries of these entities. While the Development Authorities are charged with metropolitan area development, they are politically accountable to the state government. Calls to route more funding for urban transport projects through existing UMTAs operating within Development Authorities could reinforce state dominance over urban transport. International experience demonstrates that consolidating urban transport is a long run (many-decade) institutional construction project in any case; thus, it should start on a firm foundation.

The NTDPC therefore recommends the formation of new statutorily and financially empowered agencies, the Metropolitan Urban Transport Authorities (MUTAs). These are discussed in more detail in Volume III, Chapter 5, on Urban Transport. The core point is that these bodies should be financially independent and have some authority over allocation of funding for urban transport projects. The latter is essential for ensuring that the MUTAs can exercise their statutory role in integrated planning across projects, geographies, and modes that may also be influenced by other actors in urban governance.

STRENGTHEN AND COMPLETE THE SET OF INDEPENDENT REGULATORS

A separate chapter addresses the principles and proposed design of transport regulation to oversee various aspects of access to and usage of transport infrastructure, including maintaining competiveness, de-politicising pricing and subsidies, protecting consumers, and governing public-private partnerships in delivery. We note two points here. First, regulation is a complement to the transport system and substitute for particular transport infrastructure investments. It must be used this way to conserve scarce resources. Emissions regulation, for example, increases the cost of operating a private car, and increases the attractiveness of public transportation. The extra customers swayed toward using the metro or bus system can help improve the financial

44. 'Metropolitan' regions are defined in the Constitution as 'areas having a population of a million or more, comprised one or more districts and consisting of two or more municipalities or panchayats or other contiguous area, specified by the Governor by public notification to be Metropolitan Area for the purposes of [Article 243]'
45. World Bank (2012).
46. Indian Institute for Human Settlements (2011).

sustainability of that system. Shifting passengers to public transport can also ease congestion in the same way that widening a road or building a flyover would–in fact, it is likely to be a more sustainable fix since capacity is easier to adjust. Similarly, railway pricing for freight–currently a political decision but at some point a regulatory decision–also affects the use of road versus rail infrastructure and the congestion on each mode for a given level of capacity.

Second, the regulatory framework should comprise a mix of general-purpose and sector-specific regulators as required to leverage expertise effectively. Some topics, such as monitoring and preventing anti-competitive behaviour, for example, draw on a general body of institutional design and economic knowledge and should be governed by law or multi-sector regulators in collaboration with sector experts. Other aspects of infrastructure regulation, such as the means to creating a level playing field given the technologies in use, are arguably more sector-specific and require deeper specialised expertise to be deployed within broad guidelines. India should not simply create sectoral regulators expected to cover all aspects of regulation within a sector-specific silo.

This report recommends sector-specific regulators to identify and allocate valuable inputs between public and private investors as well as between private providers, since understanding the amount, dynamics, and possible divisibility of economic value created by infrastructure development or service provision requires sector-specific expertise.

However, many of the regulatory issues related to transport come down to restricting anti-competitive behaviour, and detection of anti-competitive behaviour is arguably a more general skill. Strengthening the Competition Commission of India (CCI) and clarifying its jurisdiction could support more efficient use of existing infrastructure. Aggregating oversight and enforcement of competitive behaviour also retains flexibility to look into interactions between technologies that may functionally overlap (e.g. different modes of transport). Consolidating competition oversight in the CCI would limit fragmentation of scarce expertise and avoid inconsistent policies across sectors that may be administratively distinct but technologically inter-related. It would also reduce the potential for regulatory jurisdiction-shopping.

BUILD AND MAINTAIN A HIGH-QUALITY INTERDISCIPLINARY PROFESSIONAL BODY OF TRANSPORT PLANNING EXPERTS

Comprehensive transport planning requires a range of expertise to be drawn from different academic disciplines and put into practice. Such expertise is

> Consolidating competition oversight in the Competition Commission would limit fragmentation of scarce expertise and avoid inconsistent policies across sectors

needed to enable the development of feasible, cost-efficient policy options for national, state, and urban local bodies' consideration. Civil engineering and materials science, construction management, project management, financial structuring (whether PPPs are involved or not), economic and other social science analysis of impacts, systems science and agent-based modeling (in turn familiarity with programming and mathematical theory), geography, and other areas of expertise, all have roles to play. This is a medium to long-term goal because it will require both demand-side administrative reform to create attractive positions for transport professionals, as well as investments in the supply side, human resource development.

As discussed in the chapter on Research and Human Resource Development (Volume II, Chapter 11), India must also build up its research capacity. Most Asian and European countries (EC, France, Netherlands, Sweden, Japan, and South Korea) visited in a 2008 study tour undertaken by the United States' Federal Highways Authority believed that 'if you aren't doing transportation R&D, then you won't be globally competitive.'[47] Research and policy analysis also create important feedback loops for transport policymakers as well as those in other agencies (such as revenue) whose decision affects the system. It is not possible to integrate all factors that affect transport outcomes into one institution; research and policy analysis create an alternate means for information to flow between decision-makers. Transport data and analysis also play an important role in modulating the market response to transport policy and investment: investors and customers who are aware of their options are logically more likely to behave like the optimising individuals often assumed in models.

INDIA'S TRANSPORT GOVERNANCE–FIRST STEPS: 2013

This report recommends establishing a national 'Office of Transport Strategy' (OTS) to host data and technical expertise for developing, monitoring, and refining longer-range strategies for transport as the Ministry of Transport comes together. This OTS could be thought of as a standing version of the NTDPC, with a permanent secretariat, budget, and ability to request and generate data. In the short run, it would both develop alternatives and convene the relevant policymakers to consider options. In the

47. Office of International Programs, U.S. Federal Highway Authority. Report available at http://international.fhwa.dot.gov/pubs/pl09015/02.cfm, last accessed on October 13, 2012.

long run, the OTS could perhaps be absorbed as the technical secretariat for the Minister of Transport. However, arguments could also be made to keep the OTS associated with the Planning Commission in order to promote greater professional independence and coordination with overall planning.

State-level transport agencies would perform a similar technical role in designing transport programmes, leaving implementation to the existing Departments of Public Works. It would work closely with the State Urban and Rural Development Ministries as well as the Chief Minister on transport planning to address state development, and be the primary liaison to the national government for intergovernmental coordination of transport investment and policy. As state transport planning capacities are built, we recommend that state governments be given greater statutory responsibility for airports and rail-based urban public transport. This is particularly important as smaller regional airports are developed in the coming decades, so that complementarities between airport location and state investments in road networks, tourism infrastructure, and market hubs can be exploited.

In the long run, there is no substitute for establishing financially independent, well-staffed urban governments that would undertake transport among other roles.

OFFICE OF TRANSPORT STRATEGY: INTEGRATING NATIONAL TRANSPORT DEVELOPMENT:

Given the political challenges of consolidating India's existing division of responsibilities in the short run, India must focus on the most essential part of the groundwork for integrated transport governance: establishing a 'Strategy Secretariat' with the resources to build a technical team; aggregate, manage, and analyse transport data; and assert itself as a compelling advocate of policies that leverage transport for development goals.

The proposed Office of Transport Strategy should be set up as an independent agency along the lines of the Independent Evaluation Office of the Planning Commission.[48] The IEO has been constituted to review progress more than set forward looking strategy, but, most importantly, it has the freedom to conduct independent analysis, hold open consultations, and publish its research in any way that it sees fit.

The OTS mandate would be to build on the work of the NTDPC by providing ongoing technical support for sectoral investment programmes as they are accepted, evaluating alternatives for the institutional reforms, setting up new entities as proposals are accepted, and updating the Committee's analysis in coming years. Strategic transport planning is not a one-time exercise, particularly in times of economic and political uncertainty.

The OTS should also have the mandate to overhaul India's system of transport statistics in preparation for the creation of a Ministry of Transport. The simple act of measuring and tracking outcomes is a necessary foundation for moving investment and policy away from processes and projects to systemic impact. Perkins (2012) outlines the evolution of transport policy's focus:

'Over recent decades there has been a growing focus in transport policy making towards service delivery to end users, in both freight and passenger transport. The policy focus has shifted from intermediate goals such as annual plans and budgets for public transport corporations and annual spending on infrastructure, to final goals in terms of the effectiveness of transport services in providing access to jobs, housing and leisure activities, aiding the competitiveness of businesses and creating the conditions for economic growth.'

This transition cannot happen in a context where progress is measured by project completion or process guidelines. Perkins goes on to emphasise the importance of developing new data on transport to inform policies and investments in the system:

'This [emphasis] is reflected in a range of initiatives including requirements for public transport services to publish key performance indicators, governments providing public support for the development of advanced logistics management tools, increasing political interest in congestion and a new transport policy focus on reliability of service and, in a few administrations, the development of analytical tools to focus on the end-to-end journey.'

An OTS with a mandate to produce and disseminate policy options focused on leveraging transport investment and policy as tools for development and the powers to obtain the required inputs and ensure that its analysis is considered in key decision-making fora would fill an important gap in India's transport governance. As technical agency, it would effectively complete the triad of capabilities required for transport strategy: generation of sound policy options (OTS), review of consistency with social goals (Government), and implementation (existing Ministries-cum-Departments of the Ministry of Transport). It would leave existing agencies to pursue their current mandates, but within a clearer strategic framework. The Planning Commission, for example, would continue to coordinate investment planning across ministries and states. Each ministry would continue to be the nodal agency for policies and investments in its jurisdiction.

48. The first Director General of the IEO, Ajay Chibber, was appointed in August 2013.

Box 5. 3

Factoring Life Cycle Energy and Emissions Costs in Transport Decisions

Environmental impact assessment exercises and other environmental analyses carried out to support decision-making in transport sector do not consider the full life cycle energy and CO_2 costs/impacts of transport modes and focus on the tailpipe impacts only. It is, however, necessary that a holistic approach is adopted while analysing the impacts of the sector. Different transport modes involve varying degrees of construction and maintenance activities; while some modes may be highly material and energy intensive, the others may be comparably low intensive. Material and energy consumption at various stages of a transport project i.e. construction, operations and maintenance, needs to be examined in order to fully understand its impacts on the environment. Life cycle analyses (LCA) are typically used to assess such holistic/full-life impacts of various products, systems, projects, etc. ISO 14042 defines LCA as a systematic way of evaluating the environmental impacts of products or activities by following a 'cradle to grave' approach. It involves identification and quantification of material and energy consumption and emissions which affect the environment at all stages of the entire product life cycle.

Application of LCA to the transport sector becomes important as transport impacts are not limited to tailpipe only. Full life cycle impacts of transport need to be accounted and recognised while taking policy decisions related to 'greening' of the sector. Understanding of the life cycle energy consumption and CO_2 emissions associated with various life stages of different transport modes can help make informed choices for climate-friendly and energy-efficient modes for the country and for suggesting intra-mode improvements to reduce these impacts.

The LCA in the transport sector should aim to understand the energy and emissions equivalent impacts of at least the following activities in life cycle of any transport project (TERI, 2012)[50].

1. Production of construction materials used in transport construction activities
   - Embodied energy and CO_2 emissions in construction materials
2. Transportation of construction materials to site
   - Direct energy consumption and CO_2 emissions due to fuel consumption by vehicles transporting construction materials
   - Embodied energy and CO_2 emissions in fuels used
3. On-site construction activities
   - Direct energy consumption and CO_2 emissions due to on-site fuel consumption (by construction machinery)
   - Embodied energy and CO_2 emissions in fuels used (by construction machinery)
   - Carbon sequestration potential lost due to removal of vegetation on site
4. Operations of rolling stock/vehicles
   - Direct energy consumption and CO_2 emissions by rolling stock/ vehicles
   - Embodied energy and CO_2 emissions in fuels used
   - Energy consumed and CO_2 emitted due to manufacturing and maintenance of rolling stock
5. Annual and periodic maintenance works for fixed infrastructure
   - Material consumption (embodied energy and CO_2)
   - Energy use on site

The OTS should be granted a number of powers in order to pursue its mandate. These include:

- Mandate to recommend formation of a High-Powered Committee, Group of Ministers, Expert Group/Task Force or similar to further coordination of projects and transport initiatives that are not solely within the jurisdiction of another ministry or state agency. This is similar to the mandate of other expert bodies such as the Finance Commission. (We note, however, that the Finance Commission is a constitutional body). Government agencies would be required to accept the recommendation or provide a formal written reason for rejection.
- Statutory authority to obtain any and all available data related to transport from Union and state government authorities within a specified time.
- Representation on all government committees or other bodies related to infrastructure

49. Perkins (2012), for example, writes that 'Inter-modal transport policy in European countries is basically market driven … National transport policies seek mainly to coordinate intervention, in terms of taxation, regulation, funding and investment, to avoid waste or undermining policy towards one mode as a collateral effect of intervention in another mode.'
50. TERI (2012), Life cycle analysis of transport modes, Report prepared for the National Transport Development Policy Committee.

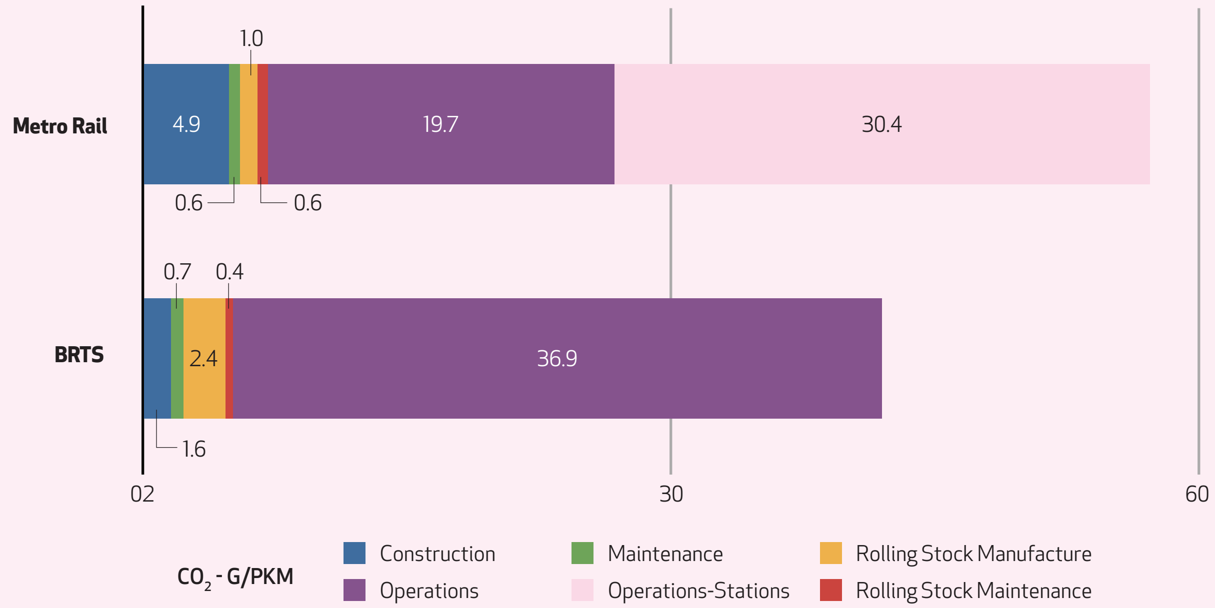
Box 5. 4
Facilitating Informed Choices of Urban Transport Modes

An understanding of the life cycle energy and emission costs resulting from the above listed activities in the life cycle of a transport project can help make informed and objective choices of transport modes and technologies in our policies and plans, especially in urban transport plans where different urban transport options are evaluated for meeting the mobility needs of the cities. As stated earlier, traditional environmental impact analysis exercises carried out to support decision-making in transport sector do not consider the full life cycle energy and CO_2 impacts of transport modes.

It is important that decisions related to choice of transport modes, especially in urban transport plans, consider the life cycle impacts in terms of energy and CO_2 emissions in addition to other financial, technical, and environmental criteria used today. This becomes important in today's context when energy security and climate change have been recognised as areas of concern and measures to address these challenges are being deliberated upon. Consideration of modes that are least energy and carbon intensive throughout their life period can help address these challenges to some extent.

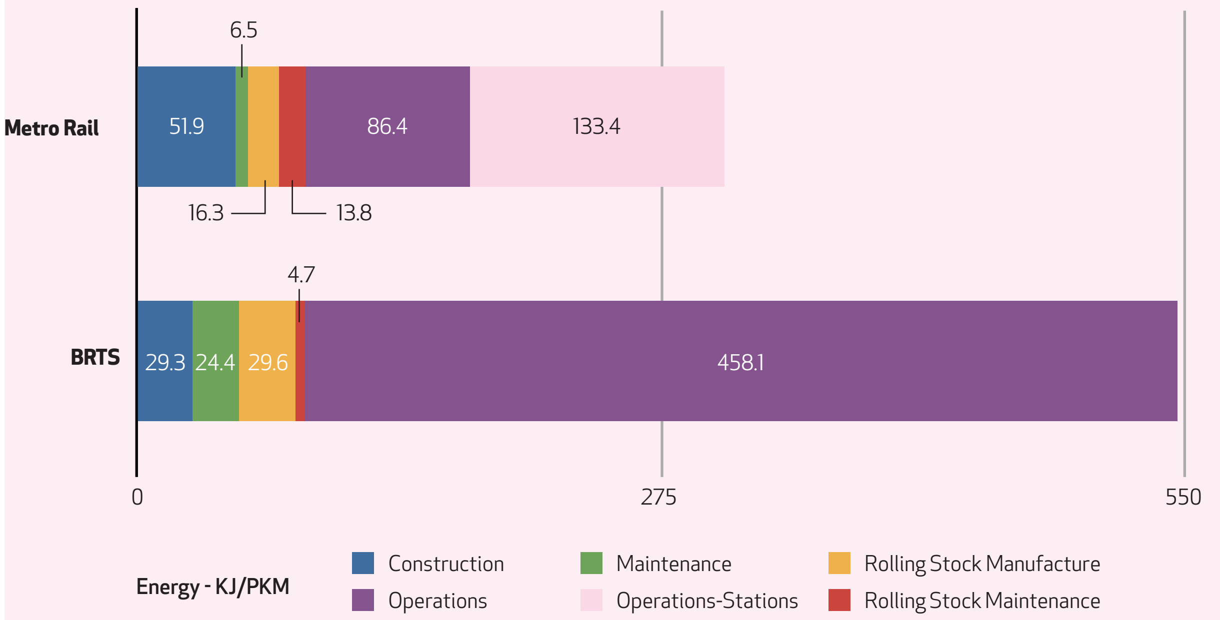
Considering life cycle energy and emission costs in urban transport modal choices can change the way we conventionally go about making choices for different transport modes in our cities. While cities may choose high capacity public transport systems like metro rail as the least carbon emissions generating technology for public transport because they generate zero emissions at tail pipe, an evaluation based on life cycle analysis indicates that a metro system generates more CO_2 emissions/PKM on a life cycle basis compared to for example a BRT system, which can also offer high levels of capacity to carry urban commuters (Figure 5.4). The same metro system, however, is more energy efficient (on a per PKM basis) for its full life period, when compared to a BRT system (Figure 5.5). Introducing life cycle impact considerations can hence bring more detailed understanding of the overall impacts of

Figure 5. 4
Life cycle CO2 emissions (Per PKM): Ahmedabad BRTS and Delhi Metro Rail (Phase I and II) Projects



a system/proposed infrastructure project that are not limited to just tailpipe or a particular city and help make informed choices based on the economic, social and environmental objectives/goals set by national, state or city governments.

Figure 5. 5
Life Cycle Energy Consumption (Per PKM): Ahmedabad BRTS and Delhi Metro Rail (Phase I and II) Projects



It is important to note that the LCA results cannot be generalised. While in smaller cities, high capacity systems like metro rail may not look desirable from a life cycle energy and emissions impact basis (per PKM) on account of the low ridership, the same systems may be highly desirable in very large cities having very high levels of ridership. The choice of a particular mode in each city hence needs to go through such detailed analysis exercise to arrive at the most context-specific and economically and environmentally feasible choice.

As stated earlier, there are significant energy and CO_2 impacts due to construction and maintenance of transport infrastructure. Construction and maintenance of transport infrastructure involves consumption of materials and fuels, some of which are highly energy and carbon intensive and lead to significant contribution to life cycle energy and CO_2 impacts of a particular transport mode. LCA, if carried out, can indicate the materials and fuels that should be replaced by alternative materials and fuels that are less energy and carbon intensive, if available. The LCA can also indicate the impact of using locally available materials in reducing life cycle energy and emissions impacts, as the transportation related energy and emissions costs are reduced due to the use of locally available materials. Some possible areas where energy reduction can be achieved during the life of a transportation system are:

- Reducing energy and CO_2 intensity of conventional materials used,
- Using alternative materials that are comparatively less energy and CO_2 intensive,
- Using locally available materials,
- Using energy efficient processes and machinery during construction and maintenance,
- Optimising resource utilisation during construction and maintenance, especially for transportation of materials (using locally available materials, reducing idling, using rail for bulk transport of materials, etc.),
- Promoting inter-modal shift (towards more energy efficient modes),
- Improving efficiency of rolling stock, and
- Reducing energy and material intensity during manufacturing and maintenance of rolling stock.

LCA also indicates that if life of projects is enhanced, then the energy and CO_2 impacts due to re-construction can be reduced/deferred, especially in the case of road-based projects that tend to have shorter life. Life of the projects can be enhanced by continued maintenance. Maintenance of constructed assets should hence be given due importance; it will help reduce both monetary and environmental costs on a life cycle basis.

Investment in technical expertise and a professional culture could help insulate the Office of Transport Strategy from the political pressures that will inevitably follow its role in deciding on large public investments

planning at the national level, including the Cabinet Committee on Infrastructure, the National Investment Board/Cabinet Committee on Investment, High Powered and High Level Committees concerning Transport. Integrated transport planning may be more focused on policies about infrastructure use than public investment in some of the wealthier countries where core infrastructure has already been fully developed,[49] but India still requires significant investment and choices made about capital investment will have long-run consequences.

- Director General to have the rank of Minister of State, and can be drawn from a global labour pool. This is an increasingly common practice for technical positions, including politically sensitive ones. The United Kingdom, for example, appointed Canadian Mark Carney as the Governor of the Bank of England.
- Personnel policy to enable hiring of experts from a global labour pool for at least the initial 10 years while research programmes and expertise in India are being strengthened. This is also important for ensuring exposure to a variety of perspectives, training backgrounds, and experience in the formative early years of the OTS-cum-Ministry of Transport. It should also allow for independent selection of performance norms to enable creation of an institutional culture linking employees to global transport research and practice as well as close attention to Indian context and priorities.
- Independent budget authority to ensure autonomy in hiring, selection and commissioning of research, and utilisation of resources for establishing and maintaining a data centre.
- An R&D budget sufficient to commission independent analysis on strategic questions that cut across modes of transports, jurisdictions of different levels of government, and/or involve trade-offs between investments in physical infrastructure and policy changes. For instance, Box 5.3 on Life Cycle Analysis for an example of a relevant approach. Box 5.4 applies the approach to illustrate some intermodal decisions integrating environment impacts that the OTS could undertake or commission and supervise.
- Dedicated budget for establishing and maintaining an integrated data centre for the proposed Ministry of Transport. This should focus on converting data into decision support tools for prioritising national, state, and metropolitan investments and for examining shadow-financing scenarios independent on the Plan-non-Plan division. It is not sufficient to simply compile data, at a minimum it should be posted online in machine-readable format so that interested groups from private sector, civil society, and academia can use it for evaluation, modeling, and development of decision support tools.

The OTS should be visibly technocratic in order to minimise accusations of politicisation. Its cost-benefit analysis and 'system impact assessments' for individual projects should be rooted in transparent analysis and credible data. Its policy advisory functions should be backed by significant in-house expertise as well as research generated by 'centres of excellence' around the country. Investment in technical expertise and professional culture could also help insulate the institution from the political pressures that will inevitably follow its role in decision making over large public investments with potentially significant private benefits. Various historians argue that the apolitical image of United States Bureau of Roads, for example, was in part due to its reputation for technical expertise even as it oversaw one of the major flows of national funds to state infrastructure.[51]

STAFFING OF THE OFFICE OFTRANSPORT STRATEGY

It difficult to give credible targets for numbers of staff, since this will depend on the organisational structure and procedural requirements, the division of responsibilities between Union and state governments, and the extent of reliance on short-term or contract employees for specialised expertise. However, some orders of magnitudes are relevant. The United States Department of Transportation has about 60,000 professional staff. This is in addition to the State Departments of Transportation, whose mandates include overall safety as well as setting State transport goals across modes, including road investments, interconnections with rail, ports and airports. California has 22,277 permanent staff (www.dot.gov), and Texas 12,000 (http://www.txdot.gov/). New York State has 10,000 plus another 4,500 staff members in the New York City Department of Transportation. (https://www.dot.ny.gov/).

The Directorate-General of Transport for the European Commission, an agency that mainly coordinates strategies across member nations through technical advice and is thus probably the most comparable in mandate, has 2,272 employees and is the largest Directorate-General (9.6 per cent of Commission Staff) of the European Commission.

Such numbers are obviously very crude comparisons, particularly since the support functions of

51. Seely, Bruce (1987).

financial management and process compliance vary widely as do the organisational structures. They also do not take consultant/contract expertise into account. Indian agencies involved in transport planning can and do rely on consultants and outside experts for policy formulation.

Creating state analogues of thre national OTS would provide an important counterweight to the national OTS and Ministry of Transport by ensuring that staters can be effective advocates of regional development needs

STATE TRANSPORT REFORMS: OTS AND DEVOLUTION

Indian states are important economic and political actors by global let alone national standards. Many would be large countries, in territory and population if not yet economies. The subsidiarity principle of federal design and international practice suggest that they should play a strong role in planning state-level multi-modal transport networks. Indian states also have substantial electoral and competitive incentives to leverage transport investments effectively as a tool for development. Lall, Wang, and Deichmann (2010) find that transport infrastructure, especially ports and highways that link locations to large internal markets, is one of the most significant factors in attracting new private investment.[52]

Creating state anahotlogues of the national OTS would be an important first step toward building the capacity to respond to these performance incentives. Second, state OTSs would also provide an important counterweight to the national OTS and Ministry of Transport by ensuring that states can be effective advocates for regional development needs and choices of mode and location for investment. A group of strong state OTSs could help offset the risk that the national OTS would be captured by particular interests.

The features of the state OTS would be analogous to those of the national OTS, including:

- Mandate to recommend formation of state-level committee or similar to further coordination of projects and transport initiatives that are not solely within the jurisdiction of another state agency. It could also recommend that the national OTS initiate intergovernmental working groups in cases where state and national investments overlap. The OTS and state agencies would be required to accept or provide formal rejection of the request with reasons.
- Statutory authority to obtain any and all available data related to transport from state government authorities within a specified time.
- Representation on all government committees or other bodies related to infrastructure planning at the state level, including in consultations with the national government.
- Director to have the rank of Minister, State Government and can be drawn from a global labour pool.
- Personnel policy to enable hiring of experts from a global labour pool for at least the initial 10 years. Experts from the OTS-cum-Ministry of Transport could also be rotated through State OTS, to encourage development of expert networks across levels of government.
- Independent budget authority to ensure autonomy in hiring, selection and commissioning of research, and utilisation of resources for establishing and maintaining a state data centre, following guidelines established by the national OTS. Government of India to provide specific-purpose funding for an integrated data centre.
- An R&D budget sufficient to commission independent analysis on strategic questions that cut across modes of transports, jurisdictions of different levels of government, and/or involve trade-offs between investments in physical infrastructure and policy changes.

States could choose whether to affiliate the OTS with the Chief Minister's office, the state Planning Commission, or make it an autonomous statutory agency. The important parts are the convening of expertise and data, alignment with the national OTS, and the ability to work as 'first among equals' with other transport-related agencies at the state level.

The OTSs would be especially important if further action were taken to reallocate responsibilities within various modes of transport to bring India's transport governance more in line with principles of subsidiarity.

States are, for example, the logical level of government for overseeing urban rail-based transport. They are large enough to consider regional and financial externalities, but small enough to also have a strong incentive to pay attention to local development requirements. Aggregating urban transport expertise at the state level is also a logical staffing choice. A big enough group can be formed to have the professional interactions, deliberate on the challenges, and also be deployed to help cities of all sizes. Declaring urban transport a state subject would also clarify ongoing ambiguity in authority and responsibility for urban public transport. The Ministry of Urban Development has been the line ministry for urban transport since 1986, but Railways retained authority over safety and technical

52. Lall, Somik, Hyoung Gun Wang, Uwe Deichmann (2010).

Box 5.5
Rail vs. Bus: Mutually Exclusive or Complementary?

The choice between rail metros and bus rapid transit systems depends on several factors: construction time and cost, estimated ridership, existence of radial corridors, and ability of the public to afford rail transit. Although often presented as a strict dichotomy, rail and bus systems can be combined to good effect.

Rail metros are very expensive, with standard Asian costs around $75mn/km (elevated) and $180mn/km (underground), although these costs are substantially lower in China (roughly half at 2008 prices). This means that metro systems rarely cover their full operating costs (Fouracre et al. 1990). At-grade alignment is approximately half the cost of elevated alignment systems, which are in turn approximately half the cost of underground alignment systems. Revenues must be approximately twice operating costs for systems to be financially viable, but only large cities with concentrated corridor flows and high revenues per passenger (this is associated with higher incomes) come close e.g. Santiago (revenue/op cost=1.84), Singapore (1.67) (World Bank, 2002).

Metro projects are **typically public sector** endeavours, with a poor record of keeping to budget (capital costs typically increase 50-100 per cent from forecasts) and schedule (implementation times up to 50 per cent longer than expected). Ridership is often less than forecasts suggest, and projections may be inflated by municipalities to attract higher investment (Pickrell 1992). **Private sector partnerships** in six concessions in Bangkok, Kuala Lumpur and Manila have led to successful implementation of metros which might otherwise not have been developed (although capital costs are higher and some problems still arise).

Bus Rapid Transit (BRT) is increasingly salient, after success in Brisbane and Latin America. It is much cheaper in terms of capital than metros, since existing road infrastructure at grade already in public ownership can be modified to accommodate bus lanes. It can thus be rolled out rapidly and can be operated without subsidy at affordable fares. BRT systems can be either open or closed (restricted access to special bus lanes) and usually run on trunk and feeder systems. Although they operate at a slower speed than metros, BRTs facilitate closer stop spacing. Private involvement is much more common: many Latin American systems have a single government control agency and multiple operators.

Chinese Example BRT systems are encouraged, and metro development is encouraged only in 'large cities with better economic conditions but more serious problems of traffic congestion'. In intermediate cases, light rail transit is developed. Buoyant demand, lower costs, and a central government willing and able to invest in infrastructure mean that viability of metros is easier to justify. The central government has defined protocols (Decree 81, 2003) for MRT technologies (three are specified), approval procedures, construction standards and safety requirements, as well as management systems for construction and operations. This standardisation improves costs and efficiency. Criteria were established for metro development in cities (see table below): high population (>3m), high GDP (>RMB100bn p.a.), high passenger demand (>30,000 passengers/hour/direction). Cities are also required to invest 40 per cent equity in metro projects to guard against excessive borrowing.

CRITERION	METRO	LRT
City population (Million)	>3	>1.5
City GDP (RMB p.a.)	>100bn	>60bn
City GDP (USD p.a.)	>16bn	>9.6bn
City GDP per capita (USD p.a.)	>5,333	>6,400
City budget income (RMB p.a.)	>10bn	>6bn
City budget income (USD p.a.)	>1.6bn	>0.96bn
Passenger demand (passengers/hour/direction)	>30,000	>10,000
City equity investment (this guards against excessive borrowing)		>40 per cent

N.B. USD-CNY exchange rate as of October 2012
Source: Developing Public Transport, Ken Gwilliam, August 2011

advice. The potential for conflict was realised during the development of the Delhi metro, in which the Managing Director of the Metro and Railways disagreed over the gauge to be used. Railways prevailed in that case, but the question of jurisdiction was re-examined by a Group of Ministers. The GoM and the Cabinet decided that urban transport should be a state subject, but with national guidance in the form of a Model Law to be drafted by the Ministry of Urban Development. The so-called 'Guided Urban Transport Act' was drafted, circulated, but not passed. The Metro-Railways Act was revised in 2009 to reinstate urban transport as a Union subject, as before with safety oversight by the Ministry of Railways.

As mentioned earlier, India's level of national government control over airport development is unusual among large federations. State governments can propose new airports or expansion of existing airports but cannot currently initiate these developments without national approval. Devolving greater autonomy in airport development would enable closer integration of planning for rural road transport with air connectivity, and is consistent with the chapter on Civil Aviation's (Volume III, Chapter 3) emphasis on the importance of remote connectivity. To quote from the Report of the Working Group on Civil Aviation:

'Airports cannot be built in isolation. There is a need for seamless coordination with other state agencies to develop ground support and logistics to provide surface connectivity. Appropriate access through road connectivity is an essential part of airport infrastructure. Delays in building road connectivity to New Bangalore airport, for example, resulted in negative implications for the facility. There is therefore a need for effective coordination between road development agencies both at the Centre and in the states, besides coordination with the railway authorities to enable seamless intermodal connectivity for passengers and cargo to and from the airports.' (NTDPC, 2012c)

Devolution of authority would create both incentives and the institutional basis for such 'seamless' connectivity.

URBAN TRANSPORT: BUILD EXPERTISE, PUBLIC AND PRIVATE

National government policy has followed two main approaches for encouraging more integrated, programmatic urban transport planning: conditionalities for intergovernmental transfers and constitutional mandates to create new integrative agencies. Neither has been effective, nor will they be until metropolitan transport authorities have access to sufficient technical expertise to respond to regional transport needs. Independent Unified Metropolitan Transport Authorities should serve as institutional focal points for extensive investments in expertise in cities above one million, while state governments support smaller urban areas. Such investment should be centred at the metropolitan level, in keeping with principles of subsidiarity and international 'best practice.'

India's level of national government control over airport development is unusual. Devolving greater autonomy to states would enable closer integration of planning for rural road transport with air connectivity, and also ensure better remote connectivity

More autonomous metropolitan planning committees, as currently required by the Constitution but only partially enacted, are also required for more general management of India's larger cities. We reiterate others' calls to move forward on the constitutional mandate for devolution. Here, we propose three interim actions.

BUILD CITY-LEVEL CAPACITY BY ESTABLISHING A 'CENTRE OF EXCELLENCE IN URBAN TRANSPORT' IN EACH MILLION+ CITY.

Local think tanks, research institutions, and universities can play an important role in generating and evaluating policy options as well as providing policymakers with information from comparative experience. Technical support for the existing UMTAs already comes from outside the government, including expertise from multilateral development banks (World Bank in Mumbai), civil society inputs (such as Chennai City Connect and Institute for Transport and Development Policy in Chennai), and academic insitutions (e.g. TRIPP at the Indian Institute of Technology, Delhi).

There are no bars to funding city-specific initiatives with researchers aligned with metropolitan interests, at least as residents. These centres will take some time to become 'excellent,' but would be valuable assets for the metropolitan government as it consolidates. Public funds could also have additional leverage if urban-interested private citizens and state governments co-invest. This strategy of autonomous capacity-building also does not create a lasting bureaucratic imprint and potential to cement state dominance of urban transport. This geographic focus may be considered as part of the HRD strategy.

INVEST IN UNIFIED METROPOLITAN DATABASES

Urban transport generally impacts areas larger than a city's administrative jurisdiction, hence regional officials should often be involved in setting priorities. Finally, implementation ability can also come

Box 5. 6
Operator Collaboration: The German Verkehrsverbund

All of the major German speaking urban areas in Europe (i.e. Germany, Austria and Switzerland) have a quasi-independent Verkehrsverbund (VVB). The largest of these, the Verkehrsverbund Rhein-Ruhr, covers the area of the Rhine-Ruhr, an area of some 5,000 km² with more than seven million inhabitants, and encompasses several cities. Others are more dispersed. For example, in the Rhein-Neckar region, the Verkehrsverbund Rhein-Neckar (VRN), which was founded in 1989, initially served the Rhein Neckar Area, but has since grown beyond its borders to cover an oblong area of 10,000 km² with a population of three million, including Mannheim and Ludwigshafen, Heidelberg, Kaiserslautern, the entire Palatinate Forest and the northernmost parts of Baden-Württemberg. VRN is owned by the three states, cities and rural districts whose area it serves. Some, like the VV Overelbe around Dresden, are more simply concentrated on a central city and perform the function of integrating the city with its suburbs and dependent rural areas.

The development of the VVB since 1970 has been in three phases. In the first phase, the VVB was simply a tariff association (public transport companies accepting each others' tickets leading to associated tariffs). In the second phase, the VVB moved on to be a broader transport association, being involved in coordination and increase of transport planning and marketing, as well as coordinated timetables for public transport. Finally, in its more advanced stage, the VVB became involved in shared timetables and common tariff setting on a contractual basis. The larger VVB now typically plans services, sets fares and timetables, markets services, coordinates fare integration between modes, and procures bus services from private sector operators. A consequence of the harmonisation of fares and aggregation of income in a single collection is that some operators gain and some lose. Hence the VVB in its most advanced form has needed to become a kind of clearing house, allocating income between the different operating agencies.

The legal structure of the VVB has developed with its functions. In the first phase, as is still the case in Warnow, the VVB was simply a voluntary association of operating companies. Later it became an association involving operators and local government representation. Finally, and now most commonly, it has become a non-operating company, jointly owned by the local authorities, regions and states, all of which have some involvement in the financing and management of urban transport.

To give an example, the Verkehsverbund Oberelbe serves an area of more than 4,800 sq km., stretching along both sides of the Elbe River from the Czech border in the south to the state border with Brandenburg in the north. The entire area has a population of 1.2 million. The Upper Elbe region has traditionally had one of the densest public transportation networks in Europe. For local rapid transit, there are 3 S-Bahn (urban railway) lines, 21 regional lines and two narrow-gauge railways. The city and the regional public transportation systems are also above average. There are currently 208 regional bus lines, 13 tram lines, 66 city bus lines, 19 ferries and two mountain railways that regularly service the VVO area. Passengers can use a total of 3,800 train stations and other stops to get into and out of their chosen means of transport.

The Verkehrsverbund Oberelbe uses more than 1,000 vehicles (buses, trams and trains). All together the buses and trains travel more than 62 million scheduled kilometres per year (as a comparison: the distance from the sun to the earth is 149 million kilometres.) The buses, trams and trains drive on a network that has a total length of almost 7,000 km. Every year, DB Regio, the local traffic subsidiary of the Deutsche Bahn (German rail), travels more than 8 million kilometres on behalf of the VVO. That is around one-third of the total rail traffic in Saxony..

In an integrated public transport system, task sharing between he public transport authorities and the operators is crucial. The VV Oberelbe, is organised on three levels. On the strategic level, political responsibility lies with Zweckverband Verkehrsverbund Oberelbe (Z-VOE), which makes political decisions and establishes guidelines for the development and performance of public transport. Z-VOE is guided by the associated district administrators and city mayors. On the tactical level, Verkehrsverbund Oberelbe GmbH (VVO GmbH) is the direct partner of public transport operators and other economic partners and is responsible for the development of tariff, network, service and marketing issues. It manages public service contracts and the integrated public transport system. On the operational level, the individual public transport companies are responsible for the performance of the railway, tram, bus and ferry services. In some cases, as in the Rhein Neckar VVB network, the operators are also organised in a company form, Unternehmensgesellschaft Verkehrsverbund Rhein-Neckar GmbH (URN)..

The distinguishing features of the Verkehrsverbund approach are (i) the organic way in which they have grown and expanded their aspirations; (ii) the continued emphasis on voluntary collaboration between independent operators. (iii) the limitation of the activities of the VVB to public transport, and (iv) the very wide and disparate areas over which they operate.

Excerpted from Annex 2 of Gwilliam, Kenneth, 2011. 'Institutions for Urban Transport,' Paper 5 prepared for the NTDPC and World Bank. August 10, 2011

from public or private organisations and need not always be locally rooted. The key is that the collection of public and private institutions be able to share information at all stages of a transport plan–from project and technology identification to implementation and maintenance–and have a clear process for discussion and decision making as well as incentives to deliver their part of the overall plan.

TRIAGE FOR PUBLIC TRANSPORT

Transport governance can be successfully created even in relatively newly formed metropolitan entities, but public transport will need to improve even faster, before metropolitan governance is consolidated, to prevent a difficult-to-reverse shift to private vehicles as incomes rise. Rapid improvements in public transport are especially important for diverting the ongoing transition from non-motorised to private motorised transport, especially two-wheelers.

Hanoi's experience in managing the growth in two-wheelers illustrates the consequences of disconnects between various forms of public transportation.[53] The city attempted to attract new motorcycle/car users to rely on public transportation instead of private transport but failed because the public transport alternative that it developed was not integrated across bus and rail, and the bus system failed to keep up with demand for both quality and quantity of service. Gwilliam (2011) attributes this problem in part to role of the incumbent public transport company (bus) in operation of bus routes, the lack of a coordinating agency to oversee segregation of bus routes from other traffic and coordinate investment in BRT when these were being made. He also cites delay in creating a comprehensive transport authority and limited capacity of the body that was eventually designated responsible for strategic planning.

This kind of outcome could be stopped with early attention to a subset of urban transport governance–coordinating existing public transport–as the broader frameworks evolve. Local efforts to integrate could be supported by demand-driven national challenge grants to pay for systems integration for ticketing and scheduling, investment in pedestrian and shelter facilities at points of interchange, small feeder buses, or other equipment as needed to improve mobility. Unified ticketing to create a seamless customer interface could also help articulate demand for public transport more clearly by helping providers track route use and passenger habits more consistently. Operator collaboration can also evolve into important contributions to the overall governance framework, as the German example in Box 5.6 illustrates.

Such a move would also be important for sustainability. Schipper, Banerjee and Ng, cited in Hidalgo, et al (2011) project that energy consumption in Indian urban transport will grow from 1.6 EJ in 2000 to 6.1 EJ in 2030 if the current movement to private transport continues. But more than 25 per cent of the energy use expected in a business-as-usual scenario could be saved if cities shift their trajectory toward more public and non-motorised transport.

Second, it will be important to establish the basis for more deliberate and informed comparisons of costs and benefits of rail and bus-based systems.

SUMMARY

The first two parts of this sub-section discuss immediate steps toward creating national and state institutions with the authority and ability to coordinate forward-looking investments in the backbone of the transport infrastructure as well as guide regulation and other policies to ensure effective utilisation of the physical infrastructure across the country. It also recommends establishing a national 'Office of Transport Strategy' (OTS) to host data and technical expertise for developing, monitoring, and refining longer-range strategies for transport as the Ministry of Transport comes together. In the long run, the OTS could perhaps be absorbed as the technical secretariat for the Minister of Transport.

53. Gwilliam, Ken (2011).

The state-level transport agencies would perform a similar technical role in designing transport programmes, leaving implementation to the existing Departments of Public Works. It would work closely with the State Urban and Rural Development Ministries as well as the Chief Minister on transport planning to address state development, and be the primary liaison to the national government for intergovernmental coordination of transport investment and policy. It should have sufficient financial resources to undertake comprehensive studies and data collections within its jurisdiction, maintain a high quality professional staff and access specialists from around the world as needed.

In the long run, there is no substitute for establishing financially independent, well-staffed urban governments that would undertake transport among other roles. In the short run, however, we focus on building the information base and capacity, inside and outside government to enable more informed decision-making by the current collection of stakeholders, including the urban citizens who have emerged as a more vocal political force in recent years. .

CONCLUSION

India faces three main institutional challenges in developing the governance infrastructure to support a transport system that will meet its needs over the coming decades. First, India will have to shed the old version of directive planning to move to a new skill of facilitation, recognising that capital investment in transport infrastructure and regulation or policy are instruments to affect the transport system rather than decrees that determine its final shape. Ultimately, mobility for passengers and services for freight are the products of individual responses to existing infrastructure and policy structures. Similarly, the transport system is one of many contributors to an emerging economic and social geography that is also the product of millions of households' and businesses' decisions about investment, living, travel, investment, and consumption.

Second, it will have to integrate decision-making across agencies that have historically focused on particular modes of transport and between elements of the system. Policies concerning physical infrastructure, its use, and investments in rolling stock have historically been undertaken in different parts of the federal system and agencies within each level of government. India's fragmentation of transport investment planning between modes of transport stands out in comparative context: it is the only country among the hundred largest economies that continues to maintain separate ministries for each mode of transport. India's allocation of responsibility across levels of government and separation of decision-making about investments in physical infrastructure versus efforts to system capacity through better management of existing facilities is more in line with international practice, but leaves much room for improvement. This fragmentation is deeply rooted in India's bureaucracy and will be difficult to overcome, but the process must begin.

'Integration' does not mean centralised decision-making, but rather setting up of systems for information flow, knowledge generation, and continuous, interactive dialogue between relevant organisations throughout the project cycle. This challenge is an old one. To quote from Hayek (1945)[54]: the 'problem of what is the best way of utilising knowledge initially dispersed among all the people is at least one of the main problems of economic policy—or of designing an efficient economic system.' We must move toward decentralised coordination, enabled by information flow among agencies with clear responsibilities and the financial and human resources to carry out their mandates. Transport planning is far too complex a problem to be conclusively solved by algorithm, even if data and reliable projections were available. It would be dangerous to rely on such an approach.

Third, it will have to reconsider the division of authority between levels of government. Transport governance in India is far more centralised than international practice, in part because of constitutional divisions of authority that have become monopolies on oversight rather than designation of leadership among collaborators, in part because of the power that fiscal centralisation awards to the Union government, and in part because of the allocation of and adaptation to scarce technical capacity. The changes we recommend here start to re-align transport governance with the principles of subsidiarity in federal design.

THE ROAD AHEAD

It is extremely important to understand that an 'integrated' approach to transport planning does not mean centralised decision making, but rather setting up of systems for information flow, knowledge generation, and continuous, interactive dialogue between relevant organisations throughout the project cycle. This chapter emphatically argues for a move toward decentralised coordination based on the principle of subsidiarity, enabled by information flow among agencies with clear responsibilities and the financial and human resources to carry out their mandates.

India's transport governance must move toward five significant changes over the next decade:

- i **Creating a consolidated Transport Ministry to focus on systemic performance;**
- ii **Setting up an Office of Transport Strategy (OTS) to coordinate transport policies at the national level.**
- iii **Clearly decentralising policy and planwen-**

54. Hayek, Friedrich (1945).

ing authority including urban transport to the constitutionally recognised urban and metropolitan governments;

iv **Building a comprehensive regulatory environment to govern transport flows, and**

v **Building an interdisciplinary cadre of transport experts.**

India must initiate the institutional investments summarised in the table below. As we discuss throughout the chapter, transport governance organisations and practices along the lines that we recommend have taken decades to develop in other countries that are under fewer fiscal, growth, and resource constraints.

	IMMEDIATE REFORMS	LONGER RUN GOALS	BRIEF RATIONALE
National	Formation of high-level, independent Office of Transport Strategy (OTS)		Required to move toward investment and strategy for transport as an integrated system
	National Transport Infrastructure Finance to be neutral with respect to means of delivering mobility, sustainability, and inclusion goals.		Principle of subsidiarity, enables experimentation and responsiveness to varied needs.
		Merge existing mode-specific Ministries into a single Transport Ministry	
State	Establish urban transport as a subject to state level.		Principle of subsidiarity. Reduce current fragmentation across road, rail, paratransport, non-motorised modes. Integrate infrastructure investment and regulatory/management oversight.
	Develop formal mechanisms for state participation in decisions about initiation, siting, size, and other aspects of airports and rail-based transport that have significant impact on regional transport systems.		
	Formation of state-level counterparts to the OTS, with particular focus on urban transport		See above. Also builds counterparts for communication between levels of governments and states
Metropolitan	Creation of UMTAs with statutory authority, independent budgets, expert personnel in all urban agglomerations with population greater than three million.		Immediate need for strategic approach to transport in mega-cities to ensure continued economic dynamism, extension of jobs creation, inclusion.
		Creation of UMTAs with independent statutory authority, independent budgets, expert personnel in all urban agglomerations with population greater than one million.	Move over time to global standard, especially as metropolitan governance is strengthened.
	Formation of metropolitan planning committees as per Constitutional mandate.		Important to integrate transport in a broader planning and investment framework. Principle of subsidiarity. Long-standing Constitutional mandate. Basis for innovative, responsive urban governance; global standard practice.
	Creation of public-private centres of excellence in urban transport in all cities larger than one million.		Builds urban transport expertise with local interests and roots as a resource for metropolitan transport authorities
	Invest in unified metropolitan databases		Facilitates transport system and other planning as well as de facto integration of planning across multiple agencies using the same images of the city.

Annex 5.1

Transport Decision Makers by Mode in India

MODE	FIXED FACILITIES			OPERATIONS		
	CENTRE	STATE	LOCAL	CENTRE	STATE	LOCAL
Roads	Ministry of Road Transport and Highways	PWD/ RD/Roads Departments	Panchayats and ULBs (maintenance)	Ministry of Road Transport and Highways	Road Transport Corporations	Local Bus Transport Corporations (although leadership often appointed by state government)
	National Highways Authority of India	Road Development Corporations		Ministry of Environment and Forests	Legislative Assemblies	
	Ministry of Urban Development	Land Development Authorities		CBCP	Transport Corporation Authorities (e.g. Metro)	
	Planning Commission	Transport Corporation Authorities (e.g. Metro)		Parliament: (Motor Vehicles Act 1988, Central Motor Vehicle Rules 1989)	RTOs	
	Border Roads Organisation					
	Ministry of Rural Development					
Civil Aviation	Ministry of Civil Aviation	State JVs for some airports		Airports Authority of India,	State Departments of Civil Aviation	
	Airports Authority of India			Directorate General of Civil Aviation		
	Airports Economic Regulatory Authority (AERA)			Bureau of Civil Aviation Security (BCAS),		
				Airports Economic Regulatory Authority (AERA)		
Ports	Ministry of Shipping, National Shipping Board	State Governments of maritime States	Involved in decisions about expansion of connecting infrastructure.	Directorate General of Shipping, Tariff Authority for Major Ports, Indian Coast Guard	State Governments (Minor Ports)	Involved in decisions about use of connecting infrastructure.
		Committee of Maritime States				
		Private companies (captive ports)				
Rail	Ministry of Railways, Zonal Railways	Metro Rail Corporations	Inputs on Metro/ Urban Rail	Ministry of Railways, Commission of Railway Safety, Indian Railway Catering and Tourism Corporation Ltd.		
				Zonal Railways (Southern Railway, South Central Railway and others)		
Inland Waterways	Inland Waterways Authority of India			Inland Waterways Authority of India, Indian Coast Guard	State legislation for registration and permits, e.g. Kerala Inland Vessels Rule	

Annex 5.2

Division of Responsibilities in Other Federations

SOUTH AFRICA Overarching Entity: Ministry and Department of Transport						
MODE	FIXED FACILITIES			OPERATIONS		
	CENTRE	STATE	LOCAL	CENTRE	STATE	LOCAL
Roads	South African National Roads Agency	Department of Transport (for most provinces). However, they only handle road transport.		Cross Border Road Transport Agency, Road Traffic Management Corporation, Road Accidents Fund, Road Traffic Infringement Agency	Department of Transport	Municipal Transport Authority, City Department of Transport
Civil Aviation	South African Civil Aviation Authority			Airports Company South Africa, Air Traffic & Navigation Services		
Ports	National Ports Authority			South African Maritime Safety Authority, Ports Regulator		
Inland Waterways						
Rail	Passenger Rail Agency of South Africa			Railway Safety Regulator		

ARGENTINA Overarching Entity: Ministry of Transport						
MODE	FIXED FACILITIES			OPERATIONS		
	CENTRE	STATE	LOCAL	CENTRE	STATE	LOCAL
Roads		Provincial Road Department			Provincial Road Department	City Governments
Civil Aviation	National Civil Aviation Administration	Office of Provincial Air Navigation Management		Regulatory Body of National Airports System		
Ports	National Secretariat of Ports and Navigable Ways			General Ports Administration		General Ports Administration
Inland Waterways	National Secretariat of Ports and Navigable Ways					
Rail	Privatised, major public carriers include Ferrobaires (Rail Buenos Aires)					

NIGERIA Overarching Entity: Federal Ministry of Transport						
MODE	FIXED FACILITIES			OPERATIONS		
	CENTRE	STATE	LOCAL	CENTRE	STATE	LOCAL
Roads		State Ministry of Transport	State Metropolitan Area Transport Authority	Federal Roads Maintenance Agency	State Traffic Management Authority	State Metropolitan Area Transport Authority
Civil Aviation	Nigerian Civil Aviation Authority			Nigerian Civil Aviation Authority		
Ports	Nigerian Ports Authority			Nigerian Maritime Administration and Safety Agency		
Inland Waterways	Nigerian Inland Waterways Authority	State Waterways Authority		Nigerian Inland Waterways Authority	State Waterways Authority	
Rail	Nigerian Railway Corporation			Nigerian Railway Corporation		

CHINA Overarching Entity: Ministry of Transport and Ministry of Railways						
MODE	FIXED FACILITIES			OPERATIONS		
	CENTRE	STATE	LOCAL	CENTRE	STATE	LOCAL
Roads	Highway Bureau					City Municipal Committee of Transportation
Civil Aviation	Civil Aviation Administration of China					
Ports			City-level Port Authority	China Ports and Harbors Association, China Maritime Safety Administration		City-level Port Authority
Inland Waterways	Water Transport Bureau, Yangtze Navigational Authority, Pearl River Navigational Authority					
Rail	Ministry of Railways	Regional (Not provincial) Railway Boards			Regional Railway Boards	

MEXICO Overarching Entity: Secretariat of Communications and Transport						
MODE	FIXED FACILITIES			OPERATIONS		
	CENTRE	STATE	LOCAL	CENTRE	STATE	LOCAL
Roads	Directorate General of Road Development		Department of Public Works	Directorate General of Road Maintenance		(City) Ministry of Municipal Utilities, Department of Public Works
Civil Aviation	Directorate General of Civil Aviation			Airports and Auxiliary Services		Airports and Auxiliary Services
Ports	Directorate General of Ports					Port Authority
Inland Waterways						
Rail	Directorate General of Railways and Multimodal Transport			Privatised		

USA Overarching Entity: Department of Transport						
MODE	FIXED FACILITIES			OPERATIONS		
	CENTRE	STATE	LOCAL	CENTRE	STATE	LOCAL
Roads	Federal Highways Administration (Federal Lands Highway Program)	State Department of Transportation, State Bridges Authority, State Thruway Authority	Metropolitan Transit Authorities	National Highway Traffic Safety Administration, Federal Motor Carrier Safety Administration	State Transportation Commission, Traffic Safety Commission	Metropolitan Transport Authorities, Quasi-Private agencies (eg. South Jersey Transportation Authority),
Civil Aviation	Federal Aviation Administration	State Aviation Administration			State Aviation Administration (or multi-state group as in the case of the Port Authority of NY and NJ)	City Transportation Division, Quasi-Private agencies
Ports	Maritime Administration Office of Infrastructure Development & Congestion Mitigation		Port Authority (working alongside with a consortium of private firms)			Port Authority
Inland Waterways	U S Army Corps of Engineers	State Waterways Advisory Board			State Departments (for eg. Washington State Ferries), State Canal Corporations	
Rail	Federal Railroad Administration			National Railroad Passenger Corporation (Amtrak), Alaska Railroad Corporation		

<table>
<tr><th colspan="7">CANADA
Overarching Entity: Transport Canada</th></tr>
<tr><th>MODE</th><th colspan="3">FIXED FACILITIES</th><th colspan="3">OPERATIONS</th></tr>
<tr><th></th><th>CENTRE</th><th>STATE</th><th>LOCAL</th><th>CENTRE</th><th>STATE</th><th>LOCAL</th></tr>
<tr><td>Roads</td><td rowspan="4">Transport Canada</td><td>Provincial Ministry of Transportation</td><td></td><td>Road Safety Directorate</td><td></td><td>City-level Transport Commissions (eg. Toronto)</td></tr>
<tr><td>Civil Aviation</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Ports</td><td>Local Port Authorities</td><td>Canadian Coast Guard</td><td></td><td>Local Port Authorities</td><td></td></tr>
<tr><td>Inland Waterways</td><td></td><td></td><td></td><td>Provincial Ministries of Transport</td><td></td></tr>
<tr><td>Rail</td><td colspan="6">Via Rail, Privatised, major players include Canadian National Railway and Canadian Pacific Railway</td></tr>
</table>

BRAZIL Overarching Entity: Ministry of Transportation						
MODE	**FIXED FACILITIES**			**OPERATIONS**		
	CENTRE	**STATE**	**LOCAL**	**CENTRE**	**STATE**	**LOCAL**
Roads	National Agency for Land Transportation, National Department of Transport Infrastructure	State Road Transport Department		National Road Transport Department, National Transit (Road Transportation) Council	Road Transport Department	
Civil Aviation	National Civil Aviation Agency of Brazil					
Ports	National Department of Transport Infrastructure, Port Authority, National Agency for Waterway Transportation			National Department of Transport Infrastructure		
Inland Waterways	National Agency for Waterway Transportation			National Department of Transport Infrastructure	Private Entities	
Rail	National Agency for Land Transport, VALEC Engineering, Construction and Rail			Privatised		

Annex 5.3

Transport Planning Responsibilities: Union Government

PLANNING COMMISSION TRANSPORT DIVISION (discussed at length in main text)

Ministry of Civil Aviation: (http://www.civilaviation.gov.in/)

'This Ministry exercises administrative control over attached and autonomous organisations like the Directorate General of Civil Aviation, Bureau of Civil Aviation Security and Indira Gandhi Rashtriya Udan Academy and affiliated Public Sector Undertakings like National Aviation Company of India Limited, Airports Authority of India and Pawan Hans Helicopters Limited. The Commission of Railway Safety, which is responsible for safety in rail travel and operations in terms of the provisions of the Railways Act, 1989 also comes under the administrative control of this Ministry.'

Ministry of Shipping (http://shipping.gov.in/)

'The Ministry of Shipping encompasses within its fold shipping and ports sectors which include shipbuilding and ship-repair, major ports, national waterways, and inland water transport. Ministry of Shipping has been entrusted with the responsibility to formulate policies and programmes on these subjects and their implementation.'

Ministry of Road Transport and Highways (http://morth.nic.in/)

'An apex organisation under the Central Government, is entrusted with the task of formulating and administering, in consultation with other Central Ministries/Departments, State Governments/UT Administrations, organisations and individuals, policies for Road Transport, National Highways and Transport Research with a view to increasing the mobility and efficiency of the road transport system in the country. e Ministry has two wings: Roads wing and Transport wing.'

National Highways Authority of India (www.nhai.org)

'The National Highways Authority of India is responsible for the development, maintenance and management of National Highways entrusted to it and for matters connected or incidental thereto.'

Ministry of Railways (http://www.indianrailways.gov.in/)

Oversees and manages all aspects of rail infrastructure, rolling stock, service, operated by Indian Railways and overseen by the Railways Board.

Ministry of Rural Development/Department of Rural Development (http://drd.nic.in/)

'Keeping in view the fact that Rural Roads are vital to economic growth and measures for poverty alleviation in the village, Government have launched a 100 per cent Centrally Sponsored Scheme called the Pradhan Mantri Gram Sadak Yojana (PMGSY). The Programme seeks to provide connectivity to all unconnected habitations in the rural areas with a population of more than 500 persons through good All-weather roads by the end of the Tenth Plan Period. In respect of the Hill States (North-East, Sikkim, Himachal Pradesh, Jammu & Kashmir, Uttaranchal) and the Desert Areas, the objective would be to connect habitations with a population of 250 persons and above.'

Ministry of Urban Development (http://urbanindia.nic.in/)

'The Ministry of Urban Development is responsible for formulating policies, supporting and monitoring programmes and coordinating the activities of various Central Ministries, State Governments and other nodal authorities in so far as they relate to urban development issues in the country.' The work allocation includes Urban Transport among other areas of infrastructure and services.

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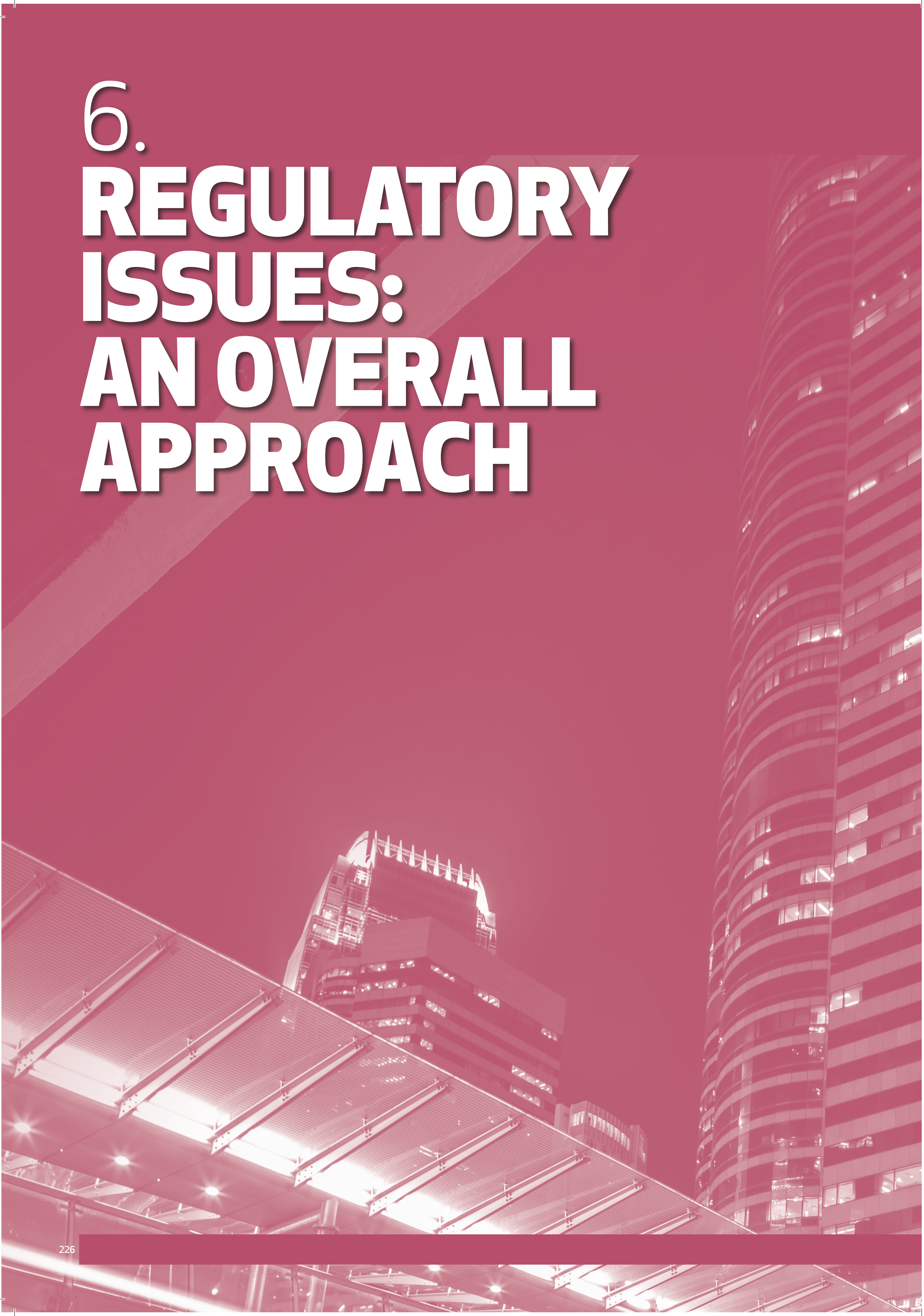
6. REGULATORY ISSUES: AN OVERALL APPROACH



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6. REGULATORY ISSUES: AN OVERALL APPROACH

Recognising the importance of transport and inadequacies in the network, India's 11th Five Year Plan had envisaged investment of $ 500 billion to modernise, expand and integrate the country's transport infrastructure and other infrastructure services such as power, telecom and urban infrastructure[1].

The 12th Five Year Plan has doubled the expected investment in infrastructure to $1 trillion[2]. Even this increased amount is hardly going to suffice given the demands that are likely to be placed on transport and other infrastructure services by a rapidly growing economy. Thus, it is both necessary and perhaps inevitable that the role of government change from that of a producer to an enabler as well. This chapter discusses an important part of that transition: the development of a regulatory framework for guiding public and private contributions to India's transport development.

Regulation is an extensive theme. The difficulty of arriving at a precise definition of regulation among other aspects of policy and administration has been widely recognised, due in part to the several justifications that have been advanced for regulatory intervention from different theoretical perspectives[3]. We define it here as the set of organisations and policy statements that establish and clarify the 'rules of the game' for both public and private actors involved in infrastructure and service delivery. 'Regulators' are the organisations charged with clarifying and applying rules to specific cases, ideally in an apolitical manner. As a discipline, regulation is best approached from multiple perspectives using instruments of economics, political economy, law and public policy[4]. As an instrumentality of the state, regulation is happily no longer seen in a state versus market dichotomy, but rather as one that reflects the changing role of the state towards market-led development[5].

Regulation is an essential part of the foundation for collaboration between public and private sectors in delivering and managing transport infrastructure and services. This collaboration is inevitable, but its outcomes will be determined by the quality of the framework for the interaction. In a country of India's size and diversity, the demands on the public purse are enormous[6]. Growing fiscal deficits and lack of fiscal consolidation restrict the ability of the state to fund capital-intensive infrastructure projects. This constraint has stimulated the development of innovative models of engaging with the private sec-

1. 11th Five Year Plan.
2. 12th Five Year Plan.
3. See Johan den Hertog (2010) Breyer (1984) for a discussion of regulatory justifications.
4. Morgan and Yeung 2007: An Introduction to Law and Regulation.
5. Kohli (2009): State Directed Development.
6. See, for example, Budget documents of various years.

The pendulum is shifting back towards a greater private sector role in financing, owning and operating transport, with public influence wielded through policy and regulations. 'Ownership' may not be the most effective way to influence transport development

tor in India and elsewhere. Since public investment will coexist with private in all transport sectors, including as public-private partnerships (PPP), the State has to be effective not only in service delivery, but also in regulation, contracting and policymaking to obviate, *inter alia*, conflicts of interest. Private sector participation however requires creating independent and effective regulatory mechanisms to ensure, on the one hand, fair returns to private investment, and on the other, protection of consumer interest, including safety and affordability. India has, thus far, been slow in creating these institutions in all areas of transport. We hope to accelerate the process by providing a clear roadmap for regulatory development as part of a larger portfolio of transport governance reforms.

The chapter addresses both general principles of regulation as well as specific recommendations for the Indian context. After the recent decades of private sector participation in traditional infrastructure industries, there is broad recognition of the need to embed it in the wider social and constitutional context—for locating it within the dynamics of state-market relations i.e., within the local context.[7] Comparative studies of regulation in other sectors have also emphasised the interplay between policymaking institutions, representative governance, the judiciary and so-called 'regulators' in creating the full 'regulatory environment'[8].

BEYOND OWNERSHIP: REGULATION AS A POLICY TOOL TO SHAPE INFRASTRUCTURE OUTCOMES

Regulation and other policy frameworks for shaping private decisions have replaced public ownership and direct planning as the primary means of public influence on transport infrastructure. Public and private sector roles in transport infrastructure have evolved over time. Private companies played a significant role in building transport networks in the 18th and 19th centuries as part of efforts to access new sources of profit such as natural resources and land for settlement. Much of the US railway system, for example, was built by private corporations with state charters. The United States (US) Army Corps of Engineers contributed civil engineering expertise and Army officers often managed parts of railway operation. American states also chartered private companies to build some of the initial highways in the late 19th century. England's rail network was initially developed by private companies focused on freight rather than passengers, while its competitor, England's canal network, was state-owned, although steamboats were run by private companies. Rail networks of China and India were initiated by foreign companies in the late 19th century.

The public sector took on a more prominent role in provision of transport infrastructure in the 20th century[9]. Public sector ownership was viewed as a way to ensure broad access, as many transport services had natural monopoly characteristics. Supply responsibilities were assigned to the state primarily because of high upfront costs and long payback periods that the public sector was seen as better able to accept. The indivisibilities in infrastructure investment and presence of externalities also limit the prospects for user charges to cover return on investments. Moreover, it was widely believed that government ownership of transport infrastructure facilities and services was the best way to achieve multiple government objectives: not just facilitating commerce, but also increasing mobility, labour migration in the shift from agriculture to industrial employment, and national integration (and international integration in the case of Europe).

The pendulum is shifting back towards a greater private sector role in financing, owning and operating transport (Box 6.1), with public influence wielded through policy and regulation. 'Ownership' is merely one means of control over infrastructure delivery, and not necessarily the most effective way to influence transport development. There is ample evidence from across the world suggesting that protected state-owned monopolies have failed to respond to demands for expanded service or improved quality[10]. Public funding dulls the incentive to respond to customers, while government mandates to provide services may be simply infeasible if they are not accompanied by sufficient financial, technology and human resources to deliver these outcomes. Inclusive, efficient transport cannot simply be decreed without an institutional framework that guides investment and management toward public goals.

The United Kingdom (UK) and the US led the shift to a hybrid approach of private ownership and/or financing, with public policies and regulation as instruments to shape infrastructure providers' incentives to provide wide access to services, consider environmental impacts, and meet other non-commercial goals. These two countries rushed

7. Döhler (2011). It is however necessary to note the origins of the concept in the United States, where 'it appeared as a form of state intervention, enforced by specialised agencies, situated at "arm"s length" from direct political control'.
8. See, for example, Levy, Brian and Pablo Spiller (1996).
9. In the 19th century, however, a good portion of infrastructure investments, particularly investments required to open up access to natural resources or new areas for development, were provided by the private sector. See Rakesh Mohan India Infrastructure Report.
10. Ashley C. Brown et al Handbook for Evaluating Infrastructure Regulatory Systems World Bank 2006.

Box 6.1
Shifting Roles in Infrastructure Provision

Regulatory reforms in infrastructure provision—transport and otherwise—have often been pushed by economic circumstances and observations of failures in the reigning model of public finance, ownership and operation. The efforts to strengthen incentives for performance by leveraging competitive pressure have played out in various ways across regulatory environments, offering both cautionary tales and some lessons from experience.

In the late 1970s, the United States initiated wide-ranging regulatory reforms because of serious challenges—including stagflation, energy crises, double-digit inflation, increased environmental concerns, the bankruptcy of backbone industries (such as railways), and a perceived erosion in national productivity and international competitiveness. Deregulation was based on the premise that unleashing competition among service providers would lower inflation and restore productivity growth. At the same time, concerns about the energy crises and environmental protection facilitated the introduction of economically efficient pricing, which was expected to discourage wasteful consumption.

During the same period, large-scale privatisation began in the United Kingdom in 1984, when 51 per cent of British Telecom was sold to the private sector. The company's divestiture was driven by the government's desire to remove telecommunications investment from its balance sheet in order to meet its targets for public borrowing. The subsequent privatisation of other utility industries was accompanied by radical regulatory reforms. Several new regulatory bodies were created, and new tasks were assigned to existing agencies such as the Monopolies and Mergers Commission. Meanwhile, members of the European Union increasingly came to see state-owned monopolies as hindrances to international trade in goods and services. Thus in the 1990s, a series of directives were issued to create a single market where goods, services, people, and capital could move freely. These directives spelled out rules for telecommunications, railways, electricity, and natural gas markets across European Union member states, mapping out a common regulatory framework and liberalising these industries.

As the United States deregulated, the United Kingdom restructured and privatised, and the European Union issued directives calling for extensive liberalisation and building a single market, a powerful privatisation movement began sweeping developing and transition economies. For many developing countries, the primary push for privatisation came from the debt and fiscal crises of the early 1980s. Another major impetus came from the extraordinarily weak performance of infrastructure. Moreover, unrealistic price controls resulted in enterprises being subject to financial distress and impairing their ability to mobilise investments and provide reliable services. In a globalised economy, poorly performing state-owned infrastructure providers were increasingly seen as constraining economic growth and undermining international competitiveness. Developing countries simply could not continue to absorb the fiscal burden of these enterprises.

Over the past decade, there has been more attention to the challenges of industrial restructuring and the details of policy implementation, as well as careful assessment of the costs and benefits of these reforms. While it is clear that structural changes and realigning the roles of the government and the private sector are important for delivering infrastructure, we are still learning about the best combinations of public and private sectors in financing, owning, operating and maintaining infrastructure.

Source: World Bank 2004 Reforming Infrastructure Privatisation, Regulation, and Competition.

toward privatisation and deregulation, beginning with telecommunications and air travel in the mid-1980s, and moving on to more difficult and challenging sectors such as railways, ports and roads[11]. Latin America and other lower-income regions joined in the shift in the 1990s, motivated by disappointment with ineffective state-operated utilities, the promise of private funding, and the greater flexibility offered by technological change and regulatory changes. Private investment in infrastructure in Latin America increased from about $17 billion in 1995 to a peak of more than $70 billion in 1998[12].

The early 2000s witnessed a rethink of the dogmatic rejection of the State-led model of infrastructure provision. In November 2005, 78 per cent of Argentines surveyed desired that infrastructure be brought back under government control[13]. This reflects a gen-

11. Thoopal R.K. (2000).
12. Luis A. Andrés et. al (2008).
13. Op cit.

Box 6. 2

Main Messages of World Development Report 1994

- Infrastructure can deliver major benefits in economic growth, poverty alleviation, and environmental sustainability, but only when it provides services that respond to effective demand and does so efficiently.
- The causes of past poor performance, and the source of improved performance, lie in the incentives facing providers. These incentives are shaped by stakeholders including investors and customers, as well as the regulatory context.
- Manage infrastructure like a business, not a bureaucracy: manage personnel to encourage organisational focus on meeting customer needs.
- Introduce competition—directly if feasible, indirectly if not; it can create incentives for innovation and efficiency.
- Give users and other stakeholders a strong voice and real responsibility.
- Public-private partnerships in financing have promise, this potential requires careful planning and allocation of roles to be realised.
- Governments will have a continuing, if changed, role in infrastructure.

eral trend in Latin America where approximately 75 per cent of the population on average expressed discontent with private sector participation in infrastructure in 2005. The public opposition stems from its perceived adverse impact on key variables such as tariffs, employment and coverage. On the other hand, private sector participation had a significant positive effect on labour productivity, efficiency and quality in telecommunications, electricity and water[14]. At the same time, in 2005, the private sector seemed to have lost its appetite for infrastructure in Latin America, illustrating a precarious combination of relatively low public and private infrastructure investment.

Beginning with the economic liberalisation of the 1990s, the State in India started to vacate some of the commanding heights of the economy, in which State responsibility for provision of infrastructure and services was synonymous with ownership. India's transport infrastructure is evolving towards more private participation, although the pace varies substantially across sectors[15]. The institutional framework for this move remains incomplete, with ongoing debates about consolidation of authority within and across levels of government, formal and informal rules of operation, the degree of consultation among stakeholders, the extent of regulatory capture, appointments to existing institutions, accountability and transparency in decision making, and opportunities for dispute settlement, among other topics.

The new approach makes space for PPPs combined with regulation to address 'market failures' to protect the public from such evils as monopoly behaviour, 'destructive' competition, the abuse of private economic power, or the effects of externalities[16]. The command and control mode is thus being replaced by a new mode of regulatory governance where PPPs and private sector participation require governmental priorities to be achieved through independent regulation and the law of contract. The proliferation of regulatory commissions and parastatals in India is a manifestation of the changed role of the State. It is reassuring that the awareness of the need to establish, and the benefits of establishing, an effective regulatory regime appears to be increasing.

First, it is important to emphasise that understanding of how to combine public and private sector strengths in infrastructure provision is still evolving. Some broad principles for motivating infrastructure provision are well known and have been known for decades. Box 6.2 summarises lessons from a survey of literature in the mid-1990s that are still relevant today. In particular, contained competition is important and increasingly possible. It is now widely recognised that some (if not all) transport operations can be undertaken by the private sector in some form, activities that may motivate public performance as well as supplement gaps in public provision. Recent changes in technology also offer increased scope for the introduction of competition horizontally and unbundling of services supplied vertically. Even where direct competition between suppliers is not achievable, greater use of market forces is still possible. For example, in terms of transport facilities, competitive award of long period concessions, licences or facility leases can be used to improve efficiency, the terms and conditions of such leases being set by an independent regulatory body with the objective of stimulating efficiency.

14. Op cit.
15. Seddon, Jessica, and N.K. Singh (2013) 'Moving India: The Political Economy of Transport Sector Reform,' in Hope, Nicholas, Kochar, Anjini, Noll, Roger, and T.N. Srinivasan, Eds. Economic Reform in India. Cambridge: Cambridge University Press; Mohan, Rakesh (1996), 'India Infrastructure Report'.
16. Op cit.

In case the facility is operated by the public sector, pricing and other decisions should be subject to the oversight of an independent regulator with the aim of reproducing the outcomes of a competitive marketplace. Second, management matters. Public and private practices for risk management, project management and technology innovation can both contribute to delivering infrastructure effectively and efficiently. The move to rebalance public and private roles also includes efforts to shift public companies toward more 'private-sector' orientation. Public and private-sector norms for corporate governance, human resource and compensation policy are starting to converge, and the 'public sector' does not have to be inefficient. State-owned enterprises in China have produced a large number of world infrastructure records, such as the largest hydroelectric project, the Three Gorges dam, and 6,400 km of high-speed rail besides new airports and railway terminals[17].

Third, both public and private sectors have important roles to play. Transport infrastructure cannot be fully commercial, given social externalities. Low levels of infrastructure investment are a concern because of the widely-documented link between infrastructure and growth, productivity, and poverty reduction[18].

However, there are no detailed blueprints for leveraging policy, public finance rules, and the market environment from suppliers to customers, to guarantee effective delivery of transport infrastructure. Moving forward, an ideologically-neutral approach towards infrastructure development and maintenance is fundamental. Wherever possible and justified, private provision of transport services will be advantageous and at the same time, the public sector will continue to play a role in both actual investment and in delivery of services while its role in regulation will be fundamental.

If anything, in India the government's evolving role in regulation could be the difference between good and 'not so good' outcomes. Effective regulation—including the setting of adequate tariff levels—is the most critical enabling condition for infrastructure reform. Crafting proper regulation is the greatest challenge facing policymakers in developing and transition economies. The new agenda therefore calls for the introduction of a robust framework for transport regulation, including for PPPs so that the much needed investments can fructify. A vast amount of empirical evidence gathered over the years suggests that the quality of regulation matters for sector performance[19]. Among the most critical tasks for policy makers is therefore to design and implement stable and effective regulation for infrastructure, thereby reducing a lot of existing and unwarranted governmental intrusion.

A robust regulatory culture is particularly important in today's fiscal environment. The massive investment requirement in maintaining existing and creating new public transport infrastructure means that governments will have inadequate resources at the best of times to finance the transport needs of a growing economy. In times of fiscal stringency, the need for private participation becomes de rigueur. While we have made the transition from exclusive provision by the public sector to a situation where there will be many entities, public and private and combinations of both, the rules of engagement must be better defined for the benefit of investors, service providers and consumers. The large requirement of funds needed to improve the quality and quantity of infrastructure can be met, in part, by tapping global capital markets, but the terms of these transactions and their costs for the country depend on the quality and credibility of regulation. Sovereign-wealth funds are in fact favouring infrastructure projects to avoid the volatility of the stock market. The Boston Consulting Group (BCG) argues that over the next 20 years, the BRIC countries will account for more than half of the growth in road travel and more than 40 per cent of the growth in air travel[20]. In order to leverage these developments, India needs to immediately establish a robust institutional and regulatory mechanism to attract much needed capital to beef up its transport infrastructure, whether driven by the State, the private sector or by PPPs.

WHY REGULATE?

Governments regulate to overcome market failures, or the consequences of markets' inability to direct effort toward public goals that cannot readily be priced or bought and sold through exchanges (Figure 6.1). In general, regulation can be defined as the use of legal instruments for the implementation of social-economic policy objectives[21]. These instruments can force individuals or organisations to comply with prescribed rules under penalty of sanctions. For example, regulated firms are often obliged to observe certain prices, maintain a minimum quality or service, or face sanctions.

A distinction is usually made between economic and social regulation[22]. Economic regulation consists of two types, structural regulation and conduct regulation. Structural regulation is used for regulating market structure. Examples are restrictions on entry and exit, rules governing mergers and acquisitions, and subjecting supply to recognised qualifications, such as in the case of professional services. Conduct

17. Op cit.
18. Both foreign and domestic investors routinely cite infrastructure as among the most severe constraints for increasing investment. See for example The Global Infrastructure Challenge: Top Priorities for the Public and Private Sectors, BCG 2010 op cit.
19. See for example Luis A. Andrés et. al (2008).
20. Op cit.
21. Johan den Hertog (2010).
22. For example, Viscusi,Vernon and Harrington (2005).

Box 6.3
The New Economics of Industrial Organisation

The traditional approach to assessing market power in the industrial organisation literature is the Structure-Conduct-Performance paradigm (SCP). The S-C-P approach assumes a stable, causal relationship between the structure of an industry, firm conduct, and market performance as measured by economic profits. Typically, the set of observable structural variables are measures of seller concentration and barriers to entry and the line of causality is envisaged to run from structure through conduct to performance or the exercise of market power. The implication is that concentration facilitates the exercise of market power. In contrast to this industry approach, the new economics of industrial organisation emphasises that industry structure is not merely an exogenous determinant of conduct and performance, but is instead endogenously determined by the competitive process in a given industry. For example, if sunk costs (irreversible commitments) exist, then the potential entrant must always consider how the incumbent firm will respond to entry. Thus the new model makes the firm the centre piece of analysis. Firms differ in the products they sell, their organisation form and internal efficiency. It is the drive to be different that encourages dynamic competition of the Schumpeterian sort. This firm approach reverses the link between structure and conduct and performance; it is firm specific efficiency advantages that determine how large a firm grows and therefore industry concentration. Thus more efficient companies with superior products or services grow to be larger than other firms. According to this logic, dominance and its abuse cannot readily be inferred from market share since it ignores importance of competitors, extent of entry and exit barriers, countervailing buying power and importantly the source of high market shares. The relation between structure and market power is therefore far from being unambiguous. America's soft-drink industry, to take one example, is noted for price competition although only two firms, Coca-Cola and PepsiCo, control three-quarters of sales. The implication of this is that economic regulation based solely on market share analysis is likely to be incomplete and misleading.

Source: Economics of Regulation and Antitrust, Viscusi,Vernon and Harrington (2005). See also Avinash Dixit (1980) Williamson (1985) Demsetz (1982), Dennis C. Mueller (1988).

regulation is used to regulate behaviour through price controls and/or minimum quality standards. Economic regulation is mainly exercised on natural monopolies and market structures with limited competition where firms possess and exercise market power but has become more nuanced in recent times (Box 6.3).

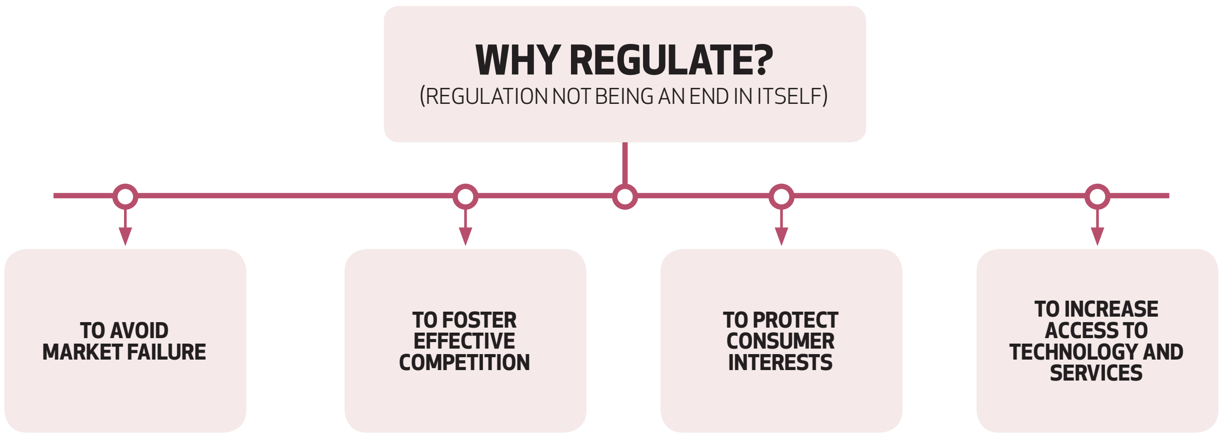
Social regulation, on the other hand, includes setting standards relating to safety, health and environment. Instruments applied here include regulation dealing with the discharge of environmentally harmful substances, safety regulations in supply and in factories and workplaces, the obligation to include information on the packaging of goods or on labels, the prohibition of the supply of certain goods or services unless firms possess a permit[23].

In most developed economies, the allocation of scarce resources is to a large extent coordinated by the market and economic theory has shown that under certain conditions this arrangement is optimal[24]. The conditions for market efficiency are however extremely demanding in practice. The theory requires that competition must be 'perfect', i.e. there must be many buyers and sellers, goods from competing suppliers must be indistinguishable, buyers and sellers must be fully informed and markets must be complete[25]. Thus, the existence of monopolies, public goods, externalities and asymmetric information that distort the allocation of resources, individually and severally, all result in pervasive market failures in practice. For the reason that these demanding conditions are frequently not achieved in practice, government regulation is required to improve the allocation of resources[26].

Addressing market failure to meet the public interest, however, is a non-trivial task. There are occasions when markets correct their own failures or may require very little, regulation in order to improve the allocation of resources. Monopoly, for instance, may seem to preclude an efficient market. But if barriers to entry are low, lack of actual competitors does not prove that the monopoly is damaging: the threat of competition may be enough to make it behave as though it were a competitive firm. The role of the government in some cases could thus be limited to reducing remaining entry barriers. That is why it is important to judge whether a market is 'contest-

23. Johan den Hertog op cit.
24. Arrow (1985).
25. State and the Market, Economist, 1996.
26. Arrow (1970); Shubik (1970).

Figure 6.1
The Goals of Regulation



Source: ICT Regulation Toolkit.

able'—that is, whether barriers to entry are high before deciding the extent and nature of regulatory intervention. (Box 6.3)

On the other hand, if a 'natural monopoly' (whose costs fall indefinitely as it increases its output) exists, from the point of view of productive efficiency, public interest would recommend concentrating the production in a single company. A monopolist striving for maximisation of profits will set a price that deviates from the marginal cost. The pursuit of productive efficiency and excessive profits in such instances will conflict with the public goal of allocative efficiency, i.e., too little of the good will be provided. Natural monopolies are therefore either subject to extensive price regulation or are provided by the State, as happens in many European countries. Regulation in such cases seeks to achieve the outcomes of perfect competition by simulating conditions. Examples of natural monopolies are the fixed infrastructure components of railways, electricity transmission and distribution, gas and oil pipelines and the like. Telecommunications was also once considered a natural monopoly. Today, however because of new technology and deregulation, it is an intensely competitive business, including in India, and therefore subject to only limited tariff regulation[27].

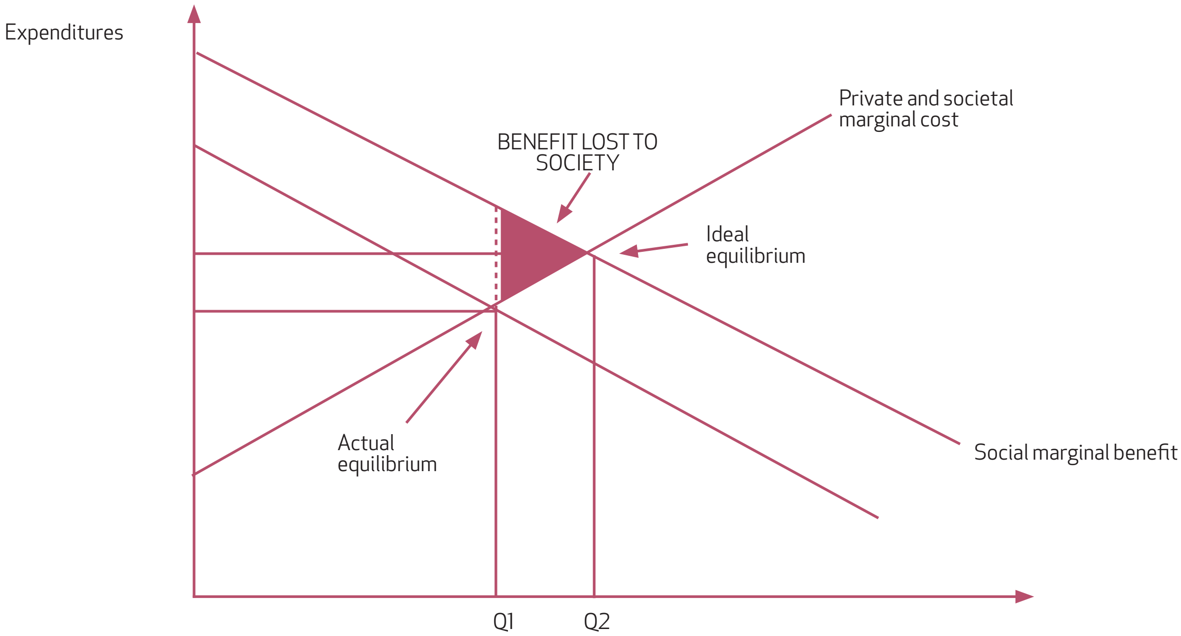
From the point of view of public interest, government regulation is also necessary where markets do not exist at all. This occurs in the presence of information problems and when transaction costs are excessive, such as in the case of externalities and public goods[28]. When it is not possible to establish the quality of goods or services in advance due to information asymmetries, *adverse selection* could occur, resulting in high-quality goods being driven out of the market by low-quality goods[29]. Consider the market for used cars. A buyer, lacking reliable information, may extract signals of quality based on average price. If sellers reduce price, buyers might be led to believe that the cars being offered for sale are 'lemons' or of poor quality, resulting in the complete breakdown of the market. In addition, incomplete and asymmetric information could also give rise to moral hazard which creates incentives for parties to misuse their information advantage. The markets for professional services, such as medical, law and architecture are examples. Problems of adverse selection and moral hazard also arise in markets such as those in insurance in which there is no incentive for the contracting parties to truthfully reveal information about individual risks[30]. Certifications, licenses and trading regulations are often used to overcome problems relating to adverse selection and moral hazard.

In addition to information failures, very high transactions costs can also result in missing markets. In a market economy, resources are efficiently used when the production of goods is increased until marginal costs equal the marginal benefits of production (Figure 6.2). 'Externalities' prevent the market from reaching this socially efficient equilibrium. For example, the cleanup cost of environment damage is often ignored by firms making their production decisions. The cost is therefore 'external' to the firm and borne by people with no say in deciding how much is produced. In the case of 'bad' externalities such as pollution, markets will produce too much of it; in the case of 'goods', too little[31]. Ronald Coase argued that, so long as property rights are clearly established,

27. TRAI (2012).
28. Samuelson (1954), Akerloff (1970), Greenwald and Stiglitz (1986).
29. The classic discussion is the used car market due to Akeroff, op cit.
30. Stiglitz op cit.
31. Consuming some goods (education, anti-lock brakes) spreads benefits beyond the buyer; again, this will be ignored when the market decides how much to produce. See Joseph Stiglitz (1986).

Figure 6. 2

The Private Market will Underinvest in Infrastructure, Foregoing Societal Benefits



externalities will not cause an inefficient allocation of resources[32]. While Coase's insight was useful in that markets might find ways to 'internalise' the externalities, the presence of very high transaction costs will prevent that from happening frequently enough, obliging the government to intervene to correct the market failure. Limits for automobile emission or permits for discharge of hazardous substances are examples. Accordingly, it is through the regulation of fuel quality and emission limits of motorised vehicles that auto emissions have been reduced.

Missing markets may also occur in the case of public goods[33]. One major reason why infrastructure receives much policy attention is that it displays features of what economists refer to as public goods. Public goods have two unique characteristics. For the supplier of public goods, it is either impossible or too expensive to exclude people from consuming it; the technical term for this is 'non-excludability'. For example, if a buyer refuses to pay for an iPad, it will not be supplied. But if a buyer refuses to pay for national defence, the service cannot easily be withheld. The temptation, therefore, on part of the consumer is to let others pay, the so-called free-rider problem[34]. Like national defence, there are other services such as law and order and clean air that are practically 'non-excludable' and since private sellers cannot expect to recover the costs of production, supply will not be forthcoming[35]. In addition to non-excludability, consumption of these types of goods by one person is not at the expense of another; the technical term for this is 'non-rivalry in consumption'. Classical examples are lighthouses, public order, street lighting and national defence. Because of the free-rider problem and the inability to establish a willingness to pay for these goods, markets will not supply these goods in optimum quantities, if at all. Government regulation or direct supply thus becomes inevitable both for supply and for designing payment methods for these goods[36]. Many other goods, such as education, healthcare, parks and within the transport sector, roads, also have public good characteristics.

In economics textbooks, the all-time favourite example of a *pure public good* is a lighthouse; since its services are both non-excludable and non-rivalrous, only the state could be expected to provide it. Conversely, markets work best in providing pure private goods or services. Such a neat example (the lighthouse), cited by economists for several years has to now contend with changes that have occurred in technology and in recent thinking in the provision of such goods. For example, television broadcasting was considered both non-excludable and non-rivalrous. Due to improvements in technology, it is now easily excludable: satellite broadcasters collect a subscription, and in return provide a card that

32. According to the Coase theorem, an efficient allocation of resources can result from a process of negotiation in the case of clearly defined property rights and in the absence of transaction costs. See Ronald Coase (1960).
33. See Samuelson op cit.
34. See Paul Samuelson (1954).
35. State and the Market: Economist, 1996, Vol. 338 Issue 7953.
36. See Joseph Stiglitz (1986).

Table 6.1
Economic Framework Infrastructure/Public Goods

BASIC PROBLEMS	SOLUTIONS
INFRASTRUCTURE	
Long horizon/Economies of scale	Natural monopoly/duopoly
Supports wide range of activity	Positive externalities
PUBLIC GOODS	
Non-rivalrous	Social obligations
Non-excludable/ Externalities	Public support for investment/ Allows internalisation

Source: Mark Cooper (2005).

unscrambles the signal to enable viewing. Tolls are used to restrict access to certain roads and also serve as a method to cover costs (and provide a profit)[37]. The government's role in this case is confined to authorising the collection. Increasingly, markets could be relied on to supply 'quasi' public goods or 'club goods' but that will need carefully designed and enforceable regulation.

Table 6.1 provides a schema developed by economists to analyse the fundamental issues that arise due to the existence of public goods and the nature of the corresponding intervention that seeks to address the problem. Markets in which economies of scale are extensive, for example in provision of port facilities or rail track, will result in one or two firms dominating the market with the attendant need for regulation or with public provision of these facilities. Rural roads result in externalities and will therefore need public support for the investment.

These market-strengthening innovations for private provision of public goods will however depend on how practicable and feasible pricing is for the specific good in question[38]. Further, even if pricing is feasible, its nature will vary across sectors and within a sector, and will need to be regulated not only for efficiency enhancements but more importantly for reasons related to access and equity. That there exists a trade off between economic efficiency and equity is not new. Regulation in the public interest that aims exclusively for economic efficiency may not be just or equitable and hence will have to be expanded to achieve social obligations[39]. In a broader interpretation, regulation for public interest not only attempts to address market failure but also aims to correct inequitable market outcomes[40]. According to this view, regulation can be construed as the socially efficient use of scarce resources. Examples are the design of minimum wage laws, cross-subsidies in postal systems and in passenger transport, and rules enhancing the accessibility of health care to lower-income or more remote populations. In the transport sector, for example, Indian Railways has been cross-subsidising passengers from the tariffs it receives from freight: hence the recommendation for a rail tariff authority, which has already been approved by the Government. This Authority should be constituted early.

The reason distributional considerations assume importance is that such investments in infrastructure often result in positive externalities that are unlikely to be captured by unregulated markets (Figure 6.2)[41]. Since private benefit is lower than social benefit, the market will produce less than socially efficient output. The resulting underinvestment is the deadweight loss or the 'Harberger' triangle, after the economist Arnold Harberger[42]. In other words, the private market undersupplies the public good, even though it is good for the public. To resolve this, governments often support public investment in infrastructure. Empirically there are clear linkages between infrastructure and public goods. Such investments generate widespread spillovers and enable 'crowding in'. The last few years, especially since the financial crisis, have seen a number of governments invest millions of dollars in infrastructure, particularly high-speed telecom broadband infrastructure. This investment is intended to capture positive externalities by stimulating economic activity since the private market will not invest in or will delay the deployment of such large-scale infrastructure projects. Public investment helps solve the problem of the inability to internalise externalities in private market transactions. In addition, as a practical matter, when infrastructure projects are first deployed and for a large part of their economic life, they tend to be uncongested and therefore non-rivalrous and unattractive for private investment[43].

37. Op. cit.
38. Using the price mechanism for resource allocation is efficient under certain conditions. See First Welfare theorem.
39. Paul Joskow (1988).
40. Richard Posner (1974).
41. Network effects associated with certain infrastructure investment means that the value of the infrastructure investment increases with the number of users. The literature on network effects distinguishes between "direct network effects," of the sort associated with computer software and "indirect network effects," which result in more supporting services around the initial investment. Formally, a good exhibits network effects if the demand for the good depends on how many other people purchase it. The classic example is a fax machine; picture phones and email exhibit the same characteristic.
42. Harberger, Arnold C. 1954. American Economic Review. May, 44:2, pp. 77–87.
43. Mark Cooper (2005).

Table 6. 2
The Public Good Character of Transport

	EXCLUDABLE	NON-EXCLUDABLE
RIVAL	**PRIVATE GOODS**	**COMMON PROPERTY**
	a) Urban Bus	a) Urban Roads
	b) Rail, Airport, and Port Services	
NON-RIVAL	**CLUB GOODS**	**PUBLIC GOODS**
	a) Inter-Urban Highways (toll roads)	a) Rural Roads
	b) Rail, Airport, and Port Services	b) Street Sweeping
		c) Traffic Signaling

Lower ← Externalities → Externalities

Source: Adapted from World Development Report 1994, The World Bank.

Such examples pervade the transport sector. Private sector port terminals need initial public investment in development of the basic port infrastructure; private airport investment cannot be made without the public provision of air traffic control; and initial investment in expressways is unlikely to be remunerative.

Economists are divided in their views regarding the prevalence of market failures. Some view the government's task as ensuring that all impediments to the proper functioning of markets are removed, i.e., regulation ought to be minimal. On the other hand, there are those who support a more active role for public policy since market failures can be pervasive. Indeed, Stiglitz has argued that contrary to the traditional view that market failures are the exception, such failures may be so pervasive as to be the norm[44]. However, it is not at all obvious that government will necessarily succeed where markets have failed. Consequently, not all cases of market failure will be amenable to correction through government action. The key to effective government intervention, therefore, lies not in demonstrating the existence of market failures (and thereby establishing a rationale for government intervention) but rather, one of identifying the nature of the intervention that would make it worthwhile.

One of our chief tasks in this chapter is to understand the kind of market failure in transport and the nature of regulatory intervention that would be effective specifically in the transport sector in India.

THE NEED FOR REGULATION IN TRANSPORT

The combination of the sector's large potential impacts on development, its distinctive technological and economic characteristics that are in sharp contrast to most other goods and services, make infrastructure subject to special policy and regulatory attention. These characteristics include[45]:

- Extensive economies of scale and scope that generally lead to market concentration and limit competition. As a result regulation cannot be completely abolished.
- Large sunk costs relative to fixed and variable (avoidable) costs. Sunk costs are those that in the short- and medium-term cannot be eliminated even by ceasing production. Such costs impose considerable risks and so discourage entry by new service providers.
- Services deemed essential to a broad range of users, making their provision and pricing politically sensitive.

Most parts of the transport infrastructure, and all transport services are private goods with potential for market failure, locating them firmly in the territory where regulation, rather than ownership is an important tool for achieving public policy goals (Table 6.2).

Services provided by the transport sector are excludable in a specific sense—their use depends on gaining access to a facility or network, for example railways, ports, airports and to urban transport services. The use of these services is and has been subject to an explicit charge in most economies. However, once a user is connected to the network utility or gains access to the transport facility that usually entails huge upfront investment, the degree of rivalry with other users depends on the costs (including congestion) imposed on existing users or on the service supplier when an additional service unit is consumed. Congestion is customary on urban roads especially during peak hours.

While transport infrastructure facilities (rights of way, track, terminals and associated traffic management) involve heavy upfront investment and display significant economies of scale, service provision (conveyance of passengers and freight) varies from being monopolistic (railways) to competitive (trucking

44. Stiglitz, J.E. (1989), The Economic Role of the State, Oxford: Basil Blackwell.
45. Savedoff and Spiller (1999).

and bus services). Consequently, trucking services are provided almost exclusively by the private sector in most countries. Besides, certain services are entirely similar to private goods, such as urban bus transport, while others such as port, air and rail services may be private or 'club goods' depending upon congestion. These services also often exhibit positive externalities: hence the existence of subsidies in public provisioning. Rural roads are the main exception and closest to being public goods: they are non-excludable (except in very specific cases where geography prevents an alternate transport path from being built), and non-rivalrous because they are rarely so congested that one person's use of the road substantially affects another's experience.

These characteristics have important implications for the manner in which transport infrastructure and services should be provided. To the extent that specific infrastructure activities entail economies of scale or depend on a network characterised by natural monopoly, they will not be efficiently provided in an unfettered market. In addition, transport is pivotal to economic development, and its inadequacy a major constraint to socio-economic progress[46].

Congestion is not the only externality that transport infrastructure and services create. Decisions about infrastructure investment, for example in roads versus public transport, rail and waterways, for example, affect energy efficiency and thus India's prospects for energy security and fiscal health. The current allocation of freight traffic between road and rail is one such negative externality. Indian Railways' (IR) relentless cross subsidisation of passenger travel with high-freight tariffs has resulted in IR losing market share to trucking, further affecting its ability to fund capacity enhancing and quality improving investments. All of India's high-density rail corridors face severe capacity constraints. As a result, India presently endures severe and chronic under-investment in railway infrastructure. The resulting diversion of freight and passenger traffic to roads, imposes a heavy burden in terms of a much larger freight cost to GDP ratio and higher environmental cost per route km of freight and passenger traffic compared to other countries. This report is therefore recommending significantly increased investment in the railways, on a proportionate basis.

Transport services and choice of vehicle and fuel affect air pollution, which in turn negatively affects public health. On the positive side, transport infrastructure, like other networks, produces 'network effects' meaning that the value of the economic activity the infrastructure supports expands simultaneously and potentially non-linearly[47]. The social impact of additional investment may be higher whenever a significant network size (or critical mass) is achieved. For example, research has shown that Indian states that achieved a penetration rate of 25 per cent or more in mobile telecommunications experienced significantly higher growth impacts compared to States that were below the threshold, i.e., the impact of telecommunications on growth is amplified by network effects[48]. This means there is an important milestone for policy makers for all types of infrastructure subject to network effects.

> Introduction of private sector participation in transport does not eliminate the need for regulation. In fact, it accentuates the role of effective regulation and regulatory institutions. The Indian experience in power and telecom clearly highlights this

Transport safety is also an externality from investments in particular forms of infrastructure as well as an 'invisible' aspect of service delivery. Regulation is thus required to reduce incentives to cut corners in parts of service provision that customers cannot readily assess when choosing which services to purchase.

In short, regulation of various parts of the transport network is needed for various reasons: to limit the potential monopoly power exercised by owners of networks with high capital costs; manage congestion, air pollution, and other negative externalities from use of transport networks; achieve positive externalities including network effects; and motivate investments in 'invisible' consumer goods such as safety. Regulation can be used to encourage extension of access to infrastructure and services to lower-income or remote services, though other instruments such as subsidies to providers or transfers targeted to the interested users are often more effective.

Many countries that have implemented economic reform in transport have sought to increase the role of the private sector in the provision of both transport infrastructure facilities and services. Introducing private sector participation in transport does not eliminate the need for regulation; in fact, it accentuates the role of effective regulation and regulatory institutions. For instance, the introduction of private sector participation in the power and telecommunications sectors in India heightened the need for effective regulation and regulatory institutions in India as these forms of policy influence replaced the mandate that ownership offers[49].

Restructuring of erstwhile monopolies and introduction of competition (where possible) are necessary but not sufficient conditions to improve the techni-

46. Ibid.
47. The magnitude of network effects could of course vary across different types of infrastructures.
48. Kathuria and Uppal (2009).
49. Dubash,and Rao, (2007); Ashok Desai (2006).

cal performance of infrastructure sectors. When the process of restructuring is initiated, these sectors typically exhibit low levels of productivity, prices are often below break-even, and service providers face poor cash flows and encounter difficulties in mobilising the financial resources necessary to maintain and construct adequate additional capacity to meet growing demand[50]. Even after the process of restructuring is started, performance levels continue to be poor due to the quality of regulatory institutions and use of these sectors to pursue a variety of social and political goals. The availability and quality of infrastructure services are often highly politicised, and corruption is widespread. The poor performance of these infrastructure sectors can be a significant drag on economic growth and development[51].

Creating regulatory institutions is challenging and has been a concern for all countries, especially developing and emerging countries. In India, institutional capacity has been weak

Although restructuring to promote competition and regulatory reform to address structural impediments has been initiated, the performance of transport sectors in India remains severely deficient even after two decades of deregulation. India's logistics network, for example, is beleaguered by inefficiencies due to the lack of infrastructure and equipment, high handling costs and damages.[52,53] McKinsey & Company estimates that losses from logistics inefficiencies cost India around $45 billion in 2007[54].

Even after further restructuring, there will be limits to competition in certain segments of the transport sector. Due to the high initial investment in fixed facilities and therefore the need to attain a certain minimum efficient size (MES), transport infrastructure will continue to exhibit important elements of natural monopoly[55]. Because investments in fixed facilities are lumpy, it is often difficult to match the availability of supply with demand at all times, resulting in episodes of overcapacity at the time of investment or under capacity later. Given indivisibilities or 'lumpiness' in investment requirements and the need to expand consumption over a long-time horizon, it is hard for private actors to realise an adequate return on such projects. Under these conditions, it is very unlikely that multiple suppliers will emerge, so the probable outcome is a natural monopoly, or at best a duopoly[56]. In addition, the associated sunk costs aggravate the problem of market power in provision which will inevitably lead to socially suboptimal outcomes if pricing and investment decisions are left unregulated.

BUILDING THE REGULATORY CONTEXT FOR TRANSPORT IN INDIA: CROSS-CUTTING THEMES

This section discusses a variety of issues that must be addressed in introducing competition and designing good regulatory institutions to motivate investment in and management of an integrated transport network for freight and passenger movement. There are four general roles for regulation in transport:

- Ensuring competition among service providers, which includes setting terms and conditions of access to bottleneck network facilities as well as tariff regulation in some cases.
- Setting a framework for PPPs, including resolving disputes that arise over the course of the partnership.
- Consumer protection, including safety and quality of service norms.
- Social regulation to reduce environmental impact and allocate costs of social services such as essential air service, road transport to remote areas, etc.

India's regulatory capacity in each of these areas requires strengthening to achieve minimum capabilities (Box 6.4). While India has been able to attract private domestic entrepreneurs who are willing to finance, operate and maintain mobile pieces of transport equipment trucks, buses, flatcars, ships and airplanes in a competitive environment, the development of an effective regulatory framework that promotes price and service competition has been inadequate. The public sector dominates fixed infrastructure such as roads, ports, rail lines and airports. Due to insufficient or timely investment, these facilities have often become physical bottlenecks to efficient transportation of goods and people. India has implemented regulatory reform in sectors such as telecom and electricity, and in transport sectors such as civil aviation and ports among others, although the governance and regulatory architecture has been subject to several design and implementation problems. All major reforms have been predicated on the expectation that effective regulation of infrastructure monopolies can be implemented fairly quickly.

Yet, building regulatory institutions has, at best been challenging and at worst, a severe disappointment.

50. This has been case for example in Indian Railways, Powerand Urban Transport.
51. Op cit.
52. India has some of the highest logistics costs in the world. India incurs around 15 per cent of its GDP as logistics costs while this figure is only 9.5 per cent for the US and 10–12 per cent for other developed countries. World Bank (2012): Connecting to Compete- Trade Logistics in the Global Economy, Washington, DC.
53. A high percentage of logistics cost in India is accounted by transportation (62%) and inventory carrying costs (34%) followed by administrative cost. (Planning Commission (2009): Report of the Working Group on Logistics, Planning Commission, Government of India, Transport Division, New Delhi).
54. McKinsey & Company (2010): Building India-Transforming the nation's Logistics Infrastructure, July.
55. See for example Joe S Bain (1993).
56. Mark Cooper (2005).

Box 6. 4

What Makes for Effective Regulation

Regulatory bodies should

- have competent, non-political, professional staff—expert in relevant economic, accounting, engineering, and legal principles and familiar with good regulatory practices.
- operate in a statutory framework that fosters competition and market-like regulatory policies and practice.
- be subject to substantive and procedural requirements that ensure integrity, independence, transparency, and accountability.

Source: World Bank 2004.

Seddon and Singh (2013) argue that the delay reflects the challenges of creating new institutions and political-organisational practices. Unless India is able to create a credible, conducive, capable and transparent institutional structure for governance of logistics, the macroeconomic goals of high, stable and inclusive growth will continue to suffer.

Social regulation on environmental issues and consumer protection are addressed in chapters on Safety (Volume II, Chapter 12) and Environment (Volume ll, Chapter 7). This section focuses first on reform sequencing, then on regulatory institutions for promoting competition, setting the framework for PPPs, and ensuring wide access to transport services. The regulatory priorities to support reforms in specific modes of transport are discussed in the next section.

SEQUENCING

Creating regulatory institutions is challenging and has been a concern for all countries, especially emerging and developing countries. In India, institutional capacity has been weak, as it has been so in many emerging markets. Strong institutions take a long time to develop; even in advanced industrial economies which have an established tradition of regulation, the pace has been sluggish[57]. Building regulatory institutions in countries with little or no regulatory tradition in any sector is therefore likely to be much more demanding and a slow process.

The challenges of creating such a context for public and private collaboration in infrastructure provision in India are daunting, but India's experience in telecommunications shows that it is possible. Although marred by recent scandal, the sector has seen the emergence of a governance structure that includes creation of an increasingly independent regulator along with easier rules for market entry, a mechanism for funding of universal access, management of scarce resources, access to interconnection and bottleneck facilities, and enforcement of regulatory rules via the creation of a dispute settlement tribunal. Arguably, the telecommunications sector best reflects the benefits of creating regulatory institutions, albeit even after 15 years in existence, the regulatory processes are still evolving.

To summarise the history: An 'independent' regulator, the Telecom Regulatory Authority of India (TRAI), was created in 1997 but extensive litigation followed its baptism. Many of its initial decisions were challenged since the public sector was reluctant to accept TRAI as the new regulator, a role it had performed since the 1950s. Successive court rulings that followed diluted many of TRAI's powers, especially those that were critical to independent regulation. Thus, the court decisions, *inter alia*, established that the Government was not required to seek a recommendation from the TRAI before issuing additional telecom licenses and that it did not have the power to make regulations on interconnection and revenue sharing, without these being negotiated between service providers[58]. Several disputes later, the Government separated the adjudicatory role of TRAI and created a new Telecom Dispute Settlement and Appellate Tribunal (TDSAT), which paved the way for the creation of many tribunals in other sectors. India's telecom experience confirms what has been known for many years—designing effective regulatory frameworks and enforcing them is highly complex and requires strong political commitment, skilled personnel, and a well-designed incentive structure. The experience also demonstrates that the independence of regulatory agencies may not be easy to create. It necessarily takes time and attributes such as independence and credibility are established on the basis of both legal foundations and actual behavior of the institutions when faced with difficult decisions that involve substantial interest group controversy[59]. Independence, according to one definition, is the ability to implement policy without undue interference from politicians or industry lobbyists,

57. World Bank Telecommunications and Economic Development. Baltimore: Johns Hopkins University Press,1997.
58. Revenue Sharing here refers to the percentage of call revenues to be shared between telecom operators involved in successfully completing a call. In case the dominant operator declines to complete the call or share a fair amount with a new entrant, regulation is vital.
59. William Melody (1997).
60. Ibid.

a test that institutions charged with governance in telecom frequently failed to satisfy[60].

In most countries, the public policy role of the Transport Ministry (and, it usually is a single ministry) has been separated from the economic regulation and/or safety regulation roles (Volume II, Chapter 5)[61]. This is a vital step that is needed right away. In addition to creating independent regulatory institutions in each transport sector, the issue of creating a mechanism for dispute settlement is also important. The state of India's regulatory institutions in transport can at best be described as rudimentary.

For the transport sector, the principle of separation of powers is met only in the breach and is one of the major areas of reform that has been identified in this report. Most transport sectors suffer from poor incentives, lack of clarity in the regulatory structure coupled with overlapping jurisdiction of institutions charged with sector oversight, and a debilitating prevalence of ad-hoc and piecemeal decision making. These have been described in the sector-specific analyses. The coexistence of large, durable assets with significant sunk costs and the highly politicised nature of consumption make certain types of transport infrastructure and similar networked utilities vulnerable to administrative expropriation—both directly and through uneconomic price controls[62]. As a result, private investors reduce their investments, demand high risk premiums, or both[63]. These basic features are common to most transport utilities in varying degrees and create special challenges for effective regulation.

Ministries are reluctant to relinquish control of the sector since it serves short-term political goals. Political constraints and ministerial preferences over time seem to have dominated the reform agenda in different infrastructure sectors[64]. It is time to recognise that institutionalising a robust regulatory philosophy based on a framework with adequate capacity is a necessary, although not sufficient, condition for accelerated and sustainable growth[65]. Experience has also shown that the regulatory strengthening must also happen before restructuring of ownership or lifting of controls on private participation (Box 6.5).

'Separation of powers' has been achieved in India (at least on paper) in the telecommunications sector. The institutional framework that has emerged in telecom and is emerging in electricity conforms to the doctrine of separation of powers. The regulators are separate from service providers while appeals against their orders are heard by Appellate Tribunals that resemble judicial bodies in form and character[66]. This principle has also been applied to the competition and securities regulatory regimes after a prolonged effort.

The first priority for India's transport regulation policy is therefore to create independent regulatory institutions where none exist and to strengthen regulatory independence where they do. The strengthening of the existing regulatory framework along the lines described above and creating new regulators where none exist is essential. Currently, roads, railways and urban transport sectors do not have independent regulators, while the mandate of TAMP is restricted to tariff regulation of major ports. What kind of regulators these sectors need is open for discussion. DGCA performs both policy and regulatory functions for Civil Aviation. This needs to be addressed. A dispute settlement body must also be constituted to ensure transparent administrative procedures and opportunities for judicial review.

Independence of the regulatory agencies in India must be strengthened by insulating them from political pressure to the extent possible. Preserving independence as well as ensuring its legitimacy is a difficult and demanding task, especially for a newly created regulator. To maintain its independence, the regulatory agency should be given functional autonomy in its day-to-day activities while the administrative ministry issues only broad policy guidelines and directives. It is noteworthy that it took several years for TRAI to create a legitimate position within the institutional framework. Establishing an independent regulator is however only a necessary condition for securing legitimacy. One way to ensure the latter is to have a transparent consultative process of decision making and opportunities for judicial review. In practice, this means holding open house discussions and posting consultation documents on the regulators website. This enables the regulator to collect evidence and also take account of the views of those who have an interest in the outcome. Consultation is an essential part of regulatory accountability—and it has now become intrinsic to the regulatory process. Regulatory decisions should be subject to judicial review thereby introducing a reasonable safeguard to regulatory authority.

Financial autonomy is often linked to regulatory independence. In India, this has not yet happened for regulatory institutions[67]. Regulatory institutions are supported by budgetary allocations that can compromise its independence. For example, TRAI is funded by the government and although it has been proposed a number of times, the government has not

61. National Transport Development Policy Committee, (2011).
62. Ioannis Kessides (2004). A key attraction of privatisation is that it places the realignment of prices with underlying costs at the centre of the reform agenda. A similar outcome could be achieved even without privatisation by creating an effective regulatory mechanism that limits or eliminates political interference.
63. Henisz and Zelner (2001).
64. Planning Commission, Government of India (2006).
65. Ibid.
66. Op cit.
67. The regulatory institutions could be financed by a percentage share of sector revenue as is international best practice.

Box 6.5

Why Timing of Regulatory Reform is Important: An Example from Indian Telecom

The change in attitude toward telecommunications was first set out in the National Telecom Policy (NTP) document in 1994. NTP 1994 stated that in order to realise the goals of India's new economic policy (1991), it was necessary to have a world-class telecommunications infrastructure. To achieve these objectives, the policy acknowledged the pivotal role of private investment and therefore NTP 1994 envisaged setting up of an 'independent' regulatory body, the Telecom Regulatory Authority of India (TRAI). Although the policy specified the creation of a regulator, the latter was not set-up until 1997. Meanwhile, implementation of the 1994 policy was carried out by the Department of Telecommunications (DoT). This was faulty institutional design since it gave DoT an enormous advantage over private operators who began commercial operations in Delhi, Mumbai, Kolkata and Madras in August and September 1995. It was later to prove to be a thorny legal matter in regard to the newly-created regulators' powers to give directions to a policy maker that also combined the role of a service provider.

The regime devised by DoT to implement policy was naturally skewed in its favour, especially as it related to its service provision functions. DoT was also not keen on setting up a regulatory body. DoT and its counterpart in Mumbai and Delhi, Mahanagar Telephone Nigam Limited (MTNL) denied or delayed private entrants' access to their networks. In order for communications systems to be effective, it must interconnect with other systems. 'Interconnection' includes both the commercial and technical arrangements under which service providers connect their equipment networks and services to enable their customers to have access to customers, services and networks of other service providers. Private licensees were forced to deal with the incumbents because they were forbidden to directly interconnect among themselves. In addition, all national and international long-distance calls had to be transmitted exclusively through DoT networks in its capacity as the monopoly long distance carrier and interconnection charges were to be borne totally by the new entrants. The effects of unsatisfactory interconnection can undo much of the benefits of good regulation in other areas. Thus, the benefits of private entry can be neutralised by a dominant incumbent, especially in the absence of a regulatory body.

Unchecked, DoT relied on unilateral internal orders in deciding the manner in which private licensees could interconnect to its networks and the process of fresh entry into the nascent telecommunications sector. The inevitable litigation that followed led the Honorable Supreme Court to declare that there had been delay on part of the government to establish an independent regulatory agency.

'The existence of the Telecom Regulatory Authority with the appropriate powers is essential for the introduction of plurality in the telecom sector. The National Telecom Policy is a historic departure from the practice followed in the past century. Since the private sector will have to contribute more to the development of the telecom network than DoT/MTNL in the next few years, the role of an independent telecom regulatory authority with appropriate powers need not be impressed. In a multi-operator environment, an independent evaluation of the economic needs for a new service provider is a condition precedent for on the one hand maintaining investors' confidence and on the other achieving public policy objectives. This is particularly so at this point in India when the Government in the DoT combines itself the roles of a licensor policy maker and service provider'

The creation of the new regulatory agency was a significant event in the need to establish an institutional framework capable of achieving the objectives of NTP 1994. A key defect in implementation of policy was the failure to create a regulatory body prior to inviting bids for private participation in the sector.

Source: Rajat Kathuria in Jaivir Singh (ed) Social Science Press.

Each transport sector is governed by numerous legislations. It is therefore imperative to simplify the legal structure. Existing sector-specific enactments need to be unified into a single statute

accepted TRAI's request for independent funding through a percentage of the revenues of regulated firms. Depoliticising the regulatory process will thus remain an important long-term goal in transport. Financial autonomy, however, may or may not guarantee independence. An additional safeguard to prevent 'political capture' is to make appointment processes transparent and grounds for removal clear and structured for all regulatory institutions. Thus, legislation should guarantee stringent conditions for removal of Member or Chairman of any Authority. For example, the term of the first TRAI was reduced from five to three years after bruising collisions between the newly-established regulator and government, indicating the political control over regulatory institutions[68].

Each of the transport sectors is governed by numerous legislations. It is therefore imperative to simplify the legal structure. This has begun to happen in sectors such as ports and civil aviation but clearly a lot more needs to be done. Existing sector-specific enactments need to be unified into a single statute. This will simplify procedures and make compliance easier. Certain sections of the existing Acts that are anachronistic would also have to be deleted and even some of the Acts repealed. But such unification may not be an easy task, and cannot be achieved within a short period of time. The process of private sector participation should not however be held up, pending completion of the work. Needless to say, a beginning must be made now, even though completion may take some time. Unification of the legislations must be supplemented by the setting up of a statutory regulatory agency for each transport sector as detailed above. Without statutory powers, the effectiveness of this regulatory agency will be lost. This regulatory body could be set up at a central level for sectors such as Civil Aviation. Where a similar body already exists, its role and powers could be suitably modified. Thus, the DGCA and AERA should be replaced by the Civil Aviation Authority (CAA) along the lines described here. If a sector is under state jurisdiction, a regulatory body could also be set up at the state levels. For sectors such as urban transport, different levels of government may be involved—municipalities, provinces or the Central Government. It is recommended that the Metropolitan Urban Transport Authority (MUTA) proposed in Volume III, Chapter 5, on Urban Transport also serve as a regulatory body for urban transport in metropolitan areas.

As independent regulation becomes more the norm rather than the exception, other questions about institutional design arise, namely: should regulation and dispute resolution institutions be created for each sector and sub-sector, or should certain functions be consolidated across sectors? India's piecemeal approach to infrastructure reform has led to the proliferation of regulatory bodies and tribunals. 'Regulatory proliferation' is seen as creating continued employment for the bureaucrats and judges, while professionals with technical expertise have been conspicuous by their absence. Commissions tend to be made up of retired civil servants or retired judges. This is worrisome and therefore it is vital to create a cadre of professional regulators with technical expertise for the complex tasks of managing the regulatory processes. If this implies revising the terms and conditions of appointment to these positions to make them attractive for professionals as is the case in the UK and US, then it should be done. The selection process itself should be transparent and based on skills needed for the discharge of regulatory responsibilities.

The alternative to sector-specific regulation (to mitigate institutional proliferation) is a single-umbrella transport regulator with specialised departments, or multi-industry regulators. In the UK, sector-specific regulatory agencies are the norm while 'multi-industry' regulatory agencies are typical of most state public utility commissions in the US. The primary argument in favour of the single-industry regulatory agency approach is that it ensures deep technical and economic expertise about the attributes of the industry within each agency's regulatory jurisdiction, and that this in turn leads to more effective regulatory decisions. The arguments in favour of a multi-industry or super transport regulator include wide-ranging deployment of common skills avoiding unnecessary duplication, opportunities for cross-learning and adoption of new practices across different sectors. Most importantly, it checks the potential for capture of regulatory agency by single interest groups, especially the firms that are being regulated[69]. There is enough overlap in regulatory issues to make it possible for a single agency to regulate transport. The thematic commonality across the different transport sectors suggest that adopting a multi-industry regulator might make the regulatory process more efficient and transparent. However, it will be a lot more difficult to implement because of the volume of regulation required in the medium term future. There is going to be enough sector-specific regulation necessary in the initial years to warrant deep expertise to be created and this is best done at the level of the sector. For regulation at the state level, they should apply the rules and standards set by the central regulatory body. The NTDPC

68. In a letter to the Minister, the TRAI Chairman sought extension of the tenure of the Authority from three to five years as is the case with other regulators, The Hindu August 15, 2006.
69. Paul Joskow (1998).

therefore recommends the continuance of sector-specific regulators.

In Australia, Brazil, Canada, Germany, Japan, Russia and the US, among others, unitary transport ministries at the level of the central government level have been created whose role is to develop and administer policies to protect and promote public interests across the transport sector. The reason is that integrated national transport policies transcend or augment individual modal interests and achieve superior coordination. China is a partial exception, although it has recently enhanced the Ministry of Transport to bring together responsibilities for national highways, ports and waterways, shipping, airports, aviation and transport integration and most recently, the railways. In India, attempts at merging the broadcasting and communication ministries met with fierce opposition in 2001 and the proposal had to be dropped. To try and integrate all transport ministries under a single integrated ministry will be difficult. However, NTDPC has taken a view that, consistent with almost all other countries, it is desirable to set up a unified Ministry of Transport (Volume II, Chapter 5). It has also recommended the immediate setting up of the Office for Transport Strategy (OTS) to coordinate transport policy in the country. As of now, however, it is neither feasible nor desirable to set up a unified transport regulator, which must remain a long-term vision. There is no doubt that all transport sectors will require coordination even in the short term. Policy on a common platform encompassing the entire transport network spanning different modes and addressing critical issues such as pricing, timely deliveries, and cost effective service need to be positioned.

ENSURING COMPETITION

First, we need to re-examine sector policies to assess whether policy is limiting the competition that is technologically possible, and if so, that the rationale for these policies remains valid.

On occasions, 'natural monopolies' could be driven by policy, even though it might be possible to introduce competition owing to technological advances in certain segments. For example, in telecommunications, it has been possible to introduce competition in the local loop ever since the divestiture of AT&T in the US in 1984[70]. There may however be legitimate reasons for policy to restrict entry even in the seemingly competitive segments in public interest or in the transition period to introducing competition. The latter is especially relevant given that the competitive model poses significant risks if not accompanied by appropriate structural and regulatory safeguards.

As of now, it is neither feasible nor desirable to set up a unified transport regulator, which must remain a long-term vision. Policy on a common platform encompassing the entire transport network and addressing critical issues need to be positioned

Second, there is need to focus regulatory effort on the segments of infrastructure delivery that are not naturally competitive, a process that would be helped by the kind of separation of powers mentioned earlier.

The prospects for competition can change over time with technological progress. Technological progress along with new ways of provision has indeed diluted, although not eliminated, the natural monopoly characteristics in certain segments of telecommunications and electricity infrastructure. Horizontal and vertical unbundling can help to separate the potentially competitive components from the natural monopoly segments. For example, in electricity, transmission and distribution have been successfully unbundled from generation in a number of Indian states[71]. Likewise, in telecommunications, technological progress and advanced thinking have ensured that the local loop can be operated separately from long distance and value added services. This has helped deliver an improved package of service to consumers.

In transport, railroads, tracks, signals, and other fixed facilities could in principle be separated from train operations and maintenance. Sunk costs are less significant for investments in rolling stock or freight-handling equipment than for the fixed facilities. In general, it is easier for firms to enter and exit activities with a relative absence of sunk costs i.e. a feature of markets that economists describe as 'contestable'. Similarly, airport facilities can be operated separately from passenger and freight services and port facilities can be 'unbundled' from handling and maintenance services. Segments where natural monopoly conditions persist and are unavoidable (generally because they involve substantial sunk capital) should be regulated and/or perhaps operated by the public sector[72]. Privatising transport facilities is much less compelling than that for services operating on the network. For rail track, basic and access port infrastructure, and portions of airport facilities—where monopoly is unavoidable or substantial sunk capital is involved—public regulation or even operation is essential[73]. Thus, in the case of both airports and ports, the public authority can act as a landlord, providing all public services, whereas private operators can provide all terminal and other services, while paying user charges to the landlord.

70. Divestiture of AT&T in 1984. For an argument in favour of public policy to support monopoly in the face of declining unit costs see William Baumol, Panzar, John C., and Willig, Robert D., (1982) It was not until 1994 in India that the National Telecom Policy (NTP 1994) first debated the efficacy of private entry.
71. Navroz Dubash and D Narasimha Rao (2007).
72. Ioannis Kessides (2004).
73. Ibid.

According to the World Bank, regulating unbundled utilities is harder than regulating vertically-integrated utilities, and may require aggressive pro-competition policies. But in some transport infrastructures, like rail track and airports, monopolies are unavoidable

On the other hand, where competition is possible, greater reliance should be placed on market forces for resource allocation, with regulatory intervention used as an exception to address the underlying market failure.

While unbundling promotes competition in downstream markets, it brings in its wake a need for providers of competitive final services to access the infrastructure network of the monopoly providers- the so called 'bottleneck' services. An important task for regulation is to ensure fair access to the monopoly network. In one sense, unbundling makes the regulatory task more complex, and requires compelling institutional capacity to drive the reform agenda since new entrants will need constant access to the monopoly network. Coordination is likely to be difficult especially since the incentives of the new entrant and the monopolist are likely to be divergent. For example, DoT's incentives to provide access to its infrastructure to new entrants (who were DoT's competitors in the downstream market) were at best limited; the non existence of an independent and neutral regulatory body exacerbated the problem (Box 6.5). *Although unbundling can reduce the need for regulation by isolating monopoly segments, and replacing regulation with competition, performance becomes much more sensitive to regulatory efficacy because the underlying monopoly segment requires much more effective regulatory oversight.*

In addition, some inefficient practices (such as internal cross-subsidies) that are possible in a monopoly environment are impractical and actually undesirable in the new setting and must be regulated. For example, the State-owned incumbent DoT, in principle, was tasked with fulfilling the Universal Service Obligation (USO) in India, which it did with the higher margins from provision of high value services, such as national long distance (NLD) and international long distance (ILD) and from the higher revenues from commercial and residential customers in urban areas[74]. Once telecom was liberalised in the mid-1990s, sustaining this form of cross-subsidy became difficult since new entrants predictably focused on the lucrative long distance segments adversely impacting the incumbent's profitability. In general, competition puts pressure on the ability of the incumbent to use cross-subsidies to fund its rural and other obligations. Since network expansion, universal access and inclusion are vital public policy goals under most circumstances, regulatory intervention becomes necessary to achieve these goals even after the introduction of competition in the unbundled segments.

According to the World Bank, regulating unbundled utilities is harder than regulating vertically integrated utilities, and may require aggressive pro-competitive policies[75]. In many segments of transportation, such as urban transport, airlines, rail and port services, pursuit of aggressive pro-competitive policies is justified, indeed desirable. For transport network infrastructure such as rail track, port infrastructure and airports, however, monopolies are unavoidable and because substantial amounts of sunk capital are involved, these segments must be regulated or even operated by the public sector.

While the new model offers benefits, these can be realised only if the model is implemented correctly. If not accompanied with effective regulation and regulatory safeguards, the model poses considerable risks. The competitive segments need access to bottleneck monopoly or 'essential facilities' to make competition in these supply segments possible (Box 6.6)[76]. Duplication of infrastructure facilities is costly and therefore the incentives between bottleneck components and competitive segments need to be aligned to avoid distortions such as those witnessed during the early years of telecom liberalisation (Box 6.5). These can be precluded by designing effective regulation with a clear dispute resolution mechanism.

A vexing task for regulators has been designing terms and conditions of access to bottleneck infrastructure facilities by competing service providers. These facilities are essential inputs in the production or delivery of final products, and cannot be economically duplicated. Examples include the local loop ('final mile') in telecommunications, the transmission grid in electricity, the network of pipelines in natural gas, the track in railroads, access to airport terminals and slots and berthing services in a port. The essential facilities doctrine has emerged in response to these challenges.

Economic theory offers two main approaches to efficiently price essential input facilities: the efficient component pricing rule (ECPR-also known as parity

74. The Universal Service Obligation is an obligation which can be imposed upon the dominant telecom operator (usually the incumbent). This obligation includes a demand to meet any request for provision of a particular telecom service to anybody within the country. The purpose of having such an obligation is to ensure national coverage of a particular telecom service also in remote rural areas, where provision of telecom service may become less profitable. ICT Regulation Toolkit ITU (2008).
Universal access policies could be cultural, based on citizenship, equality, and inclusiveness (Goggin, G., and C. Newell(2006); Preston and Flynn (2000); Others have argued that universal service resulted from interest group conflicts for the reallocation of economic resources from business users to residential users, or from urban to rural areas (Crandall and Waverman (2000) Or the state could actively pursue policy options intended to gain or perpetuate the legitimacy of state institutions.
75. Ioannis Kessides (2004).
76. Paul Joskow (1998).

Box 6. 6

The Essential Facilities Doctrine

An 'essential facilities doctrine' (EFD) specifies when the owner(s) of an 'essential' or 'bottleneck' facility is mandated to provide access to that facility at a 'reasonable' price. For example, such a doctrine may specify when a railroad must be made available on 'reasonable' terms to a rival rail company or an electricity transmission grid to a rival electricity generator. The concept of 'essential facilities' requires there to be two markets, often expressed as an upstream market and a downstream market. Typically, one firm is active in both markets and other firms are active or wish to become active in the downstream market. A downstream competitor wishes to buy an input from the integrated firm, but is refused. An EFD defines those conditions under which the integrated firm will be mandated to supply. While essential facilities issues do arise in purely private, unregulated contexts, there is a tendency for them to arise more commonly in contexts where the owner/controller of the essential facility is subject to economic regulation or is State-owned or otherwise State-related. Hence, there is often a public policy choice to be made between the extension of economic regulation and an EFD under the competition laws. Further, the fact of regulation of pricing through economic regulation, State-control, or a prohibition of 'excessive pricing' in the competition law, has implications for the nature of an EFD. Essential facilities doctrines vary significantly among legal regimes. They may vary according to the types of 'facilities', ownership and market structures to which they apply, and according to who makes the determination that a facility is 'essential'.

In the US, four elements are seen as necessary to establish liability under the essential facilities doctrine:

1) control of the essential facility by a monopolist;
2) a competitor's inability practically or reasonably to duplicate the essential facility;
3) the denial of the use of the facility to a competitor;
4) the feasibility of providing the facility.

In Australia, the report on National Competition Policy (the Hilmer Report) recommended that the following criteria must be met for right of access:

1) Access to the facility in question is essential to permit effective competition in a downstream or upstream activity [Access must be essential rather than merely convenient].
2) That it is in the public interest, having regard to:
   a) the significance of the industry to the national economy; and
   b) the expected impact of effective competition in that industry on national competitiveness.

These criteria may be satisfied in relation to major infrastructure facilities such as electricity transmission grids, major gas pipelines, major rail-beds and ports, but not in relation to products, production processes or most other commercial facilities. While it is difficult to define precisely the nature of the facilities and industries likely to meet these requirements, a frequent feature is the traditional involvement of government in these industries, either as owner or as extensive regulator.

Source: The Essential Facilities Concept Organisation for Economic Co-Operation and Development, Paris 1996.

pricing) and the Ramsey pricing rule. It is however difficult to translate either approach into workable rules and access pricing schedules[77]. Interconnection pricing in telecommunications and access pricing in electricity are two familiar examples of access pricing in India where the political economy pressures have been strong[78]. More often than not, the judiciary has had to intervene to sort regulatory decisions, causing avoidable delay in the implementation of decisions. Drawing from this experience and acknowledging the special circumstance of the transport sector in India, the newly-created regulators will need to identify variants of these rules that are technically less demanding and whose information requirement is reasonable, at least to begin with. Regulation thus needs to adapt to the local context, the changing circumstances, and new information and experiences in other regulated sectors.

To secure regulatory fairness in decisions, regulatory bodies should be independent from political interference, be staffed with sufficient skills and use their autonomy to improve transparency in the process (Box 6.4). Often the transition into this new role poses, on the one hand, the risk of 'regulatory capture', a process in which the regulatory body ends up

77. Op.cit.
78. See for example Ashok Desai (2006) and Navroz Dubash and D. Narasimha Rao (2007).

The boundaries between the Competition Commission and sector regulators will have to be established. One possibility is having the sector regulator focus on ensuring a level-playing field, and the Commission identifying anti-trust behaviour given the playing field

identifying mostly with the concerns of the industry, or on the other, it succumbs to excessive government interference resulting in what has been sometimes referred to as 'partial expropriation'. Empirical evidence shows that institutional capacity is a strong determinant of outcomes in regulated sectors, along with a host of other variables such as business culture, interest groups, patterns of social conflict, and codes of conduct[79]. Inevitably local variables or 'country characteristics' strongly affect performance i.e., the local context matters. The structure of ownership (public versus private) on the other hand, is not a key explanatory variable for differences in performance of infrastructure utilities across emerging markets[80].

Third, we need to decide who actually regulates competition. The Competition Commission of India (CCI) established in 2002 will remain the body to resolve anti-trust and competition-related issues. Consolidating competition oversight in the CCI limits fragmentation of scarce expertise and avoids inconsistent policies across sectors that may be administratively distinct but technologically inter-related. While elements of competition oversight are common across sectors, there is a delicate balance between judicial review of regulatory decisions and enforcement of anti-competitive actions by industry players. In the early stages, there is therefore a useful ongoing monitoring role for the sect oral regulatory agency which is likely to have the best information to monitor the sector. Jurisdictional overlap between the regulator and economy-wide Competition Commission is inevitable; neither has the division been clearly established by law or by precedent. One division could be for the sector regulators to set the technical rules and enforce them, while the CCI restricts itself to issues that harm competition such as predatory conduct or cartelisation by players. But ex-ante creating a watertight division between regulation and competition issues is tricky due to the fine line between the two sets of issues. Admittedly CCI's role in enforcement of competition will be a more efficient use of scarce expertise. A consistent approach to competition issues will be good for reducing political risk and cost of finance, and increasing attractiveness for investors. Finally, strengthening the CCI and creating sub-groups with technology expertise would be a more flexible structure to be able to adapt as technology changes. For example, TRAI was given the additional charge of handling broadcasting regulation, since convergence made it possible and indeed more efficient to do so.

CCI's capacity to detect and establish anti-competitive behaviour in transport services will have to be strengthened substantially, as will its independence. The Commission will often have to rule on cases involving public and private entities. Seddon and Singh (2012), for example describe one such case[81]:

'Private participation in inland container depots and logistics is technically open, but on terms set by the Railways Ministry. Private participants compete with Indian Railways and some have sued. Kribhco Rail Infrastructure and Aril Rail Infrastructure, for example, took a case to the Competition Commission of India arguing that CONCOR and Indian Railways work as a group entity and engage in discriminatory pricing. The CCI dismissed the case, arguing that CONCOR and Indian Railways could not be treated as a group entity and neither was dominant'.

The boundaries between the CCI jurisdiction and the sector regulators will have to be established over time by precedent. The option we have discussed above, of having the sectoral regulator focus on technical aspects of ensuring a level playing field, while the CCI focuses on identifying and penalising anti-competitive behaviour given the playing field is one such possibility.

PPP FRAMEWORKS AND MANAGEMENT

Governments around the world have adopted PPP programmes to complement traditional public works to improve their deficient infrastructure. Private sector participation (PSP) in infrastructure financing and service delivery are based on the common principle that PPP is a process for delivering infrastructure and services in which the private and public parties share rights, responsibilities, and risks during the duration of the contract. These differ from standard procurement in that the contract is meant to govern an ongoing relationship rather a one-time transaction. Under such an arrangement, the private sector party usually agrees to undertake the following[82].

- design and build, expand, or upgrade the public sector infrastructure;
- assume substantial financial, technical, and operational risks;
- receive a financial return through payments over the life of the contract from users, from the public sector, or from a combination of the two;

79. Luis A. Andrés, J. Luis Guasch, Thomas Haven.
80. Vivien Foster (2008).
81. Seddon, Jessica, and N.K. Singh (2012). 'Infrastructure in the 12th Plan', Paper presented at the Annual Stanford Conference on Indian Economic Development, September 2012.
82. World Bank (2011).

- usually return the infrastructure to public sector ownership at the end of the contract.

PPP schemes are often categorised as BOT (build, operate and transfer) and DBFO (design, build finance and operate). When the underlying asset is not returned to the public sector, it is sometimes referred to as a BOO (build, own and operate) contract, but the procedures to select, prepare, and bid these types of projects are usually[83] no different. Each sector may have its own specific issues, but there are commonalities that apply across the range of transport and other infrastructure sectors. When the private party charges a user-fee (for example, a road toll), the public authority grants the private party the right to design, build (or refurbish or expand), maintain, operate and finance an infrastructure asset owned by the public sector[84]. Such concession agreements under a user-fee PPP contract are usually for long durations, 25-30 years, after which responsibility for operation reverts to the public authority. In the Republic of Korea, the PPP programme also has a mechanism for providing construction subsidies to qualifying projects.

The main goals of regulation are to induce firms to produce the service at the lowest possible costs to align prices with costs so that firms to do not make supernormal profits which could be generated without appropriate regulation. Access, quality and safety are equally important regulatory goals, particularly for infrastructure sectors. Given the growing use of PPP contracts in transport, an increasing role for the regulator will be to ensure compliance with the PPP contracts. The challenge is considerable; not only because of the complexity and that it requires a learning process, but also because of the lack of a regulatory tradition and track record, scarcity of expertise, and weak formal and informal norms protecting private rights. This problem is everywhere since private participation in transport infrastructure is still an evolving phenomenon.

In the case of monopoly infrastructure, direct state provision has been the norm in India and elsewhere, although recently private participation in roads, ports and airports is noticeable in the form of PPP contracts. As stated elsewhere, fiscal stress facing the government makes PPP not only attractive but sometimes the only viable alternative for creating the bottleneck infrastructure.

Available information (Annex) suggests that total investments committed under public-private partnership projects in the transport sector over the last two decades is high for India compared to other developing countries. The PPP model for transport was popular in China through the 1990s, while it picked up in India in the new millennium. The Government of India's data on PPPs shows that road projects account for 53.4 per cent of the total number of PPP projects and 46 per cent by value because of the small average size of projects. However, ports account for 8 per cent of the total number of projects but contribute 21 per cent in terms of value. The states in India with the highest number of PPPs are Karnataka, Andhra Pradesh and Madhya Pradesh. Domestic Competitive Bidding yielded almost 84 per cent of the total investments under PPP, followed by International Competitive Bidding at 11 per cent[85].

PPP must be viewed as an instrument to not only ease capacity and financing constraints, but also as an effective tool to promote competition in service delivery and improve the quality of service. Access to finance, although commonly cited as the rationale for engaging in PPPs, is one of the weaker reasons to enter into such arrangements for project or service delivery. Governments are generally able to access finance at lower cost than private companies, and any departure from this norm may be due to distortions in intergovernmental relations that should be directly addressed rather than alleviated by market borrowing[86]. Private borrowing also creates long-term economic liabilities that may be difficult to justify if private sector efficiencies do not reduce the overall financing required relative to public finance and implementation[87]. These economic liabilities are not always readily visible in standard public accounting and so may accumulate outside of public expenditure accountability frameworks[88].

An evaluation of the outcomes and impact of the PPP transport projects in the last 20 years shows that on an average these projects have brought significant benefits, in themselves and when compared with the public works alternative, though variance has been high[89]. The main benefits of PPP have been to accelerate infrastructure deployment, provide possible short-term release of fiscal pressures, and more importantly for India, these partnerships have often offered better value for money. This implies better services over the long term, significant enhancement in the quality of service, and quality of assets and improved productivity and coverage. A critical benefit of PPP comes as a result of the usual bundling of construction, maintenance and rehabilitation for the life of the project/concession, usually from 25 to 30 years. Specifically, the benefits of transport PPPs have been in realising productivity gains ranging from 10-20 per cent to over 70 per cent, improvements in quality of service sometimes over 60 per cent, and accelerating coverage of ser-

83. Ibid.
84. The demand risk may be shared by the public sector by underwriting minimum usage.
85. Public Private Partnerships in India, Ministry of Finance, GOI.
86. Engel et al. (2007) use a variant of this argument to show that PPPs cannot be justified by their ability to free up public funds.
87. Engel, Eduardo, Fischer, Ronald, and Alexander Galetovic (2007). and Hellowell, M. (2010). World Bank (2007a).
88. Engel et al. (2009) find empirical evidence that policymakers in Latin America, for example, renegotiated roads concessions in order to prepone pre-election expenditure, at the cost of incurring greater post-election liabilities.
89. This part draws from Jose Luis Guasch (2012).

The critical components of success of PPPs are the design of the concession/contract and associated processes, the clarity and transparency of the rules of the game and the regulatory framework, along with conflict resolution mechanisms

vice. Experience has shown that reductions in tariffs are difficult to achieve (although there are notable examples such as road PPPs in Brazil and Mexico) given the often poor initial state of assets requiring investment and that the original prices tended to be highly subsidised.

Unsuccessful PPPs in transport reflect several common weaknesses. A review of 20 years of projects in transport shows that unsuccessful PPPs had weak feasibility studies, unresolved land allocation issues, overly aggressive bids, unpredictable and lengthy conflict resolution mechanisms, ambiguous tariff adjustment guidelines, ambiguous risk allocation and a lack of comprehensive planning and use of best practices[90].

The upshot is that PPP projects in transport have brought benefits, but these benefits could have been even larger and more general had best practices been followed. At the same time PPP projects also have had a number of systemic problems that have reduced their potential benefits. For example, in India, many contracts have suffered from large time and cost overruns and over the years they have been unable to meet expectations regarding transparency and accountability. The Dabhol power project had to be terminated as its tariffs turned out to be exceptionally high; the NOIDA Toll Bridge Company claimed extension of its 30-year concession to 70 years, besides grant of real estate rights; private terminal operators at major ports such as the Jawaharlal Nehru Port and Tuticorin have been charging tariffs that can be regarded as almost twice their entitlement[91].

Well-designed PPP contracts have the potential to deliver benefits and the way they are structured and bid out will influence their outcome. A crucial element in this process is the concession agreement, which as a matter of principle should not be drafted by the potential concessionaire[92]. A model concession agreement (MCA) and other bidding documents that reduce transaction costs and ensure that project terms are fair, competitive, transparent and enforced in a non-discriminatory manner will go a long way in securing for India success that PPP projects have enjoyed elsewhere in the world. This implies creating an enabling environment for PPPs, including a clearer legal and regulatory framework; improved competitive bidding procedures; more consistent sector policies, and tariff regimes that allow for greater, if not complete cost recovery.

Although the performance of PPP contracts in infrastructure in India has left much to be desired, the clear lesson that emerges from the experience is that governance needs to improve significantly for PPPs in India to deliver value commensurate with their potential. Transport PPPs can induce large benefits and increases in efficiency, but the legal, institutional, procedural and regulatory framework and the PPP contract design and proper oversight are critical[93].

The critical components of success are the design of the concession/contract and associated processes, the clarity and transparency of the rules of the game and the regulatory framework, capacity and instruments, along with conflict resolution mechanisms. Concession design and regulatory oversight are the best predictors to reduce regulatory risk and of sector performance and ex-post management problems. An excellent concession design but poor regulatory oversight will lead to deficient sector performance. An excellent regulatory oversight but with poor concession design will lead to deficient sector performance. Both are needed both for effective sector performance and to secure the gains from private sector participation[94]. Hidden subsidies must be costed and accounted for in an open and transparent manner, and evaluated in the context of competing demands for allocation of public resources (Box 6.7).

The basic principles for PPPs should be established by an overarching legal framework, but contracting and oversight would be under specific sectoral agencies.

Over time, the approach of these sector-specific agencies should become more coordinated. Sector specific tribunals have become popular in India due in part to the overburdened court system, but there are also arguments for more integrated treatment of public-private disputes, and even for moving these back into the mainstream judicial system at arm's length from regulators. Vesting judicial power and delegated legislative power within the same institution has been the subject of recurrent litigation in the case of the securities markets regulator, the telecom regulator and more recently the competition authority[95].

PRICING, SUBSIDIES AND INCLUSION

Policy reforms that usually accompany restructuring and private entry—such as eliminating cross-subsidies and moving toward cost-based prices—are also politically difficult to implement (Box 6.7 for

90. Ibid.
91. Haldea G. 2012.
92. Ibid.
93. Gausch op cit.
94. Ibid.
95. Ibid.

Box 6. 7

Why Rebalancing is Necessary before Introducing Competition: Example from Telecom

Technological progress has convincingly undermined the natural monopoly argument for telecom markets and it is now widely recognised that enhancing efficiency and investment requires the introduction of competition, which in turn needs a regulatory mechanism to facilitate competition. An essential ingredient of transition from a protected market to competition is alignment of prices to costs (i.e., cost-oriented or cost-based prices), so that prices better reflect their likely levels in a competitive environment. Tariff 'rebalancing' involves reducing tariffs that are above cost while increasing those which are below cost.

A major departure from cost-based pricing involves a high degree of cross-subsidisation. i.e., a small proportion of the subscribers account for a major share of all revenue, and these subscribers are inevitably the subject of competitive churn when private sector operators enter the market. Loss of such customers will have a significant adverse impact on the revenue situation of the incumbent, making it difficult to meet the objectives of universal service and network expansion. Under these circumstances, tariff rebalancing helps prepare for competition and avoids a number of pitfalls. Cost-based prices restrict the possibility of cream skimming by new operators, facilitate smooth inter-flow of traffic, and reduce the dependence of operators on narrow market segments for maintaining their financial viability. This in turn also promotes a greater concern among operators for a wider set of its subscriber base, and to focus on quality of service, improving technology and service options. Traditionally, DoT tariffs cross-subsidised the cost of access to the telecom network by excessive domestic and international long-distance usage charges. Thus, in order to promote desired efficiencies, 'rebalancing' of tariffs became a condition precedent to the conversion of a single operator system to a multi-operator environment. Thus, while tariffs have to be reduced for the services which are priced much above cost (e.g., long-distance and international calls), tariffs for below-cost items need to be increased. Such a rebalancing exercise is common when preparing the situation for competition. Otherwise, competition will result in a decline in above-cost prices without any compensating charge in the below-cost prices.

After a comprehensive consultation procedure covering service providers, consumers, policy makers and parliamentarians, TRAI issued a Telecommunication Tariff Order (TTO) on 9 March 1999. The Order was a landmark for infrastructure regulatory agencies in India in terms of attempting to rebalance tariffs to reflect costs more closely, and to usher in an era of competitive service provision. *The chief features of the tariff order were substantial reductions in long distance and international call charges, increase in rentals and local charges and steep reductions (an average of about 70 per cent) in the charge for leased circuits*. These changes were achieved after extensive consultation and considerable political opposition. Over time, prices have now become better aligned with underlying costs. And services have become more responsive to consumer and business needs and to opportunities for innovation.

Source: TRAI, Second Consultation Paper on Pricing, TRAI, 1998 and Telecom Policy Reform in India, Global Business Review, 2000 Sage Publications.

an example from Indian telecom). It is alleged that restructuring and private entry often lead to higher prices that hurt the poor, especially when they already have access to some sort of infrastructure services. In some cases, for example, the urban poor have access to power, so radical tariff hikes that accompany restructuring could have harsh adverse effects. If they do not have access, then tariff rebalancing is irrelevant for them. In India's context, where there is limited access to some transport services, the key is not to stop reform but to ensure that tariff rebalancing schemes wherever implemented by independent regulators, do not involve extreme price increases and are, at the same time accompanied by transparent subsidy mechanisms that cover the poor. Insufficient targeting and lack of transparency in subsidies has meant that a large proportion of subsidies has gone to people other than the intended beneficiaries. The emphasis should not be on setting 'optimal' tariffs but on reforming tariffs—to find feasible changes in tariff structures that both improve welfare and generate adequate revenue[96].

It is inevitable that most tariff increases, especially radical hikes, will be subject to relentless political resistance. For example, in July 2013, the Delhi

96. Armstrong and Rees (2000).

Unsound pricing policies and hidden subsidy mechanisms of the past have seriously undermined the financial viability of service providers, resulting in frequent undersupply and rationing of infrastructure services

Electricity Regulatory Commission (DERC) announced a 5 per cent increase in power tariffs and although energy experts believed that the hike ought to have been more, opposition political parties exploited the increase to try and drive political advantage[97]. Arm's length regulation is best equipped to handle such political pressures that more often than not trade off long-run sector interest for the short-term gains of electoral politics[98]. Such shortsightedness can have detrimental effects. For instance, relying on populist measures (and welfare subsidies), while attractive in the short term, can lead to deficit spending and asset quality degradation in the long term, which is likely to impose greater costs on society than current tariff increases. Independent and effective regulation is therefore necessary to balance these conflicting goals and to make up for the lack of competitive alternatives for the consumers while allowing a fair return on operator investment. At the same time, newly-created regulators should eschew abrupt price changes that could result in significant adjustment costs for consumers (and service providers). There exist several models of pricing reform for infrastructure sectors that regulators will be well advised to consider and adapt to local conditions while ensuring a gradual transition to efficient pricing levels and structures[99].

Admittedly, this is no easy task. Pricing of transport infrastructure services often turns out to be the most contentious aspect of sector reform. Pricing policies and associated subsidy methods play a decisive role in achieving the goals of affordable access and infrastructure development. As stated here, cross-subsidisation, the most popular means for dealing with this issue, is not sustainable in a competitive environment and creates perverse incentives against infrastructure expansion to serve the poor. With competitive entry and reform, new sources of subsidy must be established and/or rates should gradually reflect the underlying costs. A range of possibilities exist in which service levels can vary with price, reflecting consumer preferences and their ability to pay. Alternatively, the regulator can develop tariff schemes that include explicit and well-targeted subsidies, ensuring that users do not spend an unreasonable share of their incomes on infrastructure services. A common rule of thumb is that poor individuals should spend no more than 15 per cent of their income on utilities and transportation[100]. Subsidies for operators can be targeted through 'reverse auctions' or 'negative concessions' (where bidders compete on the basis of the least subsidy needed to deliver the service) or performance-based grants for specified service levels[101]. In least-cost subsidy auctions, qualified applicants bid for the lowest subsidy to provide a non-economic service as part of the universal service provision. The subsidy thus represents an amount that bridges the operator's financing gap, known in certain circumstances as viability gap funding (VGF) in India. Auctions can also be based on any other measurable characteristic such as the lowest consumer tariff to be charged or the greatest level of service to noneconomic areas.

It is important to reiterate the fact that unsound pricing policies and hidden subsidy mechanisms of the past have seriously undermined the financial viability of service providers, resulting in frequent under supply and rationing of infrastructure services, and actually exacerbated inequality. Lack of infrastructure services are a drag on the general functioning of the economy and on economic growth. Better infrastructure promotes general economic growth and enhances economic opportunities, especially for the poor. There is some evidence to suggest that increased productivity brought about by introduction of competition and related reforms in infrastructure seems to benefit the poor more than other groups[102].

The challenge for regulation therefore is to reduce (or eliminate) interest group and political pressure that is often exercised through untargeted hidden subsidies and which undermines the economic viability of each infrastructure sector and frequently becomes a significant impediment to the introduction of competition. To the extent possible, universal service and social equity goals should be implemented separately from pricing policies governing the transport sectors by designing competitively neutral mechanisms. This can be done through either a non-distortionary levy on the sector as a whole (for example, USOF in Telecom and EASF in Civil Aviation) or through the general tax system, although it is preferable to use the former. Universal service funds are desirable especially in the context of liberalised transport sectors to provide financial assistance for meeting sector-specific goals such as infrastructure

97. According to BSES, over the last 10 years Delhi power tariffs have gone up by 65 per cent when the increase should have ideally been 90 per cent. This 25 per cent gap in tariff increase has led to an estimated under-recovery of Rs 20,000 crore. In the corresponding period, CPI increased by 120 per cent, fuel by 190 per cent and bulk power cost by 300 per cent. In light of this, Delhi's tariff hike of 5 per cent is deemed to be inadequate. See http://www.bsesdelhi.com/docs/pdf/Delhi_Tariff_Economics.pdf. Note that BSES is an interested party in the matter and has an incentive to inflate tariff hikes. Nonetheless, Delhi's electricity tariffs are lower than in other metros.
98. The new Aam Aadmi Party (AAP) and the Bharatiya Janata Party (BJP) have placed electricity tariffs high on the election agenda in direct conflict over the ruling Congress party over the hike in power tariff.
99. Briceño-Garmendia Cecilia Estache, Antonio, and Shafik Nemat (2004).
100. Ibid.
101. A reverse auction is the standard way in which the government typically procures any good or service When the government needs to purchase something, it issues a request for proposals (RFP) describing specifically what it wants. Firms reply to this request, and the government picks the firm that submits the best bid. The best bid may be the lowest, but the government may also take other factors into account.
102. Benitez, Daniel A., Chisari, Omar O. and Estache, Antonio (2001).

expansion and inclusion. The goal of inclusion will be much more effectively served by ensuring the coexistence of several features in each transport sector, including a robust regulatory framework, a transparent pricing and subsidy mechanism and above all competition in supply, wherever feasible and possible.

An unfettered market for transport services will not resolve the related problems of safety, health and environment on its own. Such pervasive market failures obligate regulatory intervention, but only if such intervention works better than the market alone

REGULATION AND STANDARD SETTING

Poor infrastructure services can threaten health and safety, and the regulation of their quality is an important policy concern. Quality has many dimensions, and regulating quality is perhaps more complex than regulating price. Like economic regulation, quality regulation is also motivated by market failure and accordingly the nature of intervention should be guided by the type of market failure that is sought to be corrected. For quality dimensions such as safety, health and the environment, defining and enforcing minimum quality requirements is crucial. For example, for consumers of urban bus services, safety is a key concern. Standards above the minimum are equivalent to changing the economic value of the service for which there will be different willingness to pay by customer groups and can be left to the market.

In India, there has been a singular lack of setting and enforcing minimum safety standards for urban transport and roads, among other modes. The large number of road injuries/fatalities is evidence of laxity since these cannot be justified as mere accidents. Instead it is the result of individual and institutional apathy. Road crashes alone claim more than 118,000 lives every year, mostly pedestrians, cyclists and pavement dwellers. The pedestrian's right to safe and free passage has become a casualty[103]. It is a harrowing experience to walk in an Indian city. It is vital and urgent that Indian cities are made pedestrian-friendly and clean, efficient vehicle technology is promoted for both private and public modes in order to reduce fuel consumption and emissions. Fuel efficiency standards should be introduced in India and implemented effectively.

A beginning must be made now and virtually from scratch. There is little expertise, data or information available to address the transport safety problem in a scientific manner. The international professional consensus is that it is not very productive to focus on human error alone. According to the 1997 Swedish Road Safety Bill, '*The responsibility for every death or loss of health in the road transport system rests with the person responsible for the design of that system.*' This approach has not been internalised yet by any official organisation or institution dealing with safety in India. The predominant approach is still based on the outmoded principle of finding fault with an individual and then acting accordingly.

Demand for better knowledge and technologies in the transport sector can only be provided by public bodies such as central and state governments, and local bodies like municipalities and transit authorities. Accordingly, institutes for road, railways, water and air transport safety need to be set up to *inter alia* set standards, collect data and ensure that evidence of the effectiveness of safety countermeasures is made an integral part of decision-making at all stages, rather than just a reaction to observed safety failures or political demands. No country has been able to deal with the problem of safety without very strong professional institutional mechanisms, including enforcement. Safety Departments need to be set up within operating agencies (at different levels) for ensuring day-to-day compliance with safety standards as well as studying effectiveness of existing policies and standards, conducting safety audits and collecting relevant data.

An unfettered market for transport services will not resolve the related problems of safety, health and environment on its own. Such pervasive market failures obligate regulatory intervention, but only if such intervention can achieve a better outcome than the market alone, with all its imperfections. As a result, not only setting of standards is crucial but ensuring their compliance is equally if not more important to improve outcomes. The diffusion of responsibility and lack of coordination between existing agencies does not help. For example, in road safety, authorities like NHAI, PWDs in the states and local bodies are responsible for construction and maintenance of roads; State transport authorities are responsible for issue of driving licenses, registration of vehicles and fitness of vehicles; police is responsible for regulating traffic, enforcing laws and educating the public on road safety issues; urban development authorities deal with land use and urban road planning; health departments are responsible for medical care of accident victims; insurance companies provide insurance cover and compensation. Apart from the fragmented structure, there is no coordination among the different agencies.

Road safety and urban transport are reflective of the malaise across all transport sectors. Inadequate data, lack of expertise, absence of coordination and weak enforcement are universal weaknesses in all transport sectors and need immediate correction.

103. Working Group on Urban Transport (NTDPC).

Table 6. 3
Trends in Railway User Charges

	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Passenger Fares	No increase	No increase	No increase	Reduction	Reduction	No increase	No increase	Fare increase proposed and retracted
Freight Charge	No increase	No across the board increase	No across the board increase	No across the board increase	No across the board increase	No increase	Price increase for 'inflation concession' for some commodi-ties	Across the board increase

Source: Seddon and Singh (2012).

By its very nature, setting and enforcing standards is an integrated activity involving multiple interventions. These interventions need to be combined and implemented in an integrated manner to derive the maximum benefits from each intervention.

BUILDING THE REGULATORY CONTEXT FOR TRANSPORT IN INDIA: SECTORAL DISCUSSION

In the following five sub-sections we discuss regulatory priorities for each of the major modes of transport, highlighting the key role of regulation as a part of the overall reform agenda discussed in more detail in other chapters.

RAILWAYS

The primary regulatory need for Railways is independent price regulation to reduce the persistent cross-subsidisation between freight and passenger services and begin to restore shift freight traffic toward railways. Over time, as policy opens more opportunities for private participation in railway services, the regulatory framework will need to ensure competitive access to trunk lines and include social regulation to reduce environmental impacts and increase safety.

Social expectations of widespread access to low cost passenger service and the financial imperative to generate sufficient revenues to expand and maintain its rail network, wagons, and other equipment create conflicts while politics plays a big role in determining tariffs. The ratio of passenger fares to freight charges is one of the lowest in the world.

Unlike other regulators who fix tariffs based on elements of cost, IR has been unable to increase rates causing increasing financial stress to IR (Table 6.3). An independent Rail Regulator could depoliticise the process of passenger fare revision and arbitrate disputes and grievances of freight customers.

Creating a Railways Tariff Regulatory Authority to provide 'a level playing field to all stakeholders' is one of the many recommendations made by various committees including the Rakesh Mohan Committee on Railway Reform in 2001, the Sam Pitroda-headed Expert Committee on Railway Modernisation and by the Planning Commission. The Government had recently approved the Rail Tariff Authority and this should be constituted early. In addition, an independent dispute settlement tribunal could also be created with the existing Railway Rates Tribunal (RRT) charged with this mandate, but the risk of regulatory institution proliferation as discussed earlier must be kept in mind. International experience does not suggest the best model one way or the other, but in India, there has been an increasing tendency to separate the dispute resolution process from the regulator[104].

In the meantime, freight transport in India is dominated by road, a situation that poses significant economic and social costs. The share of road in freight transport (tonne-kilometres) in India is around 57 per cent, against railway's share of 36 per cent. Railway's share (in originating tonnage) declined from 89 per cent in 1951 to 65 per cent in 1978-79, and from 53 per cent in 1986-87 to 30 per cent in 2007-08. Although it has increased recently, it is below the comparable share of about 50 per cent in similar large countries like US and China. A share of 50 per cent for railway freight is a desirable goal for sustainable long-run growth (Volume II, Chapter 2)[105]. Inability to service growing freight demand has been due to many factors, including severe capacity constraints. As a result, IR has been forced to focus on bulk cargo and even within bulk cargo there has been preference for certain types of cargo on public policy considerations, thereby sacrificing other major potential cargo such as automobiles and chemicals which are consequently transported by road.

Such a non-optimal intermodal distribution of freight traffic is estimated to have cost the Indian economy Rs 385 billion in the year 2007, constituting 16 per cent of the total transport cost. It has also

104. The Sam Pitroda Committee has recommended creation of a PPP Ombudsman under the aegis of the Railway Board.
105. McKinsey co (2010).

Table 6. 4
Main Responsibility for Public Interest Roles

COUNTRY	INTEGRATED TRANSPORT POLICIES	RAILWAY SECTOR STRATEGY/ POLICIES	ECONOMIC REGULATION	SAFETY REGULATION
Australia	Department of Transport		Australian Competition Commission	Departments of Transport or Independent Regulators (varies by state)
Brazil	Ministry of Transport		National Agency for Land Transport	
Canada	Department of Transport		Canadian Transportation Agency	Transportation Safety Board
China	Ministry of Transport		Ministry of Railways	
Germany	Ministry of Transport		Federal Cartel Office	Federal Rail Agency
Japan	Ministry of Transport			Japan Transport Safety Board
Russia	Ministry of Transport		MOT and Ministry of Economic Development and Trade (MEDT)	Ministry of Transport
US	Department of Transport (DOT)		DOT-Surface Transportation Board	National Transport Safety Board/ DOT-FRA

Source: Freight Railways Governance, Organisation and Management: An International Round-Up, World Bank 2011

affected energy efficiency of transport: a study by the Asian Institute of Transport Development (AITD) concluded that rail consumes 75-90 per cent less energy for carrying freight traffic and 5-21 per cent less energy for passenger traffic compared to road[106]. Similarly, railway scores over road in respect of financial, environmental and social costs by a huge margin by virtue of its scale economies and being a safer and less polluting mode[107]. The diversion of freight and passenger traffic to roads produces many undesirable consequences. There is revenue loss for IR, a larger freight cost to GDP ratio and higher environmental cost per route kilometre.

Any shift of traffic from road to rail, especially in freight, would, therefore, result in substantial savings in energy consumption as well as reduced economic and social costs. This has also been corroborated by the Total Transport System Study conducted by RITES for the Planning Commission. McKinsey has estimated a loss of about 4.3 per cent of GDP due in large part by the inability of railways to enable a more balanced modal distribution. Independent price regulation alone will not achieve these goals– restructuring investment planning and improving the efficiency with which existing stock is managed are also important.

Restructuring of Indian Railways to operate on business lines is essential for enhancing capacity to meet country's social and economic aspirations in the 21st century. Several expert committees convened over more than a decade have made detailed recommendations on modernising IR's management, but political will to run IR as a commercial entity has been lacking. Nevertheless, railway restructuring must happen, and it is essential to put an appropriate regulatory framework in place before it does to address anti-competitive behaviour as well as pricing, not to mention environmental and safety goals (Volume II, Chapters 7 and 12).

The experience of rail freight liberalisation in various parts of the world has shown that there are considerable barriers to entry, so that competition is unlikely to be a strong force to encourage performance. In markets controlled by State-owned monopoly operators, there could be many barriers arising out of control of key assets and lack of effective regulation to enforce a level playing field. The level of non-discriminatory access to network and the relationship between the access provider and access seekers are also matters of considerable interest in any rail liberalisation exercise. The quantum and structure of access charges paid by entrants to the infrastructure operator play an important role in determining the extent to which effective competition can be achieved. It is a function ideally performed by an independent regulator since determining efficient level of access charges is far from straightforward[108]. For India, a vertically integrated state owned structure could be an enduring challenge for creating non-discriminatory access to core infrastructure. For an illustration of such risks due to the absence of institutional and structural prerequisites while introducing reform, see Box 6.5 for the experience in Indian telecommunications.

Similarly, the various roles in rail governance currently bundled together in the Ministry of Railways must be separated. All countries with significant rail systems have separated the public policy roles of the

106. Asian Institute of Transport Development (AITD) 2000.
107. Ibid.
108. There are several different approaches to pricing of access. See World Bank 2011 Railway Reform: Toolkit for Improving Rail Sector Performance.

Lessons from major rail markets establish the sub-optimality of India's framework. The role of the Railways Ministry as licensor, regulator and key player is not conducive for attractive private investment, much less maintaining a competitive environment

Ministry of Transport (no other major economy has separate ministries for each mode, and only a handful retain a separate Ministry for Railways) and subsectoral policy making from either the economic regulation and/or safety regulation roles (Table 6.4).

Lessons from major international rail markets clearly establish the sub-optimality of India's governance framework. The role of Ministry of Railways as licensor, regulator and a key player is not conducive for attracting private investment into IR, much less maintaining a competitive environment[109].

ROADS AND HIGHWAYS

Road transport includes a number of regulatory challenges, including managing PPPs in road construction; increasing safety and reducing environmental impact of road-based transport; ensuring competition in road transport services, and potentially using regulation among other tools to ensure widespread access to road transport.

The PPP option is on the agenda for all transport infrastructure, but particularly for roads in which technology is more straightforward and project structures can be replicated as 'model documents.' Expert regulation is particularly important for resolving disputes after the concession. Most competitive bidding processes effectively involve bets on future traffic flows. Bidding based on toll rates is obviously based on expectations about traffic. Rate of return expectations for competitive bidding for viability gap funding (VGF), as has been used by a number of state governments in India, also rests on traffic predictions. VGF allows a maximum subsidy of 40 per cent of the capital cost of the project. These funds are fully used during the high-cost construction periods where there is no offsetting revenue flow from user revenues. The road user toll is fixed, so private sector bidders bid the lowest VGF amount, in principle creating incentives for boosting efficiency. Disputes can arise when traffic flows vary substantially from projections, often provided by the public sector.

India's experience with road PPP illustrates the importance of managing disputes. Competition has grown tremendously, leading to aggressive bidding and unrealistic traffic forecasts. Together with human capacity constraints, unclear jurisdictions and institutional weaknesses, this has led to high incidence of renegotiation of contracts, and a reduction of the benefits of private participation. In recent awards, some bids have been overly aggressive, rendering the IRRs negative or lower than the cost of capital. For instance, the equity IRR for the Khagaria-Purnea annuity project was estimated as 7.8 per cent, while for the Barasat-Krishnagar project, the IRR is expected to be negative[110]. Land acquisition and clearance obligations for road sector concessions have also been frequently contentious leading to litigation and lengthy delays. According to IDFC, land acquisition and forest clearances are the biggest bottlenecks to timely completion of projects[111]. NHAI, which was constituted for execution of works on National Highways (NHs), has been involved in a number of disputes relating to its contractual obligations. NHAI has faced several claims under arbitration proceedings but progress on settling disputes has been limited. Only 14 per cent of the projects comprising less than 5 per cent of arbitration award were accepted by both parties involved in the dispute[112].

The combination of limited traffic data and weak dispute resolution can lead to a situation where private investment can only be attracted if the public sector bears demand risk, limiting one of the potential gains from PPPs. In these arrangements, the public sector makes fixed payments to the private party when, and to the extent that a service is made available. The demand risk in these availability-based PPPs is borne by the public authority. The UK pioneered the use of this form of PPP for the provision of social infrastructure (known as the Private Finance Initiative [PFI] Programme), and many other countries, such as Australia, Brazil, Canada, Japan, the Republic of Korea, Mexico and South Africa, are using this approach[113]. In India, this form of PPP is referred to as the annuity scheme.

As in rail, rationalising regulatory oversight of India's roads is important. The problem is in some ways the opposite of that described for railways: fragmented authority rather than overly consolidated powers (Table 6.5).

There is urgent need to create a strong and an independent regulatory mechanism for India's roads and highways sector, with expert staff tasked with making technical decisions. They should also ideally have incentives to serve long terms that allow the creation of a deep base of expertise and experience and like BPR should be shielded from direct

109. In 1997, regulatory powers of DoT were handed over to TRAI, in 2000 DoT was divested of its role as a service provider recognising that a service provider, licensor and regulator within the same jurisdictional boundary gives rise to conflict of interest.
110. Are PPPs working, IDFC 2012, op cit.
111. Ibid.
112. Ibid.
113. Op. cit.

Table 6. 5
Regulatory Oversight for Roads

INSTITUTION	RESPONSIBILITY	GOVERNING ACT
Transport Wing - Ministry of Road Transport and Highways (MORTH)*	1) Licensing of Drivers of Motor Vehicles and conductors of Stage Carriages 2) Offences, penalties and procedures 3) Evolves road safety standards in the form of a National Policy on Road Safety and by preparing and implementing the Annual Road Safety Plan. (Some of these are applicable to urban transport)	Motor Vehicles Act 1988, Central Motor Vehicle Rules 1989 Road Transport Corporations Act 1950 Carriage by Road Act 2007, Carriage by Road Rules
Roads Wing - Ministry of Road Transport and Highways (MORTH)*	1) Planning, development and maintenance of National Highways in the country 2) Evolves standard specifications for roads and bridges in the country	National Highways Act 1956, National Highway Rules 1957 Control of National Highways (Land and Traffic Act) 2002 National Highways Fee (Determination of Rates and Collection) Rules
National Highways Authority of India (NHAI)	Responsible for the projects under National Highways Projects	National Highways Authority of India Act, 1998

Note: *MORTH formulates and administers policies in consultation with other central government ministries, state governments, and union territories. As per the governing acts, state governments are provided legislative authority to formulate select rules and regulations in order to enable efficient road transport system across the country.

political influence while simultaneously building a culture of professionalism. Theoretically, there may not be a need for an independent regulator (where concessions can be regulated by contract). However, the need for an independent regulatory mechanism is arising on account of institutional infirmities and shortcomings in contract designs. The jurisdiction of any proposed regulator is also an issue, given the concurrent status of the roads and highways sector (national highways with NHAI/MORTH; state highways, district and rural roads with the respective state governments. The functions of the regulatory mechanism inter alia would involve: (a) tariff setting; (b) monitoring and enforcement of uniform technical standards on construction, service quality and maintenance related benchmarks; (c) collation, analysis and dissemination of sector information; (d) ongoing review of concessionaire designs to correct inherent infirmities. Monitoring of contracts has been a vexing issue; an independent regulatory mechanism will be much better suited to monitor performance outcomes associated with all contract types such as turnkey contracts, O&M contracts, BOT contracts, corridor management, etc.

The Government is actively considering the setting up of an independent tribunal under the proposed Public Contracts (Settlement of Disputes) Bill to deal with the differences and disputes that may arise during the implementation of public contracts (which include PPP contracts), refer these disputes to arbitral proceedings over which it would adjudicate and exercise supervisory control. The proposed Act lays down the process for the adjudication proceedings, hearings and enforcement of orders by the proposed Tribunal, which may be challenged by the aggrieved party only in the Supreme Court. The proposed two-stage dispute resolution process is expected to reduce the time taken for resolution of disputes arising from PPP contracts.

India also needs to create a regulatory framework to guide the use of roads. One element of this framework, traffic management, is discussed in the sub-section on Urban Transport. Regulation of interstate vehicle movements is a second area that requires rationalisation. Overlaps or ambiguity in mandates give rise to disputes and costly litigation. For example, the number of clearances that truck operators have to obtain from different agencies in order to operate is large and harrowing for the operators. The agencies involved are (i) Sales Tax, (ii) Regional Transport Officer (RTO), (iii) Excise, (iv) Forest, (v) Regulated Market Committee, (vi) Civil Supplies (check on the movement of essential commodities, black marketing, weights and measures, food adulteration) and (vii) Geology and Mining. These checks are generally conducted by respective agencies at separate points, resulting in more than one detention. Detention of vehicles causes lower speed, loss of time, high fuel consumption and idling of vehicles, leading to under-utilisation of transport capacity and adversely affecting their operational viability. Besides, it imposes economy wide costs that are not easy to assess. By introducing checks at each interstate border the road freight transport experiences significant inequity compared to the freight/cargo transport by the railways, aviation and even inland transport, which do not face such rigorous en-route checking. The system in vogue hinders rather

Table 6. 6
Regulatory Oversight in Civil Aviation

INSTITUTION	CIVIL AVIATION RESPONSIBILITIES	GOVERNING ACT
Directorate General of Civil Aviation (DGCA)	1) Responsible for regulation of air transport services to/from/ within India and for enforcement of civil air regulations, air safety, and air worthiness standards. It also coordinates all regulatory functions with the International Civil Aviation Organisation (ICAO) 2) DGCA issues licenses to pilots, aircraft maintenance engineers, flight engineers, and air traffic controllers 3) Carries out amendments to the governing acts/ rules to comply with the amendments of the International Civil Aviation Organisation (ICAO)	Aircraft Act of 1934, Aircraft Rules, Civil Aviation Requirements, Aeronautical Information Circulars
Bureau of Civil Aviation Security (BCAS)	Regulatory Authority for Civil Aviation Security in India. It is responsible for laying down standards and measures in respect of security of civil flights at International and domestic airports in India	Aircraft Act of 1934, Aircraft Rules, Civil Aviation Requirements, Aeronautical Information Circulars, The Suppression of Unlawful Acts against Safety of Civil Aviation Act (1982 and 1994)
Airports Economic Regulatory Authority	1) To determine tariff for aeronautical services 2) To determine the amount of Development Fees at major airports 3) To determine the amount of Passengers Service Fee	The Airports Economic Regulatory Authority of India Act, 2008; Aircraft Rules 1937, Aircraft Act 1934
Airports Authority of India (merged National Airports Authority and International Airports Authority)	Responsible for creating, upgrading, maintaining, and managing civil aviation infrastructure both on the ground and air space in the country. The functions of AAI are as follows: 1) Design, Development, Operation and Maintenance of international and domestic airports and civil enclaves 2) Control and Management of the Indian airspace extending beyond the territorial limits of the country, as accepted by ICAO 3) Construction, Modification and Management of passenger terminals 4) Development and Management of cargo terminals at international and domestic airports 5) Provision of passenger facilities and information system at the passenger terminals at airports 6) Expansion and strengthening of operation area, viz. Runways, Aprons, Taxiway etc. 7) Provision of visual aids 8) Provision of Communication and Navigation aids, viz. ILS, DVOR, DME, Radar etc.	Airport Authority of India Act, 1994 As amended by the Amendment Act 2003

than facilitates smooth flow of freight and passenger movement across the country and has thwarted the formation of single common market.

CIVIL AVIATION[114]

There are three main regulatory priorities for the civil aviation sector: managing PPPs and the terms for private investing in aviation infrastructure, including dispute resolution; regulating pricing and access to core facilities to ensure healthy competition among service providers; and strengthening oversight of airline practices to ensure safety and compliance with minimum standards of service delivery.

The aviation sector in India can be broadly classified into three distinct functional segments: (i) operations of public and private airlines; (ii) infrastructure, under the purview of the Airports Authority of India (AAI) and the newly created Airports Economic Regulatory Authority (AERA); and (iii) regulation and development, the responsibility of the Directorate General of Civil Aviation (DGCA) and the Bureau of Civil Aviation Security (BCAS) (Table 6.6).

As detailed in the chapter on civil aviation (Volume III, Chapter 3), stronger regulatory oversight over the sector is warranted by several factors. First, despite strong growth in demand for both domestic and international air travel, and for the movement of cargo, the airline sector itself remains weak. Many domestic airlines operate on the strength of precarious balance sheets. Meanwhile, offshore carriers dominate the market for international aviation. This may not be a bad outcome in itself if it is the result of careful policy planning. However, given India's geographical advantages and a strong home market, a sense prevails that Indian airlines competing in the overseas market have not made full use of their bilateral flying entitlements

114. The Civil Aviation sector consists of Airlines—scheduled and non-scheduled, Airports, Maintenance Repair and Overhaul (MRO), Air Cargo and Express, Ground Handling and Aviation Academies.

and landing slots. These and other issues of concern to the airline industry are documented more fully in the chapter on civil aviation.

Second, with airports being monopoly providers of critical aviation infrastructure, the regulatory imperative is clear. India is a signatory to the Chicago Convention on Civil Aviation (1944), one of the founding documents of international civil aviation. Amongst other things, the convention establishes the sovereignty of a state over territorial airspace, defines rules for international scheduled air transport, and the basic rules of aircraft safety and registration. In setting out the basic policy on airports and air navigation systems, the Convention also notes that regulatory oversight over these cannot vest with the operators, and instead must do so with the contracting states themselves. In view of the monopolistic nature of airport and air navigation services, the State is required to assume responsibility for protection against monopolistic abuses.

The practical aspects of this regulatory objective are the following[115]:

- to ensure non-discrimination in the application of charges;
- to ensure there is no over-charging, anti-competitive practice or abuse of the dominant position;
- to ensure transparency and the ready availability of financial data;
- to establish and review standards, quality and service delivery;
- to assess and encourage efficiency amidst the service providers.

These aspects are intended for consideration within the broader objectives of the development of civil aviation, promoting non-discriminatory access to airport services, and the balancing of interests between airport and users. ICAO (2006) identifies five different regulatory options that can address these goals:

i Minimum intervention in the form of self-regulation or market regulation through competitive forces. This strategy may be appropriate whenever, for example, an airport earns a large proportion of its revenues from commercial activities, thereby giving it an incentive to minimise aeronautical charges to attract traffic, or when an urban conurbation is served by several airports in competition with each other.

ii Systems of institutionalised checks and balances such as through joint ownership of airports by airlines, or by airlines in partnership with the government, or when the airport's charter specifies financial goals as not intended to generate profit.

iii Stakeholder oversight in the form of a third-party advisory commission made up of representatives of airlines, governments and passengers, with powers to call for mandatory consultation on pricing and investment.

iv Contract regulation such as through a PPP charter document, or a delegated management contract.

v Maximal regulation through economic measures. This can take place through specification of a defined rate of return or from a cost-plus pricing concept for airport operators. Essentially, it allocates wide-ranging powers to a third-party regulator to assess and authorise an airport's planned tariffs and to review its performance.

India's civil aviation sector suffers from the problem of multiple regulatory bodies with overlapping jurisdiction and often lack of clarity on their sphere of influence

The necessary development of the sector has seen several of the systemically important airports converted to joint-venture enterprises as partnerships between the AAI and private entities. The regulation of these new enterprises brings another catalogue of issues for consideration such as on the pricing and enforcement of development and investment contracts; on the pricing of aeronautical and non-aeronautical services and so forth.

There is no doubt that the regulatory mechanism has to be strengthened in civil aviation. Similar to other infrastructure sectors, there are multiple regulatory bodies with overlapping jurisdiction and often lack of clarity on their sphere of influence (Table 6.6). For example, AERA, which was established in October 2008 as an independent authority to set policies crucial for a level playing field, only regulates private airports; the others are managed—and regulated—by AAI. Contracts awarded under PPP for private participation were given without a regulatory mechanism being in place. Disputes in the agreements made prior to the birth of regulator were transferred to the AERA, leading to uncertainty and the risk of regulatory capture. Concession contracts should ideally be monitored by the regulator from the beginning, ensuring minimum deviation from the performance outcomes. Such piecemeal attempts at institutional reform are best avoided since they add to the number of regulatory agencies, render existing regulatory mandates unclear, and risk the possibility of 'forum shopping' that was common in the telecommunications sector in India when the institutions of oversight were being established.

It is imperative that the existing institutional framework be overhauled. With respect to other airports run by the AAI, the government should clarify the

115. ICAO (2006).

In civil aviation, the public policy role of the Ministry should be separated from the economic and safety regulation roles. A vexing issue here has been establishing a level-playing field between Air India and other carriers

future role of the agency. As a first step, the AAI should be separated into two distinct functions: Airport Operations and Air Navigation Services. The civil aviation chapter provides further detail on the desired functions, which will, ideally, be corporatised. The AAI should then turn its attention to developing new airports in partnership with state governments, leaving the operation detail to the dedicated bodies noted above.

Over the next 20 years, the essence of the institutional reforms will be to separate the regulatory function from the policy function: these should be clearly independent of each other. While there is an active and welcome proposal to create a civil aviation authority along the lines of UK CAA, the existing proposals essentially imply that the DGCA will be renamed a CAA without fundamental or meaningful changes in its role. What is required is for the new CAA, is to include the DGCA as one of its wings (covering airworthiness, safety, air licensing and certification); and in addition to have separate, expertly manned divisions responsible for airspace management, environment, competitiveness and customer protection. This will then bring it into line with the UK's CAA that is being adopted as a role model.

Separately, a fully autonomous Accident Investigation and Safety Board should be constituted with a lean group of full-time experts, and the empanelment of a larger group of experts drawn from different disciplines and who can be quickly be assembled for the investigation of specific accidents. The DGCA cannot both define the safety environment and then be the investigating authority when there is a breach of safety. All accident investigation reports must be published, as is done abroad, to ensure the lessons from the investigation are shared as widely as possible with the airline community in India and abroad. That leaves the Ministry of Civil Aviation to focus on the larger issues of aviation within the national and international context, to develop and fine-tune policy, all the while being advised by the expertise within the CAA.

In the radically changed, competitive (and increasingly private sector-dominated) environment, the existing institutional framework is inadequate and counterproductive. A dispute settlement body separate from the CAA as has become the practice in India in other sectors will serve to fast track disputes in the sector (see Box 6.8 for the nature of some recent disputes). The relationship between the sector-specific dispute settlement authority and the CCI will evolve over time and should be guided by the same principles that underpin this institutional relationship in other sectors.

Due to, inter alia, the capital-intensive nature of the industry, competition may not always be effective. Oversight or regulation in the presence of such failures is de rigueur; however the extant regulation should be carefully designed so as not be become a burden on the operators. Thus, regulatory costs should be kept to a minimum if competition is sought to be increased. In some trunk routes, the market will function adequately with light-touch regulation, but not everywhere. However, given the significant externalities associated with aviation infrastructure, increased connectivity is desirable but will need to be traded off with viable commercial operations. There is a mechanism currently in place for 'route dispersal', but it is not satisfactory. In the US, after deregulation, routes are determined by individual market participants in accordance with customer demand and financial feasibility, while underserviced routes are subsidised through the Essential Air Services Programme[116].

There is also a need to transparently and explicitly provide support for socially desirable but uneconomical services, whether airport or carrier. Therefore, a fund to replace the route dispersal guidelines should be non-lapsable and exclusively aimed at providing explicit and direct subsidies to airlines to make up for viability gaps on defined routes. Budgetary support will be required for this fund but the Ministry may also consider augmenting the fund through a cess on domestic passengers chargeable through tickets issued by airlines.

In civil aviation, as in other sectors, the public policy role of the Ministry should be separated from the economic regulation and/or safety regulation roles[117]. A vexing issue in this respect has been establishing a level-playing field between Air India and domestic private airlines. The existing regulation lacks competitive neutrality with regard to private airlines in terms of access to government funds for capital expenditures and potential bailout. Privatisation as a solution has often been contemplated but has been politically difficult to implement. Privatisation will depoliticise the sector and limit the use of Air India for social policy goals and effectively decouple financial resources from the government's general budgetary and fiscal situation. Privatisation though is not an end in itself but rather a means to promoting a level-playing field and competition in the sector.

116. Essential Air Services Program Office of Aviation Analysis, United States Department of Transportation <http://ostpxweb.dot.gov/aviation/x-50%20role_files/essentialairservice.htm>.
117. World Bank 2011 Freight Railways Governance, Organisation And Management: An International Round-Up.

Box 6. 8
Nature of Litigation in Civil Aviation

A case was filed with the Competition Commission of India alleging that airline operators had simultaneously withdrawn the promotional offers and increased tariffs by 25 per cent across the board in February 2009. The petitioner further alleged that airlines had again raised fares simultaneously around Diwali in 2010. Private airlines naturally denied charges of cartelisation. Following the investigation, DGCA stated that a high degree of transparency over prices and volumes exists in the airline industry. Similar fares could reflect the forces of competition. Also, most airlines follow a dynamic pricing principle, where fares move according to factors like capacity, market demand, seasonality and time of flight. The basic tenets of pricing by airlines are 'Price Parallelism' or 'Price Parity'. For these reasons, CCI did not find evidence of collusive/anti-competitive conduct during the investigation. The case however highlights the need for effective data collection and analysis by the regulator, a standard practice in mature markets.

In a case filed by the Society for Welfare of Indian Pilots against the DGCA, which brought in a few private airlines as respondents, a difference was noticed in the medical standards applicable for Indian and foreign pilots operating Indian aircrafts. The lower standards applied to foreign pilots was cited as a reason for the rise in aircraft accidents. After receiving the writ petition, DGCA, under the Aircrafts Act of 1934, issued an amendment correcting the anomaly. The case highlights the need to separate the responsibility of the licensor and regulator to enable a mechanism for regulatory checks.

Source: CCI, DGCA.

This must remain a medium- to long-term objective, notwithstanding the political impediments. The Naresh Chandra Committee had recommended as much in 2003[118].

PORTS AND SHIPPING

Shipping remains by far the main mode for international transport of goods since 95 per cent of India's international trade is waterborne. Of this, over 60 per cent is handled by the 12 major ports while the rest is handled by the 200 non-major ports, of which only around 60 handle export-imports cargo with others being mainly fishing harbors. Changing trade patterns and new trade relations are driving trade volumes and thus there is need for capacity expansion to handle the increased trade volumes and also accommodate changing vessel sizes. The neglect of port expansion in the 1980s because of low investments has led to deteriorating port services, obsolete equipment and infrastructure and, hence, a decline in the quality of port services.

The existence of two fundamentally different systems for governance of Major Ports (tariff regulated) and Non-Major Ports (tariff deregulated) creates hurdles to achieving balanced growth while rendering it difficult to draw on the experiences of either of the two or to leverage possible synergies. The current governance structure of Major Ports—the public service port model—is archaic and lacks potential to attract private capital and therefore competitiveness. Given that the Non-Major Ports under the management of maritime states have demonstrated greater success as compared to Major Ports, any progressive regulatory shift for Major Ports should attempt to bring uniformity in the approach along with desired cooperation and participation of maritime states.

Till now, investment in both Major and Non-Major Ports has been done in a somewhat haphazard piecemeal fashion, primarily due to lack of a comprehensive and coherent national strategy for port development in India. In addition to making focused investments in capacity creation, the existing regulatory structure for the Major Ports needs overhaul and a new set of incentives needs to be put in place as part of regulatory restructuring. The existing Ministry-centric port management system is a complex bureaucratic process and distorts incentives. There are unnecessary delays and opportunities for wielding political influence.

The dominance of the public sector, the inimical institutional structure and lack of sufficient hinterland connectivity have all been detrimental to promoting competition. India needs legislation which is inter alia compatible with the functioning of a market oriented economy and the global character of the maritime transport. Furthermore, the tendency to introduce more and more control elements in the port management should be eschewed. This is easier said than done and therefore a phasing out of

118. Report of the Committee on a Road Map for the Civil Aviation Sector Ministry of Civil Aviation Government of India, 2003.

Table 6. 7
Regulatory Structure of the Indian Port Sector

	RESPONSIBILITY	GOVERNING ACT
Ministry of Shipping	Coordinates the various activities related to ports, shipping and inland water transport	Merchant Shipping Act 1958
Port Trusts	Manage the daily activities of major ports in the country	Major Ports Trust Act 1963
State Maritime Boards/State Government Departments	Govern the non-major ports	Indian Ports Act 1908
Tariff Authority for Major Ports (TAMP)	Regulates tariff setting in major ports	Major Ports Trust Act 1963

Source: TERI 2008 (Competition issues in regulated industries: Case of the Indian Transport Sector).

intrusive regulation is recommended. Snapshot of the regulatory structure of the Indian port sector is placed (Table 6.7).

Attempts to modernise the port sector in the last two decades in India have proved futile. An analysis of the various attempts at port reform makes it clear that a rational framework at transforming the Major Ports into viable and autonomous undertakings capable of functioning within a market economy has been absent. Some of the measures aimed at structural changes have not been executed. For example, the Landlord Port Model for the major ports has not been fully implemented despite its apparent attractiveness. The trouble with reform in the port sector and indeed in other infrastructure sectors in India has much to do with piecemeal changes and the inability to separate policy making, regulation and commercial operations. International best practice suggests that these three functions ought to be separate—the Ministry should be charged with policy formulation, an independent regulator should exercise oversight and a public or private sector entity should run the enterprise on commercial principles responding to incentives created by the market and within the constraints set by independent regulation.

Regardless of the path taken in restructuring ports policy, important segments will continue to be natural monopolies. Accordingly, the success of restructuring depends in part on the creation of effective regulatory institutions to exercise oversight and ensure competition, since most of the benefits of private participation in port activities result from competition. Several types of competition are possible (Box 6.9). Governments and port authorities can take a number of steps to enhance competition, including introducing new berths and terminals, dividing ports into competing terminals (terminalisation), dividing port operations within terminals, and introducing short-term operating leases or management contracts. The form of competition and regulatory requirements are closely related and largely depend on the size of the port, the extent of external competition, and the degree of captive traffic that needs protection[119].

While the term 'privatisation' has often been used in the context of port reform processes, it actually refers to introduction of the private sector into the public domain by privatising terminal services under a landlord port regime. The essence of such a regime is to have major port authorities, disengaged from direct terminal operations while acting as neutral landlords to both private and corporatised public sector terminal operators. The corporatisation of port authorities, however, might need to be done through a customised act that allows considerably more room for socio-political objectives rather than just maximisation of value for shareholders. Corporatisation, apart from its other advantages for port development, opens the possibility for direct participation of the concerned maritime states by means of acquisition of shares in the Port Authority of the port(s) located within its territory (see Box 6.10 for the Gujarat example). Such shareholding should be substantial and not symbolic. In that way, the state will participate in the benefits of the development and expansion of the (former) Major Ports. The new Port Authorities should be allowed to have autonomous powers within the policy framework of the central and state governments to enable them to function efficiently within a commercial setting. All Major Ports should be unbundled and the terminal services also corporatised. It is clear that this unbundling is a complicated issue especially for the older ports. Therefore, necessary changes in legislation should allow a reasonable time for this tran-

119. World Bank 2004, op cit.

Box 6. 9
Types of Competition in Ports

- *Inter-port competition* can be fierce, as between the major container ports of East Asia. A port's success depends on its ability to process traffic quickly and reliably and integrate its activities with inland or feeder networks.
- *Intra-port competition between terminals* allows technically-efficient integration of port functions without sacrificing competitive pressure within the port. Terminal operators have complete jurisdiction over their terminal areas, from berth to gate. This approach was adopted to great effect in the liberalisation of the port of Buenos Aires.
- *Intra-terminal competition between service suppliers* is encouraged by many ports. Competition in stevedoring, warehousing, forwarding, and other services is highly desirable whenever it can be physically accommodated. From a port authority's viewpoint, such competition may be influenced by licensing requirements, which limit the number of competitors but make the concessions attractive for competitive tendering.
- *Competition for the exclusive right to provide services* is an extension of the competitive tendering of licenses and may be the only way to attract private investment in small ports. When local monopoly rights are granted, the question usually arises: to prevent monopoly exploitation, should contracts be used or a regulatory authority established?

Source: World Bank 2004.

Box 6. 10
The Gujarat Example

The state of Gujarat came into existence in May 1960 and state ports, including all Non-Major Ports, except Kandla port, were under the control of state government. The ports were administered by the Roads & Buildings Department of Government of Gujarat. Traffic of all Gujarat ports was almost stagnant from 1960 to 1982. The subsequent progress in Gujarat occurred due to state initiatives. Decentralisation played a major role in the process whilst the Centre followed a laissez faire approach.

Considering the long coastline of 1,600 kms and opportunity for development of industries in the state, the Gujarat Maritime Board was established in April 1982, under the Gujarat Maritime Board Act, 1981. This was done to give certain liberties for the development of ports. Industrial and trade representatives were included as members of the Board, along with experts from financial institutions, engineering and navigation. The Board formulated the captive jetty policy in 1986, which encouraged industries to develop their own captive harbour facilities and were given certain concessions/incentives in wharfage charges.

This policy saw traffic of Gujarat state ports increase from 2.7 million tonnes in 1986 to 16 million tonnes in 1995. The prosperity of the coastal area increased simultaneously with the establishment of many industries such as cement, petroleum, fabrication, chemical and refining. Coal imports started , which was beneficial to the foundry industries of Jamnagar and Rajkot. In 1995, the GMB announced a policy for privatisation of ports; Gujarat was the first state to take such step. All the above changes happened only because the ports were a state subject and there were no restrictions from the Centre for development.

Source: Socio-Economic Review – Gujarat State (2011-12).

sition process tailored towards the specific situation in each Major Port.

As a guide to the recommended shift to a landlord model of port governance for Major Ports, simplification of the regulatory framework in the ports sector, the following guidelines are worth considering:

- Corporatised Port Authority to be professionally run, insulated as much as possible from government intervention.

- State governments to be encouraged to have substantial shareholding to ensure their participation in development and expansion of these ports.
- Autonomy of the Port Authority with respect to financial issues. There should be a separate budget unrelated to the state budget.
- Transparency of port accounts.
- Clear financial relation between the State (Ministry of Transport/Shipping) and the Port Authority. No hidden subsidisation, no financing of terminal equipment and superstructure.
- Equal treatment of all port and terminal users, be it shipping lines, terminal operators or other service providers.
- Equal access for port and terminal service providers, no monopolies for the provision of terminal services, except in case of dedicated terminal.
- Fair competition within the ports between terminal operators and marine service providers (intra-port competition).
- Fair competition between ports, no cross-subsidisation by Port Authority between various traffic categories.

In the current regulatory configuration, the Tariff Authority of Major Ports (TAMP), a regulatory body established in 1997 under the Major Ports Trust Act, 1963, is responsible for tariff fixation for Major Ports. TAMP determines tariff ceilings for Major Ports, while Non-Major Ports are sufficiently autonomous and exercise market-driven efficient pricing. Reducing tariffs below the ceiling as a means of promoting competition is almost nonexistent in the case of major ports. Port operators also do not have much incentive in promoting inter and intra-port competition, as almost all ports in India today operate at full capacity. For instance, JNPT has three container terminals catering for similar cargo and each one is operating at full capacity. One of the private terminals, GTI, has tariffs almost 30 per cent higher than the other two terminals, but it continues to attract sufficient traffic. The second container terminal at Chennai, to compete with the existing terminal operated by DP Port (earlier P&O Ports), as well as a fourth container terminal expected to come up at JNPT, is likely to see intra-port competition emerging in India.

Besides regulating both vessel-related and cargo-related tariffs, TAMP regulates rates for lease of properties in respect of Major Port Trusts and the private operators located therein. Despite being a regulatory body, the TAMP has limited autonomy, being largely under the central government's control[120]. It has rarely used its powers to motivate efficiency of port and terminal services, while it does not have jurisdiction over selection of private parties for contracts, an increasing occurrence given the move and preference toward adopting the Landlord Port model.

In principle, tariff setting or other price controls should not be exercised under the landlord model but left to the market. Rather, economic regulation pertains to establishing conditions for fair competition on a level-playing field. Therefore, tariff setting should be deregulated and its determination should be left to market forces. To this end, TAMP should soon start delegating tariff determination and setting to corporatised terminal operators, where efficient price discovery should be market-driven rather than being regulated. Only in cases of inadequate competition between terminals in a port or among ports, or serious market imperfections, may some pricing control be required. Tariff regulation by exception rather than by rule should be the operating principle. TAMP could act as the Appellate Tribunal for all tariff related matters where tariff is determined by service providers.

A new regulatory authority, Maritime Authority for Ports (MAP), should be constituted under a modernised Indian Ports Act 1908, suitably empowered to regulate competition and port conservancy across all the major and non-major ports in the country. This might create overlapping jurisdiction between the new sector regulator and the economy-wide competition regulator, the CCI. This is not unusual and exists in all infrastructure and utility sectors that have a specific regulator. Since the sector regulator is likely to better deal with specific regulatory and competition issues, it is best to empower the port regulator to address complaints concerning alleged anti-competitive practices or abuse of a dominant position. In addition it should also be charged with merger approvals and review of draft concession agreements to advise the Port Authority on whether any provisions thereof may be incompatible with the promotion of competition. The sector (port) regulator is likely to have the best information about the sector to monitor it. For example, competition issues arising from imperfect price and non-price conditions of access to unbundled elements in Landlord Ports or cross-subsidy problems are best understood and addressed by the regulator. It is also important for the regulatory agency to focus on identifying serious, long-term performance problems, rather than to become a micromanager of the sector as has been the experience with regulation, both in India and elsewhere[121].

Questions relating to a continuing role for the regulator in promoting competition or alternatively, whether ongoing competition issues should be left to the antitrust authorities are not new. There is a delicate balance between the two but there is a useful continuing role for the regulatory agency. Besides, the sector regulator should be independent of any Government and have its own sources of income. This issue confronts all regulators in India and is discussed further in the conclusions.

120. (CUTS C-CIER (Briefing Paper – Competition and Regulation in the Indian Port Sector).
121. Paul Joskow op cit.

It is also recommended that the two Acts governing Indian ports the Indian Ports Act, 1908, and the Major Port Trusts Act, 1963 be kept separate but modernised. A review of port legislation should be undertaken to have one unified law relating to conservancy and competition and a new law to transform the port trusts to landlord port authorities with functional and financial autonomy.

URBAN TRANSPORT

Economic activity in the city depends inter alia on efficiency of mobility. Urban transport is a key urban service that imparts efficiency by providing mobility to the workforce in the city and hence productivity. By all estimates, the magnitude of the expenditure required to develop and upgrade India's urban transport system is enormous. A majority of this requirement will be for roads and urban transport. The level of investment required can be realised only if there exists an extensive and effective institutional framework including clear regulation on the terms of investment and PPPs, competitive access to infrastructure, and pricing of services as well as social regulation promoting environmental sustainability and safety.

Urban planning received scant attention in India's initial Five Year Plans. The 74th Constitutional Amendment Act (CAA) of 1992 was pathbreaking since it provided legitimacy to the third tier of government, i.e., the urban local bodies. It envisaged the creation of empowered local governments, which would take on the responsibility of city planning and management[122]. The Act was a major milestone in recognising the role and importance of cities in economic development and sought the devolution of powers to local bodies. Urban Transport (UT), however, was not devolved. It remains a policy area where multiple national and state agencies are involved with limited coordination and some competition between their efforts.

Among all transport infrastructures in India, UT is easily the most complex. UT is made up of about 20 components and is currently managed by as many agencies[123]. The governance structure for UT is fragmented and the division of responsibility among the various agencies is unclear. The regulatory regime then suffers: the fragmentation handicaps the potential for strategic coherence between infrastructure investment and regulation of its use.

Coordination of regulation with investment planning is critical in three areas in particular[124].

- Road investment and traffic management
- Traffic management and public transport
- Traffic management and transport demand management

Where *road investment and traffic management functions* are not integrated, there is a tendency for the roads unit to see the transport problems of the city purely in terms of road congestion and the solution purely in terms of increases in road capacity rather than in more effective use of existing capacity. That road infrastructure investment bias is often amplified by the lack of effective management of the existing road system. Failure to integrate *traffic management and public transport* functions has similar policy consequences. In most cities—even very large cities—road-based public transport predominates. The majority of people move in buses, yet traffic management concentrates on securing increased average speed of movement of vehicles rather than of people. Public transport vehicles tend to hamper this because of their frequency of stops. The priority of private transport over public transport tends to be institutionalised in the way in which traffic signal settings are established. Third, even within the traffic function, the absence of strategic integration results in an emphasis on traffic engineering rather than traffic restraint to increase traffic speeds. Parking policies, for example, often concentrate on increasing the quantity of off-road parking in order to increase effective road capacity to improve traffic flow, rather than managing parking capacity to restrain the volume of traffic to improve flow[125].

> Among all transport infrastructure in India, urban transport is the most complex, with about 20 components and managed by as many agencies

A paradigm shift is needed in the approach towards urban transport. Demand management will play an important and crucial role in the quest for reducing congestion on city roads as will supply-side strategies. Congestion is commonplace in metropolitan centres during peak hours and the dramatic growth in vehicle ownership during the past decade has degraded rush hour speeds especially in the central areas of major cities. For example, peak vehicular densities will likely reach as high as 610 vehicles per lane kilometre. At such densities, an average journey may take up to five hours in peak morning traffic—similar to the acute congestion that disfigures some Latin American countries. The peak private vehicular density has already touched 170 vehicles per lane kilometer—50 per cent higher than the

122. The 12th Schedule, introduced with the passing of the 74th Amendment lays down 18 functions to be performed by local bodies, the major ones being: Urban planning including town planning, Water supply for domestic, industrial and commercial purposes, Public health, sanitation conservancy and solid waste management, Roads and bridges, Fire services, Slum improvement and upgradation, Urban poverty alleviation, Provision of urban amenities and facilities such as parks and gardens, Public amenities including street lighting, parking lots, bus stops and public conveniences, Urban forestry and protection of the environment.
123. Institutions for Urban Transport, Sub-group report of WG on Urban Transport (NTDPC) Ken Gwilliam.
124. Ibid.
125. Chennai's new parking policy, modeled after a payment system use in Budapest, is a a notable exception.
126. 2010, 'India's urban awakening: Building inclusive cities, sustaining economic growth', McKinsey Global Institute.
127. S Sundar and Akshima T. Ghate (TERI, 2011).

basic requirement. Additionally, lack of investment in public transportation has resulted in a significant decline in share of public transportation, from nearly 40 per cent in 1994 to 30 per cent today[126].

Global evidence shows that an effective shift to public transport can occur only if transport demand management measures are adopted in tandem with increased provision of public transport[127]. A slew of demand management measures have been used across cities; success of each will depend upon, inter alia, local conditions. Decentralisation and empowerment will be necessary to achieve the desired outcomes. Use of information technology to reduce demand for travel, congestion pricing, restrictions on vehicles use, road space reallocation, priority for bus and non-motorised modes are some common demand management techniques. Methods such as high occupancy requirements that restrict access to certain lanes during peak hours have been adopted in some countries. New electronic techniques of monitoring road use may eventually make it technically feasible to treat many urban roads almost as private goods. Whether this is also desirable will depend on the local context and circumstances. Consider, for example, water supply, that used to be unmetered but the increasing scarcity and supply cost triggered technical innovations that have made it possible (and desirable) to price these services like other private goods.

In addition to establishing an appropriate framework, implementing modal integration and creating competition, an independent regulator will need to deal with the complex issue of transport pricing. This has to be handled by a professional body

Multiple modes of transport coexist in Indian cities, but the pattern of use is not accurately known due to data inadequacies, although one estimate puts the use of public transport at 22 per cent[128]. The objective is to raise this percentage to 60 per cent by 2017 and this can only happen if public transport becomes efficient, convenient and accessible. At present there is a huge deficit in urban public transport services and infrastructure both in quality and quantity and a 'business as usual' scenario will detract from achieving the laudable objective of increasing the share of public transport in cities.

There is, at present, no legislation that enables a regulatory framework for modern, integrated UT. The Motor Vehicles Act deals with the licensing of vehicles, Railway Act covers inter-city traffic, Metro Construction Act deals with the specific issues related to construction of the metro rail, Tramways Act deals with tramways within the road surface with free access across it. Other modes of mass rapid transit such as the bus rapid transit, the light rail transit the mono rail and several other guided modes of transport and issues of transport planning, multi-modal integration, safety, tariff and financing are not covered under any Act. Clearly, the institutional and regulatory framework for UT is antiquated, not having kept pace with rapid urbanisation, technological advancements and the needs of citizens. The emergence of Mass Rapid Transit (MRT) in certain cities has resulted in a larger system; in general the greater the number of modes involved, the more complex will be the co-ordination.

The new regulatory mechanism must recognise this reality. Often, regulatory structures in India have become a liability because of multiple reasons, such as lack of capacity, a narrow and isolated approach, lack of independence and unclear mandates, besides human capital deficiencies. MRT comprises a spectrum of modes of urban public transport and success, as in other areas of transport logistics, will depend upon effective modal integration. The key to effective modal integration is the existence of a strong local coordination authority backed by different levels of government. The city should carry the primary responsibility for UT and the role of the Centre and the state should gradually get reduced. Decentralisation should be engendered by legislation and the regulatory functions of licensing, vehicle inspection and enforcement should continue with the Transport Commissioner.

In addition to establishing an appropriate framework, implementing modal integration and creating competition, an independent regulator will need to deal with the issue of transport pricing. This is a complex matter and needs to be handled by a professional regulatory body. The National Urban Transport Policy 2006 envisaged the creation of a dedicated Unified Metropolitan Transport Authority (UMTA) to be set up in each city with population in excess of 1 million and dedicated cells in smaller cities for integrated planning and coordination and delivery of urban transport services. The current UMTAs, however, act more like advisory committees and not as empowered technical decision making and coordinating bodies. While being supportive of this broad approach, NTDPC is proposing that such a metropolitan level organisation should be designated as 'Metropolitan Urban Transport Authority (MUTA)'. The MUTA should be a professional technical body with adequate technical staff strength (Volume II, Chapter 5 and Volume III, Chapter 5). Whether regulatory functions related to standards, demand management and pricing are handled by MUTA or a specialised and independent regulatory body is a matter of semantics; the core point is that these skills must exist in an agency at the metropolitan level, and they must be protected from political pressures.

128. Faster, Sustainable and More Inclusive Growth Approach Paper to the Twelfth Plan Government of India Planning Commission October, 2011.

Box 6. 11

The Namsan Tunnels in Seoul: Simple Road Pricing Reduces Congestion and Finances Traffic Management

Traffic congestion in Seoul increased dramatically during the 1980s and early 1990s despite extensive construction of new urban freeway and subway lines. In 1996, the Seoul metropolitan government commenced charging 2,000 won ($2.20) for the Namsan #1 and #3 tunnels, two corridors with high private vehicle use linking downtown Seoul to the southern part of the city. Charges were set for one- and two-occupant private vehicles (including driver) and collected in both directions per entry or exit from 7:00 a.m. to 9:00 p.m. during weekdays and from 7:00 a.m. to 3:00 p.m. on Saturdays. Private cars with three or more passengers, taxis, and all kinds of buses, vans and trucks were exempted from charges, as was all traffic on Sundays and national holidays.

In the two years following commencement of the congestion pricing scheme, there was a 34 per cent reduction in peak-period passenger vehicle volumes, the average travel speed increased by 50 per cent, from 20 to 30 km/h, and the number of toll-free vehicles increased substantially in both corridors. On the alternative routes, traffic volumes increased by up to 15 per cent, but average speeds also increased as a result of improved flows at signalised intersections linked to the Namsan corridors and increased enforcement of illegal on-street parking on the alternative routes.

The whole of the annual revenue from the two tunnels (equivalent to about $15 million) goes into a special account used exclusively for transport projects, including transport systems management and transport demand management measures throughout the city.

Source: Hwang, Son, and Eom 1999 quoted in World Bank Cities on the Move.

The biggest challenge for the regulating authority will be to evolve a price policy so as to balance equitably the demands of a very heterogeneous passenger travel market in urban areas. In the presence of economic growth, increasing use of personalised transport is one of the key reasons for the growing urban transport problems including that of increased energy consumption. In cities, there is heavy demand for road space combined with undercharging for its use, thus contributing to shortfall in resources to support the investments in urban transport infrastructure. A shift from personal vehicles to other mass transit and non-motorised modes is also necessary to reduce energy demand from cities. As established in the introduction, one role of prices is to allocate resources; the other to raise revenue.

Urban transport pricing is however complicated by the multiplicity of objectives and by the institutional separation of road infrastructure from operations, of infrastructure pricing from charging, and of roads from other modes of transport[129]. In the interests of urban transport integration and sustainability, a move towards prices that reflect full social costs for all modes; to a targeted approach to subsidisation reflecting strategic objectives; and to an integration of urban transport funding are desirable. This means that public transport fares should reflect the extent to which road infrastructure is adequately charged[130]. Congestion pricing, fuel tax, and parking fees are methods that have been applied in practice to charge for urban transport infrastructure and this should be reflected in the pricing for public transport modes (Box 6.11).

To the extent there are non-commercial objectives imposed on suppliers of public transport services, these should be compensated directly and transparently by the government. Efficiency demands that transport operators should operate competitively, whether they are public or privately owned. Overall, pricing and financing regimes for individual transport modes should be designed within an integrated urban transport strategy. This means that the institutional arrangement transcending traditional modal barriers and vertical integration from local to national levels.

For the proposed MUTA to be successful therefore, skills in planning, design, management and in regulation of urban transport are essential. Urban transport professionals, as a rule, are not employed by cities. Given the paucity of transport professionals in India, capacity building is crucial. It will be an ongoing effort and hence this activity ought to be institutionalised. A pool of professionals should be developed through academic institutions for employment by agencies responsible for urban transport. Data deficiencies in UT, as in the roads sector, are enormous and diminish the quality of policy advice.

129. World Bank Cities On The Move: A World Bank Urban Transport Strategy Review.
130. Ibid.

Restructuring of erstwhile monopolies and introducing competition are necessary but not suffient conditions to improve technical performance of transport sectors. There will be limits to competition due to the high initial and 'lumpy' investment in fixed facilities

A beginning has been made by Ministry of Urban Development to set up a central 'knowledge management and database centre' in the central government with the help of UNDP. It is necessary that collection of data in this sector also be institutionalised. In the future similar database centres should be set up by state governments and independently by some large cities as well. The Institute of Urban Transport should be strengthened as a central repository of information and to provide support to cities. Above all, MUTA should be a statutory autonomous body with full technical and financial authority and accountable for its decisions.

The regulatory functions of pricing, standards and demand management could be entrusted to a specialised independent body, subject to the caveat that 'regulatory proliferation' in India has been criticised as a strategy aimed at defending specific interests rather than improving sector outcomes. We return to this point in the conclusions. In case these regulatory functions are to be handled separately, independent regulators at the state and national level along the lines of Public Utility Commissions in the US is recommended. Inter-state disputes relating to UT can be addressed by the national government.

SUMMARY OF KEY RECOMMENDATIONS

NEED FOR REGULATION

The combination of extensive economies of scale and scope that generally lead to market concentration and limit competition, the large sunk costs relative to fixed and variable (avoidable) costs and the fact that transport services are deemed essential to a broad range of users, make regulation absolutely essential in the provision of these services. While transport infrastructure facilities (rights of way, track, terminals and associated traffic management) involve heavy upfront investment and display significant economies of scale, service provision (conveyance of passengers and freight) varies from being monopolistic (railways) to competitive (trucking and bus services).

The prospects for competition have changed with technological progress and new ways of provision. Horizontal and vertical unbundling can help separate the potentially competitive components from the natural monopoly segments in transport. As a result, trucking services are provided almost exclusively by the private sector in most countries. Besides, certain services are entirely similar to private goods, such as urban bus transport, while others such as port, air and rail services may be private or 'club goods' depending upon congestion. Many countries that have implemented economic reform in transport have sought to increase the role of the private sector in the provision of both transport infrastructure facilities and services. Introducing private sector participation in transport does not eliminate the need for regulation; in fact, it accentuates the role of effective regulation and regulatory institutions. For instance, the introduction of private sector participation in the power and telecommunications sectors in India heightened the need for effective regulation and regulatory institutions in India as these forms of policy influence replaced the mandate that ownership offers. Most parts of the transport infrastructure, and all transport services can now be classified as private goods, albeit with potential for market failure. However, it is crucial to recognise that it is regulation embedded in the local context, rather than ownership which is vital to achieving public policy goals.

Market failures are pervasive and yet it is not clear that where the market has failed, government through its several instruments will be able to improve the outcomes. The reform will have to be carefully calibrated based on available evidence. It is now clearly established that restructuring of erstwhile monopolies and introduction of competition (where possible) are necessary but not sufficient conditions to improve the technical performance of transport sectors. Even after restructuring, there will be limits to competition in certain segments of the transport sector, due to the high initial and 'lumpy' investment in fixed facilities. In addition, we know that the availability and quality of infrastructure services are often highly politicised and corruption is widespread. The problem of market power in provision combined with the temptation for political interference means that the unfettered market will inevitably lead to socially suboptimal outcomes if pricing and investment decisions are left unregulated. Independent regulation also possesses the advantage of potentially limiting political convenience.

Congestion is an externality that is customary on urban roads especially during peak hours. It is however not the only externality that transport infrastructure and services create. Decisions about infrastructure investment, for example in roads versus public transport, rail, and waterways affect energy efficiency and thus India's prospects for energy security and fiscal health. The current allocation of freight traffic between road and rail is one such negative externality. Transport services and choice of vehicle and fuel affect air pollution, which in turn negatively affects public health. Transport safety is also an externality from investments in particular forms of infrastructure as well as an 'invisible' aspect of service delivery. Regulation is thus required to reduce incentives to cut corners in parts of service provision that customers cannot readily assess when choosing which services to purchase.

As a result, regulation of various parts of the transport network is needed for various reasons: to limit the potential monopoly power exercised by owners of networks with high capital costs; manage congestion, air pollution, and other negative externalities from use of transport networks; achieve positive externalities including network effects; and motivate investments in 'invisible' consumer goods such as safety. Regulation can be used to encourage extension of access to infrastructure and services to lower-income or remote services, though other instruments such as subsidies to providers or targeted transfers.

One of the main goals of regulation are to induce firms to produce the service at the lowest possible costs to align prices with costs so that firms do not make super normal profits which they could without appropriate regulation. Given the growing use of PPP contracts in transport, an increasing role for the regulator will also be to ensure compliance with the PPP contracts. The challenge is considerable; not only because of the complexity and that it requires a learning process, but also because of the lack of a regulatory tradition and track record, scarcity of expertise, and weak formal and informal norms protecting private rights. This problem is everywhere since private participation in transport infrastructure is still an evolving phenomenon.

CROSS-CUTTING THEMES

Designing good regulatory institutions is a non-trivial task. Attributes such independence, transparency, accountability, expertise, legitimacy and credibility are the foundation on which the new regulatory institutions should be created within the scope of local legal tradition. No doubt this is a challenge, but one that will be an important causal factor in determining the future quality of our transport services. Effective regulatory institutions must be designed to provide credible commitments for investors who incur large sunk costs, they should protect consumers from excessive prices and poor-quality service and devise a strategy for achieving universal service goals. Besides, safety and social regulations to reduce health and environmental impacts are now integral to good regulatory institutions. By its very nature, setting and enforcing standards is an integrated activity involving multiple interventions. These interventions need to be combined and implemented in an integrated manner to derive the maximum benefits from each intervention.

India's regulatory capacity in each of these areas requires strengthening to achieve minimum capabilities. Institutional capacity has been weak, as it has in many emerging markets. A unitary Transport Ministry is a vital step towards good regulatory design along with independent regulatory institutions in each transport sector that includes a separate dispute settlement arrangement. Ministries are reluctant to relinquish control of the sector since it serves short-term political goals. Political constraints and ministerial preferences over time seem to have dominated the reform agenda in different infrastructure sectors. It is time to recognise that institutionalising a robust regulatory philosophy based on a framework with adequate capacity is a necessary, although not sufficient, condition for accelerated and sustainable growth. Evidence shows that regulatory strengthening must also happen before restructuring of ownership or lifting of controls on private participation.

> Financial autonomy is often linked to regulatory independence. In India, this has not been the practice. Depoliticising the regulatory process will therefore remain an important long-term goal in the transport sector

Independence implies shielding regulatory agencies from political pressure to the extent possible. The regulatory agency should be given functional autonomy in its day to day activities while the Ministry issues only broad policy guidelines and directives. Legitimacy on the other hand, requires the regulatory agency to follow a transparent consultative process of decision making with opportunities for judicial review. In practice this means holding open house discussions and posting consultation documents on the regulators website. This enables the regulator to collect evidence and also take account of the views of those who have an interest in the outcome. Consultation is an essential part of regulatory accountability—and it has now become intrinsic to the regulatory process. Judicial review of regulatory decisions is a reasonable safeguard to regulatory authority.

Financial autonomy is often linked to regulatory independence. In India, this has not been the practice since regulatory institutions are supported by budgetary allocations that can compromise independence. TRAI's request for independent funding through a percentage of the revenues of regulated firms has not been accepted by the government.

Regulatory structures in India have often become a liability due to multiple reasons, such as lack of capacity, a narrow and isolated approach, lack of independence and unclear mandates, besides human capital deficiencies

Depoliticising the regulatory process will thus remain an important long-term goal in transport. Financial autonomy however may or may not guarantee independence. An additional safeguard to prevent 'political capture' is to make appointment processes transparent and grounds for removal clear and structured for all regulatory institutions. Thus, legislation should guarantee stringent conditions for removal of any Authority Member or Chairman.

As independent regulation becomes more the norm, questions about institutional design will arise, namely: should regulation and dispute resolution institutions be created for each sector and sub-sector, or should certain functions be consolidated across sectors? India's piecemeal approach to infrastructure reform has led to the proliferation of regulatory bodies and tribunals. 'Regulatory proliferation' is seen as creating continued employment for the bureaucrats and judges, while professionals with technical expertise have been conspicuous by their absence. Commissions tend to be made up of retired civil servants or retired judges. This is worrisome and therefore it is vital to create a cadre of professional regulators with technical expertise for the complex tasks of managing the regulatory processes.

The alternative to sector-specific regulation is a single-umbrella transport regulator with specialised departments, or multi industry regulators. The primary argument in favour of the single-industry regulatory agency approach is that it ensures deep technical and economic expertise about the attributes of the industry within each agency's regulatory jurisdiction, and that this in turn leads to more effective regulatory decisions. The arguments in favour of a multi-industry or super transport regulator include wide-ranging deployment of common skills avoiding unnecessary duplication, opportunities for cross-learning and adoption of new practices across different sectors. Most importantly, it checks the potential for capture of the regulatory agency by single interest groups, especially the firms that are being regulated. There is enough overlap in regulatory issues to make it possible for a single agency to regulate transport. The thematic commonality across the different transport sectors suggests that adopting a multi-industry regulator might make the regulatory process more efficient and transparent, but it will be a lot more difficult to implement in the short term given enormous vested interests. A unitary Transport Ministry and/or a multi-industry regulator, despite its attractiveness, is therefore neither feasible nor practicable to adopt immediately in India. It will require significant legislative changes but should however remain a long term vision.

The Competition Commission of India (CCI) will remain the body to resolve anti-trust and competition-related issues. While elements of competition oversight are common across sectors, there is a delicate balance between, judicial review of regulatory decisions and enforcement of anti-competitive actions by industry players. The boundaries between CCI jurisdiction and the sector regulators will have to be established over time by precedent. It is also important to strengthen the CCI and create sub-groups with technology expertise would be a more flexible structure to be able to adapt as technology changes.

KEY IN-PRINCIPLE SECTOR RECOMMENDATIONS

Each transport sector in India is beset with numerous legislations. It is therefore imperative to simplify the legal structure. This has begun to happen in sectors such as ports and civil aviation, but clearly a lot more needs to be done. Existing sector-specific enactments need to be unified into a single statute. This will simplify procedures and make compliance easier. Certain sections of the existing acts which are anachronistic would also have to be deleted and even some of the acts repealed. But such unification may not be an easy task, and cannot be achieved within a short period of time. The process of private sector participation should not however be held up, pending completion of the work.

Unification of the legislations must be supplemented by the setting up of a statutory regulatory agency for each transport sector as detailed here. The primary regulatory need for railways is independent price regulation to reduce the persistent cross-subsidisation between freight and passenger services and begin to restore shift freight traffic toward railways. Thus, creating a Railways Tariff Regulatory Authority to provide 'a level-playing field to all stakeholders' is a major recommendation, also of various other committees including the Rakesh Mohan Committee on Railway Reform in 2001, the Sam Pitroda-headed Expert Committee on Railway Modernisation and by the Planning Commission. In addition, an independent dispute settlement tribunal could also be created with the existing Railway Rates Tribunal (RRT) charged with this mandate. Over time, as policy opens more opportunities for private participation in railway services, the regulatory framework will need to ensure competitive access to trunk lines and include social regulation to reduce environmental impacts and increase safety.

Road transport includes a number of regulatory challenges including managing PPPs in road construction; increasing safety and reducing environmental impact of road-based transport; ensuring competition in road transport services, and potentially using regulation among other tools to ensure widespread access to road transport. The PPP option is on the agenda for all transport infrastructure, but particularly for roads in which technology is more straightforward and project structures can be replicated as 'model documents'. Expert regulation is particularly important for resolving disputes after the concession. In addition, functions such as tariff setting, regulation of service quality, assessment of concessionaire claims, collection and dissemination of sector information could be performed by an independent body with expert staff tasked with making technical decisions. They should also ideally have incentives to serve long terms that allow the creation of a deep base of expertise and experience and like Bureau of Public Roads of the US, and should be shielded from direct political influence while simultaneously building a culture of professionalism. Separately existing institutions at the centre and states, including the NHAI should be strengthened.

The primary regulatory priority for Indian ports is to unify national and state regulatory structures. The existing regulatory framework, comprising many regulators and multiple legislations is complex and needs simplification to enhance integration and improved coordination. India needs legislation which is *inter alia* compatible with the functioning of a market-oriented economy and the global character of the maritime transport. A new set of incentives needs to be put in place as part of regulatory restructuring. The existing Ministry-centric port management system is a complex bureaucratic process and distorts incentives.

The jurisdiction of TAMP extends to Major Ports only. Over time, with more competition between ports and within ports (intra-port), the role of TAMP will necessarily undergo a change. Tariff regulation by exception rather than by rule should be the operating principle and its role transformed to limiting abuses of competition and applicable to all commercial ports in the country. This might create overlapping jurisdiction between the new TAMP and the economy-wide competition regulator i.e., the CCI, but this is not unusual for sectors that have a specific regulator. At the state level, a regulatory agency should also be set up to exercise oversight on Non-Major Ports in that state.

For civil aviation, a central regulatory agency called Civil Aviation Authority (CAA) should be created replacing the existing DGCA and AERA. Similar to other infrastructure sectors, multiple regulations and overlapping jurisdictions between institutions cause confusion and delays. CAA will consolidate the existing fragmented regulatory functions and combine economic, technical, safety, environment and consumer protection regulation. A dispute settlement body separate from the CAA will serve to fast-track disputes in the sector. The relationship between the sector-specific dispute settlement authority and the CCI will evolve over time and should be guided by the same principles that underpin this institutional relationship in other sectors.

Urban transport is a key urban service that imparts efficiency by providing mobility to the workforce in the city and hence productivity. Among all transport infrastructures in India, UT is easily the most complex. UT is made up of about 20 components and is currently managed by as many agencies. The governance structure for UT is fragmented and the division of responsibility among the various agencies is unclear.

Modern legislation for integrated UT is necessary to replace the antiquated structure. Regulatory structures in India have often become a liability due to multiple reasons, such as lack of capacity, a narrow and isolated approach, lack of independence and unclear mandates, besides human capital deficiencies. The key is to create a strong local coordination authority backed by different levels of government. The city should carry the primary responsibility for UT and the role of the centre and state should gradually get reduced. Decentralisation should be engendered by legislation and a dedicated Metropolitan Urban Transport Authority (MUTA) should be set up in each city with population in excess of 1 million and dedicated cells in smaller cities for integrated planning and coordination and delivery of urban transport services.

Many governments implementing economic reform in recent years, including India, have increased the role of the private sector in provision of transport infrastructure and services recognising that under normal circumstances, the role of the state should be one of broad policy formulation and regulatory oversight. Ownership and operation by the public sector should be in extreme cases of market failure such as for infrastructure that is financially unviable and has high social value. At the same time, a robust regulatory governance structure is needed to ensure gains from the transition to this new model. Attributes of a good governance structure include *sufficient political and financial autonomy for the institutions charged with regulating the sector; structures for decision making that constrain regulatory discretion; adequate access to regulatory means, including legal provisions for effective enforcement of decisions; and efficient rules of accountability and review*.

Given the socio-economic-political context, robust institutions for regulatory governance in transport will no doubt take time, first to create and then for these to mature and gain legitimacy in India. Merely delegating regulatory powers, including enforcement, may not be enough to minimise regulatory risk. But good decisions are more likely if regulatory design is sound. Badly designed regulatory and legal institutions can become a source of performance problems. For example, the improper design of regulatory and ownership structures are believed to be major causes of poor performance in sectors such as gas, electricity and transportation leading to significant economic costs to the order of 1 per cent of GDP. The guiding principles of good regulatory institutions include independence, transparency, accountability, expertise, credibility and legitimacy. Although independent regulation in India is relatively new, there is a wealth of evidence from the telecom and power sectors that can help design and implement a performance enhancing regulatory mechanism for transport that emphasises local needs and the local context.

Annex

Total Investment Commitments in PPI Projects in Transport Sector

[in current $ Million]

INVESTMENT YEAR	ARGENTINA	INDIA	CHINA	INDONESIA	BRAZIL	SOUTH AFRICA	COLOMBIA	RUSSIAN FEDERATION	TURKEY	CHILE
1990	2,088	1.9	173	116	-	0	-	-	-	-
1991	214	-	2,378.8	10.8	-	-	-	-	-	-
1992	814.7	-	532.6	1,14.5	-	-	40	0	-	-
1993	1,439.6	-	1,172	3,51.5	-	0	260.1	0	-	93.4
1994	940.5	125	2,086.1	26.7	328.1	-	518.9	0	20	27
1995	621.2	-	309.3	502.8	989.3	-	195.8	0		419.5
1996	930	182	5,084.42	-	4,357.2	-	1,48.9	-	85	190.4
1997	1,195	405	3,092.74	-	4,048.3	426	48.8	0	305	1,949.1
1998	1,911.3	301.6	1,670.5	-	7,808.7	165.7	284	406	-	168
1999	2,345	466.7	695.55	1,028	53.9	794.7	-	-	-	367.6
2000	129.8	96.4	1,558.5	-	1,373	3.7	1,047.7	109.4	-	201.5
2001	63.5	350.8	642.23	-	917.2	484	60.5	-	-	2,340.6
2002	6.9	719.17	1,787.11	-	157.8	-	10.8	-	-	1,045
2003	0	579.14	4,054.65	0	107.8	17	110.4	-	85	18
2004	3.4	1,141.4	782.58	159.2	224.2	-	26	0	155.6	791
2005	-	1,526.51	6,628.9	-	376.5	-	242	-	2,848.2	434.6
2006	337	10,028.47	8,351.01	372	233.5	3,483	672.36	144	217	147
2007	728.7	3,924.92	4,494.38	1,139.5	3,336	-	474	23	2,578	423
2008	331	5,423.65	436.75	-	9,967.1	-	956	24	1,491.5	260.1
2009	5.89	4,871.75	2,512.87	220	8,550.3	-	-	-	0	290
2010	0	14,220.87		-	1,440.8	-	2,359	4,595.9	332.7	823
2011	0	16,087.4	1,012.09	-	4,057.2	97	-	4,284.6	1,740.35	282
Cumulative Total	14,105.49	60,452.68	49,456.08	4,041	48,326.9	5,471.1	7,455.26	9,586.9	9,858.35	10,270.8

* Source: World Bank and PPIAF, PPI Project Database. (http://ppi.worldbank.org) Date: 08/08/2012.

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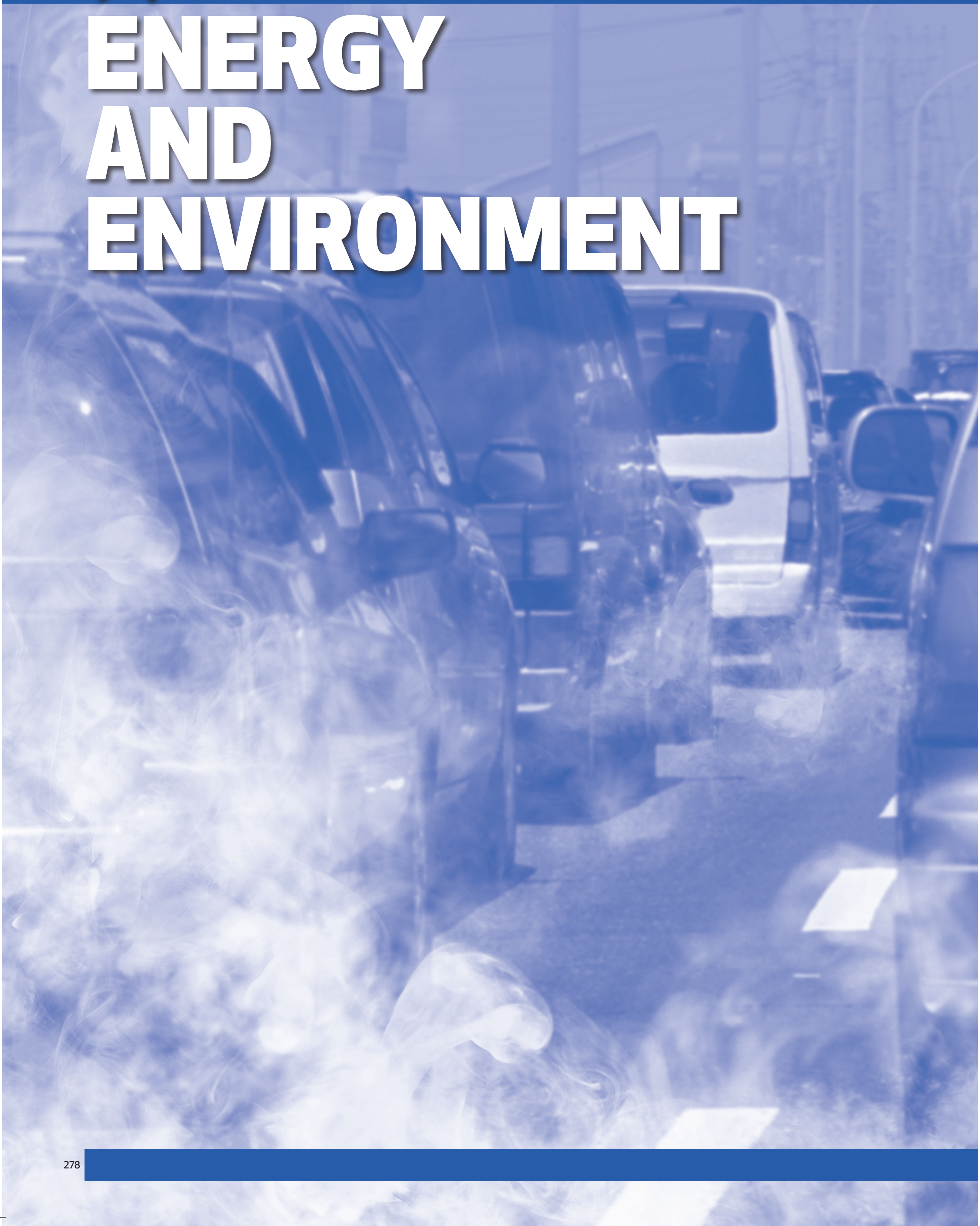
7. ENERGY AND ENVIRONMENT



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7.
ENERGY AND ENVIRONMENT

Vehicle ownership has soared in India over the last two decades. In 1991, according to the Ministry of Road Transport and Highways (MoRTH), the number of vehicles registered in the country was just over 21 million. By 2011, the number had increased to 142 million.

The high growth rate of new vehicle registrations is expected to continue, at least through the remainder of this decade.

The continued growth of the transport sector may be vital for further economic development, but it has exacerbated India's critical air pollution problem: vehicular emissions. Hydrocarbons (HC), carbon monoxide (CO), oxides of nitrogen (NO_X), particulate matter (PM), and carbon dioxide (CO_2) are a critical issue that has to be tackled on a war-time footing.

In 2011, many Indian cities featured in the World Health Organisation's (WHO) list of the world's 100 most polluted cities. The 2010 Global Burden of Disease (GBD2010) report listed ambient air pollution as the sixth most important cause of death in South Asia. According to a recent study for six cities—Delhi, Kanpur, Bangalore, Pune, Chennai, and Mumbai conducted by the Central Pollution Control Board (CPCB), the transport sector is responsible for a majority of NO_X and 30-50 per cent of PM emissions in these cities (Box 7.1).

The problem is widespread. In 2008, the CPCB identified around 70 cities, representing over 80 per cent of cities that were being monitored, that were not complying with the NO_X and PM standards. This was before more stringent air quality standards were brought into effect in 2009. An analysis by the Clean Air Initiative (CAI) Asia of PM concentrations in 130 cities in India also indicated that most of the cities exceeded the national standard, as shown in Figure 7.1. Many of these cities have air pollution levels far above the legal limit, have continuously been in non-compliance for many years, and have no tangible plans to drastically improve air quality in the near future. Increasing vehicular emissions leading to poor air quality have significant negative impacts on public health. Traffic-related air pollution, especially PM and NOx, has been shown to lead to premature morbidity and mortality. A study supported by the WHO estimated about 154,000 people died in India in 2005 as a result of ambient fine particulate matter ($PM_{2.5}$) alone. This number has most likely increased since.

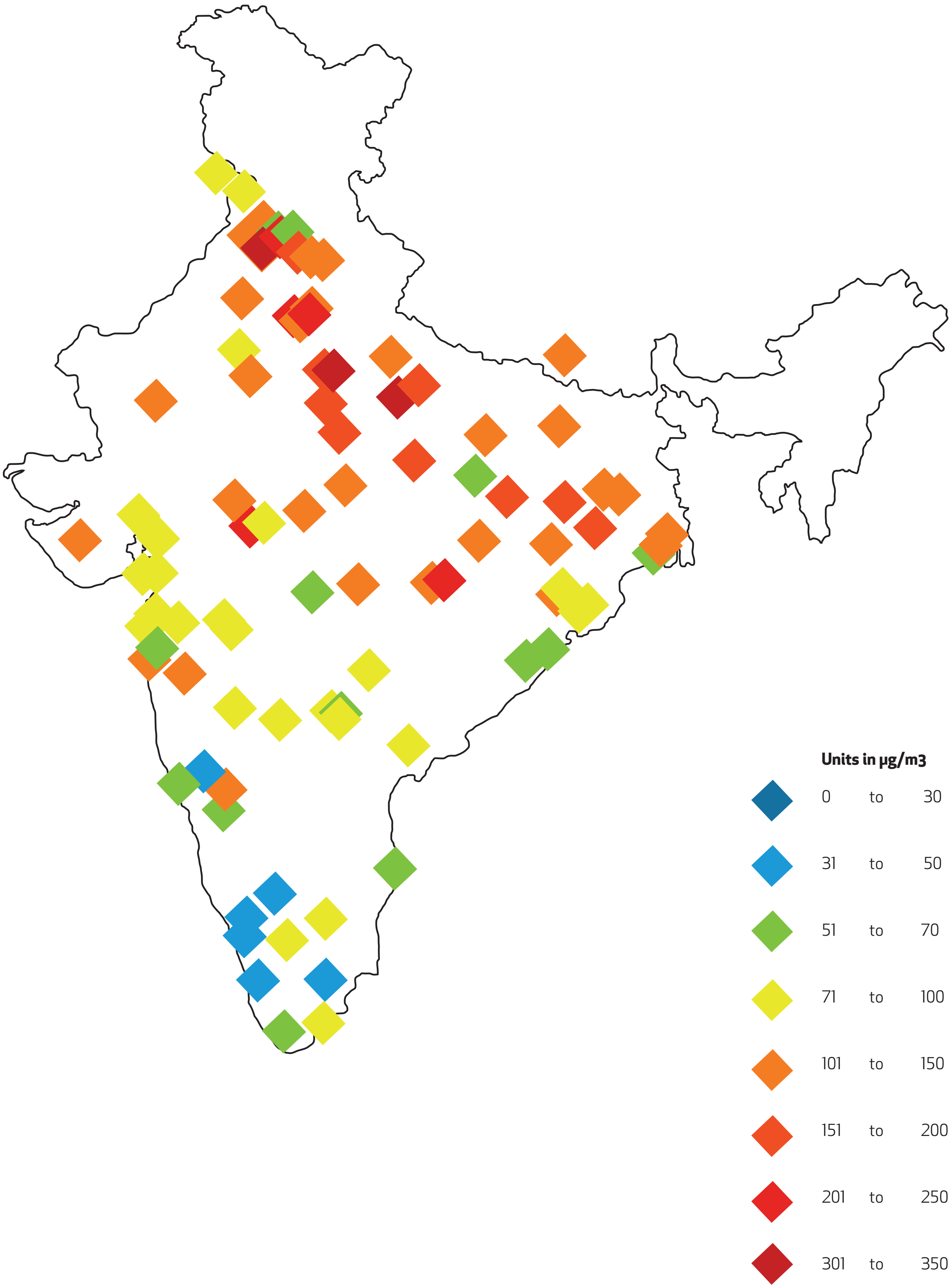
In 2002, the WHO calculated a respiratory disease mortality rate of 58 persons per 100,000 in India. By 2008, this rate had increased to 101 persons per 100,000. A meta-study by the Health Effects Institute (HEI) looked at the effects of air pollutants on human health by analysing numerous studies from around the world. It found 'suggestive' or 'sufficient' evidence that traffic-related air pollution leads to cardiovascular morbidity, asthma incidence and other respiratory illnesses in children, reduced lung function, and all-cause mortality. Studies conducted in India found much of the same results as the HEI meta-study: air pollution is linked to a variety of morbidity and mortality endpoints.

The transport sector accounts for nearly 18 per cent of the total energy consumed in India, second only to the industrial sector. Nearly 98 per cent of the energy needs of transportation are met through petroleum products, and almost half of the total consumption of petroleum products in India occurs on account of transport activities (TERI, 2012). This demand for energy is expected to grow if no action is taken.

Of the 142 MT CO_2e emissions released by the transport sector in 2007, 87 per cent were on account of road-based vehicular activities (Ministry of Environment and Forests, 2010). If no action is taken, overall transport CO_2e emissions can come close to

Figure 7.1

Annual Average PM Concentrations in 137 Indian Cities in 2008



Source for Figure 1: Clean Air Initiative for Asian Cities (CAI-Asia), 2010. "Clean Air Management Profile (CAMP) India: 2010 Edition". CAI-Asia Centre. Pasig City, Philippines

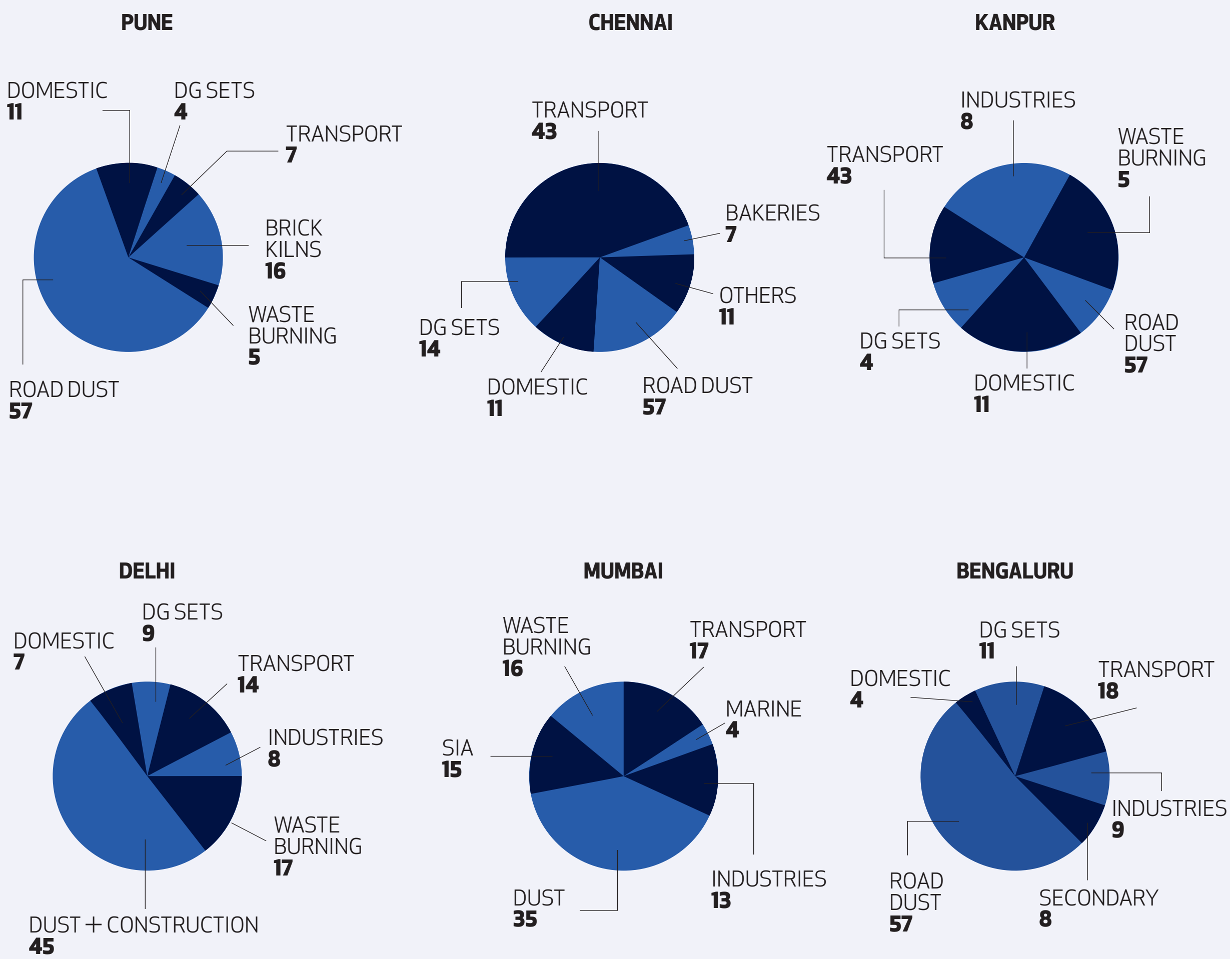
Box 7.1

TRANSPORT AND PARTICULATE MATTER: THE CPCB STUDY

In 2011, the Central Pollution Control Board (CPCB) and the Ministry of Environment and Forests, Government of India, jointly published the results of receptor modelling of particulate pollution in six cities—Pune, Chennai, Kanpur, Delhi, Mumbai, and Bangalore. The receptor modelling studies are carried out in three steps—collecting samples at representative locations in the city, chemical analysis of the samples to identify the quantities of marker elements for various sources, and statistical mass balance modelling of the results of chemical analysis of the ambient and source samples.

Urban air pollution is a complex issue, fuelled by multiple sources ranging from vehicle exhaust, on-road re-suspended dust due to vehicles, industrial flumes, construction dust, garbage burning, to domestic cooking and heating, and some seasonal sources such as agricultural field residue burning, dust storms and sea salt (for coastal areas). Receptor modelling is one way of apportioning these contributions and this methodology is dependent on the location of the sampling sites. For the six cities, the sampling was carried out at domestic, industrial, and kerbside locations and an average for all samples is presented in the figure below. For total PM emissions (particulate matter with aerodynamic diameter < 10 µm), transport remains an important source—from direct vehicle exhaust emissions and indirect re-suspension of dust due to constant movement of vehicles on the road.

Average Per cent Contributions of Major Sources to Particulate Pollution



Source: CPCB (2011)

Figure 7. 2
Timeline of Implementation of New LDV Standards in Select Countries

<table>
<tr><th colspan="11">LIGHT-DUTY VEHICLE EMISSION STANDARDS SCHEDULE</th></tr>
<tr><th></th><th>2005</th><th>2006</th><th>2007</th><th>2008</th><th>2009</th><th>2010</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th></tr>
<tr><td>India</td><td colspan="5">Bharat II</td><td colspan="5">Bharat III</td></tr>
<tr><td>India - 13 Cities*</td><td colspan="5">Bharat III</td><td colspan="5">Bharat IV</td></tr>
<tr><td>China**</td><td colspan="3">China II</td><td colspan="3">China III</td><td colspan="4">China IV</td></tr>
<tr><td>Europe</td><td colspan="5">Euro 4</td><td colspan="4">Euro 5</td><td>Euro 6</td></tr>
<tr><td>Brazil**</td><td colspan="2">Proconve L3 (Euro 2)</td><td colspan="2">Proconve L4 (Euro 3)</td><td colspan="4">Proconve L5 (Euro 4)</td><td colspan="2">Proconve L6 (Euro 5)</td></tr>
<tr><td>Thailand</td><td colspan="7">Euro 3</td><td colspan="3">Euro 4</td></tr>
<tr><td>Argentina</td><td colspan="2">Euro 2</td><td colspan="2">Euro 3</td><td colspan="6">Euro 4</td></tr>
</table>

*Delhi, Mumbai, Kolkata, Chennai, Bangalore, Surat, Agra, Hyderabad, Pune, Ahmedabad, Kanpur, Lucknow, Solapur
**Select cities have more stringent standards

1000 MT by 2030, a fourfold increase from 260 MT in 2010 (TERI, 2009).

India requires appropriate measures for urban planning, transport infrastructure development, and stringent standards and enforcement to reduce fuel consumption and emissions to curb this extraordinary growth in transport sector energy consumption and pollutant and greenhouse gas (GHG) emissions,. The current approach to urban planning and infrastructure development, that incentivises vehicle use, will have to change. The latest emissions control technologies that are already available will have to be taken advantage of to leapfrog to tighter emission standards and reduce fuel consumption. Additionally, current emission test cycles will need to be replaced by more stringent ones and in-use emissions compliance programmes will have to be solidified to ensure strict enforcement of regulations.

In many cases, these diverse problems overlap. Solutions for one help solve others. For example, measures to reduce vehicle PM emissions also help reduce Black Carbon (BC) emissions, which is a growing concern. This not only improves air quality and public health, it mitigates global warming. Similarly, many vehicle technologies that reduce pollutant emissions also improve vehicle fuel efficiency.

This chapter takes a holistic look at India's road transport sector's growing energy consumption and emissions, and it highlights the negative effects of these and possible ways to mitigate them.

VEHICULAR AIR POLLUTION IN INDIA

The impetus for vehicle emissions regulations in India began in the 1980s, with laws such as the Air Act, 1981, Environment (Protection) Act, 1986, and Motor Vehicles Act, 1988. In 1985, an expert committee was constituted to determine vehicle emission norms for new vehicles, finalise vehicle testing procedures, and approve laboratories. The committee's recommendations were notified in 1990 and India's first-ever new vehicle emission limits and pollution under control (PUC) programme for in-use vehicles were established.

In the early 1990s, a new committee led by retired Justice K. N. Sakia was appointed under the direction of the Supreme Court with the aim of examining measures to further reduce vehicle emissions in the short- and long-term. The Sakia Committee's recommendations focused on Delhi, but it established precedents that were applicable for the rest of the country.

In 1992, a separate committee constituted by the CPCB and led by Prof. H.B. Mathur recommended fuel quality and emission standards for the rest of the decade. As a result, lead in fuels was gradually phased out, fuel sulphur content was reduced, and emission limits for new vehicles were progressively tightened.

At the turn of the century, a committee led by Dr. R. A. Mashelkar was formed at the request of the Prime Minister. The Mashelkar Auto Fuel Policy Committee called for progressively tighter vehicle emission and fuel quality standards, based mostly on European regulations. The committee also recommended two sets of standards: one with more stringent norms for a few targeted cities, and the other for the remainder of the country. The Committee's recommendations were applicable through the year 2010. In January 2013, the Government of India constituted a new Auto Fuel Policy Committee to recommend vehicle emission standards and fuel quality regulations through 2025.

Figure 7.3
Timeline of Implementation of New HDV Standards in Select Countries.

<table>
<tr><th colspan="11">HEAVY-DUTY VEHICLE EMISSION STANDARDS SCHEDULE</th></tr>
<tr><th></th><th>2005</th><th>2006</th><th>2007</th><th>2008</th><th>2009</th><th>2010</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th></tr>
<tr><td>India</td><td colspan="5">Bharat II</td><td colspan="5">Bharat III</td></tr>
<tr><td>India: 13 Cities*</td><td colspan="5">Bharat III</td><td colspan="5">Bharat IV</td></tr>
<tr><td>China** China IV</td><td colspan="2">China II</td><td colspan="6">China III</td><td colspan="2">China IV</td></tr>
<tr><td>Europe</td><td colspan="3">Euro IV</td><td colspan="5">Euro V</td><td colspan="2">Euro VI</td></tr>
<tr><td>Brazil**</td><td>Euro II</td><td colspan="6">Proconve P5 (Euro III)</td><td colspan="3">Proconve P7 (Euro V)</td></tr>
<tr><td>Thailand</td><td colspan="7">Euro 3</td><td colspan="3">Euro 4</td></tr>
<tr><td>Argentina</td><td>Euro II</td><td colspan="3">Euro III</td><td colspan="6">Euro IV</td></tr>
</table>

*Delhi, Mumbai, Kolkata, Chennai, Bangalore, Surat, Agra, Hyderabad, Pune, Ahmedabad, Kanpur, Lucknow, Solapur
**Select cities have more stringent standards

CURRENT VEHICLE EMISSION STANDARDS

LIGHT-DUTY VEHICLES (LDV)wIndia follows the European pattern for LDV emission regulations. Thirteen cities are at the Bharat IV (Euro IV equivalent) level, while the rest of India is at Bharat III Europe is at Euro V, and plans to move to Euro VI by 2014. This means that new Indian vehicles are not fitted with the most advanced emission reduction technologies, despite these technologies being available to Indian automakers.

India also lags behind Brazil and China, both of which are fast developing countries like India and base emission regulations on the European pattern. China implemented China IV standards nationwide in 2011 with Beijing further ahead at China V. Thailand, too, has moved ahead to Euro IV nationwide. Brazilian LDV emission standards were behind Indian standards in 2005, but since then, Brazil has jumped well ahead. Similarly, Argentina moved to Euro IV in 2009. Figure 7.2 shows the timeline of implementation of new LDV standards in select countries.

HEAVY-DUTY VEHICLES (HDV)
For HDV regulations too, India follows the European pattern. The 13 cities with Bharat IV LDV standards also mandate Bharat IV HDV standards while the rest of country follows Bharat III.

India lags behind Europe, China, and Brazil in HDV emission standards. Euro VI emission standards, which require diesel particulate filters, went in to effect in January 2013 for new engines and in January 2014 for all engines sold across Europe. China implemented China IV HDV standards from July 2013, while Beijing implemented China V standards from February 2013 onwards. Thailand implemented Euro IV standards in 2012. Brazil mandated Euro V equivalent standards for HDVs at the beginning of 2012, leapfrogging over Euro IV. Argentina moved to Euro IV in 2009. Figure 7.3 shows the timeline of implementation of new HDV standards in select countries.

TWO- AND THREE-WHEELERS
India does not follow the European regulatory pattern for two- and three-wheelers. Instead, it uses the India Drive Cycle (IDC) to test their emission, and set emission limits accordingly. Currently, Bharat III standards are mandated nationwide for all two- and three-wheelers.

Since India does not follow European regulations for two- and three-wheelers, established Bharat IV and higher regulations do not apply to this class of vehicles. India will have to develop new emission limits to tighten standards under the IDC. Europe, which is currently at Euro III for two- and three-wheelers, has already planned to go to Euro VI by 2020. A recent expert report detailed pathways for similar action in India.

NON-ROAD VEHICLES
India first regulated non-road vehicles in 1999, with the implementation of emission standards for agricultural tractors. These were tightened over the next decade. It then implemented separate standards for construction equipment in 2007. Since then, India has worked to unify emission limits for both categories, although a few differences remain.

TEST CYCLES
India currently uses European test cycles to determine emissions from LDVs and HDVs. For two- and three-wheelers, it uses its own unique test cycle. For non-road vehicles, it follows US test cycles and procedures. In these test cycles, the emissions are often quite different from those under real-world conditions. While it is impossible to create test cycles that represent real-world conditions with perfect accu-

Figure 7. 4
Timeline of Gasoline Sulphur Content Reduction in Select Countries

<table>
<tr><th></th><th colspan="10">GASOLINE SULPHUR CONTENT SCHEDULE (PPM)</th></tr>
<tr><th></th><th>2005</th><th>2006</th><th>2007</th><th>2008</th><th>2009</th><th>2010</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th></tr>
<tr><td>India</td><td colspan="5">500</td><td colspan="5">150</td></tr>
<tr><td>India - 2010 Cities**</td><td colspan="5">150</td><td colspan="5">50</td></tr>
<tr><td>India - 2012 Cities*</td><td colspan="5">500</td><td colspan="2">150</td><td colspan="3">50</td></tr>
<tr><td>China§</td><td colspan="5">500</td><td colspan="5">150</td></tr>
<tr><td>Brazil§</td><td colspan="9">1,000</td><td>50</td></tr>
<tr><td>Europe</td><td colspan="4">50</td><td colspan="6">10</td></tr>
<tr><td>Japan</td><td colspan="3">50</td><td colspan="7">10</td></tr>
<tr><td>Thailand</td><td colspan="7">150</td><td colspan="3">50</td></tr>
</table>

*Puducherry, Mathura, Vapi, Jamnagar, Ankleshwar, Hissar, Bharatpur, Daman, Diu, Silvasa, Unnao, Raebareli, and Aligarh
**Delhi, Mumbai, Kolkata, Chennai, Bangalore, Surat, Agra, Hyderabad, Pune, Ahmedabad, Kanpur, Lucknow, Solapur
§ - Select cities have lower sulphur content

racy, India has been a party to the development of world-s-test cycles, along with other countries. These include a much wider variety of driving conditions than current Indian test cycles. Therefore, they are much more comprehensive in their requirements and make it harder to create a vehicle that 'beats' the test cycle but emits much more in reality.

Europe already has plans to replace its test cycles with world-harmonised test cycles for all vehicle types. India has taken the positive step of allowing the world-harmonised motorcycle test cycle (WMTC) to be used in place of the IDC for two-wheeler testing, but it has yet to do the same for other vehicle types.

EVAPORATIVE EMISSION

As exhaust emissions fall, evaporative emissions become increasingly relevant. Anticipating a move to Bharat VI and beyond in the future, India can begin to establish evaporative emissions now.

Apart from evaporative emissions from vehicles, fumes emitted during refuelling are harmful to human health and the environment. There are a number of vapour recovery systems that can minimise them. India should assess these options.

HISTORY OF FUEL QUALITY STANDARDS

For progressively tighter vehicle emission standards to be implemented, it is important to set fuel quality standards that enable clean vehicle technologies to function optimally.

An important achievement has been the removal of lead from all fuels in the country since the year 2000. After lead, sulphur content is the most important element that affects vehicle emissions. Fuel sulphur inhibits the proper functioning of many emission control systems. India has successfully reduced sulphur content in all its fuels over the last 20 years. Nevertheless, sulphur levels remain higher than what is necessary for the latest clean vehicle technologies to be implemented effectively.

There are other fuel quality parameters too that affect emissions, albeit less significantly. India has made important progress in improving fuel quality on all these parameters.

CURRENT FUEL QUALITY STANDARDS

India's current fuel quality standards took effect in 2010, at the same time as the implementation of the latest vehicle emission standards. Bharat IV fuel quality standards were mandated in 13 cities. Since then, 13 more cities have started receiving Bharat IV fuel. A total of 63 cities should receive Bharat IV fuel by 2015.

The current dual fuel status leads to a situation where Bharat IV vehicles, designed to operate on lower sulphur fuel, refuel in Bharat III areas. This is particularly problematic for commercial vehicles, which often do not operate in just one metropolitan area. Since many emission control technologies require low sulphur fuel to function correctly, Bharat IV vehicles refuelling on Bharat III fuel are likely to emit more than they are designed to.

GASOLINE FUEL QUALITY STANDARDS

India has made important progress in reducing gasoline sulphur content, roughly consistent with fuel sulphur content in China over the last few years. But it yet remains well behind international best practices. Europe and Japan have mandated a maximum sulphur content of 10 ppm in gasoline, and Brazil plans to leapfrog to 50 ppm sulphur gasoline by 2014. Thailand introduced 50 ppm gasoline in 2012. Figure 7.4 shows the timeline of gasoline sulphur content reduction in India and other countries.

DIESEL FUEL QUALITY STANDARDS

As with gasoline, India has significantly reduced the sulphur content in diesel over the last two dec-

Figure 7. 5
Timeline of Diesel Sulphur Content Reduction in Select Countries.

<table>
<tr><th colspan="11">DIESEL SULPHUR CONTENT SCHEDULE (PPM)</th></tr>
<tr><th></th><th>2005</th><th>2006</th><th>2007</th><th>2008</th><th>2009</th><th>2010</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th></tr>
<tr><td>India</td><td colspan="5">500</td><td colspan="5">350</td></tr>
<tr><td>India - 2010 Cities**</td><td colspan="5">350</td><td colspan="5">50</td></tr>
<tr><td>India - 2012 Cities*</td><td colspan="5">500</td><td colspan="2">350</td><td colspan="3">50</td></tr>
<tr><td>China§</td><td colspan="7">2,000</td><td colspan="3">350</td></tr>
<tr><td>Brazil§</td><td colspan="4">2,000</td><td>1,800</td><td colspan="4">1,800-500[1]</td><td>500</td></tr>
<tr><td>Europe</td><td colspan="4">50</td><td colspan="6">10</td></tr>
<tr><td>Japan</td><td colspan="2">50</td><td colspan="8">10</td></tr>
<tr><td>Thailand</td><td colspan="7">350</td><td colspan="3">50</td></tr>
</table>

*Puducherry, Mathura, Vapi, Jamnagar, Ankleshwar, Hissar, Bharatpur, Daman, Diu, Silvasa, Unnao, Raebareli, and Aligarh
**Delhi, Mumbai, Kolkata, Chennai, Bangalore, Surat, Agra, Hyderabad, Pune, Ahmedabad, Kanpur, Lucknow, Solapur
1 - Transitional: 1800 ppm will gradually be substituted by 500 ppm
§ - Select cities have lower sulphur content (10-50 ppm) to enable Euro V equivalent trucks and buses

ades. Despite this, diesel sulphur content remains higher than gasoline sulphur content in most of the country, and well below international best practices. Europe and Japan have mandated a maximum of 10 ppm sulphur in diesel. Mexico is in the process of implementing 15 ppm sulphur. Thailand implemented 50 ppm diesel nationwide in 2012. Figure 7.5 shows the timeline of diesel sulphur content reduction in India and other countries.

FUTURE VEHICLE EMISSION & FUEL QUALITY STANDARDS

Since 2010, there has been no real initiative in India to move to more stringent standards, or to expand Bharat IV to cover the entire country. This means India will continue to lag behind international best practices, and the gap will only widen as other countries take action while India does not.

The Mashelkar Committee had recommended in 2003 that an Auto Fuel Policy Committee be formed every five years to review progress and keep abreast of international regulatory and technology developments. The Government of India constituted a new Auto Fuel Policy Committee in January 2013 finally to recommend vehicle emission standards and fuel quality regulations through 2025.

CURRENT COMPLIANCE & ENFORCEMENT MECHANISMS

In any country, set standards are only as good as the compliance and enforcement mechanisms. In India, there are many laws and legal precedents that establish mechanisms for the enforcement of vehicle emission and fuel quality standards. A number of government ministries and agencies work on these issues.

MoRTH is the nodal ministry for vehicle emission regulations, collaborating with other ministries and agencies to carry out its duties.

Compliance and enforcement of vehicle emission regulations are separate for new vehicles and in-use vehicles. New vehicles undergo Type Approval (TA) and Conformity Of Production (COP) testing to ensure they meet set standards. These are usually conducted by certified testing agencies. In-use vehicles undergo PUC checks. Vehicle owners are responsible for taking their vehicles to local certified centres for these tests.

But TA and COP are not linked with PUC. The former two are national programmes that rely on new vehicle standards. PUC enforcement is done at the local or state level, and it relies on separate standards uncoupled from the vehicle's original emission standards. India does not have a national in-use testing programme that looks at a vehicle's original emission standards and set deterioration rates.

Another problem is that responsibility for compliance and enforcement is splintered. The MoRTH is ultimately responsible for vehicle compliance issues, but the primary vehicle testing agencies it relies on for this fall under the aegis of the Ministry of Heavy Industries (MoHIPE).

The MoHIPE only partially funds these agencies. They have to rely on automobile companies, the very companies they are regulating, for much of their funding. In 2003, the Mashelkar Committee had recommended the creation of a single, government-funded agency responsible for all vehicle emission and fuel quality issues, including compliance and enforcement. Unfortunately, this recommendation was not adopted by the government.

Table 7.1
Estimated On-Road Vehicular Population in India in 2030

STUDY	ESTIMATED ON-ROAD VEHICLE POPULATION IN 2030
ICCT (2012)	430 Million
TERI (2009)	315 Million
Guttikunda et al (2012)	426 Million
ADB (2006)	373 Million*

* For 2035

Officially, fuel quality regulations are handled by the Ministry of Petroleum & Natural Gas (MoPNG). In reality, it is usually managed by oil companies, which test fuel quality at various stages of production and distribution. While representatives from the MoPNG are required by law to be present at refineries and oil depots to sign off on every batch of fuel, there is little evidence that this actually happens. Fuel transporters are required to have permits issued by state governments, up-to-date lists of the retailers they supply, and quantities of fuels supplied to them.

But again, there is little evidence that this is done properly. A 2006 study by the Indian Institute of Management (IIM) Ahmedabad found that the reporting and recordkeeping on the part of fuel transporters was sloppy at best. Little was being done to ensure that trucks were going to their assigned destinations. Tracking each supply truck was not deemed feasible. Exacerbating the situation, corruption among transporters and those responsible for enforcing rules was high, especially among lower level employees.

Lax enforcement, corruption and government subsidies for certain fuels over others gives rise to fuel adulteration, in which cheaper fuels, such as diesel and kerosene, are mixed with more expensive fuels, such as petrol. Both the IIM Ahmedabad study and an earlier study by the Centre for Science and Environment (CSE) found adulteration to be a problem in many parts of India. A special anti-adulteration cell within the MoPNG was set up in 2001 to specifically tackle this issue, but it itself was laden with corruption and shut down in 2004. Another result of inadequate government vigilance of fuel quality compliance is that independent fuel testing laboratories, such as one established in Noida, are not utilised to their full potential. These labs do not have the authority to obtain samples themselves, nor to administer punishment to oil companies, fuel transporters, or retail outlets for violations of standards.

FUTURE OUTLOOK

India has taken a number of positive steps to reduce vehicle emissions over the last two decades. Per vehicle emission of the four regulated pollutants (CO, HC, NO_x, and PM) has fallen. Total vehicle emission of PM have also reduced over the last decade and total NO_x emission growth has slowed. But vehicle ownership in India is expected to continue to rise at a high rate. If no further action is taken to reduce per vehicle emissions, the benefits of past actions will be erased.

VEHICLE EMISSIONS

The Society of Indian Automobile Manufacturers (SIAM) estimates passenger car sales in India will be close to 5 million vehicles by 2020. A study by the University of Michigan had even higher projections of 7.7 million.

A study by the United Nations (UN) predicted India's total highway vehicle population to be between 206 and 309 million by 2040. Various estimates are presented in Table 7.1. Most of these studies indicate about a five to six times increase in two-wheeler and car population by 2030. Figure 7.6 shows the ICCT's projections of vehicle population breakdown by vehicle type through 2030.

Several estimates show that if no further regulatory action is taken, the trend of declining vehicle PM emission will reverse in the near future. NO_x emission will also increase at a rate faster than they are today. Figures 7.7 and 7.8 show annual PM and NO_x emission, respectively, by vehicle type between 2000 and 2030 under a business-as-usual (BAU) scenario, which assumes current policies and trends will continue. Box 7.2 gives the spatial distribution of emission concentrations in 2010 and 2030, and indicates the regions in the country that are going to be affected the most by vehicular air pollution.

Of the different types of vehicle emissions, NO_x and PM are especially problematic in India. The CPCB recently identified over 70 cities that do not meet national ambient air quality standards (NAAQS) for NO_x and PM. In almost all these cities, vehicles are an important source of pollution. Emission could continue to grow well beyond 2030 if per vehicle emission is not mitigated significantly. The harmful effects of vehicle emission will take a toll on air quality and public health in India, as well as negatively

Figure 7.6
ICCT Projections of Vehicle Population Breakdown by Vehicle Type in India Through 2030

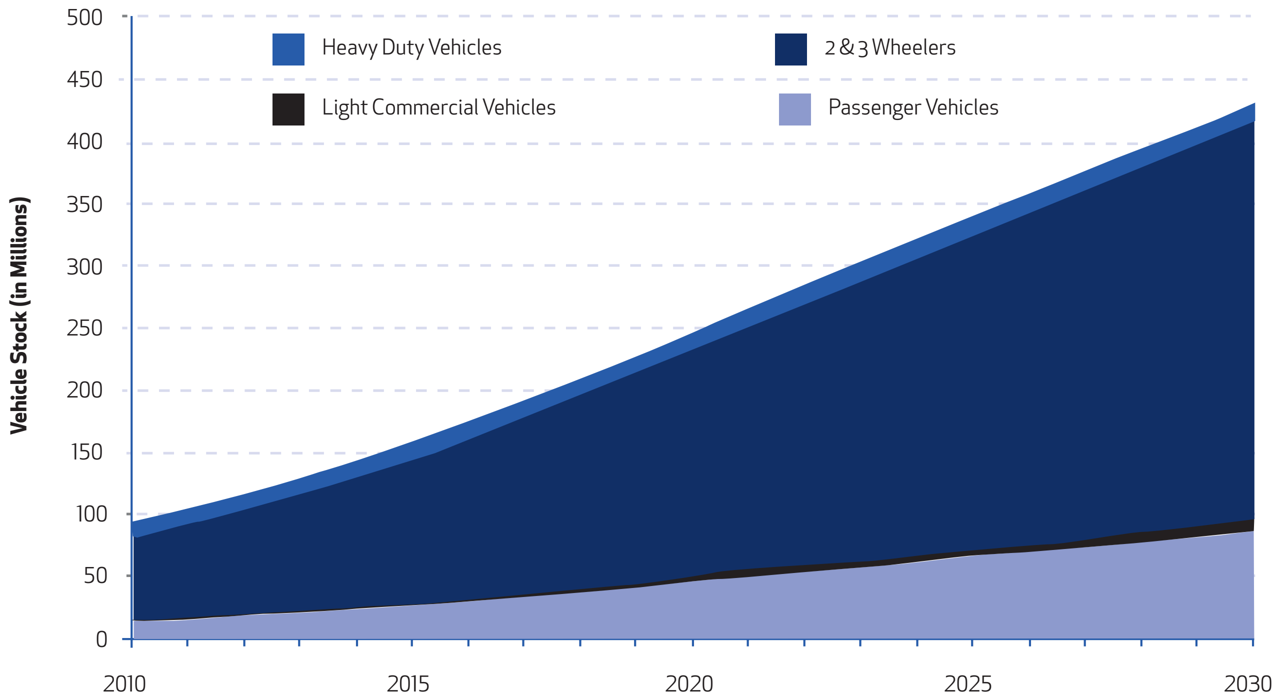
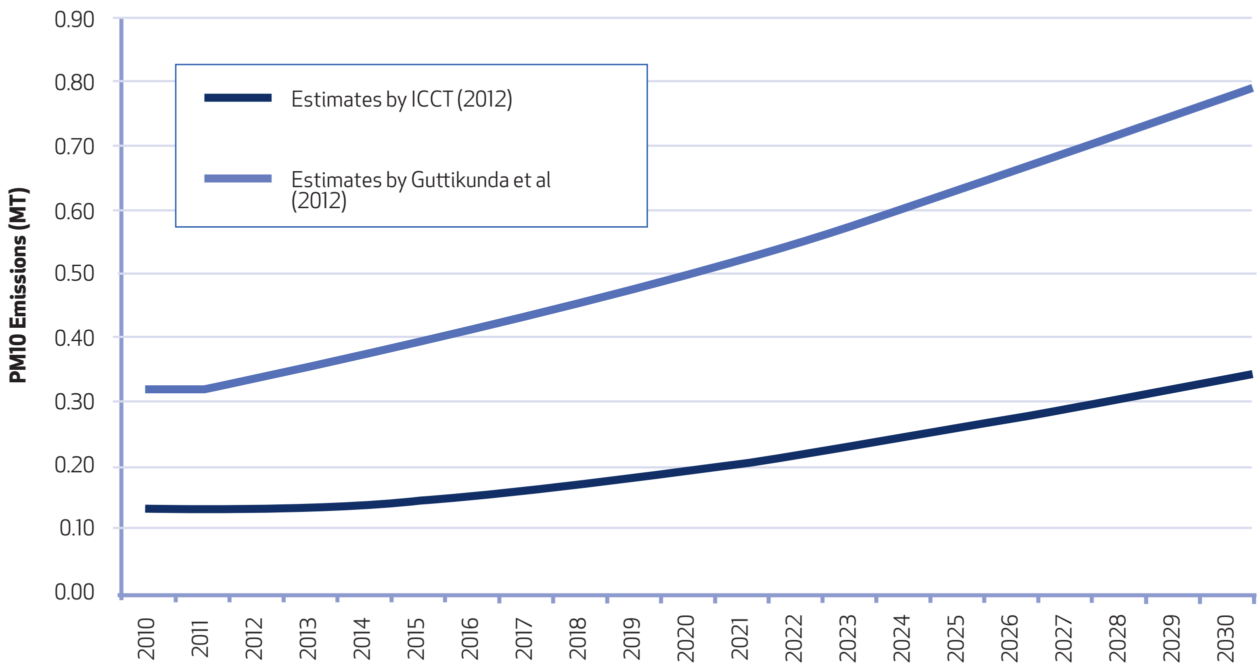


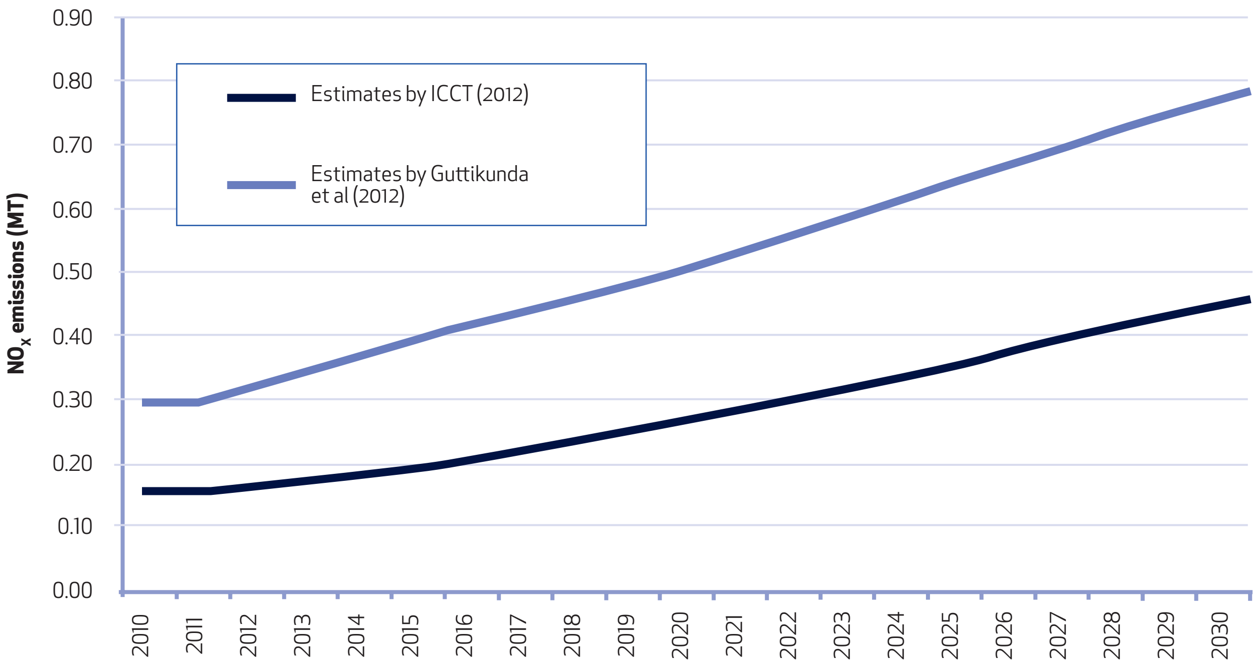
Figure 7.7
Annual PM Emission by Vehicle Type Between 2000 and 2030



impact global warming. To model what is possible in India, a few studies have developed alternate scenarios which envision tighter vehicle emission and fuel quality standards, better compliance and enforcement, and a shift away from conventional fuels. Table 7.2 shows the assumptions made under the BAU and Alternate Scenario in the study carried out by ICCT (2012). The changes envisioned in the Alternate Scenario are expected to lead to reductions in all vehicular emission, particularly problematic NO_X and PM. Figures 7.9 and 7.10 show annual vehicle NO_X and PM emission between 2010 and 2030.

Figure 7.8

Annual NO_x Emission by Vehicle Type Between 2000 and 2030



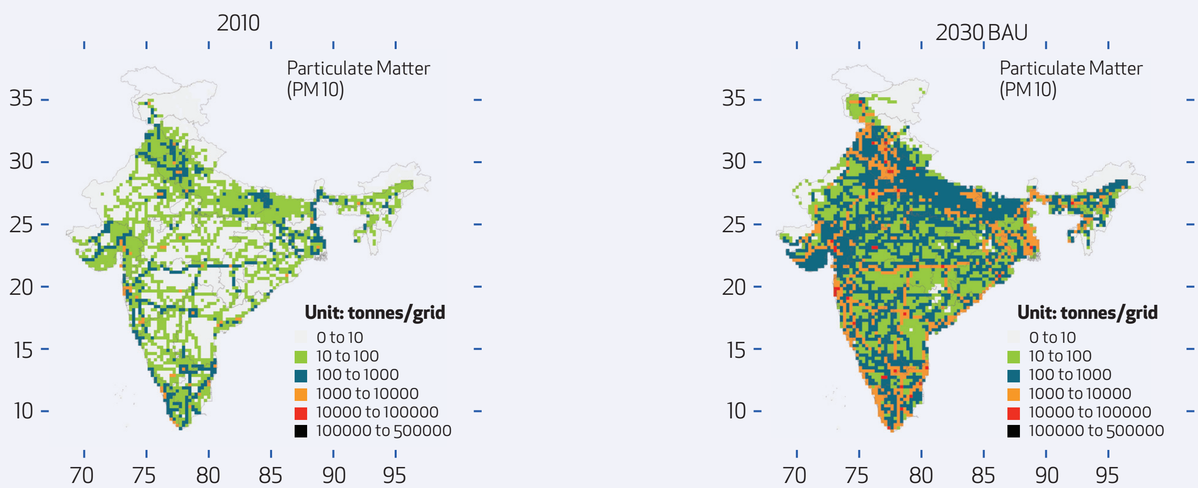
Box 7.2

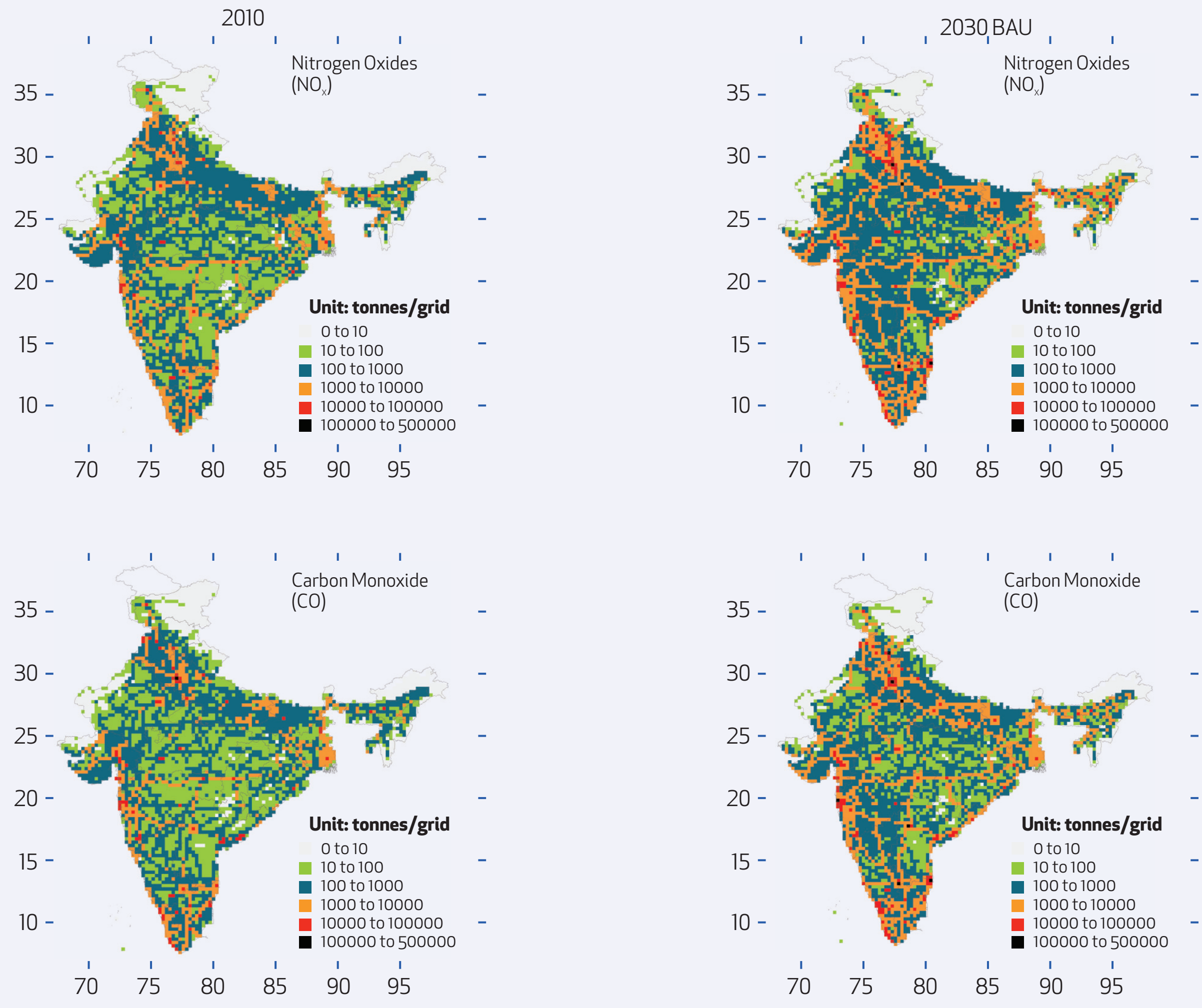
Gridded Emission Inventory at Spatial Resolution of 0.25° Resolution

Total emissions by state and by city for 2010 and 2030, under the business-as-usual scenarios are spatially gridded to a resolution of 0.25° (approximately 25 km), covering an area between 67°E and 99°E in longitude and 7°N and 39°N in latitude. While the total emission fields provide information and distinguish between high and low emitting states and cities, a gridded emission field is useful in distinguishing between hotspots such as cities and green spots such as agricultural, forest, and desert areas. The intensity of the emissions in 2030 and beyond is expected to increase around urban centres, due to growing passenger travel demand, and along highways, due to growing freight movement between cities. Compared to PM and SO_2, NO_x and CO are emitted in larger quantities by vehicles.

The layers of information utilised for modelling these emissions include (a) gridded population, (b) gridded road density maps for highways, trunk roads, and arterial roads (inter and intra city), (c) activity maps like ports and airports, which are hot spots of freight movement, (d) urban centre locations, which are hot spots for passenger travel, (e) land use maps to distinguish between populated, agricultural, mining, and forest areas.

Gridded Emission Inventory at Spatial Resolution of 0.25° Resolution





Source: Guttikunda et al (2012)

In addition to the regulatory measures envisioned by the Alternate Scenario, reductions in NOx and PM emission can be enhanced by strong urban planning interventions. Aggressive urban public transport and non-motorised transport (NMT) policies can be disincentives for using personal vehicles (Figure 7.11, Guttikunda et al, 2012).

HEALTH EFFECTS

The reductions in emissions, especially those of PM, will have tangible effects on public health. Guttikunda et al (2012) estimate that premature mortality can be reduced by almost half in the most aggressive scenario that envisages stringent regulations, that takes advantage of improvements in vehicle technology and fuel quality, in addition to promoting sustainable urban public transport policies (Figure 7.12). Annex 1 explains the methodology adopted by Guttikunda et al (2012) to estimate the health impact of vehicular pollution under two scenarios, as illustrated in Figure 7.12.

Another health impact assessment model developed by ICCT (model based on WHO health impact studies) estimates avoided premature deaths in cities from reduced vehicular $PM_{2.5}$ emission in cities, and the resulting economic benefits. Figure 7.13 shows annual avoided premature deaths in India's 337 largest cities from 2010 to 2030, as per ICCT's model. This is based on vehicle $PM_{2.5}$ emission reduction under the Alternate Scenario compared to the BAU scenario. It is estimated that from now through 2030, a total of almost 280,000 premature deaths can be avoided in India from reducing urban vehicle $PM_{2.5}$ emission alone. There would be further benefits of reduced NO_x and HC emission, as well as benefits in extra-urban areas not quantified here.

COSTS & BENEFITS

COSTS

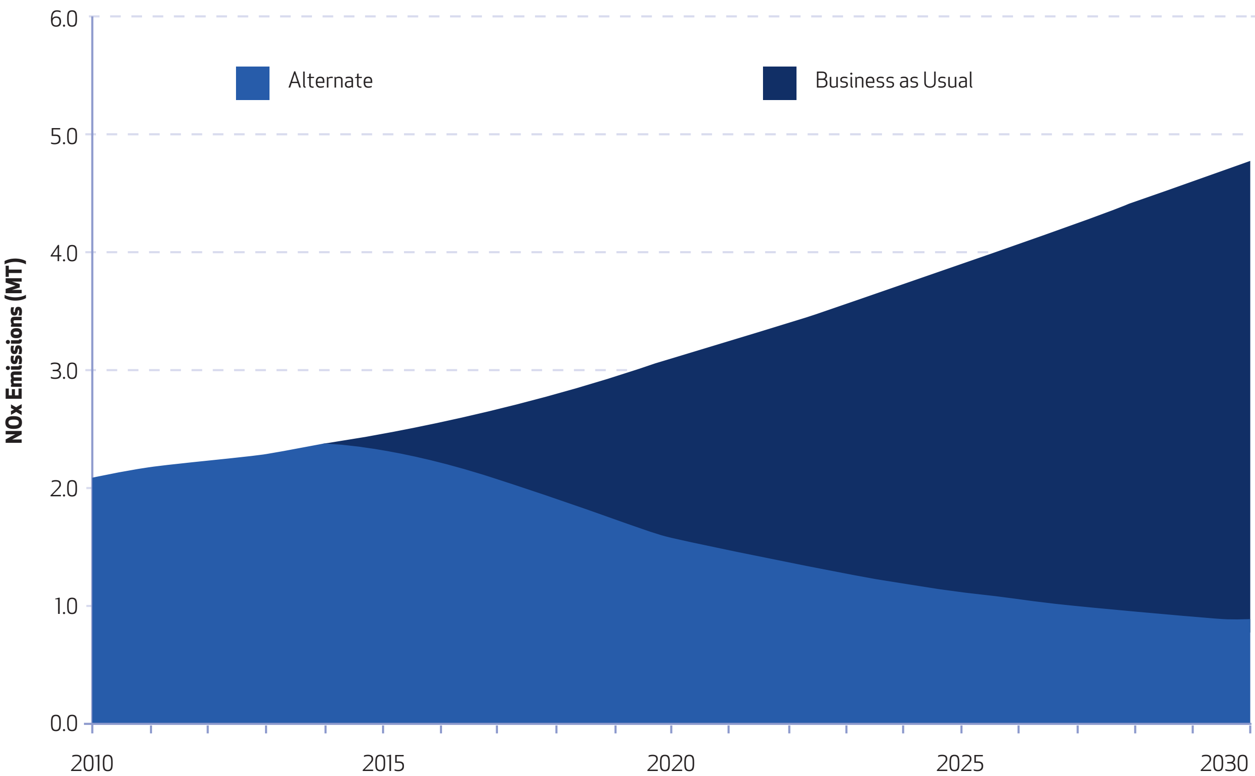
The costs and benefits of implementing clean vehicle and clean fuel policies can be weighed against each other. Costs include investments needed to upgrade refineries to produce cleaner fuel, increased operat-

Table 7.2
Assumptions Under The BAU and Alternate Scenarios in ICCT (2012)

SCENARIO	EMISSION STANDARDS	FUEL STANDARDS	ENFORCEMENT & COMPLIANCE[a]	CHANGE IN FUEL TYPE[b]
BAU	Bharat IV in 13 cities, Bharat III in rest of India	Bharat IV in 26 cities (50 ppm sulfur), Bharat III in rest of India (350 ppm sulfur)	15 per cent of vehicle fleet are gross emitters	50 per cent of new passenger car sales diesel by 2020; 60% by 2030
ALTERNATE	Bharat V by 2015, Bharat VI by 2017, and Tier 3 by 2020 for all vehicles	Low-sulfur fuel (50 ppm) nationwide by 2015; ultra-low sulfur fuel (10 ppm) nationwide by 2017	By 2020, only 3 per cent of vehicle fleet are gross emitters	15 per cent of LDV sales are CNG and 10 per cent LPG by 2030; 75 per cent of bus sales are CNG by 2030; 50per cent of 3-wheeler sales are CNG by 2030

a – Gross polluters are defined as vehicles where emission controls are non-functional
b – CNG and LPG fuel share assumed to come at the expense of diesel

Figure 7. 9
Annual NO_x Emission Between 2010 and 2030



ing costs required to lower fuel sulphur levels, and vehicle technology costs needed to reduce emissions from vehicles. Benefits are measured by monetising avoided premature deaths.

The first important study looking at costs to produce ultra-low sulphur fuels (ULSF–fuels with <10 ppm sulphur) in India was carried out by Enstrat International for the Asian Development Bank (ADB). The 2003 study concluded it would take about $445 million (Rs 22,250 million) in capital investments to produce ULSF. The increase in per litre fuel cost was estimated to be 2.80-3.15¢ (Rs 1.40-1.58). This was at a time when gasoline and diesel sulphur content were above 1000 ppm and 2500 ppm, respectively.

A more recent study by Hart Energy and Math Pro looked at what these costs would be today. This study took into account new refineries not accounted for in the Enstrat study, new technologies not well understood a decade ago, and updated estimates of fuel production and consumption in India. Total investments to produce ULSF in India were estimated to be $4.16 billion (Rs 208 Billion, assuming $1=Rs 50). Combining this with increased operating costs and annualising investments, the extra per litre cost of producing ultra-low

Figure 7.10
Annual PM Emission Between 2010 and 2030

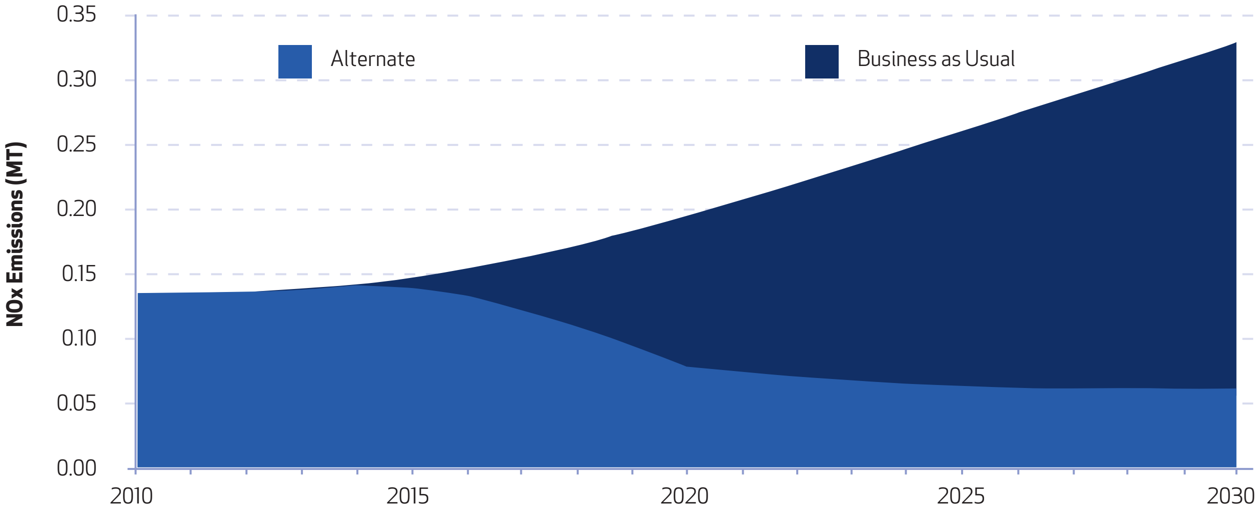
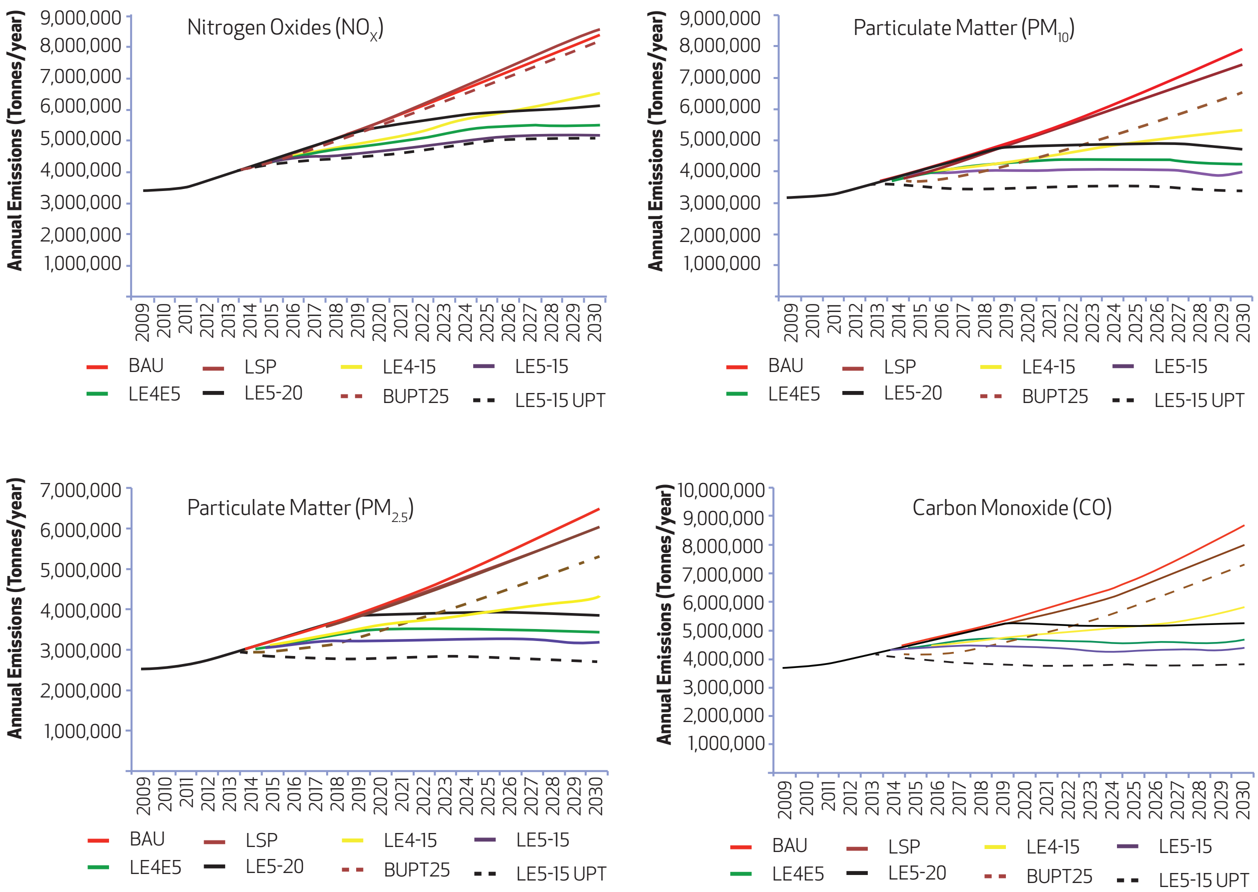


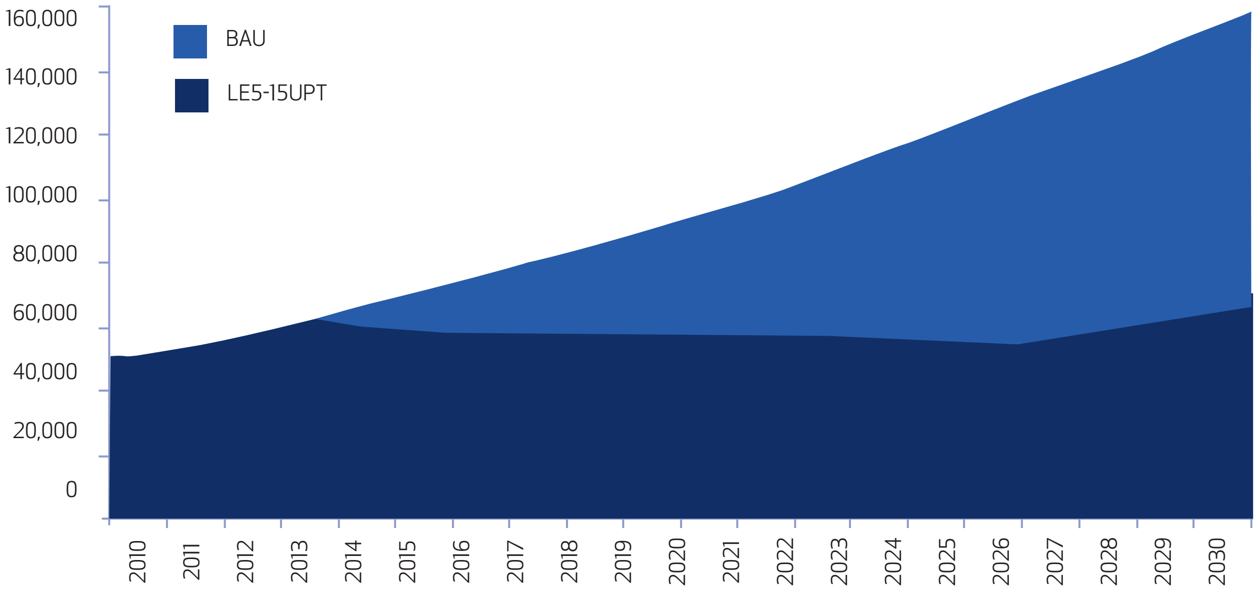
Figure 7.11
Estimated Energy and Emission Outlook for Road Transport



Scenarios in the figure:
BAU = business as usual growth rate and no change in the emission standards
LSP = lower sales projection and no change in the emission standards
LE4-15 = lower sales projection with Bharat IV standards for all vehicles by 2015 for all states
LE5-15 = lower sales projection with Bharat V standards for all vehicles by 2015 for all states
LE5-20 = lower sales projection with Bharat V standards for all vehicles by 2020 for all states (a delayed introduction of the standards)
LE4E5 = lower sales projection with Bharat IV enforced in 2015 and Bharat V standards introduced in 2020 for all vehicles and for all states
BUPT25 = business as usual with no change in emission standards, with an aggressive urban passenger transport policy to promote public transport and NMT, in order to reduce 25 per cent of the vehicle km travelled from passenger vehicles
LE5-15UPT = lower sales projections with introduction of Bharat V standards by 2015 and an aggressive urban passenger transport policy.

Source: Guttikunda et al (2012)

Figure 7.12
Premature Mortality Per Year Attributable to Road Transport Emissions Under The BAU and LE5-15UPT Scenario



BAU: Business as Usual Scenario; LES-15UPT: Scenario with lower sales projections, introduction of Bharat V standards by 2015 and an aggressive urban passenger transport policy
Source: Guttikunda et al

sulphur gasoline and diesel was estimated to be about 0.70-0.87¢ (Rs 0.35-0.44) and 0.64-0.88¢ (Rs 0.30-0.44) respectively.

Costs for clean vehicle technologies have not been studied in India as in the US and Europe. A 2003 study by the German Federal Environmental Agency estimated the cost increase per diesel LDV and HDV for Euro 5 over Euro 4 to be €200-400 (Rs 14,000-28,000) (assuming €1=Rs 70) and €1500-3000 (Rs 0.1.1-0.21 million) respectively. Studies by the European Commission found the cost of upgrading to Euro 6 from Euro 5 to be €200-600 (Rs 14,000-42,000) for LDVs and €825-2000 (Rs 58,000-1,40,000) for HDVs.

ICCT (2012) estimated clean vehicle costs in India as well as in Europe, and found costs to be lower than what was reported in European studies. Figures 7.14 and 7.15 show ICCT estimates for per vehicle upgrade costs for various four-wheelers, and two- and three-wheelers, respectively, in India.

The increased costs of cleaner vehicle and fuel production will be passed on to customers. Customers can expect to see an increase in fuel prices of less than Rs 0.50 per litre. With the current programme of adjustment in diesel prices, a half rupee increase that is required for improving the quality of fuel would not be significant for consumers. In fact, public sector refineries can add a few paise to monthly diesel price hikes already being implemented to build capital to invest in ULSF production.

Passenger car customers will see modest increases in gasoline car prices, while diesel cars prices will increase significantly. This will incentivise the production and sale of gasoline cars, which emit less PM and NOx and do not take advantage of government subsidies for diesel fuel. HDV buyers will most likely see the largest cost increase, up to 15 per cent of vehicle cost for diesel HDVs and 10 per cent for CNG HDVs.

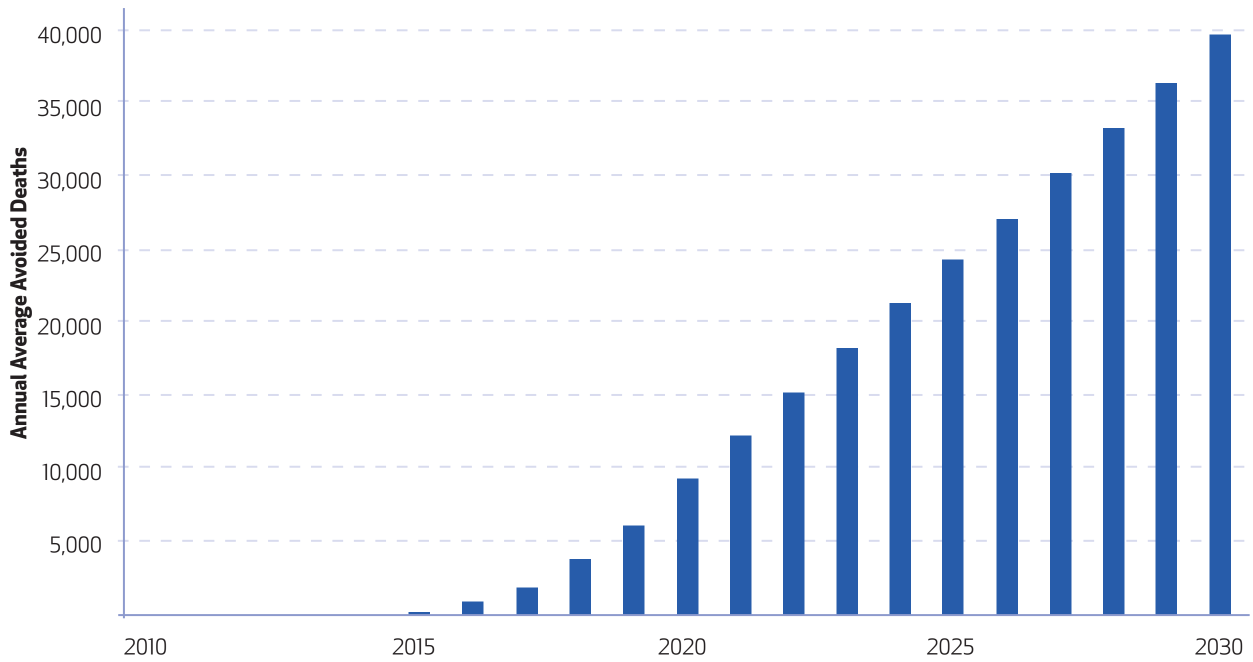
BENEFITS

Benefits are often monetised using Value of Statistical Life (VSL) analysis. VSL is multiplied by the number of avoided deaths to arrive at a cost estimate for benefits. Relatively few VSL studies have been conducted in India, but a 2006 study estimated VSL to be about $1.5 million (Rs 75 million).

Figure 7.16 shows the ICCT's cost-benefit analysis of the Alternate Scenario versus the BAU Scenario. Through 2030, total monetised benefits of avoided deaths would come out to about $500 billion (Rs 25,000 billion), whereas costs would come out to around $200 billion (Rs 10,000 billion). Annual benefits would undoubtedly continue to rise beyond the year 2030, while annual costs would stabilise, even decrease, as economies of scale and production experience allow the same products to be produced more cheaply. This emphasises that, while there is a cost attached to cleaner fuels and vehicles, the benefits far outweigh the costs in the long term

Figure 7.13

Annual Avoided Premature Deaths as A Result of Lower $PM_{2.5}$ Emission Under The Alternate Scenario



The Alternate Scenario in the ICCT study envisions actions India can feasibly take over the coming decade. Many of the policy changes outlined in the Alternate Scenario have already been put into place in a number of countries. Their experiences provide a starting point for India to move in that direction.

INTERNATIONAL EXPERIENCES

INSTITUTIONAL MECHANISMS

In India, the general process to set new vehicle emission and fuel quality standards is to establish a committee to engage stakeholders and analyse related issues. Working groups within the committee recommend standards and reforms for matters within their purview, for over the next decade or so. The committee's recommendations can then be accepted, modified or rejected by government institutions over time.

Committees that recommend future standards are not permanent. Their composition is not predetermined either, which means they often have to rely on data provided by outside sources, particularly the automobile and oil industries, to make informed decisions. This can lead to a conflict of interest, in which the regulated parties may strongly influence policymaking in their favour rather than in the national interest.

The institutions and mechanisms established in India differ from those in other countries. This section takes a look at institutional mechanisms in the US, Europe, and China.

THE UNITED STATES

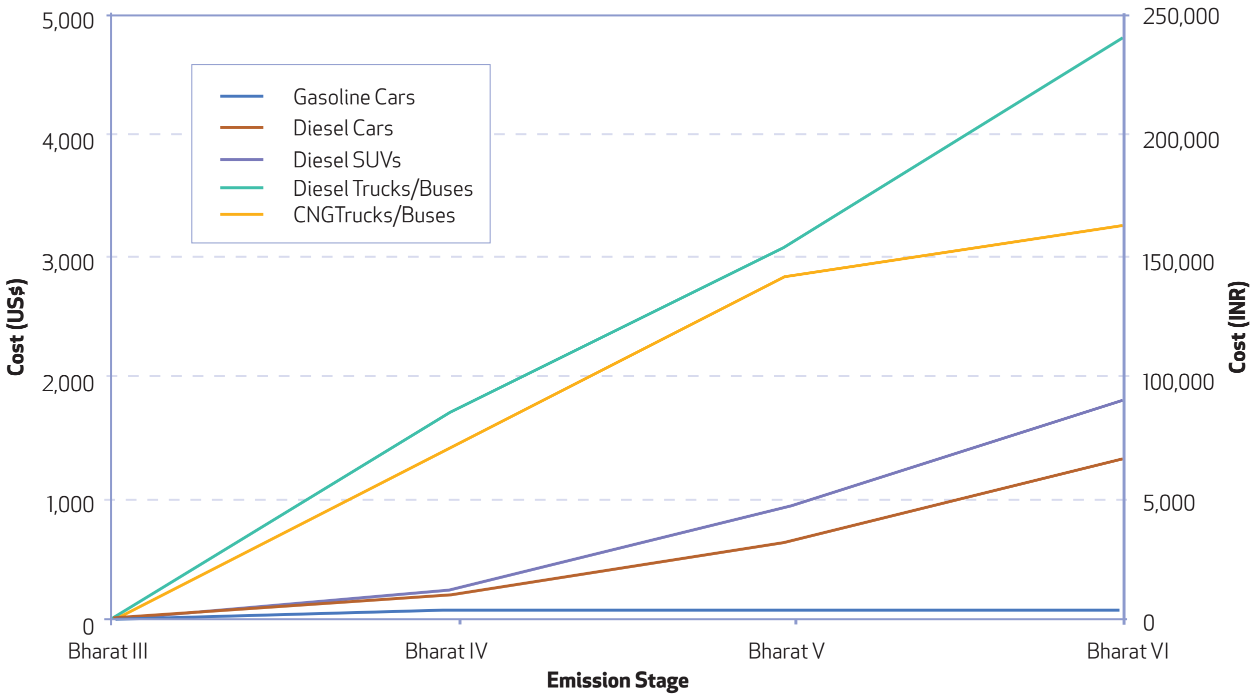
In the US, the Clean Air Act (CAA) of 1970 authorises the Environmental Protection Agency (EPA) to establish and enforce vehicle emission and fuel quality standards. Within the EPA, the Office of Transportation and Air Quality (OTAQ) is responsible for these standards. OTAQ consults various stakeholders in the standards development process.

Due to historical air quality needs, the US also allows the state of California to set vehicle emission and fuel quality standards stricter than those mandated by the EPA. Other states can choose to adopt California regulations, and so far 13 states have done so.

In California, the California Air Resources Board (CARB) establishes and enforces vehicle emission standards, in consultation with various stakeholders. CARB is a department within the California Environmental Protection Agency (Cal/EPA).

Both CARB and EPA are well-equipped and funded to thoroughly study issues before generating new standards. They have numerous laboratories and modelling programmes to test and simulate vehicle emissions. As a result, they do not have to rely on data and claims provided by the automobile and oil industries. This is in stark contrast to India, where committees set up to recommend future standards

Figure 7.14
Per Vehicle 4-Wheeler Upgrade Costs Progressing To Bharat VI Standards Over Bharat III



often lack time, and independent expertise, resources and funding.

EUROPE

In the European Union (EU), three institutions jointly establish vehicle emission and fuel quality regulations. The Directorate General (DG) of Enterprise within the European Commission first drafts the next stage of regulations in consultation with stakeholders and other DGs. The draft is then sent to the European Parliament and the European Council where it is further discussed.

In Parliament, the Environment Committee reviews the draft and may discuss it with other committees and stakeholders. Once negotiations are finalised and a compromise is reached, a recommendation is made to Parliament, which then votes on the regulation. A simple majority is needed to approve it. In the Council, ministers from the EU's member countries discuss the draft regulations. A qualified majority (74 per cent) is required for the draft to be approved by the Council.

If there are differences between regulations passed by Parliament and the Council, those two institutions negotiate a compromise. Regulations become law after this process is completed.

CHINA

China's Air Pollution Prevention and Control Law assigns responsibility for establishing and implementing vehicle emission standards to the country's environmental protection authorities. The relevant national-level body is the Ministry of Environmental Protection (MEP). MEP officials oversee the development, finalisation, and notification of environmental standards, though they do not typically engage in the actual drafting of the standards themselves.

In practice, the MEP assigns a third-party non-governmental institution to research and draft environmental standards. The institution assigned is usually one of several dozen government-affiliated research institutions that play a supporting role to the MEP. These institutions conduct basic research to support environmental policymaking, develop scenario analyses and emission inventories, draft and revise standards, and even participate in environmental policy implementation. Since Chinese law does not mandate that the MEP designate a government-affiliated research institution to draft standards, it is not uncommon for private companies or laboratories to be appointed for this purpose.

China's Air Pollution Prevention and Control Law does not specify clearly which government body should issue fuel quality standards. In practice, the authority to issue the standards lies solely with the Standardisation Administration of China (SAC), which itself has technical committees heavily stacked with oil industry representatives.

Unlike in India, the US and Europe, China does not link fuel quality and vehicle emission standards, which poses a significant problem for the country.

Figure 7.15

Per Vehicle 2- and 3-Wheeler Upgrade Costs Progressing to Bharat VI Standards Over Bharat III

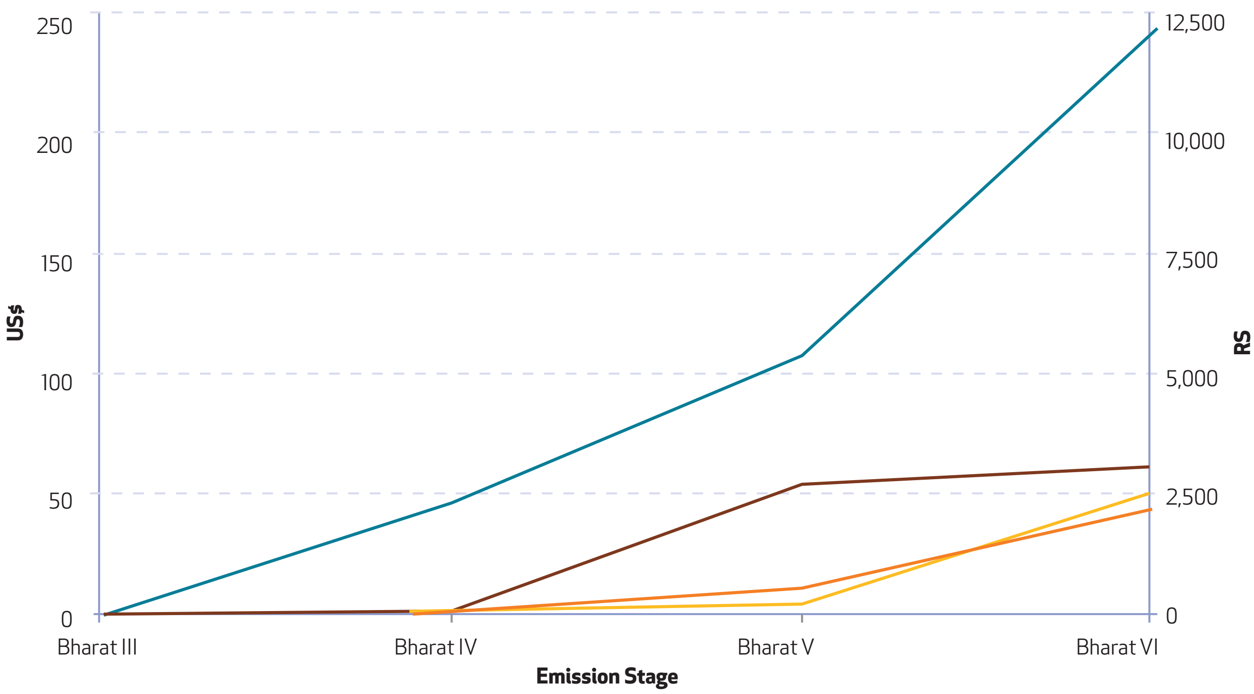
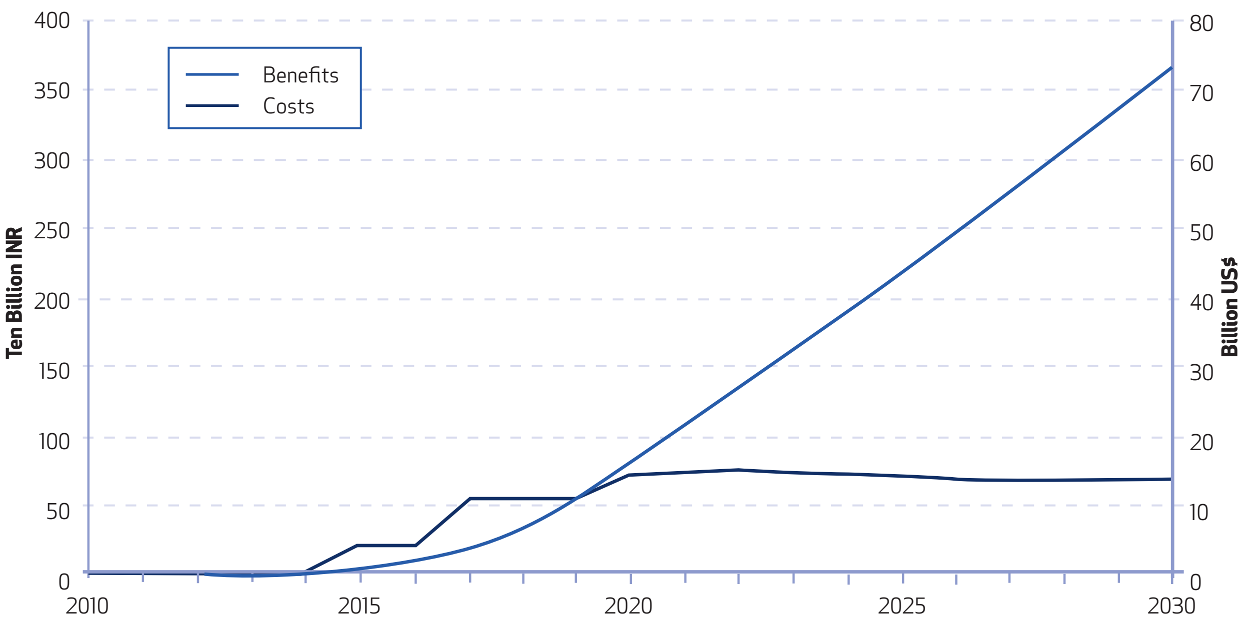


Figure 7.16

A Comparison of Costs and Benefits for The Alternate Scenario from 2010 Through 2030



China does not set or seek to set long-term vehicle emission and fuel quality standards. This means that regulations are reviewed more frequently. This means new technologies and developments can be taken into account more often.

VEHICLE EMISSIONS AND FUEL QUALITY STANDARDS

The US has been at the forefront of vehicle emission regulations for almost half a century now. The country has some of the most stringent emission standards, as well as well-established compliance and enforcement programmes. The US has also built in much flexibility in its policies, which gives the auto and oil industry wiggle room to comply with regulations. India can learn from the vast experience of

In India, certain cities have more stringent new vehicle emission standards than the rest of the country, but it has not moved to state- or region-wide implementation of different standards

the US in setting and enforcing vehicle emission and fuel standards. Apart from the US, Europe and Japan have notable achievements in rapidly cleaning up their fuels and vehicle fleets. Europe has plans to further tighten its standards in the coming years. Both Europe and Japan have some of the cleanest fuels in the world, with the strictest low sulphur compliance. The achievements of China, Brazil, and Mexico also stand out, as all of them are large developing nations like India.

China is in the process of implementing Euro 4 equivalent standards nationwide. Brazil began implementing Euro 5 standards for HDVs in 2012. It also has a ban on diesel powered LDVs. Mexico is one of the few developing countries to have 15 ppm sulphur diesel available in much of the country, with plans to expand the supply of this fuel nationwide in the near future. It also has plans to implement vehicle emission standards roughly equivalent to Euro 5 over the next few years.

The focus of this chapter, however, is on the US, which is the world leader for vehicular air pollution regulations. Japan is also looked at in detail regarding fuel quality compliance, since it has a successful advanced programme that differs considerably from that of the US.

THE UNITED STATES

VEHICLE EMISSIONS

The US emission standards are based on a 'tier' system with multiple 'bins', each with its own emission limits for regulated pollutants. A vehicle manufacturer may certify a vehicle model to any of the bins, provided that the sales-weighted average for all vehicles produced by that manufacturer meets specific fleet-average emission targets. This provides flexibility in meeting standards, while still assuring environmental targets are met. Furthermore, new standards in the US are not implemented at a single point in time. Instead, they are phased in, which allows for more flexibility with compliance.

The US system also establishes much longer durability requirements than Europe and India for HDVs and LDVs. Most LDVs must meet emission requirements for up to 10 years or 120,000 miles (193,200 km), whichever comes first. By contrast, LDVs in India must meet requirements for up to 100,000 km.

US emission standards do not discriminate on the fuel used. This suggests that establishing separate emission standards for diesel and gasoline engines, as is done in Europe, China, and India, is not necessary.

US law also allows states to adopt more stringent emission standards if they choose. A number of states have done so. India has a similar process in that certain cities have more stringent new vehicle emission standards than the rest of the country, but it has not moved to a state- or region-wide implementation of different standards. Nor can cities or states choose to have more stringent standards on their own. Tighter standards across a region are more effective than across a city for a number of reasons, a primary one being that higher-emitting vehicles from outside a city often operate within its limits. In the case of state-wide standards, most vehicles plying the roads of cities within that state would meet the tighter emission standards.

FUEL QUALITY

The US currently has separate sulphur content requirements for gasoline and diesel. Since 2006, diesel has been required to have no more than 15 ppm sulphur content. This level is sufficient for the most advanced after-treatment clean vehicle technologies to function well. Emissions from gasoline-operated vehicles are not as sensitive to fuel sulphur content, though sulphur in gasoline does increase PM and NO_x emissions as well. Sulphur content in gasoline in the US ranges between 30 and 80 ppm.

VEHICLE EMISSION COMPLIANCE AND ENFORCEMENT

Vehicle emission standards are only useful if they are enforced. Countries have various mechanisms to ensure manufacturers produce vehicles that comply with set standards. TA and COP are the most common practices for new vehicles in most countries with vehicle standards. Additionally, countries have differing programmes to test in-use vehicle emissions.

While Europe establishes uniform emission standards for the whole of the EU, compliance and enforcement are the responsibility of individual member states. This splinters this responsibility, and therefore analysing the successes and shortcomings of vehicle emission compliance in Europe is difficult.

China, like India, conducts TA and COP testing for new vehicles in government authorised laboratories. For in-use testing, the national government establishes emission standards and testing procedures, but local governing bodies are responsible for setting up and operating inspection and maintenance (I/M) programmes. This is similar to PUC programmes in India. A key new aspect of China's COP programme is the gradual implementation of COP testing without prior notice to manufacturers. While this is still in its early stages, a number of problems have already been identified. This suggests that similar problems in India may come to light if India were to adopt similar procedures.

THE UNITED STATES

Compliance and enforcement in the US is carried out entirely by the EPA, as authorised by the CAA of 1970. Many individual states and municipalities have separate in-use emission compliance programmes that may assist the EPA's work. States with more stringent emission limits than federal standards have separate in-state compliance programmes that function parallel to the EPA programme.

The EPA compliance programme looks at emissions throughout the useful life of a vehicle. New vehicles are first tested by at the pre-production stage, and certified by the EPA, if they pass. The EPA then conducts confirmatory testing on certain vehicles. Unlike in India, manufacturers are not given prior notice regarding the timeframe of confirmatory testing, nor are they told from where the test vehicles will be selected.

After confirmatory testing, the EPA relies on a number of in-use compliance programmes to ensure vehicles meet emission standards throughout their useful life. One such programme is the Selective Enforcement Audit (SEA). The SEA came into being in the 1970s, when the EPA found manufacturers were occasionally producing vehicles that did not comply with standards, even though prototypes had been certified. Under the SEA, the EPA can require manufacturers to pull vehicles off the assembly line and test them, at their own expense, in a lab of the EPA's choosing.

As other in-use compliance programmes developed, the SEA programme was phased out for LDVs, though the EPA reserves the right to reinstate it if need be. For HDVs, it is still conducted.

Emissions from in-use vehicles are tested by manufacturers and the EPA. Manufacturers pay vehicle owners to test their vehicles. If vehicles fail an initial test, the manufacturer is required to conduct more rigorous testing. All test data is sent to the EPA. If a vehicle model continues to fail tests, a mandatory recall can be ordered to fix the problem.

The EPA also conducts in-use surveillance testing of its own. Like manufacturer in-use testing, the EPA selects in-use vehicles either at random or because of reasonable belief that further testing is needed. The agency usually pays owners to test their vehicles. In-use surveillance testing verifies manufacturer testing.

Much of the US compliance and enforcement approach is based on cooperation between the EPA and vehicle manufacturers. Manufacturers are often invited to see how EPA testing is conducted, and there is considerable communication between the two before important decisions are made. This saves the US government money, as the EPA does not have to test every single vehicle. At the same time, it ensures compliance.

The US has the most comprehensive fuel quality compliance programme in the world, which has evolved over time. In Asia, Japan has set up an effective programme, successfully conducting random testing of fuel at all its retail outlets each year

Important aspects of compliance in the US are well-established recall procedures and non-compliance penalties. These incentivise manufacturers to design and test vehicles so they meet emission standards throughout their life. Not doing so means facing stiff fines and expensive recalls or production halts.

Figures 7.17 and 7.18 diagrammatically represent compliance programmes for LDVs and HDVs in the US.

FUEL QUALITY COMPLIANCE & ENFORCEMENT

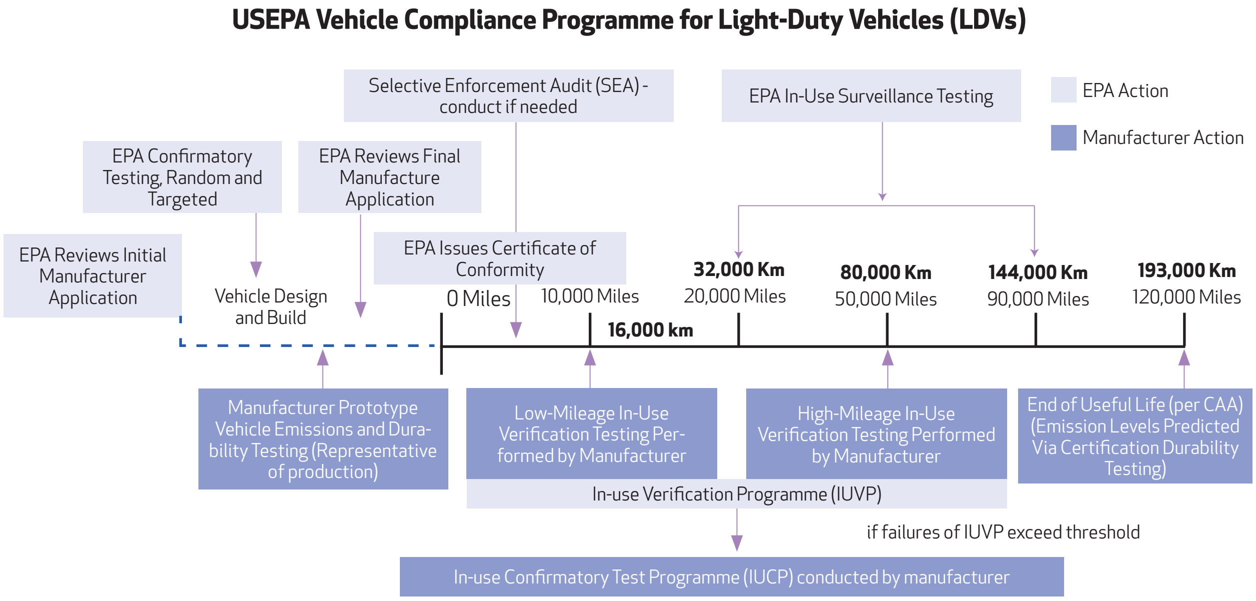
As with vehicle emission compliance, the US has the most comprehensive fuel quality compliance programme in the world. It also has many years of experience in this area, and its programme has evolved with time. In Asia, Japan has set up an effective fuel quality compliance programme. The country successfully conducts random testing of fuel at all its retail outlets each year.

THE UNITED STATES

The CAA of 1970 authorises the EPA to prohibit the manufacture or sale of fuels and fuel additives if there is reason to believe they endanger public health. This is the basis of fuel quality regulations in the country.

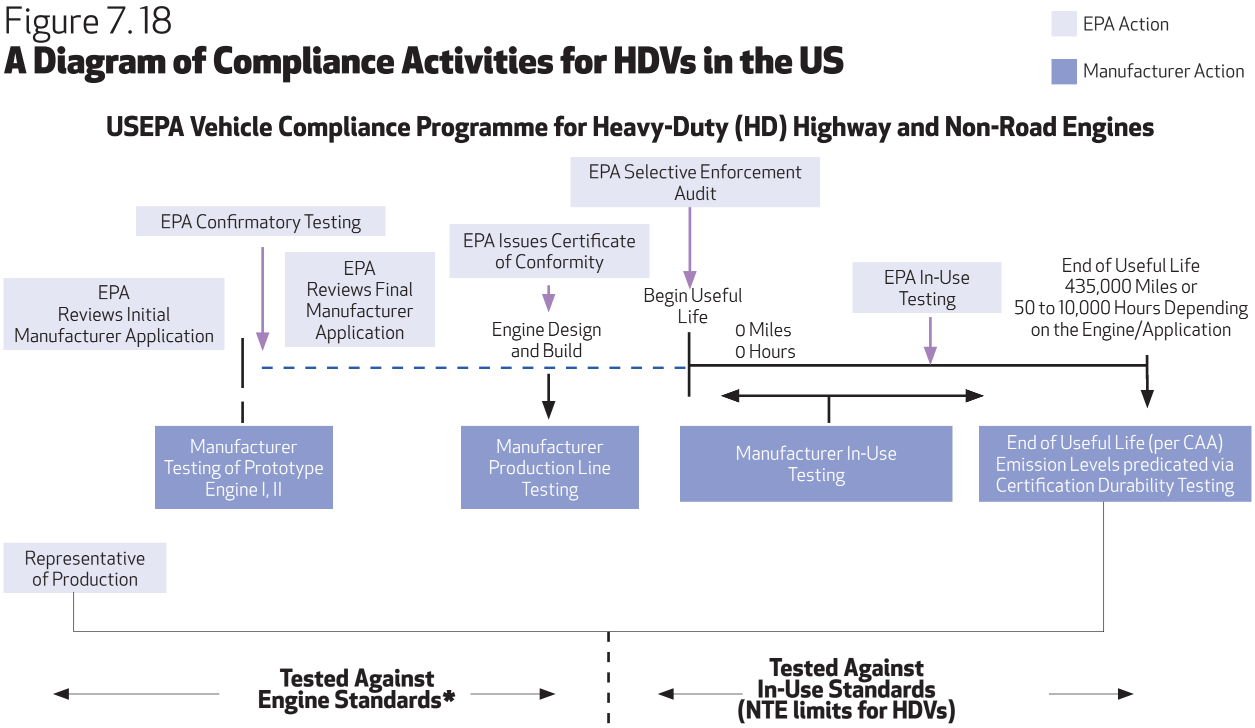
The US fuel quality compliance approach seeks to ensure that fuel quality meets set standards throughout the supply chain. At the top of the chain, fuel refiners and importers must first register fuels and fuel additives with the EPA, and conduct tests on their potential evaporative and combustion emission, prior to marketing them. After production, refiners are required to test every batch of fuel four times a year and submit results to the EPA. In addition to this, oil companies are required to hire independent laboratories to conduct fuel testing at refineries and retail outlets. Independent laboratory test results are submitted to the EPA and compared with industry test results.

Figure 7.17
A Diagram of Compliance Activities for LDVs in the US



Source: EPA. 2007 Progress Report-Vehicle and Engine Compliance Activities Oct., 2008

Figure 7.18
A Diagram of Compliance Activities for HDVs in the US



* Except HDVs Certified using chassis dynamo meter
Source: EPA. 2007 Progress Report-Vehicle and Engine Compliance Activities Oct., 2008

EPA enforcement officials also conduct their own field tests of fuel quality at various points in the distribution system. They also selectively audit the industry and independent laboratories. If laboratories do not meet standards or if documents are found to be falsified, the EPA can levy fines and shut down facilities.

Because of such comprehensive testing throughout the supply chain, the onus of complying with fuel quality standards falls on all parties in the chain. Costly penalties for non-compliance, such as fines and criminal charges against violators, create a strong incentive for oil companies to meet fuel quality standards at all times.

JAPAN
Japan's current fuel quality compliance programme grew out of the removal of a ban on imported refined fuel in 1996. As more companies started selling fuel

in Japan, and as fuel came from more diverse places, the country recognised the need to ensure the quality of these products. The Fuel Quality Control Law was then passed, which put the Ministry of Economy, Trade and Industry (METI) in charge of doing this.

Japan's approach to fuel quality compliance is based on testing fuels at the point of sale. All fuel retail outlets must be registered with METI, and fuel samples are selected at random, without prior notice, from each and every outlet. METI contracts the National Petroleum Association (NPA), an independent public corporation, to test samples from every retail outlet at least once a year.

In addition, oil companies are required to conduct their own testing. This must be done prior to distribution and sale, as well as at retail outlets. Industry test results are checked with NPA test results for consistency.

Testing fuel at the point of sale incentivises oil companies to maintain fuel quality throughout the supply chain. Retail outlets selling non-compliant fuels can be shut down and fined heavily, which is costly for the oil companies.

RETROFIT PROGRAMMES

Retrofitting high-emission vehicles, usually older vehicles, can have a strong and positive impact on air quality. Unlike stricter standards for new vehicles, the benefits of which are seen over time as the vehicle fleet turns over, retrofits allow for immediate reduction in emissions since they target vehicles already on the road.

In order to fully harness the benefits of vehicle retrofits and minimise the economic impact, retrofit programmes must be designed and implemented appropriately, and use appropriate technologies. In some instances, retrofitting vehicles may not lead to any reduction in emissions, while costing companies, individuals, and the government large sums of money. For example, studies have found that converting gasoline vehicles to CNG may only have benefits if engines are optimised and after-treatment systems are correctly installed. In some cases, retrofitting vehicles with CNG led to an increase in emissions. This is particularly relevant to India, where there is, and has been, a strong push for CNG vehicles.

At the same time, retrofit programmes that install additional after-treatment technologies on vehicles can significantly reduce emissions, provided that the requisite fuels and supporting infrastructure are available. Two successful retrofit programmes for HDVs, one in the US and one in Japan, are analysed in more detail below. The experiences of each can be a starting point for what is possible in India.

Retrofitting high-emission vehicles, usually older ones, can have a strong and positive impact on air quality. Unlike stricter standards for new vehicles, the benefits of which are seen over time as the fleet turns over, retrofits allow for immediate reduction in emissions since they target vehicles already on the road

UNITED STATES

In 1993, the EPA developed an Urban Bus Retrofit and Rebuild (UBRR) programme for model year 1993 and earlier urban buses operating in cities with a 1980 population of 750,000 or more. The programme was set to be implemented in 1995.

The programme sought to reduce bus PM emissions by 25 per cent. It allowed cities to choose whichever technologies they felt would be most appropriate, provided that they were certified by the EPA. This allowed flexibility at the local level, while ensuring no cities used technologies that were outdated or unreliable. A later study of the UBRR programme found the cost per tonne of PM reduced to be $31,500 (Rs 1.6 million). The same analysis estimated the cost of new HDV emission standards- that went into effect in 2007- to be $14,200 (Rs 0.7 million) per tonne of PM reduced.

Cost-effectiveness studies for other retrofit programmes in the US found the cost per tonne to be less. An assessment by the Texas Commission on Environmental Quality (TCEQ) found the costs of retrofit programmes in its state to be lower than the costs of new HDV emission standards.

JAPAN

The Tokyo Metropolitan Government (TMG) adopted an ordinance on environmental preservation in December 2000 that included an array of measures targeted at cleaning air, water, soil, and noise pollution. To reduce air pollution, the ordinance included a variety of directives aimed at reducing vehicle emissions, including the retrofitting of diesel-powered HDVs.

The retrofit programme had a two-tier structure, each targeting vehicles of different ages. The programme generally sought more reduction in PM emissions from older vehicles than from newer vehicles.

Emission control equipment manufacturers were required to submit data on the reliability, safety, and durability of retrofit equipment, though there were no specific regulations on minimum standards for these, as there were in US retrofit programmes.
Once a vehicle was retrofitted, it was issued a TMG sticker, which allowed it to operate within TMG city

While India focuses on certifying emissions for new vehicles, the US devotes more resources ensuring in-use vehicles meet emission standards throughout their useful lives.

limits. Vehicles operating within TMG city limits in violation of retrofit requirements were subject to a fine of up to 5,00,000 yen ($5000 or Rs 250,000).

SUMMARY & CONCLUSIONS

The institutional mechanisms to set vehicle emission and fuel quality standards differ in different regions. In India, a committee usually recommends standards for the following decade. Government ministries and agencies then choose whether to implement the recommendations over time or not.

In the US, the EPA alone develops and implements new standards, in consultation with stakeholders, based on its authority under the CAA. In Europe, regulations are developed and have to be passed by the European Commission, the European Parliament, and the European Council. Only then they become law.

In China, vehicle emission and fuel quality regulations are developed separately. The MEP and quasi-government organisations develop vehicle emission standards, while the SAC alone usually sets new fuel quality standards. This separation of regulatory authority has led to problems implementing vehicle emission standards due to poor fuel quality.

A number of countries have implemented stricter vehicle emission controls than India. In recent years, some fast-developing countries at similar economic levels as India, such as China, Thailand, Brazil, and Mexico, have surpassed India in-tightening vehicle emission and fuel quality standards. Their experience is proof that strict vehicle emission standards do not hurt economic development. The US has been at the forefront of vehicle emission control for over forty years. The US EPA has been the sole authority in charge of regulating vehicular pollution and fuel quality parameters. Its vast experience and reforms the US has adopted, provide optimal guidance for what is possible in India.

Whereas India focuses on certifying vehicle emissions for new vehicles, the US devotes more time and resources ensuring in-use vehicles meet emission standards throughout their useful life. Clear and strict punitive measures and recall policies also incentivise manufacturers to test their in-use vehicles regularly. This reduces the resource burden on the EPA.

The same holds true for fuel quality testing. While in India the MoPNG and state governments are officially required to test and certify fuels, there is little evidence that this is done and fuel adulteration persists. In contrast to this, the US EPA contracts independent laboratories to test fuels at various points in the distribution system. The EPA audits these laboratories and conducts some tests itself to verify test results. If any fraud or noncompliant fuels are found, stiff fines are implemented. This places the onus on oil companies and fuel distributers to ensure fuel quality on their own.

Japan also has a successful, comprehensive fuel quality testing programme. Japan's METI and NPA annually test fuel from all retail outlets in the country at random, without prior notice. If any outlet has non-compliant fuels, stiff fines are levied and the outlet may be shut down.

Besides ensuring vehicles and fuels meet set standards at all times, there are other actions that can reduce vehicle emissions. Retrofitting old vehicles is one such action. An urban bus retrofit programme in the US in the 1990s reduced bus PM emissions by 25 per cent in many cities. Another retrofit programme in Tokyo, Japan successfully reduced vehicle emissions there. The cost-effectiveness of retrofits to meet strict emission standards varies. Some studies show retrofits as more expensive while others say they are cheaper.

RECOMMENDATIONS

India has come a long way over the last two decades to establish vehicle emission and fuel quality standards, and to develop compliance mechanisms for them. The country has also caught up with international best practices in certain aspects. Still, there are a number of areas in which it needs to improve. Some require looking more closely at the experiences of other countries and adopting successful programmes for India. Others involve adopting the recommendations of Indian government committees themselves, particularly those of the 2003 Mashelkar Auto Fuel Policy Committee. All these recommendations are discussed here. A new Auto Fuel Policy Committee under Dr. Saumitra Chaudhury of the Planning Commission was formed in January 2013. This new committee has the authority to recommend new standards and reforms through 2025. The recommendations discussed here set an agenda for the new Auto Fuel Policy Committee to consider as they develop specific reforms and targets for India.

RECOMMENDATIONS FOR VEHICLE EMISSION & FUEL QUALITY STANDARDS

TIGHTER FUEL QUALITY STANDARDS

<50 ppm sulphur fuels should be made mandatory nationwide by 2015, and <10 ppm sulphur fuels should be available nationwide by 2020. Reforms in diesel pricing currently being implemented should at least

partially be used to pay for refinery investments needed to produce these cleaner fuels.

TIGHTER NEW VEHICLE EMISSION STANDARDS

India should implement Bharat VI standards nationwide by 2020 for four-wheelers, thus reaching Europe's fuel quality standards. For two- and three-wheelers, India should develop Bharat IV, V, and VI standards based on Europe's actions and implement them by 2020. The technologies to implement these standards are already available in India. Mandating cleaner vehicles will have positive long-term impact.

EVAPORATIVE EMISSION STANDARDS

By 2015, India should mandate:
Stage I controls for refuelling emissions which capture vapours emitted when tankers supply fuel to retail outlets- and return them to fuel tankers and

Stage II controls- which capture vapours during vehicle refuelling and return them to the storage tanks at retail outlets.

India should also mandate all new vehicles to have onboard refuelling vapour recovery (ORVR) systems at the same time that Stage II controls are implemented. These systems return vapours to a vehicle's fuel tank rather than to retail outlets. ORVR systems are generally cheaper to maintain than Stage II controls. The majority of India's fleet will have them in place about ten years after implementation begins. Once ORVR-fitted vehicles become prevalent, regulations for Stage II controls can be lifted.

WORLD-HARMONISED TEST CYCLES

India has participated in the development of world-harmonised test cycles along with other countries. However, it is yet to adopt any of them. Replacing current test cycles with world-harmonised ones will make it less likely that certain vehicles 'beat' emission testing by passing the test cycle while actually emitting much more under real-world conditions. India should make world-harmonised test cycles optional when Bharat IV regulations come into place nationwide. They should become mandatory when Bharat V regulations come into place.

REVIEW AUTO FUEL POLICY EVERY FIVE YEARS

As new technologies are developed and experiences evaluated, there is a need to review current and future standards accordingly to ensure that the country does not head in the wrong direction or fall behind the world's latest developments. In 2003, the Mashelkar Auto Fuel Policy committee had recommended a review of the auto fuel policy every five years. Yet a new Auto Fuel Policy Committee was not formed until 2013, ten years later, despite the fact that the Mashelkar Committee's mandate was through the year 2010.

Even with the formation of the current Auto Fuel Policy Committee to look at regulations through 2025, a new Auto Fuel Policy Committee should be formed five years after the current one completes its task to review progress and to make recommendations in the light of future technologies and international best practices. Provisions for a new Auto Fuel Policy Committee every five years should be made in the MoPNG's five-year plans.

India has participated in the development of world-harmonised test cycles, but is yet to adopt any of them. Replacing current test cycles with world-harmonised ones will make it less likely that vehicles 'beat' emission testing

RECOMMENDATIONS FOR COMPLIANCE & ENFORCEMENT

SINGLE AGENCY FOR VEHICLE EMISSION AND FUEL QUALITY REGULATIONS

In 2003, the Mashelkar Auto Fuel Policy Committee had recommended the formation of a National Automobile Pollution and Fuel Authority (NAPFA) responsible for setting and enforcing vehicle emission and fuel quality standards in India. This recommendation was not adopted. Currently there are a number of ministries and agencies responsible for compliance and enforcement in India, which allows blame to be passed onto others if there are problems. Therefore, the government should establish a permanent NAPFA and ensure that it is fully funded.

NATIONAL IN-USE VEHICLE TESTING PROGRAMME

A robust Inspection and Certification (I&C) regime should be established in the country to ensure safety, road worthiness and emission performance of in-use vehicles. All motor vehicle categories should be covered under the I&C regime, which should address both safety and emissions. Presently, only commercial vehicles are required to undergo fitness test for road worthiness. Private vehicles are required to undergo pollution under control checks at periodic intervals as per the Central Motor Vehicle Rules under the Motor Vehicles Act, 1988. The parameters, for which the PUC testing is done, are not related to the parameters for which vehicles are tested for emission during the. Type Approval and Conformity of Production (CoP) tests. On the line of the practice in the United States, India should, in addition to emission standards which should be adhered to by new vehicles, lay down deterioration standards for each year to test in-use vehicles for emissions. There should also be a recall policy to recall models which, on testing, do not adhere to the emission standards derived from the applications of deterioration factors.

A modern I&C regime with minimum manual interference needs to be established in a phased manner. In the beginning, I&C regime should prioritise transport (commercial) vehicles and then move to non-

Given the history of fuel adulteration in India, it is especially important that the Government develops a national plan to test fuel at retail outlets, along the lines of the US and Japan

transport (private) vehicles. Phasing the implementation of I&C regime would enhance the probability of success as commercial vehicles are much smaller in number and would be easier to target in the initial phase. Also, the investment requirements will be less and distributed if a phased approach is adopted. The phasing should target bringing older vehicles under the I&C regime earlier, as compared to the newer vehicles. Also, cities with higher vehicular pollution should be targeted first. Periodic fitness tests for commercial vehicles are included under the Motor Vehicles Act and can be initiated under the new I&C regime. I&C of private vehicles will require changes in the Motor Vehicles Act as the law does not currently call for periodic fitness certification; after the initial registration, private vehicles are required to re-register only at the end of 15 years.

A dense network of modern I&C centrecentres should be established with the required capacity for testing commercial and private vehicles. The frequency of testing should be based on the principle that commercial vehicles and older vehicles are tested more frequently, preferably annually. Private vehicles need not require I&C for the first three years, after which they should be subjected to fitness tests biennially till they complete nine years. After nine years, private vehicles should also be subjected to annual tests. In case of two-wheelers, however, the biennial tests should begin after two years till eight years of age, after which they should also have annual fitness tests.

The I&C centres should be established on a PPP basis. The central government should lay down the policy and regulatory framework for tests, equipment, manpower requirements based on the advice of an independent agency like a National Accreditation Board (NAB) that could also monitor implementation of I&C by state governments. The state governments should fix the inspection fee after analysing the cost of, each centre and the expected reasonable return on investment from it. State governments could subsidise centres that have lesser volumes of fitness tests. State governments should ensure the implementation of the I&C regime by private testing agencies, independent agencies or empanelled auditors.

CLEAR RECALL POLICIES AND PUNITIVE MEASURES

Indian law clearly authorises the government to fine violators and recall noncompliant vehicles, but there are no well-defined legal procedures for this. Until NAPFA is set up, the MoRTH should establish clear punitive measures and recall processes for noncompliant vehicles and the MoPNG should establish clear punitive measures for noncompliant fuels.

TEST FUEL QUALITY AT RETAIL OUTLETS

Oil companies are responsible for fuel compliance activities while the fuel is in their possession. While they may do this, there is little, if any, verification of their activities by the government, despite legal procedures requiring this. Furthermore, there is hardly any testing of fuels at retail outlets, where consumers ultimately get fuel for their vehicles. Given the history of fuel adulteration in India, it is especially important to test fuel at retail outlets. The MoPNG should develop a national plan to test fuel at retail outlets, along the lines of what is done by the US EPA or Japan's METI and NPA.

ENERGY SECURITY & TRANSPORT ATTRIBUTABLE GREENHOUSE GAS (GHG) EMISSIONS

Increasing energy consumption levels and emission of greenhouse gases (GHG) like CO_2, is another important challenge.

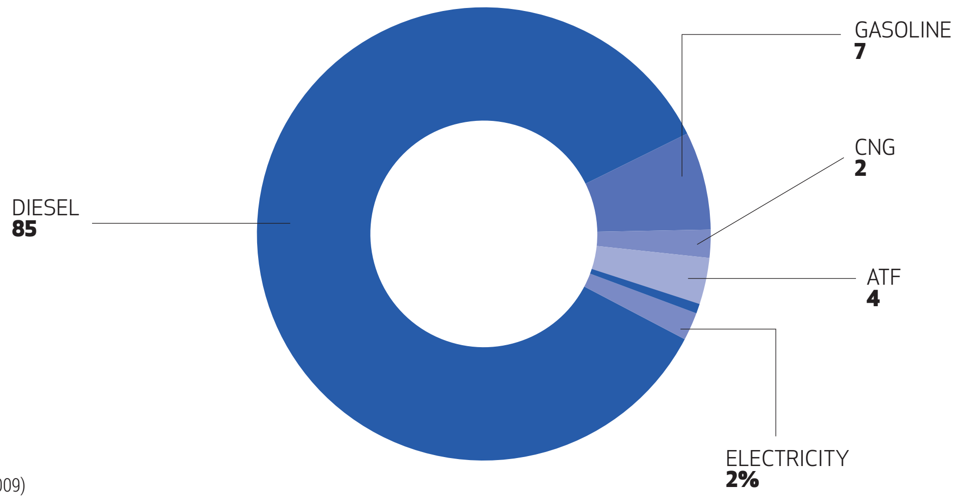
Increasing energy demand by the transport sector raises concerns about energy security and economic growth. GHG emissions from this sector also exacerbate the problem of global warming which can have long-term effects on everyday life and India's economy. Rising temperatures and changing weather patterns for instance will undoubtedly impact agriculture, which employs over half the country. Rising temperatures can also lead to higher sea levels which could inundate coastal areas permanently displacing populations.

According to TERI, in a BAU scenario, the total energy consumption by the transport sector is expected to increase from 81.3 million tonne of oil equivalent (Mtoe) in 2010 to 266.8 Mtoe in 2030, a more than threefold increase (TERI, 2009). Road transport will be responsible for more than 90 per cent (244.5 Mtoe) of the energy requirements in 2030. Petroleum will continue to be the largest fossil fuel used. Diesel will account for 85 per cent of fuel used. it, as shown in Figures 7.19 and 7.20. Some estimates predict 2030 requirements to be even higher at 318 Mtoe (Guttikunda et al, 2012). The International Energy Agency (IEA) gives a more conservative estimate of 164 Mtoe in 2030 if current policies continue. Petroleum consumption will be 91 per cent of that (IEA, 2010).

THE CHALLENGE OF ENERGY SECURITY

The current trend of growing fossil fuel use is not favourable for India's energy security or economy. Domestic petroleum production has not kept up

Figure 7.19
Fuel Mix for the Transport Sector in 2030 Under the BAU Scenario (per cent)



Source: TERI (2009)

with growing demand, making the country increasingly dependent on imported crude oil. The uncertainty of crude oil availability in the future poses a problem for India.

This upward trend is not limited to India. World oil demand for transport is estimated to increase from 4,200 Mtoe per annum in 2009 to 5,370 Mtoe per annum in 2035 if current policies continue (IEA, 2010). (See Box 7.3 for detailed analysis).

The production of crude oil in the country has increased at an average annual growth rate of around 1.6 per cent from 2000-01 to 20010-11, whereas the consumption of petroleum products over this period has increased at a rate of more than 4 per cent annually (MoPNG, 2012). The reserves to production (R/P) ratio of crude oil in India indicates enough reserves for 30 years, whereas the R/P ratio[1] worldwide indicates enough crude oil to last in the world for 46 years (TERI, 2011). India has become, and will continue to be, increasingly dependent on imported crude oil (Figure 7.21) Crude oil imports now account for almost 80 per cent of India's demand (MoPNG, 2012). If current trends continue unchecked, this will rise to 90 per cent by 2032 (TERI, 2008).

Heavy dependence on imports is bad for India's economic growth. It exposes the domestic economy to the vagaries of international crude oil prices, thereby affecting macroeconomic variables like the country's import bill and trade balance (TERI, 2011). It also sends billions of rupees abroad to purchase fuel, rather than investing the money at home.

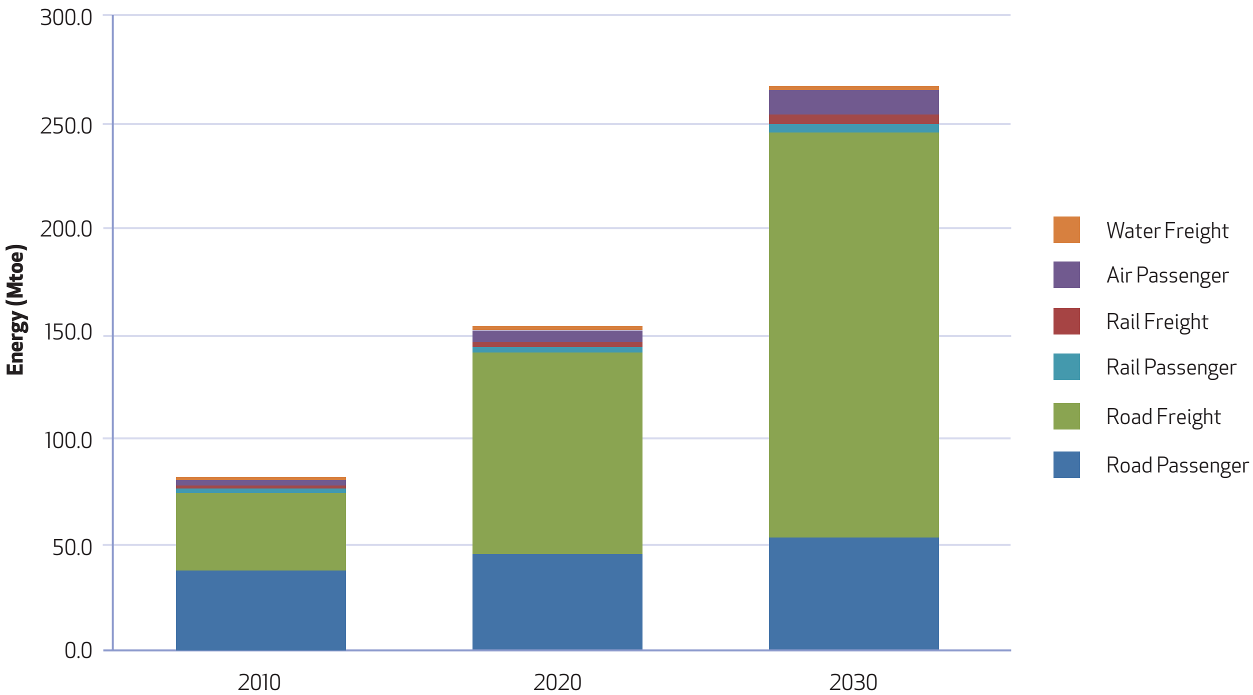
India's transport sector also uses gas and electricity in addition to petroleum products. Together, these two energy sources account for about 2.5 per cent of the energy needs of the sector. Their share is expected to go up to 3.5 per cent in 2030 under a BAU scenario (TERI, 2009). The government has been making efforts to increase the use of these fuels, not only to reduce dependence on oil, but also to lower air pollutant emission.

There have especially been fairly strong initiatives to promote natural gas use. The government has a policy of allocating natural gas primarily for the transport sector and secondarily for other sectors. Many first tier cities have shifted their public transport and intermediate public transport systems (such as auto rickshaws and taxis) to CNG and other cities are following suit. According to a proposal by the Petroleum and Natural Gas Regulatory Board (PNGRB), city natural gas distribution networks may be implemented in over 200 cities, which may be used for transportation as well.
But like oil, natural gas is not an infinite resource. The R/P ratio of natural gas in India indicates sufficient domestic production for a maximum of 28.5 years (TERI, 2011). Currently, the country imports more than 20 per cent of its domestic gas requirements, as shown in Figure 7.22. Increasing demand will further increase dependence on imports.

Electricity use in the transport sector has not been adequately promoted, the primary user being rail transport. Electricity use in road transport is expected to increase in the future as innovation in electric vehicles continues and they become economical to produce and use. The government has announced a National Electricity Mobility Mission Plan 2020 that targets 6-7 million new electric and hybrid electric vehicle sales by 2020. While the implementation of

1. The Reserves to Production (R/P) ratio is the ratio of total estimated reserves at the end of the year to the total production during the year. This ratio provides an estimate of the expected life of the existing

Figure 7. 20
Growth in Energy Consumption in Transport Sector in a BAU Scenario



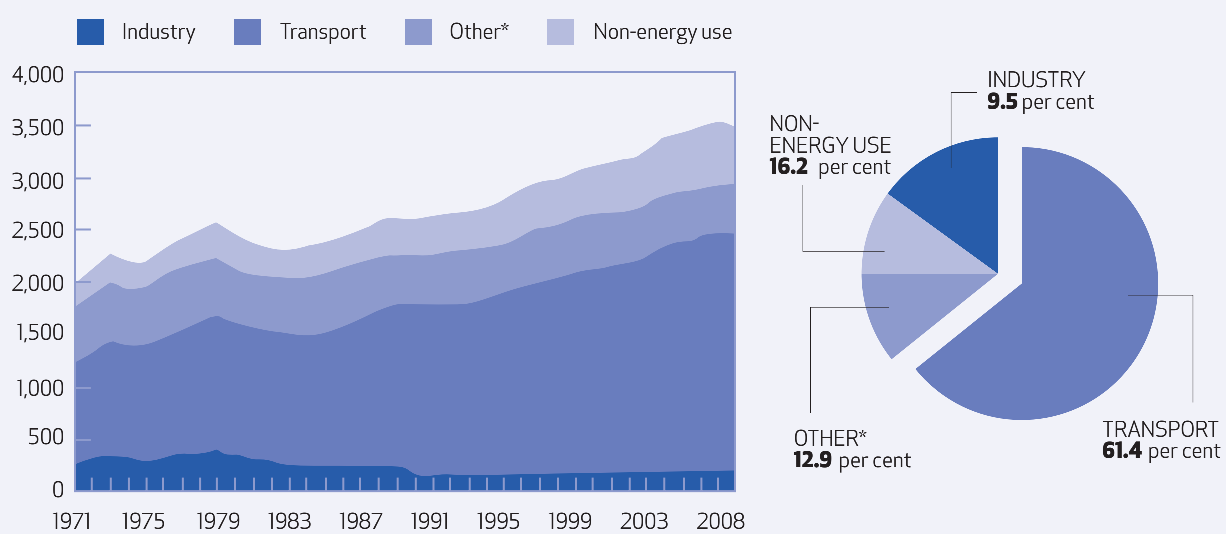
Source: TERI (2009)

Box 7.3
Share of transportation in global petroleum consumption

Worldwide, transportation accounts for a dominant share of total petroleum consumption annually. In many countries, highway vehicles consume the largest share as in the United States where they account for 61 per cent as per the US Department of Energy 2010 estimates. Clearly, any effort to enhance energy efficiency should pay particular attention to highway vehicles.

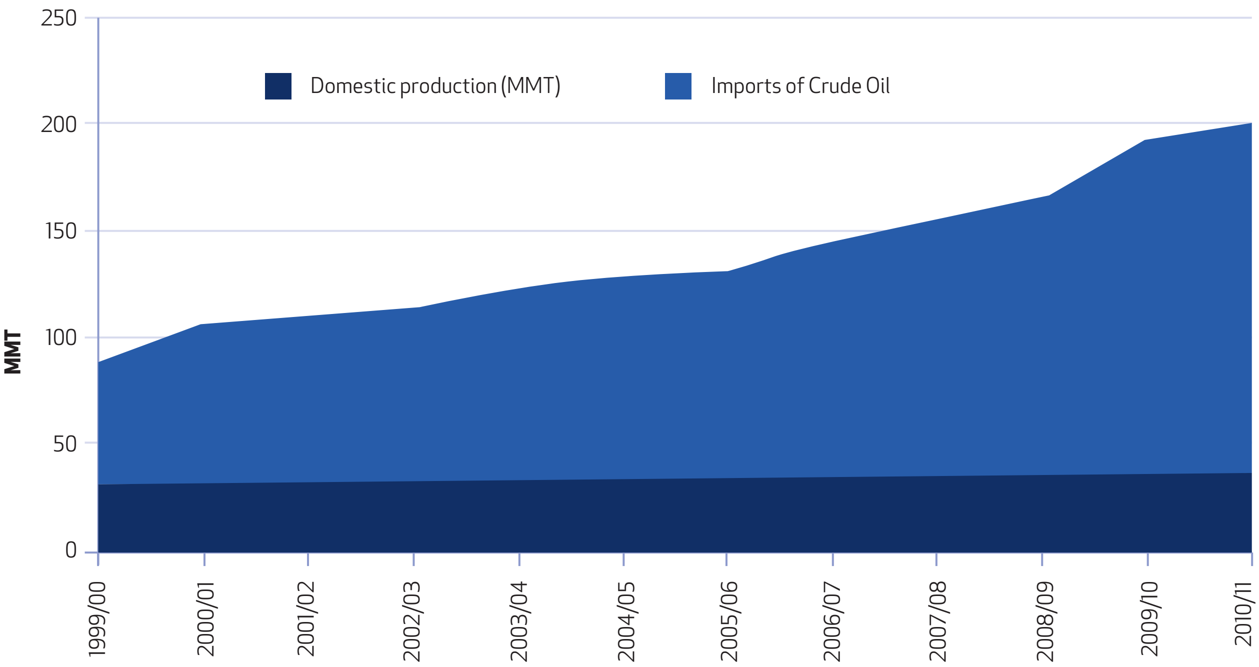
Governments worldwide are trying to improve vehicular energy efficiency for many reasons: ensuring greater energy security; enhancing economic development and competitiveness; reducing climate change impact and improving public health.

World Petroleum Consumption by End-Use (in Million Tonne of Oil Equivalent-Mtoe)



DRIVERS OF GOVERNMENT ENERGY EFFICIENCY POLICIES	
Energy security	Reduce imported energy Reduce demand increase reliability Control energy demand growth
Economic Development and Competitiveness	Reduce energy intensity Improve industrial competitiveness Reduce production costs More affordable energy customer costs
Public Health	Reduce air pollution that is attributed to vehicle emissions
Adapted from: Energy Efficiency Governance Handbook(http://www.iea.org/papers/2010/gov_handbook.pdf)	
Source: Government Policies to Encourage Energy Efficient Vehicles on Roads, Page 4-5, Kumares C. Sinha, Mohammad H. Arman, Samuel Labi, June 7, 2011	

Figure 7. 21
Domestic Production and Imports of Crude Oil in India, 1999-00 to 2010-11



Source: TERI (2011).

the Mission Plan is expected to yield liquid fuel savings of 2.2-2.5 million tonne by 2020, it will lead to an increased demand for electricity for road transport. About seven million electric vehicles will require additional power generation capacity in the range of 775-865 MW. GHG emissions and energy security concerns will be relevant if this electricity is generated from thermal power plants that depend on imports of coal and gas.

THE CHALLENGE OF INCREASING CO_2 EMISSIONS

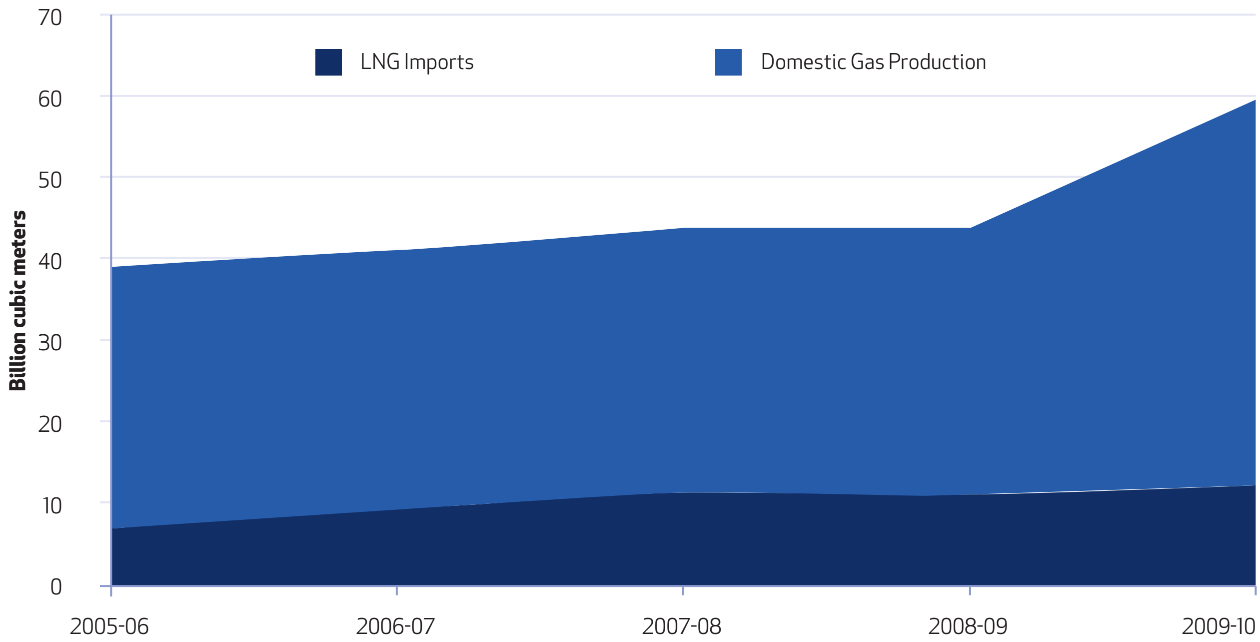
The transport sector is a key contributor to CO_2 emission. As per a Ministry of Environment and Forests (MoEF) study (MoEF, 2010), the sector was the second largest contributor to CO_2 equivalent emission (CO_2e) in 2007 and generated 142 MtCO_2e. Within the transport sector, road transport contributes 87 per cent of the total CO2 equivalent (CO_2e) emissions, as shown in Figure 7.23. As per studies (TERI, 2009; Guttikunda et al, 2012; ICCT, 2012) the trend of increasing CO_2 emissions from road transport is expected to continue if no action is taken. In 2030, road transport is expected to have CO2e emission in the range of 850-900 MTas shown in Figure 7.24. Total transport sector CO_2e emissions could go up to 900 million tonne in 2030 (TERI, 2009).

Appropriate strategies and policies need to be put in place to lower energy consumption and GHG emission from the transport sector. These strategies should include (TERI, 2011):

- Incentivise use of rail and marine transport for goods movement.
- Incentivise public transport over private vehicles for passenger transport.
- Maintain NMT options, such as biking and walking.
- Implement progressively strict vehicle fuel efficiency standards.

Figure 7. 22

Domestic Production and Imports of Natural Gas, 2005-06 to 2009-10



Source: (TERI, 2011)

Improving vehicle fuel efficiency can help achieve low-energy, low-carbon growth in the transport sector. Vehicle fuel economy regulations can free up billions of rupees, currently spent on petroleum products, for other needed investments.

In recent years, many advanced countries have established fuel economy or GHG emission standards for vehicles. These regulations are relatively new and continuously changing and expanding as new technologies are developed, and successes and shortcomings are analysed. India, too, is establishing its first-ever vehicle fuel consumption regulations.

TYPES OF VEHICLE GHG EMISSION STANDARDS

Energy consumption and GHG emissions can be reduced by setting fuel economy or fuel consumption standards, by setting vehicle CO_2 and other GHG emission standards or combination of these. Since fuel consumption correlates well with CO_2 emission for a single fuel type, limiting one, in effect, limits the other. But this does not hold true for diverse fuel types. Nor do only fuel economy or fuel consumption standards fully take into account the emission of non-CO_2 greenhouse gases, such as methane (CH_4), hydro fluorocarbons (HFCs), and nitrous oxide (N_2O). CO_2 and CO_2-equivalent GHG emission standards may be needed to regulate total vehicle GHG emissions.

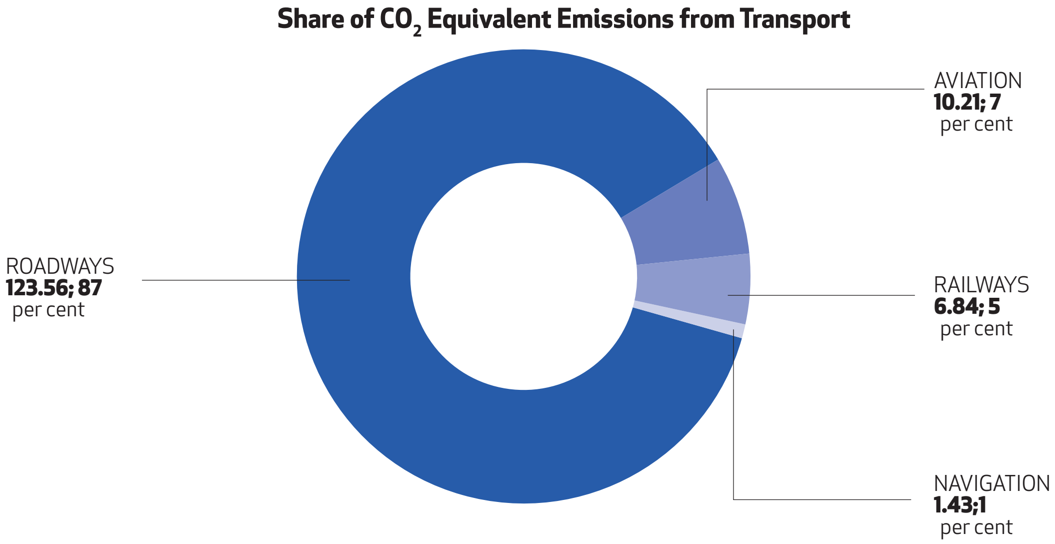
If developed and implemented correctly, GHG emission standards can also provide compliance flexibility by taking into account non-engine technology improvements. For example, operating an air conditioning system places an additional load on the vehicle engine, causing additional fuel to be consumed and therefore increasing CO_2 emission. Extra emission resulting from such loads can be reduced by increasing air conditioning efficiency and using low emission refrigerants.

Standards for fuel efficiency, fuel consumption and GHG emissions can also be established based on vehicle class or weight. But, weight-based standards give manufacturers an incentive to increase vehicle weight to qualify for more lenient standards. This penalises manufacturers who use advanced technologies to reduce vehicle weight to improve fuel efficiency. It should be noted that vehicle GHG emission standards address tank to wheel (TTW) emissions, but they do not take into account well to wheel (WTW) emissions. In certain cases, as in policies promoting the use of biofuels to promote vehicle fuel efficiency, WTW emissions may increase, even with stringent TTW standards.

INTERNATIONAL GHG EMISSION STANDARDS

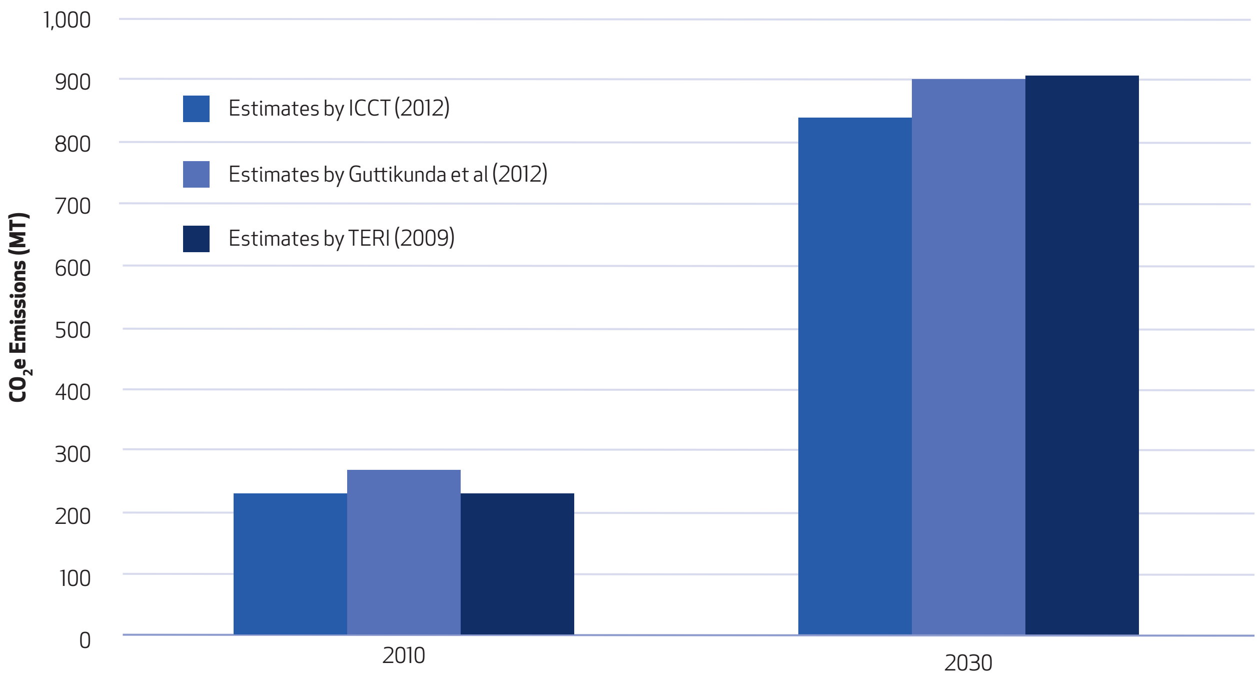
Standards have generally been established for LDVs first since improvements to reduce emission and increase fuel efficiency are best known for this class of

Figure 7. 23
CO_2 Equivalent Emissions from Transport Sector, 2007



Source: MoEF, 2010

Figure 7. 24
CO_2 Emission from Transport Sector in BAU Scenario, 2010-2030



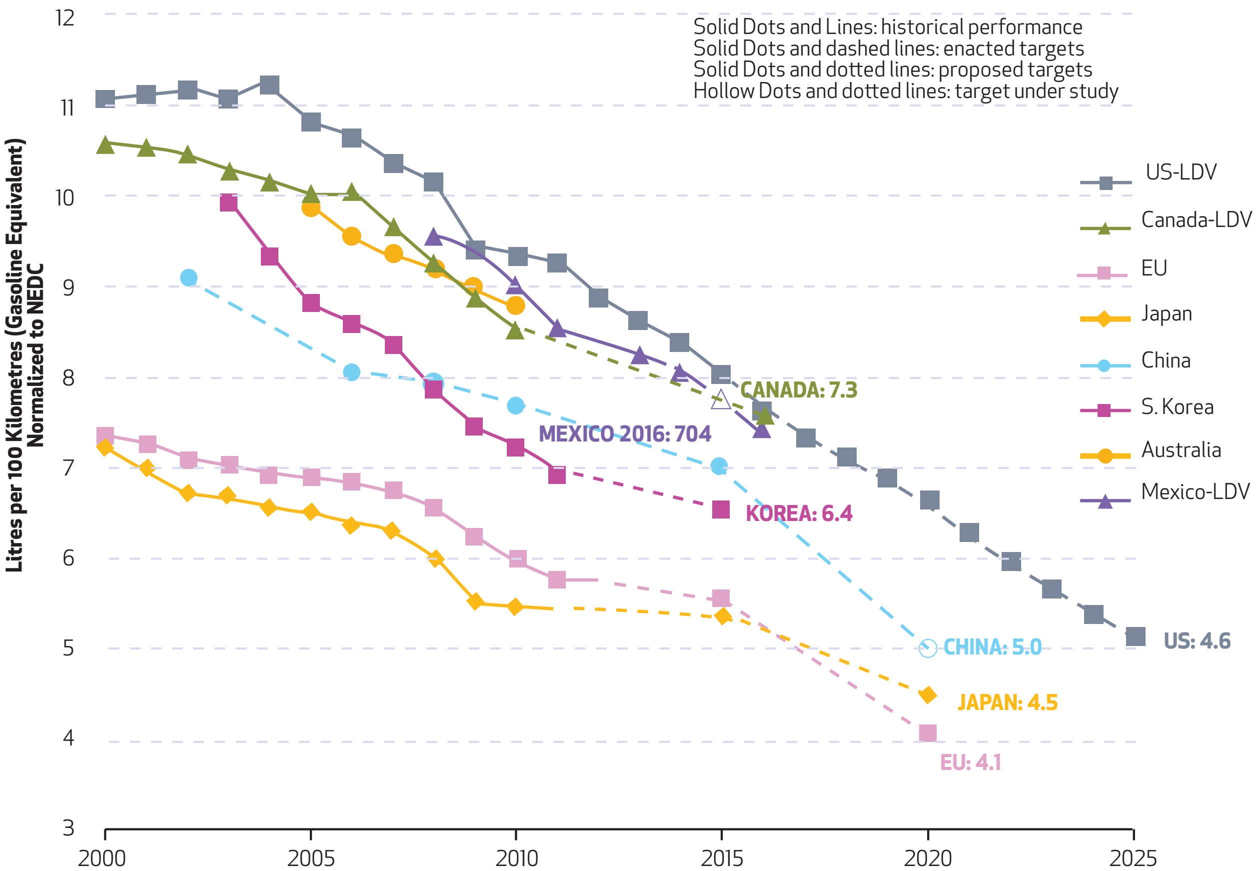
vehicles. Recently, there has been a growing interest in standards for HDVs and two- and three-wheelers too.

LIGHT-DUTY VEHICLE STANDARDS
GHG emissions from LDVs have steadily fallen over the last decade, and they are predicted to continue to do so as standards become more stringent. Figure 7.25 shows trends in LDV fuel consumption standards (or equivalents) in litres per 100 kilometres in various countries.

UNITED STATES
For decades, the motivation for the US fuel economy regulations was energy security. In recent years, climate change has become a factor as well. In 2010, the EPA and the US Department of Trans-

Figure 7. 25

Past and Proposed LDV Fuel Consumption Standards in Various Countries.



[1] China's traget reflects gasoline fleet scenario. If including other fuel types, the target will be higher
[2] US and Canada light-duty vehicles include light-commercial vehicles.

portation (DOT) finalised a new joint regulation covering GHG emissions and fuel economy for model years 2012-2016 passenger cars and light trucks.

According to the new standards, the corporate average LDV GHG emission rate will be reduced from an average of 342 gCO_2e/mile in 2008 to 250 gCO_2e/mile in 2016. Fuel economy will increase from an average of 26 miles per gallon (11.05 km/L) to 34.1 miles per gallon (14.5 km/L) during this period.

Additionally, the US is planning to extend LDV CAFE standards to 2025. Passenger cars and light trucks will be required to meet a fleet average fuel economy standard of 54.5 miles per gallon (23.17 km/L) by that year. Some leniency in that standard will be allowed through credits for enhancements in air conditioning technology and other areas that reduce GHG emissions. Box 7.4 discusses some incentives in the US to increase vehicle fuel efficiency.

EUROPE

In 2009, Europe set its first mandatory CO_2 emission target for 2015 at 130 gCO_2e/km for the fleet average for all manufacturers combined. A similar standard for light commercial vehicles (vans) was set in 2011 at 175 gCO_2e/km for the year 2017.

These targets are to be met with vehicle efficiency improvements alone, with additional cuts achieved through measures such as changes in tire pressure, gearshift indicators, air conditioning as well as an increased use of biofuels.

In 2011, a more far-reaching 2020 target of 95 gCO_2e/km was announced for LDVs. The European Commission has until early 2013 to consider the technical and economic analysis to achieve this.

The European standard for CO_2 emissions is a weight-based corporate average, while US fuel efficiency regulations are class-based. This means vehicle manufacturers in Europe do not necessarily have an incentive to decrease vehicle weight in order to increase fuel efficiency.

There are some flexibility and incentives built into the European system. For example, cars emitting less than 35 gCO_2e/km will count as 1.3 cars for up to

Box 7. 4

Improving Fuel Efficiency for Existing Vehicles: Examples of Rebates and Penalties

The United States government allows tax credits for the purchase of energy efficient vehicles. Tax credit is calculated on the basis of the vehicle's fuel economy and energy savings. After a vehicle meets the eligibility criteria, the automaker applies to the Internal Revenue Service for official certification of the incentive. Above a certain level, the tax credit amount decreases until it eventually phases out (Onoda, 2008).

The state of California developed a 'feebate' system (fee as penalty and rebate as reward). Such a system could be designed to be revenue neutral or to yield a certain pre-specified ratio of total fees to total rebates. For this policy, issues to be considered include (i) the effect of gradual reduction in energy efficiency of vehicles over time. So scheme parameters pivot point(s) and rate- need to be adjusted periodically to maintain overall revenue neutrality. (ii) there can be significant administrative cost, depending on the complexity of the scheme. The purchase of old vehicles which tend to be fuel inefficient and the production of fuel inefficient cars are penalised in certain countries. At the federal level in the US, the Gas Guzzler Tax is a disincentive established by the 1978 Energy Tax Act to discourage the production and purchase of fuel inefficient vehicles (Onoda, 2008).

The Car Allowance Rebate System (CARS), colloquially known as "Cash for Clunkers", a $3 billion U.S. federal programme, established in 2009, provides economic incentives to residents to purchase a new, more fuel-efficient vehicle when trading in a less fuel-efficient vehicle. The programme was promoted as providing stimulus to the economy by boosting auto sales, while putting safer, cleaner and more fuel-efficient vehicles on the roadways (USDOT, 2009).

In Canada, the ecoAUTO programme provides rebates for purchase or long-term lease of efficient cars and light trucks, and Green Levy-an excise tax- penalises those who purchase certain types of energy-inefficient cars (APEC, 2009).

Source: Government Policies to Encourage Energy Efficient Vehicles on Roads, Page 8-9, Kumares C. Sinha, Mohammad H. Arman, Samuel Labi, June 7, 2011

20,000 new car registrations per manufacturer. Additionally, manufacturers that develop 'innovative technologies' that are not covered by the test cycle can apply for a maximum credit of 7 gCO^2e/km.

CHINA

China regulates vehicle fuel consumption rather than fuel economy. It introduced its first national fuel consumption standards for new passenger vehicles in 2005 (Phase I). Phase I sets fuel consumption standards on vehicle weight. It was successful in reducing fuel consumption to 8.1 L/100km for model year 2008 vehicles, over an average of 9.1 L/100km for model year 2002 vehicles. Phase I standards were tightened by 10 per cent in 2008 (Phase II) for all model year 2009 vehicles and beyond. In 2009 and even more stringent standards were proposed (Phase III), which aims at a nationwide LDV fleet average fuel consumption rate of 7 L/100km by 2015.

The first two phases of the Chinese standards were per-vehicle certificate standards. Every new vehicle had to meet a maximum fuel consumption set for its weight class before it could enter the market. Such a compliance scheme, though useful in phasing out vehicles with out-dated technologies, does not encourage manufacturers to adopt state-of-the-art fuel efficiency technologies over time.

But the 2015 target may not be met as vehicles are generally getting heavierand hence will have less stringent fuel consumption standards.China is therefore considering a combined per-vehicle certificate standard and corporate average fuel consumption (CAFC) system for Phase III regulations, details of which have yet to be released.

Additionally, China also provides incentives for the production and sale of fuel-efficient vehicles as detailed in Box 7.5.

HEAVY-DUTY VEHICLE STANDARDS

Since the use of HDVs is linked with growth in freight activity, stakeholders in the HDV sector extend beyond vehicle manufacturers and owners to include those who contract services as well.

There are many well-known technical improvements to reduce HDV fuel consumption.

Box 7.5

Enhancing Highway Vehicle Energy Efficiency: China's Case

Worried about heavy reliance on imported oil and faced with increasing hazy smog conditions in Beijing and other Chinese cities, China is seeking ways to impose greater fuel efficiency. Chinese officials have drafted automotive fuel economy standards that require automakers in China to improve fuel economy by an additional 18 per cent by 2015. The Chinese government has been active in adopting policies and programmes to encourage energy-efficient vehicles on roads:

Economic incentives & disincentives are used to reduce greenhouse gas emissions, and are implemented through subsidies to individuals for purchasing new fuel-efficient or alternative-fuel vehicles or increasing the fuel efficiency of existing vehicles. Some of these economic incentives are:

- A subsidy of $455 to each consumer who buys selected vehicles with engines not exceeding 1.6 liters;
- Subsidies of up to $9,100 for the purchase of an electric car, and up to $7,580 for the purchase of a gasoline-electric hybrid vehicle, in the cities of Shanghai, Hangshou, Changchun, Shenshen and Hefei, under a trial programme, started June 2010.
- Procurement of energy-efficient vehicles for the government
- China is actively supporting research and development of new vehicle technologies. Its largest automobile company, the SAIC group, and other local and foreign auto makers are investing in R&D centres to develop alternative energy and environmentally-friendly technologies. In addition, China enforces mandatory vehicle emission inspection and retirement of old vehicles.

Hence we see that standards of new vehicles have been controlled through i) Establishment of mandatory fuel-efficiency standards for light duty vehicles. ii) Automotive industry agreements on fuel efficiency and adaptation of efficient and innovative vehicle technology. iii) Mandatory fuel-efficiency standards for passenger cars based on vehicle weight and transmission type (manual or automatic).

The Chinese Government actively promotes public outreach to enhance awareness of the need to reduce energy consumption, how it can be achieved by individual contribution as individuals monitor their energy use. For this purpose, information on vehicle performance is provided to car purchasers and vehicles are labelled with fuel consumption rates at the time of purchase.

Source: Government Policies to Encourage Energy Efficient Vehicles on Roads, Page 22, Kumares C. Sinha, Mohammad H. Arman, Samuel Labi, June 7, 2011

Setting fuel economy or GHG emission standards for HDVs is a more recent regulatory endeavour than for LDVs. Until the mid 2000s, the focus was on voluntary best practice programmes which connected fleets with resources to improve their in-use efficiency.

Recently, several countries have begun to develop and implement mandatory fuel economy or GHG emission standards for HDVs. Japan implemented the first mandatory HDV fuel economy standards in 2005, followed by the US in 2011. China has implemented a voluntary industry standard on certain vehicle types and is developing a mandatory fuel consumption standard. In Europe, HDV GHG emission standards for the 2013-2014 timeframe are under consideration. Table 7.3 shows the development of HDV fuel economy and GHG emission standards in assorted countries and regions.

JAPAN

Japan was the first country to implement mandatory fuel economy standards for HDVs. In 2006, the Japanese government introduced the first fuel economy standards for new HDVs, which were estimated to be responsible for approximately one-third of all CO_2 emission from motor vehicles in 2008. Fleet average fuel economy targets were set to be 7.09 km/L (369.6 gCO_2e/km) for heavy-duty trucks and 6.30 km/L (416 gCO_2e/km) for buses by 2015. Both targets represent a 12 per cent increase in fuel economy over fleet average fuel economy for both vehicle types in 2002.

Japanese standards are corporate average, weight-based standards. Specific targets are set for different types of vehicles and also depend on vehicle weight. Vehicles are tested on a chassis dynamometer over the urban JE 05 test. Fuel economy is then calculated based on a computer simulation that takes into account, testing and various vehicle factors.

THE UNITED STATES

In 2011, the US passed its first GHG emissions and fuel economy requirements for HDVs through model year 2018. The new requirements require up to a 20 per cent decrease in fuel consumption for tractors, a 10 per cent decrease for delivery trucks, garbage trucks, buses, and vocational vehicles, and a 17 per cent

Table 7. 3
The Development of HDV Fuel Economy and GHG Emission Standards in Various Countries

COUNTRY/ REGION	REGULATION TYPE	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Japan	Fuel Economy						Phase 1 Regulation Implemented Starting MY 2015					
				Phase 2 Development								Phase 2
United States	GHG/Fuel Efficiency	Standard proposal	Final rule			Regulation Implemented Starting MY 2014 (mandatory DOT program starts MY 2016)						
					Trailer Rule?		Phase 2 Final Rule					Phase 2
Canada	GHG/Fuel Efficiency			Standard Proposal and Final Rule		Regulation Implemented Starting MY 2014					Phase 2 Implementation?	
Mexico	Fuel Efficiency			Standard Proposal				Regulation Implemented Starting MY 2016			Phase 2 Implementation?	
China	Fuel Consumption	Test Procedure Finalised	Industry Standard Proposal	Standard Proposal	Final Rule		Regulation Implemented Starting MY 2015					
European Union	GHG	Technical Studies			Test procedure Finalised	Mandatory Efficiency Reporting and Policy Development				Policy Implementation?		
California	End-user Purchase Requirements	Requirements for new Tractors and Trailers (MY 2011+)			Additional Requirements for Existing Tractors and Trailers (<MY 2010)				Additional Requirements for Existing Trailers and Reefers (<MY 2010)			

decrease for heavy-duty pickups and vans by 2018 over 2010 year levels.

While the Japanese approach was largely based on engine improvements, the US took a comprehensive look at improving HDV fuel economy. The US programme includes separate engine-only standards as well as also aerodynamics, tires, and weight reduction in its approach.. This gives manufacturers flexibility while complying with regulations.

OTHER COUNTRIES
No other country currently has plans to implement HDV fuel efficiency or GHG emission standards in the near future. Europe and China are currently assessing their capability to set GHG emission standards for HDVs, but neither has yet announced anything definitive.

TWO- AND THREE-WHEELERS
Currently, there are only two countries in the world with two and three-wheeler fuel economy standards: China and Taiwan. China first implemented its two- and three-wheeler fuel consumption standards in 2008. It is expected to implement its second phase of motorcycle fuel consumption standards in the near future.

INDIAN GHG EMISSION STANDARDS
As a part of its low-carbon growth strategy, India has announced it will reduce its GHG emission intensity by 20-25 per cent over 2005 levels, by 2020. An expert group has been set up to develop a strategy to reduce the emission intensity for each of the critical sectors of the economy. After the power generation sector, the transportation sector is currently the second largest contributor of GHG emission in India. Its share is increasing as vehicles on Indian roads increase. Box 7. 6 for the recommendations of the expert group for the transport sector.

In India, the Bureau of Energy Efficiency (BEE) and the MoRTH are responsible for establishing and enforcing fuel economy and GHG emission standards. The BEE will set the standards and MoRTH will be responsible for their enforcement.

LIGHT-DUTY VEHICLES
India is currently developing its first ever fuel economy standards for passenger vehicles. These standards will be applicable to new cars, but will not include light commercial vehicles (LCVs). Including LCVs or establishing separate standards for them would be a good opportunity to reduce diesel consumption, and in turn, lower diesel subsidies the Indian government doles out every year.

New passenger car fuel economy standards were expected to be finalised in 2012, but have been delayed inexplicably. The new standards envision a continuous reduction in fuel consumption over a ten-year period. To give manufacturers adequate lead-time, they are expected to go into effect from 2015-2016. They will be implemented on a CAFC model.

India has developed its first ever fuel economy label for new cars sold in fiscal year 2011-2012. The label is shown and described in Figure 7.26. Apart from dis-

Box 7.6

Recommendations on the Transport Sector by the Expert Group on Low Carbon Strategies for Inclusive Growth

As a reflection of its intent to be a responsible member of the community of nations in the efforts to contain climate change, in December 2009, India announced that it would aim to reduce the GHG emission intensity of its GDP by 20-25 per cent by 2020 from its level in 2005. The fulfilment of this commitment requires sector-specific actions. An Expert Group on Low Carbon Strategies for Inclusive Growth was set up to develop recommendations for such actions. The Expert Group submitted an interim report providing a menu of options to reduce GHG emissions intensity in critical sectors of the economy. One of the critical sectors examined by the group was transport.

The strategy for reducing emissions intensity in the transport sector laid out by the Expert Group consists of three elements: avoid; shift; and improve.

1. **Avoid:** This element involves adopting a systems approach and reducing the need for transport through appropriate choices for locating industries and other businesses and through better urban planning to minimise commuting needs.
2. **Shift:** This element focuses on use of more carbon efficient modes of transport.
3. **Improve:** This element emphasises the use of the most carbon efficient technologies for any mode of transport.

The Expert Group focused on three specific interventions that follow from this strategy:

1. Increasing the share of rail in freight transport. This is a “shift” intervention. Chapter I in Volume III of this report which deals with Railways discusses this issue in greater detail.
2. Increasing or retaining the current modal shares of public and non-motorised transport in urban passenger transport. This is an “avoid” and “shift” intervention. It is covered in more detail in Chapter 5 of Volume III of this report on Urban Transport.
3. Improving the efficiency of the vehicle fleet. This is an “improve” intervention and is one of the subjects covered in this chapter.

For improving the fuel efficiency of the vehicle fleet, the Expert Group recommended:

1. Introduce vehicle labelling/rating systems.
2. Introduce minimum efficiency standards.
3. Introduce corporate fleet efficiency standards.

These recommendations are similar to those made on improving fuel efficiency in this chapter.

Source: ‘Interim Report of the Expert Group on Low Carbon Strategies for Inclusive Growth,’ Planning Commission, Government of India, May 2011.

playing the combined fuel economy of the vehicles, the label ranks fuel efficiency on a five star system. The current rankings are based on fleet average fuel consumption by kerb weight for fiscal year 2009-2010. This means that vehicles with the highest fuel efficiency may not have the highest number of stars. Conversely, vehicles with the lowest fuel efficiency may get more than one or two stars. Despite the BEE label in Figure 7.26 having been finalised, it has not yet been made mandatory.

HEAVY-DUTY VEHICLES

HDV fuel consumption standards have not yet been considered in India, though there is much potential to reduce fuel consumption from HDVs. Probably, they will follow once LDV standards have been put in place.

TWO- AND THREE-WHEELERS

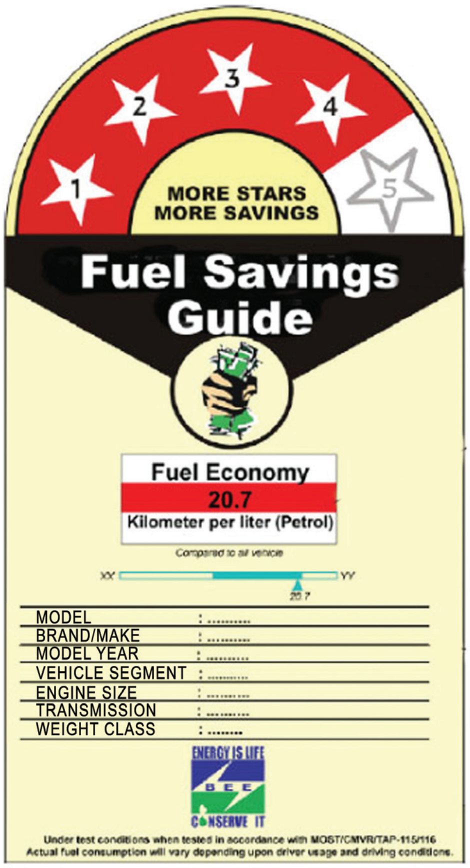
Two and three-wheeler fuel economy or fuel consumption standards may follow after LDV and HDV standards get finalised. Since sales of two- and three-wheelers are high in India, fuel consumption standards for this class of vehicles will be important in curbing overall fuel use and GHG emission. There is also much room for improvement in two- and three-wheeler fuel efficiency in India.

IMPACT OF GHG STANDARDS

According to analysis by the ICCT, fuel use and CO_2 emission in India will decrease significantly with implementation of vehicle fuel consumption standards. Figure 7.27 shows results of the ICCT’s Alternate scenario over the BAU scenario (ICCT, 2012). The Alternate scenario assumes the following annual reduction in GHG emission between 2015 and 2025: 3 per cent for LDVs; 2 per cent for HDVs; 1 per cent for two- and three-wheelers.

From Figure 7.27, it can be seen that over 1,665 million barrels of oil can be saved and 695 mil-

Figure 7. 26
India's New Vehicle Fuel Economy Label



BEE Fuel Savings Guide

Star rating scheme based on static approach applied to all vehicles

Fuel Saving Guide

Fuel Economy

20.7

Kilometres per litre (Petrol)

Compared to all vehicles

XX — *20.7* — *YY*

Model	:..
Brand/Make	:..
Model Year	:..
Vehicle Segment	:..
Engine Size	:..
Transmission	:..
Weight Class	:..

lion tonne of CO_2e emissions can be avoided if the 2030 Alternate scenario were to become reality. Certainly, reductions in CO_2 emission would continue even without further reductions in new vehicle fuel consumption, as more fuel-efficient vehicles replace old ones.

RECOMMENDATIONS TO REDUCE ENERGY CONSUMPTION AND CO_2e EMISSION

MANDATE FUEL EFFICIENCY LABEL FOR ALL NEW VEHICLES

A BEE label to clearly display a passenger vehicle's fuel efficiency has been developed, but not made mandatory. India should mandate this label for all new model year 2014 and later cars so consumers can make informed decisions when they purchase vehicles.

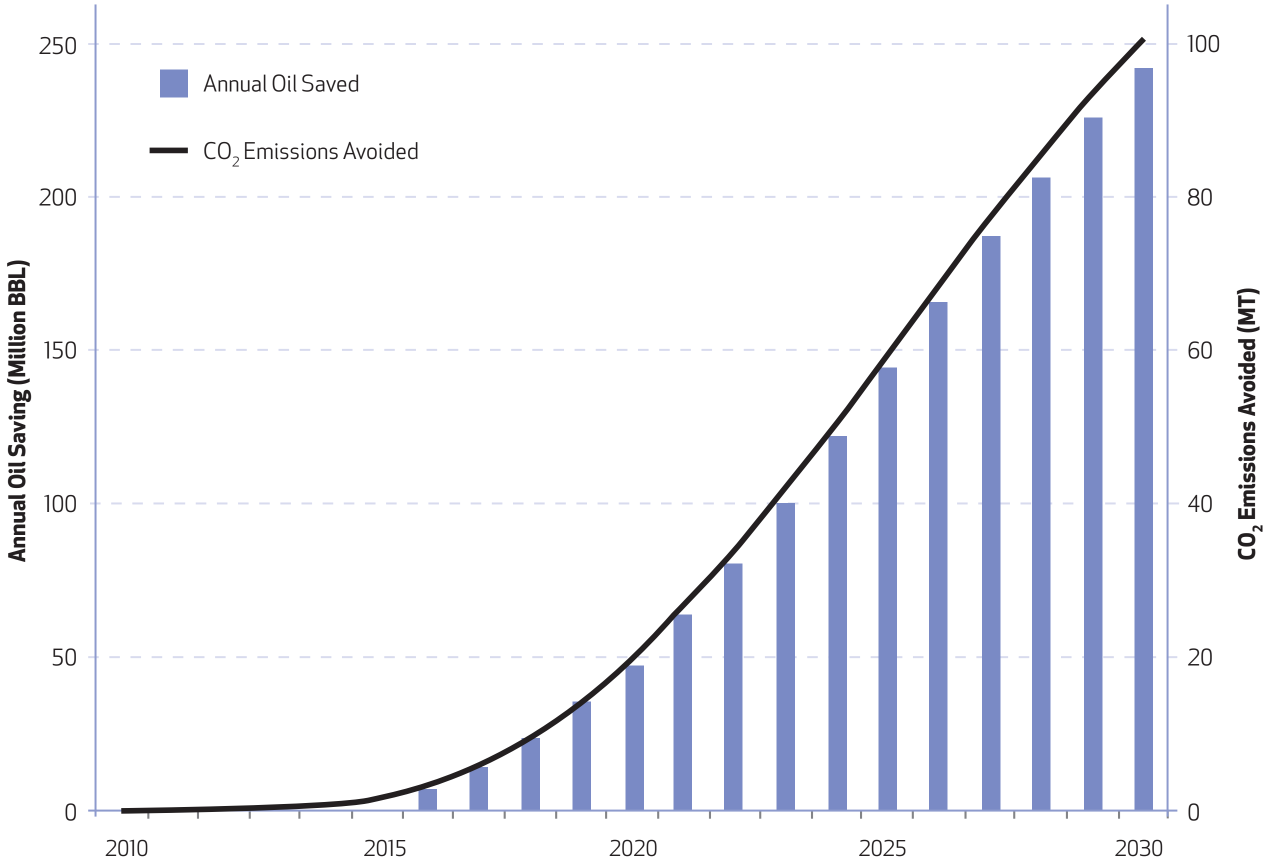
NOTIFY LDV FUEL CONSUMPTION STANDARDS

India has already developed LDV fuel consumption standards for the remainder of this decade, but their implementation has been delayed inexplicably. These standards should be notified immediately, and assessment for standards beyond 2020 should be started. Europe is targeting its LDV fleet average GHG emission to be 95 gCO_2e/km by 2020, which is far more stringent than standards proposed in India. Given that India's LDV fleet average GHG emission is roughly equivalent to those in Europe at the moment, India should aim for 95 gCO_2e/km by 2025 at the latest.

DEVELOP HDVS AND TWO- AND THREE-WHEELERS FUEL CONSUMPTION STANDARDS

The government has indicated it would begin this process once LDV standards have been finalised. There is also much that can be done to improve the fuel efficiency of HDVs and two- and three-wheelers. This is especially important in India, where motorcycles dominate new vehicle sales and are expected to do so in the future. The process to develop fuel consumption standards through the remainder of this decade for these vehicles should begin immediately. HDV standards should be in place by 2015 and two- and three-wheeler standards, by 2016. The target for both categories should be to reduce fuel consumption by 20 per cent under current levels by 2020.

Figure 7. 27
Annual CO_2 Emission Under the BAU and Alternate Scenarios



PROMOTE NMT AND PUBLIC TRANSPORT, ESPECIALLY IN URBAN AREAS

Reductions in energy consumption and GHG emissions can also come by promoting public transport and NMT, which would also stem the growth of private vehicles in most Indian cities. Adequate and quality public transport systems should be assured in all cities with populations above 500,000 and safe NMT options should be available everywhere.

SUMMARY & CONCLUSIONS

Energy use and GHG emission by the Indian transport sector are growing dramatically. This will continue unless strong action is taken. Most studies predict energy consumption by the transport sector will increase by factor of 2 to 4 over current levels, by 2030.

Increasing energy use and GHG emission means India will become even more dependent on imported fuels. This can hurt India's energy security and economy, as it sends money abroad rather than investing at home. GHG emission also exacerbates the problem of global warming, which can have dire effects on Indian agriculture and coastal populations.

To mitigate these problems India can:

i) Develop better urban development policies that incentivise public transport and NMT over private vehicle use.

ii) Implement stringent fuel consumption standards for all vehicle types. Indian vehicles are already relatively fuel-efficient, since they are typically smaller. The potential to further improve vehicle fuel efficiency over the next decade or so is also well-recognised.. Still, India risks falling behind other countries that have already implemented LDV fuel efficiency standards and are in the process of implementing HDV and two- and three-wheeler fuel efficiency standards.

India has developed LDV fuel consumption standards for the remainder of this decade, but it has inexplicably not notified them. These standards should be notified immediately, and assessment of the potential to reduce LDV fuel consumption beyond 2020 should begin immediately. India should aim for its LDV fleet average emission to be 95 gCO_2e/km by 2025.

Likewise, the development of fuel consumption standards for HDVs and two- and three-wheelers should be started immediately. Standards for HDVs should be in place by 2015, and those for two- and three-wheelers, by 2016. Both should aim to reduce fuel consumption by 20 per cent of current levels by the end of this decade.

LIFE CYCLE ANALYSIS OF TRANSPORT MODES

NEED FOR FACTORING LIFE CYCLE ENERGY AND CO_2 COSTS IN TRANSPORT DECISIONS

Environmental impact assessment exercises carried out to support decision-making in transport sector do not consider the full life cycle energy and CO_2 impact of transport modes and focus on the tail pipe impact only. It is, however, necessary that a holistic approach is adopted while analysing impact.

This is because different transport modes involve varying degrees of construction and maintenance activities; while some modes may be highly material and energy intensive, others may be comparably less energy intensive. Material and energy consumption at various stages of a transport project i.e. construction, operations and maintenance, need to be examined in order to fully understand their impact on environment.

Life cycle analyses (LCA) are typically used to assess such holistic/full-life impact of various products, systems, projects, etc. LCA is considered to be a robust decision-support tool due to the comparative character of its analysis . It helps identify life stages of a product/system having maximum impact and hence enables identification of appropriate mitigation strategies. Full life cycle impact of transport needs to be accounted for and recognised while taking policy decisions related to inter-modal choices and intra-modal greening.

ESTIMATING LIFE CYCLE ENERGY AND CO_2 IMPACTS THE SCOPE OF LCA

All stages in the life cycle of a transport mode like construction of fixed infrastructure and production of materials used in construction, manufacture of rolling stock, movement of rolling stock for transportation of people/goods, maintenance of rolling stock, maintenance of fixed infrastructure, etc require material and energy consumption and lead to CO_2 emission. The LCA should take into account all these life stages. However, certain life stages/activities can be left out in order to ensure that the LCA exercise is doable. A good LCA exercise should typically include the following life stages.

CONSTRUCTION OF THE TRANSPORT CORRIDOR/FIXED INFRASTRUCTURE

Life Cycle Analysis helps identify life stages of a product/ system having maximum impact and hence enables selection of the right mitigation strategies. Full life cycle impact of transport needs to be recognised when taking decisions on inter-modal choices

PRODUCTION OF CONSTRUCTION MATERIALS
Construction of any transport corridor requires consumption of materials. While on-site consumption of materials may not have any emission, the production of most construction materials is an energy-intensive process that also leads to CO_2 emission. The LCA framework should include this indirect energy consumption component, commonly referred as the 'embodied energy' of materials, and the resultant 'embodied CO_2' of materials.

TRANSPORTATION OF CONSTRUCTION MATERIALS
Once produced, materials are transported to construction sites by motorised modes like trucks. There are two types of energy consumption during this life stage–direct energy consumption by trucks and embodied energy of trucks. While the direct energy consumption component should be included in the LCA framework, the indirect energy consumption i.e. embodied energy of trucks need not be included because these trucks are capital assets,re-used for other construction and non-construction activities too.

ON-SITE IMPACTS: ON-SITE CONSUMPTION OF ENERGY
On-site construction processes require energy to run construction machinery, generate heat, etc. Diesel, electricity and fuel oil are the most common fuels consumed on-site. These processes and their CO_2 impact should be included in the LCA. Indirect energy consumption and CO_2 due to manufacturing of construction machinery and equipment, however, need not be included in the LCA.

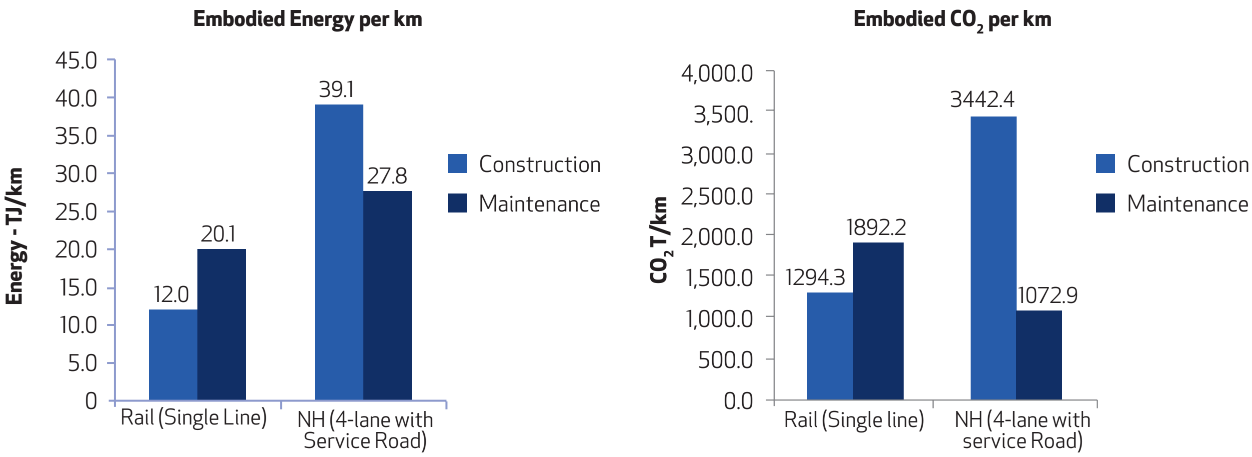
ON-SITE IMPACTS: REMOVAL OF VEGETATION
Construction of transport corridors often require removal of vegetation, which leads to loss of the carbon sequestration (CS) potential of vegetation. The LCA should include this CS potential loss.

OPERATIONS ON THE TRANSPORT CORRIDOR
Operations on transport corridors involve movement of the rolling stock. Energy consumption and CO_2 emission due to movement of rolling stock (direct) and manufacture and maintenance of rolling stock (indirect) should be included in the LCA.

MAINTENANCE OF THE TRANSPORT CORRIDOR
Energy and CO_2 impact due to annual routine maintenance and periodic maintenance/renewal should be included in LCA as done in the construction stage.

Figure 7. 28

Construction of Rail and National Highways: Embodied energy and CO_2 Emission



It should be noted that the above analysis has been carried out for sample rail and national highways projects

Source: Life cycle analysis study carried out by TERI for NTDPC

CONSIDERING LCA FOR INTER-MODAL DECISIONS

An understanding of the life cycle energy and emission costs resulting from the above activities in the life cycle of a transport project can help make informed and objective choices of transport modes and technologies in our policies and plans. While financial and technical feasibility analyses are carried out to select the most suitable mode of transport on a corridor/in a city, there is also a need to evaluate life cycle energy and emission costs of the alternate modal options and understand their environmental costs. For e.g. while financial feasibility analysis may indicate construction of national highways as being more cost effective than rail projects, LCA indicates that national highways are more energy and CO_2 intensive during construction, in comparison. (Figure 7.28).

Metro rail projects in urban areas have highest construction costs. LCA comparison indicates that construction of metro has highest environmental costs of all alternatives for urban areas (Figure 7.29).

While cities may choose high-capacity public transport systems like the metro rail as the least carbon emission-generating technology for public transport because it generates no emission at the tail pipe, an LCA evaluation indicates that a metro system generates more CO2 emission per km on a life cycle basis compared to, say, a Bus Rapid Transport system, which can also be high-capacity (Figure 7.30).

But the same metro system, however, is more energy efficient (on a per PKM basis) for its full life period, when compared to a BRT system (Figure 7.30). Introducing life cycle impact considerations can hence bring more detailed understanding of the overall impact of a system/proposed infrastructure project that are not limited to just tailpipe or operations stages and help decision makers make informed choices based on the economic, social and environmental goals set by the national, state or city governments.

It is important to note that LCA results cannot be generalised. While in smaller cities, high-capacity systems like metro rail may not look desirable on a life cycle energy and emission impact basis (per PKM) on account of the low usage, the same systems may be highly desirable in very large cities having very high usage levels. The choice of mode hence needs to be context-specific and an economically and environmentally feasible choice.

CONSIDERING LCA FOR INTRA-MODAL GREENING

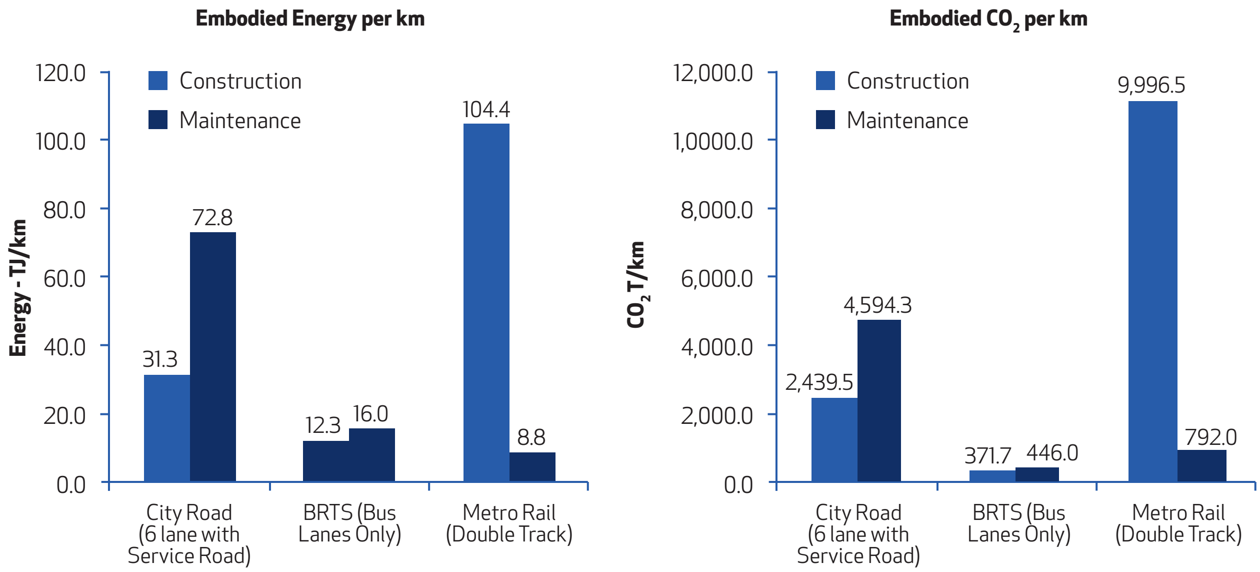
Construction and maintenance of transport infrastructure involves consumption of materials and fuels, some of which are highly energy- and carbon-intensive, significantly contributing to the life cycle energy and CO_2 impact of a particular transport mode.

LCA, if carried out, can indicate the materials and fuels that could be replaced by alternative materials and fuels that are less energy- and carbon-intensive. The LCA can also indicate the positive impact of using locally-available materials in reducing costs. Some possible areas where energy reduction can be achieved during the life of a transportation system are:

- Reducing energy and CO_2 intensity of conventional materials used,
- Using alternative materials that are comparatively less energy- and CO_2 -intensive,
- Using locally available materials,
- Using energy-efficient processes and machin-

Figure 7. 29

Construction of Urban Transport Projects: Embodied Energy and CO_2 Emission



It should be noted that the above analysis has been carried out for sample urban transport projects.

Source: Life cycle analysis study carried out by TERI for NTDPC

ery during construction and maintenance,

- Optimising resource utilisation during construction and maintenance, especially for transportation of materials (using locally available materials, reducing idling, using rail for bulk transport of materials, etc.),
- Using alternative fuels for construction processes and for transportation of materials during construction
- Promoting inter-modal shift (towards more energy-efficient modes),
- Improving efficiency of rolling stock, and
- Reducing energy and material intensity during manufacturing and maintenance of rolling stock.

LCA also indicates that if the life of projects is enhanced, then the energy and CO_2 impact due to reconstruction can be reduced/deferred, especially in the case of road-based projects that tend to have a shorter life. Project life can be enhanced by continued maintenance. This will help reduce both monetary and environmental costs on a life cycle basis.

It is recommended that LCA exercises should be carried out at least for all capital-intensive transports projects like metro rail, BRT, national highways, etc. in order to identify intra-modal improvements in terms of material substitution, bringing about operational efficiencies, reducing logistics coss, etc.

BUILDING CAPACITY FOR LCA

Conducting LCA calls for understanding of LCA concepts and analytical skills. These skills do not exist in ministries, government agencies and in most cities including metros. It might also be difficult and not cost-effective to build these skills in all agencies and cities. It is hence recommended that the capacity for conducting LCA should be built in key central agencies like the Planning Commission, state governments and in all metros. State governments can conduct LCA for the other cities.

FINDINGS & RECOMMENDATIONS

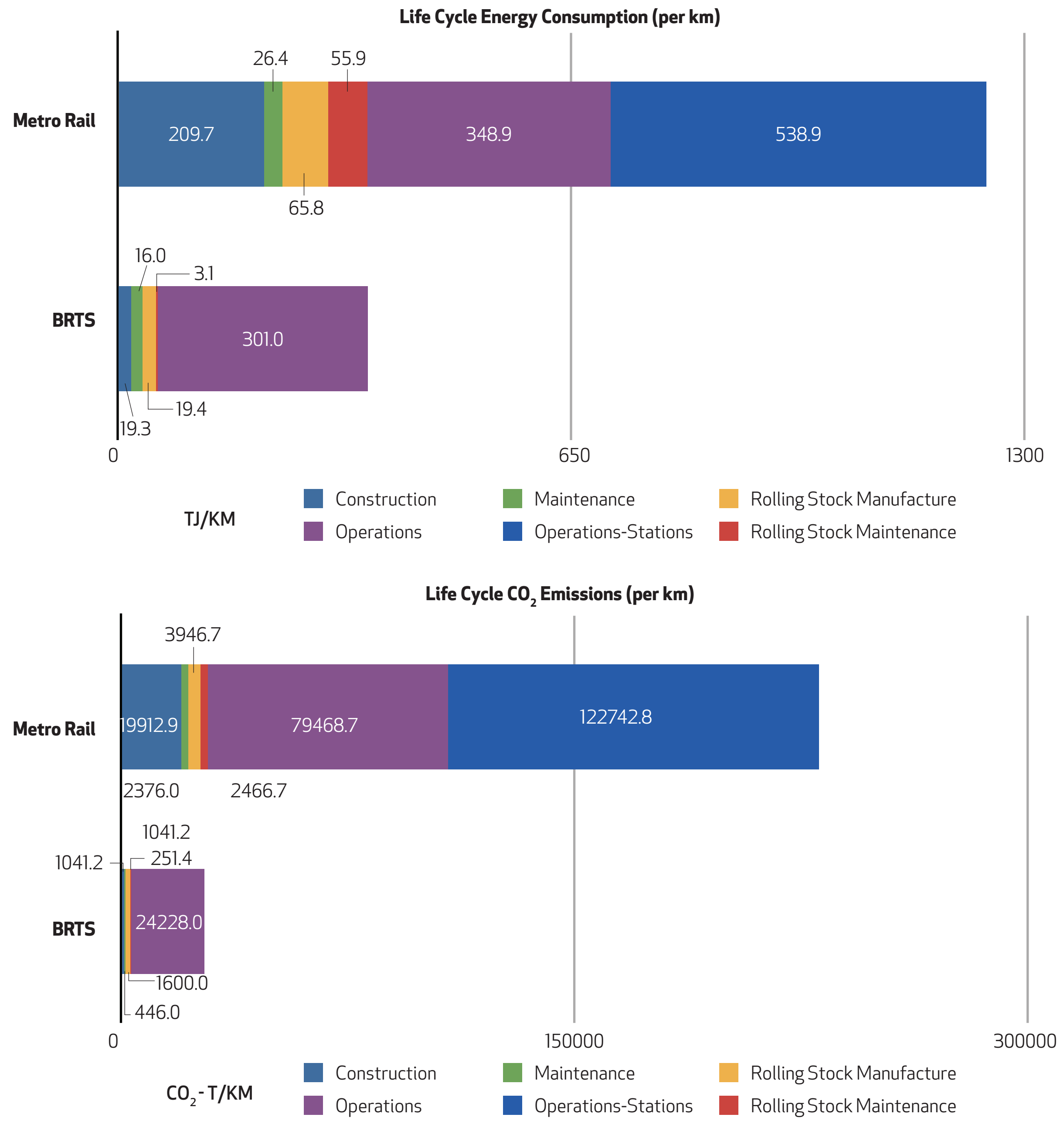
India has come a long way over the last two decades in reducing vehicle emission. Still, associated poor air quality and public health problems drive the need for further emission control. Many Indian cities have been ranked among the most polluted in the world. Vehicles are responsible for the majority of urban NO_x emission and 30-50 per cent of PM emission, in addition to significant HC and CO emission. The problem is exacerbated by the preference for diesel cars in India due to diesel subsidies. Currently, new diesel cars are allowed to emit much more NO_x and PM than gasoline cars.

India also lags behind international best practices in terms of fuel quality and vehicle emission standards. Sulphur levels in fuel remain high, well above the maximum of 10 ppm required for the best clean vehicle technologies to function optimally. Nor does India have any plans of implementing 10 ppm sulphur fuels nationwide any time soon. As a result, vehicle emission standards are not where they can be. Most of India is at Bharat III, with a handful of cities ahead at Bharat IV.

In contrast, the US, Europe, South Korea, and Japan have had 10 ppm sulphur fuels for many years now.

Figure 7. 30

Life Cycle Energy and CO_2 Emission from Metro and Bus Rapid Transit System (BRTS) Projects



It should be noted that the above analysis has been carried out for sample urban transport projects.

Source: Life cycle analysis study carried out by TERI for NTDPC

Europe is in the process of moving to Euro 6/VI. Countries at similar economic levels as India, such as China, Mexico, and Brazil, are also planning to move ahead on fuel quality and vehicle emission standards shortly.

There is much room for improvement for compliance and enforcement issues in India. Standards are meaningful only if complied with. The US, in particular, has been at the forefront of compliance efforts for over 40 years. By shifting the focus of vehicle emission compliance from new vehicles to in-use testing, over time the onus has been placed on vehicle manufacturers to ensure their products function as designed throughout their useful life. And testing fuel quality at multiple points along the distribution system has incentivised oil companies and fuel handlers to ensure fuel quality is met at all times. Clear, strict recall policies and punitive measures for non-compliant vehicles and fuels compel industry to test its own products. So the US EPA save money as it does not have to allocate resources to test many vehicles or all batches of fuel.

India can learn from the vast experience of the US and other countries to enhance its own regulatory programmes. Vehicle emission testing is currently limited to new vehicles, meaning there is little data to analyse the effectiveness of emission control technologies throughout their useful life. Weak test cycles mean that while vehicles pass initial emission testing, they may emit much more in real-world situations. While the laws provide for government testing of fuel quality, there is little evidence this is actually done.

Energy use by the transport sector is increasing dramatically, led primarily by private vehicle use. Studies predict that energy use by the transport sector will increase two to fourfold over the next 20 years. Unless strong action is taken, the consequences will be dire for India's energy security, economy, air quality, and global warming.

Enhanced public transport and NMT systems that disincentivise private vehicle use are one step towards combating these problems. These are discussed in more detail in the chapter on urban transport. Establishing vehicle fuel efficiency standards also help mitigate these problems.

India has already developed progressively stricter LDV fuel consumption standards for the remainder of this decade, but they have not yet been notified. They are also significantly weaker than European standards, despite the fact that Indian and European LDV fleets are currently at similar fuel consumption levels. Processes to develop HDV and two- and three-wheeler fuel consumption standards have not even begun while many other countries are starting to implement these standards already

It is important to treat vehicle emission and fuel use as a system. Improvements in one often lead to improvements in the other. For example, many technologies that improve vehicle fuel efficiency not only lead to lower GHG emission and fuel consumption, which mitigate global warming and reduce India's dependence on imported fuels, but also reduce air pollutant emission, which improves air quality and public health. Therefore, this chapter looks at all these issues holistically.

With the formation of a new Auto Fuel Policy Committee in January 2013, there is a lot of potential for India to make a headway on all of the points mentioned above. The committee has the authority to recommend reforms through the year 2025. The recommendations below are a starting point for that committee to reduce long-term vehicle emission and fuel consumption in India.

TIGHTER FUEL QUALITY STANDARDS

50 ppm sulphur fuels should be mandated nationwide by the middle of this decade, and 10 ppm sulphur fuels should be mandated nationwide by 2020. Reforms in diesel pricing being implemented currently should be used to pay for refinery investments needed to produce these cleaner fuels.

Energy use by the transport sector is increasing dramatically,led primarily by private vehicle use. Unless strong action is taken, the results will be dire for India's energy security, economy, air quality, and global warming

TIGHTER NEW VEHICLE EMISSION STANDARDS

Bharat IV fuel quality standard should be implemented nationwide by the middle of this decade, with a target to reach Bharat VI by 2020.

EVAPORATIVE EMISSION STANDARDS

By mid-decade, India should mandate Stage I controls when retail outlets are supplied with fuel, and Stage II controls for vehicle refuelling. India should also mandate all new vehicles to have on-board refuelling vapour recovery (ORVR) systems at the same time. These systems return vapours to a vehicle's fuel tank rather than to retail outlets. Stage II controls can be lifted about ten years after the implementation of ORVR systems because the majority of India's vehicle fleet will then have ORVR systems in place.

WORLD-HARMONISED TEST CYCLES

Replacing current test cycles with world-harmonised test cycles will make it less likely that certain vehicles 'beat' emission testing by passing the test cycle while emitting much more under real-world conditions. India should make world-harmonised test cycles optional when Bharat IV regulations go into force nationwide and mandatory when Bharat V regulations come into force.

REVIEW AUTO FUEL POLICY EVERY FIVE YEARS

In 2003, the Mashelkar Auto Fuel Policy committee had recommended a review of the auto fuel policy every five years. Yet a new Auto Fuel Policy Committee was not formed until 2013, ten years later, despite the fact that the Mashelkar Committee's mandate was through the year 2010. It should be made compulsory that a new Auto Fuel Policy Committee be formed five years after the previous one completes its work. Provisions should be made for this in the MoPNG's five-year plans.

SINGLE AGENCY FOR VEHICLE EMISSION AND FUEL QUALITY REGULATIONS

In 2003, the Mashelkar Auto Fuel Policy Committee had recommended the formation of a National Automobile Pollution and Fuel Authority (NAPFA) responsible for setting and enforcing vehicle emission and fuel quality standards in India. Currently a number of ministries and agencies are responsible for compliance and enforcement in India. This allows blame to be passed onto others in case of problems. Parliament should establish a permanent NAPFA and ensure that it is fully-funded.

NATIONAL IN-USE VEHICLE TESTING PROGRAMME

India needs to establish a robust Inspection and Certification (I&C) regime to ensure safety, road worthiness and emission performance of in-use vehicles. National-level vehicle testing needs to move beyond type approval (TA) and conformity of production (COP) to include in-use testing. All motor vehicle categories should be covered under the I&C regime. There should also be a recall policy to recall models which on testing do not adhere to the emission standards. Modern I&C centres with minimum manual interference need to be established on a PPP basis in a phased manner. In the beginning, transport (commercial) vehicles could be targeted, followed by non-transport (private) vehicles. Cities with higher vehicular pollution should be targeted first. Commercial and older vehicles should be tested more frequently, preferably annually. The central government should lay down the policy and regulatory framework for tests, equipment and manpower requirements based on the advice of an independent agency like a National Accreditation Board (NAB) that could also monitor implementation of I&C by state governments.

CLEAR RECALL POLICIES AND PUNITIVE MEASURES

Until NAPFA is set up, the MoRTH should establish clear punitive measures and recall processes for non-compliant vehicles and the MoPNG should establish clear punitive measures for non-compliant fuels.

TEST FUEL QUALITY AT RETAIL OUTLETS

There is little, if any, evidence that governmental or independent fuel quality testing is done anywhere along the fuel distribution system in India. Given the history of fuel adulteration, it is especially important to test fuel at retail outlets, where consumers ultimately purchase fuels. Until NAPFA is set up, the MoPNG should develop a national plan to test fuel at retail outlets, along the lines of what is done by the

US EPA OR JAPAN'S METI AND NPA.

Mandate fuel efficiency label for all new vehicles A BEE label to clearly display a vehicle's fuel efficiency has been developed but not made mandatory. India should mandate this label for all new model year 2014 and later vehicles so consumers can make informed purchase decisions.

NOTIFY LDV FUEL CONSUMPTION STANDARDS

India has already developed LDV fuel consumption standards for the remainder of this decade, but their implementation has been delayed inexplicably. These standards should be notified immediately and assessment for standards beyond 2020 should be started. The country should target LDV fleet average GHG emission to be 95 gCO2e/km by 2025, Europe's target for 2020.

DEVELOP HDVS AND TWO- AND THREE-WHEELERS FUEL CONSUMPTION STANDARDS

A lot can be done to improve the fuel efficiency of HDVs and two- and three-wheelers. This is especially important in India, where motorcycles dominate new vehicle sales and will continue to do so in the future. India should aim to have HDV standards in place by 2015 and two- and three-wheeler standards by 2016. The target should be to reduce fuel consumption by 20 per cent of current levels by 2020 for both categories.

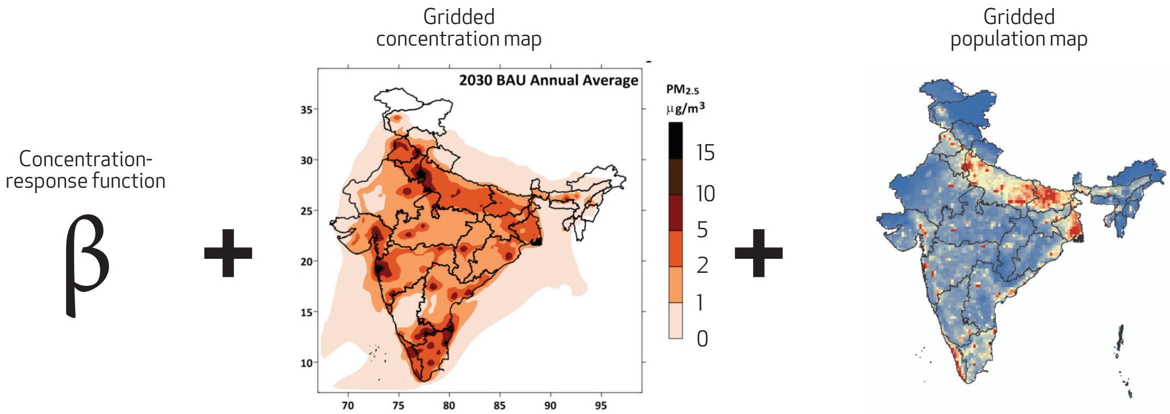
PROMOTE NMT AND PUBLIC TRANSPORT, ESPECIALLY IN URBAN AREAS

Adequate and quality public transport systems should be assured in all cities with populations above 500,000 and safe NMT options should be available everywhere. Other measures, such as integrated land use planning, enhanced traffic management systems, and integrated transport modes, also help reduce the energy intensity of urban transport systems. The chapter on urban transport details these issues and makes recommendations.

LIFE CYCLE ANALYSIS APPROACH TO BE ADOPTED IN TRANSPORT DECISION MAKING

It is recommended that the capacity to conduct LCA should be built in key central agencies like the Planning Commission, state governments and all metros. State governments can conduct LCA for the other cities. These agencies should carry out LCA analysis to facilitate decisions related to inter-modal choices and intra-modal improvements which reduce environmental costs of transport projects.

SCHEMATICS OF HEALTH IMPACTS ASSESSMENT



ANNEX

METHODOLOGY FOR HEALTH IMPACT ANALYSIS IN GUTTIKUNDA ET AL (2012)

Health impact analysis estimates premature mortality and morbidity as a result of outdoor air pollution, using concentration-response functions. However, this is not as easy to calculate and in all likelihood is a gross underestimate that captures only the direct impacts of air pollution (respiratory illness, allergies etc.). The road transport emissions account for 30 per cent of ambient pollution and isolating impacts of transport sources is tricky. The indirect impacts of exposure to pollutants are also many - an increase in inflammation, cardiac conditions, decrease in fertility, cancer, premature birth, among others.

The health impacts (mortality and morbidity) of baseline and future scenarios are estimated using the following methodology-

$$\delta E = \beta * \delta C * \delta P$$

where,

δE= number of estimated health effects (various end points for mortality and morbidity)
β= the concentration-response function; which is defined as the change in number of cases per unit change in concentrations per capita. This is established based on epidemiological studies conducted over a period of time, analysing the trends in hospital records and air pollution monitoring

δC= the change in concentrations

δP= the population exposed to an incremental concentration; defined as the vulnerable population, of age more than 17 years, which spends more time outdoors. This spatial spread of population is obtained from GRUMP (2010) and Census-India (2011).

The concentration-response function (β) (CRF) is defined as the change in the number of cases per unit change in concentrations per capita. Health effects range from minor irritation in eyes and upper respiratory system to chronic respiratory disease, heart disease, lung cancer, and lead up to premature death. In case of mortality, CRF is set to 0.225 per cent per 10 $\mu g/m^3$ increase in the PM_{10} concentrations (HEI, 2010) as the lower bound[2] and 0.6 per cent per 10 $\mu g/m^3$ increase in the PM_{10} concentrations (WHO, 2005) as the higher bound[3]; the total death incidence rate of 241 per 1,000 people was adjusted for the those due to lower and upper respiratory illnesses (including bronchitis and asthma) and cardio vascular diseases. Among the reported number of deaths, these causes account for 15 per cent of the annual death rate (DoES, 2010)[4]. Morbidity in terms of asthma cases, chronic bronchitis, hospital admissions, and work days lost is also estimated.

The population exposed (δP) is defined as the total population exposed to the incremental concentrations (δC) in each grid cell. The grid level population is estimated using GRUMP (2010) and Census-India (2012) and presented in the figure. The population data and the concentrations of PM_{10} are available at 0.25° resolution.

Comprehensive Air Quality Model with Extensions (CAMx) is used; it is an Eulerian photochemical dispersion model that allows for integrated assessments of gaseous and particulate air pollution over many scales ranging from sub-urban to continental. This model is designed to unify all of the technical features required of 'state-of-the-science' air quality models into a single open-source system that is

2. Public Health and Air Pollution in Asia (PAPA): A Multicity Study of Short-Term Effects of Air Pollution on Mortality. Health Effects Institute (2010) @ http://pubs.healtheffects.org/view.php?id=348
3. Health effects of transport related air pollution (2005) published by WHO @ http://www.euro.who.int/en/what-we-publish/abstracts/health-effects-of-transport-related-air-pollution
4. Annual Report (2010) on "Registration of Births and Deaths in India". Directorate of Economics and Statistics, the Government of Delhi, New Delhi, India.

computationally efficient, easy to use, and publicly available[5]. For the analysis of the road transport emissions in India, the CAMx model is set up to model the concentrations at 0.25° horizontal grid resolution. The vertical grid resolution extends to 12km stretched over 23 layers. The removal processes in the model include dry deposition varying with the land-use patterns and wet deposition due to predominant meteorological conditions.

The meteorological data (3D wind, temperature, and pressure, as well as surface heat flux and precipitation fields) is derived from the National Centre for Environmental Prediction (NCEP) global reanalysis[6]. The NCEP databases are available for the period of 1948 to 2012. We selected 2010 as the base year and the required data fields are processed for this year. The same meteorology for 2010 is used for all the future scenarios. The NCEP global meteorological fields are processed through the RAMS meteorological model (version 6.0)[7] and the data is available at 2 hour interval for the parameters necessary to run the CAMx dispersion model[8].

Source: Guttikunda et al (2012)

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5. The CAMx model source code, support systems, manuals, and test cases are available for download @ http://www.camx.com/about/default.aspx
6. The meteorological fields are available for free @ http://www.esrl.noaa.gov/psd/data/gridded/data.ncep.reanalysis.html
7. The RAMS v6.0 model source code, support systems, manuals, and test cases are available for download @ http://www.atmet.com
8. All the animations are available @ http://www.urbanemissions.info/india-meteorology

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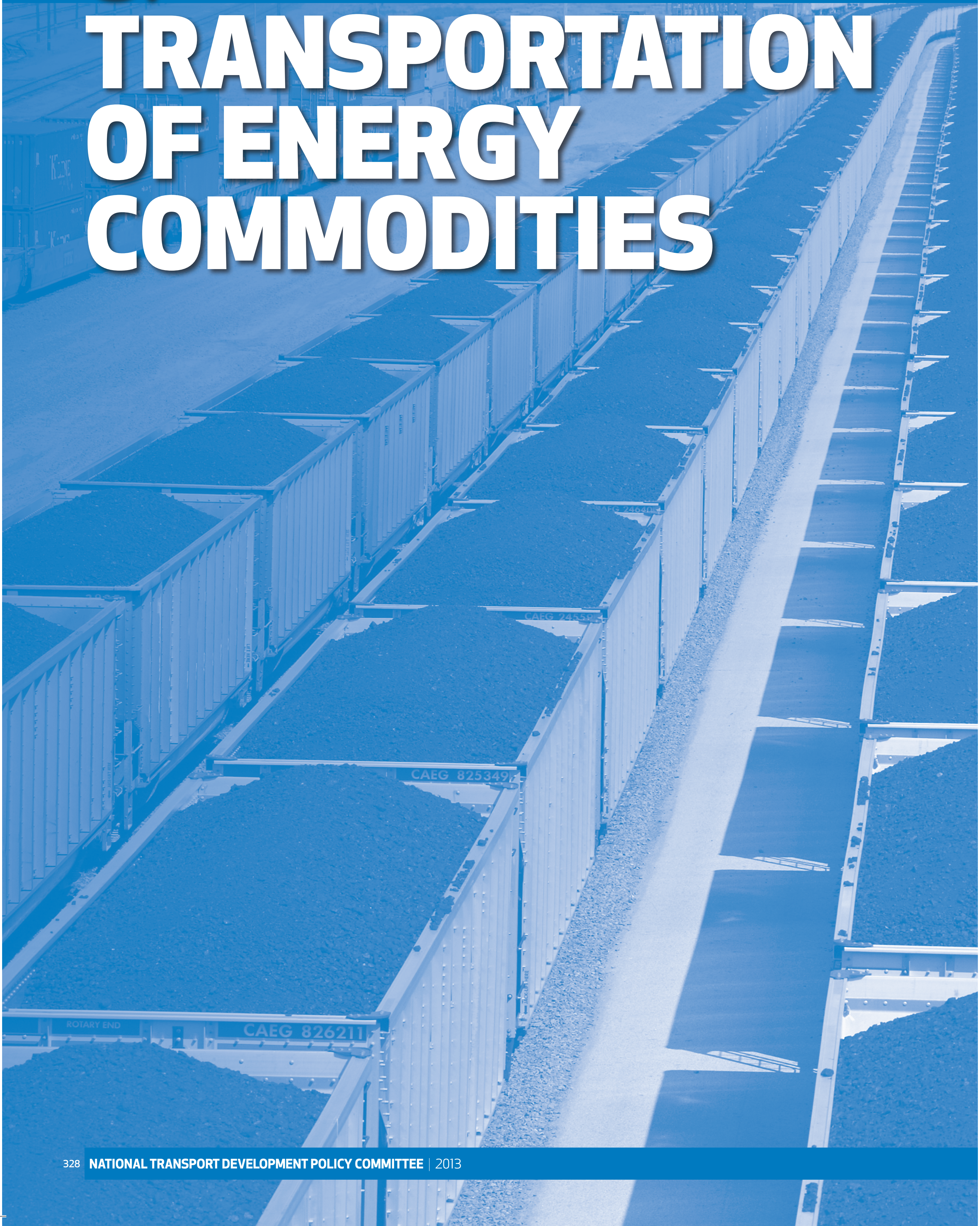
TRANSPORTATION OF ENERGY COMMODITIES

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8. TRANSPORTATION OF ENERGY COMMODITIES

The surge in economic growth, witnessed in recent years in India, has strained the capacity of its transport system as well as the energy supply, particularly electric power.

The government's ambitious development targets and plans, as well as popular discourse, attest to the importance of addressing such infrastructure constraints in a decisive manner over the next two decades, to sustain high levels of economic growth which is also inclusive.

Movement of bulk commodities is a major role of India's transportation system. Coal accounts for almost half the freight volume on Indian Railways, a major supplier of transport services to the electric power and steel industries. Indeed, the congestion caused by inadequate expansion in transport capacity to date, especially on crucial links and corridors, underlies issues such as security of supply chains, inventory of raw materials, port-handling, which affect industry.

The future poses profound challenges. Even if the ambitious aim to improve energy intensity is achieved, sustaining economic growth at 8-10 per cent per annum over the next two decades will require massive increases in power generation and transportation of bulk commodities such as coal, iron and steel.

Development plans from the key ministries of the government as well as initiatives and investment proposals from the private sector seek to address the above issues. The needs are vast and multifaceted while resources are limited. More importantly, the issues are intimately interrelated and the viability of solutions is interdependent, both in terms of the nature of the investment (e.g., transport coal or transmit power) as well as the timing and duration of execution. Hence a piecemeal approach to planning could be severely suboptimal, leading to colossal wastage of resources and time.

LOCATION OF PRODUCTION & SUPPLY

As a first step in assessing the transport requirements for bulk commodities, we identify the origins and destinations of the materials that have to be moved. Raw materials need to be moved from mines to production facilities, and finished products need to be moved from production facilities to the places they are used or consumed. We identify the location of domestic energy and mineral resources, the sources of commodity imports, and the location of production facilities. We also describe the current and projected transfer facilities. For some materials such as coal where domestic demand will outstrip domestic supply, imports will make up the deficit. Therefore, we also describe briefly the geostrategic considerations likely to affect the import of coal.

Coal, oil and natural gas are the three primary commercial energy sources. Being the most abundant fossil fuel in India, coal is by far the largest source of energy and meets about 50 per cent of the country's commercial energy needs. About 35 per cent are met by oil, with more than 80 per cent of that oil being imported. While natural gas accounts for 10 per cent, the consumption of natural gas has risen faster than any other fuel in the recent years.

Table 8.1
Major Reserves of Coal
[Billion Tonne]

NO.	COAL FIELD	STATE	GRADE OF COAL	GROSS GEOLOGICAL RESERVES (BT)	TYPE OF COAL
1	Talcher	Odisha	F	46.64	Thermal Coal
2	Ib Valley	Odisha	F	22.52	Thermal Coal
3	North Karanpura	Jharkhand	F	13.35	Thermal Coal
4	South Karanpura	Jharkhand	F	6.30	Thermal Coal
5	Rajmahal	Jharkhand	D-E	16.20	Thermal Coal
6	Korba	Chhattisgarh	D-E	11.76	Thermal Coal
7	Hasdeo-Arand	Chhattisgarh	D-E	5.18	Thermal Coal
8	Mand-Raigarh	MP	D-E	23.77	Thermal Coal
9	Singrauli	MP	C-E	12.76	Thermal Coal
10	Wardha Valley	Maharashtra	D-E	6.26	Thermal Coal
11	Godavary Valley	AP	D-E	22.05	Thermal Coal
12	Raniganj	WB	B-E	25.83	Thermal & Semi coking
13	Jharia	Bihar	LVM , C–E	19.43	Coking
	TOTAL			**232.05**	
	AVERAGE ASH CONTENT: 38-40 PER CENT, AVERAGE HEAT RATE 4,000 KCAL/KG				

Source: Report of the Working Group on Bulk Transport.

In addition to the bulk transport needs of the energy sector, we also look at the needs of the steel industry. The most important raw materials for the steel industry are iron ore and coking coal. India has very significant amounts of good quality iron ore resource, a significant amount of which was being exported until the recent ban by the Supreme Court. But the steel industry relies heavily on imports of coking coal as much of the national reserves have a high ash content rendering them unsuitable for steel-making.

COAL

About 80 per cent of the potential coal bearing area of 18,000 sq km has been covered by regional exploration. Based on these and more detailed explorations, India's total geological resource has been estimated to be about 286 billion tonne (Bt) of coal. Of this 114 Bt is proven resource, while 137 Bt and 34 Bt are 'indicated' and 'inferred' respectively. Only about 12 per cent of the geological resource contains coking coal; the bulk is non-coking coal. Indian coal is classified into grades, A through G, based on its gross calorific value (GCV) with grade A coal having the highest GCV.

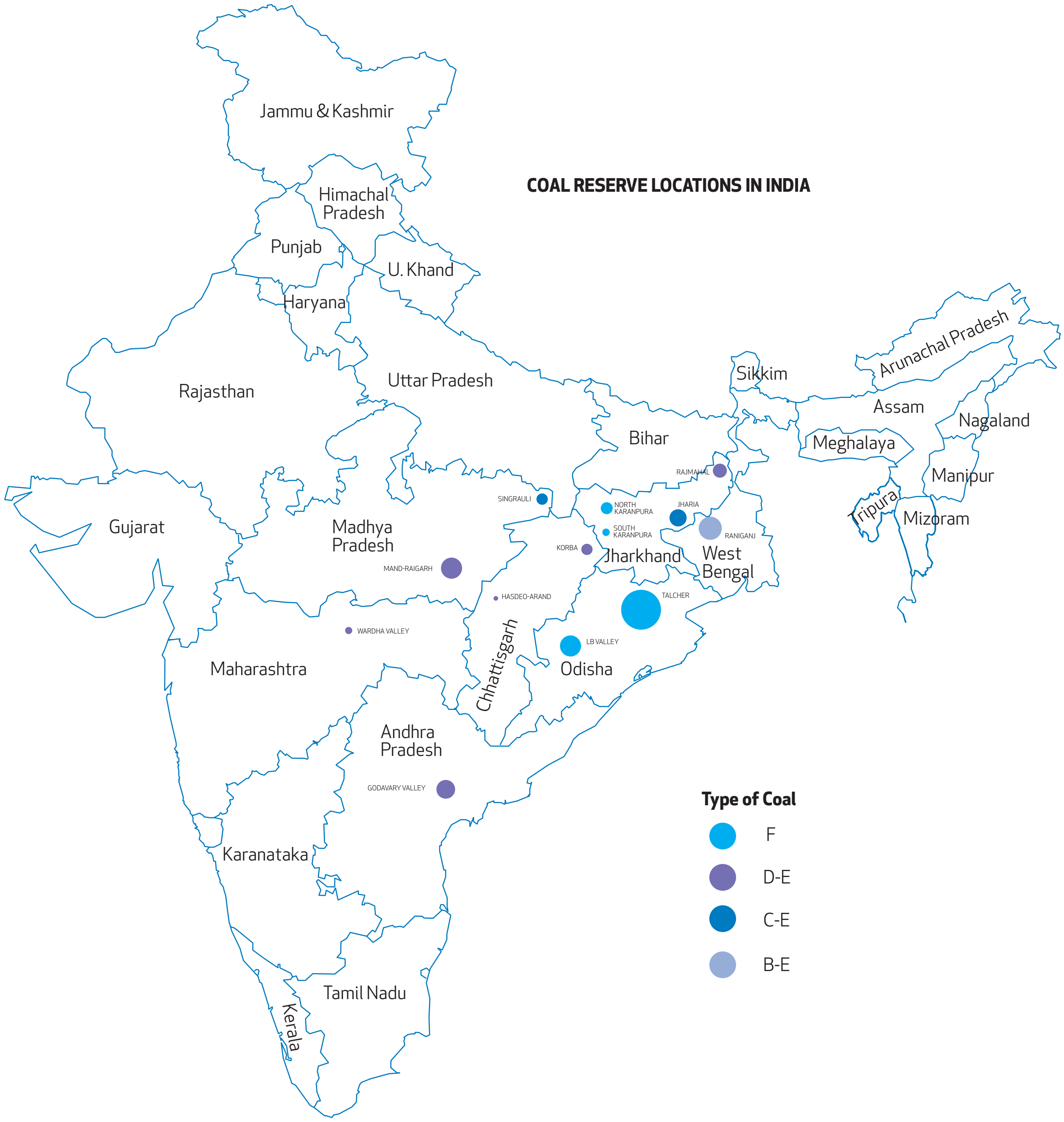
LOCATION OF COAL RESERVES

Coal India Limited (CIL) is the major indigenous coal producer and has seven production subsidiaries and an eighth subsidiary (CMPDI) that provides technical support to the other seven. Singareni Colleries Co. Ltd, jointly owned by the Governments of India and Andhra Pradesh, is also into coal production and supply.

Table 8.1 and Figure 8.1 show the major reserves of coal in the country that account for over 80 per cent of the national resource. These coalfields have a geological resource of about 232 Bt and lie mostly in the eastern part of the country.

Figure 8.2 gives the state-wise share of coal reserves. About 70 per cent of the reserves are in

Figure 8.1
Location of Reserves of Coal



Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

three states—Odisha, Jharkhand and Chhattisgarh. However, much of this coal is of the poor quality (mostly grade F, and some D or E).

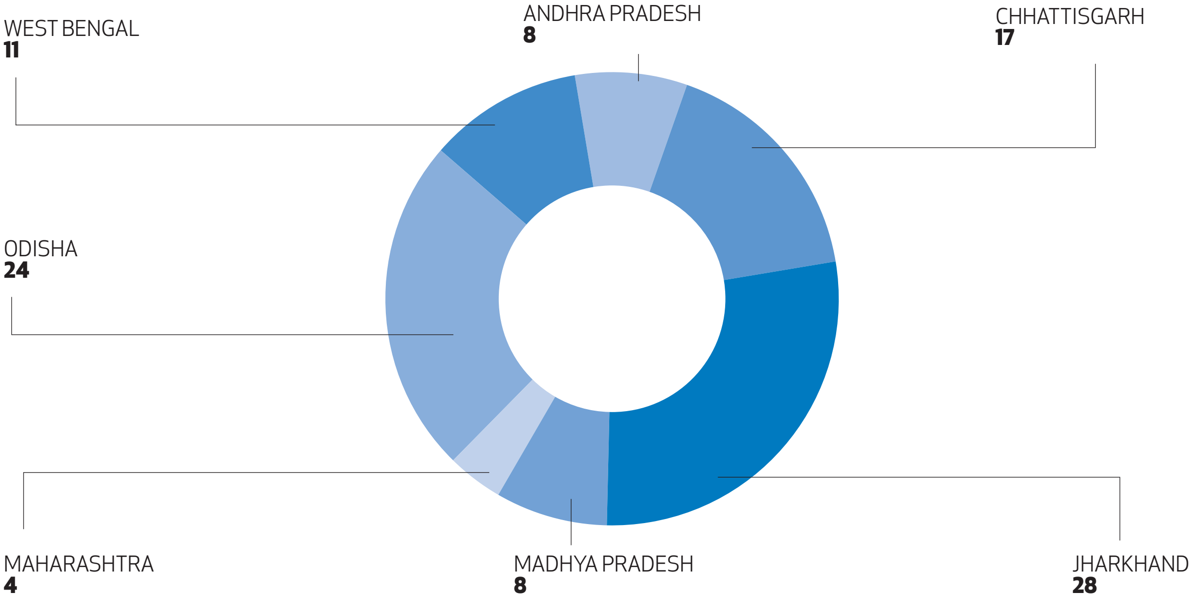
The average growth rate for domestic coal over the next 20 years is 4.33 per cent. The growth is higher (6.5 per cent) during the first decade 2011-22 than the second decade 2022-32 (2.2 per cent). The overall growth rate is considerably lower than the rate at which the demand for coal is expected to grow, necessitating increased imports.

NATURAL GAS

Interest in using natural gas as a fuel is growing because of its lower environmental impact compared to coal and oil. It is increasingly being used in combined-cycle power stations because much higher efficiencies are possible with advanced technology gas turbines. The next largest gas consumer is the fertiliser sector. Gas is also used as a fuel in other industries and in the commercial and domestic sector. Figure 8.3 shows the

Figure 8. 2

State-Wise Share of Coal Resources [per cent]



Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Table 8. 2

Forecast of Production by Coal Companies

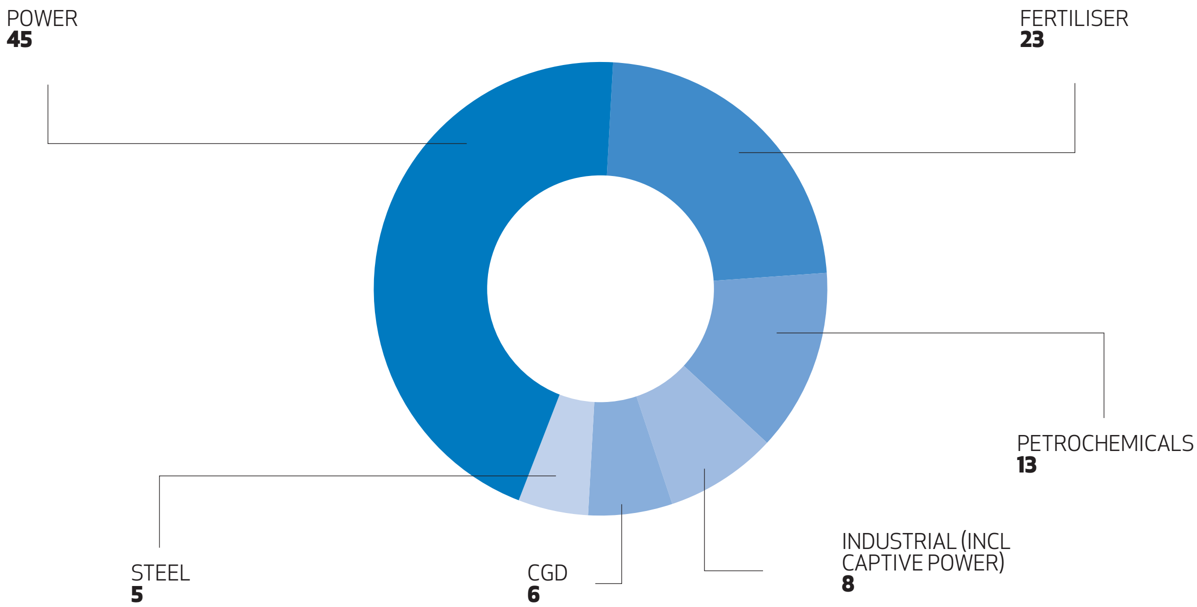
[Million Tonne]

COMPANY	2011-12 (EST.)	2016-17	2021-22	2026-27	2031-32	COAL FIELDS
ECL	33	41	51	54	57	Rajmahal, Raniganj
BCCL	30	36	40	42	45	Jharia
CCL	51	83	110	117	124	North & South Karanpura
NCL	69	80	85	90	96	Singrauli
WCL	46	45	45	47	50	Wardha Valley
SECL	112	140	182	193	205	Korba, Mand, Raigarh, Hasdeo Arand
MCL	106	140	195	207	219	Talcher, Ib Valley
NEC	1	1	3	3	3	Assam
Total CIL	447	555	710	753	798	
SCCL	51	57	63	70	77	Godavari Valley
Captive	38	97	245	312	400	
Others	18	18	18	20	20	
All India	**554**	**721**	**1,036**	**1,155**	**1,294**	

Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Figure 8. 3

Sector-Wise Gas Consumption, 2010-11 [per cent]



Source: ICRA Rating Feature (2011).

Table 8. 3

Production from Existing Gas Fields

[Million Cubic Metre]

REGION	LOCATION	PRODUCTION (MCM)
Eastern Off-Shore	• Krishna-Godavari Basin (off the coast of AP) • North East Coast Basin (off the coast of West Bengal) • Cauvery Basin (off the coast of Tamil Nadu)	22,223
Western Off-Shore	• Cambay Basin (off the coast of Gujarat) • Mumbai Offshore Basin (off the coast of Maharashtra)	21,422
On-Shore	Andhra Pradesh	1,384
	Assam	2,729
	Gujarat	2,261
	Tamil Nadu	1,119
	Tripura	610
	West Bengal	41
TOTAL		**51,789**

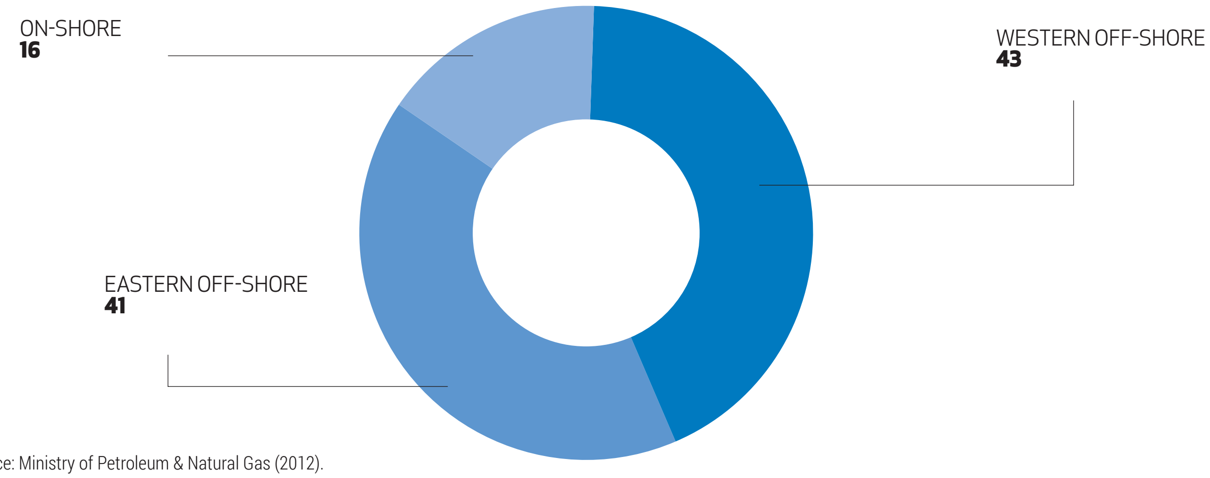
share of each sector in the total consumption of 177 million standard cubic metre per day (MMSCMD) in 2010-11.

Table 8.3 gives the main gas fields, and the production in 2010-11. As Figure 8.4 shows, the off-shore fields produce most of the domestic gas. With the recent decline in production in some of these fields, such as Reliance KG-D6 block, the contribution of off-shore production has decreased, but it still forms the bulk of domestic production.

Table 8.4 lists the gas fields being proposed for production in the next two decades. No new gas fields are proposed for the 15th Plan.

As Table 8.3 shows, domestic production of natural gas was 52 billion cubic meters (bcm) in 2010-11, corresponding to an average daily supply of about 140 MMSCMD. But consumption was 177 MMSCMD. The gap between consumption and domestic supply was met by imports of LNG. Currently, LNG re-gasification capacity in the country is 13.60 Mtpa (equiva-

Figure 8. 4
Geographical Share of Gas Production, 2010-11 [per cent]



Source: Ministry of Petroleum & Natural Gas (2012).

Table 8. 4
Additional Gas Fields Being Proposed

PERIOD	EASTERN OFF-SHORE	WESTERN OFF-SHORE	ON-SHORE
12th Plan	Mahanadi Basin (off Odisha coast)		
13th Plan		Andaman off-Shore (off coast of Andaman & Nicobar Islands)	• Gujarat (Shale Gas) • West Bengal (Shale Gas) • Tripura
14th Plan			• AP (Shale Gas) • Tamil Nadu (Shale Gas)

Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Table 8. 5
LNG Terminal and Re-gasification Capacity
[Million Tonne Per Annum]

TERMINAL	CURRENT CAPACITY	12TH PLAN	13TH PLAN
Dahej	10	15	15
HLPL Hazira	3.6	10	10
Dabhol		5	5
Kochi		5	10
Ennore		5	5
Mundra		5	10
East Coast		5	15
TOTAL	13.6	50	70

Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

lent to 49 MMSCMD). Table 8.5 provides details and lists the additional expected LNG terminal capacity. Total gas availability, including domestic production, LNG imports, and imports through trans-border pipelines will be about 360 MMSCMD by 2016-17 and 530 MMSCMD by 2021-22.

SHALE GAS

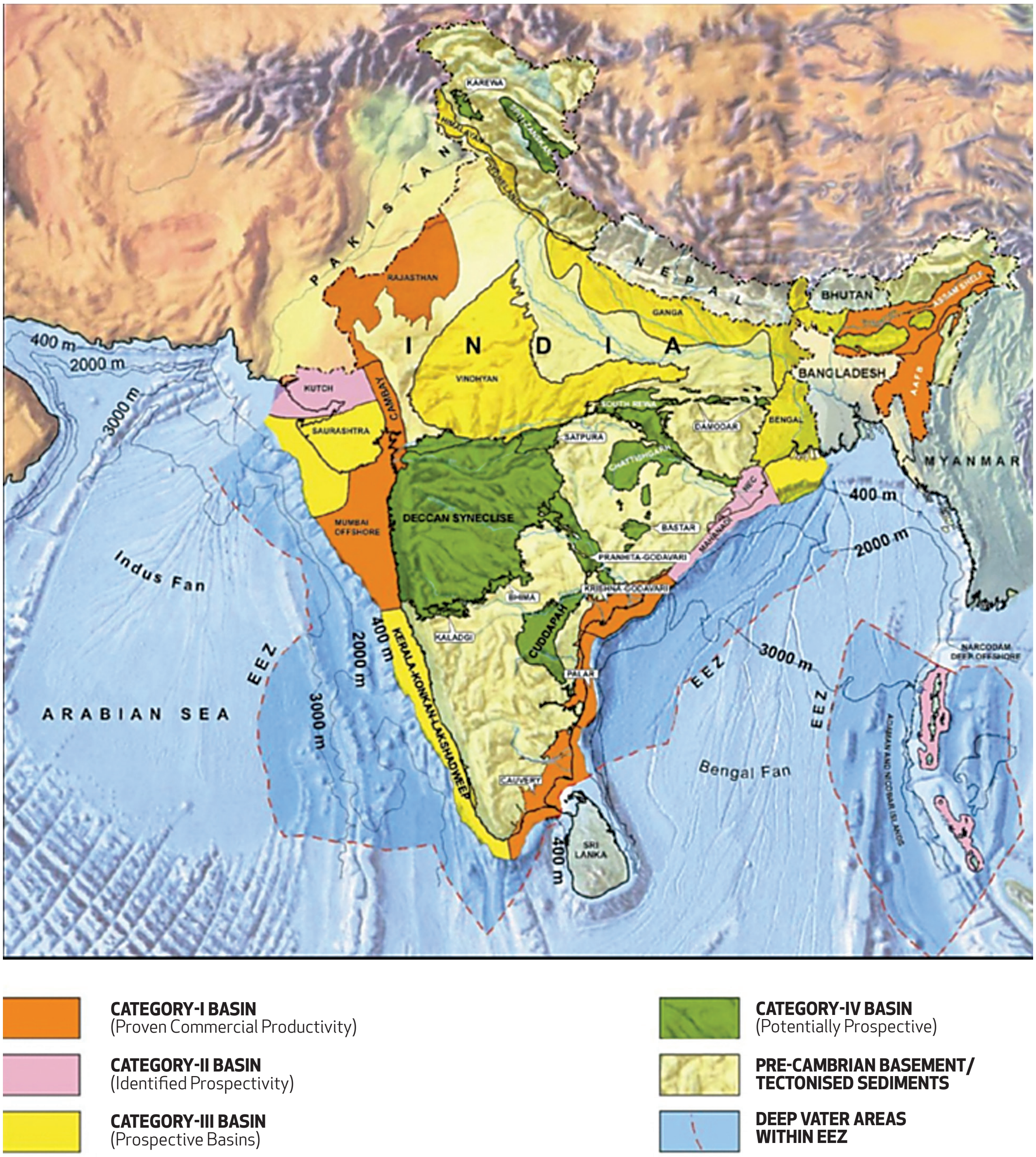
Shale gas is an unconventional source of methane (the major component of natural gas) consisting of gas trapped in rock formations. New technology to extract the gas is transforming the energy outlook in the US. Shale gas now accounts for about a third of its gas supplies and the price of gas has dropped dramatically.

Some of the on-shore sedimentary basins in India are reported to have organically rich shale, and India too has started looking into mapping of shale and generation of prospective sites. Identification of promising basins. DGH has shortlisted the following six sedimentary basins for exploration:

a. Cambay
b. Krishna-Godavari
c. Cauvery
d. Assam
e. Indo-Gangetic
f. Damodar Valley

It should be noted however, that while prima facie shale gas may seem like a potentially abundant and cheap fuel, it is likely to bring with it its own con-

Figure 8. 5
Map of Sedimentary Basins in India



Note: EEZ: An exclusive economic zone (EEZ) is a sea zone prescribed by the United Nations Convention on the Law of the Sea over which a the coastal state has sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources.
Source: Directorate General of Hydrocarbons (2012).

cerns about use. There are serious environmental concerns associated with the production of shale gas, related to water security, ground water pollution and land subsidence. Therefore, its production and use may be severely restricted unless solutions to these issues are found. If instead of increased gas availability, it is less than projected, then imports of coal would increase.

PETROLEUM, OILS AND LUBRICANTS (POL)

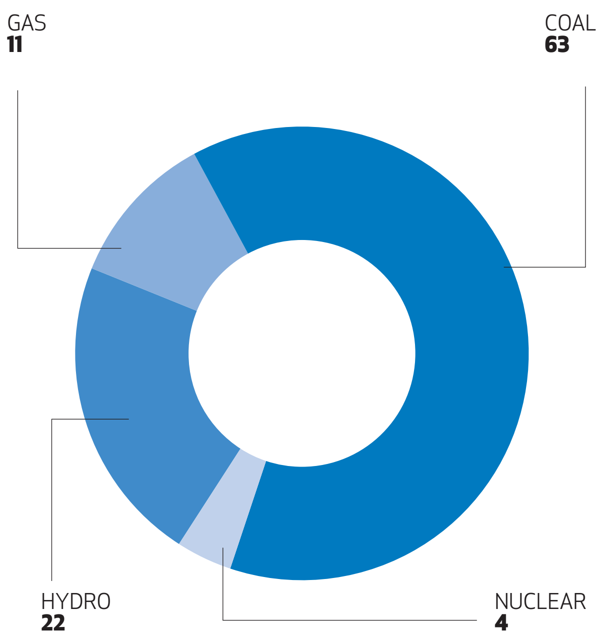
Even at the current low level of per capita consumption of energy, India imports over 70 per cent of its crude oil requirements (mostly from the Middle-East and Iran). As the economy grows and per capita consumption increases, the level of imports will increase. In 2010-11, the country con-

Table 8. 6
Production of Crude Oil, 2010-11
[Thousand Tonne]

REGION/STATE		PRODUCTION
ON-SHORE	Gujarat	5,905
	Assam/ Nagaland	4,719
	Arunachal Pradesh	116
	Tamil Nadu	234
	Andhra Pradesh	305
	Rajasthan	5,149
	Total On-Shore	**16,428**
OFF-SHORE	ONGC	17,002
	JVC/ Private	4,282
	Total Off-Shore	**21,284**
	Grand Total	**37,712**

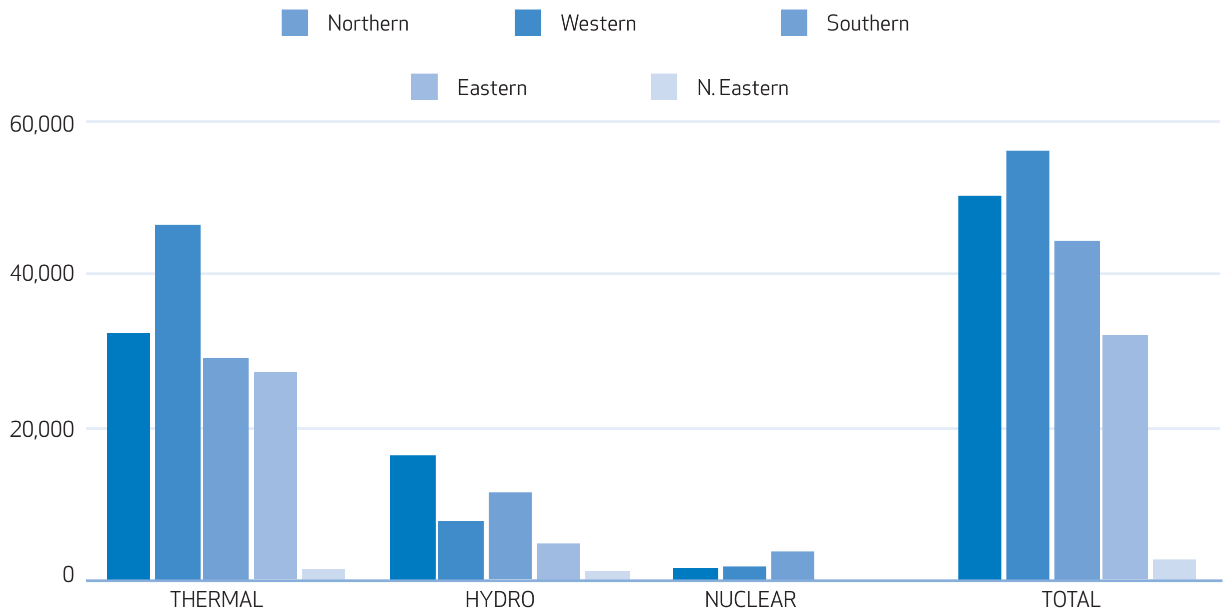
Source: Ministry of Petroleum & Natural Gas (2012).

Figure 8. 6
Generating Capacity Mix at End of 11th Plan [per cent]



Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Figure 8.7
Regional Contribution to Generating Capacity



Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

sumed 206 Mt of crude oil, of which 38 Mt was produced domestically and 164 Mt, imported (MoP&NG, 2011). About 74 per cent of the above domestic production was by government-owned companies (ONGC and OIL) and the rest by private companies or joint ventures.

Hydrocarbons (petroleum and natural gas) are found in sedimentary basins. Figure 8.5 is a map showing the 26 sedimentary basins that have been identified. However, only seven basins—Cambay, Assam Shelf, Mumbai Off-Shore, Krishna-Godavari, Cauvery, Assam, Arakan and Rajasthan—have commercial production. Kutch, Mahanadi and Andaman-Nicobar basins are known to have accumulation of hydrocarbons but there is no commercial production yet.

Table 8.6 gives the amount and location of current crude oil production from the seven sedimentary basins for 2010-11 (provisional). A little over half the production occurs off-shore, and the on-shore production is spread across several states.

REFINERIES

In keeping with the growing demand, the refining capacity of petroleum products has increased either by the expansion of capacity at existing refineries or by setting up new refineries. As of June 2011, there were 21 refineries in the country out of which 17 were in the public sector. Thirteen of them are in the coastal states. The total refining capacity is 193 Mtpa, which is far higher than the domestic requirements, making India a net exporter of petroleum products (MoP&NG, 2013e). In 2010-11, India exported about 42 Mt of petroleum products (MoP&NG, 2011).

POWER PLANTS

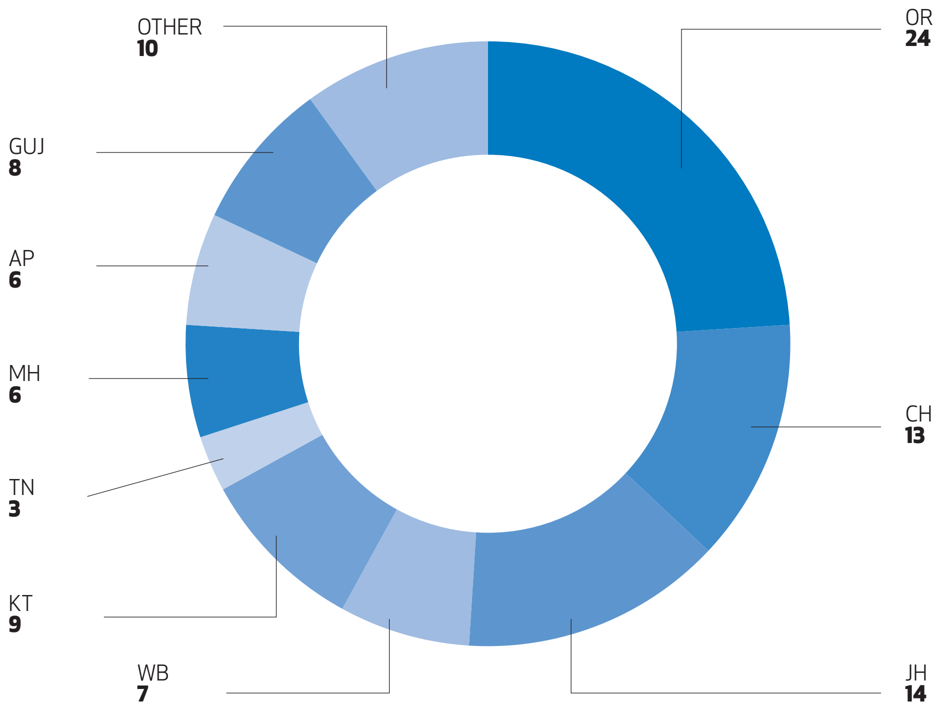
LOCATION OF EXISTING CONVENTIONAL GENERATION

At the end of the 11th Plan, generating capacity was about 175 GW, excluding generation from renewable energy sources. As Figure 8.6 shows, coal is the dominant fuel in electricity generation, firing about two thirds of the country's capacity. Figure 8.7 shows the regional contribution to generating capacity. Coal fired capacity is distributed across the country except in the Northeastern region, with the Western region being the biggest contributor. Currently, the Northern region, including the hilly regions of HP, J&K, Uttarakhand and Punjab, has the most hydro capacity, followed closely by the Southern region. The contribution of the North-Eastern region is miniscule currently but is expected to grow as more of its very large hydro potential is realised.

There are several factors related to land, environmental impact and public acceptability that constrain the amount of generation capacity that can be added in a particular state. Land acquisition in recent times has become a critical issue for developers of plants for power and other key commodities such as steel. Land is increasingly becoming a scarce resource and its availability is posing a serious challenge for future development of plants.

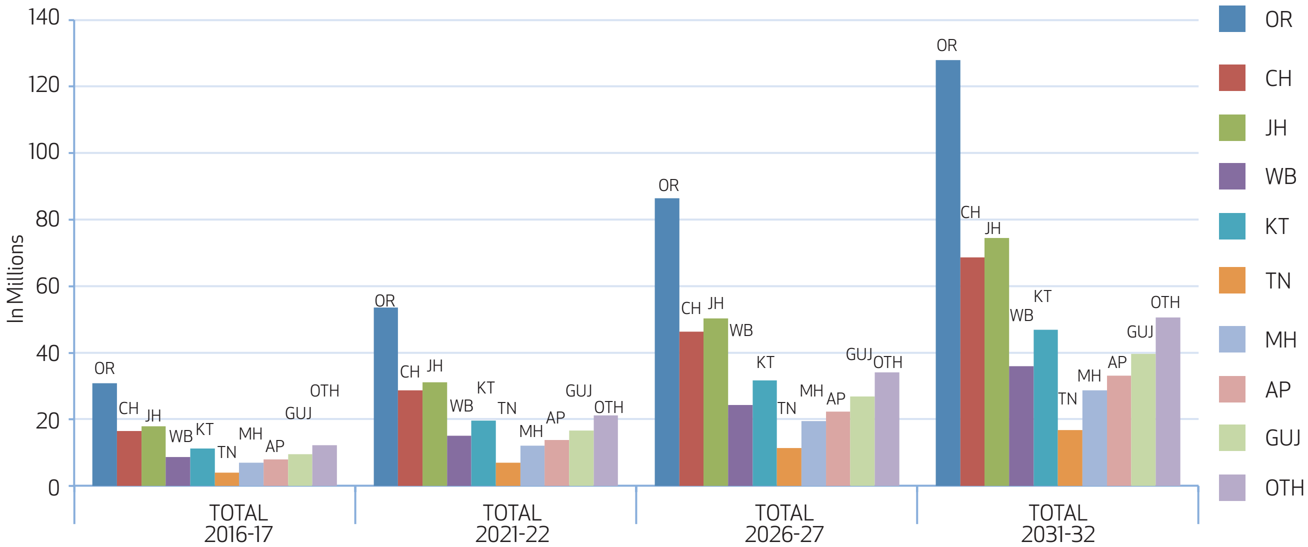
Power plants can have severe social and environmental impact: air pollution; production of large quantities of ash; water pollution due to ash ponds and deposition of mercury. In addition, thermal power plants require large amounts of water which can severely stress local water resources.

Figure 8.8
State-Wise Share of Steel Capacity [per cent]



Source: Ministry of Steel (2012a).

Figure 8. 9
Projected Crude Steel Capacity in Major Steel Producing State



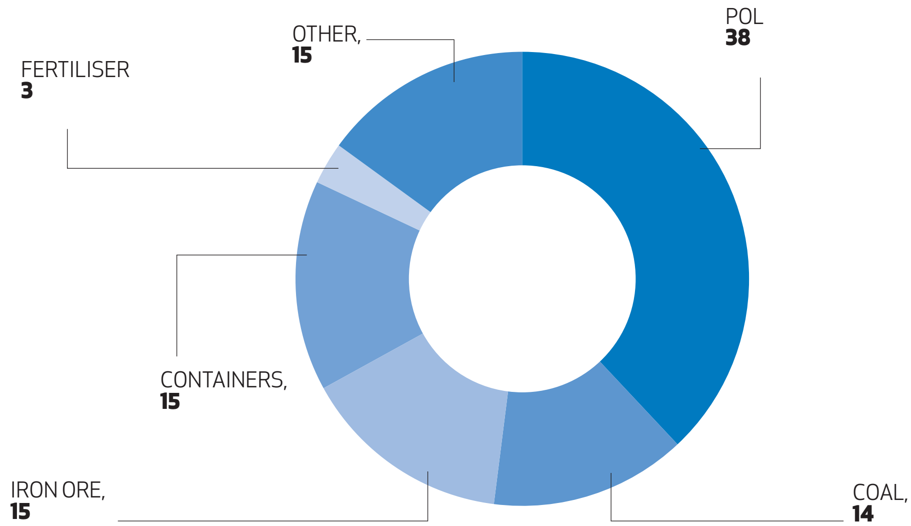
Source: Ministry of Steel (2012a).

These issues were considered in setting limits on state-wise capacity addition in the modeling exercise to identify locations for new power plants.

IRON & STEEL PLANTS

Steel capacity is located mostly near iron ore mines in the mineral-rich states. As Figures 8.8 and 8.9 show, Odisha, Jharkhand and Chhattisgarh together will have more than 50 per cent of the steel capacity through most of the next two decades. In fact, there is a definite shift in the investors' choices of location towards Odisha. Its share of steel capacity is expected to increase from 12 per cent in 2010-11 to 25 per cent by 2016-17 and remain at that level for the next two decades. In addition, there is a preference for

Figure 8.10
Commodity-Wise Break-Up of Port Traffic, 2010-11 [per cent]



Source: Ministry of Shipping (2012).

large plants which currently constitute about 65 per cent of the steel capacity. This share is expected to increase to 76 per cent in 2016-17 and remain at that level for the next two decades. These locational and size preferences are likely to continue because it is expected that Blast Furnace Basic Oxygen Furnace (BF-BOF) technology and other hybrid technologies using hot metal will continue to predominate.

Small and medium units which now use about 70 per cent sponge iron will gradually shift to using scrap as the country accumulates more scrap. When that happens, there could be a shift of steel capacity to the steel-consuming areas. However, that is likely to happen only towards the end of the study period and is expected to be gradual.

PORTS

Ports are an important component of the transport system for the import and export of bulk commodities. They could also play a significant role in the movement of bulk commodities within the country through coastal shipping. However, this potential has been exploited very little.

India's 12 Major Ports are administered by the Union Government, while the 200 notified Non-Major Ports are under the state governments and union territories.

In 2011-12, total cargo handled by Indian ports was 913.9 million tonnes. As Figure 8.10 shows, POL, coal and iron ore make up 67 per cent of the cargo handled by Indian ports, while POL has the biggest share.

MAJOR PORTS

The 12 Major Ports handled 560 million tonnes of cargo traffic during 2011-12, more than 60 per cent of the country's total seaborne cargo. This figure comprises cargo loaded, cargo unloaded and transhipped to the tune of 194 million tonnes, 341 million tonnes and 25 million tonnes respectively. The capacity utilisation—560 million tonnes against 697 million tonnes was approximately 80 per cent.

In 2005, a Committee of Secretaries was set up to establish policies to improve port connectivity. The Committee recommended that each major port should be connected, at a minimum, by a four-lane road and a double-line rail (Chapter 4, Vol III on Ports and Shipping).

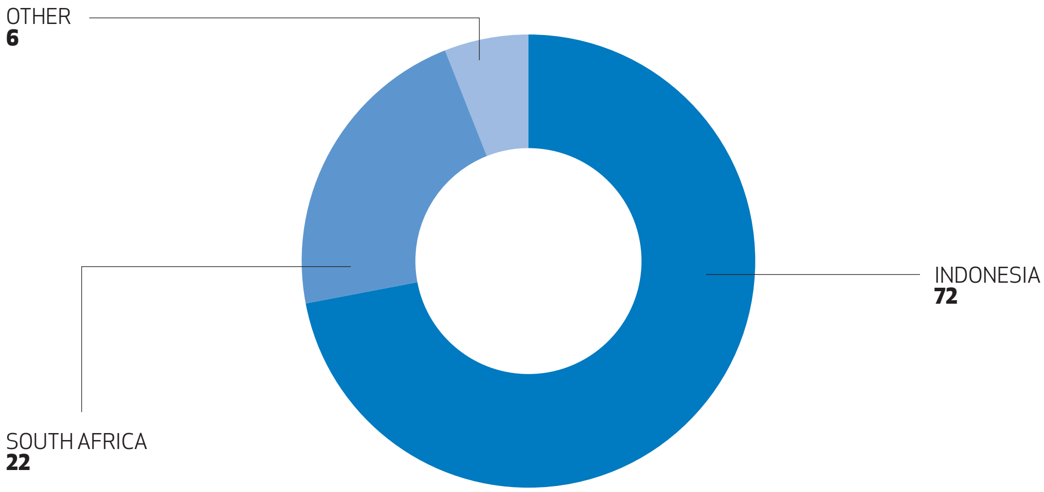
NON-MAJOR PORTS

Of the 200 Non-Major Ports, only a few ports are well-developed and provide all-weather berthing facilities. In 2011-12, only 61 ports—including ports at the Andaman and Nicobar Islands—were reported to have handled cargo traffic. Non-Major Ports in India collectively handled 354 million tonnes of traffic in 2011-12; up from 96 million tonnes in 2001-02. The CAGR in traffic during the decade was 14 per cent; double that for Major Ports. POL and its products (44 per cent) was the single largest commodity handled at Non-Major Ports in 2011-12.

IMPORT OF COAL

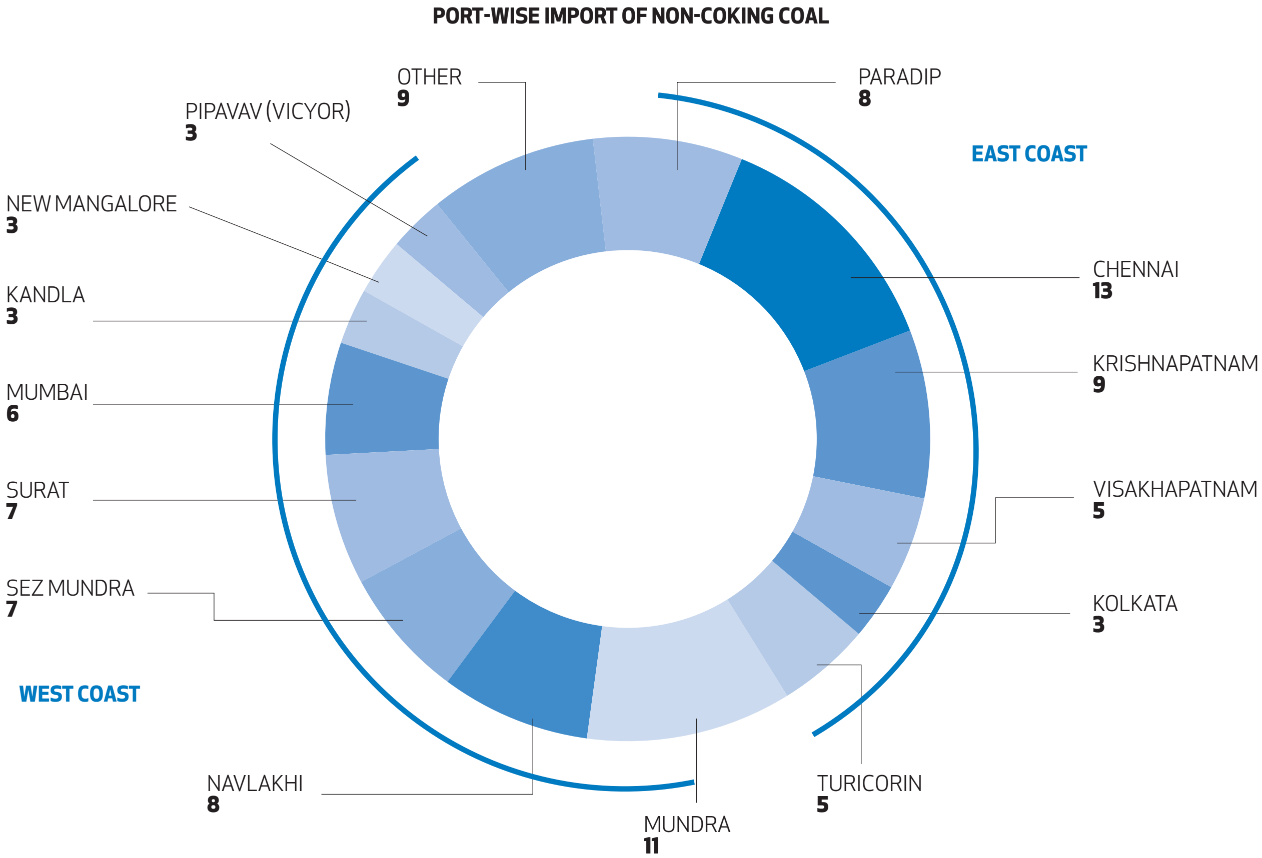
As discussed earlier, imported coal will bridge the deficit between the demand and domestic supply. In the case of thermal coal, this deficit is likely to

Figure 8.11
Import of Non-Coking Coal by Country of Origin, 2010-11 [per cent]



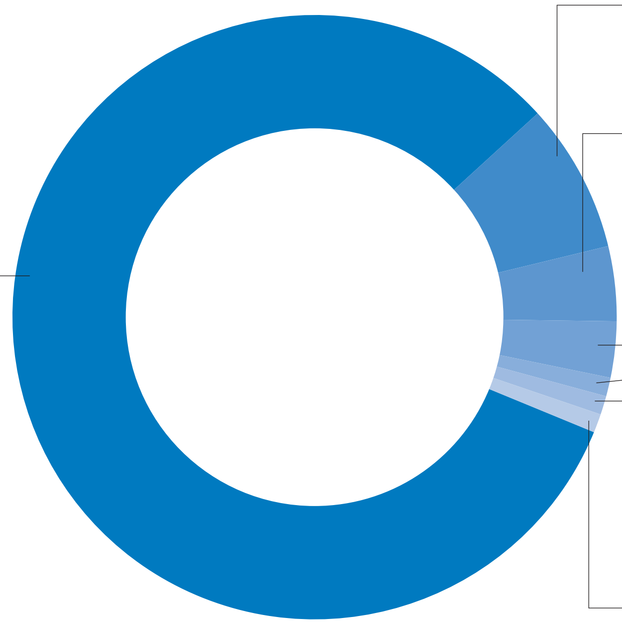
Source: Coal Controller's Organisation (2012a).

Figure 8.12
Destination Port-Wise Non-Coking Coal Imports, 2010-11 [per cent]



Source: Coal Controller's Organisation (2012a).

Figure 8.13
Import of Coking Coal by Country of Origin, 2010-11 [per cent]



Source: Coal Controller's Organisation (2012a).

increase because production of domestic coal will increase at a slower rate than demand. In the case of coking coal, there is limited availability in India and we are already importing a large part of the country's requirements. As steel production is expected to increase rapidly, the import of coking coal will also grow similarly. Imported coal is of considerably better quality than domestic coal. While most of the domestic coal has a Gross Calorific Value (GCV) in the range of 3600-4200 kcal/kg, the imported coal has a GCV in the range 5200-6500 kcal/kg. Australian coal is at the higher end of the range, Indonesian coal at the lower end and South African coal in the middle. Therefore, less imported coal is required than domestic coal for producing the same amount of electricity. A reasonable approximation is that one tonne of imported coal is equivalent to 1.5 tonne of domestic coal.

Using the data for FY 2010-11 to illustrate the pattern of India's coal imports, we see from Figure 8.11 that almost all the imported non-coking coal comes from Indonesia and South Africa with Indonesia being by far the biggest supplier (72 per cent). Figure 8.12 shows that these imports are roughly evenly distributed between destination ports on the east and west coasts.

Figures 8.13 and 8.14 show the pattern of coking coal import. Australia is clearly the predominant supplier (80 per cent). Relatively smaller amounts are also sourced from USA, New Zealand, Indonesia and South Africa. About 80 per cent of the coking coal goes to four ports on the east coast–Paradip, Kolkata, Vishakhapatnam and Krishnapatnam which are located close to large steel plants.

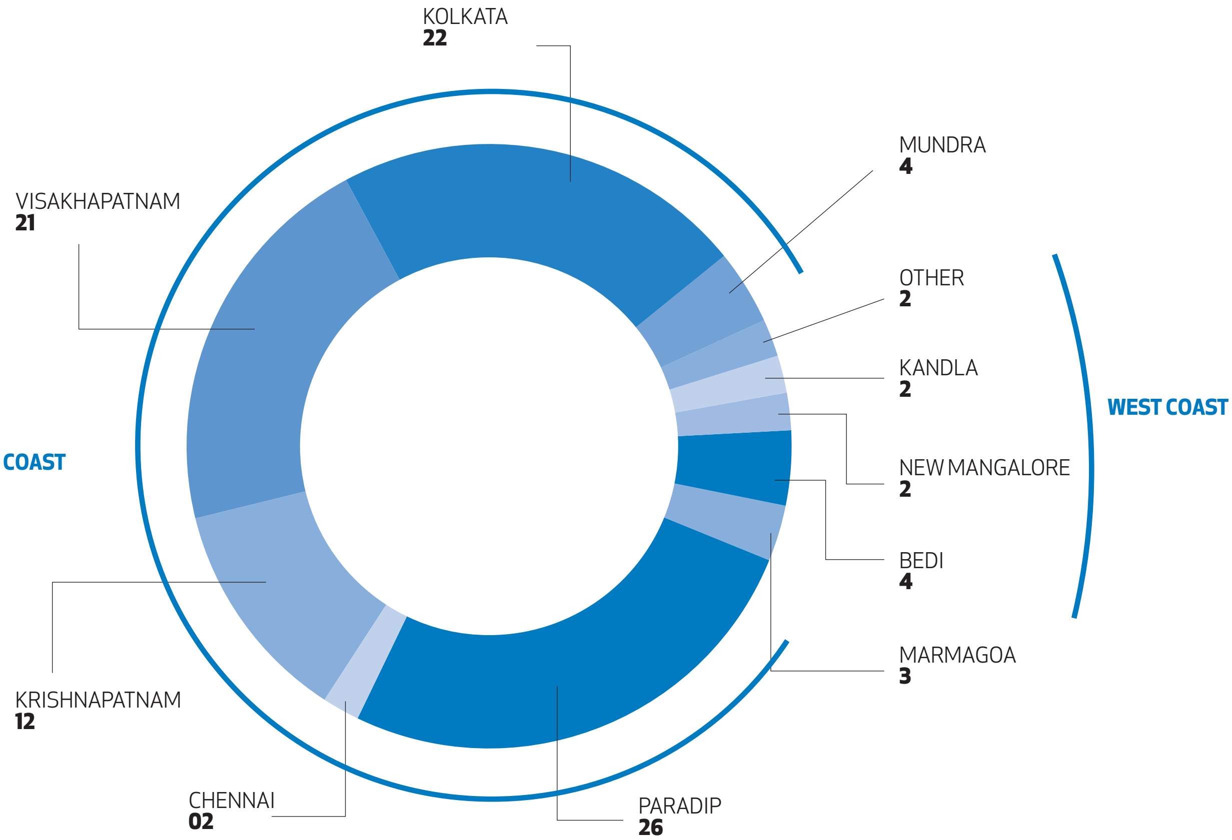
INTERNATIONAL COAL MARKET

In 2009, China and India's imports of non-coking coal constituted about 12.5 per cent and 6.4 per cent respectively of the global market of 736 Mt. With imports by other countries remaining relatively steady, China and India are expected to account for about 90 per cent of the growth in the global market (CLSA, 2010).

As China's consumption of coal accounts for about half the global consumption, a relatively small mismatch between its domestic supply and demand is likely to have a major effect on global markets (IEA, 2011). China will be the driver of the global market. There are several uncertainties about whether Chinese domestic production will be able to meet the country's growing demand. One, In addition to boosting production at existing coal mines, new coal mines will need to be developed. Two, some of the new mines are very far from the major industrial cities, posing transportation challenges for infrastructure that is already congested. Three, as China intends to reduce the environmental impact associated with its coal consumption, significant investment will be required to upgrade power plants (IEA, 2011).

Most forecasts expect prices for thermal coal to remain high and hover around $100 per tonne (in current dollars) for the next several years (CLSA, 2010; KPMG, 2012; WB, 2012).

Figure 8.14
Destination Port-Wise Import of Coking Coal, 2010-11 [per cent]



Source: Coal Controller's Organisation (2012a).

FUEL REQUIREMENTS FOR THE POWER SECTOR

India is geographically a vast nation with widely-dispersed population centres and burgeoning economic activity. As the economy modernises and diversifies its production base and living standards rise, reliable and affordable access to electricity in requisite quantities has become a critical imperative for sustainable and inclusive growth.

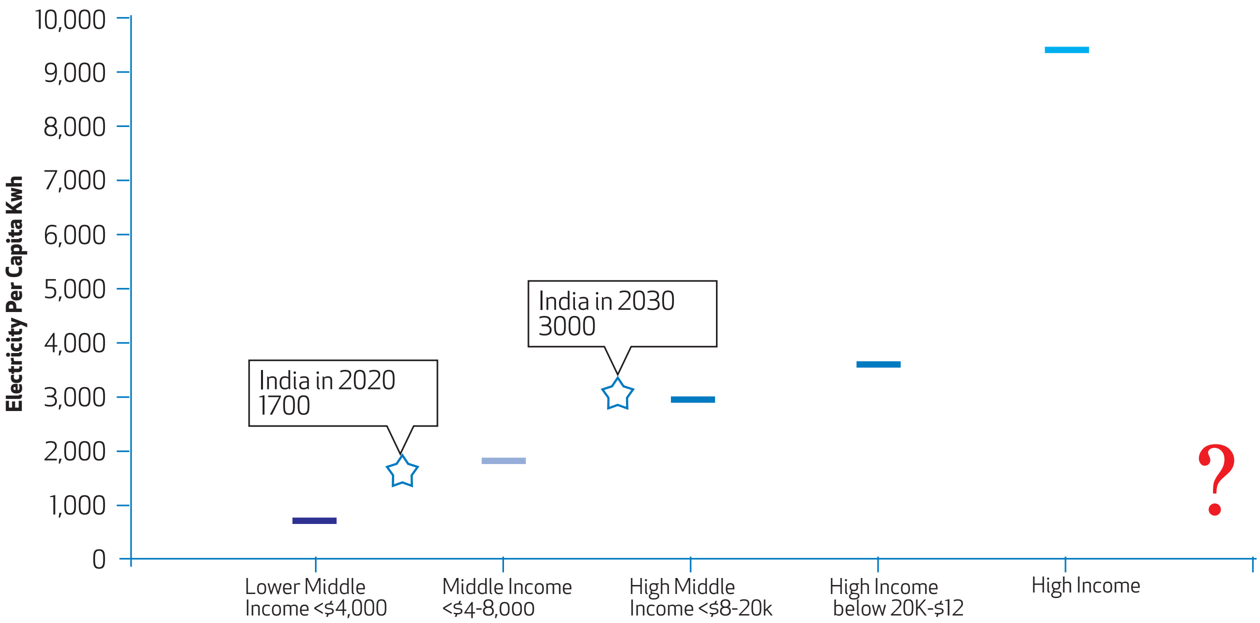
The primary energy supplies required to generate electricity include fossil fuels (coal, oil and natural gas), hydropower, fissile nuclear materials and renewable (mainly solar and wind) sources that are available in varying degrees domestically but fall chronically short in meeting needs in the aggregate. The current mix (both in terms of installed capacity and actual generation) is dominated by coal with a growing role for natural gas. This is likely to remain so for the next 20-30 years at least. India's coal reserves are concentrated in the eastern states, notably Chhattisgarh, Jharkhand and Odisha, as well as Madhya Pradesh, Bihar, Andhra and Maharashtra.

It is evident from the spatial distribution of domestic energy resources that energy needs to be transported over fairly long distances to make it available at the locations of electricity demand. Indeed, transportation of coal for power generation accounts for roughly 50 percent of the rail freight in India, contributing considerably to the increasing congestion in several key corridors of the railway network. Another telling indicator is that the cost of transporting coal to distant power generation facilities is often as much or more than the price of coal at the mine.

Energy imports are the pre-eminent component of our trade imbalance and current account deficits, and a major source of vulnerability to price shocks. Until recently, concern was focused almost exclusively on the hydrocarbon (petroleum) sector. Now attention also needs to be turned to coal availability. Coal imports have grown rapidly in the last few years, making India among the top two importers of steam coal whose entry and anticipated role in the international market is cited as a factor contributing to the rise in prices witnessed a couple of years ago.

There are several implications for the transport system. On the one hand, it is argued that transport bottlenecks have contributed to unreliability of delivering domestic coal to power plants. Others blame the inability to lift coal from mines (and/or nearby

Figure 8.15
Electricity Use and Per Capita Income



Source: World Development Indicators, World Bank.

railheads) to be a key factor as well for stagnant output of the collieries. The bigger issue, however, is to ensure that the transport system which had hitherto focused exclusively on moving domestic coal rapidly expands the coal handling capacities at ports and provides requisite rail connectivity to the demand locations. The strategic questions that arise naturally are 'which ports?' and 'how much?' in terms of their capacity.

Difficult as the questions may be, their complexity pales before the more profound issue of locating the power plants especially when two-thirds if not three-quarters of the electricity generation capacity that will exist in 2031-32 is yet to be put in place. An obvious question then arises: Would it not be better to transport energy over long distances as electricity over transmission lines instead of moving coal by rail (or gas by pipeline)?

The choice, involving a combination of economic, financial, technical and environmental considerations, is not as straightforward as comparing unit costs of transmission versus rail or pipeline transport. In addition to network effects and geographic constraints, additional complexities arise due to major differences in the properties (calorific value, ash and sulphur content) of domestic and imported coal, choice of technology and fuel type, and patterns of demand (e.g., peaking), to list a few. Yet, given the massive scale of expansion and the high costs involved, combined with the scarcity of financial resources and even more, the limited capacity to execute, it is imperative that the choices made minimise the aggregate cost to the nation of producing and delivering electricity.

Accordingly, a conceptually-simple linear programming model has been employed for the analysis. Annex I outlines this model. As a first approximation, intra-state movement has been ignored and each state constitutes both a demand centre as well as an electricity supply node. The supply options include, in principle, all forms of power generation including nuclear and renewable (solar and wind). These are pre-set at exogenously-determined maximum capacity which even at the most ambitious account for a small, almost negligible proportion. While hydroelectric facilities are also included, the focus is on thermal power generation, using domestic and imported coal as well as natural gas which differ in cost. The current costs of transport options—surface transport of coal, pipeline for gas and transmission line for electricity—once again differ significantly. Average fuel costs also differ. Domestic coal is the cheapest, imported coal and domestic gas (the price of which is regulated) are almost competitive while imported gas, at internationally-traded prices, is the dearest.

PLAUSIBLE DEMAND SCENARIOS FOR ELECTRICITY

The study used a set of three scenarios (base, high and low cases) that provided reasonable estimates of potential upper and lower bounds on demand that would be meaningful for evaluating infrastructure requirements.

BASE CASE

The Central Electricity Authority (CEA) produces electricity demand forecasts every five years under the Electric Power Survey of India (EPS). These forecasts are released to coincide with the national Five-Year Plans. EPS is one of the key electricity demand forecasts in the country. It is widely used across the industry and by the states and union territories as one of the most credible reference points. The forecasts are granular and provide details by state/union territory, and by end-use category. The EPS is developed using the partial end-use method, with inputs from the states and a wide range of stakeholders. The initial data feed is subjected to a high level of additional analysis and quality assurance before the EPS is released.

CEA's draft 18th EPS is used as the basis for the base case scenario. The EPS does not typically include captive generation, capturing only utility-level demand. However, for this analysis, the base case uses the draft 18th EPS adjusted to include captive generation. The base case in this scenario, thus, represents total electricity demand. Peak demand is derived by retaining the same energy to peak ratio provided in the draft 18th EPS.

HIGH CASE

The high electricity demand scenario is derived through a normative approach. It is important that this demand scenario is understood in the context and limitation for what it was developed: to provide an approximate upper bound for a high growth scenario.

The high electricity demand reflects aspiration goals for future per capita electricity consumption based on current observed patterns of consumption across countries. It implies that the Indian economy will have to grow in order to realise this demand. But such a normative approach avoids having to make a series of intermediate assumptions on economic growth and the electricity intensity of that growth.

Drawing on the internal and external risks, and to the energy system in particular, it can be inferred that energy delivery may not be able to keep up with the requirements of 8-9 per cent annual economic growth. An iterative process lends credence to consider the possibility of growth grinding down to 6 per cent.

Electricity use within any country represents a wide variety of underlying interrelated factors: income level, the level and composition of economic activity, electricity intensity, availability of energy resources, energy costs and supply infrastructure. One of the most visible relationships with electricity use is income level. A country's per capita electricity consumption exhibits strong correlation with its national income level as illustrated in Figure 8.16.

The relationship between electricity per-capita and GDP per-capita were econometrically derived using panel data that included a cross sectional of all countries (with available data for all years), covering 28 years between 1980 and 2008.

For the high demand scenario, the following annual per capita electricity assumption is used: 1700 kWh by 2020 and 3,000 kWh by 2030. In contrast, India's per capita electricity consumption for 2011-12 was approximately 880 kWh and is projected to reach approximately 1,500 by 2020-21 according to the draft 18th EPS.

The per capita electricity consumption in the high demand scenario might suggest that by 2020 India would achieve an income level of a middle income country, and by 2030, that of a high middle income country. Both these inferences assume a continued relationship between income and electricity demand.

The high electricity demand scenario is developed at the national level. However, the spatial distribution was modified to describe a future where the variation in the per capita electricity consumption across the states and union territories reduces over time, reflecting our aspiration not only for higher but also more inclusive economic growth. Low levels of per capita electricity consumption reflect a number of factors: lower income levels, low levels of industrialisation, poor access, poor electricity infrastructure and high energy cost.

Although each of these factors may play out differently across states, in totality, low levels of per capita electricity consumption is a strong indicator of low levels on the human development index. This scenario essentially represents a view of the future where government programmes and other targeted investments may move electricity demand to regions with lower level of human development indicators.

Like the base case, this scenario is derived using the regional distribution in the draft 18th EPS. Here, the standard deviation distribution of per capita electricity consumption in the draft 18th EPS is reduced by 25 per cent in 2021-22 and by 50 per cent in 2031-32. This has the effect of bringing the states at either end of the distribution closer to the centre without changing the mean of that distribution. The revised distribution is then used to parse the all-India demand of the high demand scenario to the state/union territory.

LOW CASE

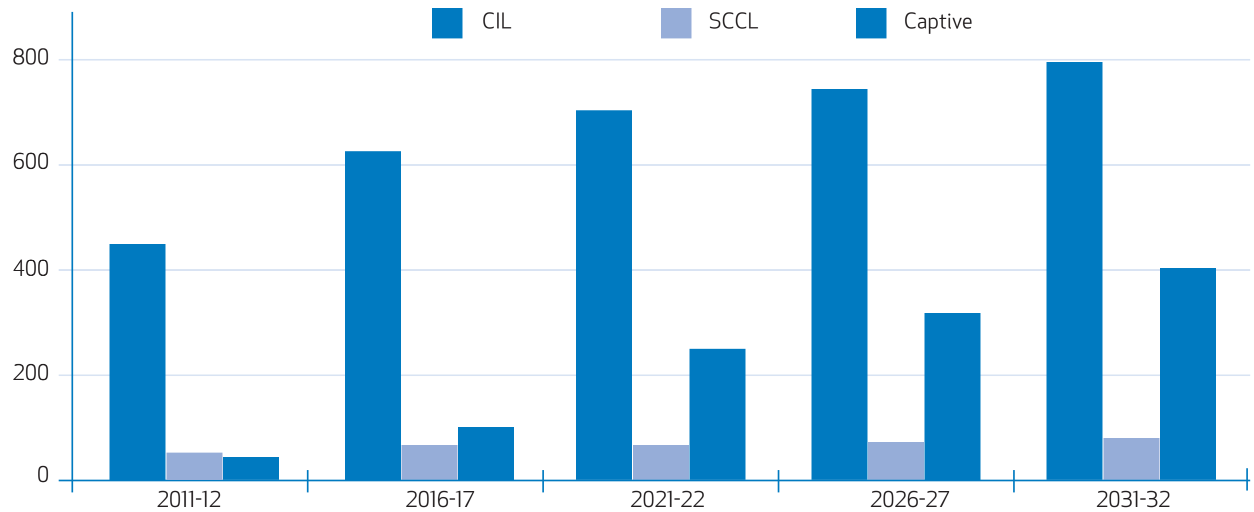
Drawing on the internal and external risks, and to the energy system in particular, it can be inferred that energy delivery may not be able to keep up with the requirements of 8-9 per cent annual economic growth. An iterative process lends credence to consider the possibility of growth grinding down to

Table 8.7
National Annual Aggregate Demand by Scenario
[Terra Watt Hour]

CASE	2016-17	2021-22	2026-27	2031-32
Base	1,516	2,118	2,938	3,857
Low	1,329	1,736	2,228	2,808
Aspiration	1,591	2,422	3,334	4,603

Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Figure 8.16
Total Domestic Coal Production
[Million Tonne]



Source: ICF International (Model Runs for Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013).

6 per cent. This is still far from a worst-case economic scenario, but is suitable for illuminating some of the strategic choices that need to be made. Accordingly, a low-case consumption scenario, closely corresponding to the 6 per cent case, was chosen. This is close to the consensus forecasts for Indian GDP growth in the near-term.

Table 8.7 shows the national aggregate electricity demand forecast for the three scenarios.

PARAMETERS AND ASSUMPTIONS

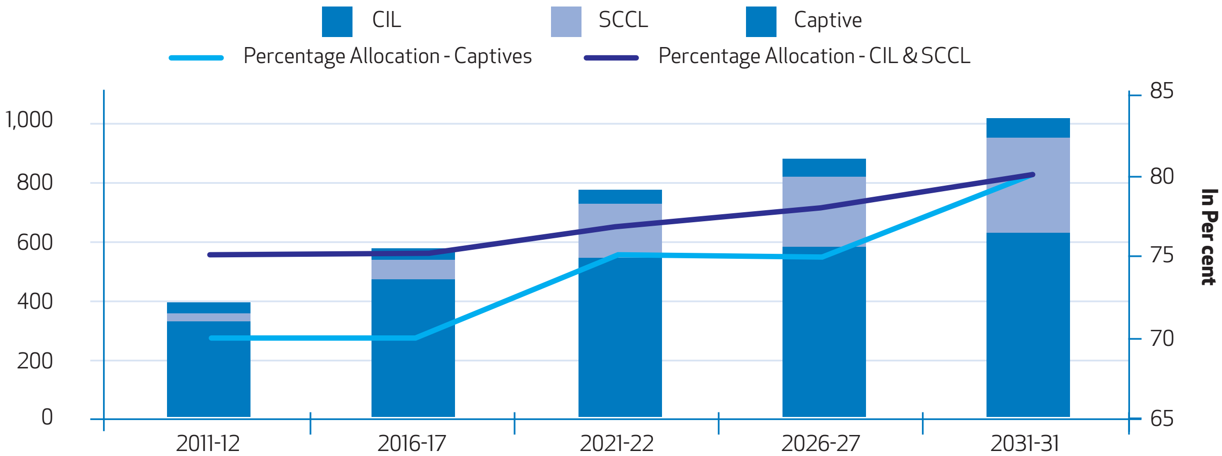
In order to focus on the strategic issues going forward and provide easiest traction for policy making, every effort has been made to ensure consistency with the work done in preparation for the 12th Five-Year Plan by the various ministries and departments of the Government of India.

Capacity Additions: For the 12th Five Year Plan, capacity additions have been considered as per the latest CEA and MoP plan. This consists of approximately 66 GW of coal-based plants plus 1.7 GW of nuclear, 4 GW of gas and 11.5 GW of hydro capacity additions. Renewable capacity is over and above the conventional capacity. State level constraints for capacity additions have been modelled as per CEA for the Plans beyond 12th Plan.

Coal Supply: The percentage of coal allocated from CIL and SCCL to the power sector is projected to reach 80 per cent by 2031-32 from the current allocation of 75 per cent of the total coal production. Allocation to the power sector from captive mines is also projected to reach 80 per cent by 2031-32. Lignite is also supplied to the power sector.

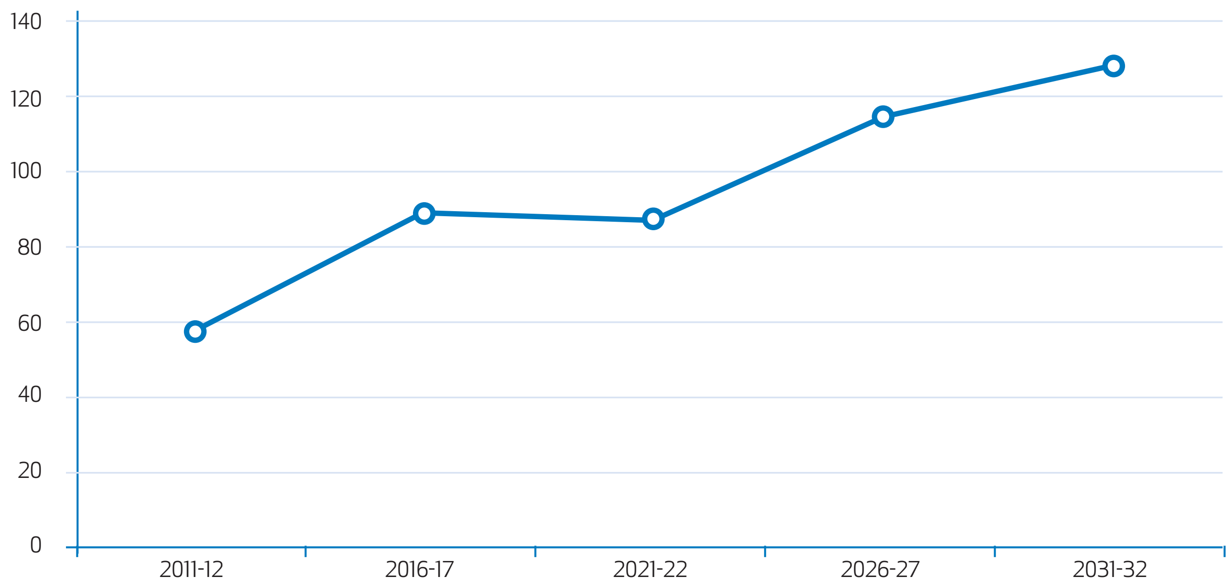
Fuel Prices: Coal prices from various subsidiaries are taken as per CIL's notified prices. Imported coal

Figure 8.17
Coal Allocated to Power Sector
[Million Tonne]



Source: ICF International (Model Runs for Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013).

Figure 8.18
Gas Demand by Power Sector
[MMSCMD]



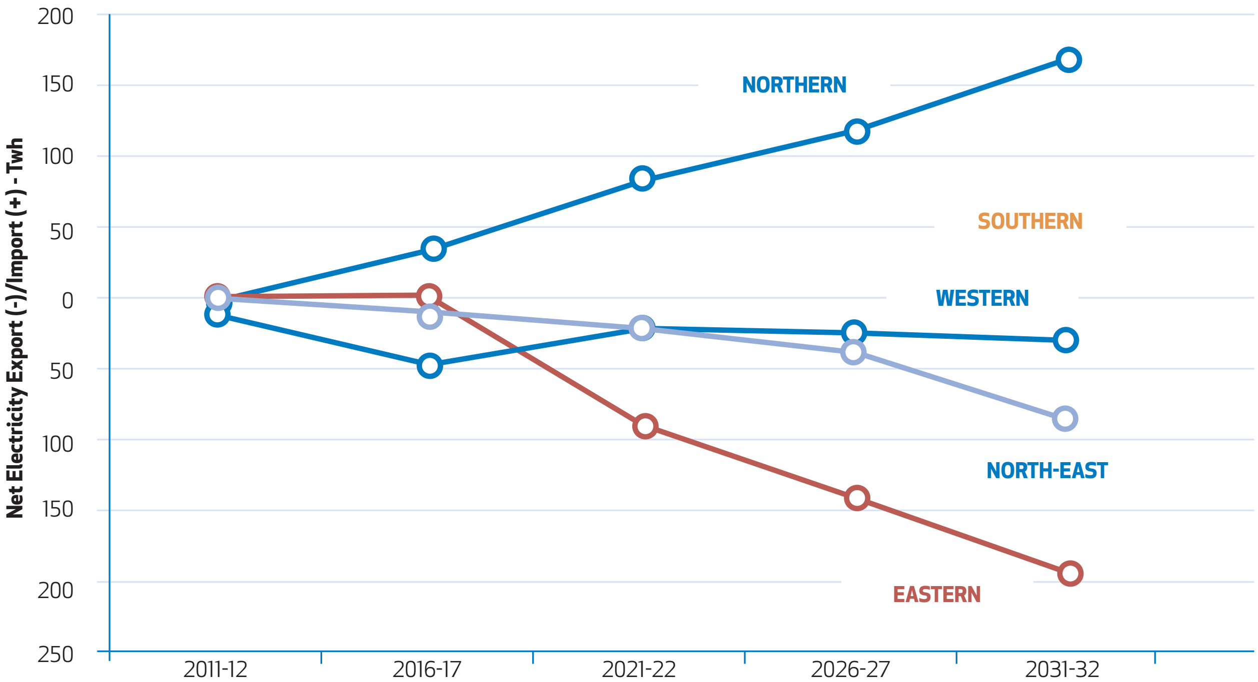
Source: ICF International (Model Runs for Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013).

price forecasts are as per the World Energy Outlook 2011 global coal price forecast and analysis shared by ICF International. Domestic gas prices are as per the prevailing market prices from the various sources (APM, NELP, JVs). LNG prices are based on IEA's WEO forecast for Asian deliveries after adjustment, corresponding to the actual contractual arrangements available for Indian buyers.

Gas Supply: The basis for gas production is the DGH-approved gas production plans for various existing and upcoming gas fields. It also reflects analyses commissioned for various stake holders including Petroleum Planning and Analysis Cell (PPAC), Ministry of Petroleum and Natural Gas (MoPNG), DGH, GAIL and others. The longer- term projections for the business as usual (BAU) and other gas supply cases (including conventional and unconventional gas) as well as supply to the power sector is based on international consultants' analysis of gas utilisation policy and expectations around supply in the longer term. More specifically, the gas supply share to the power sector is expected to be in the range of 45-50 per cent of the total production.

Renewable Potential: These assumptions are driven mainly by the requirement as per renewable portfolio obligations (RPOs) and the generation potential for various renewable energy technologies. As per the National Action Plan on

Figure 8.19
Inter-Regional Electricity Transmission Flows



Source: ICF International (Model Runs for Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013).

Climate Change (NAPCC), 15 per cent of generation should come from renewable energy by 2022. For wind potential, we have taken the latest estimates of 109 GW made by Centre for Wind Energy Technology (CWET) for a hub height of 80 meters. Various foreign institutions such as Lawrence Berkeley National Laboratory (LBNL) in the US provide even higher estimates of 700-1,500 GW for wind potential for India. Solar potential is based on JNNSM targets of 22 GW by 2021-22. For biomass and small hydro, the potential estimated by MNRE has been used.

Cost Parameters: Average, levelised parameters, constant in real terms, have been used for costs of electricity generation, coal mining as well as commodity transport and power transmission.

LIMITS ON CAPACITY ADDITIONS AT STATE LEVEL

There are limits on the amount of capacity that can be added per year, both on the national and state level. These constraints were necessary to prevent excessive concentration of power plants in some states, to reflect limits due to limited land and water availability, and to prevent further environmental degradation in areas that are already critically polluted.

More importantly, political economy considerations suggested that at least half of the incremental power consumption in each state in each Plan period must be supplied by generation capacity within that state. Without such a constraint, it was found, not surprisingly, that imported coal would go to coastal states such as Andhra Pradesh, Gujarat and Maharashtra as this would minimise the cost of imports given the overall levels of availability of domestic coal. The patterns of use of domestic and imported coal that emerged pointed to a likelihood of political wrangling as well as issues of inter-state equity with some fiscal ramifications owing primarily to the large differentials in price of domestic and imported coal. One recent signal of times to come is news reports of protectionist noises from resource-rich states.

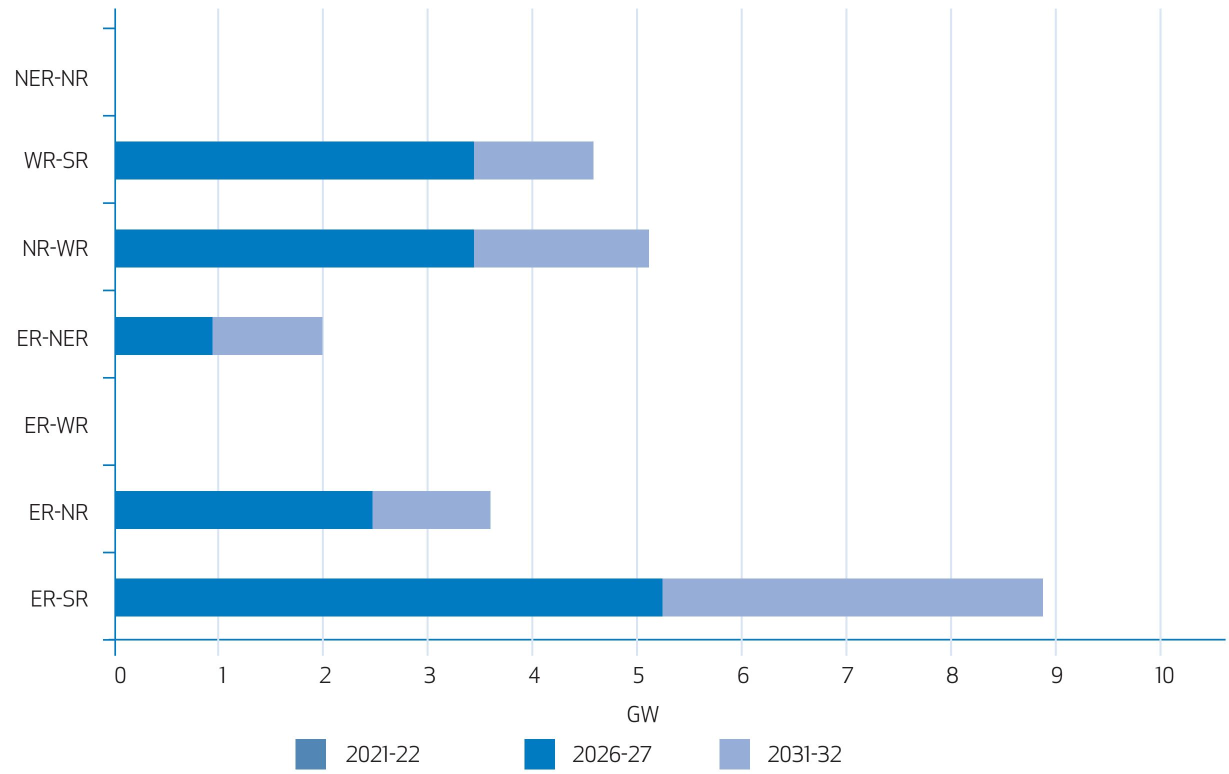
FINDINGS AND INSIGHTS FROM THE ANALYSIS

The key outputs from the modeling and analytical effort comprise the state-wise generation of electricity and the associated sources of primary energy. Since our focus is on transportation, particularly of coal, the presentation below is confined to flow of electricity and movement of both domestic and imported coal

BASE CASE

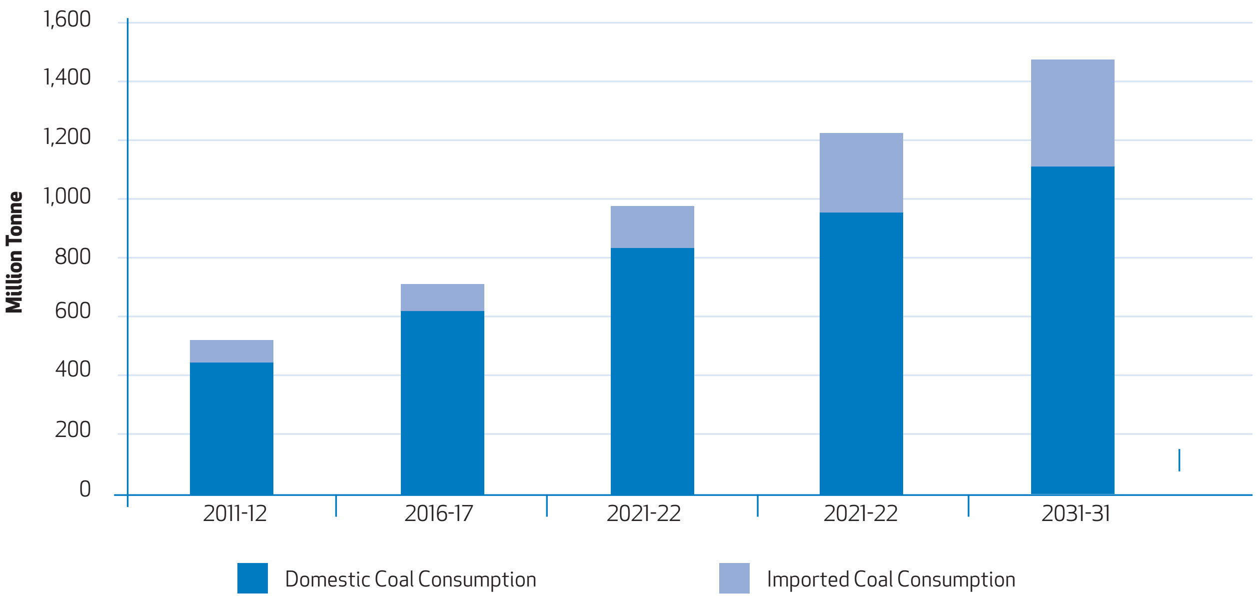
In this scenario, the Northern and Southern regions, with their burgeoning demand, become major importers of power, while the Eastern region emerges both as a supplier of coal and an exporter of electricity as power generation plants are located

Figure 8. 20
Transmission Capacity Additions



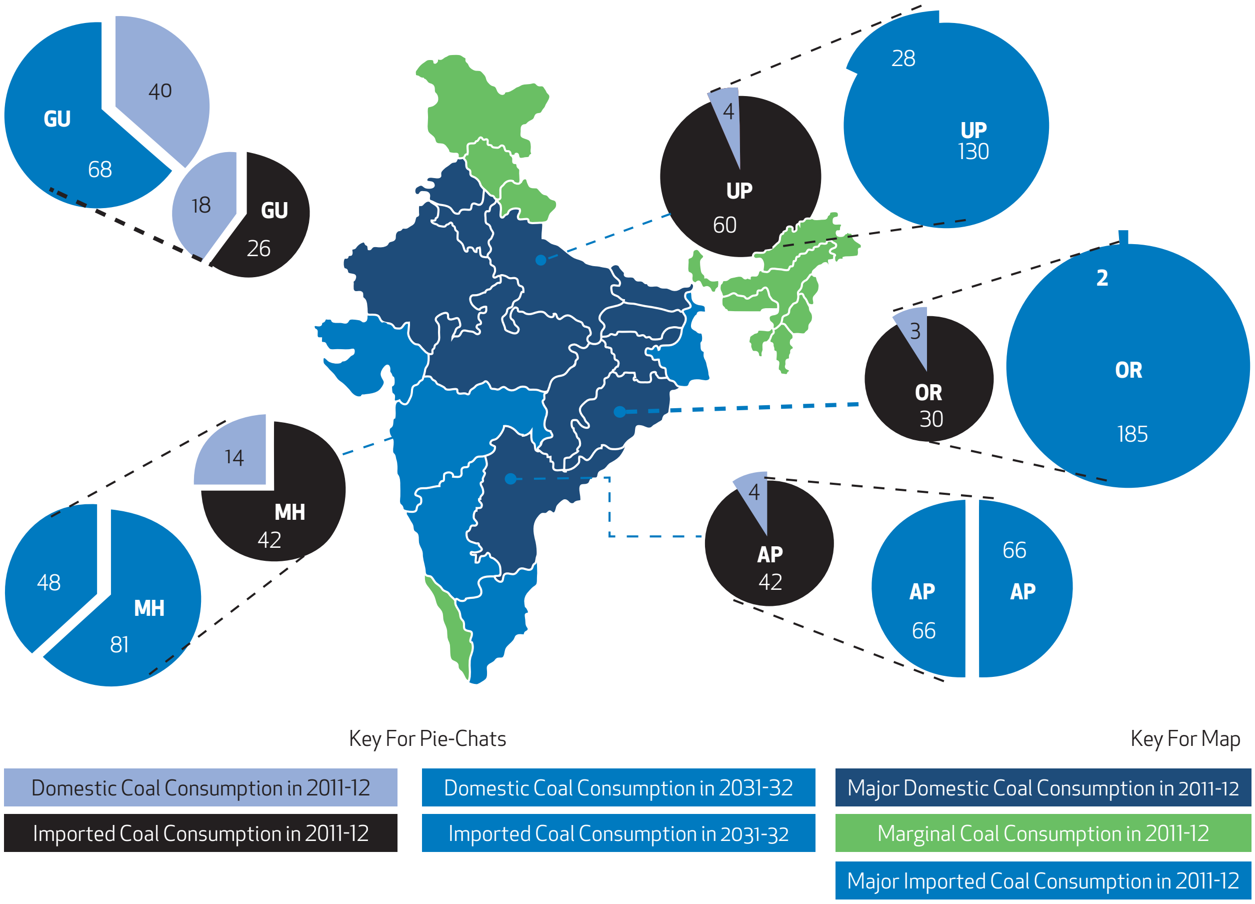
Source : ICF International (Model Runs for Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013).

Figure 8. 21
Consumption of Coal
[Million Tonne]



Source: ICF International (Model Runs for Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013).

Figure 8. 22
Base Case, State-Wise Coal Consumption, 2011-12 and 2031-32
[Million Tonne]



Source: ICF International (Model Runs for the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013).

near the mines. Odisha, for example, is expected to see a massive increase in electricity generation. The North-Eastern (in light of its hydropower potential) and Western regions also export electricity but much less than the major Eastern states.

The expected pattern of electricity flows in the base case scenario point to a major need to expand transmission capacity not only from the Eastern region but also from the Western to the South and North as shown in Figure 8.19. As discussed subsequently, however, the patterns change substantially under the other scenarios. So a robust risk analysis could help prioritise and programme transmission capacity investments, more so, to also maintain grid balance.

INCREASING RELIANCE ON IMPORTED COAL

Domestic coal supply growth (including coal from captive mines and lignite) is not sufficient to meet the increasing demand. Imported coal makes up for the shortages in domestic supply. Demand for imported coal will rise from 74 Mt in 2011-12 to 355 Mt by 2031-32.

The changing mix between imported and domestic coal varies considerably for the states as depicted in Figure 8.22. In addition to Gujarat and Maharashtra, which are already importing coal for power generation, Andhra Pradesh emerges as a major destination of imported coal with for half the total coal consumed in the state being imported. The logic is straightforward: importing coal directly to coastal states minimises transport costs by avoiding land transport over long distances.

States such as UP which are far away from the coast also need imported coal because domestic suppliers are unable to meet the large increase in demand. Thus, not only is there a need to dramatically expand the capacity of ports to handle the massive increases in coal imports but also to ensure rail connectivity to deliver in the hinterland.

The large volume flow of coal to the Eastern coastal states indicates a need for coastal shipping, which can expand more rapidly than rail links, as the preferred mode of transport.

MOVEMENT OF DOMESTIC COAL BY SURFACE TRANSPORT

The analysis also yields considerable insight in terms of planning priorities. Figure 8.23 for the base case depicts the volumes of coal movement required over the next two decades. It shows the dramatic increase in the volume of coal transported, mainly in the Eastern states. In addition, the volumes for some routes fluctuate. For example, the volume of coal transported to Rajasthan from the East decreases in 2021-22 and then increases by 2031-32. The volume for states like Gujarat and Maharashtra remains fairly constant, their growth being fired by increased imports of coal.

Some salient implications of the transport pattern for coal emerge. One, high priority to address the infrastructure requirements to enable flows depicted in 2021-22. Given the gestation periods in constructing rail links, these projects need to be undertaken now. In particular, the Eastern Freight Corridor and the links to it from the mining areas need urgent action.

Two, the differences between the requirements over the two decadal periods suggest some caution and suitable risk analysis to guard against the possibility of stranded assets due to major shifts in patterns of supply. The coal movement patterns under the other two scenarios discussed later, elucidates this point Such risks can be hedged through choice of alternative routes.

Three, the large volume flow to the Eastern coastal states indicates a need for coastal shipping, which can expand more rapidly than rail links, as the preferred mode of transport. Moreover, there may be efficiency gains in coordinating the investments with the expansion in capacity of dedicated coal terminals to handle imports. Of course, this may not be possible if separate ports and/or terminals are set up for coastal shipping.

LOW CASE

In this scenario, a preliminary iterative and investigative analysis suggested that if the imports of coal were constrained to the present level, the electricity requirements compatible with a lower rate of economic growth of around 6 per cent, could be met. Here, domestic coal almost meets the overall increase in coal requirement in the country. Southern states will need to rely on domestic, coal-based generation from Eastern and Western states and hence their dependence on other states for electricity will be higher than in the base case

The dependence of Northern states on other states for supply of electricity is expected to be low compared to the base case. Accordingly, most of the transmission capacity required has to be built towards the Southern region.

A significant and counter-intuitive result emerges from the analysis. Under the low growth scenario the movement of domestic coal actually is larger and puts even more pressure on the rail freight system. Reason: The decrease in coal use is mainly that of imports which would typically land near the demand centres in the coastal states. Domestic coal is utilised in the same volumes as in the other cases but in the low case has to move longer distances to more far-flung locations, thus increasing the surface transport burden. The economic salience of this phenomenon increases further when one considers that the low growth scenario most probably corresponds to constrained public resources and more severe infrastructure bottlenecks.

HIGH CASE

This scenario recognises that the base case itself involves considerable stretch on the supply of infrastructure as well as availability of financial resources. So, to maintain a healthy realism and to also factor in the tremendous and hitherto under-tapped potential of new technologies to increase efficiency and increase the market penetration of renewable energy, certain assumptions on the supply side of the system were also modified. Specifically, the share of renewable energy is projected to rise to 18 per cent in 2031-32. An additional increase of one percentage point in efficiency of power generation every five years is incorporated. Gas supply is also projected to be larger.

Nevertheless, in this scenario, coal imports grow more dramatically and go to coastal states. The Southern region also becomes an exporter of electricity while the Northern region alone remains an importer of electricity. Figure 8.25, 8.26 and 8.27 depict the highlights of coal consumption in different states, electricity transmission flows and finally the movement of coal by surface transport. A major implication is the need to expand port capacities even faster, to handle coal imports.

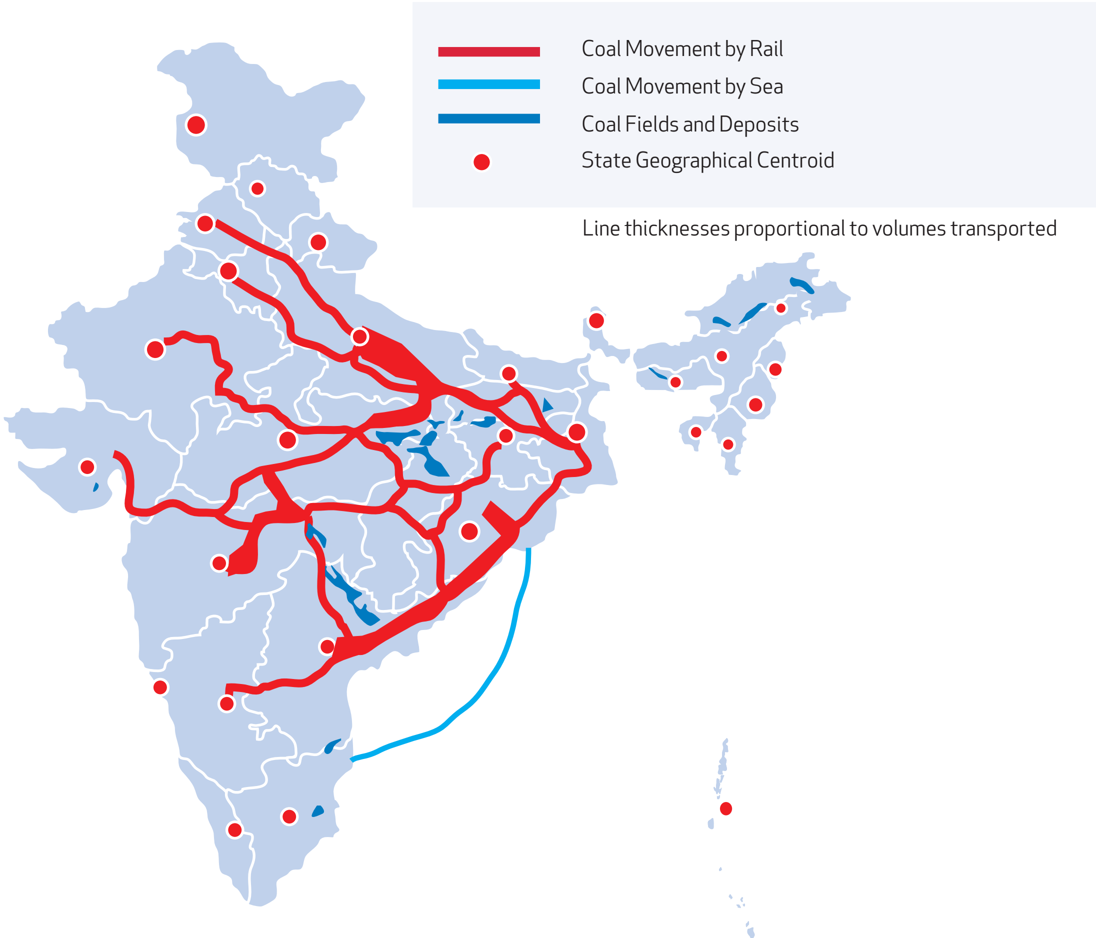
OVERALL OBSERVATIONS

A review of the modeling results in greater detail, yields the following conclusions:

- Coal continues to dominate the energy mix. Its share declines slightly from 68 per cent currently to 65 per cent, 62 per cent and 60 per cent in 2031-32 in the base, low and high cases respectively.
- Coal continues to dominate the capacity mix also. However, its share in the capacity mix declines more rapidly than its share of the gen-

Figure 8.23
Comparison of Coal Movement: Base Case

2011-22



2021-22

(Contd...)

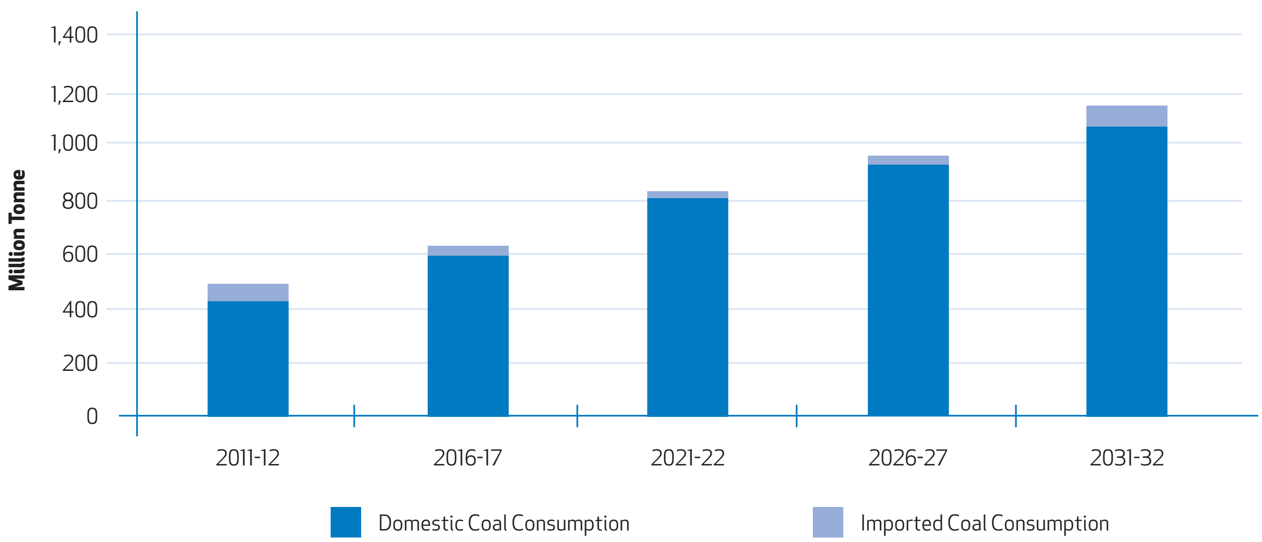
Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

(Contd...)

2031-32

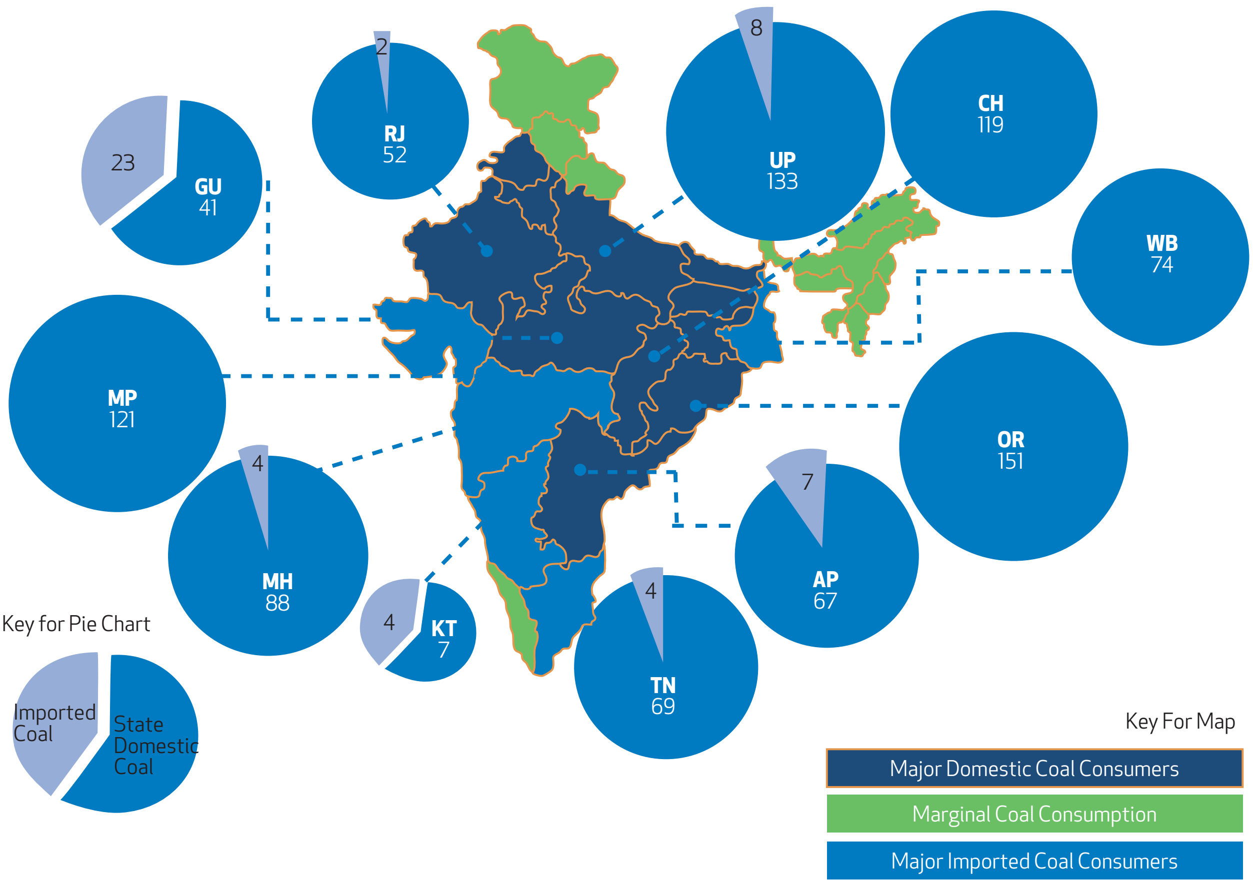
Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Figure 8.24
Coal Consumption: Low Case
[Million Tonne]



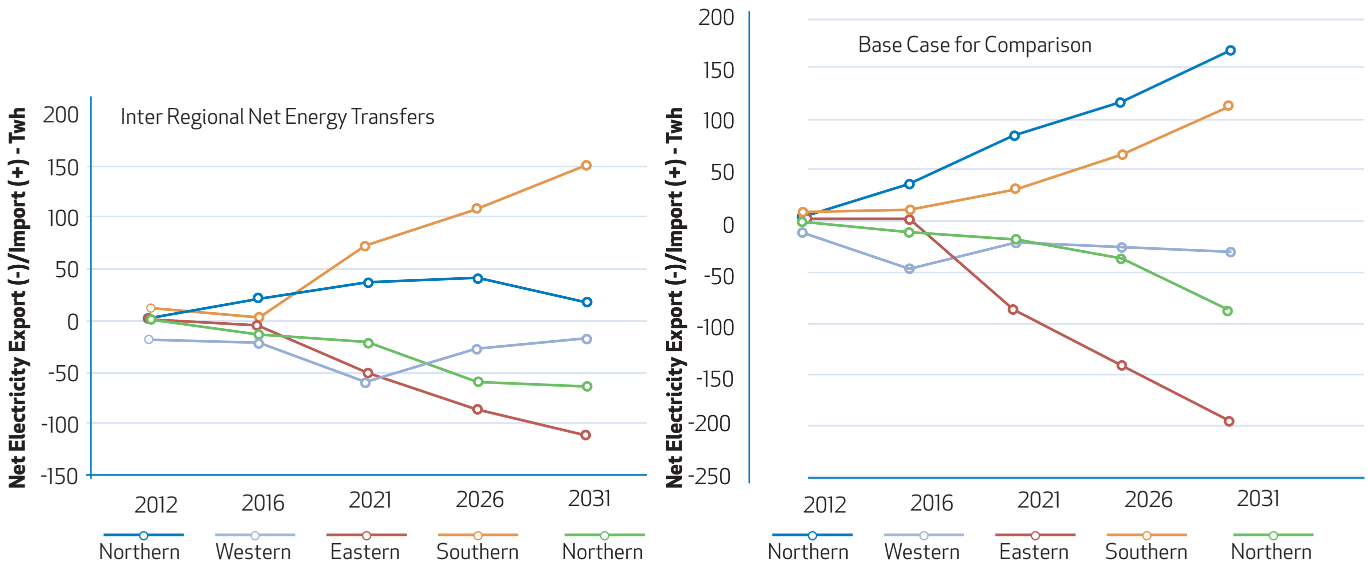
Source: ICF International (Model Runs for Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013).

Figure 8.25
State-wise Coal Consumption, 2031-32: Low Case
[Million Tonne]



Source: ICF International (Model Runs for the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013).

Figure 8.26
Transmission: Low Case

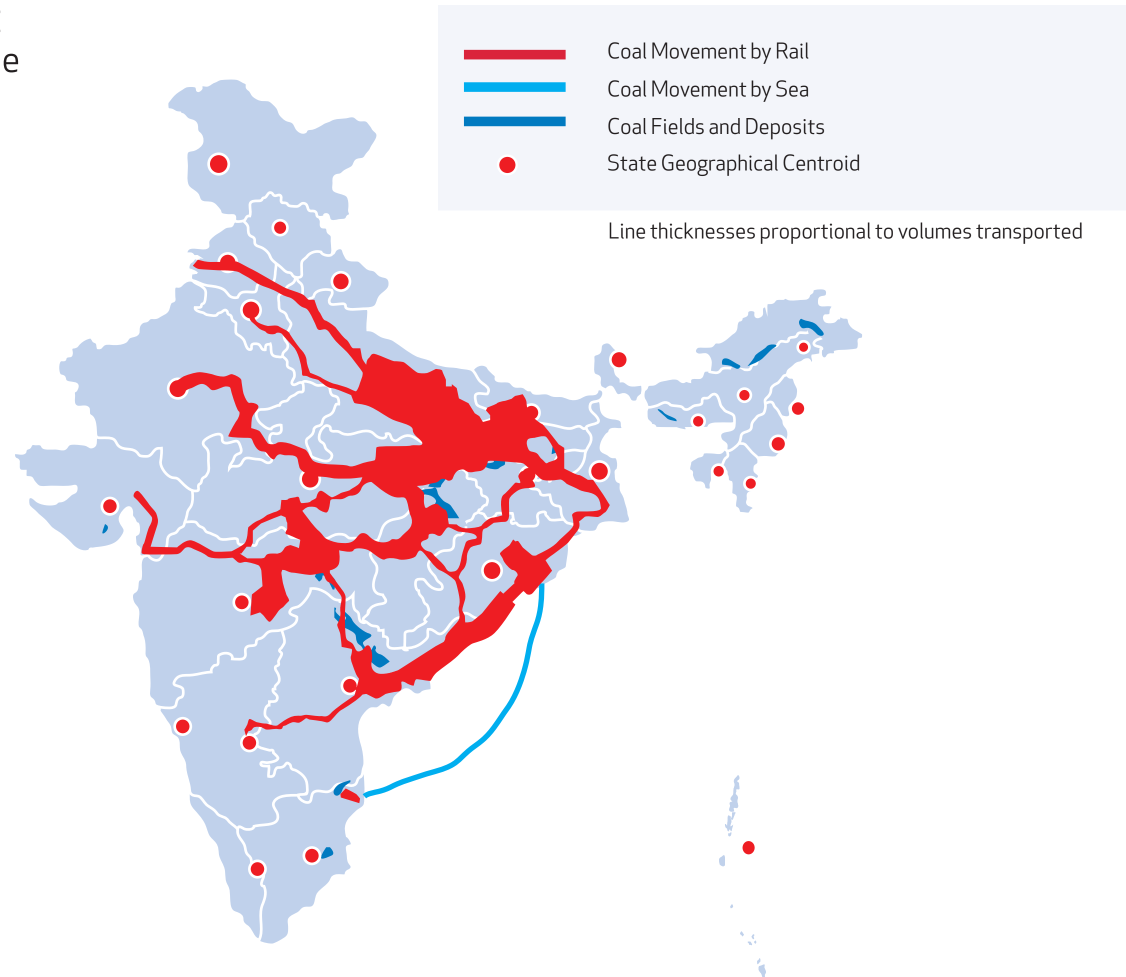


Source: ICF International (Model Runs for the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013).

Figure 8.27

Comparison of Coal Movement in 2031-32 in the Three Scenarios

2031-32
Low Case



2031-32
Base Case

(Contd...)

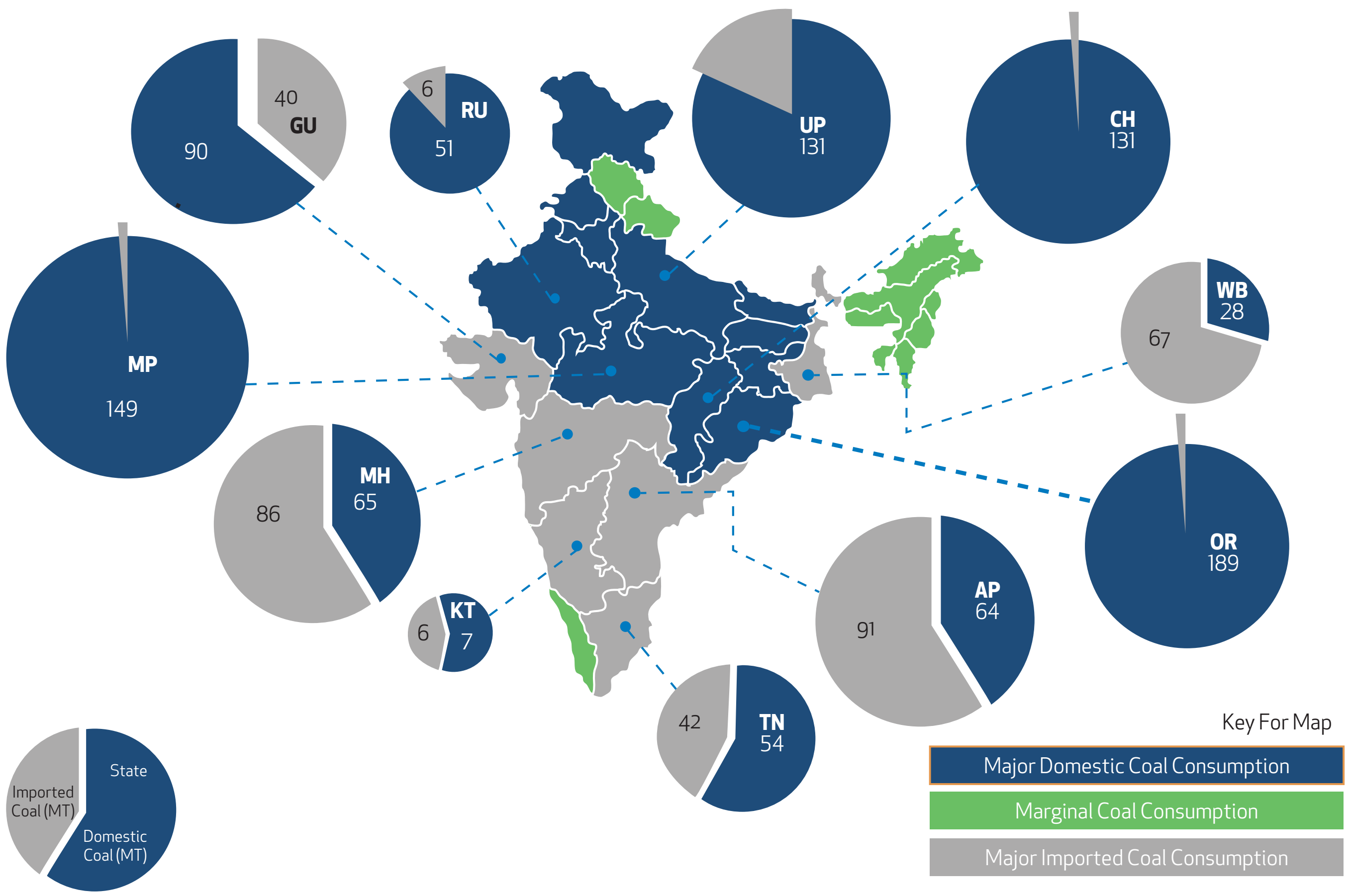
Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

2031-32
High Case

(Contd...)

Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013

Figure 8.28
State-Wise Coal Consumption, 2031-32: High Case



Source: ICF International (Model Runs for the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013)

Table 8. 8
Consumption of Domestic Coal for the Power Sector
[Million Tonne]

2011-12	2016-17	2021-22	2026-27	2031-32
442	614	828	951	1,112

Source: ICF International (Model Runs for the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013).

Box 8.1
Coal Beneficiation

The intrinsic quality of Indian coal and the way it is mined, results in poor-quality coal. It has high ash content and contains extraneous material such as shale and sandstone. Transport of run-of-mine (ROM) coal is wasteful because the extraneous material and ash are also transported with the coal. Coal Beneficiation (or coal washing) is a process by which the quality of coal can be improved, by either reducing the extraneous material or reducing the ash content or both.

Coal beneficiation is usually done by crushing the coal and putting it in a liquid to separate the lighter coal (low ash content) from the heavier coal (high ash content) and the extraneous material. Because beneficiated coal has a higher calorific value, transport costs are reduced. In addition, there are many benefits for power plants:

- Reduction in the required size of the power plant because less coal is required to produce the same electrical output.
- Better performance because of greater uniformity in the coal that is used.
- Reduction in wear and tear because extraneous material has been removed.
- Reduction in the amount of fly ash that is produced.

The Ministry of Environment and Forests (MoEF) issued a notification that the following power plants use coal with an ash content of 34 per cent or less with effect from June 2001. This was later extended to June 2002:

- Power plants at a distance greater than 1,000 km from the pit head; MoEF has proposed an amendment to reduce the distance to 500 km. CIL has to ensure that there are enough washeries to meet this stipulation (MoP, 2012: 45).
- Power plants located in critically-polluted areas, urban areas and ecologically sensitive areas;
- Power plants using fluidised bed combustion (CFBC, AFBC and PFBC) and integrated gas combined cycle (IGCC) technologies are exempted from this requirement.

Beneficiation results in some loss of coal. The yield decreases as the level of washing is increased. The optimum level of beneficiation depends on several factors: cost of beneficiation; yield; price of unbeneficiated (ROM) coal; economics of the power plant; distance to the power plant and transportation costs. It is difficult to give a single number for the savings in transportation costs. However, for typical Indian coal, the estimated savings in transportation costs for moving coal 1,000 km are about 10-12 per cent (MoC, 2012; Anderson and Nowling, 2012).

While beneficiation of coal provides many benefits, it also imposes severe stress on the environment. Beneficiation usually uses a lot of water which can be a problem in water-scarce areas. More troubling, the used water gets polluted with coal dust and harms the local environment. The use of dry processes is being explored, and they may provide better performance but at a higher cost. There is not much experience with them yet.

Rejects from beneficiation are often not properly disposed off, and they degrade fertile land and are susceptible to spontaneous combustion. Earlier efforts to burn rejects using fluidised bed combustion

(Contd...)

(FBC) were not very successful. More recently though, private sector FBC plants are reported to be operating successfully (MoC, 2012).

There is about 44 GW of capacity at a distance of more than 1,000 km and it would require about 175 Mtpa of beneficiated coal to comply with MoEF's notification. If the distance is reduced to 500 km, about 90 GW of capacity would require about 360 Mtpa of washed coal. Existing capacity for coal beneficiation is insufficient. Currently it is 96 Mtpa for non-coking coal (SG-2 report, 2011), although only half is being utilised. (based on CCO, Coal Directory, 2010-11). Coal India Ltd (CIL) has plans for adding 20 new washeries with a total capacity of 111 Mtpa, of which 19 Mtpa will be for coking coal and the remaining 92 Mtpa for non-coking coal. Together, this capacity could theoretically be just sufficient to fulfill the requirements of MoEF.

Beneficiated coal is not being used by power plants due to both supply and demand factors. Suppliers of washed coal see very little incentive in producing washed coal. There have been conflicts between CIL and its customers over who should bear the costs of washing. On the other hand power plants do not demand washed coal because there is no penalty for not complying with MoEF's directive.

eration mix. Currently it is about 55 per cent and declines in 2031-32 to 45 per cent for the base and low case and 37 per cent in the high case scenario.

- The share of natural gas in the energy mix declines for all three scenarios because it is increasingly used as an intermediate resource in the dispatch order instead of as a base load resource as done currently.

Annexes of the WG report give state-wise and region-wise details for the terminal years for each of the next four Five-year Plans for consumption of domestic coal; consumption of imported coal; consumption of natural gas; conventional generation capacity; renewable energy capacity; and net transmission.

DOMESTIC COAL USAGE

Table 8.8 shows domestic coal usage. It remains the same in all three scenarios because domestic coal is the least expensive fuel for electricity generation and is used first to meet the nation's electricity requirements. After the domestic coal available in a particular year is exhausted, other fuels are considered by the model.

The amount of coal needed for the power sector even today is large and it will grow about threefold by 2031-32. Moving it will require increasing rail infrastructure for transportation which poses great challenges for the already-strained Railways. Coal beneficiation (also known as coal washing) is one way to reduce transportation requirements. However, this comes at a cost. Box 8.1 on coal beneficiation describes the benefits and some of the environmental costs of coal beneficiation.

IMPORTS OF COAL

Table 8.9 shows consumption of imported coal for states that consume more than 3 Mt in any year and under any of the three scenarios. The amount for the entire country is also shown in the last row. Total imports are expected to grow dramatically; almost five-fold over the next two decades in the base case, and six-fold in the high case. As can be seen from Table 8.9, most of the imported coal is expected to be used in the coastal states: AP, Gujarat, Maharashtra, Karnataka, Tamil Nadu and Bengal. However, there are other states such as Haryana, Punjab, Rajasthan and UP that are also likely to be significant consumers of imported coal.

CLIMATE CHANGE AND USE OF COAL

No study of the power sector can ignore concerns about climate change and the detrimental effects on the global environment from power generation, particularly from the burning of coal. India must do what is reasonably possible to limit emissions of green-house gases (GHGs).

The scenarios were therefore modeled to reflect significant efforts to make the energy mix cleaner through the use of increasing amounts of renewable resources and gas. In particular, renewable resources have been pushed aggressively. In the base case, the capacity from renewable resources increases almost nine times over the two decades. In the high case, the introduction of renewable is even more aggressive, increasing by about twice that amount (18 times). Gas use also increases by a factor of two over the two decades, but gas use is constrained by the limited supply of gas over the next two decades.

These large increases in the use of renewable energy and natural gas were incorporated in the scenarios in spite of the very large cost advantage with coal based generation. Currently, natural gas based generation costs about 1.5 times domestic coal based generation on a per kWh basis. In the case of renewable energy, the cost penalty is even higher with wind ener-

Table 8.9
Consumption of Imported Coal for Select States
[Million Tonne]

	BASE CASE					LOW CASE					HIGH CASE				
STATES	2011-12	2016-17	2021-22	2026-27	2031-32	2011-12	2016-17	2021-22	2026-27	2031-32	2011-12	2016-17	2021-22	2026-27	2031-32
AP	4	11	27	49	66	4	5	5	5	7	4	12	28	54	91
BI	1	3	1	1	1	0	0	0	1	1	1	3	1	9	15
CH	2	0	0	0	0	0	0	0	0	0	3	11	0	0	0
GU	18	22	43	59	68	18	16	14	16	23	19	31	47	60	90
HY	4	2	6	13	17	4	0	0	0	5	04	2	9	12	18
KT	7	7	6	6	15	7	3	2	2	4	7	7	5	5	6
MH	14	20	17	35	48	12	2	3	3	4	14	20	17	43	86
PB	0	2	2	7	9	0	0	0	0	3	0	2	3	7	8
RJ	2	4	6	15	5	2	1	1	1	2	2	4	6	6	6
TN	4	5	24	37	47	4	0	1	1	4	4	8	15	35	42
UP	4	0	4	28	28	2	0	0	0	8	4	0	7	32	28
WB	6	1	1	14	48	6	0	0	0	0	6	2	18	29	67
INDIA	**73**	**88**	**138**	**266**	**355**	**61**	**28**	**27**	**28**	**61**	**76**	**106**	**158**	**295**	**460**

Note: Only states that consume more than 3 Mt in any year under any of the three scenarios are shown in this table. Therefore, the total of these states will be less than the amount shown for the entire country in the last row.
Source: ICF International (Model Runs for Working Group Research).

gy costing about twice as much and solar PV three times as much as domestic coal based generation.

Further as discussed earlier, the high case recognises that the higher growth that is postulated will also allow a greater focus on greener but more expensive options. That is why almost twice the amount of renewable resources as the base case are added. In addition, generation efficiency is assumed to increase by one percentage point every five years, and a greater availability of natural gas was assumed.

However, in spite of these initiatives, coal continues to dominate the energy mix, although its share drops to some extent to 65 per cent in the base case from its current level of 68 percent. The decrease is greater for both the low case (62 per cent) and the high case (60 per cent). One reason for the continued dominance of coal is that there is a large increase in the projected requirement for electricity. While the contribution from renewable energy increases dramatically, in absolute numbers there is still a large gap in electricity requirements which must be filled by coal.

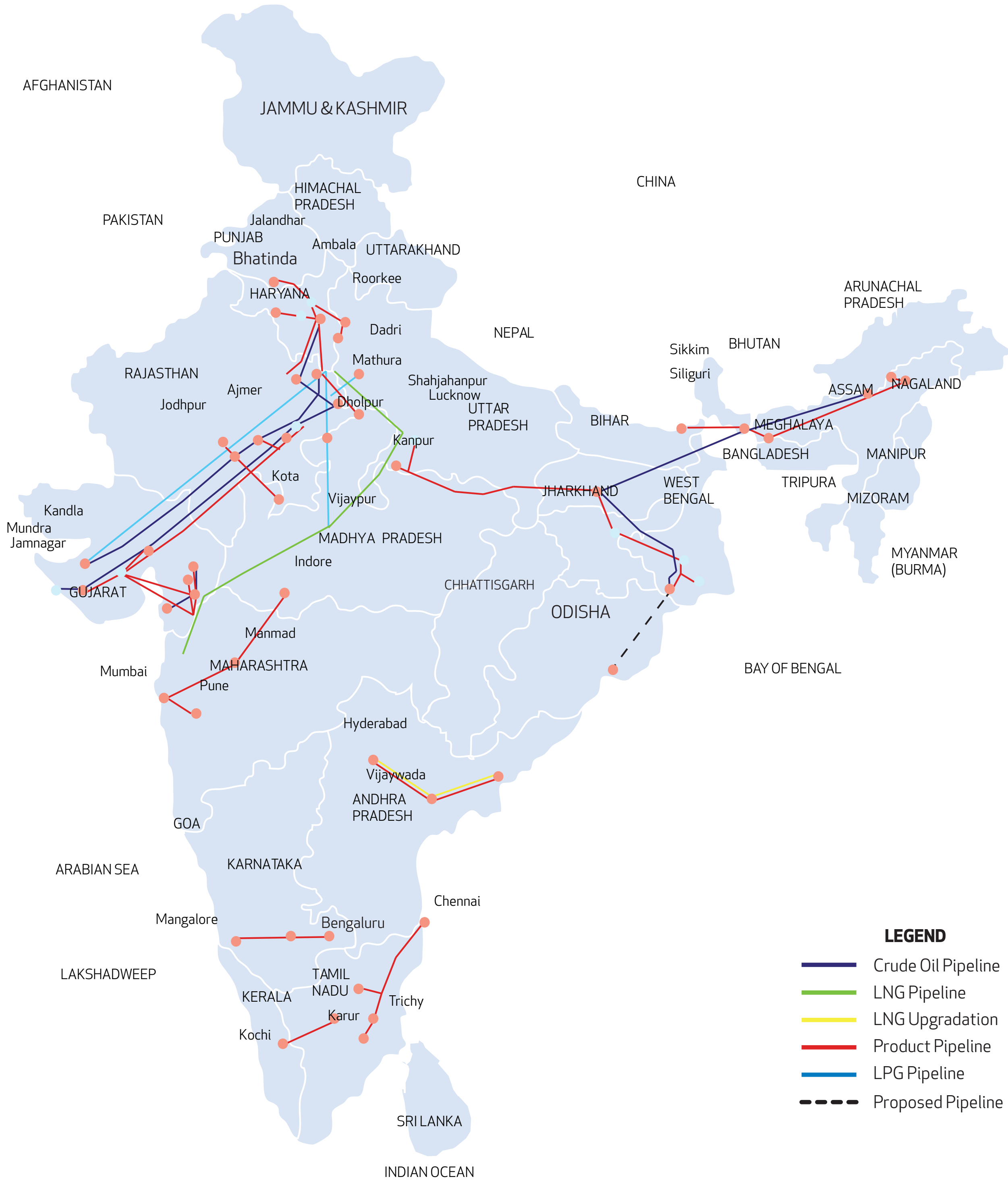
HANDLING UNCERTAINTIES

As we have seen in the three scenarios, there can be great variation in both the amount of coal to be transported and the pattern of the movement. This could be triggered by changes in the rate at which the economy is growing, greater use of renewables, increased availability of gas or higher energy efficiency.

Given this uncertainty, it is important that planning for bulk transport of energy commodities be adaptive. A strategic bulk transport planning group that monitors developments and potential developments in coal and other fuel markets, renewable energy technologies, and domestic fuel supply, should be established. In response to changing conditions, it should periodically, say every five years, direct changes in the plans for transport of fuels so that adequate fuel supplies are available to power plants without delay and at low cost. The group should include all major stakeholders and representatives from power, railways, and natural gas sectors.

Chapter 5 on Institutions for Transport System Governance, proposes an Office of Transport Strategy (OTS) that would integrate transport planning across modes and coordinate between the ministries and other levels of government. The strategic bulk transport planning group could be established under the OTS, and the OTS could extend coordination to non-transport ministries such as power, petroleum and natural gas, and steel, on issues related to transport of bulk commodities.

Figure 8. 29
Oil and Gas Pipelines in India



Source: Maps of India (2013).

TRANSPORT REQUIREMENTS FOR PETROLEUM AND NATURAL GAS

In India, all the natural gas and a major part of the petroleum and petroleum products are transported by pipelines. Even though a fraction of petroleum products is transported by rail, the amounts are insignificant compared to the amount of coal that needs to be moved, and therefore do not have much of an impact on the railway infrastructure required for movement of bulk commodities. The main intention of looking at the transport requirements for the petroleum and gas industry is to check the adequacy of the infrastructure, particularly for gas, to ensure that sufficient transport capacity is available for the power sector. Transportation for the petroleum industry covers

Table 8.10
Modes of Transport for Crude Oil
[Million Tonne]

	PSUS			PRIVATE COMPANIES		
YEAR	PIPELINES	COASTAL SHIPPING	TOTAL	PIPELINES	COASTAL SHIPPING	TOTAL
2011-12	70.2(52)	64.8(48)	135	8.25(11)	66.75(89)	75
2016-17	84.6(45)	103.4(55)	188	8.82(9)	89.18(91)	98
2021-22	97.99(41)	141.01(59)	239	10.26(9)	103.74(91)	114
2026-27	116.66(38)	190.34(62)	307	12.24(9)	123.76(91)	136
2030-31	146.68(38)	239.32(62)	386	15.3(9)	154.7(91)	170

Note: The figures in parentheses are percentage shares.
Source: Ministry of Petroleum and Natural Gas (2012).

the movement of crude oil from oil wells or ports to refineries, and the movement of petroleum products from refineries to the retail outlets.

CRUDE OIL

Crude oil is moved either by pipeline or coastal shipping to the refinery. Crude from onshore oil fields is mainly transported through pipelines, while coastal ships primarily move crude oil from offshore oil fields. Road and rail are not used. At present, there are 16 crude oil pipelines in the country, with a length of 8,560 km and capacity of 107 Mtpa (Figure 8.29). The pipelines are in the North-West and East, mostly carrying PSU crude. The PSUs transport roughly half their crude through pipelines while private companies use coastal shipping (Table 8.10).

The demand for crude oil is expected to increase from 210 Mt in 2011-12 to 286 Mt at the end of the 12th Plan and 353 Mt at the end of the 13th Plan (2021-22) with new refineries at Gujarat, Maharashtra and Tamil Nadu in the next decade, and expansion of 55 Mtpa at existing refineries proposed during the 13th Plan. In order to optimise the crude mix and product pattern to ensure adequate profitability of the companies, crude oil will be sourced from various producing nations in addition to domestic fields.

The year-wise estimate for movement of crude oil through coastal and pipelines, both by PSUs and private companies, is shown in Table 8.10.

With a number of refineries coming up at ports, the share of movement of crude oil by coastal shipping is expected to increase from 65 per cent in 2010-11 to 73 per cent by 2031-32.

PETROLEUM PRODUCTS

Petroleum products include petrol, diesel, ATF, naphtha, fuel oil, bitumen, LPG, lubricants, paraffin wax, petroleum coke etc. The movement of these products from the refineries to the retail outlets is carried out using the least cost mix of rail, coastal shipping, roads and pipelines. The primary movement of petroleum products, from refineries to depots is through pipelines, rail or coastal shipping. The secondary movement of petroleum products i.e. from the depot to the retail outlet, viz. last mile, is necessarily by road.

In comparison with rail and road, pipelines are considered much more economical. IOCL estimates for 2010-11 that the cost of movement was Rs 0.34 per Mt-km for movement through pipelines, Rs 1.39 per Mt-km by rail and Rs 2.86 per Mt-km by road. In addition to their safety and environmental-friendly approach, the per-unit cost advantage explains the economic importance of investment in pipelines for movement of oil and gas. Consequently, since 2008-09, there has been substantial investment in pipeline infrastructure. At present, there are 31 product pipelines, 11,274 km long and with a capacity of about 70 Mt. In addition, there are LPG pipelines of 2,313 km with a capacity of about 4 Mt. Table 8.11 gives the inter-modal mix of transport, for only primary movement of petroleum products in 2010-11 and the next two decades. As shown, the share of the pipelines is about 30 per cent. This is considerably less than in countries like the USA and China. In the US,

Table 8.11
Movement of Petroleum Products
[Million Tonne]

YEAR	PSUS					PRIVATE COMPANIES				
	PIPELINE	COASTAL	RAIL	ROAD	TOTAL	PIPELINE	COASTAL	RAIL	ROAD	TOTAL
2011-12	56.76(46)	18.51(15)	40.72(33)	7.40(6)	123.39	2.86(4)	60.87(85)	3.58(5)	3.58(5)	71.61
2016-17	90.14(53)	23.81(14)	45.92(27)	10.20(6)	170.08	2.88(3)	81.53(85)	5.76(6)	5.76(6)	95.92
2021-22	118.56(54)	30.74(14)	57.08(26)	13.17(6)	219.55	3.25(3)	87.84(81)	7.59(7)	9.76(9)	108.45
2026-27	157.64(54)	46.71(16)	75.90(26)	14.60(5)	291.92	4.80(4)	88.86(74)	12.01(10)	15.61(13)	120.08
2030-31	203.92(55)	55.61(15)	88.98(24)	18.54(5)	370.76	5.85(4)	103.83(71)	16.09(11)	20.47(14)	146.24

Note: The figures in parentheses are percentage shares.
Source: Ministry of Petroleum and Natural Gas (2012).

59 per cent of petroleum products were transported through pipelines, followed by coastal shipping (33 per cent), road (5 per cent) and railways (3 per cent).

Broad industry projections suggest that movement of POL products by PSUs through pipelines would be around 55 per cent, coastal shipping 15 per cent, rail 24 per cent and road 5 per cent by 2031-32.

The share of pipelines used by PSUs would increase substantially during this period, whereas the product movement by private companies would remain stable at 4 per cent. It may be inferred that, on the whole, pipelines would continue as the most preferred mode. Although railways at present transport a major share of products, their percentage contribution is expected to decline primarily due to the expansion of the pipeline network. This would ensure a balance between the ability of transport to serve economic development and to conserve energy, promote safety and sustain quality of future life.

As Table 8.11 shows, about 20 per cent (~105 Mt) of petroleum products will be transported by rail. This is small compared with movement of coal for power (~1460 Mt). Therefore, POL movement has little effect on planning for railways.

IMPORTS AND EXPORTS OF POL

Rapid growth in domestic consumption of petroleum products and refining capacity has increased the country's dependence on imports of crude oil. On the other hand, India has not only become a net exporter of petroleum products, but is now the largest exporter of petroleum products in Asia (MoP&NG, 2011). This section gives an estimate of the imports and exports of crude oil and petroleum products and the resulting liquid bulk traffic at ports.

Table 8.12 provides the details of the calculation. We first estimate the requirements for crude oil which is based on the sum of domestic demand and the net exports of petroleum products. Domestic demand has been estimated for the 12th and 13th Plan by the MoP&NG (MoP&NG, 2011: 49-50). We extrapolated the results until 2031-32 using the CAGR for the 13th Plan. While in its report for the 12th Plan, the MoP&NG did estimate the exports of petroleum products for the 12th Plan, we could not find any projections for exports beyond 2016-17. As the level of exports is linked to the global requirements for petroleum products, we have assumed that India's share of exports as a percentage of global requirements would remain at the level projected for 2016-17. Global requirements were obtained from the International Energy Outlook by the Energy Information Administration (EIA) of the US. Imports of petroleum products, which consist mostly of LPG, have remained stable at about 11 Mtpa. We have assumed that imports remain at this level throughout the study period.

The total amount of petroleum products that need to be produced in the country is equal to the domestic demand plus net exports. In Table 8.12, this amount is shown as 'Total to be Produced.' The 12th Plan data indicates that a tonne of crude oil yields about 0.93 tonne of petroleum products (MoP&NG, 2011: 163). We use this estimate to calculate the requirements for crude

Table 8.12

Estimation of POL Traffic at Ports

[Million Tonne]

	PIPELINE	2011-12	2016-17	2021-22	2026-27	2031-32
1	Domestic Demand for Petroleum Products	147	186	245	322	424
2	Gross Exports of Petroleum Products	58	91	94	100	104
3	Gross Imports of Petroleum Products	10	11	11	11	11
4	Net Exports of Petroleum Products (2-3)	48	80	83	89	93
5	Petroleum Products to be Produced in India (1+4)	195	266	328	412	517
6	Requirements for Crude Oil (5/0.93)	210	286	353	443	556
7	Domestic Production of Crude Oil	38	41	41	41	41
8	Required Imports of Crude Oil (6-7)	172	245	312	401	515
9	Total Imports and Exports of POL (2+3+8)	240	347	417	513	631
10	**TOTAL POL TRAFFIC AT PORTS (9 X 1.37)**	**329**	**475**	**572**	**702**	**864**

Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

oil in the country. By 2031-32, it is estimated to reach 556 Mt. Some of it will be met by domestic production. Recent projections for the 12th Plan period show a small decline in production (PetStats, 2011-12:42). Therefore, we have assumed that domestic production will remain at current levels. Subtracting domestic production from total requirements for crude oil give us the amount of crude oil that needs to be imported. It is expected to reach 515 Mt by 2031-32. The sum of POL imports (crude oil and petroleum products) and exports (petroleum products) is shown in Table 8.12 and is expected to reach 631 Mt by 2031-32.

Port traffic includes not just this amount but also some domestic crude that is produced off-shore and crude oil and petroleum products moved by coastal ships. Estimating this amount directly is very difficult. Instead, we looked at POL port traffic for the last several years and compared it with the total imports and exports of POL. We found that the ratio of POL port traffic to POL imports and exports over the last several years has varied between 1.25 to 1.53,with an average of 1.37. We have used the average of 1.37 to arrive at POL port traffic which is shown in the last line of Table 8.12.

NATURAL GAS

Natural gas constitutes 24 per cent of the total energy mix in the world. Its share in the Indian energy basket was around 11 per cent in 2010. It is projected that the growth of natural gas demand in India in the next two decades will alter the primary energy mix of India, by way of substitution from oil to gas, and reach up to 20 per cent. MoP&NG estimates that demand for gas will increase to 473 MMSCMD by 2016-17 and 606 MMSCMD by 2021-22, and would be about 790 MMSCMD by 2031-32 (MoP&NG, 2011a; MoP&NG, 2011b).

The production of natural gas has increased from 89 MMSCMD to 143 MMSCMD at an annual growth rate of 17 per cent in the period 2007-08 to 2010-11. More discoveries of natural gas are expected in the coming years. Demand for natural gas has increased by 24 per cent during this period. Demand for natural gas up to 2031-32 is estimated based on the domestic production estimates as provided by the Directorate General of Hydrocarbons (DGH) and expected demand for natural gas by various sectors—power, fertiliser, city gas, industry, petrochemicals/refinery/internal consumption and sponge iron/steel. It is assumed that from 2017-18 onwards, additional gas would be available domestically from CBM Blocks and other future discoveries. Accordingly, a growth rate of 6 per cent is assumed from 2017-18 onwards and the availability is expected to stabilise thereafter at an annual growth rate of 3 per cent till 2031-32.

The remaining gap in demand is expected to be met through imports using existing facilities at Dahej, Kochi, Dabhol, Hazira and other LNG terminals

Table 8.13
Estimates of Demand for Gas
[MMSCMD]

YEAR	GAS DEMAND
2010-11	170
2011-12	193
2016-17	473
2021-22	606
2026-27	703
2031-32	791

Note: Figures are based on the expectations that IPI/TAPI will be operational from 2018-19 onwards.
Source: Ministry of Petroleum and Natural Gas (2012).

proposed at places like Mangalore, Ennore, Mundra, Paradip etc. Besides, certain Floating Storage Regassification Units (FSRUs) are being planned at port locations like Dighi, Mumbai, Paradip, Vizag, Mangalore, Cuddalore etc.

The availability of transport infrastructure for gas needs to keep pace with availability of gas and commissioning of user industries. Gas transportation needs have been accordingly estimated until 2031-32 (including regional and trunk pipelines) as shown in Table 8.13.

Gas transportation estimates are related to the demand projections for gas, expected to increase substantially with the increase in demand projected by sectors like power and fertiliser. Given the present domestic availability, demand from other sectors like city gas, industrial, petrochemicals, refineries, internal consumption and sponge iron would be met mostly through imported LNG. However, the estimates have not considered the role of price elasticity in relatively price-elastic sectors like power and fertiliser. In this scenario, the actual demand could be much lower than the projected demand.

Pipelines are practically the only mode of inland gas transportation from producing regions to various consumption centres. India presently has approximately 13,000 km of gas pipelines with a total design capacity of 334 MMSCMD. As shown in Figure 8.30, this comprises around 8,400 km owned and operated by GAIL, around 1,469 km of east-west pipeline operated by RGTIL and the remaining operated by regional players like GSPC, IOCL etc. The growing gas demand and new gas fields along the East coast, emphasise the need for faster development for gas transportation infrastructure. In 2007, MoP&NG had authorised around 5,771 km of pipelines to GAIL and 2,628 km to Reliance Logistics. Besides, GAIL is also upgrading the GREP/DVPL for 1,280 km for a capacity of 54 MSMCMD.
The PNGRB has authorised 4,325 km of pipeline through a transparent bidding process. In addition, another 2,675 km of pipeline is under various stages of bidding.

Table 8.14 summarises the composition of the gas pipeline grid. The total capacity of 1,176 MMSCMD will meet the requirements given in Table 8.13.

As the table shows, additional pipelines of about 32,000 km will be needed. It is difficult to estimate the cost because the cost per km varies by a factor of four to five depending on the diameter of the pipeline and by a factor of more than two depending on the region. It should be noted that some of these new pipelines are already under construction.

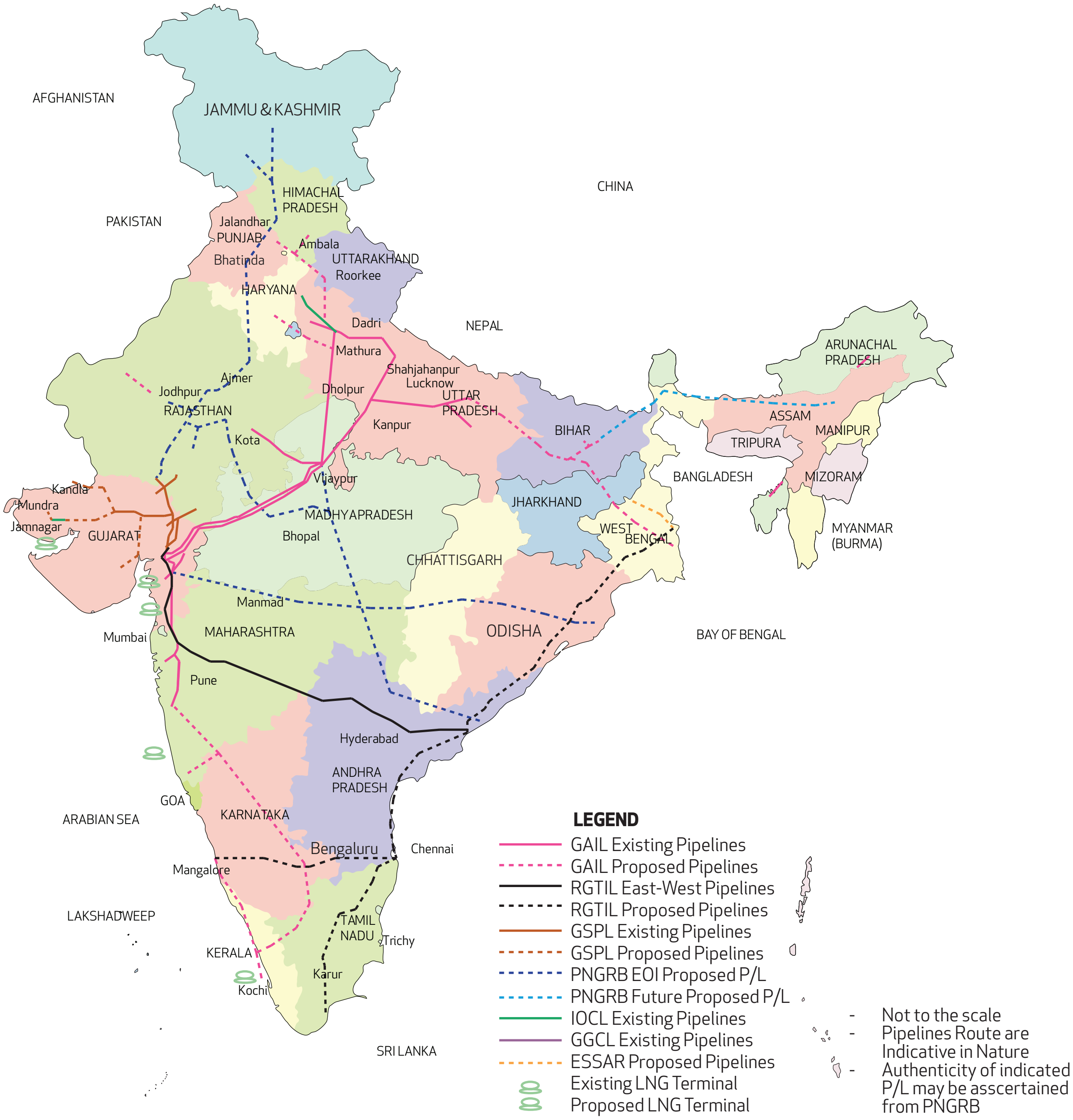
TRANSPORT REQUIREMENTS OF THE IRON AND STEEL INDUSTRY

Production of a tonne of steel requires three to four tonne of raw materials. So, to estimate the transport requirements for the steel industry, we first estimate the raw material requirements.

The calculations of raw material requirements have been projected on the basis of the following current norms of consumption and expected improvements in efficiency of operation. (Ministry of Steel, 2012a):

- Iron consumption is 1.6 tonne per tonne of crude steel (CS), based on BF/BOF technology.
- Coking coal use to decrease from 0.8 tonne per tonne of crude steel to 0.75 tonne, with increasing use of pulverised coal injection

Figure 8. 30
Existing and Proposed Natural Gas Pipelines



Source: Ministry of Petroleum and Natural Gas (2012).

(PCI) and scrap in electric furnaces. (Use of scrap expected to increase from 15 per cent in 2016-17 to 25 per cent in 2031-32.)

Input materials required to produce one tonne of crude steel will decrease from the present four tonne to three, with these efficiency improvements. This will reduce the need for transportation of raw materials.

Based on these requirements, the amount of raw material to be transported for the terminal year for each of the next four Plans has been estimated in the Table 8.15.

These transport requirements do not include those for exporting iron ore. While these exports are, and have been, quite large (~50 per cent of mined iron ore), they have declined recently because of the ban on export of iron ore. These exports will continue to decrease and will not be significant after 2016-17 as the iron ore resource needs to be conserved to ensure availability of adequate amount of steel for the country's development.

Steel production in 2011-12 was 73 Mt (provisional estimate) (MoS, 2013). Assuming the same ratio of material to be moved to finished steel production as for 2016-17, the total raw material and

Table 8. 14
Expected Composition of Gas Grid at End of 13th Plan (2021-22)

PIPELINE TYPE	LENGTH (KM)	CAPACITY (MMSCMD)	COMMENTS
Existing	13,508	334	Existing
Under Execution by GAIL/RGTIL	9,679	263	12th Plan
Under Upgradation by GSPL	1,220	30	12th Plan
PNGRB Bidding Rounds	7,000	243	12th Plan
AGCL/ OIL	350	6	12th Plan
New Greenfield Pipelines	4,000	150	13th Plan
Additional Pipelines through Augmentation	5,000	150	13th Plan
Additional Pipelines through Spurlines	4,500	0	13th Plan
TOTAL	**45,257**	**1,176**	

Source: Ministry of Petroleum and Natural Gas (2012).

Table 8.15
Estimates of Amounts of Raw Materials and Steel to be Transported
[Million Tonne]

	MATERIAL	2016-17	2021-22	2026-27	2031-32
1.	Iron Ore	217	346	526	736
2.	Coking Coal	86	135	203	280
3.	PCI	11	17	41	56
4.	Non-coking Coal	39	67	82	122
5.	Scrap	15	36	78	145
6.	Others	118	188	284	398
7.	**TOTAL STEEL MAKING RAW MATERIALS (1+2+3+4+5+6)**	**486**	**790**	**1,213**	**1,737**
8.	Total Finished Steel	113	199	325	495
9.	**TOTAL RAW MATERIAL AND FINISHED STEEL (7+8)**	**599**	**989**	**1,538**	**2,232**

Source: Ministry of Steel (2012a).

Table 8. 16
Modal Distribution of Raw Material Traffic between Road and Rail
[Per cent]

	RAIL		ROAD	
	RAW MATERIALS	FINISHED STEEL	RAW MATERIALS	FINISHED STEEL
Mega/Large Projects	90	70	10	30
Small & Medium Units	30	30	70	70

Source: Ministry of Steel (2012a).

Table 8.17
Average Lead Distances for Steel and Raw Materials
[Km]

IRON ORE	COAL	OTHER RAW MATERIALS	PIG IRON AND FINISHED STEEL
325	405	763	988

Source: Ministry of Steel (2012a).

Table 8.18
Estimated Railway Traffic Due to The Steel Sector

TOTAL INDIA	2016-17		2021-22		2026-27		2031-32	
	MT	MT-KM	MT	MT-KM	MT	MT-KM	MT	MT-KM
Iron Ore	164	53,320	262	85,142	398	129,354	557	180,978
Coking Coal	65	26,330	102	41,260	154	62,168	212	85,721
PCI	8	3,291	13	5,517	31	12,434	42	17,144
Non-coking Coal	30	12,062	51	20,633	62	24,998	92	37,323
Scrap	11	10,804	27	26,965	59	58,080	110	108,392
Others	89	68,102	143	108,736	213	162,476	301	229,663
TOTAL STEEL MAKING RAW MATERIALS (1+2+3+4+5+6)	**367**	**173,908**	**597**	**287,895**	**916**	**449,509**	**1,314**	**659,222**
TOTAL FINISHED STEEL	**68**	**67,463**	**120**	**118,806**	**196**	**194,030**	**299**	**295,522**

Source: Ministry of Steel (2012a).

Table 8.19
Estimated Road Traffic Due to The Steel Sector
[Million Tonne]

TOTAL INDIA	2016-17	2021-22	2026-27	2031-32
Iron Ore	53	84	128	179
Coking Coal	21	33	49	68
PCI	3	4	10	14
Non-coking Coal	10	16	20	30
Scrap	4	9	19	35
Others	29	46	69	97
TOTAL STEEL MAKING RAW MATERIALS (1+2+3+4+5+6)	**118**	**192**	**295**	**423**
Total Finished Steel	45	79	128	196
TOTAL RAW MATERIALS AND STEEL (7+8)	**163**	**271**	**424**	**619**

Source: Ministry of Steel (2012a).

Table 8. 20
Imports of Coking Coal for Steel Industry by State
[Million Tonne]

STATE	2011-12	2016-17	2021-22	2026-27	2031-32
Odisha	7.8	15.8	26.4	42.2	58.2
Chhattisgarh	4.2	8.5	14.1	22.6	31.2
Jharkhand	4.5	9.2	15.3	24.6	33.9
West Bengal	2.2	4.4	7.4	11.9	16.4
Karnataka	2.9	5.8	9.7	15.5	21.4
Tamil Nadu	1.0	2.1	3.5	5.5	7.6
Maharashtra	1.7	3.5	5.9	9.5	13.1
Andhra Pradesh	2.0	4.1	6.8	10.9	15.0
Gujarat	2.4	4.9	8.2	13.1	18.1
Other Locations	3.1	6.2	10.4	16.7	23.0
Total India	**31.8**	**64.5**	**107.7**	**172.5**	**237.8**

Source: Ministry of Steel (2012a).

steel that was moved in 2011-12 was about 390 Mt. This amount is projected to increase to 2232 Mt in 2031-32; almost a six-fold increase over the next 20 years (Table 8.15).

Currently, most of the material for large steel plants is moved by rail, and for small and medium units, by road. We have assumed this pattern holds throughout the study period (Table 8.16).

Current lead distances for raw materials and finished steel are shown in Table 8.17. While lead distances for iron ore are short, reflecting the proximity of steel plants to mines, the lead distances for finished steel are large (~1000 km) because finished steel is transported across the country. Consequently the transport requirements for finished steel in tonne-km are much higher than for raw materials. Using these numbers for lead distances, projected rail traffic for the steel industry is shown in the Table 8.18.

We have also estimated the road traffic for the steel sector in Table 8.19. As expected, road traffic is much less than rail.

IMPORTS OF COKING COAL

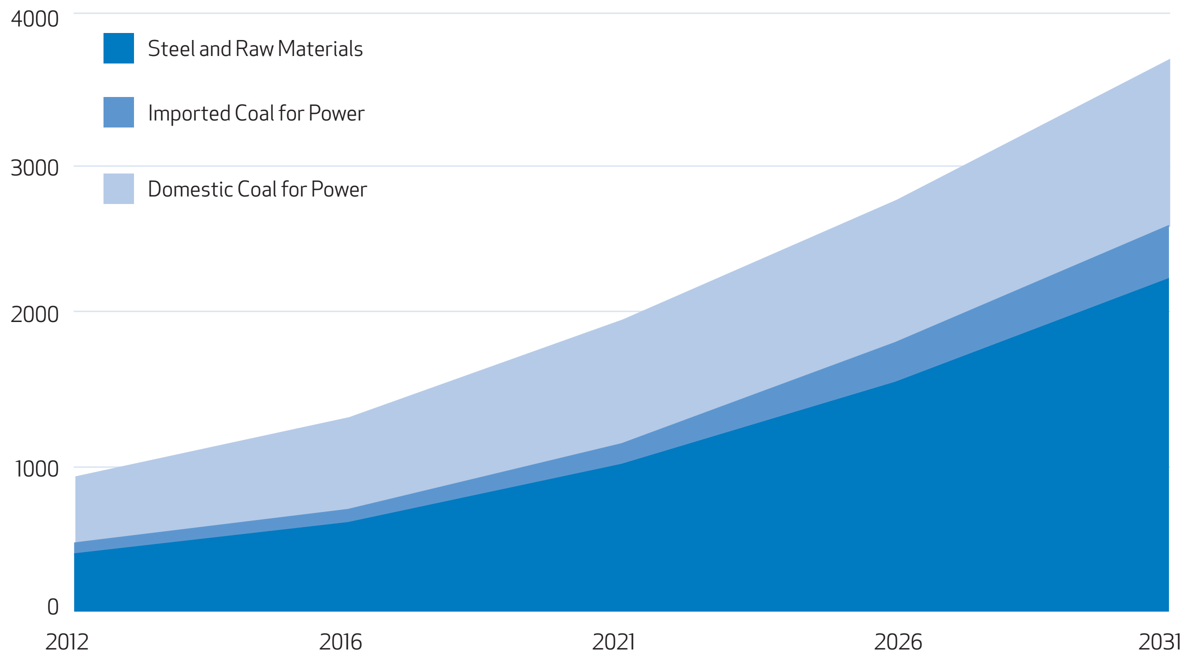
Much of the coking coal reserves in the country have high ash content, rendering them unsuitable for steel-making. Consequently, about 70 per cent of the coking coal required by the steel industry is currently imported. As the domestic production of coking coal is expected to remain stagnant or even decline, the share of imported coal is expected to increase to 75, 80 and 85 per cent in 2016-17, 2021-22 and 2026-27 respectively, and remain at that level for the rest of the study period (MoS, 2012). Using these assumptions, the imports of coking coal have been estimated in Table 8.20.

INFRASTRUCTURE REQUIREMENTS AND INVESTMENT PLANNING FOR RAILWAYS

India's requirements for bulk commodities are expected to grow rapidly over the next two decades. For the power sector, coal will remain the dominant fuel even though its share is expected to decrease marginally. The use of domestic coal for the power industry will be limited by the amount that will be produced and is expected to grow by about 2.5 times. Imports of coal for the power sector however, will grow much faster; by almost five times by 2031-32.

As the intensity of steel in the economy is expected to increase, steel requirements will grow faster than the economy. By current projections, requirements for steel will grow by almost seven times. As a tonne of finished steel requires three to four tonne of raw materials, the transport requirements for steel industry will be huge. The transport requirements for the power and steel industry are expected to grow from about 900 Mt now to 3,700 Mt in 2031-32 (Figure 8.31).

Figure 8. 31
Amount of Bulk Material to be Transported for Power and Steel Industries
[Million tonne]



Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Railways is one of the main modes of transport for dry bulk commodities. The rail network is already stretched to capacity with almost all the major trunk routes bearing traffic well above their designed capacity. This section assesses the additional requirements for transport of bulk commodities that will be imposed on the rail network and the upgradation required.

Transport of coal and iron ore by rail can be broadly broken up into five segments:

1. **First Mile Connectivity** where coal/iron ore is transported from the mine to the rail siding
2. **Feeder Routes at the Source End** which carry the coal/iron ore from the rail siding to the trunk route
3. **Trunk Routes** which carry the material long distances, usually between states
4. **Feeder Routes at the Destination** which move the material from the trunk route connection point to the rail siding at the destination power or steel plant
5. **Last Mile Connectivity** where the material is moved from the rail siding to the power or steel plant

It is important to ensure that each link in the transport chain from mine to power/steel plant functions effectively because the overall transport chain will be only as effective as its weakest link. Hence, we consider here all segments of the rail transport chain.

Of course, not all coal or iron ore shipments will traverse all five segments. For example, coal for power plants within a coal-producing state may be carried by a single feeder route that connects the rail siding at the mine to the power plant. First and last-mile connectivity are not usually provided by rail but are included because they are important in ensuring that coal or iron ore moves in an efficient and effective way. Poor first and last-mile connectivity can be a bottleneck in the transport of bulk material.

PATTERN OF MOVEMENT OF BULK COMMODITIES FOR THE POWER AND STEEL INDUSTRY

MOVEMENT OF COAL FOR THE POWER INDUSTRY

As transport requirements can be quite different, depending on the types of rail segments traversed, it will be useful to divide transport of domestic coal for the power sector into three categories:

1. Transport within the coal-producing states which relies mostly on road transport, MGR, conveyor belts/ropes and short rail routes
2. Transport to states neighbouring coal-producing states which takes place either on non-DFC routes or on short sections of high-density trunk routes that will later be covered by dedicated freight corridors (DFCs)
3. Transport to distant states which makes extensive use of high density trunk routes that will later be covered by DFCs

Table 8. 21
Movement of Domestic Coal

YEAR	CONSUMPTION WITHIN SUPPLY STATES (MILLION TONNE)	CONSUMPTION IN NEIGHBOURING STATES (MILLION TONNE)	LONG-DISTANCE TRANSPORT – (EXTENSIVE USE OF DFCS) (MILLION TONNE)	TOTAL (MILLION TONNE)	SHARE OF IN-STATE CONSUMPTION PER CENT	IN-STATE CONSUMPTION AND NEIGHBOURING STATES (PER CENT SHARE)
Base Case						
2011-12	194	64	156	442	44	58
2021-22	429	152	212	828	52	70
2031-32	664	110	260	1112	60	70
Low Case						
2011-12	194	64	156	442	44	58
2021-22	396	140	222	828	48	65
2031-32	602	114	288	1,112	54	64
High Case						
2011-12	194	64	156	442	44	58
2021-22	443	150	184	828	54	72
2031-32	693	117	222	1,112	62	73

Note: For transport to neighbouring states and for long-distance transport, only the major coal-consuming states were considered. Therefore, the total in column 5 will be slightly higher than the sum of columns 2, 3 and 4.
Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Using the outputs of the model described earlier, Table 8.21 shows the amount of domestic coal likely to be transported in each of these categories for the three scenarios[1]. The share of in-state consumption, already at 44 per cent, could increase to 60 per cent by 2031-32 in the base case. In the low case in 2031-32, it is slightly lower at 54 per cent and in the high case it is at 62 per cent.

If we include transport to neighbouring states to get an estimate of the share of transport within the coal-producing regions, we find that the share of these categories grows to 64-73 per cent by 2031-32. These trends are consistent with our earlier finding that as the economy grows, domestic coal is used 'closer to home'. While in some cases, the regional or in-state movement may be on a short part of a dedicated freight corridor (DFC)[2], a very large portion of domestic coal will not make extensive use of DFCs.

This finding is reinforced by an analysis of how much coal is transported by the various modes. A report by PriceWaterhouse Coopers states that the share of rail is about 49 per cent, MGR is 19 per cent and road is about 26 per cent (PwC, 2009) (Figure 32).

A similar pattern emerges when we examine the movement of imported coal. As Table 8.22 shows, the share of consumption by the coastal states reaches over 80 per cent in 2031-32 for the base and high case. It is slightly lower at 71 per cent for the low case. In such a scenario, where most of the imported coal is expected to be used close to the coast, short rail routes or conveyor belts are likely to be important.

Thus we see that a progressively greater share of coal will be used within the source and coastal states, and hence the share of shorter rail routes, road, MGR and belts/ropes will grow.

MOVEMENT OF BULK MATERIALS FOR THE STEEL INDUSTRY

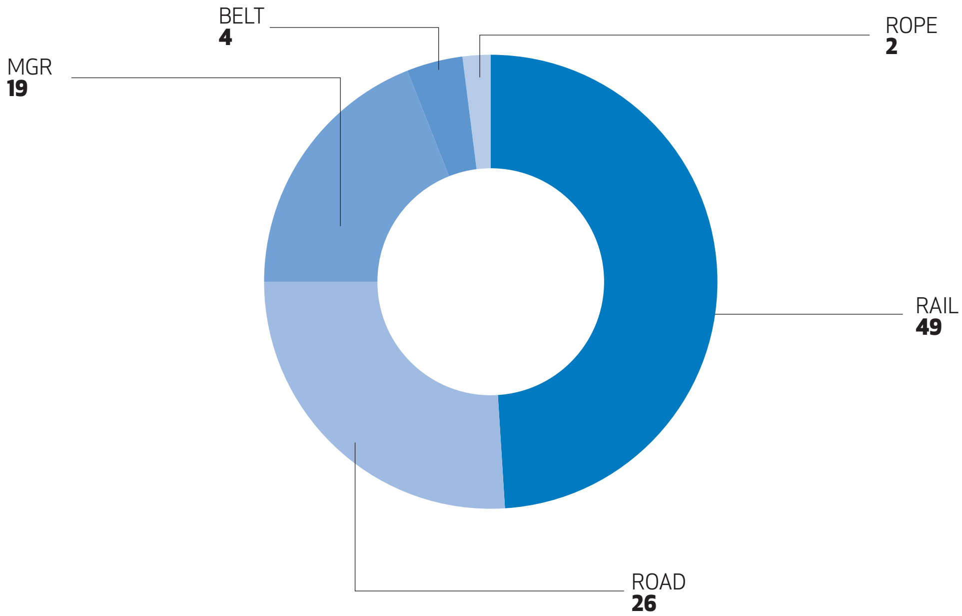
The steel industry requires transport of iron ore, coking coal, non-coking coal, other raw materials such as limestone, and finished steel. Lead distances for non-coking coal and iron ore are short because of proximity of steel plants to iron ore and coal mines. Consequently, much of the movement of iron ore and non-coking coal is on short rail routes for large steel plants and by road for the smaller plants. Similarly, because of the proximity

1. These estimates are indicative. Specifying an exact route for transport of coal would require a precise origin and destination. Because the modeling exercise treated an entire state as a node, such precise identification of origins and destinations was not possible in this study. A much more detailed modeling exercise with a much higher resolution for locating power plants would be required.
2. Indian Railways has proposed the construction of six DFCs. These are discussed in more detail later in the sub-section, 'Indian Railways Plans High Density Corridors'.

Figure 8. 32

Share of Different Modes for Transport of Domestic Coal

[per cent]



Source: PriceWaterhouse Coopers (2009).

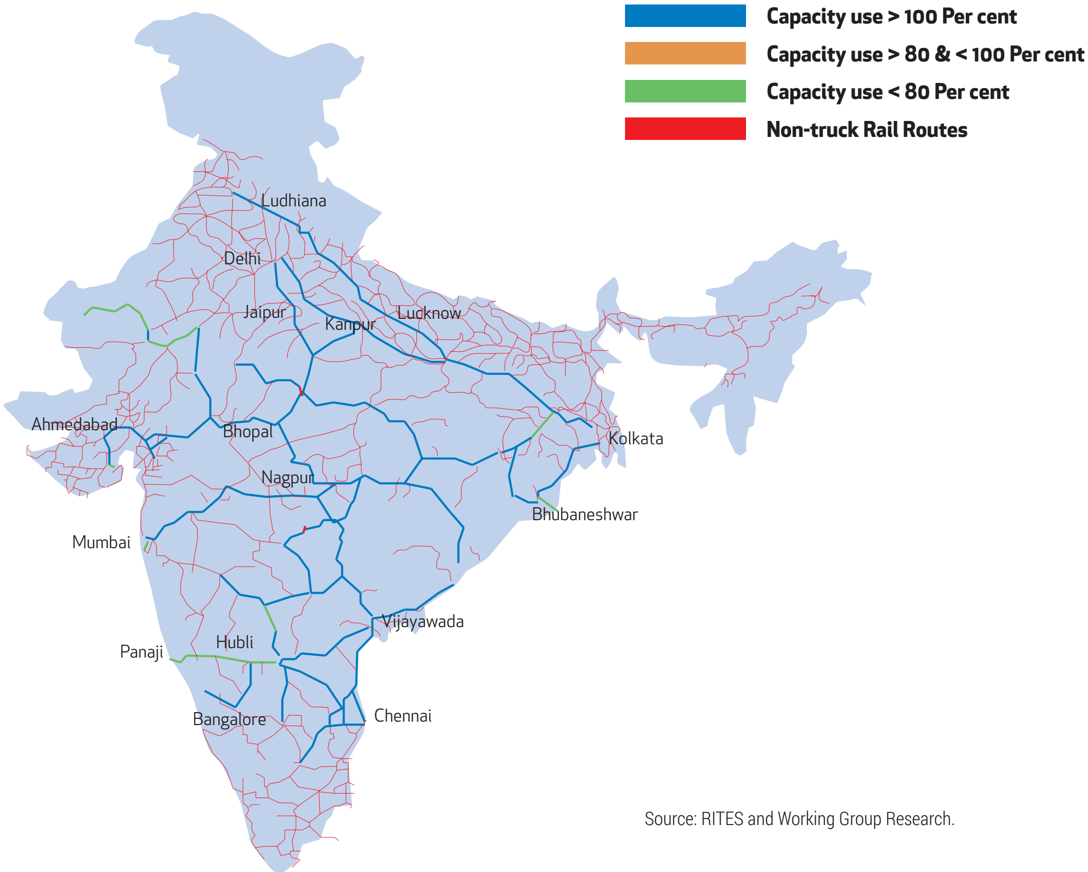
Table 8. 22

Movement of Imported Coal

YEAR	CONSUMPTION WITHIN COASTAL STATES (MILLION TONNE)	ON NON-DFC ROUTES (MILLION TONNE)	LONG-DISTANCE TRANSPORT – EXTENSIVE USE OF DFCS (MILLION TONNE)	TOTAL (MILLION TONNE)	COASTAL STATES CONSUMPTION (PER CENT SHARE)
BASE CASE					
2011-12	53	0	14	73	73
2021-22	119	0	19	138	86
2031-32	293	0	59	355	82
Low Case					
2011-12	50	0	8	61	83
2021-22	26	0	1	27	96
2031-32	43	0	18	61	71
High Case					
2011-12	54	0	15	76	72
2021-22	131	0	25	158	83
2031-32	382	0	75	460	83

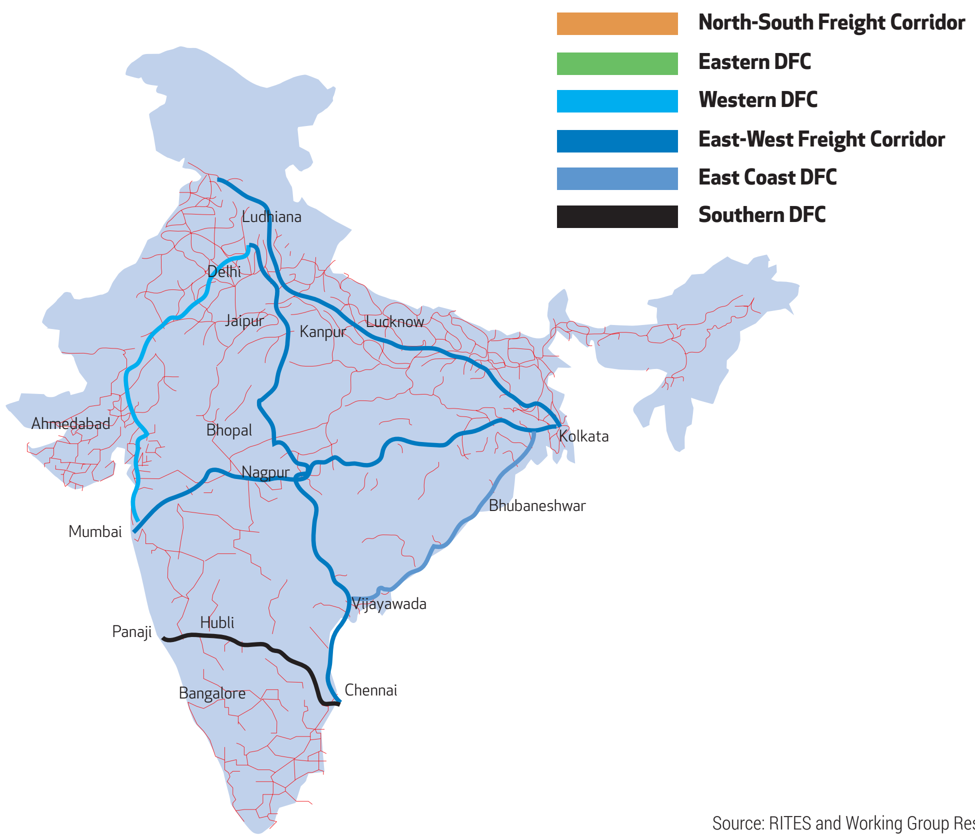
Note: For the routes covered by DFCs and non-DFC routes, only states which consumed more than 3 Mtpa of imported coal were considered. Therefore, the total in column 5 will be slightly higher than the sum of columns 2, 3 and 4.
Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Figure 8. 33
Major Rail Routes for Transport of Bulk Commodities



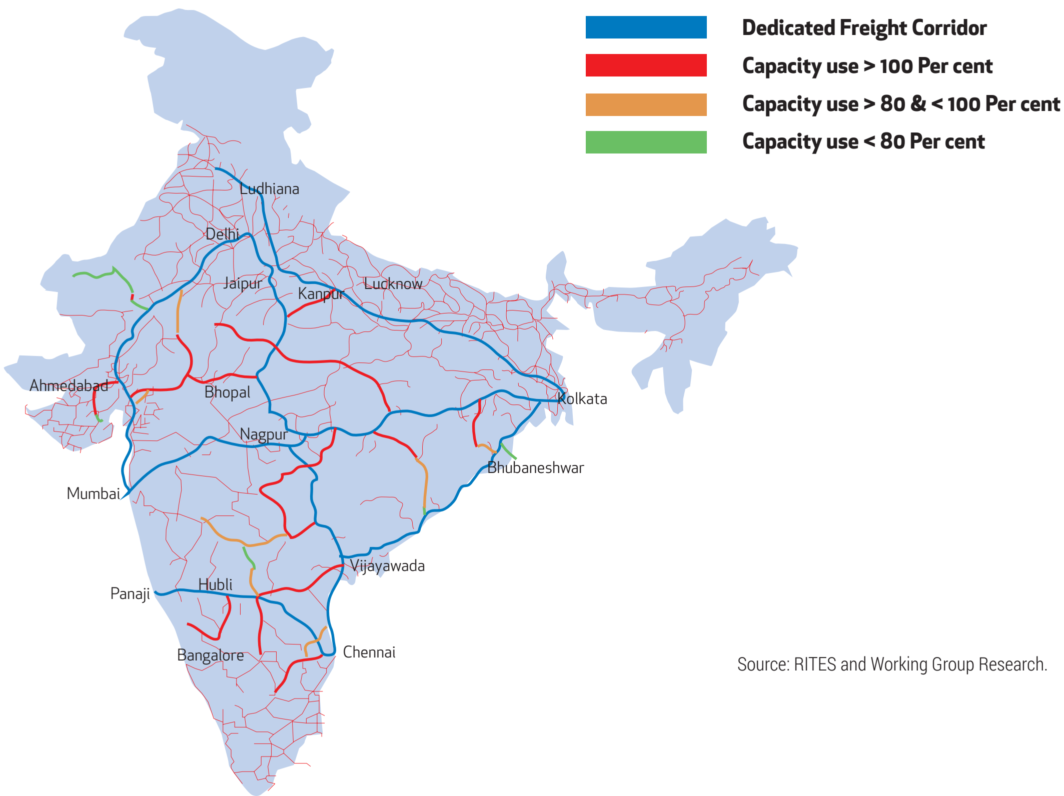
Source: RITES and Working Group Research.

Figure 8. 34
DFC Routes



Source: RITES and Working Group Research.

Figure 8.35
Impact of DFCs on Trunk Routes



Source: RITES and Working Group Research.

of the ports which receive coking coal imports, the lead distances for imported coking coal are short and transport is on short rail routes for large steel plants and by road for smaller steel plants. Finished steel is transported across the country and its effect is diffused throughout the network. So, its effect on specific routes may not be so significant, and hence is not covered here.

TRUNK RAILWAY ROUTES

STATUS OF RAIL ROUTES

Figure 8.33 shows the main rail routes that transport over 80 per cent of coal, iron ore, iron, steel, limestone and dolomite. We also examined the level of capacity utilisation for the sections of the routes. A section reaches 'saturation' if the capacity utilisation is greater than 80 per cent. Therefore, we have divided the sections that comprise these routes into three categories: where the capacity utilisation is (1) less than 80 per cent (green); (2) between 80 per cent and 100 per cent (yellow); and (3) greater than 100 per cent (red).

Almost all the sections on the map in Figure 8.33 are blue, implying that almost all sections on the major routes are operating at capacity utilisation greater than 100 per cent. So, almost all bulk commodity routes face major delays due to congestion. This is particularly relevant for transport of coal over long distances which makes extensive use of the high density network, and for transport within coal-bearing states and to neighbouring states, as some of this transport may occur over short sections of these trunk routes.

INDIAN RAILWAYS PLANS HIGH DENSITY CORRIDORS

Indian Railways recognised the problem several years back and has proposed construction of dedicated freight corridors (DFCs), shown in Figure 8.34. Six DFCs totaling 9,538 km have been proposed:

(a) Western DFC (Delhi-Mumbai) 1,534 km.
(b) Eastern DFC (Ludhiana-Kolkata) 1,839 km.
(c) East West DFC (Howrah-Mumbai) 1,976 km.
(d) East-Coast DFC (Kharagpur-Vijaywada) 1,097 km.
(e) South DFC (Chennai –Goa) 902km.
(f) North South DFC (Delhi-Chennai) 2,190 km.

Of these, the first two are already under construction and pre-feasibility studies have been carried out for the others. Figure 8.35 shows the impact of the DFCs on the trunk routes for the transport of bulk commodities. While many of the sections will no longer be congested (blue), there will still be some, shown in red and yellow, that will be congested and will require capacity augmentation.

Table 8. 23

Expected Long Distance Movement of Domestic and Imported Coal on DFCs for the Power Sector

[Million tonne]

YEAR	EASTERN	WESTERN	EAST-WEST	NORTH-SOUTH	EAST COAST	SOUTHERN	TOTAL - ON ROUTES COVERED BY DFCs
Base Case							
2012	88	6	23	30	22	0	170
2021	124	14	57	23	13	0	231
2031	211	30	30	33	15	0	319
Low Case							
2012	88	6	23	30	22	0	170
2021	99	1	62	36	25	0	223
2031	207	9	78	0	12	0	306
High Case							
2012	88	6	24	30	22	0	171
2021	105	18	60	23	3	0	209
2031	212	31	37	8	8	0	297

Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

SCHEDULE FOR DFCs

The Western DFC and Eastern DFC are under construction and scheduled to be completed by 2017. The other four DFCs have been proposed. Not yet approved, they could be completed earliest by 2023.

Table 8.23 shows the approximate volumes of domestic and imported coal likely to be transported over long distances on DFCs. Movement of coking coal is not included because most of it occurs within iron ore-rich states.

In the next decade, about half the long-distance transport of coal will take place on the Eastern DFC. By 2031-32, it will account for two-thirds. The Western DFC will carry imported coal mostly from Gujarat to the Northern and North-Western states. The East-West, East Coast and North-South DFCs will carry about the same amount of coal as one another but much less than the Eastern DFC. The Southern DFC is expected to carry almost no coal.

Therefore, for long distance transport of coal the Eastern DFC is far more important than the others and it should be given the highest priority. The traffic on the Eastern DFC will be highest closest to the coal-fields and will decrease as coal is unloaded at successive states on the route to the farthest state. This would also apply to the other DFCs. Another reason for focusing on the Eastern end of the DFCs is that transport of coal within coal-producing states and to neighbouring states is likely to use sections of DFCs that are short but the volume of traffic can be high. Almost all the use of short sections of DFCs will occur in the eastern part of the country.

Given the size of the DFC projects and the associated challenges, delays are possible, particularly in the remaining four which await approval. Given the time it will take to make the DFCs operational, even if there are no delays, the traffic will grow and some short-term augmentation will be required. Otherwise, the existing infrastructure will be strained to breaking point. This situation doubles the challenge because short-term measures are needed along with long-term. Given the limited resources, creative solutions will need to be found to ensure that there is no unnecessary duplication of efforts and expenditure. It could be that the augmentation will support increase in passenger traffic on these corridors once freight shifts to the DFCs.

RAIL FEEDER ROUTES AT MINES AND PLANTS

Feeder routes are critically important for the effectiveness of the bulk transport system, particularly at the source end, because they bring the material (coal or iron ore) up to the trunk route that then carries it to its destination. Inadequate transport capacity on these routes will have wide repercussions for the power and steel industry.

Table 8. 24
Critical Feeder Routes for Coal

RAIL LINK	DISTANCE (KM)	COST (MILLION RS)	DATE STARTED	INITIAL PROJECTED END-DATE
North Karanpura Coalfield – JH, Tori-Shivpur-Hazaribagh, New BG line	92	6,210	2000	31.12.2012
North Karanpura Coalfield – JH, McCluski-ganj-Piparwar New BG line	30.5	1,420	1990	SEP-11
Mand-Raigarh Coalfields – CH, Bhupde-opur-Baroud-Durgapur	91	31,,00	Approved	MARCH 2018
Ib Valley Coalfield – Odisha, Barpali-Jhar-suguda-Gopalpur- Manoharpur Tract	52.4	4700	2006	31.03.2012
Talcher Coalfield – Odisha, Jarpada-Angul - Talcher Rail Corridor	87	To be estimated	To be approved	NA
Talcher Coalfield – Odisha, Radhikapur West Block – Angul Rail Corridor	50	To be estimated	To be approved	NA
Talcher Coalfield – Odisha, Talcher – Dhamra Port via Bhadrak[3]	150	To be estimated	To be approved	NA
Singareni Coalfield – AP, Bhadrachalan Rd – Sattupalli	52	3,600	To be done on PPP basis	NA
TOTAL	**605**	**35,100**		

Note: For the purpose of calculating total costs for routes where costs are yet to be estimated, it was assumed that the cost would be the average cost of the other routes in Rs million/km.
Source: Ministry of Coal (2012).

Feeder routes at the destination end bring the material from the trunk route to the destination plant. They are not much of a problem because the transportation capacity required for a single plant is comparatively low. However, power plants in coal-producing states are likely to come up in clusters of about 4000 MW at locations not yet known, and are likely to require new rail lines directly from mines.

FEEDER ROUTES AT MINES

Most of the increase in coal production is expected to come from three regions: (1) Talcher and Ib Valley coalfields in Odisha with a potential increase of 110 Mtpa by 2031-32; (2) North Karanpura coalfields in Jharkhand with a potential increase of 75 Mtpa; and (3) Mand-Raigad coalfields in Chhattisgarh with a potential increase of 90 Mtpa. Table 8.24 gives a list of the critical routes in these areas. Early implementation and completion of these rail connectivity projects is important if the need for domestic coal for power is to be met in the coming two decades. As the table shows, some action has been taken by the Railways on several of these projects but much more needs to be done.

For example, the project to construct a new broad gauge line for the North Karanpura coalfield from McCluskiganj to Piparwar was started way back in 1990. IRCON was awarded the contract but it left the job in 2002. Another five years went by before RITES was hired to complete the work. The new completion date was September 2011 but the work is still on. The Tori-Shivpur-Hazaribagh line, also in North Karanpura coalfield, was started in 2000 and had a scheduled completion date of end of 2012 but only 410 million of the Rs 1500 million payment made to the Railways has been utilised. The 40-km single line rail corridor between Angul and Talcher is mostly complete but has been held up because of land acquisition issues for a 4-km stretch.

On the other hand, there are several projects such as the extension of the Bhupdeopur-Baroud-Bijari-Durgapur double line which have not even been started. For some of them, even cost estimates have yet to be made.

As Table 8.24 shows, the combined length of these links is about 600 km, estimated to cost Rs 35 bil-

3. The new line, Angul-Sukinde, has been sanctioned. The Sukinde-Bhadrak line exists but if a new line is required, then approval will be needed.

Table 8. 25
Critical Feeder Routes for The Iron and Steel Industry

STATE	NAME OF THE PROJECT	DISTANCE (KM)	COST IN RS. MILLION (2011-12)
	NEW LINE		
Odisha	Angul-Sukinda Road (Suppl.)	99	6,390
Jharkhand	Hansdiha-Godda	30	2,670
Andhra Pradesh	Bhadrachalam Road-Sattupalli	56	3,380
Chhattisgarh	Dallirajahara-Jagdalpur	235	11,050
Tamil Nadu	Attipattu-Puttur	88	4,470
Karnataka	Kottur-Harihar via Harpanhalli	65	3,540
Karnataka	Hubli-Ankola (Suppl.)	167	3,380
	DOUBLING		
Odisha	Sambalpur-Titlagarh	182	9,510
Odisha	Sambalpur-Talcher	174	6,790
Odisha	Banspani-Daitari-Tomka-Jakhapura (Suppl.)	180	9,430
Odisha	Barbil- Barajamda	10	525
Odisha	Bimalgarh- Dumitra	18.3	1,157
Odisha	Banspani-Jaruri	09	910
Odisha	Champajharan- Bimalgarh	21	1,511
Odisha	Brundamal-Jharsuguda flyover connection to join DN Line (Suppl.)	-	880
Andhra Pradesh	Vizianagram-Kottavalasa 3rd line	35	1,950
Chhattisgarh	Sailari-Urkura	25	730
Chhattisgarh	Kirandul-Jagdalpur	150	8,270
	Raipur-Titlagarh incl. NL Mandi Hasaud-Naya Raipur (20 km) and new MM for conversion of Raipur (Kendri)- Dhamtari & Abhnapur-Rajim branch line(67.20 km)		
Maharashtra	Chandrapura-Rajabera-Chandrapura-Bhandaridah	11	350
Bihar	Kajra-Kiul (Suppl.)	16	480
Jharkhand	Barharwa-Tinpahar	17	750
Jharkhand	Rajkharsawan- Sini- 3rd line	15	916

(Contd...)

STATE	NAME OF THE PROJECT	DISTANCE (KM)	COST IN RS. MILLION (2011-12)
Jharkhand	Sini- Adityapur 3rd line	22.5	953
Jharkhand	Bhojudih- Mohuda	23	1,342
Jharkhand	Goelkera- Manoharpur 3rd line (Chakradhpur- Bondamunda Section)	40	2,717
Jharkhand	Dongaposi- Rajkharsawan 3rd line (Suppl.)	75	3,094
Jharkhand	Tinpahar-Sahibganj as PH-I of doubling of Tinpahar-Bhagalpur	38	1,680
Jharkhand	Sahibganj-Pirpaniti	11	1,300
Jharkhand	Padapahar- Banspani	32	1,553
West Bengal	Rajgoda - Tamluk - Phase- II of Panskura- Haldia Doubling	13.5	869
West Bengal	Panskura - Kharagpur 3rd line (44.7km) with new MM Panskura - Ghatal(32.8 km) NL 11-12	77.5	5,292
West Bengal	Chinpai-Sainthia, Prantik-Siuri	32	5,960
West Bengal	Gokulpur- Midnapur New Bridge on diversion alignment with substructure & steel super structure on Bridge No,143	2	521
Chhattisgarh	Salkar Road-Khongsara Patch Doubling	26	1,439
Chhattisgarh	Khodri- Anuppur with flyover at Bilaspur	61.6	3,855
Chhattisgarh	Bypass at Champa	14	376
TOTAL		**2,341.4**	**117,413**

Note: For the purpose of calculating total costs for routes where costs are yet to be estimated, it was assumed that the cost would be the average cost of the other routes in Rs million/km.
Source: Ministry of Coal (2012).

lion. The Railway Plan in the 12th Plan has been estimated at Rs 5,200 billion (Bansal, 2013). The amount required for these critical feeder routes for coal is about 0.7 per cent of the total Railway Plan. Given that these links are essential for the transport of the most of the additional coal that is going to be produced in the coming two decades and the relatively low investment required, these links must be given top priority and be completed within this Plan.

Listed in Table 8.25 are rail connectivity or capacity augmentation projects for the iron and steel industry that are awaiting completion.

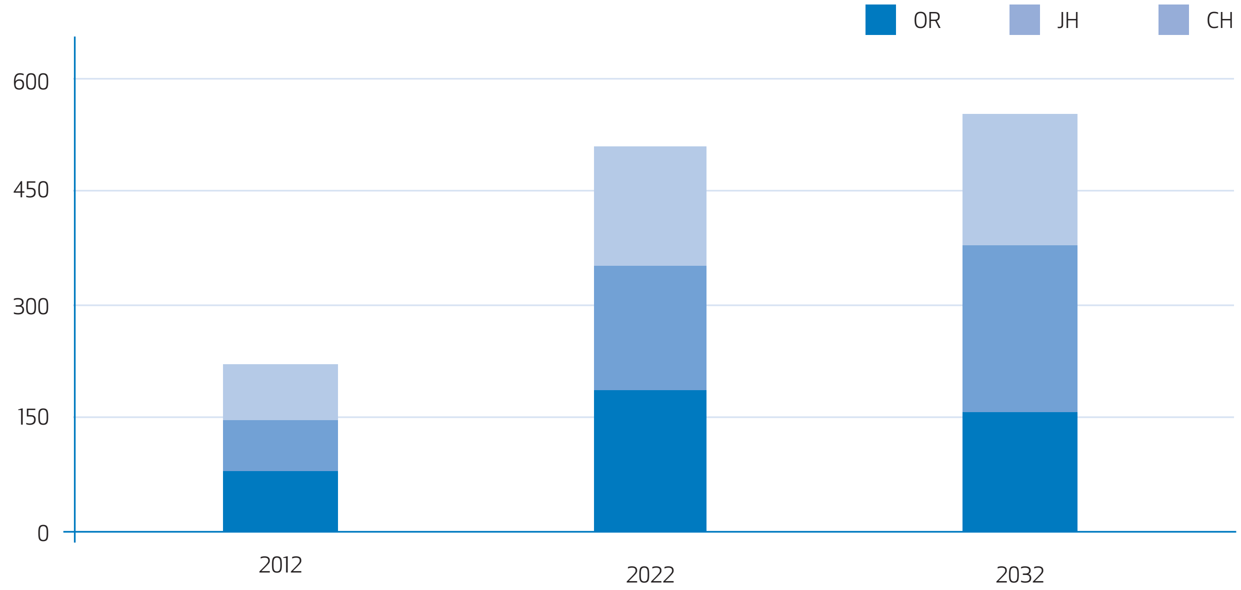
The combined length of these links is about 2,340 km and the total cost is estimated at Rs 117 billion, about 1.7 per cent of the total Railway Plan for the 12th Plan. As with the critical feeder routes for coal, these links are essential for the transport of iron ore. They must be given top priority and be completed within this Plan for the unhindered growth of the iron and steel industry. They should be designed to handle 25-30-tonne axle load so that the capacity of the lines is effectively increased.

The major reasons for the delays in providing these links are (MoS, 2012:15):

- Difficulties in acquiring land and delays in clearances
- Projects are initiated only if they meet stringent requirements of guaranteed minimum traffic to enable Railways to earn a minimum return on its investments. Private participation by steel plant owners may be one way to solve this problem.
- Rail projects have a long gestation period and more advance planning needs to be done so that railway infrastructure grows as there is economic growth in the region.

These critical feeder routes should be completed as soon as possible.

Figure 8. 36
Coal Production from Tri-State Region
[Million Tonne]



Source: Report of the Working Group on Bulk Transport.

FEEDER ROUTES TO POWER PLANTS

In-state consumption of coal for power is likely to increase and much of this new capacity will come up in clusters of about 3000-4000 MW each.Such power plants will need to be located not only near coal mines but also near sources of water. It is difficult to predict where these clusters of power plants will come up. In any case, feeder routes from the mines to the power plants will need to be provided. These links will be 70-100 km long and will be required to carry about 20 Mtpa[4]. They should be designed for heavy-haul technology where a rake per day carries 4 Mtpa. Some of these feeder routes may overlap, to some extent, with each other or the feeder routes that bring coal from the mine to the trunk route.

Consumption of domestic coal within coal-producing states is expected to grow at about 24 Mt per year. Assuming that half of this will be used in power plant clusters and the other half in pit-head plants, roughly one such feeder route to a cluster of power plants will be required every other year. Given that most of the increase in production of coal is expected to occur in the tri-state region of Odisha, Jharkhand and Chhattisgarh, about one such feeder route will be required in each of the three states every six years.

NEED TO FOCUS ON TRI-STATE REGION OF ODISHA, JHARKHAND AND CHHATTISGARH

As Tables 8.24 and 8.25 show, most of the critical feeder routes lie in Odisha, Jharkhand and Chhattisgarh as steel plants and mineral resources, particularly coal and iron ore, are concentrated in these states. In spite of the importance of these states, the development of the rail network has been inadequate.

These states produce more than half of the domestic coal used in the country and are expected to produce about two-thirds of it by 2032 (Figures 8.35 and 8.36). In addition, a quarter of the country's steel production is going to be located in Odisha by 2016-17, a share that will remain constant for the next two decades. Together, these states will have more than half the steel capacity of the country.

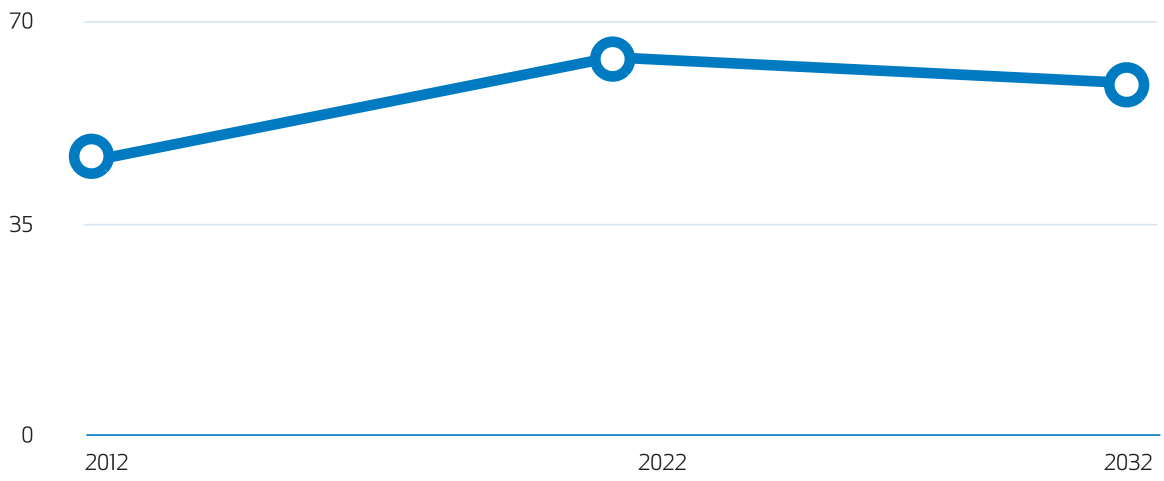
PRIVATE PARTICIPATION IN RAIL CONNECTIVITY PROJECTS

While the need for rail connectivity for previously unconnected areas is growing, Railways faces resource constraints to fulfill these demands. Therefore, Indian Railways has been working on ways to attract participation of the private sector, to provide an alternative source of funding. The first policy was Railways' Infrastructure for Industry Initiative (R3i) issued in July 2010, but it was not applicable to lines from coal and iron ore mines. In February 2011, Railways introduced a second policy, Rail Connectivity to Coal and Iron Ore Mines (R2CI). More recently, on 10 December 2012, the Cabinet Committee on Infrastructure approved a new policy on participative models for rail connectivity and capacity augmentation. This supersedes R3i and R2CI.

IR has formulated five participative investment models for its existing shelf of projects and for new projects (MoR, 2012):

4. A 1000 MW power plant requires about 5 Mtpa of domestic coal.

Figure 8. 37
Contribution of Tri-State Region to National Coal Production
[per cent]



Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

1. **Non-Government Railway Model.** This model is designed for developing feeder routes at source and destination. The project developer is responsible for land acquisition, project development and construction with no financial input by IR. The project developer will be paid 95 per cent of the net income from the project.
2. **JV Model** for operationally necessary/bankable sanctioned/to be sanctioned railway projects. This model is for bankable new line or gauge conversion projects that have clearly identifiable stakeholders such as users of the line or ports, mines, exporters, plants or state governments. The JV will include the Railways and these stakeholders. The JV will get a portion of the freight revenue.
3. **Railway Projects on BOT** awarded through competitive bidding, where the viability gap funding required would be the bidding parameter. This model is designed for cases where it may not be possible to identify stakeholders who will take the lead in making investments. An example is a long rail corridor where revenue is generated from multiple streams. Here the concessionaire will provide the funding and will be paid a user fee based on 50 per cent of the apportioned freight.
4. **Capacity Augmentation with Funding Provided by Customers.** This model is for those cases where some potential beneficiaries of a capacity augmentation project (doubling, multiple lines etc.) are willing to fund the project in order to expedite it. The funds with associated interest will be returned to the customers through rebate on freight charges.
5. **Capacity Augmentation with Annuity.** This model is for cases where it is not possible to get funding from a specific user. Here, the concessionaire would be paid through an annuity.

State governments can participate in any of these models. If they participate through the first and second models, they can bid out the projects.

The five cases cover most of the circumstances under which private investment could accelerate the development of rail infrastructure. IR will remain a key player even with private participation, carrying out the following functionsSuccess of the new PPP policy will depend on how well IR is able to execute these functions.

- Certification of the lines in all cases, and in some cases even supervision of the construction.
- Supervision and certification of the maintenance of the lines.
- Operation of the rail networkwith its rolling stock.
- Collection of freight charges and disbursal of payments to the private parites as per the terms of the specific agreement.

Large integrated producers of steel or large mining companies can enter into these PPP arrangements, but smaller parties may find it difficult to do so. Institutional mechanisms will need to be developed to facilitate coordination among SMEs and large firms in the same area to pool their resources to create common infrastructure (MoS, 2012).

FIRST MILE CONNECTIVITY

ROAD CONNECTIVITY FROM MINE TO RAIL SIDING

Coal and iron ore are generally transported from mines to the nearest rail siding by road. In many cases the evacuation of material is hampered by the following factors: (1) lack of adequate and appropriate material handling infrastructure at the mine and at the rail siding; (2) inadequate road capacity from the mine head to the railway siding; (3) occasional shortage of railway rakes.

Efforts are being made to augment material loading and unloading facilities and increase road transportation capacity. The shortage of rail rolling stock is often a seasonal issue which is exacerbated by congestion on the lines. As capacity constraints are removed, it will also mitigate the shortage of rolling stock to some extent. Creation of road infrastructure takes time. Advance planning, though rarely done, is essential to develop the required roads for movement of coal from mine-heads to rail-heads. It has also been suggested that the existing fair-weather roads in high-growth coal fields, particularly where captive coal blocks are expected to become operative, be converted into all-weather express coal corridors (MoC, 2011).

Due to the poor quality of road transportation, the loading at rail sidings shows an annual pattern: it peaks during winter and declines during summer and monsoon. The mine company is unable to utilise the rail capacity optimally, and the unused capacity is lost. Railways estimates that the drop in loading results in a loss of about 50 rakes per day for a substantial part of the year (Roy, 2012).

Further, because the coal from the mines in the traditional coal fields has to be moved through heavily-populated villages, and is vulnerable to blockage and other disturbances due to socio-political events, the following suggestions have been made about transportation from mine-heads to rail-heads (MoC, 2011).

1. Wherever possible, long-distance conveyor belt systems should be used. This will reduce the environmental impact of road transport.
2. Siding rationalisation plans should be developed.
3. Coal mining companies should consider developing a hub-based system for transporting coal from existing mines wherever feasible.

MERRY-GO-ROUND (MGR) SYSTEMS

Most pithead plants, particularly the large ones, get their coal using merry-go-round (MGR) systems. Almost 20 per cent of the country's domestic coal is transported by MGR. As a greater percentage of coal will be used within the producing state, the share of movement by MGR will grow. Therefore, it is important that this mode of transport is also efficient.

> Evacuation of coal and iron ore is hampered by lack of adequate and appropriate material handling infrastructure at the mine and at the rail siding; inadequate road capacity from the mine head to the railway siding; occasional shortage of railway rakes.

Sometimes there is a delay in the development of the mining and the MGR system, and the power plant is completed before one of the two is functional. In such cases, as a stop gap measure, coal is brought from another location in case of delay in the mine. Or Indian Railways is asked to transport coal from the mine in case of delay in the MGR system. Such stop-gap arrangements become difficult to get out of due to socio-political reasons. Therefore, synchronisation between the development of the pithead power plant and the mine and transport system is critical (MoC, 2011).

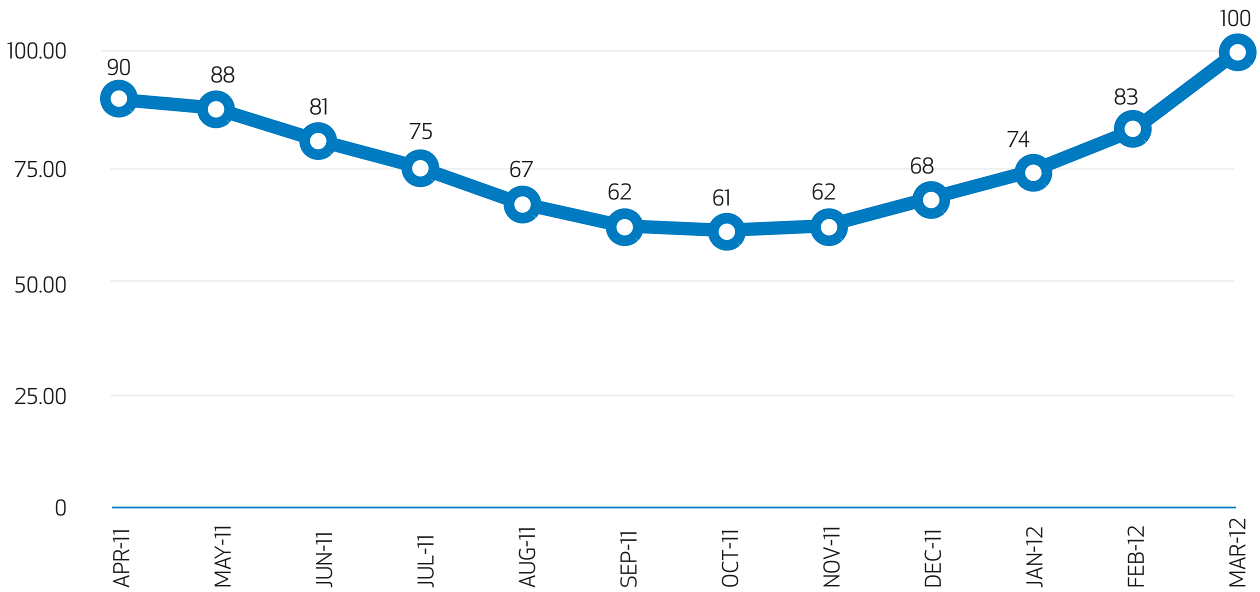
In addition, Indian Railways states that often pithead plants with MGR require augmentation of their coal supplies by Indian Railways. But often the MGR systems are not designed for handling rakes from outside (Roy, 2012). This results in delays. When pithead plants are proposed in the future, the MGR systems should be designed to handle rakes from the Indian Railways. Indian Railways can operate the MGR systems at lower cost because of its expertise on rail systems.(Roy, 2012). Therefore, it is suggested that Indian Railways be involved as a partner in the running of MGR systems.

LAST MILE CONNECTIVITY

Transport of unsized coal sometimes results in delays in unloading, especially of bottom discharge wagons, because large pieces get stuck. Sizing of coal before dispatch would avoid this problem and ensure faster unloading of rakes. It would also increase the carrying capacity of wagons through better compaction. Sometimes there are delays in unloading because the material handling system at the receiving power plant cannot handle all types of wagons. Either a power plant should be designed to handle a particular type of wagon and only that type of wagon should be sent to that power plant, or all power plants should be capable of handling all types of wagons–bottom discharge, tippler, etc. While the first option may be more economical from the perspective of the power plant, it may not be feasible, given the limited rolling stock available with the Railways. In either case, the turnaround time of rakes at power plants would be greatly improved.

There is also a need to improve the bunker, conveyor belt and stacking capacities at power plants. As the tonnage per train discharged at the power plant increases, bunkers will need to be emptied and their

Figure 8. 38
Month-Wise Pit-Head Closing Stock of Coal in 2011-12 [Per cent]



Source: Coal Controller's Organisation (2012).

content stored at the power plant site. Otherwise, overfull bunkers will become a bottleneck slowing down the unloading of trains. Therefore, additional stacking capacity will be required.

BUILD-UP OF COAL STOCKS AT PITHEADS

There has been concern about the build-up of coal stocks at the pitheads of mines awaiting transportation while, ironically, there is a shortage of coal at many power plants (Business Today, 2012).

Coal production and road transportation to rail sidings follow a pattern over the year where they peak during the winter months and decline during the summer and monsoon season. Railways is unable to meet this wide variation in demand and consequently pithead stocks peak in the winter months and decline in the summer and monsoon months (Figure 8.38).

Pit-head stocks are the cumulative effect of a mismatch between production and the amount transported by Railways.

About 45[5] Mt of coal is lying at pitheads (WG report). Such an annual build-up indicates that there is no spare capacity in the rail transport system. It is an early warning that the rail network or the amount of rolling stock or both are operating at their full capacity.

Currently we are at a low-level equilibrium where production of coal is not increasing or is increasing very slowly and the transport system is almost able to keep up. But if the amount of coal produced at the mines increases, as would be desirable, then there may not be sufficient capacity in the transport system to move that coal to power and steel plants. The transportation system will become a bottleneck, blocking the value of increased production from benefitting the economy.

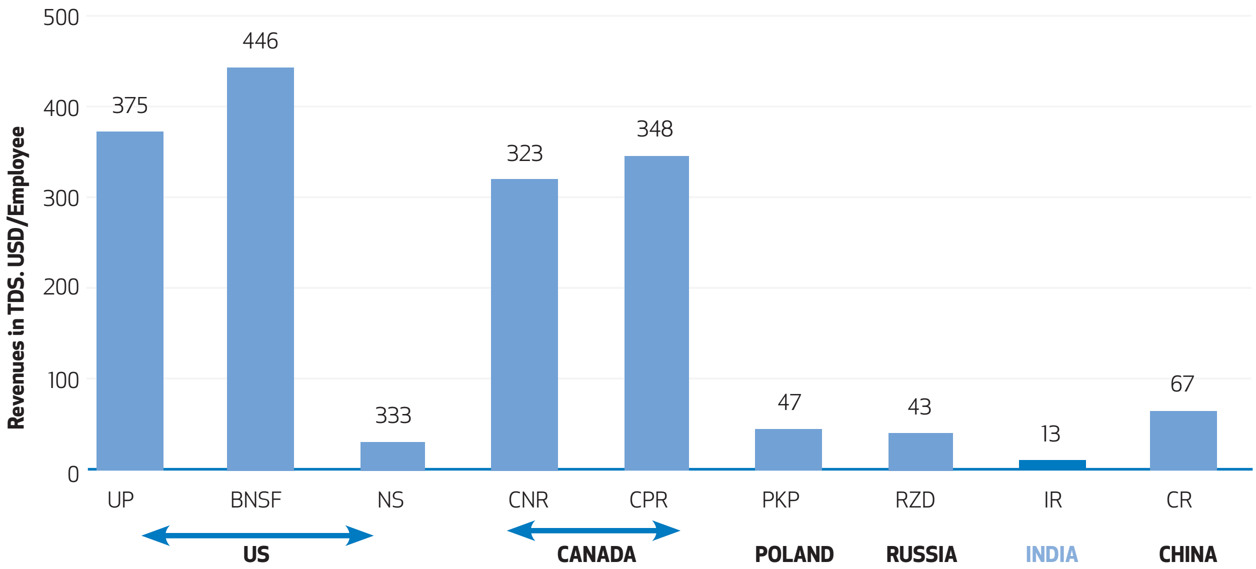
RAIL EFFICIENCY AND TECHNOLOGY IMPROVEMENTS

Freight transportation in India is far less efficient than in other countries. Figures 8.38 and 8.39 compare two indicators of efficiency of India with a peer group of countries. India's staff efficiency, measured in revenues per employee, is the lowest. It is only $13,000 per employee compared with the best of $446,000 per employee. Wagons in India provide transportation of 2.4 Mt-km per year, much lower than the best of about 12.4 Mt-km.

Transportation cost is a large fraction of the price that the customer pays. For states that are far from coal mines, rail transportation can often be more than the price of coal at the mine-mouth, effectively more than doubling the cost of fuel for power plants. Therefore, it is important that the transport cost be kept low. Furthermore, the Railways' main competitive advantage is its lower cost. It must keep costs low or its market share will erode even faster than it already is.

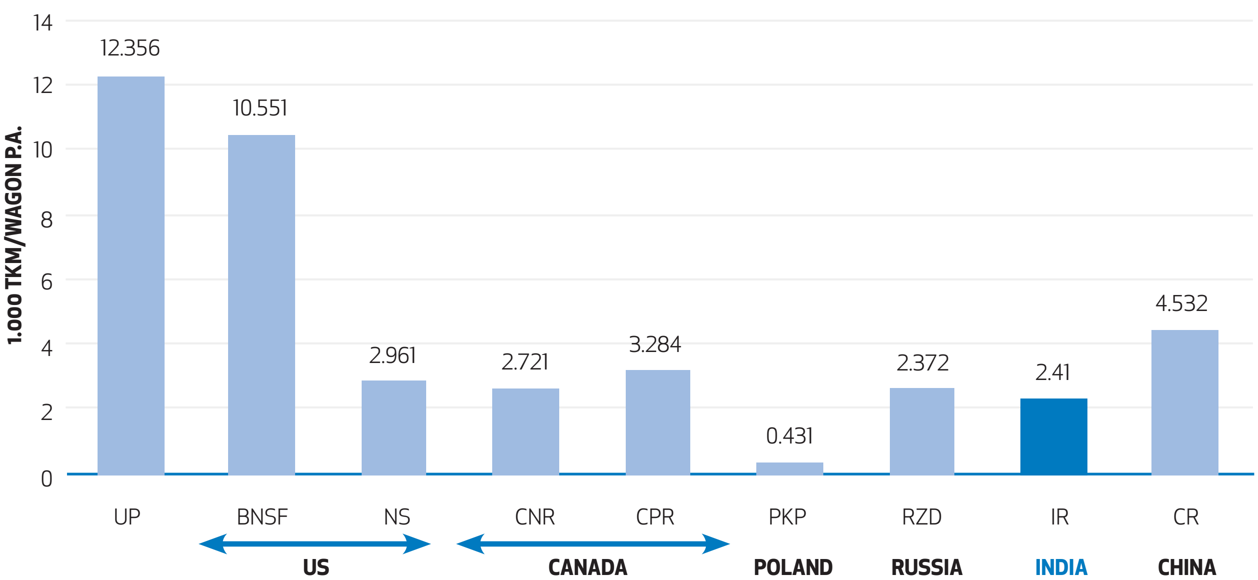
5. This number is the minimum stock and is about 60 per cent of the maximum pithead stocks reported for 2011-12. For year-by-year comparison of pit-head stocks, we think that the minimum stock for the year is a more appropriate measure of the annual mismatch between transportation requirement and capacity.

Figure 8. 39
Comparison of Staff Efficiency of Railways in Select Countries



Source: Jahncke (2012).

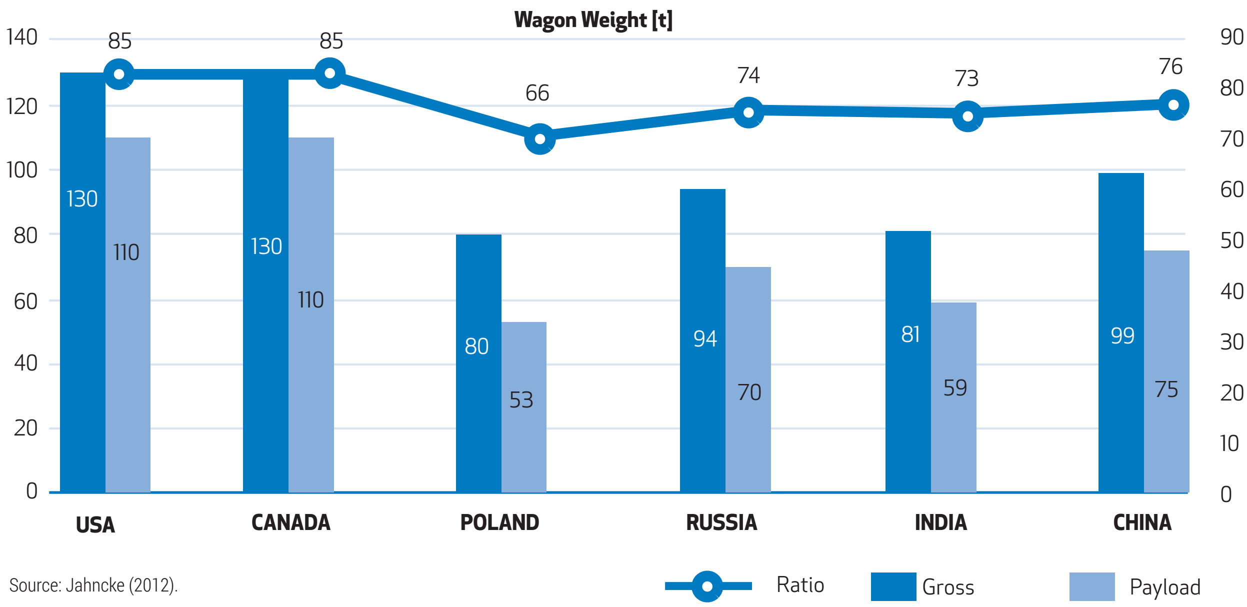
Figure 8. 40
Comparison of Wagon Efficiency in Select Countries



Source: Jahncke (2012).

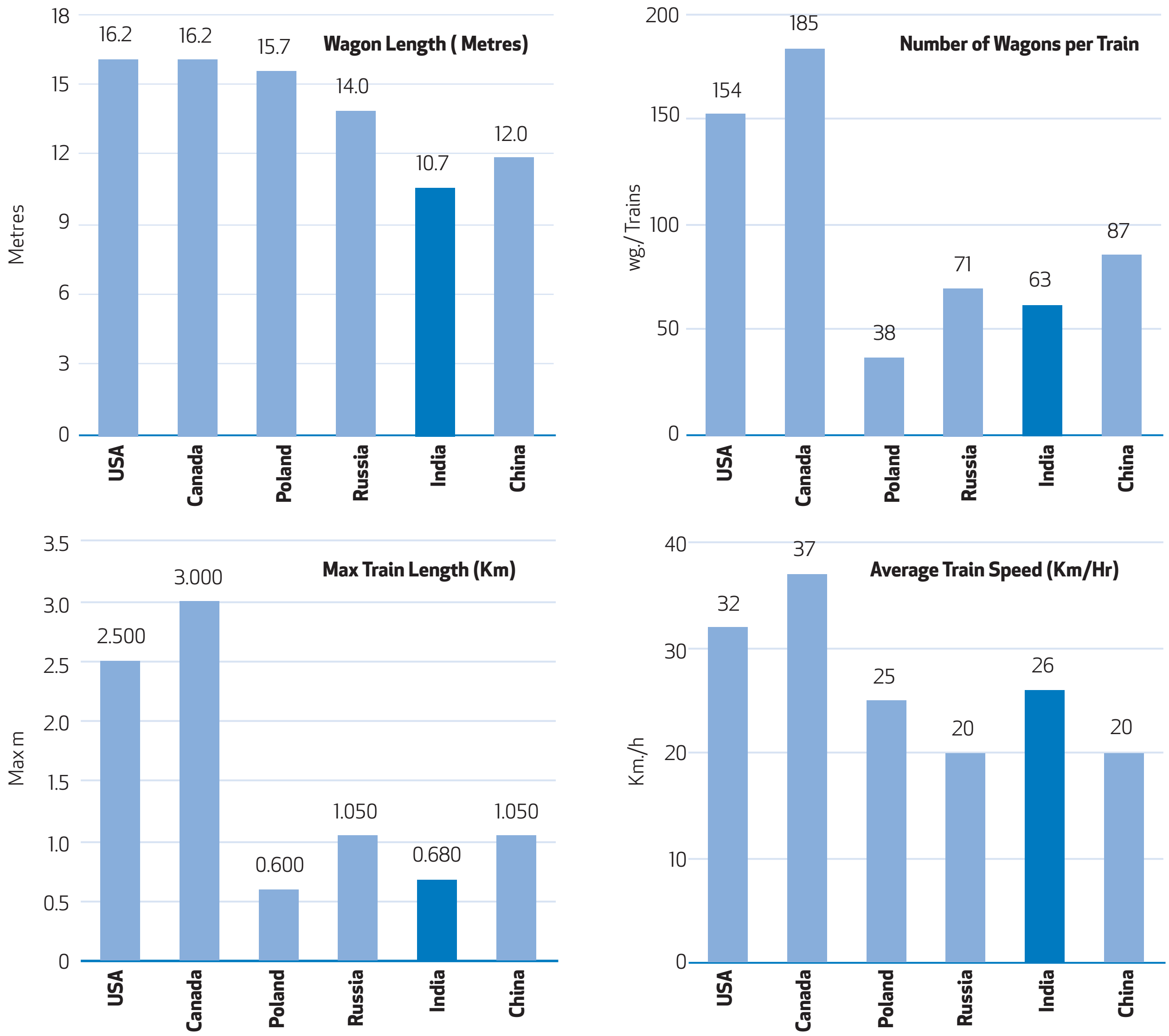
Transportation costs per tonne can be lowered by using well-loaded trains with a high net weight to gross weight ratio. Indian trains are comparable on most loading parameters with trains in Poland, Russia and China but not with trains in USA and Canada. For example, Figure 8.41 shows that Indian wagons have a net to gross ratio of 73 per cent which is significantly lower than the world's best of about 85 per cent. This means that Indian wagons are spending a larger fraction of fuel to carry the weight of the wagon itself. Further, the Indian trains, with a maximum length of 680 metre, are much shorter than trains in the US and Canada which can be as long as 2.5 to 3 km (Figure 8.41). The problem is compounded by the lower average speed of Indian trains (26 kmph) compared to the speeds in US and Canada (32-37 kmph) (Jahncke, 2012).

Figure 8. 41
Comparison of Wagon Weight and Payload to Gross Weight for Select Countries



Source: Jahncke (2012).

Figure 8. 42
Country-Wise Comparison of Components of Loading Level of Trains



Source: Jahncke (2012).

Table 8. 26
Required Investment in Rolling Stock and Terminals to Carry Additional Bulk Materials

CATEGORY OF INVESTMENT	12TH PLAN	13TH PLAN	14TH PLAN	15TH PLAN
Increase in thermal coal transported by end of each FYP (Million tonne)	187	264	251	250
Increase in iron ore transported by end of each FYP (Million tonne)	77	129	180	210
Increase in coking coal transported by end of each FYP(Million tonne)	30	49	68	77
Total increase in bulk material transported by end of each FYP (Million tonne)	294	442	499	537
Required investment in rolling stock and terminals (Rs Billion)	441	663	749	806

Note: It is assumed that each additional Mtpa to be carried will require investment of Rs 1500 million (For details see Annex III. 6.2 of the Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Indian Railways is planning to address these issues. The report of the Working Group on Railways for the 12th Plan discusses a strategy of 'heavier, longer, faster' which includes the following measures (MoR, 2012):

- Use of 25-tonne axle load wagons for iron ore, and planning for 30-tonne axle load
- Moving overall regime from 22.8 tonne to 23.5 tonne axle load.
- Greater use of long haul trains. As an interim measure, on some sections, Indian Railways is running two trains in tandem, effectively as one train to reduce the impact of capacity constraints (Roy, 2012).
- New rolling stock and infrastructure is being designed so that trains will run at 100 kmph empty and 75 kmph when loaded. Efforts are ongoing to make fully-loaded trains run at 100 kmph.

However, in order to carry the much higher volumes of bulk commodities over the next two decades, Indian Railways will have to take big strides in improvements of transport infrastructure. The focus should be on:

- Infrastructure enabling higher axle loads;
- Specialised wagon and loading technology;
- Longer trains.

INVESTMENT REQUIRED

PRIORITISATION OF INVESTMENTS IN RAIL NETWORK

Given the limited resources available for further development of the railway network, prioritising should be on two principles: (1) route developments that have the highest impact; and (2) urgently-required route developments over those where the requirement is expected sometime later.

Based on these two principles, we suggest the following priorities:

1. **Critical Feeder Routes for Coal and Iron & Steel.** All the additional coal or iron ore that is to be transported by rail will make use of these feeder routes. A delay in providing these routes will affect availability of coal and iron ore for the entire country.
2. **Construction of DFCs Starting from Eastern End.** Construction of DFCs must start at the end located in the coal-bearing region because (1) coal-bearing traffic will be the highest nearest to the coal region and (2) transport of coal within coal-bearing states or to neighbouring states is likely to use short sections of the DFCs.
3. **Highest Priority to the Eastern DFC.** The Eastern DFC must get very high priority because it is likely to carry 50-70 per cent of the coal traffic to distant states from the coal-source states. Therefore we suggest that the Eastern DFC be built within the 12th Plan. The Western DFC is required for container traffic (not discussed here) and is already slated for completion by the end of the 12th Plan. However, because it is not as important for movement of bulk materials, we suggest that about 80 per cent of the investment be done in the 12th Plan and the remaining 20 per cent in the 13th Plan. The E-W, East Coast and N-S DFCs, are scheduled to be operational by the end of the 13th Plan. To keep the investment in the 12th Plan from becoming burdensome, we suggest

Table 8. 27
Suggested Plan-Wise Investment for Railways
[Rs Million]

CATEGORY OF INVESTMENT	12TH PLAN	13TH PLAN	14TH PLAN	15TH PLAN
Critical Feeder Routes-Coal	31,500			
Critical Feeder Routes-Iron and Steel	117,400			
Feeder Routes for Power Plant Clusters	25,000	25,000	25,000	25,000
Eastern DFC	459,750			
Western DFC	268,450	115,050		
E-W DFC	164,667	329,333		
East Coast DFC	91,417	182,833		
N-S DFC	182,500	365,000		
Southern DFC			112,750	112,750
Additional Augmentation		1,157,173	1,157,173	1,157,173
Rolling Stock and Terminals	441,385	663,000	748,500	805,500
TOTAL	**1,782,068**	**2,837,390**	**2,043,423**	**2,100,423**

Note: The required investment for rolling stock and terminals is for coal and iron ore only. However, the investments for DFCs and the additional augmentation are for all commodities because it is difficult to separate the investment by commodity.
Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

that only a third of the investment be made in the 12th Plan and the remaining investment and construction take place in the 13th Plan. As the Southern DFC is not important for movement of bulk commodity, we suggest that it be shifted to the 14th and 15th Plans.

4. **Additional Augmentation.** We have removed the critical feeder routes from this list because the critical feeder routes will be covered in the 12th Plan. We suggest the remaining augmentation be spread out evenly over the 13th-15th Plans, with augmentation to routes closest to the coal and iron-ore regions getting priority.

INVESTMENT IN RAILWAYS FOR BULK TRANSPORT

Investment in the railways includes: (1) investment in rolling stock and (2) investment in the rail network. First we estimate the required investment in rolling stock and terminals. As the amount of bulk material that needs to be transported increases, the number of wagons, locomotives and terminals will have to increase. We estimate an investment of about Rs 1500 million in rolling stock and terminals for each additional Mtpa to be carried. We estimate the increase in the bulk material to be transported in the terminal years of the next four Five-Year Plans as shown in Table 8.26.

Next we look at the total investment required for transporting bulk materials by rail. Based on the principles of prioritising investments described in the previous section, we suggest the Plan-wise investment for the Railways given in Table 8.27

INFRASTRUCTURE REQUIREMENTS AND INVESTMENT PLANNING FOR PORTS

As shown in Table 8.28, the traffic at ports for thermal and coking coal and POL will grow dramatically in the next two decades. Will our ports be able to handle the traffic given that many are already stretched to capacity? Efforts are being made to improve the performance of Indian ports. However, in addition to port-wise development plans, a comprehensive strategy needs to be evolved for the port sector.

There are also issues of how poorly our ports compare with international benchmarks of performance. Perhaps, most importantly, the level of con-

Table 8. 28
Projected Port Traffic for Coal and POL[6]
[Rs Million]

COMMODITY	2011-12	2016-17	2021-22	2026-27	2031-32
Thermal Coal	97	142	224	340	423
Coking Coal	32	65	108	173	238
POL	329	475	572	702	864
Total	**458**	**682**	**904**	**1,215**	**1,525**

Note: Port traffic includes movement by coastal shipping. Because coastal shipping adds to the traffic at both the origin and destination port, the additional traffic due to coastal shipping is twice the volume of material transported.
Source: Earlier tables in this chapter.

nectivity of the ports to the hinterland needs to be considered because even the most modern and best-performing port would be useless if it lacked sufficient connectivity to the destination of materials to be imported.

Before the ban by the Supreme Court, exports of iron ore were increasing dramatically. Over the nine-year period from 2000-01 to 2009-10, they increased over threefold. In 2009-10, about 53 per cent of the iron ore produced was exported. There was a decline in 2010-11 because of the Supreme Court ban. According to the Ministry of Steel, because the iron ore resources are ultimately limited, the resources should be conserved for the domestic steel industry. Therefore, development of additional mining capacity should be undertaken in a 'well-calibrated' way so that excess capacity does not result in an incentive to export, while ensuring that iron ore is available for the domestic steel industry as it expands. Keeping this in mind, we have not focused here on transportation requirements for export of iron ore.

PORT CAPACITY

India's ports are stretched to their capacity. As Figure 8.43 shows, the capacity utilisation of the major ports averages around 85 per cent, with at least four operating at a utilisation of 100 per cent or more. International norms recommend that capacity utilisation be below 70 per cent to avoid delays.

Commodity-wise capacity utilisation for coal and POL which is of greater interest here is shown in Figures 8.44 and 8.45. Unfortunately, capacity utilisation for coal is available for only four major ports, but for POL we have more complete data. These commodity-wise capacity utilisation figures reaffirm the same picture of ports stretched to capacity. For coal, three out of four ports have capacity utilization above 80 per cent while the international norm is 70 per cent. For POL, about half the major ports have capacity utilisation above 70 per cent.

PORT PERFORMANCE

The lack of capacity at the ports and consequent congestion and delays are reflected in the poor performance of the major ports. Table 8.29 provides some measures of performance of Indian ports.

In spite of a lot of effort, we have not been able to get international benchmarks for these performance metrics that would provide a fair 'apples to apples' comparison with Indian ports. However, one indicator of the penalty that is imposed on ships at Indian ports due to lack of adequate capacity is the following observation by the Ministry of Shipping that

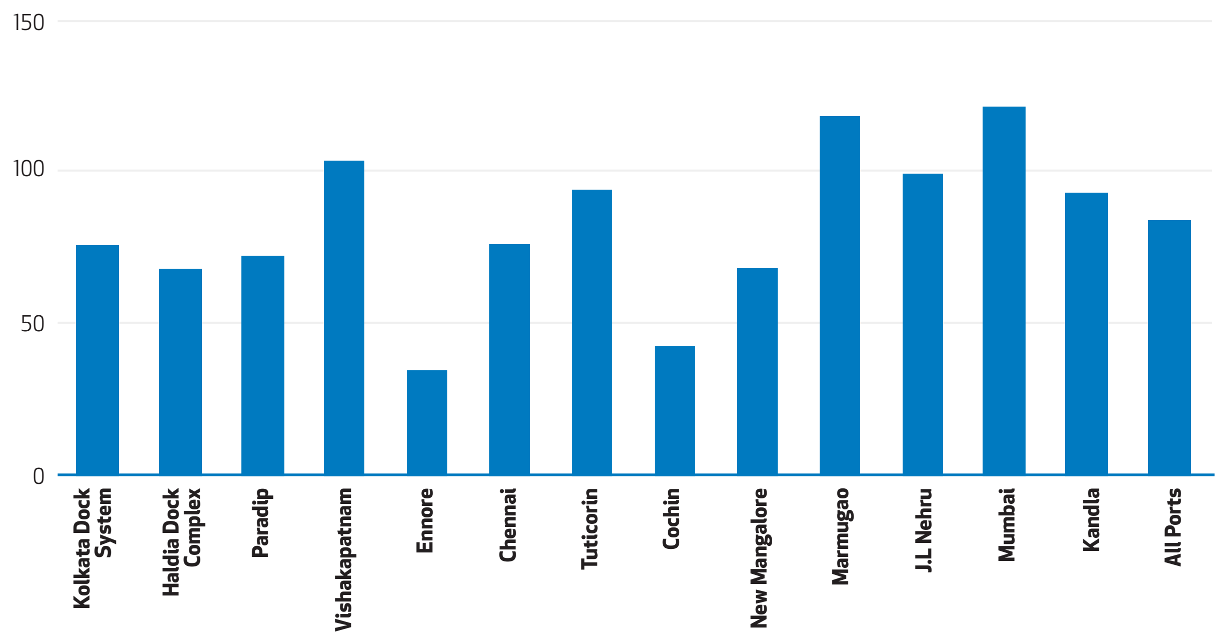
> *there is no concept of 'pre-berthing detention' as in world-class ports. The capacity is much more than the actual traffic and the planning is also done on those lines. Hence there is no question of any ship waiting at anchorage. (Ministry of Shipping, 2011)*

In contrast, on average, ships have to wait for more than two days to berth at an Indian port.

While data on port performance is not available for bulk commodities, the Maritime Agenda does have a comparison of major Indian ports with Singapore for handling of container ships. The turnaround time for container vessels at major Indian ports is 1.77 days compared to just 0.50 days at Singapore port. The cargo dwell time for containers at major Indian ports is 3.78 days while it is just 0.60 days for Singapore. Even though the performance of a port on handling of bulk cargo can be different from containers, these numbers

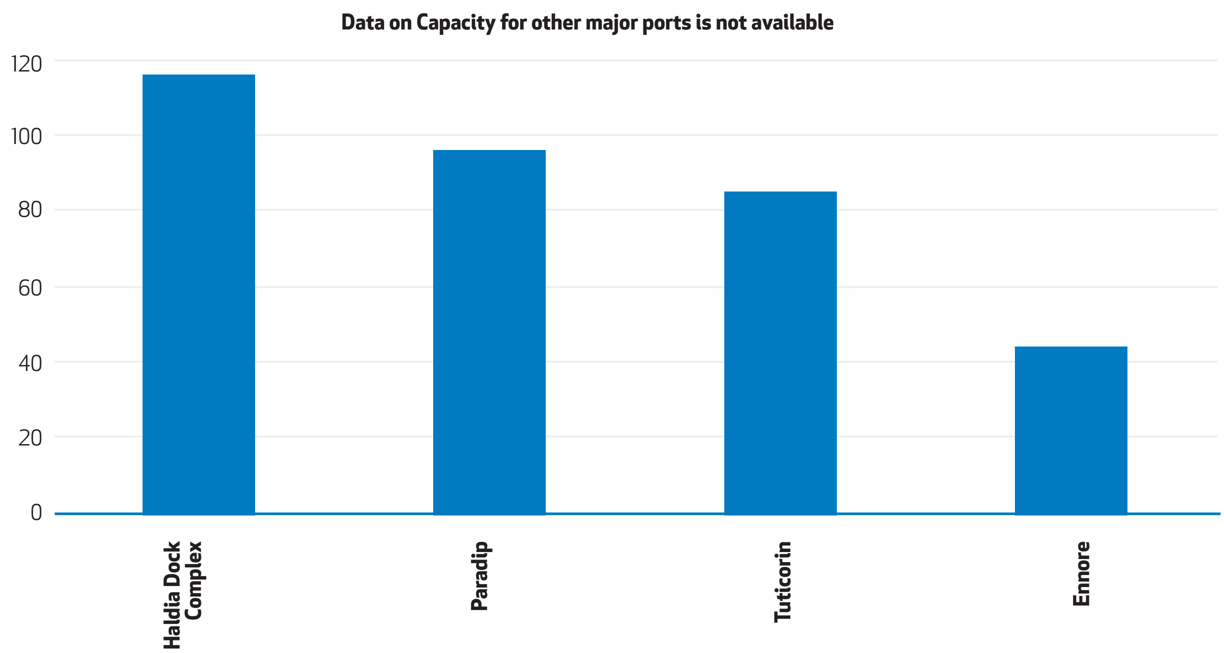
6. The traffic in this table, particularly for coal is a little lower than given in Chapter IV on ports in Volume III. The projections given here are based on expected level of imports and coastal shipping with data on 2011-12 from the Directorate-General of Commercial Intelligence and Statistics (DGCIS). The projections in the chapter on ports is based on direct projections of traffic, with data for 2011-12 from the Ministry of Shipping.

Figure 8. 43
Capacity Utilisation Percentage of Major Ports



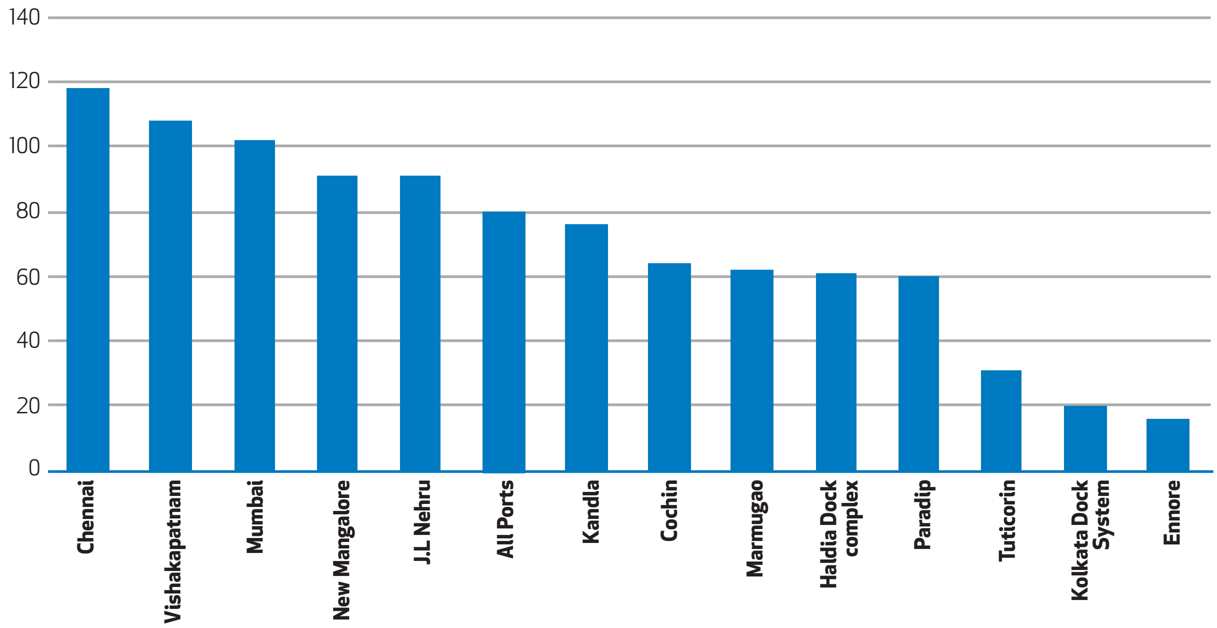
Source: Ministry of Shipping (2012).

Figure 8. 44
Capacity Utilisation Percentage for Coal at Major Ports



Source: Ministry of Shipping (2012).

Figure 8. 45
Capacity Utilisation Percentage for POL at Major Ports



Source: Ministry of Shipping (2012).

Table 8. 29
Performance of Major Ports

PERFORMANCE METRIC	AVERAGE FOR MAJOR PORTS
Pre-Berthing Dwell Time	2.1 days
Turn-Around Time	4.5 days
Output Per Ship-berth-Day	11,112 Tonne

Source: Indian Ports Association (2012).

do give an idea of the gap between the performance of Indian and world-class ports.

Some of the reasons for the poor performance at ports are listed below (PwC, 2009):

- **Low Level of Mechanisation.** Indian ports lack modern technology to handle coal and other bulk cargo. There are a limited number of berths available for handling bulk cargo with mechanised ore-handling capability. (Paradip Port is the only one with a dedicated berth for coal handling.) The low level of mechanisation, in combination with other factors leads to low productivity.
- Inadequate Cargo-Handling Equipment. Even the equipment that exists in the ports is old and breaks down frequently and takes long to be repaired. This results in long down-times, exacerbating the problem of low productivity.
- **Inadequate Navigational Aids and Facilities.** Most of the ports are not equipped with a vessel traffic management system (VTMS). Furthermore, the number of tug-boats and launches are likely to be insufficient for the increased traffic that is expected.
- **Insufficient Use of Information Technology.** Resources and equipment at the ports are spread out and without good ERP systems, are underutilised.
- **Insufficient Drafts.** The drafts at Indian ports have been very low and not in keeping with the increase in ship sizes that is occurring around the world. The older ports have drafts as low as 7 metres while a few of the new ports go up to 16 meters. For shipping of bulk materials such as coal and iron ore, the larger the ship the better because of the economies of scale (ECORYS, 2012). As Table 8.30 shows, **transport costs for bulk shipping can come down by more than 40 per**

Table 8. 30
Effect of Vessel Size on Transport Costs

SHIP SIZE	DEAD WEIGHT (TONNE)	DRAFT REQD (METRES)	TRANSPORT COSTS (INDEXED TO HANDY SIZE AS 100)
Handy Size	35,000	10	100
Panamax	80,000	12	76
Cape Size	180,000	18	58

Source: ECORYS (2012).

cent by increasing the size of the ship from Handy Size to Cape Size. However, the required draft also increases from 10 metre for a Handy Size vessel to 18 metres for a Cape Size vessel.

- **Insufficient Storage Space.** Lack of adequate stacking space results in less clear space at the port which in turn leads to higher vessel turnaround time.

COASTAL SHIPPING[7]

Coastal shipping is an important mode of transport for bulk commodities that has several advantages and can reduce the burden on other modes. Coastal shipping uses less fuel (~5 g/tonne-km) compared to road (~ 31 g/tonne-km) and rail (~ 9 g/tonne-km). Consequently, it is less expensive and has a lower environmental impact. Currently, coastal shipping carries only about seven per cent of the freight traffic, well below its potential, given India's long coastline. In comparison, the share of coastal shipping is 15 per cent in the US and 43 per cent in the EU. Even at the current low level of penetration, about two-thirds of the total traffic carried by coastal shipping is for POL, coal and iron ore. Therefore, it can play a significant role in the bulk transport of these commodities.

COMPARISON OF TRANSPORTATION COSTS USING COASTAL SHIPPING

Table 8.31 compares the costs for transporting coal from Mahanadi Coalfields Ltd (MCL) in Odisha to the coastal states namely, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Gujarat by coastal shipping with the costs of rail transport. For coastal shipping, it is assumed that coal is transported from the mine by rail to Paradip from where it is shipped to the destination ports in the states. One destination port has been selected for each state. For estimating the costs of rail transport, it is assumed that coal is transported by rail from the mine to the geographical center of the state. For both rail and coastal shipping, we have used tariffs as proxies for the costs. Ideally, costs should be compared but it was not possible to get actual costs for transportation and handling.

In spite of the much longer distance ships would have to travel, the freight charge in all cases are lower for coastal shipping even for Kandla port where the distance travelled by a coastal ship is much greater than the distance travelled by rail which cuts across the country. For Vizag, Ennore and New Mangalore, shipping freight charges are 25-50 per cent of the rail freight charges.

But on comparing total costs, it is cost-effective to use coastal shipping only for transporting coal to Ennore. For all other destination ports in the table, the customer would pay more in total for coastal shipping, because of the other charges.

Handling charges to be paid at Paradip to load the ship and at the destination port to unload the ship, and freight charges would have to be paid to bring the coal from the mine to the port of origin (Paradip in this example) and to take the coal from the port to the power plant. Together, the additional charges are almost as much or even more than the shipping freight charges. Thus, the cost advantage of coastal shipping is not realised because of high handling charges and first and last mile connectivity.

REASONS FOR SLOW ADOPTION OF COASTAL SHIPPING

There are several factors which contribute to the high handling charge for coastal shipping and the lack of interest in it:

- Major Ports do not have separate berthing and material-handling facilties for coastal vessels which are smaller. This results in higher costs and longer turnaround times.
- Minor Ports do not have adequate material-handling facilities and the equipment is often not working.
- Lack of consolidation and the resulting large number of small players hampers economies of scale.

7. This section, except the table and analysis of costs is based on information in the report by Ernst & Young (2011).

Table 8. 31
Comparison of Rail and Coastal Shipping Costs
[in Rs/Tonne]

(COAL FROM MAHANADI COALFIELDS, ODISHA TO DESTINATION PORT VIA PARADIP FOR COASTAL SHIPPING)						
DESTINATION PORT	RAIL	COASTAL SHIPPING				
	FREIGHT	FREIGHT	HANDLING	RAIL - MINE TO ORIGIN PORT	RAIL - DEST PORT TO POWER PLANT	TOTAL
Vizag	867	173	368	327	91	959
Ennore	1,164	243	368	327	91	1,029
New Mangalore	1,248	646	368	327	91	1,432
Mumbai	994	820	368	327	91	1,606
Kandla	1,445	1,173	368	327	91	1,959

Note: Freight charges for coastal shipping (Rs 0.23/tonne-km), and handling charges are based on TANGEDCO costs for transporting coal from Paradip to Ennore.
Source: Working Group Research and TANGEDCO (2012).

- The other modes of transport such as roads, railways and aviation enjoy subsidies and credit facilities butnot coastal shipping. Effectively, this increases costs.
- Connectivity between ports and the hinterland is inadequate.
- Qualified personnel are not available because most prefer to move to overseas ships that have better perquisites and tax benefits.
- Lack of an integrated transport policy which encourages and promotes inter-sectoral coordination

RECOMMENDATIONS FOR PROMOTING COASTAL SHIPPING

Over the years, the government has taken several initiatives to remove some of the disadvantages suffered by the coastal shipping industry. In 2004, a special cell was established for development of coastal shipping. As a result, in 2008, the manning scales for coastal ships were relaxed so that they were more consistent with the smaller size of the vessels, and did not impose an onerous staff requirement. In recognition of the fact that the vessels engaged in coastal shipping were smaller and did not require the same construction, equipment and safety requirements as ocean-going vessels, there was an exemption for coastal ships from these requirements of the Merchant Shipping Act. Now coastal ships are subject to requirements that are more appropriate for the kind of service they do. In addition, policies have been proposed for dedicated facilities for coastal shipping and to develop minor ports for this.

In spite of these initiatives, growth in coastal shipping has been sluggish relative to its potential. While appropriate policies have been formulated, there has been a lack of framework for implementation. Such a framework should include inputs from all stakeholders on barriers to effective implementation and suggestions for overcoming them; and assign responsibility and timelines for various tasks.

STRATEGIC CONSIDERATIONS FOR FURTHER DEVELOPMENT OF PORTS

As we have seen, currently Indian ports have severe limitations of capacity to handle bulk cargo traffic. Clearly considerable efforts and investment will be required to upgrade the ports to not only service the fourfold increase in traffic but also meet the performance benchmarks based on international standards. Efforts are being made to improve the performance of individual ports. However, a broader and coherent strategy needs to be developed for the overall ports sector based on a vision for the sector.

Some of the issues that need to be addressed, as the country develops its port strategy:

- Mega ports provide very significant economies of scale and most of the world's major economies have a few mega ports. How many mega ports should there be in the country and where should they be located?
- Should ports for bulk commodities be separate from those for other cargo?
- Should ports for coastal shipping be separate from ports for international traffic?

Except for Paradip, no major port in India has dedicated berths for unloading coal. Traditionally, this was how it was in other countries too. However, now the worldwide trend is towards development of facilities dedicated to handling bulk cargo.

Consideration of these issues, particularly regarding the number and location of mega ports are discussed in the chapter on Ports and Shipping.

EXPECTED PORT TRAFFIC FOR BULK COMMODITIES

We looked at the current level of coal imports in the coastal states to determine how much was for consumption within that state and how much was destined for other states. For each land-locked state, we were also able to make an educated guess about which coastal state was importing coal for it. This allowed us to develop a picture of the approximate route taken by the imported coal. As consumption by state for POL was not known, we simply assumed that the current pattern of imports would continue. Thus as the nationwide POL port traffic is projected to increase, the relative proportion of traffic in each state is assumed to remain the same.

THERMAL COAL

Figure 8.45-8.51 show port traffic by state for thermal coal. It is mainly imported by Gujarat, AP, Tamil Nadu and Odisha. For the coming two decades, we assume that Gujarat will import thermal coal for itself and mainly for Rajasthan, Haryana and Punjab and a small amount for MP. AP is expected to import for itself and Eastern Maharashtra; Tamil Nadu for itself and Karnataka. Odisha is not expected to use any imported coal but will import for UP, Bihar and West Bengal. Three ports on the eastern coast—one each in AP, Odisha and Tamil Nadu—could serve their own needs and those of Bihar, West Bengal, Uttar Pradesh and Eastern Maharashtra. On the western coast, Gujarat will need a mega port. In addition, it seems appropriate to have a mega port near the southern part of the coast of Maharashtra. This would serve western Maharashtra and Karnataka.

COKING COAL

Figures 8.52-54 show port traffic by state for coking coal. Odisha and Andhra Pradesh are expected to be the main ports. Odisha will import for the steel plants in the state and for those in Jharkhand. Andhra will import mainly for itself and for Chhattisgarh. Gujarat is also expected to import a significant amount. Karnataka and Goa are also likely to import some. Mega ports in AP and Odisha would be able to serve the needs of the east coast while those in Gujarat and the northern part of the Karnataka coast should be able to serve the needs of the west coast.

POL

Figures 8.55-57 show port traffic by state for POL. Gujarat is by far the dominant state for port traffic for POL. By 2031-32, the port traffic in Gujarat for POL is expected to reach 500 Mt. Clearly a mega port will be required in Gujarat. The other coastal states have POL traffic that is roughly equal to one another but much less than Gujarat.

COMPOSITE PORT TRAFFIC BY STATE

Figures 8.58-60 show the composite port traffic by state due to POL, thermal coal and coking coal. Gujarat is by far the state that has the most port traffic for all three commodities, and would clearly be a prime location for a mega port. On the east coast, three states have a large amount of traffic—Odisha, Andhra and Tamil Nadu, and are potential candidates for mega ports. On the west coast, in addition to Gujarat, one or two more mega ports will be required. Maharashtra has the largest amount of port traffic on the west coast after Gujarat, and it may be appropriate to have a port on the southern end of the Maharashtra coast that could also be used to serve Gujarat and Karnataka.

SUGGESTIONS FOR LOCATING MEGA PORTS

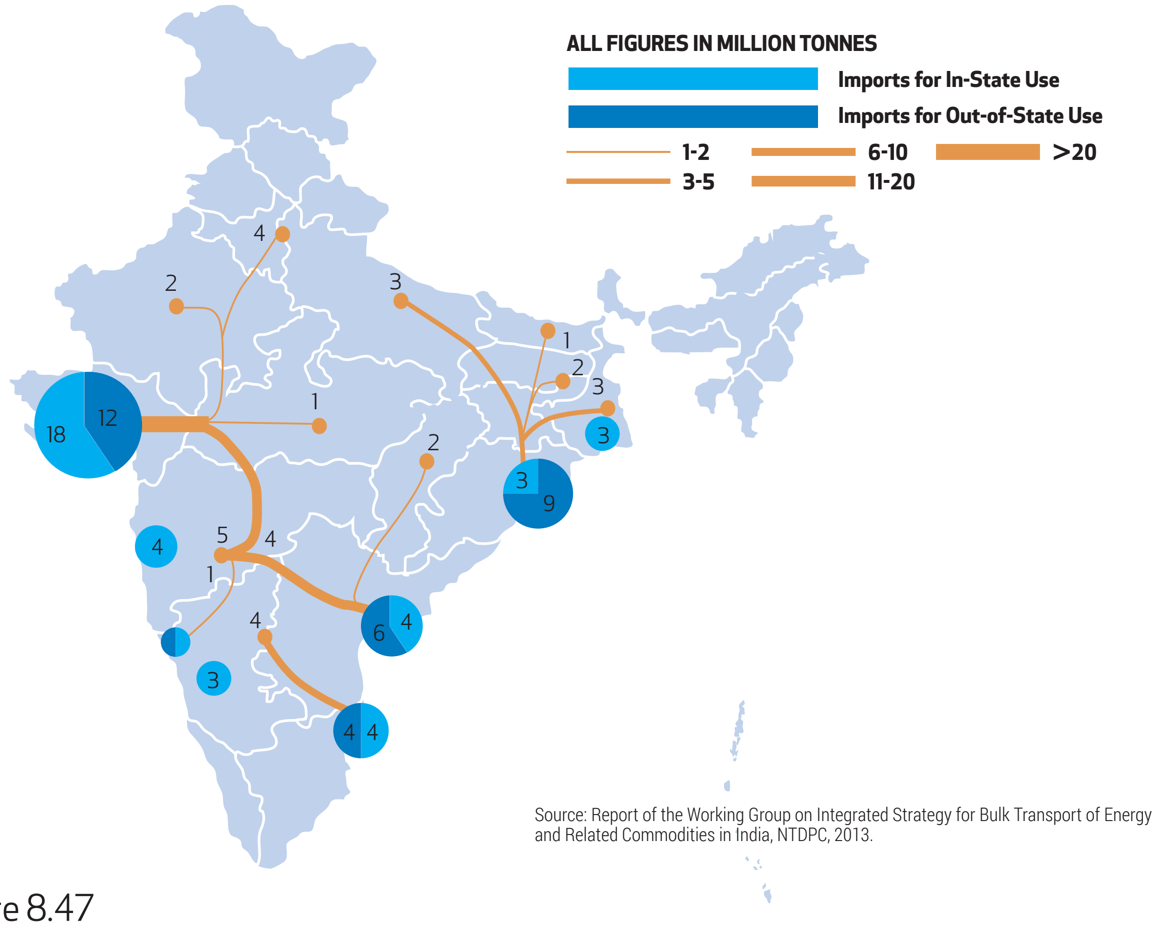
Selection of sites for locating mega ports requires extensive modeling and analysis. First and foremost, the port traffic from all commodities will need to be taken into account. In this study, we have looked at port traffic from coal and POL only. Second, detailed data are required on the cost of further development of ports at potential sites. Third, detailed modeling will be required to examine the costs and benefits of various alternative selections from a short list of potential sites.

Lack of adequate draft at the port entrance is one of the main issues that need to be addressed at a macro-level for the port sector. Except for some ports such as Mundra, Kakinada, Dhamra and Gangavaram which have a natural deep draft, most other ports have shallow natural drafts and therefore require that the depth of the approach channel be artificially created and maintained (imaritime, 2003, DPCL, 2013). Dredging is a highly capital intensive activity where the costs are very sensitive to the type of seabed that needs to be dredged. Loose sand beds are relatively cheaper to dredge but hard rock beds can be very expensive to dredge. (imaritime, 2003). These issues need to be kept in mind in strategizing about the number and location of mega ports.

The investment in breakwaters also needs to be considered. Breakwaters break the force of sea waves and thus create tranquil water conditions so that ships can be loaded and unloaded smoothly. However, they involve large investment. They also have long-term effects on the sediment transport near the shore and need to be constructed only after intensive and comprehensive geo-technical studies on ocean

Figure 8. 46

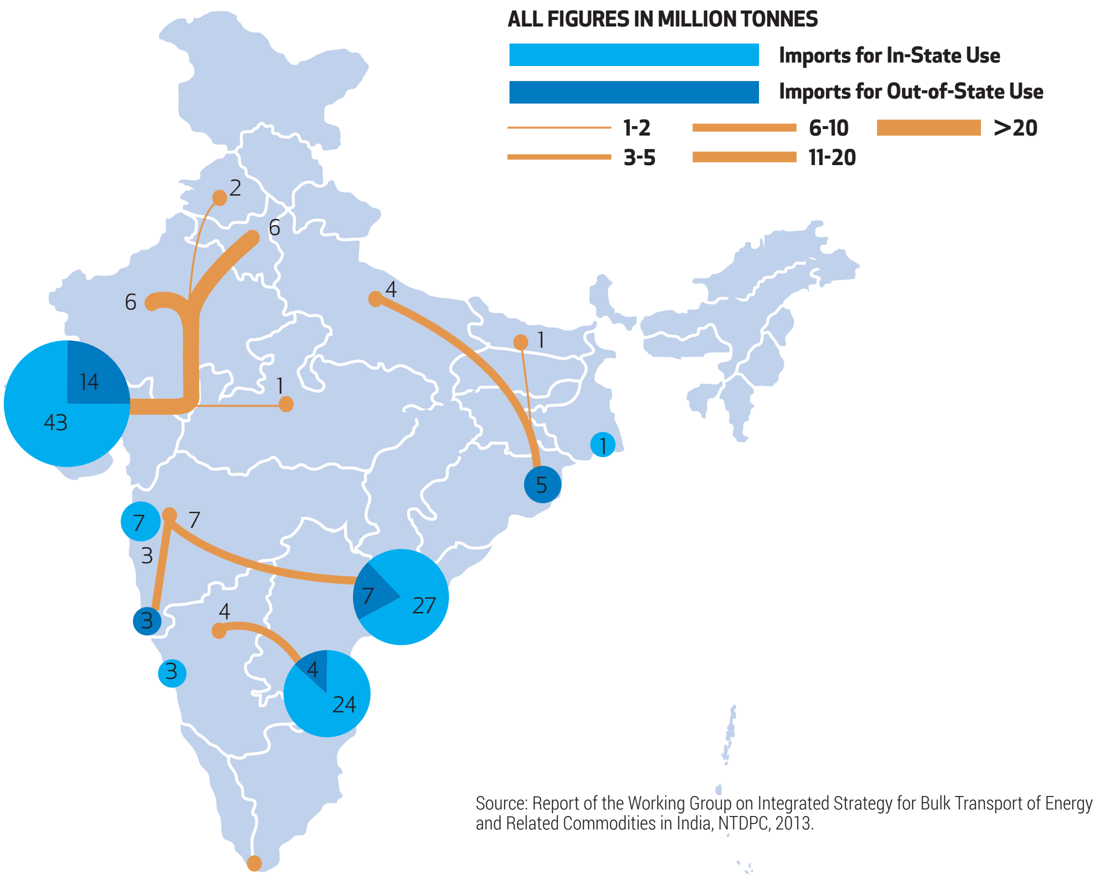
Port Traffic for Import of Thermal Coal 2011-12: Base Case



Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

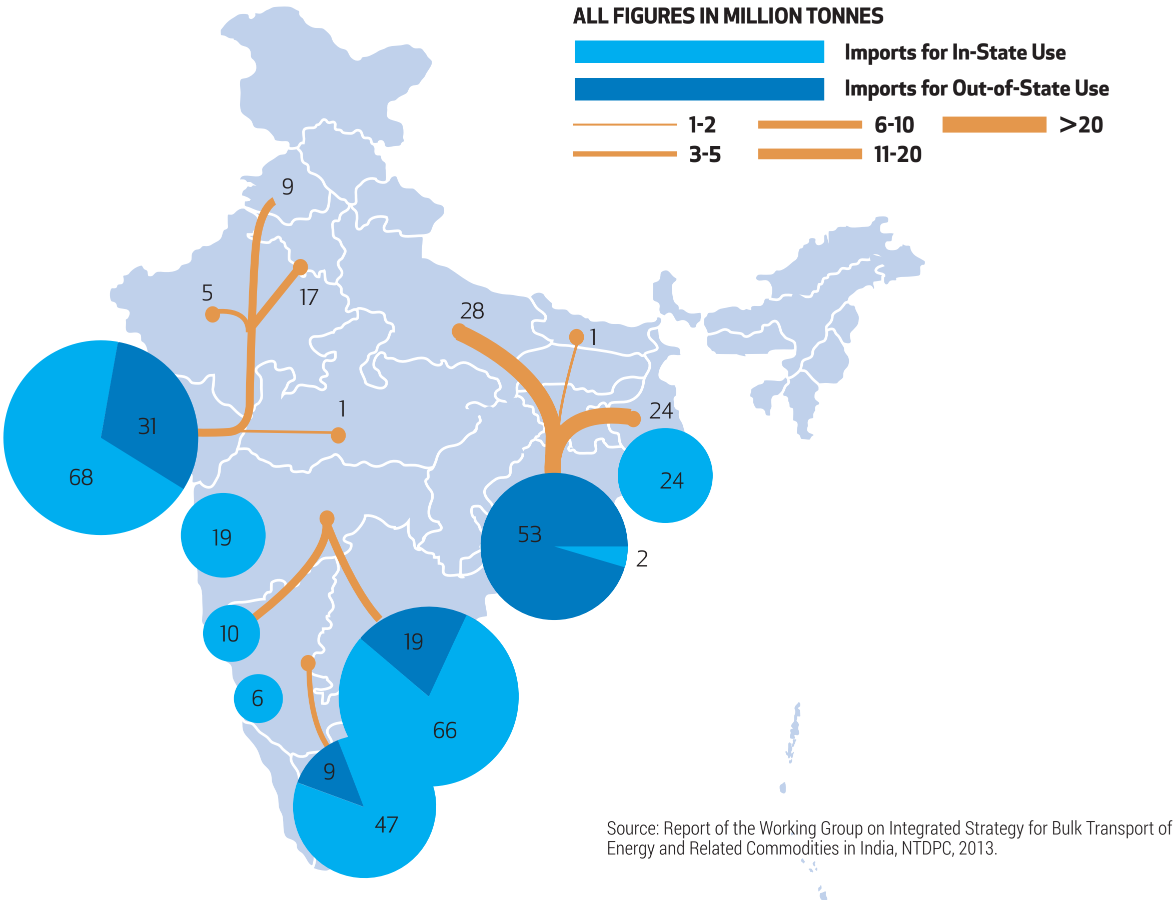
Figure 8.47

Port Traffic for Import of Thermal Coal 2021-22: Base Case



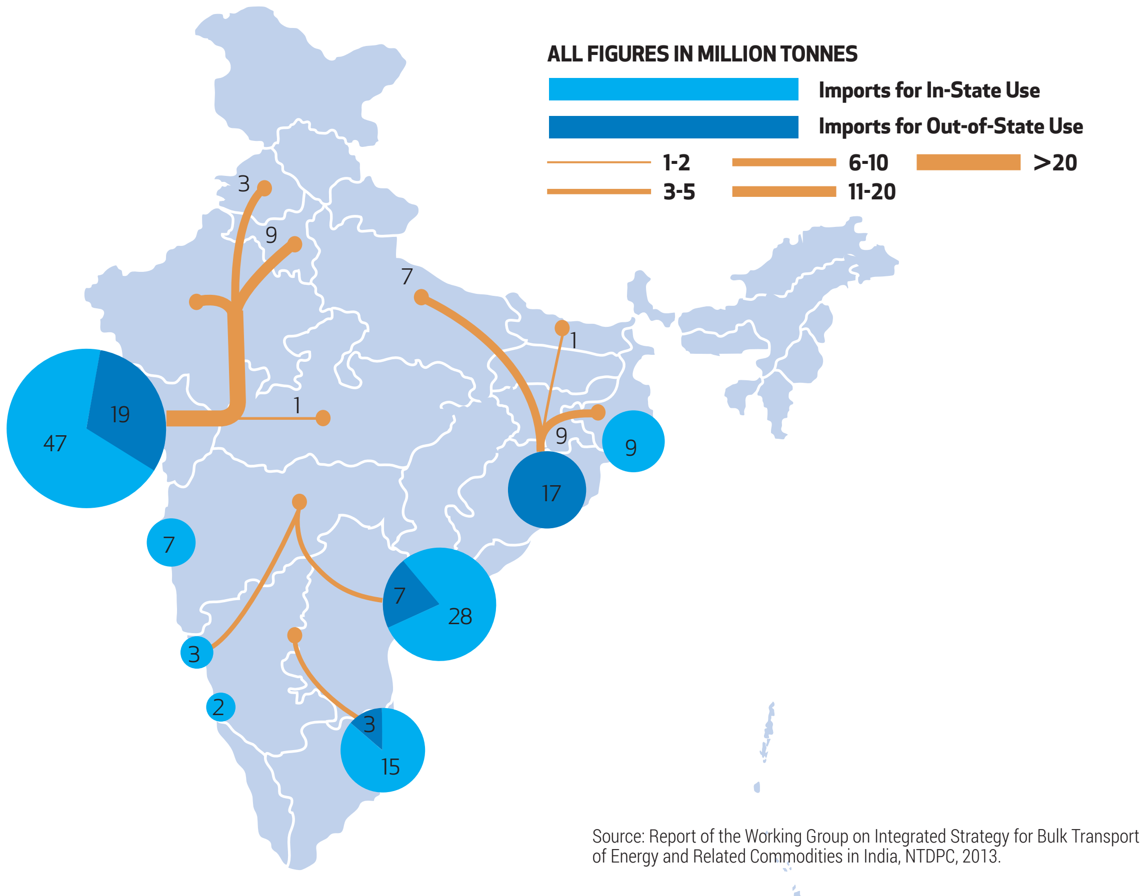
Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Figure 8.48
Port Traffic for Import of Thermal Coal 2031-32: Base Case



Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

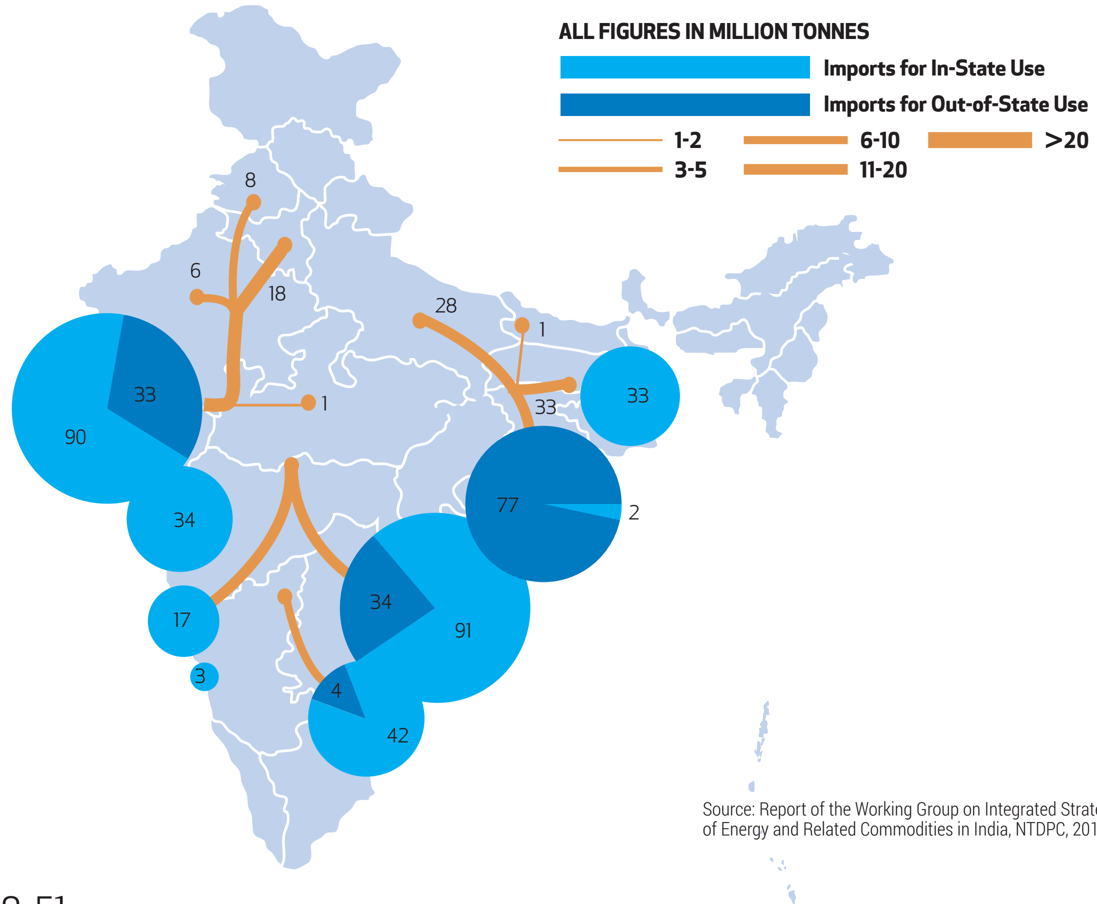
Figure 8. 49
Port Traffic for Import of Thermal Coal 2021-22: High Case



Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Figure 8. 50

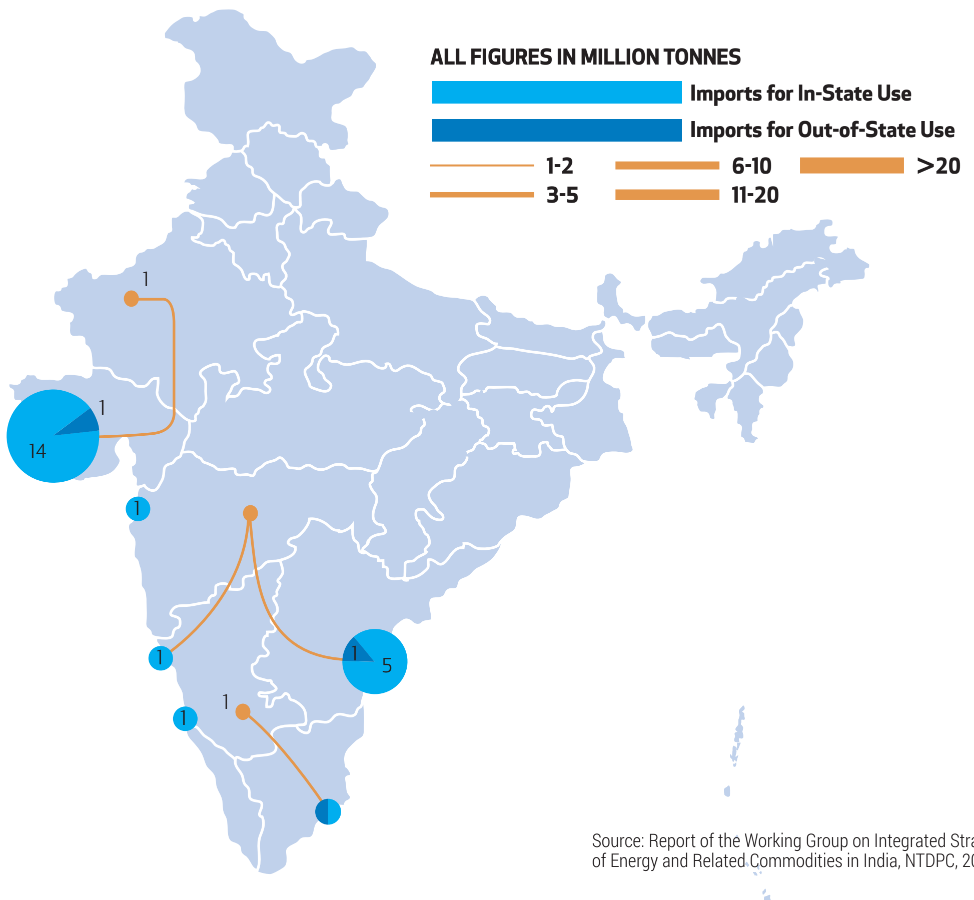
Port Traffic for Import of Thermal Coal 2031-32: High Case



Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

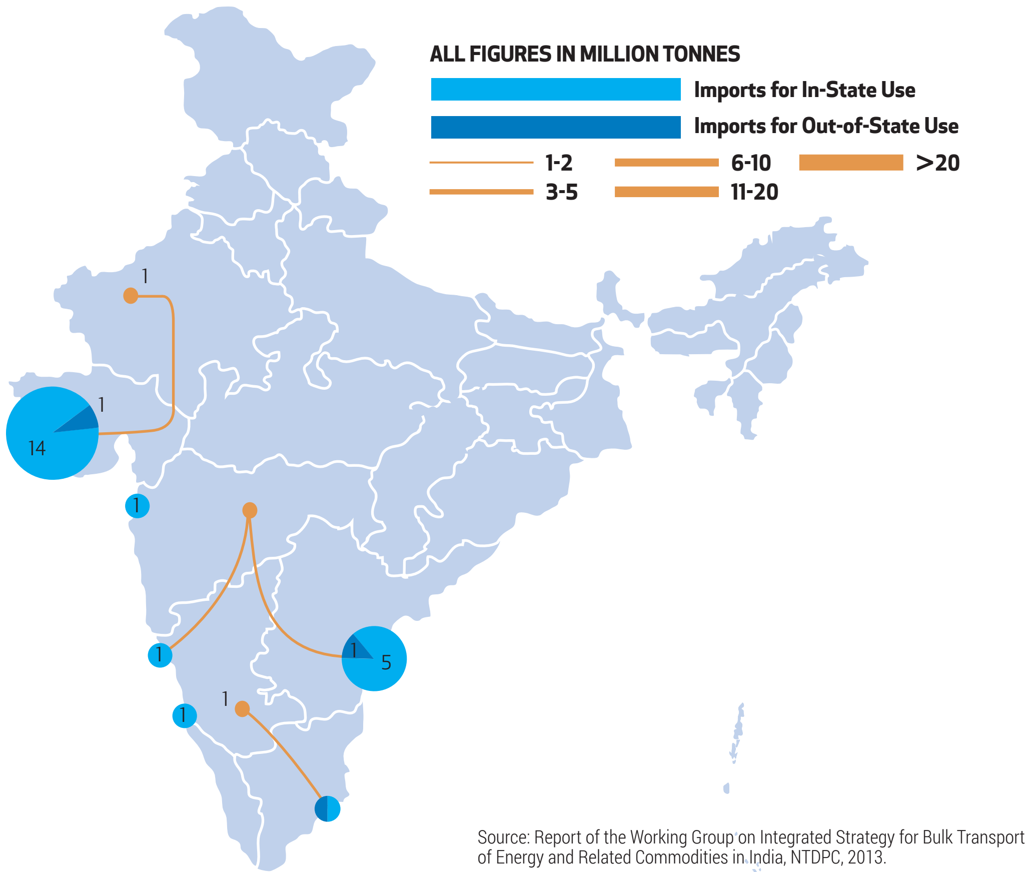
Figure 8. 51

Port Traffic for Import of Thermal Coal 2021-22: Low Case



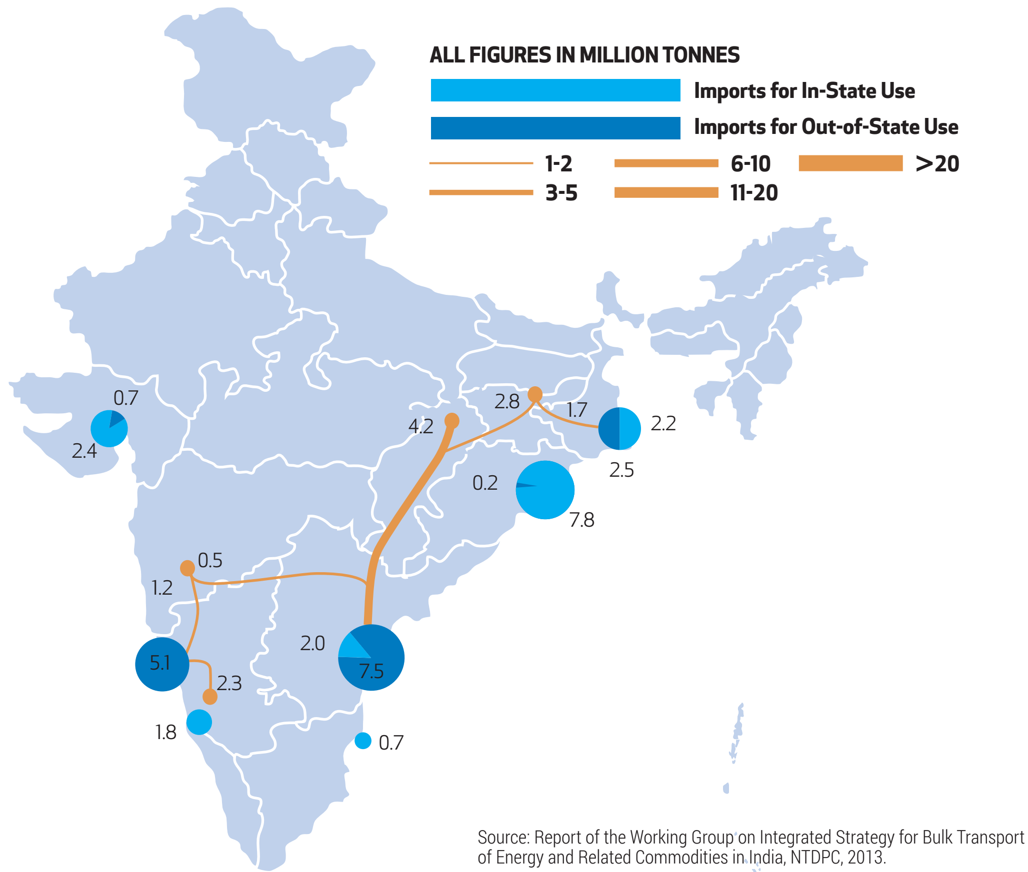
Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Figure 8. 52
Port Traffic for Import of Thermal Coal 2031-32: Low Case



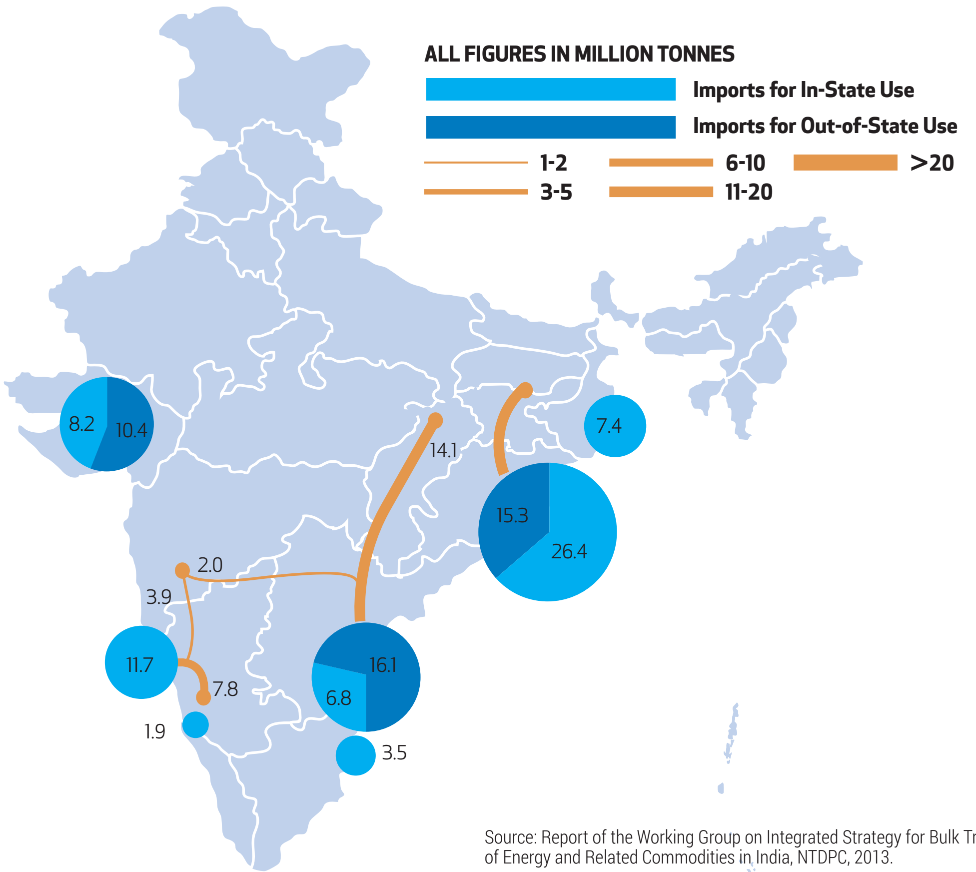
Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Figure 8. 53
Port Traffic for Imported Coking Coal 2011-12



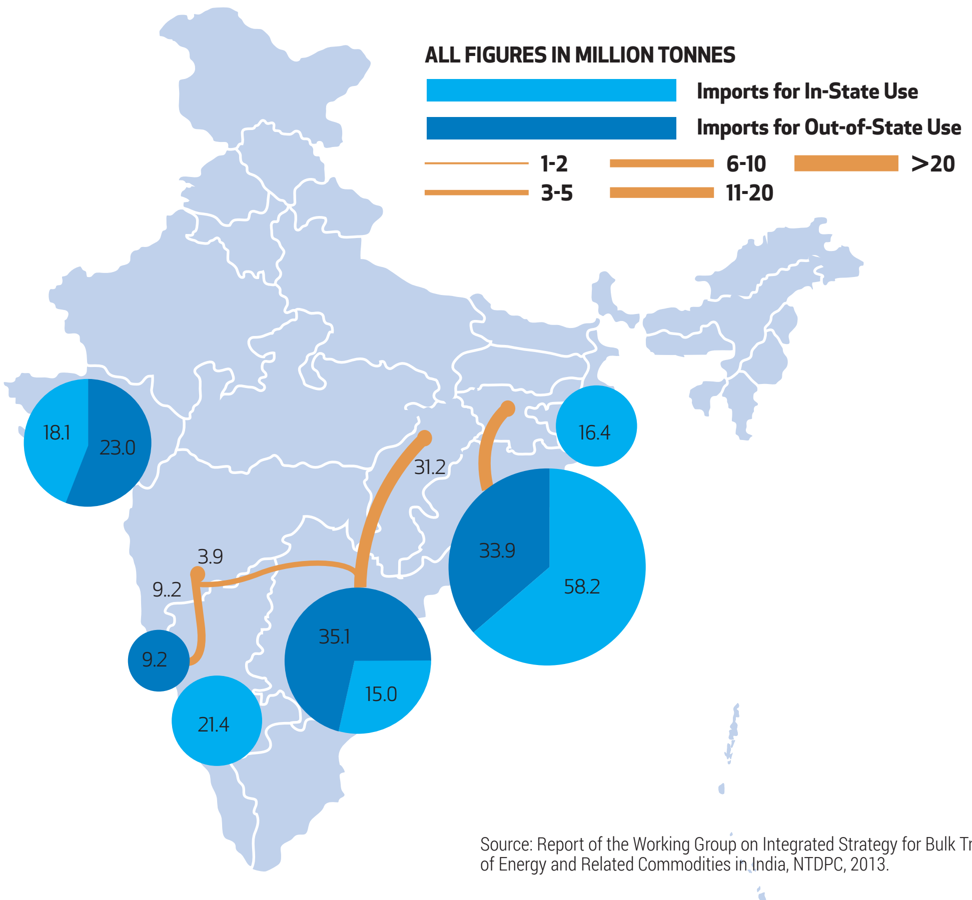
Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Figure 8. 54
Port Traffic for Imported Coking Coal 2021-22



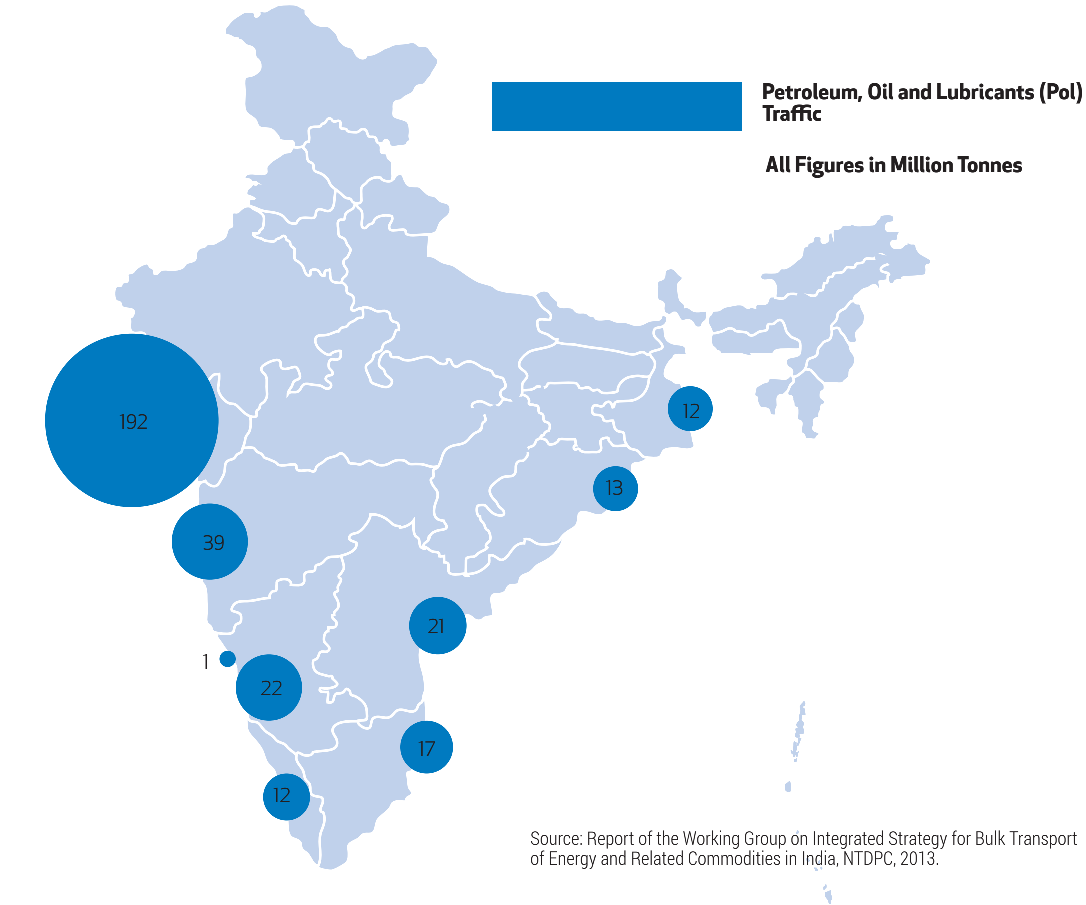
Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Figure 8. 55
Port Traffic for Imported Coking Coal 2031-32



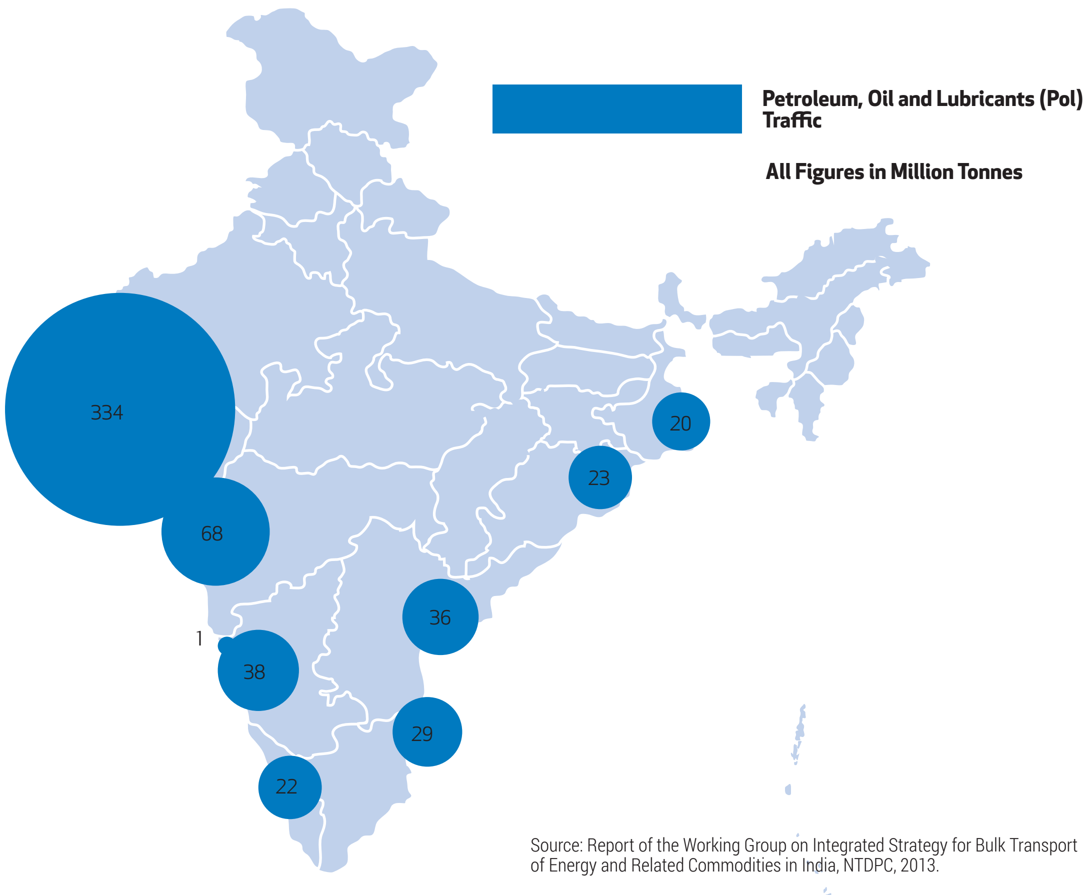
Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Figure 8. 56
Port Traffic for POL 2011-12



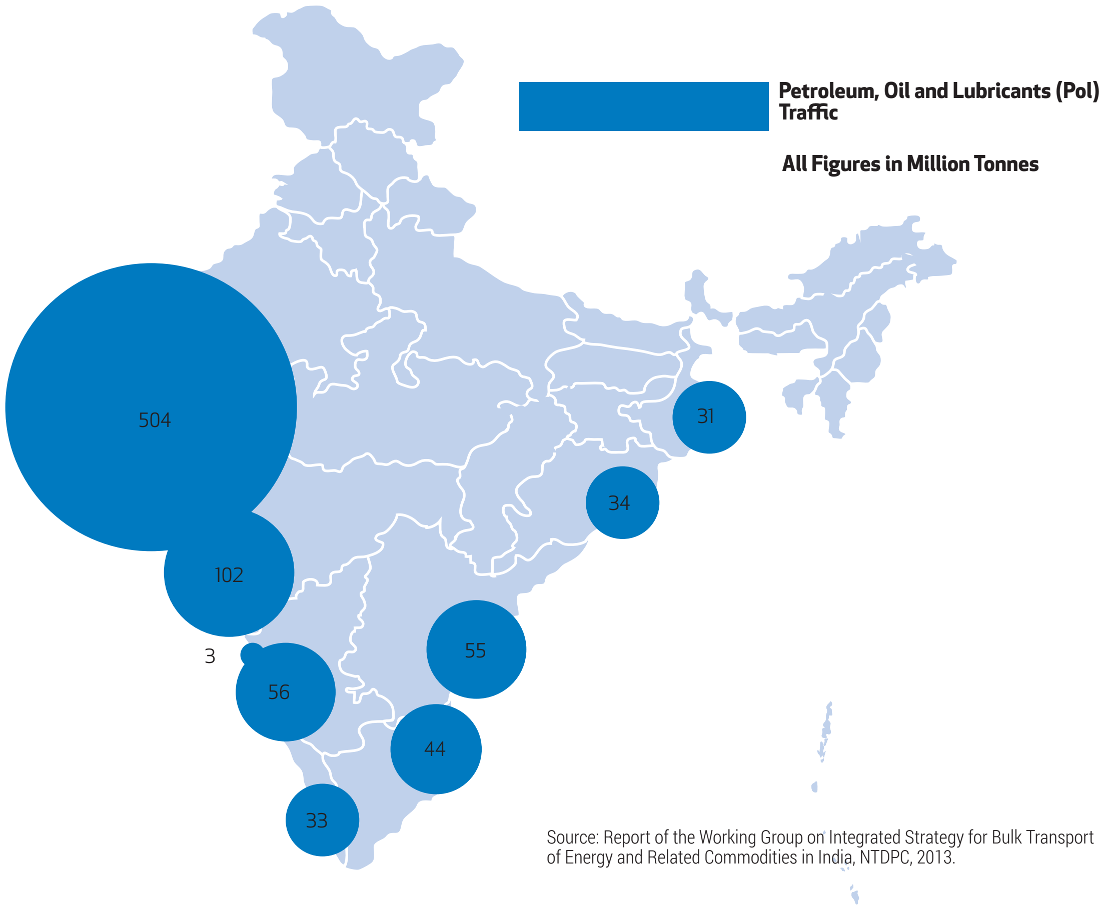
Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Figure 8. 57
Port Traffic for POL 2021-22



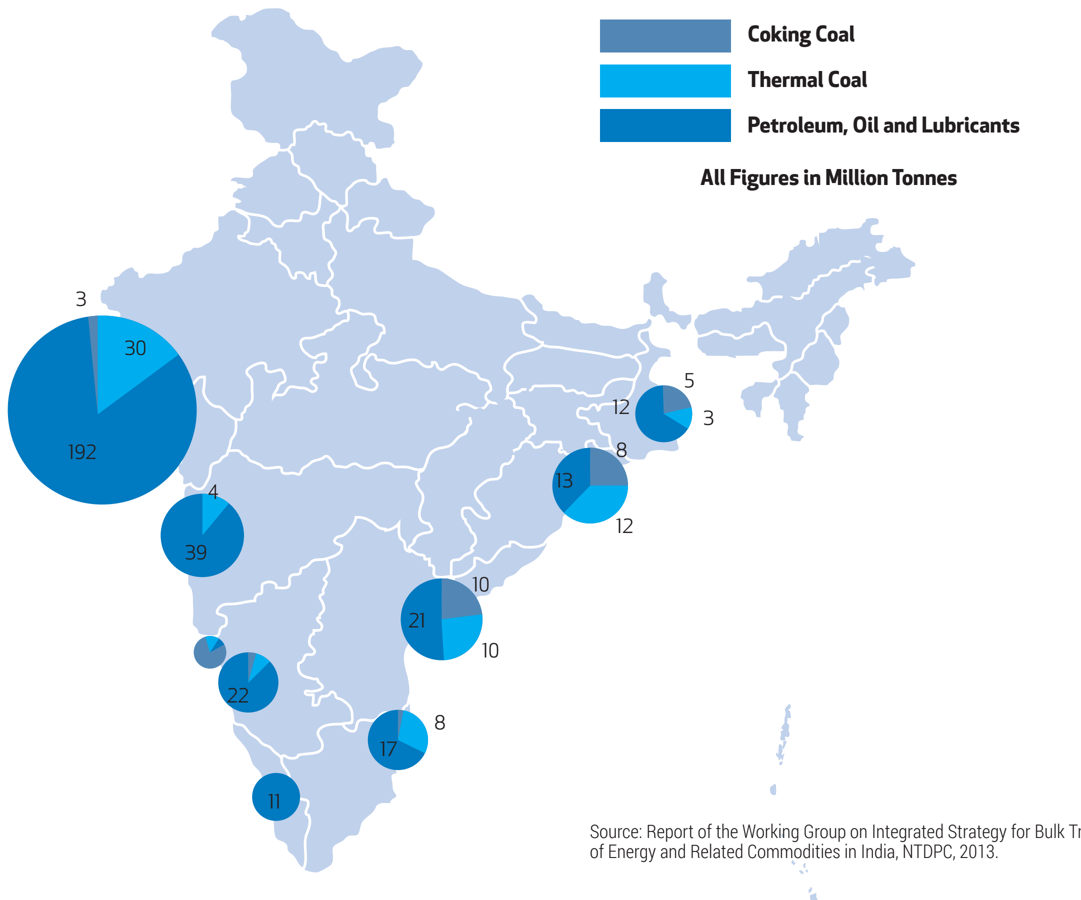
Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Figure 8. 58
Port Traffic for POL 2031-32



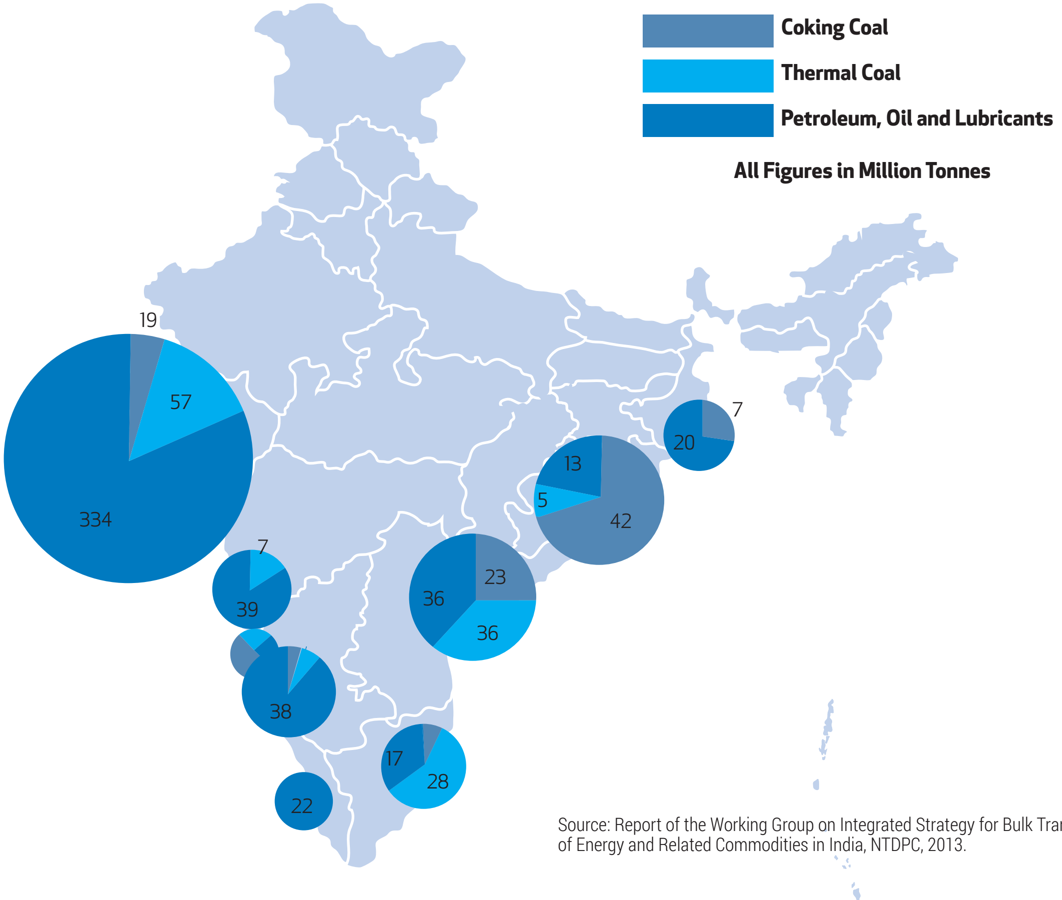
Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Figure 8. 59
Composite Port Traffic 2011-12



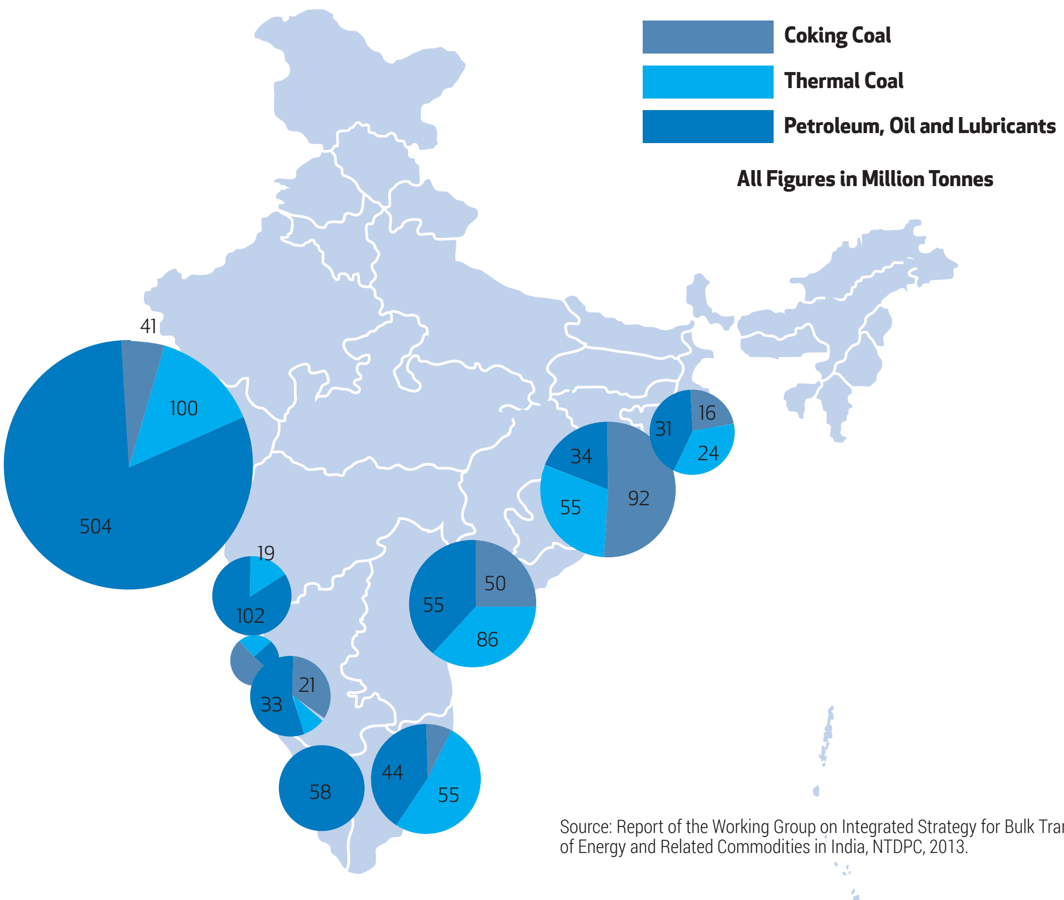
Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Figure 8. 60
Composite Port Traffic 2021-22



Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Figure 8. 61
Composite Port Traffic 2031-32



Source: Report of the Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India, NTDPC, 2013.

Table 8. 32
Ports with Dedicated Facilities for Dry Bulk Commodities

COUNTRY	PORT	COMMODITY
Canada	Port Cartier	Iron Ore
	Seven Islands	Iron Ore and other minerals
	CSL Transshipment	Iron Ore, Coal
Brazil	Tubarao Terminal	Iron Ore
South Africa	Richards Bay	Coal
	Saldanha	Iron Ore and Steel
Australia	Port of Hay Point	Coal
	Dalrymple Bay Coal Terminal	Coal
	Port of Abbot Point	Coal

Source: ECORYS (2012).

currents in order to avoid damage to the coastline. (imaritime, 2003)

DEDICATED BULK-HANDLING FACILITIES

Except for Paradip, no major port in India has dedicated berths for unloading coal. Traditionally, this was how it was in other countries too, with bulk cargo being handled along with general cargo in multipurpose ports. However, now there is a worldwide trend towards development of facilities dedicated to handling bulk cargo. Some of the reasons for this development are (ECORYS, 2012):

- The scale of shipments and size of ships for bulk commodities have increased. Bulk cargo technologies have advanced. Larger ships require more storage space and deeper water.
- Rail connectivity up to the terminal and unit train operations have become prerequisites for bulk transport.
- In an attempt to gain control over the entire supply-chain including dedicated port facilities, shippers are looking for vertical integration.
- Urban society is becoming more conscious of environmental issues and does not want 'dirty' coal and coal-dust in its neighbourhoods. Furthermore, there are safety and security issues associated with commodities such as coal and POL.

The tendency towards vertical integration will need to be monitored for monopolistic practices. If a private player sets up a terminal in a port for its exclusive use and restricts entry of others or charges monopoly rents for its use, then it may distort the market for the commodity. Appropriate regulatory measures will be required to monitor and prevent such practices.

Table 8.32 gives some examples of dedicated facilities. See (ECORYS, 2012) for details.

DEDICATED PORTS/TERMINALS FOR COASTAL SHIPPING

Ships used for coastal shipping are smaller and require appropriate berths. Major ports do not have separate berthing facilities for coastal ships. At the same time, minor ports lack adequate infrastructure and much of the equipment does not work. Consequently, turn-around times for coastal ships are high. About 70 per cent of a coastal ship's time is spent in ports and only about 30 per cent on voyages, inflicting huge losses on the coastal shipping companies (E&Y, 2011). It is suggested that several minor ports be developed along the coast every 100-200 km with the following capacity (E&Y, 2011):

- Ability to handle vessels with a requirement of draft up to 5 meters.
- Material handling and other infrastructure to turn around a vessel in 12-18 hours.
- Sufficient first and last mile connectivity to road/rail network.

This will reduce congestion at major ports and enhance the efficiency of coastal shipping.

CONNECTIVITY TO PORTS

Ports should be seen as nodes in the transport network and not a goal in themselves. Port connectivity is essential for the import of both thermal and

Connectivity to the non-major ports is very poor. Of the 200 non-major ports, only 60-65 ports are active, handling import and export of cargo. Of these, only six have complete rail connectivity.

coking coal. In 2005, a Committee of Secretaries was set up to establish policies to improve port connectivity. The Committee recommended that each major port should be connected by minimum a four-lane road and a double-line rail. As imported coal is most likely to be transported by rail, we focus only on rail connectivity here.

While Kolkata, Haldia, Vizag, Ennore, Chennai, Tuticorin, have the required double-line connectivity, for the following ports the provision of double-line connectivity is in progress:

- Paradip port is connected by a double-line section with Cuttack to the Howrah-Chennai trunk line. The Daitari-Banspani and Haridaspur-Paradip lines are under construction.
- Cochin port has single-line connectivity and is in the process of getting double-line connectivity
- New Mangalore port has limited rail connectivity and additional connectivity needs to be provided.
- Mumbai Port has double-line connectivity but the trains have to pass through a busy suburban section. Work on a third line is in progress.
- Kandla port has connectivity to Mumbai and Delhi via Ahmedabad. Doubling of the Gandhidham-Kandla is in progress.

Connectivity to the non-major ports is very poor. Of the 200 non-major ports, only 60-65 ports are active, handling import and export of cargo. Of these, only six have complete rail connectivity. Another 8-10 have a railway station nearby but still need last-mile connectivity. Provision of rail connectivity to the non-major ports needs to be improved urgently.

INVESTMENT FOR UPGRADING PORTS

The estimates of investment required in ports for bulk commodities are based on the volume of import/export traffic for coal and POL. We have considered coal and POL only so that we can estimate how much investment can be attributed to these bulk commodities. However, we recognise that actual planning and investment would consider all commodities and would take into account synergies between the various commodities. Further, these estimates are only indicative and are not based on detailed planning. Such detailed planning can only follow a detailed strategy for ports that takes into account some of the considerations outlined earlier.

The calculation of the investment required is shown in Table 8.33. It starts with estimates of traffic for import of thermal coal; import of coking coal; and POL import of crude oil and import and export of petroleum products. In order to minimise delays, international practice requires that cargo-handling capacity at ports be 30 per cent more than the anticipated traffic (Ministry of Shipping, 2012). In order to calculate the cost of creating capacity, estimates of Rs. 550 million/Mt of additional capacity for coal and Rs 520 million/Mt for POL have been used. These estimates have been suggested in the WG report and are based on calculations by TAMP of the cost of adding capacity. Lastly, 100 per cent has been added to these costs for additional facilities and activities such as deepening and maintenance of channels and other infrastructure. These calculations indicate that about Rs 1,485 billion would be required over the next two decades to support the required import/export of coal and POL.

CONCLUSIONS AND RECOMMENDATIONS

Economic growth is critically dependent on adequate amounts of electric power and steel. Almost all economic activity requires electricity and steel is an important input for many industries. In order to sustain a GDP growth rate of 8 to 9 per cent over the next two decades, it is estimated the production of electrical energy will need to increase by 3.5 times from 1,105 BU now to 3,860 BU by 2031-32. As coal is expected to remain the dominant fuel for the power sector, the requirement for coal is expected to grow correspondingly. Domestic coal is expected to grow by about 2.5 times; from about 440 Mt in 2011-12 to 1,110 Mt in 2031-32. Its use in the power industry will be limited by the amount produced and imports will bridge the deficit and grow much faster; by almost five times; from 73 Mt in 2011-12 to 355 Mt by 2031-32.

The intensity of steel use in the economy is expected to increase. So requirements for steel will grow faster than the growth of the economy from 73 Mt in 2011-12 to 495 Mt in 2031-32; almost an eightfold increase. Keeping in mind that a tonne of finished steel requires three to four tonne of raw material, the transport requirements for the steel industry will be huge; growing from 600 Mt in 2011-12 to about 2230 Mt in 2031-32.

The transport requirements for the power and steel industry are expected to grow from about 900 Mt now to 3,700 Mt in 2031-32. While POL and natural gas will also grow, most of the transport for these commodities will be carried out through pipelines. Some POL will be transported by rail but the volumes will be very small and are not expected to impact the rail

Table 8. 33
Investment Required in Ports for Coal and POL

	2011-12	2016-17	2021-22	2026-27	2031-32
Traffic (Mt)					
Thermal Coal	97	142	224	340	423
Coking Coal	32	65	108	173	238
POL	329	475	572	702	864
Capacity (Mt)					
Thermal Coal	126	185	291	442	550
Coking Coal	42	85	140	225	309
POL	428	618	744	913	1,123
Incremental Capacity Reqd (Mt)					
Thermal Coal		59	107	151	108
Coking Coal		43	56	85	85
POL		190	126	169	211
Cost of Creating Capacity (Rs Million)					
Thermal Coal		32,175	58,630	82,940	59,345
Coking Coal		23,595	30,745	46,475	46,475
POL		98,696	65,572	87,880	109,512
Total		154,466	154,947	217,295	215,332
Cost of Other Facilities		154,466	154,947	217,295	215,332
TOTAL INVESTMENT REQD		**308,932**	**309,894**	**434,590**	**430,664**
TOTAL CUMULATIVE INVESTMENT 2012-2032 (Rs Million)					**1,484,080**

Source: Ministry of Shipping and Working Group Research (2012).

network much. However, it will have a huge impact on cargo traffic at ports. It already has the largest share (38 per cent) of port traffic, that will increase by over 2.5 times from about 330 Mt in 2011-12 to 865 Mt in 2031-32.

These very large increases in the transport requirements for bulk commodities will be a great challenge because our transport systems are barely able to cope with the traffic today. The trunk railway network is heavily congested. Generally, a rail route is considered congested when the capacity utilisation increases beyond 80 per cent. Almost all the major rail routes[8] over which coal and iron ore will be transported are operating above 100 per centcapacity. Build-up of coal stocks at pit-heads is an early warning of the lack of capacity.

Similarly, the capacity utilisation for ports averages 85 per cent with at least four operating at 100 per cent or more. International norms recommend a capacity utilisation below 70 per cent to avoid delays.

Unless well-planned steps to rapidly improve the bulk transport system are successfully implemented, the transport system will become a stranglehold on

8. Overall in the country, about 40 per cent of the sections are operating at 100 per cent or higher of capacity. Another 20 per cent are operating between 80 and 100 per cent capacity. The sections making up the high-density routes fall predominantly in the first category. Therefore, high-density routes on which coal and iron ore are transported are almost all congested.

Odisha, Jharkhand and Chhattisgarh are expected to produce about two-thirds of all domestic coal by 2031-32. Together, they will also have more than half the country's steel capacity. Clearly this tri-state region will be critical for meeting the demand for domestic coal and steel for the next two decades. Ensuring adequate transportation infrastructure in this region, which also services adjoining states, is critical for the country's growth.

the economy, starving it of energy materials and other key commodities essential for economic growth.

RAIL NETWORK

Coal and iron ore are brought mostly by road from mines to the rail sidings. Feeder routes then carry the coal or iron ore from the rail sidings to the trunk routes. The trunk routes carry the minerals long distances, usually between distant states. Close to the destination, feeder routes move the materials from the trunk route to the rail siding at the power or steel plant.

Not all shipments of coal or iron ore traverse all these segments. For example, thermal coal destined for a power plant within the coal-producing state is likely to be moved over a single feeder route between the mine and the power plant. The transport requirements can be quite different depending on the types of rail segments traversed. Coal transported to plants within the coal-producing region will rely mostly on MGR, conveyor belts/ropes and short rail routes. Such routes may use only a short part of a DFC. On the other hand, transport to distant states is likely to make extensive use of routes covered by DFCs.

As the economy grows, domestic coal will be used 'closer to home' and therefore, the importance of shorter rail routes will increase. The rate of growth of the economy will affect the relative importance of short rail routes versus DFCs, highlighting the importance of adaptability of plans for bulk transport.

CRITICAL FEEDER ROUTES AT MINES

Most of the increase in coal production is expected to come from three regions: (1) Talcher and Ib Valley coalfields in Odisha with a potential increase of 110 Mtpa by 2031-32; (2) North Karanpura coalfields in Jharkhand with an increase of 75 Mtpa; and (3) Mand-Raigad coalfields in Chhattisgarh with an increase of 90 Mtpa. Feeder routes that will carry coal from the mine to the trunk routes are critical to bring the coal to power and steel plants. But eight critical feeder routes in these regions are awaiting completion. Shortages of coal, which are already slowing down the economy, will become even more acute in the future if these feeder routes are not completed. Similarly, critical feeder routes for moving iron ore must be completed to ensure steel production keeps up with the economy's requirements.

The total cost of these routes will be about Rs 35 billion for coal and Rs 117 billion for steel; just 2.4 per cent of the Railways budget for the 12th Five Year Plan, but with large benefits for the economy. These critical routes must be completed on the highest priority within the 12th Five Year Plan.

IMPORTANCE OF SHORT DISTANCE TRANSPORT OF COAL

As the economy grows, domestic coal will be used closer to home. Consumption of coal within coal-producing states is expected to increase from 44 per cent currently to 60 per cent by 2031-32. If we include transport of coal to neighbouring states, we find that about 70 per cent of domestic coal in 2031-32 will be used within coal-producing regions. As a result, a very large portion of domestic coal will make limited use of DFCs over short sections. Similarly, more than 80 per cent of the imported coal will be used by importing coastal states. *The share of short-rail routes, road, MGR and conveyor belts or ropes will thus grow and these modes should get attention to ensure that the power sector does not suffer from an insufficient supply of coal.*

FEEDER ROUTES TO POWER PLANTS WITHIN COAL PRODUCING STATES

As in-state consumption of coal for power is likely to increase, much of this new capacity will come up in clusters of about 3,000-4,000 MW each. Such power plants need to be located near coal mines and also near sources of water. It is difficult to predict where these clusters will be located but feeder routes from the mines will be needed.

We estimate that such links will be about 70-100 km long and will be required to carry about 20 Mtpa each. Therefore, roughly one such feeder route to a cluster of power plants will be required every other year in the tri-state region of Odisha, Jharkhand and Chhattisgarh. These links should be designed for heavy-haul technology where a rake per day carries 4 Mtpa. It is likely that some of these feeder routes may overlap to some extent, with each other or the feeder routes that bring coal from the mine to the trunk route. As each such feeder route will take a minimum of six years to complete, planning for these routes must be coordinated with investments being planned in the power sector. Decisions for the corresponding transport investment should be taken simultaneously.

PRIVATE PARTICIPATION IN RAIL CONNECTIVITY PROJECTS

The urgent need for such feeder routes highlights the growing need for rail connectivity to previously unconnected areas. Indian Railways (IR) faces resource constraints to fulfill these demands. Therefore, it has launched a new policy to attract private participation in rail connectivity and capacity augmentation. The five models in the policy cover most of the circumstances under which private investment could accelerate the development of rail infrastructure. IR will remain a key player even with private participation and will be responsible for many functions: certification of lines; supervision of the maintenance of lines; operation of the rail network with IR rolling stock; and collection of freight charges. Therefore, success of the new PPP policy will depend on how well IR is able to execute these functions. Large integrated producers of steel or large mining companies are likely to enter into these PPP arrangements but smaller parties may find it difficult to do so. Institutional mechanisms will need to be developed to facilitate coordination among SMEs and large firms in the same area to pool their resources to create common infrastructure.

NEED TO FOCUS ON THE TRI-STATE REGION OF ODISHA, JHARKHAND AND CHHATTISGARH

Most of the critical feeder routes for coal and iron ore lie in Odisha, Jharkhand and Chhattisgarh. This is no coincidence because steel plants and mineral resources, particularly coal and iron ore, are concentrated in these states. These states produce more than half of the total domestic coal and are expected to produce about two-thirds by 2031-32. Together, they will also have more than half the country's steel capacity. Clearly this tri-state region will be critical for meeting the demand for domestic coal and steel for the next two decades. Ensuring adequate transportation infrastructure in this region, which also services adjoining states, is critical for the country's growth.

CONSTRUCTION OF DFCS

Even though domestic coal will be used closer to home, transport to distant states will also increase. Some DFCs may be more important than others for this long-distance transport. The Eastern DFC is likely to carry an overwhelming share of the long-distance coal traffic, with its share increasing from about half currently to about two-thirds by 2031-32. Excluding the Southern DFC which is not expected to carry much coal, the other DFCs have a much smaller and about equal share of the long-distance coal traffic. Therefore, the eastern DFC must be given the highest priority among the DFCs, and should be completed within the 12th Five Year Plan. The Western, East-West, North-South and East Coast DFCs should be completed by the end of the 13th Plan, and the Southern DFC can be completed by the end of the 15th Plan. For the DFCs that have one termination point in the eastern resource-rich part of the country, construction must start from there because bulk traffic is the highest in those areas. This will also facilitate transport within coal-producing states using short sections of DFCs.

> A strategic bulk transport planning group, that monitors developments and potential developments in coal and other fuel markets, renewable energy technologies and domestic fuel supply, should be established. The group should include all major stakeholders and representatives from power, railways, and natural gas sectors.

ADAPTIVE PLANNING AND COORDINATION BETWEEN MINISTRIES

A counter-intuitive result from the model of the power sector is that under the low-growth scenario, the movement of domestic coal is larger, putting even more pressure on the rail freight system. This is because as growth slows, domestic coal will not be required to the same extent closer to the producing area and will be available to be sent to areas further away, thus reducing imports of coal. This will increase the burden on the rail transport system, unfortunately, right when public resources are likely to be more constrained. The results from the modeling exercise also show that there can be great variation in both the amount of coal to be transported and the pattern of the movement, triggered by changes in the rate at which the economy is growing, greater use of renewables, increased availability of gas or higher energy efficiency.

Given this uncertainty, it is important that planning for bulk transport of energy commodities be adaptive. A strategic bulk transport planning group, that monitors developments and potential developments in coal and other fuel markets, renewable energy technologies and domestic fuel supply, should be established. In response to changing conditions, it should periodically (say every five years) direct changes in the plans for transport of fuels so that adequate fuel supplies are available to power plants without delay and at low cost. The group should include all major stakeholders and representatives from power, railways, and natural gas sectors.

Chapter 5 on Institutions for Transport System Governance proposes an Office of Transport Strategy (OTS) that would integrate transport planning across modes and coordinate between the ministries and other levels of government. The strategic bulk transport planning group could be established under the OTS. The OTS could extend coordination to non-transport ministries such as power, petroleum and natural gas, and steel on issues related to transport of bulk commodities.

MODERNISATION OF EQUIPMENT

Freight transport in India is far less efficient than rail in other countries. There is a great need for upgrading and modernising equipment, rolling stock and rail lines. As the Railways recognises, trains must be heavier, longer and faster in order to maximise the use of existing infrastructure. Heavy-haul technology should be used wherever possible and new lines should be designed for it. This increases the capacity of trains about fourfold so that a train per day would result in transport of four Mtpa from about one Mtpa using current technology.

IMPROVEMENTS IN FIRST-MILE CONNECTIVITY BETWEEN MINE AND RAIL SIDING

Coal and iron ore are generally transported from coal mines to the nearest rail siding by road. Often, the evacuation of material is hampered by inadequate road capacity from the mine head to the railway siding. Creation of road infrastructure takes time. Therefore, advance planning is essential to develop the required roads but such planning is rarely done.

Conversion of existing fair-weather roads in high-growth coal fields, particularly where captive coal blocks are expected to become operative, into all-weather express coal corridors should be seriously considered. Coal mining companies should also consider developing a hub-based system for transporting coal from existing mines, wherever feasible.

Coal from the mines in the traditional coal fields has to be moved through heavily-populated villages and is vulnerable to blockage and other disturbances due to socio-political events. Hence, wherever possible, long-distance conveyor belt systems should be used for movement. This will also reduce the environmental impact of road transport.

BULK TRANSPORT-RELATED INVESTMENT REQUIRED IN THE RAIL NETWORK

Suggested plan-wise investments have been prioritised on level of impact of the investment; and urgency of the route development. A total investment of about Rs 8,700 billion over the 20-year period will be required. The investment is relatively higher in the 12th and 13th Plan when most of the major investments will be made.

PORTS AND SHIPPING

As discussed earlier, by 2031-32, Indian ports will have to handle five times more thermal coal than today, 7.5 times more coking coal, and about 3.5 times more POL. Indian ports are barely able to handle current levels of imports so these large increases in the future will be a big challenge.

NEED FOR A VISION FOR THE PORTS SECTOR

Efforts are being made to improve the performance of ports; however, they are focused on improving the performance of individual ports while improvements are neededon a systemwide basis. A vision needs to be developed for the ports sector and a national strategy based on it. One issue is the establishment of mega ports. Most of the world's major economies have a few. India has none. Mega ports can accomodate larger ships resulting in a reduction of up to 40 per cent of transport costs. In addition, mega ports provide very signficant economies of scale for advanced handling equipment which can dramatically reduce turnaround times for vessels. A vision for the ports sector should consider issues such as: How many mega ports should there be in the country and where should they be located? What will be the roles of mega ports, major ports and non-major ports in such a framework? What role should coastal shipping play in the framework?

SELECTION OF SITES FOR MEGA PORTS

An analysis of the expected port traffic from POL and coal over the next two decades reveals that Gujarat is by far the state that has the most port traffic for all three commodities, and would clearly be a prime location for a mega port. On the East coast, Odisha, Andhra and Tamil Nadu have a large amount of traffic and are potential candidates for mega ports. On the west coast, in addition to Gujarat, one or two more mega ports will be required. Maharashtra has the largest amount of port traffic on the west coast after Gujarat, and it may be appropriate to have a port on the southern end of the Maharashtra coast that could also be used to serve Goa and Karnataka. Some of the existing ports that have a deep draft and could be developed to become mega ports are: Mundra (Gujarat); Gangavaram (AP); Dhamra (Odisha); and Ennore (TN).

However, selection of sites for locating mega ports will require extensive modeling and analysis. First, all types of port traffic including containers and other commodities needs to be included in the analysis. Second, detailed data are required on the cost of development of candidate ports, and then detailed modeling is required to examine the costs and benefits of the potential sites.

PROMOTION OF COASTAL SHIPPING

Coastal shipping is an important mode of transport for bulk commodities that uses only about one-sixth the fuel per tonne-km as that used by road transport and about half of that used by rail. Hence, it is less expensive and has a lower environmental impact. However, coastal shipping carries about only about 7 per cent of the freight traffic, well below its potential given India's long coastline. The cost advantage of coastal shipping is not realised because of high handling charges and poor first and last mile connectivity. Handling charges can be reduced by creating dedicated ports or terminals for coastal shipping. Terminals dedicated to service coastal ships should be set up at the major ports. In addition, five or six non-major ports on the east and west coasts should be selected to be ports for coastal shipping and developed and equipped for that purpose. Adequate road and rail connectivity to these coastal shipping terminals and ports should be provided.

INVESTMENTS IN THE PORT SECTOR

Investment of about Rs 1,485 billion will be required over the 20-year period.

ANNEXE I. OVERVIEW OF INTEGRATED PLANNING MODEL® (IPM®)

The modelling of the power sector was done using the India-Integrated Planning Model® (I-IPM®) developed by ICF International. It uses linear programming to select investment options and to dispatch generating units to meet overall electric demand over the chosen planning horizon.

I-IPM® is backed by an extensive database capturing all the parameters of the Indian power sector. The key data include:

- Data on all power plants, their costs, operation parameters and fuel capability. All new power plants currently under construction, along with the characteristics of new, unplanned units
- Demand represented at the state level along with the demand profiles for each state.
- Fuel supply, extensively treated with distinct supply regions and transport infrastructure and costs.
- Transmission capability between states, including proposed new builds.

As a forward-looking model, I-IPM® determines the most efficient, capacity addition path. As the model solves for all years simultaneously, it selects the most appropriate solution to meet the demand for electricity by considering options such as building new base load or peaking units; retrofitting or repowering existing units; selecting units that should be retired or mothballed. It also identifies the timing of such events.

Outputs from the model include optimal generation capacity expansions including mothballing, retrofits, retirements and new builds, optimal transmission expansion builds, optimal fuel transportation and optimal compliance plans for individual generation units.

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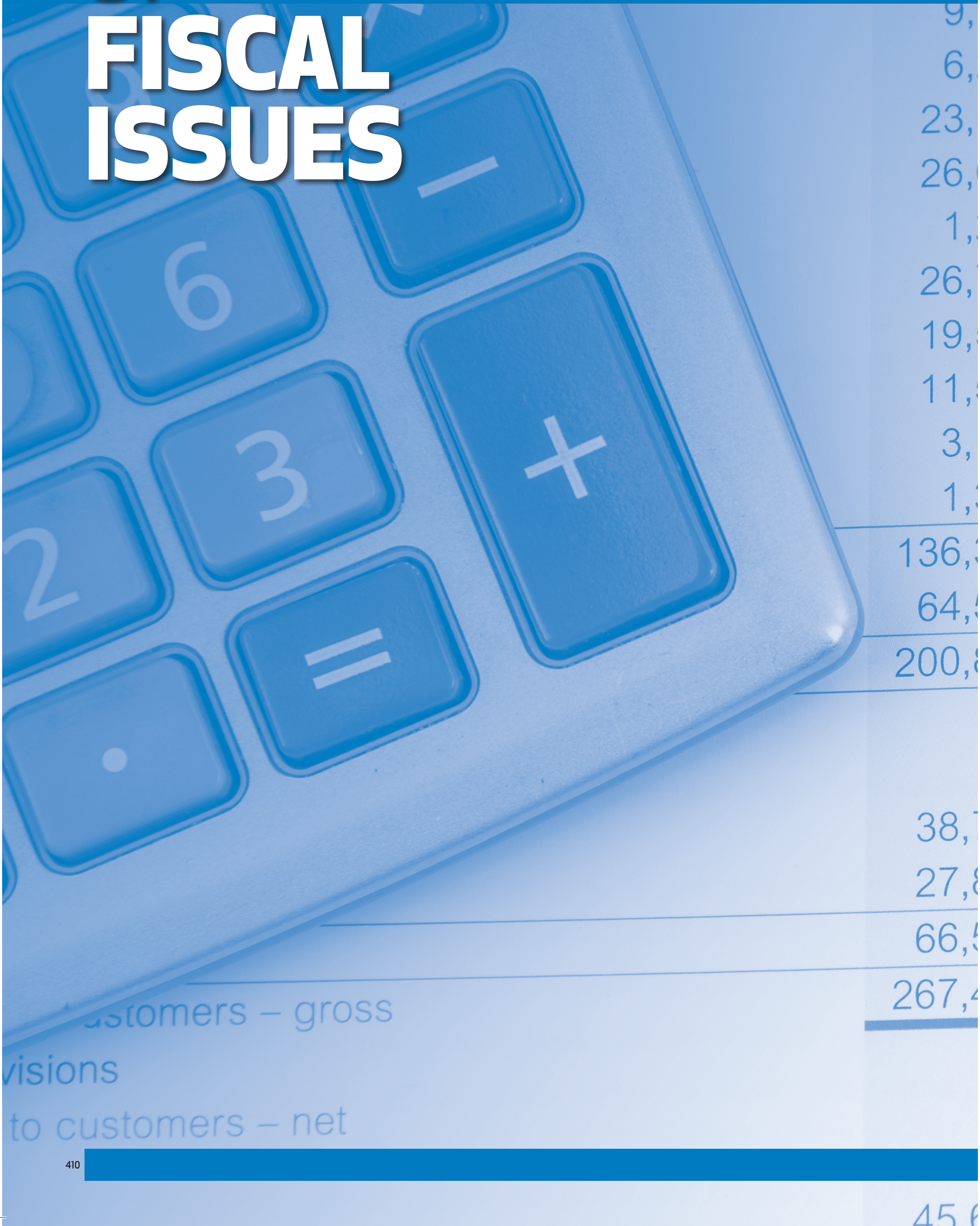
9. FISCAL ISSUES



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10,266 19,798 45,951
30,747 52,777 136,557
61,655 141,734 421,110
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9. FISCAL ISSUES

The objective of this chapter is to look into the current system of transport taxes and user charges as a part of transport pricing strategy in India. Transport pricing is a method of resource allocation through a collection of tools that affect the final price of transport services and thus influences the behaviour of users and transport service providers. It is commonly assumed that there is no such thing as the 'right' price; there are only optimal pricing strategies aimed at achieving specific objectives.

One of the major problems in setting optimal transport pricing is to decide on the right objective. For example, the optimal price for profit maximisation may differ from that required for maximising social welfare or facilitating sustainable development. Moreover, effectiveness of other public policies towards transport depends on transport pricing. This chapter aims to define rational transport pricing policies and address a range of issues related to taxation structure in Indian transport sectors.

Transport taxes and user charges are two major components of transport pricing policy. We distinguish tax from user charges in this context. However, in practice, this distinction is often blurred. Taxes are government-mandated payments which go to the public exchequer. User charges explicitly relate to the benefits derived from consuming the services provided by the transport infrastructure. For example, Road Tax (or Motor Vehicle Tax) is intended to generate revenue for the purpose of road infrastructure development and maintenance. It is more like a payment for using infrastructure and therefore, could be considered as a user charge. However, road tax is collected irrespective of whether a car owner is actually using the infrastructure. The revenue from road tax is added to the total tax pool of a state and not necessarily earmarked entirely for maintenance and development of road. Usually, the final price of transport service (fare/ freight rate) includes 1) cost of provision of the service including input taxes (tax on fuels, rolling stocks, etc) and user charges levied on transport service provider, 2) profit margin, 3) output/ service taxes (less subsidy). Conceptually, if we go by the definition of user charge, fare and freight charge may be implicitly considered as a user charge. However, following the literature, we assume that the fare or the final price of transport service is different from user charges for using other types of transport infrastructure.

To provide firms and individuals with pricing signals that guide their behaviour in a more rational economic manner, taxes and user charges need to be rationalised. Without this, interventions to manage the transport sector efficiently will be less than fully successful. Without better pricing, many investments and subsidies may be wasted and confidence in the outcomes of a wide range of policies undermined.

Broadly there are five objectives of taxes and user charges:

GENERATION OF RESOURCES

Generation of internal resources for development and maintenance of transport infrastructure could be considered to be the main objective of transport taxes. Tax revenues have more fiscal flexibility as they can be spent on anything, whereas user charges are levied closer to the point of use of transport infrastructure and can be spent on maintenance of the infrastructure. In an economy with broader social objectives, it is difficult to tightly link revenues with user charges in each transport sector for the expenditure incurred on it. Tax revenue gives this flexibility. Inter-modal, inter-regional, and intergroup distribution of resources is the main consideration while preferring taxation over user charges in a particular mode.

Theoretically, pricing should internalise the whole spectrum of externalities. However, this may lead to a very complicated tax system. There is a trade-off between improving efficiency through an array of taxes and better compliance through a simplified tax structure

Investment priorities are determined on larger socio-economic considerations. The economic viability of large-scale investment projects should be assessed by taking into account all the costs and benefits. The total cost of investment is not only the direct cost of capital but it also involves opportunity cost of capital. Taxes and user charges in transport sector should be set in such a way that the price of the services covers at least its marginal cost in short-run and recovers the opportunity cost in the long-run. While the need for cross-subsidisation is well recognised, there should not be any justification for general subsidy for transport.

It is well established in the literature that more inelastic the demand, the greater is the opportunity to impose taxes. However, in so doing, the government should ensure that the economically vulnerable sections of the society are not denied the service. Given this general consideration, taxation policies should be conducive to maximum generation of resources if huge investment demand in transport sector is to be financed. Otherwise, the fiscal authority has to compromise with other socially important spending like health and education.

ECONOMIC EFFICIENCY

The concept of economic efficiency is derived from the theory of welfare economics and it is related to efficiency in the allocation of resources. Inefficient resource allocation can be changed to better allocation such that someone is made better off without hurting others. An efficient allocation is one where no such reallocation is possible. Economic efficiency also implies minimum technological cost of providing the service. Many governments follow economic or allocative efficiency principles in transport pricing policy. Welfare economics postulates that social benefit is maximised and as a result economic efficiency achieved when prices are equated with marginal social cost. When price is set at marginal cost, the sum of producers' surplus and consumers' surplus are at their maxima. Traditional theory tells that such a condition exists in the long run under perfect competition when individual producers set their profit maximising price. However, any degree of monopoly power permits a firm to charge a price higher than marginal cost so that it can realise additional profit at the expense of reduced output. This, in turn, may lead to unfortunate circumstances where some consumers are denied the use of the service. Indeed, it is the fear of monopolistic exploitation that has led to price regulation in transport sectors in many countries.

There is another source of inefficiency in transport pricing. If marginal private cost is different from marginal social cost due to negative externalities or marginal private benefit is different from marginal social benefit due to positive externalities, transport service providers may set prices at levels different from the 'first best' solution for society as a whole. Corrective fiscal measures may change the behaviour of service providers and consumers so that economic efficiency is achieved. Under this regime, full cost including social and environmental cost is accounted for in the price of transport services through proper taxation. For example, if there is negative externality in the transport sector and marginal private cost is lower than marginal social cost, government may impose a tax on output to equate private and social costs. Similarly, if the social benefit is higher than the private benefit, government may induce higher output through subsidies.

Theoretically, pricing should completely internalise the whole spectrum of externalities. However, this may lead to a very complicated tax system. As the tax structure becomes complex, the cost per unit of revenue collection increases. It also induces higher transaction cost. There is a trade-off between improving economic efficiency through an array of taxes and reduction in cost of revenue collection and better tax compliance through a simplified tax structure.

The conditions for the 'first-best' world are rarely found in reality. There are some other crucial conditions where fiscal policies play a welfare-improving role. Problems also arise when applying marginal cost pricing principle in transport because capacity is indivisible and can be increased only in large chunks. There are obvious economies of scale. Cyclicality in utilisation of infrastructure makes marginal cost pricing complicated. We summarise below the main reasons for fiscal intervention to achieve economic efficiency.

a) externalities (both positive and negative)
b) degree of monopoly
c) indivisibilities of supply and short-term fixed capacity constraints
d) indivisibilities of demand and short-term peak load problem

For some scarce resources, taxes play a role of shadow prices. For example, India follows the principle of import parity pricing of petroleum products. In this case, the taxes and margins added on top of the production cost ensures socially efficient use of this scarce resource.

Table 9.1
Transport Pricing Policy Objectives and Conflict

PRICING POLICY OBJECTIVES	CONFLICTS
Economic Efficiency vs Profitability	Pricing to promote the efficient use of transport capacity may lead to financial losses.
Environmental Sustainability vs Income Distribution	Pollution taxes may adversely affect poorer income groups and lead to unemployment
Profitability vs Macroeconomic Policy	Pricing for profitability may lead to higher transport prices thereby creating inflationary pressures
Profitability vs Income Distribution	Pricing for profitability may lead to higher transport prices with adverse effects on poor communities
Economic Efficiency vs Macroeconomic Policy	Macroeconomic price restraint policies may conflict with the need to increase transport prices during periods of congestion and excess demand

Source: Sustainable Transport Pricing and Charges: Principles and Issues, Asian Institute of Transport Development and UNESCAP, 2001

To sum up, it is important to recognise the importance of marginal cost pricing and internalisation of externalities in transport sector–correcting the price signals through taxes and user charges so that individuals (including transport service users, service providers and investors) guide their behaviour in a more rational economic manner.

INCOME DISTRIBUTION

The third rationale for taxation and user charges is the consideration of income distribution. Policy makers are usually concerned about the distribution of income. It is indeed true that optimal pricing strategy must look into the options of equity while keeping marginal conditions unchanged. Government should attempt to move towards a more progressive tax system in transport where tax incidence for people with lower ability-to-pay is lower. However, policies promoting redistribution are often coupled with ad-hoc interventions such as excessive price controls in the transport sector and consequent perpetuation of loss-making services. Cross-subsidisation involves charging some users above the marginal cost to offset the losses made on services where prices are fixed below the relevant marginal cost.

However, cross-subsidisation often violates the principle of progressive tax since it may not target the appropriate income groups effectively. The supply of the transport service is then often curtailed adversely, affecting the very people the policy is supposed to benefit. In general, cross-subsidisation should be eliminated in the interest of economic efficiency. If subsidy is socially desirable, it should be distributed through other general transfer mechanisms without distorting price signals. It is also argued that the efficiency gain from removing cross-subsidisation may generate enough resources to compensate those who suffer from the undue burden. Therefore, it is important to identify the distributional implication of particular pricing policies and to modify them appropriately to achieve economic efficiency within the constraints of equity requirements.

ENVIRONMENTAL SUSTAINABILITY

Environmental protection has increasingly become an important policy objective in the transport sector. Transport, in general, and road transport in particular, contribute a large proportion of greenhouse gases which threaten environmental sustainability. Consequently, governments are increasingly introducing measures, including pricing tools such as pollution and congestion taxes, to control environmental pollution. Do such measures distort the pricing system? We have already emphasised the role of taxes in correcting price signals in the presence of negative externalities. Promoting environmental sustainability is consistent with the aim of welfare maximisation through economic efficiency where social welfare incorporates social environmental cost and benefit.

RELATIONSHIP WITH MACROECONOMIC POLICIES

Macroeconomic policies mainly target five interdependent variables: a) rate of growth of national output; b) level of employment; c) price or inflation; d) interest rate; and e) balance of payments (and therefore the exchange rate and capital flows). The level of investment in transport infrastructure and the transport pricing are interlinked with other macroeconomic policies. Investment in the transport sec-

Table 9. 2

Important Taxes in Transport Sectors

NAME OF TAX	LEVYING AUTHORITY	IMPORTANT COMPONENTS	MODE
Taxes on Vehicles	State Governments	Receipts under the Indian Motor Vehicles Act, Receipts Under the State Motor Vehicles Taxation Act, Receipts Under State Toll Tax, Services and Service Fees, etc.	Roads
Taxes on Goods and Passengers	State Governments	Passenger Tax, Goods Tax, Tax on Entry of Goods into Local Areas, Tolls on Roads, etc. (nomenclature depends on state specific act)	Roads and Inland Water Ways
Other Taxes and duties on Commodities and Services	State Governments	Foreign Travel Tax (Tax on travel by Air, Tax on travel by Sea), Inland Air Travel Tax	Air, Water
Taxes on Sales, Trade, etc.	State Governments	State Sales Tax Act, Central Sales Tax Act, Tax on Sale of Motor Spirits and Lubricants	All modes, Fuels
Service Tax on Transport Services	Central Government	Air Travel Agent Services Tour Operator Services Goods Transport Operator Services Port Services Service on Repair Provided by Authorised Service Station for Motor Car and Two Wheeled Vehicles Cargo Handling Services Rail Travel Agent Services Airport Services Transports of Goods by Road Ship Management Services Transports of Coastal Goods and Goods through National Waterways	All modes
Excise	Central Government	Excise duty and cess on transport goods	All modes, Fuels
Customs	Central Government	Custom duty and cess on transport goods	All modes, Fuels

tor affects aggregate output through the multiplier effect. It also generates employment and improves export competitiveness. Tax revenue collected from this sector is contributed to the consolidated pool and therefore gives greater fiscal flexibility. The prices of all other sectors are strongly linked with transport prices. Consequently, aggregate inflation may be contained through some of the fiscal instruments used in the transport sector. Macroeconomic policies, therefore, can impinge on transport pricing policies.

The set of objectives discussed above are often complex and conflicting. There is always a need for reconciling multiple objectives. For example, internalising diverse social costs associated with externalities through appropriate taxes and user charges may actually lead to an array of taxes. Similarly, reducing the complexity of tax structure through unified tax may fail to internalise diverse social costs associated with externalities but can have a significant impact on efficiency of tax collection. We may draw an analogy with tariff reforms in India during the early 1990s. A simpler tax system, especially in the road sector, may be beneficial for growth and efficiency of road transport. While there are many transport pricing policy objectives, economists usually argue that the pursuance of economic efficiency should take precedence over other objectives. A summary of pricing policy objectives and conflicts arising therefrom are given in Table 9.1.

How does the current tax structure in transport meet the objectives discussed above? Does it fulfill the principle of marginal cost pricing and achieve economic efficiency? Lack of data restrains us from in-depth analysis of fiscal inefficiencies arising from the current tax structure. However, an attempt has been made to discuss some of the important issues related to the current tax system, especially in the road transport sector. Taxes and user charges on transport modes, and the way in which they are levied, have a profound effect on traffic flows and on the development of transport infrastructure. Before discussing the sources of fiscal inefficiencies, there is a need to review the prevailing tax structure. The following section gives a bird's eye view of all indirect taxes levied on transport sectors by mode (rail, road, aviation, ports and shipping) and levying authority (centre and state).

Table 9. 3
Taxes Levied on Rail Transport

A. CENTRAL TAX:	
1) Excise Duty:	Excise duty is imposed on 1) Rolling stock, 2) Other equipments, and 3) Fuel (High Speed Diesel and Coal)
2) Custom Tariff:	Basic duty, CVD, Special CVD, education cess is imposed on rolling stock, other equipments and Fuel
3) Service Tax:	Rail travel agent services, Transport of goods by rail service are subject to service tax and education cess (education cess and higher/secondary education cess)
B. STATE TAX:	
1) Sales Tax/ Value Added Tax (VAT):	The state governments collect VAT/Sales tax on rolling stock, other equipments and diesel (HSD). The tax rate widely varies across states. Some states also charge entry tax on HSD (Karnataka, Oddisa), cess (Gujarat, Chandigarh, West Bengal), additional tax on VAT (Punjab, Haryana), Air Ambience Charge (Delhi), Social Security Cess (Kerala), etc. Electricity: State Electricity Duty (varies across states)

THE SYSTEM OF TAXES AND USER CHARGES IN TRANSPORT SECTOR

The power of regulation and imposition of taxes on transport modes have been specified under the three lists vide the Seventh schedule (Article 246) of the Indian Constitution, viz. Union List, State List and Concurrent List.

UNION LIST
Railways; National Highways; shipping and navigation on inland waterways; maritime shipping and navigation; lighthouses; major ports; airways, aircraft, and air navigation; provision of aerodromes; petroleum and petroleum products; customs; excise; and inter-state trade and commerce

STATE LIST
Roads; bridges; ferries; other means of communication not specified in Union List; municipal tramways; inland waterways not specified in the Union or Concurrent Lists; taxes on entry of goods into a local area for consumption, use or sale therein; taxes on goods and passengers carried by roads or on inland waterways; taxes on vehicles; taxes on boats; and tolls

CONCURRENT LIST
Non-major ports and parts of shipping and navigation on inland waterways subject to the provisions of the Union List with respect to national waterways

The taxes are broadly classified as ‘Central taxes’ and ‘State taxes’. The indirect taxes levied by the central government are excise, customs, and service taxes. The state governments mainly collect sales tax/ VAT, Motor Vehicle Tax (MVT) from road, and Passenger & Goods Tax (P&GT) from road and inland water transport. Table 9.2 summarises important taxes in the transport sector, levying authority and modes.

Though the central government is the levying authority for excise, customs and service taxes, a share of the tax revenues collected by the Union Government is distributed among states based on recommendations of the Finance Commission. Till the Ninth Finance Commission, only income tax and excise revenues were considered for sharing with states. After the Tenth Finance Commission (1995–2000), all taxes (except surcharges and cess) are now considered for devolution. The divisible pool includes other revenues including customs duty and service tax.

It is evident from Table 9.2 that the road sector is subject to multiple taxes at the state level. All other modes are mainly subject to the central taxes. Any variation in fuel price across regions is mainly due to the diverse state-level sales tax. We discuss the tax structure by mode below.

RAIL

The central government collects excise and customs on railway rolling stock, other equipment and fuels. Several services related to rail transport are also under the service tax net. The state governments levy VAT/ sales tax on sales of rolling stock and other equipment. Electricity and fuel are also subject to state-level taxes. Table 9.3 summarises

Table 9. 4
Taxes Levied on Road Transport

A. CENTRAL TAX:	
1) Excise Duty:	Excise duty is imposed on vehicles and parts. Motor vehicles for the transport of persons and goods are subject to varying rate on the basis of cylinder capacity, engine type, capacity, chassis, etc. Excise duty is a mixture of ad valorem and unit specific tax rates. Petrol/MS and HSD are subject to basic excise duty, Special Additional Duty, and Additional Excise duty.
2) Custom Tariff:	Motor vehicles for the transport of persons and goods are subject to varying basic duty (based on cylinder capacity, engine type, capacity, chassis, etc). CVD is also charged at the rate of excise duty. Education cess and secondary education cess are also collected.
3) Service Tax:	The following services in road transport sector are subject to service tax and education cess: Rent-a-Cab Scheme Operator Services, Tour Operator Services, Goods Transport Operator Services, Service on Repair Provided by Authorised Service Station for Motor Car and Two Wheeled Vehicles, Transports of Goods by Road, Travel Agents (other than Air Travel Agents)
B. STATE TAX:	
1) Taxes on Vehicles:	This tax is popularly known as Motor Vehicle Tax (MVT) or Road Tax. State governments generate revenue under Motor Vehicles Act, 1988 (regulation purpose), State Motor Vehicles Taxation Act (tax revenue purpose), state toll tax act, and different services and service fees. Some states have combined all these taxes and fees in a single tax scheme. This tax system varies across states and vehicle type. Some states collect onetime tax while several other states levy annual or quarterly tax.
2) Taxes on Goods and Passengers:	This tax is levied on goods and passengers carried by road or inland water way. Major components of this tax are tax on goods, passengers, entry of goods into local areas for consumption or final sale (popularly known as entry tax). Some states also collects tolls on roads under this nomenclature.
3) Taxes on Sales, Trade, etc.:	This tax group includes receipt under Central Sales Tax Act (states collect this tax), receipt under State Sales Tax Act (also known as VAT), Tax on Sale of Motor Spirits and Lubricants, and Surcharge on Sales Tax. The sales tax rate or VAT schedules vary across states.

Table 9. 5
Taxes Levied on Civil Aviation

A. CENTRAL TAX:	
1) Excise Duty:	Helicopters, aeroplanes, Aircraft launching gear; deck arrestors or similar gear; ground flying trainers; parts thereof are subject to central excise duty. Basic excise duty on Aviation Turbine Fuel (ATF) is 8 per cent. There is no additional excise duty.
2) Custom Tariff:	Helicopters, aeroplanes, propellers, air combat simulator, etc. are subject to custom duty and other trade restrictions are applied to these goods. CVD and Special CVD are applicable to private aircrafts. Basic custom duty on ATF is nil (ATF is domestically produced). However, CVD is levied on ATF (at the rate of excise).
3) Service Tax:	Air Travel Agent Services[1], Tour Operator Services, Cargo Handling Services, Airport Services , etc are taxed. The service tax on international air travel for passengers embarking in India and travelling in higher (other than economy) classes was imposed with effect from 1 May 2006. Vide Finance Act, 2010 the service tax on air travel was expanded to cover international and domestic travel in economy class[2].
B. STATE TAX:	
1) VAT/Sales Tax:	Fuel: State governments collect sales tax on Aviation Turbine Fuel (ATF). The rates vary across states substantially. VAT rate on ATF is as high as 28.75 per cent in Madhya Pradesh and lowest 0 per cent in Karnataka. Haryana imposes surcharge on ATF at 5 per cent. The average VAT rate is close to 20 per cent across states

1 Route Navigation Facility, Landing and Parking, Terminal Navigational Landing, etc are important airport services. Airport Authority of India or private operators collect user charges for providing these servises to airlines. These services are under service tax net.

2 Generally the break-up of the total air fare is the following. 1) base fare, 2) passenger service fee (marked as WO in ticket, collected by AAI or private operators), 3) airline fuel charge (collected by airlines), 4) service tax (marked as JN in ticket), and 5) development fee (marked as IN or YM in ticket, levied by airports). In addition to these, there may be transaction fee (marked as OC, collected by ticketing agent) and fuel surcharge (marked as YQ, collected by airlines).

Table 9. 6
Taxes Levied on Shipping

A. CENTRAL TAX:	
1) Excise Duty:	Ferry-boats, cargo ships, barges and similar vessels for the transport of persons or goods are taxed at 5 per cent, vessels for fishery are not taxed. Fuel: as given in section on Road and Rail
2) Custom Tariff:	Cruise ships, excursion boats, ferryboats, cargo ships, barges and similar vessels for the transport of persons or goods are taxed. CVD (other than fishing vessels) and special CVD are applicable on top of the basic rate.
3) Service Tax:	Steamer Agent Services, Port Services, Cargo Handling Services, Dredging Services of River, Port, Harbour, Backwater or Estuary, Ship Management Services, Transport of Persons by Cruise Ship, Transports of Coastal Goods, etc are taxed
B. STATE TAX:	
1) VAT/Sales Tax:	Ships and other vessels are taxed Fuel oil is subject to sales tax as described in sections on Rail and Road.

important taxes in rail transport by the levying authority.

ROAD

In addition to excise, customs and service tax levied by the central government and sales tax/ VAT levied by the state governments, there are several other taxes imposed on road transport at the state level. Taxes on Vehicles and Taxes on Goods and Passengers are two important categories of state-level taxes. There are several components of Taxes on Vehicles and Passenger and Goods Tax (P&GT). Motor Vehicle Tax (MVT–popularly known as Road Tax) is a major component of taxes on vehicle. Goods Tax, Passenger Tax, and Entry Tax are three important components of Taxes on Goods and Passengers. The road tax rates are diverse and complex in nature. The complexity of these taxes is discussed in greater detail in the next section. The VAT on fuels, levied by state governments, varies widely across states. Some states impose an additional tax on VAT, employment cess, air ambience charges, entry tax, and social security cess on fuel. Customs duty and excise tax are imposed by the central government and are, therefore, uniform across states. The taxes in road transport sector are summarised by levying authority in Table 9.4.

CIVIL AVIATION

The main tax levies on this sector come from sales tax or VAT levied on aviation turbine fuel (ATF). The sales tax rate varies across states. Domestic airlines spend around 35 to 40 per cent of operating costs on ATF while foreign airlines pay lower price for ATF due to exemption from some tariffs. ATF is also subject to central excise. Although import of ATF is not allowed, import parity price of domestically produced ATF includes CVD. International flights (domestic and foreign operators) are exempted from state sales tax on ATF. A summary of taxes imposed on this sector is given in Table 9.5.

PORTS AND SHIPPING

Water transport comprises shipping services (coastal and ocean), inland waterways, and port services (major, intermediate, and minor ports). Other subsidiary services, viz. ship building and repairing, cargo handling, freight forwarding, lighthouse facilities, and other port services are also important inputs to this sector. Tariffs in the major ports are governed by the Tariff Authorit of Major Ports (TAMP), whereas minor ports are under the state ambit. The Inland Waterways Authority of India regulates national waterways (there are five inland waterways). Indirect taxes in this sector are very similar to those in the civil aviation sector. The central government collects excise and customs tariffs from ships, boats and fuel. Service tax is also applicable to several services related to this sector. The state governments levy sales tax/ VAT on vessels and fuels. A summary of tax and user charges is given in Table 9.6.

USER CHARGES

In addition to taxes, user charges also constitute an important component of transport pricing. User charges, by definition, include a diverse range of payments for usage of transport services and infrastructure. Fare or freight charges may be seen as direct charges levied on the user. The fares are

Table 9.7
Important User Charges in Transport Sectors

NAME OF CHARGE	LEVYING/COLLECTION AUTHORITY	IMPORTANT COMPONENTS	MODE
Toll on National Highways	National Highway Authority of India, Private Operators (Public Private Partnership projects)	Toll charges on National Highways, Fees for use of permanent bridges, bypass or tunnel	Roads
User Charges in Major Ports	Major Ports (Port Trusts)	Port Dues Berth Hire Pilotage & Towage Wharfage Charges Demurrage Charges Anchorage Salvage & Divers Fees Dry Docking Water Supply to Vessels Licence Fee for Space	Water
User Charges in Airports	Airport Authority of India, Private Operators	Route Navigation Facility Charges Landing and Parking Charges Terminal Navigational Landing Charges	Air

distinct from the user charges paid by transport service provider or passengers to the owner or operator of transport infrastructure.

Several explicit user charges on roads (toll), aviation (airport-related charges) and shipping services (port-related charges) are collected either from transport service providers or directly from traveller/transporter. Unlike port and airport services, there is no explicit user charge levied on usage of rail infrastructure by Indian Railways. However, private rail container operators do pay user charges to the railways. The way infrastructure is maintained and the tariff rates are regulated in railways is quite different from that in other modes. One important distinction is that there are separate authorities for operation of the infrastructure and regulation of the tariff structure in shipping and aviation sectors. For example, either the Airport Authority of India (AAI) or private entities operate the airport infrastructure whereas the Airports Economic Regulatory Authority (AERA) regulates the tariff structure. Similarly, port trusts operate shipping infrastructure whereas the Tariff Authority of Major Ports (TAMP) regulates the tariff structure in major ports.

In contrast, the Indian Railways is the sole owner and operator of the huge railway infrastructure and at the same time it also regulates the tariff structure. Freight and passenger tariff rates in rail transport do not explicitly mention any user charge levied on usage of railway infrastructure. However, tariff rates, in principle, may implicitly internalise the cost of depreciation of infrastructure. Indian Railways does not have a proper system of internalising the cost of depreciation of own infrastructure through user charges. Though there is a Depreciation Reserve Fund of Indian Railways, the current reserve in this fund is very low and there is no clear revenue generation practice through user charges. As long as there is no internal system of payment for user charges, railways may not fully internalise the cost of depreciation of its own infrastructure. (Chapter on Railways for recommendations on reforms in Railways accounting).

Table 9.7 gives a summary of important user charges levied on transport modes.

Subsidy is an integral part of the transport pricing mechanism. Only a part of government subsidies is clearly visible in the central government's budget documents. Such explicit subsidies are mainly on food, fertiliser and petroleum. There is no explicit subsidy to transport sectors mentioned in the central government budget documents. However, Indian Railways receives subsidy towards dividend reliefs and other concessions, and reimbursement of losses to railways on operating strategic railway Lines. Under the 'Separation of Convention' the Railways are required to pay dividend at a fixed rate on capital advance by the central government. The rate of dividend is periodically revised by the Railway Convention Committee of Parliament. Railway receives, in principle, subsidy equivalent to the amount of dividend paid on investment in strategic lines, non-strategic portions of lines in north-eastern states, etc.

There are several forms of implicit subsidies in transport. According to the annual reports published by Indian Railways, there is cross-subsidisation from freight earning to passenger and other coaching earnings. Similarly, earnings of the state owned transport corporations fall short of operating

Table 9. 8

Complexity of Motor Vehicle Tax Structure

STATE	GOODS TRANSPORT			PASSENGER TRANSPORT			PERSONALISED TRANSPORT		
	Types of Vehicle	Number of Lines	Parameter	Types of Vehicle	Number of Lines	Parameter	Types of Vehicle	Number of Lines	Parameter
Andhra Pradesh	4	8	C,W,Q/L	.3	8	R,E,C,K,Q,S	4	5	C,Q/L,O
Arunachal Pradesh	3	3	A	1	1	L	4	4	L
Assam	3	11	C,Q	1	4	C,Q/A,S	4	12	P,C,R,Q/L
Bihar	3	9	C,W,A	1	3	C,A	4	7	P,W,A/L
Chhattisgarh	4	9	C,W,Q/L,U	1	4	C,M,S,K	4	6	C,P,Q/L
Goa	1	17	C,W,A	1	5	C,M,A	4	11	C,W,P,A/L,S
Gujarat	2	5	C,W,P,A	2	10	C,A	4	6	C,P,L
Haryana	1	5	C,W,A	2	4	C,A,R,I	4	7	C,W,A/L,I
Himachal Pradesh	3	5	A	1	2	C,A,R	5	7	L,H
Jammu and Kashmir	2	2	Q,U	1	1	C,Q	4	7	H,Q/L
Jharkhand	4	7	C,W,A	1	4	C,A	5	5	C,A/L
Karnataka	3	4	C,W,Q/L	1	8	C,Q,E,S,R	4	7	C,W,P,Q/L
Madhya Pradesh	1	10	C,W,Q/L	1	6	C,M,S	4	4	P,C,Q/L
Maharashtra	2	5	C,W,A/L	8	10	C,A,R,E	4	18	C,P,Q/L,S
Manipur	4	7	F,A	1	1	C,A	4	7	W,F,A
Meghalaya	5	10	C,W,A/L	2	3	C,A	4	4	L
Mizoram	4	6	C,A	1	1	C,A	4	4	A
Nagaland	4	8	C,A,U	1	5	C,R,A	4	11	W,H,R,L
Odisha	2	11	C,W,A,P	2	11	C,A,K,S	4	10	C,W,O,PA
Punjab	3	6	C,W,A,U	2	18	S,R,D/A,K	4	12	C,A/L,S

STATE	GOODS TRANSPORT			PASSENGER TRANSPORT			PERSONALISED TRANSPORT		
	Types of Vehicle	Number of Lines	Parameter	Types of Vehicle	Number of Lines	Parameter	Types of Vehicle	Number of Lines	Parameter
Rajasthan	3	16	P,L,U	2	35	C,D,P,B,T	2	9	C,H,P,L
Sikkim	3	3	C,W,A/L	1	2	A	3	9	C,H,A/L
Tamil Nadu	4	23	C,W,Q/L	3	8	C,R,Q,S	4	5	P,S,A/L
Tripura	4	8	C,W,A	3	7	C,A	4	5	A
Uttar Pradesh	4	6	C,W,Q	1	1	C,Q	4	8	C,H,P,F,Q/L
Uttarakhand	4	8	C,Q,R	1	2	C,Q/M	4	5	H,P,C,Q/L
West Bengal	4	59	C,W,Q	1	1	C,Q	4	11	C,H,L
Andaman Nicobar	3	3	A	1	1	A	4	4	A
Chandigarh	3	7	C,A	1	2	A	4	13	C,A/L
Dadra and Nagar Haveli	3	3	C,W,A	1	1	C,A	4	8	C,W,A
Daman and Diu	2	3	C,W,F,A	1	3	C,A,K	4	13	C,W,H,A
Delhi	2	10	C,A	1	5	C,A	3	8	P,L
Puducherry	2	9	W,Q	2	8	C,Q,R,S	4	13	C,W,H,S,Q,A

Source: NCAER report (NCAER, 2012). Detail tax rates are given in NCAER report.

Legends:
C: capacity
W: weight
P: price
A: annual
Q: quarterly
L: lifetime/ lumpsum

F: fuel type
R: regional
K: distance (km)
S: service
E: Earnings
M: monthly
I: institution

D: daily
B: body form i.e. whether chassis or vehicle
T: number of wheels/ tyres
O: ownership of second vehicle, age of vehicle,
H: cc (engine capacity)

cost and receive some form of subsidies from state governments. Sometimes, they receive subsidised fuel as well. In the aviation sector, some economically unprofitable regional routes receive cross-subsidisation. In recent past, the ship-building industry has also received subsidies.

The above discussion on the current system of taxes brings forth an important finding: the tax system in road transport is much more complex compared to rail, civil aviation and shipping. While there are hardly any taxes imposed by the state governments on rail transport, the other two modes, aviation and shipping, face less tax complexity due to uniformity in tax structure. Except fuel, these three transport modes are almost exempted from state-level taxes. On the other hand, the Road Tax and P&GT rates are very diverse and complex. In fact, one of the important sources of inefficiencies in the transport sector is the multiplicity and complexity of this tax structure resulting in several barriers to free movement of goods across state borders. Since road is the dominant mode of transport, any inefficiency in this sector gets multiplied through strong sectoral linkages. Why is the tax system in road transport so complex? Does MVT and P&GT comply with the objectives we discussed in the first section? These are the questions we try to address in the next section.

COMPLEXITY OF TAXES IN ROAD TRANSPORT

In addition to usual central taxes, Motor Vehicle Tax (MVT) and Passenger and Goods Tax (P&GT) are levied by the state governments in road transport. Broadly, there are two objectives of MVT. First, it can be justified as the approximate user charge for use of the road network. Second, MVT is used as a fast-growing base of tax revenue for states. Over time, it became an important revenue source of state governments. However, the complexity of this tax system has caused several impediments to smooth functioning of inter-state trade and commerce.

TAX COMPLEXITY

There are different bases for computation of tax rates across states. While the access charges vary according to vehicle type, they do not discriminate according to usage type. The current structure of MVT is only indirectly linked to usage of the road network. Moreover, the revenue generated from MVT is not necessarily earmarked entirely for road network development and maintenance. Therefore, it is not a perfect user charge. The MVT structure depends on the use of vehicle, i.e. whether it is a goods carrier, used in passenger transport, or as a personalised vehicle. Further, each of these three vehicle types includes a specified category of vehicles that are taxed differently. MVT, in its current form, is a form of registration charge on access to road network. In fact, the more distance a vehicle has travelled, the less the vehicle charge per kilometre.

The tax parameters are mainly capacity/ weight of the vehicle, fuel type, body type, engine capacity, distance travelled, ownership, cost of vehicle, etc. Tax could be paid quarterly, annually, or for life depending on state-specific rules. Some states also charge differentiated tax within regional limit. Each state has multiple lines of tax rates based on a combination of parameters for each broader group, i.e. passenger vehicle, goods vehicle and personalised vehicle. It is evident that as the tax lines increase, the tax structure gets complicated. Moreover, a varied combination of these parameters complicates and prevents formulation of a common benchmark for state-level comparison. Nevertheless, an effort has been made to summarise the extent of complexity of MVT across states based on number of tax lines, number of parameters, and types of vehicles. Wide variations in the MVT rates, not only across states, but also across vehicle types and further within are summarised in Table 9.8.

For any vehicle type, a low number of lines and parameters would indicate a simplified tax procedure whereas complexity is evident for states with higher number of lines and parameters. The tax procedures appear to be the simplest in Delhi and Chandigarh (apart from smaller states and UTs) after taking into account the variety of decisive parameters in case of goods carrier. West Bengal appears to be executing an extremely complex structure as the state has got the maximum number of lines. With regard to passenger transport, Andhra Pradesh, West Bengal and Uttar Pradesh have the simplest structures whereas Punjab and Rajasthan implement a considerably varied tax structure across vehicles transporting passengers. Tax structure on personalised vehicles is most simple in Andhra Pradesh, whereas Maharashtra exhibits huge complexity due to high number of lines as well as parameters.

MVT, levied by states under their own motor vehicle taxation acts, is mainly for revenue purpose, whereas licence fees, registration fees, permit fees, etc. collected under Indian Motor Vehicles Act are for regulatory purpose of road transport. The revenue collected from registering motor vehicles, obtaining driving licences, transfer of ownership of motor vehicles, permit for transport vehicles, and certificate of fitness for transport constitute a significant portion of states' total tax revenue.

> The Motor Vehicle Tax can be justified as the approximate user charge for use of the road network. It is also used as a fast-growing base of tax revenue for states. However, the complexity of this tax system has hampered smooth functioning of inter-state commerce.

Thus, there are four main characteristics of the current Motor Vehicle Taxation System.

a) Different classification principles of vehicles for the purpose of taxation across states
b) Variation in duration of tax cycle across states- life time vs periodic
c) Use of ad valorem vs specific rates
d) Multiplicity of tax rates

All the above features result in serious problems of cross-classification and unintended economic effects.

Some states also impose tax on entry of goods into local areas for final consumption or sale; tolls on roads; passenger tax; and goods tax. All these taxes are classified as Taxes on Goods and Passengers in state budget documents. Some states also impose surcharge on tax on goods and passengers carried by road and inland waterways. At present, all the states do not levy entry tax. Also, it is not levied on all goods. Entry tax is levied through a separate statute in each state. There may be separate statutes for the levy of entry tax on motor vehicles and other specified goods. Local area, for this purpose, means an

Table 9. 9
Multiplicity of Laws and Taxes that Regulate Road Transport Sector

TYPE OF LAWS AND TAXES	IMPORTANT LAWS/TAXES
Laws governing access control to National Highways	i) National Highways Act, 1956 (ii) National Highways Rules, 1957 (iii) The National Highways Authority of India Act, 1988 (iv) National Highways (Land and Traffic) Act, 2002 (v) Highways Administration Rules, 2003.
Laws governing inter-state movement of goods	(i) Central Sales Tax Act, 1956 (ii) Various State Sales Acts / State VAT (iii) Various Local / Municipal Acts Governing Octroi and Entry Tax (iv) The Carriers Act, 1865 (regulating the liability of carriers)
Laws governing inter-state movement of vehicles	(i) The Motor Vehicle Act (MVA), 1988 (Amended in 1994, 2000, and 2001) (ii) The Central Motor Vehicle Rules (CMVR), 1989 (Amended in 1994, 2000, 2002, 2004, and 2005) (iii) Various State Motor Vehicles Acts.
Taxes	Road Tax, also known as Motor Vehicle Tax State VAT/Sales Tax Passengers and Goods Tax (P&GT) which includes Entry Tax State Toll Taxes Service Tax on output of this sector as well as secondary activities.
User Charges/Fees	Registration of motor vehicles Obtaining of driving licenses Transfer of ownership of motor vehicles Permit for transport vehicles Certificate of fitness for transport Tolls on roads and bridges

area falling within the jurisdiction of any municipal corporation, municipality, municipal body, cantonment board, gram panchayat, or any other local authority constituted under the statutes referred to in the law for levying entry tax. This tax is generally payable only at the point of first entry in the state, except in specific situations. In certain states, entry tax may be payable on movement from one local area to another.

Vehicles and their parts attract central excise, customs duty, and state sales tax. Basic customs duty on vehicles is around 10 per cent. CVD rate varies from 10.3 per cent to 22.6 per cent. A Special CVD of 4 per cent is also imposed on some vehicles and parts thereof. Central government collects excise duty at 22 per cent for passenger transport vehicles. There is additional specific tax of Rs 20,000 per unit for some types of vehicles. Excise duty varies from 10 per cent to 22 per cent for goods carrier. Sales tax / VAT for motor car vary from 12.5 per cent (Punjab, Maharashtra, Kerala, West Bengal, etc.) to 14.5 per cent (Andhra Pradesh). Interstate transactions are subject to central sales tax of 2 per cent.

The Union Government also collects revenue from service tax on transport of goods by road, cargo handling service, tour operator's service and rent-a-cab service. The standard service tax rate is 12.36 per cent including education cess.

TOLL AND CESS

There are two important other components of road pricing that need to be discussed: toll on National Highways and cess on petrol and diesel. Toll is an instrument used to control access to road. The toll, or user fee, on National Highways is levied and collected in accordance with the provisions of the National Highways Act, 1956 and rules made thereunder. User fee is charged on all sections of the National Highways having four or more lanes, bridges, and newly constructed bypasses. A ceiling for fee rate per kilometre for different types of vehicles has been prescribed for public-funded projects. Toll is charged in India under an 'open system' that imposes a fixed payable amount independent of the facility availed. This is in contrast to the 'closed system' approach in many other countries that charge tolls on the basis of the distance travelled. In the case of private investment projects, the collection of fee levied under the rule is made in accordance with the terms of the agreement entered into by the concessionaire.

The Government of India introduced a cess on both petrol and diesel through the Central Road Fund (CRF) Act, 2000. Currently, Rs 2 per litre is levied as cess or additional duty of excise and customs on both petrol and high speed diesel (HSD) oil as per the provisions of the Act amended by the Finance Act in 2005. Parliament decided that the fund so collected

Table 9.10
State Tax Revenue From Road Transport
[Rs Billion]

YEAR (MARCH ENDING)	MOTOR VEHICLE TAXES AND FEES	SALES TAX ON MOTOR SPIRITS AND LUBRICANTS	SALES TAX ON PASSENGER AND GOODS TRAFFIC	TOTAL STATE TAX FROM ROAD TRANSPORT (A)	TOTAL STATES' OWN TAX REVENUE
2003	84	51	36	171 (12.0)	1,421
2004	101	50	42	193 (12.1)	1,599
2005	108	67	52	227 (12.0)	1,891
2006	120	30	65	214 (10.1)	2,123
2007	132	13	68	214 (8.5)	2,525
2008	151	16	68	236 (8.2)	2,865
2009	164	9	85	259 (8.0)	3,219
2010	191	10	99	300 (8.3)	3,631
2011	244	7	113	364 (7.9)	4,607
Growth Rate (per cent)*	14.2	-21.9	15.5	9.9	15.8

should be put aside in a Central Road Fund (CRF) for exclusive utilisation towards the development of a modern road network.

To sum up, the tax structure is exceedingly complex in road transport, and has wide variations across states. It is difficult to compare tax rates among states due to the differential taxation structures and different classification principles for taxation of vehicles. Moreover, some states levy specific amount as tax on motor vehicles, whereas some others collect ad valorem tax. In some states, road tax is collected in lump sum as lifetime tax, whereas in other states, it is collected periodically.

Regulation and taxation of motor vehicles are two distinct powers under the Indian Constitution. While regulation is under the concurrent list, taxation of road transport is under the state list. Except for National Highways, state governments have the responsibility of construction and maintenance of roads. Both central and state governments impose taxes at different stages–on purchase, ownership, and use of vehicles as well as 'services' related to this sector. A summary of the multiplicity of laws and taxes in the road sector is given in Table 9.9.

While the multitude of taxes and user charges lead to severe complexities, it is difficult to ignore their increasing contribution to the public exchequer. Is it possible to rationalise the tax structure in the road sector in a revenue-neutral way? What is the significance of these taxes in states' finances?

REVENUES FROM TAXES ON ROAD TRANSPORT

Revenue from MVT is one of the increasing sources of state's own tax revenue. Though it was originally envisaged to be levied as a regulatory measure, over time it became an important revenue source. According to a report sponsored by the Planning Commission (Purohit & Purohit, 2010), the revenue from MVT has increased at an annual rate of 14.6 per cent and exhibited a tax buoyancy of 1.05 during the period 1980-81 to 2007-08. Table 9.10 gives state tax revenue from road transport from 2002-03 to 2010-11. During the same period, revenue from MVT grew at a CAGR of 14.2 per cent, whereas revenue from Passenger and Goods Tax (P&GT) grew at 15.5 per cent. However, revenue from sales tax on motor spirit and lubricants declined annually at 21.9 per cent. The fall is particularly sharp between 2005 and 2006, with almost a consistent decline from thereon.

It is also important to emphasise that growth rates varies across states, especially between special and

Table 9.11
Central Tax Revenues from Road Transport
[Rs Billion]

YEAR (MARCH ENDING)	MOTOR VEHICLES AND ACCESSORIES		TYRES AND TUBES		HSD		MS		TOTAL CENTRAL TRANSPORT REVENUES (B)	STATE AND CENTRAL REVENUES C= B+(A) OF TABLE 10	TOTAL INDIRECT TAX OF CENTRAL GOVT
	Import Duty	Excise Duty	Import Duty	Excise Duty	Import Duty	Excise Duty	Import Duty	Excise Duty			
2003	12	53	..	14	46	58	..	116	300 (30.9	471	969
2004	14	56	..	11	53	73	..	126	333 (30.2)	526	1,104
2005	19	68	..	14	67	79	..	138	385 (29.9)	612	1,289
2006	21	70	..	11	57	112	..	176	447 (29.9)	660	1,496
2007	32	68	..	12	71	126	..	183	492 (27.1)	706	1,814
2008	44	67	..	14	97	129	..	201	553 (26.6)	789	2,080
2009	49	44	..	9	67	130	..	211	509 (26.1)	768	1,952
2010	41	93	15	11	47	140	34	288	669 (36.2)	969	1,849
2011	65	87	26	9	159	185	87	268	886 (34.1)	1,250	2,594

Source: State Finances: A Study of Budgets (RBI), several years.
* Annual growth rate between 2000-01 and 2010-11.
† Shares in states' own tax revenues are given in parenthesis.

non-special category states. The share of revenue from road transport in total states' own tax revenue was 12.0 percent in 2002-03. The aggregate revenue from states' own taxes has increased annually at 15.8 per cent, whereas total revenue from road transport-related taxes has increased annually at 9.9 per cent during 2003-2011. As a consequence of sudden drop in sales tax revenue from motor spirit and lubricants since 2005-06, the share of revenue from road transport in total states' own tax revenue has dropped to 7.9 per cent in 2011 from 12.0 per cent in 2003.

The Central Government generates revenue from import duty and excise duty on motor vehicle and parts, tyre, tubes, and fuels. The figures are given in Table 9.11. Total revenue from excise and customs on road transport-related goods and fuel has increased annually at 14.5 per cent during 2002-03 to 2010-11. During the same period, the share of this revenue in total net indirect tax revenue of the Central Government hovered in the range of 26 to 36 per cent, with the average being 31 per cent. Total revenue of states and central government from taxes on road transport were around Rs 470 billion in 2002-03 which have increased to about more than Rs 1200 billion by 2010-11 growing at a CAGR of 13.0 per cent.

REVENUE FROM SERVICE TAX

There are several services related to the road sector that are taxed. Some services like tour operator services, goods transport operator services (discontinued from 2005-06) and cargo handling services, do not necessarily fall under the classification of road transport. Therefore, considering aggregated revenue figures from service tax might not be useful. Table 9.12 gives the disaggregated figures of service tax revenue from road transport-related services from 2001-02 to 2011-12. Over time, new services were introduced under the service tax net. As a result, tax revenue

Table 9.12
Service Tax Revenues from Road Transport
[Rs Million]

SERVICE	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Rent A Cab Scheme Operator Services	110	150	290	530	680	1,260	2,180	2,610	2,370	2,890	3,580
Tour Operator Services	110	130	310	430	950	1,520	1,510	1,710	1,480	1,750	2,400
Goods Transport Operator Services		50	370	50							
Service or repair produce by authorized service station for motor car & two wheeled motor vehicle	170	510	790	1,480	1,570	2,200	2,420	2,820	2,650	3,170	4,510
Cargo handling (only inland cargo)	-	100	390	950	1,690	3,290	3,790	4,450	4,840	5,340	6,290
Transport of goods by road	-	-	-	1,910 [4]	14,090	24,820	28,340	32,080	26,280	30,280	33,860
Travel agent	-	-	-	30	60	100	120	120	110	190	200
Total	**390**	**940**	**2,150**	**5,380**	**19,040**	**33,190**	**38,360**	**43,790**	**37,730**	**43,620**	**50,840**

Source: Finance Accounts, Union Government, Controller General of Accounts, Ministry of Finance.

from the road sector has increased rapidly between 2001-02 and 2011-12. The largest share comes from transport of goods by road (around 66 per cent[3]).

REVENUE FROM TOLL AND CESS

In addition to taxes, toll and cess contribute significantly to the public exchequer. However, as mentioned earlier, these instruments have less fiscal flexibility to meet the resource mobilisation objective. Total toll revenue from National Highways was Rs 44 billion in 2009-10 and that increased to Rs 80 billion in 2011-12 (Table 9.13)[4]. There is increasing emphasis on PPP projects in the road sector. The construction and expansion of projects under National Highways Development Project (NHDP) Phase III and onwards is undertaken on PPP basis with build, operate and transfer (BOT) as the preferred mode to mobilise resources for infrastructure development. Share of toll revenues from publicly funded projects (including operate, maintain and transfer projects) was 37 per cent in 2009-10. The share was down to 25 per cent in 2011-12.

The fuel cess is collected by the Ministry of Finance. The revenue from cess on HSD and Petrol has increased from Rs 113 billion in 2005-06 to Rs 184 billion in 2011-12 (more than 60 per cent increase in six years). Total collection from the cess is given in Table 9.14.

The collection on this account is credited to the Consolidated Fund of India and thereafter Parliament, by appropriation, credits such proceeds after adjusting the cost of collection to the Central Road Fund (CRF). The CRF is distributed by the Planning Commission amongst the three Ministries of Rural Development, Railways, and Road Transport and Highways in the manner prescribed under Section 10 (viii) of the Central Road Fund Act, 2000. The central government is responsible for development and maintenance of the National Highways. The Ministry

3 The percentage figure is based on aggregation of all the services listed in the table. As already mentioned, there are several services that span across modes.
4 The service tax on transport of goods by road was introduced on 01.01.2005. This is the reason for this low figure.

Table 9.13
Toll Revenue from National Highways
[Rs Billion]

CATEGORY	2009-10	2010-11	2011-12
Public Funded Stretches +OMT	16	19	20
BOT Stretches (revenue share to NHAI/premium)	3	5	9
BOT Stretches (Concession accrues to the Concessionaire)	25	35	51
Total	**44**	**59**	**80**

Source: National Transport Development Policy Committee, Planning Commission
OMT: Operate, Maintain & Transfer; BOT: Build, Operate & Transfer

of Road Transport and Highways takes care of the development and maintenance work of National Highways through three agencies, viz. National Highways Authority of India (NHAI), state public works departments (PWDs) and Border Road

Organisation (BRO). The state roads and major district and rural roads fall under the responsibility of the respective state governments. These are developed and maintained by various state agencies. However, as already mentioned, some funds are also being provided by the Union Government from CRF for the development of state roads. There are two important schemes under which the state governments receive funds from CRF: (a) to develop state roads (other than rural roads, and (b) to develop interstate connectivity. These schemes are called Improvement of State Roads from the CRF and Economic Importance and Interstate Connectivity Scheme, respectively. To illustrate, an allocation of Rs 167 billion was made under CRF in 2009-10, the break-up of which is given in Table 9.15.

TOTAL RESOURCES GENERATED FROM ROAD TRANSPORT

The total resources generated from indirect taxes, cess and toll from road transport sector is around Rs 1,523 billion in 2010-11 which is around 1.95 per cent of GDP (Table 9.16). It was Rs 1,216 billion in the previous year.

Generation of economic resources is one of the important rationales for taxes in the transport sector. The above discussion has highlighted the importance of the revenue-generating role of vehicle tax, passenger and goods tax and user charges in states' finances. However, most of the state-level taxes are ad-hoc in nature and do not necessarily follow the principle of economic efficiency. There are two main explanations for that. First, there is no comprehensive study to assess and fix the tax rates on the marginal cost-benefit principle of transport pricing. Second, the multiplicity and complexity of taxes impose transaction costs and several other hurdles for inter-state movement of cargo. In the next section, we discuss the sources of fiscal inefficiencies in road transport sector.

SOURCES OF FISCAL INEFFICIENCIES

Fiscal inefficiencies in transport sectors may arise due to several reasons. First, in a federal structure, the lack of coordination between tax-levying authorities may lead to huge transaction costs. For example, lack of state-level coordination in granting permits causes difficulties for private operators. The interstate movement of cargo and passengers is delayed due to long waiting times for paper work at state borders. Second, taxes on motor vehicles, goods and passengers vary across states substantially. Not only that, the way that tax is being collected has a significant impact on overall efficiency. Some states use simplified tax slabs and less complicated parameters for tax rates. In other states, the rate not only differs across types of vehicle, it also differs by capacity, axle type, and fuel type. Some states simplified the tax collection by imposing one-time tax. Third, tax rates are not necessarily set at optimal levels that fully reflect social costs due to negative externalities. Generally, externalities depend on type of fuel, carrying capacity, engine type, usage of infrastructure, time of traffic movement, etc. However, multiple tax lines create complications and cost of tax collection increases. It may also increase probability of tax evasion. Major obstacles to interstate movement arise from transaction costs which reduce and sometimes

Table 9.14
Funds Collected from Cess on High Speed Diesel and Petrol in India
[Rs Billion]

YEAR	AMOUNT COLLECTED
2005-06	113
2006-07	122
2007-08	133
2008-09	152
2009-10	166
2010-11	170
2011-12	184

Source: Lok Sabha Unstarred Question No. 1707, dated 10 December 2008, Rajya Sabha Unstarred Question No. 1810, dated on 8 December 2011 and Rajya Sabha Unstarred Question No. 4458, dated 7 May 2013

Table 9.15
Allocation of Central Road Fund in 2009-10
[Rs Billion]

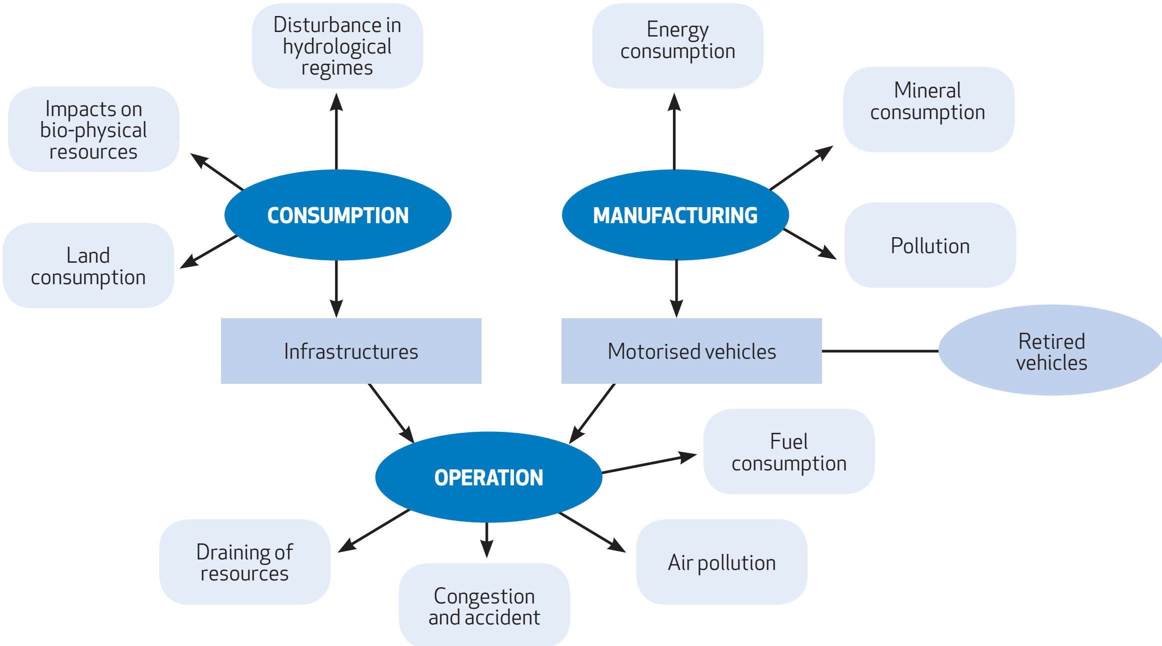
ALLOTTEE	AMOUNT
National Highways	86
Rural Roads	48
Railways	10
Grant to State Governments and UTs for State roads	21
Grant to States & UTs for Roads of Inter-State Connectivity and Economic Importance	2
Total	167

Source: NCAER Report (NCAER, 2012).

Table 9.16
Total Revenue Generation from Road Sector
[Rs Billion]

PARTICULARS	2010	2011
Total State and Central Road Tax Revenues	969	1,250
Service Tax Revenue from Road Transport	38	44
Toll Revenue from National Highways	44	60
Revenue from Cess on High Speed Diesel and Petrol	166	170
Total Revenue Generation from Road	1,216	1,523
GDP at Current Market Price	64,778	77,953
As a Per cent of GDP	1.88	1.95

Figure 9.1
Environmental Impacts of the Transportation System



Source: Environmental and Social Sustainability of Transport: Comparative Study of Rail and Road, Asian Institute of Transport Development, 2002

Table 9.17
Important Environmental Effects of Transport Modes

MODES	AIR	WATER RESOURCES	LAND RESOURCES	SOLID WASTE	NOISE	RISK OF ACCIDENT	OTHER IMPACTS
Road	Air pollution (CO, HC, NOx, particulates such as lead), global pollution (CO_2, CFCs)	Modification of water systems by road building; pollution of surface and ground water by surface run-off	Land taken for infrastructure; extraction of road building materials	Abandoned facilities and rubble from road works; road vehicles withdrawn from service; waste oil	Noise around highways	Deaths, injuries & property damage due to road accidents; risk from transport of hazardous goods	Partition or destruction of neighbour-hoods, farmland and wildlife habi-tats; congestion
Air	Air pollution, greenhouse & ozone deple-tion effects at higher altitudes due to NOx emissions	Modification of water tables, river courses and field drainage in airport construction	Land taken for infrastructure; dereliction of obsolete facilities	Abandoned facilities and aircraft withdrawn from service	Noise around airports	Deaths, injuries & property damage due to aircraft accidents	
Water Transport	Discharge of ballast water, oil spills, etc.; modifications of water systems during port construction & canal cutting and dredging	Land taken for infrastructure; dereliction of obsolete port facilities & canals	Abandoned and laid-up vessels and craft	Bulk transport of fuels and hazardous substances			
Rail	Air pollution in populated areas; global pollution from thermal generating stations for electric traction		Land taken for right-of-way and terminals; dereliction of obsolete facili-ties	Abandoned lines, equipment and rolling stock	Noise and vibration around terminals and railway lines	Derailment or collision of trains carrying hazardous substances	Partition or destruction of neighbour-hoods, farmland and wildlife habi-tats

Source: Sustainable Transport Pricing and Charges: Principles and Issues, Asian Institute of Transport Development and UNESCAP, 2001 may completely eliminate the benefit of differentiated taxing systems across states. It is observed that vehicle owners often change the address of vehicle registration to other states where tax rates are lower. Similarly, Indian ship owners are increasingly registering their ships in other tax-friendly countries.

We, however, are not in a position to quantify the loss due to obstacles at state borders (systemic obstruction that may cause slower movement of freight in India). There is a need to undertake a study to identify and quantify transaction costs caused by multiplicity of tax systems and non-harmonised regulations.

A typical carrier has to face a number of regulatory agencies when moving goods across regions: sales tax authorities, regional transport offices (RTOs), excise, forest department, regulated market committee, civil supplies (check on the movement of essential commodities, black marketing, weights and measures, food adulteration), and mining department. Clearly, all issues are not fiscal. Transporters have to face multiple detentions resulting in lower speed, loss of time, higher transaction costs, more fuel consumption, etc. All these lead to underutilisation of vehicle capacity and adversely affect operational viability. It is often argued that the road transport sector, due to these reasons, faces unequal competition from freight/cargo transport by rail, despite the fact that it has been gaining traffic share from the railways for a long time. Moreover, it causes wider economic costs which are difficult to assess.

The consequences of distortionary pricing policy are revenue loss due to tax evasion, higher expenditure on regulation and tax collection, transaction costs due to complicated tax systems, environmental damage, etc. As a result, insufficient revenue is generated for infrastructure development and maintenance. In recent years, government increasingly depends on private partnership in infrastructure projects. However, the private players may not necessarily maximise net social benefit and consequently a conflict arises.

The key questions concerning tax efficiency in the transport sector are the following:

- whether transport charges internalise marginal social costs
- whether transport sectors are subject to the same level of taxes on factors - labour and capital - in comparison with other sectors (direct taxes are beyond the purview of our analysis)
- whether transport charges on different modes are levied on the same basis
- whether subsidies in transport sector are justified under increasing returns to scale and if net charges cover fixed cost and part of marginal cost
- whether redistribution through cross-subsidisation serves its purpose by properly targeting intended recipients
- whether domestic and foreign operators pay same level of transport taxes across states

We are not in a position to investigate these sources of inefficiencies due to data limitations. Later in the chapter, in order to gauge the wedge of inefficiency, we have attempted to capture some elements of differences in the delivery of transport services across a group of countries. The countries selected for such comparison are a mix of some developed and some developing countries.

The inefficiency due to complexity in tax structure is one of the reasons behind the tariff reforms in India. Instead of multiple tariff lines and product-specific rates, India gradually moved to simplified tariff lines. Similarly, recent sales tax reform has introduced uniform three to four schedules of VAT rates. A transparent and uniform tax system across states is one step forward towards a common market in India.

Thus, while the current tax structure in the road transport sector may achieve the revenue-generating goal for the states, it creates a big challenge to policy makers for moving towards a common market in India. The objective of environmental sustainability through a proper pricing mechanism is also an important challenge. How does the Indian transport sector cause negative externalities in terms of immediate health hazards, and long-term environmental damage through greenhouse gases? Is there any role of fiscal instruments to correct pricing signals?

ENVIRONMENTAL COST OF TRANSPORT AND CORRECTIVE FISCAL MEASURES

As has been discussed earlier, if pricing does not internalise the social cost due to negative externalities, there are serious problems in allocation of resources and overall economic welfare of the society. There are several external costs relating to the damage to human health on account of transport, especially road transport. It may be caused by noxious pollution, noise pollution, congestion, climate change, etc. Some effects are immediate, while others may be observed in the longer term. Figure 9.1 and Table 9.17 give a summary of negative externalities of transport modes both at systems and modal levels.

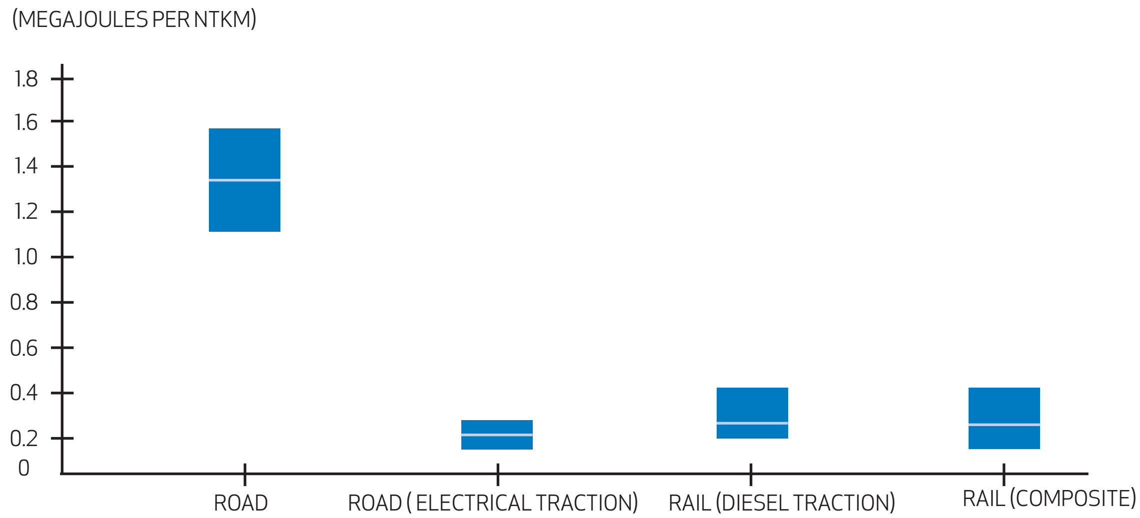
Though there is a high degree of uncertainty in estimating the correct monetary value of environmental cost in the transport sector, all studies indicate substantially high cost of damage to health. An early study ‘Environmental and Social Sustainability of Transport’ conducted by Asian Institute of Transport

Table 9.18
Environment Cost Per Tonne-Km for Road and Rail
[Rs]

MODE	COST
Road (Freight)	0.202
Rail (Diesle Traction)	0.051
Rail (Electric Traction)	0.015
Airways	0.690
Coastal Shipping	0.030

Source: Total Transport System Study by RITES (2007-08).

Figure 9.2
Energy Consumption Ranges in Freight Transport



Source: Environmental and Social Sustainability of Transport; Comparative Study of Rail and Road, Asian Institute of Transport Development, 2002.

Development (AITD) in 2002 indicates that health damage cost of rail is generally lower than that of road. In urban areas for freight traffic, it is lower by as much as 76 paise per NTKM, while for passengers, it is lower by 10 paise per PKM. Moreover, substitution of passenger traffic on road by rail with diesel traction would result in substantial savings in health damage cost per day.

A study entitled Total Transport System Study (TTSS) by RITES made an assessment of the environment cost based on another previous study, 'Estimating Cost of Air Pollution Abatement for Road Transport in India: Case Studies of Andhra Pradesh and Himachal Pradesh' conducted by Institute of Economic Growth in 2005. The cost to the environment was treated as the cost of abatement, comprising cost of upgrading vehicle technology to meet higher emission norms and cost of improving fuel quality. The study drew on the data and findings from various studies such as emission level by different modes from Central Pollution Control Board (CPCB), social cost from Environmental and Social Sustainability Study of Transport by AITD, cost of improvement

Table 9.19

Comparison of Co_2 Emission Between Rail and Road

		RAIL (SINGLE LINE)	ROAD (4 LANES WITH SERVICE ROAD)
Embodied energy (TJ/km)	Construction	12	39
	Maintenance	20	28
Embodied CO_2 emission (T/km)	Construction	1,294	3,442
	Maintenance	1,892	1,073

Source: Total Transport System Study by RITES (2007-08).

of fuel quality from the Mashelkar Committee, 2002. On the basis of analysis, the environment cost per tonne-km for road freight sector was determined as Rs 0.202. The cost for rail, airways and coastal sector was arrived at in proportion to fuel consumption under each of these sectors. A fuel consumption norm of 2.54 litres/'000 GTKM under rail, 0.00216 litres/tkm under coastal sector and 4.8 litre/100 kms for Airways was adopted. The environment cost adopted in the study under different modes is shown in Table 9.18.

The environment cost is assessed as Rs 0.051 per tonne-km for diesel rail traction while it is Rs 0.015 per tonne-km for electric-powered rail traction. The cost for coastal shipping has been determined as Rs 0.030 per tonne-km while for Airways it is found much higher at Rs 0.690 per tonne-km. Clearly, rail and coastal shipping have greater social cost advantage in freight movement. If the objective is to minimise the environmental cost and enhance sustainability, there is a clear case for shifting towards rail while also encouraging coastal shipping. With significant variation of external cost across modes and comparative cost advantage in some modes, the overall social cost of transport depends on an optimal mix of modes. A survey carried out among transporters in India suggests that the quality of service matters most in determining choice of transport mode (Dey Chaudhury, 2005).

A comparative study of relative energy consumption for equivalent volumes of traffic on rail and road modes for both passenger and freight traffic, conducted by AITD in the year 2002 revealed that rail consumes much less energy than road transport and has maximum advantage in respect of freight traffic. Figure 9.2 illustrates energy consumption (MJ/NTKM) between road and rail freight transport.

A study[5] on life cycle energy and CO_2 emissions impacts of transport mode in India by TERI (2012) suggests that understanding of the full-life cycle energy and CO_2 impacts of transport modes can help choose better inter-modal shifts that are least energy and carbon-intensive throughout their lives. It also helps promote intra-modal shift towards more 'greening' by changing share of various components that contribute to energy consumption and CO_2 emissions. Rail (single line) has around 12 TJ/km of embodied energy for construction and 20 TJ/km for maintenance (Table 9.19). Whereas, highways (four-lane with service road) has 39 TJ/km and 28 TJ/km of embodied energy in construction and maintenance respectively. When we compare same modes for their embodied CO_2 emissions, rail releases around 1,294 T/km and highway releases 3,442 T/km during construction phase. The corresponding figures for maintenance phase are 1,892 T/km and 1,073 T/km respectively. Apart from applying different scientific mitigating measures, fiscal instruments may play a vital complementary role.

Transport policy directed towards internalisation of externalities in each mode can effectively improve the sustainability. As a quasi-public good, transport network should be priced for the use of its services for both passenger and freight traffic. We have already explained the rationale behind taxation and user charges for equity and efficiency considerations. We described the major taxes – taxes on vehicle, taxes on goods and passengers and taxes on fuels and lubricants. None of these three types of taxes can be considered as representing charges related

5 Life cycle analysis of transport modes", prepared for National Transport Development Policy Committee (NTDPC) by The Energy Research Institute (2012)

Box 9.1
Sustainable Pricing in Transport Sector

1. Sustainable development should be promoted to the extent possible through transport prices that are equated with marginal social cost. The scarcity value of the natural resources used in the provision of transport infrastructure and services and the external costs due to pollution and degradation of the environment (that is, the social cost of transport), should be built into the price of providing or using transport facilities and services. Optimal pricing must balance economic efficiency, equity and transaction costs.
2. The internalization of externalities is a fundamental requirement in devising transport pricing policies to promote sustainable development. Transport generates many negative externalities or external costs, including noise, accidents, pollution and congestion. If the externality costs are not borne by those who generate them, then the market mechanism fails to allocate resources efficiently. The 'polluter pays' principle suggests that users should be made aware of the external costs they generate by imposing on them pollution tax equal to the marginal environmental cost. This would also reduce the volume of transport activity to the socially optimal level.
3. A sustainable transport policy will require intervention in the market system to ensure that:
   - the direct or indirect use of natural resources is such that they can at least be replaced by (a) their natural regeneration (e.g. hydroelectric energy for electric traction), or (b) discovery of new deposits of the currently used exhaustible resource (e.g. oil or natural gas reserves), or (c) the use of a new renewable resource (e.g. wind or solar power), or (d) conserving the use of resources per unit of transport output, or (e) a combination of these; and
   - the damage to the environment is within such limits that the productivity of other economic activities and the quality of life, in terms of health and security against accidents, do not deteriorate over time.

Source: Sustainable Transport Pricing and Charges: Principles and Issues, Asian Institute of Transport Development and UNESCAP, 2001

to the extent of usage of physical infrastructure and environmental damage. Gradually, highways are brought under the toll network which helps to internalise depreciation cost of infrastructure. It is a user cost in its true sense. However, India needs to develop an effective transport pricing policy, especially in urban transport, for environmental sustainability. We should also keep in mind that unnecessary complication in the tax system due to multiple environmental taxes may once again induce efficiency loss for reasons mentioned above.

It is an enormous task to assess the current tax system in terms of its effectiveness of achieving economic efficiency, environmental sustainability and resource generation – the three important rationales discussed in the first section. What is the extent of welfare loss due to economic inefficiencies under the current tax regime? The biggest hurdle we face in addressing these issues is limited data. As a result, it is almost impossible to disentangle the effect of fiscal inefficiency from all other inefficiencies in the sector. However, as a confidence-building exercise, we use a general equilibrium framework to answer whether welfare-improving reform in transport tax structure is possible given strong sectoral linkages in the economy.

MODELLING RESULTS

The differential multiple tax regime across sectors of production leads to distortions in allocation of resources, thus introducing inefficiencies in the sectors of domestic production. The Thirteenth Finance Commission Report has recommended moving over from a complex tax structure at central and state levels to a comprehensive and simplified Goods and Services Tax (GST) regime that would facilitate efficiency in transport sectors. A recent NCAER study has analysed the impact of introducing GST on economic growth and international trade; changes in rewards to the factors of production; and the impact on output, prices, capital, employment, efficiency and international trade at the sectoral level (NCAER 2009). GST would lead to efficient allocation of factors of production. The overall price level would go down. It is expected that the real returns to the factors of production would go up. The present study looks at distortions in the tax structure with regard to transport sectors. Given that the taxation regime in transport sectors is complex, there is an urgent need to introduce fiscal reforms in this sector.

Table 9. 20

Cross-Country Comparison of Transport Efficiency

COUNTRY	TAX INTENSITY OF TPT OUTPUT	TPT INTENSITY OF OVERALL OUTPUT	ENERGY INTENSITY OF TPT OUTPUT		
			PETROLEUM	ELECTRICITY	TOTAL
Brazil	2.7	2.9	14.8	1.4	16.2
Canada	-0.4	2.4	9.5	0.6	10.1
China	-	3.5	17.3	1.5	18.8
France	2.9	2.9	4.9	0.7	5.6
Germany	2.9	3.4	4.7	0.9	5.6
India	**4.7**	**4.0**	**20.1**	**1.6**	**21.6**
Japan	-	2.3	6.6	1.7	8.2
Korea	-	2.3	18.8	0.6	19.4
South Africa	3.3	3.6	11.3	1.4	12.7
Thailand	0.9	1.9	25.1	1.1	26.2
USA	-	2.0	8.7	0.3	9.0

TPT: Transport and Storage
Petroleum: Coke, refined petroleum products and nuclear fuel
Electricity: Electricity, gas and water supply
Source: Our computations based on OECD at
http://stats.oecd.org/Index.aspx?DataSetCode=STAN_IO_TOT_DOM_IMP

There may be many reasons for the transport sectors to be relatively less efficient compared with international standards. While we attempt to mimic overall reforms in sectors of transport, we also narrow down our focus on the efficiency introduced in these sectors just because of GST reforms in India's taxation structure. This is conceptualised through assuming a wedge to be narrowed down by reforms of various types.

Tax policies play an important role in the economy through their impact on both efficiency and equity. A good tax system should keep in view issues of income distribution. It should also endeavour to generate tax revenues to support government expenditure on public services and infrastructure development. Cascading tax revenues have differential impacts on firms in the economy with relatively high burden on those not getting full offsets. This analysis can be extended to international competitiveness of the adversely affected sectors of production in the economy. Such domestic and international factors lead to inefficient allocation of productive resources in the economy. This results in loss of income and welfare of the affected economy.

For a developing economy like India, it is desirable to become more competitive and efficient in its resource usage. Apart from various other policy instruments, India must pursue taxation policies that would maximise its economic efficiency and minimise distortions and impediments to efficient allocation of resources, specialisation, capital formation and international trade. With regard to the issue of equity, it is desirable to rely on horizontal equity rather than vertical equity. While vertical equity is based on high marginal rates of taxation, both in direct and indirect taxes, horizontal equity relies on simple and transparent broad-based taxes with low variance across the tax rates.

In sum, implementation of a comprehensive GST in India is expected to lead to efficient allocation of factors of production, thus leading to gains in GDP and exports. This would translate into enhanced economic welfare and returns to the factors of production, viz. land, labour and capital.

Table 9. 21

Percentage Change in Macro Variables, Implicit Import Tariff Simulations

ECONOMIC INDICATOR	SIM 1	SIM 2	SIM 3	SIM 4
GDP	0.0423	0.0326	0.0213	0.0148
Export	0.7361	0.5679	0.3703	0.2581
Import	0.5238	0.4041	0.2635	0.1837
Output	0.0247	0.0191	0.0124	0.0087
Real Return to Land	0.0427	0.0329	0.0215	0.0150
Real Return to Labor	0.0789	0.0609	0.0397	0.0277
Real Return to Capital	0.0678	0.0523	0.0341	0.0238

Source: Our simulation results

We use a general equilibrium model to analyse the impact of tax rationalisation in transport services. Based on the economy-wide transactions, India is modelled to produce, consume and trade in 130 sectors of the economy. These sectors include 26 agriculture and allied services, 11 mining, 68 manufacturing, and 25 service sectors. There are five transport service sectors, viz. rail, land, water, air, and transport auxiliary services. The final demand equations for various sectors are obtained assuming a single representative consumer who maximises utility subject to a budget constraint. It is assumed that the revenue from tariffs and indirect taxes gets redistributed to consumers and then spent. Intermediate demands are derived from the profit-maximising decisions of the representative firms in each sector. The manufactured products' markets are assumed to depict monopolistic competition behaviour and those in rest of the sectors (agriculture, mining, and services) operate under perfect competition. In addition to the sectoral effects that are the primary focus of our analysis, the model also yields results for changes in exports, imports, the overall level of welfare (measured through GDP) in the economy, and the economy-wide changes in real wages and returns to land and capital. Because both labour and capital are assumed to be homogeneous and mobile across sectors in these scenarios, we cannot distinguish effects on factor prices by sector.

The wedge between the efficiency levels of transport services in India in comparison with some international standard is not easy to quantify. We are not aware of any benchmarks in this regard. However, we have attempted to capture some elements of differences in the efficient delivery of transport services across a group of countries. The information on input–output flow matrices of these countries has been used for this purpose. The source of this information is OECD. The countries selected for such comparison are a mix of some developed and some developing countries. The set of countries in our sample include Brazil, Canada, China, France, Germany, India, Japan, South Africa, South Korea, Thailand and the United States. Transport intensity of total output, ratio of net indirect taxes to the output of transport services, and energy usage (petroleum products and electricity) per unit of output of transport services have been computed for all 11 countries. One of the major observations refers to the overall usage of transport services as intermediate input used by the economy as a whole. This refers to the cost incurred on the purchase of transport services for producing one unit of output of the economy. India uses 4 paise worth of transport services to produce one rupee worth of total output, i.e. a usage of 4 per cent (Table 9.20). This may be referred to as transport intensity. This is the highest value within the group of 11 selected countries. The corresponding value is 3.6 per cent for South Africa, 3.5 per cent for China and 2.9 per cent for Brazil. Thus the share of transport services used in each unit of total output in India is 11 per cent higher than that of South Africa, 14 per cent higher than that of China and 38 per cent higher than that of Brazil. The gap is much higher with respect to developed countries.

This implies relatively less efficient usage of transport services. Such an inefficiency wedge may arise due to tax complexity in transport sectors along with various other reasons including financing, maintenance, pricing, governance, etc. We have used a conservative estimate of 35 per cent for this wedge.

Another important observation addresses the issue of tax intensity of transport sectors. It is observed that the ratio of net indirect tax to the output of this sector is 4.7 per cent in India. This is much higher than the corresponding value of 3.3 per cent in South Africa, 2.9 per cent in France and Germany, 2.7 per cent in Brazil, and 0.9 per cent in Thailand. While it may not be easy to quantify the impact of tax intensity and complexity within the overall inefficiency wedge of 35 per cent, we have assumed this to be less than half and hypothesised it as 15 per cent.

India's transport services do not make efficient use of fuels consumed. The energy use for transport services in India is higher than most countries except for Thailand. This is a matter of concern with regard to the environmental pollution issues. The share of energy usage in India's transport sectors is 21.6 per cent which incorporates 20.1 per cent for petroleum products and 1.5 per cent for electricity. The total energy use intensity of transport sectors is 12.7 per cent in South Africa, 16.2 per cent in Brazil and 18.8 per cent in China. The developed countries have much lower values: France and Germany at 5.6 per cent, Japan at 8.2 per cent and the United States at 9 per cent.

In our experimental design, we attempt to simulate the impact of introducing efficiency in transport services through comprehensive reforms, inclusive of tax reform in these sectors as well as the subcomponent of rationalisation of tax structure. In the absence of any benchmarks study of this nature, we undertake some hypothetical exercises for demonstration purposes. Various scenarios have been discussed to incorporate the impact of improved efficiency realised through overall reform as well as reducing tax-related complexities and introducing a uniform GST.

In the first scenario, we assume a wedge of 35 per cent between the efficiency of India's transport sectors vis-à-vis some international standard benchmark. This implies that we guesstimate an implicit import tariff of 35 per cent on all the sectors of transport. However, as mentioned earlier, we acknowledge this efficiency wedge could be due to a combination of factors including financing, ownership (public, private, or PPP), maintenance, pricing, governance, and taxation among others. We consider an alternative scenario where such wedge is assumed to be lower at 25 per cent. The third scenario assumes that the purely tax-related inefficiency wedge may be even lower at 15 per cent. Fourthly, we also take into account the fact that all transport sectors may not be equally inefficient. We, therefore, attempt to simulate the inefficiencies in a non-uniform pattern, based on the respective transport intensity of each of the five transport sectors. All such wedges are assumed to be represented through equivalent import tariffs.

The energy use of transport services in India is higher than most countries: 21.6 per cent, compared with 12.7 per cent in South Africa, 16.2 per cent in Brazil, and 18.8 in China

Simulation 1: Elimination of implicit import tariff of 35 per cent on all the transport service sectors
Simulation 2: Elimination of implicit import tariff of 25 per cent on all the transport service sectors
Simulation 3: Elimination of implicit import tariff of 15 per cent on all the transport service sectors
Simulation 4: Elimination of implicit import tariff of 10 per cent on land transport services; 15 per cent on rail, air and water transport services; and 25 per cent on support and auxiliary transport services

Results: Our results show that the economy gains under each of the four simulations. This implies that improved efficiency of transport sectors under all the four scenarios would have a welfare-enhancing impact for the economy. However, the extent of gains varies across experiments.

We observe that welfare gains for the economy vary between 0.042 per cent under Simulation-1 to 0.015 per cent under Simulation 4, depending upon the wedge that has been knocked off (Table 9.21). There are corresponding gains in trade and output.

As the economy adjusts to the new equilibrium, resources will be allocated more efficiently as compared to the base equilibrium. The real returns to all factors of production, land, labour and capital, increase.

Scale effect, an important indicator of efficient production, is measured as output per firm. Firms in the manufacturing sector have been modelled to operate under monopolistic competition. Under the assumption of free entry and exit, as the total output in a sector expands in a country, new firms may join in and vice versa. The positive scale effect refers to an increase in output per firm and may be considered as an indicator of enhanced scale and reduced costs in the situation of monopolistic competition in the relevant manufacturing sector. A negative scale effect refers to a decline in output per firm.

As suggested by the design of our simulations, efficiency reforms in the transport service sectors would lead to lower costs of service delivery for the end

The issue of incorporating externalities, including congestion and pollution, in marginal cost pricing has not been addressed adequately while formulating tax rates

consumer. Access to relatively low-priced transport services would reduce the costs for firms with sectors under monopolistic competition in the medium-to-long run. While the firms are permitted to move in and out of the industry, only the efficient ones would stay in business. Competitive pressures leading to increasing returns of scale would show up as efficiency improvements in sectors. This would result in higher values of output per firm as the firms strive to achieve more efficient plant size and lower per unit costs. Thus, the gains in economic welfare are expected to come from improved allocation of resources, lower prices to consumers and business firms, and availability of more varieties to consumers. The realisation of economies of scale in manufacturing reinforces these welfare-enhancing effects.

The results of our demonstrative experiments bring out positive scale effects for all sectors of manufacturing. Even though the magnitude of scale effects varies across simulations, the pattern remains promising for the economy in each simulated scenario.

Economic development is becoming increasingly sensitive with regard to environmental implications. Any current policy is assessed for its environmental impact. In this section, we present and discuss the results of our simulations with special focus on energy sectors. Any changes in the energy sectors, in terms of consumption, are likely to have direct effects on the greening of Indian economy.

Based on the 130 sectors in the India input–output transaction table for the year 2003–04, we identify five core sectors that can be collectively referred to as the energy sector. These include natural gas, crude petroleum, petroleum products, coal tar products and electricity.

Various sectors of the economy have different energy requirements. We have computed energy intensities, defined as proportions of energy inputs in total inputs, across various sectors. Further, the composition of energy usage also varies across sectors with some sectors depending on a particular type of fuel. Our results show that two of the five transport services studied have high energy intensities.

The results of simulations indicate that enhanced efficiency of transport services will move the economy towards a new equilibrium with lower demand in each of the constituting sub-sectors of the composite energy sector. Thus, making transport sectors more efficient than their current performance levels would not only be welfare-enhancing but also environment-friendly.

Long-run scenario: The provision of more efficient transport services would boost the efficiency of other sectors of production. The efficiency boost would depend on the proportional amounts of transport services consumed by these sectors. This would get reflected in sectoral export gains. We assume that the existing inefficiencies in the provision of transport services impact the export prices through implicit export taxes. These export taxes are computed as proportional shares of the use of transport services across all sectors of production. The taxes are normalised to a maximum of 15 per cent. We experiment with four other simulations assuming that the implicit export taxes in agricultural, mining and manufacturing sectors are now eliminated. Each of the four earlier simulations is now run superimposed with implicit export tax elimination. The gains in GDP, trade and returns to the factors of production are much higher than those reported in previous simulations.

CONCLUSION

The current transport pricing system is an accumulation of multiple taxes and user charges implemented at different points of time at varying levels of governance. In addition, fuel tax is an integral part of transport pricing. The taxation structure is quite different across modes and states. This is partly due to the existing constitutional provisions. The central government levies indirect taxes in the forms of union excise, import duty and service tax whereas the state governments levy sales tax/VAT, MVT, and P&GT. Taxes are imposed on inputs as well as outputs of transport services, thus affecting the cost and price structure in these sectors. The tax differentiation in this sector is determined by a number of parameters that vary across states, uses and types. Apart from taxes, governments also raise revenues through user charges. The toll charges are used mainly for the development and maintenance of road infrastructure. Similarly, route navigation facility charges; landing, parking and housing charges; terminal navigation landing charges; etc. are some of the user charges in the aviation sector. Ports also collect several user charges for port services.

Our documentation of taxes and user charges in various sectors of transport indicates that the prevailing regime is extremely complex. There are wide variations in tax regimes across states. The road transport sector has suffered on account of entry barriers through taxes imposed on interstate movement. Cities located across the state borders should share a common taxation mechanism so that unnecessary wastage of time and harassment at borders are avoided. Intra-modal tax structures are also complex within each state. Taxes on various categories of fuel vary within and across states. The issue of incorporating externalities including congestion and pollution (social costs) in marginal cost pricing does not seem to have been addressed adequately while formulating the tax rates. Whereas revenue objective of pricing policy has been achieved partially, ad-hoc and complex nature of some of the taxes, especially at the state level, has resulted in less-than-efficient delivery of transport services which would, in turn, affect the efficiency of other sectors.

Inefficiencies in transport sectors get transmitted to other sectors of the economy as some of the sectors are relatively heavy users of transport services and have strong linkages with rest of the economy.

User charges should be effectively collected for railway infrastructure as well. We recommend that Indian Railways should develop a system of accounting of depreciation and internalisation of all costs into its pricing system through user charges

THE ROAD AHEAD

This chapter has documented the extreme complexity of taxes levied on the transport sector, particularly road transport. One key area of economic reform in India has been the simplification and rationalisation of taxes, both direct and indirect, at both the central and state levels.

It is therefore imperative that just as the state sales tax structure has been greatly simplified to a state VAT system, the road transport tax structure needs detailed review. Action needs to be taken to undertake a similar exercise across states to arrive at a simple and rational road transport tax structure that promotes economic efficiency and environmental sustainability. It is therefore recommended that the Ministry of Finance may convene an Empowered Committee of State Finance Ministers to undertake this exercise on collaboration with the Road Transport Ministry.

The mandate of the Empowered Committee would be to chart out a model act on road transport taxes and user charges. This would then be circulated among states and union territories for their consideration for adoption. Replacing various taxes (MVT, P&GT, etc.) by a single composite tax (some states have already implemented it) for all states is recommended by different stake holders. A relatively uniform and transparent tax regime would facilitate the move towards a common Indian market[5]. Uniformity of taxes among the states will give a boost to the interstate vehicle movement. The road tax system needs comprehensive reform rather than piecemeal and ad-hoc reforms at state level.

There is a need to integrate tax administration related to interstate movement of freight and passengers through information and communication technology (ICT) at national, state and regional level. This will greatly reduce transaction and logistic cost due to borderless and paperless movement. A competent authority may look into the possibility of implementing 'green channel' (Gujarat has already implemented) if proper paperwork has already been done in advance for specific consignments. A 'single window' clearance system for all types of taxes and charges at state border will greatly reduce transaction cost.

Transport infrastructure requires heavy capital investment and charges should be levied on users. User charges should be effectively collected for use of railway infrastructure as well. We recommend that Indian Railways should develop a system of accounting of depreciation and internalisation of all costs into its pricing system through user charges. Once the depreciation costs are accounted for, cross-subsidisation or direct subsidisation may still exist in its current form. It is important to emphasise that public transport pricing is widely used as an instrument of poverty alleviation. The fares are regulated in developing countries in order to provide affordable mode of transport to the poor. We do not recommend completely doing away with cross-subsidisation. Moreover, considering the resource constraints such as energy resources, taxation on transport is required to be designed to encourage public transportation. It is also environmentally desirable to promote the use of public transport. However, developing a system of accounting for infrastructure cost and user charges is important.

We also recommend that the competent authority proposed should undertake a study to identify and quantify the efficiency loss in transport sectors due to several obstacles for free movement of freight across states. Special focus should be given to the complexity of the tax system and lack of harmonisation of regulations across states.

Also, negative externalities need to be internalised in transport pricing, especially in urban transport. However, it is very difficult to estimate the exact monetary figure for the marginal social cost. We recommend the formation of an expert group to look into this possibility. Once a reasonable figure is found, a composite and uniform tax can replace current ad-hoc environmental cesses at state level. It is up to the expert group to decide the proper base for the environmental tax in transport.

6 This Act may be somewhat analogous to the Model Act on Agricultural Marketing (2003).

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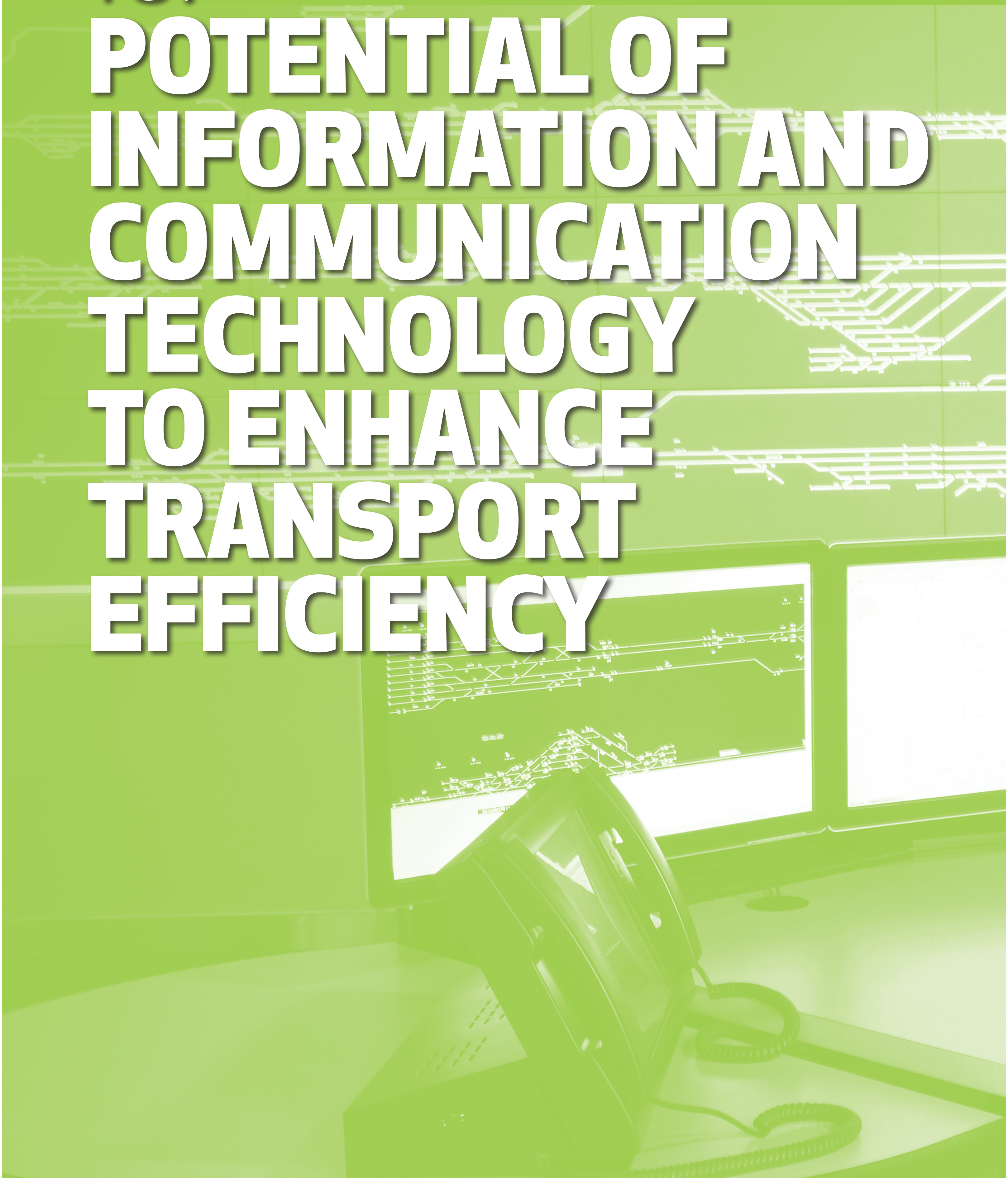
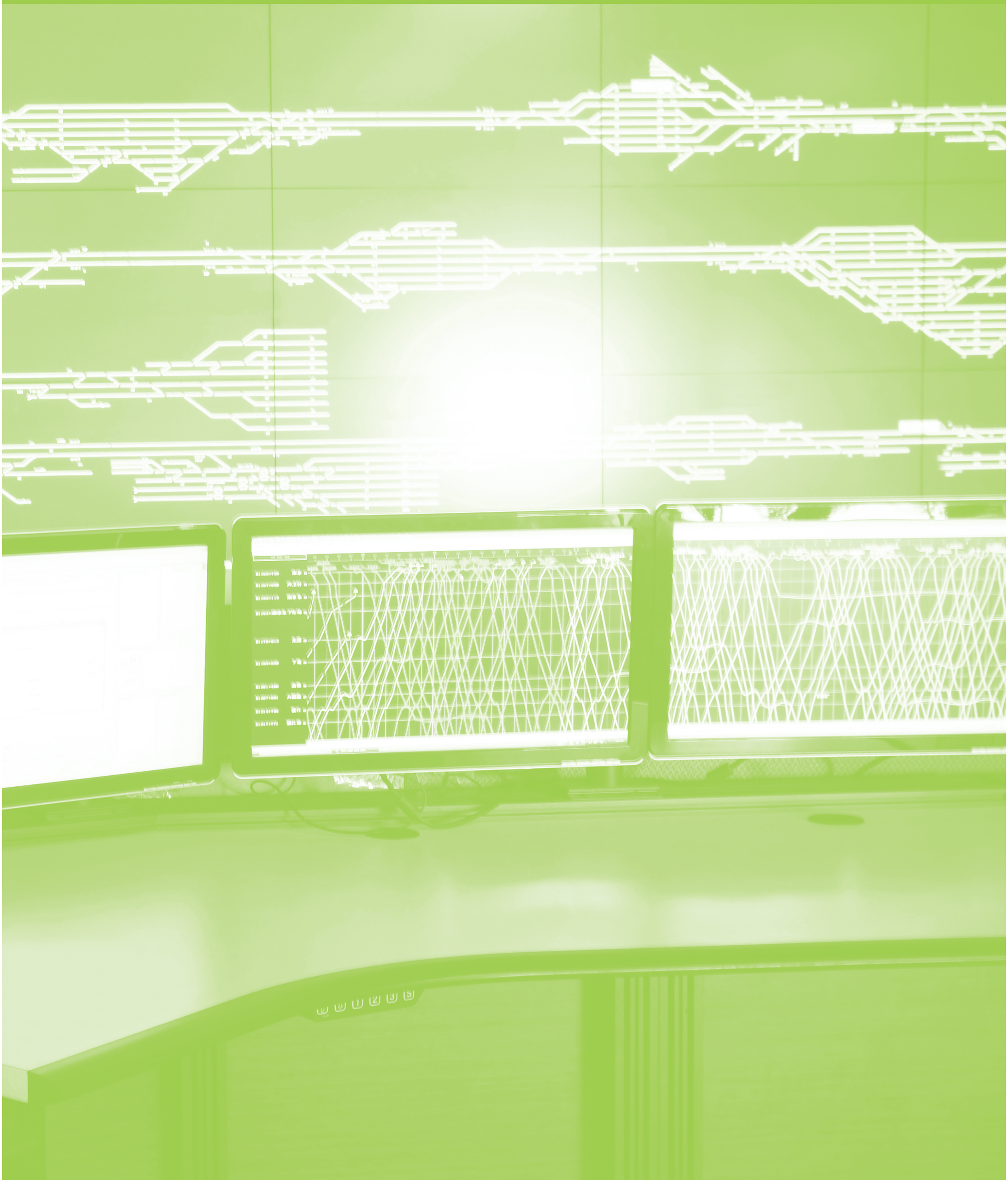
10.
POTENTIAL OF INFORMATION AND COMMUNICATION TECHNOLOGY TO ENHANCE TRANSPORT EFFICIENCY





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10. POTENTIAL OF INFORMATION AND COMMUNICATION TECHNOLOGY TO ENHANCE TRANSPORT EFFICIENCY

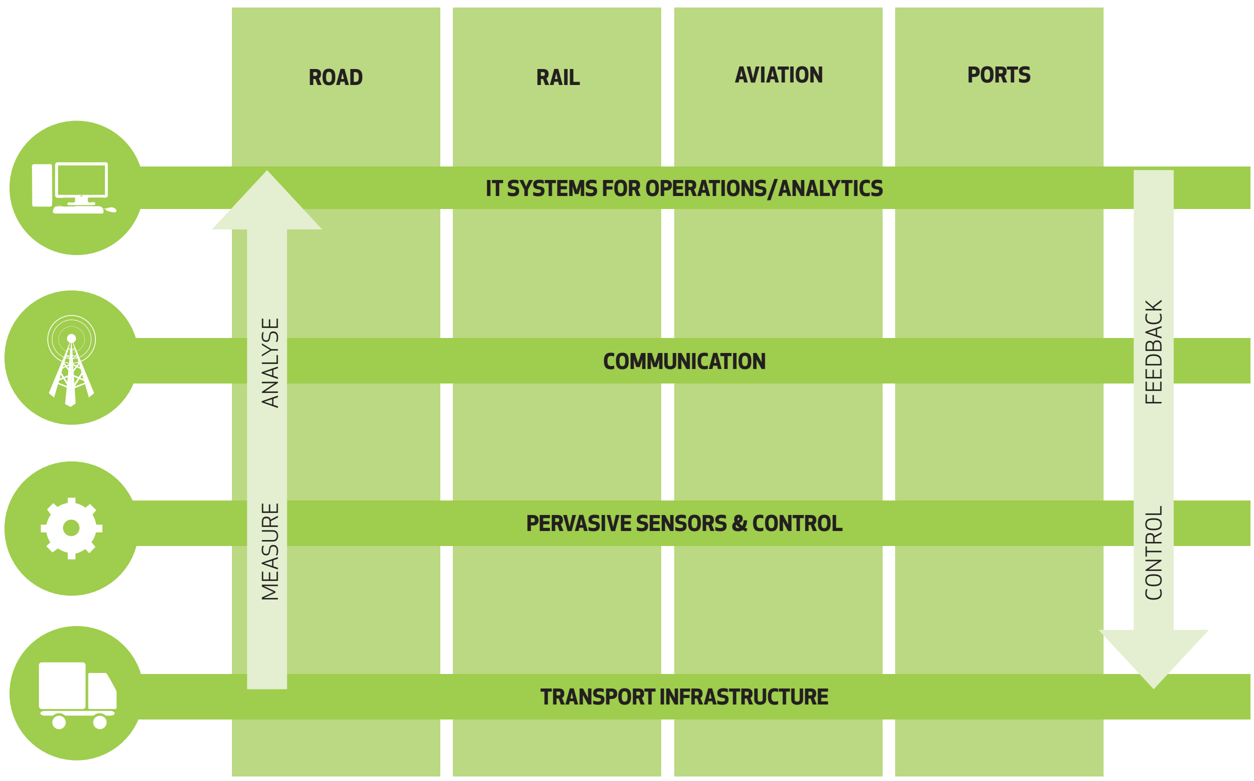
Across the world, ICT technologies have proved to be crucial to greatly enhance the quality of transportation networks and satisfaction of their users. Singapore introduced congestion pricing to reduce the number of cars in the city and to encourage people to use public transportation.

OVERVIEW OF THE POTENTIAL OF ICT IN THE TRANSPORTATION SYSTEM

Use of 'smart cards' in Hong Kong allows passengers to move seamlessly between different modes of public transport. Connected-Vehicle technology in the US is expected to greatly reduce the likelihood of road accidents. The port sector has also benefited from application of ICT. In order to improve the competitiveness of its ports and promote foreign trade, Philippines used large-scale application of ICT to implement a single window approach which has expedited the passage of goods and commodities through its customs administration. Similarly, in order to reduce congestion at the gates to the port, Singapore has installed an ICT system called 'Flow-Through Gate' which identifies container trucks, completes the necessary formalities and provides unloading instructions in less than 25 seconds per truck, handling 8,000 trucks a day.

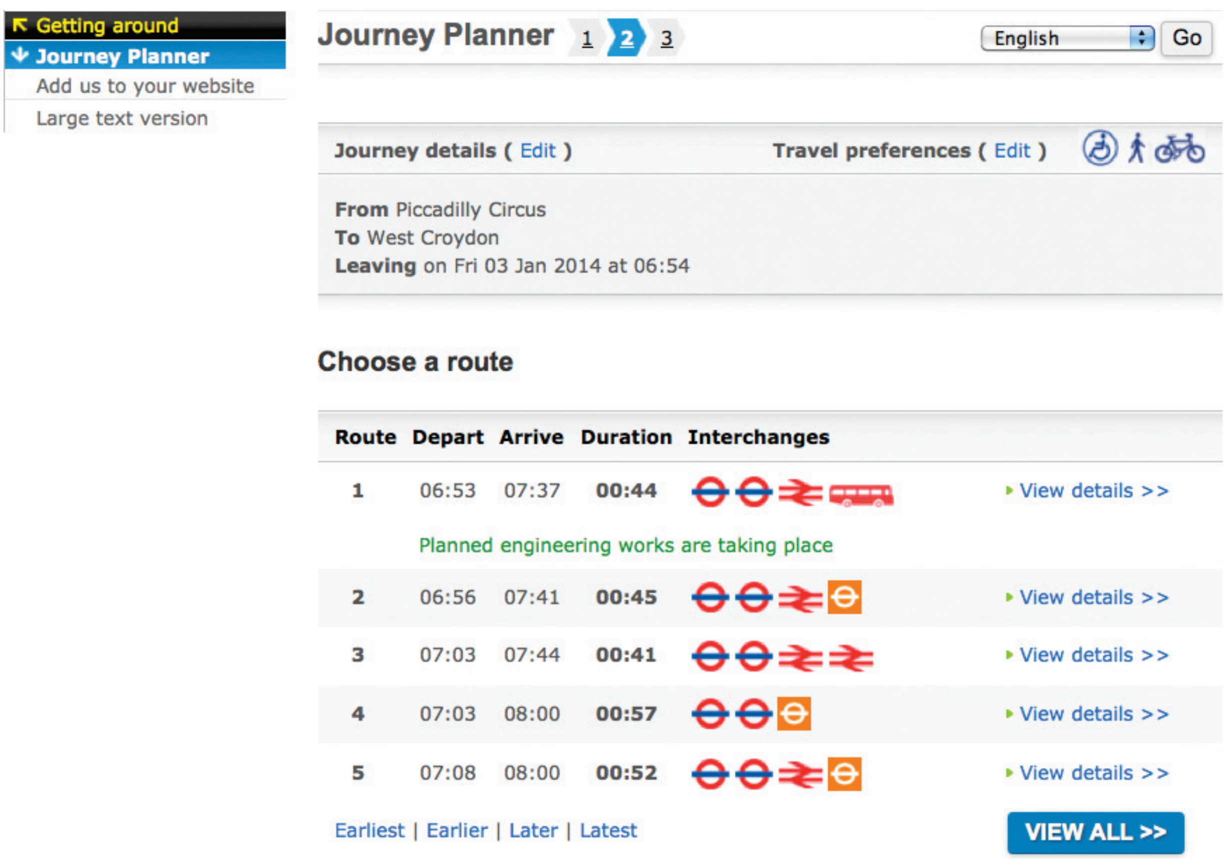
The value of ICT goes beyond just improving transport systems; ICT can also be used to integrate transport systems with other systems resulting in reduced energy use and greater customer satisfaction. For example, South Korea is building a smart city Songdo where all buildings, roads and other

Figure 10.1
ICT Layers Across Multiple Modes of Transport



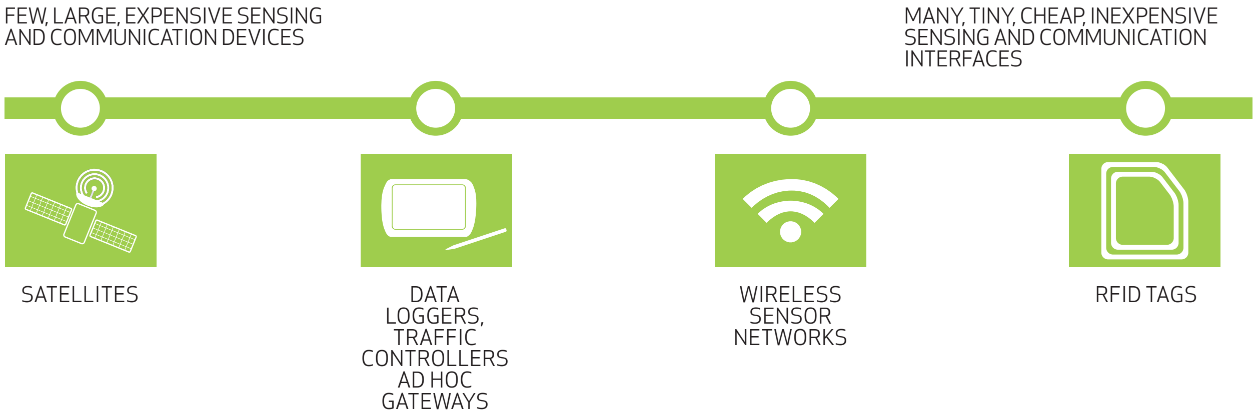
Source: Infosys Research.

Figure 10.2
Journey Planner Snapshot



Source: Transport for London; http://www.tfl.gov.uk.

Figure 10. 3
A Spectrum of Sensing Devices



Source: Adapted from the Sensor Spectrum: Technology, Trends, and Requirements, Hellerstein, Hong & Madden
Other sources:
http://www.aimil.com/product-Data_Logger-1570.aspx
http://www.spacetoday.org/images/Sats/MilSats/DSCS_SatInSpaceLockheedMartin.jpg
http://blogs.dolcera.com/files/2009/08/wireless1.JPG
http://thesmartvan.com/wp-content/uploads/rfid-chip.jpeg.

infrastructure will be connected with wireless sensors, chips and other communication technologies. Through the use of big-data computing and analytics that match supply and demand of various services or utilities, it is expected that there will be more efficient use of energy, thus enhancing the sustainability of the infrastructure. Similar efforts are being made in Masdar city in Abu Dhabi. In China too, the concept of a smart city is taking root. Ningbo is using IT to improve its port logistics and smart transportation. Wuxin is using cloud computing infrastructure to deliver benefits to its citizens.

Indian firms have been world leaders in the development of ICT technologies for the benefit of some of the world's leading business firms and various government initiatives. Given the immense knowledge, power and technology capabilities that India's organisations have deployed for the benefit of solving other countries' transportation woes, it would be in India's benefit to make use of these valuable resources for solving its own problems in transportation.

TECHNOLOGY TRENDS IN THE TRANSPORTATION SECTOR

ICT components and technologies that could be used to improve the transportation system fall into three categories: (a) automation technology (sensors and controllers) which can help in location of vehicles and control of gates at access points; (b) communication technology (e.g., 3G) which can help in receiving and transmitting information to and from vehicles; and (c) information technology (hardware and software systems) which can be built on top of the underlying automation and communication systems to manage traffic, move victims during accidents to nearby medical facilities, plan trips and coordinate transportation systems.

These three categories of technologies work together to improve transportation systems as shown in Figure 10.1. The transport infrastructure at the bottom forms the base for the system and provides a variety of information (data) such as: positions of vehicles, schedules of trains, identities of vehicles crossing check-posts. These data are 'captured' by sensors, 'transmitted' by communication networks, and 'analysed' by information systems (left side of Figure 10.1). Based on the analysis, the information systems then decide what action is necessary and that action is carried out either by a human being or directly through electronic signals to controllers which carry out the action, such as opening or closing a gate, or providing a warning message to motorists on electronic boards along highways etc. (feedback and control on the right side of Figure 10.1).

A simple example of how these three categories work to enhance customer experience is the 'Journey Planner' application provided by Transport for London (http://www.tfl.gov.uk/) shown in Figure 10.2.

This application provides 'integrated' solution options for journey planning using multiple modes. It also gives alerts in those options where there is an ongoing issue or planned maintenance activity. This solution is made possible in near real-time through the seamless usage of the three components of digital technology.

We now look at the components that are available and are likely to be available in each of these three categories of technologies.

Figure 10. 4

Trends in Communication Technology Applicable to Transportation

Source: CETSI 2008 Intelligent Transport Systems, http://www.etsi.org/images/files/membership/ETSI_ITS_09_2012.jpg.

SENSORS & CONTROLLERS

The spectrum of sensors ranges from large and expensive sensing and communication devices like satellites to tiny and inexpensive devices like RFID tags (Figure 10.3).

Satellites have been used for global positioning of vehicles. RFID tags are now commonly used in highway toll booths where the tags can be read by stationary RFID readers.

Wireless sensor networks (WSNs) have huge potential in transportation. WSNs are being used to generate safety warnings to drivers in specific black spots along the roads. These warnings are given based on data gathered in terms of vehicle volumes, speed and direction.

COMMUNICATION TECHNOLOGY

Some technologies that have been developed for transportation are: vehicle-to-vehicle, vehicle-to-infrastructure; and other central level systems to communicate traffic conditions, weather conditions and road conditions. These technologies often are extensions of existing communication technologies such as DSRC (Dedicated Short Range Communication), 4G/LTE (Long-Term Evolution), High-definition radio etc., developed to make transportation efficient and safe.

As depicted in Figure 10.4, MAN (Metropolitan Area Network), mobile, satellite communications can be used to manage traffic through receiving information from vehicles (GPS technologies etc.) and providing real-time information to vehicles. Traffic signs can be suitably altered to manage traffic according to real-time requirements. Citizens can make use of communication technologies to appropriately plan their trips. Relevant safety systems (redirection of traffic, right-of-way to ambulances and appropriate display of road signage according to real-time traffic situation) can be activated using communication technologies.

INFORMATION TECHNOLOGY

There are several new developments in software systems that could help improve the transportation sector very significantly.

BIG-DATA ANALYTICS

Big data is a term used to describe voluminous (typically petabytes[1] and above), unstructured or semi-structured data flowing in real time which can be

1. One petabyte = 10^{15} bytes.

analysed to identify patterns and take decisions as events are unfolding.

In the transportation industry, big-data analytics have tremendous potential. Various data streams from diverse sources—weather data; data on traffic flows; information on parking lots; departure and arrival schedules of trains or flights; and global positioning systems—can be aggregated across different dimensions and analysed to come up with solutions to transportation problems and needs. Alerting drivers in real time of weather-induced traffic delays and providing them with alternate routes; providing information on the availability of least expensive parking lots in the vicinity of their destination; and prediction of potential traffic volume growth to plan for the most optimal multi-modal transport option in a city are some examples.

CLOUD COMPUTING

Cloud computing relies on sharing computing resources rather than investing in resources for exclusive use. The sharing is done through the internet, with 'the cloud' being used as a metaphor for the internet. Cloud computing has traditionally offered significantly lower upfront capital costs; it also optimises operational costs through the addition of computing resources on-demand which helps in real-time scaling up as needed. Various software applications in the transportation sector, especially the ones that interface between multiple modes, are well suited to making use of cloud computing.

SOCIAL MEDIA/COLLABORATION/MOBILITY APPLICATION PLATFORMS

The advent of smart phones, social media and mobile internet has resulted in a host of new smart mobile applications. Some examples:

- **Waze.** An application that determines if one is stuck in traffic and alerts friends to take alternative routes.
- **Zimride.** An application that connects car poolers together for a one-time ride. It also integrates with the Facebook community to assess safety of travelling with an unknown person.
- **Google Transit.** Helps people plan trips using multiple modes of public transportation in more than 425 cities.

OPEN SOURCE FRAMEWORKS

There are quite a few applications that are beneficial to users of multiple modes of transport. Data exchange is a key requirement for achieving the benefits from these applications, and consequently, uniformity of data formats is also essential. Open source[2] software greatly facilitates such uniformity through wider adoption. Google Transit Feed Specification (GTFS) is an example of an open source specification which defines a format for public transportation schedules and associated geographic information. Public agencies can publish their schedules in GTFS format so that the applications can use these data in an open and interoperable manner.

MITSIMLab is an open source application that has been developed at the MIT Intelligent Transportation Systems (ITS) Programme. It helps evaluate the impacts of alternative traffic management system designs at the operational level and assists in subsequent refinement of the design. Examples of systems that can be evaluated include Advanced Traffic Management Systems (ATMs) and route guidance systems.

> The advent of smart phones and mobile internet has resulted in a host of useful applications, like Waze, which determines if one is stuck in traffic and alerts friends to take other routes; or Zimride, which connects car poolers together for a one-time ride.

The Transportation Analysis and Simulation System (TRANSIMS), is an integrated set of tools developed to conduct regional transportation system analyses. Los Alamos National Laboratory is leading the development of TRANSMIS. It is part of a programme sponsored by the US Department of Transportation and the Environmental Protection Agency (EPA).

These open source frameworks and applications help in making different systems interoperable and follow defined standards to avoid proprietary lock-in.

ICT ENABLED SYSTEMS

ICT-based systems and services fall into the following four broad categories:

1. Inter and intra-vehicle systems, which as the name suggests, are systems within vehicles which help in improving safety and navigation
2. Traffic management systems
3. Transport co-ordination systems which help in multi-modal transport of passengers and freight
4. Traveller or User Information Systems which provide users with real-time information about public transport or freight transport

Table 10.1 provides examples of systems or services under each of these broad categories.

2. Open source software refers to programmes for which the source code is available to the general public for use and modification from its original design. Open source code is typically created as a collaborative effort in which programmers improve upon the code and share the changes within the community.

Table 10.1
ICT Enabled Systems for Transportation

INTER & INTRA VEHICLE SYSTEMS	
Parking Assist System	Aids in parallel parking of cars through sensors
Collision Avoidance System	Helps avoid various collisions including rear-end collision, road-departure collision, intersection collision, etc., through inter-vehicular communication
Vehicle Diagnostics System	Alerts the driver on key parameters of the vehicle
TRAFFIC MANAGEMENT SYSTEMS	
Violation Warning System	Detects various traffic violations (signal, stop sign, etc.)
Reroute Information System	Provides alternate routes in case of congestion in a specific route
Electronic Payment System	A common system for electronic payment for tolls, parking, etc.
TRANSPORT COORDINATION SYSTEMS	
Commercial Vehicle Operations System	Identifies and tracks commercial vehicles for ease of interstate electronic clearance, automated roadside safety inspection, onboard safety monitoring, commercial fleet management among others
Multi-modal Schedule Integration System	Integrates and continuously updates the schedules of various modes of intra and inter-city transport
Freight movement coordination system	Classifies freight and appropriately routes it to its destination using the optimal mix of transportation modes
TRAVELLER/USER INFORMATION SYSTEMS	
Real-time information of public transportation system	Helps travellers/commuters reach their destinations taking into account their priorities (price, time, comfort, convenience, etc.)
Real-time information of freight transportation system	A single-window system for consignees to send their consignments and keep track of their shipments on real-time basis. The system helps shippers send their consignments based on certain parameters (price, time of travel, etc.)
Real-time information of multi-modal transportation system	A real-time single-window system (ticketing, pass-through, interface, etc.) to help travellers schedule their travel across various modes of travel

Source: Infosys Research.

FRAMEWORK FOR PRIORITISATION OF INITIATIVES

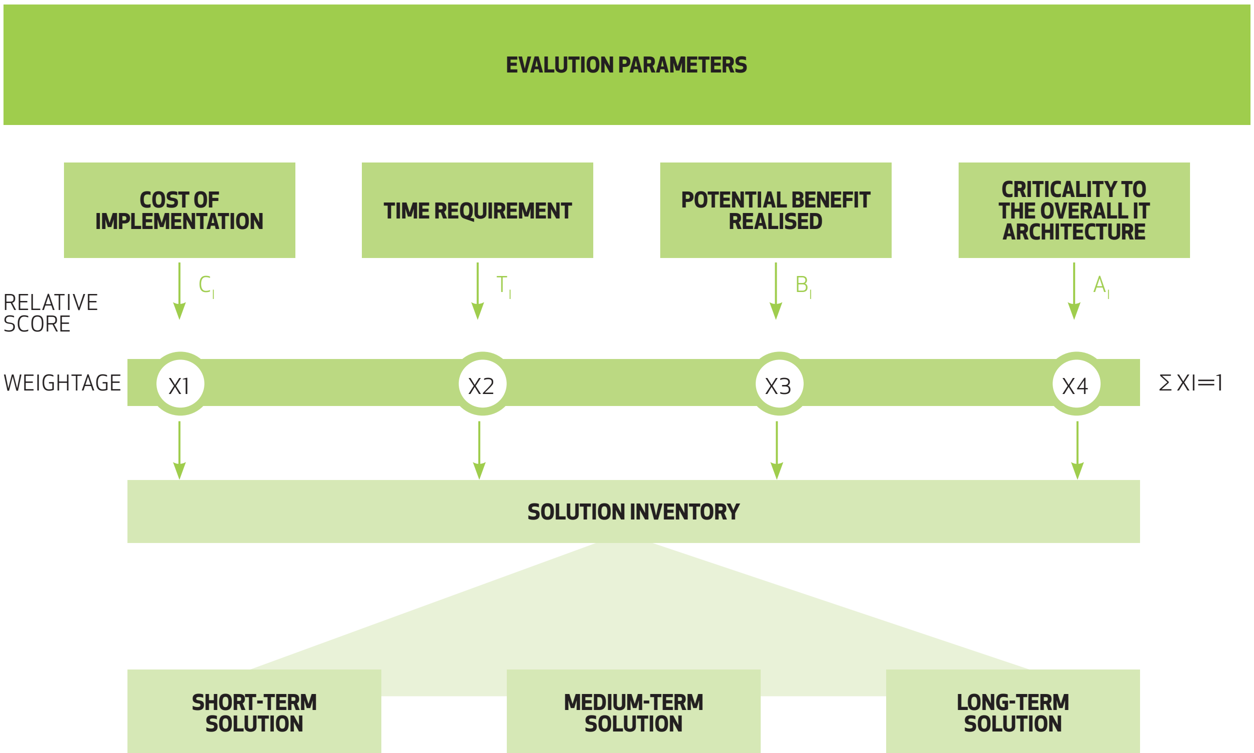
Clearly, all the ICT-based measures and initiatives described earlier cannot be implemented all at once. How then should they be prioritised? We have developed a framework for prioritisation, shown in Figure 10.5, that groups the various ICT solutions or initiatives into three categories: solutions that need to be implemented in the short term (0-5 years); the medium term (5-10 years); and the long term (10-15 years). The solutions were prioritised by scoring them on four parameters on a scale of 1 to 10:

1. Cost of implementation
2. Time requirement for implementation of the solution,
3. Potential benefit expected out of the solution, and
4. Criticality of the initiative or solution to the development of the overall architecture for a sector or for the whole transportation system

We assigned a weight to each of the parameters to arrive at an aggregate score for each solution. These aggregate scores were then used to place them in the short-term, medium-term and long-term categories. The results of this exercise and details about ICT solutions recommended in each of the three periods for the various sectors are given in the sector-specific chapters.

The solutions proposed for the short term have a heavy focus on building an efficient database for various functional areas across sub-sectors. The other sets of solutions proposed for the short term

Figure 10. 5
Application Prioritisation Framework



Source: Infosys Research.
** all solutions are scored on a scale of 1-10 with 10 being highest and 1 being lowest.

are focused on scheduling and planning, which will help in addressing some of the key capacity and efficiency issues across the sector. Solutions proposed for the medium term are the ones which will bring significant changes in operations and infrastructure and also leverage the greater availability of data and the access mechanisms developed as a result of the measures taken in the short term. The long-term solutions have customer experience and advanced technology infrastructure as some of the key focus areas. These solutions are in the long-term category because basic infrastructure installed in the short and medium term is a prerequisite. Furthermore, scheduling and planning improvements carried out in the medium term will help in designing solutions to improve customer experience in the long term.

CAPACITY BUILDING FOR INFORMATION TECHNOLOGY IN TRANSPORTATION

In this chapter and in each of the sectoral chapters, we have identified initiatives as part of the study which will enhance efficiency, utilisation and safety of transport systems. All such initiatives will require a strong institutional foundation for development and implementation.

We propose a three-dimensional institution structure (Figure 10.6) to address the needs of the Indian transport sector. The three dimensions are:

i. Geographic area of focus, which determines whether the institution is a central, state-level or a city-level organisation
ii. Functional area of focus (discussed later)
iii. Sectoral area of focus

The various functional areas of focus are described below:

a. **Standards and Process**
These institutions will be involved in setting the standards for technology in transportation (for example, the technology to be used for toll payments on highways across the country). They will also be involved in setting up processes which facilitate implementation of technology in transportation (such as implementation of Golden Care implementation).

b. **Policy Advisory**
These institutions will constantly interact with the government, central, state and city-level ministries to help develop and implement technologies for their respective sub-sector needs. They will also advise governments on the policy framework for effective traffic management.

Figure 10. 6
Proposed Structure for Transportation Institutions

Source: Infosys Research.

c. **Consulting and Project Management**
These institutions will also be involved in the conception of projects which will implement technologies for better transportation. They could also consult with private sector organisations and manage projects for deploying technologies in transportation.

d. **Training and Research & Development**
Over the years, there has been a substantial increase in the passenger and freight traffic across the transport sub-sectors. It has become imperative to build new R&D capabilities and training institutions to help in the development of technologies for solving problems in transportation. The institutions that we have proposed will develop and implement technologies for transportation and also train professionals in transportation.

We propose a multi-tier institution mechanism to oversee ICT for transportation in India (Figure 10.7):

Each of the institutions proposed can cover multiple functional areas of focus mentioned earlier. In this section, we explain the overall national level organisation, its roles and responsibilities. All the sector-specific organisation, and their responsibilities and functional areas of focus, are discussed in respective chapters on the sectors.

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY IN TRANSPORTATION (IIITT)

We recommend that an autonomous central-level institution called the Indian Institute of Information Technology in Transportation (IIITT) be created. IIITT will be similar to RITA (Research and Innovative Technology Administration), which coordinates the US Department of Transportation research programmes and helps in the deployment of state-of-the-art technologies for improving US transportation.

IIITT's charter will be to:

(1) Develop the overall framework of ICT enablement in Indian transport sector
(2) Facilitate various activities of national-level sector-specific organisations
(3) Interface with various external stakeholders, both national and international, for R&D
(4) Indigenise technology and solutions deployed by other countries for enhancing transportation in India
(5) Advise on policies regarding transportation
(6) Consult and help in the project management of implementation of technology in transportation

Figure 10.7
Four-Tier Institutional Framework for Transportation

TIER 1 - (OVERALL NATIONAL LEVEL INSTITUTION) - IIITT - INDIAN INSTITUTE OF INFORMATION TECHNOLOGY IN TRANSPORTATION

TIER 2 - (NATIONAL LEVEL INSTITUTION FOR SUB-SECTORS)

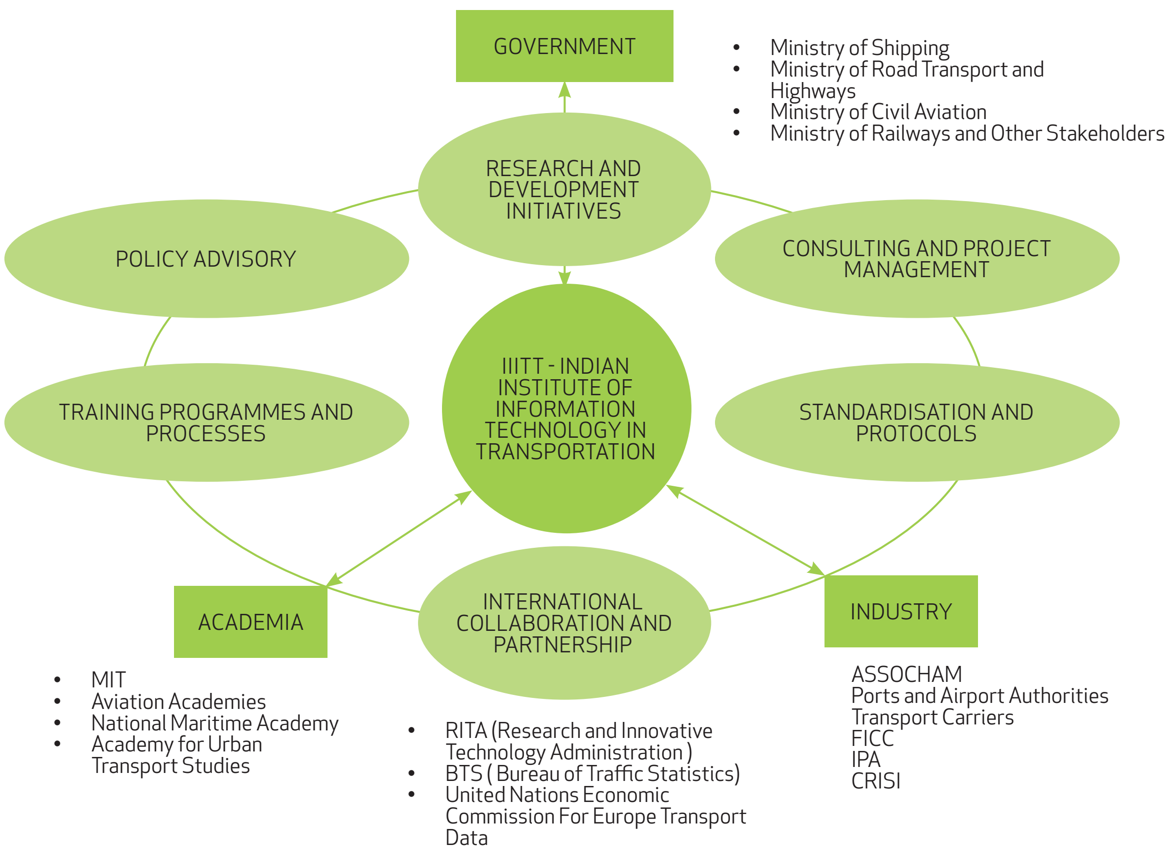
TIER 3 - (STATE LEVEL INSTITUTION FOR SUB-SECTORS)

TIER 4 - (CITY LEVEL INSTITUTION FOR SUB-SECTORS)

SUB-SECTORS	CENTRE	STATE	CITY*
RAILWAYS	✓	↔	
PORT	✓		
AVIATION	✓		
ROADS	✓	✓	✓
URBAN ROADS	✓		✓

* Cities with population greater than 5-6 million will have their own roads and urban roads institution for facilitating ICT in transportation.
↔ Railways will have a centre level institution which will interface with all states.

Figure 10. 8
IIITT - Indian Institute of Information Technology in Transportation



Source: Infosys Research.

Figure 10. 9
Sector-Specific Institutes of Transportation

TIER 2 INSTITUTIONS

ROAD – TDC ENHANCED

PORT - IIMRP

AVIATION – IARP

RAILWAYS – ITRT

INTERMODAL - ITIMT

URBAN TRANSPORT – ITUT

ROADS: TDC ENHANCED – TRANSPORT DEVELOPMENT COUNCIL

PORT: IIMRP – INDIAN INSTITUTE FOR MARITIME RESEARCH AND PLANNING

AVIATION: IARS – INSTITUTE OF AVIATION RESEARCH AND PLANNING

RAILWAYS: IRIIT – INDIAN RAILWAY INSTITUTE OF INFORMATION TECHNOLOGY

INTERMODAL: ITIMT – INSTITUTE OF TECHNOLOGY FOR INTER-MODAL TRANSPORTATION

URBAN TRANSPORT: ITUT – INSTITUTE OF TECHNOLOGY FOR URBAN TRANSPORTATION

Source: Infosys Research.

IIITT will assist the Indian government and departments related to transportation in the following functional areas (Figure 10.8):

(1) Initiate and review R&D programmes
(2) Develop and deploy new technologies relevant to transportation; consult and manage projects for implementing technologies in transportation
(3) Collect and publish transportation relevant statistics; use analytics to improve transportation
(5) Provide training for transportation professionals and serve as a knowledge and skill-dissemination repository

IIITT will coordinate with all other proposed central-level sub-sector institutions, state and city-based institutions. IIITT will also collaborate with international institutions to develop new technologies, indigenise successful technologies used in other countries for deployment in India and facilitate training for transportation professionals.

All the sector-specific national institutions (Figure 10.9) will co-ordinate with IIITT for all the areas where they need any specific assistance. The sector-specific national level institutions are as shown in Figure 10.8. Detailed roles and responsibilities of the individual sector institutions are covered in chapters on the different sectors.

ICT FOR RAILWAYS

KEY ISSUES

Indian Railways (IR) has been a pioneer in the introduction of computerisation in its major areas of activities. In the mid-1980s, it created the Centre for Railway Information Systems (CRIS) as an autonomous application development and implementation agency. Computerisation began with payroll, accounts and the apportionment of freight revenue and tonnage; then it expanded to cover almost every field of rail operations and business.

Since then, customer management, which includes booking of tickets, freight and parcels, have seen successful ICT applications. The Passenger Reservation System (PRS), Freight Operations Information System (FOIS), Unreserved Ticketing System (UTS), Parcel Tracking System (PTS) are important examples of successful implementations of ICT by IR. Similarly, operations of trains and management of crew have had full level of ICT deployments such as the Control Office Applications (COA) and Crew Management System (CMS). Production units, maintenance of rolling assets and fixed assets, workshops, human resources, accounting, safety and medical services have seen pilot IT deployments and full scale applications will be rolled out in suitable phases.

Strategic planning, which includes decisions on new routes, capacity enhancements on existing routes etc, has been assisted by the Long Range Decision Support System (LRDSS). This has enabled

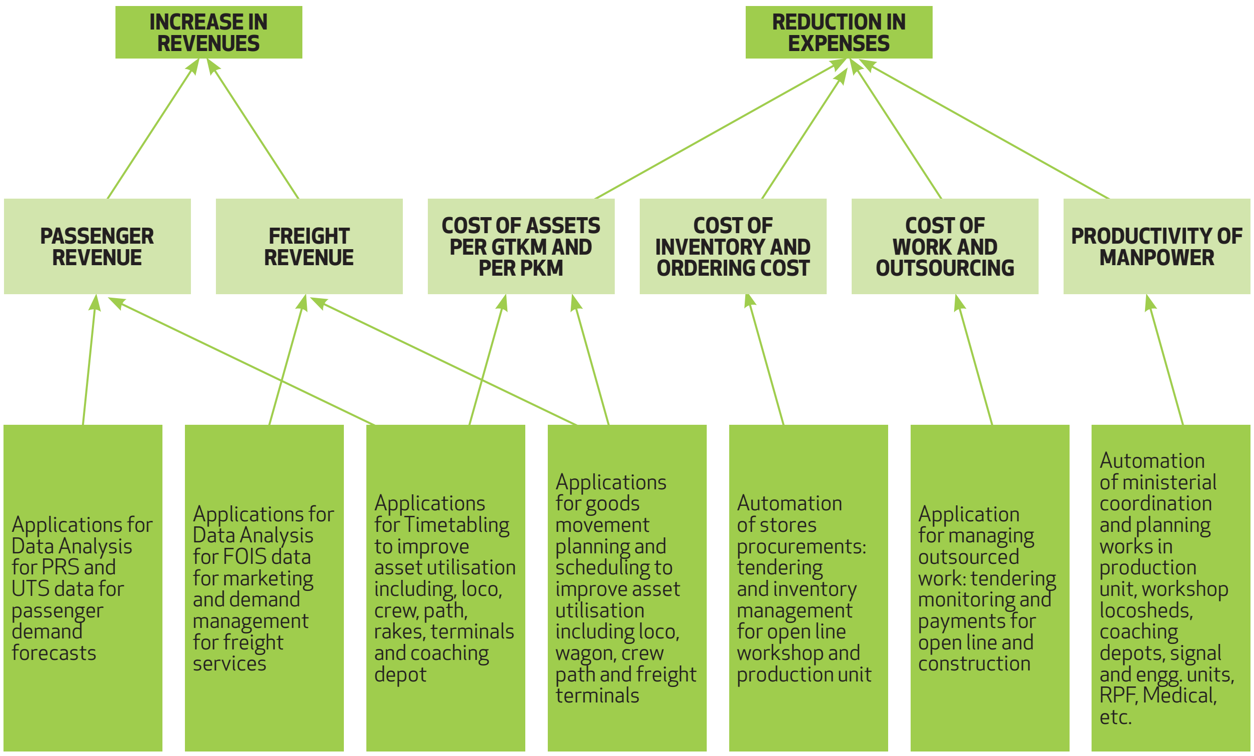
Figure 10.10
Major Departmental Activities and Applications

CUSTOMER MANAGEMENT	Passenger Reservation & Ticketing	Freight Management System	Customer Pricing	Multichannel Management	Customer Service
DEMAND FORECAST AND PLANNING	Corporate Strategy	Demand Forecasting	Operational Planning		
SALES AND MARKETING MANAGEMENT	Sales Planning	Execution Planning	Marketing Planning	Campaign Management	
OPERATIONAL MANAGEMENT	Train Operations	Crew Planning & Scheduling	Terminal Operations/ Freight Tracking	Signaling & Safety/Train Control	Decision Support System
ASSET MANAGEMENT	Asset/ Equipment Tracking & Distribution	Asset Lifecycle Management	Capital Investments & Infrastructure	Materials Management	
PRODUCTION MANAGEMENT	Production Planning	Production Scheduling & Implementation	Quality Control		
MAINTENANCE MANAGEMENT	Maintenance of Way & Reporting	Maintenance Scheduling & Reporting	Facilities Maintenance	Work Order Management	
PROCUREMENT & 3RD PARTY MANAGEMENT	Direct Procurement	Indirect Procurement	Contracts Management	Capital Goods & Services	PPP Contract Framework
F&A, MIS	Revenue & Financial Accounting	Asset Accounting	Business Intelligence & Analytics	Corporate Governance	
WORKFORCE MANAGEMENT	Recruitment	Training & Certification	Payroll & Compensation & Benefits	HR Operations	

CURRENT IT ENABLEMENT ACCROSS BUSINESS UNITS

- The IT enablement has been good and has yielded positive outcomes
- The IT enablement has been done but has not yielded the desired outcomes
- The IT enablement has either not been done or requires a great deal of process re-engineering

Figure 10.11
Potential Role of ICT in Increasing Revenue/Decreasing Expenses



sourcing of rich operational data and professional experience in its use in decision making. Unfortunately, this system has become dysfunctional due to software obsolescence.

Figure 10.10 shows the major departmental activities that need to be undertaken by IR, and the extent of use of ICT in each of these activities.

The time is now both ripe and opportune for IR to focus on developing decision support systems to enhance the efficiency of business, operations and assets management. The latter requires a changeover to a regime of need-based predictive maintenance of assets. Equally important is the development of compatible interfaces with the regional railway networks and major transport generating entities like ports, mines, etc. The issues of uniformity of data formats, development of ICT standards and protocols also need attention.
There are five main strategic and operational issues that need prioritisation.

INCREASING REVENUE AND DECREASING EXPENSES

IR is short of both passenger and freight capacity. However, revenue can be maximised by the introduction of ICT support systems. For example, the effort should be to deploy coaches in circuits to improve load factors and avoid the detention of wagons because of congestion and stabling.

Figure 10.11 illustrates how these factors affect revenues and expenses. It also shows how specific ICT applications can increase profits either through an increase in internal revenue generation or a reduction in expenses. In the following sub-sections, we elaborate on the interactions of various factors on each of the components of revenue generation or expenses. (The factors are identified in the middle row of Figure 10.11.)

PASSENGER REVENUE

Passenger revenue can be increased by raising seat and berth utilisation in existing trains and by increasing the number of trains with the same set of coaching rakes and locomotives. This requires better passenger demand forecasting, timetabling, integrated coaching and rake scheduling, scheduling of terminal facilities, optimisation of coach-crew allocation, locomotive allocation optimisation, and TTE allocation optimisation. IT solutions will make these complex tasks more manageable. There is extensive data available with the Passenger Reservation System (PRS) and unreserved ticketing system (UTS). It should be analysed for better demand forecasting which will need Business Intelligence applications.

FREIGHT REVENUE

Freight revenue can be increased by loading and carrying more freight with the same set of wagons and goods locomotives and without increasing the freight rates. The key lies in reducing the empty running ratio. FOIS and control office applications have the data on which advance data analytics can be run to provide a forecast of the pipeline for congested terminals and forecasting goods train arrival at the destination. As there are multiple constraints on the running of goods trains, it would be advisable to handle the complexity by using ICT systems for planned goods train movement. This will improve utilisation of locomotives, wagons, paths, crews and freight terminals.

COST OF PURCHASES AND INVENTORY

Procurement by the stores in the various departments is a big item of expense. A systematic management of stores and the tendering process can reduce it. Different zonal railways have different inventory management systems. This makes it difficult to integrate the management of inventory. Therefore, a best-in-class inventory management system should be deployed across the different zonal railways and production units. Having a single source of data on the level of inventory across store depots, rates paid for items, lists of obsolete items, etc., will help in better management of inventory. The resulting increase in inventory turnaround, reduction of cost of holding inventory, increased availability of materials and reduced obsolete inventory could save huge sums of money. A good inventory management system is also likely to reduce discrepancies in records of stock discrepancies and vigilance cases related to stores.

COST OF WORKS AND OUTSOURCING

An increasing amount of asset maintenance work is being outsourced. This involves tendering and contract management, which includes the maintenance of fixed assets and rolling stock. The tendering work and monitoring the work of contractors is time consuming and leaves less time for inspections and monitoring of departmental work. As a result, the overall quality of both types of work suffers. A timely measurement of works and recording the measurements in IT systems will bring transparency and accountability. Contractual works are also prone to vigilance cases and arbitration. An increase in process automation will reduce time taken in tendering related activities and work monitoring activities which will lead to better overall quality of works. Computerisation of this aspect of railway working will greatly increase quality, reduce long-term cost and improve transparency in contract management.

PRODUCTIVITY OF MANPOWER

IR employs close to 1.4 million people and human resource (HR) costs are the largest component of its operating costs. A study needs to be commissioned to understand functioning of other lean railways and to identify suitable ICT applications for adoption in IR. Workflow-based office automation[3] needs to be deployed at a very large scale. This will include automation of office work in loco sheds, coaching depots, wagon depots, signaling workshops, engineering workshops, etc.

The Personnel Department of IR needs large scale computerisation to reduce manpower and to increase transparency. Processes implemented through ICT will make the system of promotions, postings, seniority lists, service sheets, leave records, etc., efficient, transparent and employee-friendly.

The training of employees is carried out in zonal training schools and officer academies. Large scale IT deployment for training which can enable anytime-anywhere learning using mobile devices will go a long way in reducing overall training cost and increasing effectiveness of training programmes.

ENTERPRISE-WIDE INTEGRATION AND KNOWLEDGE MANAGEMENT

Most IT projects are driven by the respective departments. Different IT solutions developed by different departments or divisions function as islands of information and do not interact with one another because there is no common platform or set of standards for information exchange. This is, therefore, a fragmented process without a single, strategic and overarching roadmap driven by business objectives. Ideally, IR's business strategy should be the starting point for identifying the focus areas to be IT-enabled. This approach would ensure that there is built-in synchronisation and cohesions among different project teams which function with a clearly defined purpose.

> IT in the railways is a fragmented process. Ideally, Indian Railways' business strategy should be the starting point for identifying the focus areas to be IT-enabled. This would ensure that there is built-in synchronisation and cohesion among project teams.

Enterprise-wide integration will provide additional benefits because there will be greater uniformity in data formats which will permit greater interoperability and facilitate seamless exchange of information.

UNIFIED FOCUS AND OVERSIGHT FOR APPLICATION

Currently, the Computer and Information Systems (C&IS) Directorate in the Railway Board plays the role of a CIO within the Railways. The Directorate is supported by CRIS, which is responsible for developing, implementing and maintaining ICT applications under a dynamic operational environment.

At the zonal railway level, there is an exclusive organisational arrangement for implementing and maintaining ICT applications in operational and commercial areas. There is a need to strengthen the C&IS Directorate to prepare an enterprise-wide Master Plan for ICT application and needs to be suitably empowered.

3. Simple office automation refers to archival of documents. Workflow-based office automation is used not just for document archival but also for tracking jobs from start to finish. This is particularly useful in workshops.

Table 10. 2
Major Suggested ICT Applications

CATEGORY	ICT SOLUTIONS	APPLICATION AREA	MAJOR BENEFITS
Demand Forecasting	Passenger demand analysis and forecasting system (Augmentation of PRS and UTS)	Passenger services	Increase seat/ berth utilisation, introduction of new services, better customer satisfaction, increase in passenger revenue
	Freight demand analysis, forecasting and pricing system (augmentation of FOIS)	Freight services	Pricing system, analysis of data from FOIS, demand management
Scheduling	Passenger timetabling systems	Train operations	Optimised rake links, crew link, loco link, terminal constraint scheduling, better rake utilisation
	Goods movement planning and scheduling system	Train operations	Better customer satisfaction, increase in freight revenue
Procurement & Contract Handling	Inventory management	Stores procurement, Store depots, inventory management in Railways and production units	Reduction in inventory holding cost, increase in inventory turns, cost saving
	Management of contractual works	Construction, track and signal maintenance, loco, wagon and coach maintenance	Transparency in managing contractual works, improvement in quality of work and reduction of cost
Office Automation	Workflow-based office automation systems for loco sheds, coaching depots, wagon depots, signaling, engineering and OHE workshops	All railway establishments	Reduction of unnecessary paper work and computerisation of necessary paper work, reduction of manpower, cost saving
	Human resources management system and accounting information system	All railway establishments	Computerisation of personnel and accounts departments

Table 10. 3
Issues Addressed and Expected Benefits of Demand Forecasts

ISSUES	SOLUTION FEATURES	IMPACT
Data on passenger demand is not analysed to suggest new services	Capability to analyse data available from PRS and UTS	Knowledge of demand in actionable format
Long wait list in some classes of travel while empty seats and berths in others in same train. Similarly uneven utilisation based on service type, day of week, etc.	Capability to analyse demand for specific class, day of week, time of day, season of the year.	More utilisation of berth or seating capacity
Data analysis and freight demand forecast are done manually and are not accurate which results in lack of advance planning for resource needs	Data analysis application for FOIS data	Better demand forecasts of goods service which will lead to better planning of resources to meet the demand

Table 10. 4
Benefits of Scheduling Applications for Passenger Trains

ISSUES	SOLUTION FEATURES	IMPACT
Trains wait for entry into major terminals	Simulation of terminal facilities	Smooth entry and exit at major terminals
Trains wait for precedence to higher priority trains	Simulation of timetable to check the options to reduce the impact	Better services for low precedence trains
Goods trains paths are reduced	Optimise goods train paths	More goods trains can be run
Traffic block time for maintenance is less	Optimise the designed traffic blocks	Better maintenance
Robustness of timetable in case of failures is not checked	Simulation of timetable to see impact of equipment failures	Reduced impact of equipment failures
Unexepected events such as asset failure and public agitation make scheduling difficult	Dynamic optimisation allows system to instantaneously offer optimal utilisation of available paths	Utilisation of network capacity is optimised

PROPOSED ICT SOLUTIONS

A list of major ICT interventions that are required are shown in Table 10.2, and they fall into four broad categories:

(1) Demand Forecasting
(2) Scheduling
(3) Procurement and Contract Handling
(4) Office Automation

DEMAND FORECASTING: PASSENGER AND FREIGHT

IR has data on passenger demand between any two stations based on class of service, time of day, day of week and season of year. This data can be processed to get precise passenger demand forecasts. This will help in informed decision making with respect to pricing, introduction of new services, and increase in capacity of existing services.

Similarly, data on freight transport is also available for the last few years. A forecasting system can help make better forecasts of rake demand, which can lead to more efficient rake circuits. Therefore a thorough review of the working of FOIS needs to be carried out and additional applications need to be planned based on the review. This system should serve as the backbone for decision making in freight operation planning. Table 10.3 lists the issues that demand forecasts will address and the associated benefits.

SCHEDULING

PASSENGER TRAINS

Trains wait a long time for entry at the terminals. A holistic solution to address the causes that result in long waits is needed. Making a coaching timetable is a complex planning exercise. The objective of any time tabling exercise is to prepare a feasible and workable timetable by taking into account terminal facilities, path for running trains, maintenance of trains, etc. Timetable simulation software can help. Table 10.4 lists the issues that scheduling applications for passenger trains will address and the associated benefits.

FREIGHT TRAINS

Coaching trains run according to timetables but goods trains run as and when a path is available. To cope with the dynamic problems of freight operations, IR has implemented transaction processing systems. They include, FOIS, PRS, COA and CMS.
The next stage in IT implementation is a planning and scheduling system which can assist in making goods trains' schedule and control charts 24 or 48 hours in advance. This has the potential to change the basic character of railway operations from execution- to planning-intensive. In the absence of such a system, the operational planning complexity cannot be precisely managed in great detail and most of the decisions are taken at execution time. This reduces the utilisation of assets.

A scheduling and planning system has the potential to improve the operating ratio by 3-5 per cent by increasing the utilisation of assets. Table 10.5 lists the issues that scheduling applications for freight trains will address and the associated benefits.

PROCUREMENT AND CONTRACT HANDLING APPLICATION

The procurement of equipment and materials and handling of contracts for outsourced work need ICT applications to increase transparency and to make oversight easier. E-tendering has been implemented

Table 10. 5

Benefits of Scheduling Applications for Freight Trains

ISSUES	SOLUTION FEATURES	IMPACT
Planning for goods train operations is ad-hoc. Train-running information beyond the jurisdiction of the divisional control office is non-existent and not taken into account for precision in freight train scheduling.	Planning and scheduling system for goods train	Better plan
Terminal detention of locomotives at yards is high	Locomotive planning be integral part of scheduling application	Increased loco utilisation
Rakes wait at terminal for loading and unloading	Simulation of terminal facilities	Increased wagon turnaround
Shortage of wagon rakes for freight customers	Scientific allocation of empty rakes	More revenue from same number of rakes
Sometimes crew is available but still not used and sometimes no crew is available	Crew requirements are simulated in advance to give precise forecast of requirements	Increased utilisation of crew
Some divisions have more locomotives than they can handle	Locomotive movements are planned in advance to avoid such situation	Increased utilisation of locomotives
Conflict in traffic block commitments and goods train movements	Incorporation of traffic block commitments is lacking in goods movement planning	Better traffic block planning
Out of path coaching trains adversely affects goods movements	Tactical decisions can be made keeping in view of current running of trains	Better utilisation of paths
Advance precise information about empty rake placement or loaded rake placement is difficult to give and adhere to	Precise information of rake placement	Reduction of labour wastage for freight customers and faster release of rakes

Table 10. 6

Benefits of ICT Applications for Procurement and Contract Handling

ISSUES	SOLUTION FEATURES	IMPACT
Cumbersome process of tendering and tender processing	Automation of business rules and IT assistance at each stage of decision making.	Simplified system assisted process
Costly process for third parties to participate in tenders	Simplified process based on single earnest money, contractor/supplier profile, e-tendering, e-payment, etc.	Easy for third parties to participate, thus increasing competition and reducing cost for third parties
Lack of transparency and scope for manipulation	Transparent process with audit trails and time stamps for activities	Increased transparency, easy monitoring by vigilance agencies
Need for removal of opportunistic suppliers and contractors	Central system for monitoring, approval, blacklisting and rating	Improvement in quality of suppliers and contractors in long run
Unavailability of pricing trends for similar supplies and services in other zones	Centralised data on all previous tenders for works and stores	More information leads to better negotiations
Difficult to monitor the progress of tenders and works contracts	Easy access to information from anywhere will make it easy to monitor by higher officials	Better monitoring leads to more
Delay in measurements and inspections	Inspection and measurement recording in the system	Transparency and easy to fix responsibility for delays
Delay in payment	Invoice and payment tracking	Timely payments

Table 10. 7
Benefits of ICT Applications for Work-Flow Based Office Automation

ISSUES	SOLUTION FEATURES	IMPACT
Need for better planning of traffic blocks, power blocks and non-interlock working	System to coordinate planning block to reduce impact on train movement	More blocks for maintenance, better utilisation of blocks, less impact on train movement
Planning for inspections, recording of defects	Handheld devices for collecting inspection reports	Saving of time for inspecting staff
Monitoring of output of scheduled maintenance activities	Update of data for schedule maintenance and visibility to senior officers	Better maintenance
Material management in field maintenance	Recording of consumption of material on time	Better material planning
Monitoring of outsourced work	Timely recording of work executed by third parties	Better quality work and work monitoring

successfully for the purchase and works tenders, auctions of scrap material, and reverse auctions. The interactions between third parties and railways should be enabled by ICT applications. Previous rates should be available at a single location and ratings on quality of suppliers and contractors should be available centrally. Table 10.6 lists the issues that ICT applications for procurement and contract handling will address and the associated benefits.

WORKFLOW-BASED OFFICE AUTOMATION

The majority of IR's staff is employed in the maintenance of assets. These activities could benefit immensely by using workflow-based office automation products, particularly for recording data and scheduling of activities.

Locomotives, coaches and wagons are maintained in loco sheds, coaching depots and wagon depots and periodic overhaul (POH) workshops. The major activities at these places are inspections, preventive maintenance, breakdown maintenance, replacement of worn-out parts, lubrication, etc. These centres need unique applications, customised for their requirements. A thorough study of the activities at these places should be carried out to understand the workflow, associated paper work and record keeping, and the possibilities for improving work processes. Separate applications are likely to be needed for loco sheds, coaching departments, wagon repair shops and POH workshops.

Flexibility of operations is a key aspect of the work at these centres, and manual processes are very flexible. Therefore, any software-based application must maintain the flexibility of operations.

Fixed assets, which include rail tracks, bridges, signals, and overhead electric equipment, are maintained on location, and the maintenance staff travels to the site. Inspection, periodic maintenance, condition-based maintenance and breakdown maintenance are the major activities in the maintenance of fixed assets. Further, the maintenance of these assets often require blocking of traffic and/or electric power and disabling of interlock features.

In order to keep the number and duration of these blocks to the minimum and to make maximum use of a block when it is implemented, coordination between various departments is essential. These maintenance activities need software applications specially designed for this purpose. Separate applications will be needed for track and bridge maintenance, overhead electrical equipment (OHE) maintenance, maintenance of signals, and blocking of traffic, power and interlock operation. Table 10.7 lists the issues that office automation will address and the associated benefits.

HUMAN RESOURCE MANAGEMENT

A comprehensive HR management system should be developed to better manage processes and costs as well as to allow proper tracking of skills and gain improved efficiencies by assigning the right people to the right jobs. Such a system should also maintain an updated record of leave and entitlements, making HR management efficient and effective.

There is a strong requirement in the railways for a comprehensive IT security framework to safeguard critical information and avoid unauthorised manipulation/ damage to the data. Numerous transactions with external users need very high levels of security.

INSTITUTION AND CAPACITY BUILDING

As can be seen from the previous sections, there are several areas where IR can benefit from the use of ICT. However, given the very large size of IR as an organisation, bringing about these changes will require strong institutions and a large number of professionals having domain knowledge and expertise in ICT.

The following four features are required for any institutional structure for implementing ICT in IR on a large scale:

- **Agency with Authority and Reach:** The Agency should have the benefit of domain knowledge of the various discipline verticals as also the authority to push the required changes across the entire system. Given the geographical spread and setup of the railway system, a body of professionals would also be required at the zonal railway level.
- **Specialised Entity for Developing, Implementing and Maintaining ICT Products:** This entity will be responsible for developing, implementing and maintaining ICT applications across the entire system. It will also develop ICT standards and protocols for the entire organisation.
- **Dedicated Organisation for Operationalising ICT Applications at Field Level:** This organisation will be responsible for operationalising and maintaining ICT applications at the field level under dynamic operational environment.
- **Human Resources:** Given the size of IR, application of ICTs in the various departments across the organisation will require large numbers of staff trained in the use of ICT for specific tasks. Taking into account the dynamic nature of ICT technology and the dynamic nature of work of railways, induction and periodic training has to be an essential component of human resource development.

We, therefore, recommend the following institutional changes which are both economical and least disruptive:

(1) Computer and Information Systems (C&IS) Directorate at the Railway Board be greatly enhanced to encompass the entire gamut of ICT applications on the network
(2) Centre for Railway Information Systems (CRIS) be converted from a society to a non-profit company with much greater freedom
(3) Organisation(s) for operationalising ICT applications at field level be converted into autonomous bodies
(4) IR Institute of Transport Management (IRITM) be entrusted with the task of human resource development

C&IS DIRECTORATE

The C&IS Directorate has the responsibility of conceptualising and driving ICT enablement across the system and functions within the Railway Board. C&IS should continue being a directorate within the Board so that it can draw on the authority of the Board. However, it should be enlarged to reflect the requirements of major disciplines and the support units of IR. Furthermore, each zonal railway should have an ICT person in an executive position so that he or she can implement decisions taken by the enhanced C&IS. This Directorate will be the interface with the external stakeholders and also oversee the functioning of CRIS and the field organisations.

CENTRE FOR RAILWAY INFORMATION SYSTEMS (CRIS)

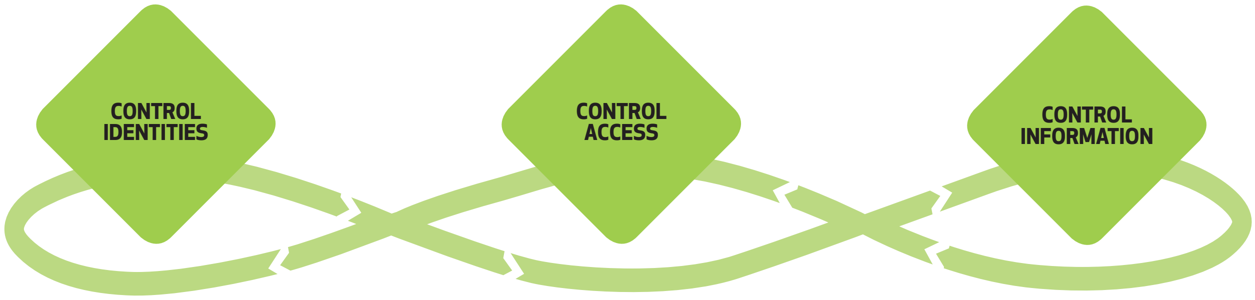
CRIS was established as a specialized organisation under the aegis of the Railway Board as a Society under the Societies Registration Act. It brings together domain experts and qualified technical personnel to create customised software products for the railways. Over the last 25 years, this innovative organisational design has enabled IR to successfully implement and sustain major IT Projects in several areas. It has helped to develop a range of applications as part of six virtual verticals—Business, Operations, Procurement, Asset Management, Planning, Financial and Human Resources, Security. CRIS can be made into a not-for-profit company with a lot more freedom and empowerment than at present so that it can attract talent. The enhanced CRIS can also assist in creating standards and protocols in areas of technology, maintenance, data management and security.

DEDICATED ORGANISATION(S) FOR OPERATIONALISING ICT APPLICATIONS

IR has created central and field level organisations for operationalising ICT applications in operations and commercial areas. These organisations are an important interface between CRIS and zonal railways. As the workload increases, there is a need for strengthening the organisational structure both in terms of autonomy and manpower continuity.

IR INSTITUTE OF TRANSPORT MANAGEMENT

IR Institute of Transport Management (IRITM) is the premier institution for training railway managers in operations and commercial disciplines. The Institute is well endowed with physical and technical resources.



Manage and govern identities and what they can access based on their role – Identity Governance – Role Management – Provisioning – User Activity Reporting	Control access to systems & applications across physical, virtual & cloud environments – Web Access Management – Federation – Authentication/Fraud Management – Privileged User Management – Virtualisation Security	Find, classify and control how information is used based on content and identity – Information Discovery – Classification – Data Policy Management

It can be strengthened with minimal expenditure for capacity building of the railway personnel from various disciplines in application of ICT in their areas of working. It can also promote need-based research and scanning of new technologies.

LONG RANGE DECISION SUPPORT SYSTEM (LRDSS) PROJECT

The LRDSS is an investment planning software tool developed by an American company in the late 1990s with funding provided by the World Bank. The software was acquired by IR for the simulation of its network and identifying capacity bottlenecks on the system under operational conditions for the purposes of investment planning. With the passage of time, the software has become obsolete and the new version has not yet been developed. CRIS has the capability to develop the required software, dovetailing the same with the operational data available with them. This tool can then be gainfully used both for long range decision making as also for operational decision support on a day-to-day basis. As such, the LRDSS project should be housed with CRIS.

SECURITY

There is a strong need for a comprehensive IT security framework to safeguard critical information and avoid unauthorised manipulation/damage to the data as well as denial of service to authorised users. There are various external applications like passenger reservations, IR portal, and freight operations involving numerous financial transactions from external users which require high levels of security. Similarly, internal application like MIS, financial applications, workshop designs containing sensitive/confidential internal data stand a risk of unauthorised access, data leakage, etc., which are required to be secured. Employee transfers happen on a regular basis and in most cases, user access/accounts are not deleted/remain active post the transfer/new assignment, thereby posing a grave security risk.

Considering the above challenges from external as well as internal users, there is indeed a great need for IR to have a comprehensively secure framework for IT network/applications/infrastructure that should at the minimum provide control for identities, access and information.

In this respect, the IT Security Framework must provide the following capabilities:

(1) Host-based access control for protecting critical servers
(2) An audit trail of untampered logs of every incident that has happened
(3) Identity management
(4) Web access management and single sign-on (SSO)
(5) Data loss prevention

It is suggested that a Joint Working Group comprising cyber experts, representatives of Indian Computer Emergency Response Team (CIRT-In), National Critical Information Infrastructure Protection Centre (CERT-In) and railway professionals is set up to address the critical issue of cyber security.

SUMMARY OF RECOMMENDATIONS

Given that there will be large benefits from introducing ICT solutions, we recommend that there be intensive implementation of ICT as soon as possible. While generally the implementation of ICT solutions can be done relatively quickly, adequate capacity in the implementation agencies is essential for effective implementation. In that context, some ICT solutions which are likely to be more centralised, such as demand forecasting and scheduling, could be implemented with less strengthening of CRIS, com-

There is very little data available on public transport and freight movement by road. Sensors and controllers can help gather raw data; communication technology can transmit it to computer systems which analyse the data.

pared to procurement, contract handling and workflow office automation which need to be introduced on an enterprise-wide level to ensure uniformity and inter-operability, and hence require integration and capacity building in the numerous field organisations

ICT in Railways should also result not only in the ability to track goods and passenger movements, but also generate 'on-time' performance in public domain to enhance transparency and accountability. We recommend that for the first three years, the focus should be on increasing both passenger and freight revenue and improving asset utilisation through ICT solutions described under demand forecasting and scheduling. Strengthening of C&IS and CRIS should also be initiated immediately, particularly to increase the number of qualified people. CRIS should be converted from a society to a non-profit company in this phase.

By the third year, we expect that CRIS would be sufficiently strengthened at both the centre and in the regional and field level so that for the it can implement ICT solutions for procurement, contract handling, office automation and human resource management. During the years three-five, we recommend that these ICT solutions be implemented and that strengthening of CRIS and C&IS continue.

ICT FOR ROAD TRANSPORT[4]

KEY ISSUES

There are three areas of the road sector where ICT could play a significant role in mitigating problems: (1) Good quality data to support evidence-based policy-making; (2) Increase in efficiency of the road transport system and satisfaction of its users; and (3) Management of safety and care of the injured.

GOOD QUALITY DATA

Effective policy making requires good quality data on aspects such as: composition and volume of current traffic; condition of roads and its association with the volume of traffic; and information about vehicles (number, kilometres travelled, level of pollution control). While a considerable amount of these data are collected, they are not available in a readily useable form and hence are not used much for policy making.

Considerable data is available on the physical achievements in the roads sector, but not much on performance and outcome-focused indicators. Such performance-related data is needed for benchmarking within the roads sector and for comparison with other modes. In that context, it should be noted that almost no data is available on non-motorised transport (NMT) even though it serves an important need for short trips and provides access to public transport.

Data is also needed on the condition of roads so that maintenance can be more effective and efficient. More extensive data is required on accidents which include the circumstances of the accidents (location, how or why the accident happened, and number of injuries and fatalities, etc.) so that roads can be designed to be safer and measures taken to reduce the number of accidents. On the requirements for data on public transport, we find that while considerable data is collected on government-owned buses, there is very little data about privately-owned buses even though they provide about 90 per cent of public transport. Similarly, almost no data is available on the movement of freight by road.

ICT will play a pivotal role in filling these data gaps. Detailed studies will be required where sensors and controllers will help gather raw data about number of vehicles, passengers, etc.; communication technologies will be used to transmit the raw data to computer systems, and hardware and software systems will be used to set up the databases. Software programs and data analysis will facilitate drawing of conclusions. For example, systematic origin-destination studies are required for freight traffic. The chapter on the roads sector describes in detail the processes required to carry out such studies.

INCREASING EFFICIENCY AND USER SATISFACTION

A lack of integration between various transport agencies, both within and between states, leads to inefficiency, delays and poor customer service.

COORDINATION BETWEEN STATES

In order to ensure uniformity and interoperability throughout the country, the Government has decided to create a National Register and State Registers of Driving Licences (DL) of drivers and Registration Certificates (RC) of motor vehicles. This initiative would help not only in interoperability between states but will also improve enforcement and instant verification of Driving Licences and Registration Certificates (see the chapter on roads for more details). Sharing of data between RTOs and

4. Chapter 2, Volume III on the roads sector covers ICT applications extensively, particularly related to issues of data collection and use.

with traffic police and insurance companies will help in ensuring that defaulting drivers/vehicles are penalised, vehicles that are not traffic-worthy can be towed, the insurance premium of at-fault individual drivers can be increased, etc.

INTER-STATE MOVEMENT OF FREIGHT

Considerable time is lost by freight transporters at borders between states, because of long waits for border checks and payments often done manually. We give three examples of application of ICT that can expedite processes at borders.

NEW NATIONAL PERMIT SYSTEM (NNPS)

Under the NNPS that is already being used in some states, permit fees can be e-paid. The technology was developed by NIC. States should use this e-payment facility to plug revenue leakage and to reduce waiting time for the freight vehicles at the border check posts.

GREEN CHANNEL

Gujarat currently implements the 'Green Channel' concept, whereby commodities with a single destination are accorded 'Green Channel' status. The papers of such commodity movements are prepared in advance and are sent to the check post. Since freight with a single destination accounts for a large proportion of consignments and is likely to increase with containerisation, this concept helps reduce delay in freight movement. We believe high-value freight and sensitive commodities should also use the 'Green Channel'. Proper sealing and certification mechanism can be put in place for safe movement of freight.

AUTOMATION AND COMPUTERIZATION OF INTER-STATE CHECK POSTS (ICPS)

Presently, Gujarat and Andhra Pradesh have automated ICPs. This has resulted in 100 per cent checking of vehicles and a fourfold increase in revenue collection. The automation can lead to faster delivery time, fewer opportunities for leakage in revenue and stabilised revenue flows.

STANDARDISATION OF TOLL PAYMENT

Operators of the many toll roads have different methods of payment resulting in long queues at toll booths. In order to increase efficiency and productivity of the toll-based system of payment, the method of toll payments should be standardised.

The Nandan Nilekani Committee on Unified Electronic Toll Collection proposed an OBU that can be read across all tolls. Details of the Committee's recommendations appear in the chapter on roads.

INTEGRATION OF TAX PAYMENTS

Currently different data on manufacturing and transportation of products is being collected by the different taxation departments (Excise, CST and VAT). These data can be brought under a centralised database system through which movement of different commodities can be tracked. The ensuing data collection can help in efficient movement (lower cost and time) of freight.

> In ports, different IT solutions function as islands of information and do not communicate with one another because there is no common platform for information exchange. This defeats the whole purpose of automation resulting in no savings in time.

SAFETY MANAGEMENT AND CARE OF THE INJURED

Indian roads have high levels of accidents and injuries. The treatment of injured persons is extremely slow and ineffective leading to a high level of fatalities. A new safety initiative (post-accident initiative) called 'Golden Care' is recommended to reduce fatalities in the event of an accident on National Highways or State Highways. The 'golden hour' is a term used in emergency medicine and refers to the time immediately following a traumatic injury, when prompt medical attention is most likely to prevent death. Under the Golden Care Initiative, when an accident occurs, medical care should be provided to the victims within the golden hour. Administrators should ensure that whenever an emergency situation occurs on the highways, victims are rushed to a nearby medical centre within 10 minutes of the accident. The chapter on roads provides further details of this proposed safety initiative.

ICT FOR PORTS

KEY ISSUES

While the cargo traffic at Indian ports is expected to grow rapidly in the coming two decades, the ports are already stretched to capacity, with the capacity utilisation already close to 100 per cent or higher at many major ports. Low productivity, congestion and delays are the norm at most Indian ports. While increases in capacity at ports will help, ICT can help improve productivity and efficiency at ports.

A preliminary study of the ICT applications at various ports in India suggests that though the basic automation of terminal operations and other functional areas has been undertaken or is being implemented, it has not yielded the desired results due to lack of integration and a holistic approach towards automation. Different IT solutions function as islands of information and do not interact with one another because there is no common platform or set of standards for information exchange. Therefore, stakeholders still need to have documents veri-

Ports are dependent on a community of service providers such as shipping lines, freight forwarders, customs, clearing agents, etc. All the stakeholders need to be ICT-enabled and share real-time information and status updates with one another.

fied at multiple points, even though each of these points or offices themselves might have been automated, as there is no communication link or compatibility between the existing systems. This defeats the entire purpose of automation resulting in no savings in time.

A discussion with the port operators highlights some of the problems they experienced in managing terminal operations:

- **Lack of standardisation:** Many of the Indian ports use proprietary formats for Electronic Data Interchange (EDI) with Customs, which are not compatible with international standards like UN/EDIFACT (Electronic Data Interchange for Administration, Commerce and Transport). There are no formal standards or formats used across stakeholders. For example, codes for identification of hazardous cargo are different between ports, customs and CONCOR. Some cargo is considered normal by the ports while CONCOR considers that cargo as hazardous.
- **Lack of real time information:** In the absence of a web portal which provides real-time information on vessel schedules, expected times of vessel arrival (ETAs) and details of berth allocation to the concerned stakeholders, often a vessel has to wait for a long time in the channel before berthing. These pre-berthing detentions add to vessel turnaround time and increase cost.
- **Lack of automation in yard planning:** Most of the ports and container freight stations (CFSs) do not have automated yard plans. Yard reports are still paper-based and are not updated every time a container is moved from one location to another, making it very difficult for the Custom House Agents (CHAs) and others to track containers, especially those of foreign origin which need to be sent back within six months.
- **Manual process for documentation:** Several processes such as issue and collection of a Delivery Order (DO), Let Export Order (LEO) released by Customs are still handled manually, thereby introducing delays in the system. A CHA has to go to different shipping agents for getting Delivery Orders (DOs) for all the importers the CHA represents. Any change in the document requires several authentications and can be very cumbersome.
- **Integration of CFS with port systems:** Currently Customs is not integrated with the CFS operations at most of the ports. Therefore, the CHA is required to accompany the trucks with the necessary documents each time they move in or out of the CFS. This creates bottlenecks in speedy clearance.
- **Traffic management at port gates:** Manual verification of documents at the port gates and issuance of gate passes take up a lot of time leading to congestion and traffic jams.
- **Origins to destination tracking of EXIM goods:** Existing logistics systems available at ports and logistics service providers do not have the provision to track cargo once it has left the port's premises. It therefore becomes very difficult for importers to get a realistic estimate of the Expected Time of Arrival (ETA) of their consignment. They are dependent on the information provided by the transport operators which is not available in real time and is often unreliable

FRAMEWORK FOR IMPLEMENTATION OF ICT

As discussed earlier, introducing ICTs in individual processes is not likely to yield much benefit in the performance of Indian ports. Attention must be paid to systemic issues such as integration of various processes.

INTEGRATED IT POLICY AND PLANNING

Going forward, all major ports would need an extensive IT infrastructure to manage their day-to-day operations. In addition to their usual assets such as cranes, machinery, etc., they will need to set up data centres, have enough computers, servers, network connectivity, application software and trained manpower to manage all these ICT-related additions. In the absence of comprehensive guidelines for ICT enablement of port operations, each port has devised its own ICT strategy and implemented custom solutions which may or may not be compatible with the ICT systems at other ports. Therefore, in order to create an interconnected network of ports and ensure consistency in ICT policies, ICT infrastructure and the business processes being covered, it is required that the Ministry of Shipping lays down the ICT policy and roadmap for India's maritime sector. Towards the end of the section, we discuss additional institutions that could assist the Ministry in development of such a policy and set of standards.

INTEROPERABILITY AND ELECTRONIC DATA INTERCHANGE (EDI)

Once a uniform policy and roadmap are established for all the ports, attention needs to be focused on making the various systems interoperable both within and between ports. Ports do not work in isolation but are dependent on a community of service providers such as shipping lines, C&F agents, freight forwarders, transport operators, customs, clearing agents, etc. Therefore, partial technology enablement will not help; instead, it will create problems related to data sharing, redundant data entry, handling of multiple paper documents, processing delays and human errors. It is therefore envisaged that in future, all the stakeholders in maritime trade will be ICT-enabled and would be able to share real-time information and status updates with one another. The shipping line will share the location of its vessel and communicate its expected time of arrival (ETA) to the port, in order to avoid pre-berthing detentions. The ports, in turn, will plan the loading and unloading schedule and evacuation strategy. Pre-submission of cargo details to customs through EDI will also save processing time. All these initiatives for stakeholder automation can significantly reduce cargo dwell time at ports and help in improving India's trade competitiveness.

The vision for the maritime sector in India is to create a well-knit community of ports and associated service providers which will help them share the latest information, analyse data, monitor progress and support quick decision making. This will require interoperability between IT systems owned by various entities and provisions for EDI. It is therefore imperative that we lay down standards and protocols for these information exchanges. All software applications and solutions developed for the maritime industry will need to conform to these standards. Since it will involve international shipping lines and other overseas service providers, it is proposed that the standards comply with international norms.

SINGLE WINDOW SYSTEM FOR TRADE FACILITATION

Maritime trade requires interaction with a number of government agencies and private service providers. A trader has to submit documents at various counters and separately follow up with them for licenses or permits and cargo clearances. The absence of a single point of contact and limited transparency across departments reduces the overall process efficiency. The Single Window concept attempts to look at various processes and documentation requirements from the trader's point of view and weed out the redundancies. Most of the leading maritime nations are moving towards creating a National Single Window (NSW) for improving transparency and reducing process lead times. Indian ports should also move to a Single Window regime to reduce turnaround and dwell times and improve India's competitiveness in international trade.

SMART CARGO

Smart cargo is the next step in automation of maritime operations. Recent developments in RFID and GPS technologies seek to make the cargo intelligent. The containers will have smart tags and will be able to identify themselves to the RFID tag reader providing information on content, origin-destination, etc. They can also have sensors attached to them which will raise alarms in case of unauthorised seal tampering or other unusual conditions like a rise/fall in temperature beyond threshold limits. We can also track the door to door movement of these containers right from the container yard to the delivery point using sophisticated technologies. This will reduce handling time and eliminate risks associated with container security and missing consignments.

> Smart cargo is the next step in maritime operations automation. Containers will have smart tags and will be able to idenify themselves to RFID tag readers and provide information on content, origin-destination, etc.

ICT TECHNOLOGIES

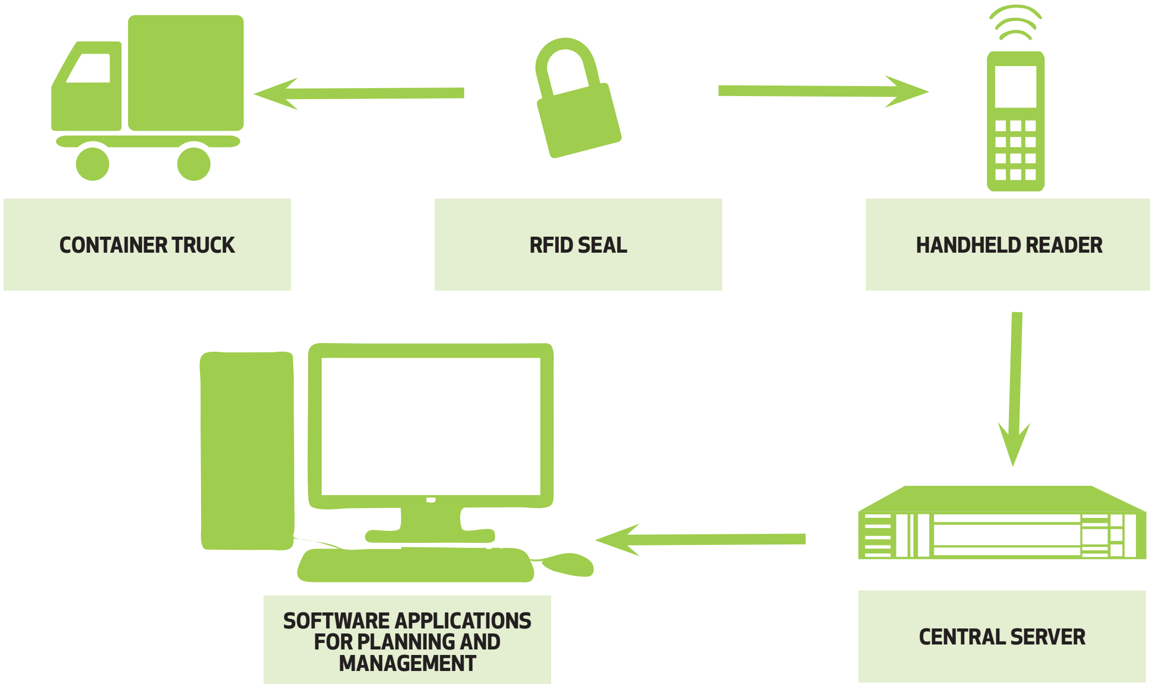
We now turn to some of the ICT interventions which can help in better management of port traffic and improve the overall efficiency of the system.

YARD PLANNING AND INVENTORY MANAGEMENT

Today over 60 per cent of the world's deep-sea general cargo is transported by containers and therefore an efficient and robust container terminal management system can play an important role in determining the overall attractiveness of a port. Efficient loading and unloading of containers and management of the storage yard is one of the most complex operations at a port and needs specialised skills. Average turnaround time for containers is a critical metric in this context, and it is here that the value of an effective and efficient yard planning and inventory management system becomes evident. In the case of consignments of perishable goods, such systems are critically important because delays can result in the loss of the entire shipment.

Currently, at most Indian ports, dry bulk cargo is stored in open yards where individual plots are not well demarcated and numbered. In most of the ports, data on the current occupancy of these plots and their availability schedule is not readily available. Exporters and importers don't get a clear view of the yard storage space to plan the movement of their cargo. This leads to sub-optimal utilisation of a port's storage yard and loss of revenue. Yet, certain sophisticated software modules are available today which employ complex algorithms to optimally utilise the available storage space in the Yard. **Geographic Information System (GIS) solutions** could be used to get a real-time view of the storage area. Data on plot allotment and expected evacuation date could be maintained online. The software also has provisions

Figure 10.12
RFID-based Yard Planning and Inventory Management System



Source: Infosys Research.

to define various rules and controls for better yard operations and planning, thereby increasing yard throughput and enhancing customer satisfaction.

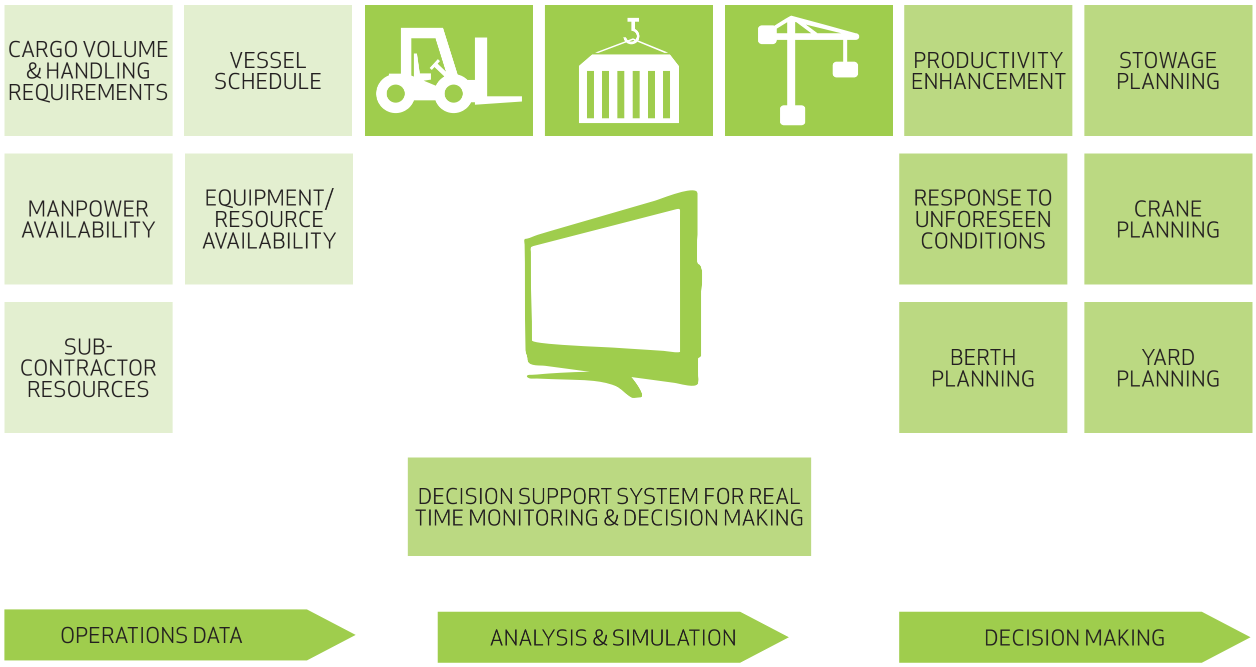
Another useful application is the **Radio Frequency Identification (RFID) technology** for monitoring container movements in the yard. RFID provides the ability to automatically collect real-time data about the physical location and properties of any container which has been RFID-tagged. An active RFID system consists of two key components: a tag which is called a transponder, and a reader device, which is referred to as an interrogator. The reader can initiate communication with the tags by sending out a wake-up signal and listening to their response. These responses could be used for the following purposes:

- **Identification and data capture:** Container identification number and other key information stored in the tags related to cargo origin-destination, etc., can be captured by the reader.
- **Location mapping:** RFID tags can be buried at regular intervals in the passageways to serve as location markers. These tags can be read by readers in the yard and provide information on the exact location of the container. Additionally, some tags can also have a GPS module which would transmit its location to the control room.
- **Electronic sealing (e-Seal) of containers**: Electronic container seals could be used to identify cases of seal tampering. These seals are active RFID tags which can broadcast the fact that they have been opened or removed without authorisation. These tags cannot be counterfeited. Everyday millions of containers are handled at various ports around the world and it is not feasible to physically inspect all of them. This creates a huge security risk. RFID can help in reducing security concerns without adversely affecting port productivity through real-time scanning of containers. Those with e-Seals that have not been tampered with can be processed in a fast track mode, while the others could be segregated for a detailed examination.

RFID technology can make Inventory management as simple as 'walking the yard' as shown in Figure 10.12. The operator can take a handheld tag reader and carry out a yard survey; in the process he would be able to capture the required information from the RFID tags in the stored containers. It would have all details related to origin-destination, date of entry-exit, etc. This would also eliminate the issue of data accuracy which is due to the usual lag between manual data collection and its entry into the system.

Even the shipping companies can know at any point in time where their containers are located and can track their movements for further analysis and route optimisation.

Figure 10.13
Decision Support System (DSS)



Source: Infosys Research.

VEHICLE TRAFFIC MANAGEMENT AT PORT GATES

Traffic congestion at the port gates is another critical problem area for terminal operators. Mandatory security checks and document verification is required before a truck can enter the port premises. Currently, most of these operations are controlled manually with very little or no automation. In order to manage the expected exponential growth in traffic, technological solutions will be essential for expediting movement of vehicles in and out of port premises without compromising on security and statutory requirements.

The entry and exit of vehicles and drivers through the gates of a container terminal can be automated. An **Optical Character Recognition (OCR) system** installed at the terminal gates can be used for identifying the tags on a container and vehicle. This information can then be compared with the expected arrival or departure of the vehicle as stored in the port database for authentication. The driver's **biometric identity** and his authentication documents could be stored in a '**smart card**' which he can flash at the counter to gain entry. An automatic barrier and traffic lights system can undertake the required physical control of the gate towards the inner area of the terminal. The yard operations manager would decide on the best possible storage location for the incoming container and pass on the information to the gate operator. At the gate, the operator would be able to identify the allotted location through the GIS system and accordingly provide the truck driver with a printed message showing the exact position or slot within the parking area.

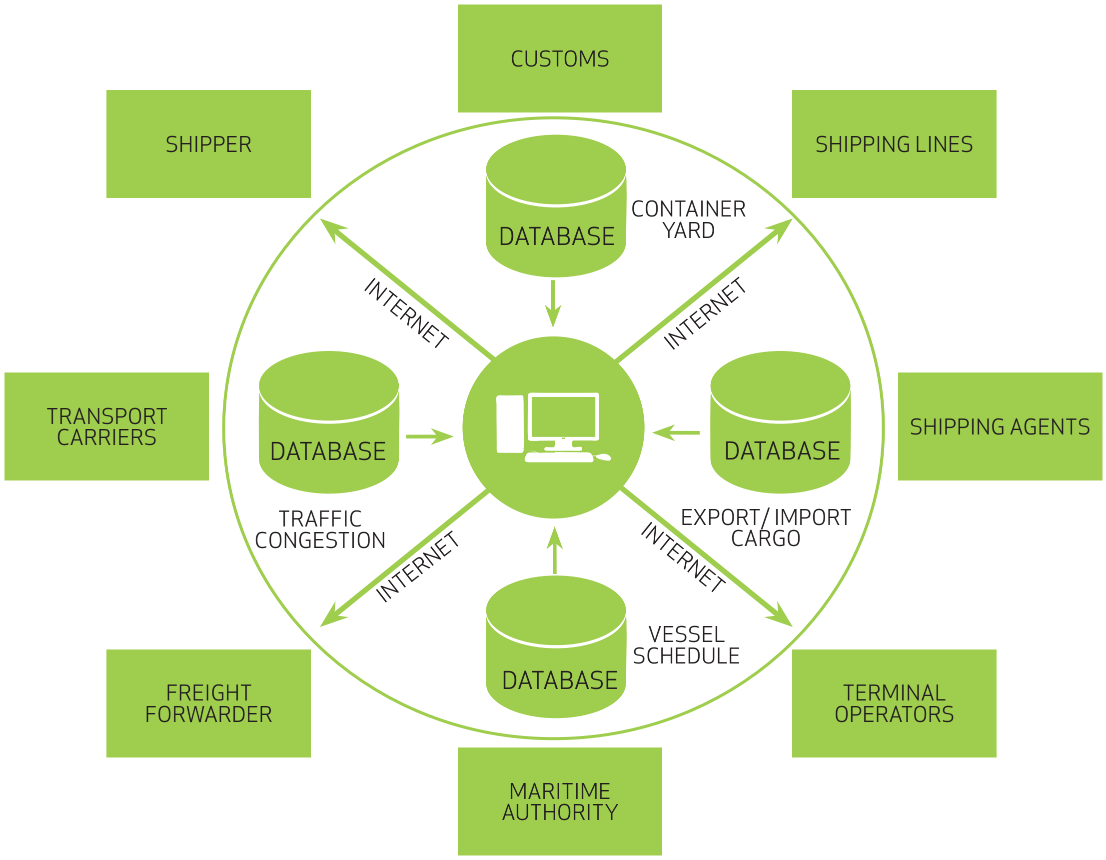
ENTERPRISE RESOURCE PLANNING (ERP) SOLUTIONS

In addition to managing port operations, the port operator also needs to carry out several administrative and human resource related functions such as payroll processing, financial management, procurement, estate management, hospital management, customer grievance redressal, etc. Many Indian ports have their own custom-made IT applications to meet each of these requirements. This lack of integration, even within a port, leads to creation of multiple data pockets which do not support seamless flow of information. Therefore, the management of a port does not get an integrated 'dashboard' view of operations, leading to inefficiencies and sub-optimal resource utilisation. The lack of uniformity across ports in reporting on these important managerial functions constrains benchmarking of performance. It would be useful for the ports to consider implementing Enterprise Resource Planning (ERP) solutions driven by an integrated suite of software modules that supports the basic internal business processes of any organisation.

PORT/TERMINAL INFORMATION SYSTEMS

These systems essentially provide a dashboard view of all the operations at the port along with related performance metrics. They are equipped to collate and integrate operational information from varied sources such as vessel berthing schedule; planned

Figure 10.14
Port Community System



Source: Infosys Research.

unloading and loading requirements; and the available equipment and manpower resources. With this information, they use complex algorithms to prepare an integrated resource management plan that includes a deployment plan and initiatives required to ensure short vessel turnaround time with maximum asset utilisation.

These modules can also be integrated with the HR management software at the port, to provide information on the availability of manpower, their skills, planned leave, etc. Detailed analysis of historical data on deployment of equipment can help in identifying underutilised or overutilised resources. Accordingly, the port management can decide to procure additional equipment which will help in increasing its throughput. It can also help in identifying critical skills which are in short supply and design training programmes for employees to acquire those skills.

SIMULATION-BASED DECISION SUPPORT SYSTEM

With the increase in size of shipping vessels and mounting pressure to reduce vessel turnaround time, most modern ports have become mechanised with sophisticated equipment for loading and unloading of cargo. Berthing of multiple vessels with competing loading or unloading schedules creates pressure on equipment operators to provide resources in time. Many factors with associated uncertainties affect the allocation of equipment. Effective and efficient allocation decisions require extensive data analysis, along with simulation that allows port operators to evaluate alternative choices. A robust Decision Support System (DSS) provides these facilities for analysis and simulation and thus can greatly facilitate more efficient allocation decisions as shown in Figure 10.13. Choices for deployment of resources assisted by a DSS can be communicated to equipment operators in real time through a Wireless LAN (WLAN).

The simulation system associated with a DSS can also be used to create a virtual environment for training the workforce. For example, training on handling of explosive or inflammable liquids such as chemicals, oils and liquefied gases and operating automated cranes can be provided under near-real conditions, thereby honing employee skills and improving efficiency.

PORT COMMUNITY SYSTEMS

A port has several stakeholders—terminal operators, cargo owners, freight forwarders, carriers, etc. The success of a port depends largely on its ability to integrate all its stakeholders with sharing of information being a key requirement. For most Indian ports, currently this is being done offline through multiple channels thus creating problems related to availability of up-to-date data, its accuracy, and the delay in decision making.

To resolve these issues, we propose creating a single technology-based platform for bringing together all the stakeholders to form a Port Community System (PCS) (Figure 10.14). In a PCS, each port would have a web portal which would provide real-time information related to all administrative and operational activities involved in the supply chain. A combination of RFID and GPS-based solution with a web interface can enable customers to constantly monitor the movement of their containers along with other information related to vessel berthing and port operations. This would help them trace and track their assets, have a real-time estimate of their inventory, and accordingly take informed business decisions.

The website could also provide other value added services such as:

- Port gate traffic view: Displays of live feeds from multiple cameras positioned at the gates
- Vessel schedule: Online publication of vessel details and berthing schedules
- Online bulletin board: To make announcements, receive feedback and resolve queries
- Cargo availability: Loading and unloading information related to export/import cargo

Once the system matures, it can include trade regulatory bodies, banks and other government agencies in this community. For example, ports can directly send invoices to the traders' banks for services offered, banks would get the necessary authorisation from the traders and credit the port's account; all these transactions being done online. An 'e-customs' solution could also be developed later, whereby all the customs-related documentation and other formalities are carried out through this portal. Such a system would increase transparency, reduce corruption and significantly improve the port's efficiency. Reduction in paperwork and follow-ups with customs officials would also reduce the cost of operations.

Implementation of a nationwide Port Community System (PCS) has already been initiated under the supervision of Indian Ports Association (IPA). However, discussions with several port officials suggest that the current PCS rollout has not been very successful mainly due to issues around proprietary message interchange formats and lack of interoperability of the IT systems owned by varied stakeholders. We therefore emphasise the need for standards and protocols for information exchange in the Indian maritime sector, in line with international norms. Before we embark upon an ambitious plan like PCS, we should first focus on building the foundation and developing stakeholder capabilities.

> An e-customs solution should be developed, whereby all customs documentation and other formalities can be managed through this portal. This would increase transparency, reduce corruption and improve port efficiency.

AUTOMATION OF BULK CARGO OPERATIONS

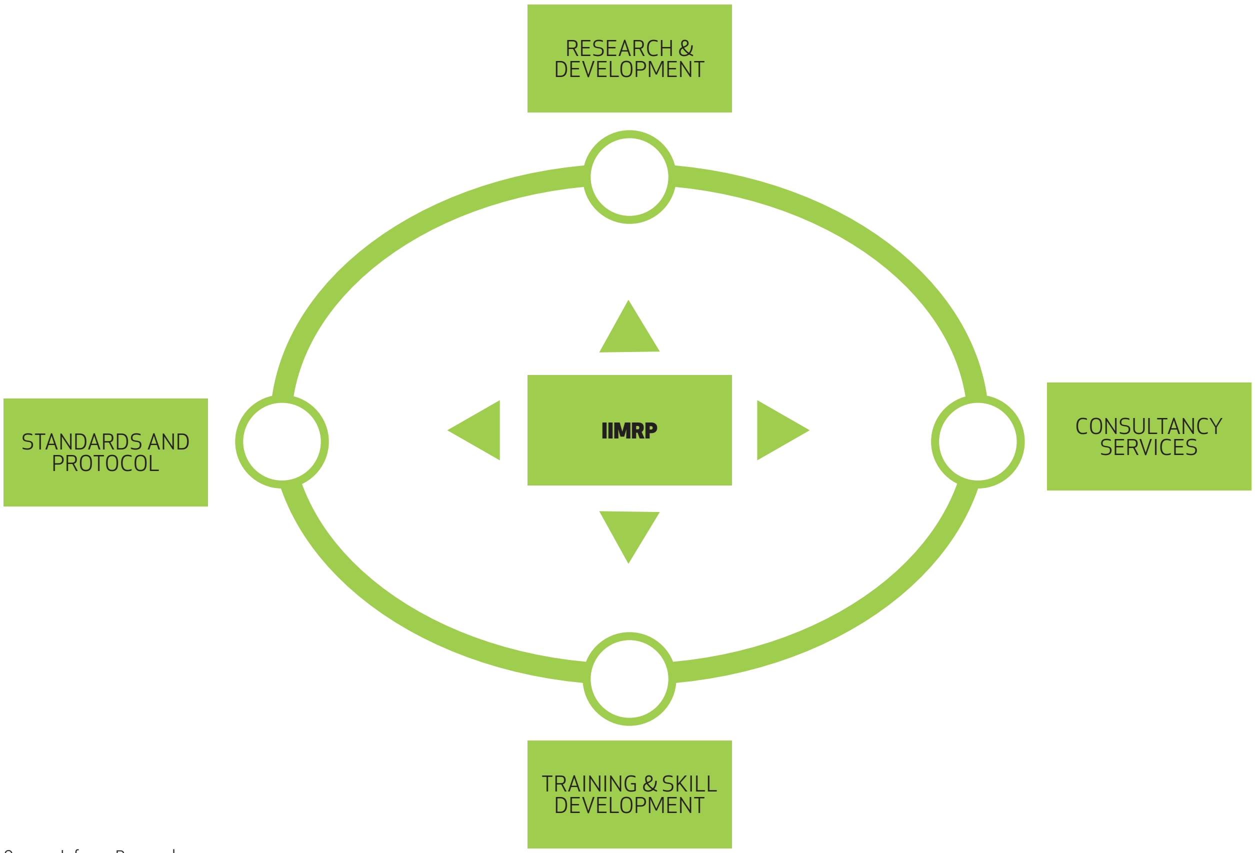
A 'smart' port is characterised by seamless integration of automated equipment, existing terminal processes and terminal operating systems. 'Last mile' automation of port operations using ICT systems can go a long way in increasing even a smart port's throughput. This is especially true, in the case of ports handling bulk cargo. Personnel dealing with last mile operations can be given mobile PDAs (handheld devices) which can be used to enter real-time operational data like time of vessel berthing, crane deployment, time taken for cargo unloading or loading, etc. These data can then be compared with planned milestones to monitor progress and take corrective actions, if required. Such a system would also save time by avoiding redundant paperwork as formalities like safety checklists, cargo discharge records, etc., that can be completed online

Another example of an ICT solution for last mile operations is when a ship is anchored at the port and cargo is being discharged. During unloading, the ship's position shifts due to change in distribution of material in the hold, tidal fluctuations, wind etc. All these have an adverse impact on the efficiency of the port's unloading and loading operations. Therefore, some ports use automatic grab ship unloaders which are equipped with hold and materials scanning system. They use sensors to detect the relative location between the hold and the loading machines as well as the actual distribution of materials inside the hold. These inputs are used by an inbuilt software module to prepare a discharge strategy for uniform loading and increasing the operating efficiency.

INSTITUTION AND CAPACITY BUILDING

A well-coordinated and integrated approach will require a strong institutional framework. In that context, the Committee recommends the establishment of an organisation, called the Indian Institute of Maritime Research & Planning (IIMRP). In addition to developing and implementing a well-coordinated introduction of ICT in the ports sector, IIMRP

Figure 10.15
Roles and Responsibilities of Indian Institute of Maritime Research & Planning (IIMRP)



Source: Infosys Research.

could be given a broader mandate to strengthen India's competitiveness in sea trade and commerce, and provide direction to the policymakers for that purpose. IIMRP would be expected to perform the following functions (Figure 10.15):

- Support the government in policy making, strategic planning and developing the road-map for the sector
- Carry out high-end research and development activities to improve operational efficiency and cut costs. This will include building large scale simulation models to analyse and predict traffic flow, as well suggest infrastructure development/augmentation
- Impart training in specialised areas for maritime professionals helping in development of a pool of qualified professional ready for managing impending growth
- Provide advisory and consultancy services to industry. It will analyse changes in international trade patterns and industry developments to chart the future of Indian maritime sector
- Develop standards and protocols for ICT solutions which would ensure interoperability between organisations and seamless flow of information.

IIMRP would be controlled by an advisory board which will have representatives from the industry, government and academia as shown in Figure 10.16. Such a body could be partly funded by the central government through annual grants and partially by the private sector. Besides, the IIMRP could also generate revenue by providing commercial research and consultancy services to the international maritime industry. Training and management development programmes for the industry could be another source of income.

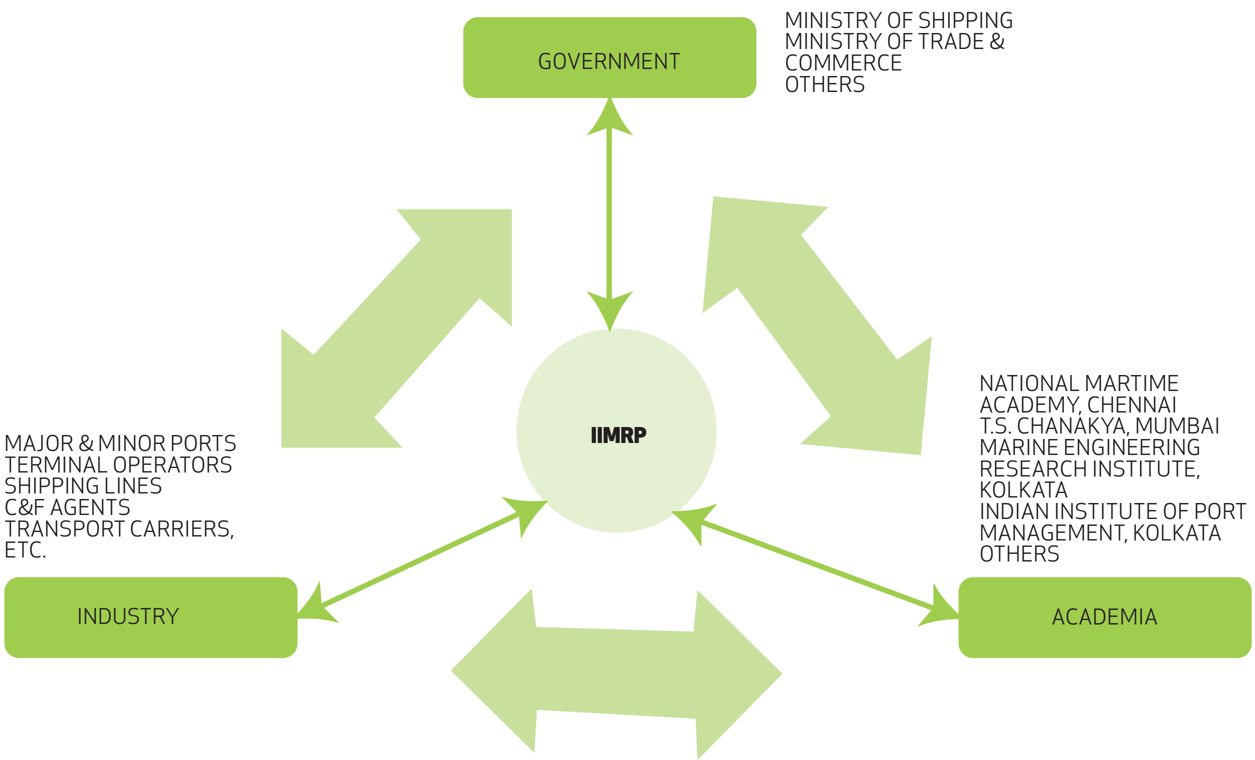
ICT IMPLEMENTATION ROADMAP

For the effective implementation of ICT applications in managing port operations, considerable groundwork is required. Therefore, we have divided this mission into three phases (Figure 10.17).

FOUNDATION BUILDING

In the first phase, the focus needs to be on: (a) developing the ecosystem; (b) capacity building; and (c) creating the necessary institutions. This phase will include initiatives such as setting up of an independent body to carry out R&D in the maritime sector, define standards and protocols for process automation, and bring about consistency in technology implementation at ports.

Figure 10.16
Organisational Framework for IIMRP



Source: Infosys Research.

EXPANSION OF ICT IMPLEMENTATION

The second phase should then focus on setting up ICT systems at ports and to provide assistance with technology implementation to the various stakeholders. Different IT solutions like ERP, PCS, e-Customs, etc., will be implemented as per the ICT policy and standards defined in Phase I. This will help in creating an interconnected network of ports and other service providers like shipping lines, transport operators, freight forwarders, etc., which will be able to exchange real time information on cargo movements, carry out extensive data analysis and support decision making.

INTEGRATED TRAFFIC MANAGEMENT

In the third phase, the focus should be on integrating business processes and IT systems of various stakeholders so as to eliminate redundancies. Some of the initiatives which could be taken in this phase include adoption of the Single Window concept, i.e., creating one interface for a trader to manage his operations so that he does not need to coordinate separately with each of the many agencies involved. Another example would be the use of technology such as RFID tagging, GPS, etc., to make cargo 'smart' so that it can signal its location and other details to concerned parties.

A review of various ports in India and interactions with some of the key stakeholders suggest that the use of ICT tools and their acceptance and maturity vary across the country. Therefore, a 'one size fits all' approach cannot be adopted. Separate studies will need to be taken up to assess the IT maturity of individual ports, benchmark their technology capabilities as compared to others and identify specific action items for each of them in line with the overall ICT enablement roadmap for the Indian maritime sector.

ICT FOR CIVIL AVIATION

The future of air transport in India will be governed by the willingness of the sector to adopt the latest technologies and by the capacity of government and regulators to create an enabling policy environment. With competitive forces at play in the airlines sector, regulators need to do little in the way of specifying exact technologies to deploy. Instead, the regulatory role is in specifying ICT protocols for (a) passenger and cargo management; (b) achievement of minimum service standards, including safety and security; and (c) for data collection. Once these ICT standards and protocols are defined, the various airlines

Figure 10.17

ICT Implementation Roadmap for the Ports Sector

INITIATIVES

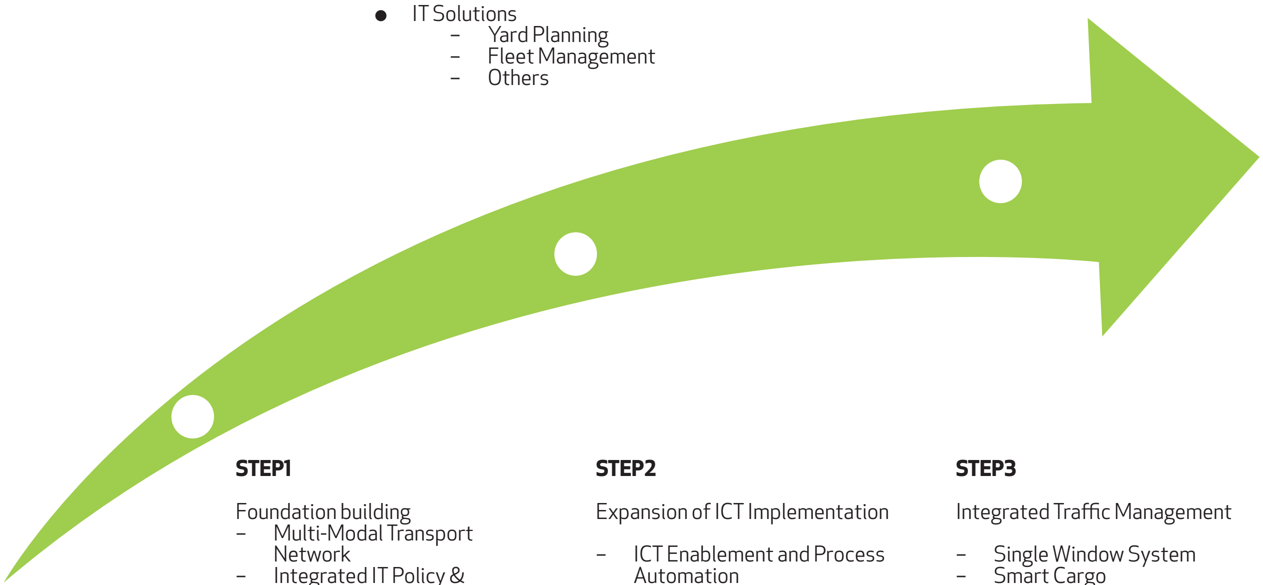
- Indian Institute Of Maritime Research & Planning (IIMRP)
- Integrated Planning & Policy Making
- Standards & Protocol

INITIATIVES

- Enterprise Resource Planning (ERP) Deployment
- Port Community System (PCS)
- Electronic Payment System
- e-Customs
- IT Solutions
  - Yard Planning
  - Fleet Management
  - Others

INITIATIVES

- Integration of All IT Systems
- Adopt Single Window Concept
- RFID Tagging of Containers
- GPSTracking



STEP1

Foundation building
- Multi-Modal Transport Network
- Integrated IT Policy & Planning
- Ecosystem for Maritime Development

STEP2

Expansion of ICT Implementation
- ICT Enablement and Process Automation
- Interoperability & EDI

STEP3

Integrated Traffic Management
- Single Window System
- Smart Cargo

1 TO 5 YEARS | **5 TO 10 YEARS** | **10 TO 14 YEARS**

Source: Infosys Research.

should be permitted ICT selection and implementation choices as per their preferences, with the regulatory role changing to ensuring compliance.

The airports present a different set of issues. The market structures are such that only one airport serves an urban catchment area, effectively rendering it a monopoly service provider. Further, rules applicable to the vast majority of airports under government administration must also apply to the handful of systemically critical airports that are managed under public-private partnerships. As locations for the processing of incoming and outgoing passengers and cargo, the government also retains a vested interest in protecting the security of the entire industry and of the country. Consequently, the appropriate regulatory principles with respect to ICT allow more room for government to be more exacting in its specifications. This is so as to prevent monopoly rents, to secure bulk purchase discounts for the airport system as a whole, and to train a common pool of staff.

The final element of the aviation sector where government has perhaps the greatest rights and responsibilities to choose and manage ICTs is in the sphere of airspace control and air navigation services. India must fulfill these sovereign responsibilities as a matter of course, as well as under the Chicago Convention of 1944 to which it is a signatory. Being the sole provider of these services, the regulatory and operational roles essentially become one and the same.

ICTs has an important role to play in data collection and management. Extensive coverage and quality data make it possible for airlines to efficiently plan their networks and schedules to best meet extant and latent demand. Data on airlines' finances and operations assists regulators in efforts at maintaining a market that is viable, competitive and functions smoothly. Authorities that regulate airports, meanwhile, must have access to current and expected airport cost structures, and to current and expected usage. The development of new airports, capacity expansion at existing airports, and the identification of strategies for network management each requires the use of sophisticated economic models to analyse and forecast passenger and cargo traffic. This sophistication notwithstanding, the quality of the results on which these important decisions are based will only be as good as the data supplied.

By rights, the aviation sector should be particularly pre-disposed to the collection, management and dissemination of complete and robust data. Each of the major agencies that participate in the sector—airlines, airports, government authorities and regulators, MRO service providers, freight forwarders and logistics firms, and so on—are established and recognised, and are subject to the oversight of some combination of domestic and international governments, shareholders, customers and specialised institutions that set safety and other operational standards. These agencies must operate robust information and technology systems to perform their activities. The closed nature of these systems means that the agencies are in complete control of all the data generated by their activities. As a simple example, airline databases maintain origin-destination records of every passenger, and or every maintenance exercise undertaken on every aircraft in their fleet. Moreover, there are in-built checks and balances within the system. For international travel, government customs and immigration databases can be used to verify the origin-destination record for any given passenger. Both airlines as well as MRO service providers maintain logs of the maintenance on an aircraft. Airports and airlines must both account for passenger traffic numbers. In short, the aviation sector normatively lends itself to the collection of high quality data. That said, there is still much that can be done to ensure the data is deployed and made widely available to best use.

By 2020, India should look towards providing a 'seamless experience' across the entire air journey for both passengers and cargo. This section looks at some specific examples of technologies that could be deployed by the sector; matters related to the creation of an enabling policy environment are considered in the Chapter on Civil Aviation.

ICT-RELEVANT ISSUES

As outlined in the chapter on Civil Aviation, growing traffic places enormous pressure on aviation infrastructure. There are five main strategic and operational issues that need attention, and where ICTs may help in reducing problems.

CONGESTION AND DELAYS

The rise in demand for air travel has led to an expansion of fleets for scheduled, non-scheduled and general aviation, leading to rapid increases in aircraft movement. This growth has put extreme pressure on Air Traffic Controllers (ATCOs) resulting in a high attrition rate. The pressure on infrastructure and personnel is exacerbated by cancellations and delays because most aircraft are not equipped with CAT III systems to aid landing during bad weather. There are high cancellation rates at Mumbai airport in the monsoon season and at Delhi airport during periods of dense winter fog. Furthermore, the majority of delays are 'reactionary' in that they are accumulated delays caused by prior unavailability of an aircraft or crew, by missed passenger connections and changed aircraft routing (see Figure 10.18).

INEFFICIENCIES IN HANDLING OF AIR FREIGHT

Air cargo represents about 10 per cent of industry revenues. Additional growth is hampered by factors such as: (a) inadequate parking bays; (b) lack of adequate warehousing space especially in Tier-2 and Tier-3 cities; (c) slow customs and other regulatory clearances; (d) 3-5 days of dwell time for import and export cargo at Indian airports vis-à-vis a global average of 6 to 12 hours; and (e) pilferage of goods in transit and storage.

> The aviation sector normatively lends itself to collection of high quality data, yet much needs to be done to ensure that the data is deployed to best use. By 2020, India should provide a 'seamless experience' across the full air journey for both passengers and cargo.

SAFETY AND SECURITY

The Central Industrial Security Force (CISF) and state police forces hold delegated responsibilities for airport security (under the overall regulatory authority of the Bureau of Civil Aviation Security), though there is wide variation in the application of desired security and safety protocols. Technology interventions such as the use of biometrics and RFID are required to increase the effectiveness of the force deployed and to automate certain operations.

NEED TO IMPROVE CUSTOMER EXPERIENCE

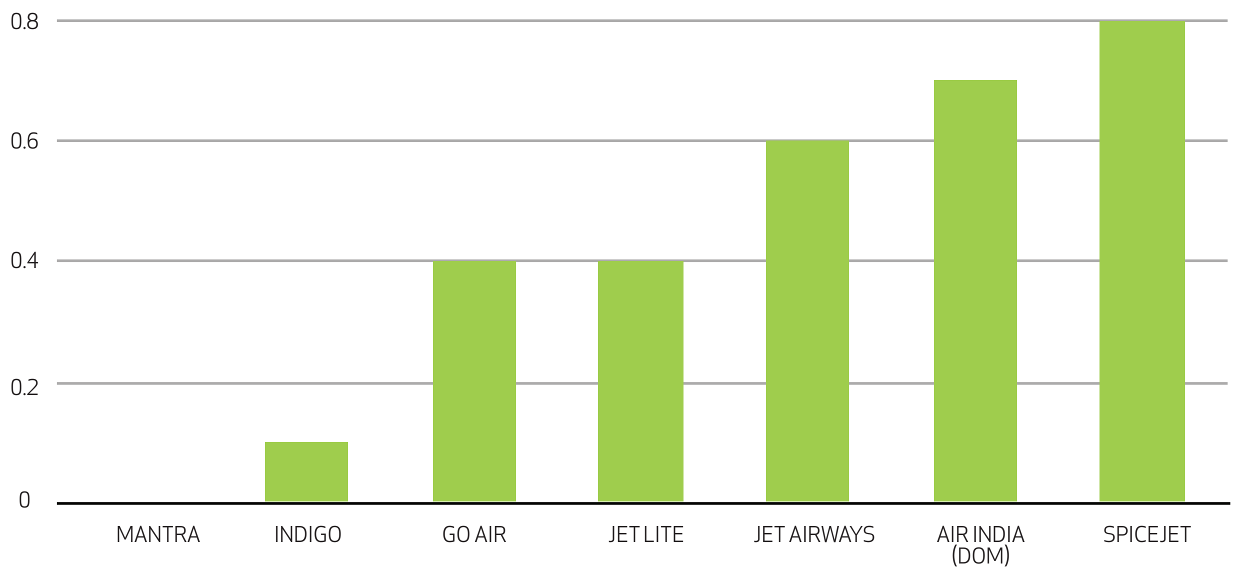
Airlines and airports find themselves squeezed between rising expectations of customers regarding their experience of air travel, and rapidly increasing numbers of air passengers which stretches personnel and infrastructure, making meeting those expectations an ever greater challenge. Consequently, airlines see a market-driven imperative to: (a) reduce delay (b) decrease waiting time both during parking of vehicles, check-in and security clearance; (c) establish hassle free boarding procedures; and (d) provide safe and reliable facilities. Airlines should work in conjunction with airports to introduce technologies and develop procedures that will shorten waiting times and allow for faster aircraft turnarounds.

LACK OF TRAINED MANPOWER

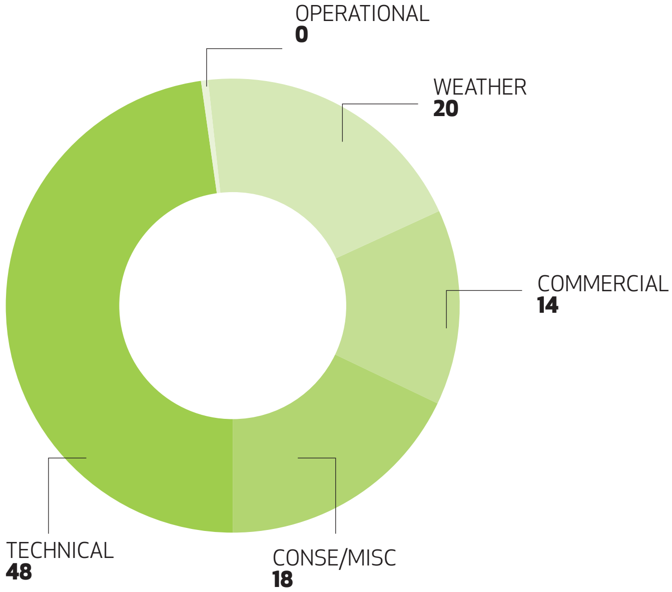
With respect to ICT, the Chapter on Civil Aviation notes that there are shortages in the sector along the following dimensions: (a) for pilots overall; (b) for engineers trained to maintain, repair and overhaul sophisticated engines and airframes; (c) for avia-

Figure 10.18
Flight Cancellation Statistics
[per cent]

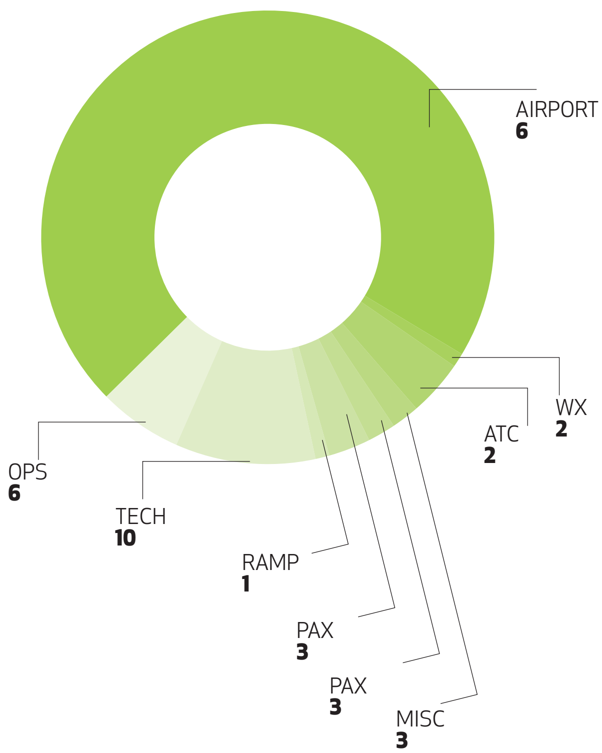
Cancellation Rate of Scheduled Domestic Flights (May 2013)



Reasons for Cancellations



Reasons for Delays



Wx = Weather
ATC = Air Traffic Control
Misc = Miscellaneous
PAX = Passengers
Tech = Technical
Ops = Operations

Source: Directorate-General of Civil Aviation (DGCA).

Figure 10.19
Present Status of ICT Applications in Aviation Industry

FLIGHT BOOKING	PASSENGER ARRIVAL	CHECK-IN	BAGGAGE HANDLING	SECURITY CHECK	BOARDING
Internet Services	FIDS	Kiosks Check-in	RFID Baggage Tracking	Biometrics	
		In-Line Baggage Screening	Baggage Reconciliation System		
		Cloud Computing			

TECHNOLOGY SOLUTIONS FOR END-TO-END PASSENGER AIR TRAVEL-AAI AIRPORTS				
Internet Services	FIDS	Kiosk Check-in	RFID Baggage Tracking	Biometrics
		In-Line Baggage Screening	Baggage Reconciliation System	
		Common Use Terminal Equipment		
		Cloud Computing		

Widely Implemented | Implemented Only in Few Airports | Under Consideration / Very Sparsely Implemented

Source: Ministry of Civil Aviation (MoCA).

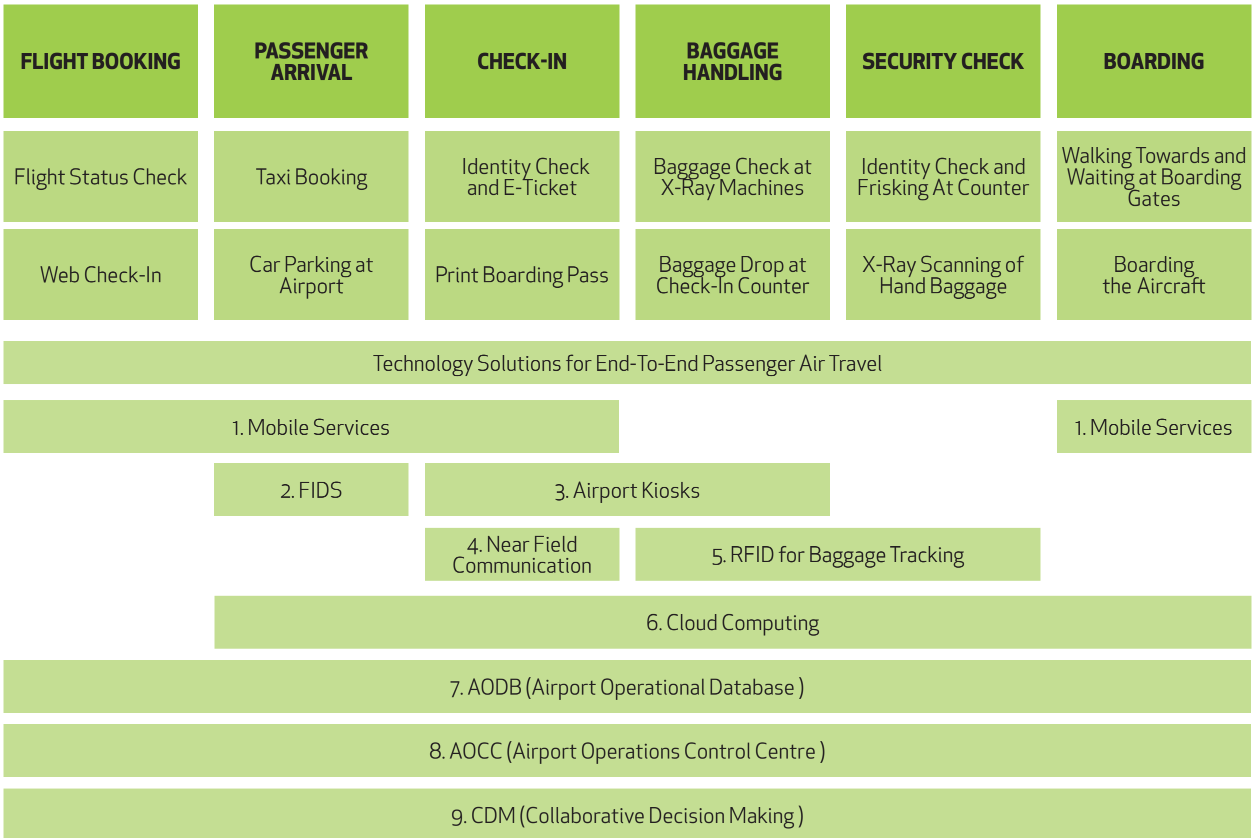
Figure 10.20
Current Status of ICT in Air Traffic

COMMUNICATION	NAVIGATION	SURVEILLANCE	DOCKING	MET SYSTEMS
Air-Ground Communication VHF (Continental)	Cross-Coupling Of Frequencies	ILS (Instrument Landing System)	Visual Docking System	World Area Forecast System (WAFS)
	GAGAN (GPS-aided geo-augmented navigation	Ads–B (Automatic Dependent Surveillance Broadcast)		Terminal Doppler Weather Radar (TDWR) System
	GBAS (Ground Based Augmentation System)	FIMS (Flight Information Management System)		Aerodrome Forecast (TAF) Production

Source: Infosys Research

Widely Implemented | Implemented in Next 1-2 Years | Under Consideration / Planning

Figure 10.21
Proposed ICT Application Map



Source: Infosys Research.

tion economists, statisticians, regulators and policymakers. Besides the core skills and knowledge base that allow these professionals to undertake their jobs, each of them will also be required to acquire enough technical skill to keep pace with changing technologies.

PRESENT STATUS OF ICT APPLICATIONS

Airports operating under public private partnerships (PPPs) in India are keen to deploy numerous technology initiatives over the next five years. Airports under the Airport Authority of India (AAI) lag the benchmarks set by the JV airports on only a few fronts. Figure 10.20 shows the level of implementation of ICT for various aviation operations. ICTs are widely used for flight booking and flight information display systems (FIDS), for example, Common-Use Terminal Equipment (CUTE) has been implemented at 38 major airports run by AAI. But for other aspects of airport operations, ICTs are sparsely used.

ICT IN AIR TRAFFIC MANAGEMENT

Because of the increase in air traffic and international compliance requirements, there has been considerable technological development in Air Traffic Management (ATM) in India since 2010. Figure 10.20 shows the status of implementation of ICTs for various sections of ATM. Some of the key initiatives recently completed or planned over the next four or five years are:

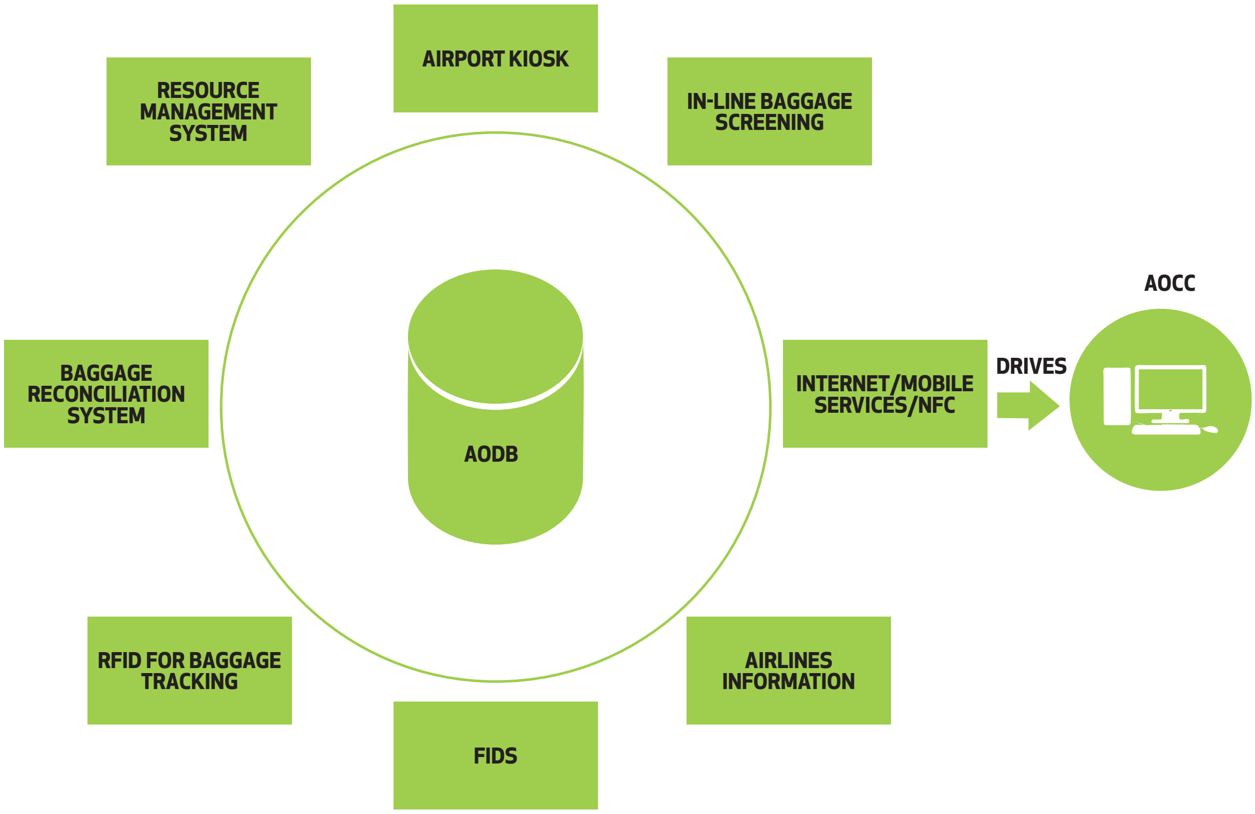
- Starting 2008, GPS-aided geo-augmented navigation (GAGAN) is currently under implementation. GAGAN implementation will make India the fourth country to have a satellite-based augmentation system (SBAS). GAGAN is currently undergoing certification by the regulator (DGCA).
- The first phase of the implementation of Automatic Dependent Surveillance-Broadcast (ADS-B) technology is underway, replacing radar as the key method for aircraft control and navigation. ADS-B has been deployed at 21 major airports.

PROPOSED ICT INTERVENTIONS

We have identified four main areas where ICT can play a role in addressing the key issues discussed earlier:

- Optimisation of airport operations
- Effective management of airspace and airside operations
- Safety and security enhancement
- Efficient air cargo operations

Figure 10. 22
The Airport Operational Database



Source: Directorate General of Civil Aviation (DGCA).

OPTIMISATION OF AIRPORT OPERATIONS

Figure 10.21 shows the various technological solutions that can be used to improve all components of airport operations starting from flight booking all the way to actual boarding of the flight by a customer. Regulatory approval and procedures should be in place to permit non-physical (i.e., via the internet of via mobile phones) check-in of passengers at all airports. This frees up requirements for physical counter space, decreases the time that passengers must spend at airports, and increases passenger processing rates. These aspects are discussed in more detail below.

MOBILE SERVICES

Smart phones have enormous potential to increase both personal and business productivity. Approximately 82 per cent of passengers carried a smart phone in 2013, up from 54 per cent in 2011, 28 per cent in 2010 and 16 per cent in 2008. Mobile phones can be used for 'on-the-go check-in' while driving to the airport. Applications are being developed by SITA (Societe Internationale de Telecommunications Aeronautiques) wherein the mobile app will guide the user through various processes based on his/her itinerary. At the airport, a mobile 2D bar coded boarding pass (BCBP) allows passengers using online check-in to carry their boarding pass in digital form on their mobile phones and then use it to navigate their way through the airport touch points—bag drop, security and boarding gate—and on to the aircraft with minimal human intervention While the technology for realising these services is available, the regulatory framework is missing.

FLIGHT INFORMATION DISPLAY SYSTEM (FIDS)

FIDS is a computer system used to display flight information (arrivals and departures) in real-time to passengers. The FIDS receives airport and flight-related information from the Airport Operational Database (AODB). AODB is a central database to store, manage and distribute information about airport operations.

AIRPORT KIOSKS

An airport kiosk is essentially an interactive computer terminal which is fully network integrated and connected with the airlines' databases. Kiosks can be used for ticket purchase, baggage check-in and flight status monitoring.

NEAR FIELD COMMUNICATION (NFC)

NFC is a wireless communication mechanism that uses electromagnetic radio fields to transmit data between digital devices such as smart phones.

Figure 10. 23
Proposed ICT Application Map for Air Traffic Management

COMMUNICATION	NAVIGATION	SURVEILLANCE	DOCKING	MEET SYSTEM
Air-Ground, Ground-Ground Voice Communication	Departure, En Route, Arrival	Terminal Approach and En Route Areas Surveillance	Visual Guidance	Information to The ATM for Safe, Efficient and Seamless Air Travel
Air-Ground Data Communication	Terminal Control	Airport/Ground Surveillance	Collision Avoidance	X-Ray Scanning of Hand Baggage
	Landing			
Technology Solution For End-To-End Airspace Management				
Complete and Overlapping VHF Coverage	ILS (Instrument Landing System)	ADS-B (Automatic Dependent Surveillance - Broadcast) System	VDGS (Visual Docking Guidance System)	Data Link Capabilities
Provision of HF R/T for Air-Ground Communication	GBAS (Ground Based Augmentation System)			Terminal Doppler Weather Radar (TDWR) System
Satellite Phone	GAGAN (GPS-Based Geo-Augmentation Navigation System)			Interactive Web Based Graphics

Source: Infosys Research.

Depending on their configuration, NFC devices can read from and/or transmit information to other enabled devices. Enabled smart phones can be put to multiple uses such as paying for airplane tickets over the POS, identity verification and security processing.

RFID FOR BAGGAGE TRACKING

Currently, bar codes are being used for tracking baggage. RFID technologies are superior to bar codes and provide the ability to automatically collect real-time data about the physical location and properties of any piece of baggage which has been tagged. RFID has three main advantages:

- More reliable, and easier to use: information is transferred via radio waves and a line-of-sight between the tag and reader is not required
- An RFID tag can store much more information and hence can identify an item uniquely
- RFID tags are very secure; it is extremely difficult to copy them and they could be made to trigger security alarms in case of theft

A RFID reader communicates with the tag to infer the identity of the object to which the tag is attached. The tags themselves consist of an electronic circuit, which stores data, and an antenna which communicates the data via radio waves. When the reader broadcasts radio waves, all the tags within range will communicate.

CLOUD COMPUTING

Cloud computing is typically subscription-based pay-as-you-go service which eliminates investment in hardware, personnel training, purchase of software licenses, and daily administration of servers. A solution provider from whom this service is purchased carries out these tasks. Thus, it results in significant cost savings in terms of infrastructure, easier software upgrades, as well as staff recruitment and training. Meanwhile, a safe and secure network to store, process and transfer confidential data is ensured. However, cloud computing may not be suitable for all applications and depends critically on the integrity and ongoing viability of the service provider, and upon the regulatory ambit of the jurisdictions in which the servers are actually housed.

With security in aviation being of paramount importance, it may be preferable to consider a 'cloud' that is sponsored either by all parties in the aviation sector, or by the government itself, once sufficient technical capacities are acquired.

APPLICATIONS INTEGRATION

All individual systems and technologies such as FIDS, CUTE and BRS implemented at the airports should be integrated using the AODB (Figure 10.22). This AODB will be used to drive the AOCC (airport operations control centre), a control room with large screens to view all the information in form of dashboards, charts and reports. This control room will house stakeholders from various departments like the baggage, passenger, cargo and airlines who together will take informed decisions for the benefit of the airports and its passengers. Such real-time on-demand availability of common information will allow for better decisions by all participants in the industry, and by regulatory authorities. AODB has been deployed at Delhi, Mumbai, Hyderabad and Bengaluru airports. In addition, AODB is under installation at 10 major airports of AAI. While Delhi, Mumbai, Hyderabad and Bengaluru have an AODB at each airport, AAI is implementing a unique Centralised AODB, which will be accessed by all the 10 airports through VPN. The Centralised AODB is scalable and in future, more airports can be added at minimal cost. This is expected to go online by March, 2014.

EFFECTIVE MANAGEMENT OF AIRSPACE AND AIRSIDE OPERATIONS

Presently, ATM (Air Traffic Management) systems in India work well and are aligned with international benchmarks, but eventually they will need to adopt next generation standards. India's ATM system utilises ground-based navigation system such as use of radars due to which flight paths are fixed and pre-determined, leading to wastage of fuel and time. Hence, efforts are in the pipeline to transition to 'flexible use of airspace'. Using advanced technologies such as GAGAN, aircraft routes will be calculated in real time, factoring inputs such as weather and the current traffic situation, etc. This will help reduce delays due to airspace congestion as well as cut down on aircraft wait times in landing at airports. There are several areas, such as communication, navigation, etc., where ICT can play an effective role as shown in Figure 10.23.

VHF COVERAGE AND NETWORKING

Presently, VHF communication is available only in continental airspace above 20,000 feet. In order to provide overlapping coverage, VHF coverage up to 10,000 feet and above in Area Control Centres (ACCs) also needs to be implemented. Also, VHF networking should be worked out to support consolidation of sectors during lean traffic and deconsolidation during peak traffic periods. VHF networking has been implemented in the Upper Area Control in Southern FIR (Flight Information Region) in India. Consequently pilots in the en route phase transiting through this FIR have to make minimal contacts on VHF with the ATCOs thus reducing fatigue. This is to be replicated in other FIRs.

GAGAN is the planned implementation of a regional satellite-based augmentation system to support en route navigation of aircraft. Currently, planes fly along predefined air routes. Planes with GAGAN receivers, however, will be able to get guidance and take shorter routes, saving both time and fuel. This will improve efficiency and save costs.

HF RADIO TRANSMISSION

Presently, HF radio transmission is available at Delhi, Mumbai, Kolkata and Chennai to use for air-ground voice communication over oceanic space. Additionally, HF R/T signals also work in mountainous and remote regions where VHF range cannot be achieved, provision of flight Information service over the continental airspace for the uncontrolled and VFR flights and for dissemination of MET information.

SATELLITE PHONES

This is an alternative low-cost, high-quality solution to high frequency radio transmission. The use of such phones will have to be carefully managed, however, as they are presently considered sensitive by Indian security agencies.

INSTRUMENT LANDING SYSTEM (ILS)

Currently, there are 66 ILS installations at 55 airports. ILS assists a pilot to fly along a precise path, defined in three dimensions, during approach to land on a specific runway using radio guidance signals transmitted by ground equipment. ILS is used in cases of low visibility when the pilot cannot see the ground through the naked eye.

GROUND BASED AUGMENTATION SYSTEM (GBAS)

GBAS is a high-safety application which augments the GPS Standard Positioning Service (SPS) thus enhancing service levels. Compared to ILS, it is a superior technology that supports entire lifecycle of airside operations including approach, landing, departure, and surface operations within its coverage area. GBAS comprises of ground equipment which is complemented by GBAS avionics that is installed on the aircraft.

GPS-AIDED GEO-AUGMENTED NAVIGATION (GAGAN)

GAGAN is being designed to support en route navigation of the aircrafts. It is a planned implementa-

Figure 10.24
Proposed ICT Solutions for Safety & Security

LANDSIDE PROTECTION	AIRSIDE SURVEILLANCE	PASSENGER AND CARGO
Public & Passenger Access Ways and Parking	Perimeter, Runway and Taxiway Protection	Passenger Flow
Passenger Terminal Secured Areas	Staff & Suppliers Accessway	Luggage/Air Freight Flow
Risk Assessment		
Security Coordination		
Technology Solutions for Security and Safety of Airports		
Biometric Enrolment and Authentication		
Access Control System (Remote Controlled Door)		
Access Control System (Vehicle Access Control)		
Ground Vehicle Monitoring and Tracking (GPS and RFID)		
Video Surveillance and Image Analysis (Using CCTV Device System)		
		Baggage Reconciliation System

Source: Directorate General of Civil Aviation (DGCA).

tion of a regional satellite-based augmentation system (SBAS). Currently, aircrafts fly from one place to another along predefined air routes. Planes with SBAS receivers will, on the other hand, be able to take shorter routes, saving both time and fuel. Hence, GAGAN would improve efficiency and save costs by:

- Reduction of ground aids
- Reduced workload of flight crew and ATCOs
- Improved capacity through reduced aircraft separation
- Higher accuracy and global coverage
- Improved safety

This project will be able to help pilots navigate in the Indian airspace by an accuracy of 3 m compared to the current accuracy of between 8-20m by using radars. The reference stations pick up signals from the orbiting GPS satellites. These measurements are immediately passed on to the mission control centres that then work out the necessary corrections that must be made. Messages carrying those corrections are sent via the uplink stations to the satellites which then broadcast the messages. SBAS receivers on the aircrafts are able to use those messages and apply the requisite corrections to the GPS signals that they receive, thereby establishing their position with considerable accuracy.

AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST SYSTEM (ADS-B)

ADS-B allows pilots and air traffic controllers to 'see' and control aircraft with more precision, and over a far larger percentage of the earth's surface, than using radars. Unlike radar, ADS-B system's accuracy does not seriously degrade with range and atmospheric conditions. It uses conventional Global Navigation Satellite System (GNSS) technology and a relatively simple broadcast communications link. There are 21 ADS-B installations in India at present providing enhanced surveillance picture to the ATCOs.

DEPLOYMENT OF AIR GROUND DATALINK COMMUNICATION

As part of ICAO-mandated Global Air Navigation Plan, data link communication is being deployed globally for air-ground communication with the following benefits expected:

- Overcoming channel congestion

- Increased speed of data delivery
- Freedom from interpretational errors
- Reduction of fatigue for pilots / ATCOs

In India, data links were first deployed over Oceanic Areas for communication with aircraft over long ranges in the form of CPDLC (Controller Pilot Data Link Communication) in the late 1990s for aircraft equipped with FANS1/A avionics. Subsequently data links have been deployed at 46 airports for dissemination of ATIS (Automatic Terminal Information Service) bulletins comprising latest weather information and latest runway conditions, etc., at the airport to aircraft in flight. Data links have also been deployed for issuing pre-departure clearances to aircrafts at six major airports.

VISUAL DOCKING GUIDANCE SYSTEMS (VDGS)

VDGS is a system which gives information to a pilot attempting to park an aircraft at an airport stand after it has landed at the airport, usually via visual methods. VDGS gives automatic and precise guidance of aircraft along the guidance line to their final parking positions at the gate.

TERMINAL DOPPLER WEATHER RADAR (TDWR) SYSTEM

TDWR system should be implemented in the terminal area of the airport to detect wind shear and microburst associated with convective storms to improve safety and efficiency of aircraft operations. The primary advantage of TDWR over previous radars is that it has a finer range resolution—meaning it can see smaller areas of the atmosphere. Currently, these radars are being used in the US and a few other countries such as China.

INTERACTIVE WEB-BASED GRAPHICS

Web-based graphics such as weather charts can be used to see, monitor and overlay specific areas in the airspace that contains clouds, fog, precipitation, visibility values, etc. This information can be used as input parameters while calculating the ideal navigation route using GAGAN system.

SAFETY AND SECURITY ENHANCEMENT

Currently, all Indian airports together handle close to 160 million passengers and this number is estimated to triple by 2020. Given this high level of traffic in the presence of elevated security threats, it is critical to install effective and efficient security measures and procedures at Indian airports that can handle the greatly increased traffic without causing congestion and yet ensure the safety of passengers and airports. Figure 10.24 shows the range of technological solutions available to enhance airport safety and security.

BIOMETRIC ENROLMENT AND AUTHENTICATION

Biometrics refers to an automated system that can identify an individual by measuring his or her physical and behavioural uniqueness or patterns, and comparing it to those on record. Biometric systems function under a three-step process under which individuals' biometric data is first recorded and then stored. Electronic sensors such as fingerprint readers or iris scanners or facial feature recognition systems then verify details periodically against the stored information as and when security clearances are required. There are severe ethical implications for the storage of biometric data, and especially for the general passenger population (as opposed to for employees of airports or airlines). Ensuring the integrity and security of the data is a critical issue, strict regulatory oversight will be necessary to prevent data misuse.

ACCESS CONTROL SYSTEMS (REMOTE CONTROLLED DOORS, SMART ACCESS CONTROL)

Solutions for access control include credentials management systems, contactless smart badges, vehicle identification systems, etc.

GROUND VEHICLE MONITORING AND TRACKING

The monitoring and tracking of passenger/ commercial vehicles, can be achieved either using RFID or through GPS tracking.

Doppler weather radar systems should be installed in terminals to detect wind shear and microbursts associated with convective storms to improve safety and efficiency of aircraft operations. Currently, these radars are being used in the US and China.

VIDEO SURVEILLANCE AND IMAGE ANALYSIS

To enhance security of the air cargo and passenger terminals, terminals must install CCTV surveillance systems. Many systems also use some form of video recorders. These stored images are high resolution images with adequate zooming capability and hence can be used to obtain minute details about any suspicious activity or person. AAI has installed CCTV systems using advanced video analytics at 50 airports. Such systems have also been installed at six joint venture and greenfield airports.

BAGGAGE RECONCILIATION SYSTEMS (BRS)

BRS is used at airports to ensure that the passenger count matches the bag count for any given flight. As passengers check in, the airline Departure Control System (DCS) generates bag tags, boarding passes and messages called Baggage Source Messages (BSMs). A BSM will contain information such as passenger name, flight number identifier, destination, class etc. A BSM is unique for each passenger. The system can also be used for reconciling departing passengers and the bags that are being loaded onto their departing flight. BRS is currently installed at Delhi, Mumbai, Hyderabad and Bengaluru airports.

Figure 10.25
Proposed ICT Solutions for Air Freight Management

SHIPPER/CONSIGNEE	AIRPORT OPERATION (CARGO HANDLER, TRUCKING COMPANY)	AIRLINE /OPERATIONS (CARRIER)
Tracking Shipment	Transport and Warehousing	Line Haul
Make /Accept Billing and Payments	Invoice/Billing	Invoice/Billing
Place/Accept Complaints & Claims	Security Clearance	Track Shipments
Technology Solutions for Safe and Efficient Cargo Handling		
Air Cargo Community System		
Electronic Data Interchange		
RFID/ GPS Vehicle Tracking		
	Smart Cards Authentication and Access Control	
	Video Surveillance and Image Analysis (Using CCTV Device System)	
	Warehouse Management System	

Source: Directorate General of Civil Aviation (DGCA).

AAI has contracted with SITA for providing their BRS solution at 38 major airports. Installations have commenced.

EFFICIENT AIR CARGO OPERATIONS

There is significant untapped potential for air cargo in India. The total air cargo handled in 2011 by all Indian airports together was 2.3 million tonnes (mt) which is far less than that handled by individual airports such as Hong Kong, Memphis, Shanghai and Paris. This is due to lack of operational efficiency in air cargo operations at Indian airports. Now, sufficient cargo handling capacity has been created through implementation of Automated Storage and Retrieval System (ASRS), Elevated Transfer Vehicle (ETV) and introduction of multi custodians for warehouse management. This is expected to meet requirements till 2020. Figure 10. 25 shows some technological solutions to enhance the operational efficiency in air freight management. The top of the figure shows the activities that are of interest to three groups of stakeholders: (a) shippers and consignees; (b) cargo handlers or trucking companies; and (c) air carriers. The bottom half shows the various technologies available and the activities and stakeholders that would benefit from the implementation of those technologies.

AIR CARGO COMMUNITY SYSTEM

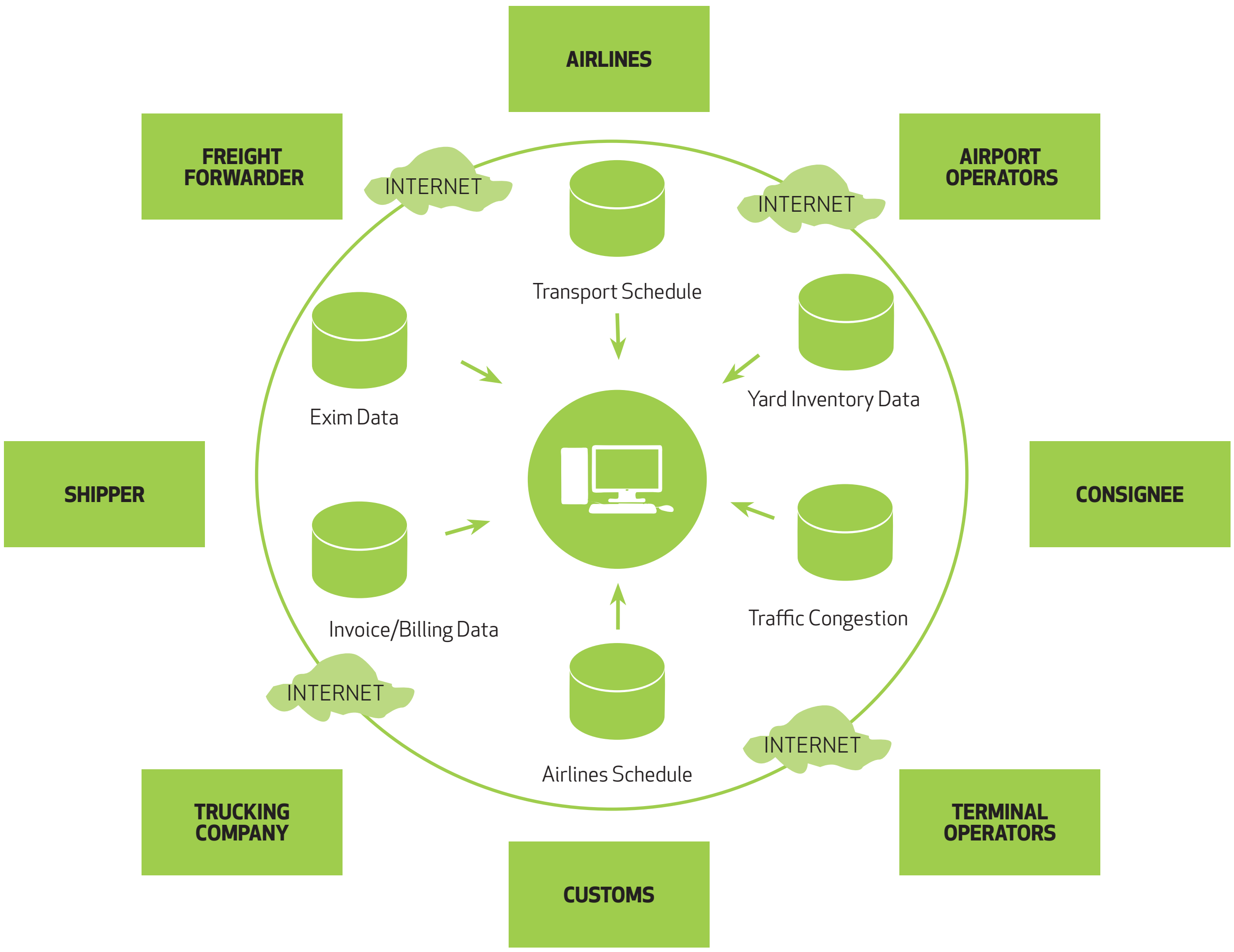
The air freight handling value chain has several stakeholders such as shippers, cargo terminal operators, trucking company, airlines, etc. Each of these entities has its own objectives and operates independently, with most of the information exchange happening manually. This leads to lost time and data inaccuracy, redundancy, increased costs and delayed decision making.

To resolve these issues, we propose a centralised information management system to integrate all these stakeholders so that there is more transparency in the entire value chain, leading to increased operational and economic efficiency. Each of the stakeholders will have a web portal wherein they can view all relevant information about other links in the supply chain (Figure 10.26).

ELECTRONIC DATA INTERCHANGE (EDI)

Generation and exchange of documents between air cargo handling authorities, customs and other agen-

Figure 10. 26
Air Cargo Community System



Source: Directorate General of Civil Aviation (DGCA).

cies is a cumbersome and time-consuming process. The manual process leads to duplication of work making the entire process slow and more prone to errors along with the possibility of breach of security of confidential documents.

The air cargo community system discussed above can be further enhanced through EDI. Of course, EDI cannot be used for non-routine business documents like complicated contracts or information meant for humans to read and analyse. EDI is in operation at JV airports like Delhi, Mumbai, Bengaluru,HyderabadandKochi.AtAAI-runairports, it is available at Chennai, Kolkata, Coimbatore, Amritsar, Trichy and Mangalore .

WAREHOUSE MANAGEMENT SYSTEM (WMS)

The primary purpose of a WMS is to control the movement and storage of materials within a warehouse and process the associated transactions, including shipping, receiving, storage and retrieval. The system also directs and optimises storage of stock based on real-time information about the status of bins. The key benefits of WMS are space savings, increased productivity, reduced labour, increased accuracy and reduced inventory levels. The international concept of movement of loaded unit load devices (ULDs) from the airport terminal to the bonded warehouses is already taking place at Chennai airport.

OVERVIEW OF IMPACTS OF SUGGESTED TECHNOLOGIES

Figure 10.27 shows the expected impact of the proposed ICT solutions on the key issues In civil aviation.

SUMMARY OF RECOMMENDATIONS

Because various airports are at different levels in terms of their current use of ICT, it is not possible to give a roadmap for general application to all airports, as has been done for the other sectors. The use of ICT to improve aviation is recommended for the

Figure 10.27
Solution Impact Analysis for Proposed Solutions

ICT SOLUTION	CAPACITY AND EFFICIENCY ISSUES	SAFETY AND SECURITY ISSUES	CUSTOMER EXPERIENCE
Biometrics	◑	●	◕
Electronic Data Interchange (EDI)	◕	◔	
GPS-Based Geo Augmented Nav. System (GAGAN)	●	◕	
Warehouse Management System (WMS)	●	◔	
Satellite Phone	◔	◑	
Instrument Landing System (ILS)	◑	◑	
Video Surveillance	◕	●	
RFID For Baggage And Cargo Tracking	◕	◕	
Kiosks	◑		●
Air Cargo Community System	◑		◕
Mobile Service	◔		●
Visual Docking Guidance System (VDGS)		●	◕
Access Control System (Remote, Smart Cards)		◑	◔
Baggage Reconciliation System (BRS)		◕	◑
Cloud Computing	●		
Airport Operational Database (AODB)	●		
Airport Operations Control Center (AOCC)	●		
Collaborative Decision Making (CDM)	●		
Very High Frequency (VHF) Coverage	◔		
Ground Based Augmentation System (GBAS)	●		
ADS-B System		◕	
RFID/GPS for Vehicle Tracking		◑	
Flight Information Display System (FIDS)			●

following activities along with the proposed technologies as follows:

- **Optimisation of airport operations:** Deploy technology solutions such as: (1) Mobile services; (2) Flight Information Display Systems; (3) Airport kiosks; (4) Near Field Communication; (5) RFID for baggage tracking (6) Airport CDM, to increase operational efficiency and reduce costs.
- **Effective management of airspace and aircraft navigation:** Proposed technology solutions are: (1) VHF coverage and networking; (2) High-frequency radio transmission for air-ground communications; (3) Satellite phones; (4) Instrument Landing System (5) ADS-B (6) SBAS and GBAS.
- **Safety and security enhancement:** (1) Biometric enrolment and authentication; (2) Access Control Systems (Remote Controlled Doors, Smart access control); (3) Ground vehicle monitoring and tracking; (4) Video surveillance and image analysis, etc.
- **Efficient air-cargo operations:** (1) Air Cargo Community System; (2) Electronic Data Interchange; (3) Warehouse Management System.
- **Capacity Building:** It is recommended that an organisation, which we tentatively call Institute of Aviation Research and Planning (IARP), be set up for conducting research, innovation and training in aviation technologies.

ICT FOR URBAN TRANSPORT

KEY ISSUES

A number of key issues that need to be addressed to improve urban transport have been discussed in detail in the chapter on urban transport of this report. That chapter documents that it is important to use ICT technologies for improving public transport and non-motorised transport (NMT). This section aims to bring out some important ways in which ICT can be deployed, particularly in these two segments.

CURRENT STATUS

Until recently, not much attention was paid to leveraging technology to meet urban transport challenges. However that is changing, but not uniformly. Some cities are far ahead in managing their transport operations with the use of technology while others are a bit behind. On the issue of ICT implementation for urban transport, cities in India can be divided into three categories:

1. **Cities using ICT for Urban Transport** such as Bengaluru, Delhi and Mumbai, where transport planning and some ICT implementation work has already been undertaken
2. **Cities starting to use ICT for Urban Transport** such as Pune, Ahmedabad and Hyderabad, where some ICT solutions are already working, however more work is required to develop them fully
3. **Cities yet to start to use ICT for Urban Transport** such as Ranchi, Lucknow, Kanpur, Meerut, Mathura, where ICT implementation is at a very nascent stage, or no ICT projects have been implemented. Some of these growing cities are still in the planning stage and have yet to use technology for managing urban transport

In order to get a feel for what can be done with ICT, we look at what has been, and is being done in Bengaluru. The city has state-of-the-art IT implementation processes in place. There has been a 7-10 per cent annual growth in the number of vehicles in Bengaluru, with personal vehicles comprising about 90 per cent of the total registered vehicles on roads, out of which 70 per cent are two wheelers and 20 per cent from light motor vehicles.

> In Bengaluru, traffic signals are vehicle-activated and networked. The timing of traffic lights is controlled remotely, The automation centre receives online field information from traffic signals and surveillance cameras.

Since 2010, the city has started implementing Bengaluru Traffic Improvement Project (nicknamed B-TRAC), to address traffic congestion and safety issues by utilising the latest traffic management technologies. The focus has been to install intelligent transportation systems using digital surveillance, improve junction and street furniture, install enforcement cameras and increase awareness and capacity building. Under B-TRAC, the traffic signals were made vehicle-actuated, networked, controlled and monitored by the Traffic Management Centre. The timing of traffic lights is changed remotely and smart phones (BlackBerry) are used for enforcement. The automation centre receives the online field information from traffic signals, surveillance and enforcement cameras. Better compliance of traffic laws and rules has resulted in a reduction in the number of road accidents, less traffic congestion in central areas and reduced journey time (due to ICT-based implementation of signal synchronization). The city has proposed a traffic training and road safety institute for capacity and institution building.

Indian urban transport needs to use modelling and simulation models to solve some of its traffic woes. There is a need to develop simulation tools that can accurately forecast the behaviour of large, complex, multi-modal transportation systems and their interaction with people and society.

ICT INTERVENTIONS

We now describe ICTs that can be used to address, to some extent, these problems in urban transportation.

MODELLING AND SIMULATION (M&S) FOR PLANNING PUBLIC TRANSPORT

Modelling and simulation are essential in the development, assessment, operation and designing of future transportation systems. Simulations can be used for long-range planning, to evaluate the impact of changes made to the transportation system, and they also aid in operation and management. The techniques can be used to get meaningful insights from real-time information, including dynamic traffic flow and supply and demand interactions. It helps in creating powerful visuals which can help in providing insights to travellers in making choices about time, route and mode of transport. Indian urban transport needs to use modelling and simulation models to solve some of its traffic woes. There is a need to 'develop simulation tools that can accurately forecast the behaviour of large, complex, multi-modal transportation systems and their interaction with people and society'.

A promising advanced simulation model is UrbanSim which is still undergoing trials, but may be used in pilot studies now and if found appropriate can be used more widely. It is a simulation system for 'supporting planning and analysis of urban development, incorporating the interactions between land use, transportation, the economy, and the environment'. It can be used to forecast the effects of the different transport investments and land use policies on the community. The technology can provide 3D visualisation and scenario creation. The open-source simulation system also enables civic engagement on issues of transport infrastructure and land use.

NON-MOTORISED TRANSPORT (NMT)

Indian mega-cities are increasingly investing in motorised-vehicle-friendly infrastructure, even though non-motorised transport has several benefits: reduction in congestion, fuel saving, lower cost, improved air quality and health benefits for passengers. However today, non-motorised transport is seen as unsafe, uncomfortable and a 'poor man's ride'. Promotion of NMT is made difficult because of the absence of any facilities that would make it a more attractive choice such as public bicycle systems; integration of cycles with other modes of public transport; park and ride facilities near railway stations and bus stops; priority for cyclists and pedestrians at intersections; dedicated and accessible footpaths. NMT can bring significant benefits for both passengers and society. There is need to change the mindset and policies so that these benefits are realised.

There are two potential initiatives for NMT that could benefit from the use of ICT.

- **Public 'Smart Bikes' sharing system for upcoming urban conglomerates:** Bike sharing is a plan in which an individual rents a bike from an unattended urban location. Multi-modal smart cards and mobile phones can make paying for the service easy, and can provide real-time information on the availability of bikes through the internet. Bicycles in the scheme can have RFID tags or Global Positioning System (GPS) systems to facilitate tracking. Public bicycle sharing can serve as a link between intercity travel and the public mass transit system. The idea can be extended to the sharing of public electric vehicles or electric bikes for short distances, thus cutting down on fuel use and associated air emissions.

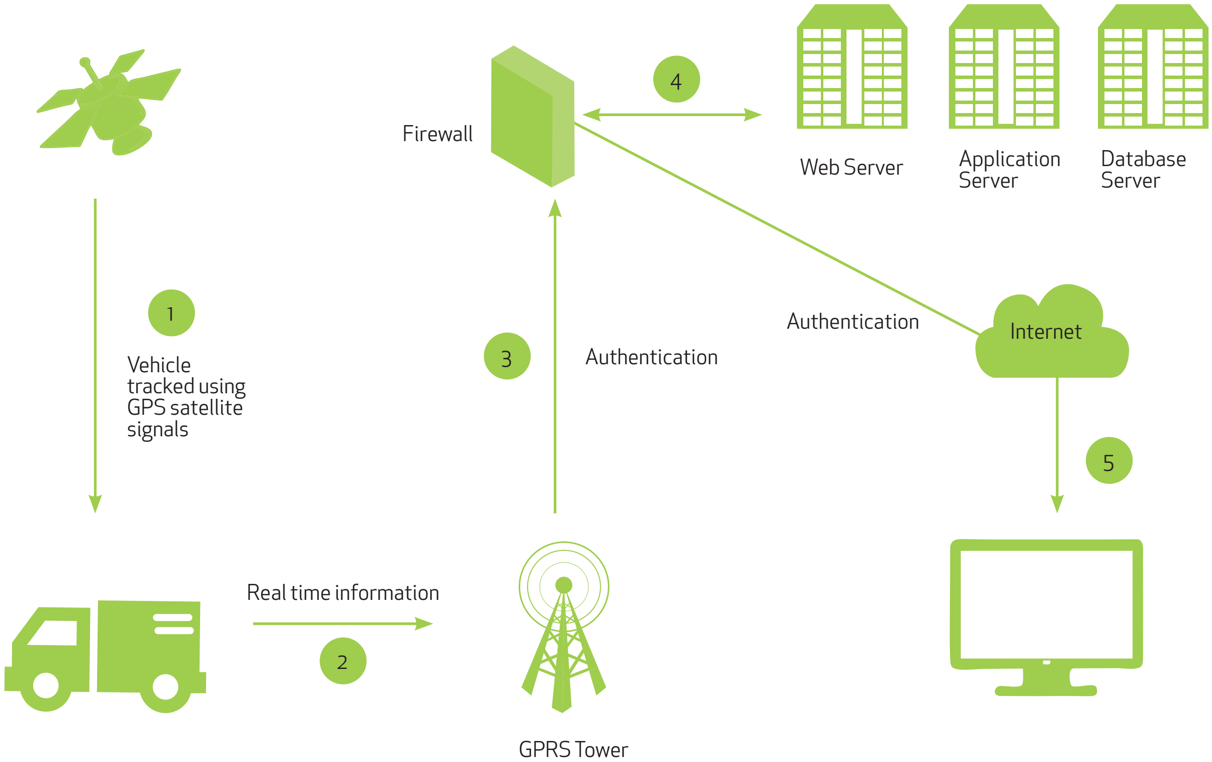
- **Intelligent traffic signals and crosswalks:** For accelerating the use of NMT, there is a need to give priority to cyclists and pedestrians at intersections. Intelligent traffic signals, crosswalks and 'cyclist priority' lights are some ICT solutions which can help in creating safe and secure intersections. In North America, certain cities have traffic signals in which pressing a button to cross the signal triggers the 'instant walk signal'.

  London has installed 'cyclist priority' signals in which cyclists get a headstart before motorists get a green light by a few seconds. In this system, while there is a red light for the motorised traffic lane, cyclists have green lights allowing them to move 12m ahead to a second stop line. This allows the cyclists to clear the turning before the traffic coming behind them.

ERP FOR IMPROVING PUBLIC TRANSPORT SERVICES

Public transport agencies can utilise ERP to improve asset management and operational efficiency. ERP can have the basic functional applications integrated with special applications required for fleet management. Today, reliability is a key issue in public transport. ERP can be leveraged for preventing costly breakdowns (due to neglected fleet vehicles) and disruption of services. With ERP, the system can keep a

Figure 10.28
Vehicle Tracking Solution



Source: Infosys Research (Adapted from VISIONTEK, Linkwell Telesystems Pvt).

record of vehicle information including Insurance, fuel economy, tire purchase and repair management, driving history etc. The system can be implemented to integrate with management Information systems.

ESTIMATION OF CONGESTION THROUGH PRESENCE OF MOBILE PHONES

According to the Telecom Regulatory Authority of India, more than 65 per cent of the people in urban areas have a mobile connection. This presence of mobile phones can be used to estimate congestion on the roads. It is reasonable to assume that in urban areas, an individual in a private vehicle has a mobile phone. Therefore, the density of mobile phones in a section of road is an indicator of the level of traffic on that section. Telecom towers are continuously in touch with all the numbers in their region, and therefore, it is relatively easy to know the number of phones in the region covered by the tower. Knowing the location of the towers, one therefore can know the number of phones (and hence traffic) in each of the regions covered by the towers. Thus, the transport department can have a map showing the level of traffic at any time in the city. The department can then provide information on congestion levels, emergency blockages, accidents and bad road conditions to drivers so that they can take alternative routes. Furthermore, the Traffic Management Centres can also use the information to take remedial measures to reduce congestion. Bengaluru, one of the major ICT hubs of India, already uses such a system to identify congested areas.

VEHICLE TRACKING SYSTEMS AND FLEET MANAGEMENT

Vehicle Tracking Systems enable keeping track of the location of a vehicle in real time. The information is collected and shared with managers for management of the fleet.

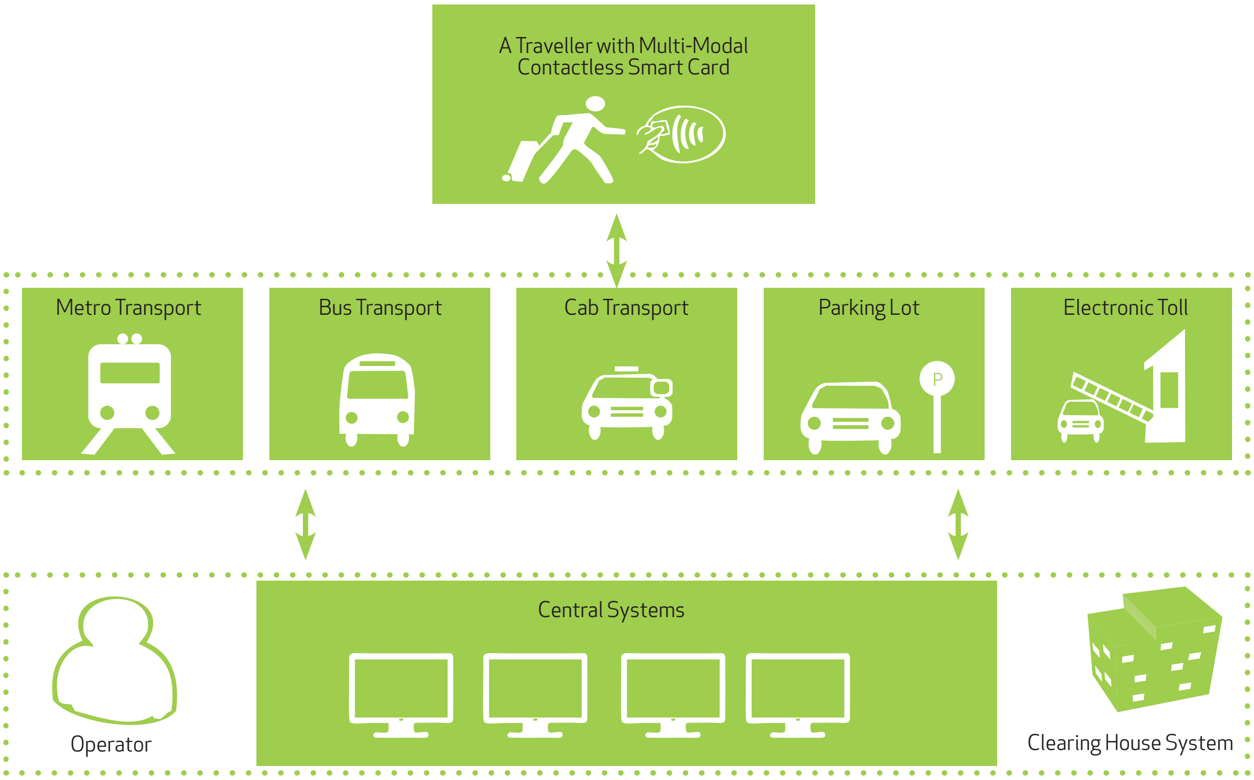
Vehicles can be tracked using mobile phone technology or GPS technology.

- Traffic scan with mobile phones can be used to track commercial vehicles. When a SIM card is installed in a freight vehicle with the required infrastructure, it can be used to track the precise location of the vehicle and determine the speed of traffic from its movement and hence is an efficient tool for fleet management. It helps in tracking actual travel time and the route used by the vehicle.
- Vehicles can also be tracked with GPS technology (Figure 10.28). An electronic device, installed in the vehicle emits signals. The signals are monitored by tracking agencies and helps stakeholders in remote management of the fleet.

INTELLIGENT TRAFFIC MANAGEMENT SYSTEMS

Intelligent Traffic Management Systems can remotely control and manage the network of traffic lights

Figure 10.29
Multi Modal Contactless Smart Cards Solution Architecture



Source: Infosys Research (adapted from e-ticketing solutions).

at different locations. Embedded Web Servers (EWS) are located at each intersection. The software at Central Traffic Management Unit monitors the operation of traffic lights and helps in remotely managing them from the Traffic Department. The system enables effective traffic management because the control is based on an integrated view of traffic in a particular urban area.

INTEGRATED FARE AND TICKETING SYSTEMS

Integrated fare and ticketing systems play a vital role in attracting passengers to public transport. Passengers benefit from an overall decrease in duration of the journey and the cost of travel. In addition, payments become easier, and the journey appears 'seamless'. The government too benefits because these systems can be blended with other e-governance activities. With enhanced data mining, analytics and decision support tools, the ridership data can be converted into customer insights and could be used by the managing authorities to create strategic plans for optimal routes, fares and scheduling, making public transport more appealing for the citizens. Further, multi-modal ticketing saves cost in maintenance of ticketing facilities, improves staff utilisation, and reduces the level of fraud.

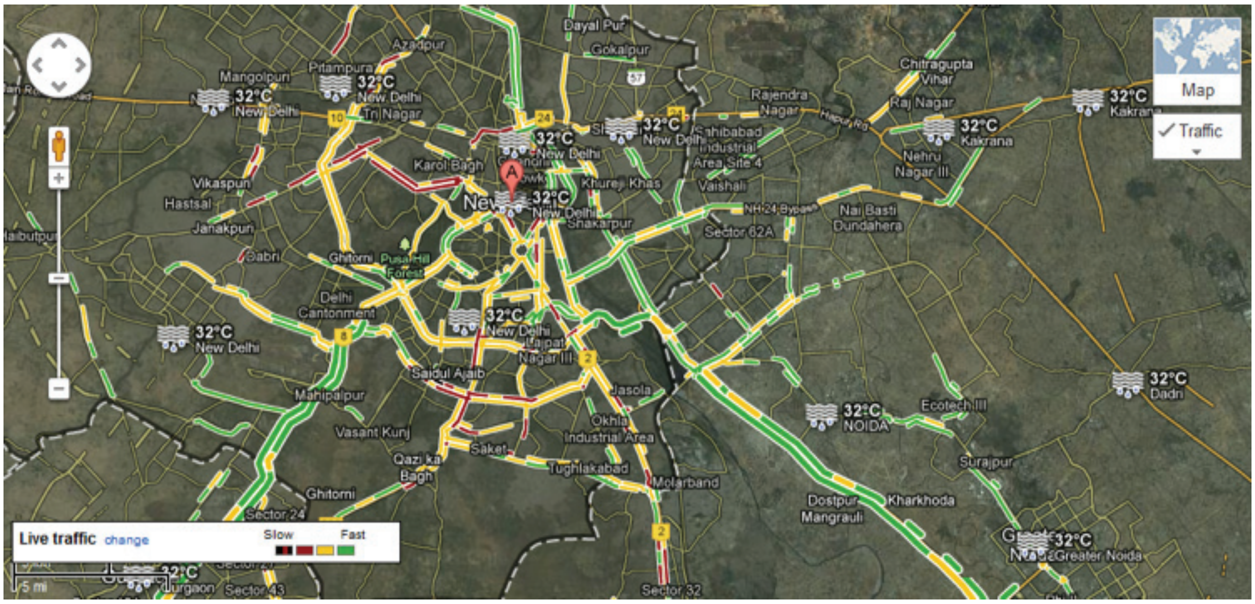
Such integrated systems use multi-modal contactless smart cards with RFID technology which can be used to pay for all modes of urban public transport (Figure 10.29). The contactless smart card is a rechargeable pre-paid card with stored value and an RFID chip embedded in it. A passenger can swipe the card across an electric reader when entering the transport system to deduct funds. The smart card can be easily reloaded through mobile wallet[5], credit-debit cards, ATMs and other authorised service providers.

The system can evolve to provide discounts for children, the elderly and students. A card holder can travel at reduced cost with earned reward points. The system can also be expanded so that one card can be used anywhere in the country for public transit. A further improvement could be the development with a personalised smart card which can be integrated with other personal details so that the card can be used not just for public transport, but also to pay parking fees and tolls.

Smart cards are successfully implemented in many Asian and European cities. Hong Kong and London are world leaders in the implementation of smart cards. Hong Kong pioneered the implementation of smart card payments systems with its Octopus card. It's one of early innovators in worldwide adoption of contactless payments in the transit market. The card can be used to make payments on public transport, retailers and facilities, and it has the highest acceptance of a commercial card system.

5. Mobile Wallet helps in instant money transfer and is an easier alterative to cash/card payment options.

Figure 10.30
Google Map of Delhi (with Traffic and Weather Layers On)



In India, Delhi has launched the common mobility card 'More Delhi' which can be used on Delhi Metro and its feeder buses. The plan is also to extend the usage of this card to DTC buses and taxis in next few months.

PASSENGER INFORMATION SYSTEM (PIS)

The success of integrated fare and ticketing systems hinge on good passenger information systems so that passengers have valuable real-time information about the various transport modes and can make their travel plans accordingly. These information systems can significantly enhance the attractiveness of public transport.

Karnataka State Road Transport Corporation (KSRTC) has deployed ICTs in its bus fleets in Mysore. The system consists of GPS and real-time PIS in buses. KSRTC also plans to have video cameras for surveillance and installation of electronic ticketing machine in buses. There is also a plan to integrate fuel consumption data into the system, helping the KSRTC ensure higher mileage. This system will help in capturing data on distance travelled, fuel consumed and driver's behaviour.

INTERACTIVE CITY DASHBOARD

An interactive city dashboard would provide real-time information about city transport to travellers. A traveller will be able to get a digital map of a city with reports of accidents, highway and arterial congestion, road construction, special events, and weather and average travel times on the routes. The traveller will also be able to get information about public transport schedules, routing details and location of stops by simply entering his or her starting point and final destination. Based on such information, a person will be able to take the most optimum mode of travel. The dashboard will be accessible by smart phones and tablets and will be searchable and user-friendly.

Google has launched real-time traffic information maps in six Indian cities: Bengaluru, New Delhi, Mumbai, Chennai, Hyderabad and Pune. A user can activate the traffic and weather layers and get a colour-coded view of the traffic and temperature in a particular area (Figure 10.30). The traffic outlay shows green for free flowing traffic, yellow for minor slowdowns, and red for significant congestion. The maps can be viewed on smart phones.

CONGESTION PRICING FOR PRIVATE MOTORISED VEHICLES

Congestion pricing is a charge levied on a road user at times of congestion. This is usually implemented during peak traffic hours on roads that see a lot of congestion. It encourages use of public and non-motorised transport, and thus assists in reducing congestion and emission levels. While congestion pricing has been successful in many countries, before implementation it is advisable to ensure that public transport is available on congested roads so that people have an alternative transport option to avoid the congestion charge. Due consideration should also be given to cost and the required political will for implementing congestion pricing. In India, it should be first studied with pilot programmes and implemented only if results are promising.

There are several technologies available for implementing congestion pricing. One option uses

Figure 10.31

Future IT Infrastructure for Urban Transport in India

Source: Infosys Research.

Dedicated Short Range Communication (DSRC) charging through transponders and gantries, where the vehicle has an on-board unit which has a smart card. When the vehicle passes the charging point, the roadside equipment, typically mounted on the gantry, communicates with the smart card and the charge is deducted from the card. At the second gantry, the vehicle's number plate is photographed for enforcement purposes. Another technology is a video-based system which relies on taking an accurate image of the number plate with the use of Automatic Number Plate Recognition (ANPR). This is the system used in London. The camera takes the picture of the number plate, converts it into appropriate alphanumeric characters and matches it with the electronic list of user accounts. In India, solutions such as KLiPR have been developed for ANPR. KLiPR can detect and read heterogeneous number plates and has a module for capturing an image of the driver to provide another layer of security for enforcement purposes. Another form of technology is GPS-based distance road pricing which is still being developed.

Congestion pricing has been successfully implemented in several cities around the world. In London, congestion pricing has been effective not only in increasing the use of buses by 6 per cent during the charging hours but also in raising revenue (£148m in financial year 2009/10). In 2008, Milan introduced an ECOPASS system in which vehicles are charged when they enter specified areas and the fee structure is based on the vehicles' potential air emissions. It uses the ANPR technology. In three years, the system resulted in reduction of highly polluting vehicles by 68 per cent and daily average emission of pollutants in the ECOPASS area of total PM10 by 15 per cent. In Stockholm, congestion pricing has reduced traffic by 18 per cent, increased green (tax exempt) vehicles by 9 per cent, and has reduced travel time on inner city and approach roads.

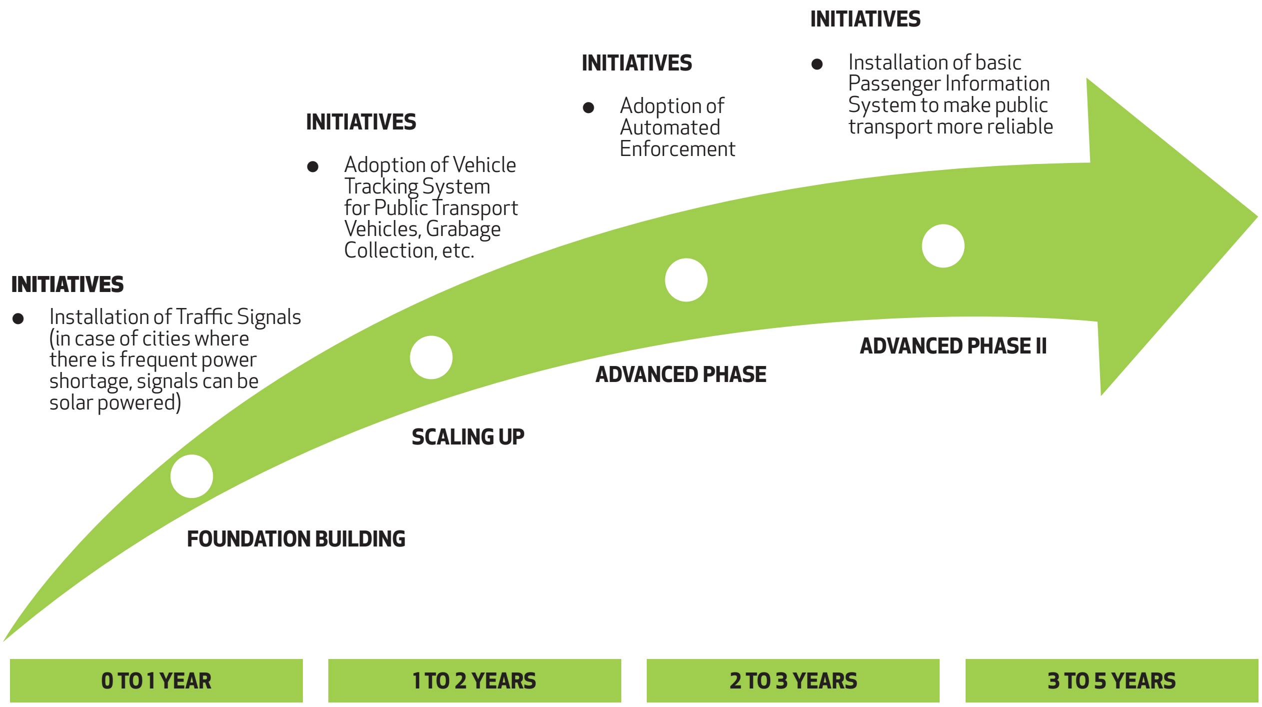
ENHANCING SAFETY THROUGH SURVEILLANCE AND ENFORCEMENT SYSTEMS

Intelligent surveillance and enforcement systems help in managing and enforcing traffic rules and regulations. These systems help in monitoring violations such as driving through a red light, jumping of lanes, over-speeding and parking violations. For such offences, enforcement cameras capture the image of the errant vehicle, locate the owner and send him or her a notice for fines. In the case of monitoring by traffic police, the use of smart phones has assisted in registering many more cases and in making the system more transparent.

ADVANCED SYSTEMS IN THE FUTURE

There are more advanced systems that are still in nascent stages. These solutions are still undergoing

Figure 10.32
Pre-Implementation Plan (Cities currently without ICT in UT)



Source: Infosys Research.

trials and will need detailed feasibility study under Indian conditions before they can be implemented. We discuss two such systems here.

PARA-TRANSIT FLEET MANAGEMENT

In para-transit fleet management, an operator who owns private buses or taxis would manage the scheduling or routing of the fleet in the city. The service would be offered through a web browser, where a traveller would prepare his own itinerary with the following options: (a) advance booking of a vehicle (bus or taxi); (b) whether shared acceptable (yes or no); (c) origin and destination of the traveller; and (d) how much waiting time would be acceptable. The payment can be made through smart cards, mobile phones, cash or internet banking.

Based on the bookings, the operator will be able to optimise the use of his fleet on two factors: (a) maximum passengers per vehicle and (b) lowest kilometre per vehicle per day. This system would enable better utilisation and improved operational efficiency of the available private fleet. The traveller will get greater flexibility, a better travelling experience and better safety.

CONNECTED VEHICLE TECHNOLOGY

With this technology which is still under development, vehicles would be connected to each other through Wi-Fi. A vehicle would have information about the speed and location of other approaching vehicles, roadway conditions and hazards which a driver may not be able to see. The technology increases the driver's knowledge about his driving environment and reduces the probability of crashes, either vehicle-to-vehicle (V2V) or vehicle-to-infrastructure (V2I). The vehicle's system would give warnings about potential collisions and other hazards. The technology is also expected to assist in collection and consolidation of real-time data from equipment located on vehicles and within the infrastructure. These data can be further used to manage the multimodal transportation system for better performance.

This technology is expected to prevent accidents and injuries on roads, and increase efficiency. The technology is undergoing initial tests under the Connected Vehicle Safety Pilot Program, run by the US Department of Transportation (DOT), Research and Innovative Technologies Administration (RITA) and University of Michigan Transportation Research Institute (UMTRI).

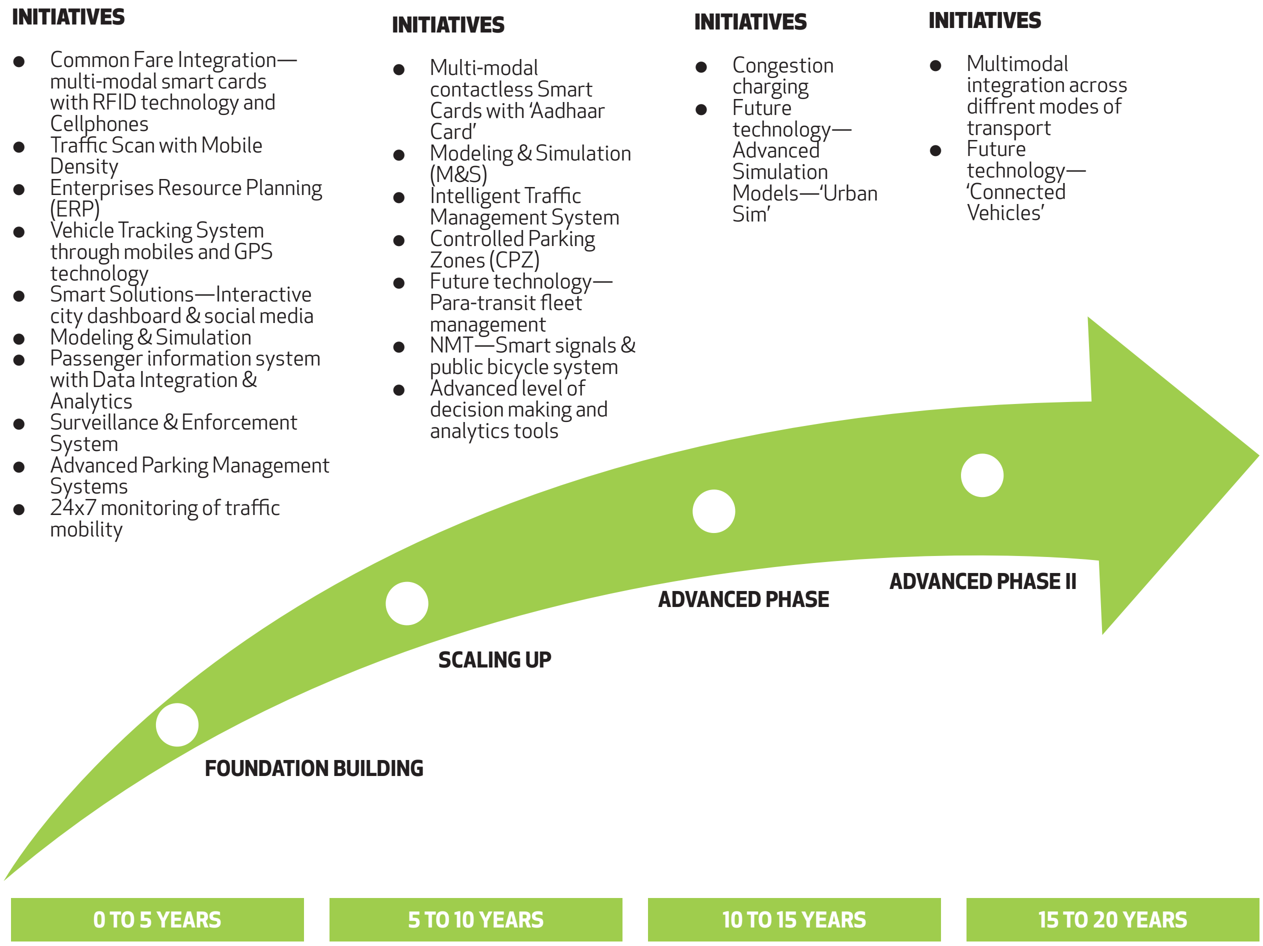
SUMMARY

Figure 10. 31 summarises this discussion on ICT technologies that would be useful for urban transport.

INSTITUTION AND CAPACITY BUILDING

As discussed in the earlier sub-sections, efforts are being made to introduce ICT in urban transport.

Figure 10.33
Implementation Plan for Category 1 & 2 Cities



Source: Infosys Research.

However, these efforts are being carried out by multiple agencies without much coordination. But the development of an effective inter-modal transport network requires coordination between transport modes and between agencies. A strong institutional structure is required for such coordination, which should be based on the basis of developing a network of IT professionals in all the different agencies involved in urban transport.

ROADMAP FOR ICT IMPLEMENTATION

Urban transportation in India requires an implementation plan which will address the issues of traffic congestion, pollution, parking, safety by utilising the latest traffic technologies feasible in Indian circumstances. The plan should be flexible to accommodate the growing population and the technology solutions should be scalable in nature. Technological solutions can be implemented in a phased manner taking into account trends in urbanisation, the existing status of technology being used and funding available for urban transport. Category 1 and 2 cities have been introducing ICT in urban transport; however cities in Category 3 have not. Therefore, the roadmap for implementing is different for Category 3 cities.

PRE-IMPLEMENTATION PLAN FOR CITIES THAT ARE YET TO START USING IT FOR UT

Cities in Category 3 need to implement a 'Pre-Implementation Plan' lasting about five years and then implement the steps that are described in the following sub-section on the Implementation Plan for Category 1 and 2 cities. (Figure 10.32)

- **Foundation Building:** Installation of traffic signals. In case of cities where there are frequent power cuts, traffic signals can be powered by solar energy.
- **Scaling Up:** Adoption of a vehicle tracking system for public transport vehicles, garbage collection vehicles, etc.
- **Advanced Phase:** Adoption of automated enforcement.
- **Advanced Phase II:** Installation of a basic passenger information system to make public transport more reliable.

Implementation Plan for more ICT-enabled urban transport system cities (Figure 10.33)

1. **Foundation Building:** Category 1 cities have used technological solutions for addressing their growing urban transport issues and have already started implementing some of these solutions. Some of proposed solutions that can be implemented at this stage are:

    - Fare Integration through multi-modal smart cards with RFID technology and mobile phones
    - Intelligent transportation systems and interventions involving digital video surveillance, 24x7 monitoring of traffic mobility, automated enforcement through smart phones and enforcement cameras and traffic modeling
    - Data collection and monitoring by using mobile density as a proxy for traffic and GPS-based monitoring of the buses
    - Setting up an interactive city dashboard and updating information of public interest on social networking websites including Facebook, Twitter
    - Information dissemination systems involving variable messaging system, use of SMS and FM channels
    - Operational efficiency through Enterprise Resource Planning (ERP) in transport agencies

2. **Scaling Up:** Some more advanced technologies can be added to urban transport in the next five to 10 years

    - Intelligent transportation systems and interventions involving intelligent traffic signals and advanced level of decision making and analytics tools, simulation models.
    - Parking management solutions—controlled parking zones (CPZ)
    - Taxi & para-transit fleet management (future technology)
    - NMT—Smart signals & public bicycle system

3. **Advanced Phase:** After a decade, urban transportation will have to be taken to a new level for a growing urban population. After feasibility studies, more advanced technologies can be considered for implementation at this phase. Some of the proposed solutions that can be implemented are:

    - Congestion charging
    - Advanced simulation models like UrbanSim which help in integrated land planning and transport
    - Bus platoon systems

4. **Integrated Urban Transport:** At this stage, more technologies can be implemented which can support multimodal integration across different modes of transport. In the next 15 years, feasibility and pilot studies on future technologies would have been performed and would be ready to be Implemented.

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11.
RESEARCH AND HUMAN RESOURCE DEVELOPMENT

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11. RESEARCH AND HUMAN RESOURCE DEVELOPMENT

In order to ensure more efficient, safer and cleaner transportation systems in India, there is an urgent need to set in place institutions and mechanisms for knowledge creation and training of professionals in all aspects of transportation planning and operations. Well-informed planning methods and use of modern scientific and technical tools for analysis and monitoring of existing systems can play an important role in transforming the transportation infrastructure in India.

The competencies of professionals working in the transportation field have to be strengthened considerably. India must also put in a place a system to continuously renew these capacities, both by updating existing workers' skills as well as inducting new expertise into public service as needed. Technology changes as well as evolving means of implementing transport projects through public-private partnerships require a variety of new skills from engineering, social and management sciences.

For the past many decades, transportation policies focussed mainly on increasing transport capacity and operational speeds. Over the next few decades issues concerning safety, climate change, harmful emissions, equity and energy efficiency, intermodal connectivity will also have to be an integral part of all transportation policies and embedded in all levels of decision making. This cannot be done without improving skills and increasing the knowledge of the transportation workforce and decision makers. We will also have to focus on supporting local transportation professionals through training, technology transfer and information exchange activities.

At present knowledge gaps exist in all areas of activity:

i. Design, construction, operation, management, maintenance
ii. Safety
iii. Demand management
iv. Project management
v. Use of ITS
vi. Finance

Data on travel patterns and needs (especially in the road sector), efficiency and performance of technologies in use, cost effectiveness analysis within and across modes of travel, suitability of different technologies in the socio-economic environment of India, management strategies needed for large systems undergoing rapid transformation, design standards accounting for real world needs, implications of a mixed vehicle fleet with differing capabilities and technologies, synergies and conflicts between safety, environmental, energy-saving and mobility concerns, etc. Expertise in such areas needs a great deal of interdisciplinary work and collaboration between knowledge producers and practitioners at all levels.

Future transportation planning and policy making will also require a much more sophisticated approach to set in place systems that ensure the consideration of climate change and safety issues as integral components of infrastructure and technology options. In particular, all agencies will have to incorporate climate change and energy efficiency issues into their transportation planning processes. In the coming years all new transportation plans will have to include explicit reference to the effects of transportation on climate change and the role of transportation in mitigating these effects. There is a need for greater involvement of both central and state governments in climate change issues. Organisations at the local level in particular will need data and expertise input on how and where to incorporate climate change. The quantification of climate-forcing and health-damaging emissions as costs to be weighed in the transportation planning process is a new challenge for transportation agencies. All this will have to be implemented across all transport sectors and national, state and city levels for:

- Multimodal transportation planning
- Selection, integration and management of technologies
- Building, construction and maintenance of infrastructure
- Management of transportation systems
- Monitoring of systems: financial, energy, emissions, lifecycle costs, safety, efficiency, etc.
- Decision-makers, transportation officials, and staff face increasingly complex issues when addressing transportation needs in their communities. Examples of expertise requirements would include:
- Air quality assessment and health impacts: natural and physical sciences, medical sciences, mathematical modelling, instrumentation
- Freight and human movement: All engineering sciences, mathematical modelling
- Safety: engineering and medical sciences, epidemiology, statistical modelling, psychology and sociology
- Asset management, cost estimation, financial planning: economics, accounting modelling
- Operations: Management, operations research, survey techniques, sociology and psychology
- Public involvement: Education, public relations

Expertise needs to be developed specifically in all these areas with special reference to different modes of transport. At present none of the agencies involved—educational institutions, research laboratories, operators, government agencies, NGOs—have adequate interdisciplinary expertise or the required number of personnel to service these needs.

One way to understand the status of knowledge production in different countries is to examine the number of scholarly articles on different subjects originating from those countries. Five key areas were identified, pertaining to the field of transportation research

1. Road Safety
2. Civil Engineering projects related to development in transport facilities
3. Emissions, covering air and noise pollution
4. Railways
5. Transportation planning, oriented towards developing the transport facilities

Each of the areas mentioned above, were indexed using unique keywords and a search done on the online search engine Scopus™. The results of the search for the countries India, China and Brazil are shown in Table 11.1 and the output normalised for population (2011) shown in Table 11.2. These tables show that not only does India fare poorly in terms of total output, when normalised for population levels in 2011, India's output appears poor in comparison with both Brazil and China. Even more worrisome is the fact that the gap between India and China has widened considerably in the past decade (Table 11.3) especially on topics dealing with railway technology.

If we assume that research output may have some relationship with per capita income and number of people in each society, even then these results show India is doing much worse than China and not even as well as Brazil.

It is possible that these data do not contain studies published from India which are not included in indexed journals, and that the quality of studies from India may be better than many originating from China. However, the gaps are so large that we need to take corrective measures on an urgent basis. The number of papers from China per-person per US$ per capita income are more than three times greater than that from India in all areas. This means that if we want to catch up with China in 10 years with their present levels of productivity, we will have to grow at more than 10 per cent per year. However, this would not be adequate enough for the kind of growth we need in knowledge generation and innovation to put in place systems in the next 10 years that serve us well for the next 30 years. It would be safe to assume that we need to plan for a dramatic increase in human resource development, research output and creation of jobs for highly trained professionals.

VISION

The research figures are only a symptom of general gaps in capacity available in India. Increase in research output alone is not likely to yield the kind of systemic changes required for ensuring a more evidence and knowledge based policy-making environment necessary to steer us towards a sustainable transportation future. The system we envision must address the unique issues of concern in India. Sustainable growth of transportation requires an integrated interdisciplinary approach that incorporates our special needs. Work for sustainable transport will need an innovative combination of current and future international knowledge adopt-

Table 11.1
Number of Academic Articles Published Originating in India, China and Brazil, 2006-10

	INDIA	CHINA	BRAZIL
Road Safety	120	911	118
Railways	121	2,167	28
Emissions	15	60	51
Civil Engineering	151	1,234	19
Air Transport	33	323	29
Marine Transport	12	97	1
Transport Planning	18	129	13

Source: Scopus™.

Table 11.2
Number of Publications, 2006-10
[Per 100 Million Population]

	INDIA	CHINA	BRAZIL
Road Safety	10	68	62
Railways	10	162	15
Emissions	1	4	27
Civil Engineering	12	92	10
Air Transport	3	24	15
Marine Transport	1	7	1
Transport Planning	1	10	7

Table 11. 3
Ratio of Journal Papers Published by China and India, 1961 -2005 and 2006-10

TOPIC	1961-2005	2006-10
	CHINA/INDIA	CHINA/INDIA
Road Safety	1.1	5.5
Transportation Planning	1.4	12.9
Emissions	0.6	4.0
Railways	8.1	23.0
Civil Engineering	3.3	8.4

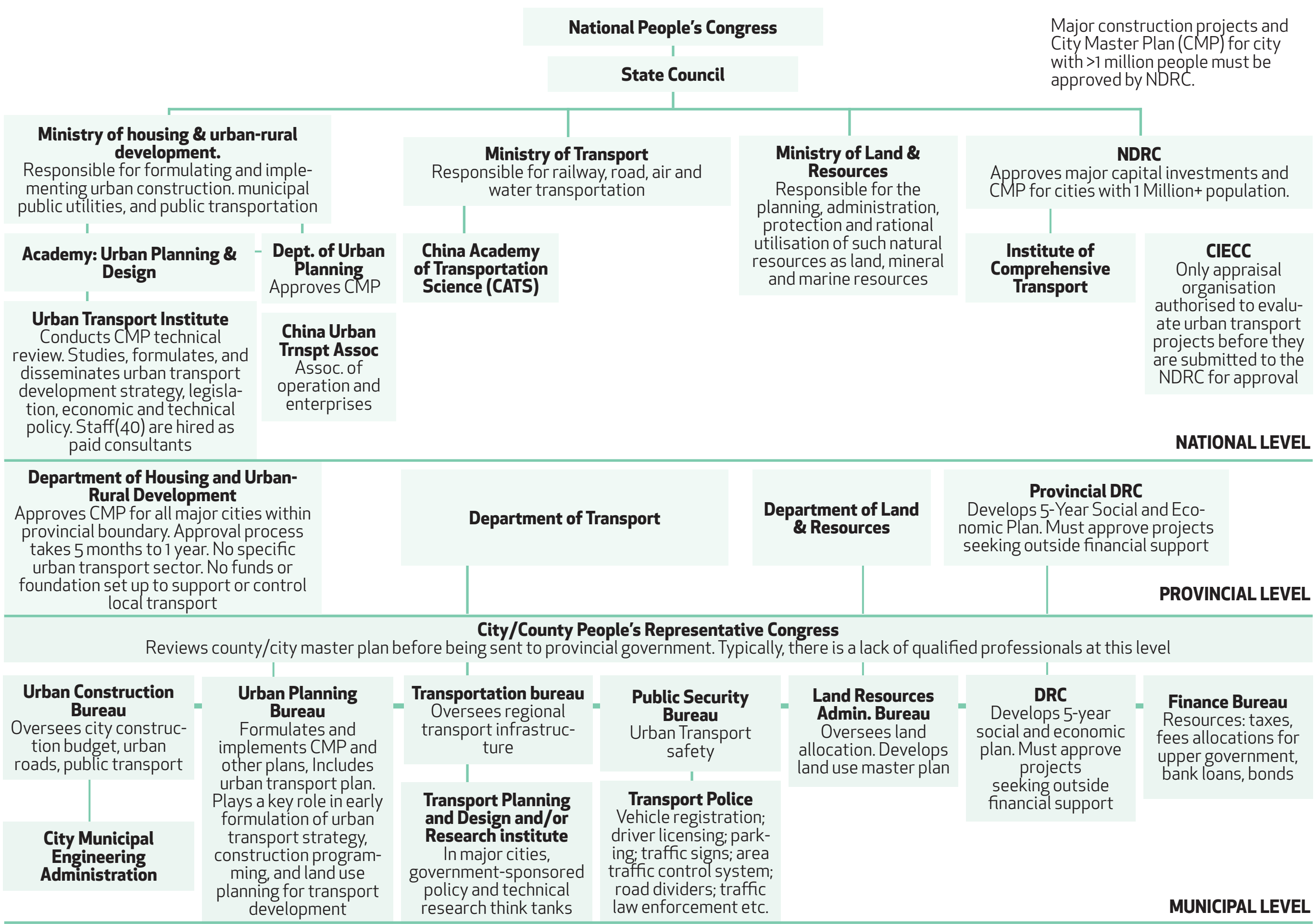
ed to local findings. This knowledge will have to be produced in India within the socially dominant forms prevalent here. We have to set up a system of research which responds dynamically to include a heterogeneous set of practitioners collaborating on problems defined here in localised contexts but integrating international concerns and learning from international experience in a rigorous, internally consistent format.

We must plan to set up systems for local knowledge producing mechanisms that aid researchers in responding to demands of society. Such systems are in a very nascent stage of development here, but the good news is that the divides between research and practice that are entrenched in many of the world's top-ranked research programmes also have not been replicated in India. It is possible to build such knowledge systems even as higher education reform moves forward, rather than having to unlearn ways of research production and then re-learn. Researchers will have develop new and appropriate tools of analysis and technological solutions for tackling the complex problems of safety, pollution, access and mobility. We must create quality resources needed for integrating hard and soft sciences research. It is these resources, publications and networking activities that will bring continuity and permanency to activities that also address quality of life issues. The effort would be to experiment with new forms of knowledge generation where there is continuous negotiation between disciplines on one hand and between scientists and society on the other, and where the solutions developed will normally be beyond that of any single contributing discipline. They will necessarily be transdisciplinary.

INSTITUTIONAL SET-UP

Functioning transportation systems in any location involve interactions between individuals, socio-economic imperatives, technologies, geophysical structures, built environment, organisational capacities, political compulsions, knowledge limitations, influence of special interest groups, and historical path dependencies of societies. As with any other complex structure, we tend to deal with transportation systems with little knowledge about these interactions and their myriad feedback loops. We have some knowledge of the input and output variables, but little of the transfer functions and the feedback loops. In such a situation it is very necessary to have organisational systems that keep track

Figure 11.1
China Transport Planning and Research



Source: World Bank report prepared by Zhu Lin, 2004.

of inputs and outputs on a continuing basis so that transfer functions can be developed and modified periodically. This understanding would help us in technology choices, development of appropriate physical and management structures and periodic course corrections.

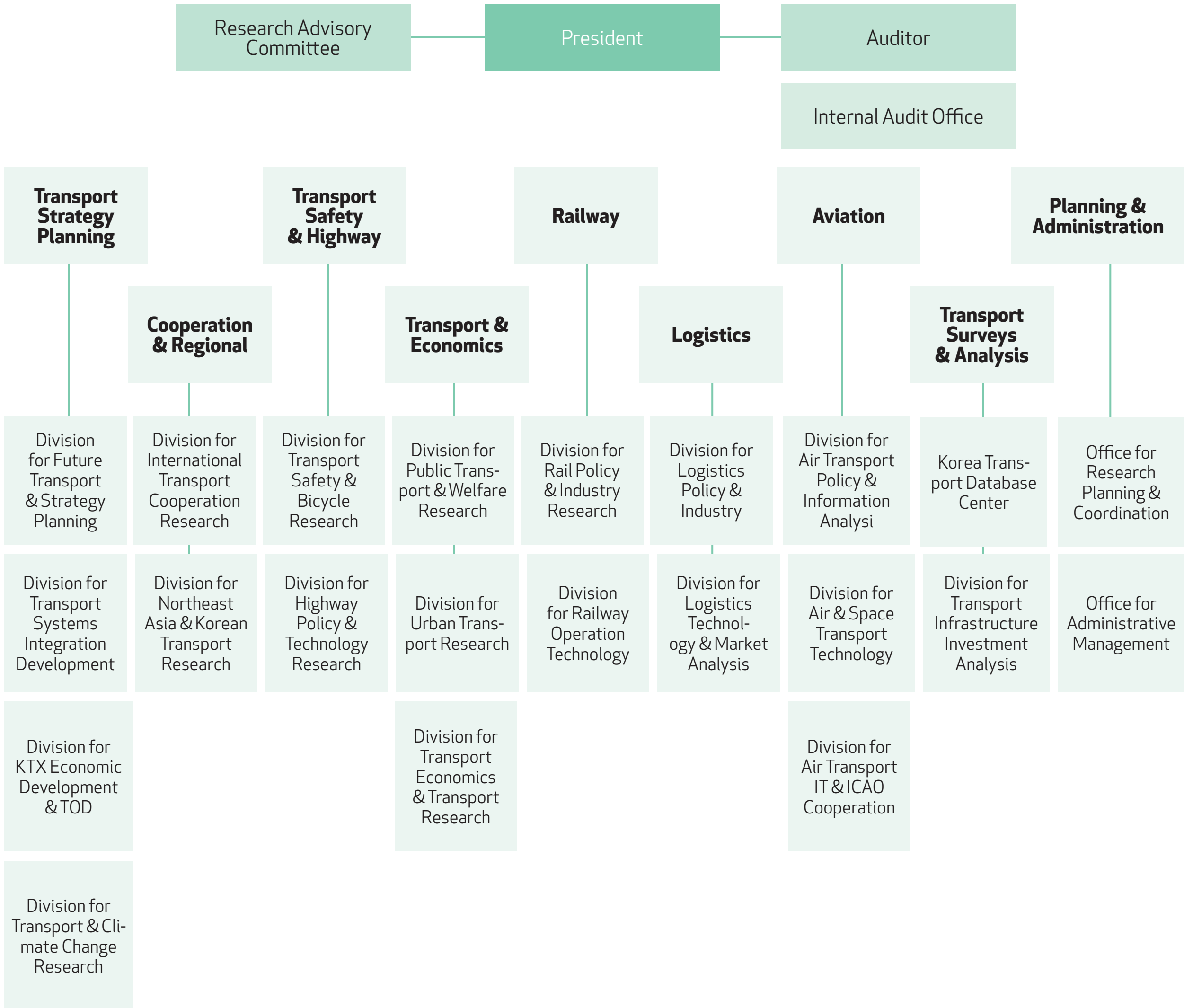
There are a large number of models available around the world for institutional frameworks that attempt to satisfy the above goals. To address deficiencies in data and data processing limitations, lack of information on costs, demand, revenues and asset condition, effective regulation procedures, management and accountability, forecasting models, technology choice assessment, different governments have established:

i. independent research institutions at national and regional levels that work on all modes of transport and also mode specific institutions;
ii. formally structured, information provision units within government or operating as service providers to government, whose responsibilities include defining, collecting, forecasting, structuring and disseminating information on transport problems and trends and the performance of policy instruments. Such units use information from all relevant transport agencies;
iii. relatively large policy making and technical research departments in ministries and operating agencies;
iv. centres of excellence at academic and research institutions.

The variety of institutions is important to ensure a flow of knowledge from global to local expertise: faculty and researchers move between independent departments on temporary basis, while their colleagues may establish longer-run relationships with public servants and policy-makers. The dispersed knowledge creation also creates scope for variety, and particular attention to local issues that researchers experience personally. It also ensures competition between research groups and insulates against mistakes or organisational challenges that one institution faces. For example, as Figure 11.1 shows, China has set up institutions that work on transportation related issues at different levels.

The following subsections give a few examples of knowledge-producing institutions for comparative perspective and summarise lessons from international experience with overall research production systems.

Figure 11. 2
Administrative Structure of the Korea Transport Institute (KOTI)



NATIONAL TRANSPORT INSTITUTIONS

THE KOREA TRANSPORT INSTITUTE (KOTI)

KOTI, established in 1985, is the official research agency for the government of the Republic of Korea. In 1987 it began operations as a government-funded institution pursuant to Article 24 of the Urban Transport Promotion Act. It joined the Korean Council of Economics & Social Research Institutes pursuant to the Article of the Government Grant Act for the Establishment, Operation and Promotion of Research Institutes. Since then it has developed into a very influential institution for developing national policies and social agenda in the transport sector with objective of:

- Providing policy-making assistance to the government (guidelines, public hearings, seminars, etc.).
- Developing future transport technologies to explore new growth engines for the national economy.
- Devising a new strategy to support national transport policies.
- Pursuing a knowledge-sharing programme in the transport sector.
- Developing global agenda and promoting cooperation with international organisations.
- Developing creative and innovative endeavours.
- To serve as a comprehensive research institute on transport and logistics and as a National Think-Tank.
- Serve as hub for global transport cooperation.

The Institute has nine departments and the structure is shown in Figure 11.2. KOTI covers all areas of transport, employs over 200 researchers, and has agreements with a large number of Korean transportation organisations and academic institutions. These include for example: Transportation Command, R.O.K, Korea Institute of Construction and Transportation Technology Evaluation, Korea Transportation Safety Authority (KOTSA), Korea Advanced Institute of Science and Technology (KAIST), Korea Institute for Construction Technology, Graduate School of Environmental Studies at Seoul National University, Daegu University, Institute of Urban Sciences at University of Seoul, Busan Transportation Corporation, The Korea Railway Association, Korea Airports Corporation, Korea Aerospace University.

Since its foundation, KOTI maintains close foreign relationships with foreign institutions and research organisations. These include MOUs and academic exchanges. Examples of these are given below:

- The Establishment of a Master plan for the Arterial Road Network in Sumatra Island, Indonesia
- Integrated International Transport & Logistics System for Northeast Asia (partner UNESCAP)
- MOUs with over 20 organisations including: The Institute for Transport Policy Studies (Japan), TRL (UK), OECD, Asian Development Bank, Land Transport Authority Academy (Singapore), The World Bank, Tsinghua University (Beijing, China), Gesellschaft fuer Internationale Zusammenarbeit (GIZ--Germany), MIT (USA) and Electronic Navigation Research Institute (Japan).

STANDING COUNCIL ON TRANSPORT AND INFRASTRUCTURE (SCOTI), AUSTRALIA [1]

The Standing Council on Transport and Infrastructure (SCOTI) (formerly known as the Australian Transport Council) was established in September 2011 and brings together Commonwealth, State, Territory and New Zealand Ministers with responsibility for transport and infrastructure issues, as well as the Australian Local Government Association.

SCOTI is advised and assisted by the Transport and Infrastructure Senior Officials' Committee (TISOC) on all non-infrastructure priorities, and the Infrastructure Working Group providing advice and guidance on the coordination of infrastructure planning and investment, across governments and the private sector.

The Council's high-level policy responsibilities include:

- Surface transport;
- Transport safety and security;
- Promotion of more efficient and environmentally conscious transport, including thorough vehicle emission standards and national cycling promotion;
- Infrastructure policy and investment, including road, rail and ports;
- Infrastructure and related land use planning; and
- Strategic planning for infrastructure and consistency with agreed criteria for capital city strategic planning systems.
- The Council works closely with the Standing Council on Regional Australia to ensure integrated action for regional Australia.

The Council's priority issues are:

1. Achieving national systems for regulation of heavy vehicles, maritime safety and rail safety;
2. Completion of the National Freight Strategy, including the development of a dedicated National Ports Strategy, with additional work undertaken to outline how airports and airport land use planning might be taken into account in the National Freight Strategy;
3. Consideration of national heavy vehicle pricing and funding reform through finalisation of the COAG Road Reform Plan process;
4. Consideration of the National Urban Policy and integration with agreed criteria for capital city strategic planning systems;
5. Developing and implementing reforms to infrastructure investment and financing;
6. Develop a National ePlanning Investment Plan by end 2012 through the National ePlanning Steering Committee.

INSTITUTION FOR TRANSPORT POLICY STUDIES (JAPAN) AND THE JAPAN RESEARCH CENTRE FOR TRANSPORT POLICY [2]

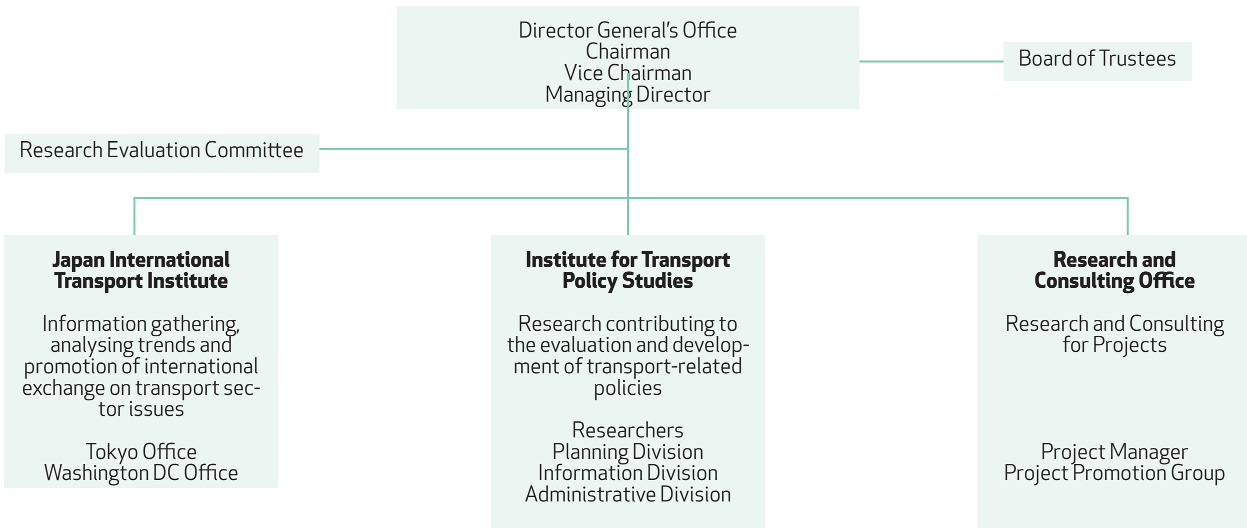
The Institution for Transport Policy Studies is an independent, non-profit foundation established under the auspices of the Japanese Ministry of Land, Infrastructure and Transport. The activities of the Institution involve comprehensive research and survey programs on transport matters. The Institution also evaluates transport policy and offers recommendations to the Japanese government and concerned parties on transport policy issues. The overall aim of the Institution is to contribute towards the development of transport policy in order to promote the welfare and quality of life of people in Japan, its economy, and greater harmony in international relations.

Primary activities are to:

(1) Conduct research and surveys on transport matters
(2) Evaluate and advise the national government on transport policy issues
(3) Collect and analyse transport-related data
(4) Survey overseas transport trends
(5) Conduct regional and international cooperative exchange programmes and activities related to transport issues
(6) Consult on matters related to transport issues
(7) Host lecture sessions, study meetings and seminars to promote awareness of transport issues.

1. http://www.scoti.gov.au (accessed 12 January 2013).
2. http://www.jterc.or.jp/english/gaiyo.htm; http://www.nikkoken.or.jp/english/index.html (accessed 15 November 2012).

Figure 11.3
Organisational Chart for Institution for Transport Policy Studies, Japan



The Japan Research Centre for Transport Policy was founded in 1971. Since then, the Centre (a private non-profit organisation involving transportation specialists and researchers active in universities, private industry, government and local governments) has been carrying out interdisciplinary academic research focused on transport policies for roads and motor vehicles, and providing educational activities and proposing policies regarding a comprehensive transport system that will contribute to the beneficial development of Japanese society. It has been formally certified as a Public Interest Incorporated Association under the new organisation reform act.

The centre conducts surveys and research pertaining to transportation policy. The primary focus is the movement of people and goods that are a vital part of the socio-economic activities of the nation. Research is conducted primarily through the efforts of the Centre's regular and associate members and by securing the participation of key outside partners. Research projects include topics selected from proposals submitted by members and includes research conducted in collaboration with associate members. Another purpose is to cultivate and mentor aspiring young researchers. Special research focused on themes of particular societal concern is often chosen for study. The outcome of the research is the formation of transportation policies for entities concerned with improving the quality of life. These entities include national and local governments, concerned institutions and various other organisations.

Examples of topics on which work is done include the prevention of global warming, preservation of natural resources and energy, social and economic impacts of a dwindling birth rate, changes in population demographics (aging and shrinking population), development of a safe and comfortable transportation system, streamlining and globalisation of physical distribution, expanding inter-regional gap between outlying regions and urban centres and funding issues concerning road maintenance and improvements.

Major activities include: Research of transportation policies that improve safety, comfort and mobility, study of transportation policies consistent with environmental, energy, national, regional and urban policy, research regarding transportation policies affecting businesses and the movement of people and goods, research and development of financing policy.

SECTORAL INSTITUTIONS

CHINESE ACADEMY OF RAILWAY SCIENCES (CARS)

Since its establishment more than 50 years ago, the history of CARS is closely related to the railway construction of the People's Republic of China. In November 1949, only one month after the PRC was founded and everything needed to be rehabilitated, the Ministry of Railways decided to establish a railway scientific research institution. On 1 March 1950, the Railway Technology Institute of the Ministry of Railways was formally founded in and in September the same year, the name was changed into Railway Research Institute of the Ministry of Railways and its leading body was then moved to Beijing. Since the 1950s, it organised personnel and material resources to revitalise the war-torn railway network and construct new lines. After the Railway Research Institute was expanded to the China Academy of Railway Sciences in 1956, their technical personnel participated in the compilation of 1956-1967 Perspective Planning of Railway Science and Technology Development and undertook its execution. In 2002, it was transformed from a state-owned institute to an enterprise under the direct control of Ministry of Railways.

In 1949, only a month after the People's Republic of China was founded, it decided to set up a railway scientific research institute

The past 50 years have seen CARS grow into a comprehensive institution with multiple disciplines and specialties and a centre of scientific research, experiment, industrial products and material inspection, scientific and technical information, and standard and metrology. In CARS, there is a staff of 2,359, of which 1,640 are professional technical personnel accounting for 69 per cent of the total. In addition, there are 510 people with senior technical titles and 755 medium-level technical titles.

Since its establishment, CARS has undertaken several thousand scientific research topics centring around subjects such as rock engineering and geo-engineering, track structure, continuous welded rail (cwr) track, bridge and tunnel construction, hydraulic and hydrological engineering, engineering blasting, structural vibration, subgrade in desert or permafrost, prevention and control of landslide and debris flow, automation of marshalling yard, station computer control, despatching control, radio communication, optical fibre communication, data transmission, computer application, metal and non-metallic new material and techniques, non-destructive flaw detection technique, automatic detection, passenger and freight transportation organisation, transport economy, loading and unloading equipment, fundamental standard, scientific and technological information as well as soft science research.

Research Institutes

- Locomotive and Car Research Institute
- Signal and Communication Research Institute
- Railway Engineering Research Institute
- Computer Technology Research Institute
- Metals and Chemistry Research institute
- Transportation and Economics Research institute
- Environmental Control and Labor Hygiene Research Institute
- Scientific and Technological Research Institute
- Standards and Metrology Research Institute

Centres

- Railway Science and Technology Research and Development Centre
- Quality Supervision and Inspection Centre for Railway products, Railway Scientific, Technological and Economics
- Inspection and Measurement Centre for Railway Infrastructure
- State Railway Test Centre
- Railway Technology Training Centre

State Engineering Research Centre

- National Centre of Railway Intelligent Transportation System Engineering and Technology

Metrological Stations

- State Track Scale Station, State Railway Tank Car Volume Measurement Station

CARS confers master's degrees in 13 specialties and doctoral degrees in five. In addition, there are two post-doctoral research centres in CARS. CARS publishes 12 kinds of academic and technical publications (including two internal publications), and has a library with a collection of over 300,000 copies of books, documents and papers. Backed by the related departments and the Ministry of Railways, CARS actively strengthens the international cooperation and exchanges as well as extends cooperation fields.

NLR (NATIONAL AEROSPACE LABORATORY, THE NETHERLANDS)[4]

The Government Service for Aeronautical Studies (RSL) was founded in 1919 to increase air safety for military aviation. The rapid emergence of civil aviation, however, caused the RSL to focus on that sector too. In 1937, the RSL was turned into a foundation (the NLL and subsequently the NLR), which created a better basis for conducting scientific research for the national aircraft industry (Figure 11.4).

NLR is the aerospace knowledge enterprise in the Netherlands. It answers questions such as: how can aircraft be made more silent, fuel-efficient and safer whilst increasing capacity on the ground and in the air? How can you ensure that satellites remain at a constant temperature so they can continue to function efficiently?

A staff of 650 employees develops new technologies, combining disciplines such as aircraft engineering, electrical engineering, mathematics, physics, information science and psychology. NLR has state-of-the-art facilities such as wind tunnels and interconnected aircraft and air-traffic control radar and tower simulators. NLR targets the entire lifecycle of aircraft: from research, via design, servicing and maintenance to modernisation in both civil and military aviation. NLR publishes about 600 reports, including some 40 technical publications annually.

NLR is the Dutch knowledge enterprise for identifying, developing and applying advanced technological knowledge in the area of aerospace. NLR is also committed to being the most competitive knowl-

4. http://www.nlr.nl/index.php (accessed 12 October 2012).

Figure 11.4
Areas of work: National Aerospace Laboratory, The Netherlands

Air transport safety Airport noise and flight track monitoring Aircraft noise policy Aircraft noise sources Airspace capacity Alternative energy and fuels	ATM and airports Avionics development and qualification Education and training Emission inventory and reduction Flight Testing Gas turbines Noise source identification	Operator performance Remotely piloted aircraft regulations Rotorcraft flight procedures Satellite navigation Simulation solutions for aircraft systems Third party risk Unmanned rotorcraft systems

edge organisation for the Dutch aerospace sector in Europe (with the best price-quality ratio). NLR has (inter)national collaboration with aerospace enterprises and miscellaneous small and medium-sized companies, with KLM-Air France, Schiphol and LVNL, universities, the Netherlands Aerospace Council, the regions in the Netherlands with aerospace ambitions and with its counterparts DLR.

VTI (SWEDISH NATIONAL ROAD AND TRANSPORT RESEARCH INSTITUTE)[5]

VTI, the Swedish National Road and Transport Research Institute, is an independent and internationally prominent research institute in the transport sector. The Institute is a government agency under the Swedish Government. VTI's principal task is to conduct research and development related to infrastructure, traffic and transport. Areas of work include: pavement technology, infrastructure maintenance, vehicle technology, traffic safety, traffic analysis, people in the transport system, environment, planning and decision-making processes, transport economics and transport system. The knowledge that the institute provides gives a basis for decisions for players in the transport sector and in many cases finds direct application in both national and international transport policies. VTI conducts commissioned research in an interdisciplinary organisation. The institute also works with investigations, provides consultancy services, and performs different kinds of measurement and testing services. The institute also has a great deal of technically-advanced equipment and world-class driving simulators. There is also a laboratory for road materials and a crash test laboratory.

VTI's researchers participate in international research projects, principally in Europe, and in international networks and alliances. In Sweden, VTI collaborates with universities and other higher education institutions that conduct related research and education. VTI has about 200 employees and is located in Linkoping (head office), Stockholm, Gothenburg and Borlänge.

5. http://www.vti.se/en/om-vti/about-vti/. Accessed 21 November 2012.

KNOWLEDGE GENERATION AND GOVERNMENT MINISTRIES.

US DEPARTMENT OF TRANSPORTATION

There are many different structures for knowledge generation within government ministries. The objectives and plans of the Department Transportation of USA (USDOT) are given here as an illustration (USDOT, 2012).

USDOT's operating administrations are:

- Federal Aviation Administration (FAA)
- Federal Highway Administration (FHWA)
- Federal Motor Carrier Safety Administration (FMCSA)
- Federal Railroad Administration (FRA)
- Federal Transit Administration (FTA)
- Maritime Administration (MARAD)
- National Highway Traffic Safety Administration (NHTSA)
- Pipeline and Hazardous Materials Safety Administration (PHMSA)
- Research and Innovative Technology Administration (RITA)
- Saint Lawrence Seaway Development Corporation (SLSDC).

All of these agencies have a role to play in capacity development, research and development, and product innovation (RD&T) and many of these agencies employ more than a hundred professionals. Though the US Federal Government owns and operates only limited portions of the nation's transportation system, the USDOT has a responsibility for RD&T investment as one of the most effective ways the Federal government can contribute to the improvement of the transportation system. USDOT role for RD&T includes:

- Developing transportation research policy.
- Creating incentives for collaborative cross-modal research focusing on the interfaces of individual modes.
- Expanding the knowledge base by investing in university transportation centres (UTCs) that advance innovation, research, education, and

technology transfer; and prepare the future transportation workforce to face the challenges of the 21st-century transportation network.
- Encouraging multidisciplinary research.
- Stimulating innovation in transportation services and products through targeted partnerships with key entities, such as States, Metropolitan Planning Organisations (MPOs), transit operators, ports, counties, cities, academic institutions, and private companies or organisations.
- Funding long-term, exploratory research as well as short-term applied research.
- Identifying, facilitating and supporting the deployment of emerging technologies and best practices.
- Developing and disseminating tools and techniques that foster greater, more efficient use of technology and innovation.

In its future plans, USDOT includes crosscutting RD&T priority areas so that it encourages collaboration across operating administrations and government agencies, and promotes consultation and partnership with stakeholders in industry and academia. The development of cross-modal research projects will require discussions with stakeholders, rigorous examination of cross-cutting transportation issues and problems, and the incorporation of ideas from peers and experts within the research, asset owner, and user communities. USDOT collaborates with other agencies, such as the Environmental Protection Agency (EPA), Department of Energy (DOE), Housing and Urban Development (HUD), Department of Homeland Security (DHS), and the Department of Defense (DOD) (including the US. Army Corps of Engineers), to provide the most effective transportation systems. In addition to collaborating with its Federal partners, the US DOT collaborates with and performs joint research with stakeholders and partners across the entire transportation sector, including State and local agencies, academia, industry, and not□for□profit institutions, such as the American Association of State Highway and Transportation Officials (AASHTO), the Transportation Research Board (TRB), and the American Public Transportation Association (APTA).

USDOT's Research Clusters include senior research professionals from each operating administration. Cross-modal research working groups and online forums have been established within each Research Cluster. There are Research Clusters in the following areas:
- Infrastructure and Materials
- Human Factors
- Energy Sustainability
- Risk-Based Analysis to Address Safety Issues
- Data-Driven Decision Making
- Multimodal Intelligent Transportation Systems
- Liveability
- Modelling and Simulation
- Positioning, Navigation, and Timing
- Transportation Implications for an Aging Population and Those with Special Needs
- System Resilience and Global Logistics
- Policy Analysis
- Travel Behaviour
- Economics

STATISTICS AND ANALYSIS

In the UK, transportation statistics are collected, analysed and published by the Department for Transport.[6] The statistics are based on two main sources—data gathered from statistical surveys, and data extracted from administrative or management systems. A number of administrative sources are currently used by the Department for Transport statistical teams to compile official statistics. In all cases where such sources are used, professional statisticians are involved in quality assuring the use of the data for statistical purposes. Examples include data from the Driver Vehicle Licensing Agency (DVLA) to produce Vehicle Registration and Licensing Statistics, and by taking a sample of vehicles from DVLA records to produce statistics for road freight statistics. Estimates of vehicle excise duty evasion are also produced using the administrative data held by the DVLA. The Maritime and Coastguard Agency (MCA) Seafarer Documentation System is used as an input to UK Seafarer Statistics. The Authority's main requirements are set out in the third Protocol attached to their Code of Practice for Official Statistics and the databases include:
- Journey time database, local authority managed roads
- Journey time database, Highways Agency managed roads
- Maritime and Coastguard Agency Training Database
- Maritime and Coastguard Agency Seafarer Documentation System
- National Road Condition Database
- DVLA Vehicle Information Database
- Driving Standards Agency: Testing and Registration System

The Department has also set up a Transport Statistics User Group that aims to:
- identify problems in the provision and understanding of transport statistics and to discuss solutions with the responsible authorities
- provide a forum for the exchange of views and information between users and providers
- encourage the use of transport statistics through greater publicity
- facilitate a network for sharing ideas, information and expertise

6. https://www.gov.uk/statement-of-administrative-sources-for-official-statistics-published-by-the-department-for-transport. Accessed 15 November 2012.

The group holds regular seminars on topical subjects connected with the provision and/or use of transport statistics. In addition, a CLIP Transport Statistics (CLIP-TS) has been established, which is a sub-group of the Central and Local (Government) Information Partnership (CLIP), the main forum for discussion between central and local government on statistical matters. Its formal terms of reference are:

- to act as a conduit for wider dissemination of transport statistics which are of particular interest to local authorities
- to discuss transport statistics of interest to either side that are not dealt with by other topic specific groups. In particular
- monitoring of transport and related plans
- sub-national statistics (including neighbourhood statistics)
- to identify gaps in coverage and investigate methods of filling these
- to investigate methods of using local authority data to satisfy local, regional and national needs

The membership of CLIP-TS includes representatives from the Local Government Association, Association of London Government, Passenger Transport Authorities, Shire Counties, Transport for London and the Department for Transport.

FUNDING RESEARCH AND TRAINING IN ACADEMIC INSTITUTIONS

USDOT UNIVERSITY TRANSPORTATION CENTRES (UTCS)[7]

In the US, The Safe, Accountable, Flexible, Efficient Transportation Equity Act, enacted on 10 August 2005, authorised up to $ 76.7 million (Rs 415 crore) per year from central funds for grants to establish and operate up to 60 University Transportation Centres (UTCs) throughout the US. Twenty of these centres were competitively selected during 2006. The University Transportation Centres (UTC) programme, initiated in 1987 under the Surface Transportation and Uniform Relocation Assistance Act, authorised the establishment and operation of transportation centres in each of the 10 standard federal regions. The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) reauthorised the UTCs for an additional six years and added four national centres and six University Research institutes (URI). The mission of the 14 UTCs was to advance US expertise and technology transfer. The six URIs each had a specific transportation research and development mandate.

In 1998, the Transportation Equity Act for the 21st Century (TEA-21) reauthorised the UTC Program for an additional six years and increased the total number of Centres to 33. In addition to the ten regional Centres, which were to be selected competitively, TEA-21 created 23 other Centres at institutions named in the Act. TEA-21 established education as one of the primary objectives of a University Transportation Centre and institutionalised the use of strategic planning in university grant management.

Vision: Internationally recognised centres of excellence, fully integrated within institutions of higher learning, that serve as a vital source of leaders who are prepared to meet the nation's need for safe, efficient and environmentally sound movement of people and goods.

Mission: To advance U.S. technology and expertise in the many disciplines comprising transportation through the mechanisms of education, research and technology transfer at university-based centres of excellence.

Goals: (1) Education: a multi disciplinary program of course work and experiential learning that reinforces the transportation theme of the Centre. (2) Human Resources: an increased number of students, faculty and staff who are attracted to and substantively involved in the undergraduate, graduate and professional programs of the Centre. (3) Diversity: students, faculty and staff who reflect the growing diversity of the U.S. workforce and are substantively involved in the undergraduate, graduate and professional programs of the Centre. (5) Research Performance: an ongoing program of basic and applied research, the products of which are judged by peers or other experts in the field to advance the body of knowledge in transportation. (6) Technology Transfer: availability of research results to potential users in a form that can be directly implemented, utilised or otherwise applied.

A UTC must be located in the United States or territories. It may be a single university or a consortium of two or more universities. Each Centre is required to obtain matching funds from non-federal sources. National and Regional UTCs must obtain matching funds in an amount at least equal to the US DOT grant amount. The amount of funds to be disbursed are reflected in the 2013-2014 call for proposals:

- Five National UTCs, up to $3.0 million (Rs 160 million) per Centre per fiscal year;
- Ten Regional UTCs, one of which must be dedicated to comprehensive transportation safety, up to $2.75 million (Rs 150 million) per Centre per fiscal year; and
- Up to 20 Tier 1 UTCs, up to $1.5 million (Rs. 80 million) per Centre per fiscal year.

UNIVERSITY RESEARCH CENTRES

DALIAN MARITIME UNIVERSITY, CHINA (DMU)[8]

DMU was created in 1953 through the amalgamation of three merchant marine institutions: Shanghai Nautical College, the Northeast Navigation College and Fujian Navigation School. In 1960, DMU was designated a national key institution of higher education. Later in 1983, the Asia-Pacific Region Maritime Training Centre was established at DMU by the United Nations Development Program (UNDP), and the IMO and in 1985 a branch of the World Maritime University (WMU) was established.

The University specialises in Maritime research and training with the following departments: 1. Naviga-

7. http://www.rita.dot.gov/utc/about. Accessed 15 November 2012.6
8. http://english.dlmu.edu.cn. Accessed 15 November 2012.

tion College, 2. Marine Engineering College, 3. Information Science and Technology College, 4. Transportation Management College, 5. Transportation & Logistics Engineering College. Over the past few decades it has broadened its scope and in addition established the following schools and departments: School of Law, Environmental Science and Engineering College, Humanities and Social Sciences College, School of Foreign Languages, Department of Mathematics, Department of Physics, Department of Physical Education, Continuing Education College.

The University includes the following special research Centres: Waterway Transportation Regulations Institute, International Maritime Law Research Centre, Ship Automation and Simulation Institute, Environmental Information Institute, Marine Environment Research Centre, Ocean Development and Management Research Centre, Marine Transportation Safety Institute, Waterway Transportation Planning and Design Institute, International Shipping Human Resource Institute, Transportation Economy Institute, Ship Electromechanical Equipment Institute, High Performance Ceramics Institute, Ship Power Engineering Institute, China Navigation History Documentation Research Centre.

MONASH UNIVERSITY ACCIDENT RESEARCH CENTRE, AUSTRALIA

The Monash University Accident Research Centre (MUARC) was established in 1987 and is Australia's largest transport safety research centre. Research, consultancy and training include safety across all modes of transport. Since our founding we have developed research-based solutions that have led directly to making Australians safer - and have made us an acknowledged leader in the field. The Centre works with a number of key stakeholders including VicRoads, the Transport Accident Commission, the Department of Justice, and Victoria Police. The work is conducted across six priority areas:

- Behavioural safety science
- Human factors
- Injury analysis and data
- Global engagement
- Regulation and in-depth crash investigations
- Safe system strategies and road infrastructure

MUARC is a part of the Monash Injury Research Institute where around 100 researchers and postgraduate students work across a range of specialised areas, including: biostatistics, computer science, engineering, epidemiology, human factors Medicine, psychology, public health, statistical analysis.

INSTITUTE OF TRANSPORTATION STUDIES AT THE UNIVERSITY OF CALIFORNIA, BERKELEY (US)[9]

The Institute was created as an Organised Research Unit in 1948 by the California state legislature in response to the deferred maintenance of transportation facilities during World War II. Its mission was to conduct research and provide instruction to a new generation of transportation professionals. More than 100 graduate students pursuing master's degrees and PhDs currently study there. The Institute's programs receive an average of $20 million in extramural funds each year, one of the largest such totals at the University for a research facility or academic department, and leverages its core state funding by a ratio of about 20:1.

ITS Berkeley is home to seven transportation research centres:

- California Partners for Advanced Transit and Highways (PATH) is the one of the world's largest programs for intelligent transportation research. It has recently merged with California Centre for Innovative Transportation (CCIT)
- National Centre of Excellence for Aviation Operations Research (NEXTOR) is the nation's leading centre for aviation research
- University of California Pavement Research Centre (UCPRC), is an international authority on pavement materials and management
- Safe Transportation Research and Education Centre (SafeTREC)—formerly Traffic Safety Centre—is devoted to the reduction of transportation system related fatalities and injuries through education and research
- Transportation Sustainability Research Centre (TSRC) focuses on six major research areas that include advanced vehicles and fuels, energy and infrastructure, and goods movement
- UC Berkeley Centre for Future Urban Transport (Volvo Centre) concentrates on the interplay of technology and policy for urban transportation

University of California Transportation Centre (UCTC), a multi-campus research unit is currently headquartered at ITS Berkeley.

THE INSTITUTE FOR TRANSPORT STUDIES, UNIVERSITY OF LEEDS (UK)[10]

The Institute's primary purpose is to advance the understanding of transport activity, operations and use, and to develop skills and best practice among transport professionals and decision makers. The history of ITS goes back more than forty years and the University of Leeds first offered a transport Masters programme in 1965. The Institute was formally established in 1972. The Institute is the UK's largest single academic group providing transport courses and training. In a typical year there are around 500 students taking undergraduate modules, 80 students on Masters programmes, up to 40 registered PhD students, and dozens of delegates participating in short courses.

9. http://www.its.berkeley. Accessed 15 November 2012.
10. http://www.its.leeds.ac.uk/about/. Accessed 15 November 2012.

The research at ITS is sponsored by a variety of organisations, including the UK Department for Transport, the European Commission, and the Engineering and Physical Sciences Research Council. ITS has approximately 50 academic/research staff and about a dozen support staff. The staff come from a wide variety of background disciplines, including economics, engineering, geography, mathematics, computing, psychology and social science. ITS staff have provided expert advice to international organisations such as the World Bank, the European Commission and the International Transport Forum, to national governments around the world and to UK entities such as the House of Commons Transport Select Committee.

OVERALL SYSTEMIC LESSONS

International experience offers several relevant lessons for building expertise and a professional community. First, it is important to establish transport planning as a high-status occupation and applied science makes it easier to attract ongoing political and financial support as well as some of the most competent professionals. In Europe, the Commissioner of Transport is often selected by the President to be one of the Vice-Presidents of the European Commission, a designation that conveys little real power but signals an important appointment and comes with a higher salary.

Boarnet (2011) argues that the ability of the National Advisory Board of Highway Research (1920) and its successors, the Highway Research Board (1925) and Transportation Research Board (1974) to create a strong culture of cutting edge research and attracting top engineers was in part due to its position as part of the National Research Council (NRC). The NRC is the United States' top science, engineering, and medicine advisory body, so the membership signalled that transportation research was a high priority rather than a low-status applied version of civil engineering. The Transportation Research Board continues to be one of just five divisions of the NRC as well as one of the most specifically defined. Similarly, merging the HRB transport research and data module within the premier data collection effort, the U.S. Census, in 1956 reiterated the importance of transport research in US policy.

The Indian structure of having CRRI as part of the CSIR, with the Prime Minister as President and the Minister of Science and Technology as Vice President, could be seen as superficially similar to the positioning of transportation research within the NRC. However, CSIR is associated with one of several 'science policy' Departments within the Ministry of Science and Technology (the Department of Scientific and Industrial Research, distinct from the Department of Science and Technology, the Department of Biotechnology, etc) in contrast to the NRC's position as a science policy advisory body for all science and engineering related questions. The CRRI also operates more like a government department than a node in larger professional ecosystem of university departments, think-tanks, and other employers of independent researchers.

Second, it is important to decentralise the institutional system and build networks. The Transportation Research and Innovation Portal (www.transport-research.info) is one example of a platform for bringing together research and datasets across a federation (the 'European Research Area') as well as providing information on events that help foster exchanges between the community of experts. Other countries visited as part of the 2008 FHWA study tour used universities and non-government research institutions as a way to encourage work with a broad perspective land, infrastructure, energy, and social outcomes that might not otherwise be undertaken by a particular Ministry. The report also noted, 'host countries' research programs incorporated academic and industry participation earlier in the research process than those of the United States. In the host countries there is a continuous flow that incorporates collaboration throughout the research process—from problem definition (which may include participation in establishing the research framework) through the conduct of the research and the delivery of research products.'

In the US, the fact that National Association for Biomedical Research (NABR), HRB and Transportation Research Board (TRB) NABR/HRB/TRB funded studies by other agencies, states, and universities rather than doing the work in-house had significant long-run benefits for policy. It meant that the program build up a regionally dispersed, diverse group of experts who shared a common professional network. Boarnet (2011) argues that this was one of the factors that allowed the United States to quickly create functional national and state agencies as new transportation needs became apparent. The tradition continues today with the Research and Innovative Technology Administration's funding of University Transport Centres and regional Transport Knowledge Networks. The distribution of funds for UTC is designed to be balanced across regions, but otherwise merit-based, fostering competition among researchers to establish strong incentives for excellence.

The funding also enabled the NABR/HRB/TRB to actively manage the portfolio of research to support state-level experiments and disseminate successful results across states, as well as to set standards for data collection that improved quality and comparability of locally-generate statistics. The Bureau of Public Roads, for example, cooperated with Chicago and Cleveland in their landmark local and regional traffic counting studies in the 1920s, and then encouraged other states to follow. Eleven other states had traffic counting efforts underway by 1930. (Seely, 1987, summarised in Boarnet, 2011).

Third, it is important to encourage transport stakeholders to learn by doing. FHWA (2008) found that several of the countries studied encourage 'collaborative innovation'–research partnerships between academia and parts of government to design programmes eligible for funding. Similarly, the United States' Bureau of Public Roads developed national programmes based on reviewing states' suggestions using transparent analytical criteria. The states that were more successful in proposing technically strong projects were thus better able to shepherd their priorities through the system to obtain concrete rewards for building capacity to site and justify roads. Boarnet (2011) argues that the collaborative approach paid off in quick implementation of the plan: 'Possibly more importantly, the decades-long effort by the BPR to develop and disseminate knowledge-based approaches to highway planning and construction had built a professional community that was ready to quickly build the national network, per accepted methods of analysis and federal standard-setting, once political questions had been settled'.

The United States' Bureau of Public Roads used transparent criteria to review states' suggestions. States that were more successful in proposing concrete projects were able to shepherd their priorities through the system

INDIAN CONTEXT

EXISTING INSTITUTIONS AND ORGANISATIONS

RAIL TRANSPORT

A. Institutions under the Ministry of Railways

a. Indian Railways Institute of Civil Engineering (IRICEN), Pune

IRICEN was established in 1959 when a 'Permanent Way Training School' was set up at Pune to provide in-house training to freshly recruited civil engineers of Indian Railways. Over the years, advancement in track and bridge technology led to the upgrading of the institute to cover track, bridges and other modules that a railway civil engineer encounters.
Professional staff: 16 (mostly BE and ME level)

b. The Indian Railways Institute of Mechanical & Electrical Engineering (IRIMEE), Jamalpur

IRIMEE is the centralised training institute of Indian Railways, for the training of officers and supervisors of the Mechanical Engineering department. It conducts (a) Professional courses for serving officers and supervisors of Mechanical Department, (b) Training of IRSME probationers, (c) Theoretical and practical training of Special Class Apprentices (d) Technical Training of Apprentice Supervisors of all Indian Railways, (e) Special courses as per requirement for Non-Railway Organisations and Foreign Railways.
Professional staff: 27 (mostly BE and ME level)

c. Indian Railways Institute of Electrical Engineering (IRIEEN), Nasik Road

The Institute was set up in the year 1988 at Nasik Road, Maharashtra, for imparting training to Electrical Engineers of Indian Railways and other departments involved in train-operation. The Institute imparts training as a statutory measure to: (a) IRSEE Probationers, (b) Integrated orientation course for Group-B, (c) Senior Professional Development Course for Junior Administrative Grade, (d) Short term special courses conducted throughout the year on specialised subjects.
Professional staff: 9 (mostly BE and ME level)

d. Indian Railways Institute of Signal Engineering and Telecommunications (IRISET), Secunderabad

IRISET provides initial as well as advanced training, theory as well as hands on, in Railway Signalling and Telecommunications. It caters to the total training requirement of the officers and supervisors of the Signal and Telecommunication department of Indian Railways. IRISET is in the approved list of ESCAP and UNDP. It provides training in railway signalling and telecommunications to private and public sector enterprises as well.
Professional staff: 21 (mostly BE and ME level).

e. National Academy of Indian Railways (NAIR), Vadodara

NAIR functions as the apex training institute for the officers of all departments of Indian Railways in general and Accounts, Personnel, Stores and Medical departments in particular. The Academy runs training programmes for officers of all disciplines and all grades right from Probationers to General Managers. Around 2,500 officers participate in various training programmes each year. The duration of programmes varies from one week to ten weeks. Managers of a few public sector undertakings, other ministries of the government and a few managers from railway systems abroad also attend training programmes in this college.
Professional staff: 25 (mostly BE and ME level).

f. Indian Railway Institute of Transportation Management (IRITM), Lucknow

The institute is a training centre for probationary officers of the Indian Railway Traffic Service (IRTS). The training module includes, planning, financing and management of transport infrastructure, transportation and logistics management, operational

practices, commercial principles, transport economics, information technology et al. The institute also imparts advanced training to in service railway officers in these areas. Besides, it also functions as a research centre in Public-private Partnership and as an accident investigation cell.
Professional staff: 7

g. Indian Railway Institute of Financial Management (IRIFM), Secunderabad
It is being set up to impart structured and professional training to finance and accounts officers of Indian Railways in contemporary areas and equip them with necessary skills on a regular basis to enable them to face emerging challenges and tap opportunities for strengthening the finances of the organisation.

B. Academic institutions
a. The Centre for Railway Research (CRR)
CRR was set up at Indian Institute of Technology Kharagpur based on the MoU signed between the Ministry of Railways, Government of India and Indian Institute of Technology Kharagpur on 13 February 2010, to develop a long-term framework for research collaboration. This is the first such research centre set up in an academic institute with direct and full funding by the Indian Railways. The following have been identified as core areas of research focus:

- Advanced Materials and Manufacturing
- Heavy Haul Technology
- High Speed Rail
- Advanced Maintenance and Operation

b. Railway Technology Cell at Indian Institute of Technology Kanpur
This cell has been established in collaboration with RDSO to handle projects related to development of a detector for wheel flats, finite element method (FEM) analysis of wheels and geo-technical problems such as field validation of design methodologies for rehabilitation of unstable structures and strengthening of existing structures for heavier axle loads.

AIR TRANSPORT

A. Directorate General of Civil Aviation
DGCA is the regulatory body governing the safety aspects of civil aviation in India. Its functions include:

1. Registration of civil aircraft
2. Formulation of standards of airworthiness for civil aircraft registered in India and grant of certificates of airworthiness to such aircraft
3. Licensing of pilots, aircraft maintenance engineers and flight engineers, and conducting examinations and checks for that purpose
4. Licensing of air traffic controllers
5. Certification of aerodromes and CNS/ATM facilities
6. Maintaining a check on the proficiency of flight crew, and also of other operational personnel such as flight dispatchers and cabin crew
7. Granting of Air Operator's Certificates to Indian carriers and regulation of air transport services operating to/from/within/over India by Indian and foreign operators, including clearance of scheduled and non scheduled flights of such operators
8. Conducting investigation into incidents and serious incidents involving aircraft upto 2250 kg and and taking accident prevention measures including formulation of implementation of Safety Aviation Management Programmes
9. Carrying out amendments to the Aircraft Act, the Aircraft Rules and the Civil Aviation Requirements for complying with the amendments to ICAO Annexes, and initiating proposals for amendment to any other Act or for passing a new Act in order to give effect to an international Convention or amendment to an existing Convention
10. Coordination of ICAO matters with all agencies and sending replies to State Letters, and taking all necessary action arising out of the Universal Safety Oversight Audit Programme (USOAP) of ICAO
11. Supervision of the institutes/clubs/schools engaged in flying training including simulator training, AME training or any other training related with aviation, with a view to ensuring a high quality of training
12. Granting approval to aircraft maintenance, repair and manufacturing organisations and their continued oversight
13. To act as a nodal agency for implementing Annex 9 provisions in India and for coordinating matters relating to facilitation at Indian airports including holding meetings of the National Facilitation Committee
14. Rendering advice to the Government on matters relating to air transport including bilateral air services agreements, on ICAO matters and generally on all technical matters relating to civil aviation, and to act as an overall regulatory and developmental body for civil aviation in the country
15. Coordination at national level for flexi-use of air space by civil and military air traffic agencies and interaction with ICAO for provision of more air routes for civil use through Indian air space

The Centre for Railway Research at IIT Kharagpur, funded by Indian Railways, focuses on advanced materials and manufacturing, heavy-haul technology, high-speed rail and advanced maintenance and operation

16. Keeping a check on aircraft noise and engine emissions in accordance with ICAO Annex 16 and collaborating with the environmental authorities in this matter, if required
17. Promoting indigenous design and manufacture of aircraft and aircraft components by acting as a catalytic agent
18. Approving training programmes of operators for carriage of dangerous goods, issuing authorisations for carriage of dangerous goods, etc
19. Safety Oversight of all entities approved/ certified/ licensed under the Aircraft Rules 1937.

B. CSIR National Aerospace Laboratory

National Aerospace Laboratories (NAL), a constituent of the Council of Scientific and Industrial Research (CSIR), India, is the only civilian aerospace R&D laboratory in India. CSIR-NAL is a high-tech oriented institution focusing on advanced topics in aerospace and related disciplines and has a mandate to develop aerospace technologies with strong science content, design and build small and medium-size civil aircraft and support all national aerospace programmes.

CSIR-NAL has many advanced test facilities (many of them recognised as National Facilities) and has a strength of 1,100 with 400 scientists, 460 technical staff and 160 administrative staff. CSIR-NAL has also provided value-added inputs to all national aerospace programmes. CSIR-NAL mandate is to develop aerospace technologies with strong science content, design and build small and medium-sized civil aircraft, and support all national aerospace programmes.

CSIR-NAL activities involve the design, development, manufacturing and certification of small civil aircraft, the only such centre in the country. Major projects completed/ in progress include certification of a two seat ab-initio all-composite aircraft HANSA-3 (15 aircraft built so far); a fourteen seat light transport aircraft SARAS, that is presently under development (two prototypes built and test flown; a production standard aircraft with CFC wing under assembly for flight testing and final certification); and the development of a new five seat general aviation aircraft C-NM5 in association with Mahindra Aerospace Pvt Ltd, Bangalore, of the Mahindra corporate group. Marking the milestone event for India's first public-private partnership in aircraft development, the C-NM5 successfully completed its maiden flight at Australia on 1 September 2011. CSIR-NAL is the lead agency identified by the Government of India for carrying out feasibility study for the development of a National Civil Aircraft (70 and 90) seater for regional connectivity.

Academic Departments

Institutions with special departments for aerospace engineering include:

- Indian Institute of Science Bangalore
- Indian Institute of Technology Kanpur
- Indian Institute of Technology Kharagpur
- Indian Institute of Technology Chennai
- Indian Institute of Technology Mumbai

These departments offer courses from bachelor's to PhD level, but are largely confined to engineering aspects of aviation.

WATER TRANSPORT

A. Indian Maritime University

The Indian Maritime University, came into being through an Act of Parliament (Act 22) on 14 November 2008 as a Central university. The objectives of the University are to facilitate and promote maritime studies, training, research and extension work with focus on emerging areas of studies like oceanography, maritime history, maritime laws, maritime security, search and rescue, transportation of dangerous cargo, environmental studies and other related fields. The IMU has its regional campuses at Chennai, Mumbai, Kolkata, Visakhapatnam, Kochi and Kandla. IMU presently offers port and marine short-term courses and degree courses in Nautical Science, Marine Engineering, Naval Architecture and Ocean Engineering, Ship Building and Repair. The Indian Maritime University encompasses under its fold the following seven premier government institutions

a. National Maritime Academy, Chennai
b. TS Chanakya, Mumbai
c. Lal Bahadur Shastri College of Advanced Maritime Studies and Research, Mumbai
d. Marine Engineering Research Institute, Mumbai
e. Marine Engineering Research Institute, Kolkata
f. Indian Institute of Port Management, Kolkata
g. National Ship Design and Research Centre, Visakhapatnam
h. IMU Kochi Campus
i. IMU Kandla Campus

ROAD TRANSPORT

The Central Road Research Institute (CRRI), Delhi.

CRRI is a national research organisation for highways traffic and transport planning and all other allied aspects. It carries out R&D in the areas of road and road transportation. CRRI was established in 1952 as a constituent laboratory of the Council of Scientific and Industrial Research (CSIR). The major R&D programmes of CRRI related to the entire spectrum of pavement design and performance, road condition monitoring, pavement deterioration modeling, maintenance planning and management, pavement management system, landslide management and hazard mitigation, geotechnical investigations and ground improvement techniques, traffic engineering and management and improved transportation planning technology for emerging urban needs. Besides these, applied research in the area of planning and engineering aspects of rural roads, material characterisation, pavement evaluation, highway instrumentation, conditioning monitoring and rehabilitation of bridges, design of high embankments and reinforced earth walls, subways and underpass construction, transportation planning, traffic engineering, road safety and environmental problems, form an integral part of the programme of the institute. The Institute employs about 60 scientists in eight departments.

B. Indian Academy of Highway Engineers (IAHE), NOIDA (UP)

IAHE is the apex training institute set up to address the training needs of Highway and Bridge Engineers in the country. It was set up as an Institute in the year 1983 with the primary objective to fulfill the need for training of highway engineers at the entry level and during the service. Its objectives include:

- To impart training to engineers and professionals of Highway Sector at entry level and during service at different levels of central and state governments, public and private sectors.
- To help highway sector engineers build up character and develop an all-round personality as a part of Human Resource Development
- To assist various organisations in developing their training institutes and training of their faculty
- To promote cooperation and foster exchange of knowledge, ideas and experience in all the sphere of highway engineering among engineers in India and abroad
- To imparts training to Highway sector professionals from India and abroad (SAARC countries, Afro-Asian countries under schemes pertaining to IAFS, ITEC, Colombo Plan, etc.)

IAHE has officers on deputation form the government and uses experts available in the area for delivering lectures in the raining programmes. There is no research activity at the IAHE.

C. Central Institute of Road Transport (CIRT), Pune

CIRT is funded by the Government of India and offers management development programmes covering general management, transport operations and maintenance engineering. The programmes are meant for practicing managers in state transport undertakings, other organisations operating transport services besides road transport officials. All programmes are residential and their duration ranges from one week to four weeks. In addition, the Institute undertakes consultancy and research assignments on transport policy, transportation planning, traffic management, maintenance management, materials management, human resource management and management information systems. CIRT employs about 15 professionals mostly at bachelor's and master's level.

D. Academic Institutions

Most Indian Institutes of Technology (IITs), National Institutes of Technology (NITs), and many state universities and private institutes offer courses in Transportation Engineering based in the civil engineering department. Most IITs, Indian Institute of Science Bangalore, and some NITs also offer masters degrees in transportation engineering, again in the civil engineering department. Institutions offering Masters programmes in Transportation Planning include Birla Institute of Technology Ranchi, CEPT University Ahmedabad, and School of Planning and Architecture Delhi.

Over the past few years, four centres of excellence for urban transport have been recognised and funded by the Ministry of Urban Development (MoUD) and one by the Government of Karnataka (GoK):

- Transportation Research and Injury Prevention Programme (TRIPP), Indian Institute of Technology Delhi (MoUD)
- Centre of Excellence in Urban Transport, Indian Institute of Technology Madras (MoUD)
- Centre for Urban Transportation Studies, NIT Warangal (MoUD)
- Centre for Excellence in Urban Transport, CEPT University Ahmedabad (MoUD)
- Centre for Infrastructure, Sustainable Transportation and Urban Planning (CiSTUP), Indian Institute of Science Bangalore (GoK)

These Centres have been awarded grants that provide research support of the order of Rs 20-30 million per year, but no support has been provided for hiring extra faculty members or building significant infrastructure or laboratories.

INDEPENDENT TRANSPORT RESEARCH INSTITUTIONS

Asian Institute of Transport Development (AITD)

The National Transport Policy Committee (1980) in its Report had observed that transport studies had been comparatively neglected in the country and there was no institution that could undertake studies on transport problems from a common outlook and approach. It had also emphasised the need for augmenting training facilities for building capacity to cater to the growing requirements of evolving, implementing and monitoring the transport projects, plans and policies. As a result, the Asian Institute of Transport Development (AITD) came into being in 1989 as an independent, not-for-profit, inter-disciplinary centre devoted to research, human resource development and regional cooperation in

Capacity building comprises three challenges: training individuals, building systems for R&D to update capacity, and ensuring that these individuals have the ability and incentives to be productive within teams and organisations. India must not only increase supply of capacity, it must also ensure a strong demand side

infrastructure sector with special focus on transport and logistics.

The Institute has since grown professionally and gained credentials both at national and regional levels. It has been granted special consultative status by the United Nations. It has also acquired a pan-Asian footprint through its activities aimed at capacity building, environmental concerns and development of regional transport corridors.

The Institute has collaborated with centres of excellence dealing with critical areas in transport sector, for example Transport Research and Injury Prevention Programme (TRIPP) at IIT Delhi. It also provides substantial support to regional country groupings–SAARC, BIMSTEC, Mekong Ganga Cooperation etc.–in human resource development.

The Institute has carried out inter-disciplinary studies dealing with intermodal choices, environmental and social sustainability, poverty alleviation, regulatory structures, funding of infrastructure etc. The Planning Commission has drawn on its expertise and knowledge while formulating the Five Year Plans and long-term policy perspectives.

FUTURE REQUIREMENTS

'Capacity building' comprises three challenges: training individuals, building systems for research and development to update capacity, and ensuring that these individuals have the ability and incentives to be productive within teams and organisations. India must not only increase the supply of capacity by expanding the number and quality of opportunities to study transport planning and allied fields, but it must also ensure a strong demand side. The effective 'demand' for capacity will depend on employment policies that attract these transport planners to public sector work as well as public expenditure and programmatic policies that encourage Ministries, state agencies, and metropolitan bodies to spend discerningly on capacity building. It will also need to invest in transport research so that training, decision support, and policy action improve over time and adapt to changing opportunities and challenges. Capacity building should also be designed to also support India's efforts integrate its many transport-related organisations with a common culture focused on transport systems across national, state, and metropolitan scales. This section discusses future requirements across these three dimensions.

SKILLS GAP

Little seems to be known about the extent and nature of the 'skills gap' in transport planning. Although all of the sector Working Groups of NTDPC were asked to 'assess the availability of human resources' and 'suggest measures for skill development and institutional capacity building for various stakeholders,' there is very little information in the Working Group reports on the scale or nature of training required.

The civil aviation and ports Working Groups provided some figures on the numbers and general skills required for the sector over the coming decade, but these are not broken down by level of government, region, or compared in detail to existing available personnel. However, the civil aviation Working Group report does highlight the magnitude of the problem faced: 'Closely related to safety in civil aviation is skill augmentation in its entire dimension. The task ahead would be of identifying the different categories of personnel required whether technical, managerial, pilots and cabin crew, trainers etc to meet the needs of airport development and operations…According to the Report of Working Group on Civil Aviation for formulation of 12th Five Year Plan (2012-17), the total manpower requirement of Indian carriers is estimated to rise from 62,000 in FY-2011 to 117,000 by FY-2017.'

The Working Group on urban transport gives some estimates of staff strength, but not broken down by skill. Railways and roads reports called for a 'training needs assessment' and a consultant to prepare a capacity building plan. There appears to be no information about the numbers and distribution of transport planning professionals familiar with GIS, impact assessment, traffic modelling, and other skills required to anticipate network needs.

What is needed is an organised approach to interdisciplinary policy-relevant research. For example, an integrated approach is needed to address transport related health impacts, from emission-related respiratory illness to injuries from traffic accidents. This can be done only if faculty members from various departments at the best institutions like IITs collaborate with government departments, industry bodies, international organisations, and other experts on research, teaching, applied projects, and on policy advice on developing urban transport systems, intercity connections, vehicles, and transport infrastructure plans. Researchers also need to collate and analyse available data to assess and report on the impact of transport infrastructure development and policies on freight patterns, mobility, congestion, and other performance indicators.

It would be worthwhile to strengthen and replicate such structures at high-quality research institutions in India to encourage and support research on other socio-economic impacts that the transport system could have. With sufficient core funding, these programs could also play an important role as data repositories for aggregating and managing information from various government and private sources. Active researchers, as users of data, are likely to have a stronger incentive to collect and maintain up to date databases than are individuals who are simply charged with building a database.

Current institutions that conduct interdisciplinary research on some of these areas include

- The Transport Research and Injury Prevention Programme (TRIPP) at IIT Delhi, which draws on faculty across academic departments, while developing a core expert team
- The Energy and Resources Institute (TERI), which, in its transport related research, focuses on issues related to energy and environment and draws on experts from its different departments
- The Asian Institute of Transport Development, which calls on experts from different fields to collaborate on research related to planning and policy issues with a focus on transport and logistics, often with an international perspective.

DATA REQUIREMENTS

There is very little reliable data available for intercity or urban passenger or freight travel patterns. In this situation infrastructure investment has to be done on a fire-fighting basis with little knowledge of long-term consequences on efficiency, or financial and environmental stability. Technology choices have to be based on hunches and influenced by powerful supplier lobbies. This situation is likely to get worse in the face of accelerated economic growth and urbanisation, as political and public pressure for provision of transportation services will demand quick fixes.

Analysis for transport governance rests on the following types of data, among others:

i. Transportation Planning and Management characteristics in cities and regions (encompassing institutions, policies, projects planned and under implementation, funding mechanism, taxation regime, etc.)
ii. Traffic Management characteristics in cities (including agencies, signal time details for signalised intersections, one-ways, etc.)

> Much of the Indian data needed for transport governance are scattered across agencies and departments, with no common geo-referencing and metadata standards

iii. Spatially referenced transportation network database for all modes: roadways, railways, airways and waterways (spatial).
iv. Mobility/Accessibility/Congestion index measurements for cities (see Bangalore Mobity Indicators 2008, for instance)
v. Commuter travel characteristics by all modes (modal split) across (time series):
    a. Cities-intercity commuting
    b. Within cities
vi. Freight transport characteristics by all modes (time series)
vii. Public transport characteristics (modes and supply details)
viii. Public terminal commuter characteristics (spatial and time series)
ix. Automobile registration database (time series)
x. Emissions and air quality characteristics (time series)
xi. Fuel consumption characteristics (time series)
xii. Accident characteristics across modes—no of accidents, fatalities, injuries (time series)
xiii. Demographic, economic, employment and density patterns of the region and/or cities
xiv. Land-use characteristics for key cities in question and their densities (spatial)

Many of these data exist, but are scattered across agencies and departments, without common georeferencing and metadata standards that allow them to be collated for system-wide analysis. The first step in building transport research capacity, or encouraging more research attention to transport issues, might be to lower the transactions costs of empirical research by collating and making public these kinds of data. India must also invest in decision support systems so that available capacity can actually be exercised for maximum effect. Geospatial Information System (GIS) expertise, for example, is wasted when available datasets on infrastructure or traffic are neither comprehensive nor spatially referenced. Decision support tools can also substitute for expertise in some cases by embedding rules of thumb in analytical algorithms. The IT backbone for decision support can also be an infrastructure for de facto integration of decision-making, by making data more easily shareable across departments, automating sharing, and automating some processes for common application across agencies, geographies, or levels of government.

CONVERTING INFORMATION INTO KNOWLEDGE

Second, the institutional framework must also be capable of converting information into transport knowledge A review of international practices in transportation research, training and development clearly shows that a large number of countries have established well-funded and professionally-staffed institutions at all levels and across disciplines. These institutions exist within government departments, as standalone institutions, within transport management organisations, and in universities and academic institutions (Annex 1). Many countries do not depend mainly on knowledge and technology transfer from other countries, even when there are peers at similar levels of income and styles of living. For example, though Australia is not very different from the US in per capita income or lifestyles, the Australian central and state governments have set up a large system with significant funding for knowledge generation and training. This is because most societies have realised that while basic theories, issues and technologies may be somewhat similar across nations, how they get applied and administered very often can be substantially different. In addition, priorities and strategies to be followed can vary dramatically depending on political structures and administrative models from place to place.

It is quite clear that there is already a great shortage of trained manpower and absence of institutional support for policy making and technology development in India. We do not have any institutions within government departments and operating agencies, universities centres or stand-alone institutions in any area of transportation that compare favourably with institutions reviewed in previous sections except for an institution or two like the National Aerospace Laboratory. The research centres at academic institutions are sub-critical in number of faculty members involved, and resources available. Except in a few centres, most of the academic activity is not interdisciplinary in nature, and there is almost a complete absence of involvement of professionals from the social sciences–economics, law, etc.

> The shift from public to private delivery with public facilitation actually places a greater burden on the public sector's project planning skills, especially ex-ante characterisation of risks in order to allocate them between partners

Most of these groups appear to have limited exchange with global transport researchers. Researchers are thus not placed in the kind of active, evolving research environment that many would view as important for innovation. The overall number of recognised experts seems small relative to the magnitude of the policy challenges. Non-governmental organisations such as EMBARQ (Mumbai and Bangalore), MapUnity (Bangalore), City Connect (Chennai, Bangalore, and Hyderabad) are also sources of policy expertise and networks of global experts, but are sometimes seen as advocacy groups rather than neutral parties.

NEW INSTITUTIONS FOR CAPACITY BUILDING

Management of transportation systems in the face of increasing energy costs and environmental pollution and threats of global warming requires that we set up new institutions and organisations at an accelerated and urgent basis for all transportation sectors. These are needed for skill development and knowledge generation for:

a. Planning
b. Management
c. Designing standards
d. Design of transport systems
e. Integration of policy options across transportation sectors
f. Dealing with environmental degradation and global warming issues

EXPERTISE FOR PUBLIC-PRIVATE PARTNERSHIPS

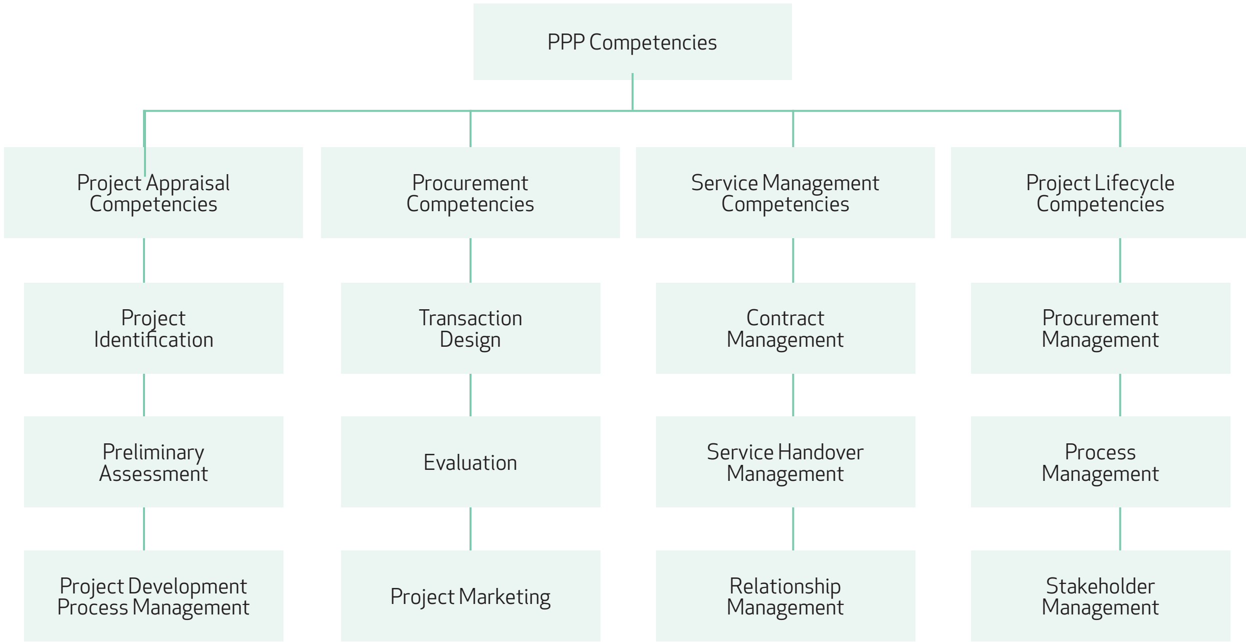
The move toward relying more extensively on public private partnerships and private provision of infrastructure is not unique to transport, but it is particularly common in roads, ports, airports and other transport infrastructure. This shift from public delivery to private delivery with public facilitation is often seen as a remedy for public sector weakness, but it actually places a greater burden on the public sector's project planning skills including especially ex-ante characterisation of risks in order to allocate these between partners. It also magnifies the consequences of poor project planning: mistakes in sequencing or delays in critical steps such as land acquisition can affect the allocation of costs between partners and lead to additional delays during dispute resolution. Figure 11.5 shows some of the individual capacities required for PPPs.

Many of the existing efforts to build capacities for PPPs have focused on building capacity for project appraisal and transaction design, both through training, lending of expert consultants, and creation of templates to allow relatively less-trained people to manage PPPs. However, the service management and project lifecycle competencies should not be overlooked.

RECOMMENDATIONS FOR INSTITUTION BUILDING

The following sections describe the effort necessary for setting up institutions and structures needed for planning, decision-making and implementation for the next two decades. This will require that funds be earmarked for these institutions as 1-2 per cent

Figure 11. 5
Capacities Required for Implementation of PPP Projects



Source: G. Devkar, PhD student, IIT Madras, 2013.

of investment for each transport sector. This is a very small amount to invest considering the challenges facing us. We have to start planning for these institutions now to catch up with other nations in a decade or so.

The number, size and type of institutions being recommended is based on international comparisons, in particular with countries with similar levels of development at present. As indicated earlier, India is significantly behind countries like China and Korea in knowledge production, skills, innovation and technology development at all levels and areas of transport operations. It has to be emphasised that scientific findings and innovation cannot be ordered. We must build capacity with a number of professionals in all fields so that a few of them may come up with path braking ideas in the future. The enormity of this task can be illustrated by the fact that in the US the Federal Government alone employs a few hundred professionals to work on road safety, where as in India the combined strength of such professionals in the central and state governments would be less than a handful.

International experience suggests that it takes more than a decade to build viable quality institutions. A demand has to be created for persons with expertise in these areas with availability of jobs in institutions. This sends a signal to academic institutions to start relevant academic programmes and for potential students to apply for the same. In the absence of a large number of such institutions good quality students do not apply for transportation related programmes even when they exist in some academic institutions. Even worse, the Indians being trained in foreign institutions on different aspects of modern transportation planning and implementation have no incentive to return to India as there is a dearth of employment opportunities that provide a meaningful work environment.

We present these institutions as distinct public and private entities, but collaboration is also important to ensure that transportation research is seen as neutral and credible, particularly if/as recommended action on route planning for road and rail, subsidies for passenger transport, air quality regulation, reinvigorating different forms of mass transport and investing in non-motorised transport takes place.

The Health Effects Institute is one example of an institutional design meant to produce credible research in a contentious setting. It was established to help overcome arguments between the US Environmental Protection Agency and the automobile industry over the impacts of automobile-related air pollution: both groups were separately funding studies, neither trusted each-others' selection of studies or examples, and the argument was playing out in public politics. The HEI was set up with equal funding from the EPA and the auto industry, and staffed with an independent board of directors pulled from eminent academic institutions (including the Presidents of Stanford University and Bell Labs). It performed wide-ranging reviews of existing literature on health impacts (to overcome each side's accusations of selection bias among studies) and funded independent research, which was then peer reviewed by external experts (to avoid claims of insider approvals).

STANDALONE NATIONAL INSTITUTIONS

Indian Institute for Transport Research (IITR)

The Institute would be responsible for research on all aspects of transport and logistics by all modes. It will be expected to play a leading role in national transport policy and technology development. The Institute may be set up under the Ministry of Science and Technology and would work closely with the Office of Transport Strategy (OTS)[11] recommended by the Committee. It would cover all modes and type of transportation by setting up departments covering aviation, national highways, urban transport, railways, maritime transport, inland water transport, environmental impact assessment, policy planning, extramural research, and statistical analysis.

The proposed Indian Institute for Transport Research will be responsible for research on all aspects of transport and logistics by all modes, and play a leading role in transport policy and technology development

IITR could develop four or five regional centres to focus on regional issues and coordination with regional authorities. At maturity, IITR should expect to employ about 300-500 professionals at the post-graduate level by the end of the 13th Five Year Plan period.

IITR would be responsible for:

1 Providing policy options and analysis to transport ministries (central and state), operating agencies and city governments.
2 Conducting cost effectiveness studies across different modes of transport and available technologies.
3 Conducting exploratory and future technology studies.
4 Providing a framework and modalities for interdisciplinary and inter-sectoral studies.
5 Identifying, facilitating, and supporting the deployment of emerging technologies and best practices.
6 International technology assessment
7 International collaboration
8 Funding research and establishing centres of excellence at academic institutions
9 Taking up studies for different transport ministries at central and sate level.
10 Identifying data needs and coordination with Indian Institute for Transportation Statistics.

A similar recommendation was made by the National Transport Policy Committee, 1980 as mentioned earlier, and AITD was set up as an independent non-government institution. The Planning Commission has extended its support to AITD, keeping in view the long-term role of the Institute in building human capital as also for providing research support on all aspects of transport and logistics. In future, the IITR could play the role for supporting and extending financial support for research to such institutions.

Indian Institute for Transportation Statistics (IITS)

IITS will be responsible for acquiring, preserving, managing, disseminating transportation data, statistical analysis and associated information for use by central, state and city transportation departments, researchers and any other concerned agencies. Its various roles would include:

- Coordinating with all national and state statistical organisations associated with collecting transport related data, especially the Office of the Registrar General & Census Commissioner and the National Sample Survey Organisation
- Serve as a central depository for data, statistics, research results and technical publications of all agencies dealing with various sectors of transport services.
- Department; and publicise, facilitate, and promote access to the information products and services.
- Publish an annual transport statistics database
- Conduct a national personal passenger and goods transportation survey every five years. This will include flows of people, goods and vehicles, social, economic, and environmental data, conditions that affect or are affected by the transportation networks for all modes of transport.
- Coordination with all agencies associated with transportation issues and IITR
- Funding studies and research in academic organisations

It would be responsible for synchronising other demographic and socio-economic data for the country. At the end of the 13th Five Year Plan IITS would have a staff of about 150-200 postgraduate professionals.

SCIENCE AND TECHNOLOGY CAPABILITY IN TRANSPORT MINISTRIES

RESEARCH INSTITUTIONS

Each Department associated with transport (air, water, road and railways) should establish a multidisciplinary research organisation for applied research on current concerns and future technology development:

11. Please see Chapter 5 on Institutions for Transport System Governance.

- Indian Institute for Aviation Research
- Indian Maritime and Water Transport Research Institute
- Indian Institute for Intercity Road Transport
- Indian Institute for Urban Transport
- Railway Research and Development Institute

By the end of the 13th Five Year Plan, each of these research institutes would have:

- 100-300 research professionals (60-70 per cent permanent employees of the institute and 30-40 per cent on deputation)
- Regional Centres for coordination with state and city governments
- Advanced laboratories for technology development and testing
- Statutory responsibility for setting standards and regulations

The service conditions at these institutions should be similar to those at CSIR and the Director General of each Institution with rank and facilities similar to those of at CSIR laboratories/Secretary to the Government of India. The Director Generals will report directly to the Minister of the appropriate Ministry. Terms of reference would be similar to those at the IITR, but with greater emphasis for applied work as per needs and requirements of each Department. We have recommended elsewhere (Volume II, Chapter 5, Institutions for Transport System Governance) the need to set up a unified Ministry of Transport. Once that happens, all these institutions would come under the umbrella of this Ministry and it would then be easier for these institutions to collaborate with each other more.

DEPARTMENT OF TECHNOLOGY DEVELOPMENT AND POLICY ANALYSIS

Each Transport Department must set up an internal Division of Technology Development and Policy Analysis. The Division must be staffed by 20-50 professionals headed by an officer of the rank of Additional Secretary to the Government of India. However, two-thirds of the professionals working in the Division would be permanent employees with service conditions same as those of scientists working in the CSIR, and one-third would be on deputation. The role of the Division Department would include:

- Liaison with IITR, IITS and with the respective ministerial research institution.
- Technology evaluation and assessment
- Data collection and analysis
- Responding to needs of operating agencies
- Funding research in academic institutions
- Outreach
- Organising scientific workshops and conferences
- Policy assessment and strategic planning
- Align areas of research with ministry goals.
- Investment policy regarding ministry R&D
- Track redundancy and duplication of effort

> At the state level, each ministry dealing with transport issues should establish a transport research department focusing on the special needs of the state

We have recommended elsewhere the establishment of an Office for Transport Strategy (OTS). Once such an office is established, these entities could work intensively with the OTS.

STATE AND CITY LEVEL INSTITUTIONS

a. All states should consider establishing State Institute for Transport Research (SITR) with objectives similar to the Indian Institute for Transport Research (IITR), but with greater focus on local issues. The SITR should include a special transport statistics division that would liaison with the Indian Institute for Transportation Statistics. At maturity these institutes should have a staff of 50-100 professionals.

b. At the state level, each ministry dealing with transport issues should establish a transport research department focusing on special needs of that state. The responsibility of the department would be to generate state level detailed plans, data needed for the same, evaluation of projects and policies, liaison with the Central Government, and funding of research projects at state level institutions and universities.

c. All megacities (population >5 million) must establish transportation planning research departments that could have responsibilities similar to state level units.

ACADEMIC CENTRES OF EXCELLENCE

At present, most of the academic programmes in India related to transport capacity appear to be much less integrated than the global norm. Outside of India, these tracks are often presented as specialisations within a single Transport Engineering programme (See Annex). Brazil's University of Sao Paulo, for example, offers a single Transport Engineering Masters with specialisations in Transport Infrastructure Planning and Management, Transport Infrastructure Construction, and Spatial Information Brazil. Transport and Sustainable Development as a combination seems to be most prevalent in Europe, perhaps reflecting that region's focus on transport policy as a part of climate change/environmental strategy. The London Centre for Transport Studies offers an MSc in Transport with specialisations in Business Management and Sustainable Development, as does the Paris Institute of Technology and the Institute of Transport Studies at University of Leeds. Australia's Planning and Transport Research Centre (PATREC) and South Africa's University of Capetown offer Transport Studies

Table 11. 4
Suggested Number of Academic Centres of Excellence

SUBJECT	NUMBER BY 2020	NUMBER BY 2030
Urban transport	20	40
Highways	20	40
Rail	15	30
Air	5	10
Water and marine	5	10

courses with a core focus on systems planning and clusters of electives in management and specialised planning topics. University of California, Berkeley offers a similar combination of core courses plus electives, in Transportation Engineering and Transports Systems Analysis.

Within India, this split seems to be between schools: specialised masters in transport planning within urban planning programs for the former and the latter training taking place in Civil Engineering departments. Specialised courses on transport management are within business schools, for example at the Indian Institute for Social Welfare and Business Management. Most of the courses are offered within particular departments, often urban planning or civil engineering, though there appears to be some tendency for more recently founded programs to be linked to multiple departments or even multiple schools. There is clearly precedent for building specialised centres that can draw on faculty from different departments while avoiding getting locked into particular forms of teaching, class schedules, policy framing, or other aspects of particular departments than may complicate launching transport-related degree programmes and shorter courses.

Investments in transport research must be spread over a wider group of professionals. Government support for research appears to be primarily directed to designated public sector research bodies focused on sectors rather than transport overall. Each Department dealing with transport and the Ministry of Human Resource Development must set up academic centres of excellence. It is expected that the centres funded by transport ministries would be more focussed on applied research, whereas those set up by the Ministry of Human Resource Development would help provide graduate scholarships, extra faculty positions and infrastructure funds. These new centres should cover all modes of transport to deal with the following subjects and societal concerns:

- Energy sustainability and global warming
- Safety
- Health effects of transport
- Energy sources, availability and future technology assessment
- Integration of transportation modes
- Affordability and economic issues
- Modelling and simulation
- Needs of children, the aging and physically challenged population
- New materials
- Human factors, psychology and social implications of transport policies
- International issues and global logistics
- Policy analysis and cost effectiveness studies
- Influence of infrastructure design and technology on travel behaviour
- Economics

Such centres must of necessity be of interdisciplinary nature and be established based on open competition among academic institutions by inviting proposals for the same. Each centre must demonstrate its interdisciplinary nature by ensuring that the participating scientists are drawn from two or more departments and can be established in all academic institutions including medical colleges. The suggested number of centres to be established are given in Table 11.4.

The level of funding would be Rs 30-50 million per year per centre. In addition to equipment, supplies, travel and research funds, the funding must include 5-10 endowed permanent Chairs and 10-20 endowed post-graduate scholarships. The establishment of these centres must include funds for development of infrastructure and extra faculty positions equal to the number of endowed Chairs.

KNOWLEDGE GENERATION IN OPERATING COMPANIES/ ORGANISATIONS/ MUNICIPALITIES

Present operating companies like DMRC, BEST, DTC, etc., and municipalities, have very little knowledge generation capacity. Mechanisms have to be set up to revamp these organisations and make them much more professional. Each one of these organisations must have a knowledge generation unit that has a budget of about 3-5 per cent of the turnover of the organisation by 2020.

Table 11. 5
Scholarship Proposed for Study in Transportation-Related Subjects

ORGANISATION	NUMBER OF NATIONAL SCHOLARSHIPS PER YEAR	NUMBER OF INTERNATIONAL SCHOLARSHIPS PER YEAR
Ministry of Road Transport and Highways	50	25
Ministry of Railways	50	25
Ministry of Civil Aviation	10	5
Ministry of Environment and Forests	40	20
Ministry of Heavy Industries and Public Enterprises	10	5
Ministry of New and Renewable Energy	10	5
Ministry of Shipping	20	10

JOB OPPORTUNITIES FOR HIGHLY-TRAINED PROFESSIONALS IN THE TRANSPORT SECTOR

a. Just the creation of research centres in academic institutions will not be sufficient for ensuring professionalisation of transportation services. Individuals trained at postgraduate levels must have job opportunities that excite and satisfy them. The creation of research centres as outlined above will create a part of this demand. However, the operating departments/organisations will also have to create a demand for highly qualified individuals who work in-house with different job responsibilities and working conditions.

b. At present India produces ~1,000 PhDs per year in engineering, whereas China produces >7,000 per year. Most Chinese PhDs find jobs within China, whereas even this smaller number of PhDs in India have problems finding a satisfying job, especially which have an operational orientation. There needs to be strong demand creation for graduates with advanced degrees, in both research as well as operational organisations, so that the country could move systematically toward a sustainable transportation future.

c. Central, state and local Governments and agencies such as Railways, NHAI, State and City Road Transport Corporations, Port Trusts, Airport Authorities, NTPC, ONGC, etc. would need to take the lead to house highly trained personnel in relevant areas sectors such as Energy, Power, Environment, Integrated Transport, Urban Development, Planning, Economics and Finance and disciplines so that new technologies, management and operational systems are explored in transportation service delivery aimed at improving the quality of mobility as well as the efficiency of the transport system.

d. Concrete policies at each agency would need to be worked out. Each agency and department should create 10-year projections for expanding the employment of higher skilled operational staff including, MTechs and PhDs to a desirable level. This would need to be accompanied by a revision of salary and service conditions that suit people with a knowledge base (CSIR service conditions can be a starting point).

PRODUCTION OF THE WORKFORCE

Each ministry/department associated with transportation issues should establish scholarships, which can be awarded through open competition at a national level. Scholarships may be given with all expenses covered to those who are able to get admission to reputed Indian and foreign universities. Those availing of scholarships at international universities would have to sign a bond to serve an Indian organisation for three years upon graduating. Students opting to study at Indian universities should get scholarships without and bonds and constraints. The number of scholarships for study in transportation related subjects to be awarded by different ministries per year for the first five years after the launching of the scheme are given in Table 11.5.

SPONSORED MASTER'S AND BACHELOR'S DEGREE PROGRAMMES

All operating departments, institutions and corporations related with transportation should be required to sponsor about 2-5 per cent of their staff for obtaining masters degrees in relevant subjects as fulltime students every year.

A task force should be constituted by the Planning Commission to prepare a report on the number of new special bachelors and masters degree programmes that need to be set up at different institutions around the country for training of the workforce necessary over the next 10-year period. The taskforce would also assess the financial implications of starting these new courses and the source of funds for the same. The task force should be able to submit its report by the end of 2014, and programmes started by 2016.

IN-SERVICE TRAINING.

The skills gap cannot be taken care of by the production of new professionals alone. Many of those already in service will be around for the next 15-20 years and it is essential that they have an opportunity to improve their skills and acquire knowledge necessary to apply modern tecniques and technologies. In service training and knowledge acquisition requires three parallel efforts:

1. Periodic testing of engineers and technical personnel.

Each area of professional activity (e.g., civil engineering, mechanical engineering, electrical engineering and important sub disciplines) should require a mid-career evaluation of professional expertise after 7-10 years of service. The form of the evaluation may be based on modern education methods based on self-paced internet learning and testing methods with some practical evaluation. The purpose of this evaluation will not be to necessarily fail individuals, but to ensure that individuals can advance in their careers only when they demonstrate they have kept up with the technical advancements in knowledge in their respective disciplines. A special task force should be set up to design the format, rules and procedures for these professional examinations and for Professional Certification by empowered agencies.

> It is essential that India builds a pool of transport professionals. The existence of a large number of professionals will ensure competition among them to keep them honest and throw up a few outstanding individuals of international standing in each area of activity

2. Short-term training programmes

All professionals should be required to participate short-term training programmes in areas for which policy movement is urgent and capacity gaps are significant at least once every five years. These courses could be one week to one month in length and organised by the department concerned with outside experts or in collaboration with existing academic institutions. Efforts in this direction have already been instituted in the 12th Five Year Plan. What is needed is greater emphasis on quality and ensuring continuity in service of those trained so that they can put their knowledge to use. Short-term training programmes being offered in other countries should be evaluated for quality and relevance periodically and 25-30 per cent of officers eligible for such training sent out of the country to gain international experience.

3. Pursuing higher degrees

All professionals should be eligible for pursuing a course of studies at the Masters or PhD level at departmental expense after about five years of service. At any given time about ten per cent of officers should be allowed to proceed on leave with appropriate adevaluation of the need for expertise and skills required. Adequate budget provisions would be necessary for about a third of such professionals being deputed to institutions outside India. Arrangements will have to be made to establish appropriate career opportunities and job responsibilities for persons acquiring higher qualifications. For example, some of them may be deputed to the new research and development organisations at the local, state or central level as proposed in this report. It is essential that professionals be given opportunity to place themselves where they fit best (on-line engineering responsibilities, management, research, etc.) as they mature mid-career onward.

LATERAL HIRING

Lateral hiring could also be a way to build critical expertise within the public sector as quickly as it is built in the country more broadly. As discussed above, India does not yet have significant reserves of transport planning capacity in the private sector, but these may be built faster than public expertise and thus ease of movement between public and private would ensure capacity flows to the areas of greatest need.

The Approach Paper of the 2nd Administrative Reforms Committee also emphasises the need to build a framework for lateral induction as policy complexity increases, including designating some policy offices requiring specific forms of expertise. Other working groups and expert committees such as the Planning Commission Working Group on Capacity Building in the 12th Plan have reiterated the value of opening hiring to appointments from outside the public sector in complex areas with significant gaps in public sector capacity.

SUMMARY

Transportation planning and policy implementation has become a very complex and contentious activity. This is partly because many infrastructure projects are capital intensive and invite narrow interest of lobbyists and technology providers, and partly because solutions to many issues are not very clear. In an age of instant information transfer, decisions can be based ahistorically on current fashions that may not suit our socio-economic environment. The fact that the future of energy availability and environmental concerns is highly uncertain makes the job even more difficult.

In this scenario, it is very important the country has a large number of professionals who are aware of all international developments in policy and technology and also have an in-depth knowledge of our local conditions and needs. The existence of a large number of such professionals will ensure competition among them to keep them honest and also throw up a few outstanding individuals of international standing in each area of activity.

At present, knowledge gaps exist in all areas of activity:

- Design, construction, operation, management, maintenance
- Safety
- Demand management
- Project management
- Use of ITS
- Finance

Future transportation planning and policy making will also require a much more sophisticated approach to set in place systems that ensure the consideration of climate change and safety issues as integral components of infrastructure and technology options.

At present, India fares poorly in terms of total knowledge output. When normalised for population levels in 2011, India's output appears poor in comparison with both Brazil and China. Even more worrisome is the fact that the gap between India and China has widened considerably in the past decade especially on topics dealing with railway technology safety and environment. This means that if we want to catch up with countries like China in 10 years with their present levels of productivity, we will have to grow at more than 10 per cent per year. We must plan to set up systems for local knowledge producing mechanisms that aid researchers in responding to demands of society.

Functioning transportation systems in any location involve interactions between individuals, socio-economic imperatives, technologies, geophysical structures, built environment, organisational capacities, political compulsions, knowledge limitations, influence of special interest groups, and historical path dependencies of societies.

International experience offers several relevant lessons for building expertise and a professional community. First, it is important to establish transport planning as a high-status occupation and applied science makes it easier to attract ongoing political and financial support as well as some of the most competent professionals. Second, it is important to decentralise the institutional system and build networks. Third, it is important to encourage transport stakeholders to learn by doing

'Capacity building' comprises three challenges: training individuals, building systems for research and development to update capacity, and ensuring that these individuals have the ability and incentives to be productive within teams and organisations. India must not only increase the supply of capacity by expanding the number and quality of opportunities to study transport planning and allied

India must invest in decision support systems so that capacity can be used for maximum effect. The institutional framework must also be able to convert information into knowledge

fields, but it must also ensure a strong demand side. The effective 'demand' for capacity will depend on employment policies that attract these transport planners to public sector work and also on public expenditure and programmatic policies that encourage ministries, state agencies, and metropolitan bodies to spend discerningly on capacity building. In addition, as some private sector infrastructure companies become large and engage in large transport projects, they can also be encouraged to use the services of transport planning specialists. The Government will also need to invest in transport research so that training, decision support, and policy action improve over time and adapt to changing opportunities and challenges. Capacity building should also be designed to also support India's efforts to integrate its many transport-related organisations with a common culture focused on transport systems across national, state, and metropolitan scales. This section discusses future requirements across these three dimensions.

There is little reliable data available for inter-city or urban passenger or freight travel patterns. In this situation, infrastructure investment has to be done on a fire-fighting basis with little knowledge of long-term consequences on efficiency, or financial and environmental stability. Technology choices have to be based on hunches and influenced by powerful supplier lobbies. This situation is likely to get worse in the face of accelerated economic growth and urbanisation, as political and public pressure for provision of transportation services will demand quick fixes. India must also invest in decision support systems so that available capacity can actually be exercised for maximum effect. The institutional framework must also be capable of converting information into transport knowledge A review of international practices in transportation research, training and development clearly shows that a large number of countries have established well-funded and professionally staffed institutions at all levels and across disciplines.

It is quite clear that there is already a great shortage of trained manpower, alongwith absence of institutional support for policy making and technology development in India. We do not have any institutions within government departments and operating agencies, universities centres or stand-alone institutions in any area of transportation that compare favourably with institutions reviewed in previous sections except for an institution or two like the National Aerospace Laboratory. The research cen-

If India is to emerge as an economic power by 2030, it needs to invest significantly in human resource institutions to exhibit much greater soft power than it does at present

tres at academic institutions are sub-critical in the number of faculty members involved, and resources available. Except in a few centres, most of the academic activity is not interdisciplinary in nature, and there is almost a complete absence of involvement of professionals from the social sciences–economics, law, etc.

INVESTMENT IN INSTITUTIONS

The effort necessary for setting up institutions and structures needed for planning, decision-making and implementation for the next two decades will be quite substantial. This will require that funds be earmarked for these institutions as 1-2 per cent of investment for each transport sector. This is a very small amount to invest considering the challenges facing us. We have to start planning for these institutions now to catch up with other nations in a decade or so.

The number, size and type of institutions being recommended is based on international comparisons, in particular with countries with similar levels of development at present. Furthermore, if India is to emerge as an economic power by 2030, it needs to invest significantly in human resource institutions to exhibit much greater soft power than it does at present. As indicated earlier, India is significantly behind countries like China and Korea in knowledge production, skills, innovation and technology development at all levels and areas of transport operations. It has to be emphasised that scientific findings and innovation cannot be ordered. Capacity has to be built with a large number of professionals in all fields so that a few of them may come up with path-breaking ideas in the future.

International experience suggests that it takes more than a decade to build viable quality institutions. Demand has to be created for persons with expertise in these areas with availability of jobs in institutions. This sends a signal to academic institutions to start relevant academic programmes and for potential students to apply for the same. We present these institutions as distinct public and private entities, but collaboration is also important to ensure that transportation research is seen as neutral and credible, particularly if the recommended action on route planning for road and rail, subsidies for passenger transport, air quality regulation, reinvigorating different forms of mass transport and investment in non-motorised transport takes place.

STAND ALONE NATIONAL INSTITUTIONS

(a) Indian Institute for Transport Research (IITR)

The Institute would be responsible for research on all aspects of transport and logistics by all modes. It will be expected to play a leading role in national transport policy and technology development. The Institution may be set up under the Ministry of Science and Technology and would work closely with the Office of Transport Strategy recommended by committee. IITR could develop 4-5 regional centres to focus on regional issues and coordination with regional authorities. At maturity, IITR should expect to employ about 300-500 professionals at the post-graduate level by the end of the 13th Five Year Plan period.

(b) Indian Institute for Transportation Statistics (IITS)

IITS will be responsible for acquiring, preserving, managing, disseminating transportation data, statistical analysis and associated information for use by central, state and city transportation departments, researchers and any other concerned agencies.

SCIENCE AND TECHNOLOGY CAPABILITY IN TRANSPORT MINISTRIES

(a) Research Institutions

Each Department associated with transport (air, water, road and railways) should establish a multidisciplinary research organisation for applied research on current concerns and future technology development: Elsewhere (Chapter 5) we have recommended the formation of a unified Ministry of Transport. As soon as such a Ministry is established, it would become easier for these institutions to collaborate with each other.

- Indian Institute for Aviation Research
- Indian Maritime and Water Transport Research Institute
- Indian Institute for Intercity Road Transport
- Indian Institute for Urban Transport
- Railway Research and Development Institute

By the end of the 13th Five Year Plan each of these research institutes would have:

- 100-300 research professionals (60-70 per cent permanent employees of the institute and 30-40 per cent on deputation)
- Regional centres for coordination with state and city governments
- Advanced laboratories for technology development and testing
- Statutory responsibility for setting standards and regulations

(b) Department of Technology Development and Policy Analysis

Each Transport Department must set up an internal Division of Technology Development and Policy Analysis. The Department must be staffed by 20-50 professionals headed by an officer of the rank of Additional Secretary to the Government of India. However, two-thirds of the professionals working in the Department would be permanent employees with service conditions same as those of scientists working in the CSIR, and one third would be on deputation. These entities could collaborate intensively with the Office of Transport Strategy (OTS) recommended elsewhere (Chapter 5)

STATE- AND CITY-LEVEL INSTITUTIONS

a) All states should consider establishing a State Institute for Transport Research (SITR) with objectives similar to the Indian Institute for Transport Research (IITR), but with greater focus on local issues. The SITR should include a special transport statistics division that would liaison with the Indian Institute for Transportation Statistics. At maturity these institutes should have a staff of 50-100 professionals.
b) At the state level the each ministry dealing with transport issues should establish a transport research department focusing on special needs of that state. The responsibility of the department would be to generate state level detailed plans, data needed for the same, evaluation of projects and policies, liaison with the Central Government, and funding of research projects at state level institutions and universities.
c) All megacities (population >5 million) must establish transportation planning research department that could have responsibilities similar to state level units.

ACADEMIC CENTRES OF EXCELLENCE

At present most of the academic programmes in India related to transport capacity appear to be much less integrated than the global norm. Each Ministry dealing with transport and the Ministry of Human Resource Development must set up academic centres of excellence. It is expected that the centres funded by transport ministries would be more focussed on applied research, whereas those set up by the Ministry of Human Resource Development would help provide graduate scholarships, extra faculty positions and infrastructure funds.

Such centres must of necessity be of interdisciplinary nature and be established based on open competition among academic institutions by inviting proposals for the same. Each centre must demonstrate its interdisciplinary nature by ensuring that the participating scientists are drawn from two or more departments and can be established in all academic institutions including medical colleges. The suggested number of centres to be established are given in Table 11.4.

KNOWLEDGE GENERATION IN OPERATING COMPANIES/ ORGANISATIONS/ MUNICIPALITIES

Present operating companies like DMRC, BEST, DTC, etc., and municipalities, have very little knowledge generation capacity. Mechanisms have to be set up to revamp these organisations and make them much more professional. Each one of these organisations must have a knowledge generation unit that has a budget of about 3-5 per cent of the turnover of the organisation by 2020.

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There needs to be strong demand creation for graduates with advanced degrees, in both research as well as operational organisations, so that the country could move systematically toward a sustainable transportation future. Concrete policies at each agency would need to be worked out. Each agency and department should create ten year projections for expanding the employment of higher-skilled operational staff including, MTechs and PhDs to a desirable level. This would need to be accompanied by a revision of salary and service conditions that suit people with a knowledge base (CSIR service conditions can be a starting point).

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CONCLUSIONS

We have placed great emphasis on the importance of human resource development in all aspects of the transportation sector. This also reflects the difficulties we have faced in compiling this report as we have interacted with ministries and government agencies at the central, state and local levels, and with the best professionals available. At the same time, the ramping up of investment in all areas of transport is already taking place, and we are recommending a further enhancement in such investment over the next two decades. Corresponding with economic growth and higher income levels, aspirations of people for higher quality of transportation are also going up consistently. Accordingly, we are also witnessing increasing demands for investment in capital intensive projects such as high-speed trains (HST), limited access expressways, urban mass transit systems such as Metros, and the like. The decision making in such projects is now being done without adequate availability of data, nor adequate appreciation of the various trade offs involved in resource allocation between different modes and options.

It is in this context that we are recommending the establishment of new institutions connected with transport on a somewhat large scale. We are aware of various criticisms, which characterise these recommendations as being utopian and unrealistic. As we have documented, comparison even with other emerging market economies shows that the kind and size of institutions recommended are quite comparable with those already existing in these countries. Compared with the magnitude of overall investment envisaged in the transport sector, the investment in such institutions would amount not more than 1-2 per cent of GDP. The gains in better planning and execution of transport projects will far outweigh the cost of such investment in essential human resource development.

Of equal importance is a focused and sustained programme of upgrading existing personnel, most of whom will be in service over the next twenty years.

Transportation planning, engineering, design, execution must all be seen as exciting areas of work, as indeed they are. Thus, we recommend that the Planning Commission establish a Special Mission to carry forward the recommendations in this chapter on unified basis, within the 12th Plan period.

Annex
Transport Planning Curricula

NAME OF PROGRAMME	UNIVERSITY	COUNTRY	COURSES
Master of Transport	Monash University–Monash Institute of Transport Studies, Department of Civil Engineering	Australia	Core Units: Traffic engineering fundamentals Quantitative methods Intelligent transport systems Transport modelling Infrastructure project and policy evaluation Transport planning and policy Transport economics Elective Units: Road traffic: Engineering and management Road safety engineering Parking policy and design Case studies in transport Fundamentals of urban public transport Link: http://monash.edu/pubs/handbooks/courses/3272.html
Master of Transport Studies	Planning and Transportation Research Centre (PATREC), a collaboration between three public universities of Western Australia: Curtin University, Edith Cowan University and The University of Western Australia	Australia	Core Units: Planning for Accessibility Transport Assessment & Evaluation Cities & Sustainability Transport Systems & Policy Elective Units: Global Distribution & Transportation Integrated Plan Making Principles of Enterprise Logistics Management Business Strategy Managing Change Contemporary Issues in Aviation Management Risk Management Advanced Transport Modelling Logistics Management Transport Safety Transport Research Methods Link: Curriculum: http://humanities.curtin.edu.au/local/files/courses/308322/brochure.pdf PATREC Home Page: http://www.patrec.org/
Masters in Transportation Planning	University of Sao Paulo	Brazil	Offers three specialisations: - Transport Planning and Systems Operation - Infrastructure Construction and Project Management - Spatial Analysis for Transport Link: http://www.euni.de/tools/jobpopup.php?lang=en&option=showJobs&jobid=346190&jobtyp=5&jtyp=2&university=University+of+S%C3%A3o+Paulo&country=BR&sid=46751&name=Transport+Engineering+%28Master%29
Master of Engineering in Transport Studies Master of Philosophy in Transport Studies Postgraduate Diploma in Transport Studies Dissertation PhDs in Transport Studies	University of Cape Town	South Africa	Core Courses: Transport demand analysis and project assessment Transport modelling Intermodal public transport planning and economics Integrated land use-transport planning Management of transport supply and demand Elective Courses: Intermodal public transport planning and economics Rail planning and operations management Bus planning and operations management Local area transport planning, management and design Non-motorised transportation Transport planning Link: http://www.cfts.uct.ac.za/study_2.html
Master of Science and Doctor of Philosophy–Transport Engineering and Logistics	Transport Engineering and Logistics Department, Pontificia Universidad Católica de Chile	Chile	Transport Economics Social Projects Evaluation Advanced Demand Traveling Models Engineering Econometric Models Transport Externalities Advanced Traffic Models Transport Networks Equilibrium Logistics Topics Highway Traffic and Queuing Theory Advanced Methods for Transport and Logistics Systems Urban Transport Systems Planning Urban Road Design Seminar Link: http://wwwold.ing.puc.cl/ict/

NAME OF PROGRAMME	UNIVERSITY	COUNTRY	COURSES
MSc Transport and Planning	Cardiff University	United Kingdom	Core Modules: Principles of Transport Economics Researching Transport Sustainable Transport Tools for Transport Analysis Transport and the City Optional Modules: Environmental Behaviours: Citizens, Consumers and Communities Environmental Management Local Food and Sustainable Development Space and Place: International Planning Practice Spatial Planning Link: http://www.cardiff.ac.uk/cplan/degreeprogrammes/postgraduate/mastersprogrammes/transportplanning/index.html
MSc Transport MSc Transport with Business Management MSc Transport with Sustainable Development	Imperial College / University College (University Of London Centre For Transport Studies)	United Kingdom	MSc Transport Core Units: Transport and its context Quantitative methods Transport engineering and operations Transport economics Transport demand and its modelling Transport policy Optional Units: Highway engineering Road traffic theory and its application Public transport Transport safety Quantitative techniques for transport engineering and planning Advanced transport modelling Understanding and modelling travel behaviour Transport and the environment Intelligent transport systems Design of accessible transport systems Freight transport Asset management, project planning and maintenance Design of roads, rail, bridges, tunnels and embankments Air traffic management Ports and maritime transport Urban street planning and design Business Management Extension Modules: Microeconomic Theory Principles of Accounting Project Management Business Environments and Construction Law Sustainable Development Extension Module: The concept of sustainable development Sustainable development and engineering innovation Applying the principles Special project Link: http://www.ulcts.cv.imperial.ac.uk/
Master of Science (MS)/Master of Engineering (MEng)/MCP (City and Regional Planning)/PhD in Transportation Engineering	University of California, Berkeley	United States of America (USA)	Core Courses: Transportation Policy, Planning and Development Operation of Transportation Facilities Systems Analysis in Transportation Transportation Engineering Courses: Design and Construction of Transportation Facilities Transportation Systems Engineering Infrastructure Planning and Management Intelligent Transportation Systems Highway Traffic Operations Public Transportation Systems Air Transportation Operations of Transportation Terminals Selected Topics in Air Transportation Transportation Systems Analysis Courses Transportation Economics Logistics Transportation Infrastructure Management Analysis of Transportation Data Behavioral Modeling for Engineering, Planning, and Policy Analysis Advanced Topics in Transportation Theory Transportation Planning Courses Transportation Planning Transportation Sustainability Traffic Safety and Injury Prevention Transportation and Land Use Planning Transportation Finance Link: http://www.ce.berkeley.edu/programs/trans

NAME OF PROGRAMME	UNIVERSITY	COUNTRY	COURSES
Undergraduate Degree in Transportation Engineering/ Doctoral Degree Transportation Planning and Management	Beijing University of Technology	China	No information on coursework Link: http://bjut.edu.cn/bjut_en/colleges.jsp?columnID=222
Master of Engineering (Transport Option)/Master of Science (Transport and Sustainable Development)	Paris Institute of Technology	Paris, France	Master of Engineering (Transport Option): Common Core Courses: Introduction to management Statistics Introduction to law Fluid mechanics or soil mechanics Transport Option: Economics of transport Modelling of demand Transport safety Transport pricing Methods for territorial analysis Master of Science–Transport and Sustainable Development • Transport Stakes and Sustainable Development • Analysis and Prevision of Transport Supply and Demand • Transport, Energy and Environment • Transport and Social, Economic and Political Regulation • Management and communication • Projects Transport et Développement Durable • French (for not-French speaking students) • Professional internship Link: Master of Engineering (Transport Option): http://www.enpc.fr/english/academics/vet.htm?sr=2&ur=3 Master of Science–Transport and Sustainable Development: http://www.enpc.fr/english/enpc/tradd_gb.pdf
BSc Transport Management	Engineering & Applied Science, Aston University	Birmingham, UK	Year 1 Modules: Introduction to Logistics Planning & Controlling Logistics Law Principles of Economics Financial Accounting Study Skills Literature Review Project Marketing Goods & Services Introduction to Business Management Year 2 Modules Transport Planning Systems Environmental Economics Project Management Operational Research 1 Management Accounting European Transport Maritime Transport Database Management Multimodal Transport Management Implementing Transport Policy Environmental Managements & Audit Final Year Modules: Passenger Service Provision Traffic and Transport Engineering Human Resource Management Operational Research II Statistical Methods Air Transport International Trade Law Final Year Project GIS Transport Impact Assessment Link: http://www1.aston.ac.uk/eas/undergraduate/our-courses/bsc-transport-management/

NAME OF PROGRAMME	UNIVERSITY	COUNTRY	COURSES
BSc. Management Transport & Logistics	Liverpool John Moores University	Liverpool, UK	Year 1: Transport Systems and Policy; Introduction to Logistics; Principles of Law; Organisation, Economics and Finance; Study Skills. Year 2: Managing Transport Operations; Logistics Operations and Materials Management; International Trade and Commerce, Research Planning and Quantitative Methods. One option from: Law of Carriage of Goods; Port Policy; Employment Law and Human Resource Management. Year 3: Transport Policies and Practices; Project. Plus three options from: Multimodal Transport and Global Logistics; Port Strategy and Development; Applied Marketing and Strategy; Management of Finance and Investment Appraisal. Link: http://www.ljmu.ac.uk/courses/undergraduate/2012/course.asp?CourseId=NK24
BSc(Hons)Transport and Logistics Management	University of Huddserfield	UK	Year 1 Core modules: • Transport: Challenges and Issues • Economics and Business Statistics • Principles of Logistics and Marketing • Professional Skills and Personal Development • Commercial Management Option modules: Choose one from - • Introduction to Air Transport • Fundamentals of Tourism • Languages Year 2 Core modules: • Logistics Management • Freight Transport Management • Managerial and Enterprise Skills • Passenger Transport Management • Logistics Planning Techniques and Applications Option modules: Choose one from - • Languages • European Business and Global Markets • Operations Management • The Travel and Tourism Industry • Airline Marketing and Operations Management Year 3 Core modules: • Strategic Management • Project • Strategic Supply Chain Management Option modules: Choose two from - • Retail Logistics • Languages • Sustainable Tourism • Global Logistics and Supply Chain Management • Supply Chain Modelling • Project, Quality and Production Management • Transport Economics and Policy Link: http://www.hud.ac.uk/courses/2013-14/full-time/undergraduate/transport-and-logistics-management-bsc-hons/
BSc (Hons) in Transportation and Logistics with Business Management	Malaysia University of Science And Technology	Malaysia	Modules Introduction to Transportation Systems Fundamental of Operations Research Introduction to Supply Chains Sustainable Development and Transportation; Transportation Planning Computer Algorithms for Transportation and Logistics Introduction to Transportation Flow Systems Transportation Demand Analysis Transportation Policy Public Transport Systems Operations and Management Transportation Economics Air Transportation Management Maritime Transportation and Logistics Freight Transportation Link:http://www.must.edu.my/index.php?option=com_content&view=article&id=107&Itemid=167

NAME OF PROGRAMME	UNIVERSITY	COUNTRY	COURSES	
MSc/PgDip/ PgCert Transport Planning and Management	Sheffield Hallam University	UK	Level one modules: Economy, society and sustainability Geographical information systems (GIS) and transport Global perspectives on regeneration Professional management skills Level two modules: Strategic land use and transport planning Financial policy and management Transport appraisal Level three modules: Applied research methods Dissertation Link: http://www.shu.ac.uk/prospectus/course/365/content/	
B.A Geography with Transport Planning	Institute for Transport Studies, University of Leeds	UK	Year 1: Introduction to transport policy, in addition to the key themes of human and environmental geography. Year 2: Specialise in human geography, alongside transport studies. Link:http://www.its.leeds.ac.uk/courses/undergraduate/geography-with-transport-planning/	
B.A Economics with Transport Studies			**Year 1**	
			Compulsory Modules:	Elective Modules include:
			Introduction to Transport Policy	Economic Institutions (Labour)
			Information Technology & Communication Skills	Economic Institutions (Industry)
			Maths and Stats for Business and Economics	Introductory Financial Accounting
			Research Skills for Economists	Introductory Management Accounting
			Economic Theory and Applications	Understanding Social Enterprises
			Personal Tutorials for Economics	Organisational Behaviour
			Instruments of Transport Policy	
			Year 2	
			Compulsory Modules:	Optional Modules include:
			Intermediate Microeconomics	Business Economics
			Applied Economics	Industrial Economics
			Intermediate Macroeconomics	International Economic Environment
			Transport Economics	Introduction to Econometrics
			Project Appraisal	Transport Land Use and Development
				Transport and the Environment
				Transport and Society
			Final year	
			Compulsory Module: Transport Dissertation	
			Optional Modules include:	
			Advanced Microeconomics	Public Transport Policy and Practice
			Public Enterprise and Regulation	Environmental Economics
			International Banking and Finance	Topics in Transport
			Travel Activity and Social Analysis	Physical Distribution and Logistics
			Advanced Macroeconomics	The Economics of Unions
			Economics of Business & Corporate Strategy	Current Topics in European Integration

NAME OF PROGRAMME	UNIVERSITY	COUNTRY	COURSES
MSc Sustainabilty (Transport)	Institute for Transport Studies, University of Leeds	UK	Compulsory modules Business, Environment and Sustainability Introduction to Sustainability Transport Planning and Policy Transport Data Collection and Analysis Sustainable Land-Use and Transport Planning Global Issues in Transport Transport Dissertation Optional modules: Climate Change: Impacts and Adaptation Environmental Governance and Sustainability Climate Change Mitigation Tools and Techniques for Integrated Ecological Economic Modelling Participatory Environmental Project/Policy Evaluation Green Logistics Analysing Transport and Society Public Transport Planning and Management Stated Preference Analysis Methods Traffic Network Modelling Transport Investment Appraisal Transport and Urban Pollution Transport in Development Safety of Road Transport Link:http://webprod1.leeds.ac.uk/catalogue/dynprogrammes.asp?Y=201011&P=MSC-TRN%2FSUS
MSc (Eng) Transport Planning and Engineering			Compulsory Modules Principles of Transport Engineering Principles of Transport Modelling Transport Planning & Policy Transport Data Collection & Analysis Dissertation Optional Modules Analysing Transport & Society Funding for Projects Global Issues in Transport Green Logistics Public Transport Planning & Management Road Geometry & Infrastructure Safety of Road Transport Stated Preference Analysis Methods Sustainable Land-Use & Transport Planning Traffic Management Transport & Urban Pollution Transport in Development Transport Investment Appraisal Traffic Network Modelling Link: http://www.its.leeds.ac.uk/courses/masters/msc-transport-planning-engineering/
MA Transport Economics			Compulsory Modules Principles of Transport Economics Welfare Economics & Cost-Benefit Analysis Transport Econometrics Principles of Transport Modelling Transport Data Collection & Analysis Economics of Transport Regulation Dissertation Optional Modules Analysing Transport & Society Funding for Projects Global Issues in Transport Green Logistics Public Transport Planning and Management Stated Preference Analysis Methods Transport in Development Transport Investment Appraisal Link: http://www.its.leeds.ac.uk/courses/masters/ma-transport-economics/

NAME OF PROGRAMME	UNIVERSITY	COUNTRY	COURSES
MSc Transport Planning			Compulsory Modules Transport Planning & Policy Principles of Transport Modelling Understanding Travel Behaviour Transport Data Collection & Analysis Sustainable Land-Use & Transport Planning Dissertation Optional Modules Analysing Transport & Society Global Issues in Transport Green Logistics Public Transport Planning & Management Safety of Road Transport Stated Preference Analysis Methods Traffic Management Transport in Development Transport Investment Appraisal Transport & Urban Pollution Traffic Network Modelling Funding for Projects Link: http://www.its.leeds.ac.uk/courses/masters/msc-transport-planning/
Graduate Courses in Transportation Systems Engineering (classified under School of Civil and Environmental Engineering)	Georgia Tech (Georgia Institute of Technology)	Georgia, US	Courses include: Computer-Aided Site Engineering & Road Design Construction Engineering Management Construction Safety and Health Discrete Choice Analysis Environmental Impact Analysis Freight Planning Geometric Design GIS in Transportation Infrastructure Management: IT Applications Infrastructure Systems Multimodal Transportation Systems Pavement Technology Project Front End Planning and Monitoring Signali sed Intersections & Networks Simulation Models in Transportation Spatial Analysis Statistical Analysis of Travel Demand Traffic Engineering Traffic Flow Theory Transportation Administration & Policy Analysis Transportation Energy & Air Quality Transportation Energy Infrastructure Management Transit Systems Planning & Design Urban Transportation Planning http://www.ce.gatech.edu/research/tse/courses
Rahall Appalachian Transportation Institute	Marshall University	West Virginia, US	Courses Relevant to Transportation offered at Different Departments: Principles of Domestic Transportation Marketing | Physical Distribution Marketing | Traffic Management Marketing | Purchasing and Inventory Control Marketing | Transportation Law and Public Policy Marketing | Carrier Management Marketing | Advanced Transportation Marketing | Advanced Physical Distribution ISC | Special Topics: Transportation and the Environment ISC | Special Topics: Transportation and the Environment PS | Physical Principles of Remote Sensing with Applications in Transportation (B) – Denotes baseline courses included in strategic plan from grant inception. For a full list of courses, go to: http://www.njrati.org/education/degree-programs/courses/
Master of Urban and Regional Planning, Speciali sation in Transportation Planning	Portland State University	Portland, Oregon, US	Required Course: Urban Transportation: Problems and Policies Choose 3: Economics of Urban Transportation Urban Transportation Planning Transportation and Land Use Travel Demand Modeling Choose 1 (3 credits, minimum): (Note: if you take all four classes in the list above, you do not need to take a class from the list below.) Transportation Seminar (one credit, can take more than once)* Sustainable Transportation Geographic Applications in Planning Pedestrian and Bicycle Planning Cost Benefit Analysis in Transportation (1 credit, can only take once)* Transportation Safety Analysis Freight Transportation and Logistics

NAME OF PROGRAMME	UNIVERSITY	COUNTRY	COURSES
			Intelligent Transportation Systems Public Transportation Systems Transportation Operations http://www.pdx.edu/usp/urban-regional-planning-transportation
Transportation Policy and Planning Concentration, Urban Planning Program	Rutgers University	United States	Core Courses (select four of six) Urban Transportation Policy Analysis Urban Transportation Planning Transportation and the Environment Transportation and Land Use International Transport Policy Public Transit Planning and Management Elective Courses Security and Safety in Maritime Transportation and Port Operations Maritime Transportation Traffic Engineering Transportation Planning Traffic Operations Design of Transportation Facilities Transportation Systems Analysis Intelligent Transportation Systems Freight Transportation Systems Advanced Transportation Economics and Modeling Port Planning, Management and Operations State and Local Public Finance Comprehensive Planning Advanced Multivariate Methods Locational Conflict Introduction to GIS for Planning and Public Policy Program Evaluation Introduction to Planning and Design Zoning for Communities of Place Environmental Planning and Management Seminar in Urban Planning: Walking and Cycling Link: http://policy.rutgers.edu/academics/uppd/concentrations/transportation.php
Master of Urban Planning, Concentration in Land Use and Transportation Planning	University of Illinois, Urbana-Champaign	United States	(Recommended) foundation courses: Transportation Planning GIS for Planners Land Use Policy Growth Management and Regional Planning Evironmental Planning Workshop (Recommended) Electives: Watershed Ecology and Planning State and Local Public Finance Urban Ecology Planning for Historic Preservation Land Resource Evaluation Economic Development Planning Sustainable Planning Seminar Environmental Planning Workshop Housing and Urban Policy Planning Neighborhood Planning Advanced Sustainable Planning Workshop Ecology for Land Restoration Watershed Hydrology Earth Systems Modeling Environment & Sustainable Development Environmental Policy Biological Modeling Spatial Ecosystem Modeling Link: http://www.urban.illinois.edu/academic-programs/MUP/concentrations/lut.html
Master of Science in Transportation (interdepartmental programme)	Massachusetts Institute of Technology		Transportation Subjects by Programme Area: Air Transportation: The Airline Industry Air Traffic Control Airline Management Air Transportation Operations Research Planning and Design of Airport Systems Analysis and Planning Methods: Demand Modeling Logistical & Transportation Planning Methods Computer Modeling: From Human Mobility to Transportation Networks Advanced Demand Modeling Computer Algorithms in Systems Engineering Transport Modeling Course Network Optimisation Logistics and Supply Chain Management: Logistical & Transportation Planning Methods Logistics Systems Case Studies in Logistics and Supply Chain Management International Supply Chain Management

NAME OF PROGRAMME	UNIVERSITY	COUNTRY	COURSES
			Logistics and Supply Chain Management Transportation Policy: Transportation Policy and Environmental Limits Transportation Policy and Planning Law, Technology, and Public Policy Environmental Law, Policy, and Economics: Pollution Prevention and Control Transportation Management: Case Studies in Logistics and Supply Chain Management Logistics and Supply Chain Management Airline Management Urban Transportation: Demand Modeling Computer Modeling: From Human Mobility to Transportation Networks An Introduction to Intelligent Transportation Systems Comparative Land Use and Transportation Urban Transportation Planning Transport Modeling Course Public Transportation Systems Cities and Regions: Urban Economics and Public Policy Comparative Land Use and Transportation Planning Advanced Seminar in Transportation Finance Link: http://cee.mit.edu/graduate/transportation/areas
Master of Science in Transportation and Urban Systems/Master of Transportation and Urban Systems/Certificate in Transportation and Urban Systems	North Dakota State University	North Dakota, US	Compilation of courses (required and elective) specific degree programmes: Spatial Analysis Focus: Introduction to Geographic Information Systems Advanced Georgraphic Information Systems Spatial Analysis in Transportation Transportation Planning Focus: Research in Transportation and Logistic Transportation Planning Information Systems Technologies Focus: Technology Advances and Logistics Emergency Response and Disaster Focus: Crisis Analysis and Homeland Security Enterprise Management Focus: Enterprise Resource Planning Organisational Change Management Electives: Logistics Systems International Logistics Management Advanced Supply Chain Planning Adaptive Planning in Logistics Logistics Research Methods Acquisition Contracts: Law & Management Transportation Systems Security Transportation Planning and Environmental Compliance Transportation System Modeling Urban Transportation Systems Analysis Context Sensitive Solutions Transportation Systems Laboratory Public Transportation Link: http://www.ndsu.edu/transportation/tus/courses/
Transportation Engineering Masters Program	University of Washington	United States	Required: Transportation Engineering Probability and Statistics Analytical Methods in Transportation One course from each of the following key areas: Planning: Transportation Survey Methods or Travel Demand Forecasting Operations and ITS: Traffic Systems Operations or Trans Data Management and Analysis Freight and Logistics: Freight Transportation or Freight Transportation and Logistics Electives: Pavement Design GIS for Civil Engineers Urban Transportation Planning and Design Infrastructure Construction Energy and the Environment Traffic Engineering Fundamentals Transportation and Construction Capstone Transportation Logistics Pavement Construction and Quality Control Link: http://www.ce.washington.edu/prospective/grads/transportation.html
M.Sc Transport Sustainability & Society.	University of East London	UK	Core Modules: Planning, Mobility and Sustainability, Mobility, Society, and Culture Optional modules: two of - Cycling in Society Comparative Mobilities

NAME OF PROGRAMME	UNIVERSITY	COUNTRY	COURSES
			Unequal Mobilities Global Environmental Politics Transportation Engineering Sustainability and the Commons http://www.uel.ac.uk/lss/postgraduate/programmes/TSS.htm
M.Sc Intelligent Transport Systems & Intelligent Mobility M.Sc Transport Engineering & Operations M.Sc Transport & Business Management M.Sc Transportation Planning & Policy M.Sc Transport & the Environment	Newcastle University	UK	Modules: intelligent mobility—policy and practice, systems and services quantitative methods transport policy in practice Intelligent Transport Systems and e-Services; transport modelling road safety characteristics of public transport systems economic and environmental appraisal of transport activities Dissertation design of transport infrastructure railway management economics and practice transport planning for sustainable development air pollution and transport emission modelling for sustainability. http://www.ncl.ac.uk/ceg/study/postgraduate/taught/
MSc/Postgraduate Diploma in Transport Engineering and Planning	University of Salford, Manchester	UK	Courses: Transport Planning Principles The general aim of this module is to provide an introduction to the key concepts and methods which underlie the four-stage model central to the theory and practice of transport planning. More particular aims are as follows: a) to present a systematic representation of the demand for travel and the supply of transport; b) to provide experience in the application of one of the main systems of software (TRIPS) used in practice for transport planning; and c) to provide the basis for study in detail of the main methods used in transport planning. close Integrated Transport Planning The aims of this module are a) to present the principles and methods involved in planning coherently for all modes of transport; b) to illustrate the application of those principles through examination of case studies; and c) to review the measures available to reduce the use of the motor car and to promote the use of alternative modes. close Traffic Data Collection and Analysis In this module you will design, construct and assess standard traffic surveys and to apply statistical methods for analysing traffic data and interpreting results. close Transport systems design This module looks at the issues underlying current practice in the basic design of transport infrastructure for a range of transport modes including cycles, motor vehicles, rail and mass transit systems. close Transport Modelling You will study the key methods which comprise the four-stage model central to the theory and practice of transport planning: a) trip generation; b) trip distribution; c) mode choice; and d) highway-traffic and passenger-transport assignment. Estimation of trip-matrices from traffic-counts will also be introduced as an auxiliary method. close Traffic Management and Road Safety This module will teach you to analyse problems and propose outline solutions relating to the management and control of traffic, with an emphasis on road safety, environmental and amenity objectives. close Analysis of Highway Links and Junctions On completion of this module you should be able to analyse problems and propose outline solutions relating to the operation of highway links and junctions and to apply theoretical models in relation to traffic flow characteristics. close Appraisal of transport schemes This module will give you a systematic understanding and critical awareness of the current and innovative methods used to appraise and evaluate transport schemes, with specific reference to economic, environmental and safety issues and to give an opportunity to obtain practical experience in these methods. close MSc Project and Dissertation http://www.salford.ac.uk/courses/transport-engineering-and-planning?mode=cd

NAME OF PROGRAMME	UNIVERSITY	COUNTRY	COURSES
MSc. Transportation Planning & Engineering	University of Southampton	UK	Transportation Planning: Policies & Methods Transport Engineering: Analysis & Design Transport Data: Analysis & Techniques Transportation Planning: Practice Transport Economics Research Project http://www.southampton.ac.uk/engineering/postgraduate/taught_courses/msc_transportation_planning_and_engineering.page?
Traffic Engineering–Certificate Transport and Spatial Development - Short course Transport Assessment - Short course Transport Planning - Professional Development - a series of short courses Transport Planning - MSc/Postgraduate Diploma/Postgraduate Certificate	University of West England, Bristol	UK	Courses: development control; junction design; economic and environmental appraisal of road schemes; road safety investigation; traffic management, signal control and data collection; transport administration policy and legislation the role of transport in encouraging economic development and regeneration, especially unintended effects the effect of increasing road capacity in inducing traffic, and the effects of reducing (or reallocating) road capacity in reducing traffic the effectiveness of travel plans and other so-called 'soft' instruments of transport policy http://www1.uwe.ac.uk/whatcanistudy/courses/professionalandshort-courses.aspx#T
MSc Transport Planning & Management	University of California, Los Angeles	US	Core Courses: (any two) Transportation, Land Use, and Urban Form Transportation Planning Introduction to Transportation Engineering Parking, Transportation, and Land Use http://publicaffairs.ucla.edu/content/transportation-policy-and-planning
Certificate in Transportation Systems	University of Southern California		Required Courses Transportation Engineering Traffic Engineering and Control Engineering Project Management Urban Transportation Planning and Management Institutional and Policy Issues in Transportation http://www.usc.edu/schools/price/programs/certificate/transportation_systems.html

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12. SAFETY

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12. SAFETY

Hospitalisation and death due to injuries and violence are major threats to health across the world. It is estimated that more than five million people die each year as a result of some form of injury and many more are disabled for life (Schopper, D. et al., 2006).

Transportation-related death and injuries constitute a significant proportion of this. For young adults and working age males, road traffic accidents have become a leading cause of death in most countries including India. Given current trends, the global burden of injuries and violence is expected to rise considerably in the coming decades, particularly in low- and middle-income countries like India.

Table 12.1 shows the number of fatalities associated with various modes of transport in India for the years 1971-2011. Statistics for non-fatal injuries are not included as the numbers reported are unreliable. Except for air crash statistics, it is possible that all other numbers are underestimates, as no systematic methods of recording injury and fatality statistics have been established in the country. The statistics as reported by the National Crimes Record Bureau (NCRB) are based on cases reported to the police in the locality where the accident occurred and then collated and sent to the central authorities. Some detailed studies for road traffic crashes estimate that the number of serious injuries reported may be only 20-30 per cent of the actual number (Gururaj, G., 2005, Mohan, D. et al., 2009).

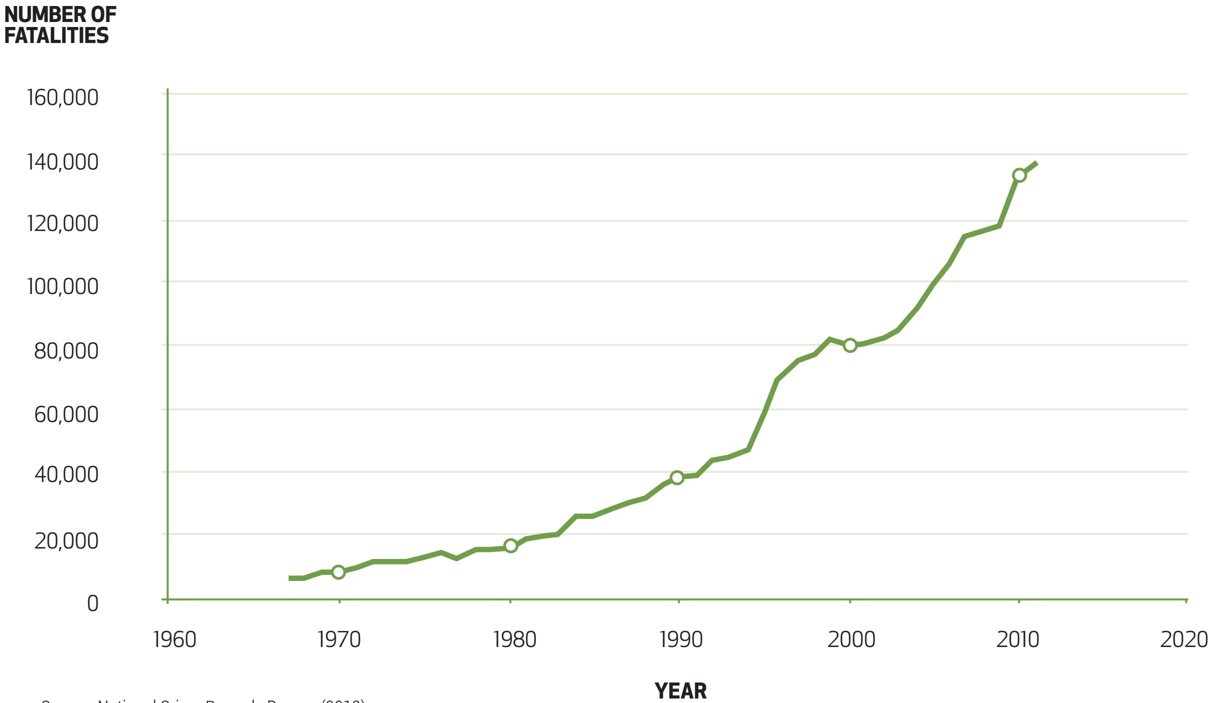
The statistics as reported show that the maximum numbers of fatalities per year occur in road transport, followed by those on railway property. The NCRB classifies railway accidents under two subheadings—'Railroad' and 'Railway other'. The former includes accidents that railway authorities consider to be 'consequential' and the latter includes accidental deaths occurring on railway property. 'Consequential' accidents include collisions, fire cases, level crossing accidents and derailments. In 2011, there were 2,366 'railroad' deaths and 25,872 'railway other' deaths. This latter group would include those killed crossing railway tracks, falling off trains, and other reasons not classified as consequential.

Table 12.1
Incidence Of Accidental Deaths By Different Modes Of Transport: 1971-2011

	1971	1981	1991	2001	2011
Air crash	205	54	15	30	18
Boat capsize	250	312	422	781	849
Road accident	9,528	17,964	38,973	80,262	136,834
Railroad	1,546	2,614	5,957	2,178	2,366
Railway other	9,652	12,408	16,080	17,076	25,872

Source: National Crime Records Bureau (2012).

Figure 12.1
Road Traffic Fatalities in India, 1967-2011



Source: National Crime Records Bureau (2012).

A few of the inland water transport deaths are captured by the NCRB but not all those associated with coastal shipping. A Planning Commission report states: 'There is also high incidence of accidents in the inland water transport (IWT) sector which caters mainly to passenger traffic. The IWT, however, is in the unorganised sector and there is absence of proper data on such accidents' (Planning Commission, 2002). It is possible that the number of deaths and injuries associated with water transport and associated infrastructure is much larger than reported by the NCRB.

It is road transport that sees the highest number of fatalities, and the number has been increasing continuously for the past few decades (Figure 12.1). The rate of increase in deaths per year shows a marked upward trend starting in the mid 1990s. Since then, the annual fatality rate has increased at a rate of about 6-8 per cent a year, and shows no sign of decreasing. Two modelling exercises have attempted to predict the time period when we might expect this rate to start to decline in India (Koornstra, M., 2007, Kopits, E. and Cropper, M., 2005). Kopits and Cropper used the experience of 88 countries to model the dependence of the total number of fatalities on fatality rates per unit vehicle, vehicles per unit population, and per capita income. They predicted that fatalities in India would continue to increase before starting to decline in 2042. Koornstra, using a cyclically modulated risk decay function model that incorporates the cyclically varying nature of a society's concerns for safety, predicted an earlier date of 2030 for peak traffic fatalities in India. If fatality rates continue to increase at the present level then we can expect about 260,000 fatalities in 2030. Neither of these projected dates (2042 and 2030) can be accepted as road safety goals for the country.

Altogether, more than 166,000 persons died in transportation-related accidents in 2011, or more than 450 a day. International experience suggests that for each transportation death, one can expect about three to five permanent disabilities, 15-20 hospitalisations, and 80-100 minor injuries (Evans, L., 1991, Gururaj, G., 2006, Martinez, R., 1996, NHTSA, 2008, Varghese, M. and Mohan, D., 2003). This would mean that in addition to the more than 450 deaths a day in 2011, at least 1,500 persons were disabled, 7,000 hospitalised and more than 40,000 sustained minor injuries every day in traffic-related accidents in the country. Table 12.2 shows the disability adjusted life years (DALYs) lost in India due to different causes in 2010 (Murray, C. J. L. et al., 2012). DALY is a measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death. By this measure, road traffic injuries rank 8th among all causes of ill health, ahead of stroke (13), HIV/AIDS (15), diabetes (16), and protein-energy malnutrition. Other causes ranked lower than traffic injuries are (not included in Table 12.2): cirrhosis (22), rheumatic heart disease (35), hypertensive heart disease (40), malaria (43) and lung cancer (46). It is also significant that road traffic injuries have moved up from rank 13 in 1990 to eight in 2010. Among the seven causes that rank higher than road injury, at least four are associated with malnutrition, hygiene and lack of child care facilities (pre-term birth complications,

Table 12. 2
Ranking of Health Burden by DALYs Lost Due to Different Causes in India, 2010

RANK	CAUSE	RANK	CAUSE
1	Preterm birth complications	11	Neonatal encephalopathy
2	Diarrheal diseases	12	Low back pain
3	Lower respiratory infections	13	Stroke
4	Ischemic heart disease	14	Major depressive disorder
5	Chronic obstructive pulmonary disease	15	HIV/AIDS
6	Tuberculosis	16	Diabetes
7	Neonatal sepsis	17	Fire
8	Road injury	18	Congenital anomalies
9	Iron-deficiency anemia	19	Protein-energy malnutrition
10	Self-harm	20	Falls

Source: Murray, et al. (2012).

diarrheal diseases, lower respiratory infections, neonatal sepsis). These estimates clearly indicate that transportation-related injuries and deaths have become a very significant health problem in India.

It is estimated that the cost of road traffic crashes alone may be about 3 per cent of GDP (Committee on Road Safety and Traffic Management, Planning Commission, 2007). Obviously, the situation is quite serious and unless policies and evidence-based countermeasures are put in place urgently, it is likely to worsen. The air rates are low partly because of the smaller number of people exposed to this mode of travel and especially because safety procedures are governed by international practices.

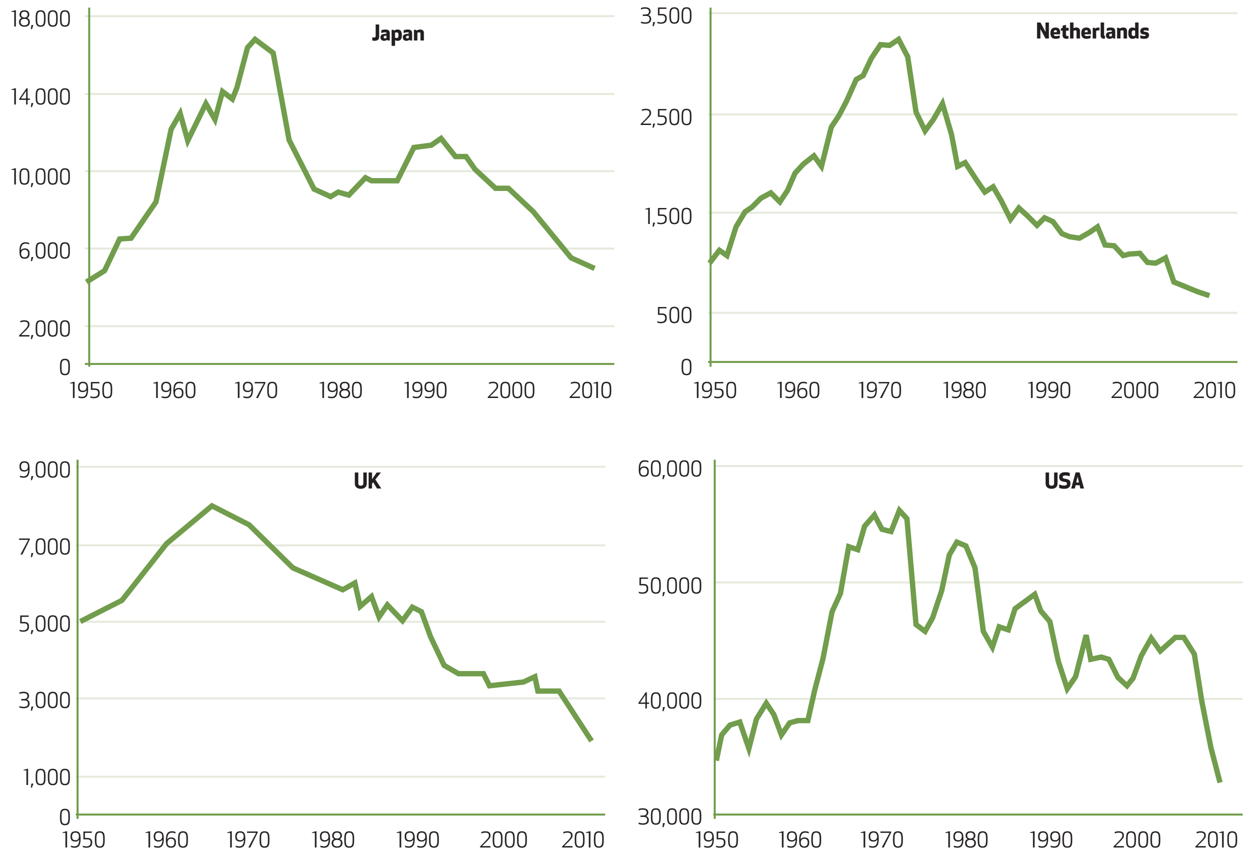
INTERNATIONAL EXPERIENCE

TRENDS IN TRANSPORTATION-RELATED ACCIDENTS

The main reason we have not been able to address the safety issue effectively is that there is little expertise, data, or information available to tackle the problem in a scientific manner. In the international safety professional community, a consensus emerged about half a century ago that it is not very productive to focus on human error alone. Writing many decades ago, Haddon, W., Jr. (1968) asserted that the successes of modern public health measures are substantially the result of a shift from an individual to a community-centred emphasis. He insisted that the 'emphasis has been on the responsibility of individuals in the general public to take steps to reduce injuries, not on the responsibility of the small number of key individuals in public and private power structures. This damagingly lopsided balance is now, however, ponderously shifting as more legal responsibility is being placed on policy-level executives to do what they can' (Haddon, W., Jr., 1980). This shift Haddon refers to is reflected in the time trends of fatal road traffic accident statistics for Japan, Netherlands, UK and USA, as shown in Figure 12.2.

The number of road traffic fatalities increased continuously from 1950 to 1970 in all these countries and the general decline started in the early 1970s. The trend is similar in most western European countries, Canada, Australia and New Zealand. Other countries were not able to make this shift and the number of deaths in traffic accidents has continued to increase. The fatality rate per 100,000 persons at the peaks for Japan, Netherlands, UK and USA were 16, 24, 15 and 26 respectively. The rate in India in 2011 was 12. There does not seem to be any pattern regarding the fatality rate at which one should expect a downturn. Recent studies also suggest that there may not be any strong relationship between income and fatality rates, and the level of safety depends on policies and safety measures put in place (Mohan, D. and Bangdiwala, S., 2013). With appropriate safety measures, it should be possible to reverse the upward trend

Figure 12. 2
Road Traffic Fatalities In India, 1967-2011



Source: National Crime Records Bureau (2012).

in India as road safety knowledge and technologies available today are superior to those in 1970.

As Figures 12.3, 12.4 and 12.5 show, air traffic fatalities reduced tenfold between 1945 and 1968, and then another significant reduction between 1970 and 1980. This is attributed to major changes in airplane and communication technologies. Railroad accident data from USA shows a sixfold decrease in accidents per million train miles between 1980 and 2000, and the UK data a fourfold reduction between 1970 and 1995.

It is interesting that these significant reductions in accident rates seen in all modes of transport in Western Europe and USA start about the same time in the 1960s and 1970s. The reduction in accidents in all these modes is probably not due to any single factor in isolation but to a wide variety of improvements in design of vehicles, operating environment and infrastructure, and enforcement of safety regulations and standards.

Water transportation-related deaths have not been included in this discussion as data on this is notoriously poor within India and internationally (Planning Commission, 2002, Waller, J. A., 1985). There is no uniform data collection and analysis system and procedures vary from one nation to another. The data is grouped under different heads and types of injuries and are collected by different departments within nations. Data for larger ships may be recorded separately from those for smaller fishing vessels. Many vessels may pick up foreign nationals once underway, and deaths and injuries of these individuals may not be reported in the vessel's country of origin. Injuries and fatalities associated with passengers and crew of vessels other than due to drowning are also reported separately from drowning cases.

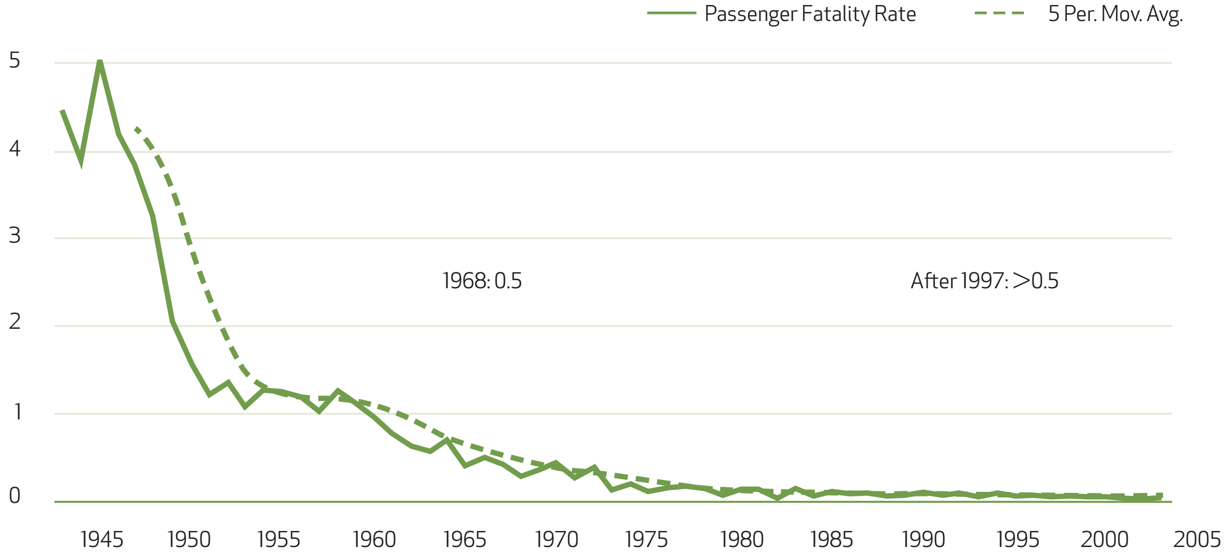
However, to get an idea of developments in efforts to prevent drowning, data for deaths due to drowning, including water transport deaths in USA, are shown in Figure 12.6. In 2008, there 3,576 drowning deaths in USA, of which 76 were attributed to water vehicle accidents (National Safety Council, 2011). The latter number does not include deaths associated with international shipping and other injuries to passengers. However, it is interesting to note that even in the case of drowning deaths in the USA, the real reduction in death rates starts in the 1970s.

The above data indicate that policy makers and transportation safety professionals in every country have found it very difficult to institute changes that actually result in a dramatic decrease in traffic fatalities and injuries in a short time. Experience

Figure 12. 3

Air Passenger Fatalities

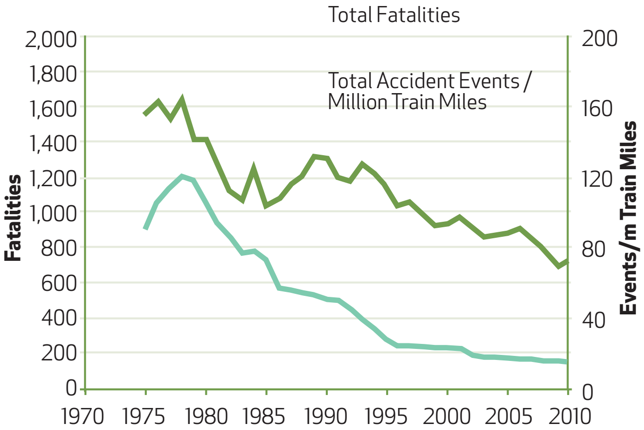
[Per 100 Million Passenger Miles]



Source: EASA (2005).

Figure 12. 4

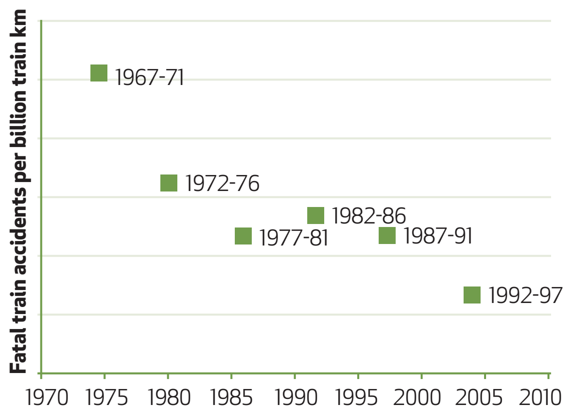
Railroad Accidents in US, 1975-2010



Source: FRA (2012).

Figure 12. 5

Fatal Railroad Accidents per Billion Train Km in UK, 1967-97



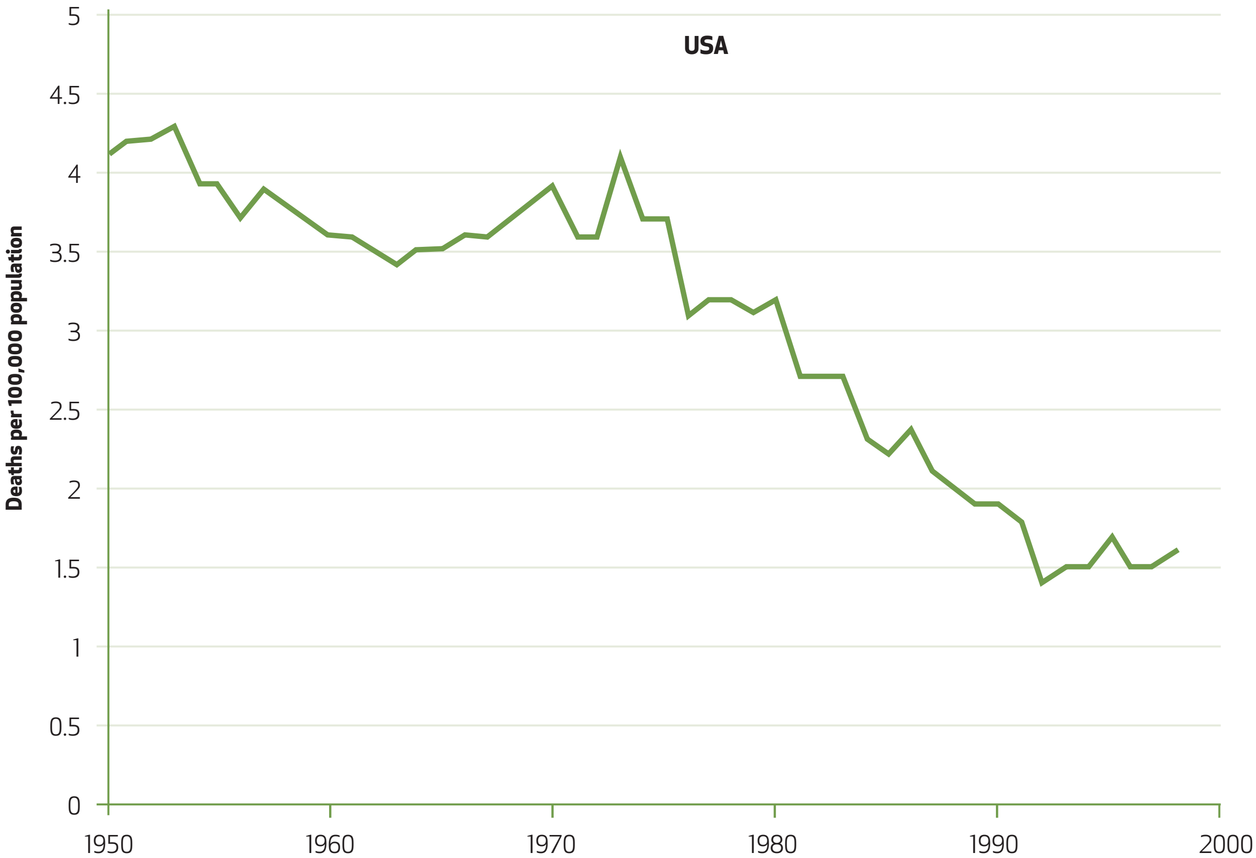
Source: Adapted from Evans (2000).

has also shown that not all individuals follow all the instructions given to them to promote road safety. Attempts to 'educate' people were also not always very effective and wide variations are found between people's knowledge and their actual behaviour (Haddon, W., Jr., 1968, Mayhew, D. R. and Simpson, H. M., 1996, Peden, M. et al., 2004, Robertson, L. S., 1983, Robertson, L. S. et al., 1974, Sandels, S., 1975). This is partly because we cannot select who is going to use the system and who is not. While some control can be exercised in licensing drivers of motor vehicles, almost no control is possible in selection of pedestrians and bicyclists. Control over the system is most difficult in the case of road transport, much easier in the case of air transport, and railroad and water transport fall somewhere in between. Almost everyone in a population can be a road or railroad user and this has implications on how we deal with the issue of traffic injuries as a public health problem.

The major shift in regarding injuries sustained by people in day-to-day activities as opposed to problems caused by errant individual behaviour took root among safety professionals in the 1960s and 1970s. This helped in analysis of transportation accidents as due to system failures that included mistakes made by individuals. It became important to understand why people make mistakes or behave in

Figure 12. 6

Deaths due to Drowning (Including Water Transport Accidents) in USA, 1950-2010



Source: National Safety Council (2011).

ways harmful to themselves and others. An important part of this understanding was that people's behaviour is itself influenced by vehicle—car, train, plane, boat—design, the infrastructure within which they operate and the level of enforcement of rules and regulations. For example, a significant part of the reduction in road traffic deaths in Western Europe and USA after the 1970s has been attributed to improving crashworthiness of cars, use of protective systems—helmets, seatbelts, airbags, development of safer and forgiving roadways, and enforcement of laws against speeding and driving under the influence of alcohol (Elvik, R. and Vaa, T., 2004, Johnston, I., 2010, Noland, R. B., 2003, Trinca, G. W. et al., 1988).

The first motorcycle helmet use law in the world was enacted in the state of Victoria, Australia, in January 1961, and the use of seatbelts by vehicle occupants was made compulsory in the state in 1971, followed by the rest of Australia and some other countries in the 1970s and 1980s. Motor vehicle crash worthiness tests became mandatory in these countries in the 1970s.

Many road and highway design changes were also initiated in the same period:

- Divided highways: 1960s
- Breakaway devices: 1970s
- Energy-absorbing barrier end treatments: late 1970s
- Shoulders widening: 1970s
- Intersection angle limits (> 70°): mid-1960s
- Clear Zone widening: 1970s

This was a major shift away from the policies in the pre-1970s which focussed mainly on changing individual behaviour through 'education' and retribution. Many of these interventions adopted over 30 years ago are still absent in India.

This move from unsuccessful to successful strategies is summarised in Table 12.3.

INTERNATIONAL BEST PRACTICES

Transportation safety management is a systematic process in which we consider the infrastructure, the users and the vehicles as integral components of a complex interactive system. The transport system has to be developed in a way that does not jeopardise the environment or public health and welfare. In this approach, it is essential that an environment be created that minimises the risk of transport users

Table 12. 3
Historical Experience and Road Safety Paradigms in Vogue During Different Periods in American and European History

ASPECT	RELATIVELY UNSUCCESSFUL		RELATIVELY SUCCESSFUL	
	PARADIGM I	PARADIGM II	PARADIGM III	PARADIGM IV
Period of domination	**1900-1925/35**	**1925/35-1965/70**	**1965/70-1980/85**	**1980/85 →**
Description	Control of motorised carriage	Mastering traffic situations	Managing traffic system	Managing transport system
Main idea and focus	Use cars as horse drawn carriages	Adapt people to manage traffic situations	Eliminate risk factors from road traffic system	Consider exposure of risks, regulate transport
Motor Vehicles per 1,000 people	Less than 25	25-250	250-500	> 500
Main disciplines involved	Law enforcement	Car and road engineering, psychology	Traffic engineering, traffic medicine, advanced statistics	Advanced technology, systems analysis, sociology communications
Organisation of vehicle production	Craft-production, craftsmen manufacturing	Mass-production workers assembling	Lean production, group assembly on sub-contracting	Recycling materials
Terms used about unwanted events	Collision	Accident	Crash, casualty	Costs, suffering
Idea concerning accidents	Transitional problem, passing stage of maladjustment	Individual problem, inadequate morale and skills	Defective traffic system	Risk exposure
Data ideals in research	Basic statistics, answers on 'what'	Causes of accidents; 'why'	Cost/benefit ratio of means, 'how, why, what, when, where..'	Multidimensional
Organisational form of the safety work	Separate efforts on trial and error basis	Co-ordinated efforts on voluntary basis	Programmed efforts, authorised politically	Decentralisation, local institutional management
Typical countermeasures	Vehicle requirements and inspection, school patrols	The three E's doctrine, screening of accident-prone drivers	Combined samples of measures for diminishing risks, focusing on the whole system	Networking and pricing transport costs
Effects	Gradual increase in both traffic and health risks	Increase in deaths and injuries continues	Successive cycles of decrease of health and traffic risks	Continuous reduction of serious road accidents

Source: OECD (1997).

making mistakes and that prevents serious human injury when designing, operating and maintaining the system. The entire traffic and transport system must be designed to account for the limitations and capabilities of users and operators.

In a transport system, the design of vehicles, infrastructure and policing methods have to be aimed primarily at the prevention of traffic crashes irrespective of the characteristics and skills of ordinary users. The system has to be designed such that, in the event of a crash, the consequences are kept to the absolute minimum.

It is far more effective to provide automatic protection than to hope that people will behave in a 'safe' way. Automatic approaches protect individuals without their having to perform some action or behave in a specific manner. For example, a person who chooses not to use her manual seatbelt (or who forgets to buckle it) has no protection in the event of her car crashing. If there is an air cushion system in her car, however, it will inflate to protect her, regardless of her state of mind, level of inebriation, or intelligence.

Since each accident is a result of a combination of human, technology and environmental factors, one cannot understand the risk factors associated with an event unless a sophisticated systems approach is followed. This understanding was behind the Zero Vision of the Road Safety Bill adopted by the Swedish Parliament (Tingvall, C., 1997) in October 1997 (Box 12.1). The vision states that 'the entire transport system must be designed to accommodate the individual who has the worst protection and the lowest

Box 12.1
The Swedish Vision

Vision Zero is a traffic safety policy developed in Sweden in the late 1990s and based on four elements: ethics, responsibility, a philosophy of safety and creating mechanisms for change. The Swedish parliament voted in October 1997 to adopt this policy, and since then several other countries have followed suit.

Ethics Human life and health are paramount. According to *Vision Zero*, life and health should not be allowed in the long run to be traded off against the benefits of the road transport system, such as mobility. Mobility and accessibility are therefore functions of the inherent safety of the system, not vice versa as it is generally viewed today.

Responsibility Until recently, responsibility for crashes and injuries was placed principally on the individual road user. In *Vision Zero*, responsibility is shared between the providers of the system and the road users. The system designers and enforcers—such as those providing the road infrastructure, the car-making industry and the police—are responsible for the functioning of the system. At the same time, the road user is responsible for following basic rules, such as obeying speed limits and not driving while under the influence of alcohol. If road users fail to follow such rules, the responsibility falls on the system designers to redesign the system, including rules and regulations.

Safety philosophy Traditionally. the approach to road safety was generally to put the onus on the road user. In *Vision Zero*, this is replaced by an outlook that has been used with success in other fields. Its two premises are: human beings make errors; and there is a critical limit beyond which survival and recovery from an injury are not possible. It is clear that a system that combines human beings with fast-moving, heavy machines will be very unstable. It is sufficient for a driver of a vehicle to lose control for just a fraction of a second for a human tragedy to occur. The road transport system should therefore be able to take account of human failings and absorb errors in such a way as to avoid deaths and serious injuries. Crashes and even minor injuries, on the other hand, need to be accepted. The important point is that the chain of events that leads to a death or disability must be broken, and in a way that is sustainable, so that over the longer time period, loss of health is eliminated. The limiting factor of this system is the human tolerance to mechanical force. The chain of events leading to a death or serious injury can be broken at any point. However, the inherent safety of the system—and that of the road user—is determined by people not being exposed to forces that go beyond human tolerance. The components of the road transport system, including road infrastructure, vehicles and restraint systems, thus need to be designed in such a way that they are interlinked. The amount of energy in the system must be kept below critical limits by ensuring that speed is restricted.

Driving mechanisms for change To change the system involves following the first three elements of the policy. While society as a whole benefits from a safe road transport system in economic terms, *Vision Zero* relates to the citizen as an individual and his or her right to survive in a complex system. It is therefore the demand from the citizen for survival and health that is the main driving force. In *Vision Zero*, the providers and enforcers of the road transport system are responsible to citizens and must guarantee their safety in the long term. In so doing, they are necessarily required to cooperate with each other, because simply looking after their own individual components will not produce a safe system. At the same time, the road user has an obligation to comply with the basic rules of road safety. In Sweden, the main measures undertaken to date include:

- Safety performance goals for various parts of the road traffic system;
- Focusing on vehicle crash protection, and support for the consumer information programme of the European New Car Assessment Programme (EuroNCAP) and securing higher levels of seat belt use and fitting smart, audible seat belt reminders in new cars;
- Installing crash-protective central barriers on single-carriageway rural roads and encouraging local authorities to implement 30 km/h zones;
- Wider use of speed camera technology, and an increase in the number of random breath tests;
- Promotion of safety as a competitive variable in road transport contracts.

While *Vision Zero* does not say that historically, road safety ambitions have been wrong, it is clear that the actions that would have to be taken are partly different. The main differences probably can be found within how safety is being promoted; and also, some innovations result from the vision, especially in infrastructure and speed management.

A tool for all *Vision Zero* is relevant to any country that aims to create a sustainable road transport system, and not just for the excessively ambitious or wealthy ones. Its basic principles can be applied to any type of road transport system, at any stage of development. Adopting *Vision Zero* means avoiding the usual costly process of trial and error, and using a proven and effective method right from the start.

Source: Peden, et al. (2004).

Box 12. 2
Safe Systems Approach in Road Safety

A Safe System approach is also well attuned to the high priority global, regional and country development goals of sustainability, harmonisation and inclusiveness. A Safe System is dedicated to the elimination of deaths and injuries that undermine the sustainability of road transport networks and the communities they serve. Its focus on safer and reduced speeds harmonises with other efforts to reduce local air pollution, greenhouse gases and energy consumption. And its priority to afford protection to all road users is inclusive of the most vulnerable at-risk groups such as pedestrians, young and old, cyclists and motorcyclists. These co-benefits of shifting to a Safe System approach further strengthen the business case for its implementation.

Source: Bliss and Breen (2009).

tolerance of violence. No event must be allowed to generate a level of violence that is so high that it represents an unacceptable loss of health for that vulnerable individual,' and, 'the responsibility for every death or loss of health in the road transport system rests with the person responsible for the design of that system.' This approach has not been internalised by any official organisation or institution dealing with safety in India, and we still operate on the outmoded principles of finding fault with an individual and then acting accordingly.

Transportation safety management has seen a shift from action based on experience, intuition, judgement, and tradition, to action based on scientific research, empirical evidence, and from consideration of safety that is tacit and qualitative to consideration of transportation safety that is explicit and quantitative. Therefore, expanding the existing system without changing it is not the best use of scarce resources. Most importantly, structures and processes need to be put in place that outlast individuals and ensure regular review and renewal of strategies. The requirements of a Safe System approach (Box 12.2) are:

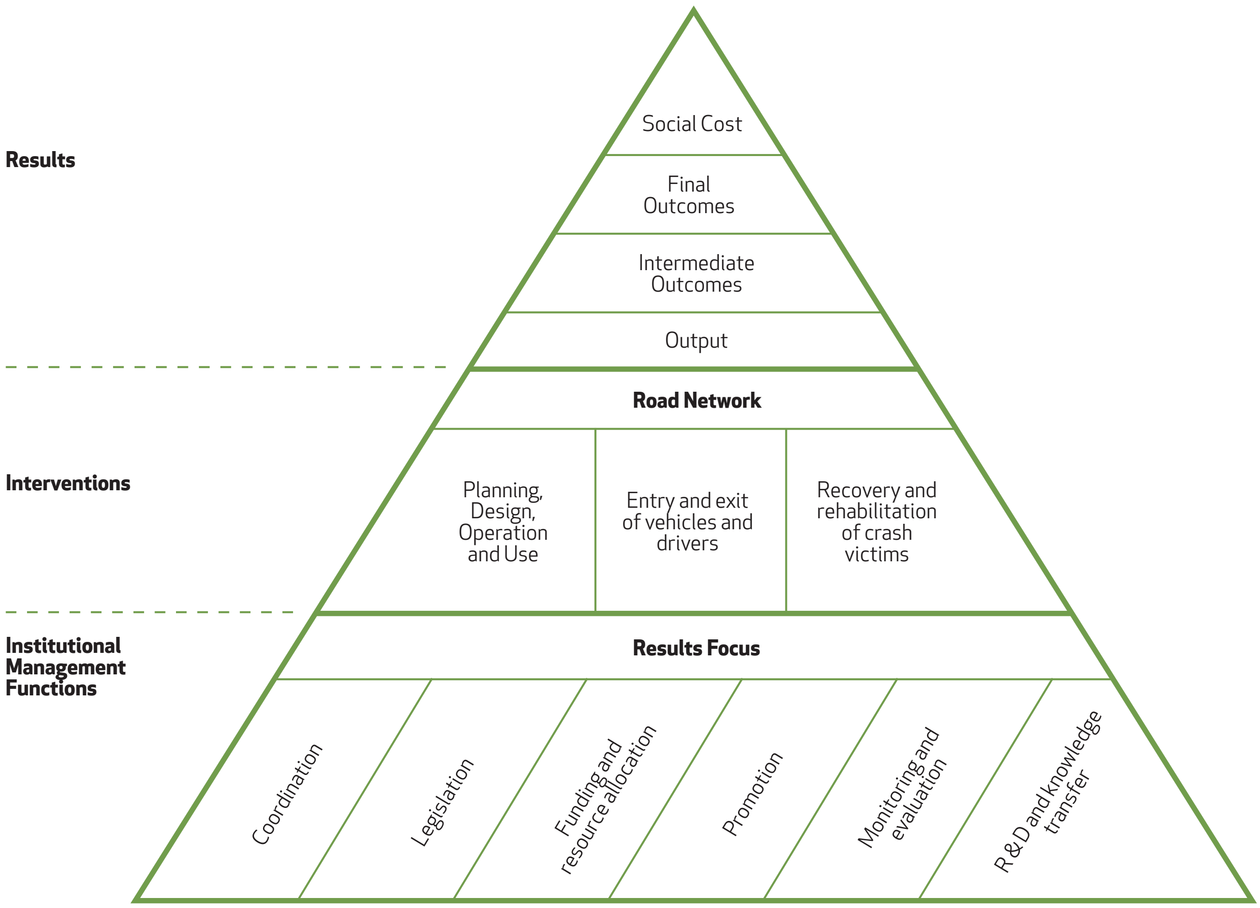
(a) Institutional structure that creates a demand for scientific work in safety issues.
(b) Formulation and enforcement of laws and regulatory requirements.
(c) Monitoring and measurement—national databases with relevant information to monitor and assess various aspects of safety policies, technologies and knowledge needs.
(d) Assuring and improving the quality of safety services provided through professionals, individual institutions and with the use of specific technologies and devices.

An example of how the Safe Systems approach can be institutionalised is given in Figure 12.7. Though this example is taken from recommendations made for setting up road safety institutional mechanisms, the approach and principles can be used for all transport systems in the planning, design, operation and use of aviation, rail or maritime networks. The same methodology applies to entry and exit of aircraft, trains and ships to these networks, and in the event of system failure, and to the management of the recovery and rehabilitation for victims from these networks.

INSTITUTIONAL SYSTEMS

Countries that have been successful in reducing transportation accident rates set up institutional mechanisms over a few decades and the results became evident starting in the 1970s. This knowledge evolved over many years through experience

Figure 12. 7
Road Safety Management System



Source: Bliss and Breen (2009).

based on research, experimentation and knowledge sharing across nations. The positive outcomes are the result of many years of capacity-building and investments by governments in institution-building and knowledge production capabilities supported by political commitment and coordination among government departments. Figure 12.7 shows the seven institutional management functions that provide the foundation on which safety management systems are built. According to Bliss and Breen, 'they produce the interventions to achieve the desired long and medium-term road safety results (expressed as a vision and related performance targets) which have been agreed across the road safety partnership at national, regional and local levels. Without effective institutional management across these functions, a country has little chance of implementing successful road safety interventions and achieving desired results on a sustainable basis. The institutional management functions are delivered primarily by the government entities producing interventions but they are also delivered in government partnerships with civil society and business entities to achieve the desired focus on results.'

The lead agency (adapted from Bliss, T. and Breen, J., 2009):

- Plays a pre-eminent role in most of the institutional management functions
- Takes responsibility within government for the development of the national safety strategy and its results focus
- Takes responsibility for horizontal inter-governmental coordination arrangements
- Ensures vertical coordination of national, regional and local activities
- Coordinates the necessary delivery partnerships between government partners and stakeholders, the professional, non-governmental and business sectors, and parliamentary groups and committees
- Ensures a comprehensive legislative framework
- Secures sustainable sources of annual funding and creating a rational framework for resource allocation
- Promotes safety strategy across government and society

Figure 12. 8
National, Prefectural and Municipal Programmes for Road Safety in Japan

Japan: Central Traffic Safety Policy Council

Source: Adapted from Kojima et al. (2012).

- Sets up systems for periodic monitoring and evaluation of safety performance, and the direction of research and development and knowledge transfer

Examples of structures of lead agencies, data collection agencies and research institutions from successful nations are given in the following sections.

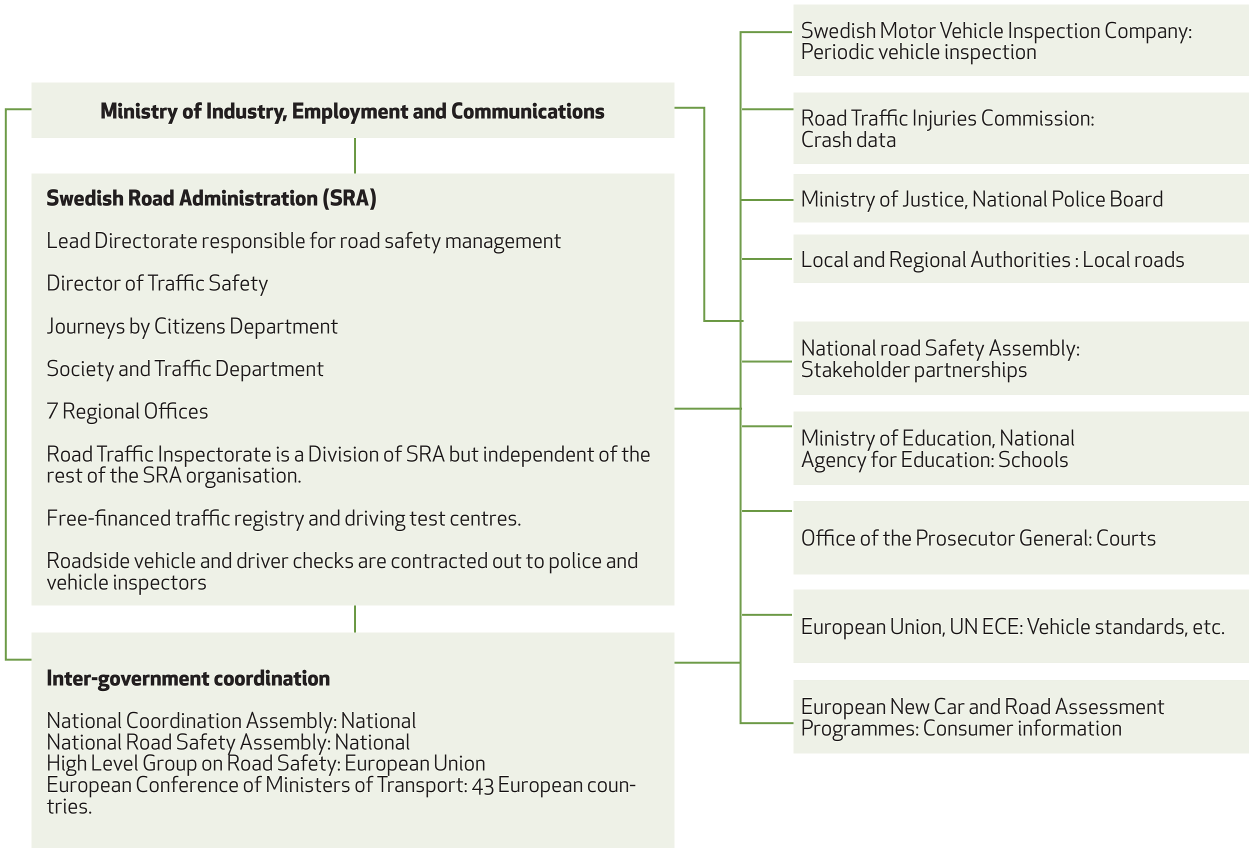
ROAD SAFETY AGENCIES

Figure 12.8 shows the institutional arrangements in Japan for promoting road safety in the country. Under the provisions of the Traffic Safety Policies Basic Act, which passed into law in 1970, the Prime Minister's Office established a Central Traffic Safety Policy Council. This Council, which is chaired by the prime minister, comprises the chief cabinet secretary, the heads of specified government agencies, and other ministers of state for special missions as named by the prime minister and is responsible for promoting the drafting and implementation of Traffic Safety Basic Action Plans (Kojima, K. et al., 2012). The Traffic Policy Institute, which was established as part of the Prime Minister's Office in 1960, was transferred to Japan's Management and Coordination Agency in 1984. During reorganisation of the central ministries in 2001, most of the duties performed by the Traffic Safety Policy Office as part of the Management and Coordination Agency were transferred to the office of the Director-General for Policies on Cohesive Society Planning in the Cabinet Office.

The Traffic Safety Policies Basic Act provides for the establishment of Prefectural Traffic Safety Policy Councils in each prefecture as well as for the voluntary establishment of Municipal Traffic Safety Policy Councils in municipalities that wish to establish them. These Councils are responsible for promoting deliberation on and implementation of comprehensive measures related to overland traffic safety as well as the drafting and implementation of traffic safety plans. These prefectural and municipal organisations are to establish traffic policy departments, traffic safety policy offices and other agencies as necessary, to coordinate administration and comprehensive promotion of traffic safety policies on their behalf.

Based on the incidence of traffic accidents and other criteria such as traffic volume, the Japanese government designated 'roads recognised as being particularly important to ensuring traffic safety' as eligible for 'complete or partial funding, or provision of supplemental funding, from the national government for improvements to traffic safety facilities.' The Japanese government would bear half the cost of special traffic safety facility improvement projects undertaken by the roadway administrator of national highways, prefectural roadways, and municipal roads, as well as provide supplemental funding amounting to 55 per cent of the cost of traffic safety

Figure 12. 9
Organisational Structure for Implementation of Road Safety Policies in Sweden



Source: Bliss and Breen (2009).

projects undertaken on municipal roads designated as school routes by government ordinance.

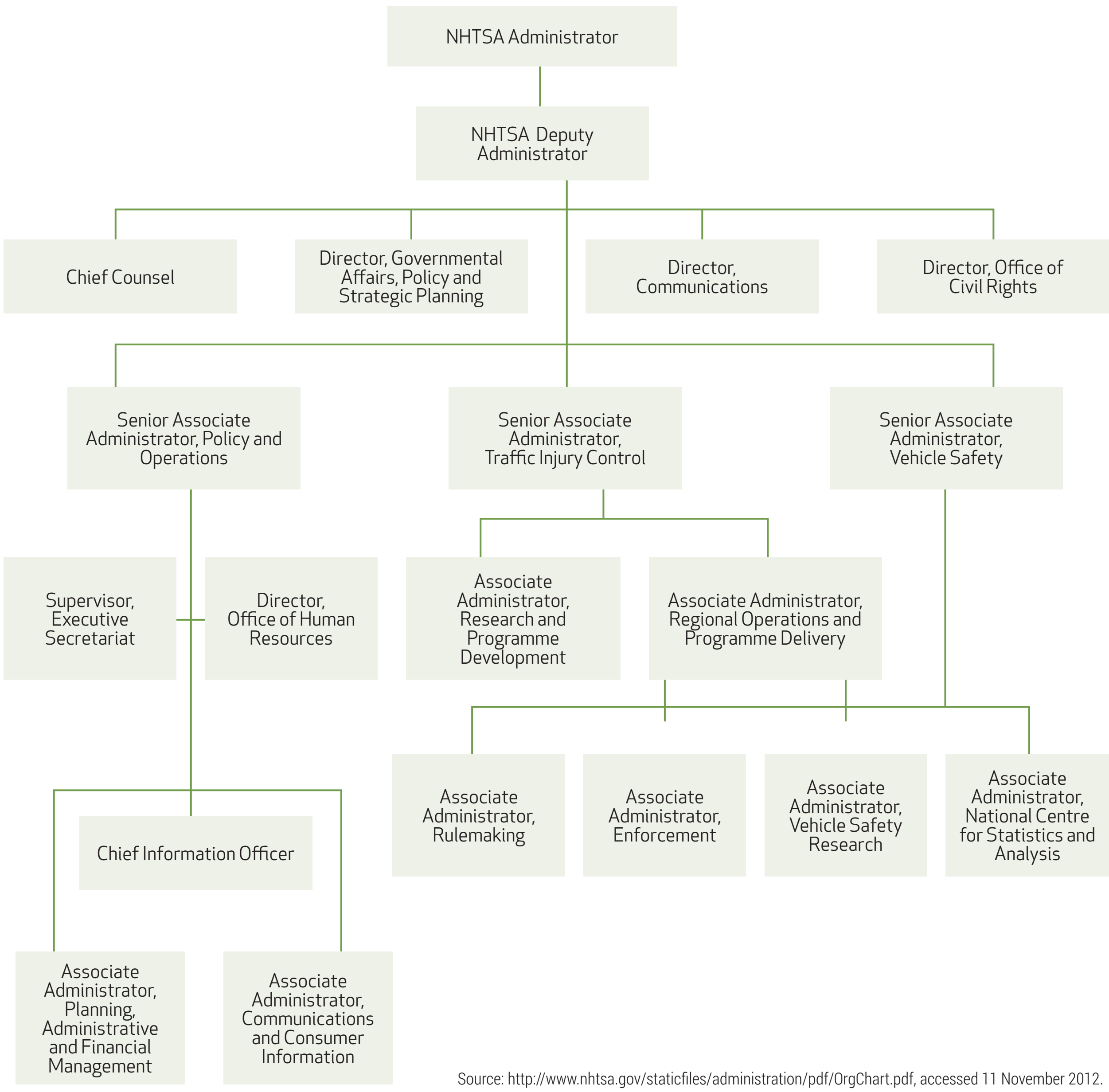
A system for traffic fines was instituted as part of the 1968 revision of the Road Traffic Act, and served as the basis for the collection of fines. Accounting procedures for these monies specified that they should be used to defray the cost of improvements to road traffic safety facilities. Specifically, these monies were to defray the cost of the installation and maintenance for road traffic safety facility projects undertaken independently by local public agencies that were designated by government ordinance, and were used for traffic signals, roadway signage, pedestrian crossings and other facilities.

Since the enactment of the Traffic Safety Policies Basic Act, the government has implemented eight traffic safety basic action plans. This has resulted in a reduction in road traffic fatalities from 16,765 in 1975 to 5,009 in 2010.

The Ministry of Industry, Employment and Communications has legal responsibility for road safety in Sweden, but the Swedish Road Administration (SRA) is the national authority assigned the overall sectoral responsibility for the entire road transport system, and the SRA is the lead agency for road safety management (Figure 12.9). The SRA is responsible for proposing national road safety goals and targets, reviewing performance and carrying out interventions in the road network. The agency also leads the Vision Zero goals through a performance agreement with the Ministry of Industry, Employment and Communications. Vertical coordination between governmental bodies, funding mechanisms for use by regional and local authorities, as well as specific road safety outputs, are overseen by the SRA.

In its capacity as road manager, the SRA is responsible for road safety on the state road network. As part of its mandate, the SRA must ensure that the construction and maintenance works contracted by it are subjected to stringent environmental demands, and encourage contractors to develop production methods that are adapted to road safety. Every head of division is to make sure that road safety is taken into consideration within his/her area of responsibility. He/she shall also endeavour to ensure that colleagues increase their awareness and knowledge about the impact of their own activities and that of the entire road transport system on road safety.

Figure 12.10
Organisation of the National Highway Traffic Safety Administration



Source: http://www.nhtsa.gov/staticfiles/administration/pdf/OrgChart.pdf, accessed 11 November 2012.

The SRA has in-house capacity to propose, ensure compliance with, and monitor road safety standards for vehicles, roads and people, as well as to provide policy advice. It establishes Commissions of Enquiry when developing and consolidating major primary legislation (Bliss, T. and Breen, J., 2009). It is the responsibility of the SRA to establish comprehensive legislation and propose vehicle, roads and road user rules and standards. Sustainable annual funding for road safety is ensured from general tax revenues which the SRA allocates to its agencies through annual agreements and transport plans. The SRA and its partners have established databases to identify and monitor final and intermediate outcomes against targets, and the results are published annually. Safety rating programmes are used to monitor aspects of vehicle fleet and road network safety respectively. The SRA established the Road Traffic Inspectorate to help monitor road safety performance and the effectiveness of partner and stakeholder activity.

Support of research and development and knowledge transfer is a very important component of the SRA's activities and responsibilities. The agency secures funding and ensures capacity for road safety research, demonstration projects and support for attendance of its personnel at international road safety meetings, seminars, workshops and field visits. Sweden in 2010 had one of the lowest road traffic

Reducing transport accident rates is usually the result of many years of capacity-building and investment in institution building and knowledge production capabilities.

fatality rates at 2.9 deaths per 100,000 persons in the country (IRTAD, 2012).

THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION (NHTSA), USA

The National Highway Safety Bureau was created by Congress in 1966. It was replaced by the NHTSA, which was established by the Highway Safety Act of 1970. The agency directs the highway safety and consumer programmes established by the National Traffic and Motor Vehicle Safety Act of 1966, the Highway Safety Act of 1966, the 1972 Motor Vehicle Information and Cost Savings Act, and succeeding amendments to these laws. The organisation chart of NHTSA is given in Figure 12.10. NHTSA consists of just over 600 staff located in Washington DC, and in 10 regions across the United States. The agency's enacted budget for FY 2012 was $860 million of which 15 per cent was for research and development. It is one of eight administrations under the Department of Transportation. The strategic goals for the organisation are:

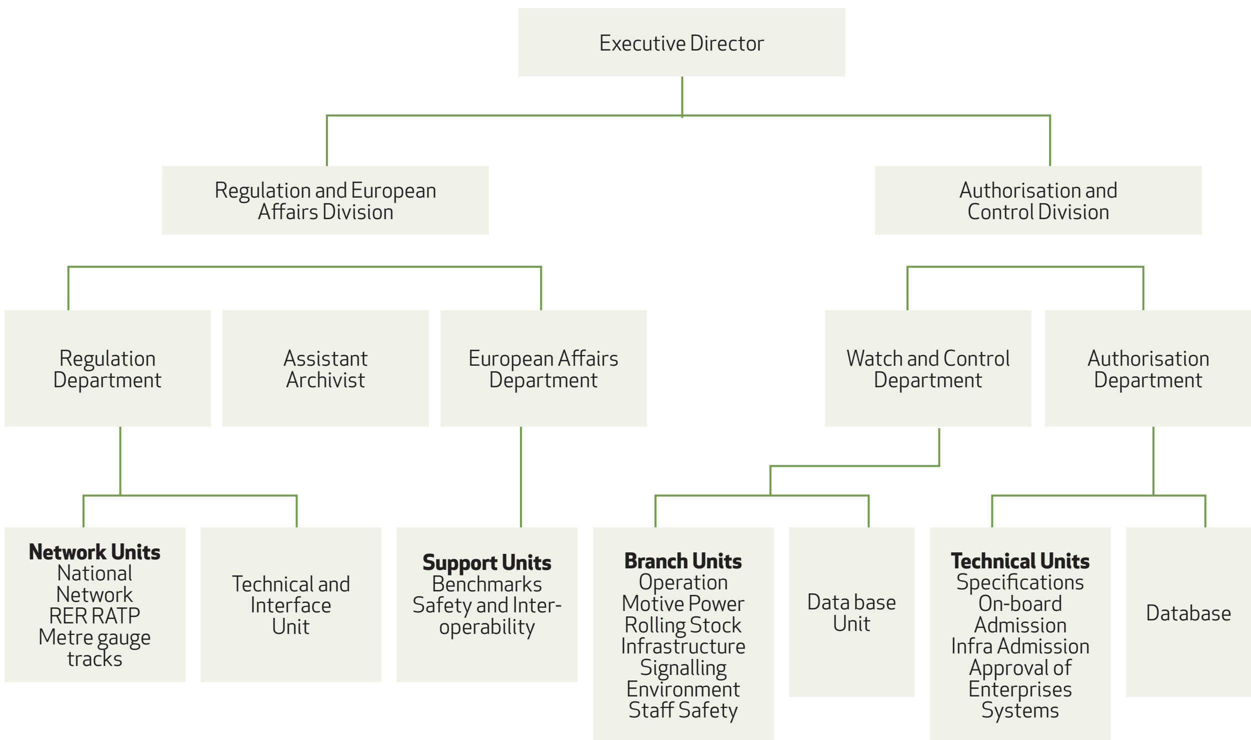
- Lead the effort to make traffic and motor vehicle safety a priority of the nation's healthcare agenda, and a national initiative to address the most significant traffic and motor vehicle safety issues.
- Deliver the highest quality technical and programme assistance to states and communities, and promote international cooperation.
- Improve data collection and analysis to better identify and understand problems, and support and evaluate programmes; expedite the availability of information to customers and partners.
- Support research and apply the results to education, engineering, and enforcement to reduce road casualties and costs.
- Reduce the number and severity of road collisions.
- Mitigate the consequences of motor vehicle crashes.
- Advance the non-safety mandates of the Agency.
- Improve NHTSA's internal processes, management, and structure to create a more effective and efficient agency that is better able to pursue its mission.
- Listen to, involve, and serve customers and partners in the planning, programmes and activities of the agency.
- Build and maintain a professional, productive, innovative, diverse work force.
- Effectively manage and use information resources.
- NHTSA's activities (2006) were the following:Set safety standards for motor vehicles and associated equipment, investigate possible safety defects, assure that products meet safety standards and are not defective--through recalls if necessary, and track safety-related recalls. Also enforce regulations on fuel economy, odometer fraud, and vehicle theft.
- Work through state highway safety agencies and other partners to encourage safe behaviour of drivers, occupants, cyclists, and pedestrians across the country: impaired driving, occupant protection, motorcycle safety, pedestrian and bicyclist safety, school bus transportation, older driver safety, national driver register, driver licensing, driver education and graduated driver licensing, speed enforcement, emergency medical services.
- Highway Safety Grant Programmes: Every state, US territory and Indian Nation, along with the District of Columbia and Puerto Rico, has an agency responsible for coordinating its highway safety programmes. NHTSA, under Section 402 of the Highway Safety Act, distributes State and community grant funds to these agencies, based on a statutory formula. The grants support highway safety plans, provide start-up money for new programmes, and give new direction to existing programmes.
- State and Community Outreach: NHTSA's 10 regional offices deliver highway safety support at the local level.
- Research and development: NHTSA conducts and sponsors a wide range of research and development projects. Examples include crash data collection and analysis, crash tests, research on human behaviour and analytical studies of vehicle components. Results of these activities are disseminated via technical reports, conferences and briefings, at workshops and public meetings.
- Keeping the public informed is a particularly important NHTSA responsibility. As the federal authority on traffic safety issues, the agency works with the national news media, the automotive industry trade press, and other sources to provide the public with information that can make motor vehicle travel much safer.

OFFICE OF SAFETY IN THE FHWA, USA[1]

Within the broad highway safety mission, the Office of Safety's mission is to reduce highway fatalities by making roads safer through a data-driven, systematic approach to putting safety first when applying engineering, education, enforcement and emergency medical services. Focus areas include: com-

1. Source for information: http://safety.fhwa.dot.gov/about/, accessed 29 October 2012.

Figure 12.11
Organisational Structure of the French Public Railway Safety Authority EPSF



Source: Troadec (2006).

prehensive strategic planning, roadway departure, intersections and pedestrians safety. The office also coordinates with other DOT agencies—the National Highway Traffic Safety Administration (NHTSA), the Federal Motor Carrier Safety Administration (FMCSA), and the Federal Railroad Administration (FRA)—to develop and implement multi-faceted, intermodal safety programmes.

The Office of Safety staff at the FHWA Headquarters in Washington DC is organised into two programme area units. Office of Safety Technologies is responsible for highway designs and technologies that improve safety performance. Major programme areas and initiatives include roadway departure, roadside hardware, retro-reflectivity, roadside safety, pavement safety, roadway systems design, intersections, geometric design, road safety audits, speed management, safe routes to school, safety countermeasure analysis and evaluation, safety performance measures and monitoring and data analysis and tools.

The Office of Safety Programmes is responsible for comprehensive federal and state highway safety programmes and activities that improve safety for all road users. Major programmes and initiatives include programme and strategic planning, the Highway Safety Improvement Program (HSIP), vulnerable road user safety, as well as coordination with external and internal safety stakeholders and advocates. The Office of Safety Programmes staff also provides customer assistance for local programmes, and support for state programmes, including policy and guidelines assistance. The Office produces a wide range of tools and technology and community resources for improving roadway user safety.

RAILROAD SAFETY AGENCY

FRANCE: ETABLISSEMENT PUBLIC DE SÉCURITÉ FERROVIAIRE (EPSF)

EPSF is the French public railway safety authority, an organisation holding all the necessary powers and competence in the field of railway safety while remaining independent of the railway operators (EPSF, 2009, Troadec, J.-P., 2006). It is entrusted with the task of issuing authorisations and ensuring, through audits and inspections, that regulatory requirements are complied with, while treating all the operators equally. It thus guarantees the homogeneity of technical and safety operating conditions and helps to enhance the interoperability of the European railway networks.

The EPSF was established by law in 2006. It is funded through a safety fee paid by railway undertakings using the national railway network and through the charges paid by promoters when asking for authorisations. This allows EPSF to use high quality means and reinforces its independence from operators. It recruits and manages its staff independently, whatever their former employment backgrounds. In 2009, EPSF had a staff of about 100 professionals. The main missions of EPSF are:

- Authorising new systems—infrastructure and rolling stock, training centres, accrediting independent experts and delivering safety certificates to railway undertakings, and safety authorisations.
- Controlling the correct use of the authorisations delivered
- Publishing technical recommendations
- Coordinating relationships and setting up partnerships at the European level

The State sets the safety objectives and determines how they are to be met. It is responsible for the regulations and for ensuring that they are applied. ARAF, the railway regulation authority, makes sure that all concerned have equal access rights to the national railway network.

RFF, the owner and infrastructure manager of the network, designs and maintains the installations, handles traffic and intervenes in the event of incidents or accidents on the network. A State public authority, RéseauFerré de France has entrusted SNCF, the established French operating company, with operational management of the network.

The railway operators implement their equipment, train their staff and draw up their operating procedures and instructions in compliance with the operating regulations and documentation. They are responsible for checking application of all these rules. The emergency services also intervene to limit the consequences of accidents, especially in the case of a fire or risks involving people. The Land Transport Accident Investigation Bureau carries out inquiries in the event of railway accidents. It has a separate and complementary role to that of EPSF.

Authorisations that EPSF issues include:

- Safety certificates for railway undertakings
- Safety approvals for the infrastructure management entities
- Authorisations to put new or substantially modified systems into commercial operation
- Safety certificates for undertakings that have signed operating agreements with SNCF
- Approvals for training centres and qualified organisations
- Approvals for rail tankers carrying hazardous materials
- Specific authorisations for exceptional traffic, such as trial runs

To fulfil its mission, EPSF undertakes several types of inspections:

- Audits carried out following issue of authorisations, and programmed to make periodical and methodical checks of compliance with the conditions of issue
- Audits 'as required' if the authority's attention is drawn to repeated significant safety-related events
- Unscheduled inspections to examine specific situations

EPSF also regularly updates its database concerning the most significant safety events, which it uses to trigger its audits 'as required' and alert operators when necessary.

EPSF has also set up long-term relationships with the other European national safety authorities (NSAs) entrusted like itself, with issuing authorisations, supervising safety on their national networks, and participating in harmonisation of practices at an European level. Within this framework, cross-acceptance agreements have led to simplifications in the authorisation procedures for rolling stock.

EPSF is also entrusted with the task of drawing up and publishing technical documents, rules of good practices and recommendations concerning railway safety.

AIR SAFETY AGENCY

EUROPEAN AVIATION SAFETY AGENCY (EASA)

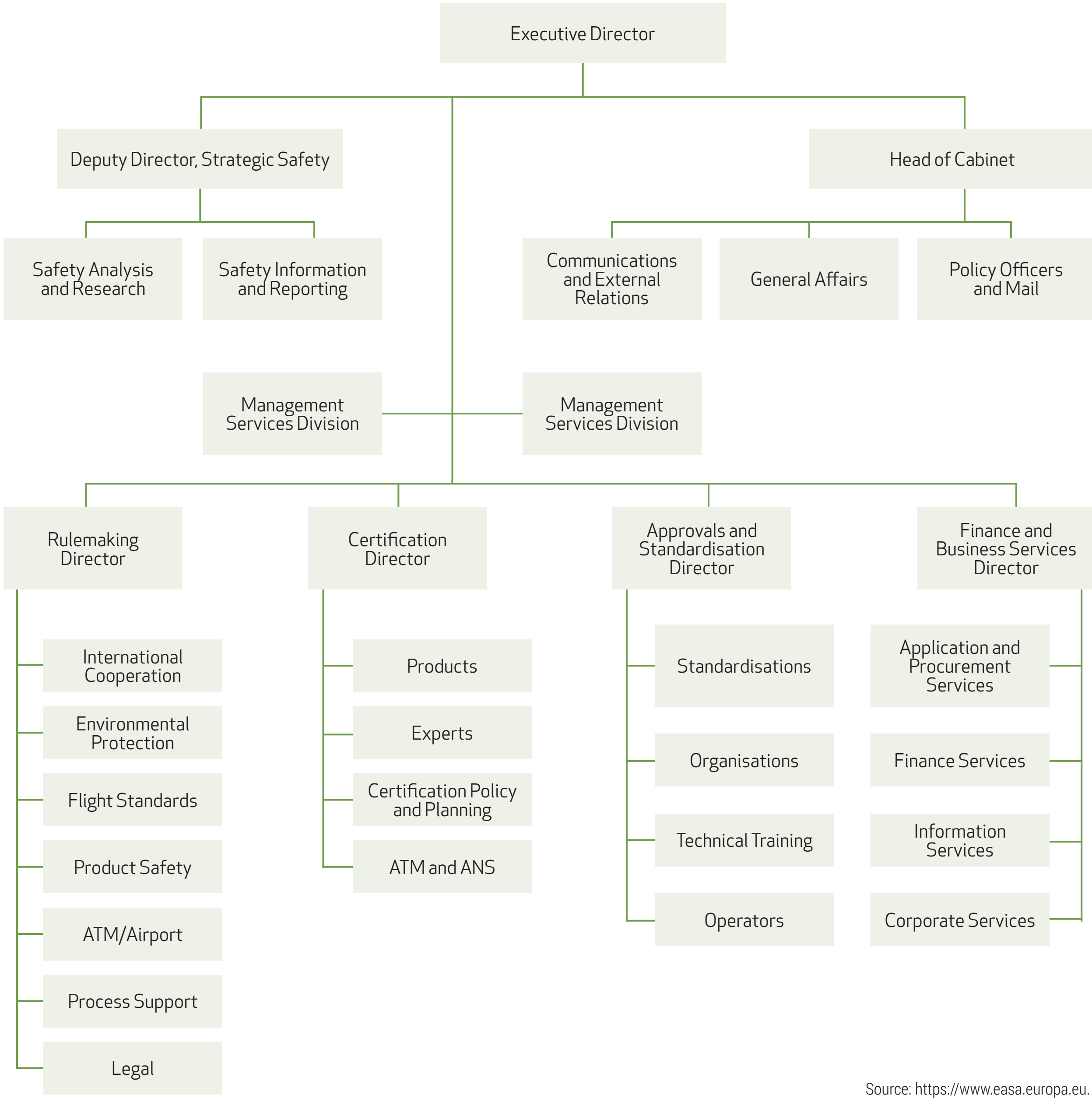
The European Union decided on a common initiative to keep air transport safe and sustainable, allowing for growth and improved safety, and established the European Aviation Safety Agency[2]. As a Community Agency, EASA is a body governed by European public law and was set up by a Council and Parliament regulation and given specific regulatory and executive tasks in the field of civil aviation safety and environmental protection. Figure 12.12 shows the structure of the organisation.

Its mission is to promote the highest common standards of safety and environmental protection in civil aviation, and develops common safety and environmental rules at the European level. It monitors the implementation of standards through inspections in the member states and provides the necessary technical expertise, training and research. The agency works hand in hand with the national authorities which continue to carry out many operational tasks, such as certification of individual aircraft or licensing of pilots.

EASA currently employs about 600 staff members and its main tasks include:

2. Source of information: https://www.easa.europa.eu, accessed 23 March, 2013

Figure 12.12
Organisation Structure of The European Aviation Safety Agency



Source: https://www.easa.europa.eu.

- Rulemaking: Drafting aviation safety legislation and providing technical advice to the European Commission and to member states
- Inspections, training and standardisation programmes to ensure uniform implementation of European aviation safety legislation in all member states
- Safety and environmental type-certification of aircraft, engines and parts
- Certification of aircrafts and components as well as the approval of organisations involved in the design, manufacture and maintenance of aeronautical products.
- Authorisation of third-country—non-EU—operators
- Coordination of the European Community programme Safety Assessment of Foreign Aircraft (SAFA) regarding the safety of foreign aircraft using Community airports
- Data collection, analysis and research to improve aviation safety

The agency has been designed in order to ensure a degree of separation between the political process—the role played by the European Commission, Council and Parliament in drafting and enacting legislation relating to aviation safety—on the one hand, and the design and implementation of the technical measures necessary for safety, on the other. This explains why the Executive Director is granted independence in decisionmaking relating to the safety issues under the agency's responsibility. This, however, is without prejudice to the chain of accountability to which the agency and its Executive Director are subject. The rules applicable to flight crew licensing (FCL) and flight time limitations (FTL) are the national rules of the EU member states.

All aircraft accidents are investigated by designated independent agencies. The safety investigation of accidents and incidents aims solely at the promotion of aviation safety, through accident prevention. It does not apportion blame or liability. Following the investigation, the published reports share the lessons learned and may contain safety recommendations for consideration.

To successfully discharge its responsibilities in this area, EASA has developed an Accident Investigation Section that is responsible for the follow-up of investigations and subsequent recommendations. Its main devoted tasks are:

- Follow the progress of aircraft accidents and incidents investigations
- Be represented in investigations and deliver technical expertise whenever needed
- Achieve the processing of safety recommendations addressed to the agency and monitor follow-up
- Provide progress reports and statistics on safety recommendations processing
- Maintain a working coordination with European accident investigation bodies
- Be aware of safety deficiencies and disseminate related information for establishing corrective actions

WATER TRANSPORT SAFETY AGENCY

U K: MARITIME AND COASTGUARD AGENCY (MCA)

MCA was established in 1998 as an Executive Agency within the Department for Transport. The Agency has an annual budget in excess of £120m, and around 1,200 staff supported by over 3,500 volunteer Coastguard Rescue Officers (MCA, 2010, MCA, 2012). Operational priorities of the agency are:

- Maintaining national maritime emergency response capability, including coordination of search and rescue. The agency provides a 24-hour maritime search and rescue service
- Ensuring ship survey, inspection and certification capability, and parallel work in relation to seafarers, to meet domestic and international obligations
- Working with the maritime industry to encourage quality companies and ships to join the UK register
- Promoting improved safety among seafarers, the commercial fishing community and the recreational sector
- Supporting a successful and sustainable maritime sector through better regulation
- Working with other government departments and industry to reduce the likelihood of, and improve the capacity to deal with, pollution incidents in UK waters

The Secretary of State, or another minister designated by the Secretary of State, is responsible for the policy framework in which the agency operates and for agreeing on its strategic objectives. The minister is supported in the discharge of these functions by an Agency Advisory Board chaired by a Director General in the Department for Transport who acts as the Agency Owner. The Secretary of State appoints the Chief Executive, on the advice of the Permanent Secretary, for a fixed term, following an open competition, with the possibility of extension, subject to satisfactory performance. The Secretary of State is accountable to Parliament on all matters concerning the agency, but will not normally become involved in its day-to-day operational matters.

The investigation of marine accidents is the responsibility of the Marine Accident Investigation Branch (MAIB), which is not part of the agency. It reports direct to the Secretary of State. The agency has an operating agreement with the MAIB. The MAIB has the primary function of learning lessons to improve maritime safety. The agency may also investigate accidents but will focus its investigation on any significant breaches of legislation. The MCA works together with many other government departments, including the Department for the Environment and Rural Affairs, the Department of Energy and Climate Change, the Foreign and Commonwealth Office, the Home Office and the Ministry of Defence, to deliver its responsibilities. It also works in close partnership with the other emergency services to provide its search and rescue services.

Accident prevention work encompasses everything the Agency does in its role as a regulator, from the development of technical policy and standards, through to the enforcement of those requirements. This work includes international negotiations, primarily through the International Maritime Organisation (IMO), the European Commission (EC) and the European Maritime Safety Agency (EMSA), but also at the International Labour Organisation (ILO). Merchant ships on the UK Ship Register undergo in-depth ship surveys which cover ship construction, equipment and on-board operations. The MCA ensures that seafarers have the right skills, are medically fit, and hold valid certificates to serve on UK-registered ships. The MCA has six National Liaison Officers for various recreational activities who provide the public with information about safety messages and campaigns.

The environmental prevention work reduces pollution from shipping, and the response activities minimise its impact. To help reduce the risk of pollution without unduly restricting legitimate activity, MCA brought into force an amendment to the UK ship-to-ship trans-

Table 12. 4

Major Federal Safety and Activity Databases Associated with Transport Safety In USA

SN	DATABASE	SN	DATABASE
1	NTSB Aviation Accident Database	22	FMCSA Motor Carrier Management Information System (MCMIS)
2	FAA Accident/Incident Data System (AIDS)	23	FRA Rail Equipment Accident/Incident Report (RAIR) Database
3	FAA/NASA Aviation Safety Reporting System (ASRS)	24	FRA Highway-Rail Grade Crossing Incident Report (GXIR) Database
4	FAA National Airspace Incident Monitoring System (NAIMS)	25	FRA Railroad Injury and Illness Summary Database
5	FAA General Aviation and Air Taxi Activity Survey (GAATA Survey)	26	FRA Railroad Operations Database
6	Near Mid-Air Collisions System (NMACS)	27	FTA National Transit Database (NTD)
7	Pilot Deviations (PD)	28	FTA Safety Management Information Statistics (SAMIS) Database
8	Operational Errors (OE)	29	RSPA Hazardous Liquid Pipelines Accident Database
9	BTS Omnibus Survey	30	RSPA Natural Gas Gathering and Transmission Systems Incident Database
10	BTS Form 41, Schedules T100 and T100(f) Air Carrier Data	31	RSPA Natural Gas Distribution Systems Incident Database
11	BTS Form 41 T-3 passengers enplaned and other traffic data	32	RSPA Hazardous Materials Information System (HMIS) Incident Database
12	NHTSA Fatality Analysis Reporting System (FARS)	33	US Army Corps of Engineers Lock Performance Monitoring System
13	NHTSA National Accident Sampling System/ General Estimates System (NASS/GES)	34	US Census Bureau/BTS Commodity Flow Survey (CFS)
14	NHTSA National Accident Sampling System/ Crashworthiness Data System (NASS/CDS)	35	University of Michigan Transportation Research Institute
15	NHTSA Crash Outcome Data Evaluation System (CODES)	36	Trucks Involved in Fatal Accidents (TIFA)
16	NHTSA Motor Vehicle Defects Investigation Database	37	USCG Boating Accident Report Database (BARD)
17	NHTSA Motor Vehicle Defects Non-compliance Database	38	USCG Search And Rescue Management Information System (SARMIS)
18	NHTSA National Occupant Protection Use Survey (NOPUS)	39	USCG Marine Safety Information System (MSIS) Vessel Casualty Data
19	FHWA Highway Performance Monitoring System (HPMS)	40	USCG Marine Safety Information System (MSIS) Pollution Data
20	FHWA Licensed Drivers Data	41	USCG Merchant Mariner Licensing and Documentation (MMLD) System
21	FHWA/BTS National Household Travel Survey (NHTS)	42	USCG Marine Information for Safety and Law Enforcement (MISLE)

BTS = Bureau of Transportation Statistics; FAA = Federal Aviation Administration; FMCSA = Federal Motor Carrier Safety Administration; FRA = Federal Railroad Administration; FTA = Federal Transit Administration; NASA = National Aeronautics and Space Administration; NHTSA = National Highway Traffic Safety Administration; NTSB = National Transportation Safety

Source: Adapted from NTSB (2002).

fers regime, intended carefully to balance economic, environmental and social concerns. MCA's international negotiations have also resulted in significant changes to the regime for garbage, intended to deliver increased protection of the marine environment from ship-generated waste. MCA was closely involved in the delivery of the mandatory energy efficiency measures adopted by IMO, which have a key role in reducing emissions from the sector.

DATA COLLECTION AND ANALYSIS AGENCIES

Enactment of safety policies and monitoring effectiveness of policies and interventions requires that reliable and accurate data regarding accidents be collected and made available. All countries that have been successful in controlling death and disability due to transportation accidents have set up systems for surveillance and analysis. The institutional systems vary from country to country, but most countries adhere to the following principles:

- Establishment of agencies professionally staffed for designing and implementing data collection systems
- Ensuring compatibility of data formats between different departments and users
- Responding to the demand of lead agencies for special needs regarding availability of data

- Ensuring that all non-proprietary and non-personal data are publicly available to all concerned stakeholders
- Setting up of systems for periodic review of the efficiency of data collecting and analysis procedures and responding to new demands as they arise from time to time

The databases help in observing trends over time and for understanding the occurrence of harmful events and their relationships to characteristics of people, technologies and environments. Table 12.4 shows the major transport-related safety data systems maintained in USA and coordinated by the the Bureau of Transportation Statistics (BTS), established in 1992.[3] The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 created BTS to administer data collection, analysis and reporting, and to ensure the most cost-effective use of transportation monitoring resources. BTS brings a greater degree of coordination, comparability and quality standards to transportation data, and facilitates in the closing of important data gaps.

BTS is headed by a Director, appointed by the Secretary of Transportation. BTS' basic authorising legislation is the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), which authorised $27 million each year for a five-year period (2005-09). This funding comes from the Highway Trust Fund, and is administered within the research and development account under the Federal Highway Administration.

As a statistical agency, BTS:

- Is policy-neutral—an objective broker for the facts
- Covers all transportation; BTS is cross-modal in nearly everything it does
- Does independent data collection and analysis, but BTS also serves all the other modes to help them be more effective and efficient
- Sets standards for transportation data and has special statutory protections for the confidentiality of data it collects
- Has unique competencies in statistics, economics, information technology, geographic information systems and transportation

Over the years, BTS has established itself with a focus in three key areas, each mandated by legislation: compiling, analysing and publishing a comprehensive set of transportation statistics; making statistics readily accessible; and implementing a long-term data collection programme. BTS serves Congress, DOT, other federal agencies, state governments, metropolitan planning organisations, local governments, universities, the private sector and the general public.

The main purpose of BTS' work is to help advance DOT strategic goals. It also aims to anticipate future needs and policy issues.

NATIONAL SAFETY RESEARCH AGENCIES

Research activities regarding transportation safety are organised in different ways across nations. This activity is carried out at four levels:

1. Regional international agencies where inter-country cooperation and coordination is essential
2. National agency
3. State level agencies
4. University departments and civil society organisations

In some countries, a national research department is included within the lead agency for each transport sector, and in others, standalone safety institutions have been established. Two examples of independent national agencies are given below.

INSTITUTE FOR ROAD SAFETY RESEARCH (SWOV), THE NETHERLANDS

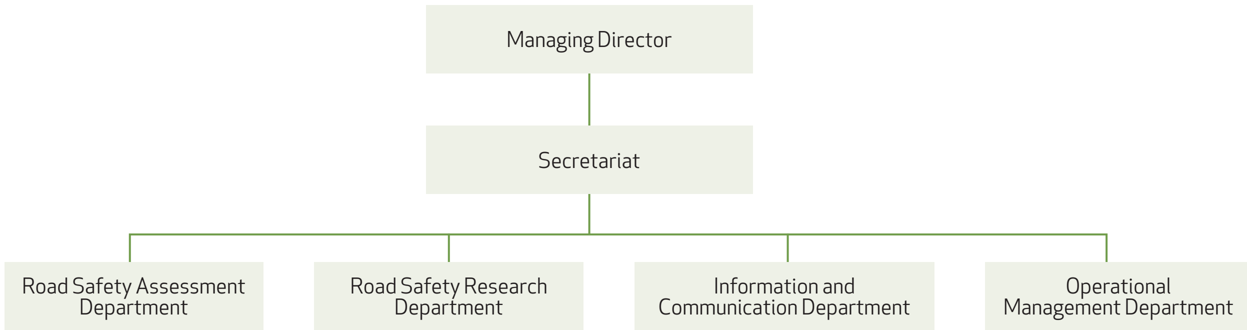
SWOV was established in 1962. The founding fathers are the Ministry of Transport and three private organisations: the vehicle industry (RAI), the motor vehicle insurance industry, and the Dutch motoring/tourist club (ANWB). SWOV is an independent institute which contributes to the improvement of road safety by using knowledge from scientific research. This knowledge is in the public domain and it is made available to anyone who is (professionally) involved in traffic and road safety, both in the Netherlands and abroad. Figure 12.13 shows the organisation structure of SWOV, which has over 100 employees.

SWOV carries out high quality fundamental and anticipatory research that can be used for practical purposes. SWOV's knowledge covers the entire range of road safety subjects. It aims at inter-disciplinary cooperation between researchers within the institute, and with other research institutions in the Netherlands and abroad.The target groups' requirements determine SWOV's activities. An essential task is distribution of knowledge and information to everybody professionally involved with traffic and road safety, both at home and abroad. SWOV's main target groups are:

- National politicians
- National, regional and municipal governments
- Advisory bodies of these governments
- Fellow researchers in the Netherlands and abroad
- Educational and knowledge institutes
- Media—parliamentary press, newspapers and professional journals

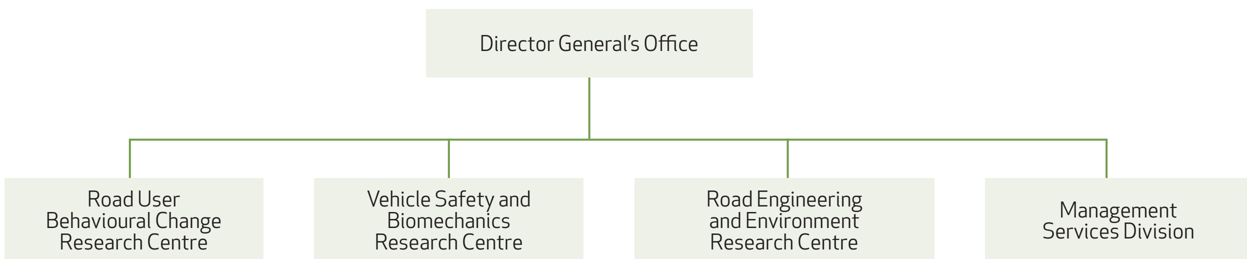
3. http://www.rita.dot.gov/bts/about , accessed 15 September 2012.

Figure 12.13
Organisation Structure of Institute for Road Safety Research [SWOV], The Netherlands



Source: Adapted from http://www.swov.nl/UK/Profiel/organigram.asp, accessed 30 September 2012.

Figure12.14
Organisation Structure of Malaysian Institute of Road Safety Research [MIROS]



Source: Adapted from http://www.miros.gov.my/web/guest/organisation, accessed 30 September 2012.

MALAYSIAN INSTITUTE OF ROAD SAFETY RESEARCH (MIROS)

MIROS is headed by a Director General and administratively organised into three Centres and one Division. The organisation structure is given in Figure 12.14.

MIROS, established in 2007, functions as a one-stop centre for the generation and dissemination of road safety information through the print media and a concerted training programme. MIROS carries out studies and evaluates current procedures on road safety to generate information that will form the core of its evidence-based intervention programmes to enhance road safety. MIROS has the following functions:

- Conduct high impact research that will be translated into road safety policies
- Develop national objectives, policies and priorities for the orderly development and administration of road safety research
- Enhance and increase knowledge based on new developments in issues related to road safety
- Serve as an audit and accreditation agency in curriculum design and standards on road safety
- Propose evidence-based cost-effective interventions/programmes
- Serve as a repository of knowledge and linkage on road safety
- Serve as a centre providing consultation and advice on road safety issues

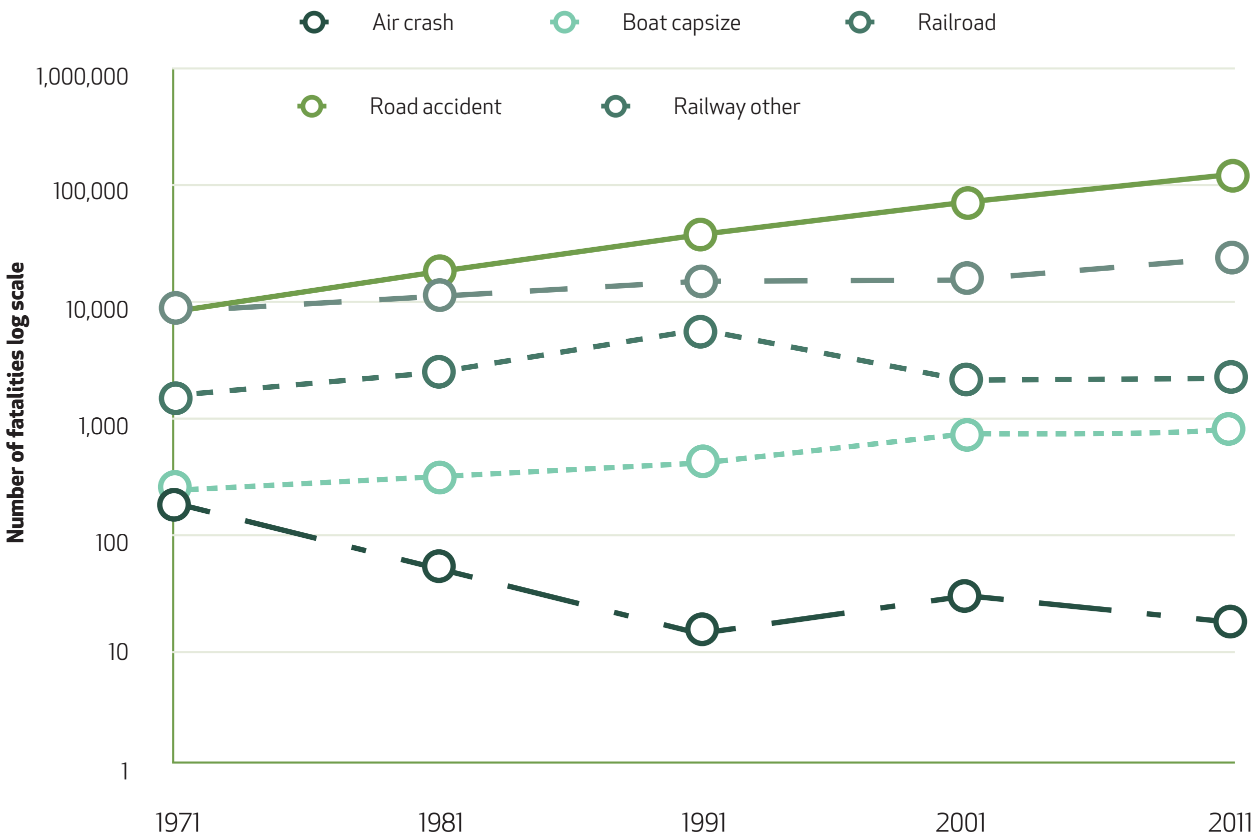
CHARACTERISTICS OF LEAD AGENCIES FOR SAFETY [4]

A variety of lead agency models can be effective in road safety management, and countries must create

4. Adapted from (1) Bliss and Breen (2009). Implementing the recommendations of the World Report on Road Traffic Injury Prevention, Wahington DC, The World Bank Global Road Safety Facility. (2) Committee (2007). Report of the Committee on Road Safety and Traffic Management [Online]. http://morth.nic.in/writereaddata/linkimages/SL_Road_Safety_sundar_report4006852610.pdf: Committee on Infrastructure, Planning Commission, Government of India, New Delhi.

Figure 12.15

Number of Fatalities in Accidents Associated with Different Modes of Transport



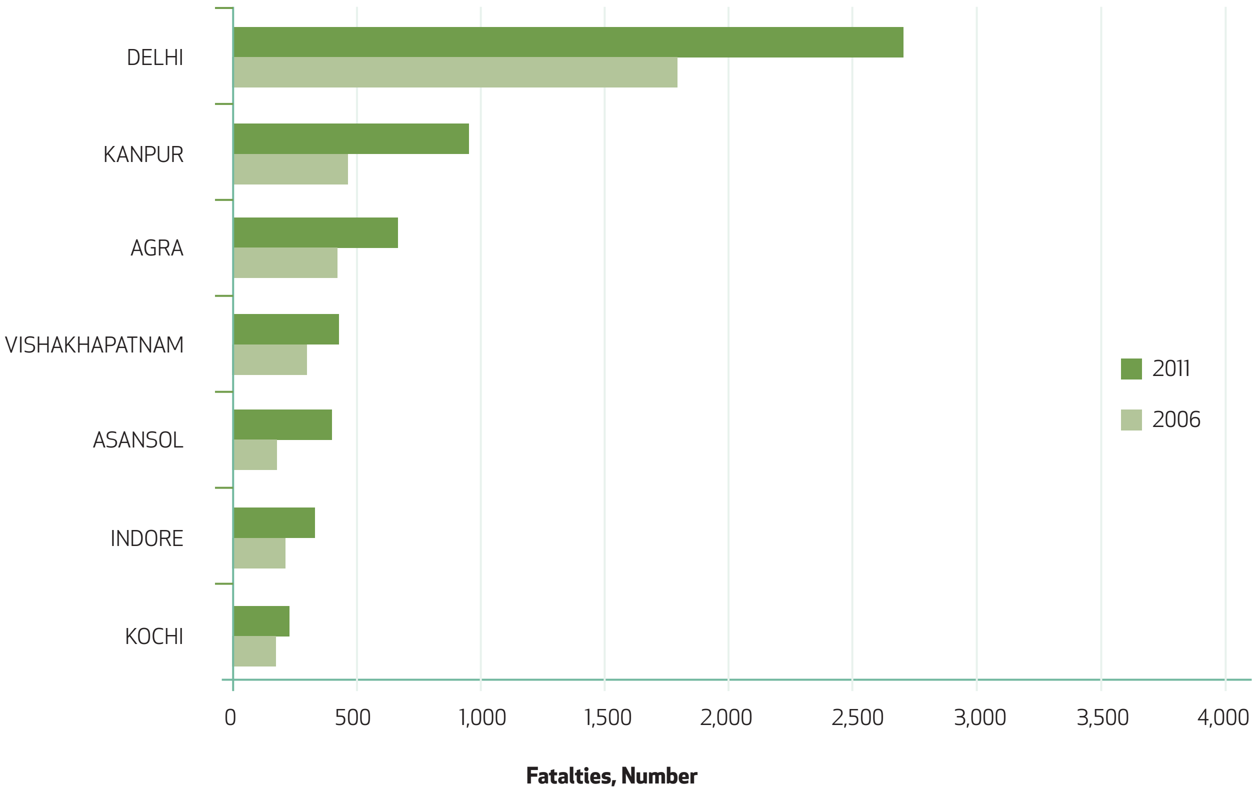
Source: National Crime Records Bureau (2012).

a lead agency appropriate to their own circumstances. Successful practice underscores the need for the agency to be a governmental body and for its leadership role to be accepted and fully supported by the rest of government to ensure appropriate funding and capacity development.

The lead agency may take the form of a designated, standalone entity with a coordinating committee representing partner government agencies. It may also be part of a larger transport organisation or be part of a Prime Minister's department. The agency might undertake much of the work itself or it might delegate aspects of work to other organisations, including provincial and local governments, research institutes or professional associations. All agencies have complex organisational structures and processes, and many partners and stakeholders. Most agencies perform all or most of the following functions:

- Set evidence-based national, regional and local safety policies, strategies and targets
- Establish systems for monitoring of progress regarding targets set and effectiveness of safety interventions
- Set performance standards for vehicles, equipment and infrastructure
- Conduct/commission safety audits of vehicles, equipment and infrastructure
- Identify subjects and institutions for research in different areas of safety, and commission and fund research projects and publish research findings, create linkages between research institutions at the local, regional and national levels
- Establish Centres of Excellence and fund safety research and education
- Establish the methodology for multidisciplinary crash investigation, data collection, reporting and analyses
- Establish procedures and systems for data collection, transmission and analysis at appropriate levels and define the role of different agencies involved in the process, and maintain comprehensive databases on safety-related issues
- Establish policies and framework for capacity building and skills among personnel of concerned government agencies, NGOs and other relevant organisations dealing with safety
- Liaise with all concerned government ministries, educational institutions, health service providers, NGOs, international agencies and organisations in other countries

Figure 12.16
Road Traffic Fatalities in 2006 and 2011



working in any area related to safety and transport management

- Promote best practices in safety and transport management, undertake safety and traffic management education programmes, and conduct campaigns to create awareness on matters relating to safety
- Establish guidelines for upgrading trauma care systems at all levels and create a grid of medical, allied medical and rehabilitation facilities to provide first aid, care during transportation, emergency care in the hospital and rehabilitation
- The agency should not only set standards but also monitor their adoption and implementation. If standards are not adhered to, the agency should have powers to take corrective action.

Two important conclusions from good practices are drawn with regard to lead agency forms and related structures and processes. First, no one lead organisational arrangement is prescribed as being the best, given the diversity of country conditions which road safety managers have to meet. However, a central road safety office with adequate human, technical and financial resources is essential. Second, effective coordination arrangements are subordinate to the leadership role. Without adequate funding, technical resources and an authoritative lead agency support, coordinating the shared responsibility for achieving road safety results has little chance of success.

CURRENT STATUS IN INDIA

The time trends of total number of deaths in accidents associated with various modes of transport as reported by the National Crime Records Bureau (NCRB) are shown in Figure 12.15. Between 1971 and 2011, the total number of deaths decreased only for air accidents. The reported number of accidents in this period increased by a factor of 14.3 for road accidents, 2.7 for 'railway other', 1.5 for 'railroad' and 3.4 for boat capsize. Of the four modes of transport, accurate statistics for accident fatalities are only available for air transport (18 deaths in 2011). The number reported killed in road traffic accidents in 2011 was 136,834 (NCRB, 2012). But road traffic accident fatality statitistics are considered to be underestimated by 15-100 per cent by different investigators (Gururaj, G., 2006, W.H.O., 2009). The total

Table 12. 5

Changes in Road Traffic Fatalities in Selected Indian Cities 2006-11 and Fatality Rates per 100,000 Persons in 2011

CITY	FATALITIES PER 100,000 PERSONS IN 2011	INCREASE IN FATALITIES 2006-11 (PER CENT)
KOCHI	36	33
INDORE	15	58
ASANSOL	69	132
VISHAKHAPATNAM	24	51
AGRA	41	56
KANPUR	34	107
DELHI	16	50

Table 12. 6

Railway Accidents Associated with the Local Rail Network in Mumbai

ACTIVITY	FATALITIES, NUMBER	
	2003	2011
Crossing tracks	2,148	-
Falling from train	532	-
Others	127	-
Total	2,807	3,458

Source: Adapted from Krishna (2012); Parasnis (2005).

number of rail-related fatalities in 2011 was 28,238. For water transport, there are no reliable statistics or estimates.

The increasing trend of accidents for water, roads and railroad is a serious cause for concern and needs special attention. Figure 12.16 shows the statistics for road traffic fatalities for selected large and small cities in India in 2006 and 2011. The data show that within a period of five years, fatalities have increased by 30 per cent to 130 per cent in these cities (Table 12.5). The range was 15-69 fatalities per 100,000 persons in 2011. This compares poorly with 4-6 fatalties per 100,000 persons per year in cities like Tokyo, London, Amsterdam, Stockholm and New York.

Urban traffic accidents are also associated with railway traffic through cities. Table 12.6 shows reported deaths on the Mumbai suburban rail network. The number is higher than the annual death toll on Delhi roads. Anecdotal evidence suggests that the number of railroad-associated injuries and deaths in other cities is also not insignificant.

It is evident that both the existing rates of fatalities are far too high and that the rate of increase in accidents is unacceptable. As shown in earlier sections, it is not necessary that accident rates increase with increase in transportation volumes in any mode of transportation if appropriate safety systems are put in place. It is imperative that we give much more importance to transportation safety in India, and this will only happen if the whole system is improved and strengthened on an urgent basis.

ROAD

The number of persons reported killed in road traffic accidents in 2011 in India was 136,834. Accurate numbers for serious injuries and disabilities are not available. Taking the 2011 number as the base, it is possible that there were about 2,800,000 hospitalisations due to serious injuries and 420,000 persons permanently disabled due to road traffic accidents in India (Gururaj, G., 2005, Mohan, D. et al., 2009). Table 12.7 shows the road traffic fatality rates in a few countries arranged by per capita income in 2010 (WHO, 2013). Two fatality rates are given—one as reported by the countries, and the second estimated by the WHO, adjusted for a 30-day period for death after the crash. A negative binomial regression model was used for estimating fatalities for each country by accounting for income, exposure, risk factors and strength of the health system. For many high-income countries, reported fatality rates and estimated rates are very similar, indicating that their reporting systems may be quite reliable. This is true for only a few low-income countries; for instance, Zimbabwe and Sri Lanka. However, this does prove that it is possible to have reliable reporting systems at low income levels if appropriate arrangements are put in place.

In Table 12.7, Sweden and the UK have the lowest death rates of 2.8 and 3.1 per 100,000 persons respectively. The reported rate for India is 10.6 and estimated 18.9 per 100,000 persons. Some nations have rates greater than 30, so India ranks somewhere in the middle among countries worldwide. It is important to note that some countries with high-income levels can have high death rates—the United Arab Emirates, Saudi Arabia, the Russian Federation and some with low income levels relatively lower rates. This is ample evidence that road traffic death rates do not have a strong correlation with per capita incomes, and that economic growth does not necessarily result in lower death rates unless evidence-based safety policies are implemented.

Table 12.7.
Road Traffic Accident Fatality Rates per 100,000 Persons, 2010

COUNTRY	GNI PER CAPITA FOR 2010 IN US DOLLARS	REPORTED FATALITY RATE PER 100,000 POPULATION	ESTIMATED FATALITY RATE PER 100,000 POPULATION
ETHIOPIA	390	3.0	17.6
ZIMBABWE	480	14.2	14.6
BANGLADESH	700	1.9	11.6
CAMBODIA	750	12.9	17.2
VIET NAM	1,160	11.5	24.7
NIGERIA	1,170	3.3	33.7
INDIA	**1,260**	**10.6**	**18.9**
SRI LANKA	2,260	11.8	13.7
ECUADOR	3,850	22.3	27.0
COLOMBIA	5,520	11.9	15.6
MALAYSIA	7,760	24.2	25.0
BRAZIL	9,540	18.7	22.5
RUSSIAN FEDERATION	9,880	18.6	18.6
SAUDI ARABIA	16,610	24.0	24.8
UNITED KINGDOM	38,140	3.1	3.7
SINGAPORE	39,410	3.8	5.1
UNITED ARAB EMIRATES	39,640	11.0	12.7
JAPAN	42,050	4.6	5.2
AUSTRALIA	46,200	6.1	6.1
SWEDEN	50,580	2.8	3.0

Source: World Health Organisation (2013).

INSTITUTIONAL SETUP

Ministry of Road Transport and Highways in the Government of India is the administrative ministry responsible for road safety efforts in the country. National Road Safety Council (NRSC), headed by the Union Minister for Road Transport and Highways is the apex advisory body. It includes the ministers in-charge of transport in the state governments and various official and non-official members. NRSC does not have adequate statutory backing, budgetary resources, professional expertise, or the mandate to be an effective organisation for executing road safety plans. The Transport Development Council chaired by the Union Minister of Transport, with the Union Ministers of Commerce, Industry, Railways and Member in-charge of Transport in Planning Commission as members, is a high level forum for the formulation of common policies for the development of road transport. It also includes all the Lt Governors/ Chief Commissioners of Union Territories and all ministers in charge of transport in the state governments. The Transport Division of the Department of Road Transport and Highways deals with matters relating to safe movement of vehicles on roads and safety awareness among users. The Road Transport Division has three sections dealing with motor vehicle legislation, transport-related matters and administration of road safety schemes. A Joint Secretary heads the Division, assisted by a Director and two Under Secretaries. The Roads Wing of the Department sets engineering standards for safety in design, construction and operation of National Highways in consultation with the Indian Roads Congress (IRC).

NCRB collects data of fatal and non-fatal road traffic accidents as reported to the police stations across the country and publishes a consolidated annual report. This is the only source for national data. However, the data is of a very rudimentary nature and as a result, we do not even have a reliable estimate of

At present, existing institutions are not well-equipped to deal with increasing traffic on the roads or adopt the advances in technology that would promote road safety. There are hardly any trained road safety professionals at central or state government level.

different types of road users killed. The data is not adequate for informed evidence-based detailed road safety policymaking.

The Government of India has established National Automotive Testing and R&D Infrastructure Project (NATRiP) between the Government, a number of state governments and the Indian automotive industry to create testing, validation, and research and development infrastructure in the country. The following centres have been finalised to setup the test facilities:

- International Centre for Automotive Technology (iCAT), Manesar, is the principal vehicle homologation testing agency in Northern India
- Global Automotive Research Centre (GARC), Chennai, is expected to have certification test facilities to conduct performance testing of a full range of automobiles, tractors and construction equipment vehicles. It is expected to be fully operational in 2014
- National Automotive Test Tracks (NATRAX), Indore, also expected to be fully operational in 2014, will be an automotive proving ground with test tracks for vehicle dynamics
- Automotive Research Association of India (ARAI), Pune, provides technical expertise in R&D, testing, certification, homologation and framing of vehicle regulations
- Vehicle Research and Development Establishment (VRDE), Ahmednagar, is a homologation centre belonging to DRDO and has set up a electromagnetic compatibility laboratory and a multi-function braking track
- National Institute for Automotive Inspection, Maintenance and Training (NIAMINT), Silchar
- National Centre for Vehicle Research and Safety (NCVRS), Rae Bareli, will have a full-fledged tractor and off-road vehicles test facility and a national data analysis centre

Many states have taken initiatives in promoting road safety at the local level, but none have established a professional road safety agency. Examples of initiatives include those in the states of Kerala, Punjab and Tamil Nadu, where data collection and safety programmes have been stepped up with financial assistance from the World Bank. However, there is no evidence of any significant advances yet in controlling road traffic crashes.

ACADEMIC SAFETY RESEARCH CENTRES

The Central Road Research Institute, New Delhi, has a small group that carries out research on road safety and transportation, and it is the only agency funded by the government specifically for this purpose. A Transportation Research and Injury Prevention Programme was established at the Indian Institute of Technology Delhi over a decade ago, and this is the only multidisciplinary research centre focussing on traffic safety in the country. Some research on traffic safety gets done at other Indian Institutes of Technology, National Institutes of Technology, and medical institutions, but is mainly based on individual initiative.

At present, existing institutions are not well-equipped to deal with the increasing traffic on the roads or to adopt the advancements made in techniques and technology that would promote road safety. There are hardly any trained road safety professionals employed at the central or state government level or in academic institutions. Responsibility for road safety is diffused and there is no single agency to deal with a range of problems associated with it. There is also no effective mechanism for coordinating the activities of the different agencies dealing with the issue.

RAIL

The Commission of Railway Safety, working under the administrative control of the Ministry of Civil Aviation of the Government of India, deals with matters pertaining to safety of rail travel and train operation and is charged with certain statutory functions as laid down in the Railways Act (1989), which are of inspectorial, investigatory and advisory nature. The most important duties of the Commission is to ensure that any new railway line to be opened for passenger traffic conforms to standards and specifications prescribed by the Ministry of Railways and the new line is safe in all respects for carrying of passenger traffic. This is also applicable to other works such as gauge conversion, doubling of lines and electrification of existing lines. The Commission also conducts statutory inquiries into serious train accidents and makes recommendations for improving railway safety[5].

Injuries and fatalities associated with the Indian Railways can be divided into three groups:

(1) 'Consequential accidents'. The total number of deaths in this category per year generally remain less than 1,000.
(2) Injuries sustained by Indian Railways employees while on duty. In the period 2007-08 to October 2011, there were 1,624 fatalities and 8,709 injuries in this category (High Level Safety Review Committee, 2012).
(3) Deaths and injuries among railway passengers and others on railway property not con-

5. http://civilaviation.gov.in/CRSS/Commission%20of%20Railway%20Safety.html, accessed 23 September 2012.

sidered as ‘consequential’ or due to a ‘fault’ of the Indian railways. The number of deaths reported in this category was 25,872 in 2011 (NCRB, 2012). According to National Sample Survey Organisation (NSSO) surveys, about 1 per cent of the Indian population suffers from locomotor disabilities, of which 26 per cent are due to injuries (Pandey, R. N. and Chatterjee, A. L., 2007). This means that about 3.3 million Indians are physically disabled due to accidents and about 10-15 per cent of these are associated with railway accidents (Singh, G. et al., 2009). However, the Indian Railways does not have any formal policy or any dedicated system for reduction of deaths and injuries.

Concerned with the high rate of railway accidents, the Ministry of Railways set up a High Level Safety Review Committee which submitted its report in February 2012 (High Level Safety Review Committee, 2012). The Committee noted that:

There is no practice of independent safety regulation by an independent agency separate from operations. The Railway Board has the unique distinction of being the rule maker, operator and the regulator, all wrapped into one. Commissioners of Railway Safety, though considered to be the safety watchdogs, have negligible role at the operational level. Compliance of safety standards set by Railways for themselves are often flouted for operational exigencies.

Regarding accidents not considered ‘consequential’, the Committee noted that :

Reluctance of Indian Railways to own these casualties, which do not fall under the purview of train accidents but are nevertheless accidents on account of trains can by no means be ignored. No civilised society can accept such massacre on their railway system.

The main recommendations of the Committee are:

1. Setting up of a statutory Railway Safety Authority (RSA) and a safety architecture which is powerful enough to have a safety oversight on the operational mode of Indian Railways without detaching safety with the railway operations. The Committee has also recommended measures to strengthen the present Railway Safety Commission to undertake meaningful regulatory inspections.
2. A Railway Research and Development Council (RRDC) to be set up at the apex level directly under the Government. This Council will have an Advance Railway Research Institute (ARRI) and five Railway Research Centres, for key safety-related railway disciplines such as rolling stock, signalling and telecommunications, motive power, tracks and bridges and operations management.

Commissioners of Railway Safety, though officially the safety watchdogs, have negligible role at the operational level. Safety standards, set by the Railways for themselves, are often flouted for operational exigencies.

3. Elimination of all level crossings (manned and unmanned) within five years at an estimated cost of Rs 500 billion which will get recovered over seven to eight years due to savings in operation and maintenance costs, and improved train operation.

ACADEMIC SAFETY RESEARCH CENTRES

At present, there are no independent academic research centres of any consequence dealing with railway safety.

AIR TRANSPORT

Safety in air transport in India is under the supervision and control of Directorate General of Civil Aviation (DGCA). As per DGCA data, India witnessed only four accidents in scheduled commercial air transport during the period 2000-2010, and non-scheduled air operations account for 22 accidents in the same period. According to the DGCA Working Group Report, ‘Though regulatory framework is amended from time to time to suit immediate needs and to meet safety norms, the basic regulatory structure remains archaic. Stakeholders indicated that DGCA broadly conforms to International Civil Aviation Organization (ICAO) norms, but lacks in detailed regulatory framework which is essential for safe operations. While model regulations based on US and European regulations are available, the same have not been adopted by DGCA due to lack of in-house resources to undertake a complete review.’

The Air Safety Directorate within DGCA is responsible for all aspects of safety associated with air travel, including:

1. Investigation of civil registered aircraft incidents
2. Accident/incident prevention work
3. Approval of flight safety organisation and personnel
4. Cabin safety facilities, crew training, in-flight cabin inspection, etc.
5. Collection, maintenance and analysis of accident data
6. To coordinate with the ICAO and other aviation agencies concerning safety
7. Ensure that operators and service providers establish and maintain the Safety Management System (SMS) in their operation

However, the shortcomings persist and in the absence of a well-staffed professional safety agency the

The 12th Plan envisages setting up an Air Navigation Services Corporation to manage safety, congestion and efficiency issues.

effectiveness of DGCA has been affected by shortage of experienced manpower to oversee fast-growing aviation activities in the country. Some of the issues facing the aviation sector are:

- It is not possible to carry out meaningful audits, surveillance of a large number of airlines, non-scheduled operators, training institutes for pilots and engineers, maintenance organisations, airport service providers without adequately trained staff
- DGCA has to discharge its responsibilities of compliance with ICAO standards, approve organisations, license personnel, certify organisations, aircraft, communication systems and so on. Investigation into incidents and accidents and learning from the outcome of such investigation by implementation of the ensuing recommendations cast huge responsibilities on the regulator. However, DGCA has been crippled by the absence of the minimum required manpower, which was reduced by half over the years due to officers retiring and the organisation not being able to recruit.
- ICAO has recommended transformation of DGCA into a Civil Aviation Authority (CAA) with necessary autonomy
- The introduction of space-based navigation systems and use of satellites for navigation are on the cards. DGCA at present has limited capacity to deal with these issues
- Training facilities for various categories of aviation personnel have not yet reached a satisfactory level. While airlines are able to meet their requirements for technical training within the country, operational/flying training for many airlines is carried out abroad.
- In the General Aviation (GA, non-scheduled) sector, specialised aspects of flight training like low visibility operations, instrument approaches, performance-based navigation, etc., are not adequately addressed. The GA sector needs to be organised to introduce manufacturers' recommended training profiles, to ensure that GA pilots are as proficient in handling modern aircraft as airline pilots.
- An appellate mechanism outside DGCA, preferably in the Ministry of Civil Aviation, should be available to operators to ensure fair enforcement of regulations

The 12th Five Year Plan strategies for civil aviation include the strengthening of regulatory framework on safety and economic regulatory aspects of civil aviation, by setting up a Civil Aviation Authority and also an independent Air Navigation Services Corporation to manage capacity, safety, congestion and efficiency issues.

ACADEMIC SAFETY RESEARCH CENTRES

At present, there are no independent research centres dealing with aviation safety in India.

WATER TRANSPORT

The Director General of Shipping is the statutory maritime authority, appointed by the Government of India under the Merchant Shipping Act, 1958, and is responsible for implementation of the provisions of the Act. The Directorate General ensures implementation of various international conventions, relating to safely requirements for prevention of pollution and other mandatory requirements of International Maritime Organisation (IMO).

The Central Government is expected to verify compliance with Merchant Shipping (Management for the Safe Operation of Ships) Rules 2000 by all the companies with the requirements of the International Safety Management Code by determining that

(a) Company's Safety Management System conforms with the requirements of International Safety Management Code; and

(b) The Safety Management System ensures that the following objectives are achieved:

   (i) Compliance with mandatory rules and regulations, and

   (ii) The applicable International Safety Management Code, guidelines and standards recommended by IMO, the Central Government, classification societies and maritime industry organisations are taken into account.

Navigational Safety in Port Committee (NSPC) is expected to cover major as well as non-major ports and its duties include port navigational safety issues, cargo-related safety aspects, and oversight function of oil pollution response mechanism, reception facilities in the ports, and so on.

The Government has established an Indian Maritime University (IMU) in Chennai, with campuses in Kolkata, Mumbai, Visakhapatnam, Kochi, Chennai and Kandla. The IMU aims to play the role of a centralised nodal agency to facilitate maritime studies and research in emerging areas such as marine science and technology, and marine environment. However, it is not clear whether there is a special focus on safety at the IMU.

The Inland Waterways Authority of India (IWAI) came into existence in 1986 for development and regulation of inland waterways for shipping and navigation. The Authority primarily undertakes projects for development and maintenance of IWT infrastructure on national waterways through grants received from the Ministry of Shipping. Based in Noida, the Authority also has regional offices at Patna, Kolkata, Guwahati and Kochi, and sub-offices at Allahabad, Varanasi, Bhagalpur, Farakka and Kollam.

It appears that there is no special agency focusing on maritime or inland water transport safety and reliable statistics regarding safety, injuries and deaths in this sector are not available.

ACADEMIC SAFETY RESEARCH CENTRES

At present, there are no independent academic research centres of any consequence dealing with water transport safety.

WAY FORWARD

Demand for better knowledge and technologies in the transport sector can only be provided by public bodies: central and state governments, and local bodies like municipalities and transit authorities. It is the responsibility of the public sector to create long-term stable demand for safety work, with the implicit understanding that progressive employment for a well-trained workforce will be available for some time to come. If respectable professional jobs become available with promising and secure career paths in safety research and operations, talented professionals will gravitate to the field. This in turn will encourage educational and training institutions to provide the programmes necessary. Thus, the problem is structural.

Institutions for road, railway, water and air transport safety need to be set up to:

(a) ensure that safety professionals in the country are abreast of international knowledge and findings
(b) provide information about the size and severity of these problems
(c) help improve our information to help prioritise problems and measure our progress in solving them
(d) gather information about strategies in situations similar to our own, and about their effectiveness
(e) ensure that evidence of the effectiveness of safety countermeasures is made part of decisionmaking at different stages, rather than just reacting to problems or political demands

NATIONAL LEVEL

ESTABLISH NATIONAL BOARDS/AGENCIES FOR ROAD, RAILWAY, WATER/MARINE AND AIR SAFETY

These Boards must be:

(a) Independent of the respective operational agencies to avoid conflict of interest
(b) The CEO of the Boards should be of a rank of Secretary to the Government of India and report directly to the Minister of the concerned ministry

> If respectable safety-related jobs become available with promising career paths, talented professionals will gravitate to the field.

(c) The Boards should be staffed by professionals who have career opportunities and working conditions similar to professionals working in IITs/CSIR laboratories
(d) The Boards should have an adequate funding mechanism based on the turnover of that sector
(e) The terms of reference can incorporate the recommendations similar to those included in the reports submitted by the Committee on Roads Safety and Traffic Management (Committee, 2007) and the High Level Safety Review Committee on railway safety. Salient features of these two reports are given below.

a. Proposed National Road Safety and Traffic Management Board

The organisational chart for the proposed National Road safety and Traffic Management Board is shown in Figure 12.17. The structure of the Board is expected to ensure that this national agency would be able take a multidisciplinary view of the problem of road safety in India and use evidence-based systems approach for recommending safety interventions, strategies and policies in India. The following functions are proposed for the Board (Committee, 2007):

(1) Road-related measures: Designing, setting standards and conducting audits
   a. Set safety standards for the design, construction and operation of the National Highways, including road infrastructure and furniture
   b. Conduct/commission road safety audits of National Highway projects through all phases (pre, during and post) to monitor adherence to prescribed standards and issue directions, where necessary, to take corrective action
   c. Recommend minimum safety standards for the design, construction and operation for roads other than National Highways
   d. Conduct/commission black spot surveys and recommend treatment
   e. Recommend traffic calming and similar safety practices
(2) Vehicle-related measures: Prescribing safety features
   a. Set standards for safety features for all mechanically propelled vehicles
   b. Conduct/commission audits to monitor adherence to standards
   c. Set the minimum conditions for the safe usage of mechanically propelled vehicles and safety standards for vehicular traffic

on various types of roads

d. Conduct/commission safety audits to monitor adherence to prescribed standards
e. Recommend minimum safety features for vehicles other than mechanically propelled vehicles and promote safe carriageways for such transport and other vulnerable road users

(3) Road safety research: Institutional linkages and training
a. Identify subjects and institutions for research in different areas of road safety, and commission and fund research projects and publish research findings
b. Create linkages between research institutions at the local, regional and national levels
c. Establish Centres of Excellence in road safety research and education
d. Establish the methodology for multidisciplinary crash investigation, data collection, reporting and analyses
e. Establish the procedure and methodology for data collection, transmission and analysis at appropriate levels and define the role of different agencies involved in the process
f. Maintain a comprehensive database on road safety-related matters

(4) Traffic laws, operations and management
a. Recommend guidelines to state governments for computerising information regarding vehicle and driver licensing
b. Recommend guidelines for training, testing and licensing of drivers

(5) Capacity Building
a. Lay down guidelines for building capacity and skills among personnel of traffic police, hospitals, highway authorities, NGOs and other relevant organisations dealing with road safety, and for training of trainers

(6) Road user behaviour strategies, public awareness and education
a. Promote best practices in road safety and traffic management, undertake road safety and traffic management education programmes, and conduct campaigns to create awareness on matters relating to road safety
b. Identify/recognise NGOs working in the area of road safety, and assist them in promoting road safety

(7) Medical care and rehabilitation
a. Lay down guidelines for establishing and upgrading trauma care systems at all levels including district hospitals and tertiary-care medical college hospitals and creating a grid of medical, allied medical and rehabilitation facilities to provide first aid, care during transportation, emergency care in the hospital and rehabilitation

(8) Other functions
a. Advise the Central Government on road safety and on the administration of the provisions relating to safety as contained in the Central Motor Vehicles Act 1988 and rules thereunder
b. Provide technical assistance to State Boards and other agencies engaged in road safety
c. Enter into agreements with state governments on behalf of the Minister for Road Transport and Highways in the Government of India for promotion of road safety and traffic management, monitor compliance and recommend the grants to be paid to/withheld from the states
d. Liaise with other agencies like education boards and institutions, health service providers, NGOs, etc., who play an active role in matters relating to road safety
e. Liaise with international agencies and organisations in other countries working in any area related to road safety and traffic management

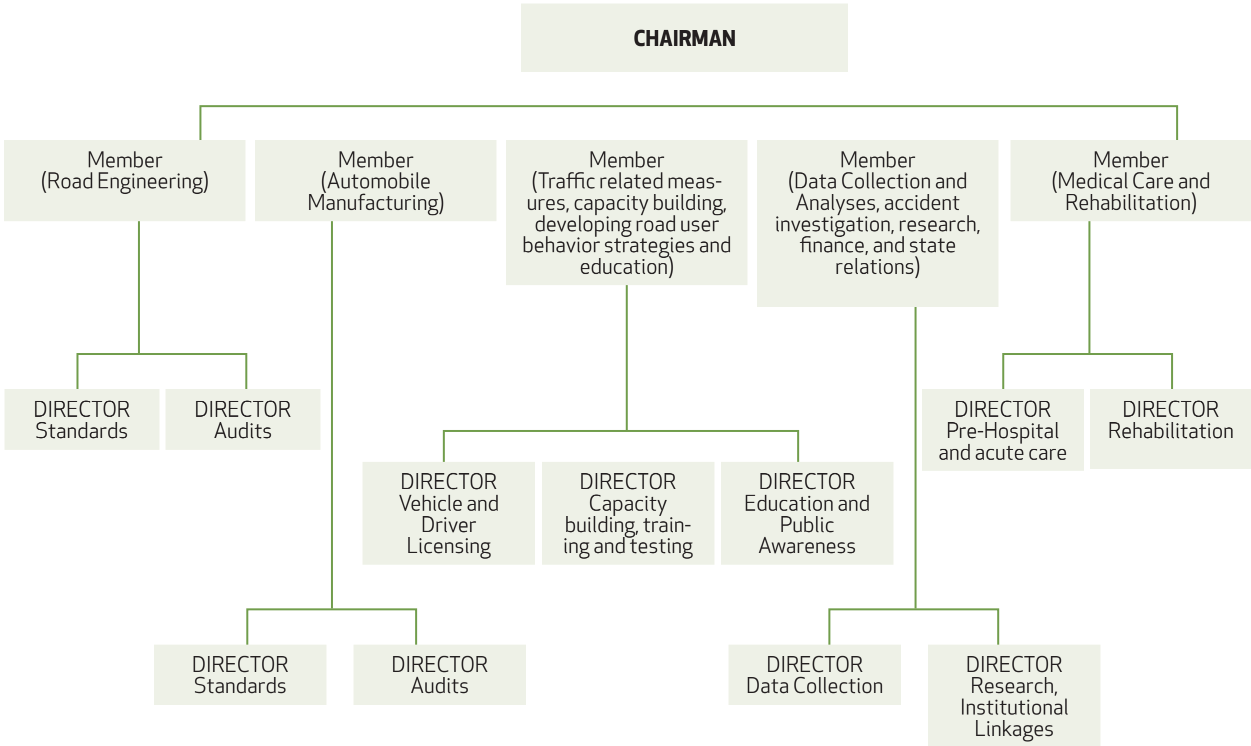
The Committee also recommended that the Board be given power to not only set standards but also monitor their adoption and implementation. For this purpose, the Board would empanel auditors to do spot checks and audits of highways under design, construction or operation to ensure that safety standards are adhered to. If standards are not adhered to, the Board would have powers to issue suitable directions with regard to corrective measures. The Board would have similar powers with regard to mechanically propelled vehicles, and also to seek information and reports, and access records and documents. Where standards set or directions issued by the Board have not been adhered to, the Board should have the power to levy penalties.

The Committee recommended that a minimum of one per cent of the total proceeds of the cess on diesel and petrol should be available to the Road Safety Fund of the Centre and the states, as road safety is a matter of concern not only on National Highways but also on the state roads, village roads and railway level crossings. Also, at least 50 per cent of the amount retained by the Government of India by way of the share of the National Highways and the Railways should be allocated to accident-prone urban conglomerations and states in addition to their entitlement. Assistance to the states from the National Road Safety Fund should be released provided that the states enter into agreements with the Government of India over road safety-related activities and faithfully implement the agreements.

STATE LEVEL ARRANGEMENTS

The Committee on Roads Safety and Traffic Management also recommended that each state pass enabling

Figure 12.17
Organisational Chart Proposed for the National Road Safety and Traffic Management Board



Source: Report on the Committee on Road Safety and Traffic Management, Planning Commission (2007).

legislation to set up state level safety boards with functions, powers and obligations similar to the National Board. This would be necessary in a federal set-up for implementation of safety policies and interventions that are the responsibility of the state government. In addition to the functions proposed for the National Board, the state level boards would also have the following responsibilities:

a. Liaise with the National Road Safety and Traffic Management Board
b. Specify minimum standards for design, construction and operation of roads other than National Highways
c. Specify minimum standards for establishing and operating trauma facilities and para-medical facilities for dealing with traffic related injuries on all roads other than National Highways
d. Specify minimum safety requirements and standards for the design and manufacture of vehicles other than mechanically propelled vehicles and promote safe carriageways for such transport and other vulnerable road users

MANPOWER REQUIREMENTS

International experience suggests that the proposed National Road Safety and Traffic Management Board at maturity would need at least 250-350 professionals to man the 11 departments envisioned by the Committee. Almost all these professionals would have to be post-graduates in different areas of expertise needed for road safety. This is essential for the following reasons: (a) the agency would need in-house technical expertise to keep abreast of scientific and technical advancements in road safety knowledge internationally; (b) Since the Board will have the responsibility of establishing safety standards, it is essential that its staff have domain expertise; (c) Since the Board will be sponsoring research in various areas of road safety, it would need to have professionals whose expertise is similar to those working in academic and research institutions, to establish research priorities and monitor projects.

The role of a national agency such as the one proposed above was highlighted in the World Report on Road Traffic Injury Prevention (Peden, M. et al., 2004). Without such an agency, accountable road safety leadership at country, state, provincial and city levels does not get established. It then becomes almost imposable to evolve sustainable policies and establish mechanisms for their implementation. The national agency will have to focus on the following objectives in the immediate future (Bliss, T. and Breen, J., 2009):

1. Set project objectives
2. Determine scale of project investment
3. Identify project partnerships
4. Specify project components
5. Confirm project management arrangements
6. Specify project monitoring and evaluation

Box 12. 3

Checklist for Lead Agency Role and Institutional Management Functions

1. Does the lead agency (or de facto lead agency/agencies) effectively contribute to the results focus management function?
    - Appraising current road safety performance through high-level strategic review? Adopting a far-reaching road safety vision for the longer term?
    - Analysing what could be achieved in the medium term?
    - Setting quantitative targets by mutual consent across the road safety partnership?
    - Establishing mechanisms to ensure partner and stakeholder accountability for results?

2. Does the lead agency (or de facto lead agency/agencies) effectively contribute to the coordination management function?
    - Horizontal coordination across central government?
    - Vertical coordination from central to regional and local levels of government?
    - Specific delivery partnerships between government, non-government, community and business at the central, regional and local levels?
    - Parliamentary relations at central, regional and local levels?

3. Does the lead agency (or de facto lead agency/agencies) effectively contribute to the legislation management function?
    - Reviewing the scope of the legislative framework?
    - Developing legislation needed for the road safety strategy?
    - Consolidating legislation?
    - Securing legislative resources for road safety?

4. Does the lead agency (or de facto lead agency/agencies) effectively contribute to the funding and resource allocation management function?
    - Ensuring sustainable funding sources?
    - Establishing procedures to guide the allocation of resources across safety programmes?

5. Does the lead agency (or de facto lead agency/agencies) effectively contribute to the promotion management function?
    - Promotion of a far-reaching road safety vision or goal?
    - Championing and promotion at a high level?
    - Multi-sectoral promotion of effective interventions and shared responsibility?
    - Leading by example with in-house road safety policies?
    - Developing and supporting safety rating programmes and the publication of their results?
    - Carrying out national advertising?
    - Encouraging promotion at the local level?

6. Does the lead agency (or de facto lead agency/agencies) effectively contribute to the monitoring and evaluation management function?
    - Establishing and supporting data systems to set and monitor final and intermediate outcome and output targets?
    - Transparent review of the national road safety strategy and its performance?
    - Making any necessary adjustments to achieve the desired results?

7. Does the lead agency (or de facto lead agency/agencies) effectively contribute to the research and development and knowledge transfer management function?
    - Developing capacity for multi-disciplinary research and knowledge transfer?
    - Creating a national road safety research strategy and annual programme?
    - Securing sources of sustainable funding for road safety research?
    - Training and professional exchange?
    - Establishing good practice guidelines?
    - Setting up demonstration projects?

Source: Adapted from Bliss and Breen (2009).

Box 12.4.
An Illustrative List of Road Safety Policies and Interventions

A. DATA
- Establish nationwide online road accident recording system for police departments
- Organise road traffic injury epidemiological data surveillance system in selected hospitals
- Establish multidisciplinary fatal accident recording system teams nationwide

B. VEHICLE SAFETY
- Near future (~5 years)
  - Standards for greater conspicuity of bicycles and other non-motorised vehicles
  - Daytime running lights and anti-skid braking systems for motorcycles
  - Mandatory crashworthiness standards for all cars including ABS, electronic stability control and air-bags for all vehicles
  - Establish an Indian New Assessment Programme (NCAP) as already present in Europe, North America, Japan, Australia, China, ASEAN and Latin America.
- Longer term (>5 years)
  - Judicious selection of active safety technology for Indian conditions—adaptive speed control, emergency braking, lane departure warning, alcohol interlock, etc.
  - Pedestrian impact safety standards for all vehicles including trucks and buses
  - Establish safety standards for para-transit vehicles
  - ITS measures for communication between vehicles and road infrastructure

C. ROAD INFRASTRUCTURE
- Near future
  - Establish procedures and measures for mandatory road safety impact assessment, road safety audit, road safety inspection, black spot management, network safety management and speed management for all urban and rural roads
  - Set targets for provision of adequate universal design pedestrian and bicycle facilities on all urban arterial roads
  - Standards for provision of service and slow traffic lanes along all four-lane and six-lane highways
  - Traffic calming on all urban roads and highways passing through urban and semi-urban areas
  - Establish standards for construction of modern roundabouts in urban areas and rural roads for different traffic volumes
- Longer term
  - Establish standards for safer urban arterials including the use of ITS systems for speed control
  - All new highways to be constructed according to new safety standards established with specific consideration of local rural needs and non-motorised road users in India

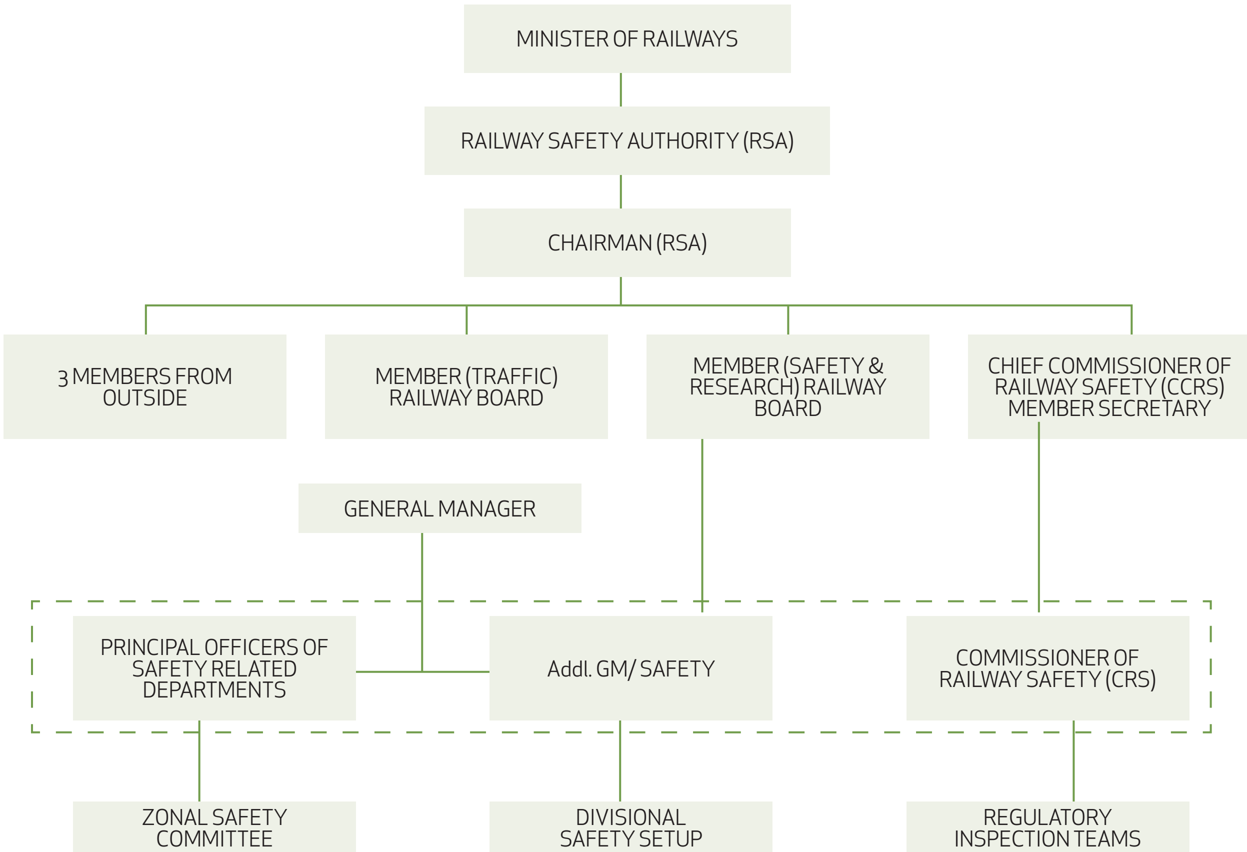
D. ENFORCEMENT AND LICENSING
  - Establish appropriate funds and policing systems to ensure nationwide enforcement of: (a) helmet use and daytime running lights by motorised two-wheeler riders; (b) seatbelt use by all motor vehicle occupants; (c) drinking and driving laws; (d) speed limits on all roads
  - Introduce Graduated Driver Licensing Systems
  - Introduce evidence based safer driver training programmes and vehicle testing systems

E. MEDICAL CARE
  - Set up one number countrywide for ambulance systems
  - Nationwide trauma care training programme for first responders, paramedics, all physicians, surgeons and trauma specialists
  - Establish advanced trauma care and rehabilitation systems in all tertiary hospitals
  - Introduce a universal insurance scheme for accident victims

F. EDUCATION
  - Educate policy makers and professionals regarding the gravity of the problem and countermeasures needed
  - Public education programme for acceptance of safety countermeasures and regulations

Figure 12.18

Organisational Chart of the Railway Safety Authority Proposed by High Level Safety Review Committee



Source: High Level Safety Review Committee, Ministry of Railways (2012).

procedures

7. Prepare detailed project design
8. Highlight project implementation priorities

Bliss and Breen (2009) have proposed a set of questions that can be asked to evaluate the strengths and weaknesses of a national safety agency (Box 12.3). The project implementation and research priorities will have to be developed on an urgent basis and measureable targets established for each Five Year Plan period. An illustrative list is given in Box 12.4. The measures and principles outlined for the agency can be modified appropriately for national agencies for other sectors.

b. National Railway Safety Agency

The High Level Safety Review Committee appointed by the Railway Ministry has recommended a statutory Railway Safety Authority (RSA) and a safety architecture which is powerful enough to have a safety oversight on the operational mode of Indian Railways without detaching safety with the railway operations. The Committee has also recommended measures to strengthen the present Railway Safety Commission to undertake meaningful regulatory inspections.

The Committee proposed that a Railway Research and Development Council (RRDC) be set up at the apex level directly under the Government. This Council would have an Advance Railway Research Institute (ARRI) and five Railway Research Centres, for key safety-related railway disciplines such as rolling stock, signalling and telecommunications, motive power, tracks and bridges and operations management. As a large proportion of deaths and injuries associated with railway operations occur at railroad crossings, they also recommended total elimination of all level crossings—manned and unmanned, within five years at an estimated cost of Rs 500 billion which will get recovered over seven to eight years due to savings in operation and maintenance costs and improved train operation. The project will also need setting up of a dedicated and empowered SPV for each railway zone to accomplish this task within a five-year period.

The Committee recommended that a Railway Safety Authority (RSA) should be set up as a statutory body independent of Railway Board under the Government. The Authority shall have a separate budget fully funded by the Ministry of Railways and shall be backed by a full-fledged Secretariat.

The structure of the proposed RSA is shown in Figure 12.18. RSA will liaise with the Railway Board through the Member (Safety and Research), Railway Board, and with the proposed Railway Research and Development Council. RSA will also have Zonal Safety Committees, Regulatory Inspection Teams and Divisional Safety Setup.

The Committee has proposed a total investment of Rs 25 billion over a period of five years in the Railway Research & Development Council (RRDC), Advanced Research Centres, RDSO upgradation, etc. This is in addition to Rs 1,006 billion proposed for all technical upgradation of the railway infrastructure. The Committee has recommended that a safety surcharge should be levied on rail passengers which is projected to yield Rs 50 billion annually at 2012 prices. Operational recommendations include:

- A new post of Member (Safety and Research) on the Railway Board should be created. This person will be the link between the Board, RSA and RRDC at the apex level
- The institution of Commissioner of Railway Safety (CRS) should be merged with RSA and should be strengthened and empowered. There should be a CRS for each zonal railway and each CRS should have a Regulatory Inspection Team consisting of HODs of the concerned technical departments
- Enhanced powers to be delegated to General Managers in regard to safety
- Core Safety Groups to be formed under the convenorship of the Additional General Manager (Safety)
- A High Level Task Force involving state governments and NGOs should be set up to recommend constructive measures which will alleviate or eliminate casualties due to railway infrastructure in the near future
- State-of-the-art signalling and protection system
- A national level expert committee should be constituted to establish the root cause of rail track failures
- All level crossings should be eliminated within the next five years
- Projects of importance to railway safety should be regularly awarded to select engineering academic institutions
- All officers should be periodically imparted training in safety engineering
- One training institute at the divisional level should be nominated and upgraded for training staff on the safety environment

Research and development activities

- The apex body to be established, RRDC, should be chaired by an eminent technologist/scientist reporting to the Railway Minister
- Financial support up to two per cent of yearly revenue of Indian Railways should be available to support the entire research ecosystem of railways
- ARRI should be established as a high-end research organisation focusing on engineering challenges in railway-specific areas
- A string of five or so Railway Research Centres should be established which should be co-located on the campuses of Indian technological academic institutions of national importance. Each centre should specialise in specific areas like signalling, rolling stock, motive power, tracks and bridges, operations management
- The present system of only having railway officers on deputation at senior positions in RDSO should be done away with, and professionals and scientists from reputed technical institutions should also be inducted at higher levels on the permanent cadre. Their career progression should be on the similar lines as followed in other Government research institutions

The Government should consider establishment of an independent National Board on Water Transport Safety.

c. National Water Transport and Aviation Safety Agencies

At present there are no proposals for setting up independent National Safety Agencies for water/marine transport and aviation. The lack of research and data collection/analysis capabilities in the country in these sectors is also self-evident. While aviation safety will be guided by international regulations, this may not be true for the growing private aircraft ownership and airport operations.

The Government of India should consider establishment of an independent National Civil Aviation Safety Agency and a National Board on Water Transport Safety. The latter could be headquartered at one of the major port cities with a branch in the Northeast for inland water transport safety. Both these agencies could take a similar approach as the proposed agencies for road and rail transport, and satisfy the guidelines listed in Box 12.3.

It is important that the setting up of these Boards is not delayed any further, as international evidence suggests that no country has been able to deal with the problem of safety without very strong professional institutional mechanisms.

NATIONAL DATABASE AND STATISTICAL ANALYSIS SYSTEMS

At present, very little epidemiological information is available in India for deaths and injuries associated with the various modes of transport, except civil

Table 12. 8

Proposed Multidisciplinary Safety Research Centres in Academic and Research Institutions

SAFETY RESEARCH CENTRES	NO. OF CENTRES	
	WITHIN 5 YEARS	WITHIN 10 YEARS
Road transport	15	30
Railroad	5	15
Marine and inland water transport	4	10
Civil Aviation	2	5

aviation. The information from the latter sector is also not available in the public domain. For evolution of evidence-based safety policies and strategies based on the systems approach, it is necessary to set up reliable data collection and analysis procedures for traffic accidents at different levels in consonance with international practices. This needs a special input for establishing special agencies in all sectors of transport. The level of effort needed is illustrated in Table 12.4 where 42 systems are listed to serve these needs in the USA.

National safety agencies for each mode of transport must include a special department for data collection and statistical analysis. International experience suggests that such departments need to employ about 50-100 statistical and epidemiology experts who design surveys, data collection methods, perform statistical analyses and publish reports. It is equally important that all such data be available in the public domain so that independent researchers outside the official agency can also perform analyses and studies.

The functions of these Departments for each mode of transport could include:

- Collating relevant data from existing surveillance systems: Census Bureau, NSSO, NCRB, Central Bureau of Health Intelligence, etc.
- Establishing systems for scientific data collection by the police department
- National surveillance systems for all fatal accidents
- Sample surveys for specially identified problems
- Sample surveillance systems in identified hospitals
- Establishment of multidisciplinary accident investigation units in academic and research institutions
- Coordinating with relevant ministries and departments at the central, state and city level for collating data collected by the respective agencies

ESTABLISHING SAFETY DEPARTMENTS WITHIN OPERATING AGENCIES

Every Ministry dealing with transport should have an internal safety department (at different levels) for ensuring day-to-day compliance with safety standards, studying effectiveness of existing policies and standards, conducting safety audits, collecting relevant data, and liaison with the National Safety Agency, etc. These departments must employ 30-60 professionals with expertise in relevant areas of safety, with 30-40 per cent of the staff on deputation from the field.

Agencies operating under the Ministries (e.g., National Highway Authority of India, Airport Authority of India, Central Inland Water Transport Corporation) should also establish their own departments of safety with domain specialists. The functions of these departments would include field audits, before-and-after studies, data collection from the field, and liaison with the relevant ministry and the national safety agency.

d. Funding Establishment of Multidisciplinary Safety Research Centres at Academic Institutions

The national safety agencies in each of the transport ministries should establish multidisciplinary safety research centres in independent academic and research institutions. These centres would ideally include three or more disciplines of research, and work in each area should be pursued at three or more centres. This would promote competition among centres and is likely to result in more innovation. Safety research involves the following disciplines: relevant engineering sciences, statistics and epidemiology, trauma and medical care, sociology, psychology, jurisprudence and computer science. For these centres to be productive, each centre should have a minimum of 8-10 professionals. It is also possible that one academic institution has more than one of these safety research centres.

The funding for each of these centres should include:

- Endowment for three or more professorial chairs
- Endowment grant for at least two post-graduate scholarships per endowed chair
- Establishment funds for critical laboratories
- Funds for supporting visiting professionals
- Support for surveys, software, travel

For these centres to function effectively, the minimum grant per centre per year would be in the range of Rs 30-40 million annually, including endowment funds. Each national safety agency should establish procedures for issuing call for proposals and for evaluating the same under open completion. A procedure should also be established for an academic peer evaluation of each centre every two years.

SAFETY POLICIES AND TARGETS

The government must announce safety policies with measurable indicators for evaluation in each sector for a five-year and 10-year period before the end of 2015.

In the area of road safety, motor vehicle standards must be in conformity with international standards and the NCAP programme in place, by 2015.

A railway safety policy covering all injuries and fatalities associated with railway property must be announced by 2015.

STATE AND CITY LEVEL

Each state must establish a Road Safety Board on the lines suggested by the Committee on Roads Safety-and Traffic Management.

Those states dealing with significant amount of water transport must set up State Water Transport Safety Boards.

Safety Departments must be established within operating agencies at different levels for ensuring day-to-day compliance with safety standards, studying effectiveness of existing policies and standards, conducting safety audits, collecting relevant data, and so on. These agencies could be state PWDs, Railway Regional headquarters, port trusts, large urban transit agencies, and municipalities of large cities. These departments must employ 50-60 per cent professionals with expertise in the relevant area of safety, and 40-50 per cent of the staff could be on deputation from the field.

SUMMARY

More than 166,000 persons died in transportation-related accidents in 2011 in India, or more than 450 a day. This would mean that in addition

The Government must announce safety policies with measurable indicators for evaluation in each sector for a five-year and 10-year period before the end of 2015.

to the more than 450 deaths a day in 2011, at least 1,500 persons were disabled, 7,000 hospitalised and more than 40,000 sustained minor injuries every day in traffic-related accidents. It is estimated that the cost of road traffic crashes alone may be about 3 per cent of the GDP. The situation is quite serious and unless policies and evidence-based countermeasures are put in place urgently the situation is likely to worsen.

The existing rates of fatalities and the rate of increase in accidents are both unacceptably high. It is not necessary that accident rates increase with increase in transportation volumes in any mode of transportation if appropriate safety systems are put in place. It is imperative that we give much more importance to transportation safety in India, and this will only happen if the whole system is improved and strengthened on an urgent basis. At present, there is very little expertise, data or information available in India to address issues of safety scientifically for any mode of transport.

Significant reductions in accident rates were seen in all modes of transport in Western Europe and USA starting about the same time in the 1960s and 1970s. The reduction was probably not due to any single factor in isolation but to a wide variety of improvements in design of vehicles, operating environment and infrastructure, and enforcement of safety regulations and standards.

Transportation safety management is a systematic process in which we consider infrastructure, users and vehicles as integral components of a complex interactive system. The transport system has to be developed in a way that does not jeopardise the environment or public health and welfare. In this approach, it is essential to creat an ecology that minimises the risk of transport users making mistakes and prevents serious human injury when designing, operating and maintaining the system. The entire traffic and transport system must be designed to account for the limitations and capabilities of users and operators. Since each accident is a result of a combination of human, technology and environmental factors, one cannot understand the risk factors associated with an event unless a sophisticated systems approach is followed.

Transportation safety management has seen a shift from action based on experience, intuition, judgement, and tradition, to action based on scientific research, empirical evidence, and from consideration of safety that is tacit and qualitative to consideration of transportation safety that is explicit and quantitative. The requirements of a safe system approach are:

a. Institutional structure that creates a demand for scientific work in safety issues.
b. Legislation and regulation—formulation and enforcement of laws and regulatory requirements
c. Monitoring and measurement—national databases with relevant information to monitor and assess various aspects of safety policies, technologies and knowledge needs
d. Assuring and improving the quality of safety services provided through professionals, individual institutions and with the use of specific technologies and devices

All countries that have been successful in reducing transport-related injuries and deaths have set up relatively large professional national safety agencies for each mode of transport. These agencies have different structures owing to different political and administrative systems in different countries, but are generally kept independent of the operating departments. However, most countries adhere to the following principles:

- Establishment of agencies professionally staffed for designing and implementing data collection systems
- Ensuring compatibility of data formats between different departments and users
- Responding to the demand of lead agencies for special needs regarding availability of data
- Ensuring that all non-proprietary and non-personal data are publicly available to all concerned stakeholders

The national agencies have to be supported at four levels:

a. State level
b. Departmental organisations at the local level
c. University departments
d. Civil society organisations

Demand for better knowledge and technologies in the transport sector can only be provided by public bodies: central and state governments, and local bodies like municipalities and transit authorities. It is the responsibility of the public sector to create long-term stable demand for safety work, with the implicit understanding that progressive employment for a well-trained workforce will be available for some time to come. If respectable professional jobs become available with promising and secure career paths in safety research and operations, talented professionals will gravitate to the field. This in turn will encourage educational and training institutions to provide the necessary programmes. Thus, the problem is structural.

Institutions for road, railway, water and air transport safety need to be set up to (a) ensure that safety professionals in the country are abreast of international knowledge and findings, (b) provide information about the size and severity of these problems, (c) help improve our information to help prioritise problems and measure progress in solving them, (d) gather information about strategies in situations similar to India's, and about their effectiveness, (e) ensure that evidence of the effectiveness of safety countermeasures is made part of decision making at different stages, rather than just reacting to problems or political demands.

THE WAY FORWARD

a. Establish National Boards/Agencies for Road, Railway, Water/Marine and Air Safety.
b. National Database and Statistical Analysis Systems.
c. Establish safety departments within operating agencies.
d. Fund establishment of multidisciplinary safety research centres at academic institutions.
e. The government must announce safety policies with measurable indicators for evaluation in each sector for a five-year and 10-year period before the end of 2015.
f. Each state must establish a Road Safety Board on the lines suggested by the Committee on Roads Safety and Traffic Management.
g. States dealing with significant amount of water transport must set up State Water Transport Safety Boards.
h. Establish Safety Departments within operating agencies at different levels for ensuring day-to-day compliance with safety standards, studying effectiveness of existing policies and standards, conducting safety audits, collecting relevant data, etc.

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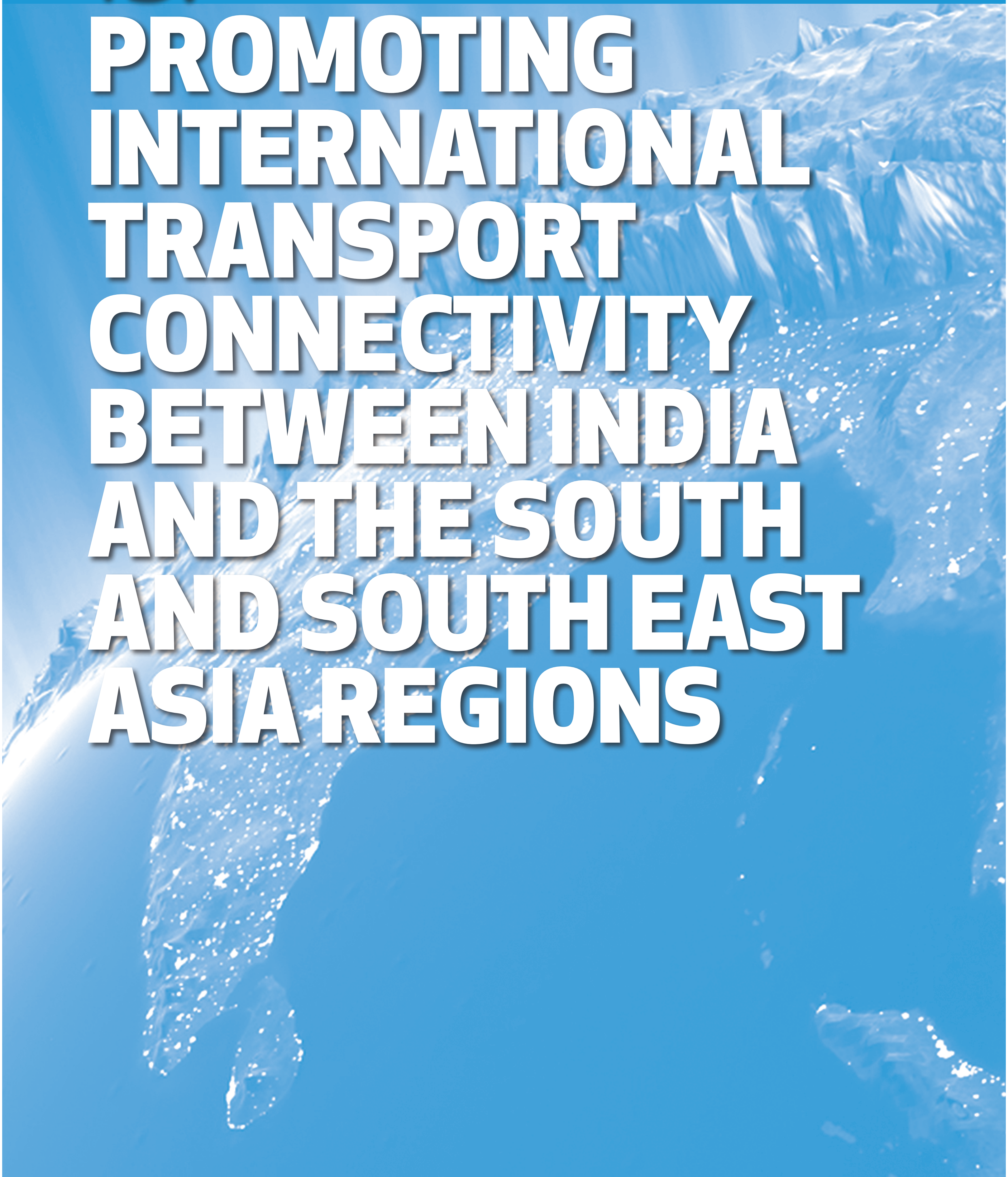
13. PROMOTING INTERNATIONAL TRANSPORT CONNECTIVITY BETWEEN INDIA AND THE SOUTH AND SOUTH EAST ASIA REGIONS



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13. PROMOTING INTERNATIONAL TRANSPORT CONNECTIVITY BETWEEN INDIA AND THE SOUTH AND SOUTH EAST ASIA REGIONS

It has become increasingly clear that among sub-regions of the world, South Asia stands out as having the least developed transport connectivity between its constituent countries. Consequently, it is also among the least interconnected regions in economic terms.

All the countries in the region have therefore suffered from an economic point of view from the lack of transport links. The irony is that, prior to Independence and partition in 1947, the whole region was much better connected since there were no such international borders. Despite the long passage of time, political developments in the region have not been conducive to the development of transport and trades linkages across borders in the region.

The situation has now begun to change for the better with a number of diplomatic and other initiatives for the expansion of trade within the region, which would augur well for the future (Box 13.1).

It is with this in mind that the NTDPC is proposing a bolder effort towards the opening of international borders for trade and commerce, and for personal movement for tourism and other purposes. We feel that, if the current momentum continues, the kind of recommendations given in this chapter would be well within the realm of reality. As such, while being aware of them, we have abstracted from the political and diplomatic impediments that would restrain

Box 13.1
ASEAN-India Connectivity: The Government of India's Approach

At the 11th ASEAN-India Summit in Brunei Darussalam on October 10, 2013, the Prime Minister of India announced that connectivity with the ASEAN region is a strategic priority for India and that the ASEAN-India Transport Agreement should be completed by 2015.

The flagship project under the ASEAN-India Connectivity initiative is the India-Myanmar-Thailand Trilateral Highway, which also constitutes part of the proposed Asian Highway network AH 1 within Myanmar. The length of the Trilateral Highway is approximately 1360 km, which will pass through Mandalay (Chaungma-Mandalay-Meitkila). India has undertaken to build the section between Tamu-Kalewa-Kalemyo (TKK) (Friendship Road), about 160 km in length. There is also a proposal for a bus service between Imphal and Mandalay.

India has set up an internal Inter-Ministerial Group on ASEAN Transport Connectivity to strengthen ASEAN-India connectivity. On 10 June 2013, India initiated an annual meeting with the ASEAN Connectivity Coordinating Committee (ACCC) as the primary policy level forum to take ASEAN-India connectivity agenda forward. At the ACCC-India Meeting, India suggested setting up of a Joint Working Group (JWG) on Maritime Connectivity between India, Myanmar, Thailand, Cambodia and Viet Nam and also that work begin on creation of soft infrastructure in order to permit seamless movement of goods and passenger traffic along the ASEAN-India connectivity corridors. The Commerce and Industry Minister also reiterated that soft infrastructure requirements for movement of goods and services across geographic connectivity corridors be discussed at a Working Group level.

In addition to the above, there is a study on a Mekong-India Economic Corridor conducted by the Economic Research Institute for ASEAN and East Asia (ERIA), which suggests connecting the production networks in the Mekong region along the GMS Southern Economic Corridor (Ho Chi Minh City-Phnom Penh-Bangkok) to the corridors in India (Delhi-Mumbai-Industrial Corridor and Mumbai-Bangalore-Chennai Industrial corridor) through the Chennai-Dawei Sea link. There is even broader potential to link trade routes from sea ports in Myanmar, Thailand, Cambodia and Viet Nam and even Japan to ports along India's eastern seaboard.

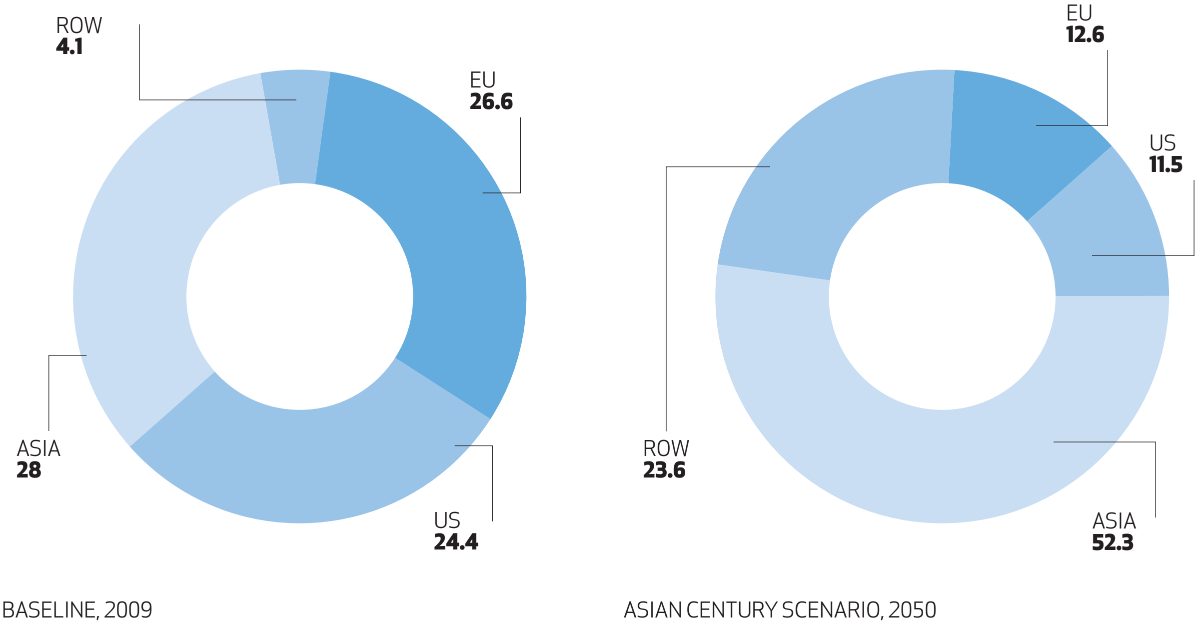
Subject to reciprocal rights to the Indian carriers, at present designated airlines of all ASEAN countries (except Lao PDR) are offered the facility to operate a daily service to 4-metro destinations besides unlimited access to another 18 tourist destinations (Patna, Lucknow, Guwahati, Gaya, Varanasi, Bhubaneswar, Khajuraho, Aurangabad, Goa, Jaipur, Port Blair, Cochin, Thiruvananthapuram, Calicut, Amritsar, Vishakapatnam, Ahmedabad and Tiruchirapally). As of February, 2013, India has offered to conduct negotiations on an open sky policy on cargo on a quid pro quo basis.

Looking ahead, the main thrust areas in ASEAN-India connectivity are as follows:

- Completion of the India-Myanmar-Thailand Trilateral Highway by 2016 and its further extension;
- Creation of soft infrastructure for utilising the Trilateral Highway and improving the surface connectivity with ASEAN through mechanisms to allow seamless movement of goods and traffic, in particular through an ASEAN India Transit Transport Agreement to be negotiated under an ASEAN-India Joint Working Group on Soft Infrastructure;
- A multimodal link-up with maritime ports in the region by working out necessary arrangements under the aegis of a Working Group on Maritime Connectivity;
- Leveraging geographic connectivity into corridors for economic cooperation to bring economic viability to the geographic corridors and make the connectivity between ASEAN and India more sustainable;
- Strengthening air services arrangements between ASEAN and India especially for air cargo and better utilisation of the open skies arrangements to the 18 tourist destinations in India, extended to the ASEAN in 2003;
- Strengthening the backend linkages into India, particularly in the North East and along the eastern seaboard

Source: Ministry of External Affairs, Government of India, December, 2013.

Figure 13.1
Share of Major Regions in World GDP
[Per cent]



Source: ADB (2010b).

the implementation of the kind of recommendations made in this chapter.

Fortunately, there is a significant body of technical work that exists for the development of transport and transport linkages in South Asia. Agencies such as UN-ESCAP, SAARC, ADB, and BIMSTEC have conducted extensive technical work over the years in this area. The NTDPC has drawn liberally from these sources to make the recommendations that have been put forward in this chapter.

It is our hope that, just as Europe has integrated economically in the six to seven decades since World War II, it should be possible for the South Asia region to get similarly integrated over the next two decades. This would require extensive investment in transport linkages across borders along with technical agreements that will be necessary to make cross border transport feasible.

THE RISE OF THE DEVELOPING WORLD AND ASIA

Until the 1980s, an area that geographically covered 60 per cent of the world, comprising Africa, developing Asia, Latin America, and the Middle East, collectively known as the 'South', contributed to less than 30 per cent of world GDP. Growing at an average annual rate of 4.8 per cent since then, the combined economic output of the South accounted for 45 per cent of world GDP by 2010. In recent years, there has been further decline in the share of developed economies in world GDP and trade, and a concurrent rise in the share of the South, and it is evident that these economies will be the potential drivers of growth in the coming decades.

In the aftermath of the global slowdown which particularly hit the industrialised economies the most, the southern economies realised the need to deepen intra-regional trade. Also, given the high population growth rates and rising average incomes, the South offers tremendous potential markets for capital investment as well. However, till date, barriers to South—South trade and investments are still higher than those with the industrial world, broadly owing to high tariff and non-tariff barriers within South. Thus, addressing this issue by promoting global and regional integration and reducing internal trade and investment barriers has become increasingly important[1].

Further, the developing economies of Asia, which constitute a large share of the South, have not only demonstrated resilience through the global recession, but also succeeded in maintaining a robust growth rate. Per capita income in developing Asia grew at 9.4 per cent annually during the period 2000 to 2010 and investment rates averaged 35 per cent of GDP over the decade. These aggregate numbers are strongly influenced by the two Asian giants--the People's Republic of China (PRC) and India. Backed by prudent macro-economic policies, it is predicted that Asia could host some of the largest global equity, debt, and banking markets and the region could become increasingly crucial in shaping the global

1. This section draws on the arguments in ADB (2010a).

Table 13.1
Structure of Global GDP
[in current US$ trillion]

	2000	2011	2016	2020	2025
World GDP	32.2	68.7	90.5	110.5	140.5
Advanced Economies	25.7 (79.7)	44.4 (64.6)	53.3 (58.9)	61.1 (55.3)	71.7 (51.1)
Developing and Emerging Economies	6.5 (20.3)	24.3 (35.4)	37.2 (41.1)	49.4 (44.7)	68.8 (48.9)
of which					
Developing Asia	2.3 (7.3)	10.5 (15.2)	17.4 (19.3)	26.6 (24.1)	40.7 (28.9)
of which India	0.5 (1.5)	1.9 (2.8)	3.6 (4.0)	5.8 (5.2)	10.0 (7.1)
Sub-Saharan Africa	0.3 (1.0)	1.2 (1.8)	1.7 (1.9)	2.5 (2.2)	3.9 (2.8)
West Asia and North Africa	0.8 (2.5)	2.8 (4.0)	3.8 (4.2)	5.0 (4.5)	7.1 (5.0)
Latin America and Caribbean	2.1 (6.6)	5.5 (8.0)	7.4 (8.2)	9.7 (8.8)	13.3 (9.5)

Note: Numbers in parentheses are percentages.
Source: 12th Plan Approach Paper, Planning Commission

Table 13. 2
India's Merchandise Trade, Region-wise
[Trade data-dated]

REGION	1997-98 PER CENT EXPORTS	2010-11 PER CENT EXPORTS	1997-98 PER CENT IMPORTS	2010-11 PER CENT IMPORTS
EU Countries (27)	26.50	18.33	27.16	12.05
Other West and East European Countries	1.77	1.51	3.20	7.20
North America	20.64	10.61	10.04	5.97
Latin America	1.42	4.08	1.46	3.84
Africa	4.03	6.27	5.85	7.05
Asia	41.48	52.05	39.35	61.16
East Asia	1.36	0.78	3.58	3.15
ASEAN	8.67	10.20	7.50	8.28
WANA	9.99	21.59	15.89	28.56
North East Asia	16.31	14.84	11.76	20.58
South Asia	5.15	4.64	0.62	0.59
Others	4.28	7.13	12.92	2.62

Source: Ministry of Commerce and Industry, Government of India.

financial architecture, monetary system and financial intermediation[2].

INTEGRATING INDIA WITH ASIA

India is expected to contribute close to 16 per cent of global GDP by 2050, and achieve per capita incomes of $22,000 by 2039 (ADB 2010b). Table 13.1 is a comparison of the structure of global GDP and India's share. However, the high growth rates that underpin these expectations are not pre-ordained. Given the new global rebalancing, India has to look to the South, to developing Asia, eastward, and within the South Asia region in order to grow (Figure 13.1). Tables 13.2 and 13.3 establish the declining share of Europe and North America as a market for South Asian countries and the rising share of Asia.

INDO-ASEAN TRADE

As global growth gravity shifts towards Asia, the Association of Southeast Asian Nations (ASEAN), with a population of over 615 million and strong domestic consumption, is becoming one of the most promising markets for now and the future. In absolute terms, the total trade within this area is about $1.7 trillion and gross domestic product is $2.3 trillion. For many ASEAN countries, an increasing trade deficit with and dependence on the Chinese

2. See ADB (2010b).

Table 13. 3
Direction of Trade for Countries of South Asia

TO	ASIA		EUROPE		NORTH AND CENTRAL AMERICA		REST OF THE WORLD	
FROM	1990	2011	1990	2011	1990	2011	1990	2011
Percentage of total merchandise exports								
Afghanistan	17.6	75.6	73.7	13.1	4.4	4.3	4.3	7
Bangladesh	14.8	13.2	41.8	57.2	32.3	24.2	11.2	5.4
Bhutan	99.3	97.7	0.6	1.9	0.0	0.2	0.1	0.1
India	21.0	32.4	47.2	19.4	16.3	13.6	15.4	34.5
Maldives	47.0	51.4	26.5	43.0	26.3	1.5	0.2	4.1
Nepal	14.7	68.5	60.0	14.9	24.1	11.1	1.2	5.5
Pakistan	28.2	32.0	40.7	24.5	14.3	16.4	16.9	27.2
Sri Lanka	14.8	19.3	30.9	35.6	28.8	23.0	25.7	22.1
Percentage of total merchandise imports								
Afghanistan	79.1	44.4	17.1	21.4	1.3	32.1	2.3	2.2
Bangladesh	47.7	62.5	22.0	8.7	8.4	3.7	21.8	25.1
Bhutan	11.2	83.6	72.1	14.8	11.3	1.4	5.3	0.2
India	**17.4**	**30.3**	**41.3**	**18.4**	**12.9**	**6.1**	**28.5**	**45.2**
Maldives	85.2	61.3	13.3	8.3	0.5	3.9	0.9	26.5
Nepal	69.4	90.5	20.1	2.6	2.8	1.1	7.7	5.8
Pakistan	30.3	43.9	29.3	11.5	14.2	5.9	26.3	38.9
Sri Lanka	47.5	67.9	17.8	11.2	8.9	3.4	25.8	17.5

Source: ADB (2011).

economy have compelled them to forge stronger economic ties with India as an alternative balancing source for growth. India's overall merchandise trade increased from $ 93 billion in 2000 to $ 792 billion in 2012-13, with a high compound average growth rate of 19.5 per cent. During the same period, merchandise trade between ASEAN and India also recorded a significant increase from $7.1 billion in 2000 to $77 billion in 2012-13, with a compound average growth rate of 22 per cent.

However, despite the good growth performance and the geographical proximity, the trade relationship between ASEAN and India is still limited. One of the major obstacles to the expansion of trade is the high cost of moving goods across the borders reflecting insufficient infrastructure for physical connectivity (RIS, 2012). Greater connectivity will provide more development opportunities for less developed areas in India such as the North East, and less developed ASEAN member countries, particularly Myanmar, which are surrounded by the three of the most vigorous economies in the world—China, India, and ASEAN. These regions are also expected to play a very important role as the physical connecting nodes. Consequently, development policies for Myanmar and North East India will be at the core of the regional approach to enhance ASEAN-India connectivity.

INDIA-SOUTH ASIA TRADE

In the past three decades, although South Asia has been second to East Asia as the fastest growing region of the world, intra-regional trade as a share of world trade has gone up only marginally. Despite favourable conditions for establishing a successful trading agreement in South Asia and the geographic proximity of countries, factors like high tariff rates and protection measures have resulted in intra-regional trade in South Asia being amongst the lowest in the world: only 4.3 per cent of its total merchandise trade in 2010 as compared to 5.5 per cent for Central Asia (including Georgia and Armenia), 26.4 per cent of ASEAN, 50 per cent for NAFTA, and 71 per cent for the EU[3].

Besides tariffs, trade costs also rise due to weak trade-related infrastructure and logistics, institutional barriers, and insufficient infrastructure for physical connectivity. For example, in 2010, it took 11 days and fewer than five documents, on average, to export or import a standardised unit of cargo among OECD economies, but it took more than twice as many days for countries in East Asia and almost three times as long for those in South Asia, with many more documents involved (World Bank, 2010). Studies based on primary surveys show high level of informal trade between countries of the region (Taneja, 2005) which are attributable to such institutional barriers.

3. Figures for Central Asia and ASEAN are obtained from the ARIC website, ADB. Central Asia is composed of the following ADB countries members: Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan. NAFTA and EU figures computed from WTO International Trade Statistics, 2011.

Geographically, India is strategically positioned to connect East and West Asia. It is also centrally placed within South Asia, connecting most of the countries to one another. India can provide key support for establishing an effective Asian institutional architecture as an important member of various regional cooperation arrangements.

Transport and communication linkages that increase current physical connectivity will also help expand future transfer of technology and investments. Closer trade links, intra-regional supply chains, and stronger financial links help bridge development gaps within a country as well between countries, promoting stable and inclusive growth. Cross-border investment, a key driver of international trade in recent years is almost completely absent in the South Asia region. While India has bilateral promotion and protection agreements (BIPAs) with 82 countries (10 in the process of ratification), there are only three with South Asian countries: Sri Lanka, Bangladesh and Nepal (up for ratification). But even with these countries, surveys repeatedly point to the lack of physical infrastructure. Without actual physical connectivity, there is little that can move, literally. Infrastructure, particularly power and transportation, are the major constraints

PROMOTING REGIONAL TRANSPORT CONNECTIVITY

Post-1947, when India gained independence, the subcontinent was divided into the territories known today as the countries of South Asia. Land borders of almost 7,400 km were created. Initially, the transport links between countries continued to operate, but subsequently were discontinued due to political issues. For example, rail and inland waterways transport (IWT) across the then East Pakistan (now Bangladesh) were suspended in 1965 during the Indo-Pak war and only IWT was restored in 1972, after East Pakistan became the sovereign nation of Bangladesh. Transit through Pakistan from India to Afghanistan remains suspended.

Border management led to closure of historical land routes at several points. North East India became a landlocked territory with its only connection to the mainland being the narrow 'chicken's neck' area through Siliguri. In subsequent years, incompatible transport technology platforms also emerged, impairing interoperability of cross-border services. This is particularly in the case of rail transport with differences in gauge. Even for road transport, the axle load for Indian trucks at 12.8 tonnes is higher than in Bangladesh at 8.14 tonnes. Intra-South Asia trade, which was 18 per cent of the total trade in 1948, dropped to 4.3 per cent by 2010.

National highway and railway networks are dense in most of India but sparse in the border areas where there are substantial missing links across national boundaries. Today's border areas, which were relatively wealthy before Partition in 1947, have become hinterlands. All this has resulted in high transaction costs, ranging between 13-14 per cent of the commodit value compared to 7-8 per cent in developed countries. Investments towards regional connectivity and especially in promoting 'last mile' efforts will have a major positive impact on India's trade potential.

THE CENTRAL ROLE OF CONNECTIVITY

Regional connectivity has three dimensions:

- National connectivity needs to be upgraded and dovetailed into a regional roadmap.
- For regional connectivity, border areas and gateways need hard and soft infrastructure.
- Hard aspects cover physical infrastructure including improvement of roads and trade and transit facilities.

The softer aspects of connectivity include measure that facilitate smooth movement of goods and people such as FTAs and transport agreements. However soft aspects will not see benefits without the hard infrastructure being in place.

For regional connectivity, border areas and gateways need hard and soft infrastructure. Hard aspects cover physical infrastructure, including improvement of roads and trade and transit facilities. The softer aspects of connectivity include measures that facilitate smooth movement of goods and people, such as free trade agreements (FTAs) and transport agreements. However, soft aspects will work only with the hard infrastructure in place.

Geographically, India is strategically positioned to connect East and West Asia. It is also centrally placed within South Asia, connecting most of the countries to one another. India is in a position to provide key support for establishing an effective Asian institutional architecture as an important member of various regional cooperation arrangements and sub-regional initiatives including the South Asian Association for Regional Cooperation (SAARC), South Asia Sub-regional Economic Cooperation (SASEC), Bay of Bengal Initiative for Multisectoral Technical and Economic Cooperation (BIMSTEC), ASEAN+1, and the Bangladesh-China-India-Myanmar (BCIM) initiative. Figure 13.2 shows the centrality of India in these regional and sub-regional projects.
India is also at a centre of a web of dynamic bilateral and regional FTAs within South Asia and between South and East Asia and South East Asia. It is thus

Figure 13. 2
Regional and Sub-regional Initiatives in Asia

essential that transport, communication and energy linkages that increase connectivity and expand logistical networks through transfer of technology, managerial knowhow, and investments are strengthened. This will result in widespread economic benefits, and as the largest country in South Asia, India has to take the lead. The critical step is connectivity. The time for South Asian integration has indeed arrived[4].

It is important to project India as the most convenient and economical transit country for all our neighbours, who should be encouraged to use the Indian transport network, its ports and airports for both import and export of goods worldwide.
Cross-border infrastructure, in the form of immigration, customs and phyto-sanitary facilities need to be developed and upgraded virtually all along India's borders. Most of the border areas have been left deliberately underdeveloped due to security concerns; borders have been looked at as separating walls rather than as connectors bringing peoples and economies together. There is also a need to plan cross-border linkages not just for border trade but as entry and exit points through which normal trade, including third country trade, can take place on most favoured nation (MFN) terms. While trade through most border trade points is currently limited to mutually agreed lists of commodities, in reality a large volume of contraband trade takes place, encouraging criminalisation, loss of revenue and threats to national security. Cross-border transport linkages must factor in this aspect.

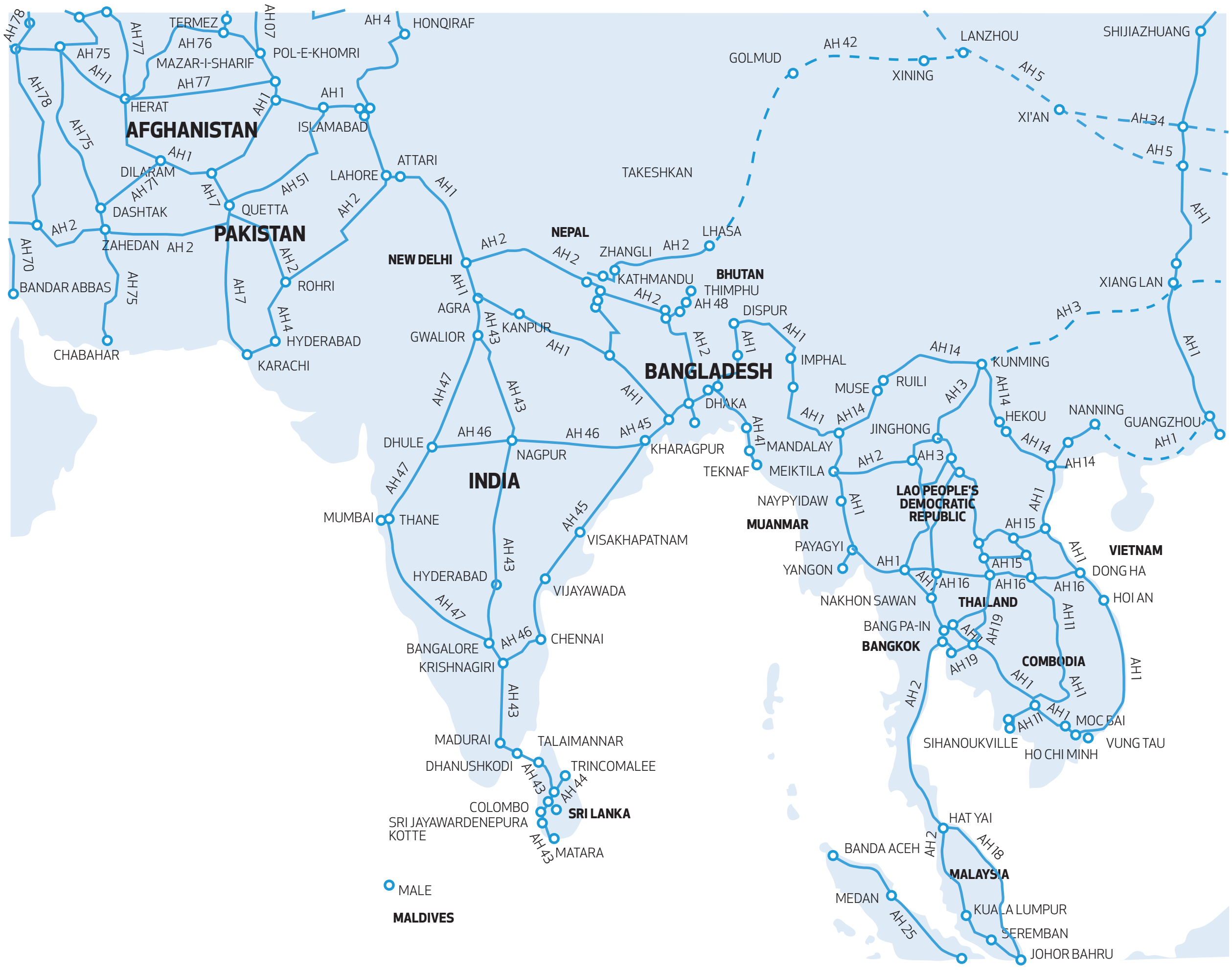
For India to emerge as an economic powerhouse in South Asia and South East Asia, the development of a dense network of transport linkages throughout this larger neighbourhood is absolutely vital.

ASEAN'S COMPREHENSIVE ASIA DEVELOPMENT PLAN

Connectivity is a central theme of the ASEAN. Its connectivity priorities include enhancing multimodal transportation links, connecting archipelagic member states to the mainland, narrowing the digital divide, facilitating energy trade, and strengthening institutional connec-

4. Roy, Jayanta, 'The need for a southern Asian economic community: Leader in the new bloc', The Telegraph, 9 August 2012.

Figure 13.3
Asian Highway Network



tivity. ASEAN has drafted strategies to upgrade existing road links, construct missing rail links, enhance infrastructure of key ports, and promote greater use of roll-on roll-off activities to integrate its economies despite physical and financial challenges. Connectivity through air is the most developed in the region.

ASEAN-India connectivity is the main theme of the Comprehensive Asia Development Plan (CADP) Phase II report. CADP recommends a strategy based on a multi-modal, multi-functional and multi-tier approach. As already mentioned, greater ASEAN-India connectivity will provide significantly more development opportunities for less developed areas in India such as the North East, and less developed ASEAN member countries, particularly Myanmar.

Reducing transport costs will do more than just increase trade. It will also help change the location of economic activities (Myo 2004). Trade between India and ASEAN is expected to reach about US$100 billion in the next two years. India-Myanmar border trade contributed an insignificant 2.08 per cent and 0.49 per cent in India's total export to and import from Myanmar respectively in the last decade which shows that the border trade potential between the two nations is far from being realised.

SAARC REGIONAL MULTIMODAL TRANSPORT STUDY (SRMTS)

Following the partition of British India, the transport systems of South Asia have developed only in the national context and little consideration has been given to cross-border issues of compatibility, uniformity of standards in infrastructure and equipment design. In general, the key issues for international road transport are the types of vehicles used, the size of operators and poor vehicle utilisation. The SAARC Regional Multimodal Transport Study (SRMTS) endorsed by SAARC countries at the 2007 New Delhi Summit, charts out an integrated plan for individual countries of the South Asia region. It recognises that regional connectivity in transport is essential and capacity augmentation is required to cater to the anticipated increased traffic along intra-regional corridors. It has been estimated for South

Figure 13. 4
Asian Railway Network

Asia that for every 1 per cent reduction in transport cost, there is a 5 per cent stimulus to trade. This reduced transportation cost then gets translated into a 1.5 per cent reduction in costs to end-users of goods moved along that corridor, which eventually leads to an estimated 1 per cent addition to regional GDP.

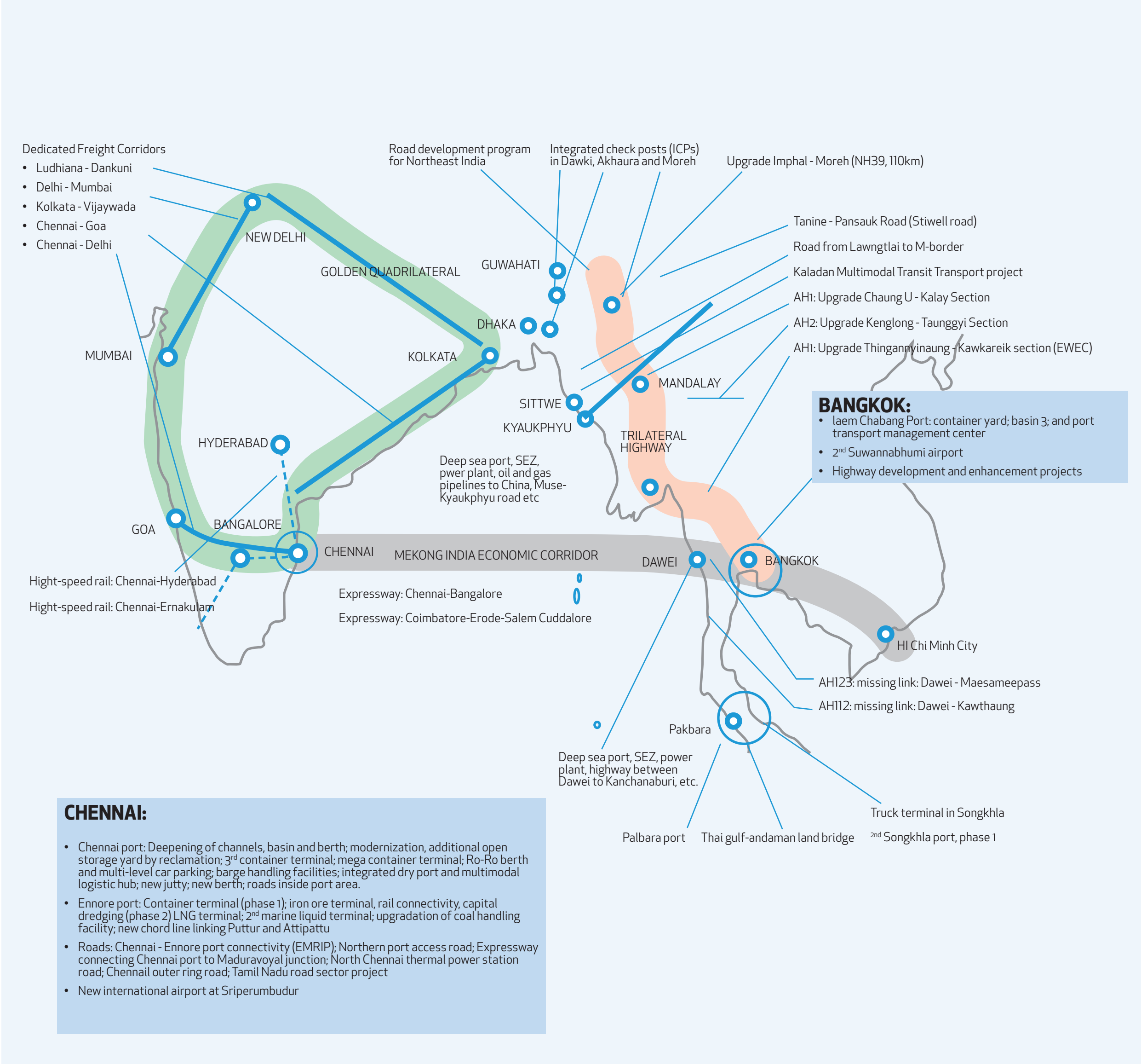
In 2003, under the auspices of the United Nation Economic and Social Commission for Asia and the Pacific (UNESCAP), the Intergovernmental Agreement on Asian Highway Network was signed, which specified the technical specifications for the regional road network. The Asian Highway Network (Figure 13.3) extends through 32 member countries and comprises 142,000 km of highways with very few missing links, but only 32 per cent of which is currently classified as Primary and Class I. The project aims to upgrade all designated national routes to Class I standards by 2020, although Class II standards would be acceptable for low-traffic, non-arterial routes. The Asian Rail Network (Figure 13.4) faces the problem of missing links.

The next sections list the important corridors for India and the measures needed to establish connectivity with its regional trading partners in a 20-year timeframe. There is need to restore the transport infrastructure which was integrated prior to independence. Assuming political and diplomatic cooperation over the near, medium and long term, this chapter proposes all the links that need to be put in place, to achieve the potential of regional economic integration.

THE MAJOR CORRIDORS: INDIA AND ASEAN

Connectivity with ASEAN in all its dimensions–physical, institutional and people-to-people–continues to be a strategic priority for India. Two major Commemorative events this year–the India-ASEAN Car Rally and the ASEAN sailing expedition of the Indian Naval Ship Sudarshini–highlight the importance and the potential for connecting India and ASEAN by sea, surface and air links. These are wel-

Figure 13.5
India-ASEAN Multimodal Connectivity Projects



Source: Economic Research Institute for ASEAN and East Asia.

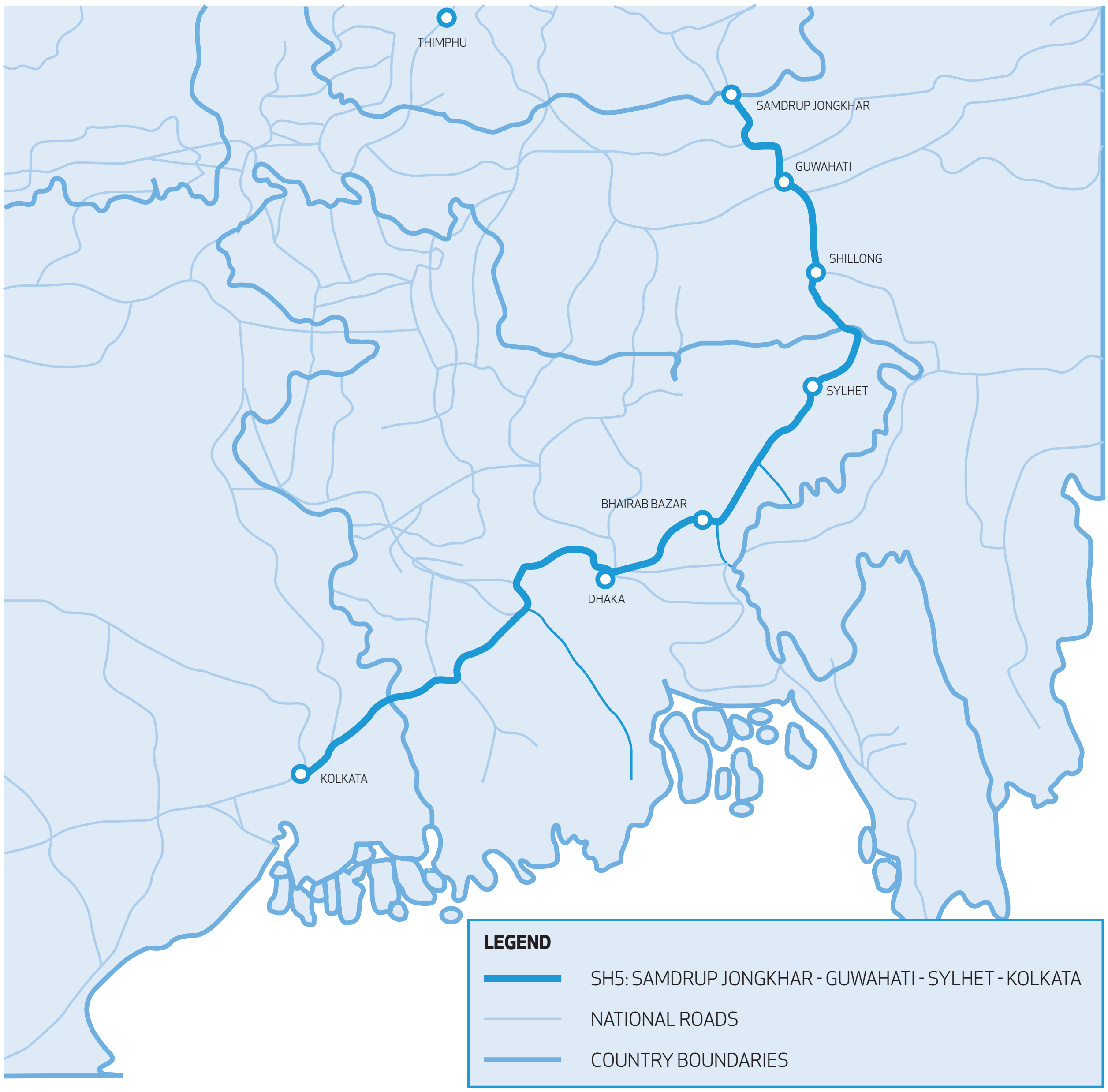
come steps in implementing the vision of India-ASEAN connectivity.
Prime Minister Manmohan Singh at the 10th India-ASEAN Summit, November 2012

ASEAN-India relations have grown rapidly from a sectoral dialogue partnership in 1992 to the signing of the ASEAN-India Trade in Goods (TIG) Agreement in Bangkok on 13 August 2009. The agreement paves the way for the creation of one of the world's largest free trade areas—a market of almost 1.8 billion people with a combined GDP of $ 4.1 trillion. ASEAN and India have concluded negotiation on the ASEAN-India Trade in Services and Investment Agreements and look forward to an its signature soon. However transport connectivity is essential to realise the potential of these agreements. The two principal proposed modes to enhance ASEAN-India connectivity are

- Sea route along the Mekong-India Economic Corridor (MIEC), the most important need here being the development of the deep sea port at Dawei, Myanmar and port along the eastern seaboard of India including Chennai;
- Land routes along the Trilateral Highway (TH)/ Asian Highway (AH)1 connecting Thailand, Myanmar and India.

ASEAN Plan of Action in Transport (1996-1998) explored various areas of transport infrastructure and facilities to enable free flow of goods, peoples, and ideas across the region, similar to the European Union. The transport links established within Greater Mekong Sub-region (GMS), for example, the

Figure 13. 6A
Kaladan Multimodal Transport Project



Source: http://www.arakanrivers.net.

North-South Corridor, Southern Economic Corridor and the 1,500 km long East-West Corridor financed by the ADB, link different parts of Vietnam to Laos, Cambodia, Thailand and Myanmar. The ASEAN Highway Network (AHN) is a flagship land transport infrastructure project which forms the major road (interstate highway) component of the overall trans-ASEAN transportation network ans is one of the 15 priority projects under the Master Plan of ASEAN Connectivity (MPAC). The ASEAN-India projects can be seen in Figure 13.5.

MEKONG-INDIA ECONOMIC CORRIDOR (MIEC)

The concept of the Mekong-India Economic Corridor (MIEC) has been under consideration for several years as a major India-ASEAN connectivity initiative. Integrating the four Greater Mekong Countries, namely Myanmar, Thailand, Cambodia and Vietnam with India through its east coast and north–east region, it will link vibrant emerging economies through a network of land and sea infrastructure. The Corridor is envisaged as a dynamic industrial region comprising large investment zones, rapid port and rail connectivity, and smart cities.

The three major areas of cooperation to enhance the connectivity between India and ASEAN is physical, institutional and people-to-people ties and this is conceptualised to come up around the main highway connecting Vung Tau in Vietnam to Dawei in Myanmar, passing through Ho Chi Minh City, Phnom Penh and Bangkok. The highway passes through three borders: (i) Moc Bai-Bavet (Cambodia-Vietnam); (ii) Poipet-Aranyaprathet border (Cambodia-Thailand); and (iii) Sai Yok-Bong Tee (Thailand--Myanmar). On the land route, the MIEC is proposed to connect Ho

Figure 13. 6B
Kaladan Multimodal Transport Project

Source: http://www.arakanrivers.net.

Chi Minh City (Vietnam) with Dawei (Myanmar) via Bangkok (Thailand) and Phnom Penh (Cambodia) with India's North East region. On the sea route, Chennai on the eastern coast of India would connect to Bangkok, and hinterland to Vietnam and Cambodia in the eastern direction and Myanmar to the west. The road alignment connecting major economic centers will serve as the main transport spine of the corridor. It is estimated that the influence zone of the corridor extends to 80-100 km on both sides of the alignment.

ASIAN AND ASEAN HIGHWAY NETWORKS

The vital projects to enhance stronger and deeper economic cooperation and regional integration are Asian Highway Network 4 linking the five neighboring countries, the ASEAN highways to improve within-ASEAN linkages, the GMS economic corridors, the BIMSTEC highway, the India-Myanmar-Thailand TH, the India-Myanmar Highways, the Paletwa border road, the Kaladan River Project, and the Kyautphyu and Dawei Deep Seaport Projects.

The three important land customs stations (LCSs) between India and Myanmar are Moreh in Manipur/Tamu in Sagaing, Zolkawtar in Mizoram/ Rihkhawdar (Chin), and Avakhung in Nagaland/ Layshi in Sagaing. Out of these, the Moreh LCS has been the busiest, handling almost 99 per cent of the region's trade with Myanmar, although North East India's trade with Myanmar has always remained less than a per cent of India's total trade with that country. The road from Imphal to Palel (49 km) is largely two-lane, flat terrain, and the surface is fairly paved and maintained. In contrast, the road from Palel to Moreh (60 km) is single-lane and mostly mountainous. The surface is paved but not maintained well, and a number of sections need to be repaired.

THAILAND TRILATERAL HIGHWAY The India-Myanmar-Thailand Trilateral Highway (TH) project which was initiated at the meeting of the Foreigh Ministers of India, Myanmar and Thailand in December 2003 is a major Initiative to enhance connectivity, trade, investment and tourism by linking the countries. The plan is to build a 1,360 km long MorehMae Sot highway the original alignment of which was to pass through Bagan, but on the suggestion of Myanmar, has been modified to pass through Mandalay now. The objective is to create a link between North East India and South East Asia.

INDIA-MYANMAR FRIENDSHIP ROAD On the Myanmar side, a 150 km road from Tamu to Kalemyo and a 10 km road from Kyigone to Kalemyo have been constructed by the Border Road Organisation (BRO) of India, and named as a Friendship Road. Completion of the project on Myanmar territory was an imperative sub-regional initiative. With the grant-aid of the government of India, the Kaly-Tamu road was completely upgraded and opened in February 2001. Of the 160 kms Tamu-Kyigone-Kalemyo section work on 132 kms has been completed, resurfaced and handed over to Myanmar September 2009. Of the

Box 13. 2
ASEAN Infrastructure Financing

The setting up of the ASEAN Infrastructure Fund (AIF) was announced in 2012. The AIF aims to finance the development of the region's road, rail, power, water and other critical infrastructure. It is estimated that ASEAN nations will require about $ 60 billion annually to fully address their infrastructure needs. AIF's total lending commitment through 2020 is expected to be approximately $4 billion. With a projected 70 per cent co-financing by ADB, AIF plans to leverage more than $13 billion in infrastructure financing by 2020. The AIF will be established with an initial equity contribution expected to be $ 485 million, of which $ 335 million is being provided by nine ASEAN members. The remaining $ 150 million is being provided by ADB. It is the largest initiative in ASEAN's history. A unique feature of AIF is that it will issue debt, which is targeted to be purchased through the Central Banks' foreign exchange reserves. With ASEAN countries holding over $ 700 billion in reserves, AIF offers an avenue for recycling the region's resources for its growing infrastructure requirements.

Private sector funding is essential for large scale infrastructure financing in ASEAN, but historically, the high degree of perceived risk on long-tenor infrastructure transactions has been a barrier for private investment. AIF is expected to help mitigate these risks, providing financing for a portion of public-private partnerships. The Fund is expected to finance approximately six infrastructure projects each year. Projects will be selected based on sound economic and financial rates of return, and the potential impact on poverty reduction. AIF will be based in Malaysia as a limited liability company. ADB has been requested by the ASEAN shareholders to administer the Fund.

Source: ADB

remaining 28 kms, work has been completed except 8 kms of resurfacing. This Friendship Road is a major part of the TH project.

TIDDIM-RHI-FALAM ROAD Zolkawtar (Mizoram) and Rihkhawdar (Rhee, Chin) have been the secondary gates for border trade between India and Myanmar. Zolkawtar is 225 km from Aizawl, capital of Mizoram. The Aizawl-Zolkawtar stretch is largely double-lane through highly mountainous terrain, although the surface is paved and better maintained compared with the Palel-Moreh section in Manipur. If the route from Aizawl to Agartala is improved, and the transit trade through Bangladesh is realised, this will become the shortest land route connecting Myanmar and Kolkata. Engineers and surveyors from the BRO and Public Works of Myanmar have prepared a Detailed Project Report (DPR) for upgrading the Tiddim-Rhi-Falam road. India has allocated $60 million for the project. India signed a MoU for construction of Rhi-Tiddim road in December 2012, which would provide connectivity from Zowkhathar in Mizoram to Tedim in Myanmar.

BANGLADESH TRANSIT ROUTE The Asian Highway (AH) routes provide road links between Bangladesh, China, India and Myanmar. It directly links New Delhi and Kunming in China through Bangladesh and Myanmar. If transit trade through Bangladesh were allowed with a reasonable level of efficiency, the scenario would change dramatically. Indeed, India and Bangladesh have already reached to an agreement on transit trade through inland waterways. Among the four states of the North East sharing national borders with Bangladesh—Assam, Meghalaya, Tripura and Mizoram, Meghalaya is the largest gateway. The enhanced connectivity between India and Bangladesh, both in physical and institutional terms, could boost border trade and open new opportunities for North East India.

MARITIME GATEWAYS

ASEAN countries are naturally endowed with some 51,000 km of navigable inland waterways. However, this is underutilised due to poor network, poor river ports and facilities, and poor intermodal connectivity. There is urgent need to develop IWT connectivity to reduce freight transport cost and time lag. The Kaladan Multimodal Transport Project will be a significant step forward, utilising Kaladan river transport and land transport for better connectivity.

The construction of new ports in Dawei, Kyaukphyu, and Pakbara are in the pipeline, and the expansion or upgrading of existing ports, such as Yangon, Sittwe, and Chennai, has been identified. Inland waterways along the Kaladan River and Ganga will significantly enhance connectivity between the mainland and Northeast India via Myanmar

RAIL CORRIDORS

Myanmar has made tremendous progress in railway construction in the last two decades. However, missing links still exist in the Trans-Asian Railway (TAR), which need to be tackled for India—and South Asia—to derive maximum benefit from SKRL.

Table 13. 4
Paved Roads in South Asia
[Percentage of Total Roads]

	2003	2004	2005	2006	2007	2008	2009
South Asia	57.0	55.7					53.9
Afghanistan		23.7	27.5	29.3			
Bangladesh	9.5						
Bhutan	62.0						
India		48.6	47.0	47.7	48.2	49.5	
Maldives			100.0				
Nepal	53.9	55.7	56.1	55.9	55.1	53.9	
Pakistan	60.0	64.7		65.4			
Sri Lanka	81.0						
World	49.4	45.0					64.9

Source: WDI (2012).
Note: Paved roads are those surfaced with crushed stone (macadam) and hydrocarbon binder or bituminised agents, with concrete, or with cobblestones, as a per cent of all roads in the country, in length terms.

Table 13. 5.
Selected Road Corridors

	CORRIDOR	COUNTRIES	BASIS OF SELECTION
SHC 1	Lahore-New Delhi-Kolkata-Petrapole/Benapole-Dhaka-Akhaura/Agartala	Pakistan, India and Bangladesh	Potential to carry major intraregional traffic; potential to providing shorter route leading to transport cost savings.
SHC 2	Kathmandu-Birgunj/Raxaul-Kolkata/Haldia	Nepal and India	Access to landlocked Nepal to Indian ports
SHC 3	Thimphu-Phuentsholing-Jaigon-Kolkata/Haldia	Bhutan and India	Access to landlocked Bhutan to Indian ports
SHC 4	Kathmandu-Kakarvitta-Phulbari-Banglabandha-Mongla /Chittagong	Nepal, India and Bangladesh	Access to landlocked Nepal to Bangladeshi ports
SHC 5	Sandrop Jongkhar-Guwahati-Shillong-Sylhet-Dhaka-Kolkata	Bhutan, India and Bangladesh	Potential to providing shorter route leading to transport cost savings
SHC 6	Agartala-Akhaura-Chittagong	India and Bangladesh	Shorter access to Chittagong port for Indian North Eastern States
SHC 7	Kathmandu-Nepalganj-New Delhi-Lahore-Karachi	Nepal, India and Pakistan	Potential of the corridor to carry future traffic
SHC 8	Thimphu-Phuentsholing–Jaigaon-Burimari-Mongla/Chittagong	Bhutan, India and Bangladesh	Access to landlocked Bhutan to Bangladeshi ports
SHC 9	Maldha-Shibganj-Jamuna Bridge (Bangladesh)	India and Bangladesh	Potential to provide direct connectivity to carry future traffic
SHC10	Kathmandu-Bhairahawa–Sunauli-Lucknow	Nepal and India	Potential of the corridor to carry future traffic

Designing of the UNESCAP's TAR began in the 1960s with the objective of providing a continuous 14,000-km rail link between Singapore and Istanbul. The TAR programme promotes railways as an energy-efficient mode of transport. But there is a missing link between North East India and Bangladesh. The railroad connecting Kulaura-Shahbajpur in Bangladesh to Mahisason in India has been defunct since 2002 due to lack of traffic as well as facilitation measures.

AIR TRANSPORT

The ASEAN Multilateral Agreement on Air Services and the ASEAN Multilateral Agreement on the Full Liberalisation of air freight services were simultaneously approved in May 2009. They call for a calibrated and gradual implementation in each contracting state, to allow countries with less developed airline industry to cope up with more developed ones. It is part of the broader ASEAN Air Transport Integration and Liberalisation Plan.

INDIA-SOUTH ASIA CONNECTIVITY

I dream of a day, while retaining our respective national identities, one can have breakfast in Amritsar, lunch in Lahore and dinner in Kabul.
Prime Minister Manmohan Singh, January 2009

In South Asia, political histories, poor physical connectivity, trade barriers, and impediments to cross-border investment are the main factors for weak economic integration. Although there have been reports identifying important connectivity corridors (ADB 2002, 2006) and investment options, there has been little progress in opening connectivity.

PRIORITY ROAD CORRIDORS

Road transport has been the dominant mode in the region and has been catering to 65-70 per cent or more of the movement in the mainland countries. SAARC countries had 3.82 million km of roads in 2002, 10 per cent of the world's road network. However, the percentage of paved roads varied greatly among countries: 47.7 per cent in India and 53.9 per cent in Nepal in 2008; 65.4 per cent in Pakistan in 2006 and 81 per cent in Sri Lanka in 2003. A physical assessment of the road corridors reveals that the quality of the road network is good, and 90 per cent of the corridors, totaling around 8,800 km, have two or more lanes; a large chunk of regional road corridors in India and Pakistan are, in fact, four-lane divided highways. Less than 5 per cent of the corridors need physical improvement and another less than 5 per cent, mostly near the border areas, need widening up to two lanes. In the context of regional road corridors, one of the most crucial non-physical barriers is the lack of a bilateral transport agreement to facilitate uninterrupted movement of goods and vehicles between India and Bangladesh, and between India and Pakistan. As a result, goods are required to be transshipped at the border between the trucks of neighbouring countries.

In the country reports prepared under Phase I of the SAARC Regional Multimodal Transport Study (SRMTS), a total of 18 regional road corridors (both existing and potential) were identified in view of their importance in carrying both goods and passenger bilateral traffic. The corridors were selected on the basis of

- Trends of existing traffic and the potential to carry future traffic
- Potential to provide direct connectivity by enabling movement across the region
- Ability to provide access for landlocked countries to ports or to other major transport networks
- Potential to provide shortcuts that would bring major transport cost savings, and
- Need to revitalise historical links or provide linkages for meeting socio-political requirements.

Of these, 10 were selected as priority. The corridors are listed in Table 13.5 and depicted visually in Figure 13.7.

PRIORITY RAIL CORRIDORS

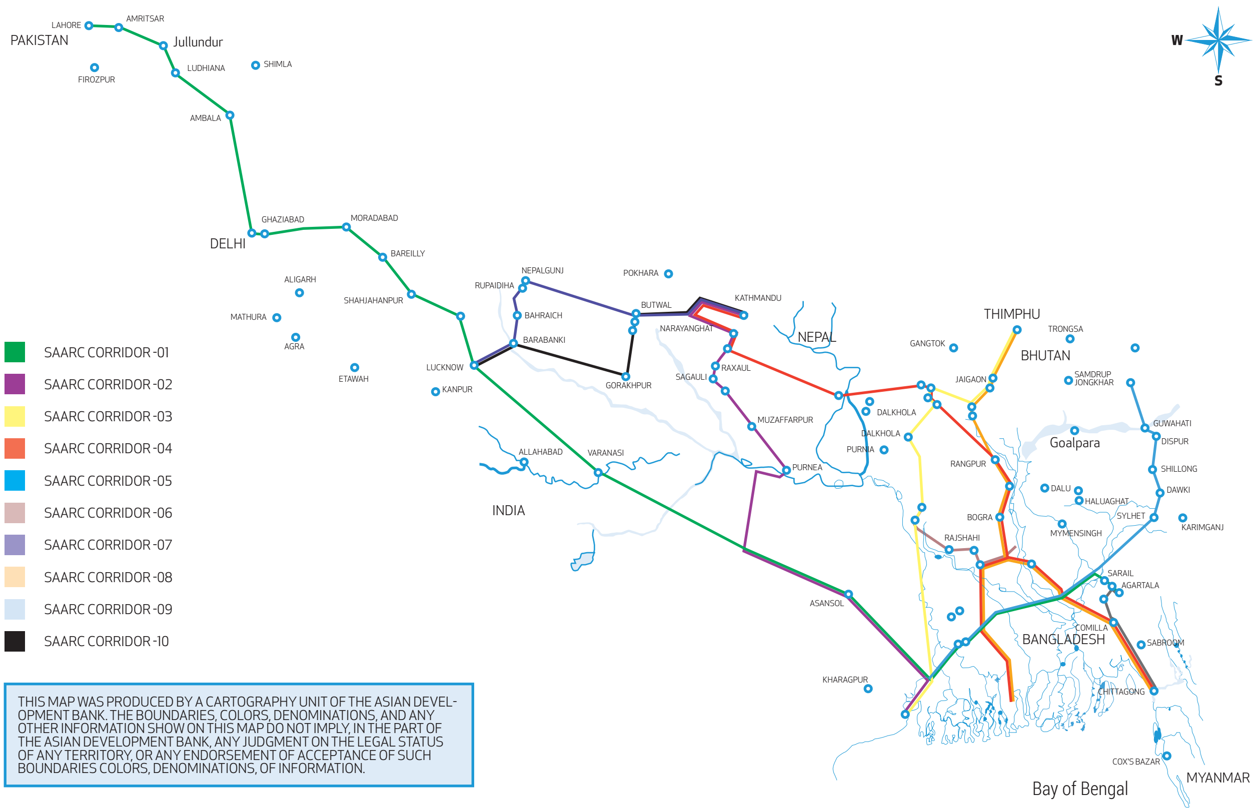
Railways have the potential of becoming one of the most important transport modes in South Asia, particularly for intra-regional movement between India, Bangladesh, Pakistan and Nepal (Sri Lanka does not have any rail link with India, and Bhutan and the Maldives do not have rail networks). South Asia also has one of the largest railway networks in the world, spreading over 77,000 route-kilometres of which 70 per cent is with three countries—India, Pakistan, and Sri Lanka .

> In South Asia, political histories, poor physical connectivity, trade barriers, and impediments to cross-border investments are the main factors for weak economic integratio. There has been little progress in opening connectivity.

Of the 15 rail corridors, seven already exist. Three of them are broad gauge rail connections between India and Bangladesh through which there is regular movement of freight. The broad gauge connectivity between Nepal and India primarily caters to the transit traffic meant for Nepal that passes through

5. The SAARC Regional Multimodal Transport Study (SRMTS) was undertaken in two phases and the report was submitted to the SAARC Secretariat in June 2006. Subsequently, the 16th SAARC Thimphu Summit in 2010 recognised the importance of developing transport infrastructure and transit facilities, especially for the landlocked countries to promote intra-SAARC trade and declared 2010--2020 as the 'Decade of Intra-regional Connectivity in SAARC'. The countries agreed on the need to expedite negotiations with a view to finalising the two agreements on motor vehicles and railways. Sustaining the momentum of the 16th Summit, the 17th SAARC Summit in November 2011 at Addu.
6. The Imperial Gazetteer of India Atlas maintained by University of Chicago. http://dsal.uchicago.edu/reference/gaz_atlas_1909/pager.html?object=28.

Figure 13. 7
SAARC Road Corridors, Inland Customs Stations and Ports



Kolkata/Haldia ports. There is no passenger movement by rail between Nepal and India. The rail connectivity between India and Pakistan through Wagha handles both passenger and small quantities of freight traffic, and the link between Munabao in India and Khokhrapar in Pakistan, passenger traffic. The other eight corridors identified existed historically and/ or have the potential to be developed as future rail corridors.

The five prioritised rail corridors are listed in Table 13.6 and depicted in Figure 13.8.

INLAND WATERWAYS

Water transport is still considered to be the cheapest mode of transport in terms of costs/km for freight, as well as passenger movements. The largest inland waterways exist in India and Bangladesh. The Palk Strait, the narrow channel between India and Northern Sri Lanka, is considered to be the part of South Asia's inland waterways.

Four inland waterway corridors have been identified between India and Bangladesh. These include both existing and potential corridors of regional significance. The corridors primarily use five major rivers– Brahmaputra/Jamuna, Padma/Ganga, Meghna, Hooghly and Bhagirathi. The existing corridors are currently used for transportation of transit traffic between India and Bangladesh, as well as intercountry traffic, for which there is a number of ports of call designated under the bilateral transit agreement. The two prioritised corridors are based on traffic volume and ability to provide direct waterway connectivity for North Eastern India to seaports at Kolkata/Haldia.

MARITIME PORTS

Maritime gateways that contributed a great deal in establishing connectivity in South Asia before Partition included Chennai, Chittagong, Colombo, Karachi, Kolkata and Mumbai. However, other gateways have been making substantial contribution in

Box 13. 3
Railways, 1947

In 1947, the single Indian railway system was divided overnight into two entirely separate systems. The North Western Railway and the Bengal Assam Railway were the most profoundly affected in that they straddled the new international boundary between India and Pakistan. The railway lines within the state of India, including 1855 miles of the North Western Railway and 1942 miles of the Bengal Assam Railway, formed the Indian Railway network. The railway lines within the state of Pakistan, including the remaining 5026 of the North Western Railway and 1613 miles of the Bengal Assam Railway, formed the Pakistan Railway networkt[7]

1947

- 1 April: Mandra-Bhaun line taken over by state (now in Pakistan).
- Independence/Partition. Two big systems, Bengal Assam Railway and North Western Railway, are no longer in India (these included the workshops of Saidpur and Mogulpura, respectively). Some 2955 route-km of NWR became the East Punjab Railway in India, leaving 8070 km in the then West Pakistan. Part of the Jodhpur Railway also went to West Pakistan. Much of the Bengal Assam Railway went to the then East Pakistan (now Bangladesh). Exchanging assets and staff dislocates all normal work, as does the large-scale movement of people between India and Pakistan.
- Assam Railway is cut off from the rest of the Indian system.
- Traffic patterns change drastically. Instead of Karachi to northern India, now all traffic is from Bombay.
- Traffic from and to Jammu and Kashmir which used to be through Lahore (via Rawalpindi and Jammu) now had to go directly to Delhi.
- There are 42 separate railway systems, including 32 lines owned by the former Indian princely states.
- Baldwin supplies the first batch of prototypes of the WP class locos (classified WP/P).
- TELCO starts production of boilers.
- Dec. 19: 56 EMU coaches ordered for Bombay suburban system from Metropolitan Cammell

Source: Chronology of Railways in India, Part 4 (1947-1970) http://www.irfca.org/faq/faq-history4.html

handling regional trade in recent years, due to the growth in containerisation. Several more have the potential to do so, including Kochi, Haldia, Tuticorin, JNPT (Nhava Sheva, south of Mumbai) in India, Mongla in Bangladesh and Bin Qasim in Pakistan. In addition, given its island status, the port of Male is critical for connectivity between the Maldives and other SAARC countries. Table 13.8 lists the prioritised corridors for India.

AIR TRANSPORT

Even though air transport has seen phenomenal growth over the last two decades, South Asia lags behind many other regions. Historically, the region developed its air travel links with Europe and more lately with East Asia and the Middle East. But it has not developed the intra-regional corridors or a regional network in the same manner. However, given the lowering of trade barriers and the anticipated relaxation in personal travel restrictions, growth potential for regional travel is high. There is evidence to this already in some corridors such as between Sri Lanka and India, which have adopted liberal aviation policies. Freight transport also stands on the threshold of rapid growth.

However, connectivity between the regional centres, especially the capital cities in terms of direct flights is still very low. Cost of travel is relatively high when compared to other regions.

Investment has failed to keep pace with the demand for airport capacity, particularly in relation to the provision of modern terminals and additional runway capacity. There are still many regulatory barriers in some countries in the region that prevents greater competition in service provision. Moreover, the region has not developed strong hub operations

7. Source: ' Statute Law Revision- Indian Railway Repeal Proposals, August 2007, published by the Law Commission of the United Kingdom (downloaded from http://www.irfca.org/docs/history/ir-uklaw-intro.html.

Table 13. 6
Selected Rail Corridors

	CORRIDOR	COUNTRIES SERVED	BASIS FOR SELECTION
SRC 1	Lahore (Pakistan)–Delhi/ Kolkata (India)–Dhaka (Bangladesh)–Mahishasan–Imphal (India)	Pakistan, India and Bangladesh	Potential growth of intraregional traffic. Reduced distance and shorter transit time.
SRC 2	Karachi (Pakistan)– Hyderabad–Khokrapar--Munabao--Barmer–Jodhpur (India).	Pakistan and India	Shorter route for intra-regional traffic. Access to Karachi Port and potential third country traffic.
SRC 3	Birgunj (Nepal)--Raxaul--Haldia/Kolkata (India)	Nepal and India	Access to the landlocked Nepal. Potential corridor for third country and bilateral traffic.
SRC 4	Birgunj (Nepal)-Raxaul-Katihar (India)–Rohanpur–Chittagong (Bangladesh) with links to Jogbani (Nepal) and Agartala (India)	Nepal, India and Bangladesh	Access to Chittagong Port for Indian & Nepalese traffic. Shorter route for North Eastern States of India through Bangladesh
SRC 5	Colombo (Sri Lanka)–Chennai (India)	Sri Lanka and India	Restoration of old rail ferry link to provide passenger and goods access from the island Sri Lanka to mainland South Asia

Table 13. 7
Selected Inland Water Transport Corridors

	CORRIDOR	COUNTRIES SERVED
SIWC 1	Kolkata--Haldia--Raimongal--Mongla--Kaukhali--Barisal--Hizla--Chandpur--Narayanganj--Aricha--Sirajganj--Bahadurabad--Chilmari--Pandu	India and Bangladesh
SIWC 2	Kolkata--Haldia--Raimongal--Mongla--Kaukhali--Barisal--Hizla--Chandpur--Narayanganj--Bhairabbazar--Ajmiriganj--Markuli--Sherpur--Fenchuganj--Zakiganj--Karimganj	India and Bangladesh

Table 13. 8
Selected Maritime Gateways

	PRINCIPAL PORTS	BASIS OF SELECTION
India	JNPT	Potential to handle intra-SAARC traffic
	Kolkata / Haldia	Ability to provide access for landlocked countries to sea ports
	Kochi	Potential to handle intra-SAARC traffic
	Tuticorin	Potential to handle intra-SAARC traffic

Table 13. 9
Selected Aviation Gateways

AIRPORT	RANK FOR CONSIDERATION
Delhi	2
Mumbai	6
Chennai	3
Kolkata	10
Thiruvananthapuram	9
Bengaluru	11
Tiruchirapalli	15
Cochin	12
Hyderabad	14

Note: Colombo is 1. There is no rank 7 (Karachi and Mumbai both ranked 6) and there is no rank 13 (Lahore and Cochin both ranked 12)

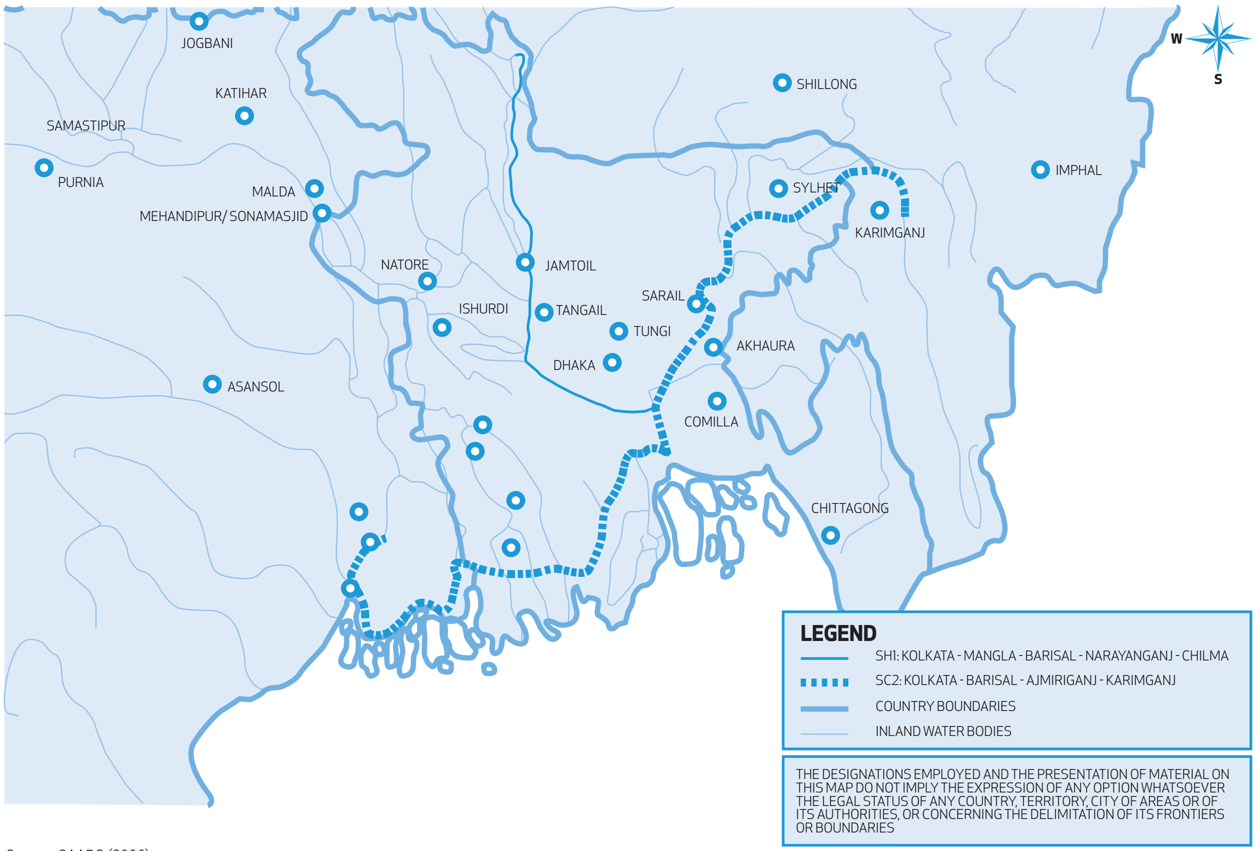
Figure 13. 8
SAARC Rail Corridors

Source: ADB, based on SAARC (2006)

for efficient regional transfers. There is a clear need to adopt more liberal aviation policies and reduce regulatory barriers for seamless regional transfers. Twenty airports within the SAARC region have flights to other regional destinations. These are considered as regional aviation gateways. In addition, five airports were considered as they could develop as gateways in the near future. Prioritisation criteria included

- Weightage to current regional freight tonnage movements
- International passenger movements processed.
- Potential for regional tourism, and
- Fast development as industrial or commercial centres.

Figure 13. 9
SAARC Inland Waterways



Source: SAARC (2006).

Of the 16 aviation gateways that were prioritised, nine are in India.

TACKLING THE CONNECTIVITY CHALLENGES WITH SOUTH ASIA

An analysis of the major South Asia corridors, the current infrastructure, and actions required is detailed in Annex 13.2. A brief discussion is provided in this section.

ROAD

Road transport is the dominant mode and its importance keeps growing. Most of the trade between India and its neighbours takes place along the land routes.

FREIGHT

Freight in the SASEC region, India allows trucks from Nepal and Bhutan to operate on designated transit routes within India. Indian trucks are allowed anywhere into Nepal, but are given a limit of 72 hours to return. Nepalese trucks need permits for every trip to India with a validity of three months, but they are allowed to the nearest market towns and rail-heads in India. India allows Bhutan to use Phuntsholing (Bhutan)-Changrabandha (India)-Burimari (Bangladesh) for trade with Bangladesh, but this corridor is not allowed for third country trade.

The border between India and Bangladesh has 10 important road-based check posts. The facilities at Banglabandha (Bangladesh)/Fulbari (India)-Panitanki (India)/Kakarvita (Nepal) are exclusively for Bangladesh-Nepal bilateral trading. The Benapole (Bangladesh)/Petrapole (India) route carries the heaviest traffic by road, accounting for about 80 per cent in terms of value and 50 per cent by volume of India's exports to Bangladesh

Between India and Pakistan, the commencement of the integrated check post (ICP) at the Attari (India) border in April 2012 will facilitate trade. Till now, 100-150 trucks could conveniently cross the border every day. The new ICP infrastructure can handle 10 times that number. Also, cargo movement between the two countries can take place for 12 hours daily against the eight hours earlier. This has started showing outstanding results. In the first quarter of the financial year 2012, imports grew by 106 per cent, while exports witnessed an increase of 39 per cent over the corresponding period in the previous year. According to a study released by the Associated Chambers of Commerce and Industry of India (ASSOCHAM), the ICP at the Attari-Wagah border and Pakistan's granting MFN status to India could increase bilateral trade to $8 billion a year in the next two years from the current level of $2.6 billion.

In another landmark development, truck services between Srinagar and Muzaffarabad and between Poonch and Rawalakote across the Line of Control between India and Pakistan-administrated Kashmir have been allowed. Trade is currently restricted to four days in a week.

The bilateral agreement between Myanmar and India limits the number of tradable items for the border trade to 40, and only in terms of barter. Trade imbalance needs to be settled by reverse trade within six months, instead of financial settlement, and there's no 'formal' foreign exchange facility in the border area. Consequently, official border trade has not been growing. According to the statistics of Moreh LCS, in FY2010-11, India's export to Myanmar was Rs 2.6 million of cumin seed, and import was Rs 32 million of betel nuts and Rs 4 million of dry ginger. Meanwhile, informal border trade has been growing. As referred in De (2011), the total trade at Moreh is estimated at Rs 2,800 million, which is far higher than the official trade statistics. This obviously indicates a strong demand in the market.

PASSENGER

There are two established routes between Bangladesh and India for passenger movement. The Dhaka-Kolkata direct bus operation started in 1999 and Dhaka–Agartala in 2003. As for movement between Nepal, Bhutan and India, citizens are allowed to move freely by road without any visa and there are frequent bus services between the countries and between border points and key cities. Between Delhi and Lahore, a cross-border bus service began in 1999, got suspended in January 2002 and resumed operations from July 2003. Other bus services between Lahore and Amritsar, and between Nankana Shahib and Amritsar, have now commenced. All these go through the Wagah–Attari border crossing. Prior to opening truck services between India and Pakistan-administered Kashmir, two bus services between Srinagar and Muzaffarabad, and between Poonch and Rawalakote were launched in 2005 and 2006 respectively.

MAJOR BARRIERS AND REQUIRED ACTION

The physical and non-physical barriers across the identified priority corridors are similar in their lack of adequate infrastructure and facilities at the border areas which result in congestion and time delays. Specific problems vary in terms of narrow roads, lack of parking facilities, and cumbersome procedures.

Physical barriers include narrow roads in India at Barasat–Petrapole (75 km 5.5m), Baharaich–Rupaidiha (25 km 3.5m), and Malda–Mohaddipur (13.5 km 5.5m) in India. Roads in poor condition are Barakar–Jharkhand and beyond in Bihar (180 km), Nanpara–Rupaidiha (15 km) and Maldah–Mohaddipur (13.5 km). Lack of facilities at the border include parking space at Dawki, Raxaul, Jaigon and Sunauli, and the immigration/ customs at Phulbari. The check post and immigration offices at Agartala and Sunauli need to be shifting and the Central Warehousing Corporation at Petrapole needs protection from rain. Other issues include congestion along towns on the Petrapole–Kolkata road and weight restriction on the 80 year-old suspension bridge at Dawki. The ADB is financing a project to upgrade the road between Jaigaon and Chagrabandha, and Panitanki and Phulbari.

> The complicated and cumbersome customs procedures at the India-Bangladesh border involve 22 documentations, over 55 signatures, and minimum 116 copies of paper for the final approval.

The non-physical barriers include lack of

- Bilateral and/or regional agreements for movement of vehicles across borders between Bangladesh, India and Pakistan
- EDI /IT system, and
- Through Bills of Lading

The cumbersome and complicated customs procedures at the India-Bangladesh border involve 22 documentations, over 55 signatures, and minimum 116 copies of papers for the final approval. There are also different documentation requirements at different border points. Working hours and weekly holidays need to be harmonised across the borders, restrictions on overloading of vehicles need to be enforced, security in some areas along the corridors has to be strengthened, and there needs to be greater transparency in inspection procedures.

RAIL

FREIGHT

Among mainland countries, India has no rail link with Bhutan and just a single link with Nepal. Bangladesh, India and Pakistan have extensive rail networks and before the partition of India in 1947, intra-sub-continental movements were mainly through the railways. Although these physical links are still there, only limited cross-border movement of freight by rail takes place between Bangladesh and India, Pakistan and India, and Nepal and India. The volumes are far less than the potential and projected growth of inter-country traffic.
Currently, three broad gauge (BG) rail corridors are active between India and Bangladesh. Indian Railway (IR) wagons are pulled by Bangladesh Railway (BR) locomotives only over a short distance inside

Since no South Asian port other than Colombo is able to accommodate fourth-generation container vessels, much of the intra-regional traffic is routed through this one port. This significantly increases transit times. In addition, all ports have capacity problems.

the country to a point where transshipment takes place. BR wagons do not cross the Indian border as the rolling stock is incompatible with the stock of IR.

Between Pakistan and India, there are currently two BG corridors, though one crossing is restricted to passengers only. There is limited freight movement by rail between India and Pakistan, partly due to lack of standardisation of infrastructure and rolling stock.

Between India and Nepal, rail movement is entirely via the broad gauge railway link connecting Kolkata port and other destinations in India through Birgunj Inland Container Depot (ICD).

It is important to note that the current railable traffic is almost entirely one-sided—from India to Bangladesh, Nepal and Pakistan. Wagons return to India empty. This is resulting in considerable under-utilisation of the existing transport capacity.

PASSENGER

The India-Pakistan Samjhauta Express resumed operations in January 2004, after more than two years of suspension of services. The twice-weekly train operates between Lahore and Delhi. Another train connection, Thar Express, was inaugurated in February 2006 to link Karachi via Khokhrapar and Munabao to Jodhpur.

The Maitree Express or Dhaka-Kolkata Express, a bi-weekly train., is the only passenger railway link between the two countries, and was started on April 14, 2008 after being closed for 43 years.

MAJOR BARRIERS AND REQUIRED ACTION

Physical barriers include missing links and the non-availability of air-braked fleet of rolling stock in Pakistan and Bangladesh. There is a missing 11.5 km link from Akaura (Bangladesh) to Agartala (India). Indian Railways has completed the final survey in August 2012 and the DPR is under preparation.

The main non-physical barrier is the absence of a Multilateral Rail Transport Agreement for intra-regional traffic. There are also restrictions on the movement of open wagons and oil tankers between India, Pakistan and Bangladesh. The turnaround time is too long, which affects trade requirements and causes problems like one-sided traffic and non-utilisation of wagon capacity. It is vital that issues such as manual documentation procedures, duplication of customs checks and restricted working hours are examined thoroughly.

INLAND WATERWAYS

Among South Asian countries, inland water transport links are available only between India and Bangladesh. Indian transit traffic and Indo-Bangladesh bilateral traffic move along these IWT routes under a protocol. This is the only transit facility for India through Bangladesh for serving the requirements of the North East. There is no inter-country passenger movement by IWT.

MAJOR BARRIERS AND REQUIRED ACTION

Physical barriers on the India side include navigational hazards such as shallow waters, narrow widths of channels in the rivers, siltation, bank erosions, shrinking of rivers in dry seasons; inadequate navigational aids; poor condition of wharves, jetties, platforms at the inland ports; lack of cargo handling equipment; insufficient spaces or sheds to store the cargo at almost all the inland ports and landing stations; poor hinterland connectivity; shortages of adequate vessels, and an old and obsolete fleet.

Non-physical barriers between Bangladesh and India include the lack of sufficient ports of call, shortage of skilled manpower, and labour unrest.

MARITIME TRANSPORT

FREIGHT

Since no South Asian port other than Colombo is able to accommodate fourth generation container vessels, much of the intra-regional traffic is routed through this one port. This significantly increases transit times. In addition, almost all ports have capacity problems in handling container traffic and require significant investment to handle projected demand.

It must be remembered that seaports being the gateways of a country play a significant role in its socio-economic development. Even after major development of roads and rail transport in recent decades, maritime transport continues to play a dominant role in carrying the external trade of most countries. Many great cities of the world grew around their ports. The Indian examples would be Chennai, Kolkata and Mumbai.

PASSENGER

There are currently no ferry services operating between South Asian countries. However, in SRMTS Phase 1, India and Sri Lanka agreed that the possibility of establishing regular ferry services between Colombo and either Kochi or Tuticorin had to be evaluated, as an alternative to Rail Corridor 5, which

would have problems of restricted draft and adverse weather conditions during the monsoons.
The 17th SAARC Summit held in 2012 at at Addu in the Maldives declared the implementation of the Indian Ocean Cargo and Passenger Ferry Services as a priority. A feasibility study has been completed. The study has recommended ferry routings between the Maldives, Sri Lanka and India, scheduling, and investments required in terminals and berths. A public-private partnership model has been suggested, and procedural changes in customs and immigration clearance. It is expected that this project will get completed faster than some of the other regional connectivity initiatives in the pipeline, and has the potential to significantly facilitate passenger movement and trade between the Maldives, Sri Lanka and India.

MAJOR BARRIERS AND REQUIRED ACTION

The main constraint for the identified Indian ports is that their capacities have almost reached their maximum limits and congestion is routine. Adequate channel depth is not available and it fluctuates considerably with tides and over seasons at Haldia and Kolkata. Cargo and ship handling equipment, and floating craft are old and insufficient at Kolkata, Haldia and Tuticorin. Haldia has very poor rail connectivity with the hinterland. Road connectivity is also poor at Haldia and Tuticorin for container carrying. Every port suffers from insufficient harbour area and channel depths to accommodate new generation larger vessels.

Non-physical barriers include poor port administration and management; limited implementation of EDI/IT systems to link up customs, ports and stakeholders, and no computerisation for port operations at Kolkata and Haldia. Customs procedures are complicated and time consuming at all ports. Labour unrest is a problem at Kolkata and Haldia, and there is no bilateral agreement between Colombo and Tuticorin/Kochi.

Ports need to be constructed on the basis of trends of existing traffic and the potential to carry future traffic; as also the ability to provide direct connectivity by enabling through movement across the region. The maritime gateways in India are mostly located on the west coast. Construction of new ports need to facilitate uninterrupted movement and bring major transport cost savings.

AIR TRANSPORT

As passenger and freight travel by air is expected to increase rapidly, there will be a capacity problem at airports for both passengers and cargo. There is low use of air travel when compared to population and economic conditions in the region. Presently, travel within the region, due to the paucity of direct links, often requires many transfers, sometimes having to go outside the region. These are the physical barriers.

The current non-physical barriers include air fares and airport charges, which are high when compared with other regions. Visa restrictions also discourage travel.

> Physical barriers to air travel within the region include paucity of direct links, often requiring many transgers and having to go outside the region. Non-physical barriers include high air fares and airport charges, and visa restrictions.

BORDER CROSSINGS

As detailed previously, besides physical links, considerable difficulties exist at the land border crossings between South Asian countries, from documentation and bureaucratic procedures, to parking space and lack of IT connectivity.

Good measures have been taken up under Government of India's ICP project, under the Land Port Authority of India identified 13 border check posts and the Ministry of Commerce has further identified several Land Customs Stations[8]. However, some are still far from adequate and the lack of transport agreements allowing the direct movement of freight vehicle across the borders results in border congestion due to the need for transhipment. This process not only increases transport costs considerably, but results in increased damage to products, pilferage and incidences of unauthorised payments.

BIMSTEC study emphasised the promotion of a regional border development program in cooperation with national Customs to ensure that all the main BIMSTEC borders are connected to their respective central IT systems.

THE WAY FORWARD

Due to its strategic geographic location and size, India needs to play a central role in taking forward regional cooperation initiatives. It is in a position to provide key support for establishing an effective Asian institutional architecture. India is also at a center of a web of dynamic bilateral and regional FTAs within South Asia and between South Asia and East Asia and Southeast Asia. India will reap large benefits from Asian integration. The overall forward strategy needs to link the soft and hard aspects of transport infrastructure development. This is only possible through a combination of initiatives are all levels. The various actions and measures indicated need to be elaborated and appropriate legislative procedures need to be adopted and an impact assessment of each of the proposals will need to be undertaken.

8. http://mha.nic.in/pdfs/BM_IntCheck(E).pdf, accessed 19 August 2013.

Box 13. 4

Transport Agreements and Lessons from International Experiences

Some of the key issues with respect to trade and transport infrastructure include the harmonisation of technical and operational standards and requirements of international routes under various modes, as well as user charges for such infrastructure.

For vehicles, the key issues include commercial operating rights, vehicle registration, vehicle technical standards, traffic rules and signage, driving licenses, third party liability, and temporary importation of vehicles for the purpose of carrying goods and people across national frontiers. While adjustment in and development of transport infrastructure in a coordinated manner is critical to ensure technical compatibility and inter-operability of national transport systems, coordination in the management and control of traffic and user information is key to optimizing the use of such infrastructure. The gains in efficiency from technical measures can however be offset in the absence of streamlined legal and administrative systems for international border-crossings. Discriminatory road charging, restrictive traffic quotas, restrictions on the use of foreign trucks on territory of particular countries and, last but not the least, the amount of time needed for police, customs and security clearance of vehicles and drivers are some of the factors that influence directly the transport operator's choice of the traffic route. When these and other factors are not adequately dealt with, traffic will be lost to alternative routes, involving waste on the side of the transit country which loses potential income from transit traffic and the shipper who takes a less efficient or more expensive route. (UNESCAP report)

Agreements aimed at developing and operationalising a transport routes and corridors need to be developed directly or by invoking other related agreements. South Asia is the least legalised region in Asia in transport and trade facilitation agreements, which are two priority areas of ADB's support. EU is the most legalised region with more than 30 regional transport and trade facilitation agreements. ASEAN ranks at second with five regional agreements and strategic frameworks to handle trade facilitation and transport.

There are a number of international conventions that govern transport. UNESCAP issued Resolution 48/11 in 1992, which recommended seven key international conventions—and later three more—related to transport for countries in Asia and the Pacific. These conventions include Convention and Statute on Freedom of Transit; Convention on Transit Trade of Landlocked States, Convention on the Law of the Sea, WTO GATT (Article V, Transit); and various conventions on road traffic, road signs and signals The international conventions set standards to facilitate the harmonisation of transport laws and regulations and the adaptation of unified transport documents for regional transit and/ or inter-state transport. More importantly, these international conventions help the streamlining of border-crossing formalities and procedures, including visa procedures for professional drivers, in order to reduce delivery time and transport costs. However, the conventions are difficult to implement at the country level for several reasons, including high cost of adjustment to meet the requirements; and lack of institutional structures at the country level.

Given these issues, except for India that acceded to Convention on Road Signs and Signals, none of countries in South Asia have acceded or signed any of the 10 important international conventions on transport.

Subregional Transport Agreements Given the difficulties in implementing the international conventions, some subregional transport facilitation agreements have been or are being formulated.

The advantages of these subregional transport agreements are threefold. One, they play an important role in opening up regional road traffic, promoting international conventions, harmonising and simplifying formalities and procedures of bilateral transport agreements, and establishing standards not covered by international conventions. Two, the subregional transport agreements also can greatly facilitate trade as most of them have built-in trade facilitation measures. And three, subregional transport agreements can be a powerful showcase politically for regional cooperation and integration.

The disadvantage of subregional transport agreements is that they often take years to conclude the negotiations and particularly to complete the legal process domestically for entry into force. The ASEAN Agreement on transit transport was signed in 1998 and its protocols have not been fully finalised till now. The ECO agreement on transit transport was signed in 1998 and took 9 years to enter into force. The implementation of these agreements at the country level is also facing complicated coordination issues as it involves many government ministries and authorities. Most of these agreements are under the purview of transport and thus customs authorities are not always active in implementing these agreements. Most importantly as these agreements often require reforms and adjustment of domestic legislations, many of them were signed and but never been fully ratified and/or implemented.

Bilateral Transport Agreements Currently, Asian countries primarily rely on bilateral agreements for international road transport. However, there is no unified database for the bilateral transport agreements in Asia and the Pacific. According to UNESCAP, during 2006--2007 there are more than 30 bilateral transport agreements signed. These often define specific routes rather than focusing on the transport network as a whole and provide designated designations and ports for transport carriers. They focus on issues such as traffic rights, conditions for transport, technical requirements for vehicles, compulsory issuance of vehicles, driving permits, safety and security, temporary importation duties, taxes and transit charges. Some bilateral agreements also bring in trade facilitation measures such as transit custom and other custom controls

The biggest benefit of bilateral transport agreements is that they provide direct access for the landlocked countries to the sea and immediate connectivity with neighboring countries. This explains why a large number of bilateral transport agreements have been signed over the last two decades.

But these agreements also have limitations. Often they are not consistent with international standards. Hence it is difficult to harmonise the bilateral transport agreements. Freight forwarders and transport carriers find it difficult to comply to different transport requirements, especially if they have to bring goods across several countries with different transport agreements. Second, managing a growing number bilateral transport agreements will be a major burden for a developing country. Third, due to restrictions of routes in these agreements, carriers are often permitted to deliver goods only to pre-determined destinations, and as a result economic efficiency is significantly reduced because of empty return of trucks.

Other Legal Instruments There are also other types of legal instruments which are frequently used such as memorandum of understanding, strategic framework, and action plan for transport cooperation. Although these documents do not have strong binding effect as international conventions or bilateral and subregional transport agreements, they serve as important means to implement, monitor and coordinate collective efforts of a group of countries in facilitating regional transport cooperation.

A summary of action points along the key identified corridors to be taken up are in Annex 13.2.

LOWERING THE PHYSICAL BARRIERS

India's connectivity with its neighbours needs to involve all modes of transportation, namely, land (including road and railways), maritime (including inland waterway transport), and air. Cross border multimodal transport has been identified as an efficient way of transporting international cargo. In this system of transportation with one transport document, one tariff rate and a single through-liability are applied.

ROADS

The reclassification of the last few km of all road corridors up to international borders along identified corridors is needed so they are treated as part of National Highways. This will promote upgrades to these often minor roads and thereby improve access to the border posts, as well as reduce transport costs. The development of modern border crossing facilities (on both sides), including immigration, parking and cargo handling facilities, will facilitate the smooth movement of both passengers and freight.

A major impediment to smooth flow of international transport is the existence of conflicting national laws and regulations. The modification of these domestic laws and regulations to the needs of inter-

Table 13.10

Summary of the Key Road Corridors

ROAD	STRETCH	BORDERS	SECTION OF INDIAN ROADS
AH1 and AH2	Asian Highways 1 and 2 through Northeastern states Moreh-Imphal-Kohima-Dimapur-Nagaon-Jorabat-Guwahati-Shillong-Dawki Land link Mekong-India Economic Corridor (MIEC) Kaladan Multimodal Transport Project Thailand Trilateral Highway project India-Myanmar Friendship Road	India-Myanmar (and ASEAN)	Moreh in Manipur/ Tamu in Sagaing (NH 39) including Imphal–Moreh (NH 39)
	Tiddim-Rhi-Falam Road	India-Myanmar (and ASEAN)	Zolkawtar in Mizoram (NH 54)/ Rihkhawdar (Chin)
		Bangladesh-India-Myanmar	Avakhung in Nagaland/ Layshi in Sagaing
SHC 1	Lahore–New Delhi–Kolkata–Petrapole/ Benapole–Dhaka–Akhaura/ Agartala	Pakistan, India, and Bangladesh	Wagah/ Attari in Punjab (NH 1) Petrapole/ Benapole in West Bengal (NH 35) Akaura/ Agartala in Tripura (SH connection NH 44)
SHC 2	Kathmandu–Birgunj/ Raxaul–Kolkata/Haldia	Nepal and India	Birgunj/ Raxaul in Bihar (NH 28A)
SHC 3	Thimphu–Phuentsholing–Jaigon–Kolkata/ Haldia	Bhutan and India	Phuentsholing/ Jaigon in West Bengal (state highways near NH 31 C and D)
SHC 4	Kathmandu–Kakarvitta–Panitanki–Phulbari–Banglabandha–Mongla/ Chittagong	Nepal, India, and Bangladesh	Kakarvitta/ Panitanki in West Bengal Phulbari/ Banglabandha in West Bengal (state highways near NH 31 C and D)
SHC 5	Samdrup Jongkhar–Guwahati–Shillong–Sylhet–Dhaka–Kolkata	Bhutan, India and Bangladesh	Dadgiri in Assam/ Gelephu Dawki in Assam (NH 40, 44)/ Tamabil
SHC 6	Agartala–Akhaura–Chittagong	India and Bangladesh	Agartala in Tripura/ Akahura
SHC 7	Kathmandu–Nepalganj–New Delhi–Lahore–Karachi	Nepal, India and Pakistan	Wagah/ Attari in Punjab
SHC 8	Thimphu–Phuentsholing–Jaigaon–Burimari–Mongla/ Chittagong	Bhutan, India and Bangladesh	Phuentsholing/ Jaigon in West Bengal Chagrabandha in West Bengal / Burimari (state highways near NH 31 C and D)
SHC 9	Maldha–Shibganj–Jamuna Bridge (Bangladesh)	India and Bangladesh	Malda in West Benal / Shibganj
SHC10	Kathmandu–Bhairahawa–Sunauli–Lucknow	Nepal and India	Bhairawa–Sunauli in Uttar Pradesh

Source: http://www.unescap.org/ttdw/common/Meetings/TFS/2011Regional-Road-Tx/Countries/India.pdf.

Table 13.11
Priority Rail Corridors

ROAD	STRETCH	BORDERS
SRC 1	Lahore (Pakistan)-Delhi/ Kolkata (India)–Dhaka (Bangladesh)–Mahishasan–Imphal (India)	Pakistan, India and Bangladesh
SRC 2	Karachi (Pakistan)–Hyderabad–Khokrapar–Munabao–Barmer–Jodhpur (India).	Pakistan and India
SRC 3	Birgunj (Nepal)–Raxaul–Haldia/ Kolkata (India)	Nepal and India
SRC 4	Birgunj (Nepal)–Raxaul-Katihar (India)–Rohanpur–Chittagong (Bangladesh) with links to Jogbani (Nepal) and Agartala (India)	Nepal, India and Bangladesh
SRC 5	Colombo (Sri Lanka)–Chennai (India)	Sri Lanka and India

national traffic is a challenging task, particularly since international traffic in general constitutes a small proportion of the total traffic within a country. A greater understanding of the domestic regulatory regimes affecting international transport is essential to create a harmonised regulatory regime at the regional level. Formalisation of AH and TAR Agreements can set the stage for more collaborative efforts in bringing greater uniformity in national transport laws, regulations and practices. Internationally agreed technical standards have a strong symbolic value, and can potentially exert a strong influence on national transport planning, particularly when these standards are an integral part of formal, legally binding international agreements. A coordinated effort in the medium term to develop agreements along important identified corridors is required as a next step. For roads, the development and adoption of bilateral transport agreements between Bangladesh and India, as well as India and Pakistan, will enable through transport to travel directly between the countries, thus eliminating the costly and time-consuming process of transshipment at the borders on all of the SAARC road corridors.

RAILWAYS

A standardisation of technologies, including track, signaling and rolling stock, in order to introduce commodity specific freight wagons capable of hauling longer and heavier axle load freight trains will eliminate avoidable marshaling, lower speeds and longer transit times is required. The development of additional container terminals connecting major commercial centers and ports along the corridors will enable movement of containerized cargo via the shorter routes in the region compared to the much longer road/rail/sea routes at present and thereby bringing down the unit transport costs. Stress should also be laid on development of the railway network of India with Bangladesh and Nepal. Coordination of the standardisation/ rationalisation of the gauge conversion programs of Indian and Bangladesh Railways will achieve seamless operations of intra-regional freight and passenger trains without the need for transshipment due to gauge differences. The uniformity of prevailing systems and procedures at interchange points, simplification of documentation, elimination of double customs checks, introduction of IT enabled data transfer facilities and introduction of round-the-clock working for trade facilitation will enhance the performance of the international rail freight services throughout the SAARC region.

IWT

A joint assessment needs to be undertaken by Bangladesh and India of the future role that inland waterways can play in regional connectivity and whether this would justify investment in dredging and vessels replacement. To make inter-country traffic movement by IWT attractive, more ports of call in Bangladesh should be allowed under the bilateral agreement. Further, installation and maintaining navigational aids to provide 24 hour travel to enhance transit times and attract new traffic; and upgrading jetties and replace old cargo handling equipment and craft needs to be undertaken.

MARITIME GATEWAYS

Improvement of port and trade facilitation measures though simplification of procedures and introduction more EDI/IT to reduce dwell times at all ports has to be surveyed and undertaken.

AVIATION

For enhanced aviation connectivity, bilateral agreements with emphasis on direct capital-to-capital air connections; and development of low cost carrier

Before entering into any regional transport agreement, countries in South Asia have to consider the required reform and adjustment of domestic legislations that are enforced by the signed regional agreements. This domestic legal process can be very lengthy.

operations to actually reduce the cost of air transport for those unable to afford the benefits of schedules services will encourage regional traffic.

NORTH EAST INDIA

The development strategies for Myanmar and Northeast India can be the core of the regional strategy to enhance ASEAN-India connectivity.

EFFICIENT LOGISTICS SYSTEMS

Among others, an efficient logistic system includes a network of inland container depot (ICDs) and container freight stations (CFSs). First, the development of ICDs is of critical for India. ICDs / CFSs are interfaces between connecting different modes of cross border transports and offer a total package of activities to handle export and import containers and general cargo flows between road, rail, and waterways in a cost effective manner with logistic services such as storage, grading, sorting, packaging, repair, and clearing activities, including custom clearance

Benefits of connectivity are limited if India does not have a functional ICD network. This is largely because a major amount of India's exports is generated in the northern states which are located far away from sea port gateways. Second, these ICDs and CFSs have to be connected by rail and road networks to the sea ports to enable smooth and seamless movement of containers. India's Container Corporation (CONCOR) has developed a number of ICDs and CFSs, which are connected with the broad rail network. However, there is still a need for development and strengthening of more ICDs, and CFSs, especially in the Northeast region to connect with ASEAN.

Second, freight forwarders and shipping lines play important roles as multimodal transport operators. Indian shipping companies are however relatively small both in terms of vessels and in terms of cargo transported with the sole exception of the state owned. Despite support from India's government, Indian shipping companies carry less than 10 per cent of total Indian container trade. (Indian Port Association).

DEVELOPMENT OF INDUSTRIAL CLUSTERS

ASEAN economies show a high level of integration with the global supply chain, and this has significantly driven the development of physical connectivity, particularly maritime trade with East Asian countries. For ASEAN India connectivity becomes more commercially and economically viable, it is important to development industrial clusters / production networks along the main road, rail, maritime, and inland water ways of ASEAN and India. For example Bangkok--Chennai can develop industrial agglomerations to lead the regional economy by providing large markets of final and intermediate goods and raw materials. Other potential regional production networks such as Chiang Mai-Kolkata-Dhaka-Kunming; Yangon-Mandalay; and Dawei-Kyaukphyu-Guwahati can be developed.

SUB-REGIONAL APPROACH

A three-level approach is proposed, where, at the national level, it is led by individual countries; at the bilateral/ sub-regional level, by two or more countries, and regionally by the entire group of countries. In the longer run, smooth flows between countries will come with development and adoption of regional transport and transit agreements to allow through movement of vehicles, goods and passengers across the region on a door-to-door basis; widening the existing visa exemption schemes to promote regional travel by citizens; undertaking a study to identify gateways that have potential to become regional aviation hubs and finally move towards a regional aviation agreement for open skies for passengers and freight transport to promote more air services.

LOWERING NON-PHYSICAL BARRIERS

Institutional connectivity refers to linking various international or regional agreements and protocols to facilitate international transactions of goods and services as well as the movement of natural persons across borders. Most of the costs and delays along India's main economic corridors with South Asia and ASAEN are due to complex trade documents and procedures. Complicated documents and procedures in custom clearance, quarantine certification, import and export licenses, transshipment, physical inspection, terminal handling, and transit causes trade delays and increase costs. Trade and transport facilitation measures therefore play crucial role for cost and time reduction for trade.

POLITICAL COMMITMENT FOR REFORM AND ADJUSTMENT OF DOMESTIC LEGISLATIONS

Before entering into any regional transport agreement, countries in South Asia have to consider the required reform and adjustment of domestic legislations that are enforced by the signed regional agreements. The lessons from ASEAN and CAREC have clearly demonstrated that the negotiation and the domestic legal process to bring a regional transport agreement into force can be very lengthy. This can be counterproductive as it may trigger a retreat to bilateral agreements if countries are frus-

Box 13. 5
A Comprehensive Approach: The European Union

I. CHALLENGES TO EU TRANSPORT

- **Unequal growth** in the different modes of transport. While this reflects the fact that some modes have adapted better to the needs of a modern economy, it is also a sign that not all external costs have been included in the price of transport and certain social and safety regulations have not been respected, notably in road transport. Consequently, road now makes up 44 per cent of the goods transport market compared with 41 per cent for short sea shipping, 8 per cent for rail and 4 per cent for inland waterways. The predominance of road is even more marked in passenger transport, road accounting for 79 per cent of the market, while air with 5 per cent is about to overtake railways, which have reached a ceiling of 6 per cent;

- **Congestion** on the main road and rail routes, in towns, and at airports; if most of the congestion affects urban areas, the trans-European transport network itself suffers increasingly from chronic congestion: some 7 500 km, i.e. 10 per cent of the road network, is affected daily by traffic jams. And 16 000 km of railways, 20 per cent of the network, are classed as bottlenecks. Sixteen of the Union's main airports recorded delays of more than a quarter of an hour on more than 30 per cent of their flights. Altogether these delays result in consumption of an extra 1.9 billion litres of fuel, which is some 6 per cent of annual consumption.

- **Increasing labour mobility** due to economic growth was also putting heavy load on the EU transport network. As far as goods transport is concerned, growth is due to a large extent to changes in the European economy and its system of production. In the last thirty years, EU moved from a 'stock' economy to a 'flow' economy. This phenomenon has been emphasised by the relocation of some industries-particularly for goods with a high labor input-which are trying to reduce production costs, even though the production site is hundreds or even thousands of kilometres away from the final assembly plant or away from users. The abolition of frontiers within the Community has resulted in the establishment of a 'just-in-time' or 'revolving stock' production system which required a more seamless EU transport network than ever before.

- **Mobilising capital** remains a key challenge EU transport development, apart from technical or environmental considerations. Traditionally, transport infrastructure has been built on the basis of public funding, whether regional, national or Community. Most of the road or rail projects currently underway follow this pattern. However, due to limited public funding, a number of EU transport projects were delayed. For example, the funds needed to develop the trans-European transport network exceed 110 billion euros for the major priority projects alone, which meant that some projects had to be delayed.

II. EU TRANSPORT POLICY TO ADDRESS THE CHALLENGES

- **Shifting The Balance between Modes of Transport** There was a growing imbalance between modes of transport in EU. The increasing success of road and air transport is resulting in ever worsening congestion as explained above, while, paradoxically, failure to exploit the full potential of rail and short sea shipping is impeding the development of real alternatives to road haulage. To solve this problem, the EU adopted five priority policies need to be attained, which include: (i) Revitalising the railways; (ii) improving quality of road sector; (iii) controlling growth in air transport; (iv) developing maritime and inland waterway transport system; and (iv) liking up the modes of transport.

- **Eliminating Bottlenecks** The EU revised the trans-European network guidelines to eliminate bottlenecks by encouraging corridors with priority to freight, a rapid passenger network rail and traffic management plans for major roads with flagship transport projects such as a high capacity railway route through the Pyrenees for freight, East European high-speed train/combined transport Paris-Stuttgart-Vienna, Fehmarn bridge/tunnel between Germany and Denmark, and the Galileo satellite navigation project.

- **Innovative Approach for Infrastructure Financing** The EU launched a consultation process in 1995-1997 aimed at encouraging the development of public/private partnerships. Some major projects-the Øresund bridge/tunnel for example—have been funded by this partnership mechanism. The guarantees are such that almost the entire risk is borne by the State. One important lesson for any innovative approach for infrastructure financing is that new infrastructure projects should benefit from an 'income' even before the first operating revenue is generated. The income from charges on competing routes-once these have been amortised-could provide a reserve of surplus financial resources. Some of this income could therefore be used to make up the shortfall in funds needed to complete other infrastructure projects, particularly rail, in the region in question. In other words, the toll or charge is applied to the area as a whole to finance any future infrastructure. The EU can no longer expect, as with the Channel Tunnel, to repay investment by charging users once the infrastructure has been opened to traffic. When this approach were applied to the Alpine crossings, the Alpine motorways and tunnels contributed to the funding of construction work on new crossings before they opened. Switzerland has adopted the radical solution of funding this type of major work almost entirely through charges on heavy goods vehicles, starting with EU lorries.

- **A Comprehensive Approach Beyond European Transport Policy** Transport policy cannot stand isolated and has to be integrated with a broad range of other policies. The EU adopted an integrated approach beyond transport policy to ensure a sustainable transport development. These include, among others, (i) economic policy to be formulated to take account of certain factors which contribute to increasing demand for transport services, particularly factors connected with the just-in time production model and stock rotation; (ii) urban and land-use planning policy to avoid unnecessary increases in the need for mobility caused by unbalanced planning of the distances between home and work; (iii) social and education policy, with better organisation of working patterns and school hours to avoid overcrowding roads, particularly by traffic departing and returning at weekends, when the greatest number of road accidents occur; (iii) urban transport policy in major conurbations, to strike a balance between modernisation of public services and more rational use of the car, since compliance with international commitments to curb CO_2 emissions will be decided in the cities and on the roads; (iv) budget and fiscal policy to achieve full internalisation of external-in particular environmental-costs and completion of a trans-European network worthy of the name; (v) competition policy to ensure that opening-up of the transport market, especially in the rail sector, is not held back by dominant companies already operating on the market and does not translate into poorer quality public services; (vi) transport research policy to make the various efforts made at Community, national and private level more consistent, along the lines of the European research area.

trated with the regional process. The SAFTA is a good example. Exhausted by the sluggish process of the SAFTA, South Asian countries have entered into various bilateral trade agreements.

WELL-DEFINED RELATION BETWEEN TRANSPORT AND TRADE FACILITATION

It is important to define the scope of a transport agreement if it should also cover trade facilitation measures or it will only be confined to transport facilitation. The CBTAs of GMS and CAREC have built-in trade facilitation measures such as transit custom, temporary admission regime for containers, custom insurance, transshipment, joint sections, and quarantine. The advantage of this is that the CBTAs are comprehensive. However, problems arise at the implementation level due to a lack of a national body that can bring together national transport, custom, and quarantine authorities. Because of this, custom cooperation in the GMS is moving slowly. Therefore, it is crucial to define at the design stage of any bilateral or regional transport agreement how trade facilitation measures will be covered; and if trade facilitation measures have to be addressed, these should be directly related to supporting transport facilitation rather than applying across-the-board trade facilitation measures.

CONSISTENCY WITH INTERNATIONAL CONVENTIONS

Regardless of what form that a legal instrument for transport cooperation may take in South Asia, it is important to ensure the consistency of the legal

Box 13. 6
The ASEAN Experience

ASEAN endorsed the Master Plan on ASEAN Connectivity (MPAC) at the 17th ASEAN Summit held on 28 October 2010 in Ha Noi, Viet Nam. In 2010, ASEAN endorsed a Work Plan of the Transit Transport Coordinating Board (TTCB) for implementation of the ASEAN Framework Agreement on the Facilitation of Goods in Transit (AFAFGIT), ASEAN Framework Agreement on Multimodal Transport (AFAMT), and ASEAN Framework Agreement on the Facilitation of Inter-State Transport (AFAFIST). In completing all Protocols to support the implementation of the ASEAN transport facilitation agreements, ASEAN encouraged the ASEAN Customs Directors-General to conclude the Protocol 2 (Designation of Frontier Posts) and Protocol 7 (Customs Transit System) of the AFAFGIT as soon as possible. ASEAN restarted the discussion on the draft Protocol 6-Railway borders and interchange stations under AFAFGIT for eventual signing. A stock-taking of road inventory of all national route sections/components of the ASEAN Highway Network (AHN) was completed and the upgrading of the ASEAN Transit Transport Routes (TTR) below Class III as a high priority of implementation was prioritised. In upgrading AHN, ASEAN agreed to install common road signs in all designated routes, with a specific priority on the TTR. ASEAN is now preparing ASEAN Regional Road Safety Strategy Plan 2011-2020 covering the strategic framework for cooperation among ASEAN Member States in this area and its policy guidelines. The Strategy Plan will be aligned with the UN Resolution on the Decade of Action on Road Safety and the Moscow Declaration of the first Global Ministerial Conference on Road Safety, Enhancing transport connectivity with Dialogue Partners. A summary of the ASEAN agreements is in Annex 13.1.

ASEAN Open Skies To facilitate and enhance air services as well as complement the transport facilitation and liberalisation efforts in ASEAN, the Ministers signed the ASEAN Multilateral Agreement in 2010 on the Full Liberalisation of Passenger Air Services (MAFLPAS) and its two Protocols, which would further expand the scope of the ASEAN Multilateral Agreement on Air Services (MAAS) to include other ASEAN cities. This Agreement and its Protocols would allow designated airlines of a Member State to provide air services from any city with international airport in its territory to any city with international airport in the territory of the other Member States and vice-versa with full third, fourth, and fifth freedom traffic rights. ASEAN signed Multilateral Agreement on the Full Liberalisation of Air Freight Services, which aims to ensure an efficient and competitive international air freight service in a move to promote economic growth; the ASEAN Multilateral Agreement on Air Services which will lead to the gradual removal of restrictions for greater flexibility and capacity in air freight services in the region; and the ASEAN Framework Agreement on the Facilitation of Inter-State Transport, which will pave the way for the implementation of integrated air transport services.

ASEAN Maritime Integration The Roadmap Towards an Integrated and Competitive Maritime Transport in ASEAN (RICMT) aims to further the goals enunciated in the Vientiane Action Programme (VAP) 2004-2010 and ASEAN Transport Action Plan (ATAP) 2005-2010, and the ASEAN Leaders' call to institute new mechanisms and measures to strengthen the implementation of its existing economic initiatives.

ASEAN Trade Facilitation ASEAN Single Window (ASW) is another trade facilitating platform, which is designed to expedite customs clearance and release of shipments coming to and departing from ASEAN. The Roadmap for Integration of Logistics Services (RILS) was endorsed in August 2008 to strengthen ASEAN as a single market and production base, and enhance its competitiveness through trade and transport facilitation. Under the liberalisation of logistics services which is an important element in achieving connectivity, the RILS calls for liberalisation of cargo handling services, storage and warehousing services, freight transport agency services, courier services, packaging services, custom clearance services, international freight transportation excluding cabotage, international rail freight transport services, and international road freight transport services, as stipulated in the RILS.

The Institutional mechanisms to work at and later endorse each of the agreements included holding: (i) ASEAN Transport Ministers Meeting annually; (ii) ASEAN Transport Working Group meetings, i.e., Secretary-level meeting that reports to the Transport Ministers; and (iii) ASEAN Sub-Committees, one for Land Transport, one for Maritime and one for Civil Aviation at Joint Secretary level, meeting every year reporting to the second rung.

Box 13. 7

Institutional Arrangements in the Trans-European Networks

Due to the early identification of needs for transport facilitation in Europe, the United Nations Economic Commission for Europe (UNECE) became a focal point for regulatory and technical intergovernmental development in the transport facilitation for inland transport modes. In particular, UNECE has developed and administers many international legal instruments in this area, including the TIR Convention (1975) and Harmonisation Convention (1982) and many of them have become truly global. The Inland Transport Committee (ITC) is the highest policy-making body of the UNECE in the field of transport. In the course of the last 60 years, together with its subsidiary bodies, the ITC has provided a pan-European intergovernmental forum, where UNECE member countries come together to forge tools for economic cooperation and negotiate and adopt international legal instruments on inland transport. These legal instruments are considered indispensable for developing efficient, harmonised and integrated, safe and sustainable pan-European transport systems.

The Trans-European Networks (TEN) were created by the European Union by Articles 154-156 of the Treaty of Rome (1957), with the stated goals of the creation of an internal market and the reinforcement of economic and social cohesion. The Treaty establishing the European Union provides a sound legal basis for the TENs. According to these objectives, the European Commission developed guidelines covering the objectives, priorities, identification of projects of common interest and broad lines of measures for the three sectors concerned (Transports, Energy and Telecommunications). The European Parliament and the Council approved these guidelines after consultation with the Economic and Social Committee and the Committee of the Regions.

The Trans-European Transport Networks (TEN-T) are a planned set of road, rail, air and water transport networks in Europe. In the case of transport, decisions covering combined transport, road and inland waterways were adopted on 29 October 1993. The original aim of TEN-T was to establish a series of interconnected and interoperable European transport networks that would remove bottlenecks and fill in missing links. The scope of the TEN-T network is defined in terms of the individual transport modes. TEN-T guidelines were initially adopted on 23 July 1996.

The Trans-European Transport Network Executive Agency (TEN-T EA) was established by the European Commission for managing the technical and financial implementation of the Trans-European Transport Network (TEN-T) program. Its mission is to support the European Commission and TEN-T project managers and promoters, by ensuring the technical and financial management of the projects and the successful implementation of the TEN-T Programme.

The TEN-T timeline

1990: Commission adopts first action plan on trans-European networks (transport, energy and telecommunications)
1993: TENs given legal base in Maastricht Treaty.
1994: Essen European Council endorses list of 14 TEN-T ‘specific’ projects, drawn up by a group chaired by then Commission Vice-President Henning Christophersen.
1995: Financial regulation for TEN-T support adopted.
1996: Adoption of TEN-T guidelines.
2001: Extension of TEN-T guidelines to port infrastructure(seaports, inland ports and intermodal terminals) adopted.
2003: A group chaired by former Commission Vice-President Karel Van Miert proposes new priority projects and calls for new means of funding.
2004: Revised guidelines and financial regulation adopted, with a list of 30 priority projects (including the original 14) and a higher maximum funding rate of 20 per cent in certain cases.
2005: Nomination of the first six European coordinators
2005: A group chaired by former Commission Vice-President Loyola de Palacio due to propose axes linking TEN-T to neighbouring countries outside the EU.

TEN-T EA
The TEN-T Executive Agency is a relatively new member in the EU family of institutions and agencies:

December 2002: Executive agencies are officially born; the legal basis for executive agencies entrusted with certain tasks in the management of European Community programmes is formalised in Council Regulation (EC) No 58/2003
October 2006: The Trans-European Transport Network Executive Agency (TEN-T EA) is established for the management of Community Action in the field of TEN-T. Its mandate covers projects which have been financed from the 2000-2006 Financial Perspective and its lifetime till 31 December 2008
July 2007: The TEN-T EA Director is nominated by the Commission
August 2007: The TEN-T EA Steering Committee is nominated by the Commission
November 2007: The Commission approves the delegation of powers to TEN-T EA to efficiently and effectively implement the TEN-T Programme within the boundaries of its mandate
April 2008: TEN-T EA becomes financially, legally and operationally autonomous
July 2008: TEN-T EA's mandate is extended until 31 December 2015 and its objectives and tasks redefined to take responsibility for the TEN-T budget linked to the 2007-2013 Financial Perspective
October 2008: The Commission modifies and extends the act of delegation to TEN-T EA to take account of its new tasks
January 2009: TEN-T EA becomes fully responsible for the management of all open TEN-T projects from both the 2000-2006 and 2007-2013 Financial Perspectives
March 2009: TEN-T EA website officially launched
November 2010: TEN-T EA moves into its permanent headquarters at Chaussée de Wavre 910 (W910) in Brussels

instrument with the standards set forth in international conventions.It is particularly important for bilateral agreements to be consistent with international standards as it can facilitate a greater harmonization of bilateral transport agreements. The Annex 13.1 to this chapter details the various multilateral transport-related agreements and initiatives that ASEAN members have agreed on over the years.

THE ROUTE

India has played a central role in regional cooperation and integration in South Asia. It is also at the center of all regional trade facilitation and transit issues. In the past, India has strengthened bilateral links with its immediate neighbors through successful FTAs and through a preferential trade agreement with Afghanistan. A fresh impetus was given to the SAFTA process with the India-Pakistan trade talks. However, the current state of surface transport networks in South Asia imposes significant barriers to trade. The problems are accentuated by poor sea connectivity for intra-SAARC trade. In such a scenario, transport facilitation efforts by India would bring vast benefits to regional trade. Removing rigidities, which have existed for decades at the borders, to enable the movement of goods across at lower cost is part of the unfinished South Asia trade facilitation agenda. India has taken a series of trade integration measures since 2007 and it is important to keep up the momentum.

Road transport is the most dominant mode of transport for India's trade with its neighbours. Yet, it continues to be underdeveloped due to poor infrastructure and ineffective protocols. Multiple agencies are involved with no single agency responsible to ensure coordinated functioning. A limited number of road routes are open for trade and a limited number of goods are allowed to be traded. The customs procedures at land ports remain far less efficient than at seaports. Rail movement is constrained by technical problems and the absence of a regional agreement.

Operational efficiency and intermodal connectivity needs to be improved. South Asian countries need to collectively strive to make land ports as efficient as seaports and charge commensurately for the facilities. The modernisation of land ports should be completed within a targeted period of three to five years. Trade through all modes should be opened up so that there are enough options available to traders. Multimodal routes need to be identified and developed and institutional reform undertaken at the borders. Trading goods across borders is also currently severely restricted by the lack of transit agreements that would allow seamless movement of goods across the region. India actively engaged in capacity building with Nepal and Bangladesh to address technical barriers to trade (TBT) and sanitary and phyto-sanitary (SPS) measures. In order to address the issue of non-acceptance of testing and certification, India needs to enter into Equivalence Arrangements and Mutual Recognition Agreements with its trading partners. Further, testing facilities need to be made available at land borders so that consignments do not have to be sent across to other places for testing.

Providing transit to landlocked countries has remained a major concern for the region, although several steps have been initiated to address the issue since 2010. The revised Afghanistan-Pakistan transit treaty will open up new transit corridors that will link Pakistan to the Central Asian countries. If Bhutan, India and Nepal are able to formulate and implement transit arrangements equally effectively, Bhutan and Nepal's dependence on India alone would be greatly reduced and the ground would be laid for a transit arrangement at a regional level. The regional agreement will eventually connect Nepal and Bhutan to Pakistan through India; and Afghanistan to Nepal and Bhutan through Pakistan and India.

The experience of EU and ASEAN will help India in moving forward transport and trade facilitation in the South Asia region and beyond.

Coordinated and focused commitment of countries is needed to resolve the various physical and non-physical barriers in order to put in place a regional multimodal transport system for South Asia and beyond. The investments requirements are nominal to achieve substantial improvements in regional transport connectivity are nominal. Many of the building blocks are in place and India needs to play a leading role in the process of promoting an environment where there blocks can be combined.

The implementation of recommendations made in this chapter will be difficult to achieve in a business-as-usual context. If there is general agreement with the kind of transport investments and agreements that have been proposed as desirable to be achieved over the next couple of decades, it will be necessary for the government to take up this task in a focused manner. The NTDPC therefore recommends that the Government of India initiate this process by forming a dedicated Joint Task Force to Promote International Transport Connectivity within the South Asia Region. Such a Task Force should have technical participation from all the neighboring countries, along with representation from agencies such as UN-ESCAP, ADB and SAARC which have already done extensive work in this area.

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Annex 13.1
ASEAN Agreements

NO.	AGREEMENT	YEAR SIGNED	MAIN FEATURES
1	AFAFGIT	Dec 1998	ASEAN Framework Agreement on the Facilitation of Goods in Transit
2	AFAMT	Nov 2005	ASEAN Framework Agreement on Multimodal Transport
3	AFAFIST	Dec 2009	ASEAN Framework Agreement on the Facilitation of Inter-State Transport To simplify and harmonise transport, trade and customs regulations and requirements for the purpose of facilitation of inter-state transport of goods
4	RIATS	2004	Roadmap for Integration of Air Travel Sector Guides multilateral air services liberalisation in ASEAN by way of a series of milestones, in particular unlimited 3rd, 4th and 5th freedom of traffic rights for air freight among all ASEAN cities, and unlimited 3rd, 4th and 5th freedom of traffic rights for passenger services between all ASEAN capitals, by December 2008 and December 2010 respectively Aims to achieve the ASEAN Leaders' vision of Open Sky in the ASEAN region.
5	RICMT		Roadmap Towards an Integrated and Competitive Maritime Transport in ASEAN A time-bound action plan for concrete actions that ASEAN Member States need to take in order to achieve a more open, efficient, and competitive ASEAN maritime transport system Covers both passengers and freight services. Implementation of the specific measures is subject to conformity with international conventions and/or the relevant national laws and regulations There is a critical element in the Roadmap calling for the implementation of an ASEAN Single Shipping Market. There are a number of issues that need to be addressed prior to the implementation stage
6	MAAS		ASEAN Multilateral Agreement on Air Services
7	MAFLAFS		ASEAN Multilateral Agreement on the Full Liberalisation of Air Freight Services
8	MAFLPAS		ASEAN Multilateral Agreement on the Full Liberalisation of Passenger Air Services
9	ATAP, 2005-2010		ASEAN Transport Action Plan
10	ASW		ASEAN Single Window The National Single Window is a prerequisite of the ASEAN Single Window ASEAN-6 countries are at various stages of implementation of their respective National Single Windows
11	RILS	Aug 2008	The Roadmap for Integration of Logistics Services

Source: ADB staff compilations

Annex 13. 2

Status of the SRMTS Roadmap for Developing Regional Corridors/Gateways as of July 2013

SL NO.	CORRIDORS/ GATEWAYS	BARRIERS AND REASONS FOR ACTION (TAKEN FROM SRMTS 2006 REPORT)	SRMTS 2006 RECOMMENDATIONS	PRESENT STATUS AND FORWARD PLANS
SHC 1	Road Corridor No 1: Lahore – Delhi – Kolkata – Dhaka – Agartala (2,453 kms)	(i) Absence of an agreement for transport movement across Benapole/Petrapole makes the border crossing extremely costly requiring transshipment of goods;	(i) Within a Regional Framework, a bilateral agreement between India and Bangladesh is needed for allowing reciprocal movement of vehicles and goods across the border;	(i) India Bangladesh bilateral Trade Agreement yet to be finalized. (ii) customs standard operating procedures (SOP) implemented at 8 land customs stations including Benapole-Petrapole, Akhaura-Agartala in 2012
		(ii) Border post at Benapole/ Petrapole works for limited hours in a day and does not work over week-ends. This causes delay in cargo clearance and leads to congestion. Again, only 300 trucks are cleared per day while several hundreds continue waiting to deliver goods. Such a working system has adverse impacts on transport costs;	(ii) Provision of 24 hours and 7 days customs service, with built in transparent inspection procedures; and strengthened security measures at the border crossing needed;	(ii) SOP includes rescheduling of working hours of the customs and simplified documentation (ii) A car pass system has been introduced at Petrapole in Jan 2012. (ii) From field study inputs, it is assessed that further improvement is required
		(iii) Slow clearance of goods at border crossing points (Wagha, Petrapole/Benapole, Akhaura/ Agartala) increases transport costs;	(iii) Introduction of EDI/IT system; simplification and harmonization of customs procedures, adoption of similar documentations at all border crossings, standardization of Indian Customs Declaration (CTD) and implementation of Automated Customs Clearance system essential;	Integrated Check Post commissioned at Wagah – Attari in April 2012 and ICPs are being constructed atBenapole-Petrapole and Akhaura-Agartala
		(iv) Acute traffic congestion along Barasat – Petrapole section leads to slow down of vehicles and increases transport costs;	(iv) Infrastructure investment is needed to widen Barasat – Petrapole road to 2-4 lanes, and build by-passes around a number of towns located along Petrapole-Kolkata portion of the corridor;	Delays over land acquisition; process to acquire land has started.
		(v) Poor road condition and narrow road along Brahmanbaria-Akhaura section, increase travel time and costs;	(v) Investment is needed to improve and widen to 2-lanes, the road section Brahmanbaria-Akhaura (Bangladesh);	Poor road condition; widening yet to start.
		(vi) Absence of facilities at Wagha (Pakistan) in terms of warehousing, loading/ unloading, and at Attari border (India), in terms of parking and space for unloading of goods;	(vi) Physical facilities at border crossing on both sides of Wagha, in terms of warehousing, parking and space for loading/unloading to be built;	Wagha and Attari ICP commissioned by Pakistan and India in April 2012. Containerized cargo is to be started to avoid examination. Joint examination and EDI is also under consideration.
		(vii) Roads in Bangladesh portion of the corridor have axle load limit of 8.2 tonnes;	(vii) Strict enforcement of restriction on overloading to be imposed when Bangladesh roads are opened to international traffic;	Administrative monitoring of implementation
SHC 2	Road Corridor No 2: Kathmandu – Birgunj - Kolkata/ Haldia (1,323 kms)	(i) About 180 km road in Bihar (India) is in poor condition, which reduces vehicles speed to 20 km/ hours and increases transport costs;	(i) About 180 km of road section in Bihar (India) to be improved immediately to reduce operating costs of vehicles and travel time;	This corridor still requires improvement, especially Motihari- Sagauli-Ramgarhwa-Raxaul section (50 km), a level crossing close to the check-post and the narrow 2-lane bridge over the River Sirsiya near the border are challenges. There is significant congestion at the border point at Raxaul.

SL NO.	CORRIDORS/ GATEWAYS	BARRIERS AND REASONS FOR ACTION (TAKEN FROM SRMTS 2006 REPORT)	SRMTS 2006 RECOMMENDATIONS	PRESENT STATUS AND FORWARD PLANS
		(ii) Kathmandu - Birgunj section is a long detour road (276 kms) that adversely impacts on transportation costs;	(ii) A 'Fast Track Road' (about 120 km) between Kathmandu and Birgunj should be built to reduce travel distance and transport costs;	Kathmandu Terai Fast Track Road Project is yet to be implemented
		(iii) Over 36 km of length along Pathalaiya-Hetauda road (Nepal), there are a number of single lane bridges, which are hazardous and adversely impact vehicle speeds;	(iii) Narrow bridges to be replaced by 2-lane wide bridges along Pathalaiya-Hetaudo Road (Nepal);	Feasibility study in progress
		(iv) Customs yard at Birgunj is very small, as a result trucks are parked along main roads causing congestion;	(iv) A freight station at Birgunj (Nepal) to be build urgently under Indian Economic Cooperation Programme;	Birgunj ICD has Rail connectivity to Kolkata/Haldia port. Birgunj ICP project is underway but delayed.
		(v) Immigration office at Raxaul lacks in basic facilities and parking space for unloading, causing inconvenience to users;	(v) Infrastructure investment is needed to provide parking and other basic facilities at immigration office at Raxaul (India);	Raxaul ICP is under construction.
		(vi) Slow clearance of goods at Raxaul border crossing increase costs;	(vi) Introduction of EDI/IT system, simplification and harmonization of customs procedures, adoption of similar documentations at all border crossing, standardization of Indian Customs Declaration (CTD) and implementation of Automated Customs Clearance system;	Indian side ICES system is implemented; Nepal side ASYCUDA is to be upgraded.
		(vii) Lack of formal agreement for vehicular movement across Nepal/India border, which may create problems in the future;	(vii) Nepal and India should consider signing a formal agreement under which vehicles could move across the border and within each others' territory;	SAARC Motor Vehicles Agreement is being discussed; shown as a priority item in 17th SAARC Summit declaration
SHC 3	Road Corridor No 3: Thimphu - Phuentsholing / Jaigon – Kolkata / Haldia (1,039 km)	(i) Physical facilities in terms of parking, cranes, and fork lift trucks are insufficient at Phuentsholing (Bhutan) and there is lack of adequate parking at Jaigon (India). These cause inconvenience to road users and increase congestion on roads;	(i) Physical facilities in term of cranes and forklifts at Phuentsholing and parking on both sides of the border need to be provided urgently;	Physical facilities need to be improved Congestion at Phuentsholing due to industrial estate traffic of Pasakha - the route from Bulan will cut short the distance from Pasakha by 9 km and emerge at Manglabari on the Indian side, 6 kilometres from Phuentsholing Gate
		(ii) Slow clearance of goods at border crossing in Bhutan increase transport costs;	(ii) Introduction of EDI/IT system, simplification and harmonization of customs procedures, adoption of similar documentations at all border crossing, standardization of Indian Customs Declaration (CTD) and implementation of Automated Customs Clearance system;	Indian side ICES system is implemented; Bhutan side BCAS is implemented.
		(iii) About 172 km road from Thimphu to Phuentsholing is a single lane, which results in slow down of vehicles and increases transport costs;	(iii) Infrastructure investment for widening 172 km of road from Thimphu to Phuentsholing to 2-lane is needed;	Double laning completed in 2010
SHC 4	Road Corridor No 4: KTM – Kakarvita – Phulbari – Banglabandha - Mongla/ Chittagong (1,362 kms)	(i) Absence of an agreement for cross border movement of vehicles makes the border crossing extremely costly requiring transhipment of goods;	(i) Within a Regional Framework, a bilateral agreement between India and Bangladesh is needed for allowing reciprocal movement of vehicles and goods across the border;	(i) India Bangladesh bilateral Trade Agreeement yet to be finalized.
		(ii) Over 36 kms of length along Pathalaiya – Hetauda roads, there are a number of single lane bridges that are hazardous and adversely impact vehicle speed;	(ii) Narrow bridges to be replaced by 2-lane wide bridges along Pathalaiya-Hetauda Road (Nepal);	(ii) customs standard operating procedures (SOP) implemented at 8 land customs stations which includes Phulbari – Banglabandha Feasibility study in progress

SL NO.	CORRIDORS/ GATEWAYS	BARRIERS AND REASONS FOR ACTION (TAKEN FROM SRMTS 2006 REPORT)	SRMTS 2006 RECOMMENDATIONS	PRESENT STATUS AND FORWARD PLANS
		(iii) No permanent immigration and custom office at Phulbari and at Banglabadha, where telephone and postal facilities are also missing;	(iii) Permanent immigration and Customs offices need to be built at Phulbari (India) and Banglabandh (Bangladesh) together with support facilities;	Improving Phulbari land customs station being explored with ADB assistance Work of private operator developing Banglabandha land port to be expedited
		(iv) 2.5 km road in India, close to Phulbari border point is in poor condition, and could be a bottleneck when traffic increases;	(iv) Infrastructure investment needed to improve 2.5 kms road near Phulbari, when traffic increases;	Improvement being considered with ADB assistance; 1 alternate road section between Phulbari and Medical Road intersection (15 km) being considered
		(v) Roads in Bangladesh portion of the corridor have axle load limit of 8.2 tonnes;	(v) Overloading restriction should be strictly enforced, when Bangladesh roads are opened to international/ regional traffic;	Administrative monitoring of this implementation is required
SHC 5	Road Corridor No 5: Samdrup Jongkhar - Guwahati - Shillong – Sylhet – Dhaka - Kolkata (906 kms)	(i) Absence of an agreement for cross-border movement of vehicles at Dawki/Tamabil makes the border crossing extremely costly requiring transhipment of goods;	(i) Within a Regional Framework, a bilateral agreement between India and Bangladesh is needed for allowing reciprocal movement of vehicles and goods across the border;	(i) load restriction on 80 year old Dawki suspension bridge, coal carrying vehicles permitted up to distance of 3 km from the border after which it moves in smaller vehicles
		(ii) 74 years old bridge at Dawki has a load restriction of 6 tonnes, which adversely impacts transport cost;	(ii) Infrastructure investment is needed to build a new bridge at Dawki (India) to facilitate movement of intra-country traffic;	(ii) New 165-m RRC bridge construction project approved but execution delayed, increased investment required, bidding process is likely to be started afresh
		(iii) Lack of parking space at the Dawki border crossing point, causes inconvenience to users and create congestion on the road;	(iii) Investment is needed to provide parking space at Dawki (India) border post;	(iii) Land acquisition issues have delayed Dawki ICP project, DPR is now approved and detailed engineering is in progress
SHC 6	Road Corridor No 6: Agartalla – Akhaura – Chittagong (227 kms)	(i) Absence of an agreement for cross-border movement of vehicles makes border crossing costly requiring transhipment of goods;	(i) Within a Regional Framework, a bilateral agreement between India and Bangladesh is needed for allowing reciprocal movement of vehicles and goods across Akhaura border;	(i) India Bangladesh bilateral Trade Agreeement yet to be finalized. (ii) customs standard operating procedures (SOP) implemented at 8 land customs stations including Akhaura-Agartala
		(ii) Narrow road along Akhaura - Dharkhar (15 kms) and poor road condition along Dharkhar-Comilla (56 km) both in Bangladesh lead to slow down of vehicles and increase travel time and costs;	(ii) Infrastructure investment is needed for widening and improvement of two road sections, Akhaura-Dharkhar (15 km) and Dharkhar-Comilla (56 km) both in Bangladesh;	Poor road condition and widening to start within next 5 years
		(iii) Lack of proper physical facilities at Akhaura border crossing causes inconvenience to road users;	(iii) Proper physical facilities at border crossing to be established at Akhaura;	Agartala ICP project construction works is in progress
SHC 7	Road Corridor No 7: Kathmandu – Nepalganj – New Delhi – Lahore – Karachi (2,643 kms)	(i) 2-road sections, Nepalganj – Baharaich and Bahraich – Rupaidiha are one-lane and in poor condition. These adversely impact vehicle speed and increase travel time and costs;	(i) Infrastructure investment is needed for widening and improving two road sections namely, Nepalganj - Baharaich and Baharaich - Rupaidiha, both in India;	Baharaich – Rupaidiha road section improvement works to start . Rupaidiha ICP DPR approved. Detailed Engineering in progress.
		(ii) Lack of a formal agreement between Nepal and India for vehicle movement across the border, may create problems in the future;	(ii) It is desirable to get a formal agreement signed between Nepal and India for smooth vehicles movement across the border and within each others territories;	Trucks allowed upto nearest market and have to return on same day

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SHC 8	Road Corridor No 8: Thimphu – Phuentsholing – Jaigon – Burimari - Chittagong (966 kms) or (ii) Mongla (880 kms)	(i) Lack of physical facilities at Phuentsholing and Jaigon, border crossing, in terms of parking, cranes, forklift trucks, etc cause inconvenience to road users and truckers leading to congestion on the road;	(i) Infrastructure investment is needed to provide vehicle parking at Jaigon (India) and both parking and goods handling equipments like cranes, forklift trucks, etc, at Phuentsholing (Bhutan);	Phuentsholing physical facilities need to be improved. ADB is working on a plan. Congestion at Phuentsholing due to Pasakha industrial estate traffic. Alternate route from Bulan will cut short the distance from Pasakha by 9 km and emerge at Manglabari on the Indian side, 6 kilometres from Phuentsholing Gate. Possible to connect this to Jaigaon-Hasimara Road (India) through a road firstly along the river bank and then through a single surfaced lane of approximately 5 km once it leaves the river bank.
		(ii) Lack of warehousing, parking, open yard at Burimari (Bangladesh), causes damage to goods and inconvenience to users;	(ii) Infrastructure investment is needed to provide warehousing, parking and open yard at Burimari (Bangladesh);	Pre-feasibility study of Burimari Land Custom Station completed.
		(iii) Absence of an agreement for cross-border movement of vehicles, necessity for transhipment of goods at the border, which adversely impacts transport costs;	(iii) Within a Regional Framework, a bilateral agreement between India and Bangladesh is needed to facilitate smooth reciprocal movement of transport across Burimari border post;	This would be mainly Bhutan-Bangaldesh trade though India; agreement yet to be completed.
		(iv) About 172 kms road between Thimphu and Phuentsholing is one-lane, which results is slow-down of vehicles and increases transport cost;	(iv) Infrastructure investment needed to widen 172 kms of road between Thimphu - Phuentsholing (Bhutan) to 2-lanes;	Double laning completed in 2010
		(v) Roads in Bangladesh portion of the corridor have axle load limit of 8.2 tonnes;	(v) Strict enforcement of restriction on overloading to be imposed when Bangladesh roads are opened to international traffic;	Administrative monitoring of implementation
SHC 9	Road Corridor No 9: Maldha - Shibganj – Jamuna Bridge (252 kms)	(i) About 13.5 kms road from Maldah-Mehdipur (India) and another 82 kms from Sonamasjid to Rajshahi (B'desh) are narrow and in poor condition which cause slow down of vehicle speed and increase transport costs;	(i) Infrastructure investment is needed to widen to 2-lanes and improve riding condition of two road sections (a) Maldah-Mehdipur (13.5 kms) in India and (b) Sonamasjid-Rajshahi (82 kms) in Bangladesh;	Roads are yet to be widened & condition improved
		(ii) Lack of an agreement for cross-border movement of vehicles between India and B'desh necessities transhipment of goods at border, which adversely impacts transport cost;	(ii) Within a Regional Framework, a bilateral agreement between India and Bangladesh is needed to facilitate smooth reciprocal movement of transport across Sonamasjid border post;	(i) India Bangladesh bilateral Trade Agreeement yet to be finalized. (ii) customs standard operating procedures (SOP) implemented at 8 land customs stations including Sonamasjid-Mohaddipur border crossing in 2012
		(iii) Roads in Bangladesh have axle load limit of 8.2 tonnes;	(iii) Strict enforcement of restriction on overloading to be imposed when Bangladesh roads are opened to international traffic;	Administrative monitoring of implementation

SL NO.	CORRIDORS/ GATEWAYS	BARRIERS AND REASONS FOR ACTION (TAKEN FROM SRMTS 2006 REPORT)	SRMTS 2006 RECOMMENDATIONS	PRESENT STATUS AND FORWARD PLANS
SHC 10	Road Corridor No10: Kathmandu – Bhairahawa – Sunauli - Lucknow (663 kms)	(i) Lack of adequate physical facilities on Indian side at Sunauli border post in terms of parking, space for unloading of goods for checking and lack of baggage scanning and rest rooms at immigration office cause inconvenience to traders and passengers;	(i) Infrastructure investment is needed to provide parking, space for unloading of goods for inspection at Sunauli border post, and also the scanning facility and rest rooms at the immigration office;	ICP at Sunauli planned in Phase 2; DPR approved; proposal under preparation
		(ii) The Indian immigration office at Sunauli is located in a busy market place, which causes traffic congestion and inconvenience to travellers;	(ii) Immigration office at Sunauli (India) to be shifted to a convenient place;	
		(iii) On Nepalese side, lack of banking facility at Sunauli border point compels the traders to take their customs payments to City Bank office at Bhairahawa, causing delays;	(iii) HMGN needs to ensure that a banking facility is established at Sunauli border post;	
SRC 1	Rail Corridor No 1: Lahore – Delhi – Kolkata – Dhaka - Imphal (2,830 kms)	(i) Non-utilization of the available capacity of Indian Railway freight wagons by Pakistan and Bangladesh - trade being largely one sided;	(i) Promotion and development of intra-regional railable traffic to utilize the existing capacity of Indian Railway wagons which are being returned in empty condition from Bangladesh, Nepal and Pakistan resulting in wastage of transport capacity;	
		(ii) Restriction on movement of commodity specific rolling stock including open freight wagons, oil tanks and containers between India and Pakistan and India and Bangladesh;	(ii) Existing bilateral agreements to be suitably modified; (ii) A multilateral agreement permitting movement of commodity specific freight wagons between the SAARC member states is needed in order to meet the requirement of trade and industry be put in place	Regional Railway Services Agreement expected to be concluded soon
		(iii) Sectional capacity constraints for increasing the throughput on the corridor in view of the growth potential;	(iii) Investments are required on priority to augment the sectional capacity in the saturated sections on the corridor, including improvement of the permanent way, signalling, additional lines and by-passes etc; (iii) Identified major capacity augmentation /gauge conversion works to be completed;	Indian Dedicated Freight Corridor project is in progress; expected completion 2017
		(iv) Inadequate capacity of the holding, yard and terminals causing marshalling of rakes and consequent detention to the rolling stock;	(iv) Inadequate capacity of holding lines, loops and terminals for Indian Railway rakes results in marshalling and consequent detentions to the rolling stock. Capacity augmentation is required on an urgent basis on Bangladesh Railway network;	Capacity may be improved
		(v) Axle load restriction on Jamuna bridge prohibiting any through movement of BG freight trains across Jamuna bridge (Bangladesh);	(v) Strengthening of the existing bridge to facilitate movement of through BG freight and container trains or provision of a transhipment hub at Ishurdi, purely as an interim measure; (v) Reconstruction of Jamuna bridge to facilitate movement of broad gauge loaded freight and container trains;	Recent study says fully loaded ISO containers on low platform flat cars of Container Corporation of India can move over Jamuna Bridge, without any load restrictions.

SL NO.	CORRIDORS/ GATEWAYS	BARRIERS AND REASONS FOR ACTION (TAKEN FROM SRMTS 2006 REPORT)	SRMTS 2006 RECOMMENDATIONS	PRESENT STATUS AND FORWARD PLANS
		(vi) Different gauges on the corridor requiring transhipment of goods;	(vi) Dual gauging between Joydebpur – Dhaka to be provided on priority;	Completed; Maitree Express runs directly between Dhaka and Kolkata
		(vii) Kulaura – Shahbazpur rail section is out of commission (Bangladesh);	(vii) The section should be restored and opened for traffic with dual gauge/broad gauge to facilitate intra-regional movement of freight and passenger trains; (vii) Metre gauge sections between Joydebpur – Akhaura – Shahbazpur (Bangladesh) and Mahishasan – Jiribam (India) to be undertaken and completed on priority;	(vii) Detailed Project Plan preparation of rehabilitation of Kulaura- Shahbazpur section of Bangaldesh Railways to start shortly; works to be taken up under line of credit from India (vii) Karimganj – Mahisasanguage conversion has been approved by India in 2011; work to commence (vii) Mahisasan-Shahbazpur MG route has not been operational since December 1996 due to lack of traffic
		viii) Missing rail link between Jiribam – Tupul (Imphal);	(viii) The ongoing work of a new broad gauge line connecting Jiribam with Tupul (Imphal) in India to be completed;	Jiribam-Tupul (98 km), work in progress, expected commissioning March 2014 Jiribam-Imphal (125 km), work started, expected commissioning March 2016
		(ix) Restricted working hours, multiple customs clearances at inter-change points;	ix) Round the clock working hours at Wagha and Gede-Darshana interchange points with simplified single custom checks should be ensured;	This is yet to be achieved.
SRC 2	Rail Corridor No 2: Karachi – Khokhrapar – Munabao – Jodhpur (707 kms)	(i) Restriction on movement of freight trains on this corridor;	(i) This being shorter route for bilateral traffic between central India and Pakistan, (currently opened only for passenger trains), should be opened for freight traffic also;	Restriction in Bilateral Trade Agreement
		(ii) Absence of infrastructure for handling freight traffic at Munabao (India) and Khokhrapar/ Zero Station (Pakistan);	(ii) Development of infrastructure for handling freight traffic including holding lines, yard lines with provisions of customs and rolling stock inspections should be taken up at Munabao and Khokhrapar/Zero Point station;	Can be commissioned in Trade Agreement removes restriction
		(iii) Single line sections and change of gauges	(iii) Gauge conversion work of Bhildi - Samdarimetre gauge line connecting ports of Gujarat from this corridor should be expedited; (iii) Hyderabad – Khokhrapar and Munabao – Jodhpur is a BG, single line section and may require doubling in view of the projected growth of traffic from ports;	Bhildi - Samdari (223 km) metre gauge conversion project completed. Expert Group meeting in July 2012 discussed the possibility of a dedicated rail route between Sindh (PAK) – Rajasthan (IND) through the Khokhrapar – Munabao border crossing point.
		(iv) Absence of bilateral agreement between India and Pakistan for running of freight trains;	(iv) Existing bilateral agreement should be expanded to incorporate movement of freight traffic via this corridor;	Restricted in Bilateral Trade Agreement
SRC 3	Rail Corridor No 3: Birgunj – Raxaul – Kolkata Port/ Haldia port (704/832 kms)	(i) Inadequate sectional capacity in different sections on this corridor affecting movement of traffic;	(i) Birgunj – Barauni section is oversaturated requiring augmentation of the capacity to handle the projected growth of traffic;	Congestion exists in this section
		(ii) Excessive transit time between Birgunj and Kolkata port;	(ii) The current transit time of over 72 hours should be brought down by minimizing en route detentions on account of change of traction and other capacity constraints in single line sections;	No significant reduction in transit time

SL NO.	CORRIDORS/ GATEWAYS	BARRIERS AND REASONS FOR ACTION (TAKEN FROM SRMTS 2006 REPORT)	SRMTS 2006 RECOMMENDATIONS	PRESENT STATUS AND FORWARD PLANS
		(iii) Lack of usage of through Bills of Lading and acceptance of a combined transport document cumbersome procedures and manual documentation at Kolkata port and Birgunj;	(iii) IT enabled customer facilitation services, streamlining of procedures and adoption of appropriate usage of through Bills of Lading should be undertaken on priority;	Documentation procedures can be considered for simplification.
SRC 4	Rail Corridor No 4: Birgunj – Katihar – Singhabad – Rohanpur – Chittagong with links to Jogbani (Nepal) and Agartala (India) (1,146 kms)	(i) Capacity constraints due to single line sections and poor condition of track and signalling;	(i) The corridor is largely on single line broad gauge/ metre gauge network with severe capacity constraints in Mansi – Katihar (India), Tungi - Akhaura (Bangladesh) and poor condition of track between Rohanpur – Rajshahi and Azimnagar – Ishurdi (Bangladesh). Immediate steps are required towards augmenting the sectional capacity which adversely affects the freight traffic on this corridor;	Track doubling work between Barauni – Mansi – Katihar (India) is expected to be completed soon. Work to remove constraints on Bangladesh side yet to pick up momentum.
		(ii) Inadequate infrastructure including loops holding lines causing avoidable marshalling and detention to the rolling stock;	(ii) Inadequate holding capacity of lines in Rohanpur yard (Bangladesh) necessitates load shedding and detention of wagons at Singhabad (India). Holding capacity of lines should be increased as a priority	Work to remove constraints on Bangladesh side yet to pick up momentum.
		(iii) Axle load restriction on Jamuna bridge prohibiting movement of loaded BG freight trains;	(iii) Strengthening of Jamuna Bridge to facilitate movement of broad gauge freight trains with higher axle loads; (iii) Reconstruction of Jamuna Bridge;	Recent study says fully loaded ISO containers on low platform flat cars of Container Corporation of India can move over Jamuna Bridge, without any load restrictions.
		(iv) Metre gauge sections - Joydebpur – Chittagong (Bangladesh) and Katihar – Jogbani (India);	(iv) Dual gauging of Joydebpur – Dhaka to be completed on priority. Ongoing gauge conversion work on Katihar – Jogbani section be expedited; (iv) Dual gauging of Joydebpur – Chittagong section or provision of broad gauge alongside metre gauge should be undertaken to enable running of trains without transhipment on this corridor;	(iv) Joydebpur – Dhaka (Bangladesh) dual guage completed; Katihar – Jogbani (India) broad guage completed (iv) Works for dual gauging of Joydebpur – Chittagong section or provision of broad gauge alongside metre gauge is to be undertaken to enable running of trains without transhipment.
		v) Missing link between Akhaura and Agartala;	(v) India and Bangladesh to undertake survey/feasibility study for construction of this short missing link connecting Akhaura with Agartala; (v) Provision of broad gauge line connecting Akhaura with Agartala to facilitate through movement of intra-regional traffic;	Final survey completed in 2012 and DPR is under preparation.
		(vi) Capacity constraints at Chittagong port;	(vi) Dredging, remodelling of railway yard and adequate supply of freight wagons should be ensured;	Work yet to be completed. Track and bridges between Dhaka ICD and Chittgong Port to be strengthened and wagon availabity increased.
		(vii) Missing link between Jogbani(India) and Biratnagar (Nepal);	(vii) Jogbani – Biratnagar BG link be constructed to operationalise the corridor link from Katihar;	DPR has been completed for Jogbani– Biratnagar 18 km BG link.
		(viii) Restriction on movement of air-braked rolling stock and commodity specific freight wagons;	(viii) Bilateral agreement should be expanded to permit movement of commodity specific open, air-braked and oil tanks wagons between India and Bangladesh;	This is yet to be done.

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		(ix) Restrictive bilateral rail transport agreement and absence of a multilateral transport agreement for third country and transit traffic;	(ix) To operationalise through movement of freight and passenger trains on this corridor with third country, transit and bilateral traffic, a multilateral transport agreement between the concerned SAARC member states needs to be put in place;	Regional Rail Service Agreement is being discussed for finalization
SRC 5	Rail Corridor No 5: Colombo – Talaimannar – Rameshwaram – Chennai (1,025 kms)	(i) Medawachchiya – Talaimannar pier railway line is currently non operational;	(i) Restoration of Medawachchiya to Talaimannar pier is required to provide connectivity between Colombo and Talaimannar pier;	Track will be constructed in two phases from Medawachchiya to Madhu and Madhu to Talaimannar Pier including pier construction. Contract has been awarded.
		(ii) Ferry link between Talaimannar and Rameshwaram is suspended for last more than 15 years;	(ii) Restoration of ferry link for transhipment of goods and passengers across the channel should be expedited;	Ferry link to be discussed between India – Sri Lanka; feasibility study being done by India for resumption of services.
		(iii) Metre gauge sections on Indian railways involving transhipment;	(iii) Rameshwaram – Madurai gauge conversion work should be completed on priority to enable through broad gauge connectivity on the corridor;	Rameshwaram – Madurai gauge conversion completed.
		(iv) Capacity constraints on Madurai – Dindigul section on Indian Railways;	(iv) Madurai – Dindigul section should be taken up for doubling to minimize the capacity constraints;	Madurai-Dindigul section has been doubled.
		v) Poor condition of permanent way and signalling in Medawachchiya – Polgahawela sections;	(v) Upgradation of permanent way and signalling should be taken up on priority on this section by Sri Lankan Railways;	Rehabilitation project of Signalling and Telecommunication System in the Northern and Talaimannar Lines of Sri Lanka Railway is in progress
		(vi) Old bilateral agreement;	(vi) Old bilateral agreement for rail-cum-ferry link connecting the island country of Sri Lanka with India should be expanded to include other ferry links and movement of containerized cargo;	Rail-cum-ferry link agreement under consideration between governments of two countries.
SIWC 1	Inland Waterways Corridor No 1: Kolkata – Haldia – Raimongal – Mongla – Kaukhali – Barisal – Hizla – Chandpur – Nerayanganj – Aricha – Sirajganj – Bahadurabad – Chilmari - Pandu (1,439 kms)	(i) Existing protocol between India and Bangladesh is currently being renewed only in amonthly basis;	(i) Existing protocol to be renewed for a longer period, say for a few years;	Protocol has been extended for longer period and is now valid till 2013.
		(ii) Lack of sufficient ports of call in Bangladesh for movement of inter-country trade;	(ii) Allow more ports of call within Bangladesh;	Silghat (India) and Ashuganj (Bangladesh under SIWC 2) included as a port of call.
		(iii) High rate of siltation in both Bangladesh and India;	(iii) Extensive and regular dredging needed to maintain safe navigability of the rivers;	Indian side dredging has improved draft to 3 m. Bangladesh side
		(iv) Navigational hazards like shallow waters, narrow width of channels and inadequate navigational aids;	(iv) Investment would be needed to install more navigational aids;	Improvements can be made; investment requirement based on business case
		(v) The vessels presently plying are old and unable to carry containers;	(v) Inland water transport operators to be encouraged to replace their vessels;	90 per cent of the vessels plying are from Bangladesh; adoption and degree of compliance to vessel building standards differ between Bangladesh and India

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		(vi) Poor condition of piers, jetties and other infrastructures;	(vi) Improvement of the condition of piers, as well as jetties and replacement of the old and obsolete cargo handling gear, support craft and cargo carrying vessels are needed;	New RCC Jetty to be readied at Kolkata in 2013
		(vii) Lack of storage facilities, cargo handling equipment, pilot boats, etc.	(vii) New storage facilities to be built at inland ports and cargo handling facilities to be enhanced	New Transit Shed to be readied at Kolkata in 2013 Transhipment facility for container handling at Ashuganj not in place; inland water-cum-road transport connectivity with the north-eastern Indian States through Ashuganj is not possible
		viii) Shortage of skilled manpower;	(viii) Measures for human resource development to be undertaken;	Skills / vocation education standards and certification requirements differ between Bangladesh and India
SIWC 2	Inland Waterways Corridor No 2: Kolkata – Haldia – Raimongal – Mongla – Kaukhali – Barisal – Hizla – Chandpur – Nerayangang – Bhairabbazar – Anmirigang – Markulo – Sherpur – Fenchunganj – Zakiginj – Karimgang (1318 kms)	Same as above for Corridor No 1;	Same as above for Corridor No 1;	Silghat (India under SIWC 1) and Ashuganj (Bangladesh) included as a port of call.
SMG 1	Maritime Gateway No 1 Karachi (Pakistan)	(i) No room for expansion of existing container terminals after doubling the capacity;	(i) In order to meet the container growth rate, other sites for the container terminals need to be planned; (i) Development of 3rd container terminal at KeamariGroyne to handle 4th generation container vessels, redevelopment of existing berths and increasing the depths alongside and increase the capacities of existing container terminals by raising performance per sqmetre;	Pakistan Deep Water Container Terminal project at KeamariGroyne started from April 2009. It can handle 4th generation container vessels. Dredging, reclaimation, breakwater, sand dykes, basin, quay wall and other key contracts awards. Road and rail links have been worked out. Land planned to be reclaimed for containerized general & bulk cargo, EPZ, customs. Land for cargo village has been identified. Targeted to be commissioned by 2013.
		(ii) Dock labour problems of inefficiency and levies/ charges on each tonnage handled at the port;	(ii) Dock Labour Board needs to be dissolved and unions to be brought under Essential Services net;	KDLB cess still in place; labour productivity is an issue; training needed to handle containerized cargo
		(iii) Draft limitations that restricts size of the vessels;	(iii) High capacity dredgers to be procured to clear the arrears and maintain designed depths. There is a need for capital dredging to increase drafts for accommodating larger vessels. City refuse should be treated before it is discharged into adjacent creeks and back waters. The dredged material should be used for reclaiming land;	KPT has increased capability to accommodate and provide safe berthing to 12.5 m draught container vessels on 2 of its container terminals.
		(iv) Non-responsive attitude of railway for clearing port cargo and slow delivery of goods at the destinations;	(iv) Railway tracks to be strengthened, more wagons to be procured and fast track system for goods trains to be programmed;	1.87 km newly laid rail track to transport bulk coal inaugurated in 2010. More collaborative working required between Karachi Port Trust and Pakistan Railways.

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		(v) Congestion in port area and high dwell time due to lack of coordination and facilitation	v) In order to reduced dwell time and congestion of the port, port and custom clearance procedures to be simplified. Awareness of the customers for use of IT/EDI system is needed. Free storage for containers be reduced and customs should enlarge their CARE system to cover whole range of cargo not only containers;	Free period for cargo clearance reduced from 10 to 5 days, average dwell time is less than 7 days. Customs Administration Reform (CARE) and Pakistan Customs Computerized System (PACCS) have simplified container clearance procedures but Agility software has issues. New WEBOC system yet to stabilize.
		(iv)Access roads are congested which has created bottleneck for the port performance;	(iv) Access roads needs to be widened, strengthened. Construct bypasses and overhead corridors for smooth and fast exit of the port traffic;	Congestion yet to ease out; plans being put in place
SMG 2	Maritime Gateway No 2 Port Bin Qasim (Pakistan	(i) The leading channel and harbour basin are subjected to heavy siltation, especially during monsoon season. Accumulation of siltation compels the authority to reduce draft during monsoon period and carry on dredging rest of the period annually. The Port does not have its own dredging fleet; therefore, dredging is contracted out. The cost of dredging also very high, therefore, committed depths are difficult to maintain during non-monsoon period;	(i) The port should develop its own fleet to maintain committed depth and get away from annual decrease and increase of drafts. The trade feels that port must increase the draft so that large bulk carriers could be accommodated from economic operations perspective;	Port is spending around Rs 3.0 billion annually to clean its channel from 5 million cubic meters silt in order to maintain its 11 meter draught. The project to deepen navigation channel for all weather 14 meter draught vessels at a cost of US$ 200 million on Design, Construct and Finance basis has been approved by Government and is under implementation.
		(ii) There is restriction on night navigation through the channel. Vessels waiting time is increased;	(ii) The channel should be properly marked. Instead of buoys, fixed beacons may be installed to prevent thefts and drafting. Night navigation must be started to save waiting time;	Night berthing has started in November 2011 with a vessel of length of 292 meters and draft of 11.7 meters made possible by the induction of three ASD tugs and one fast pilot boat.
		(iii) Dwell time are high. Clearing system still tedious and time consuming;	(iii) EDI/IT system are needed to be installed and customs CARE system to be introduced for reducing dwell time. Container free storage period to be reduced;	PACCS system has issues. New WEBOC system at QICT is stabilizing. Dwell time can be reduced.
		(iv) Shortage of railway wagons. Traders suffer and storage time is increased;	(iv) Railway wagons to be increased for carriage of container and specialized cargo up country. The railway tracks to be replaced and strengthened to increase speed;	More collaborative working required between PQA and Pakistan Railways. Pakistan Int'l Bulk Terminal (PIBT) will be connected to the railway network at Port Qasim.
		(v) Port needs further expansion as the estimated growth rate is higher in Pakistan;	v) New berths and terminals to be added to increase the capacity of the port to meet the anticipated growth;	(v) Construction of LPG, crude oil and products terminal, development of rice and other bulk cargo berths and later on development of more container terminals and a dedicated fertilizer berth;

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SMG 3	Maritime Gateway No 3 JNPT (India)	(i) The port is working at its designed capacity, whereas anticipated growth of containers by the year 2014 is 5.5 million TEUs. Port is also expected with existing space;	(i) There is need for enhancement of port capacity by developing new terminals to alleviate current problem and meet the future developments; (i) Area behind the service berth to be developed, reclamation of land for port expansion acquisition of super post Panamax RMQC and development of a tank farm;	Extension of berth by 330 mtrstowards North by DBFOT basis; 4th Container Terminal work progressing in 2 sequential phases: Phase I capacity 2.4 million TEUs, 12 RMQCs, 36 RTGCs, 4 RMGCs, 120 Tractors cum Trailors; Phase II capacity 2.4 million TEUs, 12 RMQCs, 36 RTGCs, 4 RMGCs, 120 Tractors cum Trailors; Other planned projects: Modernization and capacity addition for JNPT's self operated terminal JNPCT; Development of 5th Mega Container Terminal and other projects like ship repair yard at Nhava island; Port Based SEZ; Development of Marine Terminal for liquid cargo, tripling current capacity; Project for augmenting bulk handling.
		(ii) The road connectivity needs to be improved and there is congestion at Jawahar Customs point, waiting for export clearances;	(ii) Access roads need to be widened and repaired. There is a program underway to improve the connecting road network and this needs to be completed. A review should be undertaken of the export customs procedures to expedite their delivery into the port;	(ii) SPV created with CIDCO and NHAI with NHAI in the lead, 6-8 laning work in progress, construction of grade separators to improve connectivity
		(iii) Railway has capacity problem on Mumbai - Delhi link which slows the speed of container trains;	(iii) Additional train paths need to be provided between Mumbai and Delhi. Existing developments by IR need to be completed urgently;	(iii) Dedicated Freight Corridor (DFCC) project already taken up in 2 phases Delhi – Baroda and Mumbai – Baroda; project expected to be commissioned by 2017; will enable multi-modal high axle load freight movement
		(iv) The port lacks the modern and high performance container handling equipment;	(iv) Container handling equipment to be replaced gradually with high performance equipments and also the port should adopt modern maintenance practices that would lead to reduced equipment down time;	(iv) Orders placed for acquisition of 4 super-post Panamax RMQCs and 1 RMGC; to be commissioned by 2013
		(v) The approach channel and harbour basin is considered to be shallow and narrow for the latest large size vessels, thus effects the economic scale in the maritime transport;	(v) Plan the deepening the JNP Channel to 14 metres depth;	(v) JNPT and Mumbai harbour channel to be deepened to 14 mtr draft in 1st phase. (v) In 2nd phase, the channel is to be deepened to 17mtr; expected completion by Sept 2014
		(vi) High reliance on traditional paper work increases the dwell time and cost of the goods. There is lack of port facilitation, ICES automated clearance system at Jawaharlal Customs has not been reliable;	(vi) Efforts are needed to improve the trade facilitation by development of paperless system and adoption of revised Kyoto Convention;	(vi) ICES automated system implemented by Indian Customs; Cargo scanners and Risk Based cargo clearance system commissioned by Indian Customs, dwell time reduced by about 60 per cent

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SMG 4	Maritime Gateway No 4 Cochin (India)	(i) Cochin port is operating close to its designed capacity. This needs further capacity enhancement in line with projected traffic;	(i) Plans to be made to improve the existing infrastructure and related facilities and to expand the port by means of reclamation and development of South end Willington Island and further development at Vallarpadam The port may adopt 'Landlord' Concept to attract the investment; (i) Develop exclusive economic zone, construct bunkering terminals and further develop port area land;	Master Plan for development of Willingdon Island finalized in 2011; Vallarpadam Port Based SEZ notified and International Container Transhipment Terminal (ICTT) commissioned; Puthuvypeen PBSEZ Single Buoy Mooring facility commissioned by Bharat Petroleum; 5MMTPA LNG Terminal to be commissioned by PLL in 2013; Multi-user liquid terminal bidding in progress; Indian Oil storage tank farm development for LPG is in progress.
		(ii) The channel and basin are subject to heavy siltation due to long distance flow of river Periyar coupled with bank erosions. Round the clock dredging is needed to maintain committed depths;	(ii) Channels and harbour basins required continuous dredging. In order to reduce dredging expenditures, dredging should be contracted out on depth basis and not on dredged material basis; (ii) Dredging for ICTT project at Vallarpadam;	(ii) Channels deepened from 12.5 mtr draft to 14.5 mtr draft (ii) Berth basin dredging for ICTT undertaken (maintenance dredging)
		(iii) Progress made in computerisation in relations to customs, has not been matched by all other authorities, therefore, productivity is reduced and operational cost is increased;	(iii) Capacity building programme are required to be undertaken to improve the efficiency, operational profits and productivity as well;	Progress has been made in this direction.
SMG 5	Maritime Gateway No 5 Tuticorin Port (India)	(i) Due to draft constraints only feeder vessels are calling this port. Containers are therefore transhipped through Colombo or Singapore;	(i) There is need to increase the depths of channel and harbour basin up to 14.6 metres so that main line vessels could call directly;	In 2011, basin was deepened to 14.1 m and channel to 14.6 m.
		(ii) There is also need to expand the port capacity as its present designed capacity is 15.5 million whereas it handled 13.68 million tonnes in 2003-2004;	(ii) Berth No 9 to be constructed, the outer harbour and breakwater developed and an island breakwater constructed. With the projected traffic there is need for development of 2nd container terminal. Later there will be a need for construction of Berth No 10 and further expansion of container terminal and further studies should be undertaken for expansion of the port and enhancing the facilities;	Berth 9 constructed; Development of 2nd container terminal awarded on PPP scheme in August 2012; Feasibility Study for Outer Harbour is being processed and expected to be part of 13th Five Year Plan (2017 – 2022). Berth 10 will be part of this expansion.
		(iii) Access road and service roads are weak and narrow, therefore, remain highly congested, it is effecting efficiency of the port and difficulty to the traffic;	(iii) Condition of the access road and service roads needs to be improved through repairs. In addition the programme for widening and strengthening is also required to be expedited, preferably to provide 4-lanes for existing traffic;	Main roads have been made 4 lane to match with port connectivity with NH 7 and NH 45B. Interrior roads widened and strengthened; Plan for 6 laning during 12th Five Year Plan (2012 – 2017) with own funds and construction of 2 bridges.
		(iv) Ships handling craft are insufficient and existing are old, therefore, berthing problems are encountered;	(iv) Replace two tugs;	Proposal approved for hiring 1 tug (new) as replacement for the exisiting hired tug; Proposal for 1 new tag purchase is prepared and discussed, likely to be approved soon.
		(v) More berths are required;	(v) Construction of North Cargo Berth;	(v) The work is in progress.

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SMG 6	Maritime Gateway No 6 Kolkata/ Haldia (India)	(i) The port has handled 9.95 million tones in the year 2004-2005 which is 14.4 per cent growth. Whereas, rated capacity of the port is 9.8 million tones, this necessitates for further enhancement of the capacity of KDS. On the HDC side its rated capacity is 34.10 million tones whereas it handled 32.57 million tones in the year 2003-2004;	(i) There is need to enhance the port capacity by developing more berths which seems to be not possible due to limitation of space and drafts of approaching channel, therefore, HDS to be developed for meeting the projected traffic of 7.43 per cent annually. There is also need to develop more infrastructure to facilitate the traffic and increase the throughput;	At HDC, 2 Berths commissioned in June and December 2007; 2 RMQC for improved container handling commissioned; Construction of 2 riverine jetties outside the impounded lock being taken up; At KDS 3 Mobile Harbour Cranes, 10 Reach Stackers, 5 RTG inducted; additional RTG cranes, Reach Stackers, Hydraulic Cranes, Tractor-Trailer combination etc. are being procured / hired; IT systems to improve efficiency being implemented
		(ii) The container handling equipments are inadequate and old, that effects the performance of the port;	(ii) Both ports are required to replace certain amount of cargo handling equipment especially container handling cranes (RTGS);	
		(iii)Access road and service roads are congested which effects the flow of port traffic;	(iii) There is a need to develop road infrastructure inside and outside the docks and back up area;	4 laning of Kolaghat - Haldia section (53 km) in progress; 14 km Kona Junction on NH-6 to NS Dock (in KDS) to be taken up
		(iv) Too much siltation is accumulated which creates difficulties of the traffic, navigating through Hooghly River. Draft limitations restrict the entry of main line vessels into the ports. Therefore, the port is confined to serve only feeder vessels;	(iv) Although it is near to impossible to dredge the whole length of 226 kms the channel used for navigation needs to be maintained at least for the committed depths. The accumulation of siltation is natural phenomena, but minimum dredging required keeping the ports operational needs to be ensured;	Kolkata/Haldia Port draught is reducing further due to silting; KDS is planning to construct cargo handling jetties at Diamond Harbour, 70 km downstream from Kolkata; Plan for floating storage dock being developed in common port zone with Orissa
SMG 7	Maritime Gateway No 7 Chittagong Port (Bangladesh)	(i) The river Karnaphuli suffers from heavy siltation, which often change depths of navigation channel considerably, so at times it becomes difficult for the management to control the depths;	(i) The authorities are required to acquire high capacity dredgers to maintain committed depths;	6th FYP states capital and maintenance dredging as objective of CPA Measures to salvage sunken vessels need to be initiated.
		(ii) No night navigation due to lack of pilotage services and marking of navigable channel. Vessels have to wait for day break;	(ii) Proper marking of the navigable channel is needed to commence night navigation and save time;	Night navigation is still not permitted; measures have to be initiated
		(iii) The port is working beyond its rated capacity and remains highly congested;	(iii) Port expansion programmes needs to be undertaken to increase the capacity to cater for present and future projected traffic;	(iii) Construct another container terminal with storage area and high performance equipment, build CFS at Pangaon with capacity of 30,000 TEUs, construct LNG handling facilities in the port, enhance oil products and chemicals handling facilities;
		(iv) Cargo equipment is insufficient for both conventional and specialised cargo handling;	(iv) The port must acquire modern cargo handling equipments to improve its productivity. More container freight stations to be built to relieve congestion for the port area;	Improvements need to be done.
		(v) Dwell time is too high due to poor trade and facilitation. Port and Customs procedures are manual with significant amounts of paper work;	(v) Customs reforms are essentially needed for better service, removal of congestion and reduction in dwell time. IT/ EDI system to be installed to facilitate the port users and improve clearing system;	Dwell time can be reduced.

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		(vi) Hinterland connectively is poor. Container movements are not properly developed by road. Railway is not fully equipped to handle the port traffic. Inland Water Transport is also not equipped for container transport;	(vi) Roads need to be improved. Access road to be strengthened widened and low load bridges to be redesigned Railway tracks to be strengthened and container carrier wagons and other specialized cargo wagons to be added in the fleet;	Railway link between Pubail and Dhrasram Railway Stations; only 10 per cent of containerized cargo can be sent by rail to Dhaka ICD.
		(vii) Labour unrest, restrictive practices has resulted in poor productivity, congestion and high operational costs. Therefore, charges are high as compared to services provided;	(vii). Labour reforms are required by addressing their social and economic problems, developing human resources and capacity building programmes;	(vii) Deregularise the dock labour and create incentives to improve labour efficiency;
		(viii) Management also lacks the knowledge of modern port practices therefore it adds to problems, quality of services and port performance;	(viii) The port needs its operational efficiency for which experienced professional at top tiers to be appointed Port is needed to adopt privatization policy and landlord concept so that investments are attracted and operational efficiency is achieved;	Operational efficiency of Port can be increased; people related matters kept out side the purview of this study.
SMG 8	Maritime Gateway No 8 Mongla Port (Bangladesh)	(i) The port is working under capacity about 50 per cent. The port has high potential for growth, but due to many deficient constraints, it has not yet attracted the traffic, particularly the container traffic It is due to non-connectivity of railway and improper road net work and many more reasons;	(i) The Mongla Port Authority should launch marketing campaign together with improving and facilities and offer incentives to the trade; (i) Link the railway system with the port;	Khulna – Mongla rail link (53 km) to be established as part of 6th FYP ending 2015
		(ii) The river Paussur and Mongla Canal are subject to heavily siltation therefore, depths are always unpredictable as such vessel are always put on risk while approaching this port;	(ii) River channel and Mongla channel require extensive dredging for which either acquire high capacity dredger or contract out dredging on depth basis to achieve better result with proper monitoring;	Removal of wrecks from Pussur channel planned;
		(iii) The port lacks proper infrastructure, including container handling facilities despite having ports of Kolkata/ Haldia and Chittagong in the vicinity;	(iii) Administrative and operational plans to be made for the port to compete with regional ports;	Included as part of 6th FYP of Bangaldesh; Improved navigational aids and procurement of harbor crafts planned
		(iv) Lighters and tug-boats used for midstream cargo operations are inadequate, old and uneconomical therefore, port becomes expensive and inefficient;	(iv) This is the era of container cargo, therefore, emphasis to be given to improve container handling facilities on the shore as well as midstream operations. Adequate equipments and container lightering barges to be acquired. The best approach should be to invite private investments if paucity of funds is felt. The port must gear up its resources to install modern facilities;	Tugs, lighters and vessel for carriage of container to inland water destinations; Crane, straddle carrier; forklifts and other handling equipment planned; equipment for handling general cargo and containers will be procured for smooth operation.
		(v) Too much paperwork, exhaustive rules and regulations create difficulties for port users;	(v) Customs reforms are essential in this port. Installation of IT system would reduce paper work. The port needs to adopt trade and transport facilitation standards so that it attracts the traffic;	Improvements need to be done.
		(vi) Labour unrest and poor management of port operation affects the productivity performance;	(vi) Labour reforms are necessary for bringing improvements in the port. Experienced professionals to be appointed to manage the port on modern lines with market oriented methodology;	(vi) Deregularise the labour and offer incentives to improve efficiency;

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SMG 9	Maritime Gateway No 9 Male Commercial Harbour	(i) The port is handling traffic well in excess of its rated capacity whereas; projected growth rate is 9.8 per cent annual. It is impossible for the port in the existing conditions to match with the growth, due to limitation of land;	(i) There is great need to expand the capacity on a priority basis for which additional land will be required by reclaiming land from the inner harbour of the west side of the terminal to cater for growing traffic. Until port expansion is undertaken under a Masterplan, in the meantime interim actions are necessary to improve the current situation;	Major expansion work yet to be taken up
		(ii) Limitations of water depths, which restricts accommodating only small size vessels;	(ii) Extend the existing 101 m berth to accommodate larger and more vessels calling at the port;	Yet to be extended.
		(iii) Storage area is limited, therefore, port remains congested. Delays in berthing, high turn-around time and high berth occupancy are major factors affecting port users and with high operational cost;	(iii) Reducing free storage time on container cargo	No Ro-Ro berths. Containers and conventional cargo are being handled at Berth and at Anchorage.
		(iv) Custom and port have all manual system of documentation and examination which results in port congestion and very high clearance time. Customs also examine the containers in the port open storage/stacking areas, which further adds to the congestion; Lack of adequately trained staff in all the areas of port operation further reduces the port efficiency;	iv) Modernise customs and port procedures so that congestion is reduced and dwell time is controlled. This should include installation of IT/EDI systems systems and a dedicated cargo clearance area, supplemented by implementation of a needs-based human resource plan;	Improvements need to be done.
		(v) No container crane and inadequate handling equipment. Empties are returned, because there is no sufficient export. Therefore, Male is not ideal for containerisation;	(v) Acquire additional equipment to be able to introduce high density staking methods including a high capacity RTG for the container yard be procured and replace the old equipment;	Yet to be done.
		(vi) Lack of coordination between port management and port users. Lack of proper laws to regulate, develop and operate the port. Lack of autonomy for the port management to run the port efficiently;	(iv) Port authority also addresses the issues of management deficiencies and non-cooperative status of the shipping lines and other agencies working in the port. Restructuring the port management so that it has more autonomy by further commercialization or privatization of the port operations;	The regulatory functions of the port were transfered to the Ministry of Transport and Communication and the commercial functions was corporatized as Maldives Ports Limited on 31st July 2008. Maldives Port Limited is a State Owned Enterprise.
SMG 10	Maritime Gateway No 10 Colombo Port (Sri Lanka)	(i) The port is nearing to its rated capacity, occupancy has reached to 75-80 per cent level therefore, at times berthing delays are encountered;	(i) There is immediate need for expansion of JCT and UCT to reduce congestion; (i) Enhance capacity of JCT from 2 to 2.4 million TEUs;	(i) Detailed design has been completed and implementation of this projects will make it possible to berth two 8000 TEU Container ships simultaneously at JCT III and JCT IV.
		(ii) Area of harbour basin is limited, as such its is difficult to manoeuvre large size vessels;	(ii) Engineering solution to be sorted out for removing the limitations of harbour basin. Dredging is also essential for accommodating the new 5th generation vessels coming up on the high seas; (ii) Harbour Basin to be dredged up to 15 metres;	Current capacity at Colombo Port 4.1 million TEUs with dredged depth of 15 m. Hambantota Port minimum basin depth of 17 metres will ease congestion at Colombo Port. SLPA has already diverted trans-shipment traffic (automobiles) from Colombo to Hambantota.

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		(iii) Having high throughput and limited yard area, there is significant congestion within the container terminals;	(iii) To meet the future demand of the trade and traffic plans to be made to develop south harbour; (iii) Enhance yard capacity and create incentive schemes to improve port labour. Attract private sector to invest in port capacity and other facilities;	(iii) Capacity will be increased up to 13 million TEUs with the completion of three new terminals in the South Port by 2016
		(iv) Access roads are congested for inland transportation of domestic trade i.e. 30 per cent of the total traffic handled;	(iv) Though the port is mainly used for transhipment cargo but still about 30 per cent of the total handling is for the domestic consumption, therefore, the roads and railway need to be efficient to carry the cargo in and out of the port to reduce congestions. The port area should not be used by the trader as godowns are direct sell of cargo to other parties;	At present A2 Highway connects Colombo – Galle – Hambantota. The six-lane Expressway between Colombo and Matara scheduled for completion in 2013 is proposed to be extended to Hambantota.
		(v) Frequent changes in the management has an adverse effect on overall efficiency and continuity of policies;	(v) Consistency should be developed in decision making;	Studying this has been kept outside purview of this update
		(vi) The port suffers the same port and trade facilitation problem common in the region. It has significant effect on port traffic which leads to higher dwell times especially in relation to CFS activities;	(vi) There is major demand for development and implementation of trade and transport programme. This may be introduced based on automated customs clearance system with DTI capability. Linkage between port, custom and agents on the basis of community-type IT system to eliminate paper work and manual work;	ASYCUDA World with Direct Trader Input (DTI) implemented.
SAG 1	Aviation Gateway No 1: Dhaka (Bangladesh)	(i) There is scope for expansion by means of another runway at Dhaka;	(i) Need to construct a 2nd runway at Dhaka;	The renovation work of HazratShahjalal International Airport which includes building the second runway will need 21 months to be completed.
		(ii) The fleet of F-28 aircraft is old and spares are not available. Major complaints on flight delays and cancellations of intra-regional routes is due to this;	(ii) Need to upgrade the aircraft fleet, possibly by private sector investments;	Fleet modernization of BimanBangladesh remains a challenge. Private operators have increased their operations.
		(iii) No green channel for cargo inspection;	(iii) Investment in improved cargo facilities with improved facilitation measures.	May not be covered in renovation work of HazratShahjalal International Airport
SAG 2	Aviation Gateway No 2:Paro (Bhutan)	(i) Since Paro Airport is located in a narrow valley surrounded by mountains, it can handle only smaller aircraft;	(i) To build an alternative airport with ILS facilities and provisions for landing during the hours of darkness and to explore such locations in south central part of Bhutan	(i) Construction at the Gelephudomestic airport completed in 2012 and maybe capable of receiving international traffic in the future (i) Yongphula and Bapalathang domestic airports would also receive ADB funding.
		(ii) Due to the absence of ILS airport operates only in daylight hours and during favourable weather conditions;	(ii) To improve technical capabilities for the short term at Paro airport;	(ii) Work on modernization of the Voice communication system completed and improvement of power supply system through the procurement of UPS.
		(iii) Terminal passenger handling and baggage services capacity needs enhancement;	(iii) To Improve passenger handling capacities in the short term;	Construction of a second terminal building that would be used only for arrivals and domestic flights is expected to commence shortly and completed by 2015.
		(iv) Difficulties for passengers to purchase Druk Air tickets in other SAARC countries, except in India and Nepal;	(iv) Need to enhance ticketing arrangements;	ASA signed with Maldives; updated ASA signed with India, Bangladesh; flights to and from Nepal

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SAG 3-11	Aviation Gateways No 3 - 11: (India)	(i) Shortage of pilots and flight engineers to keep pace with the anticipated growth;	(i) Additional training capacity required and approaches to ensure that pilots and engineers stay in India;	Increasing pilots retirement age to 65 years - setting up of training institute in Maharashtra - upgradation and modernization of infrastructure at the India Gandhi RashtriyaUdaanAkademi to enhance its training capacity from 40 to 100 pilots and reduce the training period.
		(ii) The airport charges are high compared to nearby regions, especially for low-cost airlines;	(ii) Consider review of charges to promote sector and attract low cost carriers;	Kept outside purview of this study
		(iii) High import dwell time on international traffic with no green channel;	(iii) Improve trade facilitation measures with green channelling of known shippers;	Measures under consideration
		(iv) Shortage of capacity terminals, runways etc to handle future demand;	Delhi (i) New International Terminal Complex Phase II needs to be completed; (ii) Installation of automatic storage and retrieval systems for import handling required; (iii) New conveyor belt for cargo handling; Mumbai (i) International courier terminal required; (ii) New automatic storage and retrieval system for import handling required; (iii) Completion of 7 new parking stands; Chennai (i) New International Terminal Complex Phase II to be completed; (ii) Integrated Cargo terminal Phase III for imports required; (iii) Construction of a common user cargo terminal for domestic required; (iv) Completion of 3 parking stands; Kolkota (i) New International Departure building is required; (ii) Apron extension; (iii) Metro link over head corridor is to be constructed; (iv) New Integrated Cargo Terminal - Phase I under construction to be completed; (v) Perishable cargo centre to be constructed; (vi) New automatic storage and retrieval system for import handling; Trivandrum (i) New International building is required; Bangalore (i) Completion of expansion and modification of terminal building; Hyderabad (i) Extension of apron required; (ii) Extension of arrival terminal required; Cochin (i) New airport to be built by private sector;	Delhi and Mumbai: modernization done through PPP projects; both have been completed with new terminals and state of the art facilities. Chennai and Kolkata: the airports are being modernized and expanded by the Airport Authority of India (AAI). Trivandrum: new terminal constructed Bangalore: new airport commissioned Hyderabad: new airport commissioned Cochin: new international terminal to be constructed and the existing one would be converted to domestic terminal

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SAG 12	Aviation Gateway No 12: Male (Maldives)	(i) Passenger processing facilities at the present airport need to be expanded and the staff need to be trained in all the areas;	(i) Addition passenger processing facilities required and an effective human resource development programne needs to be implemented;	Male International Airport has been privatized. Maldives Airport Company (MACL) will only be responsible for Air Traffic Control, Aviation Security Command and some smaller offices. The agreement signed between the Maldives government and private operator included the upgrading and renovation of the airport up to the standard of a global airport by the year 2014. More than 1200 employees of MACL transferred to private operator as part of this agreement.
		(ii) Cargo handling area needs to be expanded with additional infrastructure as insufficient processing areas and cold store needed;	(ii) Addition cargo processing facilities required;	Private operator announced development plans including reclaiming more land at the northern end of the runway; where a new terminal is to be built. This terminal will consist of 3 separate bridged buildings and will consist of elements that reflect the traditional Maldivian resort. Plans for a separate cargo terminal have been announced.
		(iii) Service between Trivandrum and Male' needs an increase in the capacity flights;	(iii) ASA to be expanded to cover requirements for higher frequencies;	ASA with Bhutan signed in 2012 Revised ASA with India signed in 2008
SAG 13	Aviation Gateway No 13: Kathmandu (Nepal)	(i) Constraints in handling passengers and baggage;	(i) Improvements to baggage handling and passenger processing required;	is in the final stage of installing common user terminal equipment (CUTE) that will enable integrated passenger check-in and e-ticketing for all online airlines
		(ii) Inadequate passenger facilities;	(ii) Improved layout and facilities in passenger departures area;	Improvements need to be done.
SAG 14 -15	Aviation Gateways Nos 14 & 15: (Pakistan)	(i) Air terminal complex at both Karachi and Lahore lack cargo centres and modern cargo handling equipment;	(i) Cargo facilities should be upgraded as required;	Karachi has import, AFU, ICG and export terminals; a chiller facility; Dangerous Goods Storage; 2 cargo scanning machines; transactions are fully automated Lahore is first ever purpose built Air Cargo Complex, capable of handling almost 150,000 tons of cargo; latest cargo scanning machine, CCTV, Strong Rooms, and Cold Room, fitted with the latest fire fighting facilities. A separate room for DGR has been built and an exclusive area has been marked for explosives; has large number of docks for trucks/ transporters with wide open parking area.
		(ii) Modernization of security systems all airports with the state of the art equipment to ensure safety and security;	(ii) Improvements made in security systems;	SAPS Cargo maintains the international security standard.
		(iii) The Civil Aviation Authority of Pakistan has assumed a dual role being both service provider as well as regulator;	(iii) Regulator roles should be separated from operations;	Not done so far.

SL NO.	CORRIDORS/ GATEWAYS	BARRIERS AND REASONS FOR ACTION (TAKEN FROM SRMTS 2006 REPORT)	SRMTS 2006 RECOMMENDATIONS	PRESENT STATUS AND FORWARD PLANS
SAG 16	Aviation Gateway No 16: Colombo (Sri Lanka)	(i) The facilities that will be inadequate by around 2010 especially the passenger terminal (building and apron), car parks, air navigation systems and utilities;	(i) Supporting infrastructure facilities required especially to promote BIA as a transit hub;	BIA 2nd Phase expansion will include the widening of the existing runway and taxiways, a new state-of-the-art passenger terminal is also being built with separate sections for arrivals and departures.
		(ii) Sri Lanka requires a 2nd international airport. Locations have been identified, but studies have not been finalized. BIA is 32 kms from Colombo and not in close proximity to any centre of tourist attraction limits transit potential;	(ii) Selection of second international airport required;	Construction of 2nd International Airport at Mattala, Hambantota started in November 2009.
		(iii) Problems in attracting major airlines due to lack of infrastructure and inadequate ancillary services, such as high cost bunkering services, poor road transportation and insufficient accommodation;	(iii) Passenger facilities need enhancement;	BIA expansion will double the airport's passenger handling capacity to 12 million, while also expanding cargo handling capacity to 500.000 m from existing 250.000 m

Source: ADB, 2012, 'Working Paper on SAARC Regional Multi Modal Transport Corridors',prepared by Partha S. Banerjee in consultations with government officials from South Asian countries and SAARC Secretariat. Manila.

ANNEXES TO PREFACE

ANNEX P.1

CONSTITUTION & TERMS OF REFERENCE OF THE COMMITTEE

F. No. 571/2/3/2010-Cab.III
Government of India
Cabinet Secretariat
Rashtrapati Bhawan

New Delhi, the 11th February, 2010

OFFICE MEMORANDUM

Subject: Setting up of the National Transport Development Policy Committee as a High Level Committee.

It has been decided to constitute a High Level Committee, the National Transport Development Policy Committee (NTDPC) under the chairmanship of Shri Rakesh Mohan who will hold this assignment in an Honorary capacity with the status of a Minister of State.

2. The Terms of Reference of the Committee will be as under: -

(i) To assess the transport requirements of the economy for the next two decades in the context of economic, demographic and technological trends at local, national and global levels.

(ii) To recommend a comprehensive and sustainable policy for meeting the transport requirements keeping in view the comparative resource cost advantages of various modes of transport i.e. road, rail, air, shipping and inland water transport with a special focus on the modes that have developed less than economically desirable and the need to:

(a) encourage a rational mix of various modes of transport in order to minimize the overall resource cost to the economy,
(b) ensure balance between the ability of transport to serve economic development and to conserve energy, protect the environment, promote safety, and sustain future quality of life,
(c) ensure universal rural connectivity,
(d) address the special problems of remote and difficult areas on the one hand and of urban and metropolitan areas on the other, and
(e) adopt and evolve suitable technologies for cost effective creation, economical maintenance and efficient utilization of transport assets.

(iii) To assess the investment requirements of the transport sector and to identify the roles of state and private sector in meeting these investment needs and to suggest measures for greater commercial orientation of transport services. In this context the Committee should pay particular attention to reviewing the experience with the PPP approach or suggest ways of modifying it further.

(iv) To examine the laws, rules and regulations pertaining to various modes of transport and traffic and to suggest measures for strengthening their enforcement in the interest of the community and streamlining the procedures and processes in line with the needs of a fast growing modern economy.

(v) To identify areas where data base needs to be improved in order to formulate and implement policy measures recommended by the Committee.

(vi) To suggest measures to improve the capacity to evolve and implement projects.

(vii) To suggest measures for implementing various components of the recommended policy within a specified time frame.

(viii) To recommend any other measure which the Committee consider relevant to the items (i) and (vii) above.

3. The Committee may get special studies carried out by expert bodies. The Headquarters of the Committee will be at New Delhi. The Committee may visit such places and consult such stakeholders and experts as may be considered necessary for its work. The tenure of the Committee shall be 18 months.

4. The Committee will be serviced by the Planning Commission.

5. The composition of the NTDPC shall be as under:
-

Chairman
Shri Rakesh Mohan
(in Honorary capacity, with status of MoS).

Members:
Chairman, Railway Board
Secretary, Ministry of Urban Development
Secretary, Ministry of RT&H
Secretary, Ministry of Civil Aviation
Secretary, Ministry of Shipping
Secretary, Department of Financial Services
Secretary, Ministry of Coal
Secretary, Ministry of Power
Secretary, Ministry of Petroleum & Natural Gas
Adviser to DCH, Planning Commission
Chairman, RITES

Asian Institute of Transport Development
Shri K.L. Thapar, Chairman,

Former Chairman, Railway Board
Shri M. Ravindra

Former Secretary, Transport & Shipping
Shri S. Sundar

Former DG, Ministry of Road Transport & Highways
Shri D.P. Gupta

Indian Institute of Technology, Delhi
Prof. Dinesh Mohan

M.D., Great Eastern Shipping
Shri Bharat Sheth

MD,IDFC
Shri Rajiv B Lall,

Infosys Technology
Shri Mohandas Pai

AFL Group
Shri Cyrus Guzder, Chairman

Member Secretary
Shri B.N. Puri

Sd/-

(Puneet Agarwal)
Deputy Secretary
Tele : 23016576

To

Chairman and Members of the Committee

Copy forwarded to:-
(1) Smt. Sudha Pillai, Secretary, Planning Commission.
(2) Shri Davinder P.S. Sandhu, Director, Prime Minister's Office with Reference to their U.O. No. 430/31/C/12/2010-ES.I, dated 9.2.2010.

Sd./-
(Puneet Agarwal)
Deputy Secretary
Tele : 23016576

ANNEX P.2
WORKING GROUPS

1. RAILWAYS

No.-3/1/2010-Tpt
GOVERNMENT OF INDIA
Planning Commission
National Transport Development Policy Committee (NTDPC)

Capital Court, Olof Palme Marg
Munirka, New Delhi-110067
Dated: 19th July, 2010

Subject: Working Group on Railways for the National Transport Development Policy Committee (NTDPC).

It has been decided by the National Transport Development Policy Committee (NTDPC) to constitute a Working Group on Railways Sector. The Composition and Terms of references of the Working Group are as under:

1. Composition

1 Chairman, Railway Board - Chairman
2 Shri K.L. Thapar, Member, NTDPC
3 Shri M. Ravindra, Member, NTDPC
4 Member Secretary/Co-ordinator, NTDPC
5 Ms. Sowmya Raghavan, Financial Commissioner of Railways.
6 Member Traffic, Railway Board
7 Adviser (Infrastructure), Railway Board
8 MD, Container Corporation of India (CONCOR)
9 Professor S. Sriraman, Walchand Hirachand Professor of Transport Economics, University of Mumbai
10 Dr. Ram Singh, Associate Professor, Delhi School of Economics, New Delhi.

11 Shri S.K.N. Nair, Sr. Consultant, National Council for Applied Economic Research (NCAER), New Delhi
12 Shri Saurabh Srivastava, Chairman, CA Group
13 Shri R. Gopalakrishnan, Executive Director, Tatasons.
14 Representative of financial sector (nominated by Secretary, Department of Financial Services)
15 Representative of IT Sector
16 Shri S.K. Mishra, Executive Director/Traffic/PPP- Convenor

2. Terms of Reference

1. Determine the role of railways in meeting transport requirements of the Indian economy over the next two decades, keeping in view the need to
   a. Conserve energy and protect the environment,
   b. Promote safety, sustain future quality of life and reduce logistics costs,
   c. Create an optimal intermodal mix.

The group may also keep in view the recommendations of various committees including those of National Transport Policy Committee, 1980, and the Expert Group on Railways, 2001.

2. Estimate the share of railways in total transport in 2020 and 2030 consistent with the role envisaged for Railways and the projected macro-economic scenario.

3. Estimate:
   a. Passenger traffic for the year 2020 and 2030 along with broad break-up of passenger traffic in terms of long distance (1000 km and above), overnight, intercity (250 km to 1000 km), local and suburban in both premium and value segments.
   b. Freight traffic for the year 2020 and 2030 including expected composition in terms of specific segments and leads.

4. Consistent with the above, assess the current capacity and recommend the magnitude and type of capacity creation/augmentation/modernization required in the railway system. The following aspects may also be kept in view while assessing the requirements:
   a. Special problems of remote and underdeveloped areas including the north-east region.
   b. Rail connectivity with power plants, water fronts and mines.
   c. Rail connectivity with neighbouring countries.
   d. Development of regional and international railway corridors.

5. In light of the above,
   a. Assess the investment required to achieve the projected traffic growth.
   b. Identify sources of funding and assess fund requirements from budgetary, non-budgetary and private sources for different areas in rail infrastructure.
   c. Identify areas for PPP and the requirement of private and public funding in these areas.
   d. Examine the existing PPP policy framework and policy initiatives including regulatory and institutional framework and suggest changes necessary to attract greater private investment.
   e. Suggest measures for greater commercial orientation of railways.

6. Assess the full costs of rail transport, including the costs of externalities, and suggest appropriate pricing regimes for various transport products in both passenger and freight traffic, including institutional arrangements for rational pricing.

7. To suggest policy framework for provision of rail connectivity to remote areas and under developed areas.

8. Estimate the energy requirements necessary for rail infrastructure and suggest measures to put the railways sector on a sustainable low carbon path and promote energy efficiency, emission reduction and environment protection.

9. Suggest the role of railways in promoting the development and growth of integrated logistics solutions and reduction in intermodal interface impedances. This would include the development of sustainable integrated rail/road, rail/air, and rail/port transport systems.

10. Assess the availability of human resources for the railways and suggest measures for skill development and institutional capacity building for various stakeholders.

11. Suggest measures for promotion of research and development and technology upgradation in the railways, including institutional development.

12. Indicate broad areas and investment for IT in the railways to improve customer interface/satisfaction and internal efficiency.

13. Examine the issue of land availability as a critical resource and technological solutions to reduce potential land requirements. Also, suggest measures for speedy acquisition of land for railway infrastructure, along with rehabilitation and resettlement of persons affected.

14. Identify data deficiencies in railway sector and suggest measures for improving, maintaining and updating the database, including institutional measures.

15. Suggest broad areas for business process re-engineering in railways to improve its customer and business orientation as well as project execution capability.

16. Study and evaluate the international experience in rail transport with particular stress on institutional design, business strategies and freight and passenger transport products (heavy haul high speed and customer focused services), quality of service (reliability, speed, elimination of accidents), productivity and technology and development of competitive world class rail equipment industry and its relevance to IR.

3. Additional guidance for the Working Group

   a. The Group may get special studies carried out by experts.

   b. The Group may visit such places and consult such stakeholders, key users and experts as may be considered necessary for its work.

   c. The Group may examine the laws, rules and regulations pertaining to roads in connection with the TOR above and suggest legal, organizational, institutional and procedural reforms as necessary.

4. The Chairman may co-opt up to two additional members.

5. The expenditure on studies commissioned by the Working Group would be borne by the Ministry of Railways.

6. The Working Group shall submit its report within nine months.

7. The non-official members of the Working Group will be paid TA/DA in accordance with the guidelines of NTDPC. The official Members will be paid TA/DA as per their entitlement by concerned Ministry/Departments where they are working.

Sd/-
(B.N. Puri)
Member Secretary
(NTDPC)

Copy to

1. Chairman, NTDPC
2. All the Members of the Working Group

2. ROADS

No.-3/1/2010-Tpt.
GOVERNMENT OF INDIA
Planning Commission
National Transport Development Policy Committee (NTDPC)

Capital Court, Olof Palme Marg
Munirka, New Delhi-110067
Dated: 19th July, 2010

Subject: Working Group on Roads for the National Transport Development Policy Committee (NTDPC).

It has been decided by the National Transport Development Policy Committee (NTDPC) to constitute a Working Group on Roads Sector. The Composition and Terms of references of the Working Group are as under:

1. Composition

   1 Secretary (Road Transport & Highways)-Chairman
   2 Shri S. Sundar, Member, NTDPC
   3 Shri D.P. Gupta, Member, NTDPC
   4 Member Secretary/Co-ordinator, NTDPC
   5 Chairman, National Highway Authority of India (NHAI)
   6 Director General, Roads, Ministry of Road Transport & Highways
   7 Principal Secretary (Transport), Government of Andhra Pradesh
   8 Principal Secretary (PWD), Government of Assam
   9 Joint Secretary (Road Transport), Ministry of Road Transport & Highways.
   10 Joint Secretary (Rural Roads), Ministry of Rural Development
   11 Professor Geetam Tiwari, Indian Institute of Technology, Delhi
   12 Shri Partha Mukhopadhyay, Centre for Policy Research, New Delhi.
   13 Shri Athar Shahab, Dy. MD, IDFC Projects and Chairman, CII Roads Committee
   14 Shri O.B. Raju, MD, GMR Highways Pvt. Ltd., Bengaluru.
   15 Shri Parvesh Minocha, MD, Transportation Division, Feedback Ventures
   16 Representative of financial sector (nominated by Secretary, Department of Financial Services)
   17 Representative of IT sector
   18 Adviser (Transport Research), Ministry of Road Transport & Highways - Convenor.

2. Terms of Reference

1. Determine the role of road transport in meeting transport requirements of the economy over the next two decades, keeping in view the need to
    a. Conserve energy and protect the environment,
    b. Promote development of remote and inaccessible areas through universal connectivity,
    c. Promote safety and sustain future quality of life,
    d. Create an optimal intermodal mix.

2. Estimate the growth in road traffic, passenger and freight, by 2020 and 2030 in the context of economic, demographic and technological trends at local, national and global levels.

3. Consistent with the above, assess the current capacity and required capacity in future, of the physical road infrastructure. The requirements may be grouped into different categories:
    a. Expressways
    b. National Highways
    c. State Highways and Major District Roads
    d. Rural Roads – both PMGSY and non-PMGSY (urban road requirements would be addressed by the working group on urban transport).

    The following aspects may also be kept in view while assessing the requirements:
    a. Universal rural connectivity.
    b. Special problems of remote, difficult and border areas including the north-east region.
    c. Road connectivity with ports, power plants, water fronts.
    d. Road connectivity with neighbouring countries.
    e. Development of regional and international road corridors.

4. In light of the above,
    a. Assess the investment required to achieve the projected road traffic growth.
    b. Identify sources of funding and assess fund requirements from budgetary, non-budgetary and private sources for different areas in road infrastructure.
    c. Identify areas for PPP and the requirement of private and public funding in these areas.
    d. Examine the existing PPP policy framework and policy initiatives including the regulatory and institutional framework, and suggest changes necessary to attract greater private investment.
    e. Suggest measures for greater commercial orientation of road transport services.

5. Assess the full costs of road transport, including the costs of externalities, and suggest appropriate pricing regimes, both direct and indirect, including institutional arrangements for rational pricing.

6. Estimate the energy requirements necessary for road infrastructure and suggest measures to put the road construction and road transport sector on a sustainable low carbon path, promoting energy efficiency, emission reduction and environment protection.

7. Review status of road quality and safety measures and ways to ameliorate road accidents and make roads more user friendly.

8. Assess the availability of human resources for the road sector and suggest measures for skill development and institutional capacity building for various stakeholders.

9. Suggest measures for promotion of research and development and technology upgradation in the road transport sector, including institutional development.

10. Indicate broad areas and investment for IT in road transport to improve customer interface/satisfaction and internal efficiency.

11. Suggest measures for speedy acquisition of land for roads, along with rehabilitation and resettlement of persons affected.

12. Identify data deficiencies in road transport and suggest measures for improving, maintaining and updating the database, including institutional measures.

13. Assess the current industry structure, including the role played by the public and private sectors and suggest policies to promote adequate competition in road transport with the objective of enhancing access and affordability.

14. Examine the barriers to free flow of road freight traffic and suggest measures to promote seamless movement of road freight across India, including in particular the use of IT.

15. Suggest measures towards consolidation and preservation of road assets.

16. Identify social disconnects arising out of construction of roads and suggest measures for their mitigation.

17. Suggest measures for upgrading and modernizing the trucking industry.

3. Additional guidance for the Working Group

1. The Group may get special studies carried out by experts.

2. The Group may visit such places and consult such stakeholders, key users and experts as may be considered necessary for its work.

3. The Group may examine the laws, rules and regulations pertaining to roads in connection with the TOR above and suggest legal, organizational, institutional and procedural reforms as necessary.

4. The Chairman may co-opt up to two additional members.

5. The expenditure on studies commissioned by the Working Group would be borne by the Ministry of Road Transport and Highways.

6. The Working Group shall submit its report within nine months.

7. The non-official members of the Working Group will be paid TA/DA in accordance with the guidelines of NTDPC. The official Members will be paid TA/DA as per their entitlement by concerned Ministry/Departments where they are working.

Sd/-
(B.N. Puri)
Member Secretary
(NTDPC)

Copy to

1. Chairman, NTDPC
2. All the Members of the Working Group

3. CIVIL AVIATION

No. 3/1/2010-Tpt.
GOVERNMENT OF INDIA
Planning Commission
National Transport Development Policy Committee (NTDPC)

Capital Court, Olof Palme Marg
Munirka, New Delhi-110067
Dated: 19th July, 2010

Subject: Working Group on Civil Aviation for the National Transport Development Policy Committee (NTDPC).

It has been decided by the National Transport Development Policy Committee (NTDPC) to constitute a Working Group on Civil Aviation Sector. The Composition and Terms of references of the Working Group are as under:

1. Composition
   1 Secretary, Ministry of Civil Aviation — Chairman
   2 Shri K.L. Thapar, Member, NTDPC
   3 Shri Cyrus Guzder, Member, NTDPC
   4 Member Secretary/ Co-ordinator, NTDPC
   5 Managing Director, National Aviation Company of India Limited
   6 Director General, Civil Aviation
   7 Chairman, Airports Authority of India
   8 Dr. Shashanka Bhide, Senior Fellow, National Council for Applied Economic Research (NCAER), New Delhi.
   9 Shri Rakesh Gangwal, Former Chairman and CEO, US
   10 Capt. G.R. Gopinath, CMD, Deccan 360.
   11 Shri Sanat Kaul, Chairman, International Foundation for Aviation and Aerospace Development.
   12 Shri Sanjay Reddy, MD, GVK, Mumbai & Benguluru International Airports.
   13 Representative of financial sector (nominated by Secretary, Department of Financial Services)
   14 Shri U.G. Krishna, GM, ECTI, Wipro Limited.
   15 Joint Secretary, Ministry of Civil Aviation-Convenor

2. Terms of Reference
1. Determine the role of air transport in meeting transport requirements of the economy over the next two decades, keeping in view the need to
   a. Conserve energy and protect the environment,
   b. Promote development of remote and inaccessible areas,
   c. Promote safety and sustain future quality of life,
   d. Create an optimal intermodal mix.

2. Estimate the growth in air traffic by 2020 and 2030 in terms of both passengers and freight by:
   a. Total volume of traffic, domestic and international.
   b. Domestic origin – destination pairs.

3. Consistent with the above, assess the current and the required capacity in future, of civil aviation sector:
   a. Aircraft fleet
   b. Infrastructure in terms of
      i. On the ground, including airport terminals, runway capacity, apron – parking space, access to terminal buildings etc.
      ii. Airspace and air traffic control.
      iii. Creation of additional/greenfield airport infrastructure and its role in promoting regional development.

4. In light of the above,
   a. Assess the investment required to achieve the projected air transport traffic growth.
   b. Identify sources of funding and assess fund requirements from budgetary, non-budgetary and private sources for different areas in air transport.
   c. Identify areas for PPP and the requirement of private and public funding in these areas.
   d. Examine the existing PPP policy framework and policy initiatives including the regulatory and institutional.

5. Assess the full costs of air transport, including the costs of externalities, and suggest appropriate pricing regimes, both direct and indirect, including institutional arrangements for rational pricing.

6. Estimate the energy requirements necessary for air transport infrastructure and suggest measures to put air transport sector on a sustainable low carbon path and promote energy efficiency, emission reduction and environment protection.

7. Review the impact of ongoing developments of international air transport in the world and India and suggest changes in policy for India in following areas:

   a. Licensing of airlines for scheduled, non-scheduled and cargo services.
   b. Safety, security, economic and environmental issues, keeping in view the recommendations of ICAO, international practices and the conditions in India.
   c. Taxation policy affecting various sub-sectors of civil aviation, including taxes on aviation turbine fuel.

8. Assess the current industry structure, including the role played by public and private sector and suggest policies to promote adequate competition in air transport with the objective of enhancing access and affordability.

9. Assess the availability of human resources for the air transport sector and suggest measures for skill development and institutional capacity building for various stakeholders.

10. Measures for promotion of research and development and technology upgradation in air transport, including institutional development.

11. Identify data deficiencies in air transport and suggest measures for improving, maintaining and updating the database, including institutional measures.

3. Additional guidance for the Working Group

1. The Group may get special studies carried out by experts.

2. The Group may visit such places and consult such stakeholders, key users and experts as may be considered necessary for its work.

3. The Group may examine the laws, rules and regulations pertaining to air transport in connection with the TOR above and suggest legal, organizational, institutional and procedural reforms as necessary.

4. The Chairman may co-opt up to two additional members.

5. The expenditure on studies commissioned by the Working Group would be borne by the Ministry of Civil Aviation.

6. The Working Group shall submit its report within nine months.

7. The non-official members of the Working Group will be paid TA/DA in accordance with the guidelines of NTDPC. The official Members will be paid TA/DA as per their entitlement by concerned Ministry/Departments where they are working.

Sd/-
(B.N. Puri)
Member Secretary
(NTDPC)

Copy to

1. Chairman, NTDPC
2. All the Members of the Working Group

4. PORTS AND SHIPPING

No.-3/1/2010-Tpt.
GOVERNMENT OF INDIA
Planning Commission
National Transport Development Policy Committee (NTDPC)

Capital Court, Olof Palme Marg
Munirka, New Delhi-110067
Dated: 19th July, 2010

Subject: Working Group on Ports and Shipping for the National Transport Development Policy Committee (NTDPC).

It has been decided by the National Transport Development Policy Committee (NTDPC) to constitute a Working Group on Ports and Shipping Sector. The Composition and Terms of references of the Working Group are as under:

1. Composition
   1 Secretary (Shipping) - Chairman
   2 Shri Bharat Sheth, Member, NTDPC
   3 Shri Gajendra Haldea, Member, NTDPC
   4 Member Secretary/ Co-ordinator, NTDPC
   5 Director General, Shipping
   6 Director General, Foreign Trade (DGFT), M/o Commerce & Industry
   7 Additional Member, Planning, Railway Board)
   8 CMD, Shipping Corporation of India
   9 Joint Secretary, Ports
   10 CEO, Gujarat Maritime Board
   11 MD, Container Corporation of India
   12 Chief Engineer, Planning, Ministry of Road Transport & Highways
   13 External Academic Expert
   14 External Academic Expert
   15 Shri Jimmy Sarbh, Sarbh Consultancy
   16 Shri Krishna Kotak, Managing Director, J.M. Baxi & Company
   17 Shri Thomas Netzer, Director, McKinsey & Company.
   18 Representative of financial sector (nominated by Secretary, Department of Financial Services)
   19 Representative of IT Sector
   20 Adviser, (Transport Research) - Convenor

2. Terms of Reference

1. Review and determine the role of the maritime sector in meeting transport requirements of the economy over the next two decades, keeping in view the need to
   a. Conserve energy and protect the environment,
   b. Promote safety and sustain future quality of life,
   c. Create an optimal intermodal mix.

2. Estimate the potential growth in waterborne traffic by 2020 and 2030 in terms of both passengers and freight by
   a. Sea borne, Coastal and Inland Water.
   b. Major ports and non-major ports.

3. Consistent with the above, assess the current capacity and the required capacity in future, maritime infrastructure, including:
   a. Port infrastructure.
   b. Shipping.
   c. Creation of additional port infrastructure or the creation of ports at new, greenfield sites, and their role in promoting regional development.

4. In light of the above,
   a. Assess the investment required to achieve the projected maritime infrastructure capacity.
   b. Identify sources of funding and assess fund requirements from budgetary, non-budgetary and private sources for different areas in maritime infrastructure.
   c. Identify areas for PPP and the requirement of private and public funding in these areas.
   d. Examine the existing PPP policy framework and policy initiatives including regulatory and institutional framework and suggest changes necessary to attract greater private investment.

5. Examine the regulatory issues including the role of the Tariff Authority for Major Ports (TAMP) and suggest changes in policies concerning ports and shipping.

6. Review the relative role of major and non-major ports and suggest measures for integrated development of the ports sector, including a review of the current legislative provisions.

7. Estimate the energy requirements necessary for port infrastructure and shipping and suggest measures to put water transport sector on a sustainable low carbon path and promote energy efficiency, emission reduction and environment protection.

8. Review the status of rail-road connectivity of ports to the hinterland and make recommendations for development of multi-modal transport systems.

9. Assess the availability of human resources for the maritime sector and suggest measures for skill development and institutional capacity building for various stakeholders.

10. Suggest measures for promotion of research and development and technology upgradation in the

water transport sector, including evaluation of technology trends in global shipping.

11. Indicate broad areas and investment for IT in water transport to improve customer interface/ satisfaction and internal efficiency.

12. Identify data deficiencies in water transport and suggest measures for improving, maintaining and updating the database, including institutional measures.

13. Review the processes, productivity and efficiency of ports and shipping development and operations and make appropriate recommendations for their improvement.

3. Additional guidance for the Working Group

1. The Group may get special studies carried out by experts.

2. The Group may visit such places and consult such stakeholders, key users and experts as may be considered necessary for its work.

3. The Group may examine the laws, rules and regulations pertaining to maritime sector in connection with the TOR above and suggest legal, organizational, institutional and procedural reforms as necessary.

4. The Chairman may co-opt up to two additional members.

5. The expenditure on studies commissioned by the Working Group would be borne by the Ministry of Shipping.

6. The Working Group shall submit its report within nine months.

7. The non-official members of the Working Group will be paid TA/DA in accordance with the guidelines of NTDPC. The official Members will be paid TA/DA as per their entitlement by concerned Ministry/Departments where they are working.

Sd/-
(B.N. Puri)
Member Secretary
(NTDPC)

Copy to

1. Chairman, NTDPC
2. All the Members of the Working Group

5. URBAN TRANSPORT

No. 3/1/2010-Tpt.
GOVERNMENT OF INDIA
Planning Commission
National Transport Development Policy Committee (NTDPC)

Capital Court, Olof Palme Marg
Munirka, New Delhi-110067
Dated: 19th July, 2010

Subject: Working Group on Urban Transport for the National Transport Development Policy Committee (NTDPC).

It has been decided by the National Transport Development Policy Committee (NTDPC) to constitute a Working Group on Urban Transport Sector. The Composition and Terms of references of the Working Group are as under:

1. Composition
   1. Secretary, Ministry Urban Development - Chairman
   2. Prof. Dinesh Mohan, Member, NTDPC
   3. Shri S. Sundar, Member, NTDPC
   4. Member Secretary/ Co-ordinator, NTDPC
   5. Secretary, Urban Development Department, Government of Maharashtra
   6. Representative from Railways (urban/suburban/metro transport)
   7. Shri P. S. Kharola, Commissioner, Department of Commercial Taxes, Benguluru.
   8. Shri S. N. Sahai, Managing Director and Chief Executive Officer, Delhi Integrated Multi Modal Transit System Ltd. (DIMTS)
   9. Professor Sudhir Chella Rajan, Indian Institute of Technology, Madras, Chennai.
   10. Professor Geetam Tiwari, Research and Injury Prevention Programme, Indian Institute of Technology, Delhi.
   11. Dr Ashwin Mahesh, Indian Institute of Management, Bangalore.
   12. Shri K. Ramchand, Director, IL&FS Transport Network
   13. Shri Vinayak Chatterji, MD & CEO, Feedback Ventures.
   14. Representative of financial sector (nominated by Secretary, Department of Financial Services)
   15. Shri C.N. Raghupathi, Vice President, Infosys.
   16. OSD/Director, Ministry of Urban Development- Convenor

2. Terms of Reference
1. Determine the role of urban transport in meeting transport requirements of the economy over the next two decades and develop a rolling plan for 2030 in consonance with the National Urban Transport Policy. The plan should cover urban

agglomerations as well as satellite towns, including integrated suburban rail based systems, and should be based on the following considerations:

a. Promote access of all citizens to jobs, education and recreation at affordable costs and within reasonable time.
b. Minimise overall production of green house gases and pollution (well to wheel) per passenger km.
c. Minimise financial costs of transportation.
d. Minimise overall demand for transportation.
e. Achieve minimum service level benchmarks.
f. Aim towards zero traffic fatalities.

2. Estimate the growth in passenger traffic by 2020 and 2030 in the context of economic, demographic and technological trends at local, national and global levels.

3. Consistent with the above, assess the current capacity and recommend the magnitude and type of capacity creation/augmentation/modernization required in urban transport.

4. In light of the above,
   a. Assess the investment required to achieve the projected urban transport capacity.
   b. Identify sources of funding and assess fund requirements from budgetary, non-budgetary and private sources for different areas in urban transport.

5. Identify the roles of state, the private sector and the financial sector in meeting the investment needs of the urban transport sector. This would include examination of the current modes of financing urban transport and review of the Public Private Partnership (PPP) experience, which is designed to attract greater private participation.

6. Assess the full costs of urban transport, including the costs of externalities. Suggest appropriate pricing regimes including appropriate taxation measures, that would achieve the desired mode mix keeping in view affordability and access.

7. Estimate the energy requirements necessary for urban transport and suggest measures to put the urban transport sector on a sustainable low carbon path and promote energy efficiency, emission reduction and environment protection.

8. Assess the availability of human resources for urban transport and suggest measures for skill development and institutional capacity building for various stakeholders.

9. Suggest measures for promotion of research and development and technology upgradation in urban transport sector, including institutional development.

10. Indicate broad areas and investment for IT in urban transport to improve customer interface/satisfaction and internal efficiency.

11. Identify data deficiencies in urban transport sector and suggest measures for improving, maintaining and updating the database, including institutional measures.

12. Review status of quality and safety measures and ways to ameliorate accidents and make urban transport more user friendly.

3. Additional guidance for the Working Group
1. The Group may get special studies carried out by experts.
2. The Group may visit such places and consult such stakeholders, key users and experts as may be considered necessary for its work.
3. The Group may examine the laws, rules and regulations pertaining to roads in connection with the TOR above and suggest legal, organizational, institutional and procedural reforms as necessary.

4. The Chairman may co-opt up to two additional members.

5. The expenditure on studies commissioned by the Working Group would be borne by the Ministry of Urban Development.

6. The Working Group shall submit its report within nine months.

7. The non-official members of the Working Group will be paid TA/DA in accordance with the guidelines of NTDPC. The official Members will be paid TA/DA as per their entitlement by concerned Ministry/Departments where they are working.

Sd/-
(B.N. Puri)
Member Secretary
(NTDPC)

Copy to

1. Chairman, NTDPC
2. All the Members of the Working Group

6. NORTH EAST

No. 5/1/2010-NTDPC
GOVERNMENT OF INDIA
Planning Commission
National Transport Development Policy Committee (NTDPC)

Capital Court, Olof Palme Marg
Munirka, New Delhi-110067
Dated: 8th August, 2011

Subject: Working Group on Improvement and Development of Transport Infrastructure in the North East for the National Transport Development Policy Committee (NTDPC).

It has been decided by the National Transport Development Policy Committee (NTDPC) to constitute a Working Group on Improvement and Development of Transport Infrastructure in the North East. The Composition and Terms of references of the Working Group are as under:

1. Composition:
   1 Shri Vivek Sahai, former Chairman, Railway Board, Chairman
   2 Shri B.N. Puri, Member Secretary, NTDPC, Member
   3 Chairman Inland Waterways Authority of India (IWAI) or her representative, Member
   4 Director General, Roads, Ministry of Road Transport & Highways, Member
   5 Director General, Boarder Roads Organisation (BRO), Member
   6 Shri Rohit Nandan, Joint Secretary, Ministry of Civil Aviation, Member
   7 Joint Secretary (BSM), Ministry of External Affairs, Member
   8 Executive Director (Projects), Railway Board, Member
   9 Prof. Mahendra P. Lama, Vice Chancellor, University of Sikkim, Member
   10 Representative of North East Council (NEC), Member
   11 Representative of Planning Commission, Transport Division, Member
   12 Representative of Customs & Excise Board, Member
   13 Representative of Asian Institute of Transport Development (AITD), Member
   14 Ms. Jayashree Mukherjee, Joint Secretary, DONER, Convenor

2. Terms of Reference:

1) To assess the Transport Infrastructure Deficit in the North East Region.

2) To assess the role of each mode of transport for improving the accessibility and mobility of both people and goods.

3) To make recommendations for provision of transport infrastructure and facilities keeping in view:
   (a) the role of each mode of transport
   (b) the requirement of traffic demand, particularly, that relating to movement of essential commodities
   (c) need to ensure balance between the ability of transport to serve economic development of the region and to conserve energy, protect environment, promote safety and sustain good quality of life.
   (d) Need to adopt and evolve suitable technology for cost effective creation, economical maintenance and efficient utilisation of transport assets.

4) To assess transport infrastructure, requirement of providing connectivity with the neighbouring countries with a view to enabling trade between North Eastern Region and neighbouring countries.

5) To assess the investment requirement of Transport sector and to recommend measures to fund the projected investment.

6) To suggest measures to improve the capacity to evolve and implement projects in North East.

3. The Chairman may co-opt up to two additional members.

4. The representatives of the North Eastern States will be special invitee to the meeting of the Working Group.

5. The Working Group shall submit its report within three months.

6. The non-official members of the Working Group will be paid TA/DA in accordance with the guidelines of NTDPC. The official Members will be paid TA/DA as per their entitlement by concerned Ministry/Departments where they are working.

Sd/-
(B.N. Puri)
Member Secretary
(NTDPC)

Copy to:-
1. Chairman, NTDPC
2. All the Members of the Working Group

7. TRANSPORTATION OF ENERGY COMMODITIES

No. 3/1/2010-Tpt.
Government of India
Planning Commission
National Transport Development Policy Committee (NTDPC)

6th Floor, Capital Court,
Olof Palme Marg, Munirka,
New Delhi-110 067.
Dated: 5th April, 2011.

Subject: Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India.

The surge in economic growth witnessed in recent years in India has strained the capacity of its transport system as well as energy supply, particularly electric power. The government's ambitious development targets and plans as well as popular discourse attest to importance of addressing such binding infrastructure constraints in a decisive manner over the next decade in order to sustain high levels of economic growth and to make it more inclusive.

Movement of bulk commodities is a major role of India's transportation system. For example, coal accounts for almost half the freight volume on Indian Railways which is a major supplier of transport services to the electric power and steel industries. Indeed, the congestion caused by inadequate expansion in transport capacity to date, especially on crucial links and corridors underlies many issues such as security of supply chains, inventory of raw materials, port-handling, etc. affecting industry.

The future poses more profound challenges. Even if ambitious aims to improve energy intensity of the Indian economy are achieved, sustaining economic growth at 8-10% per annum over the next two decades will require massive increases in power generation and transportation of bulk commodities such as coal, iron and steel. The Integrated Energy Policy foresees generation capacity increasing six-fold to 960 GW by 2031-32 and coal requirements expanding commensurately to 2-3 BT p.a. Out of this requirement, approximately 10 to 15% will be imported coal. The task ahead is also rendered more difficult by the evolving economic geography and structural changes in the energy system, such as the increasing role of natural gas and growing imports of coal that will impose major new demands on the transport networks. Current projections for coal imports in 2031-32 and LNG imports in 2029-30 for example, are 930 million tones and 162 MMSCMD respectively.

Finally, there is increasing recognition of the adverse environmental impacts, including not just local pollution and damage to habitats and/or livelihood of vulnerable groups but also global climate change that need to be addressed in an economically efficient, equitable and effective manner.

Development plans from the key ministries of the government as well as initiatives and investment proposals from the private sector seek to address the issues alluded to above. However, the needs are vast and multifaceted, while resources are necessarily limited and more importantly the issues are intimately interrelated and the viability of solutions is interdependent both in terms of the nature of the investment (e.g. transport coal or transmit power) as well as the timing and duration of execution. Hence a piecemeal approach to planning could be severely suboptimal leading to colossal wastage of resources and lost time.

Keeping in view what is stated above, it has been decided by the National Transport Development Policy Committee (NTDPC) to constitute a Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India. The composition and Terms of Reference of the Working Group are as under:-

1. Composition
   1. Shri P. Uma Shankar, Secretary, Ministry of Power — Chairman
   2 Shri B.N. Puri, Member – Secretary, NTDPC
   3 Shri Pradeep Bhatnagar, Additional Member (Traffic), Railway Board
   4 Representative* of Ministry of Coal
   5 Representative* of Ministry of Shipping
   6 Representative* of Ministry of Steel.
   7 Representative* of Ministry of Petroleum & Natural Gas
   8 Representative* of Ministry of Road, Transport & Highways
   9 Representative* of Ministry of Environment and Forest
   10 Representative of State Govt.
   11 Representative of State Govt.
   12 Representative of CEA
   13 Private Sector Representative, Power
   14 Private Sector Representative, Gas
   15 Private Sector Representative, Steel
   16 Dr. Anupam Khanna, Principal Adviser, NTDPC — Convenor

   * *Not below the rank of Joint Secretary.*

The Chairman of Working Group may co-opt/invite representative, special experts, functionaries including that of Central Public Sector.

2. Terms of Reference
1. Develop demand scenarios for electric power and natural gas and steel for final consumption at 5-year intervals (2017, 2022, 2027 and 2032) disaggregated into a suitable number of spatial locations (transmission nodes) and consumer type.

2. Identify production locations (existing and potential) for the following:
   a. Electric Power Generation, separating out current and potential hydro- and nuclear power plants.
   b. Iron & Steel plants
   c. Coal Mines (differentiated by type of coal and ash content)

3. Indicate current and potential port terminals for
   a. Coal
   b. LNG
   c. Landing site for offshore natural gas

4. Indicate current and potential transport links
   a. Railway corridors
   b. Road Corridors
   c. Inland Waterways
   d. Possible Coal Slurry pipelines
   e. Natural Gas pipelines
   f. Coastal Shipping options for coal

5. Study the economics of transmission of energy vs. transportation of fuel (coal, natural gas) within a coherent and analytically tractable framework.

6. Make recommendation for rationalization of coal linkage by optimizing the distance of coal transportation from source of coal supply to power station taking into account economic and environmentally significant variables such as calorific values, ash and sulfur content, carbon emissions, etc.

7. Estimate the rail, road and port capacities required and associated investment to meet the demand.

8. Develop estimates of both environmental externalities as well as economic cost of shortage of energy and transport services.

9. Examine laws, rules and regulations pertaining to transport in connection with the ToR above and suggest legal, organizational, institutional and procedural reforms needed to achieve the objectives of the integrated strategy.

3. The report of the Working Group should pay due regard to the uncertainties inherent in the development of such a complex system over a long period of twenty years. Thus it is necessary to distinguish what is clearly known now and what the Group believes needs to be known through suitable an analyses. The aim should be to set robust directions for the long-term that can be adapted as events unfold but also recommend immediate concrete actions that address critical bottlenecks and identify promising options (e.g. for new corridors, dedicated facilities) in order to begin planning investments in a timely manner.

4. The Group may get special studies carried out by experts.

5. The expenditure on studies commissioned by the Working Group would be borne by the Ministry of Power.

6. The Group may visit such places and consult such stakeholders, key users and experts as may be considered necessary for its work.

7. The Chairman may co-opt up to two additional members.

8. The Working Group shall submit its report in July, 2011.

9. The non-official members of the Working Group will be paid TA/DA in accordance with the guidelines of NTDPC. The official Members will be paid TA/DA as per their entitlement by concerned Ministry/Departments where they are working.

Sd/-
(B.N. Puri)
Member Secretary
(NTDPC)

Copy to

1. Chairman, NTDPC
2. All the Members of the Working Group

ANNEX P.3

COMPOSITION OF THE WORKING GROUPS AND SUB-GROUPS

1. RAILWAYS

WORKING GROUP

Chair: Chairman, Railway Board. Shri K.L.Thapar, Member, NTDPC & Chairman AITD. Shri M. Ravindra, Member, NTDPC, Shri B.N.Puri, Member Secretary/Co-ordinator, ShriR.Gopal Krishnan, Executive Director, Tatasons, Professor S.Sriraman, Walchand Hirachand Professor of Transport Economics, Dr.Ram Singh, Associate Professor, Delhi School of Economics, Shri S.K.N. Nair, Sr.Consultant, National Council for Applied Economic Research (NCAER), Shri Saurabh Srivastava, Chairman, CA Group, Shri Anil Kumar Gupta, MD, CONCOR, Representative of the Department of Financial Services, Representative of the Ministry of Power, Shri R.K.Jain, CAO/FOIS, Dr. Badrinarayan, GM/UTS, CRIS, MD/RITES

SUB-GROUPS

External/Policy Environment Market Analysis and Demand assessment: Chair: Shri S.K.N.Nair. Sr. Consultant, NCAER Shri Sanjeevan Kapashe, CCE/WCR, Shri Jatin Sarkar, GGM/RITES), Representative of Planning Commission, Shri Manoj Singh, Dy.COM, South Eastern Railway, Shri S.K.Das, ED/TT/F, Ms.Suhash Kumar, Adv/FM, Railway Board, Shri M.K.Reddy, EDPM, Railway Board, Shri Mukesh Nigam, ED/Coaching, Railway Board, Shri Naveen Kumar Shukla, ED/PP- Convener.

Survey of International Experience & Railway Reforms: Chair: Shri M.Ravindra, Former Chairman, Railway Board . Shri Raghu Dayal, AITD, Shri Jit Sondhi, Shri Rajiv Memani, Managing Director, Ernst & Young, Shri.Adil Zainulbhai, MD, Mc Kinsey & Company India, Shri S.K.Mishra, ED/T/PPP, Shri Naveen Kumar Shukla, ED/PP – Convener, Special Invitee: Representative of Country-Head, World Bank.

Capacity Planning and Resource Mobilization: Chair: Shri S.B.Ghosh Dastidar, Former Member Traffic, Railway Board. Shri R.K.Sinha, Director (Finance), DFCCIL, Shri TCA Srinivas Raghavan, Shri Amrit Pandurangi, Price Waterhouse Coopers, Dr.Ram Singh, Professor, Delhi School of Economics, Shri Vinay Singh, ED/Works, Railway Board, Shri Naveen Kumar Shukla, ED/PP, Shri Cherian Thomas, IDFC, Representative of Finance Directorate, Railway Board, Representative of Planning Commission and Ministries of Finance, Shipping and Rural Development, Shri M.Madhusudan Rao, ED/Planning – Convener.

Strategic Planning, Organisational & HR Challenges: Chair: Shri R.Gopal Krishnan, ED, Tata & Sons. Shri R.K. Jain, CAO/FOIS, Prof. Sekhar Chaudhury, Director, IIM, Kolkata, Prof. S. Mani Kutty, IIM, Ahmedabad, Shri R.Mukundan, ED(E)N, Railway Board, Shri S.K. Mishra/ED/T/PPP – Convener.

Technology and High Speed Rail: Chair: Shri M. Ravindra, Former Chairman, Railway Board. Shri R.R.Bhandari, Ex.Member, Mechanical, Railway Board, Adv/Mech/Project, Railway Board, Shri R.M.Lal, AM/Electrical, Railway Board, Shri Rajeev Jyoti, CEO/Bombardier, India, TTCI, USA- Britto Raj Kumar, Shri S.K.Jain, CAO/Const, WR, Representative of DRDO, Shri Jit Sondhi, Shri A.K.Gupta, Advisor(T&E)/RITES, Shri Sumant Chak,, Shri Madhusudan Rao, ED/P, ED/E&R- Convener.

Information Technology: Chair: Shri Saurabh Srivastava. Shri R.K.Jain, CAO/FOIS, Representative of Chairman, ISRO/or Mr.Pai of Infosys, Ms.Achla Sinha, ED/Statistics & Economics, MD, CRIS, Shri Gopal Krishnan, Sr.DCM, Western Railway, Mumbai, R.B Das, ED/C&IS - Convener

Determination of full- costs, Accounting System and Tariff: Chair: Professor S.Sriraman, University of Mumbai . Adv/Rates, Railway Board, Adv/TT/M, Railway Board, Ms.Achla Sinha, ED/Statistics and Economics, Shri Raghu Dayal, AITD, Representative of Ministry of Finance, Representative of Finance Directorate of Railway Board, Dr.R. Badri Narain, GM/UTS, CRIS - Convener

Multi-modal & Non-Bulk Traffic: Chair: Shri R.N.Agha, Former Member Traffic. Shri Anil Kumar Gupta, MD, CONCOR, Association of Container Train Operators (ACTO), Representatives of Ministry of Shipping, Commerce, Road Trasnsport and Highways and Planning Commission, Ms. Suhash Kumar, Adv/FM, Shri H.D.Gujarati, ED/TT/S – Convener.

International rail linkage: Chair: Shri Raghu Dayal, AITD. Shri Sumant Chak, AITD, MD/CONCOR, Shri Naveen Kumar Shukla, EDPP, S.K.Das, ED/TT/F- Convener

Land use optimization: Chair: Shri Sudhir Chandra, Former Member Staff. Shri S.K.Jain, CAO/C/WR, Ms. Samantha Bastian, ED/L&A-I (Convener)

2. ROADS

WORKING GROUP

Chair: Secretary, Ministry of Road Transport and Highways. Shri S. Sundar, Member, NTDPC, Shri D.P. Gupta, Member, NTDPC, Shri B.N. Puri, Member Secretary, NTDPC, Chairman, National Highways Authority of India, Director General (Roads), Ministry of Road Transport and Highways, Principal Secretary (Transport), Government of Andhra Pradesh, Principal Secretary (PWD), Government of

Assam, Joint Secretary (Road Transport), Ministry of Road Transport and Highways, Joint Secretary (Rural Roads), Ministry of Rural Development, Professor Geetam Tiwari, Indian Institute of Technology, Delhi, Shri Partha Mukhopadhyay, Centre for Policy Research, New Delhi, Shri Athar Shahab, Dy. MD, IDFC Projects and Chairman, CII Roads Committee, Shri O.B. Raju, MD, GMR Highways Pvt Ltd, Bengaluru, Shri Parvesh Minocha, MD, Transportation Division, Feedback Ventures, Representative of the Department of Financial Services, Representative of IT Sector, Advisor (Transport Research), Ministry of Road Transport and Highways – Convener

SUB-GROUPS

Estimate the growth in road freight /passenger traffic by 2020 and 2030 and Intermodality issues: Chair: Shri B.N. Puri, Member Secretary, NTDPC. Shri M.M. Hasija, Adviser (Statistics),Ministry of Road Transport & Highways, Transport Research Wing, Dr. Anupam Khanna, Principal Adviser, NTDPC, Shri Jatin Sarkar, General Manager (Economics & Transport), RITES, Convenor.

Road capacity (National/State Highways, Expressway) upto 2020 and 2030; Investment requirement; Mode of financing; Road Pricing (Tolling); PPP policy framework; Implementation Issues; Land acquisition and rehabilitation and; Consolidation and preservation of road assets. Chair: Shri A.V. Sinha, Director General (Roads Development) & Special Secretary, Ministry of Road Transport and Highways. Shri D.P. Gupta (Retd. DG, Roads), Director Roads & Highways, Shri Athar Shahab, Deputy Managing Director, IDFC, Projects, Shri O.B. Raju, MD, GMR Highways Ltd., Shri R.J. Chand, Ernst & Young Pvt. Ltd., Shri Vinayak Chatterjee, Chairman, CII Urbanisation & Future Cities Council, Shri Parvesh Minocha, MD, Transportation Division, Feedback Ventures, Shri V.L. Patankar, Member (Projects), NHAI, Shri J.N.Singh, Member (Finance), NHAI-Convenor.

Energy, environment, technology, modernization of trucking industry and R&D and sustainable transport: Chair: Dr. Surajit Mitra, Additional Chief Secretary(PWD & Water Resources), Government of Assam. Prof. Geetam Tiwari, TRIPP, IIT, Delhi, Shri Anupam Khanna, Principal Adviser, NTDPC, Shri R.Balasubramanian, Director, Central Institute of Road Transport, Pune-Nashik Road,Pune, Shri Partha Mukhopadhyay, Centre for Policy Research, Shri S.R.Marathe, Director, Automotive Research Association of India (ARAI).

Road Safety and HRD: Chair: Shri S.K.Puri, Additional Director General (RD), Ministry of . Road Transport & Highways. Shri Saroj K Dash, Joint Secretary (T&A), Ministry of Road Transport and Highways, Shri S.P. Singh, Principal Secretary (Transport Department), Govt. of Andhra Pradesh, Prof. Geetam Tiwari, TRIPP, IIT, Delhi, Shri Arvind Kumar-Convenor, Adviser (TR), Transport Research Wing, Shri D.P. Gupta (Retd. DG, Roads), Director Roads & Highways, Shri Kamlesh Kumar, Chief Engineer-Convenor, Ministry of Road Transport and Highways.

IT and Data Issues: Chair: Shri Arvind Kumar-Convenor, Adviser (TR), Transport Research Wing, Ministry of Road Transport and Highways. Shri Mahesh Chandra, Deputy Director General,National Informatics Centre (NIC), Shri A.S. Verma General Manager (IT & data issues), NHAI, Shri K. Sen Sarma, Director(TRW), Convenor, Ministry of Road Transport & Highways, Transport Research Wing

Public Transportation and Seamless Freight and Passenger Movement: Chair: Shri Saroj K Dash, Joint Secretary (T&A), Ministry of Road Transport and Highways. Shri S.P. Singh, Principal Secretary (Transport Department), Govt. of Andhra Pradesh, Shri Arvind Kumar-Convenor, Adviser (TR), Transport Research Wing, Ministry of Road Transport and Highways, Shri Partha Mukhopadhyay, Centre for Policy Research, Shri H.M.Naqvi, Head Research & Consulting Division, Central Institute of Road Transport, Pune-Nashik Road,Pune, Shri K. Sen Sarma, Director(TRW), Convenor, Ministry of Road Transport & Highways, Transport Research Wing

Rural Roads: Chair: Dr. P.K. Anand, Joint Secretary, Ministry of Rural Development. Representative from State Governments/NRRDA, Convenor: Director, (Projects), National Rural Road Development Agency

3. CIVIL AVIATION

WORKING GROUP

Chair: Secretary, Civil Aviation. Shri M Kannan, Economic Adviser, Ministry of Civil Aviation, Convenor, Shri K. L. Thapar, Chairman, AITD, Shri Cyrus Guzder, Chairman, AFL Group, Shri B. N. Puri, Member-Secretary, NTDPC, Shri Arvind Jadhav, Managing Director, Air India Limited, Shri E. K. Bharat Bhushan, Director General, Directorate General of Civil Aviation, Shri V. P. Agarwal, Chairman, Airports Authority of India, Dr. Shashanka Bhide, Senior Fellow, National Council for Applied Economic Reaserch (NCAER), Shri Rakesh Gangwal, Former Chairman and CEO, US Airways Group, M/s. InterGlobe Aviation Ltd., Capt. G. R. Gopinath, CMD, M/s. Deccan Cargo & Express Logistics Pvt. Ltd., Shri Sanat Kaul, Chairman, International Foundation for Aviation and Aerospace Development, Shri Sanjay Reddy, MD, (GVK, Mumbai & Bengaluru International Airports), The Secretary, Department of Financial Services, Shri U. G. Krishna, GM, ECTI, Wipro Limited, Shri Kapil Kaul, CEO- Indian Subcontinent & Middle East, Centre for Asia Pacific Aviation (CAPA), Dr Rajat Kathuria, International Management Institute, Shri G. K. Malhi, CoSCA, BCAS

SUB-GROUPS

I. Economic Advisor, Ministry of Civil Aviation, Smt. Savitri, Director, DGCA, New Delhi, Shri S. Raheja, Member, Airports Authority of India, Shri Kapil Kaul, CEO- Indian Subcontinent & Middle East, Centre for Asia Pacific (CAPA), Shri Amitabh Khosla, International Air Transport Association, Dr. Rajat Kathuria, International Management Institute, Shri Arvind Jadhav, Managing Director, Air India Limited, Prof. P. S. Senguttuvan, M/s. Delhi International Airport Limited (DIAL).

II. Director (P), Ministry of Civil Aviation, Director (S), Ministry of Civil Aviation, Shri Lalit Gupta, Director, DGCA, New Delhi, Shri Cyrus Guzder, Chairman, AFL Group, ALF House, Dr. Rajat Kathuria, International Management Institute (IMI).

III. AS&FA,Ministry of Civil Aviation, Joint Secretary (N), Ministry of Civil Aviation, Shri R. P. Sahi, JOG (Retch), DGCA, New Delhi, ED (Training), Airports Authority of India, Shri Arvind Jadhav, Managing Director, Air India Limited, Dr. T. S. Shaikh, J. R. D. Institute of Aviation Management, Shri Tomar, M/s. Kingfisher Airlines Ltd.

IV. Joint Secretary (P), Ministry of Civil Aviation, Dr. Anupam Khanna, Consultant, NTDPC, Dr. Kota. Harinarayanan, Emiritus, Professor, National Aerospace Laboratories, Bangalore, Dr. A. R. Jpadhya, Director, National Aerospace Laboratories, Bangalore, Dr. Prodipto Ghosh, The Energy and Resource Institute (TERI), Shri Somasundaram, Member, Airports Authority of India, Shri Amitabh Khosla, International Air Transport Association, Ms. Harpreet Singh, Air India Ltd

V. Joint Secretary (N), Ministry of Civil Aviation, Shri G. K. Malhi, CoSCA, BCAS, Shri M. S. Bali, Spl. DG (CISF), CGO Complex, Lodhi Road, New Delhi, Shri Arvind Deep, Joint Director IB (MHA), S. Shri D. S. Mathur, Director (Security), Air India Ltd., Shri Gyaneshwar Singh, GM (Security), Airports Authority of India, Shri S. I. S. Ahmed, Security Head, M/s. Delhi International Airport Limited (DIAL), Shri Rajiv Jain, President, M/s Mumbai International Airport Limited.

VI. Joint Secretary (S), Ministry of Civil Aviation, Shri E.K. Bharat Bhushan, Director General of Civil Aviation, Shri G.S. Malhi, CoSCA, BCAS, Shri V.P. Agarwal, Chairman, Airport Authority of India, Air Marshall V.K. Verma (Retd.), Director, Indira Gandhi Rastriya Uran Academy (IGRUA), Shri R.P. Sahi, JDG (Retd.), Director General of Civil Aviation.

4. PORTS AND SHIPPING

WORKING GROUP

Chair: Shri K.Mohandas, Secretary, Ministry of Shipping. Shri Bharat Sheth, Chairman, Great Eastern Shipping Company, Shri B.N. Puri, Member Secretary, NTDPC, Dr. S.B. Agnihotri, DG(Shipping), Dr.Anup K. Pujari, Director General Foreign Trade, Additional Member (Planning), Rail Bhavan, Shri S. Hajara, Chairman & Managing Director, The Shipping Corporation of India Ltd., Shri Rakesh Srivastava, Joint Secretary (Ports) Ministry of Shipping, Shri B.K. Sinha, Chairman & CEO, Gujarat Maritime Board, Shri Anil K. Gupta, Managing Director, Container Corporation of India, Shri S.K. Puri, Additional Director General (Roads), Ministry of Road Transport & Highways, Shri Jimmy Sarbh, Sarbh Consultancy, Mr. Krishna Kotak, G.M. Bakshi & Co., Shri Thomas Netzer, Director, Mckinsey & Company Inc., Shri Arvind Kumar-Convenor, Adviser (TR), Transport Research Wing, Additional Co-opted members were Shri R. Kishore, President, Indian Private Ports & Terminal operators Association, CEO & Director, Vizag Seaport Pvt Ltd., Shri Mark S. Fernandes, Chairman, Shipping & Aviation Committee, Indian Merchant Chamber, Prof G. Raghuram, Indian Institute of Management, Ahmedabad, Prof.S.C. Mishra, Director, National Ship Design & Research Centre (NSDRC), Shri Suresh Kumar Kantholy, General Manager (ODC), Crimson Logic India Pvt.Ltd, Shri Pradeep Roy, Financial expert, Smt Bhupendra Prasad, Chairperson, Inland Water Authority of India (IWAI), Shri A. Janardhan Rao, Managing Director, Indian Ports Association.

SUB-GROUPS

Cargo Traffic, Port Capacity, Investment requirements and review of processes and operation in the Port sector: Chair: Shri Rakesh Srivastava, Joint Secretary (Ports), Ministry of Shipping. Shri Arvind Kumar, Adviser (TR), Transport Research Wing, Dr.ArchanaMathur, Economic Adviser, Ministry of Petroleum and Natural Gas, Shri A. Janardhan Rao, Managing Director, Indian Ports Association, Representative of Ministry of Power, Shri R.Kishore, President , Indian Private Ports & Terminal operators Association, CEO & Director, Vizag Seaport Pvt Ltd., Capt.S.C.Mathur, Chief Nautical Officer, Gujarat Maritime Board, Shri Jatin Sarkar,General Manager (Economics & Transport),RITES, Shri M.M.Hasija, Adviser (Statistics)-Convenor, Ministry of . Road Transport & Highways, Transport Research Wing

Rail Road Connectivity with Ports to look into current status of Port Connectivity, container/freight traffic flows and future connectivity requirements. Chair: Additional Member (Planning), Railway Board. Shri S.K. Puri, Additional Director General (Roads), Ministry of Road Transport & Highways, Shri Anil K. Gupta, Managing Director, Container Corporation of India, Shri A.

Janardhan Rao, Managing Director, Indian Ports Association, Shri B. Poiyaamozhi DA (Ports) –Convenor, Ministry of Shipping.

Data: Chair: Shri Arvind Kumar, Adviser (TR), Transport Research Wing. Shri A. Janardhan Rao, Managing Director, Indian Ports Association, Shri Suresh Kumar Kantholy, General Manager (ODC), Crimson Logic India Pvt.Ltd, Shri J.Murgadas, GM(ERP), Shipping Corporation of India Ltd., Shri M.M.Hasija, Adviser (Statistics)-Convenor, Ministry of Road Transport & Highways, Transport Research Wing

R&D and Technology evolution in Shipping, energy requirements and initiatives to put the shipping sector on a sustainable low carbon path and promote energy efficiency, emission reduction and environment protection: Chair: Prof. S.C.Mishra, Director, National Ship Design & Research Centre (NSDRC). Shri Suresh Kumar, Chief Ship Surveyor, DG, Shipping, Mumbai, Shri J.V.S. Rao, Executive Director, Shipping Corporation of India (SCI), Shri D.J.Basu, Deputy Director, Development Adviser Ports Wing-Convenor, Ministry of Shipping

IT to examine broad areas of IT investment and interface with users: Chair: Shri Janardhan Rao, MD, IPA. Shri J.Murgadas, GM(ERP), Shipping Corporation of India Ltd., Shri Suresh Kumar Kantholy, General Manager (ODC), Crimson Logic India Pvt. Ltd, Shri Rajiev Puri, Deputy Director, IPA –Convenor

Existing framework of PPP, Private financing and bench marking of Indian Shipping and Port operations/practices and efficiency parameters. Chair: Shri Thomas Netzer, Director, Mckinsey & Company Inc. Shri Pradeep Roy, Prof G. Raghuram, Indian Institute of Management, Ahmedabad, Shri A. Janardhan Rao, Managing Director, Indian Ports Association, Smt. Geetu Joshi, Director, Ministry of Shipping, Shri C.S. Venkatraman, Secretary, TAMP-Convenor, Tariff Authority For Major Ports

Status of shipping and requirement, review of processes and operation in shipping, human resource requirement of the maritime sector and related policy issues and regulations: Chair: Dr. S.B. Agnihotri, DG(Shipping), Directorate General of Shipping. Shri S. Hajara, Chairman & Managing Director, The Shipping Corporation of India Ltd, Director General Foreign Trade, Ministry of Commerce, Shri Arvind Kumar, Adviser (TR), Transport Research Wing, Shri Jimmy Sarbh, Sarbh Consultancy, Mr. Krishna Kotak, G.M. Bakshi & Co. Sapt Building, Shri Mark S. Fernandes, Chairman, Shipping & Aviation Committee, Indian Merchant Chamber, Shri Bharat Seth, Chairman, Great Eastern Shipping Company, Shri V.K.Sharma, Chief Controller Chartering, Ministry of Shipping, Shri C. Rathina Das, Deputy Director General, DG Shipping, Directorate General of Shipping –Convenor.

Inland Waterways to look into status, growth in cargo traffic and its composition, future scenario; infrastructure; technical and regulatory issues related to its operation and potential. Chair: Smt Bhupendra Prasad, Chairperson, Inland Water Authority of India (IWAI). Shri Sunil Kumar, Vice Chairman,IWAI-Convenor, Inland Waterways Authority of India, Shri Jimmy Sarbh, Sarbh Consultancy, Shri Krishna Kotak, G.M. Bakshi & Co., Shri Suresh Kumar, Chief Ship Surveyor, DG, Shipping, Mumbai, Shri G.S.Bhalla, Sr Vice President, The Shipping Corporation of India Ltd

5. URBAN TRANSPORT

WORKING GROUP

Chair: Dr. Sudhir Krishna, Secretary, Ministry of Urban Development, Government of India. Shri B. N. Puri, Member Secretary, NTDPC, Planning Commission, Shri R. Gopalan, Secretary, Deptt. of Financial Services, Shri Manu Kumar Srivastava, Principal Secretary, Urban Development, Govt. of Maharastra, Shri Rajiv Chaudhry, Executive Director (WP), Ministry of Railway, Shri P. S. Kharola, Commissioner, Department of Commercial Taxes, Karnataka, Shri S. Sunder, Distinguished Fellow, The Energy and Resource Institute (TERI), Shri B.I. Singal, Director General, IUT, Prof. Dinesh Mohan, Transportation Research & Injury Prevention Programme (TRIPP), Indian Institute of Technology, New Delhi, Prof. Sudhir Chella Rajan, Department of Civil Engineering, India Institute of Technology, New Delhi, Prof. CSRK Prasad, Head Transport Division, NIT, Warangal (AP), Prof. Geetam Tiwari, Associate professor – TRIPP, Indian Institute of Technology, New Delhi, Prof. H. M. Shivanand Swamy, Professor and Associate Director, Centre for Environmental Planning & Technology (CEPT) University, Ahmedabad, Dr. Ashwin Mahesh, Indian Institute of Management, Bengaluru, Shri S. N. Sahai, MD & Chief Executive Officer, DIMMTS Ltd., Shri K. Ramchand, Director, M/s ILFS, Shri Vinayak Chatterjee, MD & CEO, M/s Feedback Ventures, Shri Ajai Mathur, MD, UMTC, Shri C. N. Raghupati, Vice President, M/s Infosys, Shri. S. K. Lohia, Convenor, OSD (UT) and EO Joint Secretary, Ministry of Urban Development, Government of India

SUB-GROUPS

Need Assessment: Prof. Shivanand Swamy, CEPT, Shri S.Sunder, TERI, Prof. Dinesh Mohan, IIT Delhi, Prof. Geetam Tiwari, IIT Delhi, Shri Ajai Mathur, MD, Urban Mass Transit Company, Prof. C.S.R.K Prasad, NIT, Warangal, and Prof. Sudhir Chella Rajan, IIT, Madras.

Financing mechanism for UT needs: Shri Vinayak Chatterjee, MD, M/s Feed Back Ventures, Shri K.

Ramachandaran, MD, ITNL, Shri S.N. Sahai, MD, DIMTS, Prof. Shivanad Swamy, CEPT, Ahemdabad, and Shri P.S.Kharola, Commissioner, DoCT, Bangalore.

Energy & Environment: Shri S.Sunder, TERI, Prof. Sudhir Chella Rajan, IIT, Madras.

Capacity Building: Prof. Ashwin Mahesh, IIM, Bangalore, Prof. Dinesh Mohan, IIT, Delhi, Prof.C.S.R.K Prasad, NIT, Warangal, and Prof. Ashwin Mahesh, IIM, Bangalore.

IT Applications: Prof. Ashwin Mahesh, IIM, Bangalore, Shri C.N.Raghupathi, Infosys, Prof. R. Shivanandan, IIT, Madras, and Shri S.N.Sahai, MD, DIMTS.

Accessibility, Safety & Security. Prof. Geetam Tiwari, IIT, Delhi, Shri B.I.Singal, DG, IUT, Prof. C.S.R.K Prasad, NIT, Warangal, Prof. Dinesh Mohan, IIT Delhi, and Shri E. Sreedharan, MD, DMRCL.

Institutional Framework: Shri S. Sunder, TERI, Shri Ajai Mathur, MD, UMTC, Shri S. N. Sahai, MD, DIMTS, Prof. Shivanand, CEPT, Ahemdabad, and Shri P. S. Kharola, Commissioner, DoCT, Bangalore.

6. NORTH EAST

WORKING GROUP

Chair: Shri Vivek Sahai, former Chairman, Railway Board. Chairman, Inland Waterways Authority of India, Director General (Roads), Ministry of Road Transport and Highways, Lt. Gen. M.C. Badhani, VSM, DG, BRO, Shri Rohit Nandan, Joint Secretary, Ministry of Civil Aviation, Shri Harsh Vardhan Shringla, Joint Secretary (BSM), Ministry of External Affairs, Executive Director (Projects), Rail way Board, Prof. Mahendra P. Lama, Vice Chancellor, University of Sikkim, Shri U.K. Sangma, Secretary, North Eastern Council, Dr. Manoj Singh, Advisor, Transport, Planning Commission, Representative of Central Board of Excise and Customs, Representative of Asian Institute of Transport Development

7. INTEGRATED STRATEGY FOR BULK TRANSPORT OF ENERGY AND RELATED COMMODITIES IN INDIA

WORKING GROUP

Chair: Shri P. Uma Shankar, Secretary, Ministry of Power. Shri Pradeep Bhatnagar, Additional Member (Traffic), Railway Board, Shri H.D. Gujarati, Executive Director, Railway Board, Shri Shailesh Kumar Singh, Joint Secretary, Ministry of Coal, Shri Arvind Kumar, Economic Advisor, Ministry of Shipping, Shri Udai Pratap Singh, Joint Secretary, Ministry of Steel, Dr. (Ms) Archana S. Mathur, Economic Advisor, Ministry of Petroleum and Natural Gas, Shri Nitin Gokarn, Joint Secretary, Ministry of Road Transport and Highways, Dr. Nalini Bhat, Advisor, Ministry of Environment and Forests, Shri Manoj Ahuja, Principal Secretary, State Government of Orissa, Shri S. Bhattacharya, Principal Secretary, State Government of Andhra Pradesh, Shri Navneet Sehgal, Principal Secretary, State Government of Uttar Pradesh, Ms Neerja Mathur, Chief Engineer, Central Electricity Authority, Shri Harry Dhaul, DG, IPPAI, Shri S S Ramgarhia, Director, Petrofed, Shri Dileep Bhat, President, Jindal Steel Ltd, Shri Major Singh, CEA, Dr. Anupam Khanna, Principal Advisor, NTDPC, Convener and Shri Sudhir Kumar, Joint Secretary, Ministry of Power, Co-Convener.

SUB-GROUPS

Demand Scenarios: Chair: Shri Major Singh, Chief Engineer. Shri D.N. Prasad, Director, Ministry of Coal, Shri Sukhvir Singh, Director, Ministry of Petroleum & Natural Gas, Shri A.S. Firoz, Chief Economist, ERU, Ministry of Steel, Shri Rama Rao, Director, GRID, Govt. of Andhra Pradesh, Shri S.K. Agarwal, Director Finance, Department of Energy Government of Uttar Pradesh, Dr. Ritu Mathur, Associate Director, Modelling & Economic Analysis Division, The Energy and Resources Institute (TERI), Shri Bibhu Biswal, Independent Power Producers Association of India (IPPAI), Dr. Anoop Singh, Associate Professor, Energy, Infra. & Finance, IIT Kanpur, Shri Vikas Singhal, Head-Power & Fuel, ICF International.

Location of Production Facilities & Transfer Sites: Chair; Ms. Neerja Mathur, Chief Engineer, IRP Division, Central Electricity Authority. Shri D.N. Prasad, Director, Ministry of Coal, Shri N.R. Dash, Director, Ministry of Steel, Shri Arvind Kumar, Adviser (Transport), IDA Building, Shri P.L. Ahujarai, Director (PLA), Ministry of Environment & Forests, Shri Raghavendra Upadhyay, Senior Vice President, Independent Power Producers Association of India (IPPAI), Shri S.K. Chand, Senior Fellow, The Energy and Resources Institute (TERI), Dr. Anoop Singh, Associate Professor, Energy, Infra. & Finance, IIT Kanpur, Shri A.K. Varshney, Director, P&C (Parliament work), Ministry of New and Renewable Energy, Shri Vikas Singhal, Head-Power & Fuel, ICF International

Optimizing Fuel and Electricity Delivery System Networks: Chair: Shri Ranjan Jain, Adviser (Infrastructure), Railway Board, Ministry of Railways. Shri M.M. Hasija, Adviser (Transport), Ministry of Shipping, Shri Nitin Gokaran, Joint Secretary, Transport Bhawan, Ministry of Road Transport & Highways, Shri Manoj Ahuja, Commissioner–cum-Secretary, Department of Steel & Mines, Government of Orissa, Shri D.J. Pandian, Principal Secretary, Energy, Government of Gujarat, Shri Ramesh Kumar Khanna, Principal Secretary, Department of Energy, Government of Tamil Nadu, Shri Pradeep Jindal, Director, System Planning & Project Appraisal, Central Electricity Authority, Shri D.N. Prasad. Director, Ministry of Coal, Professor Yogesh K. Agarwal, Chairman, Decision Science, IIM Lucknow, Shri Vikas Singhal, Head-Power & Fuel, ICF International

Oil & Gas Pipelines & Terminals: Chair: Shri Vivek Kumar, Joint Secrtetary, Ministry of Petroleum & Natural Gas. Shri M.M. Hasija, Adviser (Transport), Ministry of Shipping, Shri Ajay Mishra, Pr. Secretary, Infrastructure & Investment Department, Government of Andhra Pradesh, Shri Anil Jain, Special Commissioner, Government of Madhya Pradesh, Shri Sukhbir Singh, Director, Ministry of Petroleum & Natural Gas, Shri S.P. Gupta, Director (Finance)/(I/C), Petroleum Planning & Analysis Cell (PPAC), Ministry of Petroleum & Natural Gas, Government of India, Prof. Priyadarshi Shukla, IIM, Ahmedabad, Shri P.K. Pal, Executive Director (Project Development), GAIL India Limited, Shri Rakesh Jain, Associate Director, Feedback Infrastructure Services Private Limited, Shri P. Raghvendran, Reliance Industries Limited, Shri S.N. Sukhwal, Deputy General Manager (Corporate Planning & Economic Studies), Shri Rahul Gautam, Dy. General Manager (Project Development), GAIL India Limited, Shri S.K. Jha, Chief Projects Manager (System), Pipelines, Shri Prabal Ghosh, Research Analyst, Integrated Research and Action for Development (IRADe)

Material Transport Needs of the Iron & Steel Industry: Chair: Shri Udai Pratap Singh, Joint Secretary, Ministry of Steel. Sanjay Misra, Adviser (Transport & Economics), RITES, Shri Arvind Kumar, Adviser (Transport), Ministry of Road Transport and Highways, Shri D.N. Prasad. Director, Ministry of Coal, Shri Dileep Bhatt, President, Corporate Affairs, Jindal Steel Limited, Shri Chanakya Choudhary, Tata Steel

ANNEX P.4

WORLD BANK TECHNICAL ASSISTANCE

1. LIST OF PAPERS SUBMITTED BY THE WORLD BANK

Railways (Mr. Paul Amos):

Summary Paper on Railways

1. Freight Railways Governance, Organizations and Management: An International Round-up
2. Passenger Railway Institutions and Financing: China, Germany, Japan and Russian Federation

Highways (Mr. Clell Harral)

Summary Paper on Highways by Kumares C. Sinha and Samuel Labi (Purdue University) and Clell Harral (Harral Winner Thomson Sharp Klein, Inc.)

1. Road Asset Management by Clell Harral, Graham Smith and William D.O.Paterson.
2. Government Policies to Encourage Energy-Efficient Vehicles on Roads by Kumares C. Sinha, Mohammad H. Arman, and Samuel Labi
3. Cost-Effective Standards for Different Types of Roads by Kumares C. Sinha, Samuel Labi and Menna Noureldin.
4. Intelligent Transportation Systems: Kumares C. Sinha, Samuel Labi, and Eleni Bardaka
5. Institutional and Regulatory Frameworks for Free Movement of Commercial Highway Vehicles Across States/Provinces by Kumares C. Sinha, Samuel Labi, and Bismark R.D.K. Agbelie
6. Traffic-Based Benchmarks for Widening Of National Highways versus Construction of Expressways by Kumares C. Sinha, Samuel Labi, and Qiang Bai
7. Direct Charging Mechanisms for Highway Use by Kumares C. Sinha, Samuel Labi, and Mohammad Arman
8. National Transportation Planning: Lessons from the U.S. Interstate Highways by Marlon G. Boarnet, Departments of Planning Policy, and Design and Economics, University of California, Irvine, and School of Policy, Planning, and Development, University of Southern California
9. Improving Road Safety Performance: Lessons From International Experience by Tony Bliss and Jeanne Breen
10. PPP in Transport: An Evaluation And Lessons From Twenty Years Of Experience-by Jose Luis Guasch

Ports & Shipping (Mr. Marten van den Bossche):

1. India Port Sector Policy Review Study: Policy papers, case study and capita selecta draft report by Marten van den Bossche , Eric van Drunen , Katrien Dusseldorp , Johan Gille and Hans Vogelaar

Urban Transport (Mr. Ken Gwilliam)

Summary Paper on Urban Transport

1. Overview Paper-The Issues for India
2. Financing Urban Transport
3. Costs of Externalities
4. Energy Efficiency in Urban transport
5. Developing public transport
6. Institutions for urban transport
7. Intelligent Transport Systems-Applications in urban areas
8. Case Studies in Urban Transport Development

2. DETAILS OF INTERNATIONAL CONFERENCES

February 6-8, 2012: Practitioners' Workshop: National Transport Development Policy Committee (NTDPC)

Monday, February 6, 2012

8:30-9:30 Registration & Coffee

Plenary Session:

Chair: Dr. Rakesh Mohan, Chairman, NTDPC

9:30-9:45 Opening remarks

	Dr. Rakesh Mohan, Chairman, NTDPC
9:45-10:00	Welcome address Mr. Hubert Nove Josserand, Operations Adviser, World Bank
10:00-10:20	Key Note Speaker : Developing Sustainable Transport Infrastructure in India Mr. B. K. Chaturvedi, Member, Planning Commission
10:20-10:50	Overview of Integrated Transportation Planning - EU TENt experience Mr. Mathew Arndt, Head of Division of Road and Rail, European Investment Bank
10:50-11:00	Vote of Thanks Mr. B. N. Puri, Member Secretary, NTDPC
11:00-11:30	Coffee Break

Session on Highways, PPPs and Safety:
Chair: Mr. S. Sundar, Member, NTDPC, Co-Chair: Mr. D.P. Gupta, Member NTDPC,
Facilitator: Dr. Kumaresh C. Sinha and Mr. Anil Bhandari

11:30-12:30	Presentation on Highways: International Lessons and comment on the resource papers presented by the Bank Mr. Nazir Alli, CEO, South Africa National Road Agency Limited & Mr. William Dachs, Ex Head of PPP Unit, National Treasury, South Africa
12:30-1:30	Lunch Break
1:30- 1:45	Highlighting the key issues relevant for long term planning in the highway sector India – presentation by the Bank Consultants Dr. Kumares C. Sinha, Director, Joint Transportation Research Program of Purdue University and the Indiana Department of Transportation & Mr. Anil Bhandari, Ex Highway Advisor, World Bank
1:45-1:55	Highlighting the key issues relevant for Road safety in India – presentation by the Bank Consultant Mr. Tony Bliss, Ex Lead Road Safety Specialist, The World Bank
1:55-2:05	Highlighting the Key Aspects of Regulatory Framework for Developing Highway Infrastructure through PPPs in India – presentation by the Bank Consultant/Staff Mr. Jose Louis Guasch, Senior Regional Adviser in the LAC region, The World Bank
2:05-4:30	Open Forum – Discussion on Key Issues in the Highway Sector Session (Moderated by the Chair)

Tuesday, February 7, 2012
Session on Urban Transport
Chair: Secretary, Urban Development Ministry, Co-Chair: Prof. Dinesh Mohan, Member, NTDPC, Facilitator: Mr. Ken Gwilliam

9:30-9:50	Key Note Speaker: Issues and Challenges in Urban Transport Sector in India Mr. Arun Maira, Member, Planning Commission
9:50 – 10:30	Presentation on Urban Transport International Lessons and comment on the resource papers presented by the Bank Mr. Dayo Mobereola, Director, Lagos Metropolitan Transport Authority, Nigeria
10:30 – 11:00	Presentation on Urban Transport International Perspectives Mr. F.Q. Partida, Project Manager, Mass Transport, National Development Bank of Infrastructure, Mexico
11:00-11:15	Highlighting the key issues relevant for long term planning for the urban transport sector India – presentation by the Bank Consultant Mr. Kenneth Gwilliam, Visiting Professor at the Institute for Transport Studies, University of Leeds
11:15-11:30	Coffee Break
11:30-1:00	Open Forum – Discussion on Key Issues in the Urban Transport Sector Session (Moderated by the Chair)
1:00-2:00	Lunch Break

Session on Railways
Chair: Chairman, Railway Board, Co-Chair: Mr. M. Ravindra, Member NTDPC,
Facilitator: Mr. Paul Amos

2:00-3:00	Presentation on Passenger and Freight Railways: International Experience and comment on the resource papers presented by the Bank Mr. John Thomas, Rail Regulation Specialist, Arcadia, United Kingdom
3:00 – 3:15	Highlighting the key issues relevant for long term planning in India – Freight and Passenger Railways - Presentation by the Bank Consultant Mr. Paul Amos, Consultant to the World Bank
3:15-3:30	Coffee Break
3:30-5:00	Open Forum – Discussion on Key Issues in the Railway Sector Session (Moderated by the Chair)
5:30 onwards	Informal Reception

Wednesday, February 8, 2012
Session on Ports
Chair: Ms. Rani Jadhav, Chairperson, TAMP, Co-Chair: Mr. K. L. Thapar, Member NTDPC, Facilitator: Mr. Marten Van Der Bossche

9:30-10:15 Presentation on Port Regulation – International perspective
Mr. Christiaan Van Krimpen, International Legal Counsel

10:15 – 10:45 Presentation on Ports: International Perspective on long term Port Planning
Mr. John DM Koppies, Koppies and Stevens BV, Nederland

10:45-11:00 Highlighting the key issues relevant for long term Port planning in India – Presentation by the Bank Consultant
Mr. Marten Van Der Bossche, Chairman, ECORYS, Nederland

11:00-11:30 Coffee Break

11:30-1:00 Open Forum – Discussion on Key Issues in the Port Sector
Session (Moderated by the Chair)

1:00-2:00 Lunch Break

Session on Intermodal transport and Concluding Session
Chair: Dr. Rakesh Mohan, Chairman, NTDPC

2:00-2:45 Presentation on Intermodal Coordination: International Best Practices
Mr. Stephen Perkins, Head of Research Centre, International Transport Forum (ITF)

2:45- 3:30 Presentation on Intermodal-Coordination, US Experience
Mr. Rakesh Tripathi, Director of Transportation Planning, Texas DOT, USA

3:30-4:30 Presentation of Key findings from the workshop and Way Forward -
Dr. Rakesh Mohan, Chairman, NTDPC
Mr. Ben L. J. Eijbergen, Lead Transport Specialist, World Bank
Members/Member Secretary, NTDPC

4:30-4:45 Concluding Remarks
Mr. Montek Singh Ahluwalia, Deputy Chairman, Planning Commission

June 15, 2012

Workshop on "Developing Integrated Strategy for Bulk Transport of Energy and other Key Commodities in India": National Transport Development Policy Committee (NTDPC)

Venue: Multi-Purpose Room, India International Centre (Main)

Agenda

Friday, June15, 2012

9:00-9:30 Registration & Coffee

Plenary Session:
Chair: Mr P. Uma Shankar, Secretary , Ministry of Power

9:30-9:45 Opening remarks
Mr. P. Uma Shankar, Secretary, Ministry of Power

9:45 – 10:00 Welcome address
Mr. Hubert NoveJosserand, Operations Adviser, World Bank

10:00-10:45 Setting the Context – Medium- and Long-Term Issues in Transport of Energy &Bulk Commodities in India
Dr. Anupam Khanna, Chief Economist, NASSCOM and Convener, Working Group on Bulk Transport, NTDPC

10:45-11:00 Coffee Break

Session on International Experiences in Integrated Transportation Planning for Bulk Commodities - I:
Chair: Mr S.K. Srivastava, Secretary, Ministry of Coal; Discussant: Mr Ranjan Jain, Advisor (Infrastructure), Railway Board

11:00-11:45 Presentation on International Lessons in Bulk Transport of Energy and Related Commodities from the United Kingdom

11:45-12:00 Questions & Answers
Mr. Paul McMahon, Office of Rail Regulation, UK

12:00-12:45 Presentation on International Comparison of Bulk Transport by Rail
Questions & Answers

12:45- 1:00 Mr. Ralph Jahncke, Chairman, Trancare AG, Germany

1:00-2:00 Lunch Break

Session on International Experiences in Integrated Transportation Planning for Bulk Commodities - II:
Chair: Mr. A.S. Bakshi, Chairman, Central Electricity Authority; Discussant: Mr H.D. Gujrati, Executive Director (TTS), Railway Board

2:00-2:45 Presentation on International Lessons in Bulk Transport of Energy and Related Commodities from China

2:45-3:0 Questions & Answers
Dr. Zhaoguang Hu, Vice President, State Grid Energy Research Institute, Republic of China

3:00-3:15 Coffee Break (During Session)

3.15-4.00 Presentation on Lessons for India from Other Major Coal Transporting Countries
Questions & Answers

4.00-4.15 Mr. Ralph Jahncke, Chairman, Trancare AG, Germany

Concluding Session:
Chair: Dr Rakesh Mohan, Chairman, NTDPC

4:15-5.15 Key Conclusions from the Workshop and Way Forward
Dr.AnupamKhanna, Chief Economist, NASSCOM and Convener, Working Group on Bulk Transport, NTDPC; All International Presenters.

5.15-5..30 Vote of Thanks
Mr. B. N. Puri, Member Secretary, NTDPC

ANNEX P.5

SOUTH-SOUTH TOUR TO SOUTH AFRICA

NTDPC - South-South tour to South Africa

Schedule - March 19 to March 28, 2012

Time	Official/Dept. to be met	Team	Venue	
	Monday March 19, 2012			
	Fly to Addis from New Delhi by Ethiopian Airlines ET 689, leaving 0245 AM, Reaching Johannesburg at 13:20 PM, stay in **Sheraton Pretoria Hotel**			
	Tiesday March 20,			
3:00 PM	Meeting with Deputy Minster, Minstry of Transport	Indian Delegation	Minstry of Transport, Pretoria	
7:00 PM	Dinner Hosted by SANRAL			
	Wednesday, March 21, 2012			
9:00 AM	Meeting with SANRAL Management Team	Indian Delegation	SANRAL Office, Johannesburg	
11:00 AM	Visit to SANRAL Overload Control Center	Indian Delegation	SANRAL Overload Control Center	
12:30 PM	SANRAL multi-lane toll system and ITS , Working	Indian Delegation	SANRAL Central Corridor Station	
4:00 PM	Back to Pretoria			
	Thursday, March 22, 2012			
7:00 AM	Travel to Expressway N4, proceed to Malelane and visit Kruger National Park, stay the night in Nelspruit **Leaveslodge Hotel**			
	Friday, March 23, 2012			
8:00 AM	Meet CEO MCLI (and officials from	Indian Delegation	MCLI office, Nelspruit	
9:00 AM	Proceed to Maputo, Working Lunch	Indian Delegation		
3:00 PM	Return to Nelspruit	Indian Delegation	Stay the night in Nelspruit in **Leaveslodge Hotel**	
	Saturday, March 24, 2012			
	Return to Johannesburg by Road, Fly to Capetown by SA 347, stay in **Taj Hotel Cape Town** , departure 15:05 PM, Arrival in CT 1715			
	Sunday, March 25, 2012			
	Monday, March 26,			
9:00 AM	Meeting with CEO, Port Regulator	Indian Delegation	To be confirmed	
11:00 AM	Visit to cape Town Port	Indian Delegation	To be confirmed	
	Tuesday, March 27, 2012			
	Fly to Johannesburg by SA 316 Departing from Capetown at 08:50 a.m., arriving in Johannesburg at 10:50			
	Fly to New Delhi via Addis, ET 808, departing J'burg 14: 20 PM			
	Wednesday, March 28, 2012			
	Arriving in Delhi at 9:10 AM			

ANNEX P.6

LIST OF PARTICIPANTS AT CONSULTATIONS WITH STATE GOVERNMENTS

1. State Consultation at Patna on October 8 - 9, 2012

	Name of the Officer	Designation	Ministry/Department/ Organisation
NTDPC			
	Shri K.L. Thapar	Member	NTDPC
	Shri D.P. Gupta	Member	NTDPC
	Shri B.N. Puri	Member Secretary	NTDPC
	Shri M.M. Hasija	Adviser	Ministry of Shipping
	Shri Shri R.K. Pandey	Chief Engineer	Ministry of Road Transport & Highways
	Shri Davendra Singh	Director	Ministry of Railways
	Shri Dipankar Khasnabish		Infosys
	Dr. Krishna Dev	Consultant	NTDPC
	Ms. Shruti Jain	Consultant	NTDPC
Government of Bihar			
	Shri Vrishin Patel	Hon'ble Transport Minister	
	Shri R.K. Mahajan	Pr. Secretary, Transport	Govt. of Bihar
	Shri Pratyaya Amrit	Secretary	Road Construction Deptt., Bihar
	Shri Udai Kumawat	Administrator	BSRTC
	Shri N.P. Yadav	Joint Secretary	Transport Department, Patna
	Md. Reyazuddin	Executive Engineer	BRRDA, Rural Works Department, Bihar, Patna
	Shri Chandra Shekhar		Road Construction Deptt., Bihar
	Shri Babban Ram		Road Deptt., Bihar
	Dr. Neena Jha	ADPRO	Govt. of Bihar, Patna
Government of Chhattisgarh			
	Shri Sanjay Singh	Jt. Tpt. Commissioner	Chhattisgarh, Raipur
Government of Jharkhand			
	Shri A.K. Sinha	Secretary to Transport Commissioner	
	C.B. Sahu	Programme-cum	
Government of Odisha			
	Shri S. Mahapatra	Commissioner & Spl. Secretary, C&T Deptt.	
Ministry of Railways			
	Shri Neeraj Ambastha	Chief Transport Planning Manager	
Ministry of Civil Aviation			
	Shri Arvind Dubey	Director, AAI	
Ministry of Shipping			
	Shri Gurmukh Singh	Director	IWAI, Patna
	Shri K.K. Sahoo		IWAI, Patna
Urban Development Department, Bihar			
	Shri S. Siddharth	Secretary	Urban Development Department
	hri A.K. Singh	Joint Secretary	UD &HD
Stakeholders from State of Bihar			
	Shri T.K. Sinha	Hony. Secretary	Automobile Association of Eastern India, Patna
	Shri Anand K. Sinha	Hony. Joint Secretary	-do-
	Shri Amit Mukherjee	Member	-do-
	Shri Jagannath Singh		Bihar Motor Transport Federation, Patna
	Shri Dhirendra Bhati		Bihar Motor Transport Federation, Patna
	Shri Prabhat P. Ghosh	Director	Asian Development Research Institute, Patna
	Shri Bhanu Shekhar Prasad Singh	President	Bihar Truck Owner's Association, Patna
	Shri Shashi Shekhar	Member	-do-
	Shri Arun Kumar	Principal	NINI (IWAI)
	Shri Uday Shankar Singh	President	-do-
	Shri Irfan Alam	Founder	Sammaan Foundation

2. **State Consultation at Mumbai on February 4 - 5, 2013**

Name of the Officer	Designation	Ministry/Department/ Organisation
NTDPC		
Shri B.N. Puri	Member Secretary	NTDPC
Shri D.P. Gupta	Member	NTDPC
Shri Vivek Sahai	Member	
Shri Cyrus Guzdar	Member	NTDPC
Shri SK Lohia	OSD (UT)	M/o Urban Development
Shri M.M. Hasija	Adviser	Ministry of Shipping
Shri Anil Devli	CEO	INSA
Shri Kripakaran		Infosys
Dr. Krishna Dev	Consultant	NTDPC
Shri Honey Gupta	Consultant	NTDPC
Government of Maharashtra		
Shri Gulabrao Deokar	Hon'ble Transport Minister	
Shri JK Banthia	Chief Secretary	Government of Maharashtra
Dr. SK Sharma	Pr. Transport Secretary	Government of Maharashtra
Shri VN More	Transport Commissioner	Government of Maharashtra
Ms. K Vijaya Laxmi	Addl. Chief	MMRDA
Government of Madhya Pradesh		
1. Shri Anthony Desa	Addl. Chief Secretary	Government of MP
4. Government of Goa		
1. Shri Arun Desai	Director (Transport)	
Government of Gujarat		
1. Shri JP Gupta	Transport Commissioner	
UT of Dadra & Nagar Haveli and Daman & Diu		
1. Shri KT Parmar	Assistant Director, Transport	
Stakeholders from State of Maharashtra		
1. Shri Nitin Dossa	Executive Chairman	Western India Automobile Association
2. Shri Shirish Deshpande	President	Mumbai Grahak Panchayat
3. Shri Malkit Singh Bal	President	All India Motor Transport Congress
4. Shri Shashank Rao	President	Mumbai Autorickshawmens Union
5. Shri AL Quadros	General Secretary	Mumbai Taximen's Union
6. Shri Anil Garg	President	Bus Owners Association
7. Shri Prem Singh	President	Mumbai Taxi Association
8. Shri Ashok Datar	Chairman	Mumbai Environment Social Network
9. Shri Akshay Mani	Project Manager, Urban Transport	Embarq India
10. Shri Madhav Pai	Director	Embarq India
11. Shri Bhavesh Patel		Manavata
12. Shri Shailesh Goyal	Member Zonal Railway	
13. Shri Sudhir Badami	Transport Consultant	
14. Shri Daljeet Singh	President	Maharashtra Transporter's Welfare Association
15. Shri DS Naik	Secretary	School Bus Owner Association
16. Brahma Kumaris	Transport & Travel Wing	Brahma Kumaris

3. **State Consultation at UT of Chandigarh on May 27, 2013**

NTDPC		
Shri K.L. Thapar	Member	NTDPC
Shri B.N. Puri	Member Secretary	NTDPC
Shri D.P. Gupta	Member	NTDPC
Shri M.M. Hasija	Adviser	Ministry of Shipping
Shri OP Shemar	Adviser	M/o Road Transport & Highways
Shri Devendra Singh	Ed/Planning	Ministry of Railways
Dr. Krishna Dev	Consultant	NTDPC
Shri Honey Gupta	Consultant	NTDPC

Name of the Officer	Designation	Ministry/Department/ Organisation
Government of UT of Chandigarh		
Shri Ajoy Sharma	Special Secretary (Tpt.)	Govt. of Chandigarh
2. Shri MM Sabharwal	Joint Secy. (Transport)	Govt. of Chandigarh
3. Shri Balbir Singh Dhol	Secy, STA	Govt. of Chandigarh
4. Shri Sanjay Gaur	Executive Engg.	M/oRT&H Regional Office, Chandigarh
5. Shri Mahesh Kumar	EIC, PW(B&R)	Govt. of Chandigarh
6. Shri SP Parmar	GM, CTU, Chd	Govt. of Chandigarh
Government of Haryana		
1. Shri Bhupendra Singh	Addl. Transport Commissioner	Govt. of Haryana
2. Shri NK Garg	Chief Engg,	ULB, Govt. of Haryana
3. Shri AK Bhardwaj	DSP Traffic, Highways (Karnal)	Govt. of Haryana
4. Shri Rakesh Sharma	Traffic & Highways, Karnal	Govt. of Haryana
5. Shri Gurmeet Singh		Govt. of Haryana
6. Shri Mandeep		Govt. of Haryana
7. Shri Jitender Singh	Sr. Town Planner	T&CP Deptt., Govt. of Haryana
8. Dr. Parveen K. Garg	Director, Health Service	Govt. of Haryana
9. Shri Deepak Bhardwaj	Chief Ground Instructor (HICA)	Haryana Institute of Civil Aviation
10. Capt. Kamal Kishor	Executive Director	Haryana Institute of Civil Aviation
11. Shri Naresh Kumar	Admn. Officer	Haryana Institute of Civil Aviation
12. Shri SB Boora	CE,	PWD, Govt. of Haryana
13. Shri Satish Kumar Ruhil	Jt. State Transport Controller	State Tpt., Haryana
Government of Himachal Pradesh		
1. Ms. Shubhra Tiwari	Addl. Secy. (Transport)	Govt. of Himachal Pradesh
Government of Jammu and Kashmir		
1. Shri MM Kakroo, IAS	Secretary, Transport	Govt. of J&K
2. Shri JS Tandon	MD, J&K SRTC	Govt. of J&K
Government of Punjab		
1. Shri A. Venu Prasad	Secretary, Civil Aviation, Punjab	Govt. of Punjab
2. Shri Amarpal Singh	Addl. Secretary, Transport	Govt. of Punjab
3. Shri Harmail Singh	Addl State Tpt Commissioner	Govt. of Punjab

4. State Consultation at Jaipur, Rajasthan on August 1, 2013

NTDPC		
Shri K.L. Thapar	Member	NTDPC
Shri B.N. Puri	Member Secretary	NTDPC
Shri S Sundar	Member	NTDPC
Shri DP Gupta	Member	NTDPC
Prof Dinesh Mohan	Member	NTDPC
Dr. Krishna Dev	Consultant	NTDPC
Shri Honey Gupta	Consultant	NTDPC
Shri Kripakaran		Infosys
Government of Delhi		
Shri Raj Kumar Singh	Addl Transport Commissioner	Govt of Delhi
Government of Rajasthan		
Shri RP Khandelwal	Secretary,	PWD
Shri Naresh Pal Gangwar	CMD	RSRTC
Shri GL Rao	CE (R)	PWD
Shri GP Meena	CTPM/NWR	Railways
Shri SP Mishra	Addl Transport Commissioner	Govt of Rajasthan
Shri JC Mohanty	Pr Secretary	PWD
Shri Viswas Jain	MD, CEG	
Shri Vishram Meena	ED	RSRTC
Shri Mukul Raj	Addl Transport Commissioner	Govt of Rajasthan
Shri Gorrmal	PRO	Govt of Rajasthan
Dr UN Pandey	MS	RSPCB

Name of the Officer	Designation	Ministry/Department/ Organisation
Shri RRD Kirori	CEG Limited	
Ms Preeti Mathur	OSD, JSTSL	
Ms Suchi Sharma	MD	JCTSL
Shri Suresh Singhal	FA, Transport Deptt	Govt of Rajasthan
Shri Ravindra Yadav	Dy. Transport Commissioner (Modernisation)	Govt of Rajasthan
Shri RC Yadav	Dy. Transport Commissioner (Tax)	Govt of Rajasthan
Shri Satveer Yadav	Dy. Transport Commissioner	Govt of Rajasthan
Ms Nidhi Singh	Dy. Transport Commissioner	Govt of Rajasthan
Shri DS Rathore	Addl Transport Commissioner	Govt of Rajasthan
Shri Ravindra Joshi	Addl. Transport Commissioner	Govt of Rajasthan
Government of Uttar Pradesh		
Shri BS Bhullar	Pr. Secretary, Transport	Govt. of Uttar Pradesh
Shri Rajnish Gupta	Transport Commissioner	
Government of Uttarakhand		
Shri SK Singh	Dy. Transport Commissioner	Govt of Uttrakhand

5. State Consultation at Bangalore, Karnataka on August 26, 2013

NTDPC		
Shri S Sundar	Member	NTDPC
Shri B.N. Puri	Member Secretary	NTDPC
Shri D.P. Gupta	Member	NTDPC
Shri Vivek Sahai	Former Chairman	Railway Board
Prof Dinesh Mohan	Member	NTDPC
Ms Archana Srivastava	ED/Plg/LRDSS	
Shri Raj Kumar Singh	Director (UT)	Ministry of Urban Development
Shri OP Shemar	Adviser	M/o Road Transport & Highways
Shri Devendra Singh	ED/Planning	Ministry of Railways
Dr. Krishna Dev	Consultant	NTDPC
Ms Shruti Jain	Consultant	NTDPC
Shri Dipankar Khasnabish		Infosys
Shri Kripakaran		Infosys
Shri Ramesh K Sharma	AAO	NTDPC
Government of Andhra Pradesh		
1 Shri G. Anantha Ramu	Commissioner (Transport)	Govt of Andhra Pradesh
Government of Karnataka		
Shri SV Ranganath	Chief Secretary	Govt of Karnataka
Shri Rajkumar Khatri	Pr Secretary, IDD	Govt of Karnataka
Shri SK Pavithra	Superintendent Engg.	Office of KRDCL, Bangalore
Shri B. Chandapur	Under Secretary (EAP)	PWD
Shri Shivananda	Dy Chief Engineer	BMRCL
Shri C. Jayaram	Director (Project)	BARL
Shri Shailendra Singh	Special Officer, DLLT	UDD
Ms V Manjula	Pr Secretary, Planning	Govt of Karnataka
Shri NRN Sinha	KSIDC	
Shri Anjum Parwez	MD	BMTC
Shri MB Burji	Addl Secretary	KPWD
Shri PS Kharola	MD	BMRCL
Shri Rabi Satav	PPP (E) in IDD	ADB
Shri Manivannam P	CPO	Karnataka State Highway Improvement Project
Shri SN Srivastava	CS, HMRDC	K-RIDE
Shri G. Sreedhar Rao	Consultant	K-RIDE
Shri Pon. Semhalmathan	Assistant Secretary	State Transport Authority
Government of Kerala		
Shri Alex Paul	Joint Transport Commissioner	Govt of Kerala
Government of Tamil Nadu		
Shri R Radhakrishnana	Joint Transport Commissioner	Govt of Tamil Nadu

ANNEX P.6

CONSULTATIONS WITH THE STATE GOVERNMENTS

REGIONAL CONSULTATIONS

States have a crucial role in assuring a healthy, comprehensive, and integrated transportation system in India. Therefore, the NTDPC organized 5 state level regional meetings in Patna, Mumbai, Chandigarh, Jaipur and Bengaluru, with the objective of building a common understanding on issues, interests, and concerns and to solicit inputs from the State Governments and other stakeholders on the formulation and implementation of the policy framework.

ISSUES HIGHLIGHTED AND THE WAY FORWARD:

A Roads Transport

Current Impediments:

a) Environmental, forest & wildlife clearances: Many projects face substantial delays in receiving environmental, forest or wild life clearances and permission to cut trees.
b) Need for a Regulator: India's Roads & Highways sector needs a regulator. Current arrangements at the centre and states (MORTH, NHAI, MPRDC, PWD etc.) can result in conflict of interest as the rule making body is also the implementing body and there is no independent assessment of its performance. Key functions of the proposed regulator can include tariff setting, regulation of service quality, assessment of concessionaire claims, collection and dissemination of sector information, setting service-level benchmarks, etc..
c) Tolling Issues relating to Private Parties: Leakages in toll collections because of presence of alternate routes to various stretches is a major issue.
d) Tolling Issues relating to Users: In 6-laning projects, users are required to pay the full toll rates applicable for 4/6 lane roads even during the upgradation, despite significant deterioration in the quality of service during that time.
e) Financing of Projects: An underdeveloped bond market has forced PPP road projects to mainly depend on debt from commercial banks.
f) Land Acquisition: Land acquisition is a long-drawn out process. There is no framework that outlines the role of a state government in providing assistance to NHAI in acquiring land.
g) Lack of consolidation and preservation of road assets: Lack of regular maintenance and repair, has qualitatively impaired the road network.
h) Institutionalization of a database system: The current data collection system for the road sector on topics like the road inventory, bridge inventory, condition of roads, bridges and other structures, road cost, traffic carried and accidents etc. is mainly ad-hoc. This hampers decisions-making processes in planning for road development and its regular maintenance.
i) Inter-disciplinary coordination: There is lack of synergy between the planning authorities, implementation authorities, and authorities responsible for monitoring projects.
j) Inadequate road network coverage: The National Highways constitute only 2% of the road network of India, but carry nearly 40% of the total traffic, leading to severe congestion. Thus, freight travels only a third of the distance in India as compared to the developed countries.
k) Poor road quality: It is estimated that less than 10% of the road network is motorable. Large stretches of National Highways are two-laned which reduces their traffic-handling capacity.
l) Human resources: The construction and ongoing maintenance of Indian roads is severely limited by a shortage of skilled professionals. Hardly any ITIs or training centers impart training to workers, equipment operators and work supervisors.

The Way Forward:

a) Toll pricing: Fixation of user fees should be based on the additional benefits accruing to the users due to construction/upgradation of the infrastructure. A study should also be done to assign costs of building and maintaining roads to different types of vehicles.
   The existing policy of fixation of toll rates needs to be reviewed. The policy of reduction in the rate of tolling after the recovery of capital cost for public funded projects or after the expiry of the concession period for private investment projects needs to be reviewed.
   The tolling system should be standardized by using RFID based tolling for electronic toll collection and by allowing a single toll card for toll payment across major toll plazas. Electronic Toll collection (ETC) system needs to be progressively introduced.
   A "Congestion Pricing" policy may be adopted for levying additional toll, especially for Heavy Goods Vehicles (HGVs), depending upon the number of axles and emission class.
b) Alternate revenue mechanisms: These include: a) advertisement rights, b) Real estate development along the Highway Corridor, c) Way side amenities, and d) fees from Right of Way (ROW) users like optical fiber, mobile towers etc.
c) Capacity Development: Enhance cross-functional understanding of implementation agencies through training and development programs; develop capacity in NHAI to raise resources, vendor management, concessionaire management and project implementation; training policy to focus on training at entry and on job site, and provide periodic refresher courses; encourage engineering and technical institutions to attract students in highway engineering profession.
d) Faster Implementation of Projects can be done by using technological solutions for real-time

project monitoring, taking timely necessary corrective actions, faster decision making, etc.

e) Advanced Traffic Management System (ATMS) can be introduced progressively, especially on 4-lane National Highways and National Expressways, to enhance safety and comfort of road users.
f) Environmental Aspects: A rational timeline should be prescribed for processing and finalizing the various mandatory clearances. MoEF may consider enhancing the powers of its Regional Offices for granting forest clearance. Conditions for forest clearance should be standardized. Resurfacing, strengthening and widening should be allowed on the existing roads where no diversion is involved. Once approval is granted for doing surveys on an alignment, the proposal should not be rejected subsequently on other grounds.
g) Rehabilitation & Resettlement (R&R) of project affected people: A uniform R&R policy should be evolved for all types of projects, applicable both for the Central Sector and the State Sector. For green-field expressway projects a separate framework is required considering the vast socio-economic implications, land severance issues, land use changes, environmental issues etc. The project-affected people can also be involved as stake holders in such projects.
h) Consolidation and preservation of Road assets by involving the Private Sector is required. "Pavement Preservation Strategy" has to be evolved on priority. "Pavement Management System" (PMS) and "Bridge Management System" (BMS) also need to be developed.
i) Maintenance of database: An integrated Road Information System (RIS) should be established and periodically updated both at the Central and the State levels.
j) A Comprehensive Master Plan should be developed for network development of NH, SH, MDR & ODRs of 20-25 years with a nodal department for development of each component.

Barriers to Road Freight Movement

a) Multiple check points: Truck operators deal with a number of different agencies (including Sales Tax, Regional Transport Officer, and Excise) for either obtaining clearances for carrying goods or paying certain charges. These checks are generally conducted at different points resulting in more than one detention, which contributes to lower average speed and higher fuel consumption. This adversely affects inter-state road transport as compared to freight/cargo transport by the railways, aviation and even inland transport, which do not face such rigorous en route checking. This has also thwarted the formation of single common market in India.
b) Road transport sector is subject to myriad levies/taxes (both Central and State) with no provision of set-offs in many taxes/levies. These levyies/taxes include: (i) taxes on vehicle purchase, (ii) taxes on operation of motor vehicles, fuel taxes, motor parts, tyres and tubes, etc., (iii) Sales tax/VAT, (iv) Registration and Transfer fees, license/permit fees, etc. High incidence of these fees/taxes erodes the competitiveness of domestic manufactures.

Suggested Measures to Overcome Barriers in flow of Road Freight Movement

a) Integrate Tax administration with inter-State road freight and passenger movement through online communication network system at national, regional and local levels. This will help move towards border-less and paper-less movement of freight traffic across borders. Checking / verification work can be done through electronic surveillance and computerization.
b) Adopt the concept of "Green Channel", currently being implemented in Gujarat. Freight with single destination accounts for a large proportion of consignment and this proportion is likely to increase with increasing containerization. Such road cargo could be accorded "Green Channel" treatment provided necessary papers are prepared and sent to the check post in advance. Introduction of smart cards for vehicle registered ("Vahan") and driving license ("Sarathi") will be a pre-requisite. Development of National Registers for vehicles and the traders, who are frequent users of Check Posts, will also be required.
c) Adopt "Single Window Clearance System" for all authorized charges/clearances both at origin and at Check Posts. The Andhra Pradesh approach for computerization of the Inter-State Check Posts (ICPs) may be adopted. Use of a common software has ushered in a Single Window Checking Facility covering 8 major departments at 5 ICPs on National Highways (NHs) bordering adjoining States.
d) Freight agents and brokers are important actors in the trucking industry. They have now been brought under the purview of legislation, Carriage by Road Act, 2007. This provides for registration/accreditation of brokers and freight agents.
e) Abolish requirement of a transit pass.
f) Amend MV Act, removing penalty payment clause and retaining only removal excess load from the trucks. Install WIM (Weigh-in-Motion) to identify violators. The colour of truck number plate of inter-State vehicles should be different from the intra-State vehicles to help segregate goods vehicles and reduce the intermediate checking of inter-State freight movement.

Issues concerning seamless road passenger movement

a) Lack of uniformity in motor vehicle taxation including taxation for various passenger transport vehicles like tourist taxis, maxi cabs, All-India tourist buses, etc.

b) Problems faced by private service vehicles and educational institutional buses transporting workers and students respectively between neighbouring States.

c) Issue of Inter-State Agreements for Stage Carriage buses.

d) Absence of holistic transport planning including non-availability of benchmarks for bus operations in India, assessment of passenger and goods travelled demand on a regular basis.

e) Absence of inter-modal integration in terms of common ticketing, transfer stations, etc.

f) Problems affecting State Road Transport Undertaking (SRTUs) including recurrent losses resulting from various internal and extraneous factors.

Recommendations/Suggestions for improving the system

a) Rationalization of tax structure in passenger transport: Taxation on different categories of vehicles should be harmonized to achieve uniformity in the taxation rates.

b) Inter-modal integration: For greater efficiency of the transport network, proper integration of different modes such as rail, bus, and other para-transit modes is essential with regard to: (i) transfer station(s), (ii) ticketing (iii) harmonization of arrival/ departure schedule, etc.

c) Guidelines for Inter-State Agreements: Entering into inter-State agreements, as required under Section 88 of the MV Act, is a long-drawn process and hampers smooth movement of passenger buses between States. Government of India could frame basic guidelines in this matter to facilitate speedy finalization of such agreements.

d) Seamless movement of passenger transport vehicles in line with the New National Permit System for goods vehicles: It is essential that All India Tourist Taxi Cabs, Maxi- Cabs, All India Tourist Buses and buses covered by Special Permits under Section 88(8) of MV Act, 1988 should also be subjected to uniform fees for free movement throughout the country.

e) Scientific assessment of passenger and goods travel demand: Traffic studies for major transport corridors can help assess demand for both passengers and goods. This can assist in a making a proper assessment of the requirement of bus fleet, bus frequency, augmentation of routes, and for building infrastructure for goods transport such as parking facilities, rest facilities for operators, weighing bridges, fuel stations, etc..

f) Framework for Competitive Public Bus Passenger Transport Services should be prepared, and should encourage: (a) competition in the market: this occurs where there is no restriction on entry, and (b) competition for the market: where entry is restricted, it is possible to increase competition for the right to service individual routes, for the sole right to provide a whole network or to undertake particular functions as a subcontractor to a monopolist operator.

g) Electronic toll collection (ETC) system can improve throughput at toll centers by 3 to 4 times, thereby significantly reducing waiting times and fuel consumption. Toll operators also benefit from lower personnel requirements and reduced leakages.

h) Para-Transit policy framework should be evolved.

i) Enforcement of higher fuel efficiency norms for vehicles could help address the twin problems of energy security and environmental pollution.

j) Fleet Modernization by replacing older vehicles with newer ones (with better technology and lower emissions) needs serious consideration. This can be done by giving incentives to owners of commercial vehicles older than 15 years to modernize their fleet, encourage owners of private vehicles older than 15 years to replace their vehicles through a suitable tax regime, a vehicle recycling policy, and improvement in the inspection and certification regime.

k) Encourage use of multi axle vehicles (MAV): MAV (gross tonnage including weight of truck of over 16.2 tonnes) are cheaper to operate compared to smaller trucks i.e. medium commercial vehicles and light commercial vehicles, by over 25%. The incremental cost of a MAV can be recovered in less than three years. Measures to promote the use of MAVs could be considered including excise duty reductions for MAVs similar to small and fuel efficient cars, stringent monitoring of overloaded trucks and enforcing pollution and safety norms.

l) Vehicle Safety Standards, Inspection & Certification: Mandatory checks are presently required only for commercial vehicles. Private vehicles are also required to be checked for fitness once in 15 years. All vehicles should be required to be tested for emissions at least once in six months. There should be a regular audit of pollution checking Centres. A Vehicle Inspection & Certification system should be put in place in a phased manner under PPP with strict supervision. Private vehicles also need to be brought into the regular fitness regime. A third party vehicle inspection programme can be considered, and the State Road Transport Authority could monitor and audit the system.

m) Ensuring passenger safety requires strict enforcement of road safety regulations focusing on proper driver selection, training and regulating their driving conditions and hours of work. There is a need to identify unregulated service providers like shared autos and set certain core standards. Smaller vehicles like three-wheelers should ideally serve as a complementary system or render feeder service to the public transport instead of supplementing it.

B. Railways

Major issues confronting Railways

a) Capacity constraints: Indian Railways has suffered a steady decline in its share in freight and passenger traffic as its network is plagued by infrastructural and carrying-capacity constraints.
b) Investment Planning: Investment in Indian Railways has to be sharply focused and directed towards removing capacity constraints and improving operations. Investment should be focused on total capacity creation including rolling stock, asset renewal, technology induction etc. This should be quantifiable in terms of incremental tonne kms.
c) Project Execution: IR does not have good track record on funding and execution of projects. Available funds are spread thinly on numerous projects which are then left incomplete.
d) Safety & Reliability of Operations: Failure of equipment and disruption to traffic on account of accidents continues to be a problem and affects operational reliability.
e) Social and commercial objectives: For long-term sustainability, IR has to strike a balance between the commercial and the social parts of the business, which have to be kept distinct and separate and managed appropriately.
f) Financial issues (cost, tariff and accounting): In the short run, most of the costs incurred by IR are fixed and therefore, the only option left is to expand volumes on a large scale.
g) Tariffs: Passenger tariff-setting has to be made rational and attuned to business growth requirement. Freight tariff needs to be based on differentiation linked to type and quality of service offered. Setting fares for freight and passenger should consider the competition from other modes, provision of subsidy, and need for generation of surpluses for reinvestment.
h) Accounting System: The present system of accounting does not assist decision making. For example, it gives little information on how to control costs, as accounts are kept on "heads of account" rather than on the basis of activities. There is no satisfactory way to figure out, for example, which are the paying lines and which are not; which trains yield how much; what is the cost of a marshalling operation, or the cost of overhaul of locomotives at each depot.
i) Productivity: The wage costs are high and the productivity of employees as measured in terms of transport output (million of passenger-kms and freight-ton-kms per employee) is relatively low compared to USA, Japan, Russia and China. Similarly, NTKMs per wagon per day and transport output per route kms is low compared to Chinese and Russian Railways.
j) Human Resource: HR functions in Indian Railways have traditionally evolved in the context of its being in the government. There is no mechanism for attuning recruitment and training to the job requirements through rewards and incentives. Multiplicity of departments and services would need to be reviewed.
k) Organization Structure: Railway is organized in terms of several functional departments. The staffing pattern does not match the skills required to build a technologically sophisticated, responsive and customer-focused organization. IR also performs a wide range of activities from manufacturing of coaches/locomotives to running of schools/hospitals. Each one of these activities needs be examined afresh from the perspective of either retention or hiving off based on operational need for integration, and "make or buy" decision. There is also a need to empower heads of Zonal Railways to a higher degree and hold them accountable for not only operational, but also financial results.
l) Research & Development: Indian Railways has not been in the frontier of developing or innovating railway technologies. The gap between the state-of-the-art and technology adopted in construction, maintenance and operation on IR needs to be bridged.

Desirable Plan of Action

a) Investment: Prioritization is needed in many areas viz. dedicated freight corridors, high capacity rolling stock, last mile rail linkages & improved port connectivity. Operationally urgent and quick pay-off projects that can ease capacity constraints the fastest need to be prioritized for full funding and time-bound execution.
b) Development of logistics parks would also need to be taken up on priority to create matching terminal and handling capacity and facilitate integration of rail with other modes.
c) Enhancing Project execution capabilities is critical for speedy capacity creation and improving returns on investments.
d) Capacity constraints: The planning framework needs to change to ensure creation of capacity ahead of demand. In addition to removing bottlenecks that already exist, planning for future must be based on an in-depth analysis of the market trends. Planning should consider the service delivery strategy, prioritization of projects, requirement and mobilization of the resources and strengthening the organizational capacity for project execution.
e) Replacement and renewal of assets: The present ad hoc approach in respect of appropriation to Depreciation Reserve Fund needs to be replaced by a rule-based approach.
f) Safety and Reliability of operations: A comprehensive and holistic approach to planning and operation is needed to attain a state-of-zero accident as stated in Vision 2020.
g) Social and commercial objectives: The commercial and social roles of IR should be kept distinct

and separate. The commercial part of the business has to be run with a clear set of objectives and judged by commonly accepted financial measures such as revenue, profit, return on capital and productivity of assets. The social part of the business would need to meet different goals and judged by parameters such as improvement in connectivity, service level, and efficiency of delivery/provision of projects/services.

h) Cost structure: Viability in the short run dictates that the volumes expand at viable tariff levels. As larger volumes bring down unit cost of operations, it could lead to a virtuous cycle of even larger volumes. This, however, presupposes that capacity is not a constraint and that the services offered create value for the customers.
i) Accounting System must be revamped to accurately reflect the cost of various activities.
j) Productivity: Increase in axle load, better payload to tare ratio, higher trailing load and improvement in headway etc. could improve productivity relatively quickly.
k) HR: To attract, nurture and retain talent in large numbers for growth in future, IR has to take a close look at its HR policies and practices. Recruitment of highly qualified PhDs from IIMs/IITs and lateral recruitment from market at suitable compensation should be considered.
l) Research & Development: R&D projects need to be identified based on operational needs and potential financial returns. These need to be supported through allocation of the adequate resources along with clear-cut accountability for their completion. An annual performance audit of RDSO and the R&D projects needs to be instituted.
m) Organizational Reforms: IR has to undertake a number of internal organizational reforms to speed up decision-making and bring about result-orientation even while retaining the departmental structure. This includes reorganization on business lines, separation of policy making and operational responsibilities at the Railway Board level, outsourcing/hiving off of certain activities, empowerment of Zonal Railways along with accountability, investment planning, increasing project execution capability, accounting separation on business lines, business process re-engineering, setting up independent tariff–setting and dispute resolution mechanisms for PPPs, etc.
n) Information Technology: Business processes need to be reviewed and reengineered, wherever needed, before adoption of IT tools. Use of existing IT infrastructure needs to be optimized and adoption of relevant emerging technologies like cloud computing and crowd sourcing, systematically planned. There is a need for a comprehensive IT security system and change in management practices to take advantages of the investment in IT.

C. Civil Aviation

Issues for Consideration

a) Route Dispersal Guidelines of 1994 serves a social need, but economically it results in losses for India's domestic airlines, since they must allocate their scarce resource, aircraft, to service routes that experience light passenger traffic. This also adversely impacts the entry of potential carriers, and creates a disincentive to further expand an airline's fleet and service. It skews the market towards large firms.
b) Slot Allocation Policy: The rules of the slot allocation policy create barriers to entry for new entrants, thus limiting the number and range of air carrier service providers. Application of the grandfather rule, freeing-up of underutilized slots only every six months, the same carrier controlling slots that are utilized 80% or more during the following season, and banning trading of slots between carriers aggravate the anti-competitive results of this policy.
c) Fleet and Equity Requirements for Domestic Passenger Air Service: These regulations also raise barriers to entry, limiting both the number and size of new market entrants.
d) Airport Infrastructure: Poor airport facilities stand in the way of the development of the air transport sector and hinder overall economic growth.
e) Anticompetitive Behavior and Pricing: Abnormally low fares are affecting the financial viability of the airlines. While a cartel erects barriers to entry into the market place, predatory pricing itself makes it unprofitable for new entrants and thus limits competition. In either case the long term viability of the industry is harmed to the detriment of consumers.
f) Taxation and Pricing of Air Turbine Fuel (ATF): High fuel costs make it difficult for incumbent Indian airlines to grow and for new airlines to enter the market.
g) Human Resource Development: Indian aviation needs to recruit and train people in large numbers. As other countries are competing for the same talent pool, this presents a problem.

Key Enablers

a) Development of heliports is important to support the growth of general aviation in India, especially in areas that cannot have runways for financial or terrain related challenges. There is a need to develop standardized route operating procedures for helicopters and a PPP policy for the development of heliports.
b) Support infrastructure at airports in Tier 2/3 cities needs to be developed. This includes night-landing facilities, enhancement of passenger amenities and state support in statutory services (like security) to boost the GA industry. GA facilities at metro airports also need an upgrade in terms of separate terminal, parking space, etc.

c) Upgradation of non-operational air-strips: Non-operational air strips need to be upgraded in places of economic significance such as ports, tourist places and industrial clusters.
d) Regulatory framework for equitable treatment to General Aircraft (GA) operators: With the current traffic load of scheduled flights at metro airports, GA aircrafts, at times, get a lower priority compared to scheduled operators. MoCA and DGCA should hold consultations to review the existing regulatory and operational framework.
e) Training Institutions should be set up for training of airport managers, air traffic controllers, navigation and communication engineers, airport security and fire-fighting personnel and they should be licensed by the Government.
f) Regional airlines that connect areas from big business centres like Central and State capitals to other commercial centres should be promoted.
g) Policy on air connectivity should be formulated. A plan to develop and construct landing strips at various places should be framed and implemented with State or Centre support.
h) Burden of taxes and fees on regional airlines should be kept as low as possible for initial period of operations in order to make their operations financially viable. The possibility of granting tax holiday to new regional airlines should be considered. Central Government should consider launching incentive schemes to attract such airlines.
i) Introduction of seaplanes for achieving air connectivity to remote and inaccessible areas that are suitable for landing of seaplanes should be considered.
j) PPP model for the development/modernization of airports would be a very viable and practical model. Government should however retain an active stake and control, especially in policy matters, to make sure the public interest is not upstaged by commercial considerations.
k) Development of Back-end Capabilities and Technologies: Private industrial manufacturers may be awarded product development programs. New technologies – for e.g. development of aluminum alloy sheets, bar-stock, extrusions, forgings – should be developed.

D. Shipping and Inland Water Transport

Impediments faced by the Ports, Shipping and IWT sector

a) Inspections and Audits by the Navigational Safety in Ports Committee (NSPC) should be completed in a time, preferably within 60 days of port declaring its readiness for such audit.
b) Rail-Road Connectivity for Ports is an important concern. State Highways/ Zilla Parishad roads need to be upgraded to NH standards.
c) Inland Waterway Transport (IWT) sector needs to be encouraged for hinterland cargo movement. Promote coastal shipping to connect entire coastline.
d) Inter port and intra port competition: Inter-port competition is constrained by hinterland economic activity, connectivity & inland transit costs. Intra-port competition can serve to mitigate the pricing power, but it may be constrained if ownership is concentrated.
e) Financing of port infrastructure is a problem due to the long gestation period (15 years) for green field port projects.
f) Land acquisition and environmental clearance involves significant delays.
g) Scale of operations at Indian Ports is quite fragmented and small as compared to China.
h) Draft limitations restrict large vessels accessing Indian ports which results in higher number of ship calls, increasing the congestion and the demand for berthing.

Key Recommendations for the Ports Sector

a) Capacity Creation: It may not always be possible to adhere to the recommended minimum gap of 30% between the installed capacity and the traffic to allow for proper maintenance of berths, equipment etc. A smaller gap does imply a short-term efficiency gain, but it would be better if the ports create capacity in excess of 30% of actual traffic over a period of time.
b) Massive Mechanization: With the kind and size of vessels with higher parcel sizes calling at Indian ports, massive world-class mechanization is the need of the hour. Each berth should be equipped adequately with high capacity versatile Cranes, Conveyer Systems, Silos, Harbour Mobile Cranes, Grab Unloaders and Gantry Cranes.
c) Development of Adequate Storage Areas is important for speedy clearance of cargo from the wharf to/from some other plot. Storage areas near a port allow the cargo to be cleared from the port faster and help achieve lower turnaround time. Provision of warehousing space near ports is also an incentive to attract traffic.
d) Hinterland connectivity: Improvements in logistics network outside the port is important for improving the competitiveness of Indian ports. For example, for European ports, cargo is transported throughout Europe in an uninterrupted and smooth fashion. Indian Ports should have a minimum 4-lane road connectivity as well as double line rail connectivity.
e) Cost Efficiency: Shipping lines charge that port charges at Indian ports are very high as compared to international ports. However, the factual position is that vessel related charges are perhaps higher in India, but cargo related charges are much lower.

Key Recommendations for IWT

a) Integration of waterways with other modes of transportation to form an efficient multimodal transport network is the key to achieve sustainable development of IWT sector. This requires detailed mapping of waterways and industrial clusters and analysis of origin and destination of cargo to undertake development of suitable waterways as well as multimodal transport hubs in IWT corridors. b) Public investment in development of waterways could serve as an important economic lifeline for development of North Eastern (NE) region as its water resources are ideal for IWT.

c) Policy support for creation of floating infrastructure i.e. barges/inland vessels is critical to attract private capital for development of IWT sector. An institutional arrangement wherein the risk on investment is shared through a PPP mode could be effective.
d) Extending mandatory intermodal share for cargo movements (currently mandated to all PSUs by PMO) to all public limited companies and creation of a suitable tradable instrument on the lines of Renewable Energy Certificate (REC) can serve as a significant policy support.
e) An institutional framework to appraise critical projects is needed for timely implementation.
f) For effective resolution of policy and administrative issues, setting up State Level Coordination Committees (SLCC) of various State Government agencies and IWAI under the State Chief Secretaries is of critical importance. Every riverine/coastal State should set up an IWT organization and to frame a long-term strategy for the IWT development.
g) Creation of adequate education and training facilities is necessary. IWT training facilities in the country are limited, and need to be expanded. The National Inland Navigation Institute (NINI) can function as the apex level training institute and Regional Crew Training Centers (RCTCs) can be set up at the State level.
h) Private Sector Participation in the development, maintenance and regulation of some stretches of rivers for inland water transport may be looked into. Power utilities should bear cost of construction and O&M of material handling at power plant end, as is the case with the facilities for unloading of railway wagon.
i) Dredging of Rivers would help develop the IWT.
j) Installation of world class mooring buoys is needed to facilitate imports/exports operations on a large scale at the anchorage.
k) Centrally sponsored schemes for the development of infrastructure should be started to promote IWT and for development of minor ports.

E. Urban Transport

Key issues in the Urban Transport sector

a) Vehicular Emission: Metropolitan cities are facing serious environmental problem due to growing air pollution caused by fuels used in vehicles.
b) Congestion: Traffic congestion in cities results in delays and higher pollution levels. High average age and poor maintenance of vehicles compounds the problem.
c) Road Safety Issues: Pedestrians, bicyclists, motorcyclists, and non-motorized vehicle occupants are often the most vulnerable in Indian cities.
d) Parking Problems: Haphazard parking contributes to higher levels of traffic congestion.
e) Inadequate public transport: Public transport systems in India are generally inefficient, due to outdated technology, incompetent management, corruption, overstaffing, and low worker productivity. They also require increasingly large subsidies.

Way Forward

a) Promoting regional economies and compact townships: Regional economies that reduce the need for long-distance travel should be promoted. Similarly, building self-sufficient compact townships would reduce the need for short-distance travel within the cities.
b) Focusing on public transport particularly bus transport: Passenger mobility in urban India relies heavily on roads. Rail based mass transport system should be planned in all cities with population more than 2 million. Urban transport plans should also emphasize setting up a modern and efficient bus transport system.
c) Introducing variety of bus transport services: Segmentation of supply of bus transport system to provide different services for different people is required.
d) Adopting optimal pricing strategies for transport services could effectively be used to encourage the public transport and restrict the use of private vehicles. Today, the operating cost of using the private vehicles is far less than the marginal social costs: this encourages people to use private vehicles. Government policies artificially lower not only the cost of vehicle ownership (through very low one time registration fee, low sales tax, etc.) but also the vehicle usage. Market based instruments such as annual registration fee, parking fee, road tax, fuel tax, congestion charges, etc. could be used to increase the (actual) marginal cost of private vehicle use to equal the marginal social costs of the same. Public transport could be promoted by abolishing annual motor vehicle tax and passenger tax on public vehicles.
e) Enhancing transport coordination: To encourage people to use public transport, the transportation system should be seamlessly integrated across all modes. An authority to coordinate the operations of various modes is required with the objective of improving the efficiency of service delivery and comfort for commuters. A single ticket system, where commuters can buy a transport ticket that is valid throughout the public transport network

within the coordinating authority's jurisdiction, should also be developed and promoted.

f) Demand side management measures, such as parking fee, fuel tax, congestion pricing, etc., should be implemented in conjunction with other transport planning, supply side management, and transport pricing measures.

g) Supply side management measures, such as one way traffic system, improvement of signals, traffic engineering improvement measures for road network and inter-sections, bus priority lane, etc., could be used as short-term measures to ease traffic congestion. Medium-term measures like new road alignments, hierarchy of roads, provision of service roads, bye passes, ring roads, bus bays, wide medians, intersection improvements, construction and repair of footpaths and roads, removal of encroachments, etc. should be introduced at least in million plus cities. Long-term measures include technology upgradation and introduction of high speed, high capacity public transport system along high-density traffic corridors, etc.

h) Encouraging green modes: Transport policy should encourage the need for developing green modes like bicycles, cycle rickshaws, pedestrians, etc. The safety concerns of cyclists and pedestrians have to be addressed adequately, by having a segregated right of way for bicycles and pedestrians. This will also help in improving traffic flow, increasing the average speed of traffic, and reducing emissions resulting from low vehicle speed.

i) Strengthening urban institutions: The functional responsibilities for urban transport are fragmented among central, state and local level governments. Central government provides suburban rail service through Indian Railways in four mega cities. MoRTH is responsible for the national highways, including the stretches within urban areas. State governments control local land use policies, motor vehicle and sales tax rates, bus transport systems, policies for private sector participation, etc. Most of the Urban Local Bodies (ULBs) rely heavily on capital grants from the states for almost all infrastructure projects as their own revenues are barely sufficient for meeting their current expenditures. Therefore, insufficient funds are available for operation and maintenance of existing assets which badly affects the service delivery. ULBs should be empowered to raise funds for developmental projects. They may also be authorized, through legislation, for overall coordination of activities relating to provision of transport infrastructure by various government agencies in urban areas.

j) Innovative financing mechanisms using land as a resource: Alternative methods of financing need to be explored. The Central Government could encourage the levy of dedicated taxes to be credited to an urban transport fund and used exclusively to meet urban transport needs within the State. Such dedicated taxes could be in the form of a supplement to the petrol and diesel taxes, betterment levy on land owners or even an employment tax on employers. Revenues from a betterment levy along new high capacity public transport corridors could be included as a component of the financing plan for such new public transport systems. The commercial utilization of land resources, available with public transport service providers, is also recommended to raise additional resources.