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Promoting Low Carbon Transport in India

Workshop Report for

Workshop on Developing Policies and Strategies for Low Carbon Transport in India 24-25 August 2012, New Delhi

Organized by

Indian Institute of Management, Ahmedabad



Workshop on Promoting Low-Carbon Transport in India

Summary

The Indian Institute of Management organized a 2 day workshop related to the project on Promoting Low Carbon Transport in India, at Hotel Le Meridian, New Delhi on 24-25 August, 2012. The workshop focused on “Developing Policies and Strategies for Low-Carbon Transport in India”.

This workshop was a part of the UNEP project on “Promoting Low Carbon Transport in India”, a major initiative of Germany’s International Climate Initiative (ICI), and the United Nations Environment Programme (UNEP), and endorsed by the Ministry of Environment and Forests (MoEF), Government of India. The project is being jointly implemented by the UNEP Risoe Centre, Denmark (URC); Indian Institute of Technology, Delhi (IIT-D); Indian Institute of Management, Ahmedabad (IIM-A); and CEPT University, Ahmedabad

The workshop involved review and discussions on the case studies that have been already completed under the project (National level case studies), strategies for the development of Low-carbon mobility Plans for the Indian cities (City level case studies). It focused on reviewing the data collection methodology employed and the primary results arrived at for low carbon mobility plans of the three case cities (Rajkot, Udaipur and Vizag) based on the already developed sustainability indicators, bringing about integrated assessment (energy and transport modelling) for development of a national transport action plan, and assessment of transport technology options and leading towards inclusiveness of the various transport systems in city mobility. They aimed at addressing transportation growth, development challenges and climate change issues in an integrated manner while demonstrating the requirements of a low carbon development path.

Workshop on Promoting Low-Carbon Transport in India

Workshop on Developing Policies and Strategies for Low-Carbon Transport in India
Venue: Inspire, Hotel Le Meridien, Janpath, New Delhi

24th August 2012

Workshop Programme

09:30 – 10:00 Registration

Inaugural Session

Chair : Prof. P.R. Shukla, Indian Institute of Management, Ahmadabad

10:00 – 10:05 Welcome & Workshop Agenda, Prof. P.R. Shukla, IIMA

10:05 - 10:20 Inaugural Address, Dr. Sudhir Krishna, Secretary, Ministry of Urban Development, GoI

10:20 – 10:30 UNEP Transport Programme, Mr. Robertus J Jozef, UNEP

10:30- 10:50 India's Second National Communication to UNFCCC – Overview, Dr. Subodh Sharma, Senior Advisor, Ministry of Environment & Forests, GoI

10:50- 11:05 Integrated Assessment at National Level, Prof. P R Shukla, IIMA

11:05- 11:30 Tea Break

Session 2 : Low-Carbon Scenarios for Transport Systems

Chair : Dr. Manoj Singh, Advisor Transport, Planning Commission

11:30 – 11:50 Alternative Scenarios with Logistic Grids, Dr. Subash Dhar, UNEP Risoe Centre

11:50 – 12:10 Case Study - Delhi Mumbai Freight Corridor, Prof. Prem Pangotra, IIMA

12:10 – 12:30 Case Study - Konkan Railway Corporation Limited, Prof. Amit Garg, IIMA

12:30 – 13:00 Panellists: Mr. Rajesh Jain, General Manager, DFCCIL
Mr. S A Verma, Additional General Manager, Delhi Metro Rail Corp.

13:00 – 14:00 Lunch Break

Session 3: Low-Carbon Scenarios for Sustainable Vehicles

Chair : Mr. Robertus J Jozef, UNEP

14:00 – 14:20 Fuel Economy and Emissions at National Level, Dr. Subash Dhar, UNEP Risoe Centre

14:20 – 14:40 Characteristics of Vehicle Technologies within Indian Cities, Prof. Dinesh Mohan, IITD

14:40– 15:15 Panellists: Dr. Sudhir Sharma, UNEP Risoe Centre
Ms. Anumita Roychoudhary, CSE

15:15 – 15:30 Tea Break

Session 4: Low-Carbon Scenarios for Sustainable Mobility

Chair : Prof. Prem Pangotra, Indian Institute of Management, Ahmedabad

15:30 – 15:50 Sustainable Mobility and Passenger Transport, Prof. P R Shukla, IIMA

15:50 – 16:05 Travel Behaviour in Delhi, Prof. Geetam Tiwari, IITD

16:05 -16:20 Inclusive Transport for Cities, Prof. Darshini Mahadevia, CEPT

16:20 – 17:00 Panellists: Prof. Dinesh Mohan, IITD
Representatives of Rajkot, Udaipur and Vizag

17:00 – 17:15 Conclusion & Summing Up

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Project Workshop on Low Carbon Mobility Plan for selected cities

Venue: Inspire, Hotel Le Meridien, Janpath, New Delhi

25th August 2012

Workshop Programme

Session 1: Review of interim outputs from cities (Based on results from surveys within cities)

Chair : Mr. B. I. Singal, Director General, Institute of Urban Transport

09:30 – 09:35 Welcome, Prof. Geetam Tiwari, IITD

09:35 – 10:05 Rajkot : Prof Talat Munshi, CEPT

10:05 – 10:35 Vizag : Dr. Anvita Arora, iTrans

10:35 – 10:45 Tea Break

10:45 – 11:15 Udaipur : Mr. Ankush Malhotra, UMTC

11:15 – 11:45 Comments and Q&A from the Floor

Session 2: Scenarios for LCMP

Chair : Prof Geetam Tiwari, IITD

11:45 – 12:05 BAU and Alternative Scenarios for Transport and Land Use, Prof R R Kalaga, IITD

12:05 – 12:20 Back-casting approach for achieving a climate target, Prof P. R. Shukla, IIMA

12:20 – 12:40 Comments and Q & A from the floor

12:40 – 13:40 Lunch Break

Session 3: Indicators & Benchmarks

Chair: Prof Darshini Mahadevia, CEPT

13:40 – 13:55 Indicators and benchmarks for Mobility and Accessibility, Prof Darshini Mahadevia, CEPT

13:55 – 14:10 Indicators and benchmarks for Infrastructure and land use, Prof Geetam Tiwari, IITD

14:10 – 14:30 Indicators and benchmarks for Safety, Security, and Environment, Prof Dinesh Mohan, IITD

14:30 – 15:15 Discussion

15:15 – 15:30 Tea Break

Session 4: Training on Stakeholder Consultation

Discussion Facilitator: Dr. Subash Dhar, UNEP Risoe Centre

15:30 – 16:00 Multi criteria approach for prioritising infrastructures and technologies (URC)

16:00 – 16:15 Template for LCMP report (URC /IITD)

16:15 – 16:30 Discussion

Workshop on Promoting Low-Carbon Transport in India

Day 1: 24th August, 2012

Workshop on “Developing Policies and Strategies for Low-Carbon Transport in India”

The Workshop on “Developing Policies and Strategies for Low-Carbon Transport in India” was held on 24-25th August, 2012. Prof. P R Shukla welcomed the delegates and requested Dr. Sudhir Krishna, to inaugurate the workshop and chaired the inaugural session. The workshop was inaugurated by Dr. Sudhir Krishna, Secretary, Ministry of Urban Development (MoUD), Government of India. Dr. Subodh Sharma, Senior Advisor, Ministry of Environment & Forests (MoEF), Government of India was an invited speaker during the inaugural session.

Session 1: Inaugural Session

Key points from the Inaugural Speech by Dr. Sudhir Krishna, Secretary, Ministry of Urban Development (MoUD), Government of India

In his speech, Dr. Sudhir Krishna highlighted the urbanization and development linkages. He expressed that he felt privileged for being a part of the workshop of developing policies and strategies for low carbon transport in India. He suggested that the efforts put by the participants were very important for the country. He noted that he has learnt so much over the period since he has been associated with this sector and felt very much benefited. He further noted that in spite of India getting independence around the same time as a few other countries, its obsession with the rural development, its obsession with the villagers, republic and its obsession with poverty probably did not let it think in a visionary mode. According to him, if one was to match the level of urbanization with the development indicators of countries one would see the positive connotation. He further talked on what is urbanization? Urbanization is planned densification of settlements. From 1947 to 2007 there are no programmes worth the while for urban development. In 2007 the Jawaharlal Nehru Urban renewal mission was launched. He gave an insight into the National Urban Renewal Mission (JnNURM) adopted by the government in 2007, drawing attention to the recent good practices cases of Agra and Indore solid waste management systems. He also acknowledged the fact that socio-economic justice, inclusivity and financial viability are some of the issues that the projects face. The ruralization policy as per his views has led to pauperization. If common man is impoverished the country will be impoverished. This is simple dynamics of development and so for those who are working for urban development, the cities must be developed in a planned manner. Cities must become host to economic activities which is happening worldwide. But the learning in India happens in villages.

By providing good transport services, people will be able to move from one end to the other end; with out hassle and adding value to their efforts in terms of their time, their energy, their money, whatever they are investing must give them value. He pointed out the importance of transit oriented development and how it helps the cities. Dr. Krishna stressed upon the importance of statutory backup to various initiatives.

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He informed the participants of the works being undertaken by the ministry like that of developing bench marks on urban infrastructure like solid waste and sewage and water supply. The one on transport were developed in 2009. So they become the framework for operating the government policies. He intimated to the participants about the Urban Mobility in India workshop in December. They will be partnering with governments at various levels, the centre state and local bodies and also educational institutions including IIT Delhi, IIM Ahmedabad, IIT Chennai, and CEPT. The Ministry is partnering with over 50 such institutions in the country and is proposing to expand the network of institutions to work with them. They also hope to increase the collaboration in an increasingly sustainable and expansive way in the future. He concluded by thanking Dr. Subodh Sharma and Prof. Shukla and his team for giving him the opportunity and hosting a very important workshop. Lastly, he wished the event all success. A transcript of the speech is available in [Annexure-1](#)

UNEP Transport Programme, Mr. Robertus J. Jozef, UNEP

Mr. Robertus J. Jozef, Head, UNEP Transport Unit, based in Nairobi, Kenya, made a presentation on UNEP's transport programme. This presentation provided a quick overview on the core activities of the Transport Unit at the UNEP. He began the presentation with an insight into the link between the increasing vehicle ownership all over the globe and environment. He update everybody present with the fact that the global vehicle fleet is set to triple by 2050 and over 90% of this growth will take place in developing and transition countries leading to increase in the remarkable increase in the energy consumption.

UNEP has adopted an integrated approach for project development that covers fuel, vehicle, non-motorized transport and public transport systems. He informed the participants of the four major campaigns that UNEP Transport Unit has taken up, namely:

- Reduce small PM pollution through cleaner fuels and vehicles
- Vehicles and climate change
- Investment in non-motorised transport road infrastructure
- Bus rapid transit

Further he provided detailed information on these four focus areas and the projects that UNEP has undertake under each of them. The Partnership for Clean Fuels and Vehicles (PCFV) campaign is a part of the focus on to reduce Vehicular PM Pollution and desulphurization of fuels is promoted under this campaign.

The Global Fuel Economy Initiative (GFEI) intends to double the fuel efficiency of the global fleet by increasing the fuel economy. Launched on March 4 2009 at the Geneva Motor Show, by 4 partners - International Transport Forum (ITF), International Energy Agency (IEA), Fédération Internationale de l' Automobile (FIA) and the United Nations Environment Programme (UNEP), the Global Fuel Economy Initiative (GFEI) aims to catalyze and help harmonize large reductions of greenhouse gas emissions and oil use through improvements in automotive fuel economy in the face of rapidly growing car use worldwide.

The Fuel Efficiency Initiative aims to promote a 50% improvement in the average efficiency of the whole world's car fleet by 2050 (hence the 50x50 campaign slogan):

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Currently the global fuel economy average is around 8L/100km. The goal is to have a global fleet average of 4L/100km (25km/L). This represents a 50% improvement in fuel economy of new cars by 2030, leading to the overall goal of a 50% improvement in the fuel economy across the global vehicle fleet by 2050. While the initial focus is on cars and other light duty vehicles, this could expand to include heavy duty trucks. The primary focus is on new vehicles, but will also contain elements relating to the fuel economy of in-use vehicles. Cutting global average automotive fuel consumption by 50% would reduce emissions of CO₂ by over 1 gigatonne (Gt) a year by 2025 and over 2 gigatonnes (Gt) by 2050, and result in savings in annual oil import bills alone worth over USD 300 billion in 2025 and 600 billion in 2050 (based on an oil price of USD 100/bbl), in addition to lowering harmful pollutant emissions – including black carbon. Each of the four partners will play a part in implementing the four components of the GFEI, as well as specializing in certain tasks/areas as follows:
FIA Foundation – Secretariat, Communications and outreach
IEA – data and modelling
ITF – cost effectiveness, 2010 Roundtable event
UNEP – Toolkits, Regional meetings

Data collection and analysis of fuel economy potentials by country and region: there is little information on fuel economy levels, trends and potential for improvement for many countries that could greatly benefit from this information. Support for national and regional policy-making efforts: currently there is a patchwork of policies in OECD countries and almost no policies in non-OECD countries except China; we need to assist governments to develop and implement strong, cost-effective fuel economy policies
Outreach to stakeholders (e.g. vehicle manufacturers): we need to build capacity in this area. Information campaigns around the world to educate consumers, stakeholders: there is a low level of awareness of this issue and the potential latent in a fuel economy approach to vehicle emissions.

He also discussed the IEA scenarios on the transport fuel consumption under the Promote Investment in NMT infrastructure in Africa - The UNEP Share the Road programme. IEA scenarios show modal shift as one of the top three areas for GHG reduction – in urban areas, this means integrated NMT and public transport systems. Mobility is essential to development, but current infrastructure investment is unsustainable and largely disregards the poor, who rely on NMT modes. Over 90% of the 1.3 million people who die in road crashes are in low-income and middle-income countries – in large part due to pedestrians & cyclists lacking NMT infrastructure.

Under the Clean and Efficient mass Transit focus, the UNEP is Promoting Bus Rapid Transit Systems in African cooperation with a group of partners since BRT is the most affordable option and is being used in many countries.

He concluded by introducing the three year project on “Promoting Low Carbon Transport in India” that was initiated in November 2010, and shall run till 2013. The main implementing agency is UNEP and four implementing partners led by URC alongside IIMA, IITD and CEPT University, Ahmedabad. The project has been funded by ICI.

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Presentation by Dr. Subodh Sharma, Senior Advisor, Ministry of Environment & Forests (MoEF), Government of India

Dr. Subodh Sharma, Senior Advisor, Ministry of Environment & Forests (MoEF), Government of India was the invited speaker for the session. He presented India's Second National Communication to the UNFCCC. He opened with the demographic and economic national circumstances of India in 2010 and then further proceeded to the key outcomes of the exercise of generating the GHG emissions inventory for the country.

According to the UNFCCC, all Parties are required to report on the steps they are taking or envisage undertaking to implement the Convention. Each non-Annex I Party (that includes India) is required to submit their national communication and biennial update report. India had already submitted its Initial National Communication in 2004. This report had a 1994 baseline and the emission information of upto 2000 had been included. The 2nd report was submitted in May this year with information upto 2007.

He outlined the positive aspects and improvements in the emissions inventory making process that the NATCOM had achieved during the preparation of this report as compared to the 1st report. The second national communication consists of GHG inventory by sources and sinks for the base year 2000 & 2007 with reduced uncertainties. India is the only country to submit the 2007 inventory. This was possible due to strengthened institutional networks and improved scientific measurements, monitoring, reporting, and learning capacities and informed decision-making. He also acknowledged the 31 institutes that were involved at various stages of the inventory making. The total Greenhouse Gas (GHG) emissions from India in 2000 (excl. LULUCF*) were 1523.78 million tons of CO₂ equivalent (eq) of which

- CO₂ emissions were 1024.77 million tons;
- CH₄ emissions were 19.39 million tons; and
- N₂O emissions were 0.26 million tons

GHG emissions from Energy, Industry, Agriculture, and Waste sectors constituted 67.4%, 5.8%, 23.3% and 3.4% of the net CO₂ eq emissions respectively.

Energy sector emitted 1027.02 million tons of CO₂ eq, of which 543.75 million tons of CO₂ eq were emitted from electricity generation and 98.10 million tons of CO₂ eq from the transport sector. Industry sector emitted 88.61 million tons of CO₂ eq. while LULUCF sector was a net sink. It sequestered 222.57 million tons of CO₂.

The second report also talks about the Impacts, Vulnerability Assessment and Adaptation Approach other than just providing with the emissions estimates. Under this section, the tasks of Development of improved Climate Change Scenarios (A1B scenario), Projections of climate change scenarios using PRECIS regional climate model Generate scenarios for extreme events, Projects to Study impacts of climate change on onset of monsoon, Sectoral impact assessments of climate change in key sectors Enhanced institutional capacity for undertaking V&A assessments and informed decision making were taken up. He also informed the participants of the key challenges that exist. He concluded by giving away the steps forward to the third national communication report and the biennial update reports.

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Presentation by Prof. P. R. Shukla, IIM, Ahmedabad

Prof P. R. Shukla made a presentation on Integrated Assessment of Low Carbon Transport at National Level on behalf of himself and Dr. Subash Dhar. He introduced the concept of Low Carbon within the climate negotiation arena (e.g., Copenhagen Accord to which India is a signatory) which is essentially the IPCC 2°C stabilization scenario which is the broadly agreed upon scenario in the global discussions. Reduction of carbon from the transport sector could be achieved either by interventions from the demand or supply side. He also pointed that the national level assessment is a little different from the city level assessment since it is inclusive of the aviation and the intercity passenger/freight transportation.

The presentation consisted of the various global emission pathways. It also gave a framework on the sustainable low carbon society development and the importance of transport in the assessment of the same. He further described the IPCC discussions have started revolving around the year 2300 scenarios as long term and discussions around 2100 is being labelled as medium term globally, whereas for India 2050 could be the medium term and 2030 may be refer as short term discussions.

Further he presented a sustainable low carbon mobility framework acknowledging the fact that the urban patterns, population age profile, income levels and the carbon policies are very varied and a lot of changes will happen in future making it a difficult to consider all the aspects rendering the currently built infrastructure as an investment lock-in. While describing the architecture and the results of the low carbon transport scenarios, he also gave the various scenario storylines. The scenarios he discussed included

- Business as Usual (BaU) Scenario
- Sustainable Low Carbon (Examples)
 - Coal by wire
 - Regional Pipelines
 - Dedicated Freight Corridors
 - Urban Low Carbon Transition

He highlighted the energy security co-benefits from the technology as well as policy choices that we have on both the transport supply and the demand management sides and described it as a portfolio problem that India faces today.

The key conclusion that he brought out are as follows:

- Passenger transport: Sustainable urban design, modal shift can contribute nearly a quarter of emissions reduction in freight transport, Facilitate non-motorized transport
- Freight transport: Location decisions, Modal shift and regional energy market development can contribute nearly a quarter of emissions reduction in freight transport.
- Vehicle Technologies: Fuel-Efficiency Standards, Remove fuel-subsidies, Environmental taxes,
- Fuel Mix: Low carbon transition due to global carbon price will influence significant change in the transport fuel mix including decarbonisation of electricity

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- Co-benefits: Sustainable low carbon transitions will deliver significant co benefits, e.g., reduced air pollution, energy security, energy access, etc.

Session 2: Low-Carbon Scenarios for Transport Systems

Dr. Manoj Singh, Advisor Transport, Planning Commission served as the chair throughout this session. While Mr. Rajesh Jain, General Manager, DFCCIL and Mr. S A Verma, Additional General Manager, Delhi Metro Rail Corp. served as the esteemed panellists for this session.

Presentation by Dr. Subash Dhar, UNEP Risoe Centre

Dr. Dhar made a presentation on Alternative Scenarios with Logistic Grids. The presentation focused on the logistics and freight transportation assessment for making them low carbon and sustainable. Dr. Dhar pointed out that a substantial amount of emissions come from the freight movement all over the country.

The presentation further described the transport scenarios for passenger as well as freight transport in terms of the conventional and sustainable development pathways. He outlined the demand side management strategies. Reducing the freight demand through options like Coal by Wire that has the potential to reduce 43% of the coal transportation that happens through rail by moving the power plants to the coal mine pitheads was illustrate further. He emphasized on a strong central policy requirement to achieve such goals. He also discussed the option of regional pipeline network development that would reduce gas transportation through LNG mode along with Modal Shift options like Road to Rail shift by improving efficiency of railways and Rail to Pipelines shifts. As per Dr. Dhar's assessment the overall demand for energy from freight would decrease due to sustainable logistics by 3.3% in 2020 and by 25.1% in 2050. Despite a lower share in demand the share of energy for road transport is obtained to be higher.

He concluded with the results of his assessment. These results are as below:

- Location decisions for industries which consume or produce materials with large demand for logistics essential for reducing freight demand (e.g., Coal based power plants)
- Railways can play a major part in reducing CO2 emissions from freight. The contribution can be much higher if electricity is cleaned.
- Regional gas pipelines can deliver reductions in GHG emissions by lowering fugitive emissions.

Presentation by Prof. Prem Pangotra, IIM, Ahmedabad

Prof. Pangotra presented the results of the case study of the Delhi - Mumbai Freight Corridor that was conducted under the UNEP project on "Promoting Low Carbon Transport in India". He opened the presentation with the role of infrastructure in developing a low carbon transport future. Dedicated Freight corridor was one such infrastructure that was of substantial importance. The Eastern Dedicated Freight Corridor (1839 km) and the Western Corridor (1483 km) are being implemented by DFCCIL. Both corridors will be commissioned by 2016-17. The two corridors on

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completion would cost about Rs. 80,000 crore in 2016-2017. Funding is through combination of debt from bilateral/multilateral agencies, equity from Ministry of Railways and Public Private Partnerships.

He further outlined the scope and premises of the case study that was conducted by IIM Ahmedabad. This study provides long-term assessment of CO₂ emissions during the operations phase of the project over a 30-year time period. Two business-as-usual (BAU) scenarios based on continuation of current trends of freight movement, technologies and energy mix at the national level. Third scenario based on a low-carbon (LC) pathway at the national level, supported by a carbon tax, aimed at achieving the global CO₂ stabilization target (corresponding to 2°C global average temperature rise until the year 2100)

The key findings of the study suggest that by 2046-47, the Western DFC project would reduce annual CO₂ emissions by nearly 81% under the business-as-usual scenario and by 97% under the low-carbon scenario compared to the level of emissions in the absence of the DFC. Compared to the BAU (Without DFC) scenario, cumulative emissions are expected to reduce by 77% under BAU (With DFC) and by 92% under the LC (With DFC) scenario. The maximum cumulative reduction expected from the six proposed DFCs, over the 30-year period, is 1168 million tons of CO₂. This could be used to leverage substantial climate financing. The decomposition analysis explaining the difference in annual CO₂ emissions between BAU (Without DFC) and BAU (With DFC) scenarios revealed that almost 87% of the difference in 2046-47 can be attributed to the modal shift from rail to road in the scenario without DFC, because of the saturated line capacity in the existing rail network.

The presentation wrapped up with the policy recommendations for the policymakers as follows:

- The project has the potential to generate large CO₂ reductions with significant co-benefits. Ensure time bound completion.
- Matching support infrastructures, such as freight terminals, special wagons, stack containers etc., should be adequately provided and become part of a comprehensive plan.
- Concurrent implementation of the DMIC project would maximize secondary development benefits.
- Accelerated implementation of the remaining five DFCs would yield maximum economic returns in the long-run.
- Long-range planning to make the national freight transport system low-carbon and conducive to sustainable development.

Presentation by Prof. Amit Garg, IIM, Ahmedabad

Prof. Amit Garg made a presentation on Vulnerability and Impact Assessment and Management Framework for Long-life Assets: A Case of Konkan Railways (KRCL). This case study focused on the Climate Change risks on the infrastructure. According to his presentation, huge investments are being committed in new infrastructure projects in developing countries. Infrastructures are long-life assets and are designed to withstand normal variability in climate regime. The presentation listed out the uncertainty and risks for the infrastructure sector. As per the presentation, there are two types of risks. One being implementing safety works for an event that does not eventually occur

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translating into excessive safety measures and wasted expenditure on it labelled as the Type-1 error. While the other is about not planning for an extreme event which eventually occurs rendering into lower adaptation of safety measures and exposing passengers and goods to risks called the Type-2 or beta error.

The recently constructed Konkan Railway has met with two major accidents after its inception due to bad weather conditions. This case study presents a framework for assessing the likely climate change impacts on long-life assets using a methodology of reverse matrix for climate change impact analysis. The framework links climate change variables (temperature, rainfall, sea level rise, extreme events, and other secondary variables) and sustainable development variables (technology, institutions, economic, and other policies).

Climate Change uncertainty therefore creates:

- Risk of unwanted events happening
- Costs required to avoid them (Preventive)
- Costs to restore the system, in case events do occur (Palliative)
- Costs of insurance against (un-covered) events
- How much Safety works are adequate to manage climate change risks?
- Can we, and should we, climate proof every railway line? What are the costs?
- Are there any instruments that could take care of un-covered risks?

He noted that KRCL had already spent over Rs. 280 crore on additional safety works since 2001 (excluding development costs of Raksha Dhaga etc) and had plans to invest another Rs. 340 crore in next 5 years, mainly to reduce risks of boulders falling and soil slippage. About 20% of their annual engineering maintenance expenditure was due to weather related events. This turned out to be almost 15% (converted to constant prices) of its total construction cost of about Rs. 3500 crore. He emphasized on the development of risk estimation, risk valuation and damage function estimates for the new infrastructure.

Panel Discussion

Mr. Rajesh Jain, General Manager, DFCCIL

Mr. Rajesh Jain raised the issue of challenges that need to be faced while taking up any project as the system is not isolated from the political circumstances and equations in the real world. According to him some of the major challenges that DFCCIL faces is that of land acquisition. He informed the participants that DFCC has successfully completed almost 90% of the land acquisition for their stretch from Baroda to Revadi and the loans had also been tied up for that phase. They had started working on the Revadi to Dadri phase. While the next phase in pipeline was Ludhiana to Bhavpur. He pointed out that the phasing of the project was based on the funding phases that they will be receiving from Government of Japan.

He informed that participants that taking cue from the KRCL and the accident events that have happened so far, the DFCC has been designed such that they will have only 1 major tunnel of 1km length and a few viaducts rendering most of the section on plain lands. DFCC is also looking forward to achieving energy efficiency through technology improvements in their locomotives, the signalling system and by having 2 X 25 KV

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electrical systems. He concluded by remarking that the Indian Railways will be a co-beneficiary of the project since their will an increase in the existing passenger capacity on the route. The Indian Railways is already planning to upgrade the passenger services on the Delhi-Mumbai route. According to him even the achievement of as low as 50% made a great sense environmentally and commercially.

Mr. S. A. Verma, Additional General Manager, Delhi Metro Rail Corporation Limited

Mr. S. A. Verma said that the Environment Impact Assessments (EIA) that has been mandated by the MoEF need to be looked at in a new light based on Prof. Garg's presentation. He referred to a MTA, USA study that had mapped the co-benefits of investing into transport infrastructure. The authors of the study had looked at the transit effect multiplier in terms of benefits from modal shift, change in trip length and land use change. According to them the benefits were around 8.24 units.

Mr. Verma also highlighted the importance of carbon finance as a source of good money. He added that the revenue that DMRC earns from the Phase-II is a good supplement to the operating expenses. The management needs to be proactive about this and should be able to provide verifiable and authentic long-term data about the project. He noted that 90% of the CDM certified projects belong to the private sector as maintain proper data records in one of the major criteria. He also pointed out the need for modifying the CDM methodologies that exist while acknowledging the fact that there are very few success stories in the transport sector as far as CDM was concerned. He informed the participants that DMRC had developed a methodology got it approved, developed the project, validated and registered it and it is now at the verification stage of the CDM cycle. He concluded with a remark that the carbon financing would a blessing for a huge project like the DFC.

Summary and Comments from the Floor

Session Chair: Dr. Manoj Singh, Advisor, Transport Planning Commission

Dr. Manoj Singh, the session chair, summed up the session for the participants and also moderated the questions for the session.

The questions that were discussed included the issue on coal transport versus having power plants at the coal mine pithead that was mentioned in Dr. Dhar's presentation. Dr. Singh informed the participants that the Rakesh Mohan committee was the planning commission sub-group on bulk transportation as a part preparation of the 12th five year plan. The gains that could be made by going for such an option have already been assessed through extensive analysis and the have been presented to the main committee. There were a lot of techno-economic issues involved and need to be addressed. Dr. Dhar clarified that it was one of the scenario situations that he had foreseen while creating his scenario storyline for the assessment of freight transport. Prof. Dinesh Mohan further pointed out that the coal import projections for 2030 are around 2 million tons which is almost 6 times than today. While the states and government are not willing to agree that any power station should be depending on more than 30% of imported coal due to the energy security concerns. Also the electricity costs at pithead and the other transmission costs when worked out do not

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turn out the way we anticipate them. The other major concerns are the issue with forests and reserved areas near the coal mines. The other idea put forth was of shipping coal to ports and coastal areas which was efficient as compared to hauling the coal by rail. Dr. Dhar pointed out that there is not much advantage by moving power stations to pitheads as far as the delivered price of electricity was concerned but the overall cost to benefit was substantially better.

Dr. Sudhir Sharma further pointed out that the model scenarios project the 'what if' questions. He wanted to further explore the budgetary aspects of the same. Prof. P R Shukla was asked for his opinion on the same. He pointed out that there would be quiet a few impacts in terms of the environmental conditions and the local economic development. Also, since the global agreement was towards a 2°C global temperature rise, there were very many impacts on the budget for India when this target was back-casted for the country. A global CO₂ price would have to be applied in all sectors under this situation and a lot of financial and technology transfers would be required. He also remarked that different sectors respond in a different manner and that the elasticity of the transport sector is comparatively low making it more rigid and slow at changes. A long horizon needs to be considered in case of imposing a huge burden on the transport sector. A series of models need to be run for the long-term and cannot be sliced into short-term assessments.

Dr. Singh concluded the session pointing out that the 12th plan is looking forward to increase the share of railways by 2% in the coming 5 years. It will be putting major thrust on improving the share of railways and waterways in the national transport system. He informed that China had dedicated passenger corridor lines of 8000kms in form of high speed rails, while India was trying to come up with the dedicated freight corridors. He said that these high speed rails could prove to be very costly and that the freight corridors may have much more economic value as compared to the passenger corridors. The planning commission under the 12th plan will be taking up 1 line of high speed passenger rail corridor between Ahmedabad and Mumbai along with the 15 lines that will be added to the Himalayan states as discussed in the Rajyasabha. They were looking at railway capacity expansion versus the line expansion. The Bilaspur to Jammu 450kms railway line will be costing 4000 crores. Thus, funding is a major issue along with the environmental impacts and clearance issues.

Session 3: Low-Carbon Scenarios for Sustainable Vehicles

Mr. Robertus J Jozef from the UNEP Transport Unit, served as the chair throughout this session. Dr. Sudhir Sharma, UNEP Risoe Centre and Ms. Anumita Roychoudhary, Centre for Science and Environment were invited as the venerated panellists for this session.

Presentation by Dr. Subash Dhar, UNEP Risoe Centre

Dr. Dhar made a presentation in this session on 'Fuel Economy and CO₂ emissions at national level'. He opened his presentation by recapitulating the participants with the transportation scenario storylines with emphasis on passenger transport systems and its future. He discussed the cross country market segmentation of passenger cars to highlight that by the year 2011 India has highest share of small cars and the share of medium size cars was growing the fastest in the country as compared to the other

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countries. This shift in the vehicle size was reducing the overall fuel economy. A lot of things need to happen in the field of the vehicle technology at global level and not just India. He also noted that the domination of small cars and vehicles is there but the stock is quiet efficient.

He further discussed a BEE consultation paper from October 2011 that has been approved by the Prime Minister's Office in August 2012. The paper is one of the fuel economy improvement initiatives in India and deals with the programme of labelling cars in India based on their weight categories. The maximum stars achievable under this scheme are 5 stars. There are 2 different standards under this scheme for years 2015 and 2030. The labelling also specifies the average fuel efficiency (in ltr/ 100kms) as a parameter along with the weight categories to earn the stars. The 2030 GFEI vision scenario considers 4ltr/100km. But such efficiencies can not be delivered by conventional drive train technologies and rather it is technologies such as hybrids which would be required for this scenario especially if vehicle weights increase. The improvements in engine technologies for cars also diffuse into 2 wheelers and buses. He emphasized on these additional efforts in order to change the baseline scenario.

His analysis suggested that the overall demand for energy in transport would reduce by 8.2% from BAU in 2020 and 9.1% from BAU in 2050. Also the Cumulative reductions of GHGs from transport would be between 2010 and 2050 are 1,696 Million tones. He concluded the presentation with the observations that i) Vehicle labelling can help in improving average efficiency of vehicles ii) Additional efforts towards technology improvement would be required for 4 lit / 100 km target for 2030 and iii) Post 2020 efficiency improvements will necessitate a greater role for hybrids, etc although the hybrids are really costly currently and thus maybe people are forced to buy conventional small cars.

Presentation by Prof. Dinesh Mohan, IIT Delhi

Prof. Dinesh Mohan presented on "Characteristics of Vehicle Technologies within Indian Cities". He opened with the remarks on requirement to reduce fuel consumption in today's world and the challenging need for hybrids. He listed out India's options and likely adoptions by 2030 for future fuel and emission reduction. He emphasized on the need for improved and efficient internal combustion engines. He also noted that weight of a vehicle goes a long way in reducing the fuel consumption and that safety is not where co-related to the weight of the vehicles. He also suggested de-linking the safety features from the model and making it mandatory. India has increased its fleet efficiency by almost 15% over the last 5 years and the planning commission is looking forward to around 30% savings from fuel efficiency in the next 5 years. He also put forth the need to have common fuel standards for all the cities unlike different standards of today along with putting up a policy that encourages the oil companies and refiners to provide cleaner fuel. At present, the 20 major cities are receiving Bharat IV (50-ppm sulphur) fuel supply. MoPNG has announced plans to supply BS IV fuels to a total of 50 cities soon. The emission standards also need to be uniform all over and Bharat -6 norms need to be implanted in very near future. A differential taxation for small and big cars should also be implemented. He further outlined the current data collection that is underway. The parameters they are looking at are:

- Speeds by mode

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- Cars, Motorcycles, Buses, and 3-wheelers
- Approximately 2,000-3,000km of travel time is expected from each mode to generate the sample
- Age distribution of vehicles
- Fuel consumption and emissions
- Trip characteristics by income groups

Some of the inferences from the data analyzed so far say that the average life span of a car is around 18-20 years which is almost the same as that in Europe. The old car runs much less than the newer cars. More than 50% vehicles travel less than 10 kms a day and very few travel for 15 kms.

Panel Discussion

Dr. Sudhir Sharma, UNEP Risoe Centre

Dr. Sudhir Sharma noted that it was important to understand the vehicle and travel characteristics in terms of ownership and use and their implications on efficiency. There should an assessment of inherent improvements with in the country. He raised his concerns on whether the standards remain the same beyond 2020. From a policy making point of view, vehicle ownership segregation by size, weight etc have a lot of impact on the emissions. He also suggested studying the implications of increasing and decreasing efficiencies and hoped to see a post 2010 emission standards roadmap.

Ms. Anumita Roychoudhary, CSE

Ms. Roychoudhary expressed her pleasure to see that the fuel efficiencies standards were being set for the first time. Her opinion was that while looking at CO2 emissions, a focus on the people rather than vehicle becomes important. Motorization has large impacts on public health as well. The Mexico BRT had become a pollution corridor as well until a fuel shift to cleaner diesel took place. She remarked that India had the initial advantage of the small cars but Indian small cars are still more inefficient as compared to French small cars. If a stronger regulation doe not come in the diesel fleet will keep expanding at the Euro 3 standard level. According to a statistics she quoted, more than 40% of diesel cars sold have more than 1500cc engines. She stressed on the fact that the automobile industry needs to base its technology choices on efficiency and emission goals. The 2-wheelers give an efficiency of 60-70 km/litre but a new 2-wheeler emits more NOx and PM as compared to a new car. She highlighted the importance of co-benefits that the low carbon pathways need to ensure. A uniform fuel quality and technology road map for the entire country is the need of the hour.

Summary and Comments from the Floor

Session Chair: Mr. Robertus J Jozef, Head Transport Unit, UNEP

Mr. Jozef, the session chair, open the session for the questions and summed up the session for the participants.

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The first question to be talked about was on the consideration of para-transits in the discussion. Mr. Ravi Gadepalli pointed out that 20% of the trips in small cities happen through the auto-rickshaws and they need to be a part of the discussion to which Ms. Anumita responded saying innovations in the para-transits are quite limited to electric 3-wheelers while the transition from 2 stroke 2-wheelers to 4 stroke 2-wheelers has been very quick. In case of auto rickshaws, the affordability, ownership and maintenance become the detrimental hurdles. A policy thrust on innovation and design of the vehicle may be needed since a mere conversion to CNG/ LNG would not give enough positive results.

Mr. Jozef summarized the session indicating that fuel economy was one part of the overall solution. He stressed on the importance of the fuel quality and requirements of low-sulphur fuel. His core message was that India has a very good base situation but if things are not come now, the advantage will be lost. A win-win for both vehicle technology and clean fuel is a good way to go about it. According to him there has been a 2.7% improvement every year from 2010. In the developing countries the hybrids and electric vehicles may not make as huge an impact as the improvements in the internal combustion engines might have. He suggested setting the base of the industry at the latest standards since it will take time to really make an impact. This is because any car sold today will be around for next 15-20 years.

Session 4: Low-Carbon Scenarios for Sustainable Mobility

Prof. Prem Pangotra from the Indian Institute of Management Ahmedabad, served as the chair throughout this session. Prof. Dinesh Mohan and the representatives of the cities served as the distinguished panel for this session.

Presentation by Prof. P R Shukla, IIM, Ahmedabad

Prof. Shukla in his presentation on “Sustainable Mobility and Passenger Transport” talked about the inter-city and intra-city sustainable mobility scenarios. For the intercity travel, he described the business-as-usual (BAU) scenario as:

Modal Shift to Rail by improving attractiveness of existing rail corridors is the policy objective, achieved by varied interventions, e.g.;

- By increasing travel speeds to enable maximum speed of 160-200 km/hr.
- Introducing High Speed Train Corridors on select corridors
- By improving coach services – through better amenities
- Constraints - Financial and revenue rationalization constraints

Where as he described the sustainable mobility scenario as:

A major shift towards rail for intercity transport is realized due to relaxing financial constraints which enable

- Adequate investments for improving attractiveness of rail through incremental approaches (speed and quality of services)
- Creation of High Speed Corridors (Max. Speed > 300 km/hr) beyond current proposals leading to increase in share of Rail from 14.5% in 2010 to 30% in 2050. (Overall travel demand for intercity travel kept unchanged)

He similarly gave away the details of the intra city scenarios for BAU and Sustainable mobility. He further discussed the inferences drawn from the analysis. According to the

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results, in terms of the overall energy demand from the transport sector would reduce. In 2020 the Oil demand would be less by 2.6% and by 2050 by 19.9%, where as the electricity demand would be however higher by 11.9% by 2050. But the emission intensity of the grid is suggested to go down from 0.99tCO₂ / GWh in 2010 to 0.69 in 2050. He concluded the presentation with the following major inferences from the exercise:

- Sustainable Mobility strategy will require major changes in infrastructures and urban design.
- Sustainable mobility strategy can deliver reductions in CO₂ emissions, but would fall short of what is needed for efficient response to achieve 2°C global climate stabilization target.
- Sustainable low carbon mobility would require alteration in fuel mix, especially clean electricity supply.
- A portfolio of options is needed to achieve low carbon mobility transformation in India.

Presentation by Prof. Geetam Tiwari, IIT, Delhi

Prof. Tiwari opened her presentation on “Low Carbon Mobility Plan for Indian Cities: Data Requirement and BAU Scenario” with identifying the captive users of the public transport systems and non-motorized transport (NMT). She discussed the expected outcomes of the low carbon mobility plans (LCMP). The data in order to model the travel behaviour in existing situation, BAU and alternate scenarios is required to be collected carefully and thus, she further discussed the data collection strategy and sampling methodologies. After describing the particulars of the BAU scenario, she proceeded to present the results of two case studies, one of the Delhi Metro and the other of a NMT. Her observations about the revenue generation and costs for Delhi metro were:

- Fare-box contributes less than 50 percent of total revenue of Delhi metro
- Dependence of metro systems on real estate development and hence a permanent change in the city’s structure.
- DMRC has a current debt of \$3 billion and the annual interest and financial charges reached more than \$36 million for 2011
- With increasing cost of operations and debt repayment with an increasing network size, the cost burden of Delhi metro is going to increase significantly

Also, according to the results, more than 80 percent of all the respondents travelled more than 10 km of distance on metro while only 17 percent of trips are more than 10 km long in Delhi. The lifecycle GHG emission from CNG buses was much less than that of Delhi metro but the local pollutant emissions was higher. The impacts of the metro on the human health were also on the higher side as compared to the CNG buses. She noted that the number of bicycle users increased by 70% in Delhi. But still there are barriers in realizing the full benefits from NMT infrastructure in Delhi as the road space has been encroached by Cars, two-wheelers, construction materials etc.

Presentation by Prof. Rutul Joshi, CEPT Ahmedabad

Prof. Joshi presented on the subject of “Inclusive Transport for Cities”. He started with the Ivan Illich, quote from ‘Energy and Equity’, 1973. While describing the inclusive

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transport planning process, he emphasized that the LCMPs should not only measure 'mobility' but also analyze 'mobility constraints' like lack of accessibility, affordability and locational issues, social groups (gender, caste etc.), occupation (i.e. on-foot street vendors etc.) and travel modes (walking, cycling). He further while describing the case study of Ahmedabad BRT pointed that multiplicity of agency is not a problem as the municipal Corporation is the sole co-coordinating body there. The issue with inclusivity in Ahmedabad includes minimal or no usable space for cycle tracks and walking paths, relocation and rehabilitation issues with the displacement taking place due to building of new wider roads, etc. He observed that the people travelling by the BRT have a substantially increased trip length and the sustained ridership has not yet been reached. He further observed that all the modes favourable to the poor (walking, cycling, shared auto rickshaws, public buses) seem to be not being planned or implemented properly leading to the fund from JnNURM not facilitating the needs of urban poor.

He concluded the presentation with policy recommendations. According to the case study the first level of issues is the implementation of the BRT projects

- lack of interest in the city administrations to implement such complex projects on a long-term basis
- lack of coordination amongst various government agencies
- lack of effective monitoring from the national government

Second level of issues are building selective infrastructure.

- BRT as a system of low-carbon mobility consisting of walking, cycling infrastructure and parking management not only as a central verge infrastructure.
- How to move towards low-carbon mobility?
- The foremost policy recommendation is to actively follow and implement the objectives of the National Urban Transport Policy (NUTP).

Summary and Comments from the Floor

Session Chair: Prof. Prem Pangotra, IIM Ahmedabad

Prof. Pangotra concluded the session by inviting questions from the participants.

There was a question of induced trips to Prof, Joshi to which he answered that there were 13% induced recreational trips due to the Ahmedabad BRT and that putting it in the low carbon paradigm was a challenging task. Also, on a separate note, Prof. Tiwari pointed out that comparing BRT with the metro system was comparing apples to oranges due to service level disruptions in both the systems. Also, for upto less than 6kms of total travel distance, metro proved to be the slowest mode. The representative from Udaipur noted that the population of the city was around 5 lakh and the area was 90 sq. kms. They face the constraints in implementing the BRT system due to private operator monopoly and the existing alternate system of auto rickshaws. In order to solve the congestion problem they were looking forward to bicycle services. On the concluding note Prof. Dinesh Mohan observed that cities like Melbourne, London, Boston etc have been design in a way that there is forced car ownership and we should look forward to similarly have forced public transport ownership.

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Day 2: 25th August, 2012

Project Workshop on Low Carbon Mobility Plan for selected cities

The second day of the workshop was titled as 'Project Workshop on Low Carbon Mobility Plan for selected cities'. Thus, the discussions on the second day revolved around the development of low carbon mobility plans for the three selected cities namely Rajkot, Udaipur and Visakhapatnam.

Session 1: Review of interim outputs from cities

Mr. B I Singal, Director General, Institute of Urban Transport served as the chair throughout this session. Prof. Geetam Tiwari from IIT Delhi welcomed the participants and opened the second day of the workshop by inviting the cities to present their cases.

Presentation by Prof. Talat Munshi, CEPT

Prof. Talat Munshi presented the case of the city of Rajkot. He informed the participants of the progress done on the project till date. He described the tasks already completed and the nature of information that CEPT had collected till date. He also suggested a revised work plan for the LCMP preparation of Rajkot. He familiarized the participants with the city geography and demography along with the administrative boundaries of the Municipal Corporation and the Urban Development Authority. A temporal analysis of the special growth of the city from the 1820 AD to present day suggested that the city was growing in all directions and the growth was very fast in western direction, rapid industrial development was in southern direction while the low Income housing was booming in the North and Eastern directions. An analysis of the regional setting implied that it was well connected to the surrounding cities and ports in the region since it is an important commercial hub of Saurashtra Region. The urban structure of the city was composed of mostly high density low rise development.

He noted that the road network formed a Ring-Radial pattern. The average trip length of the city was observed to be 3.71 kms (including walk) and 4.75 kms (excluding walk). For the pre-feasibility study for the transportation sector of the city, the old RUDA (Rajkot Urban Development Authority) had been considered and the time horizon was taken to be from 2006 to 2011. Traffic and Transportation Improvement Plan had been prepared with the object of identifying short, medium and long term transport improvement measures and prepare detailed improvement plans considering the RMC boundary and some outside village boundaries for a horizon of 20 years upto 2021. This consisted of 76 Traffic Analysis Zones (TAZ) for analysis. He informed the participants that they had studied the landuse and occupation pattern for the city from the building footprints in order to arrive at the type of development taking place in the city. The TAZs were created keeping in mind the ward boundaries. This was done as per the methodologies suggested under the UNEP project and they could get 190 TAZs inside the RMC boundary while 425 TAZs outside the RMS boundary and inside the RUDA boundary.

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A lot of information was available in the digital form still the ground truthing process was taken up. This was done using the GPS enabled devices. During this process the footpath widths, encroachment details were also noted. The aggregate level accident data was available but road-wise details were yet to be obtained from the police department. They had also stated with the household surveys based on the survey performance template decided upon under the UNEP project. Their sample size was 2743 and they were conducting the survey using the stated-revelled preference method. He also noted that it took anywhere from 45 minutes to 1.5 hrs to complete one household survey. The survey data was planned to be fed into the scenario that will be created for the city. He wanted a discussion and a clear understating on how to conduct the household surveys.

Presentation by Dr. Anvita Arora, iTrans

Dr. Anvita Arora presented the case of the city of Visakhapatnam (Vizag). She opened her presentation with an introduction to the city characteristics of Vizag. She further described the time series analysis of the way the city had grown to its present state with specific emphasis on the way the transport sector has taken shape over the years from 1856 to 2005. Dr. Arora presented a framework for the vision for the low carbon mobility plan development for Vizag. The methodology was extremely stakeholder oriented and aimed at understanding the problems faced by the administrators and the citizens. The very first task taken up after this was of delineating the planning area and project boundary. The plan will look forward to 2017 for short term, 2022 for medium term and 2030-2040 for long term perspectives.

The area finally included The City of Visakhapatnam, Gajuwaka, 32 villages in the GVMC area, Visakhapatnam Export Processing Zone and the Industries with a population of 1.73 million. She put in the picture for participants the situation with the under construction BRT corridor. She also noted that the city had 2 vehicle free zones between 5AM and 7.30 AM. Later in the presentation she presented the review of the data collection process and the preliminary observations. The primary data already in progress included the household surveys, traffic volume counts and the Origin-Destination (O-D) survey, while the road inventory, PT and IPT User Profile, freight survey and petrol pump survey were yet to be taken up. The secondary data in terms of the CDP, Master Plan and BRT DPR, GVMC Map with Ward boundaries, Property Tax Data for individual HHs, Annual Budget and accounts data were available with them and they were awaiting information on bus route and operations data, safety data, PT and vehicle inventory from various departments. 3,000 households out of 4,19,343 in the city (0.72%) had been taken as the sample size for HH Interviews out of which 1100 had been collected till date. The 72 wards were divided into 9 zones for the purpose of this exercise. The Rajiv Awas Yojana (RAY) data had been used to validate the information on the slum HHs. The summary of the information based on the 100 analyzed questionnaires turned out to be as follows:

- Avg. HH Size – 4
- Avg. HH Income – Rs. 13,000
- Daily needs dist. – 1.6km
- % Car Ownership – 8%
- %2W Ownership – 51%
- % Bicycle Own. – 15%

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Also, the Turning Movement Counts were taken at 7 Outer Cordon points and 13 Screen line points while the OD surveys were carried out at 4 outer cordon and 2 Point sources namely the Railway Station and the Regional Bus Depot. The challenges face while carrying out the surveys included high floating population of the city due to large industrial and tourist (religious) economy of the city. The revealed- stated preference survey took least 45 minutes to be administered and thus posed to be a great challenge. Initially administering the survey took longer time even though the team carrying out the survey was provided with one week training on the same. The budget analysis for the GVMC gave insights into the expenditure on the transport. It was found that 21% of the city money went to transport, but not much was being spent on the NMT. She emphasized the need to have stakeholder consultations (like FGDs, Interviews, and Surveys) and the methodology to conduct them. She concluded by presenting the updated work plan for the project.

Presentation by Mr. Ankush Malhotra, UMTC

Mr. Ankush Malhotra introduced the case of Udaipur city with the current status of the project. An approval from the government of Rajasthan had been received on the 19th July, 2012 and the project inception meeting was held on the 22nd August, 2012. Thus MoU signing was under process. Also, the orientation Workshop with different stakeholders like Urban Improvement Trust (UIT), Udaipur with concerned technical personnel, Town Planning Department, RTO, Udaipur ,Transport Department, Mayor, Municipal Council, Udaipur, Tourism Department, Public Works Department, Udaipur etc. were under progress. The area under the municipal limits was 64 sq. kms and that under the UIT was 350 sq.kms. The area under the municipal area houses a population of 4.8 lakhs as per the 2011 census document. Udaipur is a tourist city with 7 major lakes that attract a lot of national and international vacationers. The tourist population has almost doubled to 1375000 in 2010 from 719580 in 2001. The area that needs to be taken up under the project was not yet decided upon.

The city transport infrastructure consists of 822 kms of road network length. There are 2.98 lakhs (2005-06) registered vehicles that have been annually growing at the rate of 7-10% for cars, 2 wheelers and commercial vehicles. While the Para transit systems are growing at 6.4%. The city transport system covers around 44 routes while the BRTS runs on 16 of the city bus routes.

Mr. Malhotra expressed his concerns over the following data collection issues:

- Socio-Economic data at ward level as TAZ: Sample TAZs?
The zones for the analysis of the traffic were not defined for the city and needed to be done.
- Road Network inventory: Sample TAZ wise? Extrapolation?
- Household surveys @ 1% at ward level
Survey zones were needed to be fixed for the project on the basis of property tax data like Vizag or on the basis of the way the city has grown and the distances of a locality from the core of the city. Finally the ward boundaries were considered as the zone boundaries for the purpose of the survey.
- State preference surveys: Survey formats and Sample size?

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Stratified survey data was comparatively easy to get and they had already created their own 1st level stratification. The spatial data was not very easily available for the city of Udaipur. Just like the other two partners, he also noted that the survey questionnaire was long. He was looking for suggestions from the participants on how to go about administration of the survey- what kind of questions should be asked first, the transport related or the HH related.

Dr. R P Sharma from the Urban Improvement Trust also presented the case of Udaipur in terms of the projects and programs taken up by in order to revive the city infrastructure.

Summary and Comments from the Floor

Session Chair: Mr. B I Singal, Director General, Institute of Urban Transport

Prof. Geetam Tiwari put up her views on the apprehensions that Mr. Malhotra had expressed on selecting the project boundary. According to her opinion, the urban development authority boundaries were a good representation of the future situation since the project was looking towards the long-term plans.

The Chair, Mr. Singal, summed up the session by putting forth his views on the discussion. He pointed that congestion was a grave issue that the cities face today and the floating population also has a substantial role to play in this. He noted that setting a boundary for the plan or delineating a study area was also a very important topic to be discussed as it has much influence on the final outcomes of the study. He informed the participants that institute of urban transport along with UMTC were trying to development indicators for the service-level benchmarks across six studies in order to access the how implementable they were and what changes were required. He also suggested the participants to refer to the SFBMs from the ministry before undertaking the study.

Session 2: Scenarios for LCMP

Prof. Geetam Tiwari, Indian Institute of Technology, Delhi served as the chair for this session.

Presentation by Prof. R R Kalaga, IIT Delhi

Prof. Kalaga presented the experimental design and analysis for the stated preference survey method. The purpose of this study was to evaluate acceptability of innovative modes and services, quantify sensitivity to level of service by varying values of access time, waiting time, travel time, cost etc., and measure willingness-to-pay and to investigate effects of attitudes and perceptions. He emphasized that the stated preference survey method was required in order to estimate the impact of different strategies on the mode choice of the travellers. He also familiarized the participations with the limitations of the survey. According to his experience, it was difficult to obtain sufficient variation in observations to examine all variables of interest and estimate parameters reflecting proper trade off ratios. The survey also could not be used to

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evaluate demand in a condition that does not exist. The other major limitation of the method was that it took into account measurable attributes like time and cost, other variables like safety and comfort that cannot be judged.

He further described the steps involved in taking up the survey. The first step is to define the variables or the factors based on the interest area of the study, in this case the attributes that influence the mode choices. These parameters may not be uniform for all the modes. The attributes could be direct as well as indirect. In case of a Revealed Preference Choice Survey, the values of the attributes are known from the existing level of service. While for a Stated Preference Choice Survey, the values vary based on the scenarios in order to capture mode choice variations in different conditions. He also advised the participants about the choice of the experimental design and precautions to be taken by ensuring that choices are not very large and appropriate choice set need to produce meaningful behavioural responses in the context of strategies. While designing the questionnaires, the fractional factorial design methods need to be adopted in order to reduce the size of questionnaire. He also recommended face to face interview method as the most optimal way to go about the survey. He concluded by outlining the analysis techniques. According to him, for stated choice surveys, Multinomial logit (MNL) model and Nested logit models were the most appropriate choices. He further explained the kind of results that the softwares BIOGEME and NLOGIT come up with when such an analysis is taken up using these models. He also described a method to calculate the CO₂ emissions.

Presentation by Prof. P. R. Shukla, IIM, Ahmedabad

Prof. Shukla presented on the Back-casting approach for achieving a climate target. He started with explaining the global low carbon transition pathways and the alternate development perspectives for conventional climate centric as well as sustainable development and climate paradigms. In reference to the sustainable low carbon mobility framework, he explained the Geographical/Temporal scales for various scenarios and roadmaps. He further highlighted the three important models/tools useful in developing the low carbon society scenarios namely AIM/CGE, Extended snapshot tool (ExSS) and Back-casting model (BCM). He then went ahead to explain the process of scenario development which is essentially divided into two stages:

- Stage one: Design of a Low Carbon Society
- Stage two: Construction of a policy roadmap toward the Low Carbon Society

He also spoke about which models need to be applied at what stage of scenario building. He presented the co-benefit analysis framework in terms of regional co-benefits derived from a low carbon society. In order to undertake the assessment, various component models also need to be employed. A cohort component model for population, a household headship rate model for household types, with spatial resolution of provinces, land-use types and climate zones and five family types was developed, and is used to analyze effects of depopulation and changes in family composition on the realization of LCS. Also, a Passenger Transportation Demand Model (PTDM) can simulate transportation demand associated with changes in population distribution, people's activity patterns, modal shares and average trip distances.

The demands in this model are divided into two types,

- 1) Intra-regional transportation within the daily living area,
- 2) Inter-region transportation between the daily living areas,

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He further described how a Soft-Linked Integrated Model System (SLIM), was useful in linking these various model databases. He described the kind of lock-ins the transportation sector can get into and the co-benefits received by avoiding those from a city planning point of view. He outlined some instruments like Perform, Achieve and Trade (PAT) which when implemented have substantial low carbon benefits. He concluded with a slide on the approach towards low carbon society perspective.

Summary and Comments from the Floor

Session Chair: Prof. Geetam Tiwari, Indian Institute of Technology, Delhi

Prof. Geetam Tiwari, who was the session chair, summed up the session for the participants.

Session 3: Indicators & Benchmarks

Prof. Darshini Mahadevia, CEPT University, Ahmedabad functioned as the chair for this session. She also made a presentation in the session.

Presentation by Prof. Darshini Mahadevia, CEPT University

In her presentation Prof. Darshini Mahadevia provided an insight into the indicators and benchmarks in order to assess the parameters of mobility and accessibility under the UNEP project. These would prove of importance to the city consultants to come up with an inclusive mobility plan. She presented the parameters and their relevance as far as inclusiveness is concerned. According to her for example a model share by social groups based on average family income or women headed households would state the equity in service levels. It would help to understand whether the low carbon transport is by choice for vulnerable groups of society or not. She also indicated that more travel time for vulnerable groups was an indicator of social exclusion and with the help of disaggregation by trip purposes, specific measures could be taken to increase social sustainability. Trip purpose wise average trip length disaggregated by social groups would help in identifying the required change in land use structure specifically for the different groups of society to attain social sustainability.

She presented some long-term modal share for mid-size cities by activities for non-motorized transport, public transport and private transport modes. Similarly she noted the long-term modal shares for the mid-sized cities by income class like very poor, low, middle and high income. In order to benchmark the travel time, she indicated some typical travel times per modes for a mid-size city by activities. Accordingly the affordability benchmark for very poor, low income and middle income groups would be 5%, 7.5% and 10% of the income.

Presentation by Prof. Geetam Tiwari, IIT Delhi

Prof. Geetam presented the indicators and present status of infrastructure and landuse. Under the infrastructure quality, ease and comfort the parameters like Average speed on roads for motorized modes (cars, MTW, Bus, three wheelers) on arterial, collector and local roads, Access to public transport for various households bifurcated based on social groups and income levels, Average number of interchanges per public transport

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trip for the households, Accessibility for disadvantaged by different modes etc need to be looked at. She also informed the participants how these parameters need to be measured and which questions in the reference survey will help them measure the parameters. The affordability indicators like Affordability of PT by social group and cost of commuting were also very important benchmarks for an inclusive low-carbon mobility plan. Investments for development of infrastructure for various modes, Mode wise tax burden and Percentage of subsidies granted to public transport were the economic indicators that she insisted need to be assessed. She stressed on the importance of setting up realistic targets indicator-wise acknowledging the budget constraints. Such phasing of activities will help achieve the targets. She also pointed that there could be jurisdiction issues for taxation and funding from state and central governments.

Presentation by Prof. Dinesh Mohan, IIT Delhi

Prof. Dinesh Mohan presented the indicators and benchmarks for safety, security and environment for transport systems. He opened the presentation by stating the need for linking-up transport planning and urban design, public health and transport safety, well-being and the built environment. There were concerns of the pedestrian, cyclist, and public transport passenger must be considered at the 'eye-level' of humans in the city. According to him, the key to the LCMPs development approach should be to recognize that walking is the most universal form of transport and all cyclists, public transit riders and motorists begin their journey as pedestrians. Also, the transit and automobile network can only be as good as the pedestrian network that brings them to other modes of transit. He indicated that the planning has to be done for poor keeping in mind that India is expected to have a huge population of poor until medium term. He pointed out that high speed and separated car traffic create a barrier and a no man's land. Thus, along such movement lines and in such spaces, crime and traffic accidents proliferate. The safety indicators could be risk exposure mode wise, risk imposed by modes, overall safety, speed limit restrictions and quality of footpath infrastructure. While percentage of road lighted, percentage of footpaths lighted and percentage of people feeling safe to walk/cycle and use public transport in city by gender were good to measure the security aspects. He listed the environmental impacts, land resource depletion and health hazard indicators as follows:

- Per capita consumption of land for transport activity
- Land consumed for different transport activities
- GHG emissions
- Lifecycle cost of different modes
- Fuel consumption
- Vehicle efficiency by mode and fuel type
- Percentage of population exposed to air pollution
- Percentage of population exposed to noise levels > 50 dB

Summary and Comments from the Floor

Session Chair: Prof. Darshini Mahadevia, CEPT University, Ahmedabad

Prof. Mahadevia, the chair for the session, concluded the session by summarizing the highlights of the presentations for the participants.

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Session 4: Training on Stakeholder Consultation

This was the concluding session for the workshop. Dr. Subash Dhar facilitated the discussions on Multi criteria approach for prioritising infrastructures and technologies and Template for LCMP report.

Dr. Subash highlighted that stakeholder consultation is an important component of this project. He highlighted three possible decision points for stakeholder engagement

- Getting buy in for Scenario outputs from modelling exercise
- Valuation for alternative Policy choices
- Project prioritisation

From the discussion that involved inputs of project partners (Prof. Geetam, Ms. Deepty and Prof. Darshini), consultants (Ms. Anvita, Mr. Ravi, Prof. Talat, Mr. Ankush and Mr. Sandeep) and city managers (Mr. Sharma) following points came out:

- Greater buy in the project by the city managers
- Long term sustainability of the project outputs e.g., LCMP plans, project proposals, etc.
- Active citizen involvement

Issues to consider for designing a stakeholder consultation process

1. Cultural : A hierarchical society and therefore difficult to do stakeholder consultation. Also if the meeting is chaired by Municipal Commissioner then many stakeholders, NGOs, etc may not voice their opinions freely.
2. Institutional arrangement : Cities have their own institutional arrangements for taking decisions and we can not propose a new structure for this project
3. Transfers : Key functionaries e.g., Municipal Commissioners transferred frequently and therefore this can affect the continuity of the process
4. Include Divisional Commissioner : In project we are working with Municipal Commissioners office however operational responsibility is with DC and therefore need to involve them
5. Feedback : The process should have a feedback loop for taking care of inputs received from the stakeholders
6. Bias : Many stakeholders may have bias for some options therefore need to highlight costs and benefits clearly
7. Selection : Different set of stakeholders required for different discussions, therefore it needs to be clarified as to who are the stakeholders.
8. Indicators : The project has come up with indicators and these should be used as a basis

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Annexure-1

Transcript of Speech by Dr. Sudhir Krishna

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It is a privilege for me to be in this workshop of developing policies and strategies for low carbon transport in India. The persons present here, I take that you are the leaders and prime messengers for what we aim at in making lives of people better. I want to suggest to you the importance of your efforts in our country. Probably somebody may appreciate truly and somebody may not. Those who do not appreciate are probably ignorant of the importance of the subject that you are handling. So you pardon them their ignorance and strive to reach the message to them. Not merely feeling bad about them. I myself have learnt so much over the period I have been associated with this sector and I feel so much benefited and I feel that so much is possible. And as our committee said that if we work long enough and..... strong enough then I can move the earth. So much so is the work that you are doing in the development of the country which is why the realization in life. I am sure some of you will agree and some of you would have already felt that.

I want to say that our country should have developed so much more. We got independence along with a series of other countries whether it is Malaysia or Indonesia or China, and so on and so forth. Around the same year. But in the march of development in many parameters we have succeeded but in many parameters we have not been able to keep pace. And the reason is, it appears to me, that we have not kept focus on a clear development paradigm. Our obsession with the rural development, our obsession with the villagers..... republic and our obsession with poverty probably did not let us think in a visionary mode. We could not think beyond our village. And we paid the heavy price. It goes with out saying that I mean those who... empirically, urbanization is equal to development. And empirically I say because if we match the level of urbanization with the development indicators of countries and you yourself see the positive connotation. Within the country the more urbanised states have higher per capita GDP, higher literacy ratio, and so many other development parameters. This is an empirical point and the empirical evidence have to be converted into...postulated into...formulated into a hypothetical..... theory and the theory goes like this. There is nothing magical about the label of urbanization...there is no magic that you put the label urban and everything becomes wonderful. And you put the label of municipality and low and behold it becomes very good. It doesn't work that way. Because it is very fundamental...

What is urbanization? Urbanization is planned densification of settlements. It is as simple, nothing more than that. It is densification of settlements. That is all. Otherwise rural - urban, all are human beings only. They breed, they eat, they work, and so are people in the cities also. So this fundamental we lost that. And from 1947 to 2007 there were no programmes worth the while for urban development. There was no talk also. We always felt that we must improve our villages. That is not wrong, we must... wherever human beings are living, and we must improve. But it must be a visionary approach for the country as a whole. And somehow so in 2007 the Jawaharlal Nehru Urban Renewal Mission was launched. It is a small step, if I can say a small step for man

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and a giant step for mankind, and convert that 'mankind' to the Indian framework only. It's a small step for the people of India but a giant step for the society of India. India as a whole. Small small efforts have changed the lives. I had gone to Agra last, a few days before. The city had changed so much. If you compare with other developed countries in Europe, I don't think we can match. But people like me who have been going from childhood to Agra, and I come from Varanasi so I have gone to these cities and I have seen their march to decay. I was amazed. I went to Varanasi in early June and the city was much cleaner, and I have gone to Agra... because there was pressure... you don't have to explain why it did not improve. But why did it improve, that is the question. So they said it is the JnNURM, under which we have developed the solid waste management programme, under which there is a door to door collection, and also there is scientific disposal and so on and so forth.

And of course, managerial issues are also there. If something good is happening as a paradigm, then participants also feel excited here and there to do something better. If something is messy then you don't know where to start. Then you get entangled with distress calls. There is a mess here; there is an outbreak of disease there. But when things are better you start to think how to make things even better. That's how the paradigm of development management is. And so they were so very happy about this, the other day I had a presentation, and others making a presentation in Indore city. They also said that this waste is becoming a wealth. And since we still do not have the confidence to make urban projects bankable, we are not sure of the returns of the projects, so no body prepared the financial viability of the projects. Nobody is admitting that. They are shying away... society must take risk, government must take risk...not taking the bull by horn and the economics of it. And in Indore they proved that everybody is making money, the city corporation is making money and the company which has undertaken the task is also making money. And if they stretch it a little bit even the capital cost can be recovered. And now their operating cost only, they are operating on that model.

So urbanization and this ruralization that we have pursued where we think that only one eye is good enough for us and the second eye we don't care. One eye must be good and what about the second eye. And in the process if someone's one hand is very strong and the other hand is very weak, will you call that person very strong. So, in our path to ruralization, we thoroughly ignored urban issues. That's what happened in the beginning, we could not allow people to come to cities. And even when people were coming there was no plan, no framework in which they could be accommodated. As a result they converted into slums.

We say of and on that 50 percent of Mumbai is slums and Delhi more than 50 percent is slum and so we have forgotten about it. In the process what happened was that people who were coming from urban areas to marginal areas, they did not become very rich or prosperous when they migrated. They were getting 200 rupees in income in rural areas and they were getting 4000 rupees in urban areas. But the only thing is that they do not do odd things in the presence of their relatives and friends. That is one great safety for them. That stigma is not there that I am doing odd job, that I am living in slum. It is a big thing for them. And they are able to send some cash home without indicating all their misery. So it is a big thing for them. And secondly it is like frying pan to fire, there is not much to choose from, so they are slightly better. In this scenario, urbanization has taken

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place only partially which we cannot be proud of the – the level of urbanization that we are having. We have to have much faster urbanization and if we are not able to attract the people in a framework of positive development to urban areas, so they don't come...

And look at the land holdings in urban areas. It was 3 hectare in 1971 and it's still higher than when we got independence and today it is only 1 hectare. Two thirds of the population have less than one hectare of land holding and more than two third of them are having dry land holdings. So, it is nothing but a march to pauperization. This ruralization policy has led to pauperization. If common man is impoverished the country will be impoverished. This is simple dynamics of development and so those who are working for urban development are present. If you don't appreciate what they are doing, you are ignorant. Pardon them their ignorance, but work for their enlightenment. Work for their enlightenment with your conviction. That what you are doing is helping the country to march towards development.

So I say that the cities must be developed in a planned manner. Cities must become host to economic activities which is happening worldwide. But our learning in India is happening in villages. We have pushed us into thought process that we could not come out of it. And we created best for the people for whom we directly work and created less for the urban people for whom we never thought. So this is the history which we must not forget. I always say that we must not regret too much history because it is a lesson for the future. That is all the importance of history. When we are proud of history, we are not shy of history. Our history. We should only learn lesson from that. That is all about history. So then I say that cities have to be planned and the planning has to come from a transit oriented plan. The cities must be based on mobility based planning. That is like the backbone...the orthopaedic structure of the city is the transit oriented plan. The mobility oriented plan is the backbone or the solid structure of the city plan.

The next paradigm I am suggesting for your concentration – People will be able to move from one end to the other end, with out hassle and without compromising on...in fact it must add to the value of their efforts. It must add value to their efforts in terms of their time, their energy, their money, whatever they are investing, it must give them value. And how transit oriented development helps. Very very simple example, right here in Delhi. The detailed project report for Delhi Metro had been prepared and showed that the average travel distance is going to be four to five kilometers. And today the DPR has been proved to be wrong, which many of the DPRs are unfortunately. They are turning out to be wrong off and on. And today it is three times that ...three to four kilometers. The reality is that the average distance travelled by Delhi metro is 15 kilometers. It is not that people love to travel by Metro. It is a simple thing...empirical evidence converted into development formulations and transport models. For better economic opportunities, people travel.

And looking back at my home state Karnataka...Bangalore is my home base. Bangalore is not famous for what it should be famous for, garment industry, but it is famous for IT. But in the base of Bangalore is the garment industry. The feet of Bangalore are in the garment industry but the head is with the IT sector. So you will see the head, you will not see the garment industry. A lakh of people are engaged in the garment industry. So many shirts and things you will get, it often states that it is made in Bangalore. And it heavily employs women. Almost 90 percent of the workforce in the garment industry is

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women. It is not only that they are adept at it, because you know traditionally men have been tailors for ages for generations. It is because women are prepared to work at lower wages. And of course there are other factors also. One can do research why they are working for little, but what I have come to believe is that it is because women are prepared to work for lower wages. And why they are prepared to work for lower wages is because they are not prepared to commute for longer distances. They are not prepared to spend hours on travelling both ways. Because whatever happens they cannot ignore their household. Whatever salary you may offer, easily they cannot leave their households. Because they cannot commute, because of public transport system and they cannot negotiate the mess on the roads so wherever half kilometer or one kilometer, wherever they get employment they work. It is good for the employer also. But the moment you give public transport facility, they are willing to travel longer distances and get better job opportunities. Safe and convenient public transport and they are willing to commute longer distances.

And in the Bangalore metro they said that there is a high proportion of women travelling in the Bangalore metro. And in the Delhi metro also I am told the proportion of women commuter is more than their proportion in employment...though very reliable statistics, I doubt. So friends, urban mass transit system has a great role in ...just as planned urbanization has a great role in the development of the country, transit oriented development and mass transport systems have a very very important role, equally important role in the planned development of cities. And of course the carbon issue etc, they go without saying.

There are a lot of issues which are driving the urban transport sector. We have developed from the Ministry in collaboration with a series of institutions a handbook on service based benchmarks for urban transport and I am sure you must have seen it, I will leave a copy and you can send in requests for more copies of this book. So this covers the bench mark in terms of public transport system in the overall sense, then pedestrian infrastructure facilities I have not gone into details of organized transport which we will discuss later and which are very very important, and the pedestrian infrastructure facilities bench marks are there. Benchmarks for other non motorized transport, level of use of ITS, which is also a very important sector. The ITS facilities, the benchmarking for the travel speed, benchmarking on parking, road safety parameters, pollution parameters, integrated line use transport parameters, and lastly the financial sustainability of public transport, such as by bus. Those indicators are there in this handbook.

We are developing bench marks on other urban infrastructure like solid waste and sewage and water supply. This was developed in 2011 -12 and the one on transport was developed in 2009. So they become the framework for operating our policies. We have our. We are insisting henceforth on all the DPRs to follow these bench marks and all the projects should strive to attain those bench marks and your suggestions in this regard will be very valuable. In our federal structure we have to work in close collaboration with state governments and local government bodies. There are issues at all levels. There are times when we create a paradigm where achievement becomes more difficult than before. For instance for everything we have got a law. And the law creates a paradigm for administering existing laws which depend on other paradigms and other

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laws. So we end up creating a series of administrative systems independent of each other which make it difficult to achieve what we strive to achieve.

Take the case of all our benchmarks for pollution or sustainable environment factors. Each government body has got its own law, environment authority has got its own law, environment authority has got its own law, town planning has got its own law, municipal authority has got its own law; road transport authority has got its own law, and so on and so forth. So each law has got its own authority and each authority has got its own structure of administering the law. So how do you sign a..... So we have to very carefully now see, that while we are trying to rationalise these laws but in the meantime we try to create a managerial paradigm where these laws are synergized so that we can get the best while trying parallelly to modify the legislative paradigm. As we say our country is ruled by laws...and as we have a saying in South Delhi that the operation was successful but the patient died. It should not happen that too many laws that are aiming at results...ultimately the patient for whom the laws were made... do not serve the purpose, and ultimately the patient is not able to survive.

So friends were are also having the Urban Mobility in India workshop in December and our partners here and others who are here are welcome to participate in your own way. And we are also partnering with governments at various levels, as I said the centre, state and local bodies, we are also partnering with educational institutions including IIT Delhi, IIM Ahmedabad, IIT Chennai, and CEPT. Most of the institutions. It is a matter of great pride for us at our Ministry that we are partnering with over 50 such institutions in the country and we are proposing to expand the network of institutions to work with us and we hope to increase the collaboration in an increasingly sustainable and expansive way in the future. So I thank Dr. Subodh Sharma and Dr. Shukla and his team for giving me this opportunity and hosting this very important workshop. I wish the event all success.

Workshop on Promoting Low-Carbon Transport in India

Annexure-2 Workshop Pictures



Photo-1: Participants at the workshop



Photo-2: (L-R) Prof. P R Shukla, Dr. Subodh Sharma and Mr. Robertus J Jozef during the inaugural session

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Photo-3: (L-R) Prof. Dinesh Mohan, Dr. Subash Dhar and Mr. Robertus J Jozef during a Q&A Session



Photo-4: Mr. Ankush Malhotra presenting the case study on the city of Udaipur