Urban Transportation and the Environment

Sudhakar Yedla

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Issues, Alternatives and Policy Analysis

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“To my loving son Dhiren”

Preface

Small towns grow up riding bicycle both for short daily trips and long and occasional trips on “ride-cycle-ride” mode. The small towns and villages in India have always been sustainable, whether it is transportation, or waste management, or even resources management. It is only a surprise that, in the name of green growth, the international development agencies are now trying to introduce the same old principles of sustainability to the developing world which they have already been following since long (it is even practiced today in smaller towns/villages).

Rapid economic growth brings opportunities and they bring significant changes in lifestyles. The average distance between “home” and the office has increased (as we call it migration) and so have the daily trip lengths. Due to the fastness in movements and longer distances to travel in shorter time, motorization has become the face of transportation in Indian metropolitan cities. Services sector-driven economic growth has resulted in increased per capita incomes and purchasing power. With the need to move faster and farther, the number of personal vehicles (cars and bikes) has increased many times over the last two to three decades. The infrastructure provision also got skewed towards motorized modes, marginalizing the golden and age-old mode of transport—the non-motorized modes such as walking and cycling. Rapidly growing personal vehicles, poor quality, and insufficient public transport have resulted in inequality in service provision, due to which the urban poor are subjected to extreme hardship for their travel needs. As the limited road space without a functional footpath needs to be shared among pedestrians and slow- and fast-moving vehicles alike, urban transportation is faced with a large number of accidents involving urban poor and NMT users, congestion, poor energy efficiency, severe air and noise pollution, and carbon emissions leading to climate change. It is rather a quick journey from a “sustainable and environmentally friendly mobility” system to a “chaotic urban transportation” that is unsustainable and also inequitable.

Since the 11th Five Year Plan, Indian cities are competing with each other in developing metro systems in their respective cities, and quite a few of them would soon be flashing their metro smart cards as the new face of their transport system.

However, the marginalization of NMT continues to be evident from the metro development plans that they share with the public.

This necessitates a change in the way transportation is planned for future years. The city policy makers are in a dilemma on whether to focus on the provision of good-quality travel service or aim to control local and noise pollution or target the low carbon pathways to control carbon emissions. The present book has evolved from this “policy makers’ dilemma.”

Started off with the regional research initiative on energy, environment, and climate change by Sida (Swedish International Development Cooperation Agency) about 15 years ago, our research work on the transportation sector has been long and covered various important aspects including greenhouse gas mitigation; evaluation of alternative and cleaner options in transportation; barrier analysis; identification of appropriate policy measures to implement the alternatives; means to promote NMT; prioritization of alternatives, barriers, and policy measures using multi-criteria framework and AHP; integration of environmental concerns into long-term transportation planning; and incremental cost analysis to find the carbon competitiveness of the sector and sustainable mobility and its link to sustainable development goals (SDGs). These works, published by various agencies and journals, form the core material for this book. They have been cited at appropriate places along the text of this book. Although we are benefitted from the support of various international agencies such as Sida, the United Nations Development Program (UNDP), and the Institute for Global Environmental Strategies (IGES), Japan, at various stages in conducting the research, the opinions contained in this book are those of the author and should not be attributed to any of these agencies or its associates.

The material presented in this book has been developed over 15 years of research. The research work has evolved over time and followed closely the transformation of urban transportation. While this could address the issues as they evolved, some of the earlier works dated early 2000 may appear outdated for the sake of numbers. In the case of simple statistics, they have been updated with the most recent available information. However, if they represent an analysis aiming at comparative presentation of alternatives/scenarios, they have been left intact as the old dated information would not make any difference in the interpretation.

This book addresses the problems of urban transportation comprehensively by identifying potential alternatives, barriers for their implementation, policies for the implementation, and comparative analysis of different approaches of planning such as local pollution mitigation approach and global emission control approach. It considers the environmental dimension of sustainability and proposes a new and more effective policy framework. Such a framework would be of immense help to city and transportation planners and policy makers.

This book, in its attempt to develop a policy framework that is more effective, presents three different methodologies for prioritizing alternatives (barriers and policy measures), viz., analytic hierarchy process (AHP), multi-criteria group decision making with multi-stakeholder consultative process, and multi-criteria

analysis with supra user and differentiated weights based on potential contribution toward the objective. Case studies are included for these three approaches which could help the reader in comprehending the methodology.

Starting with the basic planning and the need to look at sustainability principles (Chap. 1), this book goes on exploring the trends in urban transportation (Chap. 2). Difficulties in service provision owing to the changing urban dynamics are analyzed, and the environmental and climate implications of urban transportation are presented in Chap. 3. Chapter 4 presents all alternative options for environmental inclusion in transport and proposes a methodology for a comprehensive assessment of the same by means of energy-saving potential, emission reduction potential, and economic viability on life cycle operation. Chapter 5 identifies the problems in promoting NMT which can make commendable contributions toward environmental sustainability and social equity. Chapter 6 identifies barriers for NMT implementation and other cleaner alternatives such as clean fuels and alternative technologies. Such barriers have been prioritized using the popular analytic hierarchy process (AHP) so that the policy maker can easily pick a set of barriers that need to be addressed.

Chapter 7 identifies policy measures that are essential for the removal of barriers for the implementation of NMT and other cleaner alternatives in transport. These policy measures have been prioritized using two distinct methods of multi-criteria analysis. Chapter 8 presents all the regulatory and economic instruments that can be applied for the sustainability of urban transportation. Such a presentation is further augmented by various examples from all over the world. Means to integrate environmental concerns into urban transportation planning are attempted by developing a dynamic optimization model with environmental and carbon emission constraints. Chapter 9 applies the optimization model to analyze the co-benefits and carbon abatement costs of local emission control strategies and global emission control strategies.

This book aims to help the policy makers by suggesting and demonstrating a new policy framework to integrate sustainability and climate change mitigation into urban planning.

Mumbai, India

Sudhakar Yedla

Acknowledgments

My involvement with research on urban transport has been for 15 years, and I am happy to be consolidating it into a meaningful book. The material presented in this book is drawn from the research work carried out well over a decade, and I thank all my associates and colleagues who have helped me in various assignments and at different times.

I am grateful to all those who supported my research financially and technically by means of reviews and constructive comments at different platforms. Particularly, I wish to thank the Swedish International Development Cooperation Agency (Sida), Asian Institute of Technology (AIT), United Nations Development Programme (UNDP), and Institute for Global Environmental Strategies (IGES), Japan, for their generous support in conducting my research works on the transport sector.

Support by the parent institute, Indira Gandhi Institute of Development Research (IGIDR), has been remarkable, and the pleasure of working at IGIDR is the key driver behind this book. I wish to express my gratitude to the institute, the director, and all the former directors of IGIDR.

This book would not have been possible without the continued support of my family. Thank you everyone for inspiring me. Thanks to my son Dhiren and wife Namratha for their understanding and support, without which I would not have been able to complete this task.

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Abbreviations

ASIF	Activity, structure, intensity, and fuel framework
BEST	Brihanmumbai Electric Supply and Transport
BIS	Bureau of Indian Standards
BOV	Battery-operated vehicle
BRTS	Bus rapid transit system
CC	Climate change
CERP	Common emission reduction potential
CNG	Compressed natural gas
CO	Carbon monoxide
CO ₂	Carbon dioxide
CPCB	Central Pollution Control Board
CRRRI	Central Road Research Institute
dB	Decibels
DHDS	Diesel hydro de-sulfurization
ERP	Emission reduction potential
ESP	Energy-saving potential
GDP	Gross domestic product
GHG	Greenhouse gas
GoI	Government of India
HC	Hydrocarbons
HEV	Hybrid electric vehicle
IGIDR	Indira Gandhi Institute of Development Research
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
JPOI	Johannesburg Plan of Implementation I
JRY	Jawahar Rojgar Yojana
LCC	Life cycle operating cost
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
MAC	Marginal abatement cost

MMRDA	Mumbai Metropolitan Region Development Authority
MoEF	Ministry of Environment and Forests
MoUD	Ministry of Urban Development
MRTS	Mass rapid transit system
MUIP	Mumbai urban infrastructure project
MUTP	Mumbai urban transportation project
NAMP	National Air Quality Monitoring Programme
NCR	National Capital Region
NCT	National Capital Territory
NGV	Natural gas vehicles
NMT	Non-motorized transport
NMV	Non-motorized vehicle
NO _x	Oxides of nitrogen
NUTP	National urban transport policy
PAC	Pollution abatement cost
PAH	Polycyclic aromatic hydrocarbons
PJ	Penta joules
PKM	Passenger kilometer
PMGSY	Pradhan Mantri Gramin Sadak Yojana
PUC	Pollution under control
RSPM	Respirable suspended particulate matter
SO _x	Oxides of sulfur
SPCB	State pollution control boards
SPM	Suspended particulate matter
TERI	The Energy and Resources Institute
TKM	Ton-kilometer
TSP	Total suspended particulate matter
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UNWCED	United Nations World Commission on Environment and Development
VAT	Value-added tax
VED	Vehicle excise duty
WHO	World Health Organization
WRI	World Resources Institute

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