Supported by 日本財団 THE NIPPON FOUNDATION

A Study of Long-Term Transport Action Plan for ASEAN

April 2014

Institution for Transport Policy Studies

Preface

The Institution for Transport Policy Studies has been engaged in the three-year "Study of Long-Term Transport Action Plan for ASEAN" since FY2011, with full support from the Nippon Foundation. This study aims to recommend long-term action plans to reduce CO2 emissions from the transport sector in each ASEAN country and the ASEAN as a whole, with the cooperation of researchers and research institutes in the ASEAN and international and other organizations with outstanding experience in the transport and environment sector, such as Clean Air Asia. We have implemented this study project with three major objectives.

The first objective was to conduct a study with a long-term perspective.
Many of existing transport plans deal with a short period of time. For instance, with regards to the ASEAN region covered by this study, a transport action plan prepared every five years is the longest concrete transport plan as the ASEAN. At the national level, each country tends to have transport plans covering a period until around 2020 to 2025. That is, national plans also tend to be limited to a period of 10 to 15 years at the longest. However, it is well-known fact that the climate change is an issue requiring an ultra-long-term perspective. We believe that we stand at a turning point in reviewing conventional traffic planning methods. In fact, our hearing investigations revealed that the ASEAN region, which consists of developing countries, also has a need for long-term transport plans. That is a need for long-term transport plans as measures against climate change.

The second objective was to establish a method to build plans with such a long-term perspective.
The issue of climate change is an ultra-long-term issue and we adopt the method of backcasting in which we set a goal prior to analyses to deal with such an ultra-long-term issue. This means that we need to set a goal for an ultra-long period. However, in the first place, the traffic demand is said to be a derived demand. Therefore, in order to introduce an ultra-long-term goal, we need to know the demand of the ultra-long period. Likewise, present-day transport policies are required not only to deal with measures against climate change but also to address other immediate problems. Environmental problems include not only the issue of climate change but also emissions of exhaust gases such as NOx, SOx or PM, or noise problems. We have not eradicated a basic problem of traffic jams. Policies related to public transport fares or taxation on fuels are also among such issues to be addressed by transport policies. The comfort or safety can be also important elements in actually selecting means of transport. If we ignore these problems, it will be difficult to derive a necessary transport system for the future. We thus aimed to develop plans with several perspectives as mentioned above by focusing on the society which always exists behind the transport system and by deriving a future vision of the society as well as transport needs arising from it.

The third objective was to consider features of the ASEAN.
In terms of features, we have focused on two points. The first features are related to the transport system. Such features are represented by the necessity of a deeper insight to para-transit systems which are common in developing countries and by the importance of marine transport, that is, the existence of regions and countries separated by the ocean. The

second features are related to the perspective as a community. It can be said that the current ASEAN is a community in which each member country is highly independent unlike Europe which is also a community. Even if we consider the possibility of its transformation to an economic community in 2015, unlike Europe, it is likely that each member country will remain highly independent. Under such conditions, we have implemented our study eventually focusing on overall policies as a community, in which each member country's plans are incorporated and harmonized.

We have conducted our study based on our awareness of these issues. This report will be the final report. We believe that this study will surely lead to meaningful discussions regarding the future of transport policies which take the issue of climate change into consideration and the selection of transport policies to address this issue. Finally, we would like to take this opportunity to thank the Nippon Foundation again for their support in this project.

A Study of Long-Term Action Plan for ASEAN

Steering Committee Member

<FY2013>

Member （Alphabetical Order）	Title (at the time of member)
Mr. Damantoro	Transport Policy Specialist, Indonesia Transportation Society
Ms. Kathleen Dematera	Environment Researcher, Clean Air Asia (CAA)
Ms. Sheila Flor Dominguez-Javier	University Extension Specialist, UP-National Center for Transportation Studies, University of the Philippines Dillman
Dr. Masanori Gennai	Director, International Affairs Office, Japan International Transport Institute, Institution for Transport Policy Studies (ITPS)
Dr. Mohamed Rehan Karim	Director, Center for Transportation Research, Faculty of Engineering, University of Malaya
Mr. Iwao Matsuoka	Deputy Director (Fund), The Sasakawa Pan Asia Fund, The Sasakawa Peace Foundation (SPF)
Mr. Alvin Mejia	Low Emissions and Urban Development Program Manager, Clean Air Asia (CAA)
Dr. Kazutaka Oka	Chief Consultant, Global Environment, Environment and Energy Division 1, Mizuho Information & Research Institute, Inc.
Dr. Danang Parikesit	Professor and Senior Researcher, Transport Planning and Financing, Center for Transportation and Logistics Studies, Gadjah Mada University
Mr. Yusa Cahya Permana	Transportation Planner, Indonesia Transportation Society

Dr. Mongkut Piantanakulchai	Assistant Professor, School of Civil Engineering and Technology, Sirindhorn International Institute of Technology, Thammasat University
Dr. Jose Regin F. Regidor	Professor, Institute of Civil Engineering, College of Engineering, University of the Philippines Dillman
Mr. Mark Angelo Y. Tacderas	Transport Researcher, Clean Air Asia (CAA)
Dr. Hiroyuki Takeshita	Research Fellow, Japan International Transport Institute, Institution for Transport Policy Studies (ITPS)
Dr. Ly Huy Tuan	Former Director-General of Transport Development and Strategy Institute (TDSI) , Ministry of Transport, Socialist Republic of Viet Nam

Secretariat
（Alphabetical Order）

Ms. Yukiko Furuichi	Administrative Assistant, International Affairs Office, Japan International Transport Institute, Institution for Transport Policy Studies (ITPS)
Ms. Catherine Hita	Administrative Assistant, Clean Air Asia (CAA)
Ms. Gianina Panopio	Executive Assistant, Clean Air Asia (CAA)

Former Steering Committee Member

<FY2011>

Member （Alphabetical Order）	Title (at the time of member)
Ms. Heather Allen	Programme Director Sustainable Transport, Transportation Division, Transport Research Laboratory (TRL)
Dr. David Banister	Professor of Transport Studies and Fellow of St Anne's College, Director of the Transport Studies Unit and Acting Director of the Environmental Change Institute, School of Geography and the Environment, University of Oxford
Atty. Glynda Bathan	Policy and Partnership Manager, Clean Air Initiative for Asian Cities, (CAI-Asia) Center
Dr. Crispin Emmanuel Diaz	Professor, School of Urban and Regional Planning, University of the Philippines; President, Transportation Science Society of the Philippines
Mr. Paul Emmerson	Principal Transportation Officer, Transport Research Laboratory (TRL)
Mr. Herbert Fabian	Transport Program Manager, Clean Air Initiative for Asian Cities, (CAI-Asia) Center
Dr. Helen Gibson	Researcher, Transport Research Laboratory (TRL)
Dr. Melanie Hobson	Director, Aether Ltd.
Dr. Marcus Jones	Principal Consultant, Transport Research Laboratory (TRL)
Mr. Iwao Matsuoka	Deputy Director, International Affairs Office, Japan International Transport Institute (ITPS)
Mr. Alvin Mejia	Environment Specialist, Clean Air Initiative for Asian Cities, (CAI-Asia) Center
Mr. Denis Naberezhnykh	ITS Consultant, Transport Research Laboratory (TRL)

Dr. Kazutaka Oka	Chief Consultant, Environment, Natural Resources and Energy, Mizuho Information & Research Institute
Mr. Derek Palmer	Head of Sustainable Transport Planning, Transport Research Laboratory (TRL)
Ms. Kaye Patdu	Air Quality Researcher, Clean Air Initiative for Asian Cities, (CAI-Asia) Center
Ms. Sophie Punte	Executive Director, Clean Air Initiative for Asian Cities, (CAI-Asia) Center
Mr. Yosuke Takada	Director, International Affairs Office, Japan International Transport Institute (ITPS)

Secretariat （Alphabetical Order）	
Ms. Yukiko Furuichi	Administrative Assistant, International Affairs Office, Japan International Transport Institute (ITPS)
Ms. Mayuko Homma	Administrative Assistant, International Affairs Office, Japan International Transport Institute (ITPS)

<FY2012>

Member （Alphabetical Order）	Title (at the time of member)
Ms. Heather Allen	Programme Director Sustainable Transport, Transportation Division, Transport Research Laboratory (TRL)
Atty. Glynda Bathan	Deputy Executive Director, Clean Air Asia (CAA)
Mr. Paul Emmerson	Head of Transport Modelling, Transport Research Laboratory (TRL)
Mr. Herbert Fabian	Transport Program Manager, Clean Air Asia (CAA)
Mr. Sudhir Gota	Technical Manager (Transport), Clean Air Asia (CAA)

Mr. Taizo Hayashi	Senior Research Fellow, Institute for Transport Policy Studies (ITPS)
Dr. Marcus Jones	Principal Consultant, Transport Research Laboratory (TRL)
Mr. James Mason	Technical Architect, Transport Research Laboratory (TRL)
Mr. Iwao Matsuoka	Program Officer, Program Department, The Sasakawa Peace Foundation (SPF) Research Advisor, International Affairs Office, Japan International Transport Institute (ITPS)
Mr. Alvin Mejia	Low Emissions and Urban Development Program Manager, Clean Air Asia (CAA)
Dr. Kazutaka Oka	Chief Consultant, Global Environment, Environment and Energy Division 1, Mizuho Information & Research Institute, Inc.
Ms. Kaye Patdu	Air Quality Specialist, Clean Air Asia (CAA)
Ms. Sophie Punte	Executive Director, Clean Air Asia (CAA)
Mr. Derek Palmer	Head of Sustainable Transport Planning, Transport Research Laboratory (TRL)
Mr. Yosuke Takada	Director, International Affairs Office, Japan International Transport Institute (ITPS)
Dr. Hiroyuki Takeshita	Deputy Director, International Affairs Office, Japan International Transport Institute (ITPS)

Secretariat
（Alphabetical Order）

Ms. Synthia Angelina	Graduate Student, Universitas Gadjah Mada
Ms. Yukiko Furuichi	Administrative Assistant, International Affairs Office, Japan International Transport Institute (ITPS)
Ms. Gianina Panopio	Executive Assistant, Clean Air Asia (CAA)

Experts and Officials Involved in the Study

<FY2011>

Experts / Officials（Alphabetical Order）	
Mr. Athibhu Chitranukroh	Senior Plan and Policy Analyst and Chief of Railway Information Center, Office of Transport and Traffic Policy and Planning (OTP), Thailand
Mr. Philippe Crist	Administrator, Joint Transport Research Centre, Organization for Economic Cooperation and Development, OECD/ITF
Mr. Tran Anh Duong	Deputy Director General, Environmental Department, Ministry of Transport, Vietnam
Dr. Axel Friedrich	Consultant, Consultant to the German International Cooperation (GIZ)
Mr. Roland Haas	Programme Director, ASEAN-German Technical Cooperation on Cities, Environment, and Transport in the ASEAN Region, German International Cooperation (GIZ)
Mr. Cornie Huizenga	Consultant, Asian Development Bank (ADB)
Dr. Khuat Viet Hung	Director, Centre for International Research and Education Cooperation and Chairman, Transport Planning and Management Section, University of Transport and Communications
Mr. Lemar Jimenez	Senior Transportation Development Officer, Department of Transportation and Communications, Philippines
Dr. Mohamed Rehan Karim	Professor and Director, Center for Transportation Research, Faculty of Engineering, University of Malaya
Ms. Phan Quynh Nhu	Secretary General, Vietnam Clean Air Partnership
Dr. Danang Parikesit	Professor and Senior Researcher, Transport Planning and Financing, Center for Transportation and Logistics Studies, Universitas Gadjah Mada

Dr. Mongkut Piantanakulchai	Head, School of Civil Engineering and Technology, and Coordinator of Civil Engineering Curriculum, Sirindhorn International Institute of Technology (SIIT), Thammasat University
Dr. Jose Regin F. Regidor	Director and Professor, National Center for Transportation Studies, Institute of Civil Engineering, College of Engineering, University of the Philippines
Dr. Jane Romero	Climate Change Specialist, Climate Change Group, Institute for Global Environmental Strategies (IGES)
Mr. Ko Sakamoto	Transport Economist, Sustainable Infrastructure Division, Regional and Sustainable Development Department, Asian Development Bank (ADB)
Dr. Elly Sinaga	Director, Urban Transport System Development, Ministry of Transportation, Indonesia
Mr. Bandith Sulayakham	Deputy Director of National Transport Committee Secretariat Office, Department of Transport, Ministry of Public Works and Transport, Laos
Mr. Haruramathever a/l Suppiah	National Key Result Area (NKRA) Coordinator, Ministry of Transport, Malaysia
Dr. Bambang Susantono	Vice Minister, Ministry of Transportation, Indonesia
Mr. Arif Wismadi	Deputy Director for Research and Partnership, Center for Transportation and Logistics Studies, Universitas Gadjah Mada

<FY2012>

Experts / Officials （Alphabetical Order）	
Ms. Manasawee Achariyawong	Plan and Policy Analyst, Professional Level, Office of Transport and Traffic Policy and Planning (OTP), Ministry of Transport, Thailand
Dr. David Banister	Professor of Transport Studies and Fellow of St Anne's College, Director of the Transport Studies Unit and Acting Director of the Environmental Change Institute, School of Geography and the Environment, University of Oxford

Mr. Philippe Crist	Administrator, Joint Transport Research Centre, Organization for Economic Cooperation and Development, OECD/ITF
Dr. Lewis M. Fulton	Co-Director, Next STEPS Program, Institute of Transportation Studies, University of California, Davis
Mr. Roland Haas	Programme Director, ASEAN-German Technical Cooperation on Cities, Environment, and Transport in the ASEAN Region, German International Cooperation (GIZ)
Mr. Thomas Hamlin	Inter-Regional Adviser on Energy and Transport, Division for Sustainable Development, Department of Economic and Social Development, United Nations (UNIES)
Dr. Melanie Hobson	Director, Aether Ltd.
Dr. Khuat Viet Hung	Deputy Director General, Department of Transport, Ministry of Transport, Vietnam
Mr. Nopporn Jaroongkrait	Plan and Policy Analyst, Practitioner Level, Office of Transport and Traffic Policy and Planning (OTP), Ministry of Transport, Thailand
Dr. Mohamed Rehan Karim	Director, Center for Transportation Research, Faculty of Engineering, University of Malaya
Ms. Atik S. Kuswati	SE, MM.Tr (Researcher), Research and Development of Ministry of Transportation, Indonesia
Ms. Anne Patricia E. Mariano	Project Development Officer, Infrastructure Projects, Department of Transportation and Communications, Republic of the Philippines
Dr. Deo Leo N. Manalo	Special Adviser for Transport Projects, Department of Transportation and Communications, Republic of the Philippines
Mr. Wigit Nimitrwanich	Director, Bureau of Safety Planning, Office of Transport and Traffic Policy and Planning (OTP), Ministry of Transport, Thailand
Mr. Peter O’Neill	Chief, Transport Policy and Development Section, Transport Division, United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP)

Dr. Danang Parikesit	Professor and Senior Researcher, Transport Planning and Financing, Center for Transportation and Logistics Studies, Universitas Gadjah Mada
Dr. Mongkut Piantanakulchai	Assistant Professor, School of Civil Engineering and Technology, Sirindhorn International Institute of Technology (SIIT), Thammasat University
Ms. Chutinthorn Praditphet	Policy and Plan Analyst, Professional Sustainable Transport Promotion Group, Safety Planning Bureau, Office of Transport and Traffic Policy and Planning (OTP), Ministry of Transport, Thailand
Ms. Puttamon Ratajean	Chief of Sustainable Transport Promotion Group, Safety Planning Bureau, Office of Transport and Traffic Policy and Planning (OTP), Ministry of Transport, Thailand
Dr. Jose Regin F. Regidor	Professor, Institute of Civil Engineering, College of Engineering, University of the Philippines
Dr. Madan B. Regmi	Economic Affairs Officer, Transport Policy and Development Section, Transport Division, United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP)
Dr. Jane Romero	Climate Change Specialist, Climate Change Group, Institute for Global Environmental Strategies (IGES)
Mr. Ko Sakamoto	Transport Economist, Sustainable Infrastructure Division, Regional and Sustainable Development Department, Asian Development Bank (ADB)
Dr. Chula Sukmanop	Director General, Office of Transport and Traffic Policy and Planning (OTP), Ministry of Transport, Thailand
Dr. Bambang Susantono	Vice Minister for Transportation, Republic of Indonesia
Mr. Chanchai Suwisuttagul	Deputy Director – General, Office of Transport and Traffic Policy and Planning (OTP), Ministry of Transport, Thailand
Ms. Tazkiyah	SH, MT (Researcher) Research and Development of Ministry of Transportation, Indonesia

Mr. Vu Anh Tuan	Lecturer, Institute of Transport Planning and Management, University of Transport and Communications Doctoral Candidate, Vietnamese-German Transport Research Center (VGTRC), Vietnamese-German University.
Mr. Tali Trigg	Energy Analyst – Transport Sector, Energy Technology Policy Division, International Energy Agency (IEA)
Ms. Wipada Unlumlert	Plan and Policy Analyst, Safety Planning Bureau, Office of Transport and Traffic Policy and Planning (OTP), Ministry of Transport, Thailand
Dr. Wolfgang Warnecke	Chief Scientist Mobility, Director Research and Development, Shell Global Solutions (Deutschland) GmbH
Mr. Lloyd Wright	Senior Transport Specialist, Sustainable Infrastructure Division, Regional and Sustainable Development Department, Asian Development Bank (ADB)
Dr. Eric Zusman	Senior Policy Researcher, Climate Change Group, Institute for Global Environmental Strategies (IGES)
Mr. Zulfikri	Researcher, Ministry of Transportation, Research and Development Agency, Indonesia

<FY2013>

Experts / Officials （Alphabetical Order）	
Ms. Heather Allen	Programme Director, Sustainable Transport, Transportation Division, Transport Research Laboratory (TRL)
Mr. Sann Myint Au	Managing Director, Road Transport Department, Ministry of Rail Transportation, Union of Myanmar
Dr. David Banister	Professor of Transport Studies and Fellow of St Anne’s College, Director of the Transport Studies Unit and Acting Director of the Environmental Change Institute, School of Geography and the Environment, University of Oxford

Atty. Glynda Bathan	Deputy Executive Director, Clean Air Asia (CAA)
Ms. Florencia Alano Creus	Director, Planning Service, Department of Transportation and Communications, Republic of the Philippines
Mr. Philippe Crist	Administrator, Joint Transport Research Centre, Organization for Economic Cooperation and Development, OECD/ITF
Ms. Joyceline Goco	Deputy Executive Director (Assistant Secretary), Climate Change Commission Philippines
Mr. Sudhir Gota	Technical Manager (Transport), Clean Air Asia (CAA)
Dr. Yoshitsugu Hayashi	President, World Conference on Transport Research Society Director and Professor, Nagoya University
Ms. Vichet Ratha Khlok	Head of GHG Inventory and Mitigation Office, Climate Change Department, Team Leader, Climate Change Knowledge and Learning, Cambodia Climate Change Alliance (CCCA), Ministry of Environment, Kingdom of Cambodia
Ms. Vanhdavone Kittavong	Project Coordination Officer, Division of Planning and Budgeting, Department of Transport, Lao People's Democratic Republic
Dr. Bindu N. Lohani	Vice-President for Knowledge Management and Sustainable Development; Office of Information Systems and Technology; Office of Regional Economic Integration; Regional and Sustainable Development Department, Asian Development Bank (ADB)
Mr. Choudhury Rudra Charan Mohanty	Environment Program Expert/Coordinator, United Nations Centre for Regional Development (UNCRD)
Mr. Peter O'Neill	Chief, Transport Policy and Development Section, Transport Division, United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP)
Mr. Ildefonso T. Patdu Jr.	Assistant Secretary for Project Implementation, Department of Transportation and Communications, Republic of the Philippines
Mr. Ko Sakamoto	Transport Economist, Sustainable Infrastructure Division, Regional and Sustainable Development Department, Asian Development Bank (ADB)

Dr. Bambang Susantono	Vice Minister for Transportation, Republic of Indonesia
Mr. Tali Trigg	Energy Analyst–Transport Sector, Energy Technology Policy Division, International Energy Agency (IEA)
Dr. Malee Uabharadorn	Chief, Sustainable Transport Department, Office of Transport & Traffic Policy and Planning (OTP), Ministry of Transport, Kingdom of Thailand
Ms. Natasha Binti Mohd Zulkifli	Special Officer to CEO (Strategic Initiatives & Projects), CEO's Office, Land Public Transport Commision (SPAD), Malaysia

Authors and Editors

Mr. Damantoro *(Indonesia Transportation Society) [Ch. 3, App. C]*

Ms. Kathleen Dematera *(Clean Air Asia) [Ch. 3, Ch. 4, App. C]*

Ms. Sheila Flor Dominguez-Javier *(University of the Philippines Dillman) [Ch. 3, App. C]*

Dr. Masanori Gennai *(Institution for Transport Policy Studies) [Editor]*

Mr. Iwao Matsuoka *(The Sasakawa Peace Foundation) [Ch.1]*

Mr. Alvin Mejia *(Clean Air Asia) [Ch. 3, Ch. 4, App. C]*

Dr. Kazutaka Oka *(Mizuho Information & Research Institute, Inc.) [Ch. 2, App. A, App. B]*

Dr. Danang Parikesit *(Gadjah Mada University) [Ch. 3, App. C]*

Mr. Yusa Cahya Permana *(Indonesia Transportation Society) [Ch. 3, App. C]*

Dr. Jose Regin F. Regidor *(University of the Philippines Dillman) [Ch. 3, App. C]*

Mr. Mark Angelo Y. Tacderas *(Clean Air Asia) [Ch. 3, Ch. 4, App. C]*

Dr. Hiroyuki Takeshita *(Institution for Transport Policy Studies) [Ch. 4, Editor]*

Table of Contents

Chapter 1

Study Outline

1.1 Study Outline

In this section, we will provide a brief explanation about basic information on this study project.

1.1.1 Study Background

1.1.1.1 CO_2 Emissions from Transport

The International Energy Agency (IEA) predicts that the current emissions from transport nearly account for one-fourth of the total amount of artificially released CO_2, and that the amount of emissions will double in 2050 (reference case)[1]. According to that estimate, while the emissions from transport in developed countries will remain almost unchanged until 2050, the share of emissions from developing countries (non-OECD countries), which only accounts for about 35% today, will nearly double (approximately 66%) in that same period. In other words, in the world 40 years from now, the major sources of CO_2 emissions from transport will be non-OECD countries, which are, current developing and emerging countries. If the traffic demand is a derived demand of the society and economy, it is expected that the traffic demand will steadily increase with economic growth and rising populations, and that this increasing trend will be one of important future challenges for Asia, which will continue to develop for years to come.

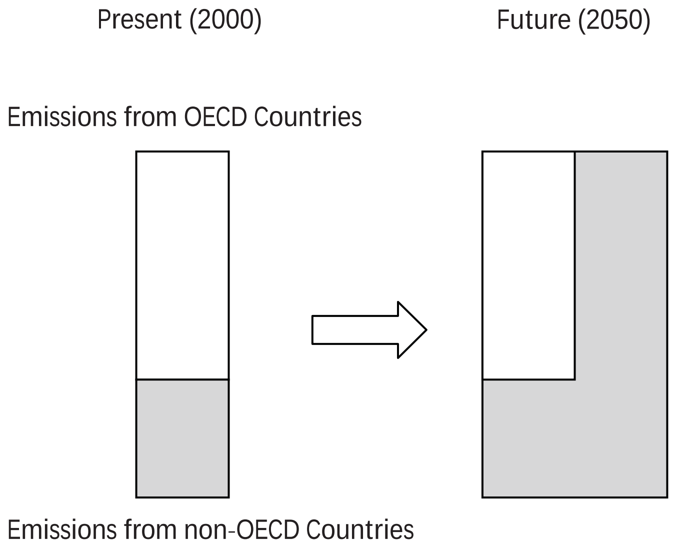


Figure 1-1. Image of Shift of CO_2 Emissions from Transport

1.1.1.2 Measures against Global Warming

According to the Intergovernmental Panel on Climate Change (IPCC), we need to reduce greenhouse gas emissions to the half of the current level or by 80% depending on scenarios by 2050 in order to stabilize our climate (to limit the future rise in temperature to two degrees Celsius or less). Of course, this goal concerns all sectors, not limited to the transport sector. However, while the goal of 50% reduction compared to the level in 2000 that we suggested

1 TRANSPORT, ENERGY AND CO2, IEA, 2009

in our previous project launched in 2008 (STL/a study on the transport regime considering the global warming) faced oppositions by some members at that time, it is now deemed as a generalized value. Therefore, the goal of halving the global emissions in the remaining 40 years is by no means a wrong goal setting.

However, if we set a goal using CO_2 emissions from transport per capita, even in Japan whose amount of emissions per capita is the smallest among developed countries, it is necessary to limit emissions to one-fifth of the current level. In fact, there are very few countries introducing public rail transport systems in urban areas at an equivalent level to that of Japan and this goal setting is such that a drastic reduction of emissions is required even in Japan, a country with such a developed public rail transport system.

1.1.1.3 Influence from the Previous Study

In our previous study titled the "Study of Transport System in a Low Carbon Society" (hereinafter, STL), we have derived necessary policies to reduce CO_2 emission from transport in the world. STL covered five major regions with significant CO_2 emissions from transport (North, Central and South America, Europe, China, India, Southeast Asia: The share of CO_2 emissions for the five regions accounts for approximately 80% of the total) and we could obtain study outcomes which are also beneficial to this study (awareness of the issues). Three major study outcomes of STL are as follows.

■Existence of transport systems which are unique in developing countries
There are numerous paratransit modes in the regions of Central and South America, China, India and Southeast Asia and such paratransit modes can be considered as unique transport systems in developing countries. However, the analytical precision for such transport systems remains poor as we do not have developed statistics on such paratransit modes as public transport. Despite this statistical problem, we need to make efforts to depict the future of these unique transport systems in developing countries more clearly.

■High level of awareness on the global warming in Southeast Asia
In the arena such as the Conference of the Parties to the United Nations Framework Convention on Climate Change, G77, whose key members include so-called BRICS represented by countries such as China, India, and Brazil in South America, exists as key players of developing and emerging countries. On the other hand, we have an impression that the position of Southeast Asian countries is overshadowed by G77. However, in the reality, Southeast Asia is an enormous block in terms of scale of emissions. ASEAN countries are not a solid economic entity like Europe, and even among ASEAN members, the development level differs from one country from another. Some countries like Indonesia have already presented clear global warming countermeasures. ASEAN is also considering the possibility of economic integration in 2015. We thus believe that we now need to develop strategies in consideration of global warming countermeasures as the region of ASEAN, not in a larger framework of developing countries.

■Geographical specificities of Southeast Asian countries
The greatest geographical difference between Southeast Asian countries and other regions is that Southeast Asia has many places which are physically separated from other countries or areas in the same country by ocean. In particular, Indonesia and the Philippines, which are major ASEAN countries, are nations consisted of several islands and even among countries which are connected by land, it is not rare to transport goods by ship along coasts or using large rivers. With the future economic growth, there is a possibility that the water transport will have further significance.

1.1.1.4 Novelty of Study Methods

In this study, we employ study methods which are not very familiar particularly in Asia, but were partially employed in the STL project. The first method is the backcasting method, in which we first set a goal and then consider the path to reach such a goal. It is one of ideas introduced in STL and it has been used for the formulation of long-term national strategies, etc., in Europe. However, in Japan, it has been employed only partially, in some studies with

long-term perspectives by actors in global warming issues, etc.
The second method is a process called "visioning". It is a method which intends to depict the future transport by developing a scenario for the future society and by using that vision of the future world as a sort of constraint conditions. It is a method employed through the discussion with Prof. David Banister of the Transport Studies Unit at the University of Oxford, and studies focusing on scenarios are extremely rare in policy studies in Japan. In recent years, the National Institute for Environmental Studies depicted two future visions in its research on comprehensive global warming countermeasures with the target year of 2050. In fact, the scenario planning which became a basis for this method is often used in the business area to formulate midterm plans, etc. This study is one of new opportunities to use that new method in the business field in the development of policies.

This study has two novelties, which are, to understand issues from a meta-perspective and to make a target-oriented policy selection. The traffic policy is a study field which requires to solve an enormous number of problems at hand, and as a result, we have an impression that it tends to develop strategies from a much shorter-term perspective than the perspective in the issue of global warming. However, as previously stated, one-fourth of artificial GHG emissions are attributed to transport and the amount is on the increasing trend. The transport sector is a field in which we can take a few effective measures against this issue of global warming, and we believe that it is indispensable to develop strategies with a long-term perspective, which is suitable to address the issue of global warming requiring a long-term perspective of several decades or a century. This study is a rare opportunity to introduce such a long-term perspective in the transport sector.

1.1.2 Study Purpose, Target Areas, Period, etc.

1.1.2.1 Purpose of the Study

We aim to make policy recommendations for the reduction of CO_2 emissions from transport in ASEAN countries. Specifically, by setting a target year and targets for CO_2 emissions from transport (reduction targets) for the ASEAN region, we seek to derive necessary traffic policies and make recommendations of such policies. In order to derive traffic policies which are necessary to achieve the goals, we have employed the backcasting method as in the previous project, STL. In doing so, ASEAN countries will be able to acquire a backbone for the traffic planning with a long-term perspective in consideration of the global warming, and expect to develop global warming countermeasures (traffic policies) based on long-term strategies including NAMAs in the transport sector. We will explain about the goal setting separately, later in this report.

1.1.2.2 Target Areas

This study covers 10 ASEAN countries (Singapore, Indonesia, Malaysia, the Philippines, Thailand, Vietnam, Laos, Myanmar, Cambodia, and Brunei). We have divided these 10 countries into three large classifications and applied different levels of precision. These classifications were defined mainly by considering different levels of available traffic statistics.

First of all, we have divided these 10 countries into two groups of five major ASEAN countries (Indonesia, Malaysia, the Philippines, Thailand and Vietnam) and other countries. At the stage of prior examination, we have concluded that minimum required statistics for quantification are available in the major five countries although they are not sufficient, and that we have a relatively easy access to such statistics. In particular, with regards to Indonesia and the Philippines, which are two large countries expected to develop further in the future, we seek to make very detailed analyses. While we originally intended to include Singapore in these major countries, as it is a country whose GDP per capita is equivalent or higher than those of developed countries, we have concluded that it can take own measures like developed countries and although it is a country which is still developing, we have decided to exclude Singapore from the targets of detailed analyses.

Figure 1-2. Target Areas (Countries indicated with darker green are areas in which we have a relatively easy access to statistics)

1.1.2.3 Subject of the Study

The subject of evaluation in this study is carbon dioxide released from transport in the above-mentioned areas. Likewise, as in the previous project, we limited the scope of policies covered in this study to "traffic policies". In considering CO_2 emissions from the transport sector, the problem of ambiguity regarding the evaluation of alternative fuels, etc., would arise depending on the setting of CO_2 emission factors. Generally, as indicators to classify emission factors, there are so-called "Tank to Wheel (TTW)" in which we measure emissions from the fuel tank (Tank) to the wheels (Wheel) and "Well to Wheel (WTW)" in which we consider emissions from the well (Well) to the wheels (Wheel). We will discuss these indicators in detail later. It should be noted that missions from production or construction of infrastructures are outside the scope of this study. Likewise, CO_2 emissions in the use of electric vehicles, etc. are generally indicated in Well to Tank (WTT). However, in this study, in order to see the impact of the introduction of new technologies on the amount of emissions, TTW is applied in this study. Details will be discussed in Chapter 2.

1.1.2.4 Study Period

The target year in this study is 2050. This study aims to derive policies to reduce emission of carbon dioxide from transport in ASEAN in 2050 to the defined target value. The period for the policy evaluation using the model is the period from 2010 to 2050, and the evaluation will be made by making estimates for every five years. As a result, policies to reduce carbon dioxide will be introduced every five years.

1.1.2.5 Study Framework

We will seek to reflect policies considering regional characteristics in cooperation with researchers on the transport in ASEAN. Basically, the model for calculations will be developed in developed countries, such as Japan and UK. However, in the process of developing the model, with the participation of experts from developing countries, we tried to take account of problems in Asian region, etc. in the model.
Likewise, we sought to cooperate with experts in international organizations, including for the review of study outcomes. In particular, we realized collaborations with persons in charge of the transport in the Asian Development Bank, or with other international organizations such as the International Transport Forum and the International Energy Agency. For details, please refer to the list of participants attached to this report.

1.1.2.6 Progressive Development in the Future

After the completion of this study year, we plan to continue to manage the model (tool) developed in this study through an affiliate research organization. As we also cooperate with persons in charge of the transport in Southeast Asia in the International Energy Agency (IEA) for this study, it will be possible to utilize their experiences, etc., where necessary. However, users need to make minor modifications for detailed responses in units smaller than countries (local level). For that purpose, we will provide indirect supports by distributing manuals and other materials simultaneously. These support materials will be provided in English.

1.2 Study Method

In this section, we will briefly describe the basic information on the study method used in this study project.

1.2.1 Goal Setting

In this study, in order to derive traffic policies to drastically reduce carbon dioxide from transport in the ASEAN region, we employ the process in which we first set concrete goals and depict future visions for the society or transport, and then make a concrete policy selection considering such goals and visions. In this section, with regard to the initial goal setting, we will explain the process of goal setting and relevant problems, etc.

1.2.1.1 Goal Setting and Backcasting

The reason for setting goals first is that, as previously stated, a drastic reduction of GHG emissions in the future is required in the current international movements related to the global warming. The international community believes that it is important to achieve such a drastic reduction in the global society, and that it is an effective way to actually diminish the impact of the climate change. On the other hand, in the Kyoto Protocol, quantitative reduction targets need to be determined for developed countries. The method in this study in which we first determine quantitative goals also conforms to this method in the Kyoto Protocol. In the framework of the Kyoto Protocol for the next period, it seems that discussions are currently made in the direction of shifting to the voluntary goal setting. Also in this case, while a more political perspective may be added to the ground of setting target values, it is expected that the policy of first setting goals will eventually continue to some extent.
As just described, the method of first setting goals and then considering ways to reach to such goals is called backcasting. Literally, backcasting means looking backward. Looking back from the future that is the goal and paving the way toward the goal. The biggest difference from the forecast is that in the backcasting approach, we only need to know the current situation and the goal in the future. For instance, the so-called forecast involves measuring certain values in the future, but it is not a mainstream work in backcasting. As in the case of the global warming, if reduction targets are calculated from scientific calculations, by predicting the complex future of the society, we do not need to set goals themselves. In this manner, in backcasting, goals are often those applied to the fields to be calculated for exogenous reasons. When this method is employed at a policy level, it is not rare that goals are exogenously determined as a result of detailed analyses. There are cases where a very simple goal setting (such as "The public transport in Tokyo is excellent. We thus aim to realize a public transport system which is equivalent to the one in Tokyo") is made. In such cases, goals are set without rational analyses of differences between the cities, although the background of Tokyo where public transport accounts for an important share in transport and that of the city may be totally different. In cases of the global warming, it is not rare that the reduction target of GHS emissions that the government set as a policy target is applied as a goal for individual areas after very simple calculations. In other words, in the policy decision-making process, there are cases where a goal which is different from the past trend is set. We may say that backcasting, which is a process to look at things from a pre-determined goal, is appropriate for such cases in essence.

1.2.1.2 Fairness

This study takes over many methodologies from the previous study, STL. The same can be said for the goal setting and as in the previous study; we use the amount of carbon dioxide emissions from the transport sector per capita as a basic element for the goal setting. Under the idea that the acceptable amount of carbon dioxide emissions per capita is equal among developed countries and developing countries, we used the value dividing the current amount of carbon dioxide emissions from transport (estimated value) by the future world's population as a basic element for calculating the target value, and by multiply this value by each country's population, we calculate the ultimate acceptable amount of emissions as the target value. The biggest reason for dealing with this value is the fairness.

According to the forecast by the International Energy Agency (IEA) and others, the amount of carbon dioxide emissions from developing countries in 2050 will be more or less the same amount released from developed countries. It is also predicted that Southeast Asia will be one of the regions with the most signification emissions in the world, along with the United States, China and India. The biggest reason for such a forecast is the economic development. Unless special measures are taken, the economic development and the increase in traffic volume have a positive relation. In the region of Southeast Asia where the economic development is expected to continue, the future traffic volume will be also on the increasing trend, and unless various measures are taken, it is expected that the amount of carbon dioxide emissions will also augment with the increase in energy consumption. If we look at this situation in an opposite manner, a policy which limits the traffic volume would result in impairing the future economic development. In fact, in the previous study, we were advised from researchers from some countries to introduce a goal setting which takes the future economic growth into account. Specifically, we were advised to introduce the method to limit the amount of carbon dioxide emissions by the GDP per capita. In this method, the amount of carbon dioxide which can be released increases as the GDP per capita grows. It is expected to have a goal setting which will not prevent the development of developing countries, or to be more precise, which will not prevent the development of developed countries, either. However, as increased emissions will be accepted with the economic growth, indicators in such goal settings are not appropriate for the case of the global warming in which we need to reduce the absolute amount of emissions. The Intergovernmental Panel on Climate Chang (IPCC), etc. uses the ratio by weight of carbon dioxide (greenhouse gases in the Protocol) to the air capacity for the reduction target. That is, it is an indicator which allows us to control the absolute amount of emissions at a certain point in time. With these examples, we can easily understand how meaningless to have a goal setting allowing the increase in the amount of emissions with the economic growth in the areas expected to rapidly grow economically in the future.

1.2.1.3 Problems in Goal Setting (Reality)

As we see later in this report, backcasting designates the final goal as a starting point for examinations. Such an approach is totally different from conventional forecasts. A forecast is basically a method to derive certain values in the future. In backcasting, however, these are given values integrated from the outside. That is reversing the logical order of things if we make a forecast to set such given values, but the cases in which backcasting can demonstrate the most significant effect should be those where the national goals are changed by international agreements. In this study, we assume cases where reduction targets of greenhouse gases are set at a level higher than the country level, by international organizations or movements related to the global warming such as the United Nations Framework Convention on Climate Change. As there are countries like Indonesia in which reduction targets have been set by a presidential initiative, the new international framework concerning the global warming is moving in the direction that countries voluntarily present their reduction targets to the international community as in the case of NAMAs. In other words, in policies regarding the global warming, as the global warming is a global issue, goals may be set from the outside of the country or at a level which is different from the current trend of domestic policies. This is a feature which is suitable for backcasting.

Once goals have been set, these goals will be independent from significant changes in the future or uncertain elements. On the other hand, as we have explained over and over again, the present-day world is rich in changes and there are risks that unpredicted changes would arise. As these exogenous changes have significant influences on the future policy development, the flexibility is required for the policy development. However, as goals are set first, there may be cases where the goals lose touch from the later situation when significant changes arose. It was the case with Japan, where it became difficult to realize the reduction target of carbon dioxide set by the energy industry as a result of a long-term suspension of operation of nuclear power facilities. In such cases, or in cases where there is a significant gap between the current trend and goals, it is highly likely that this approach of backcasting comes under criticism that it is not realistic. In fact, also in this study, many similar comments were made by some members.

In a word, this problem is a matter of degree but it is also a matter relating to the basis of method selection. For instance, if the country will collapse for sure unless it achieves certain policies, many of policy makers may aim to implement policies even if such policies seem to be more or less out of point of view from the present perspective, even by removing barriers for the introduction of such policies. However, when the perspective of the global warming is one of perspectives to be considered, it may be judged to be an unrealistic perspective after coordinating with other perspectives. That is, two important issues are concealed here.

1. Uncertainties regarding possible damages by the increased global warming
2. Relative importance of the global warming

While these two elements have a strong relation, we can hardly expect that everyone understands this relation at the real-life level. First, just like important points in the Kyoto Protocol, many of current global warming countermeasures are implemented from the perspective of prevention, rather than because of the awareness on clear relations between the global warming and certain concrete disasters. By proving conclusively that natural disasters like heavy typhoons are actually attributed to the climate change caused by artificial greenhouse gas emissions and by linking it to future risks of the climate change, this problem of global warming can be perceived as an issue which should be given priority over others. In terms of the latter point, it is possible to aim for a balanced policy selection by introducing ideas of multi-targets or co-benefits. However, when a very challenging goal has been set, such balance is likely to be limited. Unless the global warming is considered as an important issue, a strict goal setting can be criticized by various stakeholders even if we may suffer significant damages without it. This problem may cause frictions such as those between experts with extended knowledge on environmental policies who tend to accept strict restrictions for environmental reasons and researchers on traffic policies who relatively tend to criticize such strict restrictions. In particular, there remains a possibility that administrators who have many problems to solve at hand give a relatively low priority to measures against global warming, which deal with an issue in a remote future with high uncertainties, and whose causal link with current abnormalities in weather is vague. The “reality” indicated in the title of this subsection may simply mean a reality but it also actually implies an aspect of impacts over real problems at hand.

By removing uncertainties from future scenarios or goal setting, we can expect to address this problem to some extent. Uncertainties here involve not only uncertainties regarding the future but also those in causal links. For instance, the energy shortage in the near future is more familiar and easier to quantify than impacts on the global environment and probably has less uncertainties. However, there is no problem as long as the ultimate goal is the reduction of carbon dioxide. For research organizations, it can be the very objective of a research part. However, it is not necessary that the driving force at the negotiation stage of the research has the same ground with the one for the research as a whole. If we are to introduce backcasting as a research methodology, and if we can derive research outcomes more efficiently by introducing a similar method in the negotiation process, we should also consider eliciting the reality from that possibility.

We have already explained that a significant gap between the initially applied goals and the current condition or trend would lead to a sense of distrust vis-à-vis these goals. In a simple term, people would have an impression that “such goals cannot be achieved” or “it is an unrealistic goal setting”. There is also a way to tackle this problem head-on. In order to eliminate a sense of distrust regarding the reality that the technique of backcasting will necessarily cause to some extent, we use predicted values for some of preconditions. For example, in this study, we make forecasts regarding many of technological factors using quantitative values, through hearings of experts, etc. As a result, it becomes meaningless to integrate policies for technological development, and the focus of this study will be at which stage and how such technologies should be diffused. Furthermore, we integrate known existing policies of each country, as a brake which will not allow us to make a significant change in direction suddenly. Fortunately, many developing countries only have plans for relatively short periods and the impacts of existing policies are not vital yet. As we have explained so far, practitioners should consider covering problems in each method by combining the backcasting method and the conventional method of forecast.

1.2.1.4 Target Value in this Study

While we discuss details later in this report, we will describe the goals that we have set for this study in the end of this section regarding the goal setting. In this study, we use CO_2 emissions from transport per capita and by considering the population, we have set reduction targets for each country. According to existing studies by the International Energy Agency (IEA), etc., we have set the global average of CO_2 emissions from transport per capita at 1t-CO_2/year. The population of 2050 is estimated to reach 9 billion, which is approximately half as large again as the current population. On the other hand, according to a report by IPCC (Intergovernmental Panel on Climate Change), it will be hard to limit the increase in temperature within 2 degrees unless we reduce greenhouse gas emissions by 50%-80% of the current amount of emissions. Therefore, as a more conservative setting, we selected a goal of reducing global CO_2 emission from transport to the half of the current amount by 2050.

As a result, we set the target value of CO_2 emissions from transport per capita in 2050 at 0.3t-CO_2/year, considering the increase in the total population in the world (1 1/2 times) in the half amount (0.5t) of the current global average of CO_2 emissions from transport per capita of 1t-CO_2/year.

In this goal setting, we use only the current total amount of CO_2 emissions from transport, the target reduction rate that IPCC derived from scientific analyses, and the estimated value for the future population. Therefore, in terms of uncertainties regarding the future, this study only involves a factor with the highest certainty (population).

On the other hand, no economic or social factor is included in the goals in this study. For instance, goals are set in the same scale for countries with vast territories and for city-states like Singapore. In other words, while it is more likely that public transport is utilized in densely-populated areas like cities, it is not at all considered in this study. In contrary, it will be not easy to cover the whole territory with public transport in countries like Indonesia which has a vast territory stretching east to west for 5,000 km and is consisted of countless islands. In other words, the current method of goal setting would be more realistic if we integrate information regarding land use. In fact, in this study, we have sought to quantify the relationship between the national land use (including dimensions) and transport by using numerous statistics. Unfortunately, however, we could not find a way to clearly demonstrate it. As a result, there may be a room for improvement in these target values.

Likewise, no factor related to the economy is considered in this study. Usually, it is considered that the economic development and traffic demand have a positive relation and in fact, economically developed countries tend to release more CO_2. Among highly developed countries, statistics show that the transport in Japan is the one with the least amount of emissions but its CO_2 emissions from transport per capita still reaches 2t-CO_2/year. In Europe, the amount exceeds 3t and that in the United States is over 4t. In ASEAN, GDP per capita largely differs among member countries and when we consider their further economic development in the future, not a small number of people would raise doubts about this strict goal setting regarding CO_2 which would lead to restraints to the traffic demand. For instance, it is expected to have a goal setting considering economic indicators. In terms of this problem, we have conducted examinations from the first fiscal year in this research project and selected a goal setting which does not consider economic indicators so that it will be a more neutral indicator. Likewise, this study focuses on backcasting and it covers the decoupling of the economic growth and traffic demand (avoid policies). The goal setting in this study avoids possible contradictions (elements to be controlled are set as goals from an uncontrolled perspective) by integrating elements to be controlled in the goals, and we believe that it conforms to the main purport of our methodologies.

1.2.2 Visioning

In this study, in order to derive traffic policies to drastically reduce emissions of carbon dioxide from transport in the ASEAN region, we employ a process in which we first set concrete goals and depict future visions of the society and transport, and then make a concrete policy selection considering such goals and visions. In this section, we will explain about visioning which is a process to depict future visions of the society or transport as well as methodologies which became a basis for the tool. We will explain about the actual tool separately, later in this report.

1.2.2.1 Limitation of Forecasts

Big Data is utilized in various areas including the business world. We believe that it became possible to put this kind of new analysis method into practical use only when the improvement of information technologies which enables us to deal with large quantities of data, methodologies identifying relations, etc. which are not obvious from such data at first glance, and the existence of large quantities of data which are premises for all of them were combined together. In fact, even before Big Data, there were numerous attempts to reuse data lying in companies in the past. However, in the world where data are prepared with papers and pencils, the utilization of such data should have been limited. Large quantities of statistics in storage and current technologies which allow us to process these statistics in a moment should have elevated the analytical precision dramatically.

However, even when they use large quantities of data and make full use of the latest information technologies, most of existing forecasts are made considering the past. By performing statistical processing of data which seem to be relevant to something to be predicted, we draw a line for the future. When we feel uneasy to depict a future, we may make several future scenarios (cases) by selecting drivers with significant impacts from quantitative variables used for a forecast and by changing their values. We may also provide ranges for the possibility for the future line by adding a probabilistic approach. As previously stated, with the improvement of technologies in recent years, it is believed that the precision of forecasts is ameliorating. However, the situation is such that most forecasts hardly go beyond the analogy from the past.

With such an existing method for forecasts, it is difficult to estimate tremendous changes or paradigm shifts which involve changes in the current system itself. While (we would like to believe that) there were several economists who predicted the failure of Lehman Brothers, most of economic forecasts should have failed to predict such a serious economic crisis. While there were experts who warned the following debt crisis in Europe, most measurement models apparently failed to detect the crisis in advance. In the Asian region, the same can be said for the currency crisis in the late 1990s. When such events which would significantly change the future system arise, the judgment on how to handle such events will be important and where possible, it is expected that we prepare for such events in advance. However, the current forecast method is not very useful in such critical events.

It is presumably because the current forecast method uses the possibility as a keyword. The existing method is the one in which we depict a future which seems to be the most likely from past experiences, or, a future which follows the past trend. As long as it focuses on this likelihood, it may not be easy to derive responses for singularity-like events as mentioned above. Of course, by designing several scenarios, it is possible to seek to depict the uncertain future more accurately. However, as long as we make forecasts based on past data or statistics, we do not think it easy to depict situations which have never existed in the past.

On the other hand, the world is rapidly globalizing. We can also say that globalization started more than 100 years ago. The Age of Exploration was also a globalization in a sense, so as the world wars. We may also say that during the Great Depression before World War II, many countries were caught in the wave of globalization of that period. Similarly, the “globalization” in the sense that we have used since the second half of the twentieth century may become a globalization of a certain period for people in the future. However, there is no doubt that the current globalization is progressing more rapidly than those in the past. In particular, the development of information technologies not only led to the expansion of existing movements such as distribution of goods and movement of people, but also enabled us to rapidly diffuse institutions or systems themselves. Here, we do not intend to prove whether such trends are uncontrollable moves which cannot be stopped anymore. However, it is necessary to mention that the period we live in now is more global than ever before and also is rich in changes and difficult to predict. In particular, when we make an evaluation or analysis on something in the future, we should be aware that we are in a totally different situation than ever before.

What we are dealing with is the global warming and it is sometimes said that we need to have a century-long perspective to solve that issue. When we take such a long-term perspective, uncertainties regarding the future dramatically increase. Furthermore, the society today is complex and rich in changes. Under such circumstances, we have been continuously asking fundamental questions such as what we should depict for the future, what will allow us to achieve our goals among all possible elements which would exist or what is our objective in this study. As an answer to such questions, we partially introduced the concept of scenario planning in this study. This method is totally different from forecasts. It is also independent from the possibility, the element which binds us.

1.2.2.2 Tool to Think about the Next Step

The objective of this study is to seek a future action plan which takes the global warming into account in the transport sector in the ASEAN region. However, what is the real objective of such policy research? At the stage of designing the research, many researchers claim to provide more precise forecasts and derive concrete policies based on such forecasts. In fact, our objectives include similar descriptions.

However, the real objective of researches regarding policy recommendations is literally to recommend policies. The reason for making forecasts is because depictions of the current situation or the future will make the judgment on necessary policies more understandable. For instance, when it is estimated that a person will develop metabolic syndrome if he continues his current dietary habit, it will be possible to make a recommendation to restrict his diet or to do some exercise. However, if he is just likely to develop metabolic syndrome at the present stage, unless we do not think about his future, such a recommendation cannot be derived. In other words, we can think about steps to avoid future problems only when we make forecasts or think about the future. That is, when we make policy recommendations, the important point is what kind of policies we should implement. The forecast is a support system to think about such policies, and for consultants, it is an important support tool to make their clients understand such policies.

When we see from such perspective, it can be said that what is important in making policy recommendations is actually the method which allows us to understand what we should do for the depicted future. The most important thing we can provide to policy makers implementing policies is to inform them which policies they should select. Forecasts are nothing more than a supporting tool which allows us to accept such policies. It is true that researchers tend to be attracted to a model with higher precisions which allows us to consider more complex things. However, researchers need to understand how difficult it is to make long-term forecast, particularly in this changing society. Creators or users of tools need to pay more attention to extensive policy options or relations among various intricately-intertwined factors, etc., than simply ameliorating the forecast precision.

1.2.2.3 Importance of Meta-Perspective and Departure from the Possibility

With regards to the ideas we have explained earlier, people may misunderstand that we advocate for rough ideas as they will not be proved right anyway. However, it is a fundamentally wrong understanding. In a word, the focus of our method is different from that in conventional methods. We will explain this point using the case of metabolic syndrome as previously mentioned.

Let’s assume a case where quantitative data such as his weight or calorie consumption indicate that he is likely to develop metabolic syndrome in the near future. In a more understandable index, it will be pointed out that there is a risk that his waist circumference will exceed 86 cm in the near future. Here, we take the extra step to think about the same situation. We will see the background of his increasing waist circumference. Then, we may be able to know that he is a pastry chef in the making and he has been tasting creams in large quantity every day for two years in order to learn from the taste of his master. In addition, we may come to know that he is living in the second floor of the shop where he works and normally, he rarely do physical exercises outside of work. He may be particularly disregarding for his health because he feels stressed as he cannot see his girlfriend he finally got recently. Through these backgrounds behind a certain index, his future which was simply predicted may look a bit different.

For example, if he has almost mastered the taste of his master, the amount of creams he steals and tastes may drastically decrease suddenly. In that case, the risk of metabolic syndrome will draw a different curve from the growing trend which had been simply predicted. If he is to marry his girlfriend in the near future, it may be also expected that his state of nutrition will drastically improve. As a result, he may gain weight further or as a result of the balanced diet his future wife would prepare, his waist circumference would turn to a decreasing trend. Upon their marriage, he may leave his room above his working place and purchase a house in a remote, quite area. That will positively affect his physical inactivity and his waist circumference will decrease a bit. We will be able to notice that the temporal shift of his waist circumference, which just seems to be on a simple increasing trend from statistics, had various possibilities when we use meta-perspective.

Let's see his background more broadly. The recent economic recession is also related to their monthly salaries. In the neighborhood of the shopping area in which his shop is located, the number of children is limited due to the falling birth rate and many customers are attracted to a large-scale shopping center recently opened in the neighborhood. He is getting close to 40 years-old and there is nothing left of the athletic he used to be when he was young. When you became aware of such backgrounds, you will become aware of the possibilities that his living condition will not largely ameliorate even after his marriage, that his shop may be closed in the near future, and that he will not be able to lose his weight easily due to his current body constitution even if he quit tasting creams. If his shop is closed, the trend will be totally different from that in the past. There is a possibility that he may not choose to continue to live in this area. In that case, you may give up making a concrete recommendation of commuting by foot and rather choose to recommend doing exercises to develop his body trunk more strongly. It is because such exercises are effective measures regardless of his environment. Furthermore, some may become aware that there is a possibility that his waist circumference will not reach 86 cm even without any exercises because he lost his work. Of course, it is important to do some exercises for his health, but in this case, a recommendation that he does nothing is totally acceptable as the objective is to reduce his waist circumference to below 86 cm.

This example explains two points which are different from conventional forecasts. The first point is the importance of meta-thinking. By seeing the relation among complex elements behind a certain event, we will be able to correctly understand conceivable possibilities in the uncertain future. It is not necessarily limited to quantitative data. According to hearsay, in the case of Shell which made the scenario planning famous, they designed the future scenario also considering the characteristics of the royal family. The surrounding environment of a certain event or interpretation from a meta-perspective are effective perspectives in understanding hidden elements which would significantly change the future or driving force.

The next point is the departure from the possibility. In the above case, it is not easy to quantitatively calculate the possibility that his shop gets closed. However, if we cannot eliminate such possibility considering the surrounding situation, what we should recommend him? We will explain him about possible futures and provide recommendations which correspond to these futures as well as recommendations which are commonly effective for all possible futures. In this case, the objective is not to improve the precision of forecasts or the precision of future possibilities. It is important to be aware always that the objective in the real sense is not to exclude these possibilities and provide recommendations which will allow us to address such possibilities.

1.2.2.4 What Scenarios Present

As in this study, if the objective is to find a step for a next policy, and if it is important to show a path towards a certain final objective, a scenario regarding the surrounding environment means nothing other than presenting exogenous conditions to select a way towards the final objective.

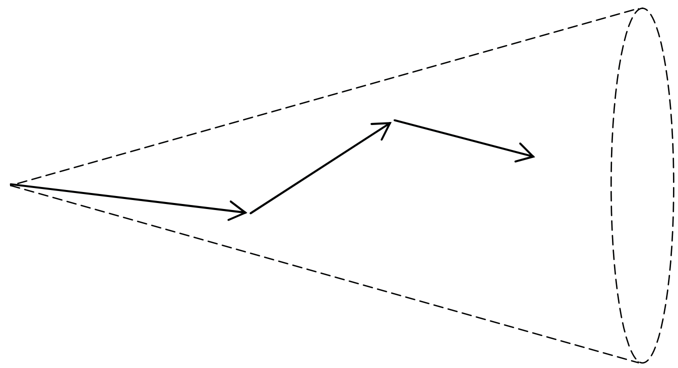


Figure 1-3. Meaning of Scenarios

In that case, we may be able to say that a scenario is something to present a direction with a broad range towards the possible future to which the selection of a policy will lead. For instance, if a rough direction we could obtain from a scenario regarding the future surrounding environment indicates that we should solve a certain issue with technologies, it will be more likely that many of selected policies will be related to technologies.

When we provide such explanations, some may misunderstand that we mean the range of the final goal. It is a misunderstanding that the goal to be achieved in the future has a certain range and we need to select a policy whose outcomes will be within such range of the goal. In fact, regardless of whether a certain range is set for the goal or not, what we intend to explain with the above range of scenario is totally different from such understanding. The range of scenario in this study means a situation where a variety of policies are accepted to some extent within the range. For example, in the scenario in which we have no option other than conventional fossil fuels, among all options, the selection of policies related to alternative fuels or new energy sources will inevitably fail to conform to the surrounding environment. In that case, the introduction of policies related to such new energies is not a realistic option, and probably will not conform to the needs of the depicted future society. In other words, the scenario regarding the surrounding environment limits future policies to some extent. However, it has nothing to do with the goal of reducing greenhouse gases itself. The goal is a goal which is independent from policies and narrowing the range of policy options does not change the goal. In other words, if we employ the same method as the one in this study, by developing a scenario, we will apply restrictions which will lead us to select policies that will fit the future society in the scenario. It is what we mean when we said in the beginning of this subsection that scenarios function as exogenous preconditions.

1.2.2.5 Preconditions for Analyses

What we have explained so far may be nothing special for researchers who develop more sophisticated forecasting models. There exist numerous forecasting models which cover industrial structures, etc. behind GDP and we often see studies in which a number of future cases are prepared by setting several future visions for the target industry. What we have described so far might have caused a misunderstanding that we need something which replaces conventional forecasts. However, the points we have explained so far are nothing other than the idea to divaricate several future cases. It is a way to notice that the industrial structure is the driving force lurking in the background, and a method to consider significant changes and complex relations lurking in the background which are not apparent from simple forecasts. In other words, it is nothing more than one of the ways to explore various possibilities in conducting forecasts or analyses, or, to divaricate several futures. In this process, what we see is not what the future holds but we examine what the future would hold. In a complex, rapidly changing world, by looking at the relation or combination of complex elements which are difficult to predict, we can see future possibilities although it is difficult to make forecasts there. By incorporating this method, we believe that we can expect to prepare concrete policies or countermeasures for possible futures of the global, rapidly changing world.

1.2.2.6 Basic Methodologies to Depict Futures

Here, we will mention to methodologies to depict future visions. In this study, as a way to depict futures, we developed a visioning tool. The basic design of this tool is based on the method of scenario planning, and by simplifying and automating the method for various reasons mentioned below, it enables even persons who are not familiar with the relevant field to design futures. In the previous subsection, we mentioned to the importance to depict several futures. However, the tool offered in this study depicts only one future at a time. Therefore, in order to depict several futures, we need to use the tool several times. We would like to clarify in advance that it is resulted from the link with the policy selection which is a later stage of the process and it does not exclude the points in the previous subsection. As we see the concrete way later in this report, in this subsection, we will summarize the way adopted in this study and information which is necessary to understand it.

It was in the 1960s that the method to develop military scenarios began to be used to solve social challenges or formulate strategies at the private level. This method entered the limelight when Shell prepared the scenario on the demand and supply of crude oil in the 1970s. Prior to the oil shock, when crude oil was supplied at a low price, they formulated a scenario with escalating crude oil prices. Although the idea was internally rejected once as a scenario with the least likelihood, it was eventually accepted after the team explained that the possibility of this scenario could not be excluded. It was one of the several scenarios existed at the time but it enabled Shell to prepare responses they should take when crude oil prices went sky-high. The oil shock actually happened but Shell could avoid significant damages by refraining from making excessive business investments. As a result, it emerged as the second largest company in the industry after the oil shock. Shell continued to develop scenarios and published a new scenario last year in 2013.

Now that 40 years have passed since the private sector started to use this method, we believe that various ways exist in various areas. However, its rough scheme is as in the procedure explained below and we believe that this scheme is more or less common among different ways. Hereinafter, we will explain every stage of the procedure one by one.

1 Set objectives
2 Collect necessary data or information for scenarios
3 Identify driving forces
4 Find scenarios’ diverging axes
5 Develop scenarios
6 Examine actions to be adopted

■ **Set objectives**

Before we depict scenarios, we first need to decide for what we develop scenarios. In this study, we set a goal of drastically limiting emissions of carbon dioxide from the transport sector of ASEAN in the future. For example, if our objective is to realize world peace, we may set various secondary goals to be achieved. Likewise, if we can make a quantitative goal setting by using a certain index, it will be one of the criteria for ultimately selecting actions. It will be also the criteria which can be referred in backcasting from the goal. Furthermore, setting a timeline is also important. By setting the point in time which will be the goal, it will be possible to depict concrete scenarios. In this study, in order to set an ultimate quantitative goal, we set an objective of reducing emissions of carbon dioxide from the global transport to the half of the current amount by 2050 as a background, and then calculated the acceptable amount of emissions per capita to set a goal for each country and combine it with the population forecast for each country in the ASEAN area.

We also suggest considering relevant stakeholders in this goal setting. For instance, in the case of this study, we have the energy sector as a sector related to emissions of carbon dioxide from the transport sector and we needed to have substantial discussions to determine how to deal with policies related to the energy sector in our scenario. Policies related to new fuels such as hydrogen and electricity go beyond the bounds of traffic policies. The questions of whether we should consider these policies as those to be controlled by the scenario or we should understand them as exogenous elements which come from the outside of traffic policies are closely related to the reasons for developing scenarios. In this study, with a view to make policy recommendations to ministries of transport or relevant agencies of ASEAN countries, we decided to consider many of energy policies as exogenous elements, which are problems outside the scope of issues to be controlled by policies. If they had been considered as national strategies, we would have address energy policies within the scenario as policies to be controlled. In this way, it will be possible to develop clearer scenarios by clearly supposing the scope and objective of analyses, which are, possible beneficiaries of recommendations and reasons for making recommendations when we set goals.

■Collect necessary data or information for scenarios

The process which requires the longest time is this data collection. In particular, as in this study, when a study covers developing countries with limited statistics or data and deals with the transport sector in which statistics or data are further limited, and when we cannot expect available data to be accurate, the availability of data will be one of the most important factors which affect the quality of scenarios.

Here, we will need to consult knowledge or experiences of experts in two points. The first is information on the availability of data or statistics. For example, in the case of statistics on transport, it is not rare that data or statistics which are common in developed countries are not available in developing countries. The definition of passenger vehicles may differ from one country from another. In the case of developing countries, especially in countries where the automobile inspection system, etc. lacks precision, it will be necessary to look at the number of unregistered vehicles or that of discharged vehicles. We need to consider the definition of paratransit modes which are unofficial transport systems. Helps by experts with relevant knowledge will be very beneficial.

Furthermore, their extensive experiences will be beneficial in selecting important elements to depict future transport. For example, their answers to simple questions (such as “what will be the biggest difference between the urban transport in Manila 20 years from now and the current urban transport in Manila?”) will serve as a useful reference in finding driving forces in the later stage of the process. Experts here are not limited to experts in a certain area. In considering the society as a whole, knowledge of experts on economy or politics will be also necessary. In actual cases, we think it is rare to refer to opinions of various experts by holding meetings, etc., from this stage. However, if time and funds allow, we should consider organizing meetings from the stage of data collection.

In this study, as minimum data and statistics are already ready in the tool with helps of experts from various countries, we will not take time for such meetings in this process, except cases where we add data and statistics.

■Identify driving forces

Once we set goals, measured targets and collected necessary data and statistics, we hold discussions gathering stakeholders. If preparatory works are done and there is an excellent facilitator, the later stage of the process will be completed with intensive discussions of a few days. However, the process hereafter will be the very core of scenario development.

At this stage, we identify elements which have significant impacts on the future (driving forces). Potential elements include both quantitative data and qualitative information. When we assess a society, its GDP and population are quantitative elements and these are also important driving forces. What is more complicated is that when such elements have a hierarchical structure which is determined by other elements, it is common that such elements have a structure in which these elements are intricately interrelated and cannot be simply identified.

Among methods to derive such elements, the most known one is PEST analysis. This is a method to classify the environmental information surrounding a certain event into the following four categories and determine relevant elements by using the classified information as clues.

1 Political elements (Political)
2 Economic elements (Economic)
3 Societal elements (Societal)
4 Technological elements (Technological)

We seek to make analyses by largely setting these four directions. In recent studies, there are cases incorporating new elements such as the environment or energy in the E part, in addition to economic elements. As previously stated, this PEST analysis is used to examine the environmental information or status of change of the targets.

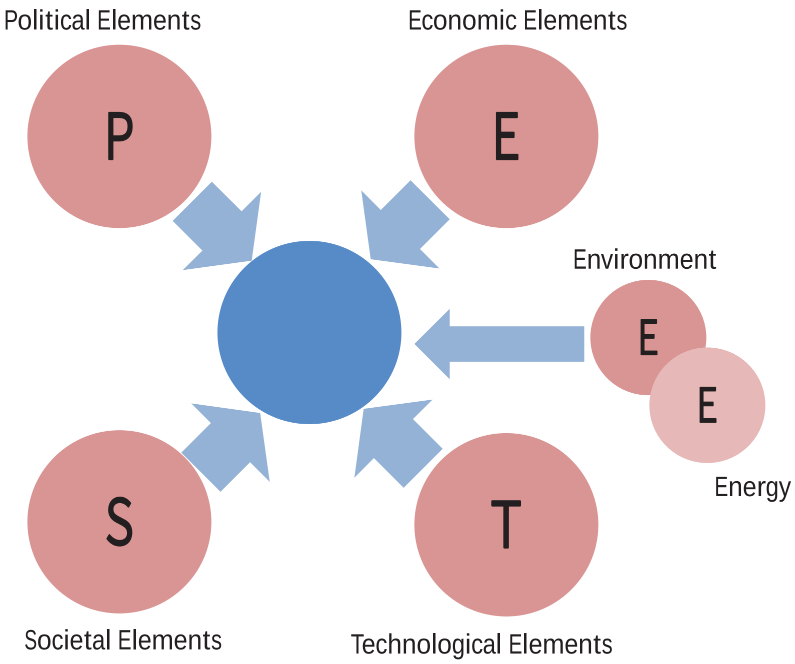


Figure 1-4. PEST Analysis (From the FY2012 Report)

While PEST promotes understanding by simply classifying the society into four classifications, when we actually seek to derive elements, it may be difficult to identify all elements as categories are too broad. In scenario planning in the business area, there exist cases using categories such as society, technologies, economy, business methods, natural resources, politics, demographic situations, international, laws or environment. As we also explained in the FY2012 report, we set 10 axes by reference to "Quality of Life" (QOL) which is commonly used to define a society in Europe and ultimately set more than 60 elements in our previous project titled *Study?of? Transport?System?in?a?Low?Carbon?Society*. As our theme is transport, we focused on elements such as land use while elements such as business methods are not included.

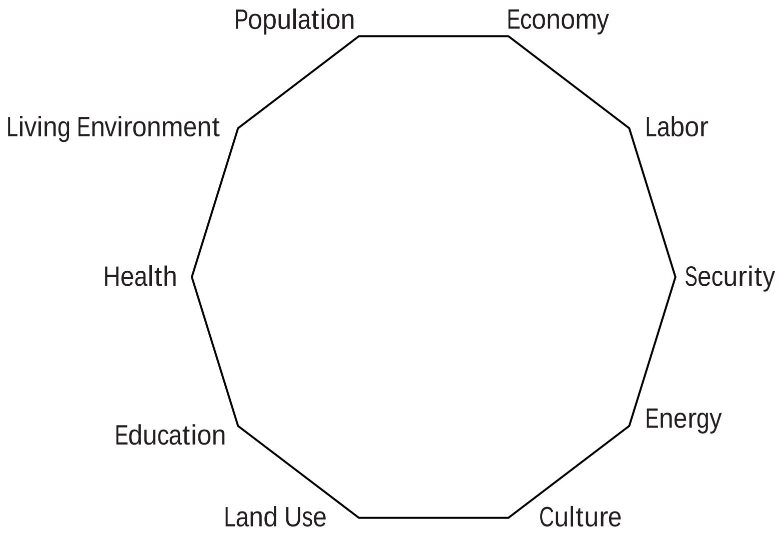


Figure 1-5. Component Axes of the Society in the Previous Project (10 Axes/ From the FY2012 Report)

In this study, we eventually set five categories and set approximately 80 elements below these categories in the tool. Furthermore, by enabling to set these categories and elements separately for each area (cites, inter-cities, etc.), we achieved to develop (a) more detailed scenario(s). Specifically, we determine elements which constitute the society by answering several hierarchized questions interactively and set an overall vision of the society. Currently, we use differences with the society which is supposed as BAU for questions and we derive a future society by considering these differences.

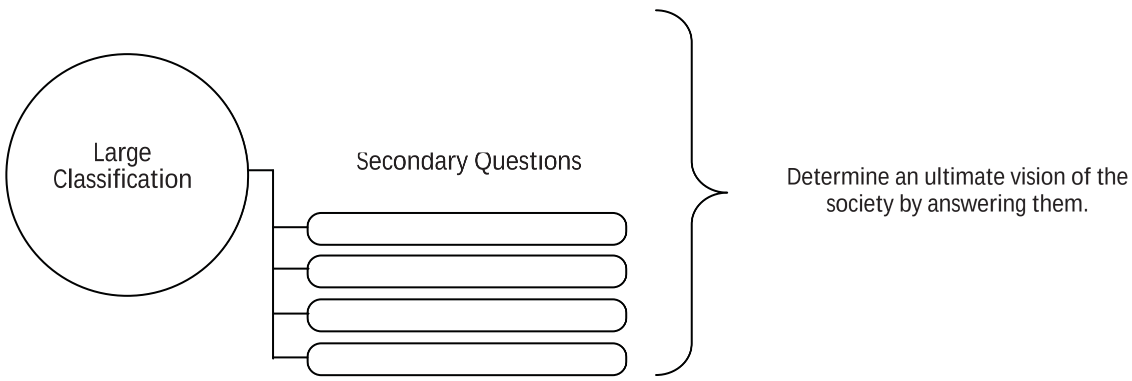


Figure 1-6. Process to Develop Images for the Future Society

Essentially, what is the most important in this process is to clarify the mutual causal link among driving forces while deriving driving forces affecting the scenario. However, if we develop all of these logics into a program, it will be difficult for users to add societal elements later as needed. Therefore, we redefined the notion of the block system described in the FY2012 report into an interactive system, and in place of using binding logics, we decided to explain the impacts that elements would have in questions. In doing so, not only we could cover the problem in the block system, that is, the ambiguity of logics to some extent but also we could improve the system so that we can subsequently add elements which cannot be considered at the present stage due to the lack of data, etc., although it is not easy. We will discuss details later in this report.

■Find diverging axes for scenarios

After selecting driving forces, we will determine the elements which will divaricate scenarios among these driving forces. Here, we will explain about two ways to determine such diverging axes.

The first one is the way to determine diverging axes by the uncertainty of elements and the significance of impacts. Using these two axes, we depict a matrix with four squares. The first thing we should focus on as a diverging point (element) of a scenario is the one with a significant impact and high uncertainty. While it has a significant impact, it is not clear how it progresses in the future. It is the very point which divaricates the scenario.

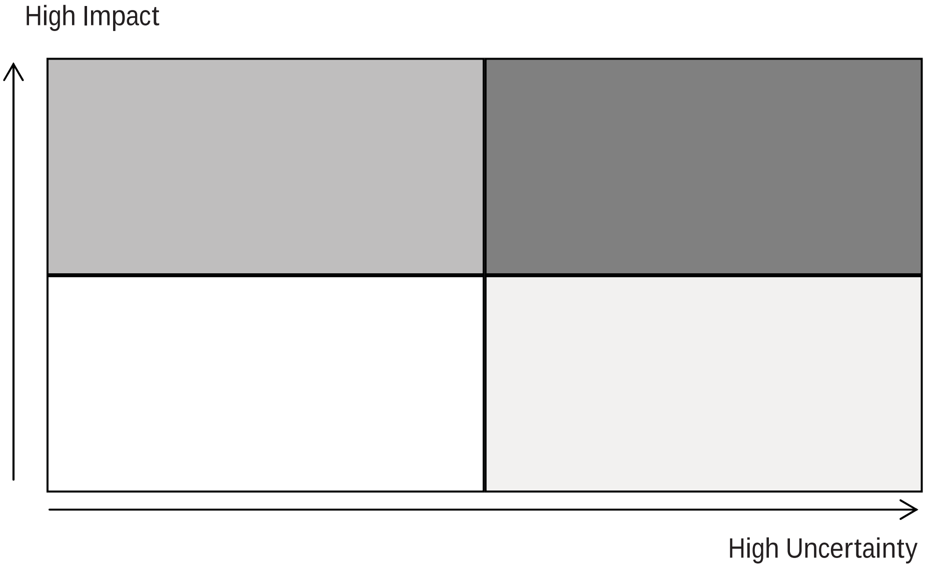


Figure 1-7. Example of Classification for Scenario Divergence

According to this idea, while an element with a low uncertainty like the population is a driving force as it has a significant impact; it is likely that it is positioned in the second place as a group. Likewise, the progress of globalization, etc. is considered as a predetermined course to some extent and it also has a low uncertainty. However, it surely has a significant impact and it will be thus placed in the second-place group. However, when we consider the notion of degree in the progress of globalization, and use it as a more concrete indicator which is not simple With-Without, it will be possible to further emphasize its uncertainty.

Actually, it seems more common to capture driving forces by the magnitude of impacts, rather than the uncertainty. We believe that it will be easy to make discussions if we consider the uncertainty in this framework and determine ultimate diverging axes.

The next is a way using the Iceberg analysis. We mention to this method in the ＦＹ2012 report. It is a method in which we made a classification in which the uncertainty increases as we go deeper in an iceberg and by linking each element, and identify the element which comes up to the surface of the water, that is, the element with a high certainty as the diverging element.

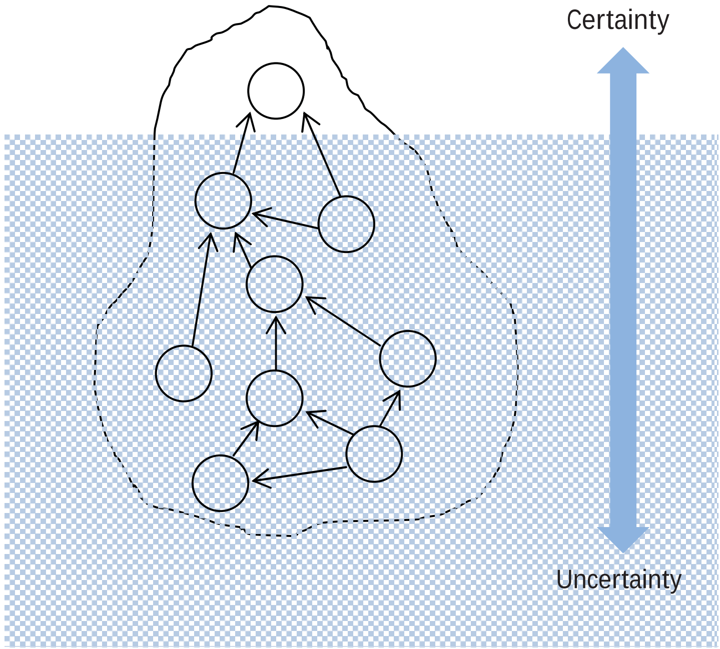


Figure 1-8. Iceberg Analysis (From the FY2012 Report)

In this study, we adopted a way which is close to this iceberg analysis. However, as previously mentioned, the tool developed in this study does not divaricate the scenario and aims to depict a future scenario which corresponds to a policy selection. We take a process of actually selecting among numerous divarications by interactively answering to nearly 80 questions per area in the visioning tool offered. In other words, we will naturally select a future society. What is underlying in this process is the existence of an ideal vision of the society that always lays in our mind in depicting a future scenario. Some earlier studies first set an ideal society or desirable society. Rather than first defining the society, we first set the type of society that we wish to live in or transport which we wish to realize at the stage of scenario development. We then examine policies which will lead to the ideal society and transport. In that case, the scenario itself will be the one incorporating a sort of future goals. If we set this kind of goals like an ideal society and depict a scenario which will lead to such goals, we may take the same process as backcasting as we see later in this report. We believe that the combination of visioning which is a process to develop a scenario by considering possibilities in a future society and depicting it first, and backcasting which is a method to derive means (policies) to realize a certain goal in that society is an ultimate combination to depict a path to the future we wish to attain. As just described, adopting the method of scenario planning to define a society to some extent is a unique feature of this study.

Generally, the divarication of two axes is often considered to depict a scenario which can be shown dimensionally (that is, four scenarios). However, we believe that the number of scenarios differs from one case to another. For instance, the scenarios regarding the reconstruction from the disaster in Tohoku present more than four scenarios dimensionally by considering divarications along the timeline. Likewise, the reason for showing scenarios dimensionally is simply because it is easy to depict and there is no problem to have a smaller number.

■Develop scenarios

Then, we put these divaricate scenarios together. In many cases, the thing which is completed first in this process is a snapshot of the target year. In this study, it corresponds to the vision of transport (or the society) in 2050. It is also common to attach images or titles which are easy to understand. In this process, we will examine the status of the target in a certain year by reference to classifications, etc. in the pre-determined scenarios and then, work to narrow them down into one story.

In most cases, the story a causal link with the timeline. In other words, from the snapshot (a still image) mentioned above, we need to depict a scenario to reach there. In Japan, it seems to be common that the terms “case” and “scenario” are used without making a clear distinction, but the scenario is just like a scenario in movies or TV programs and we need to incorporate stories there. By the way, the scenario is often depicted in a retroactive way from the point in time supposed in the snapshot. In this process, we will depict an almost same process as backcasting explained below (considering what to do retroactively from the goal point) by using the causal link of elements and combining timelines. The story like the one a future person would tell by recalling the past will be a scenario.

One of the points to be noted in this process is that we need to consider the consistency, etc. with those which are already predicted to some extent. For example, it is likely that the credibility of the story as a whole will significantly decline if there is any contradiction between a given thing and relevant elements. For instance, we can easily understand that the scenario involves a critical problem if we depict a scenario in which gas is produced from a gas field earlier than 2020 although it is physically impossible to start the operation of the gas field before 2020. In cases where we deal with a thing which is not given thing, it is possible to make some adjustments even when the current plan exists as a controllable element.

We believe that this process is the most creative in the whole procedure. It is a process to build a story from nothing. Conversely, depending on the creativity of persons who is in charge of scenario development, an uninteresting story may be created. When it was prepared by an excellent facilitator or a person with extensive experiences, a story like in the movie may be developed. We can freely describe the story: We may depict a future economic crisis in Asia having a bank staff in Singapore as a protagonist or we may depict a future from a third-person political perspective like in a diary of an assistant to the prime minister. Such dramatizations can be negatively taken in Japan but the essence of scenarios is a story incorporating causal links and time as we explained above. We believe that all we need to assure is that participants select a way which is the most understandable for others despite various cultural backgrounds.

However, in this study, we did not adopt this kind of active scenario development. First of all, as we provide a tool which can be supposedly used individually, we needed to keep in mind that scenarios are basically created by one person. While this creative process is the most creative one in the whole process, it is likely that a user who is not familiar with such works will suffer significant birth pangs until the completion if he or she is to develop a scenario alone. In fact, even if a scenario is collectively developed, this process takes the longest time in the whole process. Furthermore, when a scenario is formulated like a story, it will be more likely that the reality of the whole scenario is questioned when it is prepared by a person who is not familiar with such a process. As previously stated, a bank staff in Singapore who was created to depict an active story is an imaginary case which does not exist in reality. When we deal with the future which is an uncertain thing, many people will have negative images about incorporating further fictions. Therefore, we design this study so that we can depict the future by combining the outcomes selected through the visioning tool.

■Examine actions to be adopted

Finally, after we developed future scenarios, we will examine actions or countermeasures (policies) to be subsequently adopted to achieve the objective. In this study, in order to depict the future of transport in consideration of the global warming as well as the policy selection to attain there, we introduced two stages which are visioning for scenario development and backcasting for policy selection. In a sense, the latter, backcasting, is same as the process we explained in this section. However, we incorporated a process to select a direction of policy selection at the later backcasting stage beforehand, in the scenario development, that is, after we selected societal elements. While quantitative evaluations or many selection options will be required for a detailed policy selection, by making a summary immediately after thinking about a future society or transport and selecting a rough direction of policies, we sought to improve the affinity of the two different processes, which are visioning and backcasting. Specifically, we will select the direction to adopt CNG as a future automobile fuel in the process of visioning, and examine how we use that fuel in backcasting.

1.2.2.7 Visioning in this Study

So far, with regards to the process to develop a scenario, we have explained the method of scenario planning as a premise for the methodology of the visioning tool, which is a scenario development tool we have developed. We have already explained about some of differences with the tool in this study and we will see details on how to handle it later in this report. In the end of descriptions on visioning, we will describe the features of the tool as a whole, its use, its position, and etc.

First, in this tool, we sought to realize a design which enables a user with no scenario development experience to make a scenario without supports by experts. Specifically, it has the following features.

- Almost all items will be completed just by answering interactive questions
- Provide information which can be used as references in answering questions

For example, constituent elements of the society to be found in stakeholders' meetings, etc. are essentially preset in the tool. Likewise, the relationship of these elements is also set in advance in a simplified manner. These processes are essentially obtained through discussions with many stakeholders. By incorporating what we have discussed in our project as preset elements, we designed our project in a way that a user can attain a scenario which is an ultimate outcome just by answering questions asking for his/her opinion about the preset elements. By doing so, while there remains a possibility that the scenario may not fully fit to the target region, our project is free from the risk of not selecting important societal elements.

Actually, as the above primary discussion process will lead to changes in opinions of experts in the region concerned and as it will enables us to address minor regional differences, we should organize such discussions where possible, and develop scenarios. One of the objectives of this tool is to widely provide visions other than conventional simple forecasts or future designs based on trends, through experiencing the scenario development. While it is possible to individually design a scenario by using this tool, by organizing stakeholder meetings based on the outcomes, etc. of this tool, it is expected that even a beginner in the scenario development will be able to realize a facilitation of meetings of a certain level alone.

1.2.2.8 Problems in Actually Introducing Visioning

The issue of global warming is a super-long-term issue. It is self-evident that we need to develop strategies against such an issue with a long-term perspective. However, as there have been numerous immediate and urgent problems in the transport sector, many of transport-related strategies tend to have a perspective with a shorter time scale, at least than those related to the global warming. The introduction of so-called transport infrastructures such as expressways and railways actually requires a perspective of several decades and many of them should have been actually planned under such a long-term perspective. However, in cases of planning of target-oriented policies, especially when there is a significant gap between the goal and the current situation or trend, many of them are rejected because they are considered unrealistic. In fact, the determination of what is "realistic" and what is "unrealistic" is an issue which always arises, especially when we develop long-term strategies. One of possible solutions for this problem is to introduce a scenario as we explain here and consider future actions not based on a probabilistic judgment but from a perspective of possibility. In other words, we consider future actions not by the probability in the future but by the possible existence. This method seems to be a logically sound method but in the actual application, it has problems which cannot be avoided by its logic. Prof. David Banister of the University of Oxford is an expert of policies in the transport sector and an authority for long-term scenarios. For instance, he points out the importance of the following three perspectives in introducing long-term scenarios.

1. Research perspective
2. Political perspective
3. Economic perspective

Among the above perspectives, the method for scenario development adopted in this study is the research perspective. It is a method to set an ultimate goal and introduce necessary policies to achieve such a goal. However, researchers, etc. who wish to introduce this method need to examine actions considering other perspectives. The political perspective is, in short, an election cycle. Particularly in cases where the ruling party changes at every election (for instance, cases where competing two large parties govern a country, etc.), as a result of an election, existing political policies may shift to a completely opposite direction. This cycle is usually a cycle of four to five years (in some cases, a shorter cycle) and stakeholders with this perspective are more likely to make judgments with a relatively short-term perspective. The economic perspective is a cycle of funds. While the infrastructure investment, etc., usually requires a long period to recover, if the investment is made for a business-oriented purpose, we need to also examine short-term outcomes. The business fluctuation is also a very important issue. In this manner, stakeholders assess policies in different timeframes. In this study, it is possible that the existence of stakeholders who tend to make assessments in the short run becomes a practical barrier for the introduction of a long-term perspective. In contrary, when we make a policy assessment for a shorter term, the value of the long-term perspective will relatively decline.

When we introduce an idea or a method which does not exist in the existing mainstream, we need to examine responses to stakeholders with different opinions. They are not enemies in considering the future. They just have different perspectives, etc. For instance, in a country with the two-party system, we should consider coordinating with the both parties. In a nation with a strong bureaucracy, it is necessary to consider cooperating with administrative agencies, rather than politicians. In a decentralized nation or a multiethnic country, the cooperation with local authorities, ethnic groups or stakeholders may enhance potential to obtain outcomes more smoothly.

Among above perspectives, a short-term issue may arise more than once in a long-run. As we explained with the term “cycle”, as long as radical measures are not taken, it is likely that we face the same issue again. If we imagine the case where an election is organized every few years, it will be easy to imagine that such an issue arises several times. In actually introducing the long-term policy development, we believe that the selection of stakeholders and discussions in depth with them will be important.

1.2.3 Backcasting

In this study, in order to derive traffic policies to drastically reduce carbon dioxide from transport in the ASEAN region, we employ the process in which we first set concrete goals and depict future visions for the society or transport, and then make a concrete policy selection considering such goals and visions. In this section, with regard to the process to make a concrete policy selection which is the final stage of the whole process, we will explain methodologies which became a basis for the tool. For the actual tool, we will see separately later in this report.

1.2.3.1 What is Backcasting?

Backcasting means first setting a goal and then deriving necessary actions to reach there. In other words, the ultimate objective of this stage of the process is to depict actions to be taken to attain the goal.

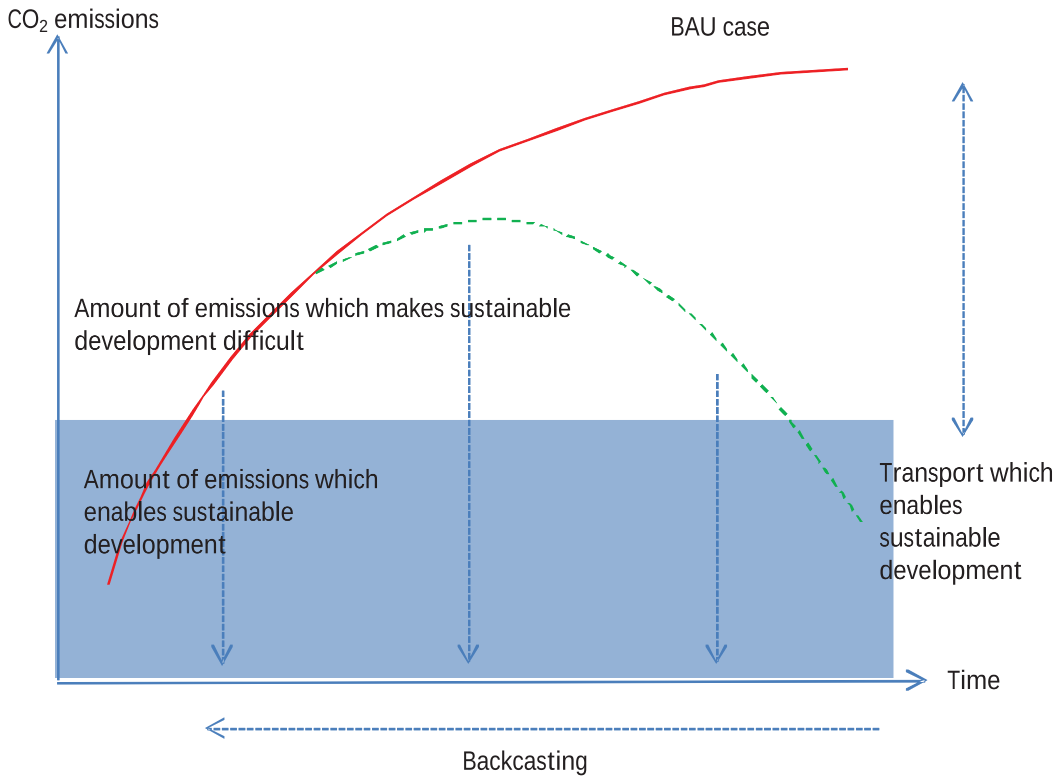


Figure 1-9. Conceptual Diagram of Backcasting (From the STL Report)

This is by no means a new concept. On the contrary, we use this method at the individual level quite often, when we manage our works. In particular, in the situation where a clear deadline is set, the tasks which should be completed by that time will be the final goal and the final year (time) and the work to consider tasks to be incorporated in the process from present to the final goal and timings of such tasks is nothing other than backcasting. There should be various constraint conditions such as phone calls from other clients, responses to an urgent trouble, drinking parties or personal affairs, and there are many possibilities that sudden events arise. It is a method to continue to perform tasks without losing sight of the goal under such circumstances. It is a very familiar management method for us, which is not limited to the work situation but is also introduced as a mean for self-realization.

There are many cases in which similar methods are used in a research or a long-term policy planning by the government. The formulation of long-term policies in Sweden and recent studies related to the global warming are well known examples. However, in considerations regarding many long-term policies, the conventional forecasting approach is often adopted. It is so-called forecast. There are several reasons to adopt this approach.

First of all, its precision or method is getting more sophisticated every year. At least until the invention of the calculator, the best forecast we could expect should have been the one using a dozen of formulas. However, the complexity that a forecast can deal with has rapidly increased with the use of computers in economic forecasts, etc. As in the recent case of Bid Data, the amount of variables and data which can be dealt with has grown than ever before. Such developments enabled us to incorporate minor variables or complex data which could not have been dealt with into models.

The second reason is the target period. For example, it is said that in order to predict the next 10 years, we need data for 20 years, a period of twice as long as the one to be predicted. If the period to be predicted is relatively short, if we use the computer system and statistics of present day, it will be possible to make calculations at least for developed countries.

The fact that statistical methods have been further generalized than before can be also cited as a reason. Software for statistics is now available free of charge and once he or she gets familiar with the operation, even a student can instantaneously analyze a complex calculation which required a long time 30 years ago. Like this, the fact that the number of human resources engaged in statistical analyses have increased significantly and that the understanding in this field has been improved should be also an important change.

However, such forecasts have not been necessarily used to deal with long-term issues. When the Club of Rome submitted a report regarding the sustainable development, they used the system dynamics (SD) model, rather than the so-called econometric model. While this SD model which examines possible movements from the relationship among elements does make forecasts, it focuses on future behaviors, rather than the numerical values obtained from such forecasts. It captures the society as a system and essentially uses the analytical method which has been used to promote an industry's efficiency, etc. to depict the future society.

In a theme which requires a very long-term perspective like the issue of global warming, methods are changing further. As previously stated, the reduction target of greenhouse gases in 2050 has been already calculated using scientific calculations. In other words, the goal setting for the reduction of emissions in 2050 was calculated on scientific grounds. That is to say, in an extreme argument, a forecast on the amount of greenhouse gases released from social activities is not necessary at this stage. The value to be predicted using forecasting has been already obtained from other calculations. What is actually needed at this stage is a way to attain this value.

We will explain further using the above conceptual diagram. BAU (Business As Usual) shows an extension of the current trend. This is the forecast for the case without significant behavioral changes and in this study the upper right edge of this curve will be the amount of carbon dioxide emissions in the target year. The goal is to limit the amount of carbon dioxide emissions in that year to the point which is indicated far below. What we should consider is a way to attain that goal. Specifically, we need to quantify actions or policies which will limit emissions of carbon dioxide, and bend the curve down to the goal by selecting such actions or policies by the target year. This is the backcasting in this study. While the National Institute for Environmental Studies is engaged in comprehensive studies including scenario development and backcasting in Japan, it is still a rare approach in Asia.

In many studies or policies, we consider policies based on forecasts, on the basis of the current development trend and etc. However, as we explained in the subsection on visioning, in this rapidly changing global society, the precision of forecasts is decreasing. It will be easy to understand what we mean if you imagine a sail in a storm, but what is needed under such circumstances is not a regular operation. In the case of sails, the destination should be pre-determined in most cases. Sailors will thus adjust course and take various measures while always keeping the objective of arriving at the destination in mind. In other words, it will be necessary to have an environment which enables them to be always aware of the objective, the capacity to determine the route which will lead to the destination in a storm, and the flexibility to deal with minor changes in cool blood and promptly. In fact, as its name shows, backcasting originally only dealt with one of the above points, that is, being aware of the objective. However, we made it possible to freely change combinations of policy selection at any time, by providing the method of policy selection as a tool. The process of scenario development as previously mentioned is a tool to assess the impacts that environmental changes would have on transport and it can be also considered as a method to assess the impacts that a storm would have on the ship course. As a result of not holding a zero-based meeting to amend policies, the speed of response to changes will dramatically improve and we will be able to get close to more flexible responses.

1.2.3.2 Differences between Forecasting and Backcasting

A big difference between forecasting and backcasting is their target. In forecasting, the ultimate terminus ad quem is the target in itself. In other words, it is a method we use when we have no idea about what the future holds. On the other hand, in backcasting, the goal is set from the outside as we explained earlier. In other words, we do not know what would be the ultimate point as in forecasting. The objective of this approach is to find a necessary approach which is required to attain the pre-determined goal and a path towards the goal. In many cases, the future to be attained is already given for various reasons, and what we do not know is the way to reach there.

However, in reality, the boundary between the two approaches is often vague. Also in this study, calculating quantitatively the effects of introducing policies means calculating in a positive direction (from present to the future). Of course, it is not conventional forecasting in which we examine trends, we do not assume a system which totally deviates from the current paradigm. Conversely, there are cases where backcasting is performed using a forecasting model. For example, MoMo (mobility model) of the International Energy Agency (IEA) is a model to predict energy consumption or emissions in the transport sector and performs the same analysis process as backcasting by separately setting CO_2 reduction targets in the scenario analysis.

Table 1-1. Differences between Backcasting and Forecasting

	Backcasting	Forecasting
Origin of Evaluation	Goal point	Starting point (present in many cases)
Target	Way to attain the goal (what to do)	Goal point (what happens)
Examples of Possible Questions	What should we do to halve CO_2 emissions from transport in the future?	What would be the possible amount of CO_2 emissions from transport if we keep on this way?

If we are to define backcasting with our experiences of these last six years, it will be a very simple definition. That is, as previously mentioned, to set a target value first, and think from that point which is a starting point. If we make evaluations using a model whose objective is to make forecasts, if we set a goal in the same manner and select policies so that we can reach there, it is also backcasting. We should recognize that what we should focus on is not the type of tools used in the analysis process but the target of such process.

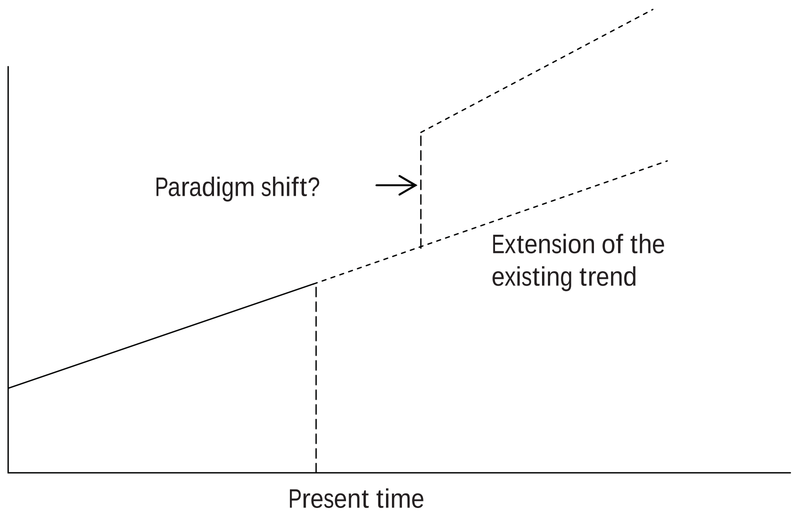


Figure 1-10. Shift which is Difficult to Predict

In fact, differences are not limited to what we have explained. By having a future as a starting point, there is a merit that the study is likely to be away from current constraints. When we see the future from the past and present, we will be more likely to be affected by past trends. However, the degree of such influences will be alleviated by keeping backcasting in mind. Likewise, backcasting is effective in dealing with long-term cases. In particular, when economic activities are incorporated as elements, and if it is for a period of 10 years or more, it is likely that changes which overturn the existing trend arise. The most recent cases of such changes include the economic downturn precipitated by the Lehman Brothers bankruptcy, the debt crisis in Europe or the Thai baht crisis in the end of 1990s in Asia. When we consider political elements, the current political disorder in Thailand is an event which was not predicted 10 years ago, so as the market liberalization in Myanmar. These changing points which largely shift the existing trends are not easy to consider in advance in an ordinary forecasting model. As we mentioned earlier, it is possible to incorporate such changes in forecasting conditions as scenarios. However, the number of researchers who were able to incorporate many of the above events as scenarios should be limited.

In the case of backcasting, we can make a policy selection with fewer influences from these changing points than forecasting. It is because some backcasting cases do not use something predicted as the goal which is a starting point of the process. Such cases include goals set on impulse or targets selected from a totally political judgment. For instance, while reduction targets of the global warming are calculated based on scientific knowledge and countless scientific or physical formulas should be related behind such goal setting, the goal is not necessarily limited to those predicted. However, if these reduction targets of the global warming are set strongly depending on the outcomes of a certain forecasting model, uncertainties in forecasting will be also integrated in the future goal. In particular, if it is a goal calculated based on a forecasting model which deals with a complex society including the economy, politics or social activities, it is likely that the calculation has a higher uncertainty than those based on a physics or science-based model and as the period to be predicted gets longer, the uncertainty will further increase. The merit that we will be partially free from that risk by using backcasting will be important when we deal with a long period as a target.

1.2.3.3 Treatment of Forecasting in Backcasting in this Study

In this study, we could not clearly overcome the above differences between forecasting and backcasting. As a result of several consultations with local experts or stakeholders, we introduced forecasts as given BAU in our backcasting, and we estimated the ultimate impacts of introducing policies by considering the change rate from BAU. In other words, the uncertainty of forecasting remains in this study. This is the judgment considering the facts that a reduction target of greenhouse gases at a mid-term level had been adopted in Indonesia which is the largest country in ASEAN and the goal had been set based on the reduction rate from BAU. In doing so, while we took a risk that the degree of difficulty to attain the ultimate goal (as it is the amount of carbon dioxide emissions from transport per capita, this goal uses the future population which is a very solid forecast and the amount of carbon dioxide emissions in 2000 which exists as a past record, and thus has a very low uncertainty related to forecasting) will significantly vary depending the adopted BAU, we could make it possible for each country to integrate their own forecasting outcomes in the model and use it in the development of national strategic goals.

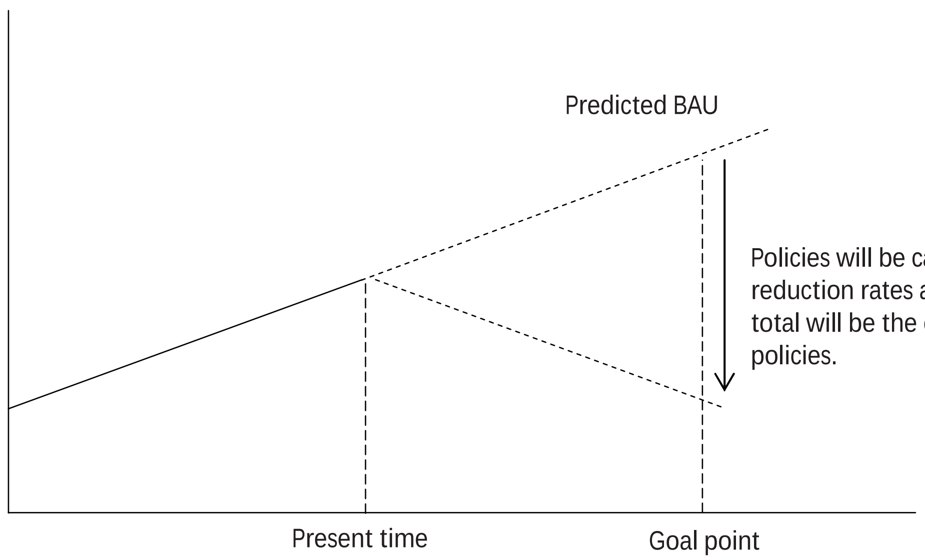


Figure 1-11. Idea of Backcasting in this Study

1.2.3.4 BAU in this Study

As previously stated, backcasting in this study enables us to quantitatively determine whether we can ultimately attain the goal by calculating the reduction rate from a given case (BAU). As we have also explained earlier, the precision of this BAU case will have significant influence over the precision of this model. Basically, for BAU, we plan to adopt the one estimated by leading transport experts in ASEAN or an estimated figure by the government. However, we should also pay attention to the definition of BAU.

BAU (Business As Usual) is essentially the case following the current patterns. However, a slight gap in interpretations may arise in this term of “Usual”. That is a difference between the idea that we should consider the case incorporating what should be included in the current trend of policies as BAU or the one considering the case not adding anything other than those already incorporated as BAU. In this study, we basically selected the latter. It is because there is a risk for overlapped calculations if we introduce BAU in the former meaning, as we have incorporated existing policies or policy proposals so that they will be replicated in the model. As a result, while we use the term “BAU” by definition, what we mean by that term may be actually close to designations such as “Without Case” or “Do-Nothing Case”.

In order to adopt this method, in this study, we incorporated existing policies related to the global warming separately as data, as well as those published as future policy plans. However, with regards to future policy plans which are not indicated quantitatively, it is possible to make changes in their degrees, etc. Likewise, even when they are indicated quantitatively, it is also possible to make a sensibility analysis or other estimates by setting different degrees and it is designed in a way that administrators, etc. may make trials by analyzing impacts on a trial basis, etc. when they use this model.

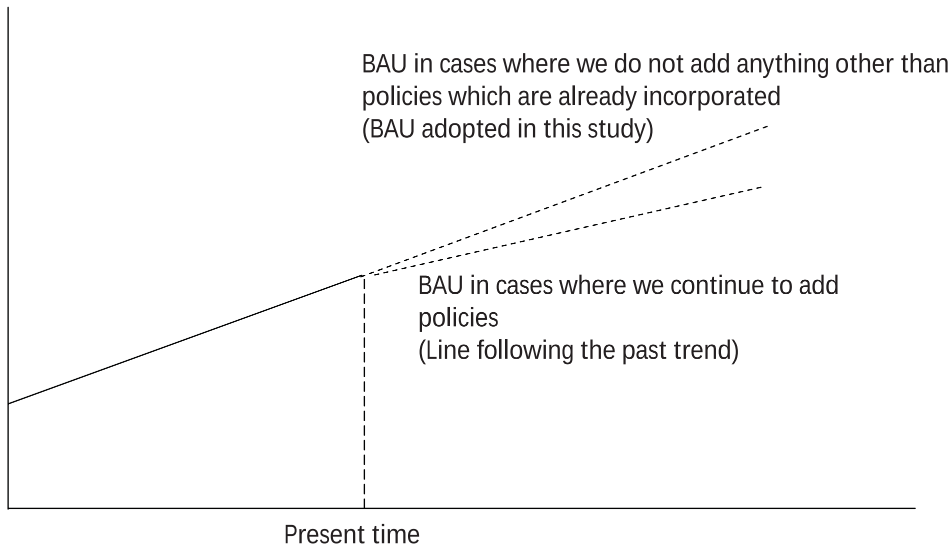


Figure 1-12. Definition of BAU in this Study

1.2.3.5 Policies in Backcasting in this Study

By calculating the impacts of a policy (reduction rate) from a given case (BAU), we will determine quantitatively whether we can attain the goal. In other words, the policy needs to have the reduction rate of carbon dioxide as its variable. In the same time, it will be possible to consider the timing of introduction by having the introduction year or period as policy elements. Furthermore, we incorporated the time lag between the introduction of a policy and the emergence of its effect. It is thus possible to calculate impacts of policies without immediate impacts by using this parameter.

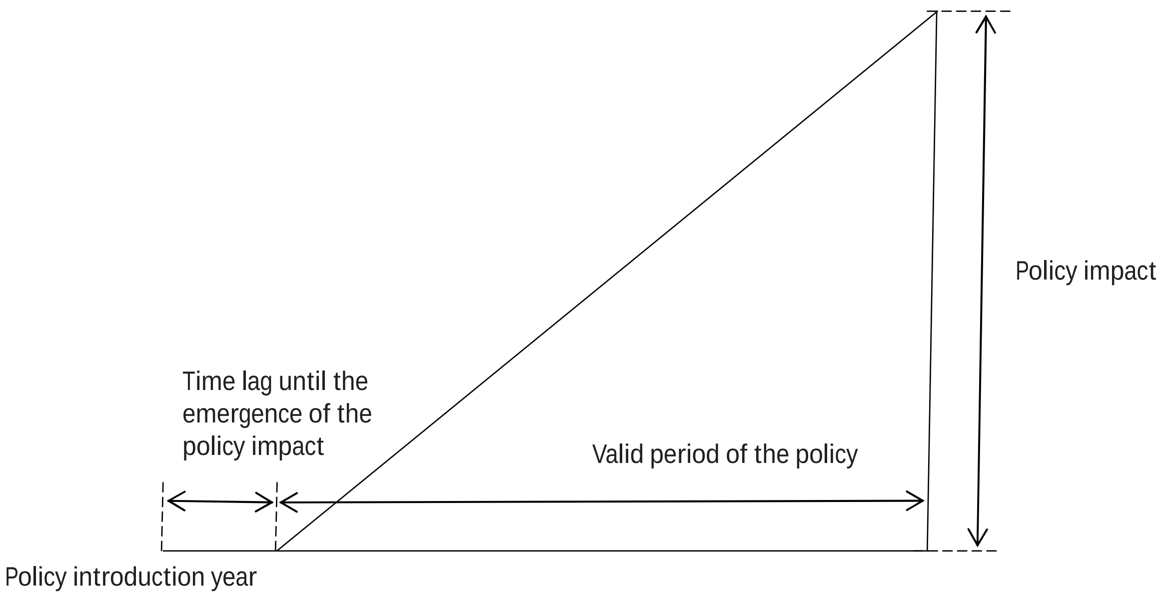


Figure 1-13. Image of Policy Impacts

When we turn this figure upside down and subtract the amount shown by the upside-down line from the BAU line, we can obtain the amount of carbon dioxide emissions considering the impact of a policy quantitatively. Essentially, a policy impact is not necessarily shown with a simple line shape but it can be depicted by various curves such as learning curve or a step-like line depending on policies. Here, in order to simplify to facilitate understanding, we depicted BAU in a wedge (line) shape. Backcasting in this study has a same meaning as combining such wedge-shaped policies innumerably and doing subtraction.

This wedge-shaped dimension shows the efficiency of reduction (reduction amount per unit) considering its quantitative elements (diffusion rate, etc.). In other words, if a policy has a wider impact, its reduction rate will accordingly improve. Likewise, a technology with higher reduction efficiency will lead to a higher reduction rate compared to cases where other technologies are adopted.

Furthermore, while some policy impacts may be time-limited (a special measure for a limited time, etc.), it is expected that many policies continue to have impacts on a long-term basis. In particular, most of policies in the transport sector which are related to CO_2 are expected to have long-term impacts. Therefore, in this study, it is expected that the amount of emissions will gradually show a downward slope with additional policies, when we introduce several policies in different timings.

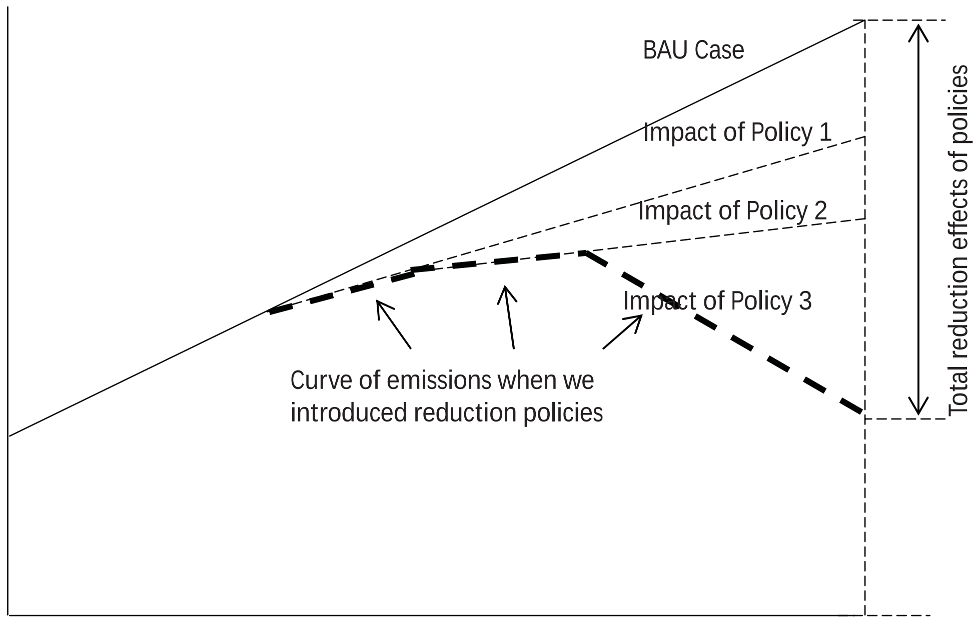


Figure 1-14. Image of Impacts of Introducing Policies

Policies in this study mean policy packages. In this study, we divide policies into two different levels, which are packages and measures. A bundle of several measures is a package but the relation between the two is not necessarily simple, as a measure may be also incorporated in a different package. We conducted studies so that we can replicate, where possible, measures and packages including their complex relations in the model, through calculations using the impacts of measures. However, we decided to limit the policy level covered by this study to the package level, because many of evaluations of policy impacts referred for our quantification are those at the package level. Likewise, while we would use evaluation outcomes in developing countries where available, policy evaluations are often available only in developed countries. We thus incorporated them in the model on the basis of values in developed countries.

There exist policies (measures) which shift policy impacts. Such policies include a subsidy policy to facilitate replacement of vehicles taken as a measure to encourage the popularization of low-pollution vehicles. It is the case of a subsidiary measure which aims to achieve the goal of the popularization of low-pollution vehicles in five years when the replacement to such vehicles is predicted to take 10 years, by incorporating a strong subsidy support in a measure to promote the popularization of low-pollution vehicles. In this case, even if the policy does not affect the ultimate number of low-pollution vehicles, the speed of introduction of that policy will be accelerated for reasons like there is a target number of low-pollution vehicles and a budget is set according to that number. In this study, we developed a tool which allows us to adjust variables related to policies, considering the possibility to incorporate such subsidiary policies. However, in order to incorporate impacts of such policies quantitatively and in a simplistic way, we need further analyses and studies regarding such subsidiary policies.

Likewise, the existence of policies (measures) which increase the policy impact itself should be also taken into consideration. For instance, if the above subsidy policy for a measure to popularize low-pollution vehicles is introduced with sufficient funds, the number of such vehicles itself should also increase. In this study, we provide a tool which allows us to change the maximum value of policy impacts. However, as in the case of a subsidiary policy for the acceleration of popularization, the adjustment should be made manually. In this study, we deal with quantitative impacts of policies as policy packages. These subsidiary policies will be thus incorporated in packages. In making an evaluation, we should try to avoid counting impacts of these subsidiary policies redundantly.

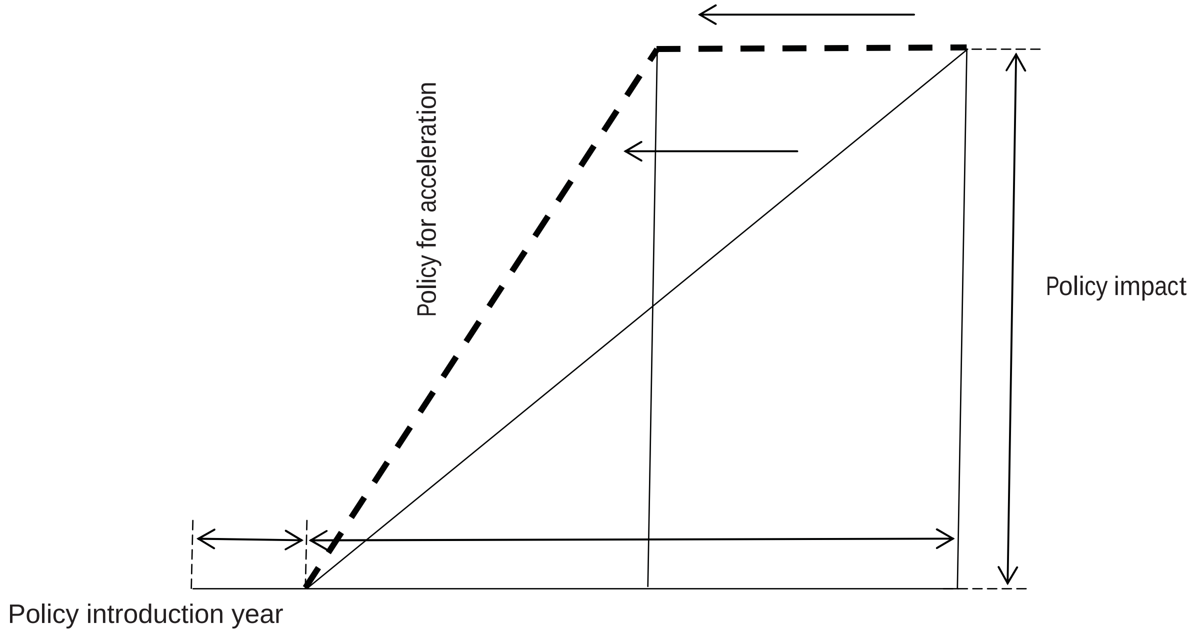


Figure 1-15. Image of a Subsidiary Policy Accelerating the Speed of the Policy Impact

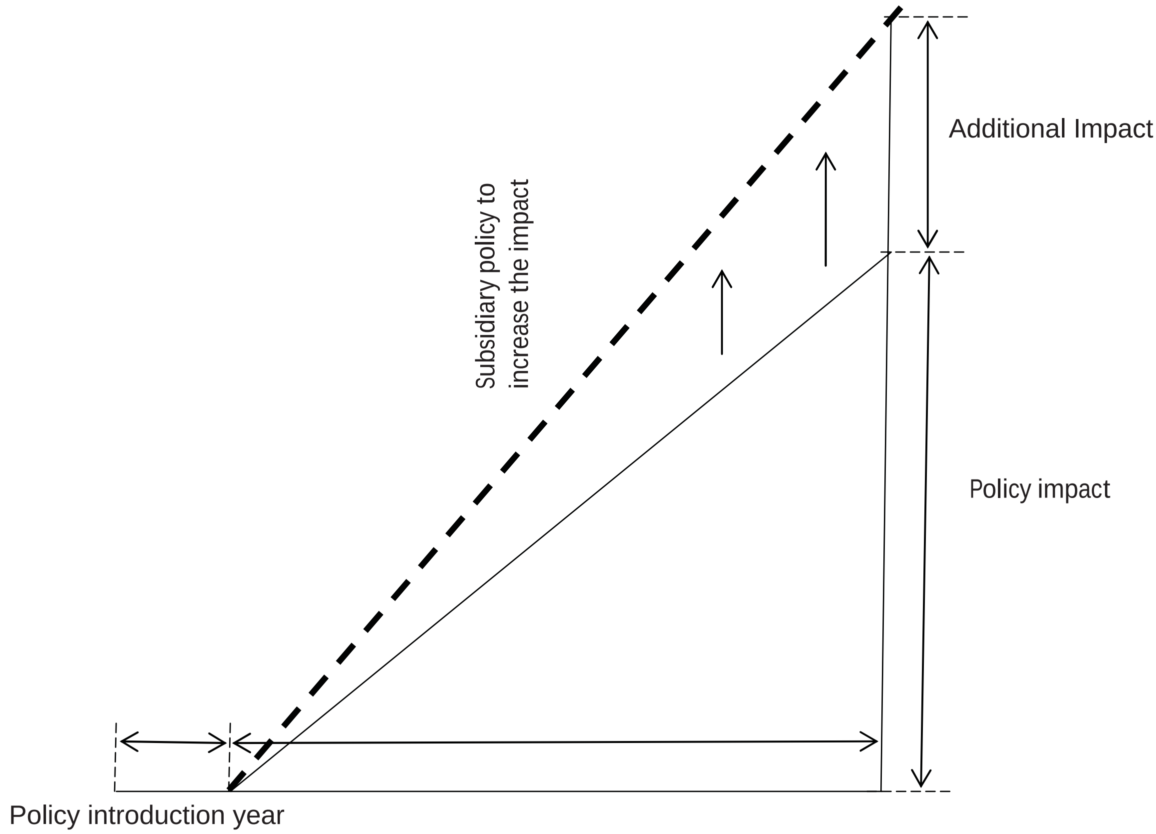


Figure 1-16. Image of a Subsidiary Policy Adding Policy Impacts

1.2.3.6 Consideration of Regional Characteristics

The transport will be largely affected by geographical conditions. Means of transportation will differ in large cities and in countryside, so as the traffic volume and travel distance. Under such circumstances, we need to consider differences of traffic policies at the national and local levels. This challenge was one of the biggest issues in our previous study, STL. While many researchers wish to consider such differences, many are unable to do so due to insufficient statistics or data. Also in this study, while we considered statistics at the local level if available, such statistics at the local level do not exist in most cases.

In this study, using the population ratio, we tried to change the scope of impacts of traffic policies by regions. While it is a method which is difficult to verify, we verified its reality as much as possible by reference to opinions of local experts, etc. A centralized urban design with a huge capital and several large cities is common in the ASEAN region and there should be cases where the percentage that the transportation in the capital area currently accounts for in the total transportation in that country is extremely high. However, there is a possibility that cities are decentralized in the future, and even in countries like Thailand and Indonesia, it is necessary to suppose that the land use would shift to the one centering on several huge cities.

In this regard, while it became a very rough and challenging response, we designed our tool so that each user can make modifications by him/herself based on the future improvement of statistics. We see details in this regard later in this report.

Chapter 2

Policy Evaluation Methodologies

2.1 Introduction

What should the traffic system, which is needed in the future society, be like? In order to answer this question, we need to review how transport demands are generated first.

The figure 2-1 shows the objects leading to transport demands (hereinafter referred to as the "external sectors") and the surrounding society. The "external sectors" include "leisure," "commuting," "shopping," "education" and "freight." Reviewing transport as a phenomenon in this figure would make you realize that transport demands are not generated for the purpose of "transfer," but traffic is generated to achieve the purposes of the "external sectors." By paying further attention, it would be easy to realize that the forms of the "external sectors" are formed where there exists a society (herein referred to as the "external factor").[1]

In order to discuss what the traffic system, which is needed in the future society, should be like, now you see that defining how the future society (external factor) advances and how the external sectors are formed in the society (external factor) allow the first discussion.

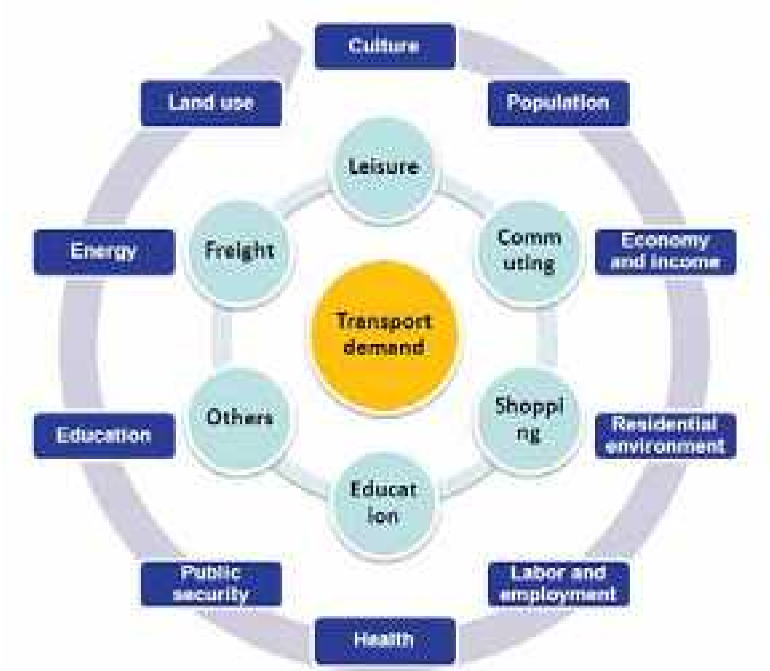


Figure 2-1. External Factors Leading to Transport Demands and the Surrounding Society

How does the future society advance? What should the traffic system, which is needed in the society, be like? Conventionally, for discussing these, social economy experts, traffic experts and other stakeholders gather to create a vision based on various deliberations. However, such a process usually takes a long time, and it is also quite a difficult work for people with little experience. It can be easily imagined that a tool to help to create the above-mentioned vision would be very useful (hereinafter, such a tool will be referred to as the "Visioning Tool").

According to the fourth report of the IPCC published in 2004, the CO2 emission from the traffic sector accounts for

1 For more details, see "Beyond Transport Policy: Understanding and Managing the External Drivers of Transport Demand, 2008, EEA" or other documents.

23% of that of the energetic origin. According to the report[2] of the International Energy Agency (hereinafter referred to as IEA), it is predicted that the CO2 emission from the traffic sector in 2050 will be about doubled compared to 2000 mainly due to increase of emission in developing countries (Figure 4-2). To aim to reduce CO2 emission in the traffic sector, it is important how much the current CO2 emission can be reduced in developed countries, and how its increase can be reduced in developing countries, where a large increase is expected to continue. Especially in developing countries, it is expected that vehicles will increase in number and infrastructure will further be developed to meet the increasing transport demand in the future. In such circumstances, it is crucial to include a transport policy with reduction of CO2 emission in aiming for a low carbon society. And it would be very useful if there were a tool to estimate the effect of reducing CO2 emission in case of introducing such a transport policy (hereinafter, such a tool will be referred to as a "Backcasting Tool"[3]).

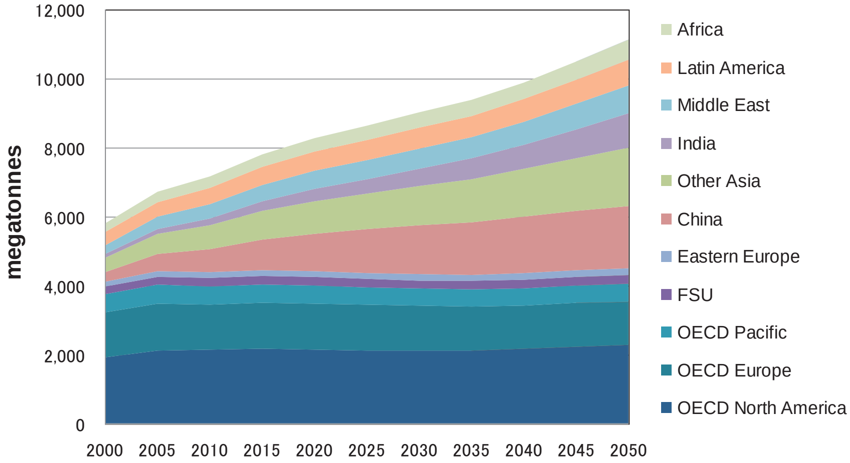


Figure 2-2. CO2 Emissions by Region (TTW)

It is predicted that population increases and rapid economic development in the ASEAN region will lead to a further escalation in motorization in the future. In addition, a substantial rise in CO2 emissions resulting from escalating motorization is anticipated. Given this situation, the objective of this study is to map out an overall vision for low-carbon transport in the ASEAN region in the super long term. In order to contribute to this objective, a visioning tool was created in order to formulate a vision for future society and transport, and a backcasting tool was created to estimate the effects of introducing transport policies, coupled with reductions in CO2 emissions.

Having first set the target for future CO2 emissions (as a percentage), the visioning tool is used to develop a vision for the society and transport of the future. Based on this, the level of CO2 emissions and reduction achieved are calculated using the backcasting tool. If the calculation results show that the level of reduction that was initially set will not be achieved, the parameters entered into the backcasting tool are reset, or a new vision for future society and transport is created using the visioning tool, before considering the CO2 emissions and reduction achieved that can be deduced from that vision. It should be noted that these tools cannot be used to automatically calculate future CO2 reductions (as a percentage).

2 TRANSPORT, ENERGY AND CO2, IEA, 2009

3 What kind of path should we follow to reach a desirable future if reckoning backwards? Such an approach of discussion is called backcasting, which is used as a tool to discuss a future where achieving goals is difficult by forecasting. It will be referred to as the Backcasting tool herein because it is considered to be used as a tool to achieve future goals.

2.2 Development of the Tool

2.2.1 Introduction

The objective of this study is to map out an overall vision for low-carbon transport in the ASEAN region in the super long term. In order to contribute to this objective, a visioning tool has been created in order to formulate a vision for future society and transport, and a backcasting tool has been created to estimate the effects of introducing transport policies, coupled with reductions in CO2 emissions.

Figure 2-3 shows the steps involved in calculations using the visioning tool and the backcasting tool.

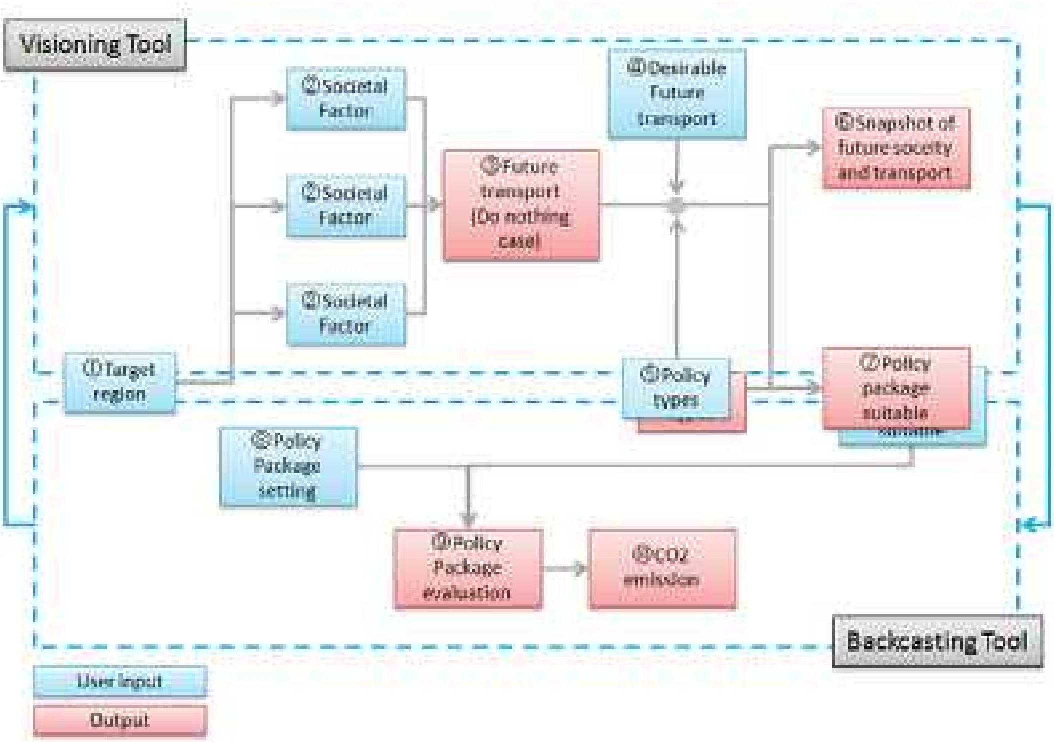


Figure 2-3. Steps Involved in Calculations Using the Visioning Tool and Backcasting Tool

(1) Visioning Tool

① Selection of region to be evaluated
② Consideration of societal factors in order to map out the future vision
③ Establishment of the future transport vision in the "do nothing" scenario, based on consideration of the societal factors
④ Consideration of the desirable future transport vision
⑤ Consideration of policy realms for achieving the future transport vision
⑥ Presentation of a snapshot of the future society and transport vision
⑦ Presentation of a policy package for achieving the future transport vision

(2) Backcasting Tool

⑧ Establishment of settings relating to details of the policy package to be introduced
⑨ Various evaluations based on the policy package settings
⑩ Presentation of the results of calculations of the level of CO_2 emissions, etc.

The following provides a detailed commentary on the aforementioned steps ① to ⑩.

2.2.2 Concepts and Modelization

Section 2.2.2 provides a commentary on steps ①, ⑤, and ⑧, which are common to the visioning tool and the backcasting tool.

2.2.2.1 Selection of Region to be Evaluated (①)

While subways are found in large cities, there are hardly any in small and medium-sized cities. One reason for this is that a subway needs to be able to expect a certain number of passengers to be commercially viable. In light of such conditions, it can be understood that the policy packages that can feasibly be introduced when considering low-carbon transport differ according to the scale of the city.

Consequently, when considering visions for future society and transport, it is necessary to take into account differences in the policy packages that can be selected, depending on the scale of the city.

Accordingly, in this study, the target countries were classified into the nine categories of region listed below when calculating the volume of transport and CO_2 emissions, to allow a vision for the future to be mapped out for each region. The reasons for classifying them into nine categories are based on the following perspectives.

- Is the focus domestic or international transport?
- If domestic transport, is it intra-urban transport or inter-urban transport?
- Intra-urban transport was classified into four categories, by scale of population. The population categories were primary cities with a population of around 10 million (No.1), large cities with a population of at least 1 million (No.2), cities with a population of at least 200,000 (No.3), and non-cities[4] (No.4).
- Only one category was set for inter-urban transport (No.5).
- International transport was categorized as either intra-ASEAN (No.6) or extra-ASEAN (No.7).
- The national total was defined as the total for domestic transport alone (No.9) and the total for domestic transport plus international transport (No.8).

Table 2-1 shows a list of regional categories. This is just one example of regional categorization. Appropriate regional categories could be introduced according to the situation in each country.

[4] Cities with a population of less than 200,000.

Table 2-1. Classification of Region

No	Domestic / International	Intra / Inter	Level	Description
1	Domestic	Intra urban	Primary city	Jakarta, Manila, etc.
2	Domestic	Intra urban	Large city	population of more than 1 million
3	Domestic	Intra urban	City	population of more than 200,000
4	Domestic	Intra urban	Non city	population of less than 200,000
5	Domestic	Inter urban	-	Inter urban
6	International	Intra ASEAN	-	Intra ASEAN
7	International	Except Intra ASEAN	-	Except Intra ASEAN
8	Domestic+ International	National Total	-	National Total （Including International）
9	Domestic	Intra urban+ Inter urban		National Total （Excluding International）

Intra-urban transport was classified into four categories (No.1-No.4) according to the scale of the city, but it is anticipated that fluctuations in the population of each city will result in changes in the category to which they are assigned. If the categories are re-compiled each time this kind of change in the category occurs, discontinuities will emerge in the volume of transport and CO2 emissions in each category. Accordingly, this study uses the population of each city in 2050 as the benchmark for each of the aforementioned categories[5]. Consequently, a city that is currently in the "cities with a population of at least 200,000" category, but is forecast to grow to become a large city with a population of at least 1 million by 2050 is classified under the "large cities with a population of at least 1 million" category.

The backcasting tool was configured so that when CO2 emissions for intra-urban transport (No.1-No.4) were estimated, it displayed not only the results for intra-urban CO2 emissions in the city in question, but also the results reflecting CO2 emissions from inter-urban transport (No.5) (Figure 2-4). This is because emissions due to inter-urban transport are caused by emissions arising from movement between cities by people living in one or other of those cities, so they should be allocated to their respective regions. In this study, the volume of transport in inter-urban transport has been apportioned to the respective population categories on the basis of the proportion of the population for which they account.

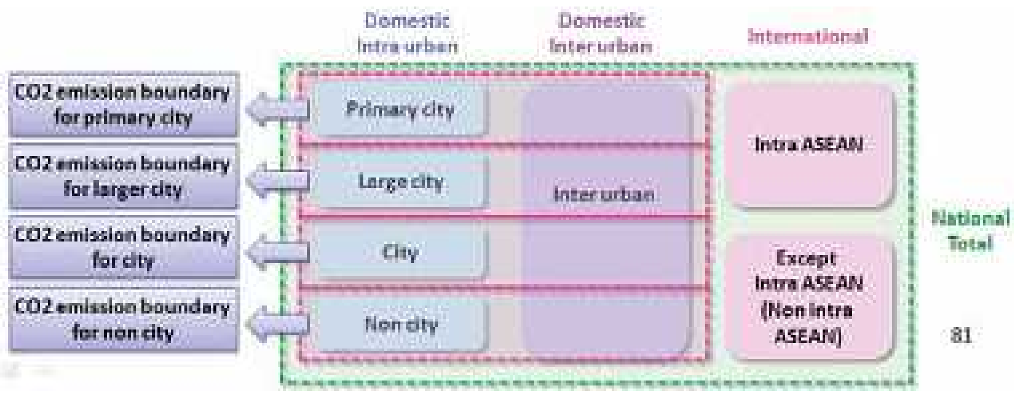


Figure2-4. Classification of Region

5 This is just one example of an approach to compiling the categories. Users can employ an appropriate method that suits their needs.

2.2.2.2 Consideration of Policy Realms for Achieving the Future Transport Vision (⑤)

When considering the vision for sustainable societies and transport, it is very important to take into account the alleviation of adverse impacts on the environment. In the field of transport, matters that fall into the category of adverse impacts on the environment include not only carbon dioxide, which is air pollution on a global scale, but also various other issues, such as SOx and NOx, which is air pollution on a regional scale, as well as noise. It can be seen that the perspectives that are important in the field of transport are not confined to the environment, but also include a variety of other issues, including contribution to economic development and equal opportunities to travel (Table 2-2).

The main objective of this study is the reduction of carbon dioxide, as it aims to map out a vision for low-carbon transport. However, in light of the issues in the transport field other than carbon dioxide, such as those detailed above, it has also been made possible to calculate the carbon dioxide reduction effect arising from the selection of a policy package that incorporates improvements in the areas of SOx and NOx, contribution to economic development, and equal opportunities to travel.

Table 2-2. Issues in the Transport Field[6]

No	Objective/Target	Content
1	Economic efficiency	・Economic efficiency in terms of transport and housing markets
2	Environment	・Reducing local or regional air pollution ・Protecting precious land (green belt, cultural heritage) ・Avoiding urban sprawl ・Reducing fragmentation (of residential areas) ・Protecting (specified) vulnerable regions ・Reducing noise
3	Lifestyle	・Increasing freedom of movement for vulnerable road users ・Achieving positive external effects on social, cultural, and recreational activities
4	Safety	・Reducing traffic accidents
5	Equity	・Accessibility for those who do not own a vehicle ・Accessibility for those with disabilities ・Equity, and compensation for those who suffer harm ・Careful use of taxpayers' money
6	Economic development	・Creating potential for economic development
7	Intergenerational equity	・Reducing energy use and avoiding climate change

2.2.2.3 Presentation of a Policy Package for Achieving the Future Transport Vision (⑦)

Although there are various policies that could contribute to making low-carbon transport a reality, there are limits to what can be achieved by introducing individual policies, such as cases in which introducing an individual policy would have only a small effect, or would require the introduction of a separate policy as a prerequisite. Accordingly, this study has examined policy packages featuring a combination of several policies, rather than considering individual policies. A policy package is defined as a combination of individual policies that can exert a substantial physical effect.

[6] This study focused on the topics presented in KonSULT (http://www.konsult.leeds.ac.uk/public/level1/sec07/index.htm).

Using policy packages has the advantage that it reduces the number of policies that need to be considered, but it goes without saying that this is not an approach suited to the consideration of individual policies.

In this study, the policy packages have been classified into three strategies – Avoid, Shift, and Improve – as shown in Table 2-3, based on the nature of the effects that each policy package will have.

The strategies that are effective in tackling issues in the transport field were considered on the basis of the combinations shown in Table 2-4[7].

Table2-3. Strategies in the Transport Field

No	Category	Content
1	Avoid	Avoiding or reducing the need for travel by devising land use / urban develop measures that allow access to key facilities without involving excessive travel
2	Shift	Shifting to low-carbon transport modes, such as public transport and waterborne transport, or maintaining mode share
3	Improve	Improving the fuel efficiency / carbon efficiency of motor vehicles via improved engine or fuel technology

Table 2-4. Effective Strategies to Tackle Issues in the Transport Field

No	Strategy	Objective	Efficiency	Environment	Livability	Safety	Equity	Economic Growth	Intergenerational Equity
1	Avoid	To control demand	○	○	○	○			○
		To control vehicle use	○	○	○	○			○
2	Shift	To improve alternative modes	○				○	○	
3	Improve	To improve road networks	○					○	
		To improve vehicles and fuel	○	○	○	○			○

The policy packages considered in this study are shown in Table 2-5. See B.1 for the individual policies included in each policy package.

[7] Compiled on the basis of Urban Transport and Environment, Institution for Transport Policy Studies, 2004.

Table 2-5. Policy Packages Considered in this Study

No	Strategy	Content
1	Large-scale supply of compressed natural gas (CNG) vehicles	Policy package involving the supply of CNG vehicles in that country. This policy package includes such individual policies as R&D of CNG vehicles and responses to demand for fuel (CNG).
2	Encouraging widespread use of CNG vehicles (mainly via economic means)	Policy package involving promoting the sale of CNG vehicles via economic means, particularly tax incentives and fuel subsidies.
3	Large-scale supply of hybrid vehicles	Policy package involving the supply of hybrid vehicles in that country. This policy package includes such individual policies as R&D of hybrid vehicles.
4	Encouraging widespread use of hybrid vehicles (mainly via economic means)	Policy package involving promoting the sale of hybrid vehicles via economic means, particularly tax incentives and fuel subsidies.
5	Large-scale supply of electric vehicles	Policy package involving the supply of electric vehicles in that country. This policy package includes such individual policies as R&D of electric vehicles and responses to demand for electricity.
6	Encouraging widespread use of electric vehicles (mainly via economic means)	Policy package involving promoting the sale of electric vehicles via economic means, particularly tax incentives and subsidies.
7	Biofuel development	Policy package involving the supply of biofuels in that country. This policy package includes such individual policies as R&D of biofuels and responses to demand for biofuels.
8	Encouraging widespread use of biofuels	Policy package involving promoting the sale of biofuels via economic means in particular, such as fuel subsidies.
9	Improving the fuel efficiency of aircraft	1% improvement in fuel efficiency per year in the business as usual (BAU) case. This package would result in a 2% improvement per year.
10	Improving the fuel efficiency of ships	1% improvement in fuel efficiency per year in the BAU case. This package would result in a 2% improvement per year.
11	Eco-driving	Policy package involving reducing the volume of transport. This policy package includes such measures as speed limits and driving license tests focused on eco-driving.
12	Alleviation of traffic congestion	Policy package aimed at reducing traffic jams.
13	Encouraging use of buses/BRT (passenger)	Policy package aimed at increasing the modal share of bus/BRT without the need for new bus/BRT infrastructure. This policy package includes such individual policies as encouraging use of bus/BRT and fare-related incentives.
14	Development of bus/BRT infrastructure (passenger)	Policy package involving increasing the modal share of bus/BRT by constructing new bus/BRT infrastructure. This policy package includes such individual policies as investing in bus/BRT.
15	Encouraging use of rail/LRT (passenger)	Policy package aimed at increasing the modal share of rail/LRT without the need for new rail/LRT infrastructure. This policy package includes such individual policies as encouraging use of rail/LRT and fare-related incentives.
16	Development of rail/LRT infrastructure (passenger)	Policy package involving increasing the modal share of rail/LRT by constructing new rail/LRT infrastructure. This policy package includes such individual policies as investing in rail/LRT.
17	Encouraging use of ships (passenger)	Policy package aimed at increasing the modal share of water transport without the need for new shipping infrastructure. This policy package includes such individual policies as encouraging use of water transport and fare-related incentives.

No	Strategy	Content
18	Development of shipping infrastructure (passenger)	Policy package involving increasing the modal share of water transport by constructing new shipping infrastructure. This policy package includes such individual policies as investing in ships and related infrastructure.
19	Encouraging use of rail (freight)	Policy package aimed at increasing the modal share of rail without the need for new rail infrastructure. This policy package includes such individual policies as encouraging use of rail transport and fare-related incentives.
20	Development of rail infrastructure (freight)	Policy package involving increasing the modal share of rail by constructing new rail infrastructure. This policy package includes such individual policies as investing in rail.
21	Encouraging use of ships (freight)	Policy package aimed at increasing the modal share of water transport without the need for new shipping infrastructure. This policy package includes such individual policies as encouraging use of water transport and fare-related incentives.
22	Development of shipping infrastructure (freight)	Policy package involving increasing the modal share of water transport by constructing new shipping infrastructure. This policy package includes such individual policies as encouraging use of water transport and fare-related incentives.
23	Framework for regulating charges	Policy package involving reducing the volume of transport. This policy package includes such measures as car parking charges and congestion charging.
24	ICT and travel	Policy package involving reducing the volume of transport. This policy package includes such measures as travel routes, guidance systems for parking, and communications systems.
25	Communication activities	Policy package involving reducing the volume of transport. This policy package includes use of the internet and mobile technology, and efforts to raise awareness via campaigns.
26	Travel planning	Policy package involving reducing the volume of transport. This policy package includes such measures as planning travel to work or school.
27	Vehicle ownership	Policy package involving reducing the volume of transport. This policy package includes such measures as car club vehicle rental schemes and frameworks for vehicle-sharing.
28	Improved travel awareness	Policy package involving reducing the volume of transport. This policy package includes such measures as educational programs concerning global warming and educational programs about transport options.
29	Subsidiarity in freight transport	
30	Dematerialization of freight	Policy package involving reducing the volume of transport. This policy package includes incentives for the rental and sharing of products and services.
31	Urban planning and land use plans	Policy package involving reducing the volume of transport. This policy package includes such measures as strategic urban planning and design, and improving conditions for walking, cycling, and urban transport.

2.3 Visioning Tool

2.3.1 Introduction

How will the societies of the future develop? And what kind of transport systems will be needed in those societies? Conventionally, when considering these matters, experts in socioeconomics and experts and stakeholders in the field of transport have been brought together to discuss a variety of matters, and a vision has been formulated on the basis of these discussions. This process usually takes a great deal of time and it is very difficult for people who are inexperienced. It would be useful to have a tool that could assist in formulating this kind of vision. Accordingly, in this study, a tool for formulating a vision for future society and transport (called a "visioning tool") was developed, in order to meet this need.

This visioning tool provides the following two outputs:

- A snapshot based on the vision
- Information about the package of measures required to realize the vision

The effects of introducing the policy packages obtained via this process are calculated using the backcasting tool.

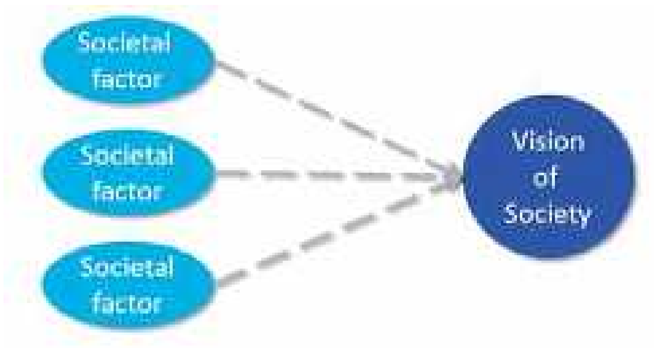


Figure 2-5. The Vision for Society (Vision for Transport) Derived from Societal Factors

2.3.2 Concepts and Modelization

2.3.2.1 Consideration of Societal Factors in Order to Map out the Future Vision (②)

How can we map out a vision for future society and transport? As shown in Figure 2-1, our societies are shaped by numerous societal factors. The approach adopted in this study was to consider the desirable future vision for society and transport through consideration of these societal factors (Figure 2-5). As there are a great many societal factors, it is impossible to consider all of them using the visioning tool. Accordingly, in this study, the societal factors that are important in building a vision for future transport were chosen.

Table 2-6 shows the societal factors selected.

Visions for future society and transport are considered according to the nature of the changes in the societal factors selected. Among these societal factors are some in which there is no scope for consideration by users, as future trends are already known, to some extent. These societal factors will be called preconditions.

Table 2-6. List of Societal Factors Selected

Field	Societal Factor	Item	Precondition
Population	Population dynamics	Population aged 0-14	〇
		Population aged 15-64	〇
		Population aged 65 or over	〇
	Regional population share	Share of the population in the target area	〇
	Total population	Total population	〇
	Urbanization	Urban population share	〇
Economy	GDP	GDP	〇
	Income	Per capita GDP	〇
	Income inequality	Gini coefficient	〇
Culture	Allure of the car		
	Eco-action	Company	
		Individuals	
	Product transport time		
	Transport	2/3-wheeled vehicles	
		Paratransit	
	Journey time		
Energy	Biofuel	Impact on food	
	Emission coefficient	CO2 emission coefficient of electricity	
	Fuel availability	Biofuel	
		Electricity	
		Natural gas	
		Fuel (gasoline/diesel)	
	Fuel costs	Fuel (gasoline/diesel)	
	Fuel subsidies	Fuel (gasoline/diesel)	
Environment	Air pollution		
Environment	Climate change		
IT	Development		
	IT		
Infrastructure	Plants	Biofuel	
	Fuel stations	CNG vehicles	
		Electric vehicles	
		Fuel cell vehicles	
		Gasoline/diesel	
Land use	Zoning	Roads for non-motorized transport (NMT: walking/cycling)	
		Urban areas	
	Population	Population density	
Lifestyle	Lifestyle differences		
Technology	Fuel	CNG	
		Electricity	
		Electric vehicles	
		Fuel vehicles	
		Hybrid vehicles	

Field	Societal Factor	Item	Precondition
Transport (domestic)	Usable modes	BRT	
		Bus	
		LRT	
		Public transport	
		Rail	
	Traffic jams	Average speed	
Transport (international)	Usable modes	Bus	
		Rail (freight)	
		Rail (passenger)	
		Ship (freight)	
		Ship(passenger)	

2.3.2.2 Consideration of the Desirable Future Transport Vision (④)

The visioning tool is set up so that the user can choose what kind of transport they would like to introduce, depending on their future vision for society. However, while the introduction of subways is commercially viable in large cities, it would seem to have little commercial viability in small and medium-sized cities. Accordingly, the visioning tool was designed to show the user information about the challenges and advantages of introducing each transport mode when they are choosing which modes of transport to introduce.

2.3.3 Output from Model

2.3.3.1 Establishment of the Future Transport Vision in the "Do Nothing" Scenario, Based on Consideration of the Societal Factors (③)

Based on the current situation and future changes in societal factors entered by the user, the tool shows what transport would look like if no measures were adopted in response to the current situation. It should be noted that this is a qualitatively-evaluated image based on changes in societal factors, rather than being based on a quantitative evaluation. For example, when estimating future increases in the volume of passenger transport, the approach adopted involved formulating and considering the flow chart of societal factors shown in Figure 2-6.

See B.2 for the flow charts used to estimate other visions for transport.

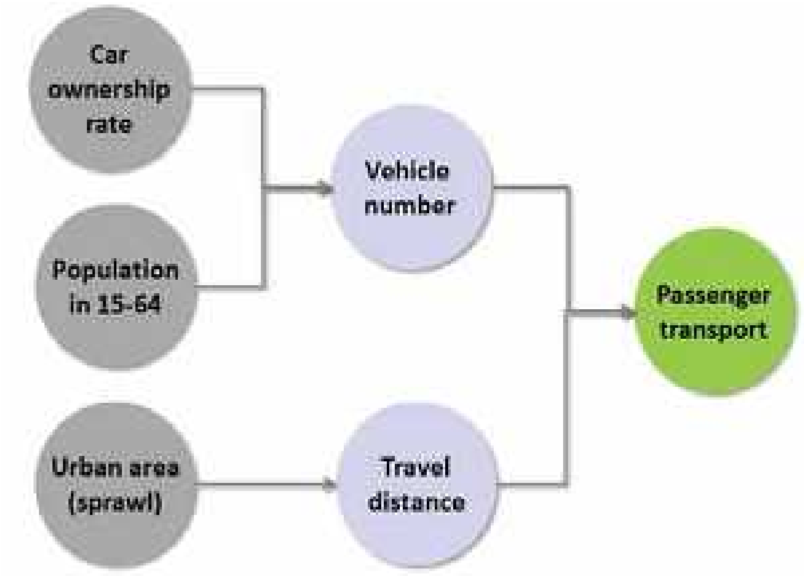


Figure 2-6. Flow Chart for Qualitative Evaluation of the Volume of Passenger Transport

2.3.3.2 Presentation of a Snapshot of the Future Society and Transport Vision (⑥)

Moreover, the visioning tool presents a snapshot of the vision for society and transport that has been mapped out. This snapshot is based on the societal factors and transport vision entered by the user.

2.3.3.3 Presentation of a Policy Package for Achieving the Future Transport Vision (⑦)

What kind of measures should be selected as a policy package suited to the desirable vision for society and transport that has been formulated? In order to contribute to this objective, the visioning tool provides information about the policy packages suited to the vision for society and transport that the user has mapped out. The suitable policy packages are evaluated qualitatively, based on changes in societal factors, etc. For example, the ITS package is judged to be a suitable measure in societies where there has been considerable progress in information technology compared with the current situation.

See B.2 for the flow charts used to evaluate other policy packages.

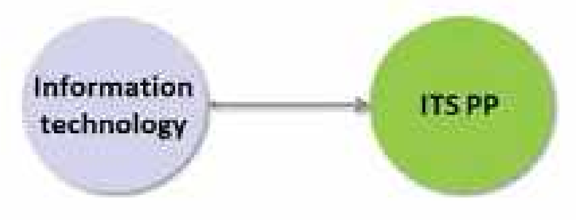


Figure 2-7. Flow Chart for Evaluating the Suitability of the ITS Package

2.3.4 Designing Visioning Tool

If it is necessary to install special software in order to use the visioning tool, and if that software has to be paid for, the tool will be very hard for users to use. Consequently, the visioning tool needs to be designed to function in all PC environments.

Accordingly, bearing in mind that most users are likely to be using Windows-based PCs, it was decided that a tool that could function in this environment should be developed in this study. More specifically, it was decided to build a tool that would run in Microsoft Excel, with a GUI created using Windows Visual Studio .net 2012. The tool can be used simply by installing Excel ver.2007 or 2010 and .NET Framework ver.4 on the user's PC.

See A.1 for guidance on how to use the tool in question.

2.4 Backcasting Tool

2.4.1 Introduction

The visioning tool allows a vision for future society and transport to be formulated, and policy packages compatible with the development of that vision are presented.

So to what degree can carbon dioxide emissions be reduced by introducing the policy packages presented? It was decided to build a backcasting tool to facilitate these calculations.

The term backcasting means calculating backwards from a posited future target, to work out how to reach that target (Figure 2-8). As this study uses this tool for the purpose of achieving future goals by considering the extent of the policy packages required, it was decided to call the tool a backcasting tool.

This backcasting tool provides the following two main outputs:

- Volume of passenger and freight transport
- Tank to Wheel-CO_2 and Well to Tank-CO_2[8]

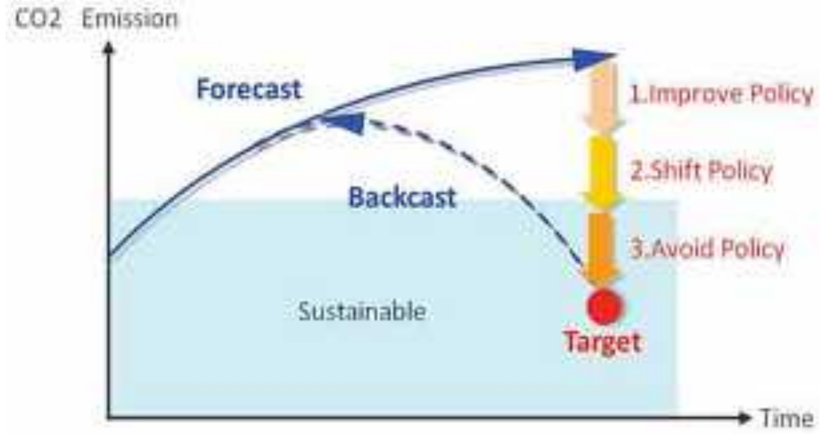


Figure 2-8. Illustration of Backcasting

In this study, having first set the target for future CO_2 emissions (as a percentage), the visioning tool is used to develop a vision for the society and transport of the future. Based on this, the level of CO_2 emissions and reduction achieved are calculated using the backcasting tool. If the calculation results show that the level of reduction that was initially set will not be achieved, the parameters entered into the backcasting tool are reset, or a new vision for future society and transport is created using the visioning tool, before considering the CO_2 emissions and reduction achieved that can be deduced from that vision. It should be noted that these tools cannot be used to automatically calculate future CO_2 reductions (as a percentage).

The backcasting tool can be used without first using the visioning tool.

[8] Tank-to-Wheel refers to the portion from the fuel tank to the wheel. Well to Tank refers to the portion from the well site to the fuel tank. It should be noted that electric vehicles do not generate CO_2 emissions while running, but CO_2 is emitted in the power generation sector. In ASEAN countries in particular, the share of fossil fuels in power generation is high, so CO_2 emissions per kWh would be higher than in Japan. To facilitate consideration of such matters, this study opted to take CO_2 emissions resulting from power generation into account under Tank to Wheel.

Table 2-7 provides an overview of the backcasting tool.

Table 2-7. Summary of Backcasting Tool

Target Years	2000-2050 (5-year intervals)
Base Year	2010
Target Region	10 countries: Indonesia, Singapore, Thailand, Philippines, Malaysia, Brunei Darussalam, Vietnam, Myanmar, Laos, Cambodia (in order of accession)
Target Transport Modes	The transport modes targeted depend on the situation in each country. ● Passenger: Cars, 2/3-wheeled vehicles, buses/minibuses, passenger rail, passenger air transport, etc. ● Freight: Trucks, rail freight, air freight
Target Fuels	Gasoline, diesel, electricity, LPG/CNG, biofuels, etc.
Transport Policies	● Avoid Policies: Avoiding or reducing the need for travel via land use / urban development patterns that enable people to access the facilities they require without excessive travel. ● Shift Policies: Shifting to or, at the very least, sharing carbon-efficient forms of transport, including non-motorized transport (cycling or walking), public transport, and water-based transport. ● Improve Policies: Improving the energy/carbon efficiency of motor vehicles via improved engine and fuel technology.
Other	✓ Volume of intra-urban / non-intra-urban transport (passenger) ✓ Share of journeys by purpose (passenger) ✓ Evaluation of the impact of traffic jams on fuel efficiency in intra-urban transport
Output	✓ Volume of passenger/freight transport ✓ TTW and WTT-CO2 emissions

2.4.2 Concepts and Modelization

2.4.2.1 Establishment of Settings Relating to Details of the Policy Package to be Introduced (⑧)

In the backcasting tool, the policy packages are classified into three strategies: Avoid, Shift, and Improve (see Table 2-3 for details). The suitability of introducing these policy packages in these fields is judged on the basis of the content selected by the user on the control sheet. The following shows the items that form the judgment criteria for each strategy.

(1) Avoid

Table 2-8. Judgments on Suitability of Introducing Avoid Policy Packages

Item	Content
Issues to be tackled by the policies	Flag for determining whether or not the policy package will be effective in dealing with the issues to be tackled by the policies, as selected by the user on the control sheet
Policy package level	Flag for determining whether or not the package is included in the level selected by the user on the control sheet, in relation to each of the following: Cost, Ease of Implementation, and Time Requirement
Mode	Flag for determining the type of vehicle targeted by the introduction of the policy package
Purpose of journey	Flag for determining the purpose of journey targeted by the introduction of the policy package
Region	Flag for determining the region targeted by the introduction of the policy package

(2) Shift

Table 2-9. Judgments on Suitability of Introducing Shift Policy Packages

Item	Content
Purpose of introducing policies	Flag for determining whether or not the policy package will be effective in dealing with the issues to be tackled by the policies, as selected by the user on the control sheet
Policy package level	Flag for determining whether or not the package is included in the level selected by the user on the control sheet, in relation to each of the following: Cost, Ease of Implementation, and Time Requirement
Original mode to be transferred	Flag for determining the original mode to be transferred targeted by the introduction of the policy package
Destination mode to be transferred	Flag for determining the destination mode to be transferred targeted by the introduction of the policy package
Region	Flag for determining the region targeted by the introduction of the policy package

(3) Improve

Table 2-10. Judgments on Suitability of Introducing Improve (Excluding Biofuels) Policy Packages

Item	Content
Purpose of introducing policies	Flag for determining whether or not the policy package will be effective in dealing with the issues to be tackled by the policies, as selected by the user on the control sheet
Policy package level	Flag for determining whether or not the package is included in the level selected by the user on the control sheet, in relation to each of the following: Cost, Ease of Implementation, and Time Requirement
Mode	Flag for determining the mode targeted by the introduction of the policy package
Fuel	Flag for determining the fuel targeted by the introduction of the policy package
Region	Flag for determining the region targeted by the introduction of the policy package

Table 2-11. Judgments on Suitability of Introducing Improve (Excluding Biofuels) Policy Packages

Item	Content
Purpose of introducing policies	Flag for determining whether or not the policy package will be effective in dealing with the issues to be tackled by the policies, as selected by the user on the control sheet
Policy package level	Flag for determining whether or not the package is included in the level selected by the user on the control sheet, in relation to each of the following: Cost, Ease of Implementation, and Time Requirement
Biofuels	Flag for determining the biofuel targeted by the introduction of the policy package

2.4.2.2 Various Evaluations Based on the Policy Package Settings (⑨)

(1) Method of Calculation

It was decided to use the ASIF method to calculate the volume of transport and CO2 emissions in the transport field. ASIF is an acronym that stands for Activity (volume of activity), Structure (mode structure), Intensity (fuel efficiency), and Fuel type.

Altering each aspect in ASIF leads to changes in CO2 emissions. For example, Avoid policies are effective in reducing Activity (volume of activity), while Shift policies are effective in altering Structure (mode structure) and Improve policies are effective in improving Intensity (fuel efficiency) and Fuel type.

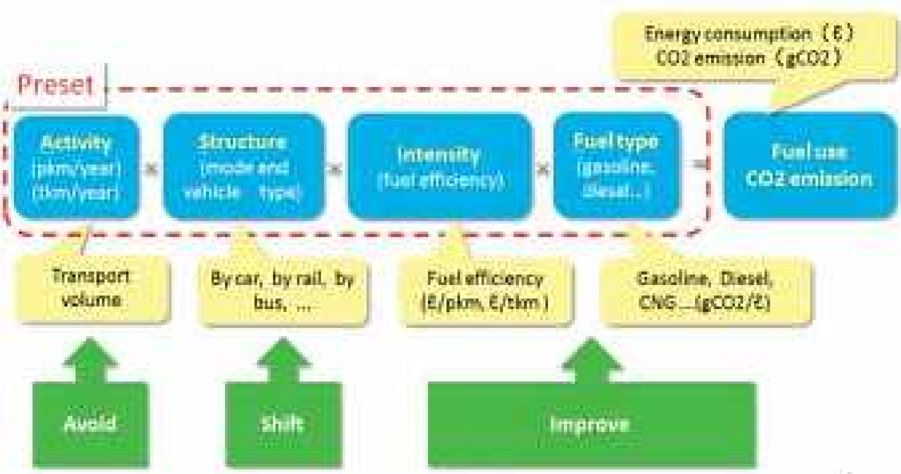


Figure 2-9. Method of Calculation (ASIF Framework)

When carrying out the aforementioned calculations using the backcasting tool, the data listed in Table 2-12 are used as input values. It should be noted that population data by city scale are required when separating out the volume of transport according to the scale of the city (see 2.2.2.1).

Table 2-12. Main Indicators to be Entered in the Backcasting Tool Model

	Cars, 2/3-wheeled Vehicles	Rail, Air	Ship
Activity	・Number of cars (vehicles) ・Distance traveled per vehicle (km/vehicle/year) ・Load factor (people or tons)	・Total volume of transport (pkm/year, tkm/year)	・Energy consumption (L)
Mode structure	・Handled endogenously in this tool, to estimate the volume of transport in each mode		
Intensity	・Fuel efficiency (L/pkm, L/tkm)	・Fuel efficiency (L/pkm, L/tkm)	
Fuel type	・CO2 emission coefficient (gCO2/L)	・Fuel efficiency (L/pkm, L/tkm)	・CO2 emission coefficient (gCO2/L)

Figure 2-10 shows the data entered for cars and the flow for calculating CO2 emissions.

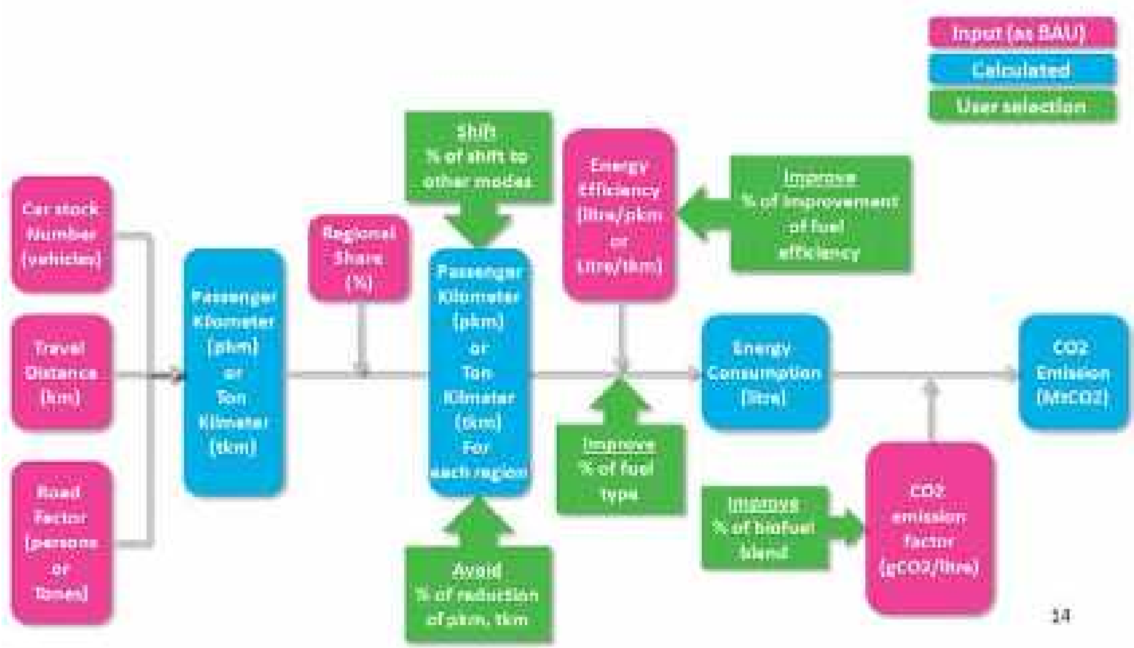


Figure 2-10. Data Entered for Cars and Flow for Calculating CO2 Emissions

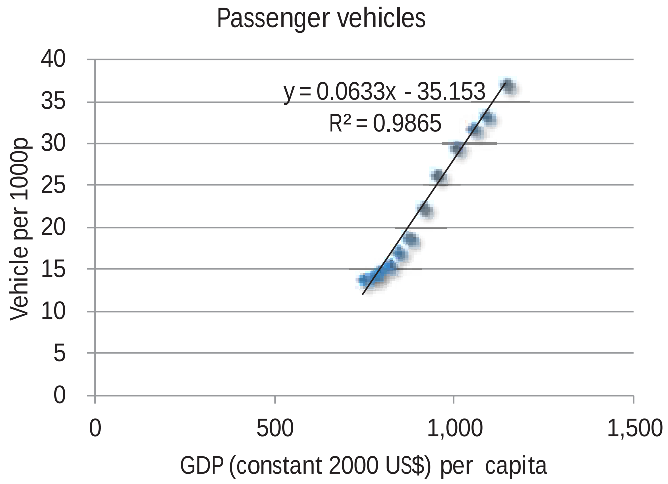
(2) Formulating Data to Create the Baseline

This study has the period to 2050 as its target. As such, it is necessary to forecast how the volume of transport will change in the future. Accordingly, this study assumes that the indicators shown in Table 2-13 will vary as a function of GDP per capita in Indonesia and the Philippines in the future.

For reference, Figure 2-11 shows the correlation between GDP per capita and vehicle ownership (passenger cars and motorcycles) in Indonesia.

Table 2-13. Indicators to be Forecast for Each Mode of Transport

Transport Mode	Indicator to be Forecast	Remarks
Motor vehicles 2/3-wheeled motor vehicles	・Vehicle ownership rate (vehicles/1,000 people)	・Upper limit of 10 vehicles/1,000 people set for buses. ・Upper limit of 500 vehicles/1,000 people set for motorcycles. ・In the event of a negative correlation, it was assumed that the level would be fixed at the current figure.
Rail, Air	・Total transport per capita (pkm/1,000 people, tkm/1,000 people)	・In the event of a negative correlation, it was assumed that the level would be fixed at the current figure.
Ship	・Energy consumption per capita (L/person)	・In the event of a negative correlation, it was assumed that the level would be fixed at the current figure.



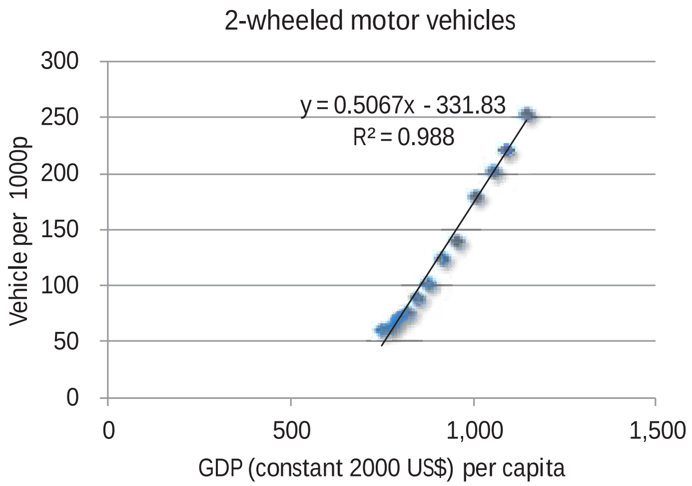


Figure 2-11. Correlation between GDP per Capita and Vehicle Ownership in Indonesia (Top: Passenger Vehicles; Bottom: 2-wheeled Motor Vehicles)

(3) Baseline

The backcasting tool calculates changes in the volume of transport and CO_2 emissions resulting from the introduction of policies. Consequently, it is necessary to set a baseline for the volume of transport and CO_2 emissions. Although the baseline has already been set in the backcasting tool, it is possible for the user to adjust the baseline according to their needs.

It is preferable to gather the data shown in Table 4-6 in order to calculate the baseline in the backcasting tool. However, it was difficult to gather all of these data in this study. Accordingly, data for other countries and estimated values were used, as the need arose. The volume of CO_2 emissions that forms the final output was calibrated against statistics from bodies such as the IEA to check the accuracy of the projections. If more precise data are found in the countries under consideration in the future, it would be desirable to install these data in the backcasting tool.

Figure 2-12 shows the formula used to calculate baseline CO_2 emissions. This formula is based on the ASIF method.

(4) Evaluation of Policy Packages

Figure 2-13 shows the method used to calculate CO_2 emissions following the introduction of a policy package. It should be noted that the effects of introducing the policy packages are taken into account as percentage reductions or percentage changes from the baseline, not as percentage reductions or percentage changes from 2005, which is the base year.

There are a number of important periods in the introduction of the policy packages. The first important period is the point when the policies are introduced (Start Yr). Policies will not necessarily start to have an effect immediately after their introduction. Accordingly, the time lag between introducing policies and their effects beginning to appear has been taken into account in this study (Time lag)[9]. There are cases in which there is another time lag between the point when effects start to appear and the point when the effects are at their maximum. This kind of time lag is referred to as "Period"[10]. In this study, it was assumed that the maximum effect would be sustained after reaching "Yr for max".

In addition, it was assumed that the policy introduction effect would progress in a linear fashion between "Yr for effect" and "Yr for max"[11].

If multiple policy packages focused on Avoid and Shift are introduced, the timing of the introduction of those policies is key to their evaluation. For example, if Shift policies are introduced in relation to a particular mode of transport after introducing Avoid policies, the volume of transport shifting from that mode of transport to other modes would differ from the volume that would shift if Avoid policies were introduced after Shift policies. Consequently, the timing of the introduction of these Avoid and Shift policies is important when calculating the effects of policies. In this study, it is anticipated that multiple Avoid and Shift policies will be introduced, but it is very difficult to make calculations that take into account the introduction periods of all of the policies introduced, so it was decided to make the following two calculations:

① Irrespective of the timing of policy introduction, the effects of introducing Shift policies are always evaluated as a priority, with Avoid policies being evaluated after that (Shift→Avoid).
② Irrespective of the timing of policy introduction, the effects of introducing Avoid policies are always evaluated as a priority, with Shift policies being evaluated after that (Avoid→Shift).

[9] The year when the effects of the policies introduced begin to appear is called "Yr for effect".
[10] The year when the effects of the policies introduced are at their maximum is called "Yr for max".
[11] A logistic function may be appropriate for some policies, while a step function may be appropriate for others, but in this study, the change was assumed to be linear in order to simplify calculations.

The backcasting tool shows the results of these two calculations. The question of which set of results to prioritize is left up to the user[12,13].

[BAU case]

$$CO2_k = \Sigma_i [(CN_i * TL_i * LF_i) * US_k * \Sigma_j (VS_{ij} * EF_{ij} * CF_{ij})]$$

$CO2_k$: CO2 emission of region "k" [gCO2]
CN_i: Vehicle number for vehicle type "i" [vehicles]
TL_i: Travel distance for vehicle type "i" [km/vehicles/yr]
LF_i: Load Factor for vehicle type "i" [persons or tones]
US_k: Transport share for region "k" [%]
VS_{ij}: Vehicle stock share for fuel type "j" form vehicle type "i" [%]
EF_{ij}: Fuel efficiency of fuel type "j" [litre/pkm or litre/tkm]
CF_{ij}: CO2 emission factor of fuel type "j" [gCO2/litre]

Figure 2-12 Method of Calculating Baseline

[Mitigation case]

$$CO2_k = \Sigma_i (CN_i * TL_i * LF_i) * \Sigma_i (100 - AD_i) * (100 - \Sigma_m SF_m) * US_k * \Sigma_j (VS_{ij} \text{->} VS'_{ij} * EF_{ij} * (100 - \Sigma_n IM_n) * CF_{ij} \text{->} CF'_{ij})$$

AD_i: pkm or tkm reduction by avoid policy package of "I" (%)
SF_m: Modal shift rate by shift policy package of "m" (%)
VS_{ij}->VS'_{ij}: Modified vehicle stock share by Improve policy package
IM_n: Fuel efficiency improvement by Improve policy package
CF_{ij}->CF'_{ij}: Modified CO2 emission factor by Improve policy (biofuel) package

Figure 2-13. Method of Calculating CO2 Emissions after Introduction of a Policy Package

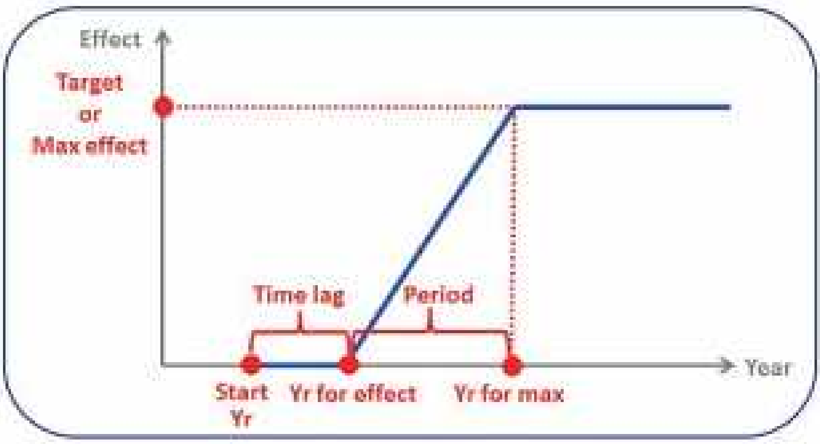


Figure 2-14. Policy Package Introduction Periods

[12] In general, introducing Shift policies after introducing Avoid policies would appear to be more economically efficient.
[13] In the results display module in the GUI, Avoid→Shift results are displayed (see A.2).

(5) CO2 Emission

In the backcasting tool, it was decided to handle the emission coefficients of electricity and biofuels as shown in Table 4-8 and Table 4-9, respectively. Firstly, in the case of electricity, CO2 emissions arising from power generation are usually considered under Well to Tank. Electric vehicles do not generate CO2 emissions while running, but CO2 is emitted in the power generation sector. In ASEAN countries in particular, the share of fossil fuels in power generation is high, so CO2 emissions per kWh would be higher than in Japan. To facilitate consideration of such matters, this study opted to take CO2 emissions resulting from power generation into account under Tank to Wheel (Table 2-14).

In the case of biofuels, Tank to Wheel was set at 0, with CO2 emissions arising from the production of biofuels being taken into account under Well to Tank (Table 2-15).

Table 2-14. Handling of the CO2 Emission Coefficient of Electricity

Process	Handling of figures
Tank to Wheel	not zero
Well to Tank	Zero

Table 2-15. Handling of the CO2 Emission Coefficient of Biofuel

Process	Handling of figures
Tank to Wheel	zero
Well to Tank	not zero

(6) Co-benefit

When considering the vision for sustainable societies and transport, it is very important to take into account the alleviation of adverse impacts on the environment. In the field of transport, matters that fall into the category of adverse impacts on the environment include not only carbon dioxide, which is air pollution on a global scale, but also various other issues, such as SOx and NOx, which is air pollution on a regional scale, as well as noise. Accordingly, this study calculated not only the reduction in CO2 emissions resulting from the introduction of the various policy packages, but also the other benefits that these packages are likely to bring about, treating them as external economies.

The external cost coefficients used in this study when calculating external costs are based on the results of research conducted in Europe. Accordingly, although it is inappropriate to apply these values as they are to ASEAN countries, figures for external cost per unit for ASEAN countries appear to be unavailable at present, so it was decided to use the aforementioned basic units. Given this situation, the external costs calculated in this study have been positioned as reference values.

Table 2-16 and Table 2-17 show the external cost per unit for passengers and freight. Users can alter the external cost per unit in the backcasting tool as required (see A.2.3.3).

Table 2-16. External Cost Coefficients (Passengers)[14]

	Passenger Transport				
	Road			Rail	Air
	Car	Bus	Motorcycle, motorized bicycle	Passenger transport	Passenger transport (cont.)
	€/(1,000 pkm)	€/(1,000 pkm)	€/(1,000 pkm)	€/(1,000 pkm)	€/(1,000 pkm)
Accidents	32.3	12.3	156.6	0.6	0.5
Air pollution	5.5	6.0	11.8	2.6	0.9
Climate change (high scenario)	17.3	9.1	11.1	1.5	46.9
Noise	1.7	1.6	14.4	1.2	1.0
Congestion (cost of delays)	26.7	11.3	21.8		
Total	83.5	40.3	215.7	5.9	49.3

Table 2-17. External Cost Coefficients (Freight)[15]

	Freight Transport				
	Road		Rail	Waterborne	Air
	LDV (light duty vehicle)	HDV (heavy duty vehicle)	Freight transport	Freight transport	Freight transport
	€/(1,000 tkm)	€/(1,000 tkm)	€/(1,000 tkm)	€/(1,000 tkm)	€/(1,000 tkm)
Accidents	56.2	10.2	0.2	0.0	0.0
Air pollution	17.9	6.7	1.1	5.4	8.9
Climate change (high scenario)	44.5	9.8	0.9	3.6	15.6
Noise	6.3	1.8	1.0	0.0	235.7
Congestion (cost of delays)	62.4	18.0			
Total	187.3	46.5	3.2	9.0	260.2

2.4.3 Output from Model

2.4.3.1 Presentation of the Results of Calculations of the Level of CO2 Emissions, etc. (⑩)

The results output from the model show the results of calculating the volume of transport in the target region, energy consumption, CO2 emissions, and CO2 emissions per capita, as well as graphs depicting these results (example for CO2 emissions: Figure 2-15).

[14] "External Costs of Transport in Europe - Update Study for 2008"
[15] "External Costs of Transport in Europe - Update Study for 2008"

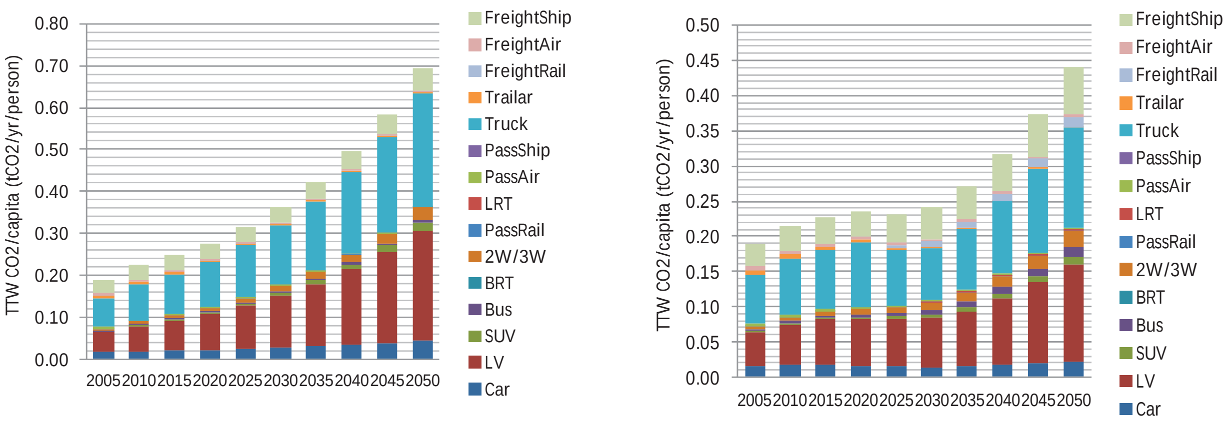


Figure 2-15. Transport and CO2 (Left: Baseline Case; Right: Scenario Case)

2.4.4 Designing Backcasting Tool

If it is necessary to install special software in order to use the backcasting tool, and if that software has to be paid for, the tool will be very hard for users to use. Consequently, the backcasting tool needs to be designed to function in all PC environments.

Accordingly, bearing in mind that most users are likely to be using Windows-based PCs, it was decided that a tool that could function in this environment should be developed in this study. More specifically, it was decided to build a tool that would run in Microsoft Excel, with a GUI created using Windows Visual Studio .net 2012. The tool can be used simply by installing Excel ver.2007 or 2010 and .NET Framework ver.4 on the user's PC.

See A.2 for guidance on how to use the tool in question.

Chapter 3

Country Report

3.1 Introduction

This chapter shows an integrative report for whole ASEAN region firstly, and then the "country reports" for each ASEAN country in alphabetical order.

"Country report", which is one of the outputs of this study, summarizes the present social and transport situations, future social scenarios, future transport images in accordance with future social scenarios, proposal of action plans to reduce CO2 emissions, and results of CO2 reduction simulation of 10 ASEAN countries.

As previously mentioned in Chapter 1, we have divided ASEAN countries into two groups: five major ASEAN countries (Indonesia, Malaysia, the Philippines, Thailand, and Vietnam) and other countries. In this chapter, an executive summary of these major ASEAN countries are placed. We have conducted more detailed analysis for these 5 countries, and the detailed reports for them are provided in Appendix C.

3.2 Summary: Whole ASEAN Region

3.2.1 Study Approach

- **Objectives and Scope**

  - As previously mentioned in Chapter 1, the main objective of the study is to assess the possibility for Southeast Asian countries to reach the 0.33 tons/capita target for transportation in 2050 based on nationally-appropriate policies[1] and to propose long term action plans for the countries towards achieving low carbon transport leading in 2050. The details of the action plans are given in the individual country reports that have been developed.
  - The study primarily looks at the period 2005-2050. The 0.33 tons/capita target that was adopted was based on calculations done by the International Energy Agency (IEA). The calculations basically state that globally, there is a need to reduce greenhouse gas emissions by 50% from current values. The target assumes that global transport CO2 emissions will be equal in 2050, thus, the target is the same across the ASEAN countries.
  - The country studies include all transport modes (land, rail, air, water). However, there was limitation in terms of incorporating activity data for water transport. Instead, its impacts (particularly in the current baseline) have been included in the CO2 emissions directly.

- **Brief Description of the Scenarios**

  - The business-as-usual scenarios in the study are not strictly "do-nothing" scenarios. They include the impacts of policies that are currently in place. These were mainly based on projections on the ASIF parameters (activity-structure-intensity-emission factors) as defined by the current trends and policies.
  - The alternative scenario embodies policy packages that were assessed to be appropriate for the countries in the future. The policies were assessed and translated into a form that can be taken in by the backcasting tool (e.g. in terms of mode shift rates and technology penetration rates). The backcasting tool has been used in assessing the impacts of these policy packages on transportation CO2 emissions.

[1] "Nationally-appropriate" policies that were assessed based on limiting factors as dictated by the future realities in the country (e.g. electrictification of the road fleet will not be assessed in a country that is expecting massive electricity supply deficit in the future and that currently does not have a comprehensive plan to address the issue) and development priorities.

- **Outputs**

  The study produced the following outputs in the process:

  - Backcasting tool – tool for assessing the mitigation potential of different policy packages for transportation.
  - Visioning tool – tool for assessing future societal factors which are necessary towards directing which policies will be appropriate for the future.
  - Country reports
    - ✓ Research on societal factors, policy pipeline and development priorities and consultation workshops (particularly for the Philippines and Indonesia) were done in order to identify appropriate policy packages for each country.
    - ✓ Business-as-usual scenarios for each country were developed using projections based on historical trends.
    - ✓ The mitigation potential of the policy packages that were selected were assessed for each country.
    - ✓ Recommendations for additional policies (whenever applicable) were given.

3.2.2 Society

The study utilized the principles of the visioning-backcasting approach, wherein trend breaking analysis was incorporated by taking into consideration 3 main things: a) the primary target, defined in this study as the CO2 emissions per capita in 2050; b) the transportation images in the future as defined by quantifiable parameters such as travel activity, mode shares, fuel efficiencies and technology splits of the fleet; d) societal images which influence the formation of the transportation images in the future, as well as the selection of appropriate policies that are included in the analyses.

The sections below discuss the main parameters that were looked at in the study in terms of defining the future societies in the different ASEAN countries. These were particularly important as they had been used in forming the transportation images in the future (e.g. forecasting of vehicle numbers in the BAU scenario; defining which policies will be “nationally-appropriate” in the future).

3.2.2.1 Population Growth

- In 2005, the estimated population in the region is 560.8 million.
- In 2050, there will be 785.4 million people in the region. This means that an additional 4.99 million people will be added in the region per year leading up to 2050.
- The population in the ASEAN countries will be growing at an average annual growth rate of 0.75%.
- 42% of the additional population (2005-2050) will be in Indonesia, 31% from the Philippines.

Figure 3-1. Population (000s)
Source: United Nations, 2012

- Laos and the Philippines are highest in terms of expected long-term population growth rates at 1.35%.
- Thailand is the only country that is expected to have a negative population growth rate leading up to 2050 at -0.13%.

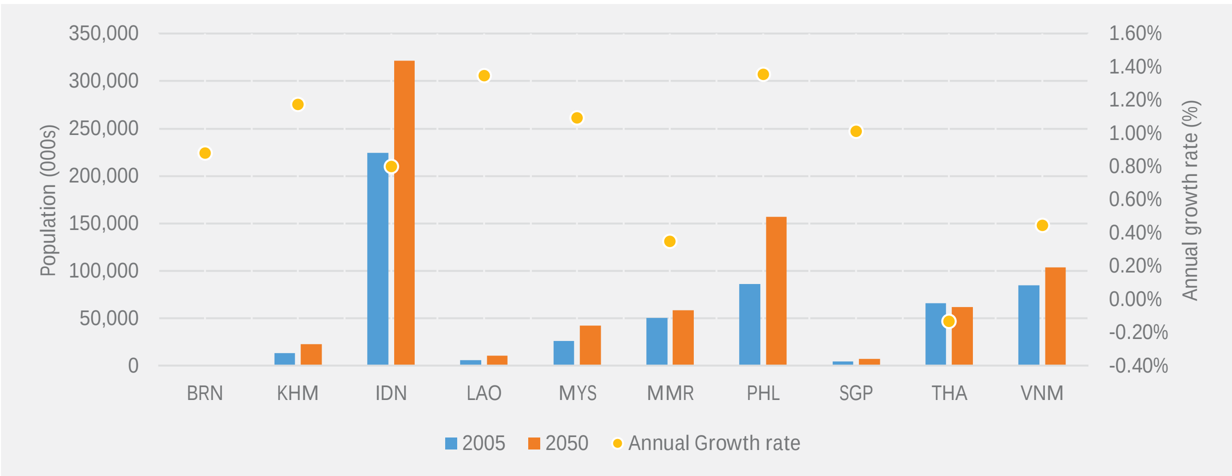


Figure 3-2. Population per Country (000s) and Growth Rates (2005-2050)
Source: United Nations, 2012

3.2.2.2 Urbanization

- In 2005, 41% of the population in the region lived in urban areas, totaling around 229.8 million people.
- In 2050, 66% of the population will be in urban areas, totaling around 519.5 million people.
- The urban population growth rate in the region will outpace general population growth at 1.83% per annum.
- Cambodia will be the only country that will have a predominantly rural population in 2050 (38%), even if it is expected to have the highest rate of growth in terms of urbanization (2.7% per annum).

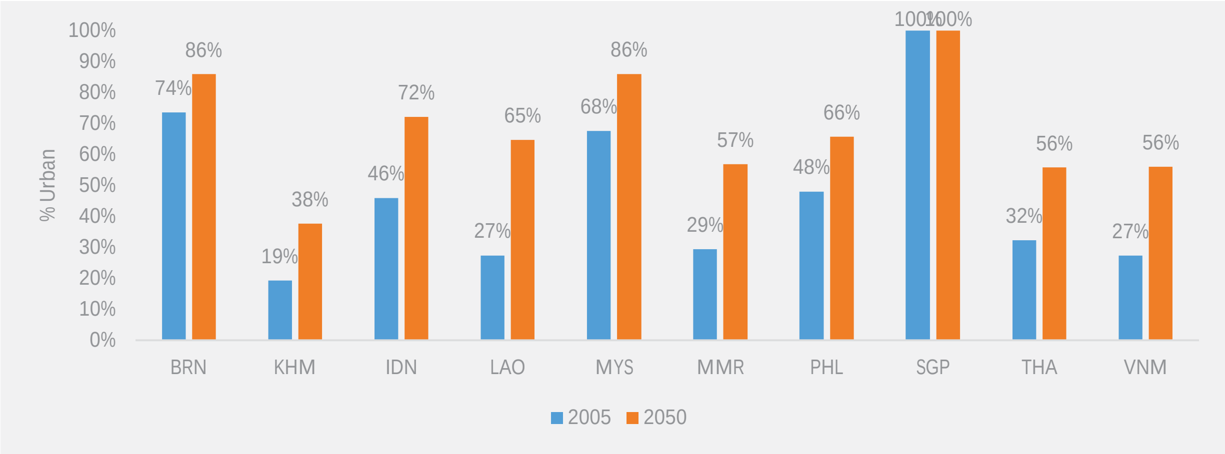


Figure 3-3. % Urban Population (2005 and 2050)
Source: United Nations, 2011

3.2.2.3 Age Structure

- In 2005, the population in the region was quite young in terms of age structure, with only 5% of the total population in the 65 and above age bracket (30.4 million).
- 56% of the population in 2005 was within the working age bracket of 20-64.
- In 2050, the region will be moving towards becoming ageing societies. 17% of the total population will be 65 and above (136.9 million).
- The following countries are expected to have the highest proportions of senior citizen in 2050: Thailand (30%), Malaysia (30%), Singapore (29%).
- 59% o the population will be within the working age bracket in 2050.

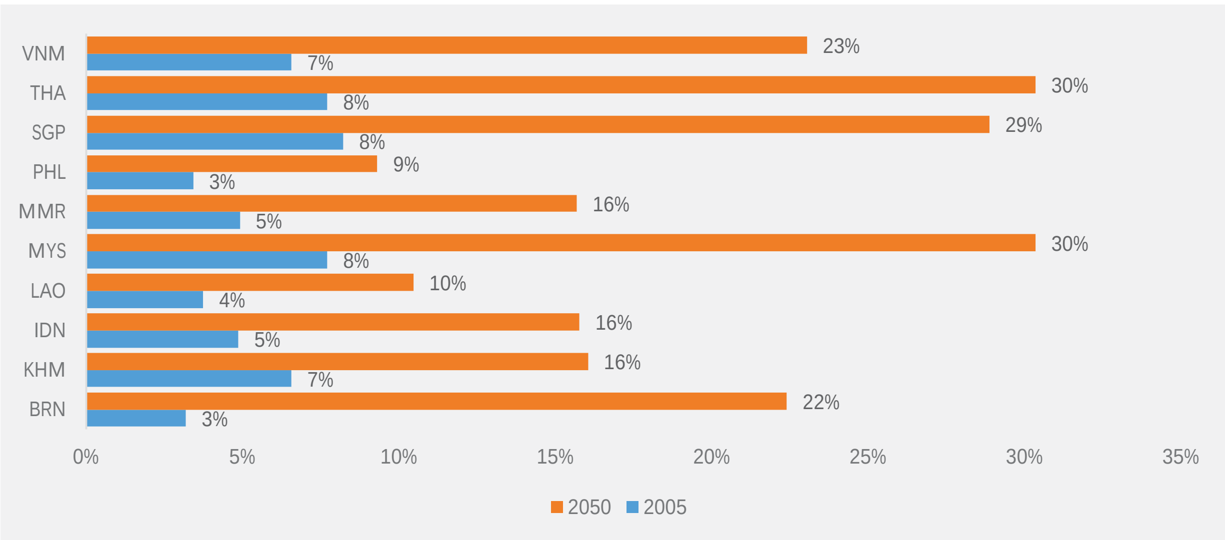


Figure 3-4. % of Population Aged 65 and Above (2005 and 2050)
Source: United Nations, 2012

3.2.2.4 GDP per Capita

- The projections for the GDP per capita in this study mainly utilized base historical rates (World Bank, 2013), projections for economic growth (ADBI, 2012) and population projections (United Nations, 2012) from external sources.

- The GDP per capita values were particularly important in projecting transportation activity and vehicle ownership in the business-as-usual scenario[2].
- The economic growth projections were also utilized in projecting transport activity for the other modes such as rail and air, and energy and CO2 emissions for water transport.
- The results of the GDP/capita analysis are given below. All the GDP/capita values are expressed in 2005 constant USD.

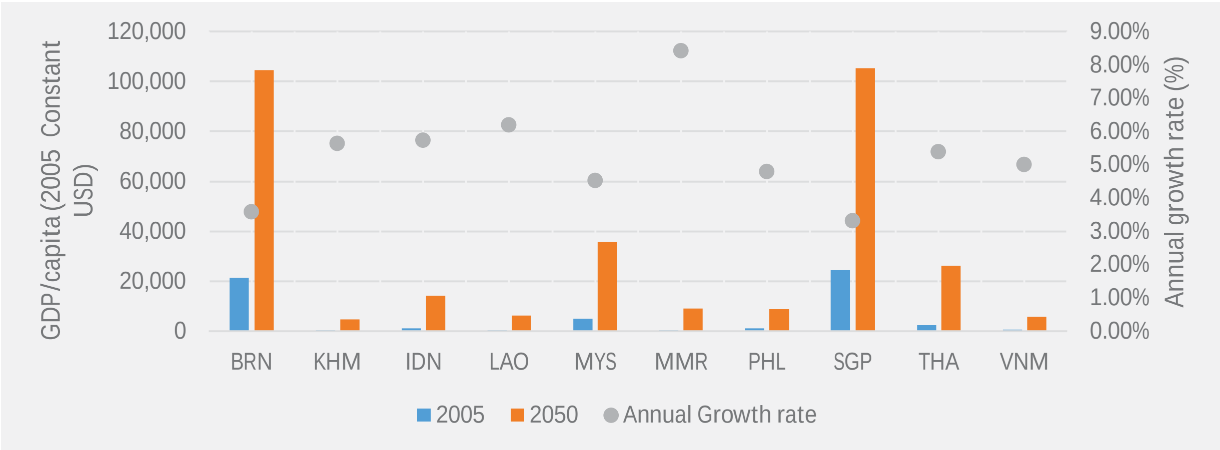


Figure 3-5. GDP per Capita per Country and Growth Rates
Source: ADBI, 2012, World Bank, 2013 and United Nations, 2012

[2] Gompertz functions which correlated historical data on vehicle ownership with historical data on GDP/capita were utilized in projecting road vehicles for each country, except for Indonesia and the Philippines (See Chapter 2). See Dargay, et al. 2007.

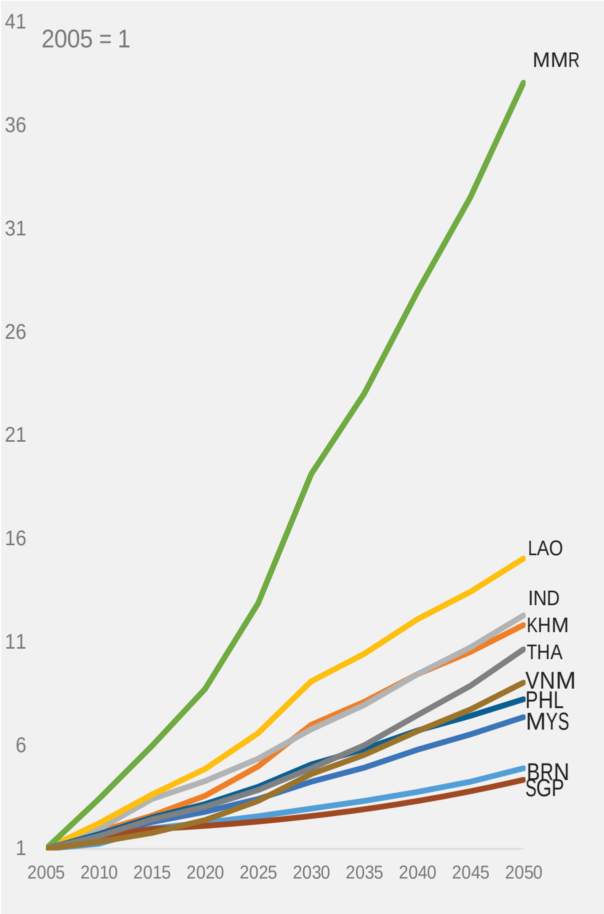


Figure 3-6. GDP per Capita Growth Index (2005=1)

- The weighted average GDP per capita in 2005 was 1,469 USD.
- Singapore was highest at 24,431 USD per capita, followed by Brunei at 21,402 USD per capita.
- Myanmar was lowest in 2005 at 238 USD per capita.
- In terms of expected long term growth rates, Myanmar leads the countries as it is expected to growth at an annual rate of 8.42% leading up to 2050, followed by Laos at 6.21%.
- Singapore and Brunei, which are currently the most economically-advanced countries in the region are expected to growth at slower rates at 3.31% and 3.59% per annum up to 2050.
- In 2050, the weighted average GDP per capita will be at 14,132 USD.
- This means on average, the GDP per capita will increase almost 10-fold in the region from 2005-2050.
- The chart on the left shows the movement patterns for GDP/capita for each country expressed as indexes (with 2005= 1)
- The region will experience high levels of economic growth in the next 40 years and the countries would have to be ready to accommodate the changes that will be necessary for the transportation system to accommodate the needs brought about by the rapid economic growth.

3.2.3 Transport

This sections presents the images (BAU and alternative scenarios) of transportation in the future, interpreted using relevant transportation parameters such as transport volumes (passenger-km and ton-km) and mode shares. More visual descriptions of these images are given in the country reports. The numbers given in this chapter reflect transport that occurs within the boundaries of the countries (and excludes international transport)[3].

3.2.3.1 Passenger Transport

- Summary : Transport Volumes and Mode shares
    - o In 2005, the total passenger-km (PKM) was at 1.5 trilliion PKM, this is estimated to grow at an annual rate of 3.5% per annum up to 2050 in the BAU scenario. It is estimated to increase 5-fold in 2050 to 7 trillion PKM.
    - o The alternative scenario posits a 49% reduction in total PKM by 2050 as compared to the BAU scenario (at 3.56 trillion PKM (2% annual growth rate).

[3] The backcasting tool enables the calculation of emissions from transport including international transport. It was deemed necessary to concentrate on "local transport" primarily as the recommendations to the countries would have to start with measures that are within their scope and control. Nonetheless, this study does not undermine the importance of international transport in terms of emissions and this issue has to be taken in regional or global platforms.

- o The reduction in the PKM is explained by the impacts of the avoid policies (such as land use planning and the use of information and communications technology to replace the need for physical travel).
- o The per capita PKM values are as follows: 2005 – 2,635 PKM; BAU 2050 – 8,934 PKM; Alternative 2050 – 4,542 PKM.

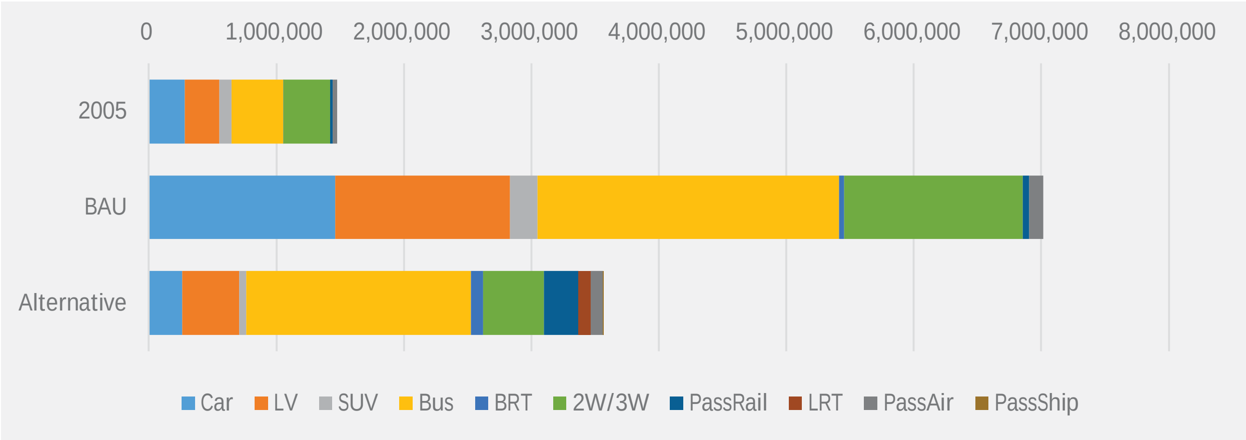


Figure 3-7. Passenger-Kilometer (million PKM)
Source: Calculated

- o Passenger transport was dominated by road transport in 2005 and is estimated to be the same in the BAU 2050 scenario (98% of PKM). In the alternative scenario, rail-based transportation is noticeably higher, contributing 11% of the PKM (as compared to 1% in the BAU 2050 scenario).
- o The alternative scenario also highlights the importance of having better road public transport (BRT and buses) as these contribute 52% of the PKM as compared to 35% in BAU 2050.

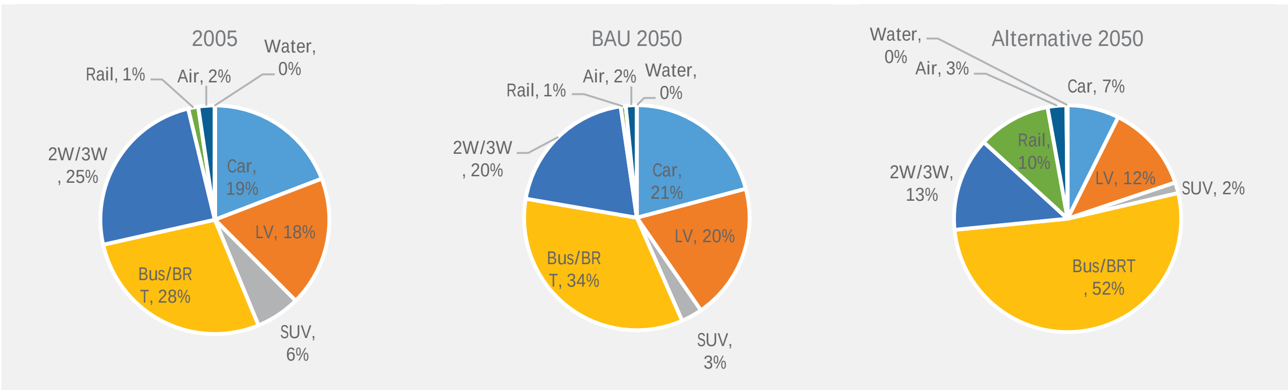


Figure 3-8. Passenger-Kilometer Mode Shares (%)
Source: Calculated

- Road
  - o Road transport activity volumes (PKM) are expected to increase at an annual rate of 3.5% in the BAU scenario. 2050 PKM volumes are expected to be almost 5-fold from 2005 values.
  - o The alternative scenario postulates that the increase will be limited to 2% per annum.

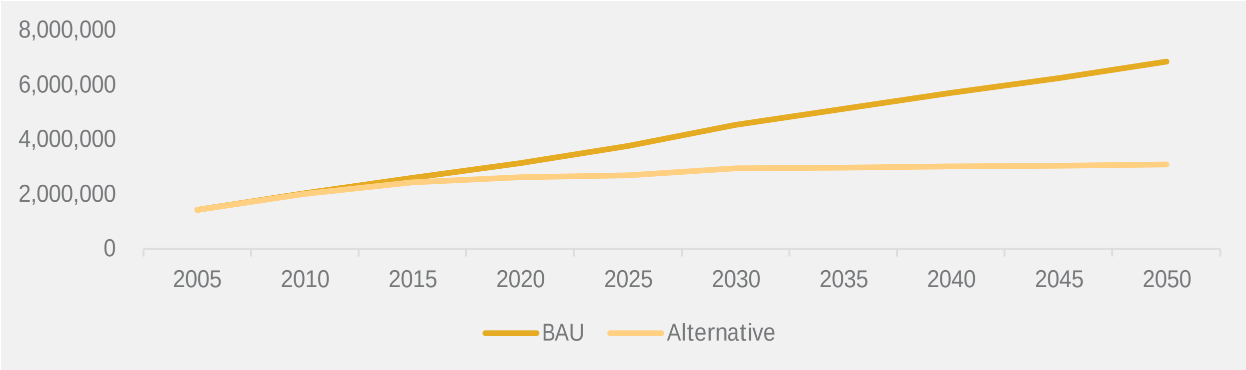


Figure 3-9. Road Passenger-Kilometer (million PKM)
Source: Calculated

- o In 2005, 4-wheeled private motorized passenger transport contributed 45% of the road-based PKM, while motorcycles contributed 26%. Buses, on the other hand, contributed 29%.
- o In the BAU, it is projected that the 4-wheeled private motorized modes will still contribute similar levels (44%), while motorcycles will decrease in importance, contributing 20%. Buses are seen to contribute 35% of road PKM in BAU 2050.
- o The alternative scenario posits that bus-based systems will contribute 60% of the road PKM, emphasizing the need to develop high quality and high level of service bus-based systems in the region.

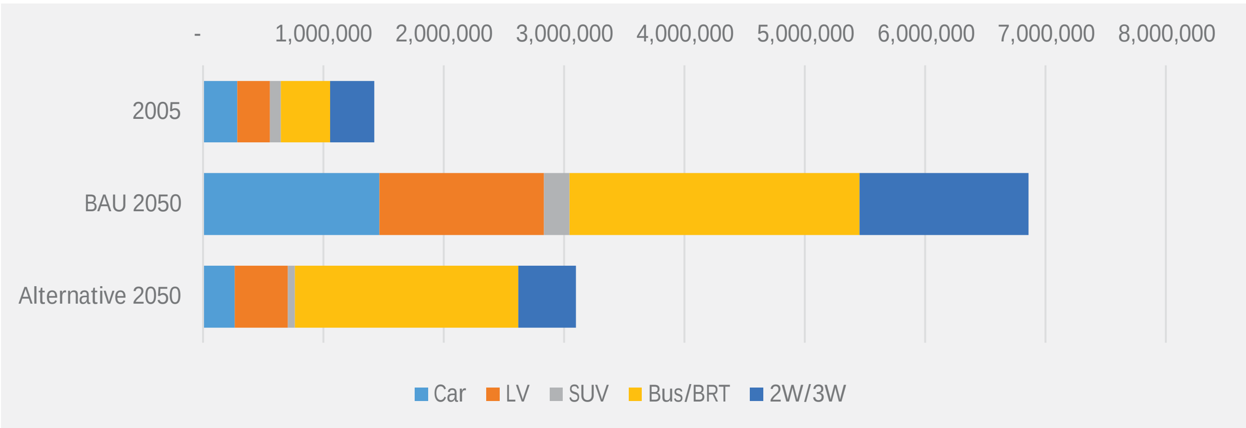


Figure 3-10. Road Passenger-Kilometer Mode Share (%)
Source: Calculated

- Rail
  - o Rail transport activity volumes (PKM) are expected to increase at an annual rate of 2% in the BAU scenario. 2050 PKM volumes are expected to be 2.4-fold of the 2005 values.
  - o The alternative scenario postulates a much higher increase in rail-based transport at 6.6% per annum growth rate. The 2050 value for the alternative scenario is 17-fold higher than the 2005 value.

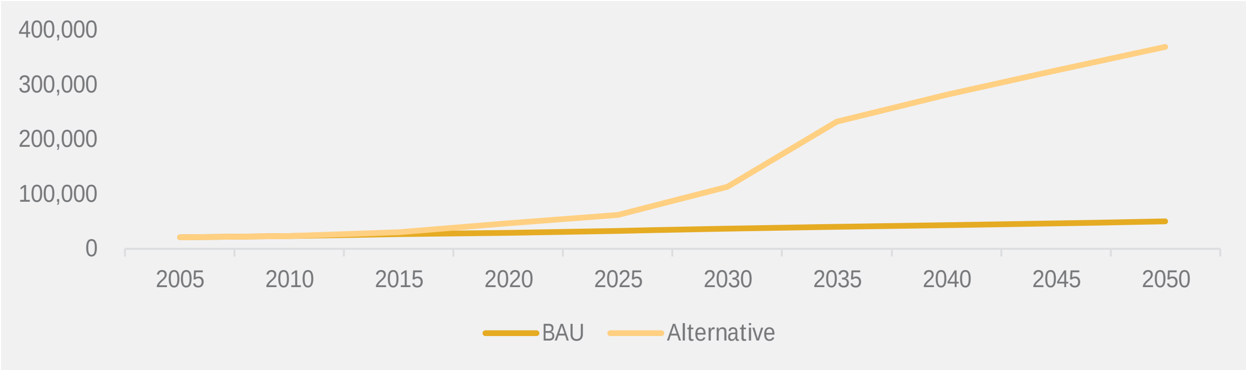


Figure 3-11. Rail Passenger-Kilometer (million PKM)
Source: Calculated

- Air
  - o Air transport activity volumes (PKM) are expected to increase at an annual rate of 2% in the BAU scenario. 2050 PKM volumes are expected to be 3.23-fold of the 2005 values.
  - o The alternative scenario postulates lower demand for air travel, where PKM will be growing at 2.3% per annum The 2050 PKM volumes for air transport will be 2.77-fold of the 2005 values.

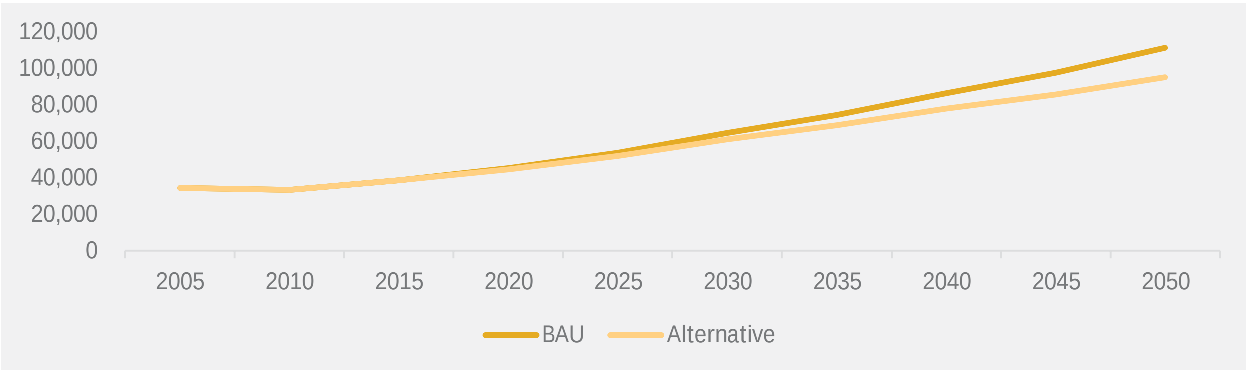


Figure 3-12. Air Passenger-Kilometer (million PKM)
Source: Calculated

- Water
  - o The study was limited in incorporating activity data for water transport as there was very limited information that was available for the different countries. The impacts of water transport have been directly inputted into the energy consumption and emissions analysis as these were based mainly on IEA estimates for sectoral energy and CO2 emissions. Further data collection will be needed in the future in order to properly reflect water transport in the activity analysis.

3.2.3.2 Freight Transport

- Summary : Transport Volumes and Mode shares
  - o Total freight transport activity volumes in 2005 are estimated at 611 billion TKM. It is expected to grow 4.7 fold in BAU 2050 at 2.9 trillion TKM (3.5% annual growth rate).

- The alternative scenario postulates a reduction in annual growth rate at 2.2% per annum. The 2050 total TKM is estimated at 1.7 trillion TKM in the alternative 2050 scenario, 2.7 fold of the 2005 value.
- The per capita TKM values are as follows: 2005 – 1,090 TKM; BAU 2050 – 3,680 TKM; Alternative 2050 – 2,113.

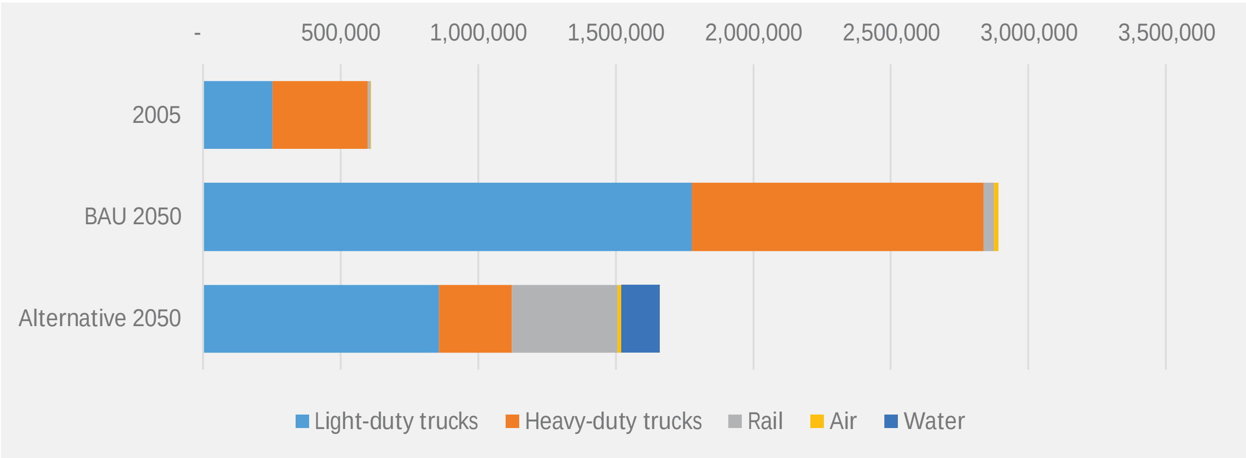


Figure 3-13. Freight Ton-Kilometer (million TKM)
Source: Calculated

- The 2005 estimates as well as the BAU 2050 estimates show that freight transport is and will be dominated by road vehicles (98% of the TKM).
- The alternative scenario postulates a more diverse freight transport network in 2050 in the region as the contribution of road vehicles to the total TKM is reduced to 68%. Rail-based transport is expected to contribute 23% of the total TKM in the alternative 2050 scenario.

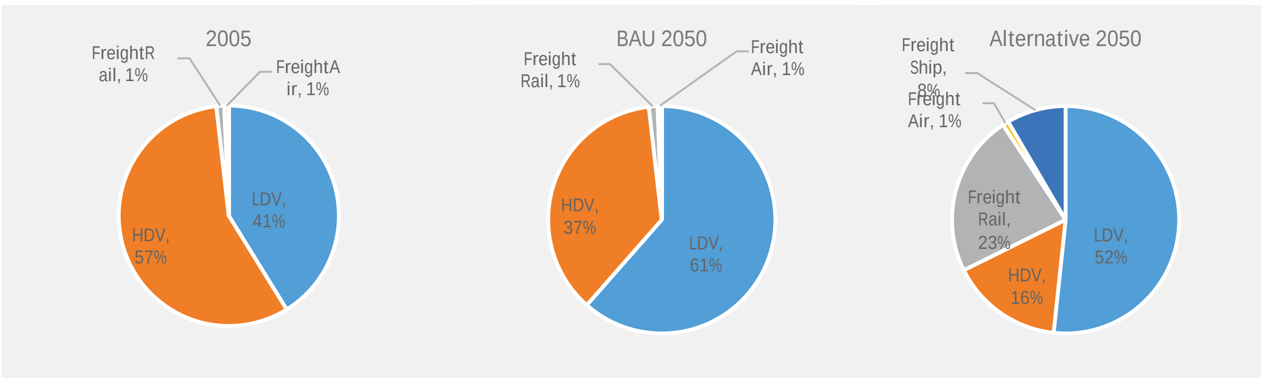


Figure 3-14. Freight Ton-Kilometer Mode Share (%)
Source: Calculated

- Road
  - Road freight transport activity levels are expected to increase 3.5% per annum in the BAU scenario. The 2050 BAU 2050 value is 4.7 times the 2005 value.
  - The alternative scenario postulates an annual growth rate of 1.4% and ultimately a 60% reduction versus the BAU 2050 value.

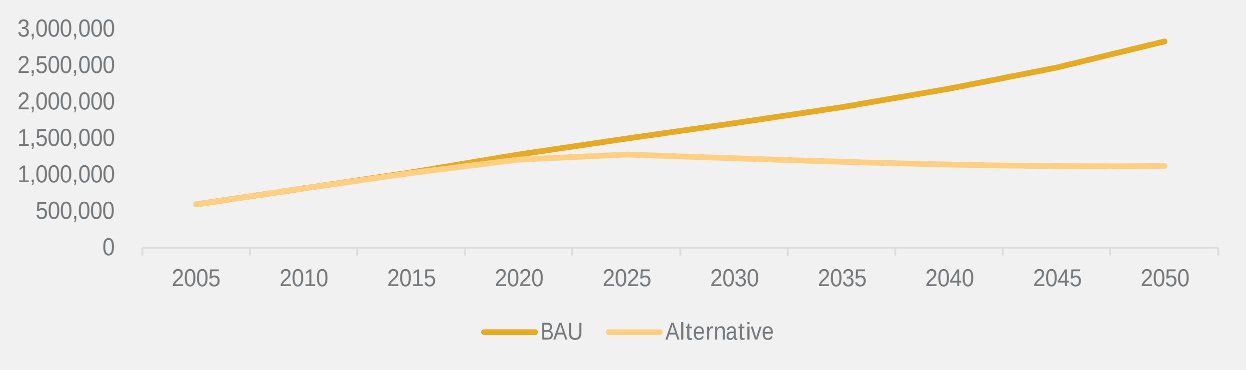


Figure 3-15. Road Freight Ton-Kilometer (million TKM)
Source: Calculated

- Rail
  - Rail-based freight transport is expected to increase much higher in the alternative scenario, as it embodies assumptions that will shift road freight activity towards rail. The alternative scenario resulted in an annual growth rate in rail freight of 9.3%, as compared to 3.7% in the BAU scenario.

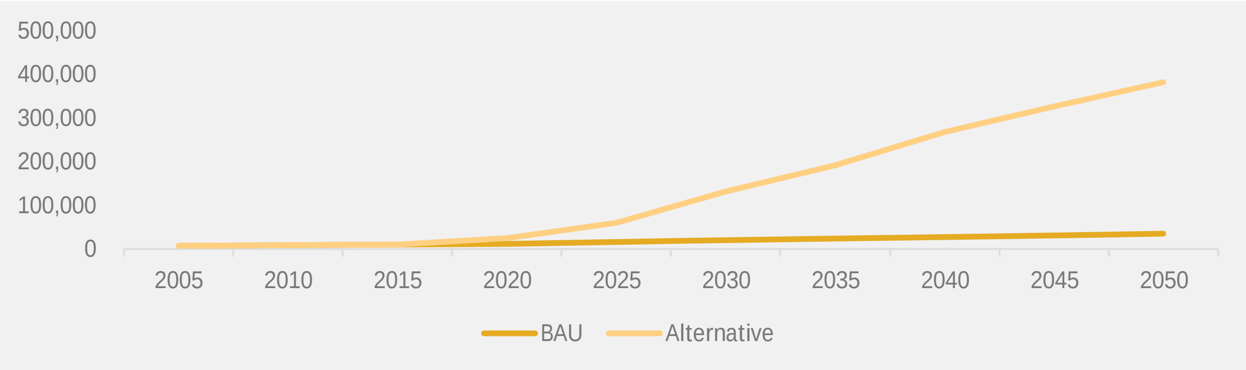


Figure 3-16. Rail Freight Ton-Kilometer (million TKM)
Source: Calculated

- Air
  - The BAU scenario postulates that air freight volumes will increase at an average rate of 3.3% per annum, resulting in a 4.2 fold increase in 2050 vs 2005. The alternative scenario resulted in a 2.9% increase per annum as much of the increase will be in the rail-based systems.

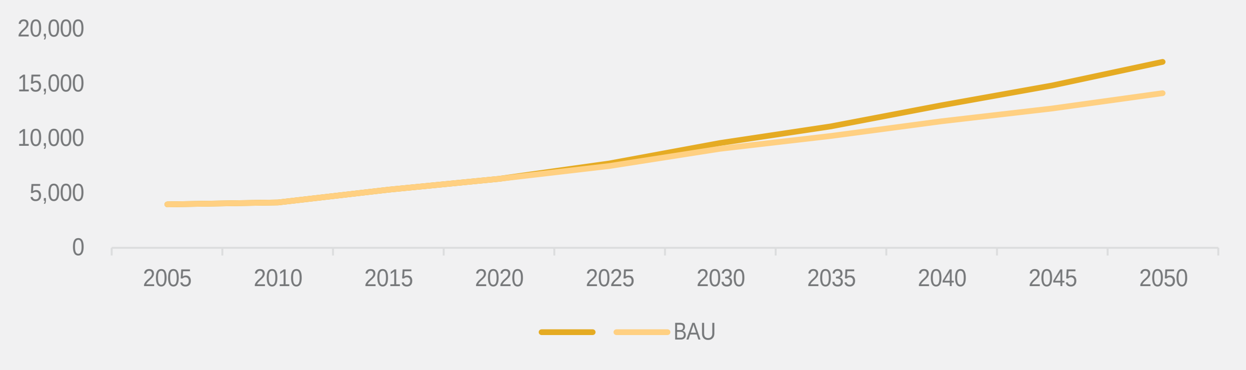


Figure 3-17. Air Freight Ton-Kilometer (million TKM)
Source: Calculated

- Water
  - o As with passenger transport, the study was limited in the way it incorporated water transport in the activity analysis. The backcasting tool showed an 8% contribution from water transport in the alternative 2050 scenario as this was a result of directly shifting activity from the other modes.

3.2.3.3 Road Vehicles

- This section on road vehicles is included as a section as much work has been done in order to get the projections that were used (primarily in the BAU scenario for the study) and is deemed to be an interesting topic for policy makers to look into as the gravity of the current and potential CO2 emissions from road transport in the region is substantial.
- In 2005, it was estimated that there were 89.9 million vehicles in the region. 11.6 million of these were passenger cars, while 65.6 were motorcycles (including 3-wheelers). The weighted average for 4-wheeled vehicles/1000 people is 43.33, while the motorcycles/1000 is 117.
- Brunei had the highest 4-wheeler motorization rate at 448 vehicles/1000, followed by Malaysia at 299 vehicles/1000.
- Malaysia was also highest in the 2-wheeler motorization rate at 271 motorcycles/1000 people, followed by Vietnam at 189 motorcycles/1000 people.

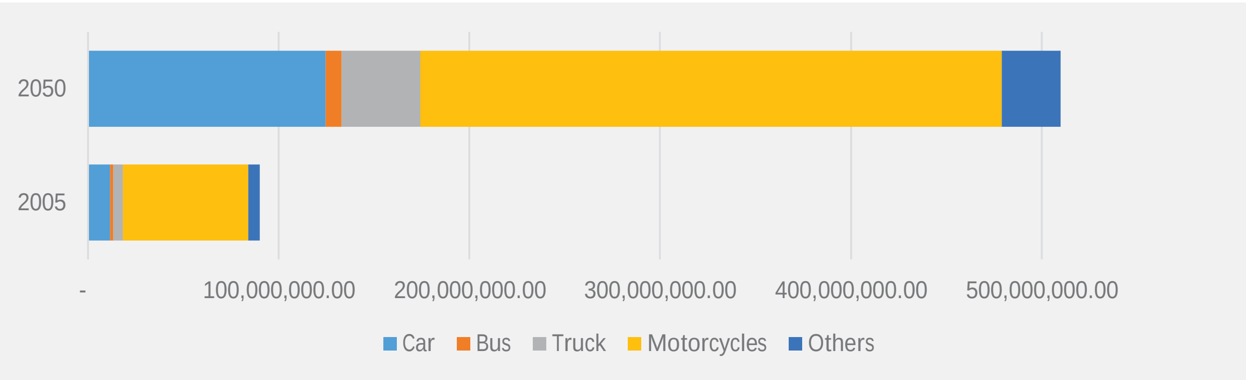


Figure 3-18. Road Vehicle Population (2005 and 2050)
Source: Calculated

- In 2050, it is estimated that there will be 510 million vehicles in the region, 124 million will be cars, while 305 million will be motorcycles.
- The motorization rates will be at 378 4-wheelers/1000 people and 388 motorcycles/1000 people (weighted average). Brunei is still seen to be the highest in terms of 4-wheelers/1000 people at 815. Vietnam will be experience motorcycle saturation at 550 per 1000 people in 2050.

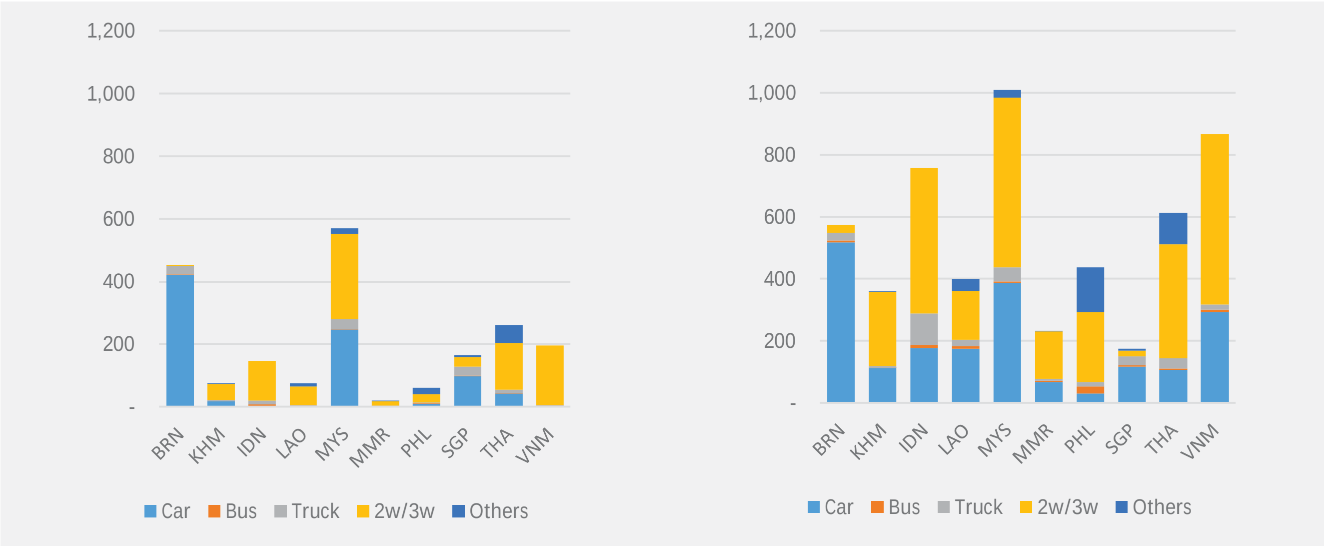


Figure 3-19. Vehicle Motorization Indexes: Vehicle/1000 People (2005 and 2050)
Source: Calculated

3.2.4 Transport CO2 Emissions

3.2.4.1 Baseline (2005)

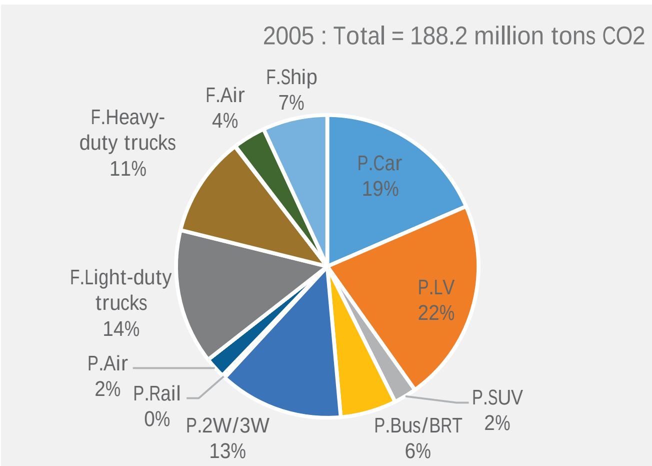


Figure 3-20. CO2 Contribution by Mode (2005)
Source: Calculated[4]

- The total transport CO2 emissions in 2005 was 188.2 million tons
- In terms of the actual CO2 volume, Thailand is the highest contributor to the total (28%).
- In terms of modes, passenger 4-wheeled vehicles contributed 43% of the total CO2 in 2005. Motorcycles and 3-wheelers contributed 13%.
- Road freight vehicles contributed 25% of the total CO2.

[4] P = Passenger ; F = freight

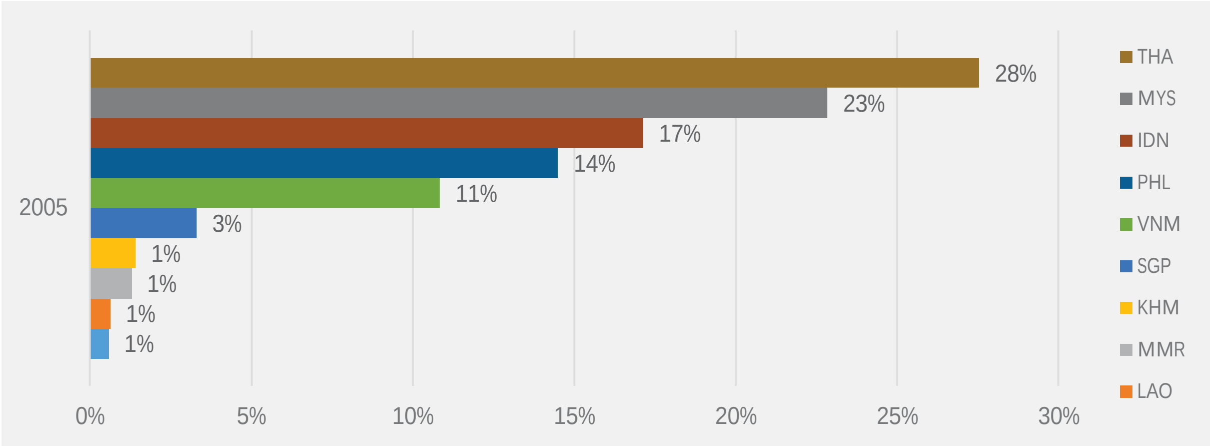


Figure 3-21. CO2 Contribution by Country (2005)
Source: Calculated

- In terms of per capita emissions, Brunei was highest at 2.9 tons CO2 per capita in 2005. Myanmar was lowest at 48 kg/capita (.048 tons/capita).
- The weighted average CO2/capita in 2005 is .422 tons/capita.

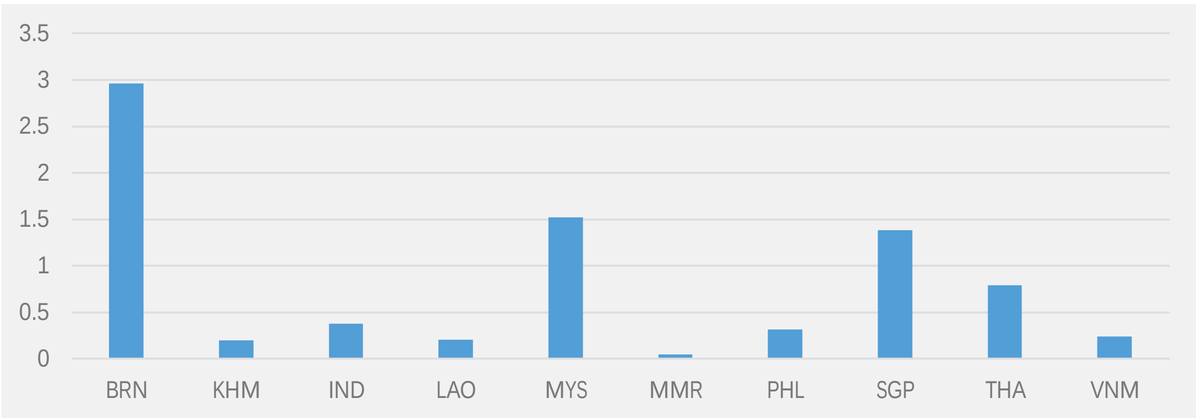


Figure 3-22. Transport CO2 Emissions per Capita (ton CO2/person) 2005
Source: Calculated

3.2.4.2 BAU Scenario

- The BAU scenario postulates that the transport CO2 in the region will grow at an annual average of 3.3%. The total CO2 emissions in 2050 are 822 million tons.
- This means that the 2050 transport CO2 will grow 4.36-fold as compared to 2005.
- Emissions from buses are expected to grow the fastest (3.9% per annum), similar to SUVs and LVs. Motorcycle emissions will grow at 3.5% per annum while passenger car emissions (sedans) will grow at 2.8% per annum.
- Emissions from light-duty trucks will still grow the fastest for the freight sub-sector at 3.6% per annum, while emissions from rail will increase at 3.2%.

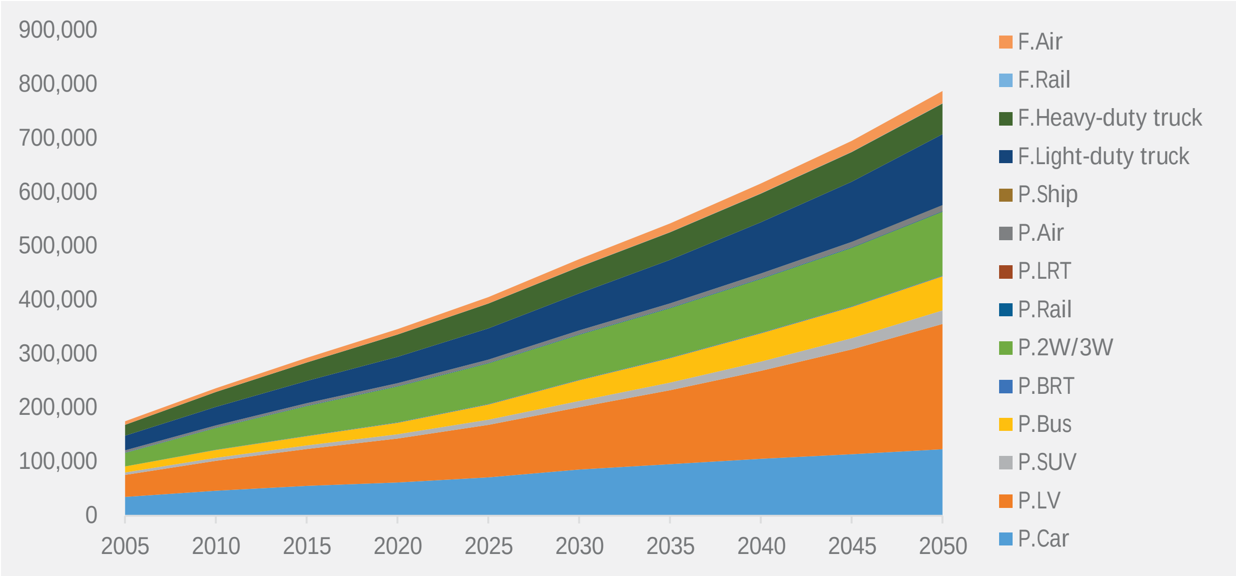


Figure 3-23. Total Transport CO2 Emissions: BAU (thousand tons CO2)
Source: Calculated

- In terms of % contribution, 4-wheeled passenger vehicles (cars, LV, SUVs) are estimated to contribute 46% of the CO2 emissions in 2050 under the BAU scenario.
- Trucks (light and heavy duty) will contribute 23% of the CO2 emissions in BAU 2050.
- Motorcycles will contribute 14%.

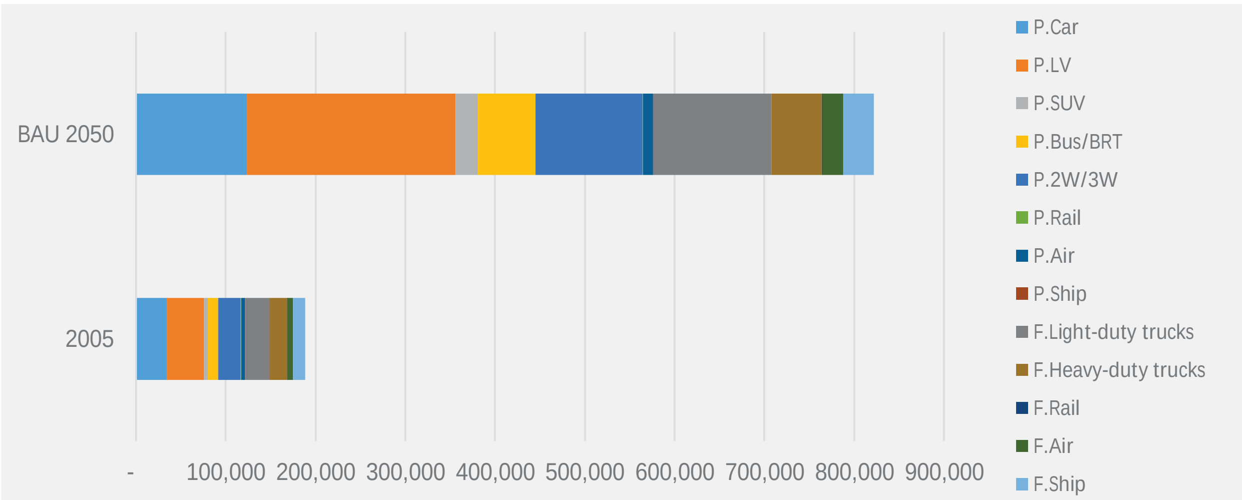


Figure 3-24. Transport CO2 Emissions by Mode: BAU 2005 and 2050 (thousand tons CO2)
Source: Calculated

- The resulting weighted CO2 emissions per capita in 2050 are 1.36 tons/capita, increasing more than 3 fold from the 2005 value.
- Brunei is still seen to be the highest in terms of ton CO2/capita at 2.66, but has decreased from its 2005 value of 2.96 ton CO2/capita. Myanmar is still the lowest at 0.60 tons per capita.

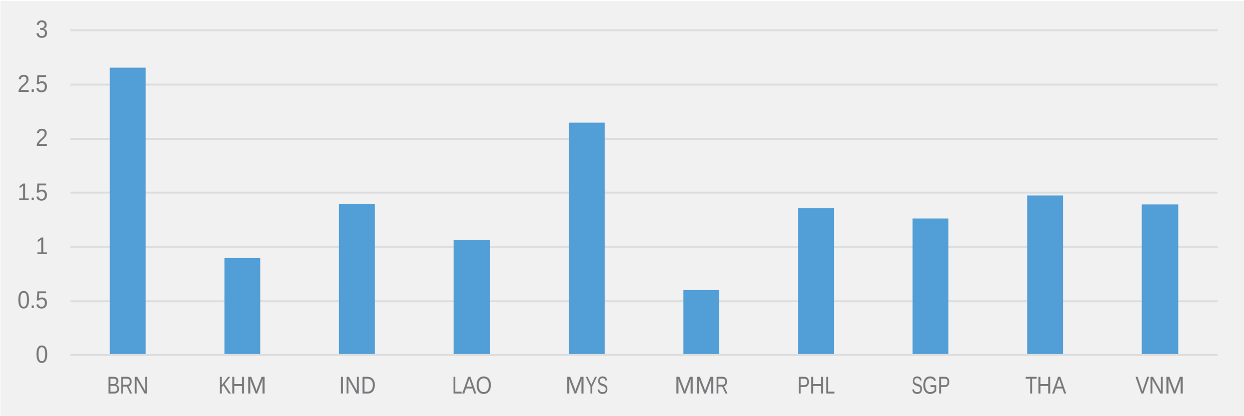


Figure 3-25. Transport CO2 Emissions per Capita: BAU (ton Co2/person)
Source: Calculated

3.2.4.3 Alterative Scenario

- The selected policy packages for the countries were applied into the backcasting tool to estimate the emission reduction potential in 2050.
- The total CO2 emissions in the alternative 2050 scenario is 286.7 million tons, 65% lower than the BAU 2050 value.
- This means that transport CO2 emissions would have to be limited to a 0.9% annual growth up to 2050. The scenario calls for negative growth rates for car emissions (-1.2%) and heavy-duty trucks (-1.1%).
- Higher growth rates for emissions from buses (2.9%), rail-passenger (5.3%) and rail-freight (9.1%) will be needed as the scenario shifts substantial passenger and freight activity towards these modes.

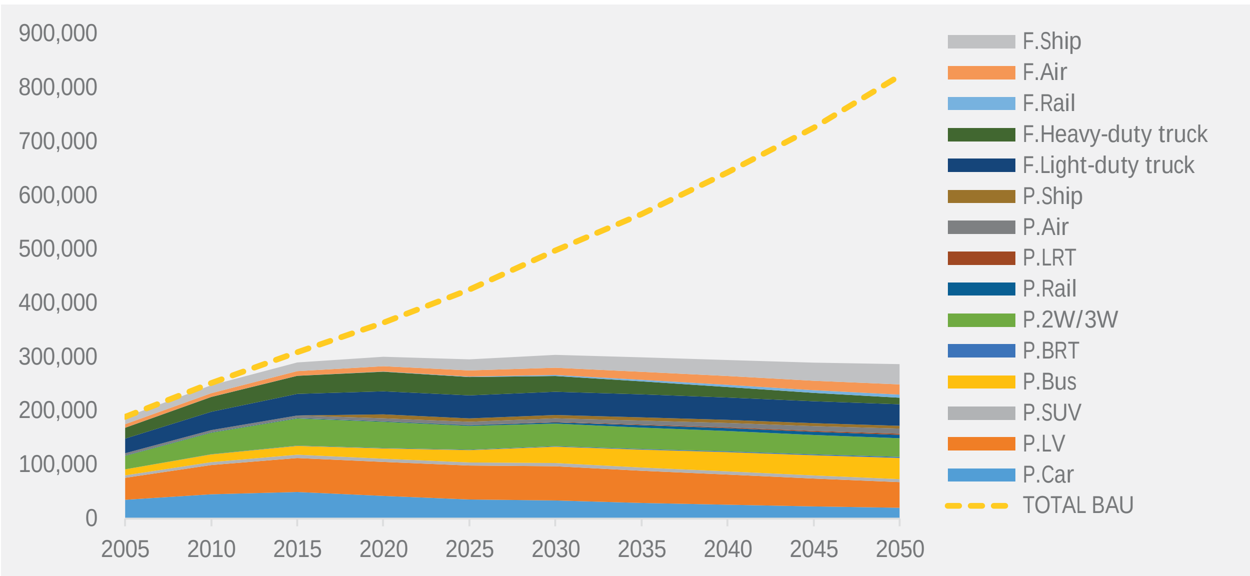


Figure 3-26. Total Transport CO2 Emissions: Alternative Scenario (thousand tons CO2)
Source: Calculated

- In terms of % contribution, 4-wheeled private passenger vehicles will be limited to 26% contribution in the alternative 2050 scenario as compared to 46% in the BAU 2050 scenario. Buses will contribute 14% in the alternative 2050 as compared to 8% in BAU 2050, as buses are seen to contribute 52% of the total passenger kilometers in 2050.

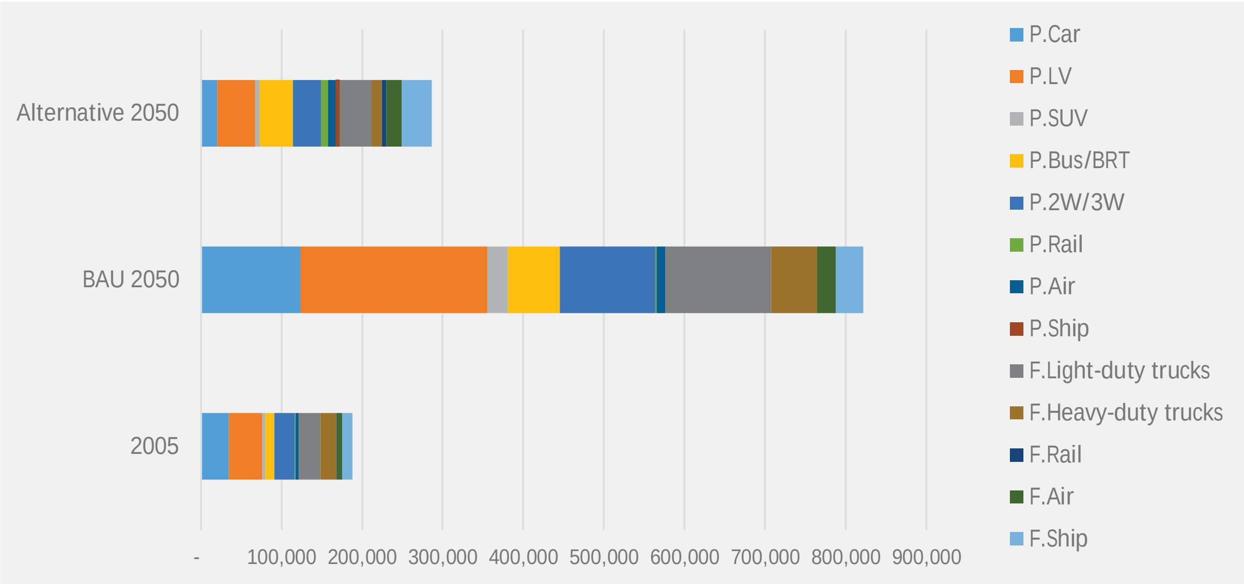


Figure 3-27. Transport CO2 Emissions by Mode: Alternative Scenario (thousand tons CO2)
Source: Calculated

- The alternative scenario shows that the weighted CO2 emissions per capita in 2050 can be reduced to 0.47 tons/capita (from 1.36 in the BAU 2050 scenario). However, this is still above the target of 0.33 tons/capita. Future applications of the tool would need to look into additional policies, but would have to be assessed as nationally appropriate.

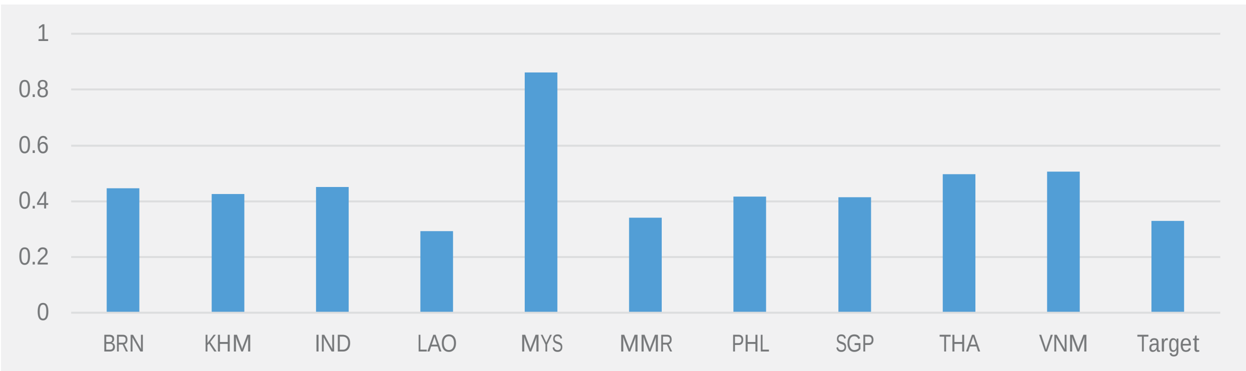


Figure 3-28. Transport CO2 Emissions per Capita: Alternative Scenario (tons CO2/person)
Source: Calculated

3.2.5 Proposed Policies

- The table below shows a summary of the policies that were applied into the backcasting tool. The details of the applications are within the country reports. These policies have been applied to the countries with variations in terms of the shift rates, penetration rates and timing of application. These were based on policy documents and the review of other external sources.

Table 3-1. Summary of Policies Applied in the Backcasting Tool

	BRN	KHM	IND	LAO	MYS	MMR	PHL	SGP	THA	VNM
Avoid										
Pricing Regimes	◦	◦	◦	◦	◦	◦	◦	◦	◦	◦
ICT	◦	◦	◦	◦	◦	◦	◦	◦	◦	◦
Tele-activities	◦	◦	◦	◦	◦	◦	◦	◦	◦	◦
Travel plans	◦	◦	◦	◦	◦	◦	◦	◦	◦	◦
Improved travel awareness	◦	◦	◦	◦	◦	◦	◦	◦	◦	◦
Urban and land use planning	◦	◦	◦	◦	◦	◦	◦	◦	◦	◦
Fuel price control	◦	◦	◦	◦	◦	◦	◦	◦	◦	◦
Shift										
Passenger – to bus	◦	◦	◦	◦	◦	◦	◦	◦	◦	◦
Passenger – to rail	◦	◦	◦	◦	◦	◦	◦	◦	◦	◦
Passenger – to water			◦	◦	◦	◦			◦	
Freight – to rail		◦	◦		◦	◦			◦	◦
Freight – to ship		◦	◦						◦	◦
Improve										
CNG	◦	◦	◦	◦	◦	◦	◦	◦	◦	◦
Hybrid vehicles	◦	◦	◦	◦	◦		◦	◦	◦	
Electric vehicles			◦	◦	◦		◦	◦		
Fuel cell vehicles	◦		◦					◦	◦	
Biofuel	◦	◦	◦		◦	◦	◦		◦	◦
Eco-driving	◦	◦	◦	◦	◦	◦	◦	◦	◦	◦
Air fuel efficiency improvement	◦		◦				◦	◦		
Ship fuel efficiency improvement			◦				◦	◦		
Rail electrification		◦	◦	◦	◦	◦			◦	◦

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Country Report

Brunei

Prepared by Clean Air Asia

Present Society

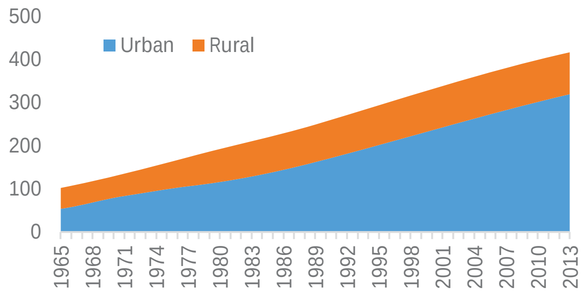

Figure 1. Population (000s)[1]

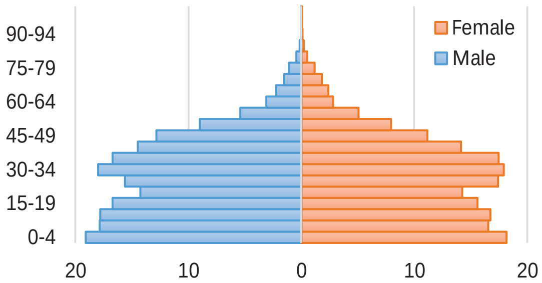

Figure 2. Population by Age (000s), 2010[2]

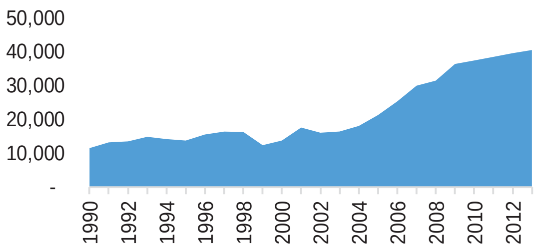

Figure 3. GDP/Capita (2005 Constant USD)[3]

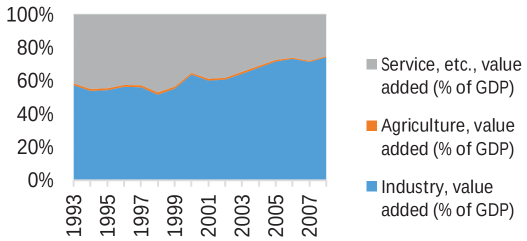

Figure 4. % Contribution of Sectors to the GDP[4]

INTRODUCTION

- Brunei Darussalam is located at the north coast of Borneo, and completely surrounded by the Sarawak State of Malaysia, aside from its coastline with the South China Sea
- Brunei's land area is 5,765 sq. km. and has a coastline of 161 km.
- The country is divided into four districts and 38 sub-districts, which are called "mukims" or wards.

POPULATION

- Brunei's population (2013) is currently about 417.17 thousand people.
- It has grown at an average of 2.14% per annum from 1990 to 2013.
- It is estimated that 76.68% of the population are presently in the urban areas. (UN 2012 and 2011).

AGE STRUCTURE

- 59% of the population are in the working age of 20-64.
- Only 3% of the population are 65 years old and above. (UN 2012)

GDP per CAPITA

- GDP per capita currently stands at USD 40,617 (2005 constant USD), the second highest in the region. It increased at an average rate of 5.59% from 1990 to 2013 (WB 2012).
- It has grown particularly strong in the period 2002-2010, averaging an annual growth rate of 11.1%.

ECONOMIC STRUCTURE

- In 2008, the industrial sector contributed 74% of the total GDP in Brunei and has been increasing since 2001 (WB 2012).
- Agriculture has not been a significant sector in terms of contribution to the economy. 80% of Brunei's food requirements are imported from other countries (Brunei Economic Development Board).
- The services sector contributed 26% of the GDP. However, its percentage contribution has declined, as it stood at 47% in 1998.
- Crude oil and natural gas production account for a significantly large fraction of Brunei's exports, Hydrocarbon resources account for 90% of its total exports. Apart from mining, and domestic and foreign investments, Brunei's economy depends largely on the oil and gas sectors. According to Brunei Economic Development Board, the country is the 4th largest oil producer in the region and the 9th largest exporter of liquefied natural gas in the world.

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1 United Nations. 2012 and United Nations. 2011.
2 United Nations. 2012.
3 World Bank. 2013.
4 Ibid.

Present Transport

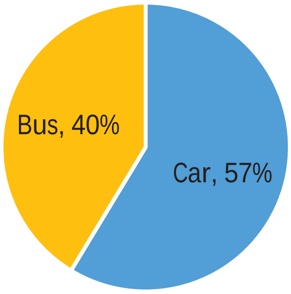


Figure 5. Passenger Transport Mode Share (% of PKM), 2010

Source: Study estimates

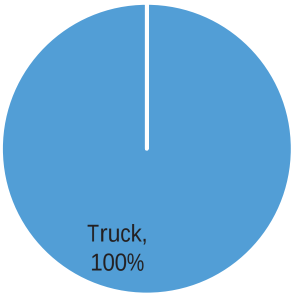


Figure 6. Freight Transport Mode Share (% of TKM), 2010

Source: Study estimates

Table 1. Population of Road Vehicles (2010)

Passenger

Mode	No. of Vehicles	Percent
Car	181,196	92.7
Bus	1,596	0.8
2W/3W	2,772	1.4
Freight		
Truck	9,848	5

PASSENGER TRANSPORT

- As of 2010, passenger transport is at an estimated 10.9 billion passenger-kilometers.
- Passenger transport has increased by 4.3% per year between 2005 and 2010.
- Road transport (primarily cars) serves 57% of passenger transport and already dominates the road transport of Brunei. Public transport services are limited in Brunei, and car ownership in Brunei is about one car for every two persons, or two cars per household at least. Taxis barely exist as they are expensive and usually un-metered, with less than a hundred fleets and mostly serving those originating from the airport or major shopping malls.

FREIGHT TRANSPORT

- 2010 freight transport is at an estimated 7.2 billion ton-kilometers, which are largely dominated by trucks.
- Freight transport increased by an average of 1.16% per year between 2005 and 2010.

ISSUES AND CHALLENGES

- Brunei is a top exporter of oil and gas, accounting for 67% of its domestic income. However, the country is depleting its natural resources. APEC estimates that the oil reserves will last about 25 years and the gas reserves will last about 40 years (APEC, 2013) For transport, this means that car use should be re-evaluated and policies that would promote new technology must be advanced.
- Buses are the country's main mode of public transport. They face challenges in ridership as they provides limited information to the commuters, and passengers note the irregularity of services (Oxford Business Group, 2013).
- Brunei has the highest car motorization index in Southeast Asia at 452/1000 people (2010).

Future Society

VISIONS

- The future of Brunei will largely be driven by Wawasan or Vision 2035, which define three goals: to ensure well-educated, highly-skilled and accomplished Bruneians; to ensure a high quality of life; and to build a dynamic and sustainable economy. Policy directions have been identified in the first Outline of Strategies and Policy for Development (2007-2017): education, economy, security, institutional organisation, local business development, infrastructure, social security, and environment.
- According to the Wawasan Brunei 2035, it will widen the economic base by 2035 and move away from being overly dependent on the oil and gas sectors
- Priority sectors indicated in the plans are the following: hospitality, finance, agriculture, halal products and software development.

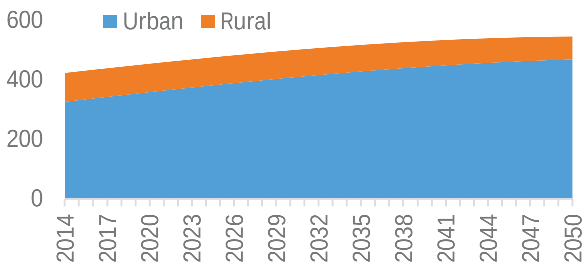


Figure 7. Population (000s)[5]

POPULATION

- It is estimated that in 2050, there will be 545,000 people in the country.
- The population will grow at an average of 0.88% per annum from 2005-2050
- 85.9% of the population will be living in urban areas by 2050. Growth in the urban population is higher than the total at 1.23% per annum from 2005-2050 (UN,2012 and UN,2011).

[5] United Nations. 2012 and United Nations, 2011.

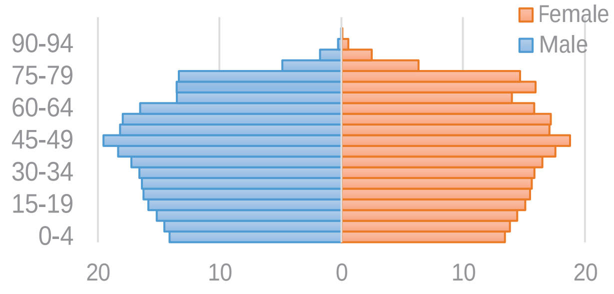


Figure 8. Population by Age (000s), 2050[6]

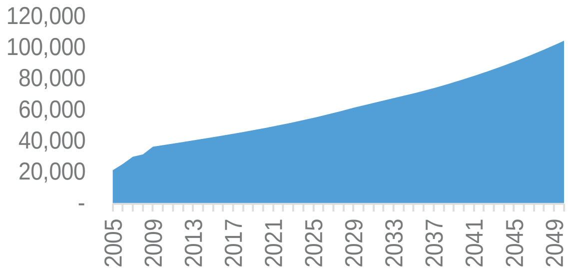


Figure 9. GDP/Capita Projections up to 2050[7]

AGE STRUCTURE

- 57% of the population will be in the working age of 20-64 in 2050.
- By 2050, 22% of their population will be 65 years old and above (UN, 2012).

GDP per CAPITA

- GDP per capita is projected to increase to USD 104,560 (2005 constant USD) in 2050.
- It is forecasted to grow at an average of 3.59% per annum from the period 2005-2050[8].

ECONOMY

- The oil and gas sector has been the backbone of the economy of Brunei, but with contractions in energy production and depletion in natural resources, Brunei is looking for ways to diversity its economy.
- Oil reserves are estimated to last up to 25 years and the natural gas reserves are expected to last up to 40 years, according to APEC Energy Supply and Demand Outlook – 5th edition.

Future Transport

PLANS AND VISIONS

- A land transport master plan for Brunei has been completed. It primarily focuses on improving the public transport system to address two goals: reduce Brunei's dependence on private cars as well as improve their energy efficiency and reduce carbon emissions.
- By 2020, Brunei envisions road systems incorporating bus, bicycle lanes as well as walkways.

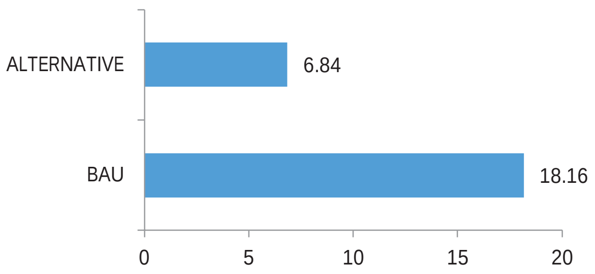


Figure 10. Passenger Travel (billion PKM), 2050

Source: Study estimates

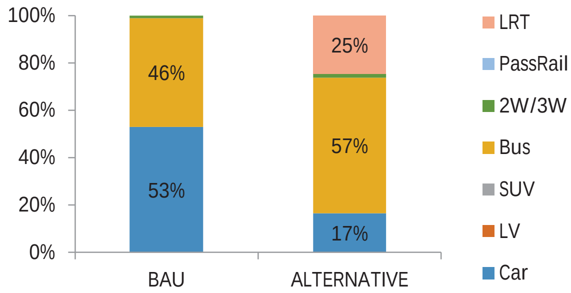


Figure 11. Passenger Mode Shares, 2050

Source: Study estimates

PASSENGER TRANSPORT

- Under the BAU scenario, passenger transport will increase to 18.2 billion passenger kilometers by 2050, less than double the current passenger traveled distance.
- The alternative suggests a reduction of PKM to 6.8 billion passenger kilometers, due to the impacts of avoid policies.
- Future transport in Brunei under the alternative suggests travel by high quality and high level of service LRT/MRT and buses.
- Reducing car travel demand is key: approving and implementing the plans for MRT in the country will be important in dissuading the future population from using cars. The rising public awareness of depleting natural resources might catalyze such a move.

[6] Ibid.
[7] ADBI. 2012 and United Nations, 2012.
[8] ADBI, 2012 and United Nations, 2012.

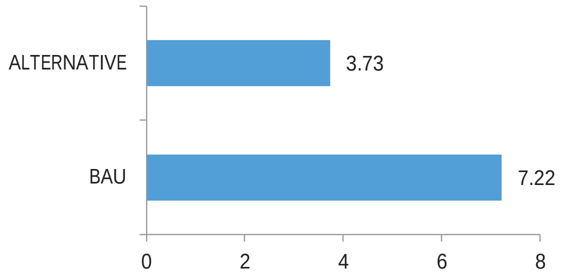


Figure 12. Freight Travel (billion TKM), 2050
Source: Study estimates

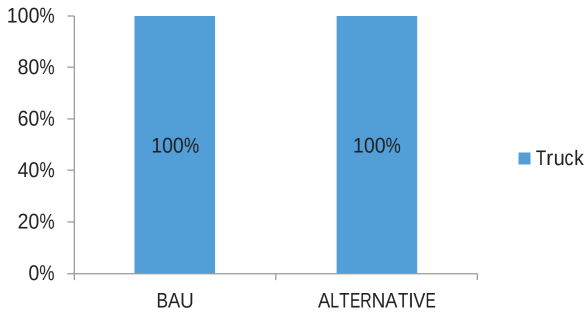


Figure 13. Freight Mode Shares, 2050
Source: Study estimates

FREIGHT TRANSPORT

- Meanwhile, freight transport is expected to increase to 7.2 billion ton-kilometers in 2050 under the BAU scenario. The alternative suggests a reduction of freight trip distance to 3.7 billion ton-kilometers in 2050.
- All of future domestic freight travels is expected to be on trucks.
- Future trucks are seen to run on alternative fuels as well, especially CNG trucks and hybrid trucks.

ISSUES AND CHALLENGES

- The depletion of natural resources will be the biggest pressure on the transport sector. When crude oil becomes scarce in 30 years, Brunei will have to look for alternative sources of energy both locally and internationally.

Results of Simulation

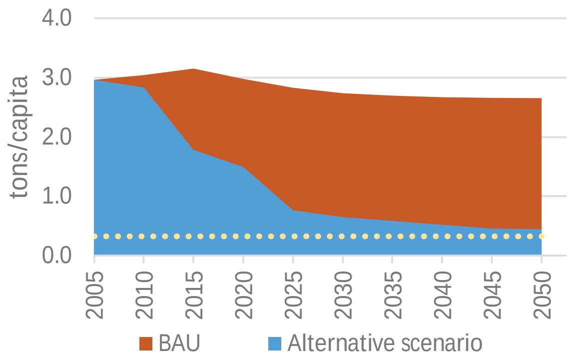


Figure 14. Tons CO2/capita

- The simulation of alternative policies suggests a mitigation potential from 2.66 tCO2 per capita to 0.45 tCO2 per capita for transport.
- The first step to CO2 mitigation in Brunei is the strengthening of public transport. In Brunei, interest rates on car loans are low and automobile purchases are subsidized. It is recommended that such policies be put in place to incentivize public transport in the country.
- Shifting away from crude oil dependency is both a challenge and an opportunity for Brunei. Brunei may have to begin converting to public transport that runs on their LNG. Unfortunately, studies suggest that the local reserves of natural gas may deplete in 40 years. Advanced technologies such as fuel cells, hybrids and electric vehicles are options to look into.

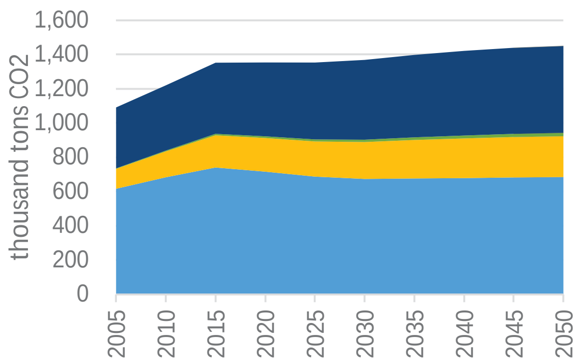


Figure 15. Total CO2 – BAU

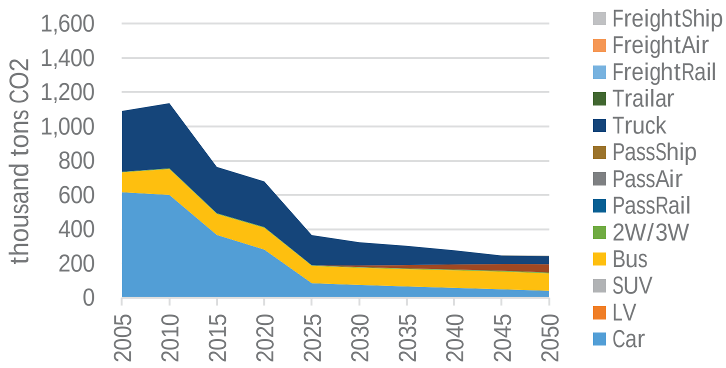
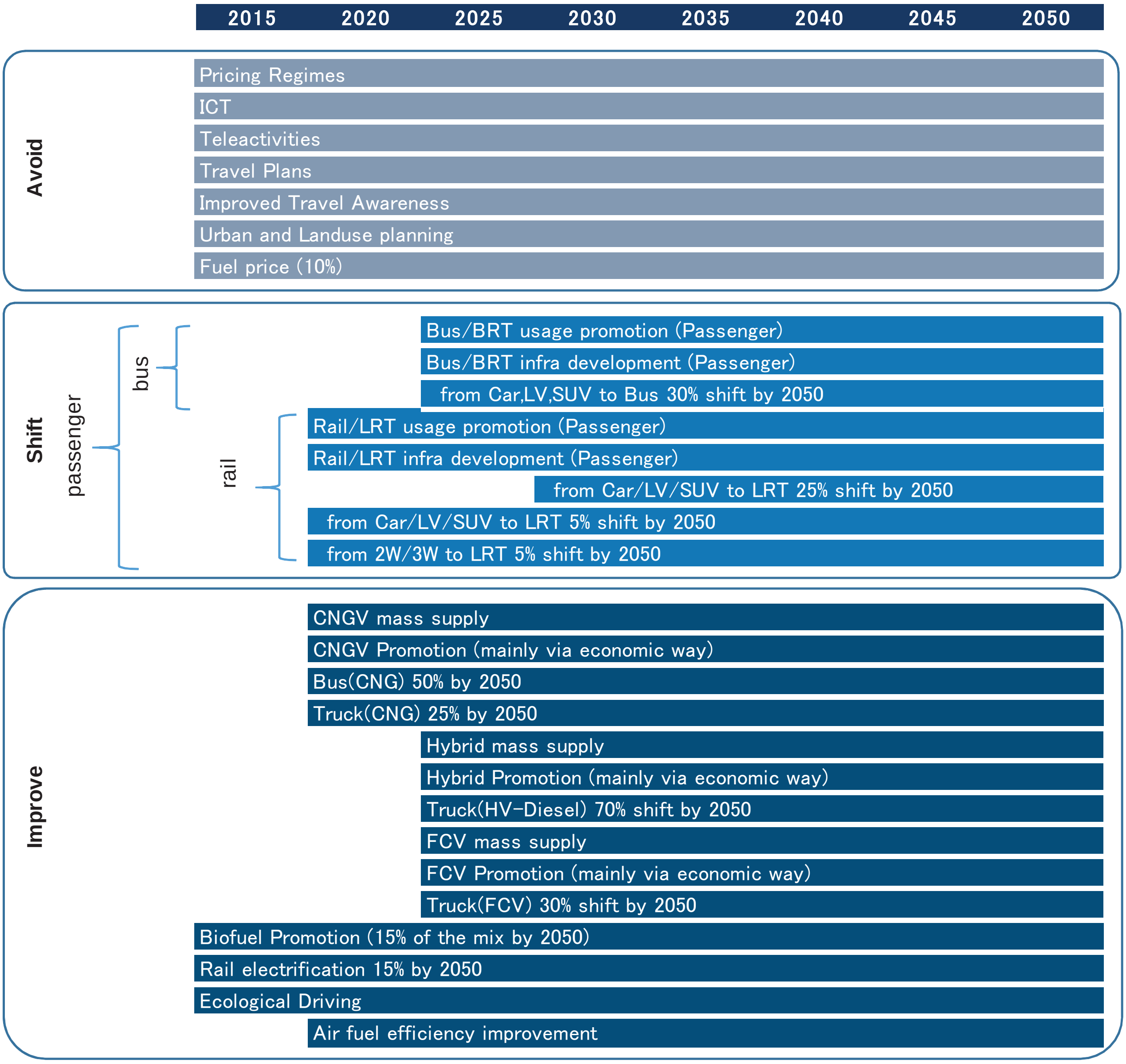


Figure 16. Total CO2 - Alternative

- In the BAU scenario, the largest emitters in Brunei will be cars and trucks. Cars will contribute up to 33% of all transport emissions in 2050 as citizens continue to utilize cars as their primary mode choice in the future. Although car ownership shows signs of saturation, car use will continue to be the top cause of emissions in the transport sector of Brunei.
- The total CO2 emissions from transport in 2050 (BAU) is 1.4 million tons.
- In the alternative scenario, the existence of a public transport system has been considered. Plans have been proposed to build MRT systems around the country. This may motivate people to use public transport instead of cars.
- Energy efficient bus technologies and renewable fuels are seen to be adapted into the current buses, especially in a low crude oil supply scenario.
- The alternative scenario resulted in a reduction of 83% in total CO2 emissions from transport in 2050 vs the BAU (244 thousand tons CO2).

ACTION PLAN



	Characteristic Policies	Future Image
Passenger Transport	Vehicle tax and quotas, as well as park-and-ride schemes can be put in place to encourage the shift to various modes of transport other than private cars. Public bus transit system should be improved, Bike lanes and walkways, and other infrastructure for cyclists and pedestrians, should be constructed to encourage a shift to non-motorized transportation. Smart urban and land use planning should be implemented to reduce transport activity. Land use *and* transport integration should be considered accordingly.	As awareness of depleting resources becomes apparent, so shall the initiatives to create fuel savings. Brunei will move away from car use to public transport towards 2050, with a network designed to serve the upper class.
Freight Transport	Cross-border freight agreements with Malaysia and Indonesia should be in place. Brunei Muara Port should be improved, as well as water transport for freight in general. Advanced vehicle technologies will penetrate the freight fleets.	Brunei will be one of the pioneer users of energy-efficient air transport, reducing emissions by 50% through innovations in aviation technology.

Challenges

- Brunei is a top exporter of fuel and natural gas. However, evidence shows that the country's reserves will be depleted in 30 years.
- The country will have to diversify its energy portfolio to ensure that it will be ready to face the challenges posed by its depleting natural resources.
- Lack of public transport will continue motivating car use. If this will remain in the future, Brunei may experience worse traffic congestion, thus further exacerbating future transport emissions.
- Owning a car is generally easy in Brunei due to low car loan interest rates and subsidized car purchase. This explains the high number of cars in the country and at the moment, car ownership is about two cars for every household. Unchecked, the number of carsvolume would likely double in number from 150,000 in 2005 to 282,000 in 2050.
- Car ownership is generally considered as a status symbol, similar to most countries in Asia, hence convincing the population of Brunei to shift to public transport appears to be a challenge.

Co-Benefits

- Inadequate public transport system in Brunei is believed to be affecting the tourism sector in Brunei.
- While Brunei currently enjoys expansive road networks, the increase in car use may cause worse traffic congestion towards 2050.
- Public transport can potentially prevent congestion by motivating the people to lessen their dependency on cars, thus reducing the number of vehicles that are on the road.
- With less fuel available, Brunei will be able to conserve its resources through more energy efficient vehicle technology. The costs may be high in the short term, but the amount potentially saved will be more significant.

Conclusion

- It will be a challenge for Brunei to achieve the 0.33 tCO_2 per capita target in 2050 but is possible. This simulation proposes a mitigation potential from 2.66 tCO_2 to 0.45 tCO_2 per capita.
- Cleaner technologies for transport should be considered, as Brunei, as compared to the other Southeast Asian nations, is in a better economic position to do so.
- Similar to Singapore, Brunei has the advantage of being compact. Densification can be the future alternative to reduce travel demand.
- Urban and land use planning that would include city designs that manage car use would prove beneficial. Disincentives on car ownership such as increased taxation and fuel prices may also be considered. Ultimately, a good public transport option would be the most important factor in reducing car use in Brunei.
- Brunei will have to improve its public transport system and cease supporting high levels of car use.

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Cambodia

Prepared by Clean Air Asia

Present Society

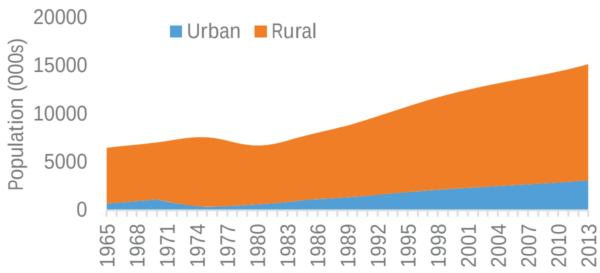


Figure 1. Population (000s)

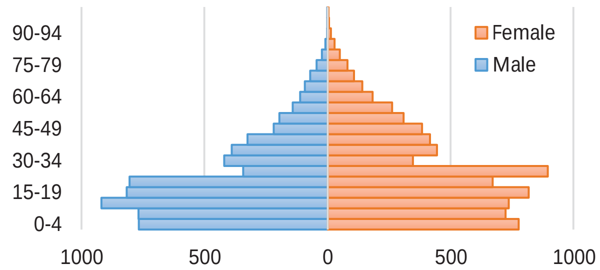


Figure 2. 2010 Population by Age (000s)

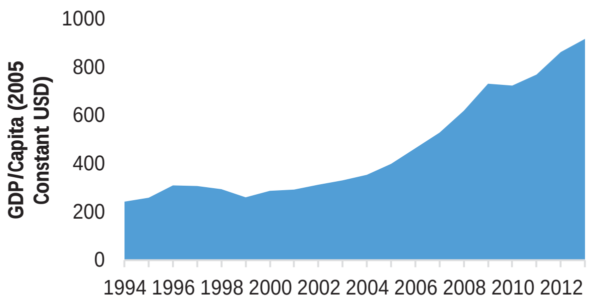


Figure 3. GDP/Capita (2005 Constant USD)

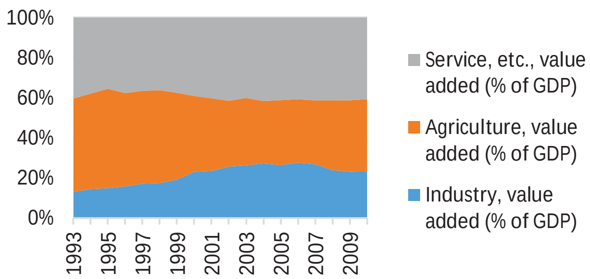


Figure 4. % Contribution of Sectors to the GDP

INTRODUCTION

- The Kingdom of Cambodia is bordered by Thailand to its west, Laos to its north, Vietnam to its east, and the Gulf of Thailand to its south.
- Cambodia's land area covers 181,035 sq. km. Phnom Penh, Cambodia's capital city, is located at the southern part of the country, occupying 0.37% of Cambodia. The country has a coastline of 443 km. Two significant water bodies are present within Cambodia: the Mekong River, which traverses from north to south of Cambodia, and Tonle Sap River, which is the largest freshwater lake in Southeast Asia located in the northwestern portion of Cambodia.
- Significant cities in the Cambodia, apart from Phnom Penh, include Battambang, Kampong Cham, Siem Reap, and Sihanoukville.

POPULATION

- The population of Cambodia as of 2008 census was 13.4 million, 51.4% of which were female.
- Its population density is about 81.2 persons per sq. km., but in Phnom Penh, the population density is nearly 2,213 persons per sq. km.
- Cambodia has grown at an average of 2.26% per annum from 1990 to 2013. Its urban population has grown at an average of 3.47% during the same period.
- Current level of urbanization is estimated at 20.4%

AGE STRUCTURE

- 50% of the population is in the working age of 20-64.
- Only 5% are 65 years old and above.

GDP per CAPITA

- Cambodia is still recovering from the civil war and remains to be a relatively poor nation. GDP per capita currently stands at about USD 917 (2005 Constant USD) and is increasing at an average of 6.88% from 1990 to 2013.

ECONOMIC STRUCTURE

- The service sector and the agriculture sector contribute about 40% and 36% to the total GDP, respectively. Timber, rubber and rice are among its main exports, as well as garments. The industry sector contributes a little over 20% of the GDP.
- While agricultural sector contributes substantially to Cambodia's economy, economic growth is mainly concentrated in the capital city. Since about 80% of its population live in rural areas and depend on agriculture for livelihood, the slow agricultural development results to a substantially large income gap. A large area of the country's lands is left underutilized, further hampering rural development.

Present Transport

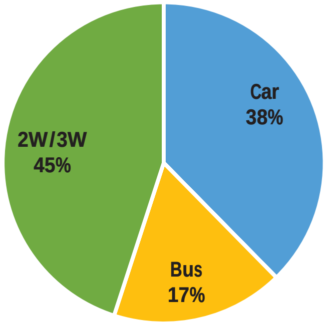


Figure 5. Passenger Transport Mode Share (% of PKM), 2010

Source: Study estimates

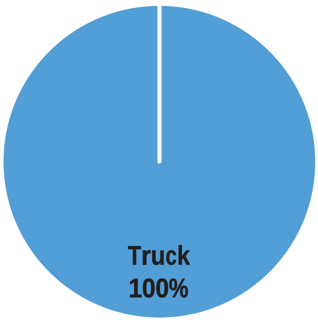


Figure 6. Freight Transport Mode Share (% of TKM), 2010

Source: Study estimates

Table 1. Population of Road Vehicles (2010)

Passenger vehicles

	No. of Vehicles	Percent
Car	241,9925	25.4
Bus	3,632	0.4
2W/3W	671,312	70.6

Freight vehicles

Truck	34,198	3.6

PASSENGER TRANSPORT

- Existing public transport modes in major cities are dominated by para-transit, namely motodops (motorcycle taxi), tuktuks (motorized auto rickshaws), and taxis.
- Passenger traveled distance as of 2010 is 46.2 billion person-kilometers. Passenger traveled distance increases by an average of 6.58% annually. Travel demand as of 2010 is highest through buses and two-wheelers. The tuktuk serves a large portion of travel demand in Cambodia, although data is very limited.
- Almost 100% of domestic passenger transport is road transport. The navigable inland waterways support the road transport.
- Road length is about 44,919 km, only 10% of which are paved (2012).
- Mass transportation in Cambodia is minimal, although buses serve inter-city travel. In February 2014, bus transit service has been revived for a one-month trial along Monivong Boulevard, a central thoroughfare in Phnom Penh, despite the failed attempt in 2001. The trial involves 10 buses running a 7.5-km. route.
- Its railway network consists of two lines, both originating in Phnom Penh: the north line connects it to Poipet which is close to the border of Thailand and the south line connects it to the Sihanoukville, Cambodia's main seaport.

FREIGHT TRANSPORT

- Freight traveled distance is about 10.2 billion ton-kilometers in 2010.
- Freight travel has been slow, rising by about 0.37% per year between 2005 and 2010. Low economic activity in these years stagnated freight travels.
- Almost all of freight travels has been through trucks. Only a small portion was through rail due to the limited capacity and worsening state of the rail.
- There is a cross-border trade with the Greater Mekong Sub-region (GMS) (Thailand and Vietnam). Cambodia has two major seaports, namely Phnom Penh Autonomous Port and Sihanoukville Port, and several coastal and river ports. Freight via rail is facilitated through the southern line linking Phnom Penh and the seaport of Sihanoukville.

ISSUES AND CHALLENGES

- Cambodia heavily relies on imported fossil fuel, resulting to high energy costs. However, hydropower resources are largely available, and off-grid projects such as solar power and biomass are in progress.
- Basic transport infrastructure is lacking in many areas of Cambodia, both urban and rural, and officials believe that developing rural infrastructure (including electrification) should be priority given that a large fraction of its population resides in such areas. However, there were nearly 80,000 cars and 220,000 motorbikes registered in Phnom Penh alone as of 2008 (Sovan, 2008). Such concerns–the resulting congestion in the urban capital, the large rural population and the lack of infrastructure in both areas–split the priorities of the government.

Future Society

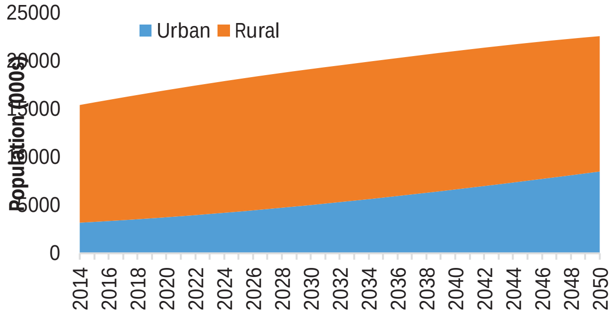


Figure 7. Population (000s)

POPULATION

- It is estimated that the population of Cambodia in 2050 will reach 22.6 million.
- The population will grow at an average of 1.17% per annum from 2005-2050. 37.6% of the population will be in urban areas by 2050, growing at an average of 2.70% per annum from 2005-2050.

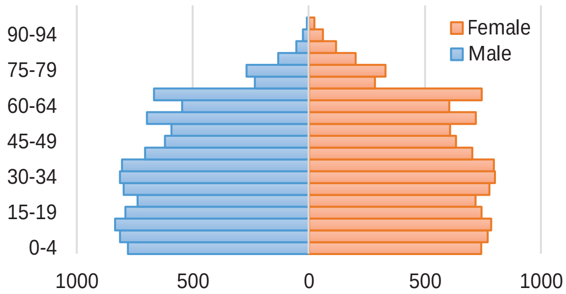


Figure 8. Population by Age (000s), 2050

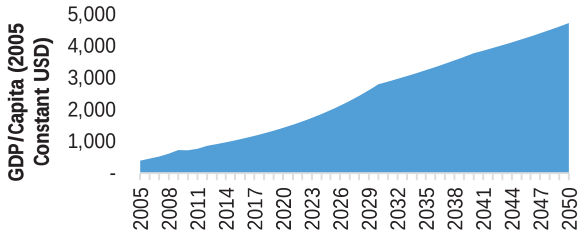


Figure 9. GDP/Capita Projections up to 2050

AGE STRUCTURE

- 66% of the population will be in the working age of 20-59
- Only 8% of the population are 65 years old and above.

GDP per CAPITA

- GDP per capita is projected to increase to USD 4,720 (2005 Constant USD).
- It is forecasted to grow at an average of 5.64% per annum over the period 2005-2050.

ECONOMY

- The government estimates that Cambodia will be a lower-middle-income country by 2015-2016. Economic growth is expected to be a priority alongside social progress such as continued poverty reduction as well as resolving income and gender inequalities, improvement in health care services and quality of education (De Carteret & Kunmakara, 2013).
- While its waterways could be a great advantage, cross-border trade is hampered by weak customs infrastructure (Cambodia Development Resource Institute, 2011).

Future Transport

PLANS AND VISIONS

- The study for the possible Master Plan for Railway Network Development has been submitted to Cambodia by Korea International Cooperation Agency (KOICA) in December 2013.
- No transport master plan is in place but a comprehensive transportation study is being conducted and will be completed at the end of 2014. According to Japan International Cooperation Agency (JICA), the target year for implementation of public transport system according to the 2035 Urban Transport Master Plan is 2035 (Di Certo & Channyda, 2012).
- In its Rectangular Strategy of 2008, energy policy reform is integrated within the four pillars of Cambodia to growth. The Green Growth Roadmap, adopted in 2009, emphasizes the need for energy-efficient vehicles.
- Cambodia and Vietnam signed the bilateral Treaty on Waterway Transport. This may potentially lead to an inter-country development of the river networks that can improve the state of water transport in the future.

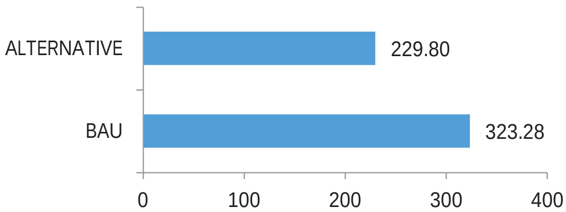


Figure 10. Passenger Travel (billion PKM), 2050

Source: Study estimates

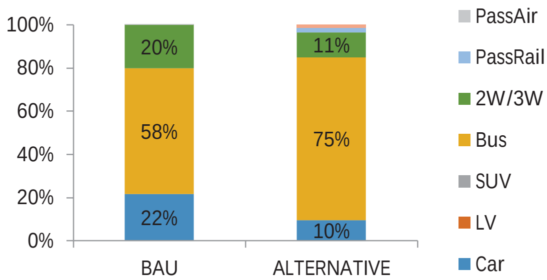


Figure 11. Passenger Mode Shares, 2050

Source: Study estimates

PASSENGER TRANSPORT

- In the BAU scenario, passenger traveled distance would increase to 201.7 billion passenger-kilometers as the mobility increases. The alternative scenario suggests a near-halved travel distance by 2050 at 229.8 billion passenger-kilometers.
- Car and motorcycle are expected to be reduced with the availability of more buses around the country. Public transport would accommodate 58% of overall travel demand.
- Motorcycle traveled distance is projected to increase by 4.7% under the BAU scenario. Alternative scenario suggests that there will be less demand for motorcycle use, thus the growth rate will be much slower at 2.6% annually towards 2050.
- Solar-powered tuk-tuks, or SolarTuks, launched in 2013 (De Carteret & Kimsay, 2013), are expected to roll off the assembly lines of an energy firm in Cambodia this year. Solar energy potential in the country is acknowledged to be huge primarily because there are few alternatives. Solar power initiatives have been increasing in the country especially in the rural households as a result of the government decision in 2009 to remove the 15% import duty on materials needed to build solar plants.

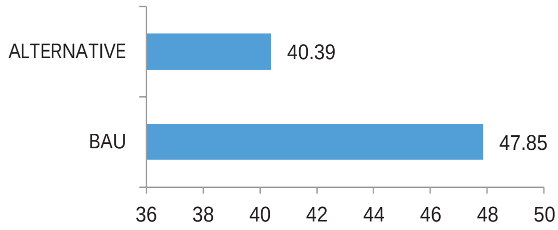


Figure 12. Freight Travel (billion TKM), 2050

Source: Study estimates

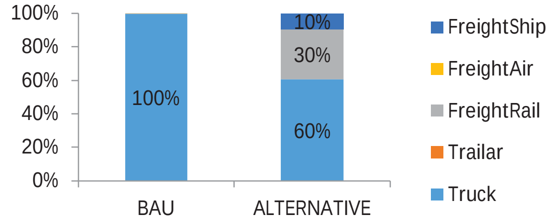


Figure 13. Freight Mode Shares, 2050

Source: Study estimates

FREIGHT TRANSPORT

- Meanwhile, freight travel demand is seen to increase to 47.8 B ton-kilometers in the BAU scenario. Alternative suggests a reduction of freight travel distance to 40.4 B ton-kilometers.
- Alongside the rehabilitation of railways, GMS has allowed for the development of the Southern Economic Corridor, and, Cambodia is benefitting from cross-border trade with Thailand and Vietnam.

ISSUES AND CHALLENGES

- Car use will surge by more than 8 times its current level by 2050, indicating a BAU scenario similar to the current state of neighboring Thailand. Alternatively, motorcycles will exceed car use similar to the case of Vietnam. The problems arising from these neighboring countries may reflect onto future Cambodia, therefore necessitating early action.
- The railway network in Cambodia dates back to 1930s and thus have poor infrastructure. The lack of efficient rail freight service results to road congestion.

Results of Simulation

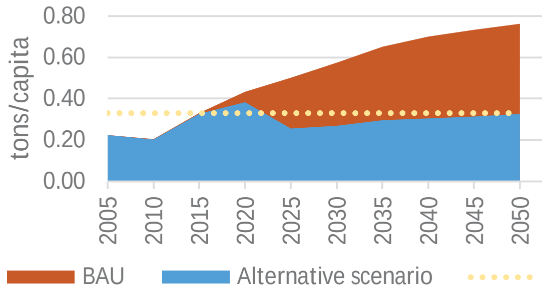


Figure 14. Tons CO2/capita

- Under the BAU scenario, Cambodia's transport sector will emit from 0.20 tCO2 per capita to 0.89 tCO2 per capita in 2050.
- The alternative scenario suggests a mitigation potential from 0.89 tCO2 to 0.43 tCO2 per capita in 2050, not reaching the target.
- Sources of mitigation are as follows:
- Bus service improvement
  - CNG and Hybrid vehicle promotion
  - Rail development and rehabilitation
  - Mekong River transport optimization
  - LRT implementation in Phnom Penh
  - Close monitoring of car use and car acquisition disincentives
  - NMT promotion as an alternative to motorcycles

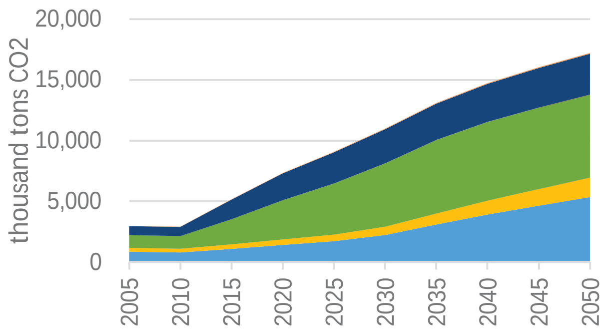


Figure 15. Total CO2 – BAU

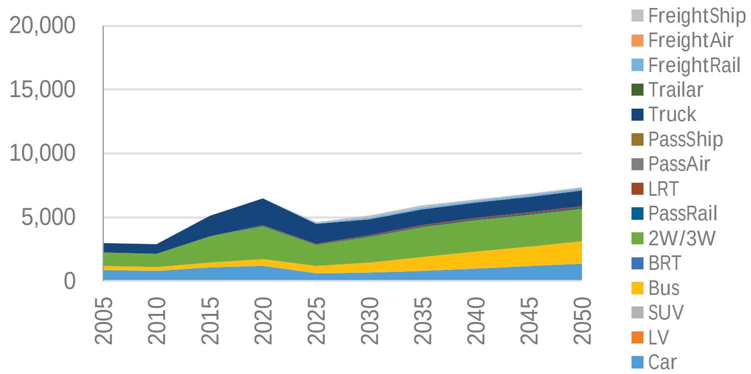
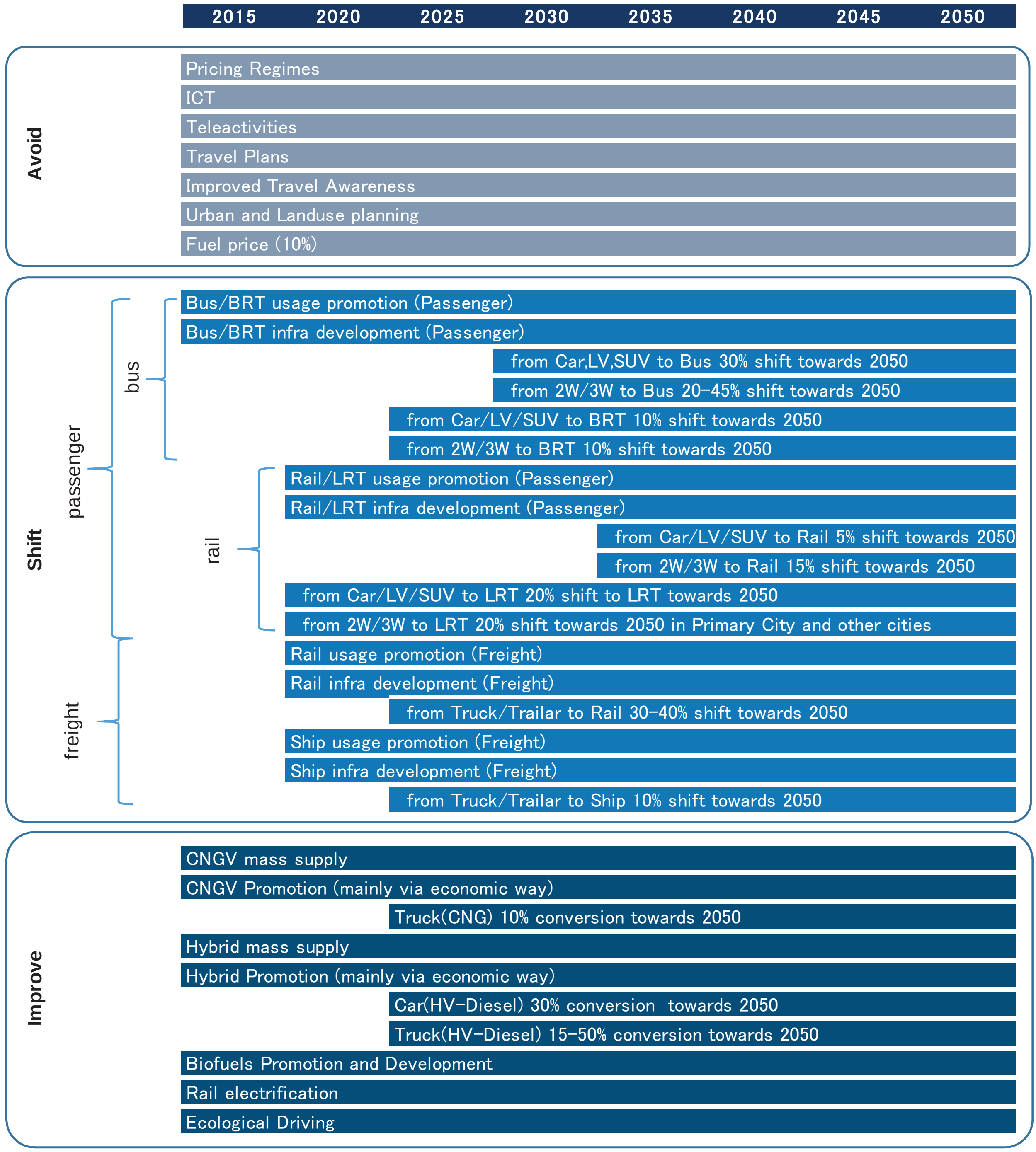


Figure 16. Total CO2 – Alternative

- In the BAU scenario, the largest emitters in Brunei will be cars and trucks. Cars will contribute up to 33% of all transport emissions in 2050 as citizens continue to utilize cars as their primary mode choice in the future. Although car ownership shows signs of saturation, car use will continue to be the top cause of emissions in the transport sector of Brunei.
- The total CO2 emissions from transport in 2050 (BAU) is 1.4 million tons.

- In the alternative scenario, the proposed time for CO2 reduction will be sometime between 2020 and 2025. It is expected that Cambodia will finish the studies it is currently embarking on transport by 2015, thus projects will be implemented from then on.
- Mitigation will be largely from private transport, as future citizens may opt not to acquire or use private vehicles in the future. This requires that alternatives to such modes will be provided for before demand sets in.
- Shifting to alternative cleaner fuels such as CNG will also be important, although the promotion of hybrid vehicles may be an alternative until such time when Cambodia is able to find sustainable sources of natural gas.
- The plans to rehabilitate and extend rail networks will be impertinent to reduce future truck traveled distance at the interregional level.
- In the future, Cambodia may look into optimizing its Mekong River transport system, just as the other countries along the river may do towards 2050.

Action Plan



Summary of Characteristic Policies and Corresponding Future Transport Image

	Characteristic Policies	Future Image
Passenger transport	Plans for railway development should be implemented. Para-transit, namely motodops (motorcycle taxi), tuktuks (motorized auto rickshaws), as well as taxis, should be organized so that implementation of cleaner technologies will not be as difficult. SolarTuks should begin to be manufactured. Improved para-transit could serve as feeder systems to buses, and bus transit should start replacing many of para-transit and serve as feeder system to the railways to be developed. Because Phnom Penh is starting to be congested, urban and land use planning should be studied and implemented in growing corridors and pricing regimes should be set in major roads so there will be a decrease need for motor vehicle ownership.	Para-transit will continue to dominate the road transport given that Cambodia will focus on road infrastructure for rural connectivity. Energy efficient vehicles will start to increase, but not significantly.
Freight Transport	The navigable inland waterways should support the freight sector. Plans to improve connectivity to rural areas should be implemented.	Trucks will continue to dominate the transport of goods alongside the development of roads, but with the improvement in railway system and the development of inland waterways, a fraction of the transport will shift from road to rail and water.

Challenges

- Inadequate and inefficient transport infrastructure restrains the economic development and poverty alleviation. This also implies that the disadvantaged groups, which form part of a large fraction of the society, have limited access to basic government services.
- Only a quarter of its land is urbanized. Rural electrification remains to be among top priority, hence physical infrastructure might take a while.
- Development of roads in rural areas could be a concern if it will accelerate illegal logging. Additionally, as the government is faced with ensuring rural electrification and the society is dependent on agriculture, Cambodia cannot sacrifice its food crop production for biomass. This could post an opportunity for other renewable energy projects such as hydropower and solar.
- Insufficient budget could be a key challenge in the development and paving of roads as well as the rehabilitation of its current transport system and installation of traffic control devices.
- Rehabilitation of railway networks also requires the need to relocate the people who reside along its corridors, and some railway projects have not realized due to the challenges involving resettlement and provision of new livelihoods to them.
- While it is essential that inspection and maintenance programs be in place as motor vehicles are expected to increase, one of its foremost pre-requisite is the availability of dat on vehicular emission and characteristics of vehicle fleet. Cambodia is only recently beginning to address this (National Institute of Statistics, 2012).

Co-Benefits

- Congestion in Phnom Penh is starting to concern its citizens. Average travel speed in Phnom Penh significantly dropped in just a period of 10 years.
- About 68% of traffic accidents involve motorcycles as a result of over-speeding and drunk-driving. Many of its current transport initiatives aim at ensuring safety, such as improvements in road signals.
- With a reasonable fare, bus transit can provide service to both high- and low-income users, allowing for more equitable access, whereas rail transit cover limited geographical coverage and its rehabilitation will displace many people living along its corridors. The bus transit can reduce the dependence of an economy to petrol use as a result of reduced congestion. The increase in mobility of the population, the decrease in travel time and the reduction of fuel use as a result of the decrease in congestion and of the inclusivity of the bus transit system, translate to economic savings.

Conclusion

- Cambodia has a relatively clean slate in terms of future transport. The advantage is that through the Backcasting tool, it has a wide horizon of opportunities to tackle sustainable transport.
- This simulation proposes a mitigation potential from 0.89 tCO_2 to 0.43 tCO_2 per capita in 2050, thus it is seen that Cambodia can maintain its low emission per capita towards the future.
- Mitigation requires early action. Important considerations are disincentives for motor vehicle use and ownership and the promotion of public transport.
- Inspection and maintenance is a fundamental step toward emission abatement in road transport, but Cambodia must address its transportation data gaps.
- Cambodia must begin reinforcing its regional planning system to ensure that mobility and future developments do not hinder each other. Similar to its neighboring countries, is crucial then for institutions to have adequate capacity to implement these systems and development plans.

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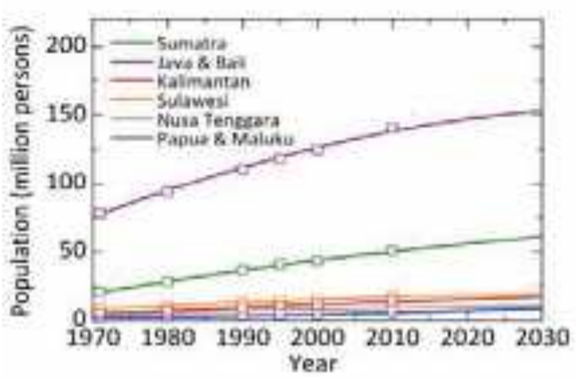
Indonesia

Prepared by Danang Parikesit, Damantoro, Yusa Cahya Permana

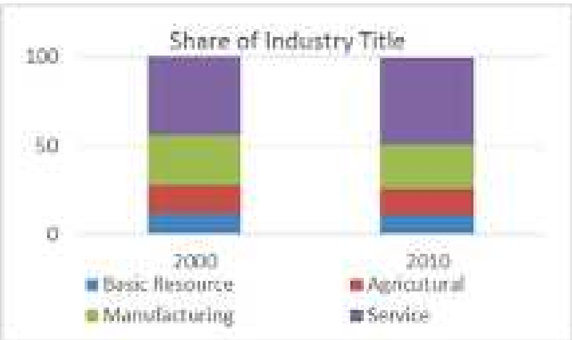
Present Society

POPULATION



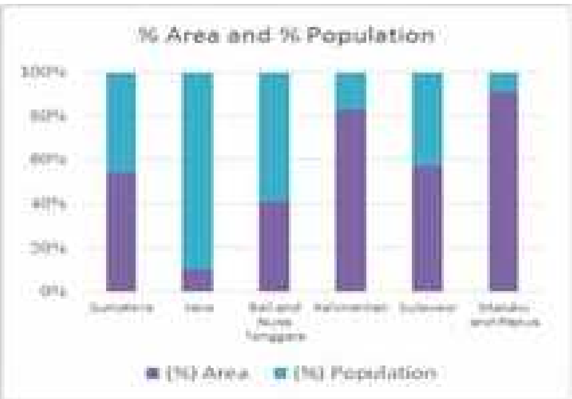
- Indonesia is 4th biggest country by population with 240 million people
- Population growth rate at around 1,4% per annum
- Demographic concentrate in Java and Sumatera Island with up to 80 percent of population people
- Has young and productive demographic with 66 percent of people within 15-64 years.
- Average family size is 4-5 people.
- Domestic migration drives rapid urbanization in major Indonesia cities.

ECONOMY



- Indonesia economy have been growing at 5% per annum over the last five years despite of global economic downturn
- Strong domestic consumption and increasing share of services industries built up most of Indonesia economy
- Java continues as the economic center contributing 58% of National GDP
- Middle income people built up 60% of total population with average income of USD 3.800
- Unemployment > 6% and poverty rate > 11%

LAND USE AND DEMOGRAPHIC DISTRIBUTION



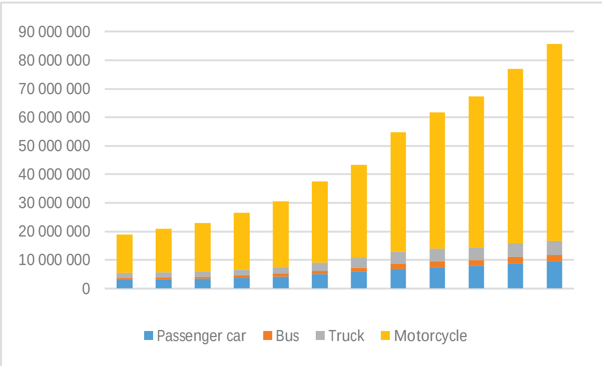
- Jawa and Sumatera only have 33% of total Indonesian area but inhabited by 82% of total Indonesian population in 2012
- Java Island is the most developed and populated island
- Since 2010, more than 50% population are living in urban area
- Current population's distribution pattern is characterized by population mostly live in Java-Sumatra area
- Manufacturing and other highly added value industries mainly located in Java

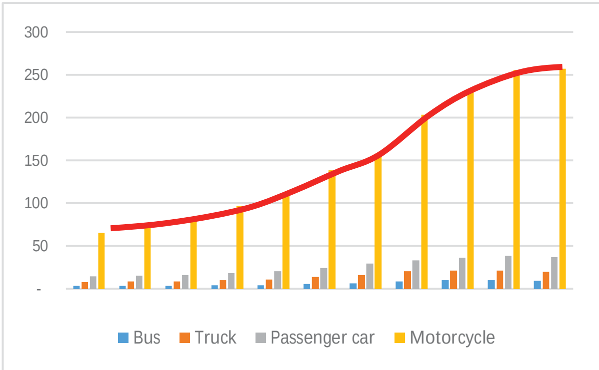
Present Transport

No	Item	Present Condition
1	Transport Energy	Dominated by oil fuel
2	Urban Transport Performance	High fuel inefficiency, high accident rate, high transportation cost 10-17 km average urban daily trip 10-21 km/h average speed Declining share of public transport Low average vehicle speed
3	Transport Emission*	80% Regional transport, 15% Urban transport, 4% others
4	Transport mode share	Domination of motor cycle
5	Transport system	Dominated by road based transport
6	Transport infrastructure	Dominated by road infrastructure
7	Vehicle Technology	Domination of fuel combusting engine technology
8	Inter-island movement	Dominated by road based transport
9	Freight Transport	90% road based transport domination

*ICSSR-Bappenas, 2010

Vehicle Number and Ownership





Source: BPS, 2013

Congested Urban Area

City	Bandung	Bogor	Depok	Bekasi	Tangerang	Bodetabek
km/h	14.30	15.32	21.40	21.86	22.00	20.12
City	Surabaya	Medan	Makassar	Semarang	Palembang	Metro City
km/h	21.00	23.40	24.06	27.00	28.54	24.80

Source: Perhubungan dalam Angka, 2013

Future Society

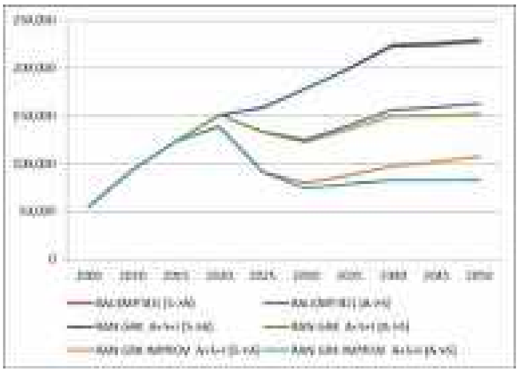
- Absolute social condition will be improved especially in term of health, education, and life expectancy.
- Technology will continue to develop and enhance social interaction and activity instead of replacing it.
- Private vehicle and property remain as social and economic symbols for most of the population except for only a little number of people with high education and experience living abroad.
- Gap of income and welfare will remain and become social challenge but with smaller gap due to steady growth of employment opportunity.
- Higher environment awareness lead to greater demand for environment protection.
- Most people will live in urban area as a result of rapid domestic migration.
- Due to land space constrain, urban sprawling will be more intensified with more people will live in high raised residential buildings.
- Dynamic and mobile urban lifestyle is common lifestyle for the most of population.
- Motorized travel activities will continue to growth as income increase.

Future Transport

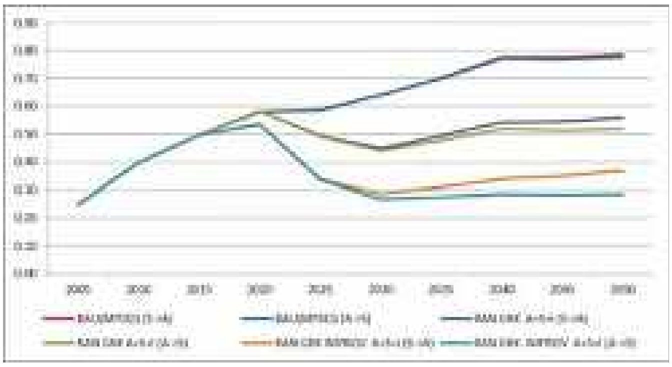
No	Item	Future Vision
1	Transport Energy	25 percent share of renewable energy
2	Urban Transport Performance	More efficient transport 10-15 km >30 km/h average speed More efficient mobility
3	Transport Emission*	63% Regional transport, 24% Urban transport, 12% others
4	Transport mode share	Domination of motor cycle but smaller proportion to total caused by increase number of car
5	Transport system	Increase role of rail, sea, and air transport
6	Transport infrastructure	More development of rail infrastructure, sea port, and airport
7	Vehicle Technology	Higher use of hybrid and electric vehicle for both car and motorcycle
8	Inter-island movement	More integrated multi modal inter-island transport
9	Freight Transport	Increase of rail and sea transport in freight movement

*ICCRS, 2010

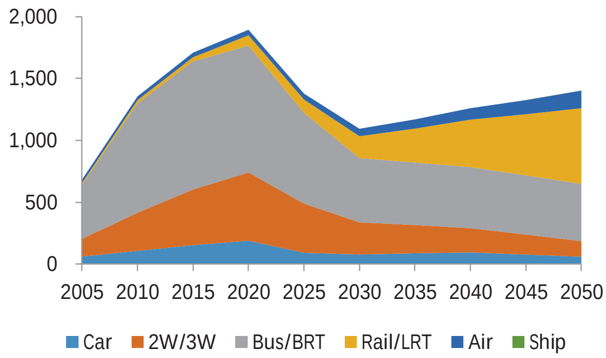
MODAL SHIFT		Target Percentage			Target Year
From	To	BAU	RAN	IMP RAN	
Car, LV, SUV	Rail	10%	15%	45%	2050
Car, LV, SUV	Bus, BRT	4%	8%	20%	2050
2W/ 3W	Rail	6%	10%	45%	2050
2W/ 3W	Bus, BRT	8%	8%	20%	2050
Bus/BRT	Rail	15%	30%	40%	2050
Truck/ trailer	Ships	10%	15%	25%	2050
Truck/ trailer	Train	10%	10%	35%	2050
Air	Ships	-	6%	10%	2050
Air	Train	-	6%	10%	2050



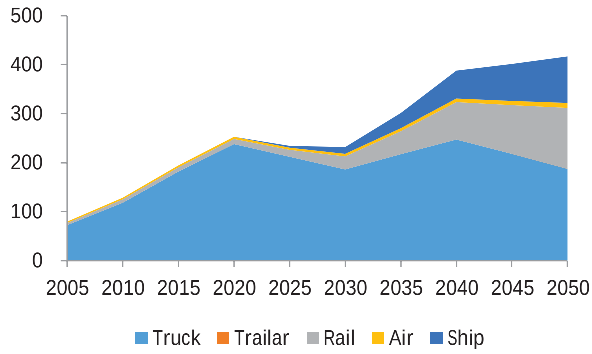
Total Emission (Million ton Co2/year)



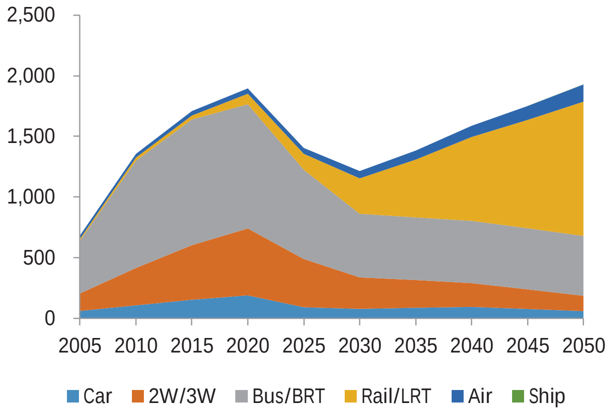
Emission per Capita (Million ton CO2/year/capita)



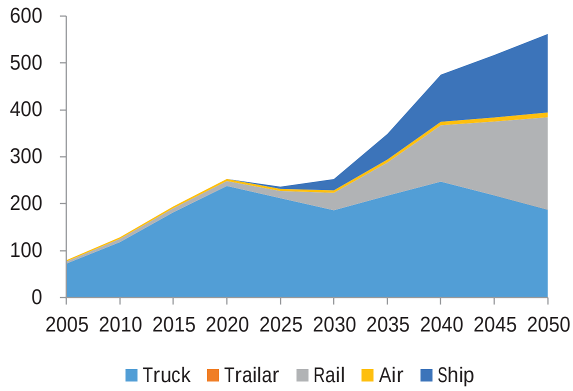
Improved RAN Passenger Transport Demand A->S (BPKM)



Improved RAN Freight Transport Demand A->S (BTKM)



Improved RAN Passenger Transport Demand S->A (BPKM)



Improved RAN Freight Transport Demand S->A (BTKM)

ACTION PLAN

	2015 – 2020 – 2025 – 2030 – 2035 – 2040 – 2045 – 2050
Avoid	Pricing Regimes
	ICT
	Teleactivities
	Travel Plans
	Car Ownership
	Improved Travel Awareness
	Freight Transport Subsidiarity
	Freight Dematerialization
	Urban and Land Use Planning
	Fuel Price Increase (10% in 2015 additional 25% in 2025)
	2015 – 2020 – 2025 – 2030 – 2035 – 2040 – 2045 – 2050
Shift	Railway Promotion and infrastructure development , with target: - 45% Modal shift from private vehicle (LV, Car, SUV) into railway by 2050 - 45% Modal shift from motorcycle into railway by 2050 - 40% Modal shift from BRT/ bus into railway by 2050
	Bus, BRT Promotion and Infrastructure Development , with target: - 20% Modal shift from private vehicle (LV, Car, SUV) into Bus/BRT by 2050 - 20% Modal shift from motorcycle into Bus/BRT by 2050
	Railway Freight Promotion and Infrastructure Development , with target: - 35% Modal shift from truck/trailer freight into railway freight by 2050 - 10% Modal shift from air freight into railway freight by 2050
	Ship Freight Promotion and Infrastructure Development , with target: - 25% Modal shift from truck/trailer freight into ship freight by 2050 - 10% Modal shift from air freight into ship freight by 2050
	2015 – 2020 – 2025 – 2030 – 2035 – 2040 – 2045 – 2050
Improve	CNG Vehicle Introduction , with target: : - 40% Energy shift for Car, LV from Gasoline into CNG by 2050 - 30% Energy shift for SUV from Gasolineinto CNG by 2050 - 30% Energy shift for bus from Diesel into CNG by 2050 - 60% Energy shift for BRT from Diesel into CNG by 2050 - 30% Energy shift for truck and trailer from Diesel into CNG by 2050
	Hybrid Vehicle Introduction, with target: : - 20% Energy shift for SUV, Car, LV from Gasoline into Hybrid-Gasoline by 2050 - 20% Energy shift for bus, BRTfrom Diesel into Hybrid-Diesel by 2050 - 10% Energy shift for truck from Diesel into Hybrid-Diesel by 2050 - 5% Energy shift for trailer from Diesel into Hybrid-Diesel by 2050
	Electric Vehicle Introduction, with target: : - 10% Energy shift for Car, LV, SUV from Gasoline into EV by 2050 - 50% Energy shift for 2w/3w from Gasoline into EV by 2050
	Biofuel Introduction, with target mixing percentage : - 5% by 2015 - 10% by 2015
	Rail Electrification, with target electrification 30% by 2050
	Air Fuel Efficiency
	Ship Fuel Efficiency

Level	Characteristic Policies	Future Image
National	National policy is planning and implementation guideline for local government policies. The National level targeting: • Increase share of renewable energy based vehicle • More efficient and reliable urban transport system and mobility • Reduce dependency on private vehicle by shiftting into public transport system with the development and promotion of modern public transportation system • Reduce consumption of fossil fuel with behavioural change, transportation planning, reduction of physical mobilities, and more energy efficient vehicle technologies, etc • Reduce dependency on road based freight system by developing and promoting rail and ship based freight system	• National transportation system will be based mostly on public transport system especially on urban areas • National freight system will see much higher share for ship and rail based system • Reduction of dependency on fossil fuel as the main energy source • Better transportation behaviour and much more efficient mobilities
Regional	Regional policies will be the regional implementation of national policies. It should be flexible enough to maximize CO2 emssion reduction by taking into a count local variables. Example : • Jakarta as Primary City can implement almost all of national level policies such as railway system optimization, extensive BRT system, multiple energy source implementation program except geographical related condition such as ship freight because of the local condition does not enable it to be optimally implemented	• Jakarta mostly depend on public transportation system especially railway sytem in addressing mobility needs of its population • Other large cities will also tremendously reduce the dependency on private vehicle replaced by new, modern and reliable public transport system • TOD will be implemented to tackle land use, mobility and distence issues • Renewable energy based vehicle will be implemented to tackle private vehicle emission

Challenges

Improve policy:
Huge and expensive investment on new technologies
Behavioral challenges for the population

Shift policy:
Huge dependency on private vehicle use
Poor condition of current public transport
Huge investment requirement for public transport system
Huge dependency on road based freight system
Relatively low interest on rail and ship based freight system for domestic use

Avoid policy:
Behavioral challenges from the population
Requirement for good telecommunication technologies and infrastructures
Law and regulation on land use planning and implementation
Resistance on the implementation of car ownership related issues

Co-Benefits

- IMPROVED RAN scenario will **reduce energy consumption** up to 65% while RAN scenario will reduce up to 39% compared to BAU in 2050.
- Despite of consumption reduction, both scenarios still **allow for transportation volume growth.**
- The emission reduction serves as a **new indicator and target for development agenda.** This new target will create need for coordination and harmonization of development agenda. This particularly will improve development planning process and implementation coordination.
- The emission reduction actions stated in RAN and RAD GRK will create opportunity for new and **greener economy**. Soon the government will give more incentive for green economy or industry to attract investments.
- As void policy implementation will bring more opportunities for policies of **integration between land use and public transport development**. Investment for both sectors can be coupled in on development program.

Conclusion

- Implementation of current action plan will **not achieve national target and global commitment.**
- **Improving national action plan will** further **reduce significantly** transport GHG emission.
- The government **requires** an introduction of **various "avoid" measures** and providing options for energy supply in transport.
- This intervention **calls for** a policy to influence **behavioral changes.**
- GHG mitigation policies will **also improve passenger and freight transport efficiency**, thus the competitiveness of the transportation system; and reducing energy consumption.
- **More progressive policy measures and transport investment** should be immediately taken by the government.
- **Shift to more advance vehicle technology and cleaner fuel** options
- Push policy for transport **behavioral changes.**
- Largest benefit on the energy consumption (61% reduction), congestion relieve (35% reduction).
- Combination of transport competitiveness, energy efficiency and GHG emission reduction will help the Indonesian government **achieving global climate change commitment as well as improving the economic and local environmental condition.**

Lao PDR

Prepared by Clean Air Asia

Present Society

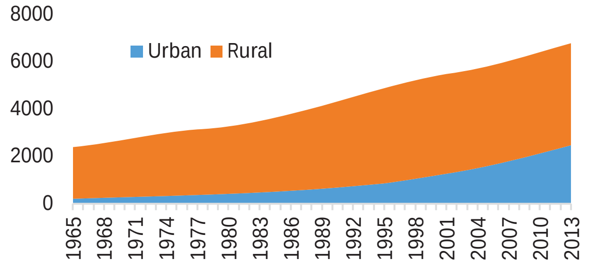


Figure 1. Population (000s)[1]

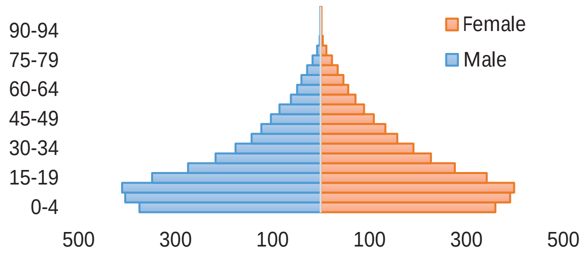


Figure 2. Population by Age (000s), 2010[2]

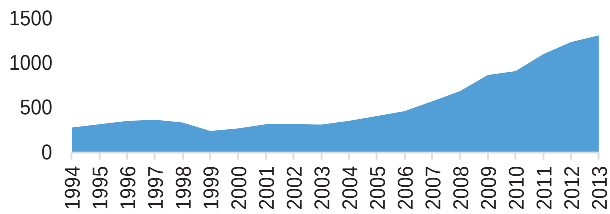


Figure 3. GDP/Capita (2005 Constant USD)[3]

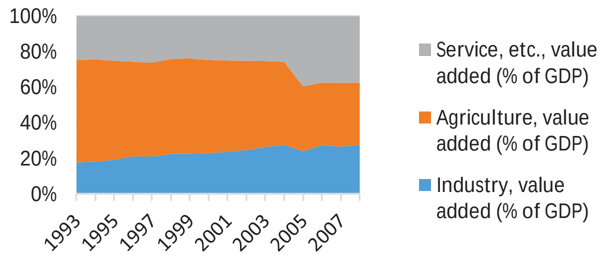


Figure 4. % Contribution of Sectors to the GDP[4]

INTRODUCTION

- Officially known as Lao People's Democratic Republic (Lao PDR), "Laos" is a landlocked country with a land area covering 236,000 sq. km. It is bordered by Vietnam, Thailand, China, Cambodia and Myanmar. Its capital and largest city is Vientiane. Other notable cities are Pakse, Luang Prabang and Savannakhet.

POPULATION

- As of 2013, the estimated population of Laos is 6.8 million. It has grown at an average 2.05% over the period 1990-2013.
- The urban population is only about 35% as of 2012, but has grown at an average of 5.92% annually since 1990 (UN, 2011).

AGE STRUCTURE

- Laos has a young population base, with 40% of the population aged 0-14 years.
- 52% of the population belongs to the age of 15-64, with a high labor force participation rate for both adult males and females at 79.5% and 76.5% respectively as of 2011.
- 4% are aged 65 years and over (UN, 2012).

GDP per CAPITA

- GDP per capita is at USD 1,312 as of 2013, which is one of the lowest in Southeast Asia, but has grown annually by 9.34% from 1990-2013 (World Bank, 2013).
- The United Nations categorizes Laos as one of the least developed countries (LDCs) in the world.

ECONOMIC STRUCTURE

- Laos is still primarily an agricultural country, with about half of its GDP coming from the agricultural sector. Part of the socio-economic development plan is to expand agricultural and forestry industries in the future.
- Its economy is benefitting from foreign aid and foreign direct investments like massive hydropower projects, logging and construction.

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1 United Nations. 2012 and United Nations. 2011.
2 United Nations. 2012.
3 World Bank. 2013.
4 World Bank, 2013.

Present Transport

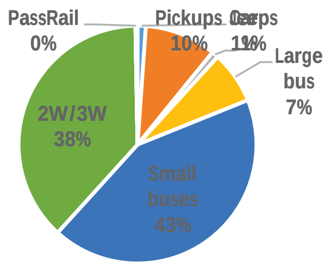


Figure 5. Passenger Transport Mode Share (% of PKM), 2010

Source: Study estimates

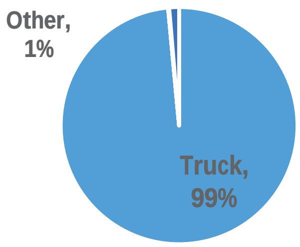


Figure 6. Freight Transport Mode Share (% of TKM), 2010[5]

Source: Study estimates

Table 1. Population of Road Vehicles (2010)

Passenger

	No. of Vehicles	Percent
Cars	11,204	3
Pickups	42,994	10
Jeeps	8,668	2
Large bus	4,234	1
Small bus	4,862	1
Motorcycles	345,762	80

Freight

Trucks	13,441	3

PASSENGER TRANSPORT

- Current passenger-km estimates show that the mode split between private and public transport are almost equal (50% each).
- However, motorcycle travel is increasingly becoming an important mode of travel, covering 10.4 million passenger-kilometers in 2010. Between 2005 and 2010, travel by motorcycles has been increasing by an average of 25% per year. At the same time, motorcycle ownership has been increasing by about 6% per year. This is an indication of increasing demand for mobility.
- Motorcycles not only serve as household vehicles but also as informal intermediate public transport in the form of tuktuks which are suitable for the generally rural characteristic of the country.

FREIGHT TRANSPORT

- Virtually all of freight transports in Laos are on trucks, covering high distances especially on the interregional level.
- Freight travel of trucks in 2010 reached 5.3 million ton-kilometers. Traveled distance of freight has been increasing by about 14% per year since 2005.

ISSUES AND CHALLENGES

- The government of Laos has been heavily investing in new road infrastructure but falls short on road rehabilitation due to lack of funding capacity.
- Laos depends heavily on external assistance for transport infrastructure development. According to a report from OECD, the spending on road infrastructure from 2008 to 2010 amounted to USD 88.5 million, 55% of which came from external assistance.
- Among the biggest challenges for Laos is its high dependence on road transport for both passenger transport and freight due to the lack of railway networks and maritime infrastructure (despite the presence of Mekong River and its tributaries). Infrastructure is likewise underdeveloped in rural areas.

Future Society

VISIONS

- By 2020, Laos aims to lose its status as a Least Developed Country. To achieve this, Laos aims to restructure its economy, increase support for agricultural and industrial development.
- Laos envisions becoming an important transit country similar to its neighbors Thailand and Vietnam.

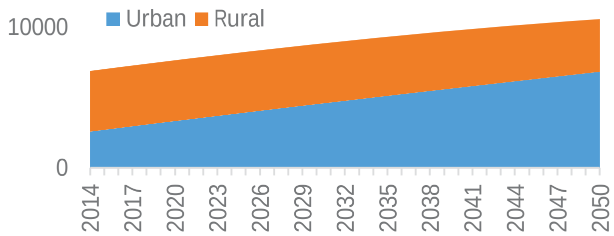


Figure 7. Population (000s)[6]

POPULATION

- Laos' overall population is expected to grow on the average by 1.35% per annum from 2005-2050. Its urban population is expected to grow by 3.3% annually over the same period, comprising 65% of the total population.
- It is expected to reach 10.6 million.
- In 2050, population in the Laos will increase by +56% its current size.

[5] Air freight is at .004%. Water transport is 1%.

[6] United Nations. 2012 and United Nations, 2011.

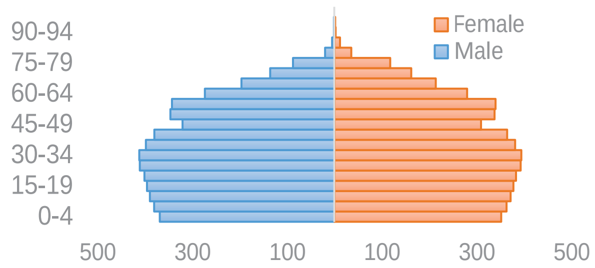


Figure 8. Population by Age (000s), 2050[7]

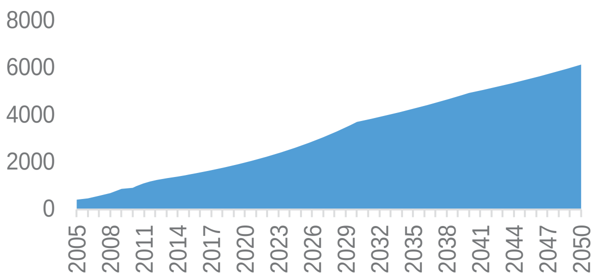


Figure 9. GDP/Capita Projections up to 2050[8]

AGE STRUCTURE

- By 2050, Laos' workforce is expected to comprise 62% of the population, potentially increasing domestic production and improving the economic activity of the country.
- Dependency ratio may potentially increase to 31% (21% young dependency and 10% senior dependency).

GDP per CAPITA

- Laos' GDP will increase annually by 9% towards 2030, reaching USD 3,713 per capita. By 2050, this will double, attaining USD 6,148 per capita.
- Average annual growth for Laos is estimated at 6.21% from 2005 to 2050, which is currently close to the growth rates of neighboring industrializing countries in Southeast Asia.

ECONOMY

- Laos is envisioned to continue to support its agricultural sector and will develop into agro-industries in the long run. Laos may also accelerate its growth through the mining industry.
- Recognizing its hydropower resources and potential because of Mekong River, Laos is looking into selling electricity to its neighbors by building more dams to support hydroelectric projects, becoming the "battery of Southeast Asia."
- Foreign direct investments is expected to continue to thrive in Laos as the government provides incentives for such in addition to giving corporate income tax exemptions of up to 10 years.

Future Transport

PLANS AND VISIONS

- The Land Transport Master Plan for Laos has been drafted (2013). Among its major thrusts are the following: land use planning, environmentally and people-friendly urban transport infrastructures, vehicle emission control and other inspection and maintenance programs, cleaner fuels, road safety and maintenance, and non-motorized transport.
- Laos can potentially become the "transit nation of Southeast Asia" due to its strategic location.
- The Master Plan comprises a road network development plan, public transport development plan and a transport management plan.
- Relevant plans covering the transport sector include Comprehensive Vientiane Capital Urban Transport Master Plan in 2008 and Vientiane Capital Urban Master Plan in 2011.

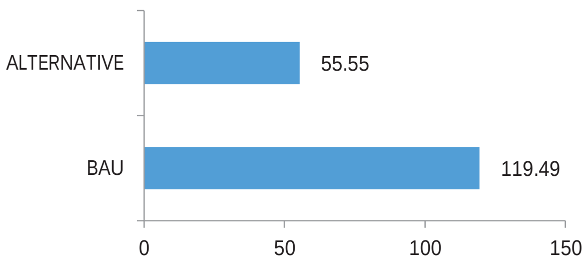


Figure 10. Passenger Travel (billion PKM), 2050
Source: Study estimates

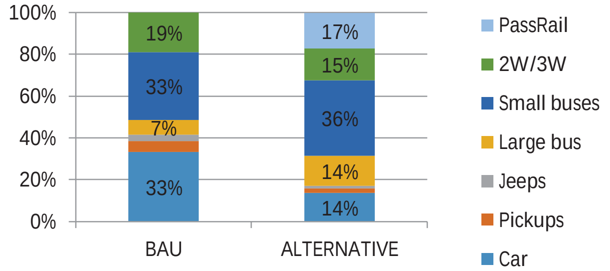


Figure 11. Passenger Mode Shares, 2050
Source: Study estimates

PASSENGER TRANSPORT

- The alternative scenario suggests a reduction of trips to from a potential 119.5 billion passenger-kilometers to 55.55 billion passenger-kilometers in 2050, particularly with the mitigation impacts of avoid policies such as land use planning. Higher public transport shares are also expected (67%).
- As Laos approaches becoming the transit nation of Southeast Asia, large developments of its rail and bus systems are expected in the future.
- Car ownership rates are expected to grow rapidly due to the rapid economic development, the right policies and early transport and traffic management can mitigate the need for vehicle ownership, allowing for increased share of travel for larger more efficient buses that cover high distances around the country.

[7] United Nations, 2012.
[8] ADBI. 2012 and United Nations, 2012.

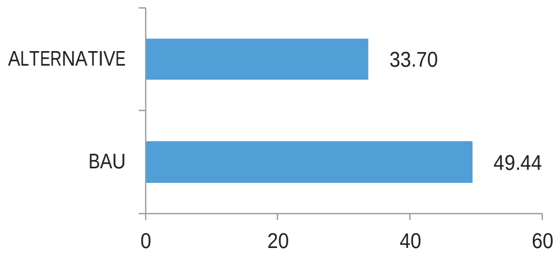


Figure 12. Freight Travel (billion TKM), 2050

Source: Study estimates

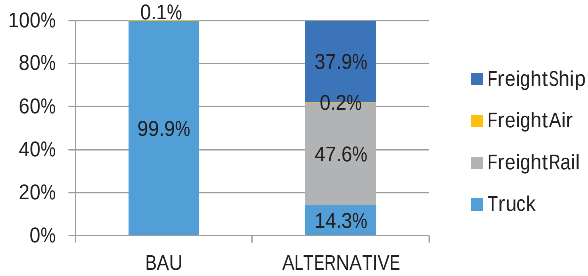


Figure 13. Freight Mode Shares, 2050

Source: Study estimates

FREIGHT TRANSPORT

- Freight transport is expected to be reduced from 49.4 billion ton-kilometers to 33.7 billion ton-kilometers in 2050 in the alternative scenario, which simulates a diversified freight transport system (significant contributions from rail and water-based freight).
- Rail freight is expected to increase in travel shares assuming that the railway systems are strengthened and prioritized. Inland water freight is also expected to play a key role in the future freight transport in Laos, as it utilizes its river network.

ISSUES AND CHALLENGES

- Diversification of the transport services and provisions for ensuring access and efficiency in the transport sector are key challenges for Laos as it moves towards development.
- Laos currently has plans to invest a total amount of USD 7.2 billion for developing rail transport within the country. The goal is to link Laos to China, Thailand and Vietnam. Railway development will be essential for Laos in the future.

Results of Simulation

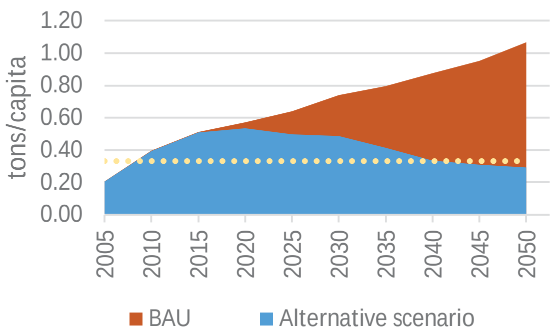


Figure 14. Tons CO2/capita

- The simulations using the Backcasting tool show a mitigation potential from 1.07 tCO_2 per capita to 0.29 tCO_2 per capita in 2050 (alternative vs BAU).
- In the medium-term (up to 2030) CO_2 mitigation will be driven by the impacts of avoid policies and the provision of future rail services (seen as the country's priority in order to achieve becoming a transit country in the Southeast Asian region). From 2030 onwards, CO_2 will decrease further as small buses decrease in favor of larger buses for passenger transport while rail and river freight transport will become more prominent.
- The demand for CNG will increase the region, and given that Laos is looking into improving its current fleets, Laos is anticipated to consider CNG. In 2050, Laos will be in a better position to look into adopting cleaner technologies for both passenger and freight transport.

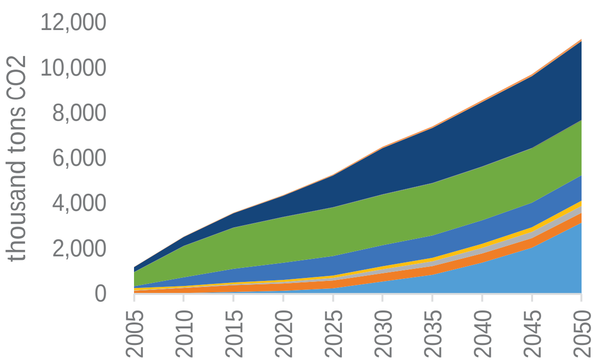


Figure 15. Total CO2 – BAU

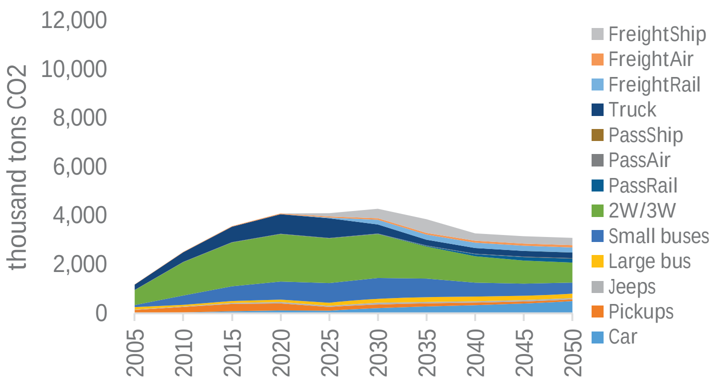
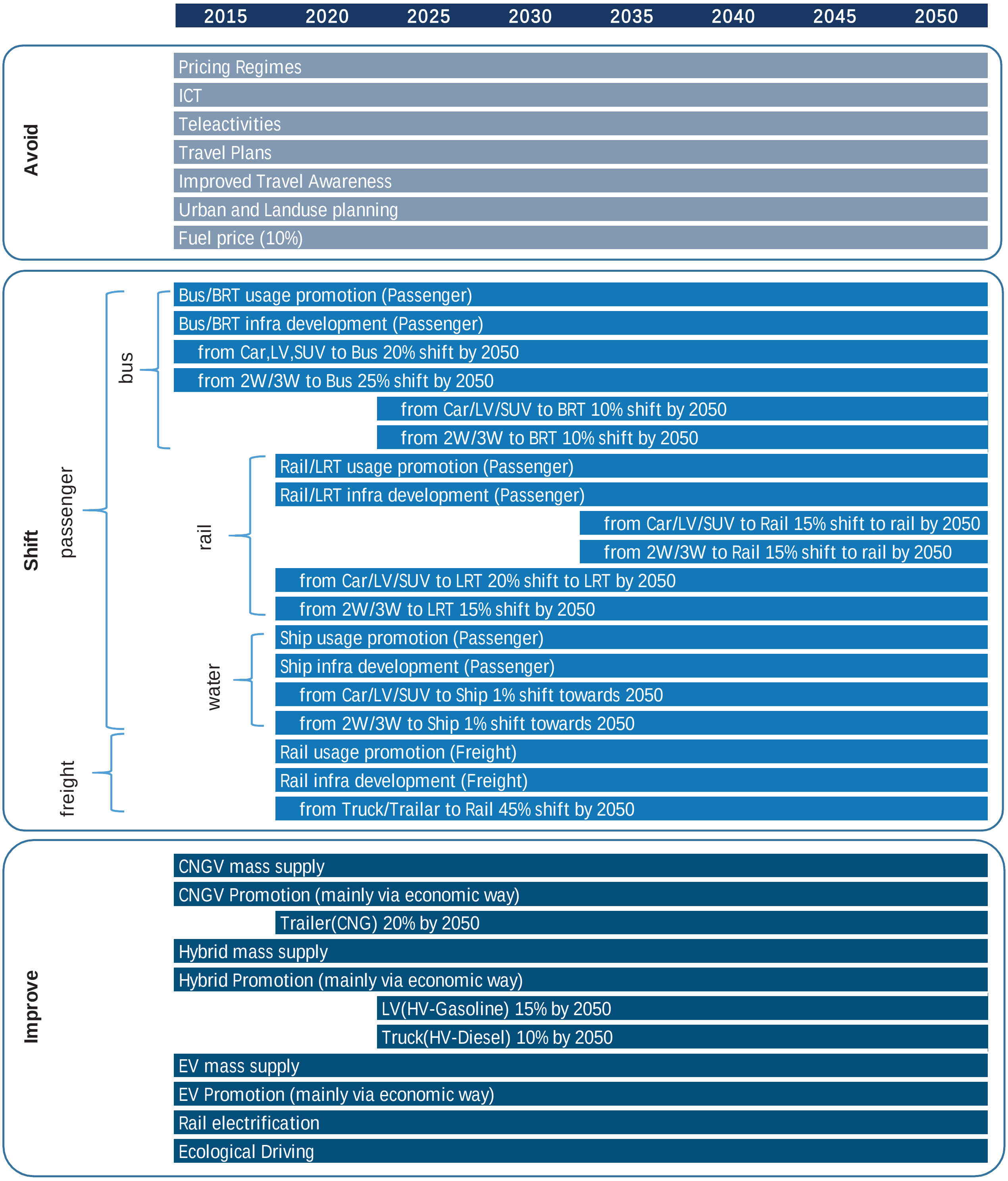


Figure 16. Total CO2 - Alternative

- Total CO_2 emissions from transport are simulated to grow by more than 9 times vs 2005 (11.2 million tons in 2050, 1.1 million in 2005).
- Under the BAU scenario, the largest emitters of future Laos will be its trucks, cars and motorcycles, accounting for a total of 48% of national CO_2 emissions.
- In the alternative scenario, CO_2 will have been controlled from 2015 onwards by increasing the share of large buses, thus reducing emissions from the numerous small buses on the road. These buses are expected to run on clean fuels. Hybrids will also be more prominent in the future.
- The alternative scenario total CO_2 is 72% lower (3 million tons) than the BAU.

ACTION PLAN



	Characteristic Policies	Future Image
Passenger Transport	Buses should be promoted and there should be strategic selection of the corridors as they can act as a catalyst for area developments. Buses should also be able to reduce the motorcycles on the road, and they could act as feeder transport to a light rail transit which should also be developed in Vientiane. Motorcycles should have cleaner technologies (e.g. four-stroke engines). EV should be introduced especially in Vientiane and Luang Prabang. The capacity of Vientiane Capital State Bus Enterprise (VCSBE) should be enhanced accordingly. Better land use planning should be implemented alongside the urbanization to ensure cycling and walking infrastructure development.	The cities in Laos will have adequate and quality bus services. Rail-based systems will also play a role in serving the populace, particularly in meeting inter-regional transport demand.
Freight Transport	Inspection and maintenance program to abate emissions should be established, and Intelligent transport system should be implemented for efficiency. Inland waterways should be optimized to reduce the trucks on the road.	Freight will still be dominated by trucks but inland water transport is expected to become more dominant and preferred due to inadequate connectivity to rural areas.

Challenges

- The priorities of the government are split among various socioeconomic development projects and rural accessibility.
- Poor rural and sub-urban road infrastructure will have to be addressed immediately as many provincial districts remain to be inaccessible by road, further widening income gap between the rural and urban population.
- Laos will have to promote and convert its public transport to run on cleaner fuels and shift the motorcyclists as well as the commuters of small buses to using mass transit. However, building infrastructure for larger buses and for railways will entail financial investments–an expenditure that Laos cannot easily allot for.
- As Laos primarily depends on road transport, inspection and maintenance programs should be in place. Trucks continue to go beyond the allowable load limits and have poor fuel economy. However, one of its foremost pre-requisite is the availability of reliable data on vehicular emissions and on the characteristics of existing vehicle fleet such as the number of vehicles, age, types of engines and emissions, and mileage. Laos does not yet have a sophisticated database for such types of information.

Co-Benefits

- Due to the lack of paved road networks and organized transit systems, rural accessibility remains a problem. The rural population remains to be very poor. As the government improves the connectivity between urban and rural areas, and agricultural activities thrive, the rural community can participate more as the government plans for hydropower projects which could also generate employment.
- Higher public transport shares in the future can lead to reducing road accidents, which currently mostly involve motorcycles.
- Strengthening the capacity and quality of the public transport systems will play a key role in alleviating the impending motorization growth in Laos, and will be translated in terms of lower fuel and energy demand, air pollution and other externalities.

Conclusion

- The simulations show a mitigation potential from 1.07 tCO_2 (BAU) to 0.29 (alternative) tCO_2 per capita in 2050, lower than the 0.33 target.
- Urban and land use planning will allow for a long-term perspective of the direction of transport in Laos, so that sufficient land would be allotted to support infrastructure and future developments, including plans for large-scale rail systems.
- Provisions for quality public transport systems will be crucial in alleviating the potential impacts of rapid motorization in Laos.
- Rail systems, though supported by foreign organizations, will still entail operation and maintenance costs as well as information and communication technology. Bus systems can act as catalyst for area developments.
- Diversification of modes for freight transport is needed – utilization of maximization of the inland waterways and rail freight are key.

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Malaysia

Prepared by Clean Air Asia
Supported by Dr. Mohamed Rehan Karim

Present Society

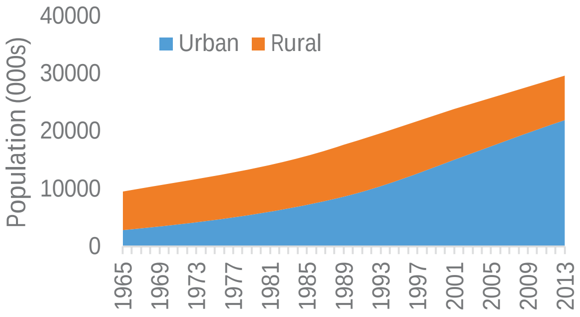


Figure 1. Population (000s)[1]

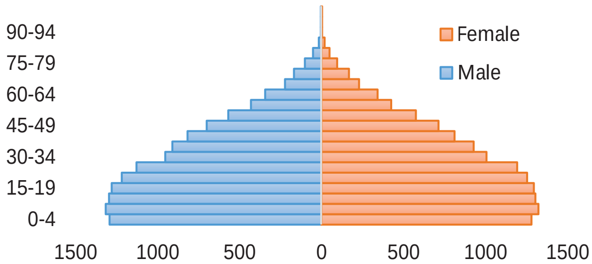


Figure 2. Population by Age (000s), 2010[2]

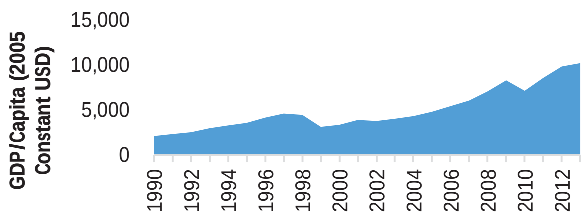


Figure 3. GDP/Capita (2005 Constant USD)[3]

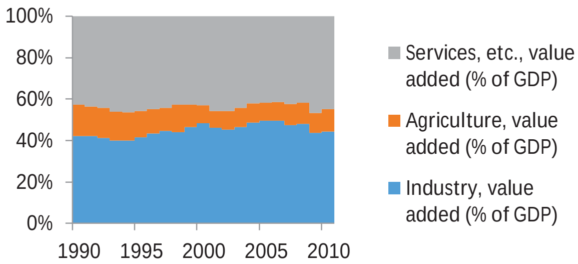


Figure 4. % Contribution of Sectors to the GDP[4]

INTRODUCTION

- With a total land area of 330,290 sq. km., Malaysia is composed of 13 states and three federal territories. The country is divided by South China Sea into two regions: the Peninsular Malaysia consisting 11 of the states and two of the federal territories, and the East Malaysia consisting the two remaining states and one federal territory.
- The federal Kuala Lumpur, covering an area of 243 sq. km., serves as the capital city of Malaysia.

POPULATION

- The population of Malaysia is estimated at 28 million according to the 2010 census of the Department of Statistics. It has grown at an average of 2.15% per annum in the period 1990-2013.
- The urban population of Malaysia in 2010 reached 72% of the total population, increasing from the estimated 62% in 2000.
- The most populous states are Selangor, Johor and Sabah, hosting about 42% of the total population of Malaysia.
- Malaysia has a population density of 86 persons per sq. km. in2010. A large fraction of the population lives in Peninsular Malaysia. The most densely populated areas are Kuala Lumpur, Penang and Putrajaya. While Selangor is the most populous state, it only has a population density of 674 persons per sq. km.

AGE STRUCTURE

- 55.4% of the population are 20-64 years or age, 40.2% are below 20 years of age, while 4.4% are 65 years and over.

GDP per CAPITA

- GDP per capita is about USD 10,221 in 2013 (2005 constant USD) and increased at an average of 6.48% from 1990 to 2013.Among the states and federal territories that have the highest GDP are Selangor, Kuala Lumpur, Johor and Penang.

ECONOMIC STRUCTURE

- In 2012, the largest contributors to the Malaysian GDP were the services sector and the manufacturing sector. The services sector includes the repair of motor vehicles and motorcycles. They have been increasing together with the agricultural, mining and quarrying, and construction sectors.
- Malaysia's export orientation makes the country one of the largest exporter of electrical and electronic products globally. Its other major exports are manufactured goods and articles, palm oil and palm oil-based products, liquefied natural gas, and petroleum products (Department of Statistics, 2012).

1 United Nations. 2012 and United Nations. 2011.
2 United Nations. 2012.
3 World Bank, 2013 and United Nations, 2012.
4 Ibid.

Present Transport

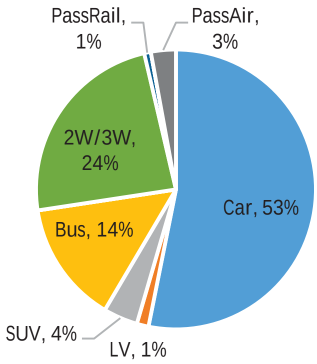


Figure 5. Passenger Transport Mode Share (% of PKM), 2010

Source: Study estimates

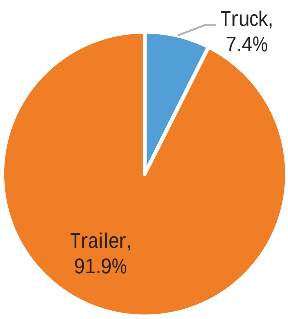


Figure 6. Freight Transport Mode Share (% of TKM), 2010

Source: Study estimates

Table 1. Population of Road Vehicles (2010)

Passenger

Mode	No. of Vehicles	Percent
Cars	9,114,293	45.1
LV	102,961	0.5
SUV	493,451	2.4
Bus	69,149	0.3
Motorcycles	9,441,907	46.8
Freight		
Truck	512,074	2.5
Trailers	454,103	2.2

PASSENGER TRANSPORT

- 2010 travel demand is at 320 billion passenger-km.
- The whole of Malaysia has a total of 155,426 km. of roads as of 2011, 125,776 of which are paved.
- Privately owned four-wheeled cars and SUVs dominate the travel demand in Malaysia, totaling 57% of the total passenger-km, while two- and three-wheelers cover 24% of the total travel demand.
- Motorcycles and cars are the most preferred modes of transport in Malaysia. By contrast, public transport accounts for a small share in the vehicles registered.
- The buses cover almost all cities of Peninsular Malaysia and hence have become a popular mode of intercity transport (Roza, Koting, & Karim, 2013). Other areas of Malaysia are served by mini-vans and unlicensed taxis.
- There are a total of 1,792 km of railway tracks in Malaysia. The rail network is shared by the transport of passenger and goods.

FREIGHT TRANSPORT

- Goods vehicles presently comprise close to 5% of the total motor vehicles. Land freight grew by 9.9% from 2004 to 2011, and hit 302.5 billion ton-km. Port Kelang, the largest port in Malaysia located in the state of Selangor and 38 km. southwest of Kuala Lumpur, is among the world's leading maritime ports by cargo weight and by twenty-foot equivalent unit handled. About 95% of the country's international trade is carried through its international seaports.

ISSUES AND CHALLENGES

- Tax exemption for fully imported hybrid cars has just been discontinued for the reason that it was unable to attract enough investments for local production. The revised National Automotive Policy 2014, however, now enables foreign makers of energy efficient vehicles to obtain licenses to manufacture in Malaysia to be able to compete with Indonesia and Thailand.
- Trains generally travel at low speeds and have limited network coverage while bus systems are poorly integrated and do not incorporate intelligent transport systems albeit covering a relatively wide scope especially in Peninsular Malaysia. There is also an unhealthy competition that leads to poor service.

Future Society

PLANS AND VISIONS

- The future scenario of Malaysia will largely be driven by Vision 2020, which seeks to narrow the ethnic income gap and aspires that no particular ethnic group will be inherently economically backward by 2020, including the Bumiputeras of Sabah and Sarawak.
- The vision also sets realistic economic targets up to 2020, which includes, firstly, making GDP 8 times larger in 2020 than it was in 1990, i.e. about RM 920 billion, requiring an average growth of about 7% annually in real terms until 2020.

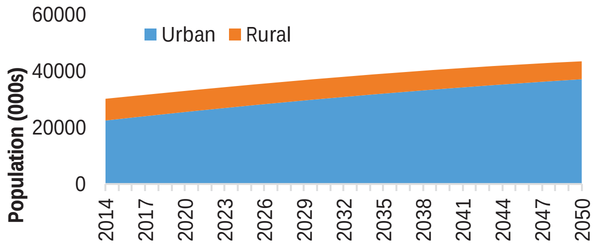


Figure 7. Population (000s)[5]

POPULATION

- It is estimated that there will be 43 million people in 2050.
- The population will grow at an average of 1.16% per annum from 2005-2050, and urban population will grow at an average of 1.69% over the same period.
- About 86% of the population will be living in urban areas by 2050.
- Kuala Lumpur is expected to be a city with more than 2 million people. It is estimated that, in 2050, there will also be 8 cities with more than 1 million people.

[5] United Nations. 2012 and United Nations, 2011.

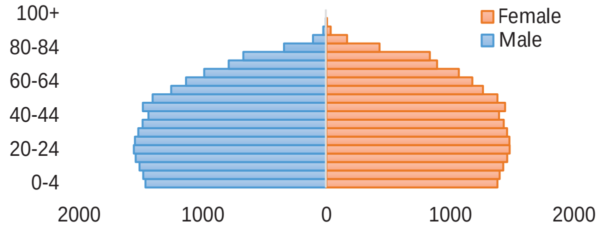


Figure 8. Population by Age (000s), 2050[6]

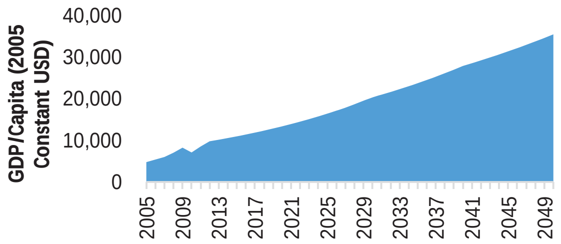


Figure 9. GDP/Capita Projections up to 2050[7]

AGE STRUCTURE

- In 2050, 27% of the population will be below 20 years of age, 58.4% of the population will be aged 20-64, and 15% will be 65 years of age and over.

GDP per CAPITA

- Estimates from ADBI (2012) show that in the long-run, Malaysia will likely to have a per capita GDP of USD 35,564 (2005 constant USD) in 2050. It is projected to grow at an average of 4.54% per annum in the period 2005-2050.
- According to the government of Malaysia, with the implementation of Malaysia's various blueprints and plans, their GDP is expected to reach USD 376 billion in 2020, indicating a per capita GDP of USD 13,400. In 2050, the GDP per capita is expected to soar up to USD 35,000.

ECONOMY

- The national vision seeks to diversify its growth, and to balance the development in the industrial, agricultural and services sectors, with an economy that is self-reliant, export-led, and technology intensive
- Focusing on key growth engines by building urban agglomerations, focusing corridors around clusters and developing National Key Economic Areas (NKEAs), which consist of 11 sectors and one geographic area of focus of the economic transformation plan: oil and gas; palm oil and related products; financial services; wholesale and retail; tourism; information and communications technology; education; electrical and electronics; business services; private healthcare; agriculture; and emphasizing the importance of the Greater Kuala Lumpur area.

Future Transport

PLANS AND VISIONS

- The government recognizes that Vision 2020 has major implications for the transportation sector.
- The government recognizes the need to adapt quickly and transform the public transportation to reduce the pressure of motorization on the current road infrastructure and traffic, which remains to be significantly comprised of private vehicles.
- The National Urbanization Policy released in 2006 turned to the urban centers and placed an emphasis on the development of an integrated public transportation system, and on the integration of both transportation and land use planning.
- The second phase of Government Transformation Program (GTP 2.0), launched in January 2010, identified seven National Key Result Areas (NKRAs) in support of the vision, one of which is to improve the urban public transport, aiming at a public transport mode share of 25% by 2015 in Kuala Lumpur and surrounding areas.
- Consequently, the 10th Malaysian Plan 2011-2015, a comprehensive blueprint prepared by the EPU, places more emphasis on moving people via public transport and as supported by non-motorized transport-friendly networks and seamless connectivity
- The 20-year National Land Public Transport Master Plan was released with the objective of increasing the mode share of public transport in urban areas by 40% in 2030. It also states the need for state-level regional master plans to be developed in addition to inter-regional master plan.

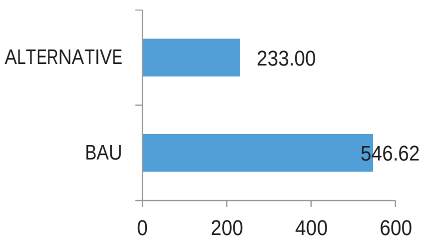


Figure 10. Passenger Travel (billion PKM), 2050

Source: Study estimates

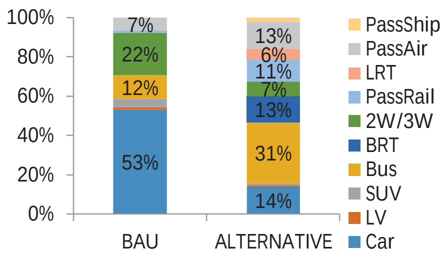


Figure 11. Passenger Mode Shares, 2050

Source: Study estimates

PASSENGER TRANSPORT

- Passenger travel would reach 546 billion passenger-km under the BAU scenario
- In the baseline scenario for 2050, there will be 34.8 million vehicles, 47% of these are passenger cars.
- There will be 576 passenger cars/1000 people, 546 motorcycles/1000 and 68 trucks/1000 people in 2050. The highest growth rates during the period are still with the cars, averaging 2.1% increase per year.

[6] United Nations, 2012.
[7] ADBI. 2012 and United Nations, 2012.

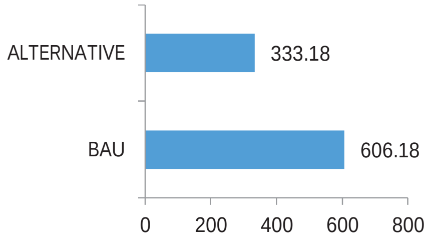


Figure 12. Freight Travel (billion TKM), 2050

Source: Study estimates

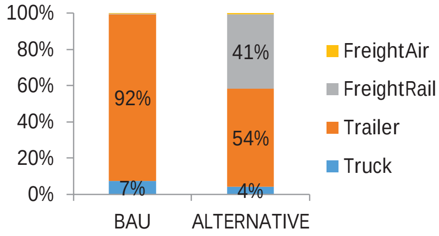


Figure 13. Freight Mode Shares, 2050

Source: Study estimates

FREIGHT TRANSPORT

- Meanwhile, freight travel is expected to increase to 606 billion ton-km by 2050 under the BAU scenario (252 billion ton km in 2005).
- Virtually all of the total ton-km will be serviced through road trucks and trailers.
- The truck population is estimated to increase by 1.95% per year.

ISSUES AND CHALLENGES

- Transport development in Malaysia is highly focused on its peninsular region, and a large number of projects and plans are being implemented primarily in the major urbanized areas especially the Greater Kuala Lumpur region.

Results of Simulation

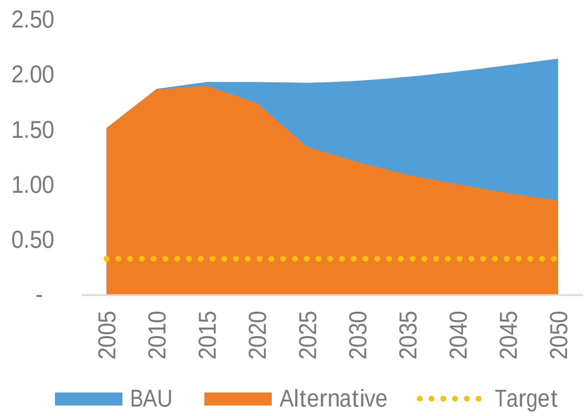


Figure 14. Tons CO2/capita

- The application of the selected policies resulted to a reduction of total CO2 emissions in 2050 from 90.5 million tons (BAU) to 36.3 million tons, a reduction of 60%.
- For passenger transport, the annual growth rate in passenger-km is limited to 0.1% in the alternative scenario, while the BAU postulates a 2% increase per year. The reduction of passenger activity is mainly hinged on the "avoid" policies, particularly the impacts of land use planning. A similar case is the same for freight transport activity, as the growth is limited to 0.6% in the alternative scenario, while the BAU also has an annual growth rate of 2%.
- For passenger transport, the alternative scenario emphasizes the use and development of public modes such as buses and rail-based transport. Buses will serve 31% of the total passenger-km in 2050 (vs 12% in the BAU) and rail will serve 11% of the total passenger- km(as compared to less than 1% in the BAU).
- The impacts of the policies resulted in a 2050 per capita CO2 value of .86 tons per capita (as compared to 2.15 in the BAU scenario.

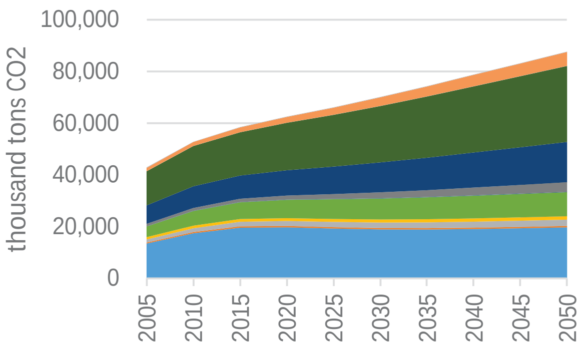


Figure 15. Total CO2 – BAU

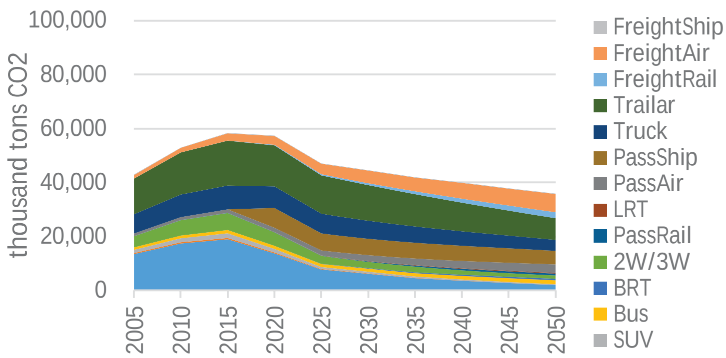
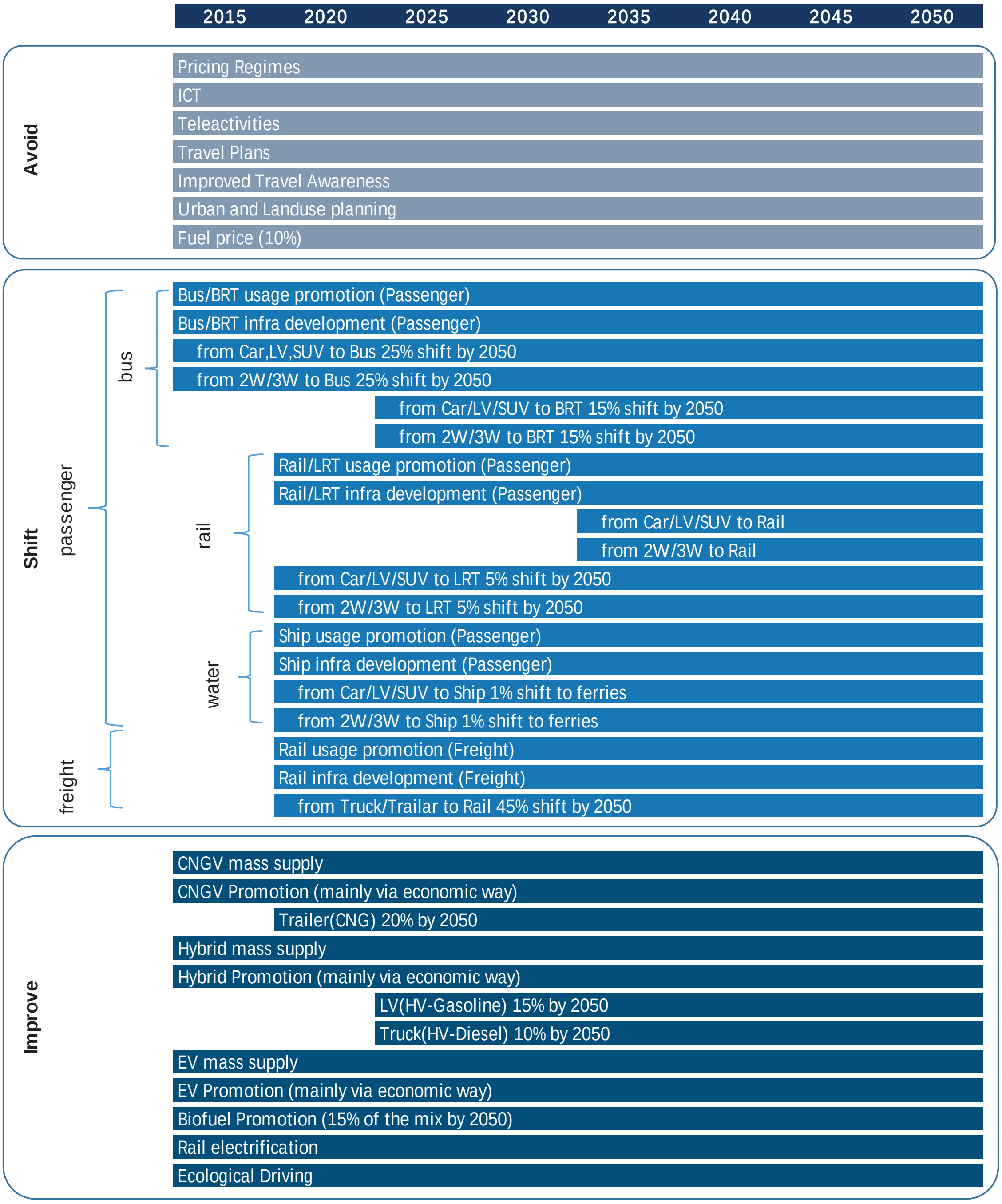


Figure 16. Total CO2 - Alternative

- The national transport CO2 emission as of 2005 in Malaysia is at 43 million tCO2. By 2030 the number will increase to 70.2 million tCO2 and by 2050, Malaysia's transport sector will have emitted 87.8 million tCO2.
- Largest emitters from passenger transport are private vehicles, particularly cars and motorcycles. Largest overall emitters are freight transport modes, especially cargo trailers.
- Freight transport in Malaysia is seen to increase in emissions from 21.8 million to 50.6 million tCO2 towards 2050, or about 3% annual increase in emissions per year.
- Overall transport emission is expected to increase at an average of 2% annually, while road transport alone will grow an average of 1% annually.
- The alternative scenario suggests less emission from car, LV and SUV use such that the contribution is limited to 6% in 2050 (as compared to 26% in the BAU). The contribution of buses will increase (due to higher bus volumes and usage) to 6% (as compared to 1% in the BAU). Rail-based passenger transport will contribute 2% of the CO2 emissions in the alternative scenario (as compared to 0.16% in the BAU).
- Emissions contributions from freight trucks (LDVs and HDVs) are limited to 33% in 2050 as compared to 50% in the BAU scenario. This is the result of the diversification of the freight system in the country. In the BAU scenario 99% of the total ton-km in 2050 will be done through the road trucks, while in the alternative scenario, this is reduced to 57%. Majority of the ton-kmhas been shifted to rail which will constitute 41% of the total ton- kmin 2050.

ACTION PLAN



	Characteristic Policies	Future Image
Passenger Transport	Malaysia should consider investing in public transport infrastructure immediately, especially that of mass transit system. The bus service system in its major urban areas should be improved, and the capacity of LRTs should also be increased. Malaysia's urban planning should be prioritized as densification and diversification at the appropriate corridors can reduce the length of travel.	By 2050, in the ideal scenario, public transport will cover 61% of all passenger travels in Malaysia. Buses will be the primary mode choice for passenger transport, especially with the development of important economic corridors on both peninsular Malaysia and Malaysian Borneo.
Freight Transport	Freight transport should be given more attention for policy implementation in two ways: shifting a large fraction of travel activity to rail freight to reduce the trucks on the road, and improving the remaining vehicle fleets by promoting hybrid vehicles for freight. ICT should also be applied in logistics to reduce freight vehicle mileage, and land use planning (in terms of clustering destinations and construction of new logistics centers) should similarly be considered for more efficient distribution of goods.	Freight shall be composed mostly of cargo trailers, but will also be largely accommodated by an expansive freight rail that covers 54% of freight transport.

Challenges

- Malaysia has one of the highest motorization rates in the region, which is estimated at 521 vehicles per 1000 in 2005. Curbing the "car-oriented culture" will be a challenging task for the government if it wants to shift passenger transport from private into public modes.
- High levels of freight transport activity prove to be a major point of consideration for the government in looking at CO2 emissions in the future.
- Malaysia will be a net fuel importer within the next 25 years; alternative sources of energy for transport have to be developed in order to mitigate the social, environmental and economic costs of this impending reality.

Co-Benefits

- By 2050, Malaysia's transport sector would be consuming 36.2 billion gasoline liters at the rate that the vehicle volume would be growing. This indicates a fleet-wide fuel cost of about USD 35.1 billion (current prices). The alternative scenario suggests a reduction of fuel costs by 60%.
- Reduction of vehicle trips would directly impact the traffic conditions and the level of service in the urban areas. By striving for low-carbon sustainable transport, congestion would be reduced and even minimized.

Conclusion

- The BAU scenario estimates that the total transport CO2 emissions will increase 2.1 fold from 42.9 million tons in 2005 to 90.5 million tons in 2050. In terms of per capita emissions, it will increase from 1.66 tons per capita in 2005 to 2.15 tons in 2050.
- The estimates project that interregional transport will be a significant aspect to look into in terms of mitigation policies. It is estimated to contribute 79% of the total transport emissions in 2050 in the BAU scenario.
- In terms of the different modes, the heavy duty trucks (32%), cars (22%) and light-duty trucks (17%) will contribute the most in 2050.
- Based on the simulations using the Backcasting tool, the current assumptions on the policy packages and their impacts will only reduce the tCO2 per capita to 0.86 (compared to 2.15 tCO2per capita in BAU 2050), still well above the 0.33 tCO2 per capita target. Further reduction in transport CO2 will require a complete paradigm shift towards embracing public transportation as the backbone of the passenger transport in Malaysia, as well as more aggressive policies that will shift more freight activity into railways. Malaysia will be in a position in the future to adopt more advanced vehicle technologies for its road transport fleet, such as hybrids and electric vehicles.

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Myanmar

Prepared by Clean Air Asia

Present Society

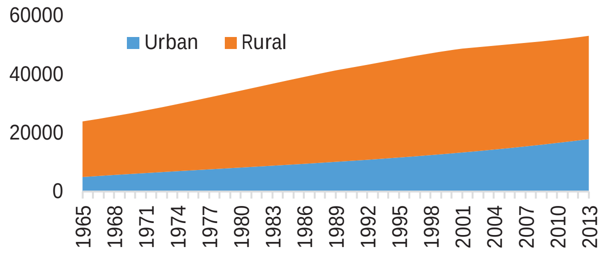

Figure 1. Population (000s)[1]

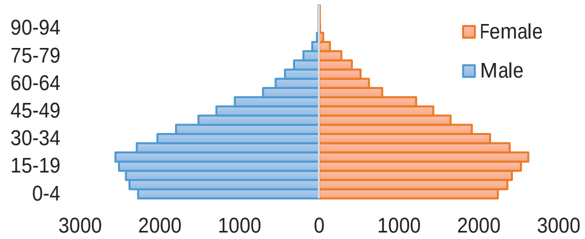

Figure 2. Population by Age (000s), 2010[2]

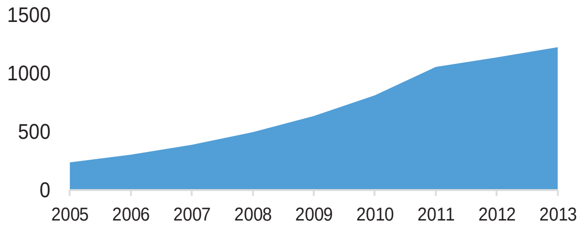

Figure 3. GDP/Capita (2005 Constant USD)[3]

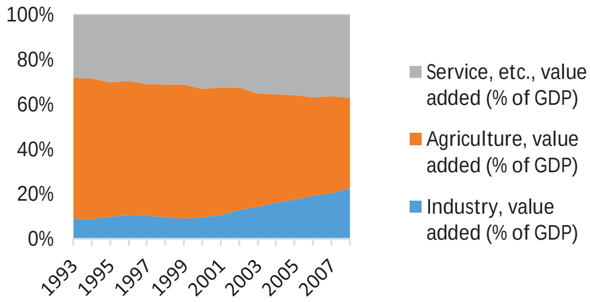

Figure 4. % Contribution of Sectors to the GDP[4]

INTRODUCTION

- The Republic of the Union of Myanmar is the westernmost country in Southeast Asia, bordered by Thailand, Laos, China, India, Bangladesh, and the Bay of Bengal and Andaman Sea to its southwest and to its south.
- Myanmar's land area is 676,578 sq. km. and has a coastline of 2,832 km. It is the largest country in the Indochina peninsula.
- Myanmar is divided into Nay Pyi Daw Union Territory and 14 states and regions. Yangon (also called Rangoon), the largest city, was the former capital of Myanmar. In November 2005, the government designated Nay Pyi Daw as the new capital and relocated many of its offices accordingly.

POPULATION

- The population of Myanmar is estimated at 53.3 million (UN, 2012). About 70% of the population lives in rural areas (UN, 2011).
- Myanmar's population grew at a rate of 1.03% per year on the average from 1990 to 2013 (UN, 2012). Its urban population grew at a rate of 2.42% over the same period (UN, 2011).
- National density is at 73.9 persons per sq. km., one of the lowest in the region. Yangon's density is at around 10,000 persons per sq. km.

AGE STRUCTURE

- Myanmar's working age population is currently 56.9% of the total population.
- Dependency ratio in the country is at 33%. (28% are 0-14 years of age and 5% are 65 years and over).

GDP per CAPITA

- Myanmar's GDP per capita is about USD 635.61 currently, growing on the average by 9.54% over the period 2005-2013.

ECONOMIC STRUCTURE

- Agriculture contributes about 40% to Myanmar's GDP. The country is a prime rice producer, with rice covering 60% of cultivated land. With its vast continental shelf, fisheries sector also contributes significantly to the economy. Myanmar is endowed with natural resources which include land, water, forest, coal, mineral, petroleum and natural gas.
- Myanmar is also one of the prime producers of gems and minerals in the world, and 90% of the world's rubies come from the country.
- Myanmar's climate, mountain ranges and plateau, coastline and waterways are favorable for agricultural activities.

[1] United Nations. 2012 and United Nations. 2011.
[2] United Nations. 2012.
[3] World Bank, 2013 and United Nations, 2012.
[4] World Bank, 2013.

Present Transport

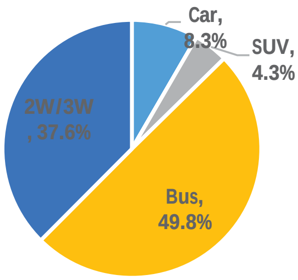

Figure 5. Passenger Transport Mode Share (% of PKM), 2010[5]

Source: Study estimates

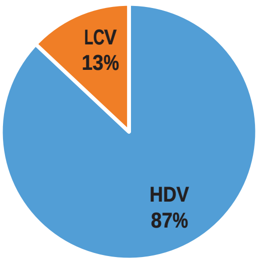

Figure 6. Freight Transport Mode Share (% of TKM), 2010

Source: Study estimates

Table 1. Population of Road Vehicles (2010)

Mode	No. of Vehicles	Percent
Passenger		
Motorcycles	1,888,402	83.8
Cars	197,402	8.8
"Other"	86,975	3.9
Bus	17,500	0.8
Freight		
HDV	37,198	1.7
LDV	26,802	1.2

While the above data estimated 2.2 million motor vehicles, the news cites the road transport administration estimating 3.9 million motor vehicles as of September 2013, 86% of which are motorcycles and 10% are cars (Shanghai Daily, 2014).

PASSENGER TRANSPORT

- 2010 passenger transport volume is at 56.4 billion passenger-kilometers.
- Available data indicate that almost all passenger transport in Myanmar is on road, while a small fraction travel by water.[6]
- Myanmar's road network spans 142,395 km. as of 2011, about 21.7% of which are paved (Zaw, 2013).
- In terms of PKM, private motorized modes are estimated to serve almost the same level of transport volumes as with public transport (buses), both at almost 50%.
- Motorcycles, both private ones and motorcycle taxis, are the second most dominant form of road transport. However, no motorcycles are allowed in Yangon since 2003, one of the reasons being the danger it poses to the public with increasing accidents and fatalities.
- There are about 5,000 km navigable waterways, about half of which are inland waterways, which facilitate transport of passengers and goods.
- Railway network, run by the state-owned Myanmar Railways, is nearly 4,000 km, though not at all maximized and is in poor condition. One of the major lines is the Yangon-Mandalay railway. There are no efficient feeder services.

FREIGHT TRANSPORT

- Freight transport demand is at 14.4 billion ton-kilometers.[7]
- The freight sector is dominated by large trailers at 87% of all freight traveled distance.
- Numerous rivers and tributaries, such as Ayeryarwaddy (or Irrawaddy) and Chidwin river, also facilitate transport of goods.[8]

ISSUES AND CHALLENGES

- Myanmar's transport sector remains underdeveloped, and similar to developing countries, priorities of the government are split between improving urban transport infrastructure and rural areas.
- A large part of the national roads are unpaved, hampering access between regions in the country, and likewise limits the access of rural population to basic services.
- Roads are currently in a poor state due to heavy traffic from trucks.
- There is inadequate institutional capacity in existing enforce rules and regulations. Its transport sector is also run by the government, which has limited funds, while the private sector has limited role.

Future Society

VISIONS AND PLANS

- The Strategic Urban Development Plan of Greater Yangon envisions Yangon to become an international hub, a comfortable city for its residents, a city with good infrastructure, and a city of good governance by 2040.
- The plan acknowledges that Yangon could be a megacity by 2040, with population reaching 10 million.
- The government recognizes the need for integration of zoning policies, rehabilitation of reservoir system, among others.

[5] While motorcycle is the dominant mode of transport, buses have the highest passenger-kilometers traveled as transport demand (in passenger-kilometers) is a function of vehicle numbers, vehicle-kilometers traveled per year, and occupancy. In Myanmar, a bus transports more passengers than a motorcycle within the same distance. In contrast to other indicators, the measurements *passenger-* and *ton-kilometers traveled* consider the demand for a certain mode and assesses user consumption.
[6] Passenger travel demand data on water in passenger-kilometers is unavailable.
[7] Analysis excluded water transport-tkm, but these were accounted in the emissions calculations directly.
[8] Freight travel demand data on water in ton-kilometers is unavailable.

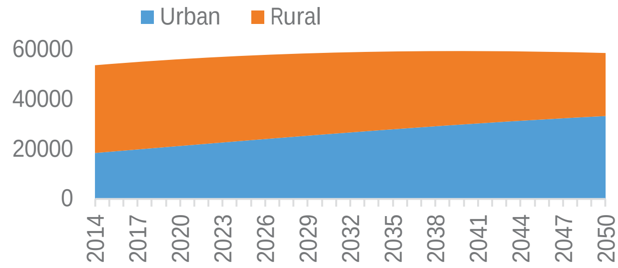

Figure 7. Population (000s)[9]

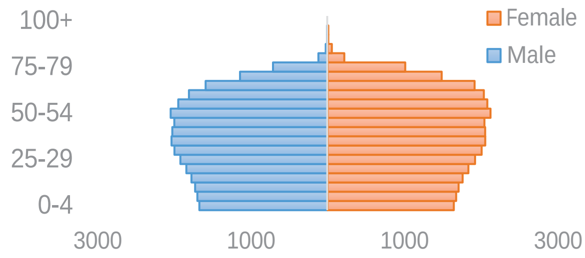

Figure 8. Population by Age (000s), 2050[10]

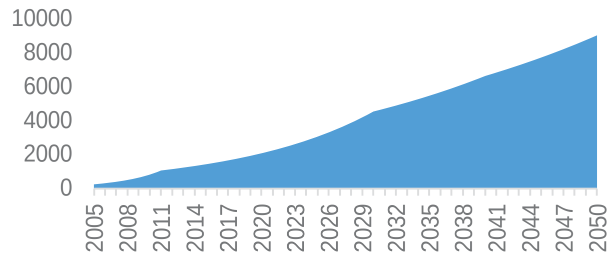

Figure 9. GDP/Capita Projections up to 2050[11]

POPULATION

- By 2050, Myanmar's population will be 58.6 million people (UN, 2012).
- At this time, 57% of Myanmar's population will be urban. Rural-urban transition is expected sometime around 2040 (UN, 2011).

AGE STRUCTURE

- By 2050, the working age in Myanmar will reach 62% of the population.
- Young dependency ratio will decrease while old dependency ratio will increase.
- Dependency ratio will reach 32% of the population (17% young dependency and 15% senior dependency)

GDP per CAPITA

- Myanmar's economy is expected to increase rapidly towards 2030, reaching USD 4,545 per capita. From 2030 to 2050, Myanmar's GDP would double to USD 9,049 per capita (ADBI, 2012 and WB, 2012).
- Myanmar is expected to continue to further its market-oriented system since its first adoption in 2008, and to continue to encourage private investments domestically, to encourage foreign direct investments, as well as to strengthen its agricultural base to promote its exports. It is also expected to realign economic development based on the Plan for 24 Special Development Zones.

ECONOMY

- Myanmar's economy would retain a high agricultural base. The government is anticipated to prioritize the improvement in the agriculture sector and seek for self-sufficiency, modernizing agricultural production and boosting production (Ministry of Health, 2013).
- It is expected that the country will experience rapid industrialization as 2050 approaches, and both the service and industry sectors is anticipated to considerably advance alongside.

Future Transport

PLANS AND VISIONS

- In January 2014, the Yangon regional government has announced that a transport master plan has been completed for Yangon, with the support of Japan International Cooperation Agency (JICA) whereby the implementation of short-term projects up to 2018 will soon begin. The plan also has medium-term projects up to 2025 and long-term ones up to 2035. The plan includes introduction of bus rapid transit and urban mass transit systems, as well as upgrading car parking as the illegal car parking on roads at the present create congestion (Win & Toe, 2013; Thitsar, 2014). A 10-km subway and elevated train system is planned for operation by 2025 (DVB Multimedia Group, 2014). Port and airport development plans for ports in Yangon and for Yangon International Airport, respectively, are covered in the master plan (Myanmar Update, 2013).
- Plans at the national level include the strengthening data collection and, ultimately, the reforming of the tourism sector with the Myanmar Tourism Master Plan 2013-2020. One of the projects identified in the master plan is the improvement of connectivity and tourism-related infrastructure, recognizing the need to address inadequate and poor transport services and to modernize railway networks, to improve feeder roads and expand access to environmentally friendly transport services. One of its key objectives is to ensure tourism is included as a key element of the National Transportation Strategy.

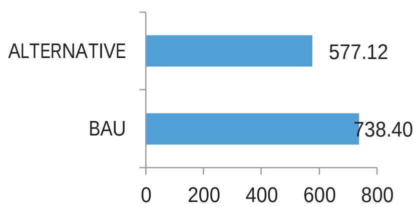

Figure 10. Passenger Travel (billion PKM), 2050

Source: Study estimates

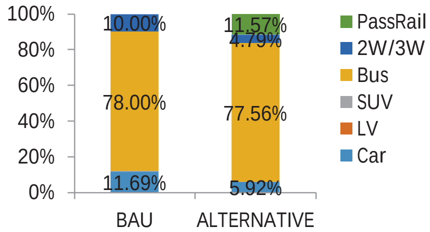

Figure 11. Passenger Mode Shares, 2050[12]

Source: Study estimates

PASSENGER TRANSPORT

- Passenger transport is expected to be reduced to 577.1 billion passenger-kilometers in 2050 under the alternative scenario from 738.4 billion passenger-kilometers in the BAU scenario.
- High penetration rates for buses are seen in both the BAU and alternative scenarios, but the alternative scenario boasts of a more diverse passenger transport system, particularly with the contribution of rail.

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[9] United Nations. 2012 and United Nations, 2011.

[10] United Nations, 2012.

[11] ADBI. 2012 and United Nations, 2012.

[12] The bus transport volumes were estimated to be high as projections were based on historical data. The data on the registered buses shows quadrupling of bus numbers from 2000 to 2010.

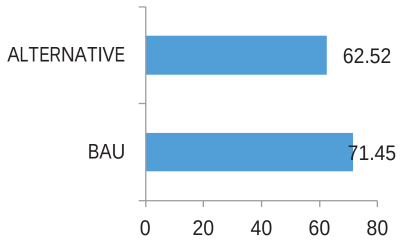


Figure 12. Freight Travel (billion TKM), 2050

Source: Study estimates

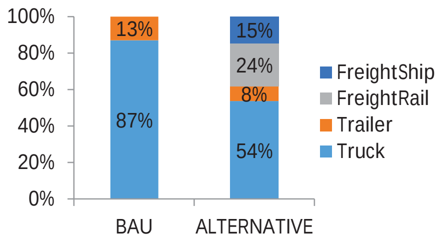


Figure 13. Freight Mode Shares, 2050

Source: Study estimates

FREIGHT TRANSPORT

- Freight transport under the alternative is expected to drop from 71.45 billion ton-kilometers (BAU) to 62.52 billion ton-kilometers in 2050.
- It is also expected that rail freight and inland water freight transport will arise in the long term. More freight will pass through the navigable inland waterways in the future, slightly reducing road freight demand.
- Freight transport will potentially be reduced by 14% between BAU and alternative scenarios with the increase in rail activity in the long term.

ISSUES AND CHALLENGES

- The implementation of rail transit requires a large investment, and operational subsidies are normally still required for rail transits. The substantial subsidy required for rail transits decreases the savings that can be expended for the public health care and education, and other government services.
- The urban planning department was only established in 2011 and more attention on urban planning will have to be given in order to curb the impending trends in terms of growing travel activity and distances.

Results of Simulation

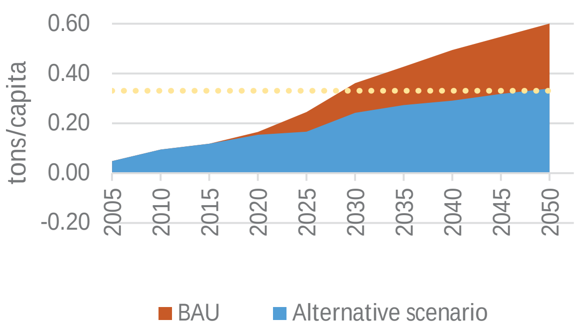


Figure 14. Tons CO2/capita

- Under the BAU scenario, Myanmar will emit from 0.05 tCO2 per capita in 2005 to 0.60 tCO2 per capita in 2050.
- The alternative scenario simulated in the Backcasting tool resulted in a mitigation potential of 0.60 tCO2 per capita to 0.34 tCO2 per capita.
- Primary mitigation areas are as follows:
    - o CNG promotion for freight transport and buses
    - o Development of navigable inland waterways for freight for reducing road freight load (Green Inland Ports establishment)
    - o Rail development and modernization
    - o Improvement of Urban and Land Use Planning System towards 2050

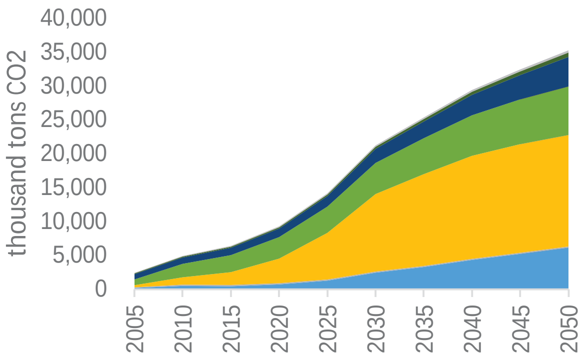


Figure 15. Total CO2 – BAU

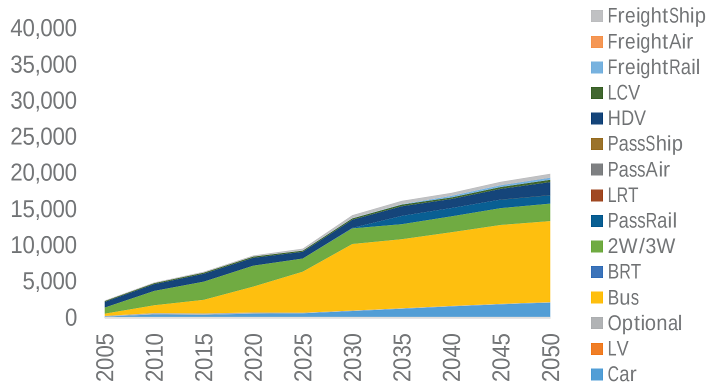
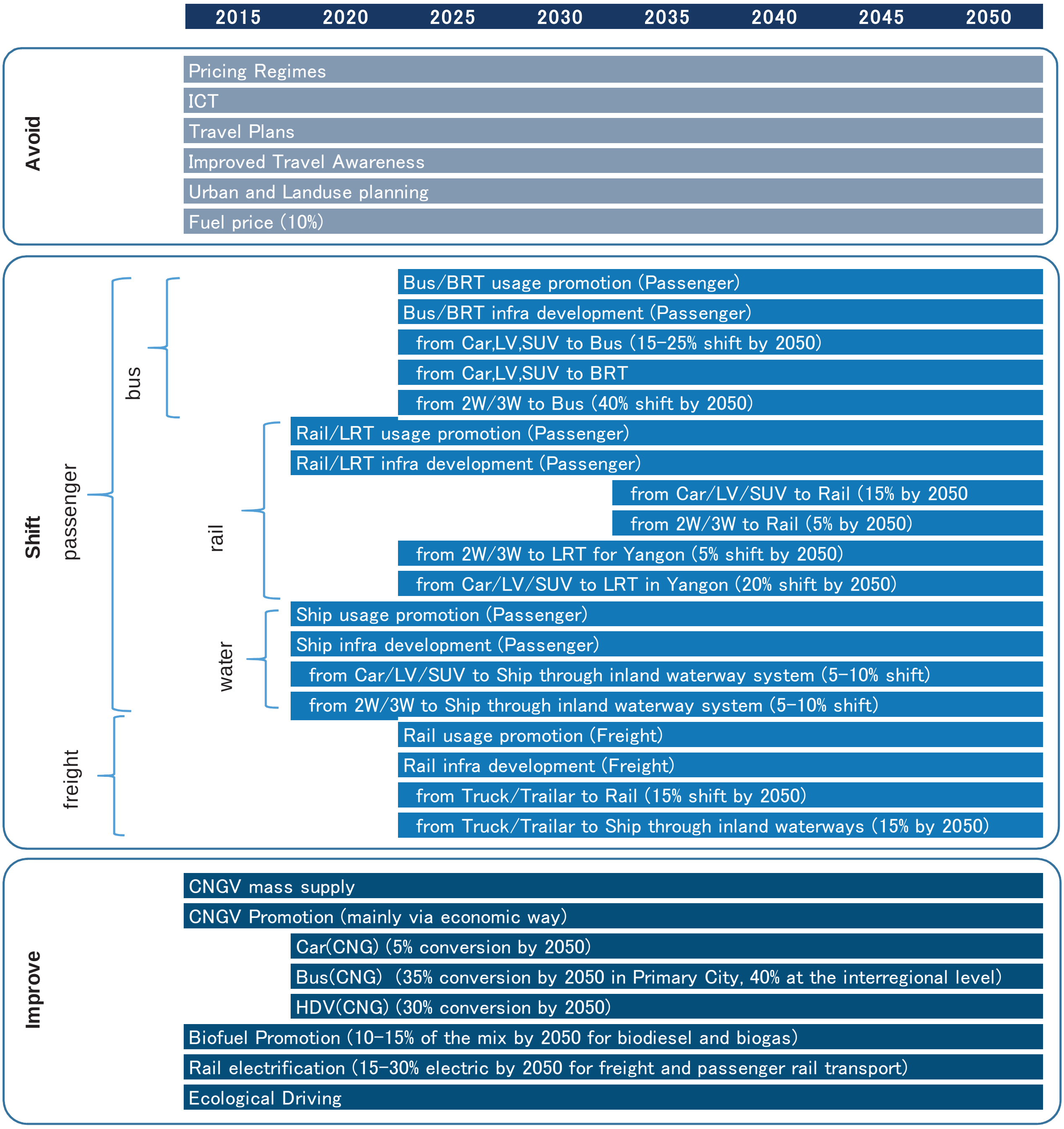


Figure 16. Total CO2 - Alternative

- Under the BAU scenario, passenger transport emissions will increase by 7% per year on average, while freight emissions will increase by 4% per year on average from 2005-2050.
- Buses will be the top most emitter towards 2050, contributing 46% of the CO2 emissions.
- Motorcycles will contribute 20% of the CO2 emissions in 2050.
- In 2050, it is estimated that the total CO2 emissions from transport is 35 million tons (2 million in 2005).

- The alternative scenario for Myanmar highlights the adoption of clean technology for buses and for trucks.
- CNG conversion for bus and trucks will reduce CO2 emitted by the vehicles towards 2050. The introduction of hybrid vehicles will also be important. The government must ensure that new buses and trucks be of higher emission standards and/or fuel economy standards.
- This will be an important development from the bus transport sector, so that future mode shifts for passenger transport will be to low-carbon buses.
- Ultimately, the appropriate urban and land use planning strategies that would manage travel in the long run should be the priority in the immediate future.
- Myanmar has the opportunity to plan its finances to accommodate future developments in rail transport.

ACTION PLAN



	Characteristic Policies	Future Image
Passenger Transport	" Improve" policies should be promoted, especially with regard to the engines of the buses. Intercity travel should likewise be dominated by CNG-run buses. Bus system should be improved and a bus rapid transit should be introduced in Yangon and Mandalay. City circular trains, as well as regional rail transit lines, should be upgraded, and the plan to improve the Yangon-Mandalay track should be implemented. A smartcard system could be introduced in the process of modernizing the rail transit. Inspection and maintenance program (e.g. fitness test) should be established and modernized. Old vehicles should be scrapped alongside and there should be vehicle replacement programs. Avoid policies, particularly urban planning, will alleviate the increase in motorized travel in the future.	Buses will continue to dominate passenger transport in the future, mostly running on cleaner technology. Many will shift to buses once facilities are upgraded because road safety is a concern for motorcycle drivers. Some vehicles will start having energy-efficient engines.
Freight Transport	Green inland ports should be established and optimized. There should be a national legislation of the regulation for the prevention of pollution of oil in coastal and inland waterways.	Trucks will continue to dominate the freight sector but with the initiatives to improve the rail and maritime transport of goods, Myanmar will see a shift from road to water and rail.

Challenges

- Myanmar's transport system must be able to respond and support social and economic needs, primarily the anticipated increase in proportion of those in the working age, increase in GDP per capita, as well as the increase of private investments.
- Access to rural areas will prove to be one of the greatest challenges to ensure access to the rugged terrain in the northern parts of Myanmar and to other areas with underdeveloped lands.
- Myanmar continues to struggle with the overlapping institutional responsibilities as well as the inadequate capacity to enforce standards.

Co-Benefits

- While air pollution in Myanmar is not a significant problem, its rising congestion in the city of Yangon is beginning to result to worsening air quality. In January 2012, monitoring devices recorded particulate levels 60% above the maximum standard set by World Health Organization, due particularly to industry and vehicles (The Myanmar Times, 2012).
- Fatalities and accidents involving motorcycles are likewise common, which was the reason by no motorcycles are permitted in Yangon since 2003. Among the types of road transport vehicles, two-wheeler motorcycles recorded the most number of road crashes in 2012 which resulted to 52% of total road accidents, 47% of total injuries, and 44% of total deaths (Zaw, 2013).

Conclusion

- The simulations show that the alternative scenario leads to 0.34 tCO2capita in 2050, very close to the target.
- As a largely agricultural country, Myanmar is in a good position of averting future transport emissions by developing a comprehensive planning system that encompasses future socio-economic developments and the role of transport.
- Essential institutions and framework for sustainable development are beginning to be set in place, e.g. Yangon's urban planning department and the transport master plan, to be able to meet the mitigation potential.
- Myanmar can continue providing access to rural and agricultural areas so it could generate income with exports, and ensure that the transport of goods to the ports are sustainable, with trucks adopting clean technology.
- On the other hand, in the urban areas, the results of the tool suggest that the public transport systems are key (particularly buses) and should feature clean technology.
- Myanmar can optimize its inland waterway networks for both passengers and goods transport.
- Railways can play a significant role in serving inter-regional passenger transport and freight transport in general.

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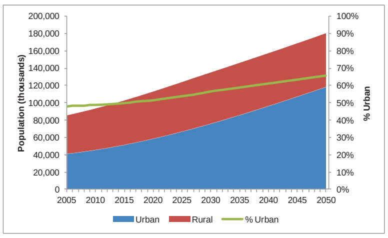
The Philippines

Prepared by Jose Regin F. REGIDOR, Sheila Flor D. JAVIER

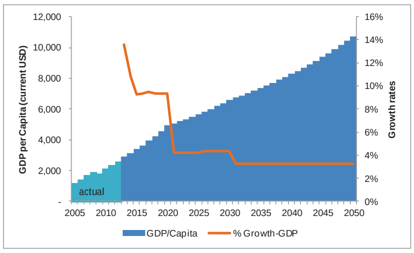
Present Society

Population and Urbanization



- The population of the Philippines is 92.34 million in 2010 and is to be about 98.92 million in 2013 (PIA, 2012).
- There will be increase in the percentage of elderly and working population.
- The top three regions in terms of population count are Region IV, National Capital Region (NCR) and Region III and its share is 40.45%.
- The lack of development in most rural areas in the Philippines acts as a push factor for urban migration. This contributes to the rapid increase of urban population, resulting to increased need for mobility.

GDP per Capita and Economic Growth

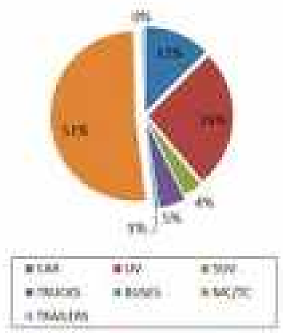


- Per capita GDP in nominal GDP is at USD 2,918 (IMF, 2013).
- Gini coefficient for the country is estimated as 43.0 (WB, 2012).
- Urban areas are the centers of economic growth in the Philippines. These include the Metro Manila and conurbations such as Metro Cebu, Metro Davao, Metro Iloilo, Metro Bacolod and Metro Cagayan De Oro.
- Consumption of luxuries is increasing as employment rates stabilize and compensation (i.e., salaries) increase especially in the services sector (e.g., BPO) leading to more disposable income available for spending.
- Local and foreign travel is also increasing due to economic growth and the emergence of low cost carriers that made air travel affordable.

The key societal factors that will determine the future of Philippine society are population, economic growth, energy, land use and urbanization. These factors are inter-related in the sense that each influences the others. For example, economic growth influences both land use and urbanization as cities evolve according to the people attracted to economic centers. As such, multiple urban centers will emerge as a response to the growing populations in part because of their attraction of people due to the perceived opportunities in these cities. Economic growth will also spur consumption, which will encourage commercial development and ultimately influence land development.

Present Transport

Present Transport Volume



Road Transport

- For 2012, total registered vehicles were already 7.5 million units, which is almost 4.5 times as that of vehicles registered in 1990.
- Jeepneys and motorized tricycles dominate public transport while trucks provide freight transport.

Rail Transport

- The Philippines only has four operation railway lines including the three LRT/MRT lines in Metro Manila (LRT Lines 1 and 2 and EDSA-MRT 3). The other railway line is the Philippine National Railways, which is comprised of a commuter service and a long distance rail service to the Southern regions of the main island of Luzon.

Air Transport

- Low cost carriers provide inexpensive fares for local and foreign destinations.

Maritime Transport

- Roll-On/Roll-Off (RORO) vessels provide inter-island passenger and freight services.
- Fast craft vessels provide faster water transport between principal cities of major islands.

Philippine Energy mix

- The primary energy mix for the country in 2011 is approximately 51 % is imported energy, of which 31 % is imported oil and 20 % is imported coal. The percent share of the natural gas is very small, amounting only to 8 %.
- Of the total energy demand for the Philippines, transport accounts for over 40% compared to 23% for residential, 25% for industry and 10% for commercial. 80% of the 40% is by road transport.
- In terms of sectorial oil consumption, transport accounts for 80% compared to about 9% for commercial and about 7% for residential.
- Based on the Philippine Energy Plan 2012-2030, 30 percent of all public utility vehicles are expected to run on alternative fuels nationwide by 2030.

Motorization continues to increase in the country and vehicle ownership will also increase as the country's economic also continues to grow. Vehicle ownership growth will be mainly for cars and motorcycles and will be due in part to limited public transport options in most cities and municipalities. Road transport vehicle technology will improve and in the future there will be a significant number of hybrid and electric vehicles provided that incentives are given for these. Inter-regional land transport will continue to be dominated by buses and trucks if regional rail infrastructure is not constructed. Inter-island passenger transport will be provided mainly by low cost carriers though there will be significant traffic using RORO and fast ferry services. Meanwhile, freight transport will be mainly by RORO and cargo vessels.

Future Society

Population: The Philippines will have a large working population based on the age range. This growth of the working population from 2010 will be sustained by the significant population growth rate bringing the working population up to more than 53% by 2030 and more than 54% by 2050. Meanwhile, the number of senior citizens is also expected to grow in part due to improved health services to more than 11% by 2030 and more than 15% by 2050.

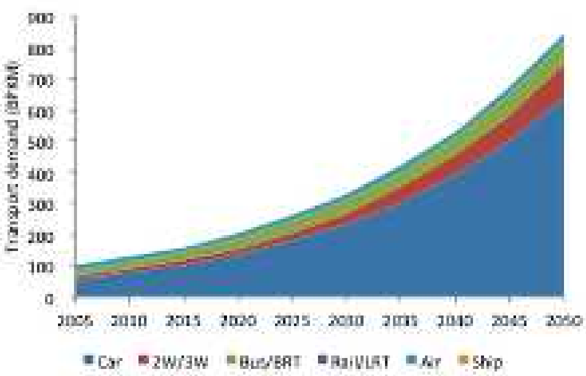
Economy: The annual GDP growth rate of 4% in the long-term is achievable and the country is expected to be able to achieve middle-income status by 2050 (i.e., ~10,000 USD per capita). Economic growth will be boosted by tourism and industrial development while growth in the services sector particularly in Business Process Outsourcing (BPO) will be sustained. The country will continue to have a significant number of its workers abroad but in more high value or high-income jobs including technical positions in information technology, engineering, and maritime transport.

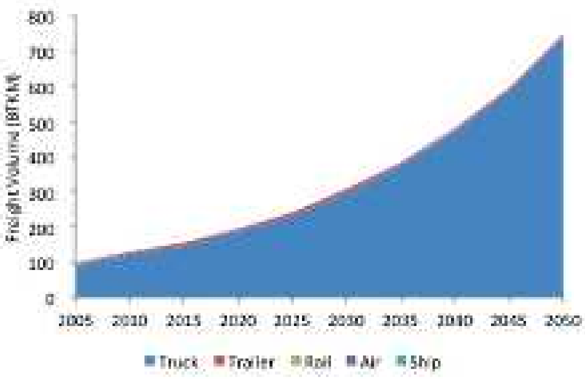
Industry: Stakeholders have indicated that industry should grow or at least remain the same but for agriculture to preferably grow more compared to the services sector. One reason cited for this is that the country should pursue more agriculture to ensure food security. This growth in the agriculture sector should be achieved through the modernization of agriculture including mechanization.

Consumption: With the sustained growth in the economy, it is expected that consumption of necessities will increase and so will the consumption of luxury items considering people will have more disposable income. It is expected that people will be working harder in order to gain more wealth and to sustain their lifestyles (i.e., high consumption or consumerism) but then this will also lead to an increased desire for leisure. Increased leisure will naturally lead to increased local tourism and this will be consistent with the country's push to be a major tourism destination with the development of attraction throughout the country. Meanwhile, overseas tourism will also increase, as people will have the resources as well as the interest to travel locally and abroad mainly for leisure.

Future Transport

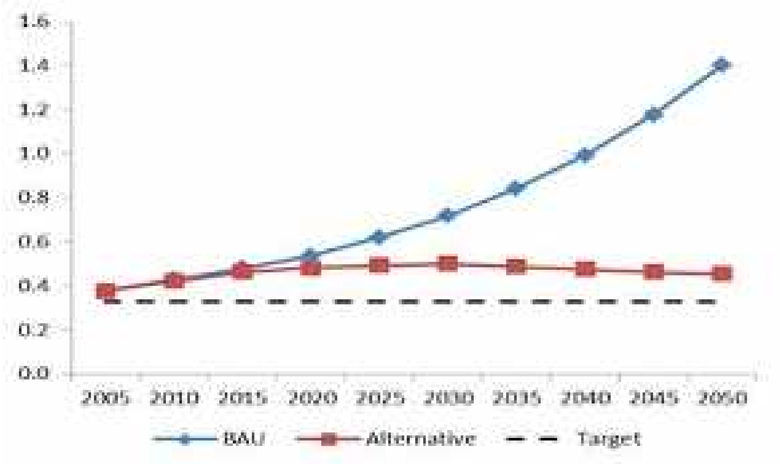
Motorization and increase in vehicle ownership will continue to be influenced by economic growth and consequently, consumption. The continued failure to provide modern mass transit systems (i.e., rail transit). The estimated mode shares for the country by 2030 indicate road transport to remain dominant over all other modes with rail having a miniscule share (i.e., only in Metro Manila). Such future for transport is estimated for four scenarios including a baseline scenario that can be considered as business as usual (BAU). Jeepneys and tricycles will continue to have a significant share of passenger transport (i.e., in terms of passenger-km) though cars will comprise a significant share in terms of vehicle-km traveled. For freight, road transport in the form of trucks will be the dominant mode in terms of both ton-km and vehicle-km traveled.



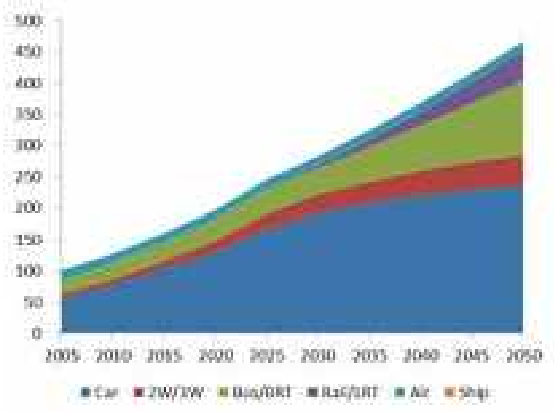


Results of CO2 reduce simulation and Long-term Action Plan

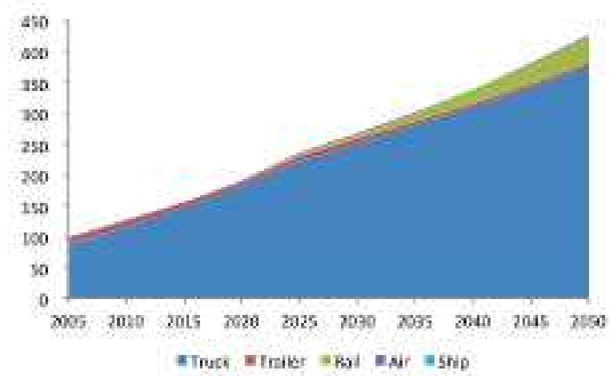
National Total CO2 Emission (t-CO2/capita/year)



Alternative Passenger Transport Demand (BPKM)



Alternative Freight Transport Demand (BTKM)



Action Plan

Policy package	2015	2020	2025	2030	2035	2040	2045	2050
Avoid			Pricing regimes					
	ICT, teleactivities, travel plans, improved travel awareness							
Shift	Bus/BRT usage promotion							
	Bus/BRT Infrastructure development							
	Rail/LRT usage promotion							
	Rail/LRT Infrastructure development							
	Rail usage promotion for freight							
	Rail infrastructure development							
Improve	CNGV promotion for bus							
	Hybrid promotion for car and bus							
	EV mass supply for car, 2W, 3W							
	EV promotion for LV, 2W, 3W							
		EV promotion for car						
		Hybrid promotion for trucks						
	Biofuel development for land vehicles							
	Biofuel promotion for land vehicles							
	Ecological driving for land vehicles							
	Air fuel efficiency improvement for aircraft							
		Ship fuel efficiency improvement for sea craft						

	Characteristic Policies	Future Image
Primary City	A. Rail transit such as MRT to form a comprehensive network. B. BRT and bus transit for other major routes and as feeders to MRT. C. Electric jeepneys and tricycles as feeders to bus and rail. D. Hybrid and electric cars will be dominant over conventional cars. 	Metro Manila will be like the present Hong Kong because of policy A and B. CBDs of high-density developments including high-rise condominiums will be served by mass transit systems comprised by rail and bus. These will be complemented by modern 4- and 3-wheeled paratransit, which will evolve from today's jeepneys and tricycles. Most cars will be hybrid or electric by 2050.
Large City	A. Rail transit (MRT or LRT) introduced starting 2025, targeting perhaps at least 2 lines for each city by 2050. B. BRT and bus are introduced starting 2020 and 2015, respectively. C. EV is pursued as dominant mode for modern jeepneys and tricycles. D. Hybrid and electric cars will replace conventional cars though not as widely as in Metro Manila. 	Large cities such as Metro Cebu and Metro Davao will eventually have their own mass transit systems including BRT and rail systems because of A and B. However, these will not be as extensive as Metro Manila's. Modern jeepneys and multicabs will serve feeder routes to buses and rail, and electric tricycles will serve residential areas and local streets. A significant number of cars will be hybrid or electric.
City	A. Bus introduced by 2020 to serve main routes. B. Promotion of electric and LPG jitneys C. Promotion of electric tricycles D. Promotion of hybrid and electric cars. 	Smaller cities will have buses serving main routes because of A. Mix of modern and conventional jeepneys and tricycles serve minor roads and residential areas due to B and C. Significant NMT and pedestrian facilities in most small cities.
Non City	A. Major routes to be served by jitneys with capacities similar to present day jeepneys. B. Promotion of electric tricycles C. Promotion of NMT paratransit D. Provision of pedestrian facilities 	Major transport routes in municipalities will be served by jitneys instead of tricycles because of A. Tricycles will still provide motorized transport in many areas but those in the CBDs will include many e-trikes due to B. Many areas will be
Inter Regional	A. Incentives for upgrade of truck fleets B. Incentives and investments for regional rail infrastructure 	Rail transport will become the backbone of land-based freight and passenger transport by 2050 because of B, primarily for Luzon Island. Trucks will run on hybrid-diesel and natural gas if B is effective.
International	A. Airlines, particularly low cost carriers, are given incentives including deregulation B. Maritime transport companies are given incentives to upgrade their vessels. C. Easing of travel restrictions such as visa requirements across ASEAN as well as other countries 	As the Philippines is an archipelago that is physically detached from mainland Asia, international transport will be dominated by air (for passengers) and maritime (for freight) transport. There will be more travel between ASEAN countries as restrictions across the region are eased.

Challenges

The Philippines seeks to increase infrastructure spending to 5-6% of its GDP by 2016. The country needs to invest in rail and BRT to achieve 1.6% and 15.7% national share by 2030, and 10.5% and 26.6% passenger-km share by 2050, respectively, while decreasing the share of cars and jeepneys throughout the country. The Philippines needs to aggressively implement programs that seek to increase infrastructure spending by 5-6% by 2016. However, this may not be enough for the long term considering the backlog of transport projects particularly to address mobility and transport efficiency in cities and at the inter-regional level. This assumes also that incentives (e.g., financial, tax, etc.) for rail are put in place. Such incentives are also required for other transport infrastructure, and particularly for the private sector to be involved and interested in implementing projects through Public-Private Partnership (PPP) arrangements.

Co-Benefits

It was revealed during the stakeholder consultations in Manila that there was less appreciation about CO_2 compared with other factors such mobility, pollution and safety. As such, the economic benefits of associated parameters like fuel savings, less air pollution, and improved transportation safety are better appreciated in the Philippines.

Studies such as those by the WHO (2011) have established the health benefits of good public transport combined with pedestrian and cycling infrastructure. Independent studies (e.g., Litman, 2012) provide in-depth analysis of valuating climate change and other co-benefits such as congestion, road crashes, air pollution and noise. Thus, it can be shown that significant reduction in external costs can be achieved with CO_2 reduction that is directly proportional with corresponding reduction in costs associated with congestion, safety, reduced air pollution, noise, and climate change.

Conclusion

It is clear that the country needs to invest more to develop its transportation systems. Such infrastructure is necessary to effect significant changes that will improve passenger and freight transport that will result in significant CO2 reduction.

In terms of the applicability or usability of the tool for the country, the Climate Change Commission (CCC) has stated that GHG mitigation is already in the national agenda. However, they have no tools or methodology (e.g., NAMAs) for quantitative assessment of mitigation so the agency expects to be able to use the tool to this end. Meanwhile, the DOTC has a National Implementation Plan (NIP) for transport and the environment that identifies mitigation options and mentions the use of tools to measure the impacts of these options. There is no specific tool to complement or support this and the Visioning and Backcasting Tools can be useful for DOTC for assessing impacts (e.g., in terms of carbon reduction, etc.) of policies and projects in different cities and at the national level over the long term.

Singapore

Prepared by Clean Air Asia

Present Society

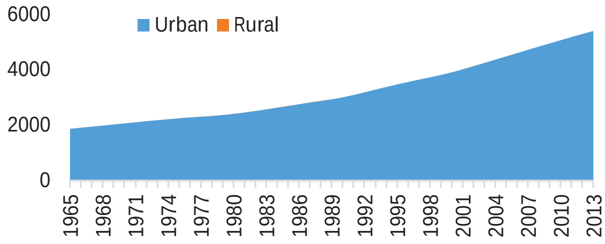


Figure 1. Population (000s)[1]

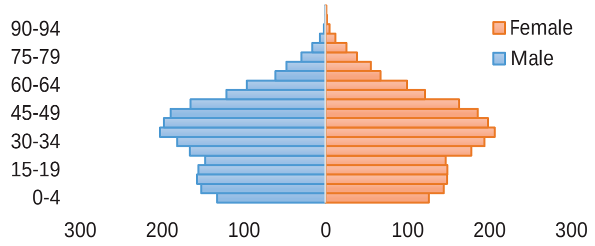


Figure 2. Population by Age (000s), 2010[2]

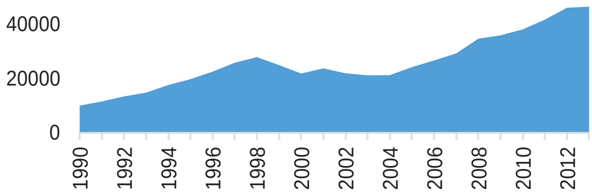


Figure 3. GDP/Capita (2005 Constant USD)[3]

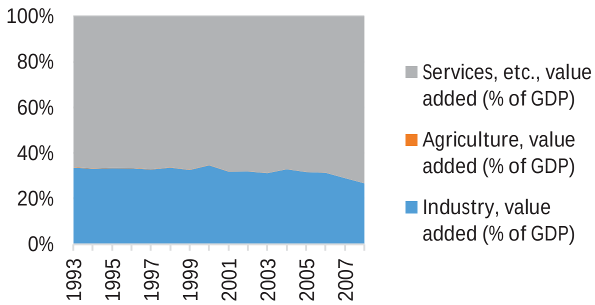


Figure 4. % Contribution of Sectors to the GDP[4]

INTRODUCTION

- The Republic of Singapore lies between Indonesia and Malaysia. The country is strategically located on major sea lanes.
- Singapore has a land area of 716.1 sq. km. and a coastline of approximately 190 km. Its land area was about 581.5 sq. km. in the 1960s, but it has increased through large-scale land reclamation.
- Singapore is composed of one built-up urbanized island and about 50 offshore islets. The Central Area of Singapore is the considered as the central business district.

POPULATION

- The population of Singapore is currently 5.4 million, about 31% of which are non-Singaporean citizens and permanent residents. Its population density is about 7,540 persons per sq. km.
- It has grown at an average of 2.57% per annum from 1990 to 2013 (UN, 2012).
- Singapore is a highly urbanized and industrialized nation; 100% of its population is urban (UN, 2011).

AGE STRUCTURE

- 66% of the populations are 20-64 years old.
- Only 8% of the populations are 65 years old and above (UN, 2012).

GDP per CAPITA

- GDP per capita currently stands at about USD 46,606 (2005 Constant USD)[5] and is increasing at an average of 6.88% from 1990 to 2013.
- Though not directly hit by the 1997 Asian Financial crisis in the late 1990s, Singapore was affected by the economic slowdown in the region due partly to a sharp decline of exports as a result of the decline in the demand of crisis-hit economies (Ngiam, 2000).

ECONOMIC STRUCTURE

- Singapore's economy started recovering in 1999 particularly due to the strengthening of the service and manufacturing sectors.
- The service sector contributes about 70% of the total GDP. This sector comprises trade, transport and storage, banking, business and financial services, and recreation and personal services.
- The industry sector contributes about 30% of the GDP. This is comprised predominantly of the petrochemical industry, and the manufacture of electronics, and transport equipment.
- The agricultural sector barely contributes to the economy as the country lacks arable land.

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1 United Nations. 2012 and United Nations. 2011.
2 United Nations. 2012.
3 World Bank. 2013.
4 Ibid.
5 World Bank 2012 and United Nations 2012.

Present Transport

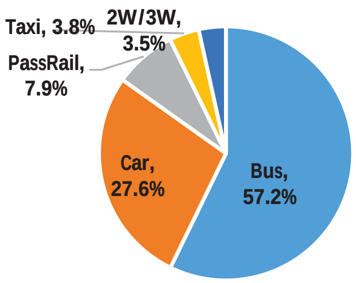


Figure 5. Passenger Transport Mode Share (% of PKM), 2010

Source: Study estimates

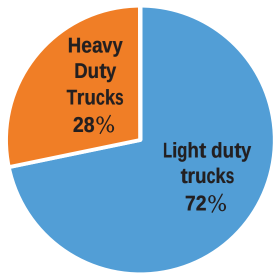


Figure 6. Freight Transport Mode Share (% of TKM), 2010

Source: Study estimates

Table 1. Population of Road Vehicles (2010)

Passenger vehicles:

Mode	No. of Vehicles	Percent
Cars	595,185	64
Taxi	26,073	3
Bus	15,936	2
Motorcycles	147,282	16

Freight vehicles

HDV	45,068	5
LDV	98,545	11

PASSENGER TRANSPORT

- 2010 travel demand is at 99.8 billion passenger-kilometers.
- Road passenger serves 92.1% of land travel demand while the remaining is served by passenger rail systems. The latest Household Interview Travel Survey conducted between June 2012 and May 2013 reveals that public transport mode share was 63%, primarily rail and bus services(LTA, 2013), similar to the estimates of the study.
- As of 2008, Singapore has the following infrastructure:
- 153 km. of express ways
  - o 109.4 km. of Mass Rapid Transit with 66 stations
  - o 28.8 km. of Light Rapid Transit with 33 stations

FREIGHT TRANSPORT

- The coastline of Singapore features natural deepwater ports. Singapore is among the five busiest ports in the world in terms of shipping volume, with its annual vessel arrival tonnage and container and cargo throughput hitting a record high in 2013. Maritime industry contributes about 7% to Singapore's economy (Wong, 2014).
- 2010 freight transport is at 23.1 billion ton kilometers, virtually by light and heavy duty trucks.

ISSUES AND CHALLENGES

- Singapore has become a benchmark of sustainable transport practice in Southeast Asia. Its extensive bus systems provide an efficient and cost-effective feeder service to the rail system which covers almost every border of the country. Its public transport implements a sophisticated intelligent transport system. Strings of policies that limit car use such as congestion charging and disincentives for car ownership have spurred an ideal environment for public transport use.
- Singapore has been firm on enforcing road transport policies due to its geographic limitations, as 12% of the land area has already been dedicated for road.
- However, car use may potentially increase in the future, increasing by 39% in 2050 from 2005 despite strong measures for limiting its use and acquisition.
- Additional problems also arise from externalities such as noise around the railway corridors, safe access for the ageing population, connectivity and quick transfer.

Future Society

SINGAPORE'S VISION OF THE FUTURE

- A More Competitive Economy: a global city well known for its knowledge, expertise and services in helping cities achieve both economic growth and high
- The Best Home for Singaporeans: clean air, clean water, and a lush green environment, plus the ability to travel around the city easily.
- A Global Magnet for Talent: first class living environment and economic opportunities for those who work in Singapore; a vibrant and cosmopolitan global city

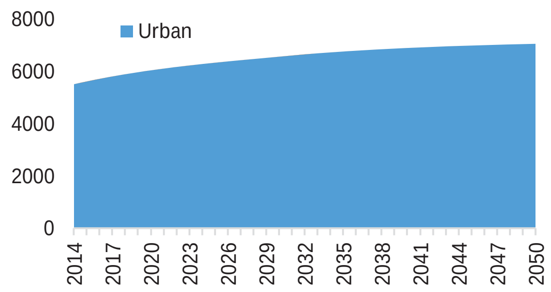


Figure 7. Population (000s)[6]

POPULATION

- It is estimated that in 2050, there will be 7.06 million people in Singapore (UN, 2012).
- The population will grow at an average of 1.01% per annum from 2005-2050 (UN, 2012). Singapore will continue to attract foreign labor force, both low-skilled (mostly manufacturing) and high-skilled workers (mostly finance) in the future.
- However, Singapore has started setting stricter immigration policies and workforce control, one of which is the "Fair Consideration Framework." The said policy requires companies to foremost consider locals in the hiring process, and those with disproportionately low share of Singaporeans at senior levels will be subject to government scrutiny. As a result, the fraction of the locals in the future is seen to be larger than the current 69%. Conversely, Singapore seeks to make raising birth rates among its locals a priority.

[6] United Nations. 2012 and United Nations, 2011.

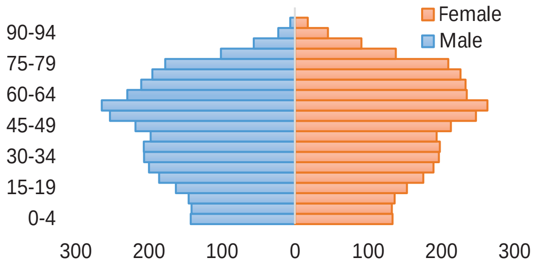


Figure 8. Population by Age (000s), 2050[7]

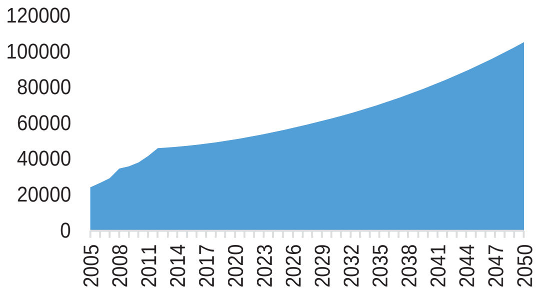


Figure 9. GDP/Capita Projections up to 2050[8]

AGE STRUCTURE

- Singapore will be an ageing society by 2050. About 57% of the population will be in the working age of 20-59by 2050 while 29% will be 65 years of age and over (UN, 2012).
- This is due to declining birth rates, later marriages and preferences of couples to have fewer children. The government will have to focus much of the service it provides on taking care of the ageing population.

GDP per CAPITA

- GDP per capita is projected to increase to USD 105,471 (2005 Constant USD), highest in Southeast Asia and indicative of a wealthy majority in the population (ADBI 2012 and UN 2012).
- It is forecasted to grow at an average of 3.31% per annum in the period 2005-2050.

ECONOMY

- Singapore is expected to strengthen its service sector based on banking and financial sectors as well as tourism, education, and medical services, as a result of its policies to reduce reliance on foreign manpower, a large fraction of which are primarily in domestic labor and construction. This also resulted from its inadequate supply of land and local labor.

Future Transport

PLANS AND VISIONS

- Land Transport Master Plan 2013:the government aims to add five more MRT lines, 100 new trains, 800 more buses, and 40 new bus services by 2030, as well as 200 km. more of sheltered walkways, over 700 km. of cycling paths by 2030.
- Singapore is now investing in liquefied natural gas (LNG) hub and bunkering capacity in anticipation of the need to improve the current road transport vehicles (apart from shifting commuters to public transport) and the fuel of the ships, as well as to meet the demand in neighboring countries. The transport sector is seen is reduce its dependence on oil and shifting to cleaner and alternative energy and technologies.

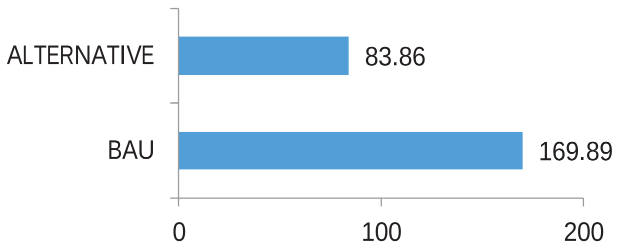


Figure 10. Passenger Travel (billion PKM), 2050

Source: Study estimates

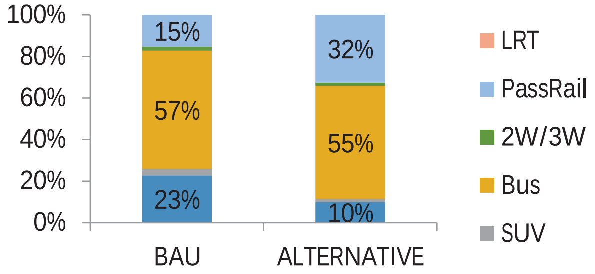


Figure 11. Passenger Mode Shares, 2050

Source: Study estimates

PASSENGER TRANSPORT

- Under the BAU scenario, passenger transport will increase to 169 billion passenger kilometers by 2050,
- The alternative suggests a reduction of passenger kilometers to 83 billion passenger kilometers, taking into account the additional impacts of avoid policies toward the future.[9]
- From the current 92.1%, only 68% of passenger travel is expected to be on road in the future.
- A large percentage of existing buses is seen to be mostly running on alternative fuels, especially CNG and FCV buses which are currently being tested.
- Singapore will continue to increase its bus service lines alongside the improvements on the urban MRT system, allowing for a large share of public transport in the urban transport system at 83% in 2050.

[7] United Nations, 2012.
[8] ADBI. 2012 and United Nations, 2012.
[9] The BAU also simulates the impacts of current policies that are expected to continue in the future.

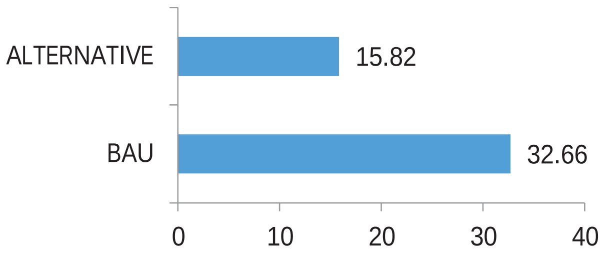


Figure 12. Freight Travel (billion TKM), 2050

Source: Study estimates

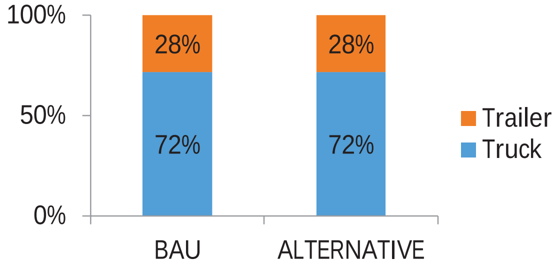


Figure 13. Freight Mode Shares, 2050

Source: Study estimates

FREIGHT TRANSPORT

- The alternative scenario shows that freight transport can be halved from a potential BAU scenario of 32.7 billion ton kilometers to 15.8 billion ton kilometers in 2050. 72% of freight travels will be HDVs up to half of which may be running on compressed natural gas fuel (CNG).

ISSUES AND CHALLENGES

- By 2050, Singapore will have an aging population, increasing the need for improved transport accessibility. The focus will thus become improved public transport service for the old and disabled.
- In terms of sustainability, it is seen that Singapore will now need to focus on converting public transport to run on clean fuels. The demand for alternative fuels will increase not just in Singapore but also across the neighboring Southeast Asian countries (Collins, 2013). This implies that there will be heavy importation of CNG, hydrogen gas and even electricity. While these resources maybe readily available for neighboring countries, Singapore has no natural resources, requiring heavy importation to continue support for clean technology. Developing Singapore into the LNG trading hub in the region is crucial in ensuring a sustainable alternative fuel scenario in the country (Ten Kate, Varró, & Corbeau, 2013).

Results of Simulation

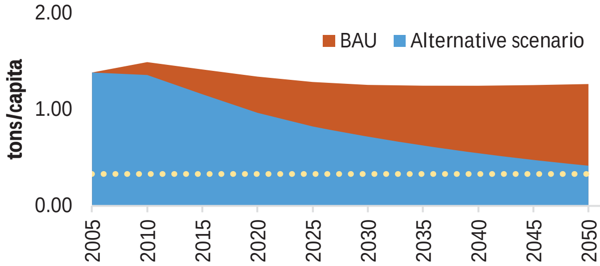


Figure 14. Tons CO2/capita[10]

- Under the BAU scenario, Singapore's transport sector will result in 1.38 tCO2 per capita (2005) to 1.26 tCO2 per capita in 2050.
- The alternative scenario simulations resulted in a mitigation potential from 1.26 tCO2 to 0.42 tCO2 per capita in 2050.
- Mitigation in Singapore will require aggressive promotion of alternative fuel - powered vehicles into the market.
- The alternative scenario for Singapore is largely supported by the projections made by the APEC on the future of energy in member countries. Moreover, this scenario is largely supported by the potential of Singapore as a future hub for LNG in Asia.

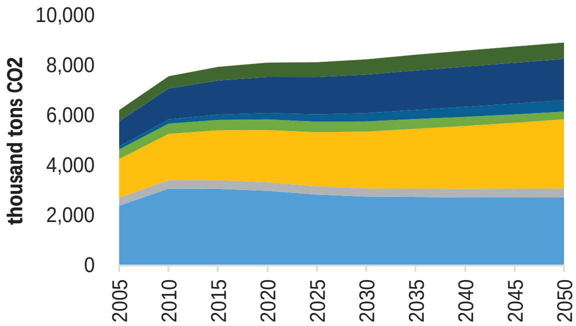


Figure 15. Total CO2 – BAU

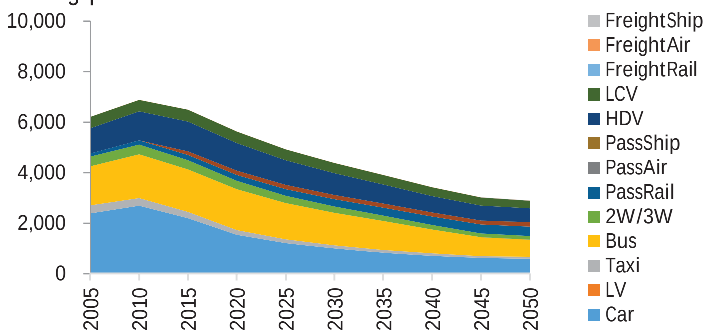


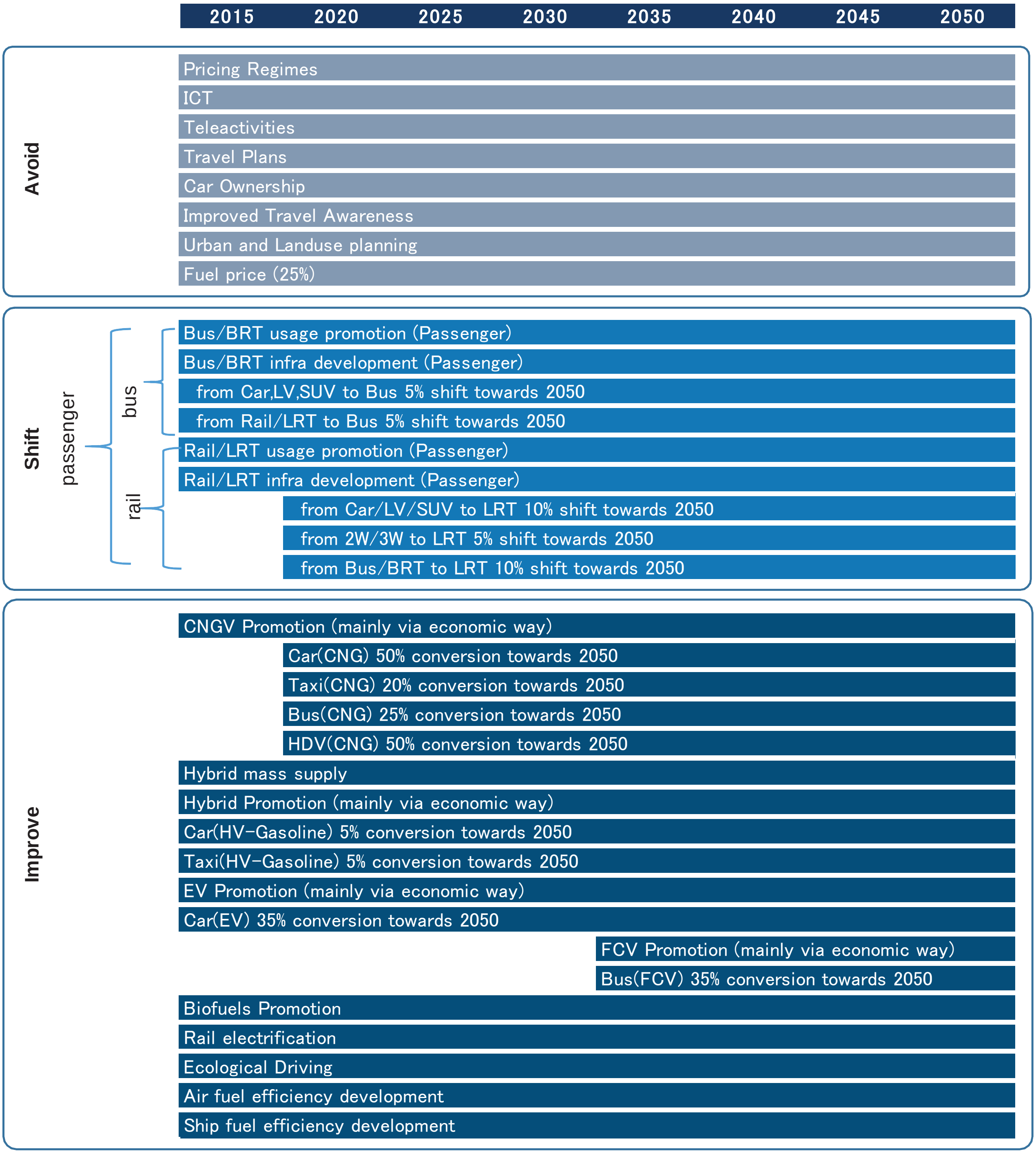
Figure 16. Total CO2 - Alternative

- Under BAU scenario, cars and buses will each contribute 31% of the total emissions in 2050, with buses as the top emitters at 2.8 million tCO2.
- HDVs will contribute the largest emissions from freight, and is the third top emitter in 2050 under the BAU scenario.
- Car use will increase by 39% from now until 2050 as citizens become more capable of purchasing and even afford the policies in place for car acquisition.
- The resulting total CO2 emissions from transport in 2050 are 8.9 million tons.

- The alternative scenario total CO2 emissions for transport are at 2.9 million tons in 2050.
- In the alternative scenario, it is seen that a large number of vehicles will have converted to renewable and clean fuels. Moreover, fuel efficient modes will have entered the market for public use.
- Car use will have significantly decreased with the presence of MRT extensions in the city. The scenario suggests a strict control over the number of cars and most will run on clean fuels and will follow strict fuel economy standards.
- Buses will remain as top emitters, although clean technology will have significantly reduced this towards 2050. There will be a good mix of FCVs and CNG vehicles which not only reduces emissions but will also significantly reduce the public spending on petroleum products.

[10] Total CO2 from transport will continue to grow, but the growth in population is expected to be higher, thus, the per capita emissions are expected to go down.

ACTION PLAN



	Characteristic Policies	Future Image
Passenger Transport	There should be a continuation of the vehicle quota and electronic road pricing schemes as well. ICT for transport substitution will be utilized. Pricing regimes should be continued to discourage car ownership. Cleaner technologies and alternative energy for vehicles should be used. There should be continued strengthening of public transport (bus and rail-based).	Singapore will maintain and further improve its public transport system. Advancements in technologies for passenger rail will be present and accessibility will further be improved, while the buses will be of cleaner technologies. Public transport will still be the dominant mode as the improvements will be coupled with negative incentives for private travel. A significant share of the private vehicles will be of cleaner technologies (CNG, hybrid, electric and fuel cell).
Freight Transport	Adoption of cleaner technologies for freight LDVs and HDVs	Freight transport will still be dominated by trucks (LDVs and HDVs), but as with passenger transport, future trucks plying on the road will mostly be of cleaner technologies.

Challenges

- Singapore's biggest challenge has always been its limited land area and natural resources. Road expansion is expected to reduce to 0.5% per year from 2007 to 2022. As for its natural resources, Singapore had to import many of its renewable energy from neighboring countries until it began investing heavily in adding natural gas bunkering capacities and terminals.
- Car control has shifted from vehicle ownership to vehicle use, thus car ownership has become much easier for the average Singaporean. It remains to be seen if this will continue to keep the current traffic flow towards the future, or whether the potentially increasing number of users will in fact create problems in congestion despite car use control. According the National University of Singapore, there would be a huge challenge in transport if Singapore depends too much on its usage-based control policy. Thus, public transport improvements will be impertinent.

Co-Benefits

- In response to its social needs, Singapore is ensuring that public transport services and infrastructure accommodate the elderly and less mobile,
- The government also recognizes that infrastructure and support for non-motorized transport such as walking and cycling are important factors benefitting the ageing population of the city.
- In Singapore's Land Transport Master Plan 2013, the government aims to add 40 more lifts at pedestrian overhead bridges to assist the less mobile and elderly, as well as 20 km. of noise barriers on MRT tracks.
- Modern public transport system attracts tourists as well as further investments in business and transportation.
- The high costs for investing in new technologies at the short term will largely be compensated for cheaper fuel spending in the future. Under the BAU scenario, Singapore's transport sector will be consuming up to 3.5 million gasoline liters. In the alternative scenario, the transport sector will be consuming 1.01 million Gasoline liters, thus cutting consumption by more than half. This equates to about USD 2.4 billion savings in 2050 (current fuel prices).

Conclusion

- Depending on the stringency of Singapore's policies on new vehicle technologies and the amount of financial resources that will be allotted, Singapore can achieve a future scenario where most of the transport modes run on cleaner fuels and energy efficient technology. This simulation suggests a mitigation potential from 1.26 million tCO_2 per capita to 0.42 million tCO_2 per capita in 2050.
- The prospect of Singapore as a LNG Hub of Asia will play a key role in moving towards low carbon transport for the country.
- Singapore's compact development is crucial in ensuring the reduction of the need to travel long distances. ICT will play a more substantial role in the future.
- The proposed increase in buses and expansion of bus networks will improve the public transport service and motivate use of public transport as these are crucial feeder modes to the mass rail transit.
- Attaining a 0.33 million tCO_2 per capita will require additional policies such as further improvement of public transport and moving towards cleaner vehicles. Despite this, Singapore is in the best financial position to adapt massive technological improvements in the future, especially now that a large number of the technologies are underway and in the process of testing within the country.

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Thailand

Prepared by Clean Air Asia
Supported by Dr. Mongkut Piantanakulchai

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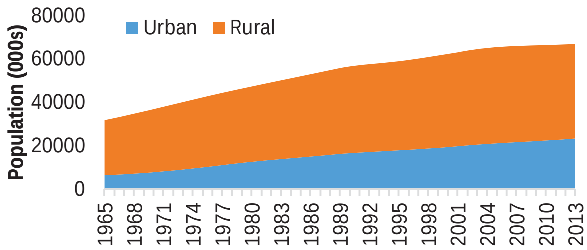

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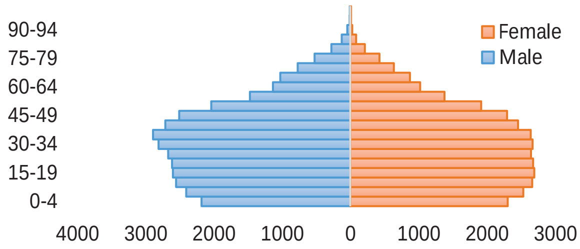

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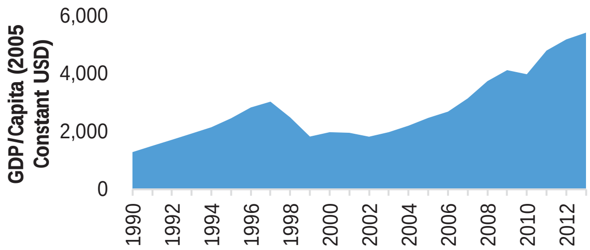

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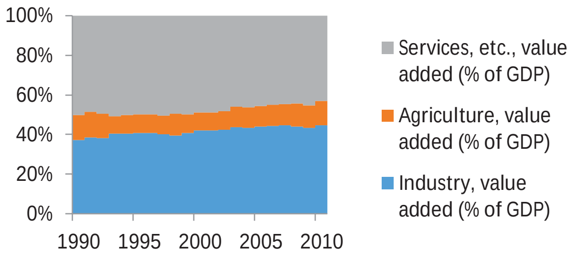


Figure 4. % Contribution of Sectors to the GDP[4]

INTRODUCTION

- Thailand covers a land area of over 513,120 sq. km. and is bordered by Lao PDR and Myanmar to the north, by Lao PDR and Cambodia to its east, by the Gulf of Thailand and occupying a part of Malay Peninsula to its south, and by Andaman Sea to its west.
- The land used for agriculture is approximately 40% of its total land area (NESDB). Thailand is composed of 76 provinces and the specially administered areas of Bangkok and Pattaya. These provinces are grouped and divided into six geographical regions comprising of many provinces: Northern, Northeastern, Eastern, Southern, Western, Central (includes Metropolitan Bangkok).
- Bangkok covers a land area of 1,568.7 sq. km. An urban conglomeration which comprises Bangkok, Nakhon Pathom, Pathum Thani, Nonthaburi, Samut Prakan and Samut Sakhon is called the Bangkok Metropolitan Region (BMR), or Greater Bangkok, covering an area of approximately 7,760 sq. km. (MOT, 2013).

POPULATION

- The population of Thailand was recorded at 66 million persons in 2010. This indicates an average annual growth of 0.74% over the period 1993-2013. Meanwhile, the urban population has grown at an average rate of 1.48% during the same period.
- It is estimated that at present, 34% of the population are in urban areas
- The country has a population density of 128.6 persons per sq. km. in 2010, and that of Bangkok is about 77 times higher than that of the North with 5,294.3 persons per sq. km.

AGE STRUCTURE

- A large fraction of the population belongs to the working age group (62%). Currently, only 8% of the populations are 65 years old and over (Figure 2). Despite Thailand being predominantly an agricultural country, a large fraction of those in the working age are employed in non-agricultural sector.

GDP per CAPITA

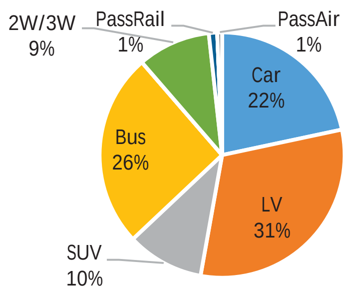
- GDP per capita is currently about USD 5,409 (2005 constant USD) and increased annually by 6.48% from 1990 to 2013.
- The period of 2002-2010 saw an increasing GDP per capita level, averaging an annual growth rate of 10.31%.

ECONOMIC STRUCTURE

- A large fraction of Thailand's income is driven by the services sector. Agricultural products were reported to be having a declining output and to have contributed only USD 9-12 billion to Thailand's real GDP in 2009, while the services sector contributed about USD 60.6 billion
- Despite Thailand being predominantly an agricultural country, a large fraction is employed in non-agricultural sector. Thailand relies heavily on its exports of electronics, automobile and parts, computer parts, and agricultural commodities, accounting for 60% of its GDP.

1 United Nations. 2012 and United Nations. 2011.
2 United Nations. 2012.
3 World Bank, 2013
4 Ibid.

Present Transport



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Source: Study estimates

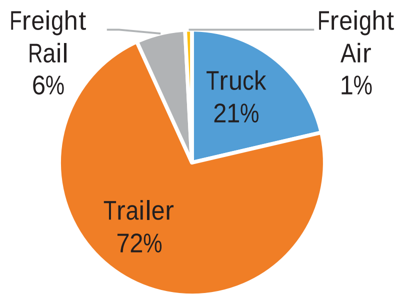

Figure 6. Freight Transport Mode Share (% of TKM), 2010

Source: Study estimates

Table 1. Population of Road Vehicles (2010)

Mode	No. of Vehicles	Percent
Passenger		
Cars	4,223,992	19.5
Light Vehicles	4,439,929	20.5
SUV	328,454	1.5
Bus	137,943	0.6
2W/3W	11,691,746	54.0
Freight		
HDV	726,194	3.4
LDV	83,238	0.4

PASSENGER TRANSPORT

- Between 2005 and 2010, passenger travel in Thailand has increased by 4.5% annually. As of 2010, passenger travel is at 773.27 billion passenger-km. Its road transport is largely dominated by motorcycles, cars/sedan and vans or sports utility vehicles and pick-up trucks. As for the public transport sector, the bus is the primary mode. Bus rapid transit was launched in Bangkok in 2010 and is locally called Bangkok Rapid Transit (BRT)
- The total road network in Thailand totals 202,000 km, 98% of which are paved.
- The railway infrastructure of Thailand spans approximately 4,034 km as of 2011. An estimated 41 million passenger traffic was carried by the rail network in 2011, transporting 7.5 million passenger-km
- Water transport is commonly used in Thailand for the transport of passengers daily, i.e. commuting to and from work, with "khlong" boats crossing canals and rivers. In 2012, about 38 million passenger journeys were made, or 100,000 per day.

FREIGHT TRANSPORT

- Freight travel in 2010 was 52.9 billion ton-km, increasing by about 1% per year from 2005 to 2010.
- The rail network is also utilized for the transport of goods with 6,016 freight wagons concentrated mostly in Bangkok as well as facilitating transport from its ports (e.g. Laem Chabang, Lad Krabang).
- The goods transported by freight transport in 2011 were mostly comprised of petroleum products, cement and other building materials, and containers.

ISSUES AND CHALLENGES

- There is increasing pressure in decongesting BMR, but its gravity in pulling people due to its economic importance, quality of services and life, will most likely continue the trend of sprawl within the area.
- Thailand is still continuing in its increase in vehicle motorization rates, partly due to some of the policies of the government to encourage consumers to buy new vehicles.
- The government is still subsidizing the use of fossil fuels (e.g. diesel). The removal of which may pose problems in the future.
- The freight sector is highly dependent on road transport.

Future Society

PLANS AND VISIONS

- Thailand envisions a "happy society with equity, fairness, and resilience by 2027." Efforts will be made to improve the quality and provision of all basic social services, including development of human resources aimed at increasing resilience for change, strengthening of the agriculture sector to increase food security and also to provide energy, and the improvement of regional connectivity through regional cooperative agreements, among others.

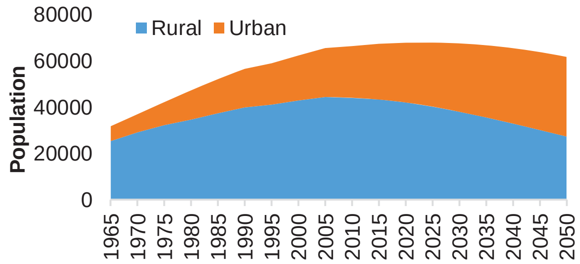

Figure 7. Population (000s)[5]

POPULATION

- In 2050, it is estimated that there will be 61.7 million people in Thailand. The population is expected to show a declining growth rate at an average of -0.13% per annum from 2005-2050. Meanwhile, urban population is expected to grow by 1.09% annually from 2005 to 2050. Population is expected to peak at around 2025 at 67.8 million and will experience decline up to 2050.
- 56% of the population will be living in urban areas in 2050.

[5] United Nations. 2012 and United Nations, 2011.

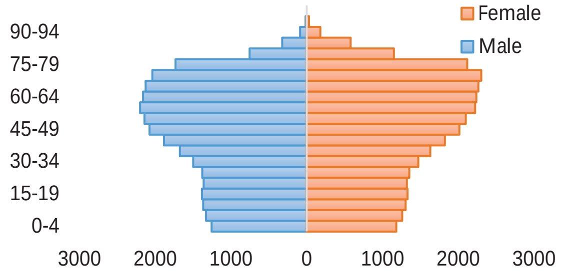

Figure 8. Population by Age (000s), 2050[6]

AGE STRUCTURE

- 53% of the population will be 20-64 years of age in 2050. Thailand will be an ageing society by 2050 as 30% of their population will be 65 years and over.
- The 11th National Economic and Social Development Plan acknowledge that, by 2025, Thailand will be an ageing society. The government of Thailand is anticipating a shift in the population structure by age by 2040, saying that a quarter of its population could be over 65 years of age, with the average age of males being 75.3 years while that of the females being 81.9 (The Nation, 2013). UN estimates that by 2050, 37% of the population will be senior citizens, i.e. 60 and above.

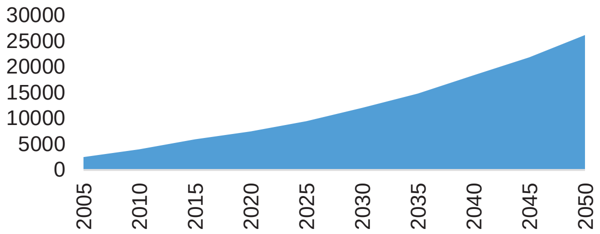

Figure 9. GDP/Capita Projections up to 2050[7]

GDP per CAPITA

- The Asian Development Bank Institute (ADBI, 2012) estimates the growth in Thailand to be sustained at around 5% per annum up to 2030. This is expected to taper off in the longer term, stabilizing at 4% to 3% from the periods 2030-2050.
- GDP per capita is projected to increase to USD 26,178 (2005 constant USD). It is forecasted to grow at an average of 5.39% per annum during the period 2005-2050.

ECONOMY

- Industrial energy growth will be driven by demand for food and beverages, chemicals and non-metallic minerals (APEC, 2012).
- New and renewable energy resources are expected to grow rapidly and will comprise 19% of the 2035 total energy supply (APEC, 2012); nuclear power is also a possibility that can be realized in Thailand.
- The emergence of the other areas in terms of population growth and economic activity contribution is expected in areas such as Chonburi, Nonthaburi, Pathumtani, Phuket and Rayong.

Future Transport

PLANS AND VISIONS

- Thailand is expected to move towards being more energy efficient as it strives to meet its own target of 25% energy intensity reduction by 2030 as compared to 2010 levels.
- Among the initiatives planned to be undertaken by Thailand in accordance with its 11th National Economic and Social Development Plan (NESDP 2012-2016) are the development of multi-modal transportation, shift towards energy efficient transportation and logistics, expansion of the coverage of the public transport network and the development of infrastructures integrating roads, railways, and water and air transport for both domestic and international uses.
- Transit routes will be added to the existing public transport system to extend its coverage from central Bangkok to surrounding provinces as well as the airports.
- With regard to the improvement of existing fleets, plans of purchasing 3,183 new buses (NGV) are also in discussion.
- The goal of having environmentally friendly transport sector is likewise supported by the Renewable and Alternative Energy Development Plan for 25% in 10 years (AEDP 2012-2021).

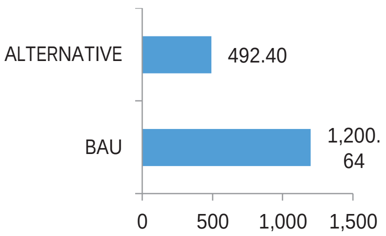

Figure 10. Passenger Travel (billion PKM), 2050

Source: Study estimates

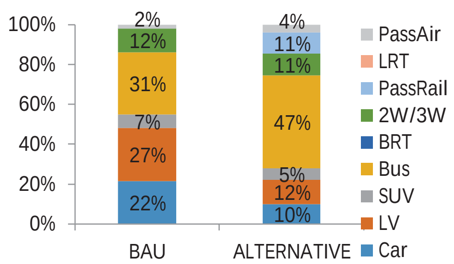

Figure 11. Passenger Mode Shares, 2050

Source: Study estimates

PASSENGER TRANSPORT

- Passenger travel would reach 1.2 trillion passenger-km under the BAU scenario, and can potentially be reduced to 492 billion passenger-km in the alternative scenario.
- In the baseline scenario for 2050, there will be 45.5 million vehicles, 50% of these are motorcycles and three-wheelers.
- There will be 206 passenger cars/1000 people, 369 motorcycles/1000 people (including 3-wheelers) and 32 trucks/1000 people in 2050. The values for these motorization indexes in 2005 are 97, 150 and 11 respectively. The highest growth rates during the period is in the SUV (microbuses and passenger vans), averaging an 8% increase per year, light duty trucks will grow at an annual average of 2.46%, followed by cars (sedans and taxis) at 2.02%.

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[6] United Nations, 2012.
[7] ADBI. 2012 and United Nations, 2012.

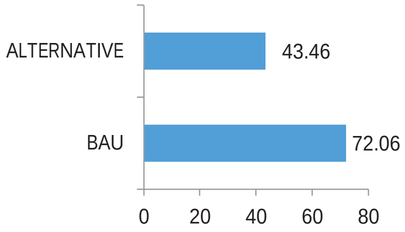


Figure 12. Freight Travel (billion TKM), 2050

Source: Study estimates

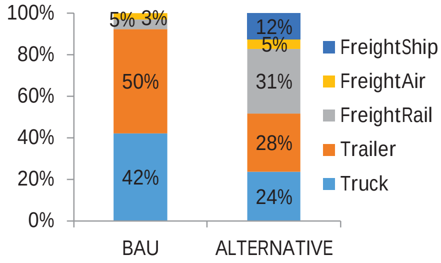


Figure 13. Freight Mode Shares, 2050

Source: Study estimates

FREIGHT TRANSPORT

- Meanwhile, freight travel is expected to increase to 72 billion ton-km by 2050 under the BAU scenario and would potentially decrease to 43.4 billion ton-km in the alternative.
- 92% of total ton-km will be serviced through road trucks and trailers.

ISSUES AND CHALLENGES

- The issue of an ageing society is a real concern for Thailand. From a transport perspective, access is a key concern that has to be integrated into the future systems to be adopted in Thailand.
- Growth in the secondary cities will be faster in the future, and thus, much attention is needed in putting sustainable, low emission transport modes and systems in these areas.

Results of Simulation

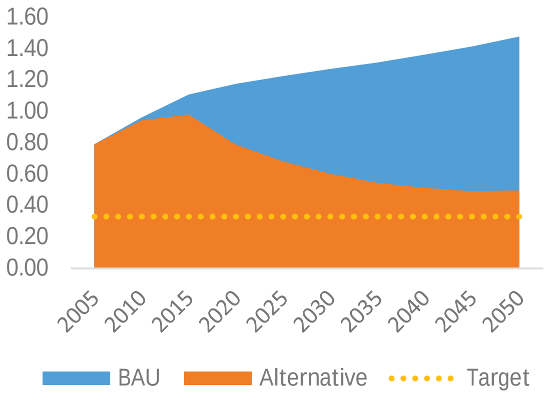


Figure 14. Tons CO2/capita

- The application of selected policies resulted to a reduction of total CO2 emissions in 2050 from 91.2 million tons (BAU) to 30.7 million tons.
- The alternative scenario posits a negative growth rate in emissions at -1.0% average annual rate of change, as compared to the BAU scenario which has a 1.3% annual average growth rate in transport CO2 emissions.
- The application of the policy packages resulted in notable changes in the transportation volume, as the alternative scenario results in a -0.6% rate of change in transport volume from 2005-2050, as compared to the BAU scenario where total transport volume is increasing at 1.5% per year.
- For passenger transport, the alternative scenario emphasizes the use and development of public modes such as buses and rail-based transport, while the private modes are growing at a negative rate. Buses will serve 49% of the total passenger-km in 2050 (vs 31% in the BAU) and rail will serve 10% of the total passenger-km (as compared to less than 1% in the BAU).
- For freight transport, the rail systems are much more utilized in the alternative scenario, contributing 31% of the total ton-km in 2050 (as compared to only 5% in the BAU).

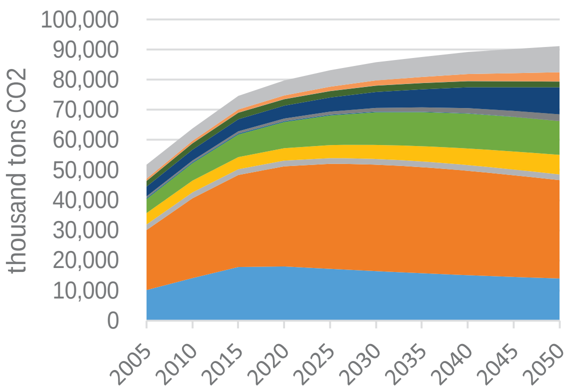


Figure 15. Total CO2 - BAU

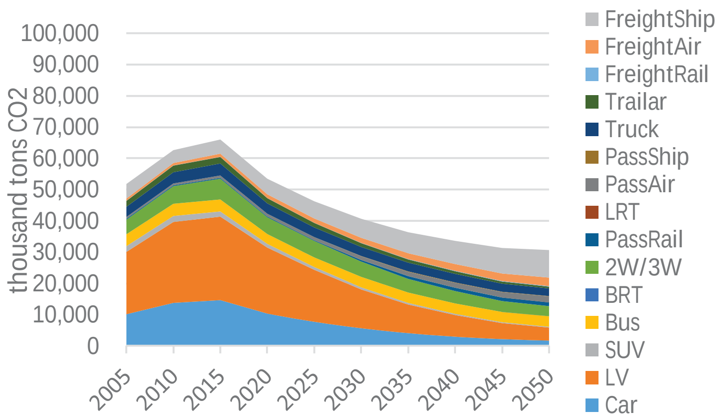
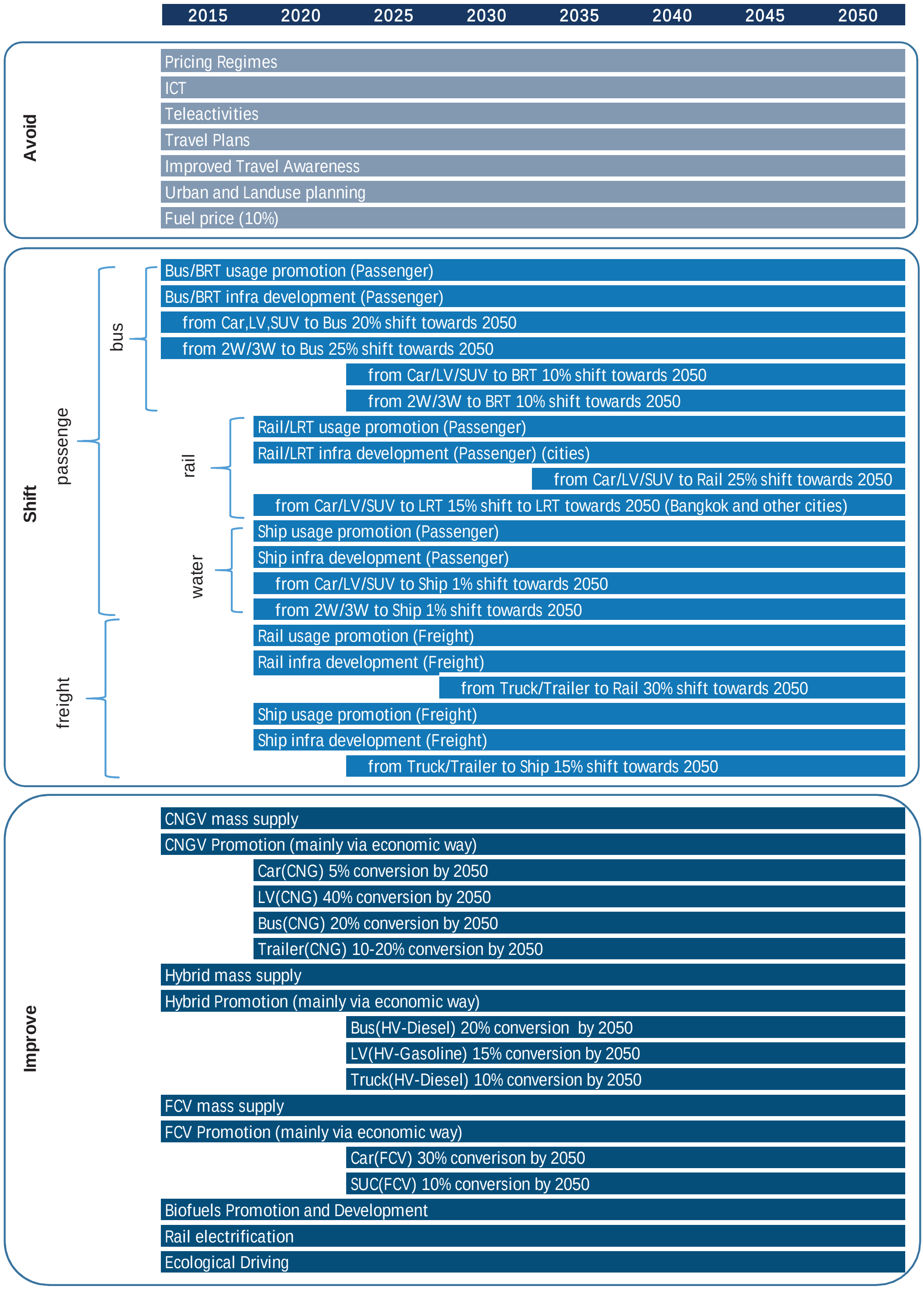


Figure 16. Total CO2 - Alternative

- The total transport emissions (including domestic air and sea transport) in 2005 were at 51.8 million tCO2.
- By 2050 Thailand will have already reached 91.2 million tCO2, or approximately 1.48 tCO2 per capita (0.79 tCO2 per capita in 2005).
- This implies a 1.3% increase in total emissions per year.

- The alternative scenario suggests less emission from car, LV and SUV use such that the contribution is limited to 20% in 2050 (as compared to 53% in the BAU). The contribution of buses will increase (due to higher bus volumes and usage) to 11% (as compared to 7% in the BAU). Rail-based passenger transport will contribute 4% of the CO2 emissions in the alternative scenario (as compared to 0.03% in the BAU).
- The alternative scenario results in a larger contribution from freight water transport (29% in the alternative vs. 10% in the BAU) as the alternative scenario postulates shifting of freight activity towards water transport.

ACTION PLAN



	Characteristic Policies	Future Image
Passenger Transport	Because road transport emission is high, measures to encourage a shift to mass transit systems should be encouraged. Bus transit should be improved and developed. Existing and new bus fleets should utilize more energy efficient technology and fuel alongside. Thailand's current stringent policies (Euro 4; diesel sulfur limits of 50 ppm) should be strongly implemented, and its fuel economy standards should be completed and implemented as well. Rail transit should be encouraged, and water transport via the water taxis or the khlong boats should be formalized and enhanced. To reduce the road transport activity, congestion charging, which is already in discussion, should be introduced.	Infrastructure for water transport will be developed, and traveling by public boats will be made less pungent with sewage and waste water treatment. Rail transit and BRT will be enhanced alongside and their mode share will increase as Thailand recognizes the increasing motorization and congestion.
Freight Transport	Encouraging a shift of freight transport mode from road vehicles will require linkages between regions; hence rail infrastructure and water transport should be able to support this. Fuel economy standards should be implemented in the land freight sector.	Because the government has recognized its weaknesses in the freight sector, infrastructure will be developed to increase efficiency in logistics.

Challenges

- Economic development in Thailand is usually concentrated in urban areas, primarily in BMR. Many of rural population remain in poverty indicating a high regional inequality. Those remote from BMT have significantly lower incomes and have limited access to better government services
- Transport activities in both passenger transport and freight have been increasing, indicating the increasing consumption of energy in the transport sector.
- As for the road transport, congestion charging has been in discussion for Inner Bangkok. Then again, such schemes will only be supported when the public transport system is in excellent and pleasant condition
- Trucks could also have more fuel-efficient engines. Thailand must do this by balancing food and energy crop production, i.e. without threatening its food security and its agricultural export output.
- The use of private vehicles is further required by the need to travel to areas outside of Bangkok. Encouraging a shift of transport mode from private vehicles to public transport will require linkages between regions, either with more roads or better rail connectivity. However, the feasibility of rail transport remains to be a concern due to investment requirements.

Co-Benefits

- Traffic congestion is a recognized concern especially in Bangkok where the average vehicle speed during the morning rush hours is 17.2km/hour, and 24.2 during the evening. Congestion is made worse with insufficient infrastructure to support transit from the suburbs. However, with the implementation of the proposed shifts to mass transit and with the enhancement of water transit, congestion is expected to result from decreased number of motor vehicles.
- The primary environmental benefit of energy efficient vehicles is the reduced dependency on crude oil and reduced emissions. Their effectiveness in cutting down vehicular emissions substantially depends on the source of power and the emission intensity of the fuel used, but not very much on reducing the number of vehicles on the road.
- The future of transport in Thailand when projects will proceed as planned can be characterized by decreased travel distance as BMR becomes denser, and the densification is supported by LRT and rail, increased eco-cars on a national level through the eco-car policy, expanded railway linkages between rural and urban areas, balanced spatial planning with transit-oriented development as developments tend to sprawl around the planned railway networks.

Conclusion

- Based on the simulations using the Backcasting tool, the current assumptions on the policy packages and their impacts will only reduce the tCO2 per capita to 0.50, still above the 0.33 tCO2 per capita target.
- Policies were analyzed in order to come up with an alternative scenario which embodies realistic and context-specific policies that are applied in the different regions of analysis.
- The alternative scenario postulates the following main characteristics of the future transportation image in the country:
  - o Passenger transport in the primary urban, other urban, non-urban areas and inter-regional transport will utilize bus systems more in the future, forming a significant portion of the transportation mode share in 2050 (49% of passenger-km).
  - o 4-wheeled vehicle-based transport activity growth will have a negative rate of change in the alternative scenario (average of -2.7% per annum).
  - o Buses would need to serve 34% of the total passenger-km by 2030, and rail-based systems would need to serve 12% of the passenger-km in the same year.
  - o Freight transport will be more diverse. Shifting substantial freight activity towards railway and water will be important (31% of total t-km in 2050).

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Vietnam

Prepared by Clean Air Asia
Supported by Dr. Ly Huy Tuan

Present Society

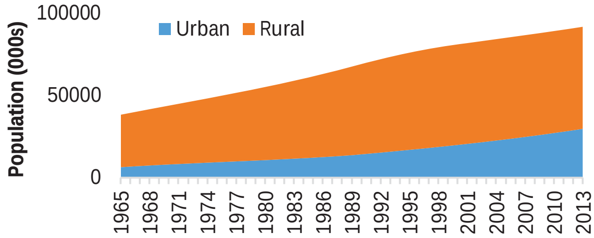

Figure 1. Population (000s)[1]

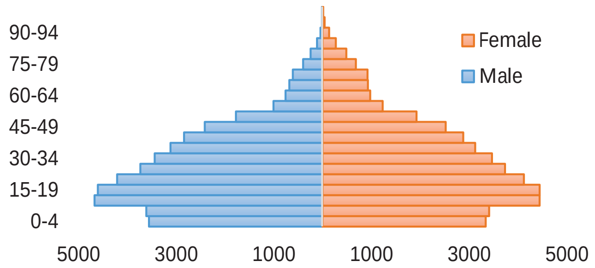

Figure 2. Population by Age (000s), 2010[2]

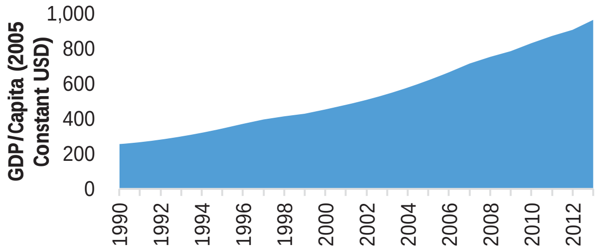

Figure 3. GDP/Capita (2005 Constant USD)[3]

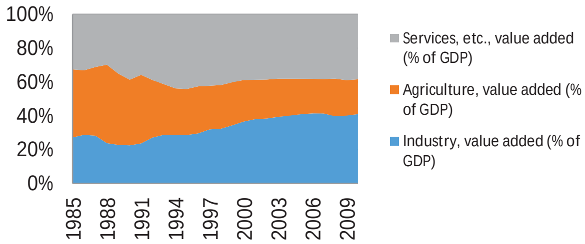

Figure 4. % Contribution of Sectors to the GDP[4]

INTRODUCTION

- Vietnam is bordered by China to the north, South China Sea to the east and to the south, Cambodia to the southwest, and Lao PDR to the northwest
- Vietnam has a land area of 330,951 sq. km. The river network of Vietnam is covers 42,000 km., 8,000 km. of which are utilized for inland water transport.
- Administratively, there are 3 regions (Northern, Central, Southern). There also exist socio-economic regional clusters (Northern Midlands, Red River Delta, North and South Central Coast, Central Highlands, Southeast, Mekong River Delta).

POPULATION

- Vietnam has an estimated population of 89.6 million, with a population density of 286.94 persons per sq. km.
- It has grown at an average of 1.25% per annum from 1990 to 2013. The urban population has grown at an average of 3.32% over the same period.
- It is estimated that about 32% of the population are in urban areas.

AGE STRUCTURE

- Vietnam has a young population base. 56% of the population is in the age of 20-64, and 38% are below 20.
- Only 7% of the population are 65 years and over.

GDP per CAPITA

- GDP per capita currently stands at USD 967 (2005 constant USD) and increased at an average rate of 5.92% from 1990 to 2013.
- It has grown particularly strong during the period 2002-2010, averaging an annual growth rate of 6.32%
- Vietnam's economy has market-based orientation. Economic reform has been guided by the Socioeconomic Strategy 2001-2010 and reinforced by continuous updates to the Socioeconomic Development Strategy.

ECONOMIC STRUCTURE

- While Vietnam is still generally regarded as an agricultural country, the contribution of the agriculture sector to the overall GDP has been gradually decreasing over the years as a result of the Doi Moi platform.
- This resulted to a shift to services and industry sectors when the government encouraged urbanization and promoted the growth of the manufacturing industry to reach its targets. The two main cities, Hanoi and Ho Chi Minh City, played vital roles to achieving this.

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1 United Nations. 2012 and United Nations. 2011.
2 United Nations. 2012.
3 World Bank, 2013
4 Ibid.

Present Transport

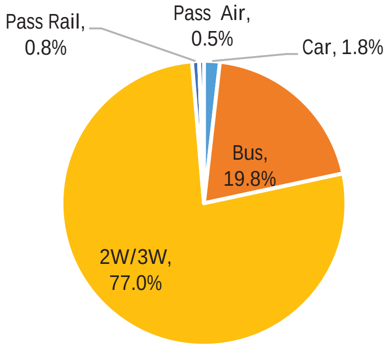


Figure 5. Passenger Transport Mode Share (% of PKM), 2010

Source: Study estimates

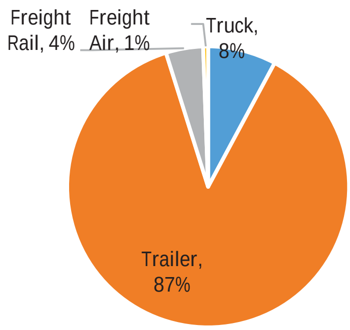


Figure 6. Freight Transport Mode Share (% of TKM), 2010

Source: Study estimates

Table 1. Population of Road Vehicles (2010)

Passenger

Mode	No. of Vehicles	Percent
Cars	546,690	1.7
Bus	102,713	0.3
Motorcycles	31,155,154	96.3

Freight

HDV	420,376	1.3
LDV	125,567	0.4

PASSENGER TRANSPORT

- Passenger travel has been increasing by 1.3% per year in Vietnam and in 2010 travel has reached 538.3 billion passenger-kms.
- Vietnam has 210,000 km of roads, 62% of which are rural. 8% of the total road length is national roads, and 84% of the national roads are paved. The railway network in Vietnam is 2,347 km. long.
- 96% of on-road vehicles in Vietnam are motorcycles, and these two-wheelers cover 77% of passenger travel as of 2010
- In 2012, it was estimated that there were 38.4 million vehicles that were registered in Vietnam, 95% of which were motorcycles. The vehicle fleet has grown at an average of 16% per annum from 2000-2012. The growth in cars is highest at 18% during the same period.

FREIGHT TRANSPORT

- Freight transport has grown by 1.9% per year between since 2005 and has reached an estimated 162.5 billion ton-km in 2010 (68.6 in 2005). Trucks and trailers cover 95% of all freight travels.
- Cargo trailers dominate freight transport at a national level, with about 89% of all freight transport activity (ton km) are done by trailers or heavy duty trucks (2010), 8% are done by light-duty trucks and only 2% are serviced by rail. 90% of cargo trailer transports are inter-regional.
- The contribution of rail in servicing the total tonnage of freight volume is only 1% (GSO, 2013) and has historically been reducing. It has grown at an annual average of 3% in 1995-2011, but during the last five years of the said period, it has declined at an annual average of -3%.

ISSUES AND CHALLENGES

- Due to the rapid increase in motorization in economic activities during the last decade resulting in much higher travel demand, coupled with the challenges faced by the public transport sector to keep up with the travel demand, there is now a high dependency on private transport, particularly in the major cities in Vietnam.
- Vietnam will need adequate financial capacity to optimize its resources. Vietnam has its own reserves and resources of fossil fuels such as crude oil and natural gas (APEC 2013). Vietnam is a net exporter of energy. Hydropower still remains the highest contributor to the electricity in Vietnam (39% in 2010).

Future Society

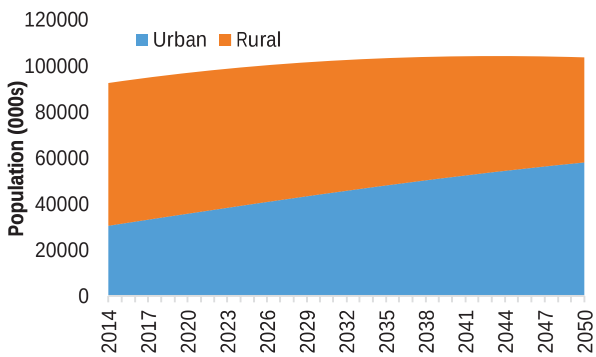
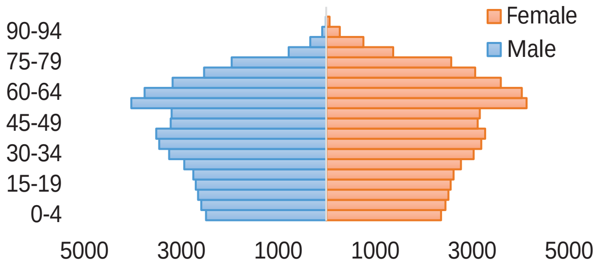


Figure 7. Population (000s)[5]

POPULATION

- The country's population is projected to grow to 104 million people by 2050.
- The population is expected to grow at an average of 0.44% per annum from 2005-2050.
- The urban population growth rate is expected to slow down gradually, growing at an average of 2.06% during the same period. Nevertheless, 55.9% of the population will be living in urban areas by 2050. In 2038, the urban population in Vietnam is expected to take-over the rural population in the country.
- There is an apparent concentration of urbanization to certain regions of the country particularly those nearer the peripheries of the major cities (GSO, 2009).
- In 2050, two additional primary cities (i.e. cities with more than 2 million people) may emerge in Vietnam: Hai Phong (by 2020) and Bien Hoa (by 2041). Urban agglomerations (i.e. with over 200,000 people) will almost double, from 17 in 2010, to 30 in 2050.

[5] United Nations. 2012 and United Nations, 2011.



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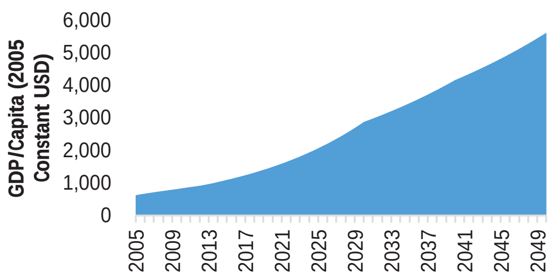


Figure 9. GDP/Capita Projections up to 2050[7]

AGE STRUCTURE

- 59% of the population is expected to be 20-64 years of age in 2050 (UN, 2012).
- By 2050, 23% of the population of Vietnam will be aged 65 and over.

GDP per CAPITA

- The Asian Development Bank Institute estimates the growth in Vietnam to be sustained at around 7% per annum up to 2030 (ADBI, 2012). This is expected to taper off in the longer term, stabilizing at 4% to 3% from the periods 2030-2050.
- GDP per capita is projected to increase to USD 5,621 (2005 Constant USD). It is forecasted to grow at an average of 5.01% per annum during the period 2005-2050.

ECONOMY

- In accordance with the initial 10-year Socioeconomic Strategy, Vietnam aimed for the following economic structure by 2010: 16-17 % agriculture, 40-41 % industry, and 42-43 % services.
- The government, through the Socioeconomic Development Plan for 2011-2015, has aimed for an annual growth rate of 6.5-7% annually (Vietnam, 2012, www.chinphu.vn/portal).
- Projections based on historical data shows labor force trends going towards the services and manufacturing sectors. Agriculture hosted 48% of the labor force in 2011, 21% are in manufacturing and 31% are in the services sector. In 2050, this is simulated to be 28% agriculture, 32% manufacturing and 38% services sector.

Future Transport

PLANS AND VISIONS

- The Vietnam power development plan 2011-2020 states targets towards increasing the share of renewable energy to 4.5% in 2020and 6% in 2030 and this is seen to be realized in the future image of society.
- Updates on the environmentally sustainable transport policies of Vietnam to 2020 (EST) as reported to the UNCRD EST forums. The EST specifies 10 priority targets by 2020, including an ambitious 30-45% mode share from public transport, especially from the Urban Rail System.

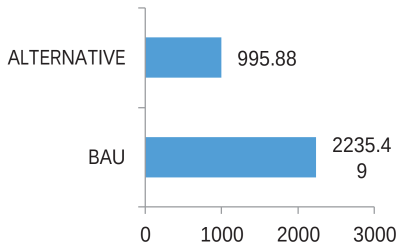


Figure 10. Passenger Travel (billion PKM), 2050

Source: Study estimates

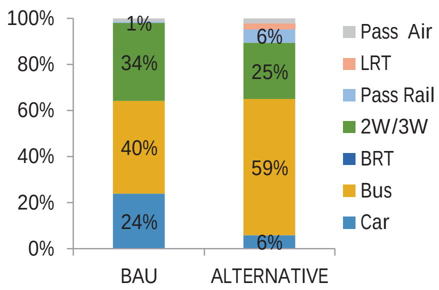


Figure 11. Passenger Mode Shares, 2050

Source: Study estimates

PASSENGER TRANSPORT

Passenger travel in 2050 will be 2,235.49 billion passenger-km under the BAU scenario.

The results of the projections show that Vietnam will reach 550 motorcycles/1000 people by 2037. The results also show that the cars per 1000 people will be 292 (higher than current levels in Malaysia) in 2050.

The baseline scenario for 2050 suggests that there can be 89 million vehicles, 57 million of which will be motorcycles. The share of the motorcycles in the total fleet will be lower at 63% as compared to the 97% share in 2005. This is mainly due to the increase in the cars in the fleet. Growth in the cars will be the highest at an annual average of 12% from 2005-2050, while motorcycles will be at 3%.

[6] United Nations, 2012.
[7] ADBI. 2012 and United Nations, 2012.

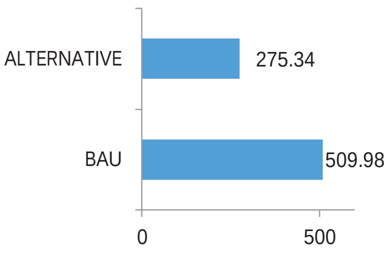


Figure 12. Freight Travel (billion TKM), 2050

Source: Study estimates

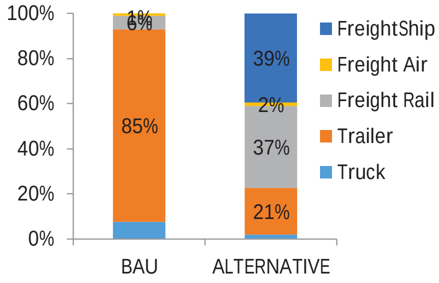


Figure 13. Freight Mode Shares, 2050

Source: Study estimates

FREIGHT TRANSPORT

- The freight travel activity will be growing at an average of 4.6% for the period of 2005 to 2050, increasing to 510 billion ton-km under the BAU scenario.
- Heavy duty trucks will continue to use diesel engines.
- It is also expected to increase in the future (average annual growth rate in ton-km at 5.3%), given that continuous capacity additions are materialized.
- Air freight will continue to grow at an average of 4% per annum in terms of million ton-km.

ISSUES AND CHALLENGES

- Multiple urban centers will emerge as a response to the growing population density in current urban centers (World Bank, 2011). Efficient inter-regional transportation systems will be needed (such as expressways, long haul rail systems, airports).
- Increased consumption driven by the growing economy will drive the increase in freight demand. Vietnam is strategically located in the region, and with its ports and land access to the other Southeast and East Asian countries, it can be a regional hub for freight as well as a hub for the manufacturing sector. As average wages go up in China, investors and businesses will look into other alternatives such as Vietnam.
- The use of private motorized transport will be prevalent. The use of cars, in particular, will gain more traction as people gain more access to these vehicles due to higher incomes.
- Vietnam is expected to be a net energy importer by 2020. While there is currently energy resources in Vietnam from fossil fuels, natural gas and hydropower, among others, their supply will have to meet the continuing energy demand from economic growth. Oil import dependency is expected to commence in 2014 and will reach 66% in 2035 (APEC, 2012).

Results of Simulation

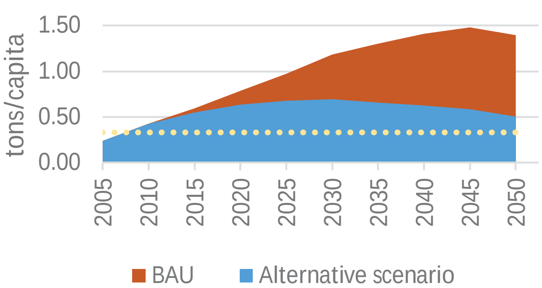


Figure 14. Tons CO2/capita

- The application of the selected policies resulted to a reduction of total CO2 emissions in 2050 from 144 million tons (BAU) to 52 million tons.
- The alternative scenario limits the annual increase in total CO2 emissions for transport to 2.1% per year, as compared to 4.5% in the BAU scenario.
- The application of the policy packages resulted in notable changes in the transportation volume, e.g.: reduction of the annual growth in car transport volume to 6.4% as compared to 11.7% in the BAU, higher annual rates of increase in passenger rail usage (5.9% vs 2.9% in the BAU) and freight rail usage (8.2% vs 2.9% in the BAU).
- The impacts of the policies resulted in a 2050 per capita CO2 value of 0.51 tons per capita (as compared to 1.40 in the BAU scenario).

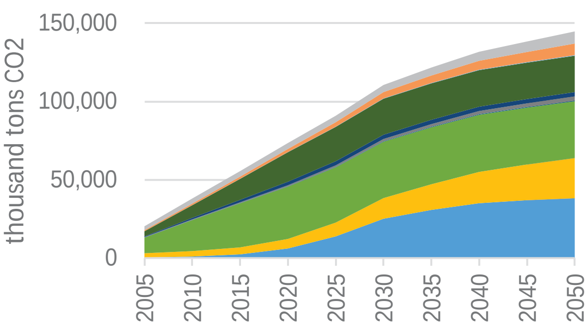


Figure 15. Total CO2 - BAU

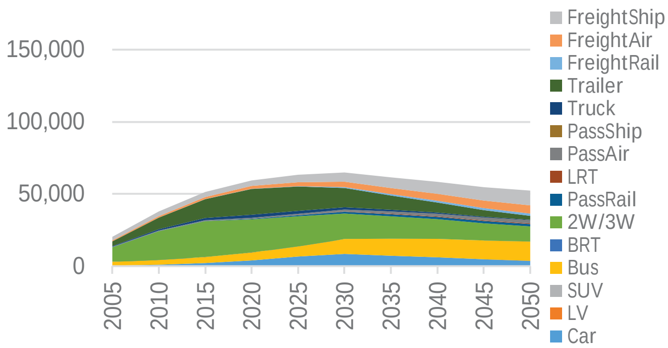
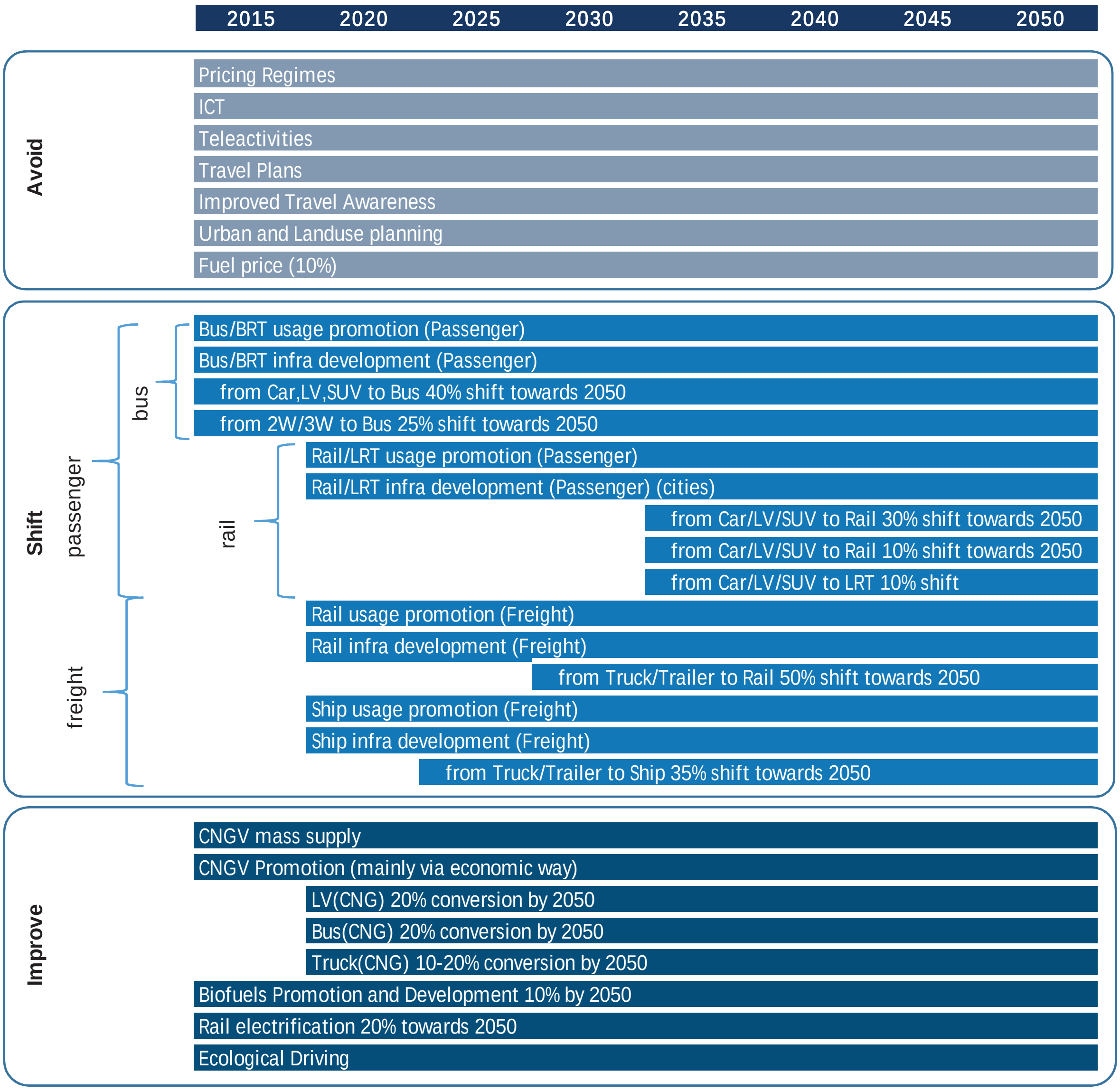


Figure 16. Total CO2 - Alternative

- The total transport emissions (including domestic air and sea transport) in 2005 were at 20.3 million tCO2. The national road transport emissions totaled 16.8 million tCO2.
- By 2050, Vietnam will have already reached 144.7 million tCO2, or approximately 1.4 tCO2 per capita. Road transport will reach 126 million tCO2 or 1.22 tCO2 per capita.
- This implies a 4.5% increase in emissions per year.
- Motorcycles are the largest emitters in Vietnam, contributing 53% of CO2 emissions in 2005. However, car use is seen to increase significantly from 2005 to 2050, averaging at 12% increase in car travel per year versus a mere 3% increase in motorcycle travel per year.
- By 2050, under the BAU scenario, the contribution of cars to the total emissions will be almost at par with motorcycles, at26% and 25%, respectively.
- The alternative scenario suggests less emission from car use such that the contribution is at 7.1%. Meanwhile, motorcycles are expected to continue to contribute largely to total transport emissions at 20%. Nevertheless, the improvement of bus networks is expected to reduce the emissions from cars and motorcycles significantly.
- The alternative scenario results to a larger contribution from freight water transport (20% in the alternative vs. 5% in the BAU) as the alternative scenario postulates shifting of freight activity towards water transport. It is anticipated that with the growth of port cities in Vietnam, water freight transport from north to south would increase, slightly reducing road freight emissions but increasing ship emissions.

ACTION PLAN



	Characteristic Policies	Future Image
Passenger Transport	Rail transit should be developed and promoted. Bus transit should also be enhanced in both Hanoi and Ho Chi Minh City. Because the development of rail transit requires more financial investments, Vietnam should improve the services of its bus transit and ensure that they cover smaller roads. Ensuring smarter urban and land use planning should be a priority in the development of transport plans to reduce the distance traveled by vehicles.	Motorcycles will still play a significant role for transport in primary cities. Private fleets, particularly the motorcycles, will employ more fuel-efficient engines and will have low emissions. As the urban areas in Vietnam are expanding, the bus transit system is expected to be flexible enough to be restructured to cover new areas, and to have expanded operations in the primary cities. These buses are envisioned to run on alternative fuels such as CNG or even electricity-driven. Rail systems will play a much more significant role in commuting in the primary cities. Light rail lines will be existent in these urban areas, but with less penetration rates as in the primary areas.
Freight Transport	Maritime and rail transport infrastructure and service for port cities should be improved to make these modes more competitive with road cargo trailers. Land use planning, transport planning, and logistics industry planning should be integrated to ensure that freight vehicle mileage is reduced with smarter routing. To improve those that remain dependent on road transport, fleets should have more fuel-efficient engines and should follow inspection and maintenance programs (roadworthiness of trucks), and drivers should participate in ecological driving. CNG-run vehicles should also be considered.	Heavy duty trucks will continue to use diesel engines, but natural gas-driven trucks will eventually be used, although this is expected to remain dependent on the initiatives of the private sector (i.e. trucking companies). The mode share of rail freight is still expected to increase, given that its historical trend suggests an average annual growth rate in ton-km of 5%, provided that the continuous addition of capacity and networks are materialized. Air freight will continue to grow at an average of 4% per annum in terms of million ton-km. Water freight will expand and will be a major factor for the country's development, particularly in the regions where inland waterways will be maintained and developed.

Challenges

- There is now a high dependence on private motorized transport in Vietnam as a result of the increase in incomes during the last decade and the increase in travel demand, as well as the inadequacy of the public transport infrastructure to accommodate the rapidly increasing travel demand. It has been presented in earlier chapters that cars will greatly contribute to future transport emissions.
- The BAU scenario estimates that the total transport CO_2 emissions will increase 7-fold from 20.3 million tons in 2005 to 144.7 million tons in 2050. In terms of per capita emissions, it will increase from .24 tons per capita in 2005 to 1.4 tons in 2050.
- The estimates suggest that further development of mitigation policies in interregional transport would be a significant matter of consideration. Interregional transport is projected to contribute 57% of the total transport emissions in 2050, with heavy-duty trucks contributing the highest.
- In terms of the different modes, the car is estimated to be the highest contributor in 2050, emitting 26% of all transport CO_2 emissions.
- The study presents future societal factors for Vietnam based on available information on forecasts for the economy and population characteristics of the country.
  - o By 2050, the population of Vietnam will be 103.6 million, 59% of whom will be within the working age, 23% will be senior citizens.
  - o 55.9% of the population in 2050 will be living in urban areas

Co-Benefits

- The implication of high motorcycle use is dire: road safety has become a major issue in Vietnam. Speed and maneuverability do not mix well with irresponsible driving, and in Vietnam 59% of road traffic collisions are from motorcycles (WHO, 2014). WHO reports of approximately 16.1 deaths per 1000 population each year or 14,000 people dead from road accidents each year. Striving for low-carbon transport can reduce the number of motorcycle accidents by reducing the travel demand and improving the mode mix on road, including providing options to motorcycle users.
- In Ho Chi Minh City, increased number of vehicles and lack of public transport has worsened the traffic conditions, leading to road congestion and exacerbating levels of air pollution (Vu Hai Luu, 2014).

Conclusion

- Based on the simulations using the Backcasting tool, the current assumptions on the policy packages and their impacts will only reduce the tCO_2 per capita to 0.51, still above the 0.33 tCO_2 per capita target. It is recommended that additional policies on mitigating emissions from the primary urban areas be put in place, particularly in those that are likely to join the 2million plus population category in the future (e.g. Bien Hoa and Hai Phong) as these areas will be fastest in terms of growth in the contribution to the total CO_2 emissions from transport.
- Freight is an important theme of policy design and adoption in the near future. Implementation of advanced rail that can reduce the number of cargo trailers on the road is an option. It is highly recommended that rail development be prioritized from 2020 onwards to support increase in freight travel demand resulting from a growing manufacturing industry. The development and utilization of water transport facilities will play a key role in the future of freight transport in Vietnam.
- The Vietnamese will continue to favor the motorcycle as the primary mode choice. Capping motorcycle use through government control and vehicle quotas is recommended.
- Vietnam currently lacks tools for monitoring carbon emissions. The Backcasting tool can definitely support the measurement, reporting and verification (MRV) of transport initiatives especially now that new transport developments are being undertaken particularly in Hanoi and Ho Chi Minh City.

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Chapter 4

Conclusion

This chapter presents what will be needed to reduce CO2 emission from the transport sector drastically and to meet the 0.33 tCO2 target in the AESEAN region in accord with the results of chapter 3.

The following conclusions are based on the results of the discussion at the meeting with local transport experts which was held on February 19th, 2014.

(1) Tools are now available to enable assessment and prioritization of low carbon transport strategies for ASEAN

The Visioning and Backcasting tool, which is one of the outputs of the study, makes it possible for the ASEAN region to consider appropriate policies for themselves and to assess the mitigation impacts by introducing selected policies.

Furthermore, the tools are able to be customized by users by inputting new data and policy settings etc. This means that impacts of technological innovation in the future will also be able to be assessed by these tools. We hope that the tools will be developed further by incorporating new data, new policy options and new technological innovations and so on.

Tools will be available shortly by downloading from the URLs shown as below;

http://cleanairinitiative.org/portal/LPA (main page regarding LPA project)
http://cleanairinitiative.org/portal/lpadownload (downloads page)

(2) ASEAN region cannot avoid "Avoid policies"

The countries in the ASEAN region cannot disregard "Avoid policies" anymore in order to drastically reduce future CO2 emission from the transport sector and to meet the 0.33 tCO2 target. "Avoid policies" are generally disregarded due to their complexity in terms of policies and plans in the pipeline. For example, "Avoid policies" such as transit-oriented development are generally least prioritized because of their general insufficient ability to generate revenue. However, it is agreed that "Avoid policies" are most important especially at the present time from the view point of a long term vision and that they should be prioritized.

"Behavioral changes" of the people in ASEAN region are also required in order to mitigate CO2 emissions. "Avoid policies" generally involve "induced behavioral change" through design and policy. In addition, the ASEAN region would allow the decoupling of economic development and increasing transport demand at an early stage by these policies and behavioral changes. From the view point of a promotion of behavioral changes, Avoid policies are a necessity.

(3) ASEAN countries should aim at keeping and improving public and non-motorized transport mode shares needs

Shift policies in the region are important in mitigating "reverse shifting" (e.g. shifting from public transport towards private motorized transport). The present modal share of public transport and non-motorized transport is relatively high, and to maintain this share is important to mitigate transport CO2 emission in the future. To do this, the introduction of improved and high quality public transport would be an important key.

The improvement of policies should be context-based depending on the mode mix; consideration for endemic vehicles is important. Improve policies particularly technology should be flexible especially with the rapid emergence of better new technology that is fast becoming available

In addition, “Improve policies” can concentrate on public transport in order to create a synergy effect with “Shift policies” and such effects would be able to mitigate reverse shifting.

(4) Early adoption of low carbon transport policies will maximize benefits

Achieving the 0.33 tCO2 target is possible for the ASEAN region, but it will require stringent efforts, such as the introduction of more improved vehicles and a shift rate from private cars, and so on.

Also, reflecting on the numbers, 2050 is not far away, especially if we look at the bigger projects (e.g. involving urban transformation, construction of big transport infrastructure) and considering the lag time and construction times, only a small portion of the time will be allotted for actual implementation of these projects, so the time to act is now.

And our tools also enable peoples of ASEAN countries to consider how to allot the times for the policy implementation towards 2050.

(5) Multi-stage, multi-sector cooperation is needed to achieve low carbon transport

Other areas, especially secondary and tertiary cities should be given attention, as these will be the main areas of growth leading up to 2050. Currently, policies, financial assistance and development aid are mostly channeled to primary cities and there is a need to adjust attention towards other rapidly growing cities. The policy options for primary cities are generally broader; however, the options become narrow for smaller size cities. To consider effective policies for such areas is also required.

Freight and inter-urban travel should be given more attention. A large portion of CO2 emission is due to inter-urban travel, especially with the increasing use of trucks and cargo trailers. However, there are at present few policy options for such means of transport; therefore to develop policies to mitigate CO2 emission from them is also required.

Of course, transport decisions will not be taken based on CO2 mitigation analysis alone. In addition, CO2 mitigation has not always been deemed to be prioritized yet in the ASEAN region. Therefore, the need to communicate the co-benefits of the policies and integrate a holistic multi-criteria analysis in the process must be taken.

In addition, solutions may lie outside the transport sector and therefore, horizontal integration is needed. Stakeholders involved in areas such as urban planning, environment planning and energy must be involved in the process of promoting sustainable and low emissions transport. Vertical integration is also needed. Provincial governments and local government units must be part of the process as effective implementation of transportation interventions requires the actions of the local governments.

Lastly, we sincerely expect that this report and these two tools will be useful for considering an effective future transport system in the ASEAN region.

Appendix A

How to Operate Visioning and Backcasting Tools

A.1 Visioning Tool

A.1.1 How to Operate the Visioning Tool

This section shows how to operate the visioning tool. The flow of operations is shown in Figure A-1.

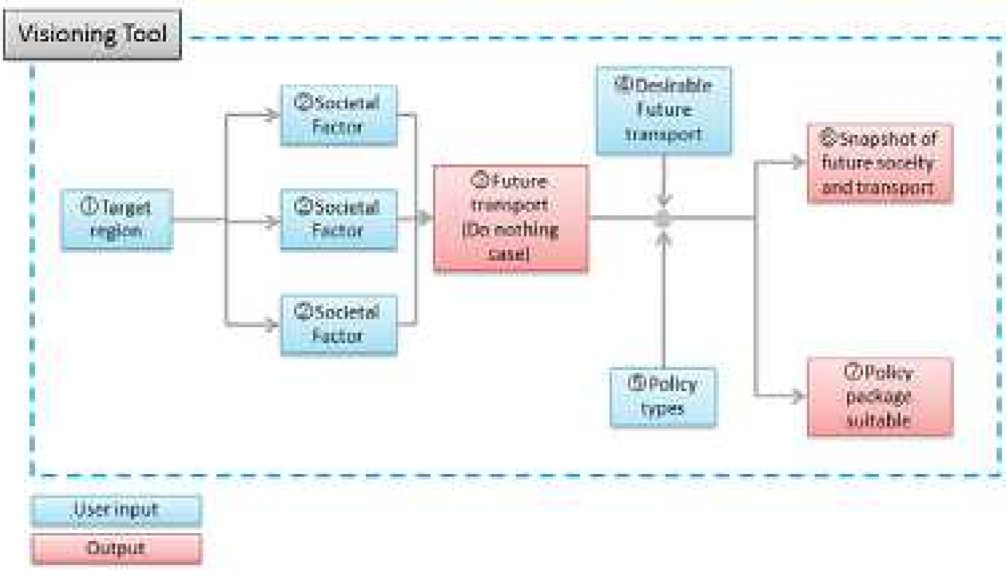


Figure A-1. Flow of Operations of Visioning Tool

(0) Advance Preparation

- Check that Microsoft Excel ver.2007 or 2010 and .NET Framework ver.4 have been installed on the user's PC.
- If any Excel files are open, close all of them.

(1) Start

- Double-click on [Visioning Tool.exe], which is an executable file.

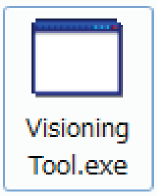


Figure A-2. Executable File

- A screen like the one below will be displayed. If using it for the first time, click on the [Start] button; if using a previous case again, click on the [Restart] button.

Figure A-3. Start Screen

(2) Select Target Country and Set Case Name

- A screen like the one below will be displayed. Select the country to be evaluated.
- Enter the case name for this project.
- To proceed to the next process, click on the [Next] button.

Figure A-4. Select Target Country and Set Case Name

(3) Select Region to be Evaluated

- A screen like the one below will be displayed. Select the region to be evaluated. There are 9 target regions.
- To proceed to the next process, click on the [Next] button.

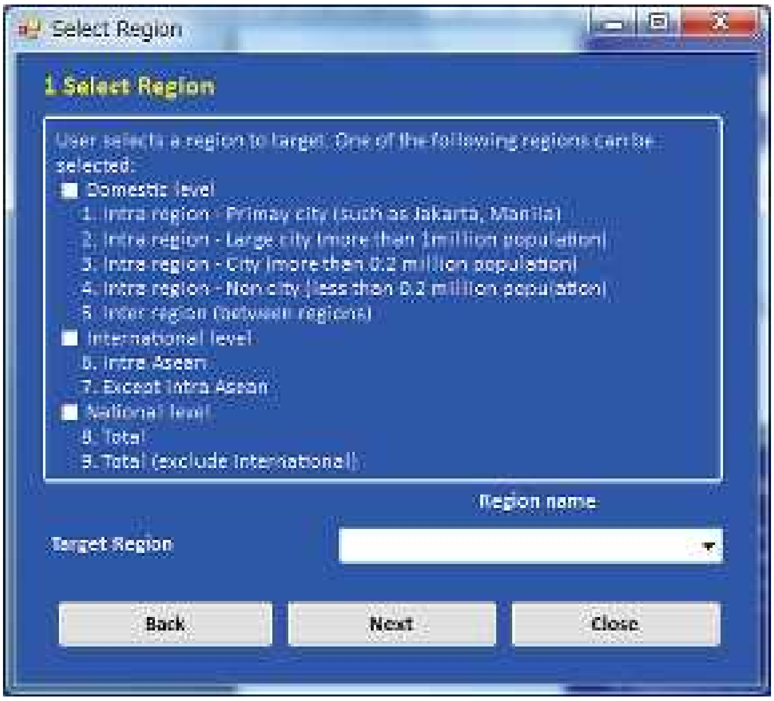


Figure A-5. Select Region to be Evaluated

(4) Questions about Current Societal Factors

- A screen like the one below will be displayed. Answer questions about the societal factors. To move to the next question, click on the upper [Next] button. If the cell is colored orange, this denotes that the indicator is a fixed value[1]. There are around 50 questions in total.
- To proceed to the next process, click on the [Next] button.

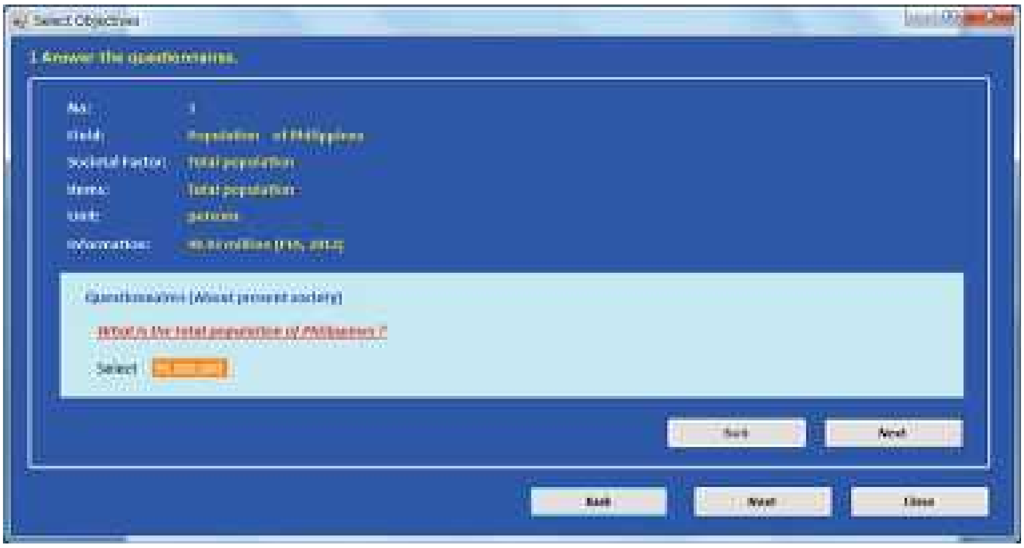


Figure A-6. Questions about Current Societal Factors (In case the factor is preconditions)

[1] In this study, these indicators are called preconditions. In this study, future projections concerning the economy and population are viewed as being fixed.

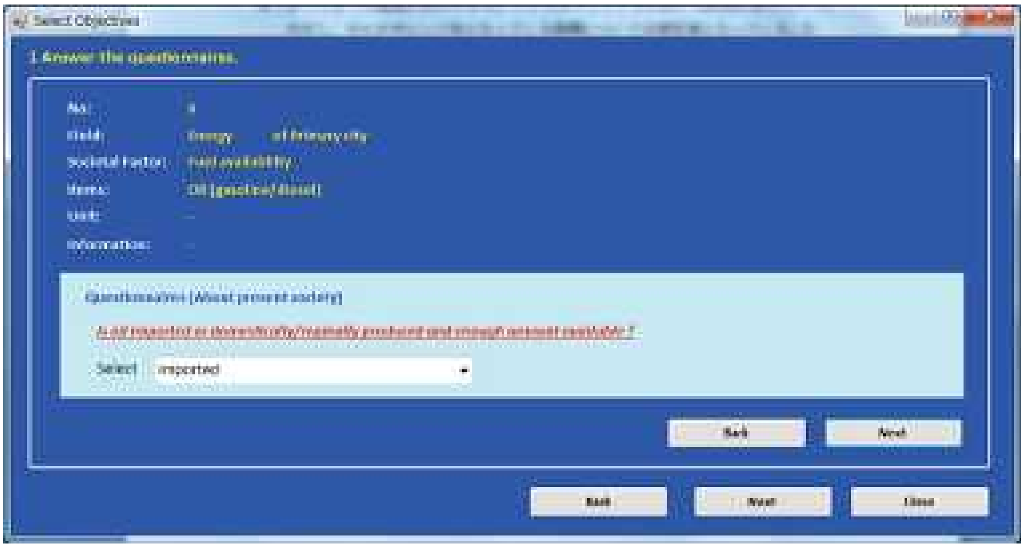


Figure A-7. Questions about Current Societal Factors (In case the factor is variable)

(5) Questions about Future Societal Factors

- A screen like the one below will be displayed. Answer questions about the societal factors. To move to the next question, click on the upper [Next] button. If the cell is colored orange, this denotes that the indicator is a fixed value[2]. There are around 30 questions in total.
- To proceed to the next process, click on the [Next] button.

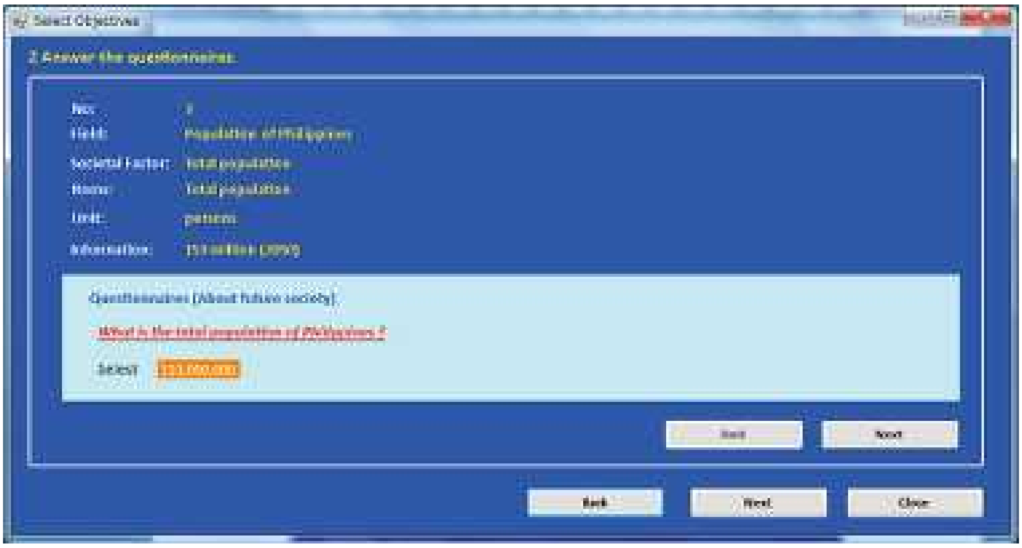


Figure A-8. Questions about Future Societal Factors (In case the factor is preconditions)

[2] In this study, these indicators are called preconditions. In this study, future projections concerning the economy and population are viewed as being fixed.

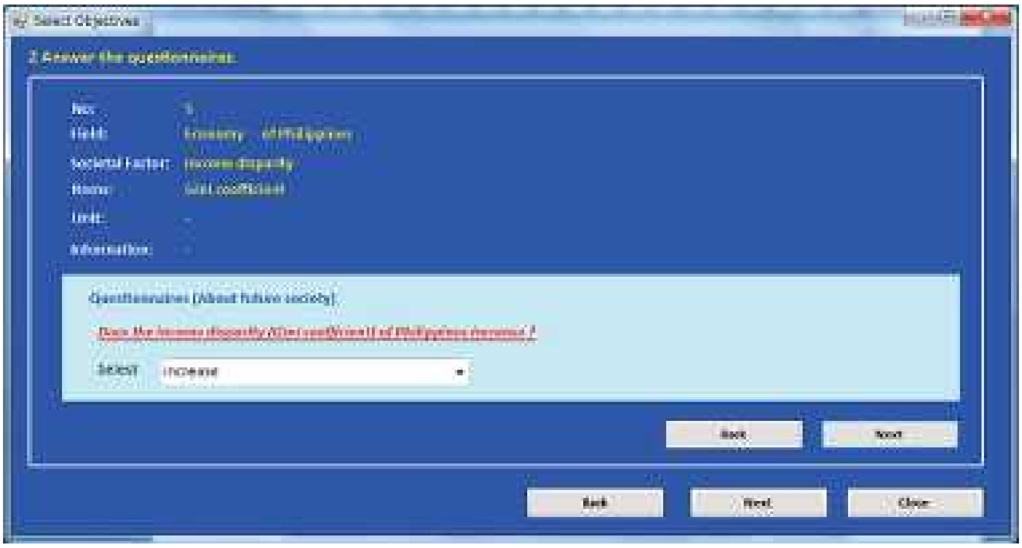


Figure A-9. Questions about Future Societal Factors (In case the factor is variable)

(6) The Trend of Transport in the Future

- A screen like the one below will be displayed. Trends for around 30 key indicators relating to transport in the Do Nothing scenario will be displayed. To move to the next indicator, click on the upper [Next] button. About 25 questions have been prepared concerning the indicators.
- To proceed to the next process, click on the [Next] button.

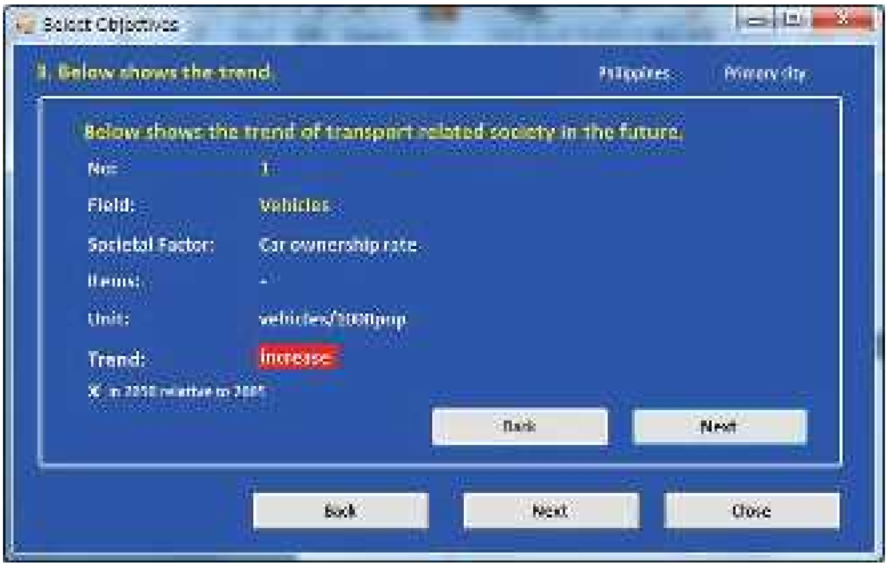


Figure A-10. Future Transport Trends in the Do Nothing Scenario

(7) Purpose/Objective User Wants to Relieve and Tackled to Meet User's Ideal Society

- A screen like the one below will be displayed. Trends for objectives and issues relating to future transport in the Do Nothing scenario will be displayed. For objectives and issues that are deteriorating, choose whether or not to formulate a social scenario aimed at improvement in the user's future vision.
- To proceed to the next process, click on the [Next] button.

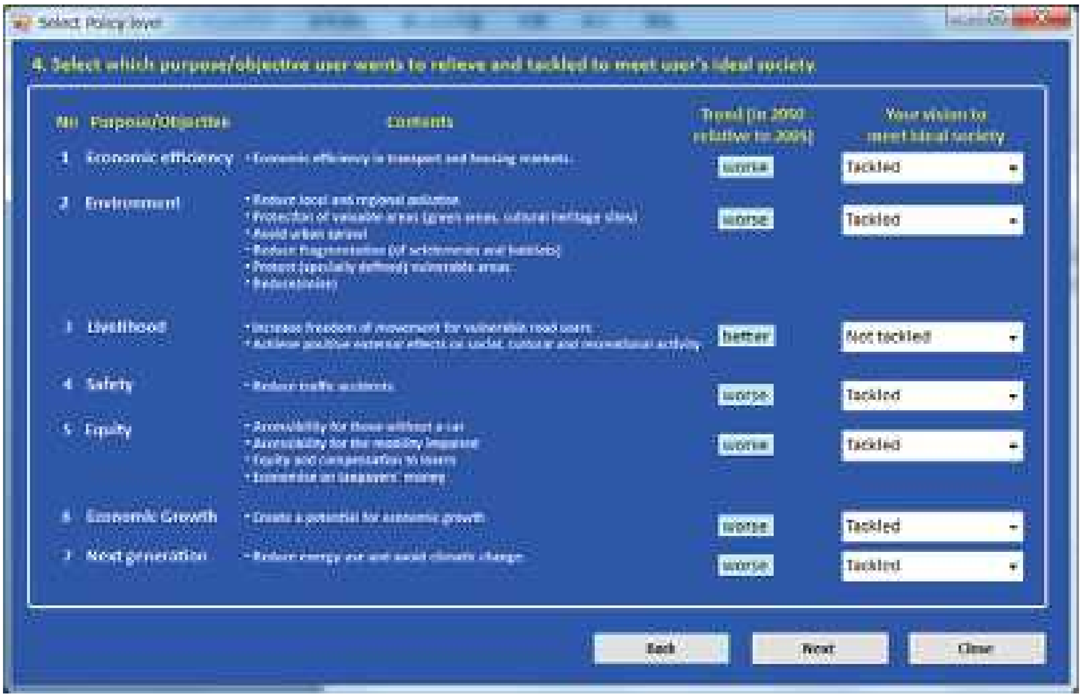


Figure A-11. Choose the Trends for Objectives and Issues in Future Transport and the Desired Society

(8) Select Level of Policy

- A screen like the one below will be displayed. Select the policy level required in this project, for each of the criteria [1. Cost], [2. Ease of Implementation], and [3. Time Requirement].
- Clicking on the [?] button for [1. Cost], [2. Ease of Implementation], or [3. Time Requirement] will display content specific to the criterion in question.
- To proceed to the next process, click on the [Next] button.

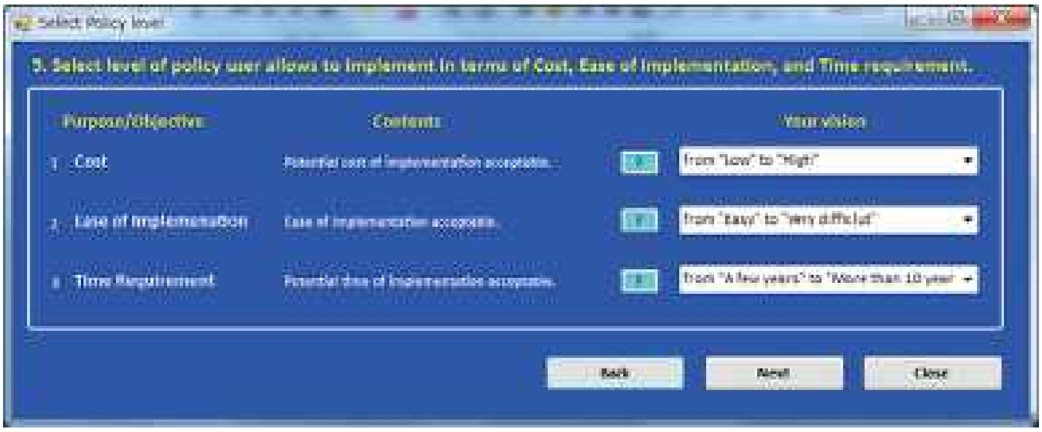


Figure A-12. Select Level of Policy

(9) Select Fuel Types Which User Wants to Introduce to Meet User's Ideal Society

- A screen like the one below will be displayed. The [Possible issues] field contains notes on possible issues relating to fuel. The [Key driver] field displays changes in the status of the societal factors selected by the user.

Based on the information described above, the user selects on this screen the type of fuel to be used in future in order to achieve the desired society. To move to the next indicator, click on the upper [Next] button. About 5 questions have been prepared.

- To proceed to the next process, click on the [Next] button.

Figure A-13. Select Fuel Types Which User Wants to Introduce to Meet User's Ideal Society

(10) Select Public Transport Which User Wants to Introduce/Improve to Meet User's Ideal Society

- A screen like the one below will be displayed. The [Possible issues] field contains notes on possible issues relating to public transport. The [Key driver] field displays changes in the status of the societal factors selected by the user. Based on the information described above, the user selects on this screen the public transport to be used in future in order to achieve the desired society. To move to the next indicator, click on the upper [Next] button. About 5 questions have been prepared.
- To proceed to the next process, click on the [Next] button.

Figure A-14. Select Public Transport Which User Wants to Introduce / Improve to Meet User's Ideal Society

(11) Select Avoid Policy Packages for User's Ideal Society

- A screen like the one below will be displayed. The [Do nothing future] column evaluates whether or not this measure is easy to introduce in the society mapped out by the user. Based on this information, the user considers whether to select Avoid measures.
- To proceed to the next process, click on the [Next] button.

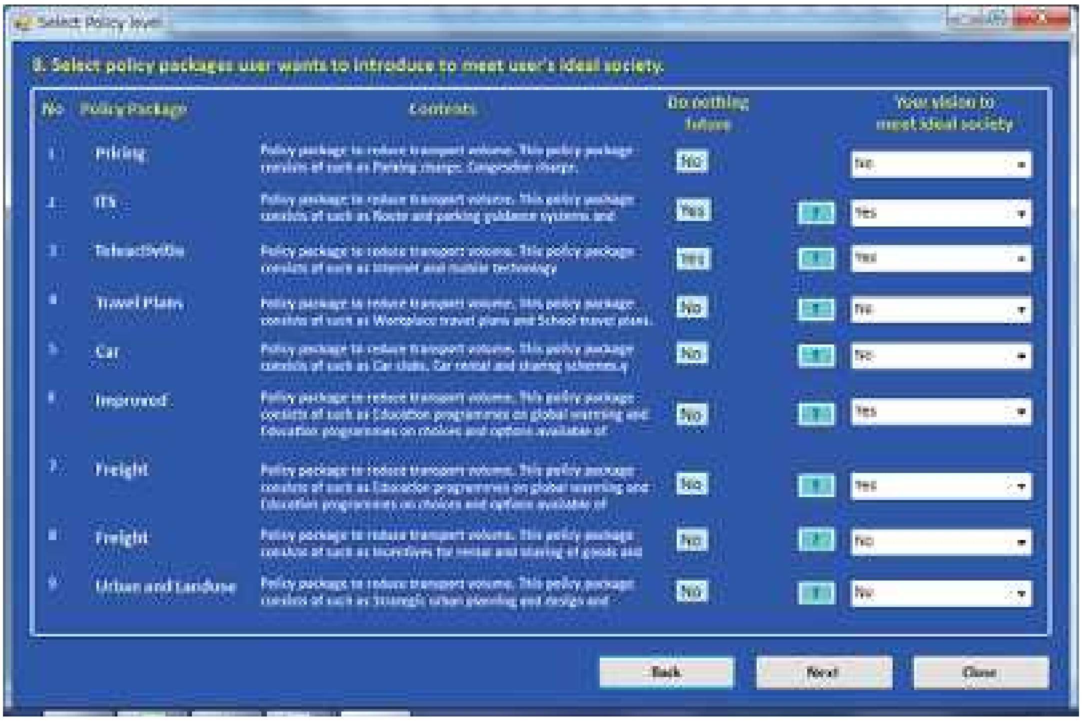


Figure A-15. Select Avoid Policy Packages for User's Ideal Society

(12) Show Results

A screen like the one below will be displayed.

1. Show result (Storyline)
2. Show result (Policy)

Figure A-16. Select Results to be Shown

1. Show Result (Storyline)

- This displays a storyline.

Figure A-17. Select Storyline

2. Show Result (Policy)

- The policy package aimed at a low-carbon society based on the user's vision will be displayed. See A.2 for instructions on how to carry the results over to the backcasting tool.

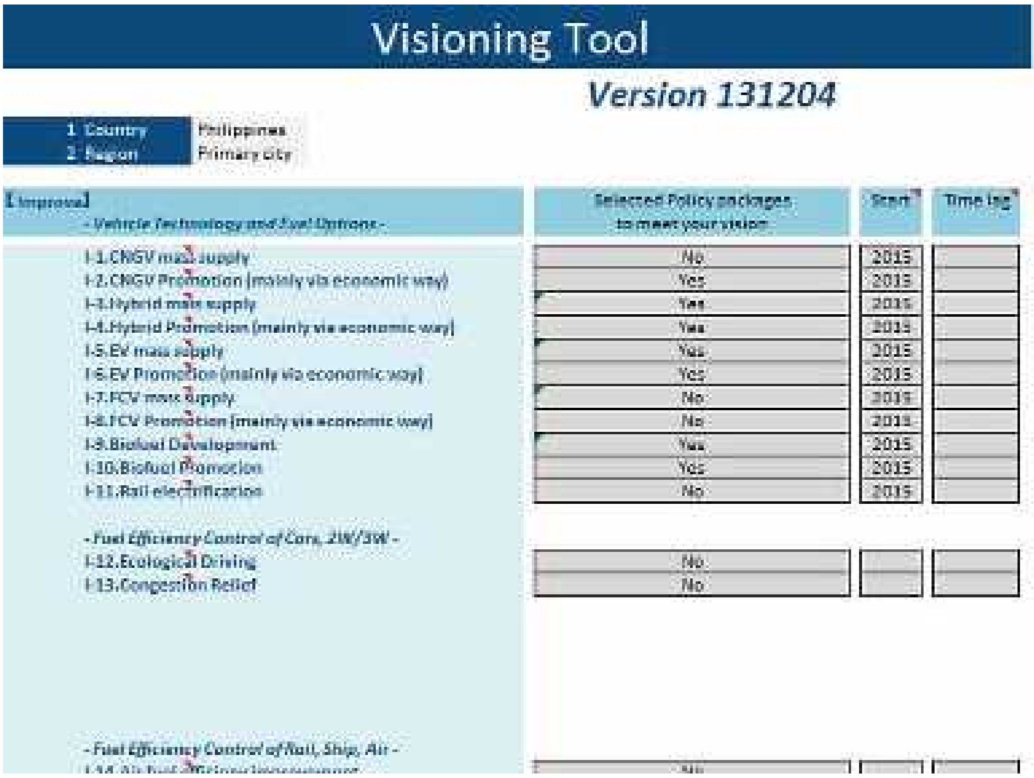


Figure A-18. Select Storyline

A.1.2 Configuration File

As well as the version using the GUI shown in A.1, the visioning tool also has a version that works in Excel. These versions are not independent of each other; the GUI version loads from the Excel version. In other words, the content manipulated using the GUI version is recorded in the Excel version.

The visioning tool consists of the folder structure shown in Figure A-19. Firstly, the first-level folder [Visioning Tool] contains two folders ([Image] and [Indonesia] [Philippines]).

The [Image] folder contains the graphics used in the visioning tool GUI, but the user has no opportunity to use the data in this folder.

The [Indonesia] [Philippines] folder contains the visioning tools for the nine regions in the country in question (Figure A-20). Table A-1 shows the correspondence between the nine regions and the file names. These files are templates and if the user sets the case name in the GUI version, a folder bearing the name of the case ([Case Name] folder)[3] will be created directly below it, with a series of files being copied into this folder. In the GUI version, the files in the [Case Name] folder can be manipulated.

[3] In Figure A-19, this is the folder called [CASE 1].

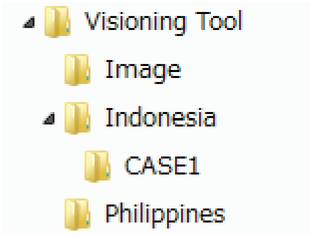


Figure A-19. Folder Structure in the Visioning Tool

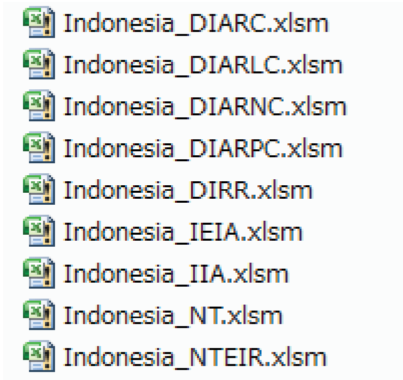


Figure A-20. Excel Version of the Visioning Tool in the [Indonesia] Folder

Table A-1. Correspondence between the Nine Regions and the File Names

No	Domestic / International	Intra / Inter	Level	File Names
1	Domestic	Intra urban	Primary City	Country Name_DIARPC.xlsm
2	Domestic	Intra urban	Large city	Country Name_DIARLC.xlsm
3	Domestic	Intra urban	City	Country Name_DIARC.xlsm
4	Domestic	Intra urban	Non city	Country Name_DIARNC.xlsm
5	Domestic	Intra urban	-	Country Name_DIRR.xlsm
6	International	Intra ASEAN	-	Country Name_IIA.xlsm
7	International	Except Intra ASEAN	-	Country Name_IEIA.xlsm
8	Domestic+ International	National Total	-	Country Nam _NT.xlsm
9	Domestic	Intra urban+ Inter urban		Country Name_NTEIA.xlsm

A.1.3 Customizing Data

Although data on the preconditions[4] in the country in question are already loaded in the visioning tool (Figure A-21), there may be cases in which the user wants to make appropriate changes to the pre-loaded data. The user can alter the precondition data as required.

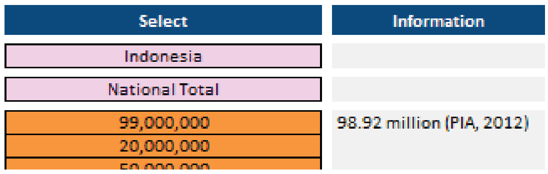
Although it is possible to install new policy packages in the backcasting tool (see A.2.3.2), please note that it is difficult to reflect these in the visioning tool.

- Data storage
  - Target files: Visioning tool (9 regions)
  - Sheet used: 1.Present Society
  - Target cells: Dark orange cells (I11-I15, I17-I21, I23-I25, I31, I66)

- Data storage
  - Target files: Visioning tool (9 regions)

[4] See Chapter 2, Table 2-6 for more information about the precondition data.

✧ Sheet used: 2.Future Society
✧ Target cells: Dark orange cells I11-I15, I17-I21, I23-I24)



Select	Information
Indonesia	
National Total	
99,000,000	98.92 million (PIA, 2012)
20,000,000	

Figure A-21. Example of Precondition Data in the Sheet [1.Present Society] (Dark Orange Cells)

A.2 Backcasting Tool

A.2.1 How to Operate the Backcasting Tool

This section shows how to operate the backcasting tool. The flow of operations is shown in Figure A-22.

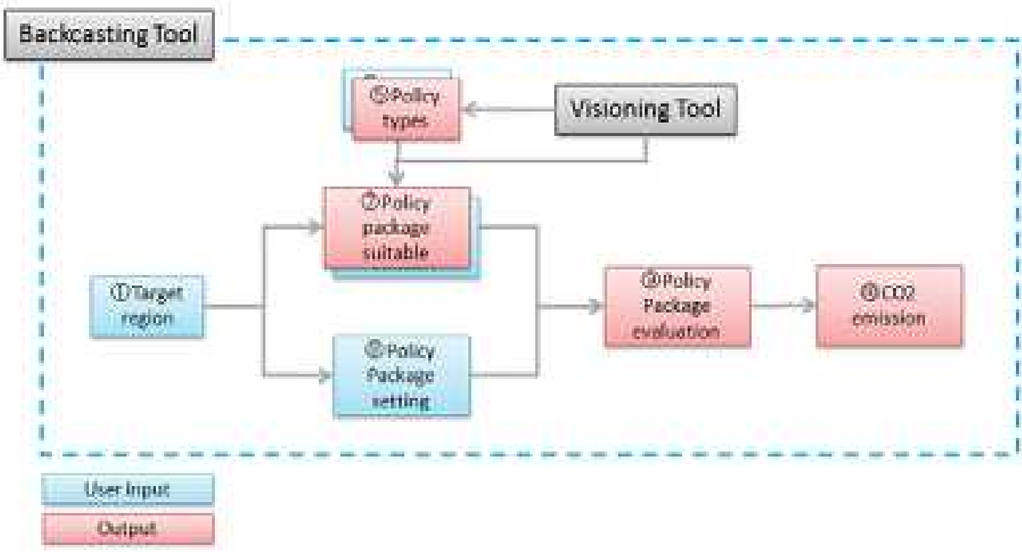


Figure A-22. Flow of Operations of Backcastig Tool

(0) Advance Preparation

- Check that Microsoft Excel ver.2007 or 2010 and .NET Framework ver.4 has been installed on the user's PC.
- If any Excel files are open, close all of them.

(1) Start

- Double-click on [Backcasting Tool.exe], which is an executable file.

Figure A-23. Executable File

- A screen like the one below will be displayed. If using it for the first time, click on the [Start] button; if using a previous case again, click on the [Restart] button.

Figure A-24. Start Screen

(2) Select Target Country and Set Case Name

- A screen like the one below will be displayed. Select the country to be evaluated.
- Enter the case name for this project.
- To proceed to the next process, click on the [Next] button.

Figure A-25. Select Target Country and Set Case Name

(3) Select Region to be Evaluated

- A screen like the one below will be displayed. Select the region to be evaluated. There are 9 target regions.
- If using results from the visioning tool in this calculation, click on the [Open a file] button and specify the file to be loaded.
- To proceed to the next process, click on the [Next] button.

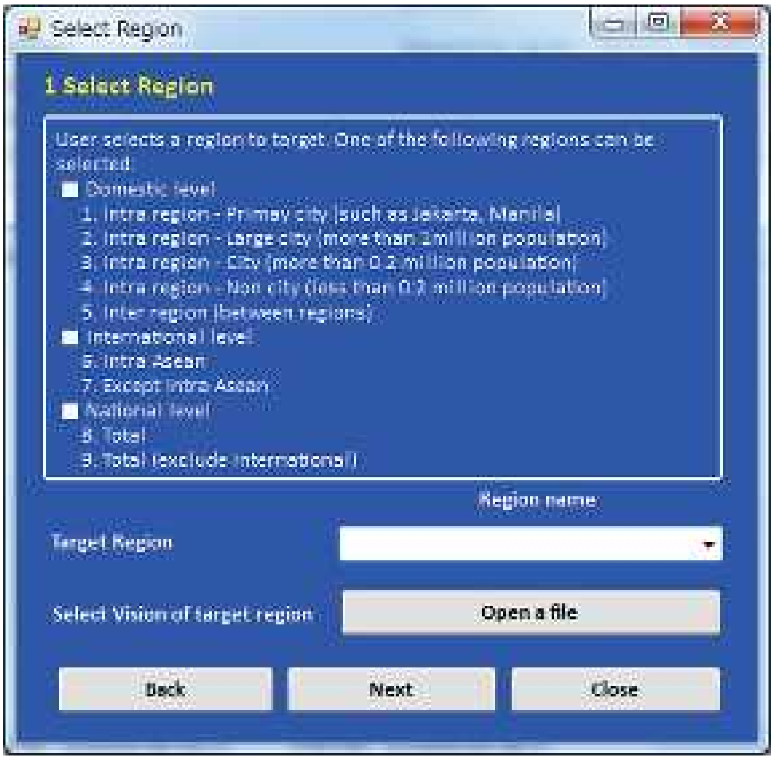


Figure A-26. Select Region to be Evaluated

(4) Select Purposes and Challenges

- Screens like the two below will be displayed, along with the Excel file[5]. Select [Yes/No] for each purpose and challenge on the [Select Objective] screen.
- Click on the [?] button next to each objective and challenge to display content relevant to that item.

[5]If intra-urban transport has been selected in step (3) [Select region to be evaluated], the calculation file for the region in question and the calculation file for inter-urban transport (inter-urban) will be displayed. If an option other than intra-urban transport is selected, only the calculation file for the region in question will be displayed.

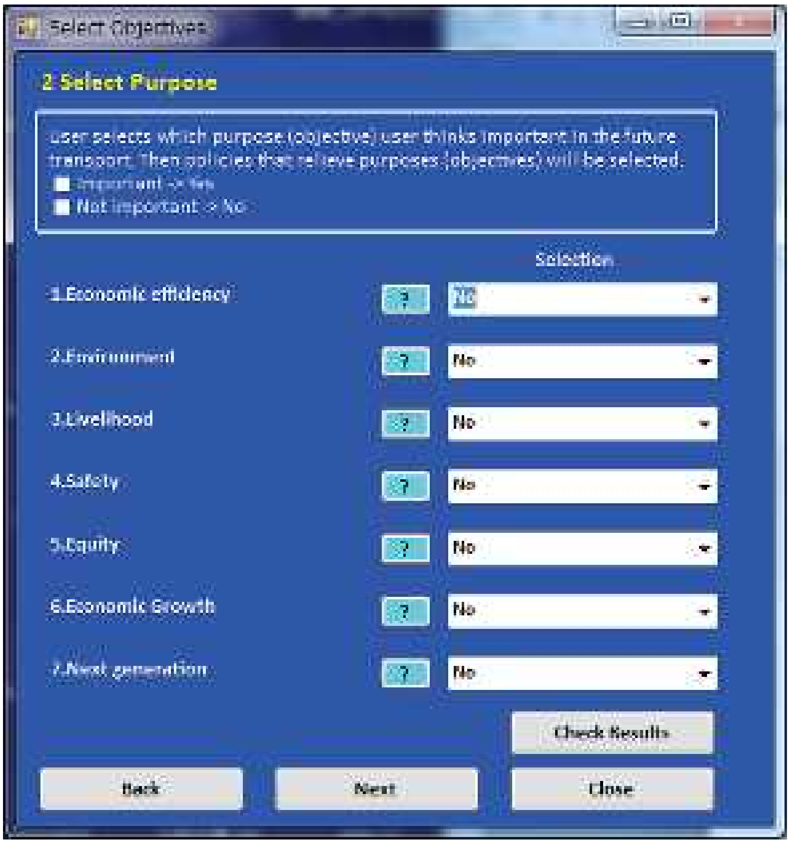


Figure A-27. Select Purposes and Challenges

- Click on the [Check results] button to see the screen displaying the results of the calculations.

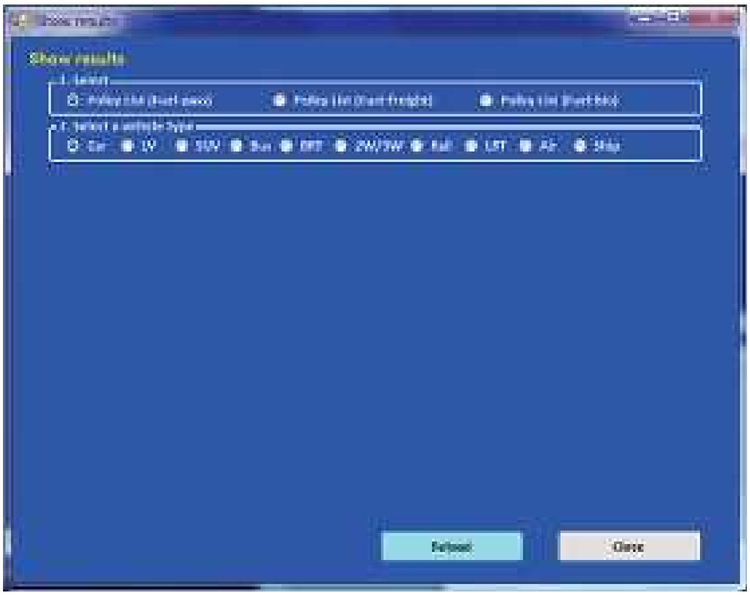


Figure A-28. Screen Showing Results of Calculations (Fuel Structure Display Screen)

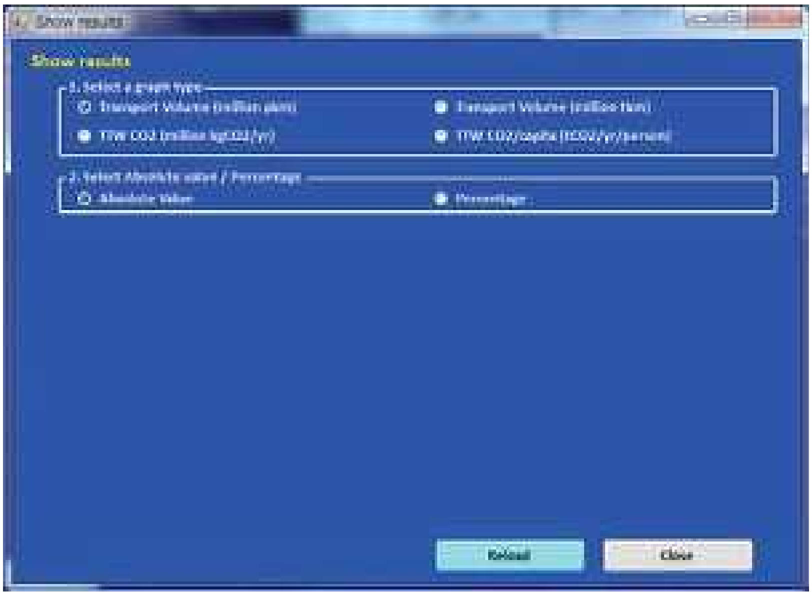


Figure A-29. Screen Showing Results of Calculations (Transport Volume and CO2 Display Screen)

- Click on the [Reload] button on the [Show results] screen to display the current level of CO2 emissions.[6] At every stage, clicking on the [Reload] button will display the current level of CO2 emissions.
- To proceed to the next process, click on the [Next] button on the [Select Objective] screen.

Figure A-30. Screen Showing Results of Calculations (Transport Volume and CO2 Display Screen, after Clicking on the [Reload] Button)

[6]If intra-urban transport has been selected in step (3) [Select region to be evaluated], two diagrams will be displayed. The left-hand diagram will show CO2 emissions in the region in question and the right-hand one will show CO2 emissions in the region in question plus emissions from inter-urban transport (inter-urban). If an option other than intra-urban transport is selected, only the calculation file for the region in question will be displayed, in the left-hand diagram.

(5) Select Level of Policy

- A screen like the one below will be displayed. Select the policy level required in this project, for each of the criteria [1. Cost], [2. Ease of Implementation], and [3. Time Requirement]. See Tables A-2, A-3, and A-4 regarding the meanings of the respective levels.
- Clicking on the [?] button for [1. Cost], [2. Ease of Implementation], or [3. Time Requirement] will display content specific to the criterion in question.
- To proceed to the next process, click on the [Next] button.

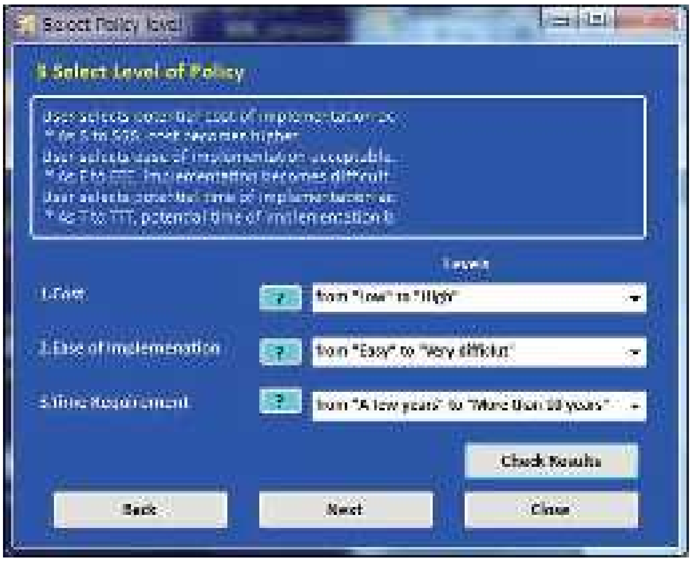


Figure A-31. Select Level of Policy

Table A-2. Description of Level - Cost

No	Description
Level 1 ($)	Refers to measures that don't entail large amounts of money as these measures are perceived to have no major physical infrastructure/technological requirements, or may be done through government mandates, or through increased awareness achieved through existing channels of information.
Level 2 ($$)	Refers to measures that may not require large amounts of money as the physical infrastructure and technology needed may only be supplemental to current ones, or the measure can be implemented through better planning requiring marginal increases in required capital. These may also refer to measure that may not require any substantial amounts of money for implementation, but there are costs that are carried by society in general due to the implementation of the measure.
Level 3 ($$$)	Refers to measures which would normally require major and additional physical infrastructure development and/or resources put into procuring more advanced technologies.

Table A-3. Description of Level - Ease of Implementation

No	Description
Level 1 (E)	Refers to measures that are relatively easy to implement as the pre-conditions necessary for implementing them are normally in place.
Level 2 (EE)	Some improvements/changes are needed in order to implement the measures.
Level 3 (EEE)	Refers to measures which requires major changes in society, policy settings, physical infrastructure in order to achieve the pre-conditions

Table A-4. Description of Level - Time Requirement

No	Description
Level 1 (T)	Refers to policies that can be put in place within a short period of time after approval (e.g. within few years).
Level 2 (TT)	Refers to policies that can be put in place within a reasonable amount of time, but not immediately after approval. (e.g. within 5-10 years)
Level 3 (TTT)	Refers to policies that requires several years before it is actually up and running after the approval. This is influenced by the pre-conditions that need to be in place for the different measures (e.g. putting up of physical infrastructure or organizational requirements, among others).

(6) Select Policy Package

- A screen like the one below will be displayed. In the backcasting tool, the policy packages have been collated into six fields. Select the policy package to be introduced in the current project in each field.
- The pages that follow show how to use the tool to adjust each of the six fields.
- To proceed to the next process, click on the [Next] button.

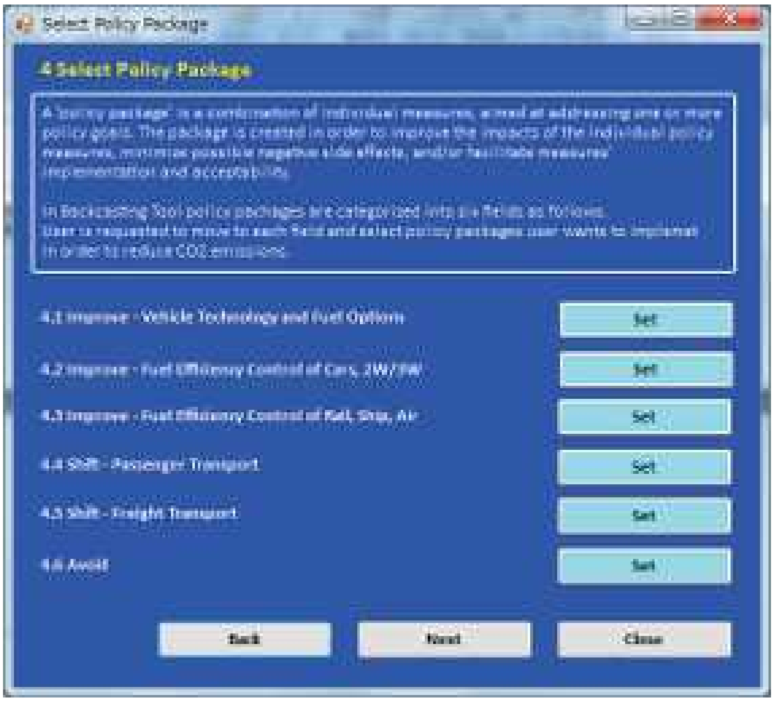


Figure A-32. Select Policy Package

① If [4.1 Improve - Vehicle Technology and Fuel Options] has been Selected

- A screen like the one below will be displayed. The policy packages against which [Select] is displayed in the [Message] column can be selected. Select [Yes/No] in the [Selection] column for each of the policy packages that can be selected.
- Select [Start Year]. [Start Year] is the year in which the policy package is introduced.
- Policy packages will not necessarily start to have an effect immediately after their introduction. Accordingly, the gap between introducing the policy package and its effects beginning to appear is set in the [Time lag] column.

- Click on the [?] button to display content relevant to that item.
- Click on the [Go] button to check whether or not the policy package in question has been selected in other regions[7].

- The detailed settings for fuel composition are set in step (7) [Select vehicle fuel composition].

Figure A-33. Select Policy Package
(4.1 Improve - Vehicle Technology and Fuel Options)

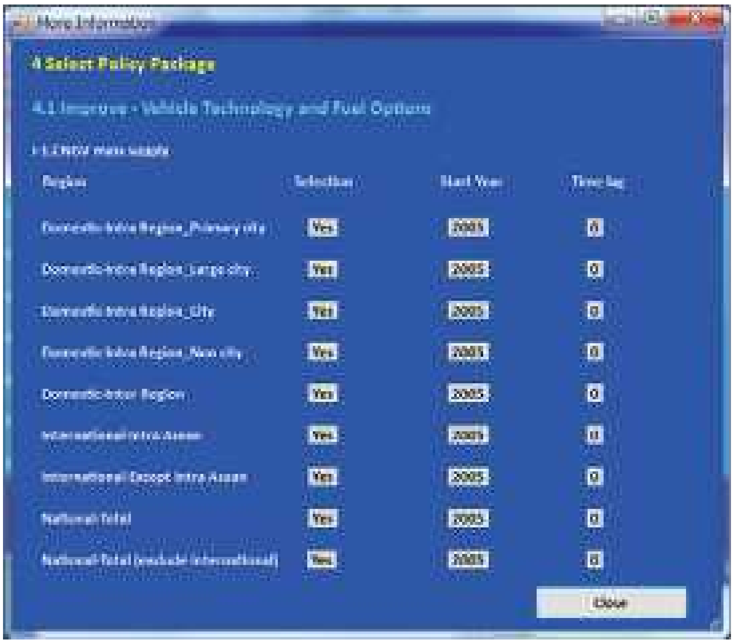


Figure A-34. Selection Status of a Policy Package in Other Regions

7 Please note that it can take some time to check the selection status of a policy package in all nine regions.

② If [4.2 Improve - Fuel Efficiency Control of Cars, 2W/3W] has been selected

- A screen like the one below will be displayed. The policy packages against which [Select] is displayed in the [Message] column can be selected. Select [Yes/No] in the [Selection] column for each of the policy packages that can be selected.
- Select [Start Year]. [Start Year] is the year in which the policy package is introduced.
- Policy packages will not necessarily start to have an effect immediately after their introduction. Accordingly, the gap between introducing the policy package and its effects beginning to appear is set in the [Time lag] column.
- It is envisaged that it will take time for policies to achieve maximum effectiveness after they are introduced and begin to take effect. This period is set in the [Period] column. [Year for Max] indicates the year in which maximum effectiveness is achieved. This effect remains at the maximum level thereafter.

- Click on the [?] button to display content relevant to that item.
- Click on the [Go] button to check whether or not the policy package in question has been selected in other regions [8]

Figure A-35. Select Policy Package
(4.2 Improve - Improve - Fuel Efficiency Control of Cars, 2W/3W)

③ If [4.3 Improve - Fuel Efficiency Control of Rail, Ship, Air] has been Selected

- A screen like the one below will be displayed. The policy packages against which [Select] is displayed in the [Message] column can be selected. Select [Yes/No] in the [Selection] column for each of the policy packages that can be selected.
- Select [Start Year]. [Start Year] is the year in which the policy package is introduced.
- Policy packages will not necessarily start to have an effect immediately after their introduction. Accordingly, the gap between introducing the policy package and its effects beginning to appear is set in the [Time lag] column.
- The policies on this screen are set to be effective until 2050. Accordingly, the default setting for the year in which maximum effectiveness is achieved is [2050], with [Period] being calculated back from that date. [Year for Max] indicates the year in which maximum effectiveness is achieved. This effect remains at the maximum level thereafter.

- Click on the [?] button to display content relevant to that item.

[8] Please note that it can take some time to check the selection status of a policy package in all nine regions.

- Click on the [Go] button to check whether or not the policy package in question has been selected in other regions.[9]

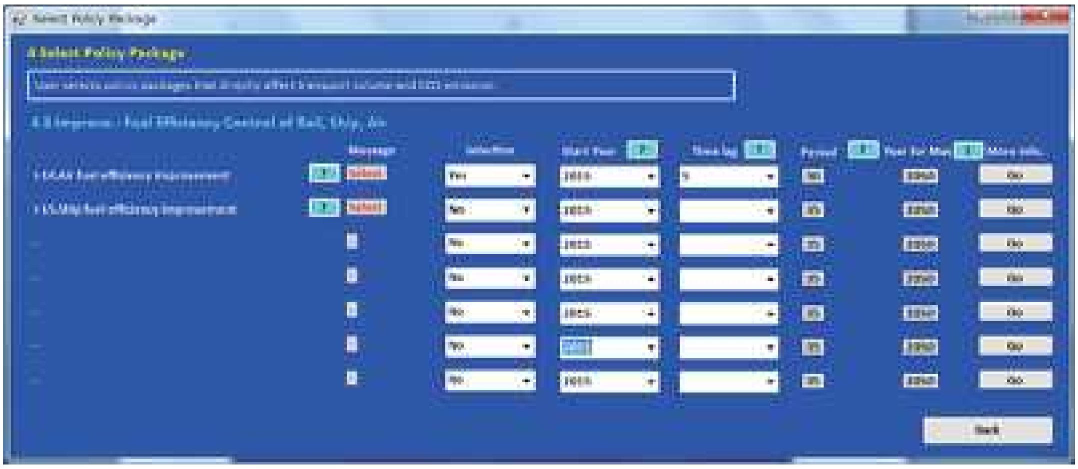


Figure A-36. Select Policy Package
(4.3 Improve - Fuel efficiency Control of Rail, Ship, Air)

④ If [4.4 Shift - Passenger Transport] has been Selected

- A screen like the one below will be displayed. The policy packages against which [Select] is displayed in the [Message] column can be selected. Select [Yes/No] in the [Selection] column for each of the policy packages that can be selected.
- Select [Start Year]. [Start Year] is the year in which the policy package is introduced.
- Policy packages will not necessarily start to have an effect immediately after their introduction. Accordingly, the gap between introducing the policy package and its effects beginning to appear is set in the [Time lag] column.

- Click on the [?] button to display content relevant to that item.
- Click on the [Go] button to check whether or not the policy package in question has been selected in other regions.[10]

- The detailed settings for fuel composition are set in step (7) [Select vehicle fuel composition].

9 Please note that it can take some time to check the selection status of a policy package in all nine regions.
10 Please note that it can take some time to check the selection status of a policy package in all nine regions.

Figure A-37. Select Policy Package
(4.4 Shift - Passenger Transport)

⑤ If [4.5 Shift - Freight Transport] has been Selected

- A screen like the one below will be displayed. The policy packages against which [Select] is displayed in the [Message] column can be selected. Select [Yes/No] in the [Selection] column for each of the policy packages that can be selected.
- Select [Start Year]. [Start Year] is the year in which the policy package is introduced.
- Policy packages will not necessarily start to have an effect immediately after their introduction. Accordingly, the gap between introducing the policy package and its effects beginning to appear is set in the [Time lag] column.

- Click on the [?] button to display content relevant to that item.
- Click on the [Go] button to check whether or not the policy package in question has been selected in other regions.[11]

- The detailed settings for fuel composition are set in step (7) [Select vehicle fuel composition].

[11] Please note that it can take some time to check the selection status of a policy package in all nine regions.

Figure A-38. Select Policy Package
(4.5 Shift - Freight Transport)

⑥ If [4.6 Avoid] has been Selected

- A screen like the one below will be displayed. The policy packages against which [Select] is displayed in the [Message] column can be selected. Select [Yes/No] in the [Selection] column for each of the policy packages that can be selected.
- Select [Start Year]. [Start Year] is the year in which the policy package is introduced.
- Policy packages will not necessarily start to have an effect immediately after their introduction. Accordingly, the gap between introducing the policy package and its effects beginning to appear is set in the [Time lag] column.

- It is assumed that it takes time for a policy package to be introduced and its effects become the maximum. Accordingly, this period is set in the [Period] column. [Year for Max] indicates the year in which maximum effectiveness is achieved. This effect remains at the maximum level thereafter.

- Click on the [?] button to display content relevant to that item.
- Click on the [Go] button to check whether or not the policy package in question has been selected in other regions.[12]

[12] Please note that it can take some time to check the selection status of a policy package in all nine regions.

Figure A-39. Select Policy Package
(4.6 Avoid)

(7) Set Vehicle Fuel Composition

- A screen like the one below will be displayed. Select the fuel composition for passenger transport and for freight transport.
- The pages that follow show how to select the fuel composition.
- To proceed to the next process, click on the [Next] button.

FigureA-40. Set Vehicle Fuel Composition

① If [5.1 Passenger] has been Selected

- A screen like the one below will be displayed. The sections in pink show which fuel types can be set (upper) and display warnings about the fuel type settings (lower). Comply with these messages when setting the fuel type.
- The policy packages against which [Select] is displayed in the [Message] column can be selected. In the [Mode] column, select the target vehicle type.
- In the [Fuel] column, select from the available fuel types.

- Select [Year for Effect]. [Year for Effect] is the year in which the policy package will start to have an effect. Select a year that is no lower than the one shown immediately to the right of the [Year for Effect] menu[13].
- In the [Increment] column, select the percentage points by which the target fuel type will increase in future.
- In the [Period] column, select the length of time that it will take until the fuel type in question reaches its target share. [Year for Max] will be the year in which the target fuel share is reached. The fuel share will remain at the target level thereafter.

- Click on the [?] button to display content relevant to that item.

Figure A-41. Set Vehicle Fuel Composition (Passenger Transport)

② If [5.2 Freight] has been Selected

- A screen like the one below will be displayed. The sections in pink show which fuel types can be set (upper) and display warnings about the fuel type setting (lower). Comply with these messages when setting the fuel type.
- The policy packages against which [Select] is displayed in the [Message] column can be selected. In the [Mode] column, select the target vehicle type.
- In the [Fuel] column, select from the available fuel types.
- Select [Year for Effect]. [Year for Effect] is the year in which the policy package will start to have an effect. Select a year that is no lower than the one shown immediately to the right of the [Year for Effect] menu[14]
- In the [Increment] column, select the percentage points by which the target fuel type will increase in future.
- In the [Period] column, select the length of time that it will take until the fuel type in question reaches its target share. [Year for Max] will be the year in which the target fuel share is reached. The fuel share will remain at the target level thereafter.
- Click on the [?] button to display content relevant to that item

[13] The years given here are determined by what was entered in step (5) [Select policy package].
[14] The years given here are determined by what was entered in step (5) [Select policy package].

Figure A-42. Set Vehicle Fuel Composition (Freight Ttransport)

(8) Set Biofuel Usage

- A screen like the one below will be displayed. Click on the [Set] button to select the biofuel mixing ratio.
- The pages that follow show how to select the biofuel mixing ratio.
- To proceed to the next process, click on the [Next] button.

Figure A-43. Set Biofuel Usage

- A screen like the one below will be displayed. The sections in pink show which fuel types can be set (upper) and display warnings about the fuel type setting (lower). Comply with these messages when setting the fuel type.
- The policy packages against which [Select] is displayed in the [Message] column can be selected. In the [Mode] column, select the target vehicle type.
- In the [Fuel] column, select from the available fuel types.
- Select [Year for Effect]. [Year for Effect] is the year in which the policy package will start to have an effect. Select a year that is no lower than the one shown immediately to the right of the [Year for Effect] menu [15]

[15] The years given here are determined by what was entered in step (5) [Select policy package].

- In the [Increment] column, select the percentage points by which the target biofuel type will increase in future.
- In the [Period] column, select the length of time that it will take until the fuel type in question reaches its target share. [Year for Max] will be the year in which the target biofuel mixing ratio is reached. The biofuel mixing ratio will remain at the target level thereafter.

- Click on the [?] button to display content relevant to that item.

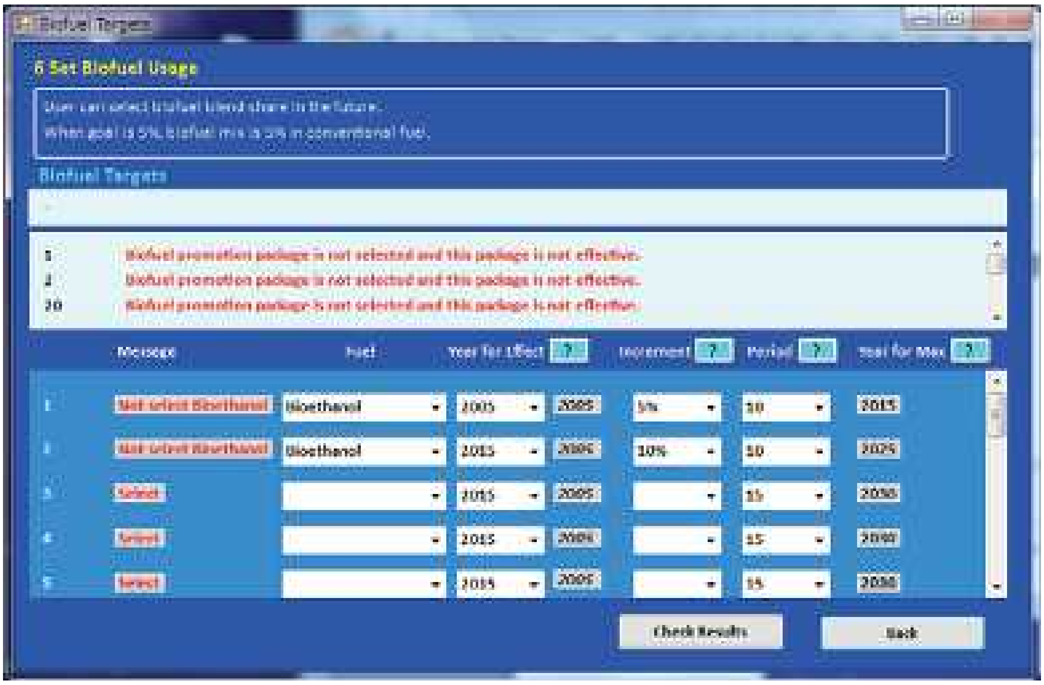


Figure A-44. Set Biofuel Usage Mix

(9) Set Shift Rate

- A screen like the one below will be displayed. In the backcasting tool, this is collated into four fields[16]. Select the individual fields to be introduced in the current project.
- The pages that follow show how to use the tool to adjust each of the four fields.
- To proceed to the next process, click on the [Next] button.

[16] They are classified on the basis of the following two perspectives. (i) Passenger or freight transport. (ii) Encouraging the use of existing public transport or putting in place new public transport.

Figure A-45. Set Shift Rate

① If [Passenger – Usage promotion] has been Selected[17]

- A screen like the one below will be displayed. The sections in pink show to which modes a shift is possible (upper) and display warnings about the modal shift settings (lower). Comply with these messages when setting the modal shift.
- The policy packages against which [Select] is displayed in the [Message] column can be selected.
- In the [From] column, set the mode of transport from which the modal shift is to take place.
- In the [To] column, set the mode of transport to which the modal shift is to take place.
- Select [Year for Effect]. [Year for Effect] is the year in which the modal shift will start. Select a year that is no lower than the one shown immediately to the right of the [Year for Effect] menu[18].
- In the [Shift rate] column, set the target for the share of transport in the original mode that is to shift to the new mode.
- In the [Period] column, select the length of time that it will take until the target share for the modal shift is reached. [Year for Max] will be the year in which the target share for the modal shift is reached. The target shift rate will apply in this year onward and a shift will always take place from the original mode to the target mode at this rate from the baseline.

- Click on the [?] button to display content relevant to that item.

[17] This focuses on passenger transport and is used when aiming for a shift to existing public transport.
[18] The years given here are determined by what was entered in step (5) [Select policy package].

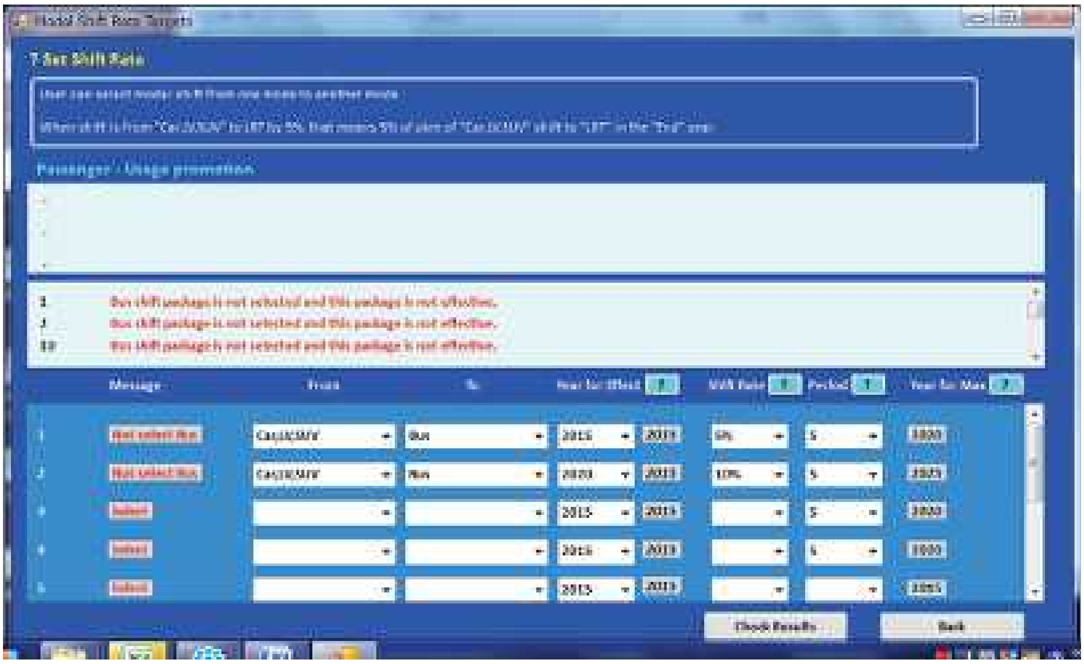


Figure A-46. Set Modal Shift Rate (Passenger - Usage Promotion)

② If [Passenger – Infra development] has been Selected [19]

- A screen like the one below will be displayed. The sections in pink show to which modes a shift is possible (upper) and display warnings about the modal shift settings (lower). Comply with these messages when setting the modal shift.
- The policy packages against which [Select] is displayed in the [Message] column can be selected.
- In the [From] column, set the mode of transport from which the modal shift is to take place.
- In the [To] column, set the mode of transport to which the modal shift is to take place.
- Select [Year for Effect]. [Year for Effect] is the year in which the modal shift will start. Select a year that is no lower than the one shown immediately to the right of the [Year for Effect] menu[20].
- In the [Shift rate] column, set the target for the share of transport in the original mode that is to shift to the new mode.
- In the [Period] column, select the length of time that it will take until the target share for the modal shift is reached. [Year for Max] will be the year in which the target share for the modal shift is reached. The target shift rate will apply in this year onward and a shift will always take place from the original mode to the target mode at this rate from the baseline.

- Click on the [?] button to display content relevant to that item.

[19] This focuses on passenger transport and is used when aiming for a shift to new public transport.
[20] The years given here are determined by what was entered in step (5) [Select policy package].

Figure A-47. Set Modal Shift Rate (Passenger - Infra Development)

③ If [Freight – Usage Promotion] has been Selected [21]

- A screen like the one below will be displayed. The sections in pink show to which modes a shift is possible (upper) and display warnings about the modal shift settings (lower). Comply with these messages when setting the modal shift.
- The policy packages against which [Select] is displayed in the [Message] column can be selected.
- In the [From] column, set the mode of transport from which the modal shift is to take place.
- In the [To] column, set the mode of transport to which the modal shift is to take place.
- Select [Year for Effect]. [Year for Effect] is the year in which the modal shift will start. Select a year that is no lower than the one shown immediately to the right of the [Year for Effect] menu[22].
- In the [Shift rate] column, set the target for the share of transport in the original mode that is to shift to the new mode.
- In the [Period] column, select the length of time that it will take until the target share for the modal shift is reached. [Year for Max] will be the year in which the target share for the modal shift is reached. The target shift rate will apply in this year onward and a shift will always take place from the original mode to the target mode at this rate from the baseline.

- Click on the [?] button to display content relevant to that item.

[21] This focuses on freight transport and is used when aiming for a shift to new public transport.
[22] The years given here are determined by what was entered in step (5) [Select policy package].

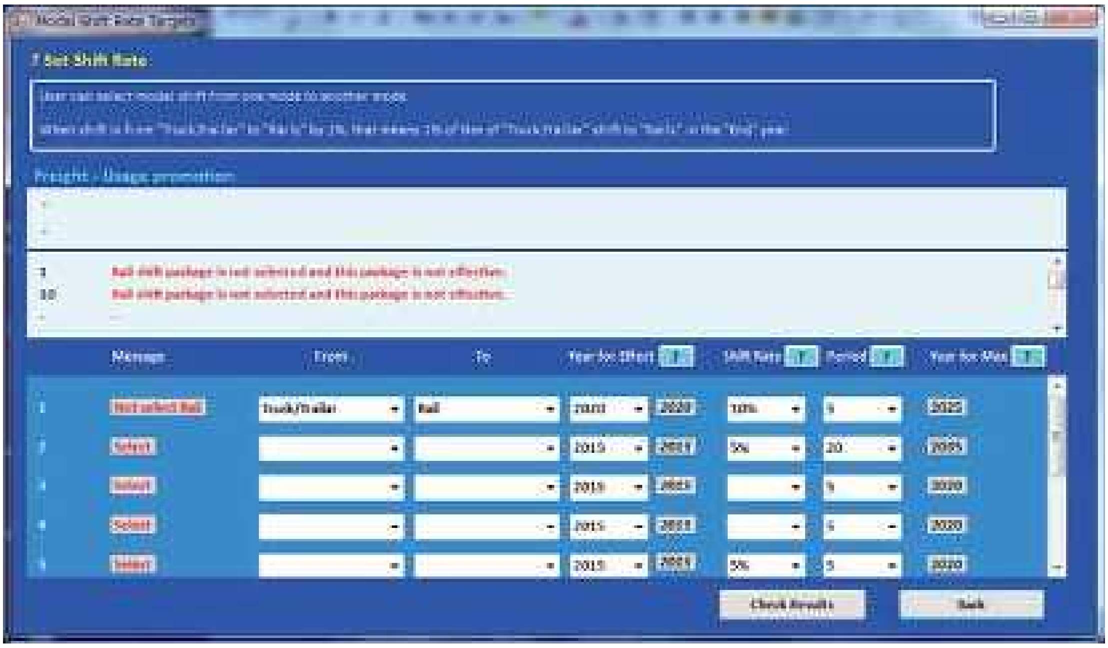


Figure A-48. Set Modal Shift Rate (Freight - Usage Promotion)

④ If [Freight – Infra development] has been Selected [23]

- A screen like the one below will be displayed. The sections in pink show to which modes a shift is possible (upper) and display warnings about the modal shift settings (lower). Comply with these messages when setting the modal shift.
- The policy packages against which [Select] is displayed in the [Message] column can be selected.
- In the [From] column, set the mode of transport from which the modal shift is to take place.
- In the [To] column, set the mode of transport to which the modal shift is to take place.
- Select [Year for Effect]. [Year for Effect] is the year in which the modal shift will start. Select a year that is no lower than the one shown immediately to the right of the [Year for Effect] menu[24].
- In the [Shift rate] column, set the target for the share of transport in the original mode that is to shift to the new mode.
- In the [Period] column, select the length of time that it will take until the target share for the modal shift is reached. [Year for Max] will be the year in which the target share for the modal shift is reached. The target shift rate will apply in this year onward and a shift will always take place from the original mode to the target mode at this rate from the baseline.

- Click on the [?] button to display content relevant to that item.

[23] This focuses on freight transport and is used when aiming for a shift to new public transport.
[24] The years given here are determined by what was entered in step (5) [Select policy package].

Figure A-49. Set Modal Shift Rate (Freight - Infra Development)

(10) Show Results

A screen like the one below will be displayed.

1. Transport and CO2 (Target Region): Volume of transport in the target region and CO2 emissions
2. Policy Road Map: Road map for the policy packages selected
3. Multi analysis (Target Region): Diagram analysis
4. Transport and CO2 (Target Region + Inter-Urban) : Volume of transport in the target region plus inter-urban transport and CO2 emissions
5. Co-benefit analysis (Target Region) : Co-benefit analysis for the target region. It should be noted that these are reference values at present.
6. Co-benefit analysis (Target Region + Inter-Urban) : Co-benefit analysis for the target region and inter-urban transport. It should be noted that these are reference values at present.

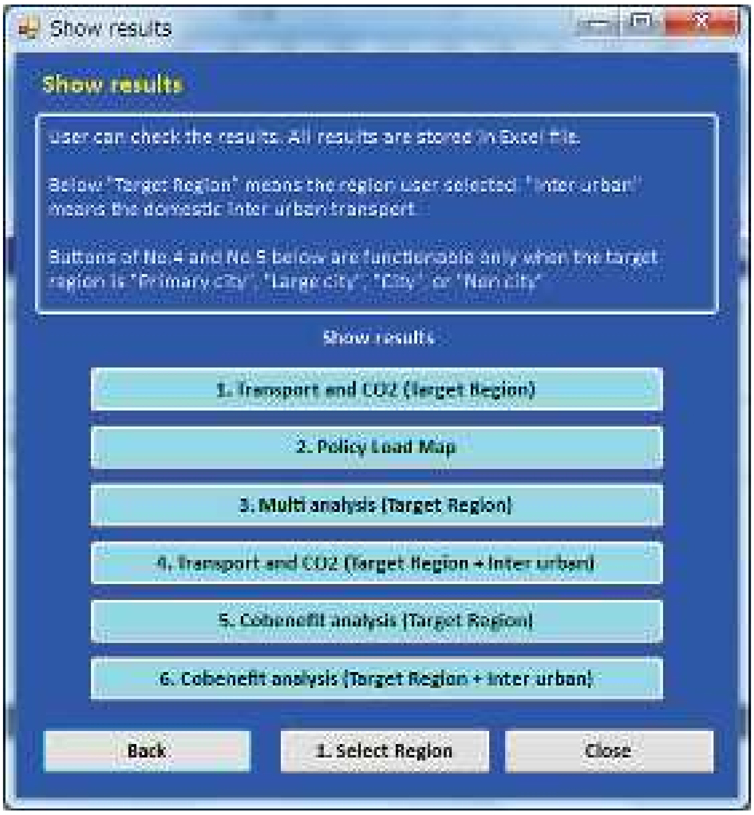


Figure A-50. Select Results to be Shown

① Transport and CO2 (Target Region)

- The results of calculating the volume of transport in the target region, energy consumption, CO2 emissions, and CO2 emissions per capita are displayed, as well as graphs depicting these results.

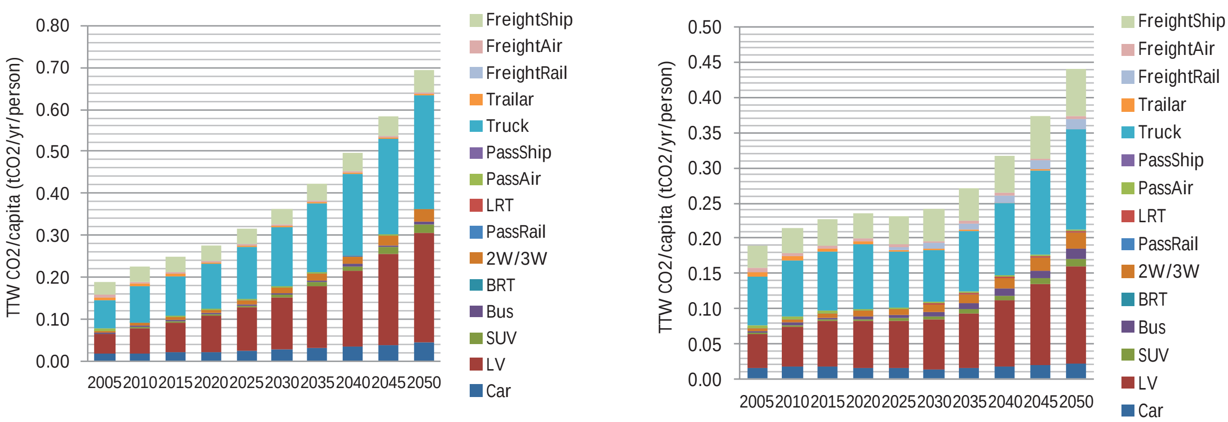


Figure A-51. Transport and CO2 (Left: Baseline Case, Right: Scenario Case)

② Policy Road Map

- A road map for the policy packages selected is displayed.

Figure A-52. Policy Road Map

③ Multi Analysis (Target Region)

- The results of diagram analysis are displayed. This diagram shows the rate of change from the baseline on each axis.

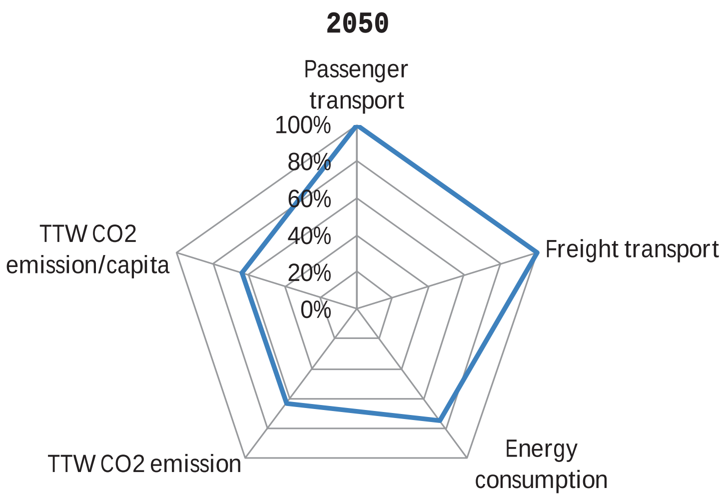


Figure A-53. Multi Analysis of Policy Packages Introduction

④ Transport and CO2 (Target Region + Inter-Urban)

- The results of calculating the volume of transport in the target region plus inter-urban transport, energy consumption, CO2 emissions, and CO2 emissions per capita are displayed, as well as graphs depicting these results.

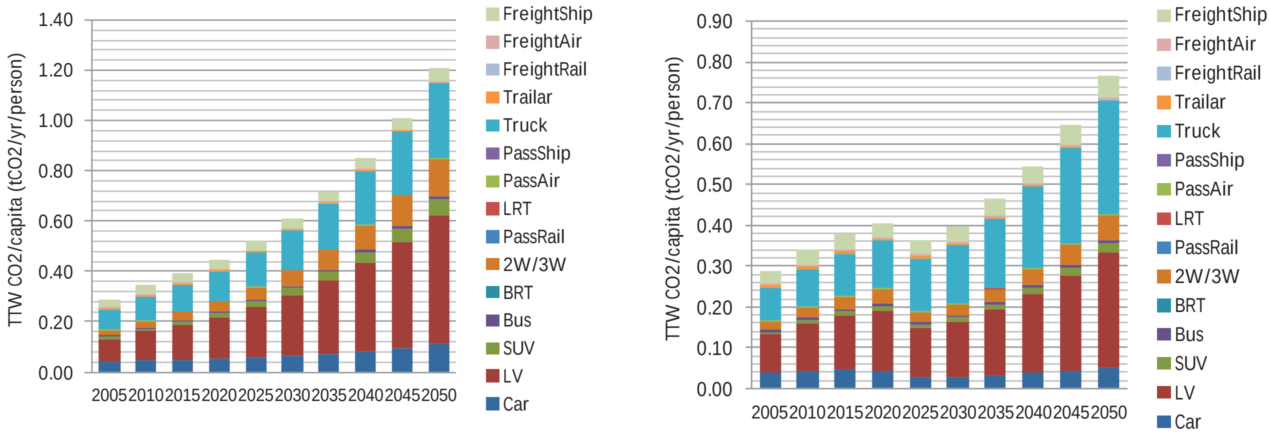


Figure A-54. Transport and CO2 （Left: Baseline Case, Right: Scenario Case）

⑤ Co-Benefit Analysis (Target Region)

- Co-benefit analysis for the target region is displayed. External economies are measured, focusing on co-benefits in areas other than global warming, such as noise, congestion, air pollution, and traffic accidents. It should be noted that these are reference values at present.

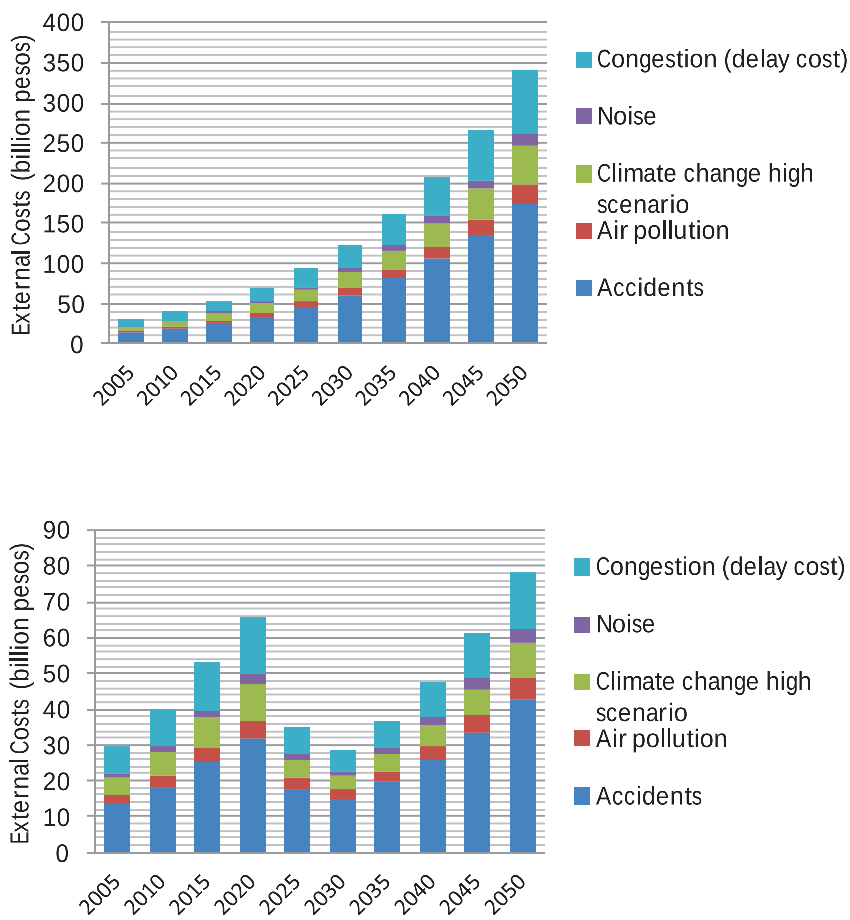


Figure A-55. Co-Benefit Analysis （Top: Baseline Case, Bottom: Scenario Case）

⑥ Co-Benefit Analysis (Target Region + Inter-Urban)

- Co-benefit analysis for the target region and inter-urban transport is displayed. External economies are measured, focusing on co-benefits in areas other than global warming, such as noise, congestion, air pollution, and traffic accidents. It should be noted that these are reference values at present.

A.2.2 Configuration File

As well as the version using the GUI shown in A.2.1, the backcasting tool also has a version that works in Excel. These versions are not independent of each other; the GUI version loads from the Excel version. In other words, the content manipulated using the GUI version is recorded in the Excel version.

The backacasting tool consists of the folder structure shown in Figure A-56. Firstly, the first-level folder [Backcasting Tool] contains two folders ([Image] and [Indonesia] [Philippines]).

The [Image] folder contains the graphics used in the backcasting tool GUI, but the user has no opportunity to use the data in this folder.

The [Indonesia] [Philippines] folder contains the backcasting tools for the nine regions in the country in question (Figure A-57). Table A-5 shows the correspondence between the nine regions and the file names. These files are templates and if the user sets the case name in the GUI version, a folder bearing the name of the case ([Case Name] folder)[25] will be created directly below it, with a series of files being copied into this folder. In the GUI version, the files in the [Case Name] folder can be manipulated.

The file [Summary.xlsx] shown in Figure A-57 is a file for cross-sectional analysis of the results for each region.

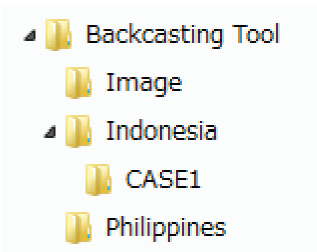


Figure A-56. Folder Structure in the Backcasting Tool

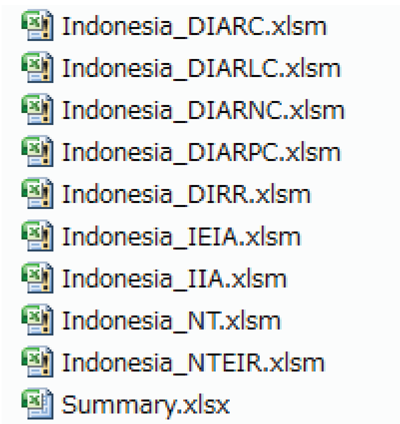


Figure A-57. Excel Version of the Backcasting Tool in the [Indonesia] Folder

[25] In Figure A-19, this is the folder called [CASE 1].

Table A-5. Correspondence between the Nine Regions and the File Names

No	Domestic / International	Intra / Inter	Level	File Names
1	Domestic	Intra urban	Primary City	Country Name_DIARPC.xlsm
2	Domestic	Intra urban	Large city	Country Name_DIARLC.xlsm
3	Domestic	Intra urban	City	Country Name_DIARC.xlsm
4	Domestic	Intra urban	Non city	Country Name_DIARNC.xlsm
5	Domestic	Intra urban	-	Country Name_DIRR.xlsm
6	International	Intra ASEAN	-	Country Name_IIA.xlsm
7	International	Except Intra ASEAN	-	Country Name_IEIA.xlsm
8	Domestic+ International	National Total	-	Country Name_NT.xlsm
9	Domestic	Intra urban+ Inter urban		Country Name_NTEIA.xlsm

A.2.3 Customizing Data

Although data for the country in question are already loaded in the backcasting tool, there may be cases in which the user wants to make appropriate changes to the pre-loaded data. Accordingly, this section shows how to customize the pre-loaded data.

In the backcasting tool, energy consumption and CO2 emissions are calculated using the method shown in Figure A-58. In other words, the user can change the indicators shown in Figure A-58. Each of the policies introduced affects the corresponding indicators.

A.2.3.1 explains how to change the indicators concerning volume of transport, in relation to Activity, Intensity (fuel efficiency), and Fuel type (CO2 emission coefficient), based on the formula below. [Modal share (Structure)] is calculated endogenously, so there is no need for the user to alter the settings.

A.2.3.2 explains how to change or add to the policy settings.

A.2.3.3 explains changes relating to the calculation of co-benefits.

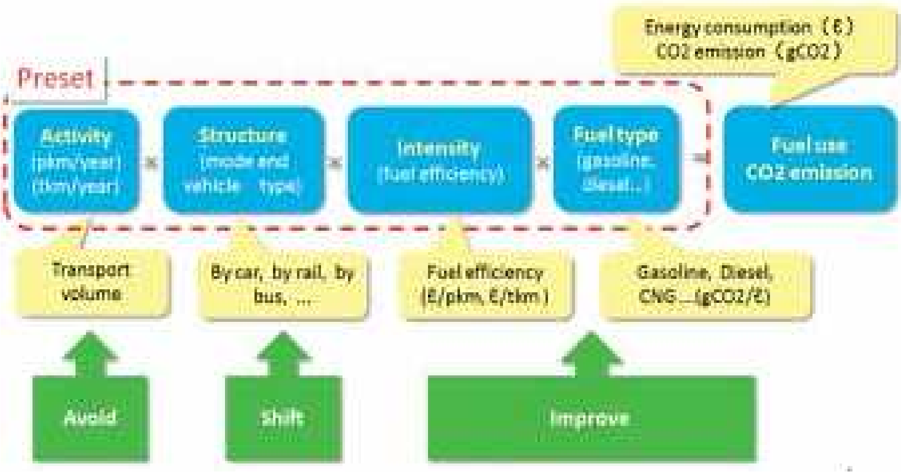


Figure A-58. Method of Calculation (ASIF Framework)

A.2.3.1 Changing the Transport Indicators

The following explains how to change the indicators concerning volume of transport, in relation to Activity[26], Intensity (fuel efficiency), and Fuel type (CO2 emission coefficient), based on the formulas below. Please note that it is necessary to complete step (4) [Saving the BAU (Do nothing case)] if the indicators have been changed.

(1) Changing Activity

Firstly, the volume of transport in the region in question is calculated in the backcasting tool using the formula below, based on the volume of transport (pkm, tkm) for the country as a whole (domestic + international)[27]. It can be seen that the exogenous data that determine the volume of transport in the respective regions in the formulas below are [total transport volume], [proportion of domestic/international transport volume], [proportion of intra/inter-regional transport volume], [proportion of intra/extra-ASEAN transport volume], and [proportion of population in region i]. Sections ①-③ below explain how to change these indicators.

- Domestic transport (transport mode j, domestic and intra-regional):
  Transport volume j (within region i)
  = Total transport volume (domestic + international) j × Proportion of domestic transport volume j (%)[28]
  × Proportion of intra-regional transport volume j (%)[29] × Proportion of population in region i (%)[30]
- Domestic transport (transport mode j, domestic and inter-regional):
  Transport volume j (inter-regional)
  = Total transport volume (domestic + international) j × Proportion of domestic transport volume (%) j[31]
  × Proportion of inter-regional transport volume j (%)[32]
- International transport (transport mode j, international and intra-ASEAN):
  Transport volume j (intra-ASEAN)
  = Total transport volume (domestic + international) j × Proportion of international transport volume j (%)[33]

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[26] This includes changes to the population categories.
[27] In reality, the volume of transport in each region is not proportionate to the proportion of population, but as no valid statistical data exist at present, it was decided to apply this method of estimation.
[28] Uses the proportion of domestic transport volume element of the proportion of international and domestic transport volumes.
[29] Uses the proportion of intra-regional transport element of the proportion of intra- and intra-regional transport volumes.
[30] Uses the proportion of the total population accounted for by the population of the region in question.
[31] Uses the proportion of domestic transport volume element of the proportion of international and domestic transport volumes.
[32] Uses the proportion of inter-regional transport volume element of the proportion of intra- and intra-regional transport volumes.

× Proportion of intra-ASEAN transport volume j (%)[34]

- International transport (transport mode j, international and extra-ASEAN):
  Transport volume j (extra-ASEAN)
  = Total transport volume (domestic + international) j × Proportion of international transport volume j (%)[35]
  × Proportion of intra-ASEAN transport volume j (%)[36]

① Changing the Volume of Transport

First of all, in the backcasting tool, the setting for the volume of transport (pkm, tkm) for the country as a whole (domestic + international) forms the basis for calculating CO2 emissions. If the user wishes to change the total volume of transport, it is necessary to load the data into the cells shown in Table A-6. When revising data, the data for all nine regions in the backcasting tool must be revised.

Please note that it is necessary to complete step (4) [Saving the BAU (Do nothing case)] if the indicators have been changed.

◆ Data storage
- ✧ Target files: Backcasting tool (9 regions)
- ✧ Sheet used: Transport Volume
- ✧ Target cells: Indicated in Table

Table A-6. Cells to be Amended when Updating / Revising Data for Total Transport Volume

Mode and Vehicle Type	Input index	Transport Volume	Target Cells
Passenger Vehicles[37]	Vehicle population (million)	Mpkm/year	Car: C4–L4, LV: C5–L5, SUV: C6–L6
	Load factor (person/vehicle)		Car: M4–V4, LV: M5–V5, SUV: M6–V6
	Travel distance (km/vehicle/year)		Car: W4–AF4, LV: W5–AF5, SUV: W6–AF6
Bus/BRT	Vehicle population (million)	Mpkm/year	Bus：C7–L7, BRT：C8–L8
	Load factor (person/vehicle)		Bus：M7–V7, BRT：M8–V8
	Travel distance (km/vehicle/year)		Bus：W7–AF7, BRT：W8–AF8
2/3-wheeled motor vehicles	Vehicle population (million)	Mpkm/year	C9 – L9
	Load factor (person/vehicle)		M9 – V9
	Travel distance (km/vehicle/year)		W9 – AF9
Freight Vehicles	Vehicle population (million)	Mtkm/year	Truck：C18–L18, Trailer：C19–L19
	Load factor (ton/vehicle)		Truck：M18–V18, Trailer：M19–V19
	Travel distance (km/vehicle/year)		Truck：W18 – AF18, Trailer：W19 – AF19
Passenger Rail	Traffic volume (Mpkm/year)	Mpkm/year	Rail：AG10–AP10, LRT：AG11–AP11
Passenger Air	Traffic volume (Mpkm/year)	Mpkm/year	AG12–AP12
Freight Rail	Traffic volume (Mpkm/year)	Mtkm/year	AG20–AP20
Freight Air	Traffic volume (Mpkm/year)	Mtkm/year	AG21–AP21
Ship	Energy consumption volume (million L/year)	M L/year	

33 Uses the proportion of international transport volume element of the proportion of international and domestic transport volumes.
34 Uses the proportion of intra-ASEAN transport volume element of the proportion of intra- and extra-ASEAN international transport volumes.
35 Uses the proportion of international transport volume element of the proportion of international and domestic transport volumes.
36 Uses the proportion of extra-ASEAN transport volume element of the proportion of intra- and extra-ASEAN international transport volumes.
37 Three types of passenger vehicle can be considered.

② Changing the population categories

It is conceivable that the user might wish to use different population categories from those used in this study (see Chapter 2 Table 2-1). Accordingly, based on the categories that they wish to use, the user can identify the proportion of population accounted for by each category of city and load these into the backcasting tool.

Please note that it is necessary to complete step (4) [Saving the BAU (Do nothing case)] if the indicators have been changed.

- Data storage
  - Target files: Backcasting tool (9 regions)
  - Sheet used ①: Transport Volume
  - Target cells ①: B38-L49

Table A-7. Population Categories from Those Used in This Study

million	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Primary city	1.6.E+07	1.7.E+07	1.9.E+07	2.1.E+07	2.2.E+07	2.4.E+07	2.5.E+07	2.7.E+07	2.8.E+07	2.9.E+07
Large city	1.6.E+07	2.1.E+07	2.7.E+07	3.2.E+07	4.0.E+07	4.5.E+07	4.9.E+07	5.6.E+07	5.8.E+07	6.0.E+07
City	1.5.E+07	1.9.E+07	2.1.E+07	2.5.E+07	2.5.E+07	2.5.E+07	2.5.E+07	2.3.E+07	2.4.E+07	2.4.E+07
Non city	1.7.E+08	1.8.E+08	1.8.E+08	1.8.E+08	1.8.E+08	1.8.E+08	1.8.E+08	1.8.E+08	1.8.E+08	1.8.E+08
Total	2.2.E+08	2.3.E+08	2.5.E+08	2.6.E+08	2.7.E+08	2.8.E+08	2.8.E+08	2.9.E+08	2.9.E+08	2.9.E+08

Table A-8. Population Categories Proportion from Those Used in This Study

%	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Primary city	7.1%	7.5%	7.8%	8.0%	8.2%	8.6%	8.9%	9.2%	9.5%	9.8%
Large city	7.5%	8.9%	11.1%	12.4%	14.8%	16.2%	17.2%	19.2%	19.9%	20.5%
City	6.8%	8.2%	8.5%	9.5%	9.3%	9.0%	8.9%	7.8%	8.1%	8.3%
Non city	78.6%	75.5%	72.6%	70.1%	67.7%	66.3%	65.0%	63.7%	62.6%	61.4%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

③ Changing the Proportion of Transport Volume in Individual Regions

Next, using the population categories identified, calculate the elements marked in red in the formulas on A.2.3.1(1) for the respective regions[38]. When calculating the elements marked in red, it is necessary first of all to determine [proportion of domestic/international transport volume], [proportion of intra/inter-regional transport volume], and [proportion of intra/extra-ASEAN transport volume]. In this study, these have been set as shown below (Tables A-9, A-10, and A-11).
Table A-12 uses figures for car transport as an example, while Table A-13 uses the example of passenger air transport. Please note that the proportions for the regions must together add up to 100%.

Please note that it is necessary to complete step (4) [Saving the BAU (Do nothing case)] if the indicators have been changed.

[38] It is necessary first of all to determine the figures to be used for [proportion of domestic/international transport volume], [proportion of intra/inter-regional transport volume], and [proportion of intra/extra-ASEAN transport volume].

- Data storage
  - Target files: Backcasting tool (9 regions)
  - Sheet used ①: Regional Transport Ratio
  - Target cells ①: Q2-AC150

Table A-9. Proportion of Domestic / International Transport Volume

Mode and Vehicle Type	Proportion of Domestic / International Transport Volume	Remarks
Passenger Vehicles	100% : 0%	Assumption
Bus/BRT	100% : 0%	Assumption
2/3-wheeled motor vehicles	100% : 0%	Assumption
Freight Vehicles	100% : 0%	Assumption
Passenger Rail	100% : 0%	Assumption
Passenger Air	Different by country	Set based on ICAO statistical data
Freight Rail	Different by country	Set based on IEA Energy Balance data
Freight Air	Different by country	Set based on ICAO statistical data
Ship	Different by country	Set based on ICAO Energy Balance data

Table A-10. Proportion of Intra / Inter-Regional Transport Volume

Mode and Vehicle Type	Proportion of Intra / Inter-regional Transport Volume	Remarks
Passenger Vehicles	60% : 40%	Set based on "Transport, Energy and CO2" IEA
Bus	30% : 70%	Set based on "Transport, Energy and CO2" IEA
BRT	100% : 0%	Assumption
2/3-wheeled motor vehicles	80% : 20%	Set based on "Transport, Energy and CO2" IEA
Freight Vehicles	0% : 100%	Assumption
Passenger Rail	20% : 80%	Set based on "Transport, Energy and CO2" IEA
LRT	100% : 0%	Assumption
Passenger Air	0% : 100%	Set based on "Transport, Energy and CO2" IEA
Freight Rail	0% : 100%	Assumption
Freight Air	0% : 100%	Set based on "Transport, Energy and CO2" IEA
Ship	0% : 100%	Assumption

Table A-11. Proportion of Intra / Extra-ASEAN Transport Volume

Mode and Vehicle Type	Intra / Extra-ASEAN Transport Volume	Remarks
Passenger Air	50% : 50%	Assumption
Freight Air	50% : 50%	Assumption
Ship	50% : 50%	Assumption

Table A-12. Example of Loading Data into the Backcasting Tool (Car: Q2-AC10)

Car			2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Domestic	Intra Region	Primary city	4%	4%	5%	5%	5%	5%	5%	6%	6%	6%
Domestic	Intra Region	Large city	4%	5%	7%	7%	9%	10%	10%	12%	12%	12%
Domestic	Intra Region	City	4%	5%	5%	6%	6%	5%	5%	5%	5%	5%
Domestic	Intra Region	Non city	47%	45%	44%	42%	41%	40%	39%	38%	38%	37%
Domestic	Inter		40%	40%	40%	40%	40%	40%	40%	40%	40%	40%
International	Intra Asean		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
International	Except Intra Asean		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total			*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*

Table A-13. Example of Loading Data into the Backcasting Tool (Air (Pass): Q82-AC90)

Air (Pass)			2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Domestic	Intra Region	Primary city	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Domestic	Intra Region	Large city	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Domestic	Intra Region	City	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Domestic	Intra Region	Non city	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Domestic	Inter		37%	37%	37%	37%	37%	37%	37%	37%	37%	37%
International	Intra Asean		32%	32%	32%	32%	32%	32%	32%	32%	32%	32%
International	Except Intra Asean		32%	32%	32%	32%	32%	32%	32%	32%	32%	32%
Total			*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*

(2) Changing Fuel Efficiency (Intensity)

It is envisaged that users will wish to amend fuel efficiency figures to reflect the latest data. Changes to fuel efficiency can be made by amending the sheets and cells listed below. The units used to express fuel efficiency are L/pkm in the case of passenger transport and L/tkm in the case of freight transport.

Please note that it is necessary to complete step (4) [Saving the BAU (Do nothing case)] if the indicators have been changed.

Table A-15 uses car transport as an example.

- Data storage
  - ✧ Target files: Backcasting tool (9 regions)
  - ✧ Sheet used: Cal (FE)
  - ✧ Target cells: B2-M59 (Passenger), B63-M86 (Freight)

Table A-14. Fuel Efficiency Settings

Mode and Vehicle Type	Remarks	Proportion of Improvement of Fuel Efficiency (% / Year)
Passenger Vehicles	Set based on each country's literature, etc.[39]	0.5% / Year (Assumption)
Bus / BRT	Set based on each country's literature, etc.	0.5% / Year (Assumption)
2/3-wheeled motor vehicles	Set based on each country's literature, etc.	0.5% / Year (Assumption)
Freight Vehicles	Set based on each country's literature, etc.	0.5% / Year (Assumption)
Passenger Rail	Set based on IEA SMP's data, etc.	0.5% / Year (Assumption)
Passenger Air	Set based on Japan's data, etc.	0.5% / Year (Assumption)
Freight Rail	Set based on IEA SMP's data, etc.	0.5% / Year (Assumption)
Freight Air	Set based on Japan's data, etc.	0.5% / Year (Assumption)
Ship	Set based on Japan's data, etc.	0.5% / Year (Assumption)

Table A-15. Example of Loading Data into the Backcasting Tool (Car: B2-M11)

		Fuel Efficiency (L/pkm) - BAU									
		2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Car	Gasoline	0.073	0.073	0.071	0.07	0.068	0.066	0.065	0.063	0.061	0.06
Car	Diesel	0.073	0.073	0.071	0.07	0.068	0.066	0.065	0.063	0.061	0.06
Car	HV-Gasoline	0.044	0.044	0.043	0.042	0.041	0.04	0.039	0.038	0.037	0.036
Car	HV-Diesel	0.044	0.044	0.043	0.042	0.041	0.04	0.039	0.038	0.037	0.036
Car	CNG	0.066	0.066	0.064	0.063	0.061	0.06	0.058	0.057	0.055	0.054
Car	LPG	0.066	0.066	0.064	0.063	0.061	0.06	0.058	0.057	0.055	0.054
Car	EV	0.018	0.018	0.018	0.017	0.017	0.017	0.016	0.016	0.015	0.015
Car	FCV	0.018	0.018	0.018	0.017	0.017	0.017	0.016	0.016	0.015	0.015

(3) Changing the CO2 Emission Coefficient (Fuel type)

It is envisaged that users will wish to amend CO2 emission coefficient figures to reflect the latest data. Changes to the CO2 emission coefficients can be made by amending the sheets and cells listed below. The CO2 emission coefficient for passenger transport is expressed as kgCO2/L. In the case of electricity, this has been converted into liters based on the calorific value.

Please note that it is necessary to complete step (4) [Saving the BAU (Do nothing case)] if the indicators have been changed.
Table A-17 shows the example of TTW CO2, while Table A-18 shows the example of WTT CO2.

- Data storage (TTW CO2)
  - Target files: Backcasting tool (9 regions)
  - Sheet used: Cal (TTW CO2 EF)
  - Target cells: B100-M108

[39] No data were available for hybrid, electric, or fuel cell vehicles, so the fuel consumption of hybrid vehicles has been set at 60% of the internal combustion engine (ICE) level, while that for electric and fuel cell vehicles has been set at 25% of the ICE level.

- Data storage (WWT CO2)
  - Target files: Backcasting tool (9 regions)
  - Sheet used: Cal (TTW CO2 EF)
  - Target cells: B100-M108

Table A-16. Setting the CO2 Emission Coefficient

Fuel Type	Remarks
Gasoline	Set based on each country's literature, etc.
Diesel	Set based on each country's literature, etc.
Kerosene	Set based on each country's literature, etc.
Bioethanol	Set based on each country's literature, etc.
Biodiesel	Set based on each country's literature, etc.
Biogas	Set based on each country's literature, etc.
Biofuel	Set based on each country's literature, etc.

Table A-17. Example of Loading Data into the Backcasting Tool (TTW CO2: B101-M108)

		2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Gasoline	TTW	2.69	2.69	2.69	2.69	2.69	2.69	2.69	2.69	2.69	2.69
Diesel	TTW	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62
Kerosene	TTW	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62
Bioethanol	TTW	0	0	0	0	0	0	0	0	0	0
Biodiesel	TTW	0	0	0	0	0	0	0	0	0	0
Biogas	TTW	0	0	0	0	0	0	0	0	0	0
Biofuel	TTW	0	0	0	0	0	0	0	0	0	0

Table A-18. Example of Loading Data into the Backcasting Tool (WTT CO2: B101-M108)

		2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Gasoline	WTT	0.35	0.35	0.35	0.36	0.36	0.37	0.37	0.37	0.37	0.37
Diesel	WTT	0.35	0.35	0.35	0.36	0.36	0.37	0.37	0.37	0.37	0.37
Kerosene	WTT	0.35	0.35	0.35	0.36	0.36	0.37	0.37	0.37	0.37	0.37
Bioethanol	WTT	2.568	2.568	2.589	2.61	2.646	2.684	2.684	2.684	2.684	2.684
Biodiesel	WTT	2.568	2.568	2.589	2.61	2.646	2.684	2.684	2.684	2.684	2.684
Biogas	WTT	2.568	2.568	2.589	2.61	2.646	2.684	2.684	2.684	2.684	2.684
Biofuel	WTT	2.568	2.568	2.589	2.61	2.646	2.684	2.684	2.684	2.684	2.684

(4) Saving the BAU (Do Nothing Case)

When comparing the BAU (Do nothing case) with the scenario case in the backcasting tool, information concerning the volume of transport and CO2 emissions is loaded on the basis of the existing values for Activity, Intensity (fuel efficiency), and Fuel type (CO2 emission coefficient). Consequently, if the user has changed any of the indicators, the transport volume and CO2 emissions in the BAU case will change, so it will be necessary to save this information again in the backcasting tool. This can be done by following the steps below.

1. In the backcasting tool (Excel version), under [User Control], change all of the objectives in [2. Select Purpose] to [No] (cells G8-G14)[40].
2. In the backcasting tool (Excel version), select [View] - [Macros] - [View Macros] (Figure A-59).
3. Run the two macros [Result1] and [Result4] (Figure A-60).

Figure A-59. Select Macro

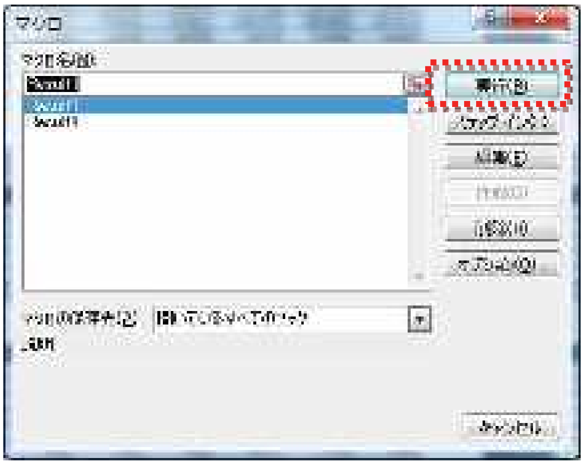

Figure A-60. Execute Macro

A.2.3.2 Changing/Adding Policies

Each of the policies introduced affects the corresponding indicators, based on the formula shown in Figure A-58. In the backcasting tool, the policy packages are classified into the three categories Avoid, Shift, and Improve, based on differences in the transport indicators affected by each policy package.

It is conceivable that users might wish to change or add to these policy packages. This section explains how to do so. Table A-19 shows whether policy packages in each category can be changed or added to. [○] indicates that the operation in question is possible. On the other hand, [-] indicates that it is not possible to add a new policy to this category.

Table A-19. Possibility of Altering / Adding Policies

No	Category	Alter Policies	Add Policies	Sheet used
1	Improve (Improve Fuel Efficiency)	○	○	・Policy List (Improve)
2	Improve (Fuel Change)	○	-	・Policy List (Fuel-pass) ・Policy List (Fuel - freight) ・Policy List (Fuel-bio)
3	Shift	○	-	・Policy List (Shift-pass) ・Policy List (Shift - freight)
4	Avoid	○	-	・Policy List (Avoid)

40 This disables the policy packages that have already been selected.

(1) Improve (Improve Fuel Efficiency)

Users can alter or add to the policy packages focused on improving fuel efficiency (Table A-19). The attributes of the policy packages focused on improving fuel efficiency are set in the various items shown in Table A-20. The user can change the attributes shown in Table A-20 in the existing policy packages.

In addition, if adding a new policy package, the user can add a new row with information about the attributes shown in Table A-20.

Table A-20. Details of Attributes Set for Policy Packages in the Improve Category (Improving Fuel Efficiency)

Item	Task	Corresponding Column
Policy package name	Enter the name of the policy package.	D
Names of individual policies[41]	Enter the names of the individual policies of which the policy package consists.	E
Policy introducer[42]	Enter the flag [1] against the corresponding body introducing the policy.	F-H
Policy target[43]	Enter the flag [1] against the corresponding target of the policy.	I-K
Technical classification of the policy package[44]	Enter the flag [1] against the corresponding classification.	L-P
Effect of policy package	Set the effect of introducing the policy package. The value entered here is the percentage reduction from the BAU when the policy package achieves maximum effectiveness.	Q
Policy package level (Cost)[45]	Set the policy package level. Enter the level (1, 2, or 3).	R
Policy package level (Ease of Implementation)[46]	Set the policy package level. Enter the level (1, 2, or 3).	S
Policy package level (Time Requirement)[47]	Set the policy package level. Enter the level (1, 2, or 3).	T
Mode of transport (Passenger) affected by policy package[48]	Enter the flag [1] against the corresponding mode of transport (Passenger).	Y-AH
Mode of transport (Freight) affected by policy package[49]	Enter the flag [1] against the corresponding mode of transport (Freight).	AI-AM
Fuel type affected by policy package[50]	Enter the flag [1] against the corresponding fuel type.	AN-AU

41 The individual policies that make up the policy packages in the Improve category (focused on improving fuel efficiency) can be specified.
42 At least one (Government, Local authority, Others) must be flagged.
43 At least one (User, Citizen, Others) must be flagged.
44 At least one (Technology, Regulation, Information, Economic, Plan) must be flagged.
45 See Table A-2 regarding the meanings of the respective levels 1-3.
46 See Table A-3 regarding the meanings of the respective levels 1-3.
47 See Table A-4 regarding the meanings of the respective levels 1-3.
48 At least one (Car, LV, SUV, Bus, BRT, 2W/3W, Rail, LRT, Air, Ship) must be flagged.
49 At least one (Truck, Trailer, Rail, Air, Ship) must be flagged.
50 At least one (Gas, Diesel, HV-Gasoline, HV-Diesel, CNG, LPG, EV, FCV) must be flagged.

- ◆ Data storage
  - ✧ Target files: Backcasting tool (9 regions)
  - ✧ Sheet used: Policy List (Improve)
  - ✧ Target cells: C3-AU25

(2) Improve (Fuel Change - Passenger)

Users can alter the policy packages focused on achieving a change in the fuel used for passenger transport (Table A-19). The attributes of the policy packages focused on achieving a change in the fuel used for passenger transport are set in the indices shown in Table A-21. The user can change the attributes shown in Table A-21 in the existing policy packages.

New vehicle types cannot be added in the backcasting tool. Accordingly, new policy packages in the Improve (fuel change – passenger) category cannot be added.

Table A-21. Details of Attributes Set for Policy Packages in the Improve (Fuel Change - Passenger) Category

Item	Task	Corresponding Column
Policy package name	Enter the name of the policy package.	D
Names of individual policies[51]	Enter the names of the individual policies of which the policy package consists.	E
Policy introducer[52]	Enter the flag [1] against the corresponding body introducing the policy.	F-H
Policy target[53]	Enter the flag [1] against the corresponding target of the policy.	I-K
Technical classification of the policy package[54]	Enter the flag [1] against the corresponding classification.	L-P
Policy package level (Cost)[55]	Set the policy package level. Enter the level (1, 2, or 3).	R
Policy package level (Ease of Implementation)[56]	Set the policy package level. Enter the level (1, 2, or 3).	S
Policy package level (Time Requirement)[57]	Set the policy package level. Enter the level (1, 2, or 3).	T
Mode of transport (Passenger) affected by policy package[58]	Enter the flag [1] against the corresponding mode of transport (Passenger).	Y-AH
Fuel type affected by policy package[59]	Enter the flag [1] against the corresponding fuel type.	AI-AP

[51] The individual policies that make up the policy packages in the Improve category (focused on improving fuel efficiency) can be specified.
[52] At least one (Government, Local public, Others) must be flagged.
[53] At least one (User, Citizen, Others) must be flagged.
[54] At least one (Technology, Regulation, Information, Economic, Plan) must be flagged.
[55] See Table A-2 regarding the meanings of the respective levels 1-3.
[56] See Table A-3 regarding the meanings of the respective levels 1-3.
[57] See Table A-4 regarding the meanings of the respective levels 1-3.
[58] At least one (Car, LV, SUV, Bus, BRT, 2W/3W, Rail, LRT, Air, Ship) must be flagged.
[59] At least one (Gas, Diesel, HV-Gasoline, HV-Diesel, CNG, LPG, EV, FCV) must be flagged.

- Data storage
  - Target files: Backcasting tool (9 regions)
  - Sheet used: Policy List (Fuel-pass)
  - Target cells: C3-AP26

(3) Improve (Fuel Change - Freight)

Users can alter the policy packages focused on achieving a change in the fuel used for freight transport (Table A-19). The attributes of the policy packages focused on achieving a change in the fuel used for freight transport are set in the indices shown in Table A-22. The user can change the attributes shown in Table A-22 in the existing policy packages.

New vehicle types cannot be added in the backcasting tool. Accordingly, new policy packages in the Improve (fuel change – freight) category cannot be added.

Table A-22. Details of Attributes Set for Policy Packages in the Improve (Fuel Change - Freight) Category

Item	Task	Corresponding Column
Policy package name	Enter the name of the policy package.	D
Names of individual policies[60]	Enter the names of the individual policies of which the policy package consists.	E
Policy introducer [61]	Enter the flag [1] against the corresponding body introducing the policy.	F-H
Policy target[62]	Enter the flag [1] against the corresponding target of the policy.	I-K
Technical classification of the policy package[63]	Enter the flag [1] against the corresponding classification.	L-P
Policy package level (Cost)[64]	Set the policy package level. Enter the level (1, 2, or 3).	R
Policy package level (Ease of Implementation)[65]	Set the policy package level. Enter the level (1, 2, or 3).	S
Policy package level (Time Requirement)[66]	Set the policy package level. Enter the level (1, 2, or 3).	T
Mode of transport (Freight) affected by policy package[67]	Enter the flag [1] against the corresponding mode of transport (Freight).	Y-AC
Fuel type affected by policy package[68]	Enter the flag [1] against the corresponding fuel type.	AD-AK

[60] The individual policies that make up the policy packages in the Improve category (focused on improving fuel efficiency) can be specified.
[61] At least one (Government, Local public, Others) must be flagged.
[62] At least one (User, Citizen, Others) must be flagged.
[63] At least one (Technology, Regulation, Information, Economic, Plan) must be flagged.
[64] See Table A-2 regarding the meanings of the respective levels 1-3.
[65] See Table A-3 regarding the meanings of the respective levels 1-3.
[66] See Table A-4 regarding the meanings of the respective levels 1-3.
[67] At least one (Car, LV, SUV, Bus, BRT, 2W/3W, Rail, LRT, Air, Ship) must be flagged.
[68] At least one (Gas, Diesel, HV-Gasoline, HV-Diesel, CNG, LPG, EV, FCV) must be flagged.

- Data storage
  - Target files: Backcasting tool (9 regions)
  - Sheet used: Policy List (Fuel-pass)
  - Target cells: C3-AK26

(4) Improve (Fuel Change - Biofuel)

Users can alter the policy packages focused on greater use of biofuel (Table A-19). The attributes of the policy packages focused on greater use of biofuel are set in the indices shown in Table A-23. The user can change the attributes shown in Table A-23 in the existing policy packages.

New biofuels cannot be added in the backcasting tool. Accordingly, new policy packages in the Improve (fuel change – biofuel) category cannot be added.

Table A-23. Details of Attributes Set for Policy Packages in the Improve (Fuel Change - Freight) Category

Item	Task	Corresponding Column
Policy package name	Enter the name of the policy package.	D
Names of individual policies[69]	Enter the names of the individual policies of which the policy package consists.	E
Policy introducer[70]	Enter the flag [1] against the corresponding body introducing the policy.	F-H
Policy target[71]	Enter the flag [1] against the corresponding target of the policy.	I-K
Technical classification of the policy package[72]	Enter the flag [1] against the corresponding classification.	L-P
Policy package level (Cost)[73]	Set the policy package level. Enter the level (1, 2, or 3).	R
Policy package level (Ease of Implementation)[74]	Set the policy package level. Enter the level (1, 2, or 3).	S
Policy package level (Time Requirement)[75]	Set the policy package level. Enter the level (1, 2, or 3).	T

- Data storage
  - Target files: Backcasting tool (9 regions)
  - Sheet used: Policy List (Fuel-bio)
  - Target cells: C3-T34

[69] The individual policies that make up the policy packages in the Improve category (focused on improving fuel efficiency) can be specified.
[70] At least one (Government, Local public, Others) must be flagged.
[71] At least one (User, Citizen, Others) must be flagged.
[72] At least one (Technology, Regulation, Information, Economic, Plan) must be flagged.
[73] See Table A-2 regarding the meanings of the respective levels 1-3.
[74] See Table A-3 regarding the meanings of the respective levels 1-3.
[75] See Table A-4 regarding the meanings of the respective levels 1-3.

(5) Shift (Passenger)

Users can alter the policy packages focused on achieving a shift in passenger transport (Table A-19). The attributes of the policy packages focused on achieving a shift in passenger transport are set in the indices shown in Table A-24. The user can change the attributes shown in Table A-24 in the existing policy packages.

Please note that there is no need to add to the backcasting tool new policy packages in the Shift category, due to the attributes of these policies.

Table A-24. Details of Attributes Set for Policy Packages in the Shift (Passenger) Category

Item	Task	Corresponding Column
Policy introducer[76]	Enter the flag [1] against the corresponding body introducing the policy.	E-G
Policy target[77]	Enter the flag [1] against the corresponding target of the policy.	H-J
Technical classification of the policy package[78]	Enter the flag [1] against the corresponding classification.	K-O
Policy package level (Cost)[79]	Set the policy package level. Enter the level (1, 2, or 3).	R
Policy package level (Ease of Implementation)[80]	Set the policy package level. Enter the level (1, 2, or 3).	S
Policy package level (Time Requirement)[81]	Set the policy package level. Enter the level (1, 2, or 3).	T

- Data storage
  - Target files: Backcasting tool (9 regions)
  - Sheet used: Policy List (Shift-pass)
  - Target cells: C3-S26

(6) Shift (Freight)

Users can alter the policy packages focused on achieving a shift in freight transport (Table A-19). The attributes of the policy packages focused on achieving a shift in freight transport are set in the indices shown in Table A-25. The user can change the attributes shown in Table A-25 in the existing policy packages.

Please note that there is no need to add to the backcasting tool new policy packages in the Shift category, due to the attributes of these policies.

[76] At least one (Government, Local public, Others) must be flagged.
[77] At least one (User, Citizen, Others) must be flagged.
[78] At least one (Technology, Regulation, Information, Economic, Plan) must be flagged.
[79] See Table A-2 regarding the meanings of the respective levels 1-3.
[80] See Table A-3 regarding the meanings of the respective levels 1-3.
[81] See Table A-4 regarding the meanings of the respective levels 1-3.

Table A-25. Details of Attributes Set for Policy Packages in the Shift (Freight) Category

Item	Task	Corresponding Column
Policy introducer[82]	Enter the flag [1] against the corresponding body introducing the policy.	E-G
Policy target[83]	Enter the flag [1] against the corresponding target of the policy.	H-J
Technical classification of the policy package[84]	Enter the flag [1] against the corresponding classification.	K-O
Policy package level (Cost)[85]	Set the policy package level. Enter the level (1, 2, or 3).	R
Policy package level (Ease of Implementation)[86]	Set the policy package level. Enter the level (1, 2, or 3).	S
Policy package level (Time Requirement))[87]	Set the policy package level. Enter the level (1, 2, or 3).	T

- Data storage
  - Target files: Backcasting tool (9 regions)
  - Sheet used: Policy List t (Fuel - Freight)
  - Target cells: C3-S26

(7) Avoid

Users can alter or add to the policy packages in the Avoid category (Table A-19). The attributes of the policy packages in the Avoid category are set in the indices shown in Table A-26. The user can change the attributes shown in Table A-26 in the existing policy packages.

In addition, if adding a new policy package, the user can add a new row with information about the attributes shown in Table A-26.

[82] At least one (Government, Local public, Others) must be flagged.
[83] At least one (User, Citizen, Others) must be flagged.
[84] At least one (Technology, Regulation, Information, Economic, Plan) must be flagged.
[85] See Table A-2 regarding the meanings of the respective levels 1-3.

[86] See Table A-3 regarding the meanings of the respective levels 1-3.
[87] See Table A-4 regarding the meanings of the respective levels 1-3.

Table A-26. Details of Attributes Set for Policy Packages in the Avoid Category

Item	Task	Corresponding Column
Policy package name	Enter the name of the policy package.	D
Names of individual policies [88]	Enter the names of the individual policies of which the policy package consists.	E
Policy introducer[89]	Enter the flag [1] against the corresponding body introducing the policy.	F-H
Policy target[90]	Enter the flag [1] against the corresponding target of the policy.	I-K
Technical classification of the policy package[91]	Enter the flag [1] against the corresponding classification.	L-P
Effect of policy package	Set the effect of introducing the policy package. The value entered here is the percentage reduction from the BAU when the policy package achieves maximum effectiveness.	Q
Policy package level (Cost)[92]	Set the policy package level. Enter the level (1, 2, or 3).	R
Policy package level (Ease of Implementation)[93]	Set the policy package level. Enter the level (1, 2, or 3).	S
Policy package level (Time Requirement))[94]	Set the policy package level. Enter the level (1, 2, or 3).	T
Mode of transport (Passenger) affected by policy package [95]	Enter the flag [1] against the corresponding mode of transport (Passenger).	Y-AH
Purpose of transport (Freight) affected by policy package[96]	Enter the flag [1] against the corresponding purpose of transport (Passenger).	AI-AM
Mode of transport (Freight) affected by policy package[97]	Enter the flag [1] against the corresponding mode of transport (Freight).	AN-AR
Region affected by policy package[98]	Enter the flag [1] against the corresponding mode of transport (Region).	AS-AZ

- Data storage
  - Target files: Backcasting tool (9 regions)
  - Sheet used: Policy List(Fuel - Freight)
  - Target cells: C3-AZ54

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88 The individual policies that make up the policy packages in the Improve category (focused on improving fuel efficiency) can be specified.
89 At least one (Government, Local public, Others) must be flagged.
90 At least one (User, Citizen, Others) must be flagged.
91 At least one (Technology, Regulation, Information, Economic, Plan) must be flagged.
92 See Table A-2 regarding the meanings of the respective levels 1-3.
93 See Table A-3 regarding the meanings of the respective levels 1-3.
94 See Table A-4 regarding the meanings of the respective levels 1-3.
95 At least one (Car, LV, SUV, Bus, BRT, 2W/3W, Rail, LRT, Air, Ship) must be flagged.
96 At least one (Leisure, Commuting & Business, Shopping & Private, Education, Others) must be flagged.
97 At least one (Truck, Trailer, Rail, Air, Ship) must be flagged.
98 At least one (Primary city, Large city, City, Non city, Intra Region, Intra Asean, Except Inter Asean, National Total) must be flagged.

A.2.3.3 Changing the co-benefit coefficients

The co-benefit coefficients used when calculating co-benefits are currently set on the basis of European research. The user can change the co-benefit coefficients as needed.

- Data storage
  - ✧ Target files: Backcasting tool (9 regions)
  - ✧ Sheet used: Result5、Result6
  - ✧ Target cells: AC8-AL13

A.2.3.4 Customization Q&A

(1) How to revise the BAU (Baseline)

- What should I do if I only have an estimate of the BAU?

  → Calculate the data from the BAU estimate in accordance with A.2.3.1(1) ① and load them into the backcasting tool.

- What should I do if the vehicle categories are different?

  → Prepare the data in accordance with the user-defined categories and load them into the backcasting tool.

- If I have only a minimal amount of data, what should I enter and where?

  → If you do not have the data stipulated in A.2.3.1(1) ①, use data for other countries, etc.

(2) How to divide up the regions

- What should I do if I want to change the way in which the regions are divided up or I find a good means of doing so?

  → See A.2.3.1(1) ②.

- How can I reduce the number of region categories?

  → If you wish to use fewer than the current number of population categories, set the proportion of population in the categories no longer required to 0%.

(3) How to add policies and policy packages

- How do I add policies to a policy package? (For example, in cases in which it is obvious that inserting additional policies into a policy package will double its effect)

  → It is possible to add policies to policy packages in the Improve (improve fuel efficiency) and Avoid categories. For details of how to add policies, see A.2.3.2(1) (Improve (improve fuel efficiency) and A.2.3.2(7) (Avoid)).

- How do I add another policy package?

  → It is possible to add policy packages in the Improve (improve fuel efficiency) and Avoid categories. For details of how to add policy packages, see A.2.3.2(1) (Improve (improve fuel efficiency) and A.2.3.2(7)

(Avoid)).

- How do I alter the effects of policies and policy packages? (For example, to change aircraft fuel efficiency from 1% to 5%)

  → It is possible to alter the effects of policy packages in the Improve (improve fuel efficiency) and Avoid categories. For details of how to amend policy packages, see A.2.3.2(1) (Improve (improve fuel efficiency) and A.2.3.2(7) (Avoid)).

(4) How do I alter the fuel efficiency / emission coefficients?

  → See A.2.3.1(2) (Fuel Efficiency) and A.2.3.1(3) (Emission Coefficients).

(5) How do I expand or reduce the target scope for other countries and regions?

- For example, to focus on Timor-Leste as well.

  → Prepare the data for Timor-Leste, including population, population categories, and volume of transport, and load them into the backcasting tool in accordance with A.2.3.1(1) ①.

- To evaluate the whole of ASEAN at once.

  → Prepare the data for the whole of ASEAN, including population, population categories, and volume of transport, and load them into the backcasting tool in accordance with A.2.3.1(1) ①.

(6) What if I want to change the preconditions?

- For example, to use the high-end (low-end) forecasts from UN population estimates.

  → See A.2.3.1(1) ②.

Appendix B
Reference Material

B.1 Policy Database

The following tables show individual policies or measures which are contained in each policy package[1]. Please note that all of the policies or measures are not always necessity to activate each policy package. And it is possible to add new or additional policies or measures.

B.1.1 Improve Policy Packages

I-1.CNGV Mass Supply

Policy Package		Policy Name	Contents
I-1.CNGV mass supply	Development	R&D	Research and development on hybrid technology and lighter materials, together with improved battery design.
I-1.CNGV mass supply	Development	Vehicle Design	Design of vehicles to improve with light materials and aerodynamic design, especially for freight vehicles.
I-1.CNGV mass supply	Development	On vehicle diagnostics	On vehicle diagnostics systems will give information to drivers that their vehicles are operating at optimal efficiency and within the accepted emissions range.
I-1.CNGV mass supply	Development	Programmes to raise awareness	Programmes to raise awareness of CO2 profiles and to label vehicles according to various eco dimensions.
I-1.CNGV mass supply	Development	Fuel demand availability	In order to increase the number of CNG vehicles, there should be enough CNG amounts to meet the demand.

I-2.CNGV Promotion (mainly via economic way)

Policy Package		Policy Name	Contents
I-2.CNGV Promotion (mainly via economic way)	Promotion	Strong Incentive	Strong incentives to the motor industry to dramatically increase the output of diesel and petrol hybrid cars and LGVS/HGVs/buses.
I-2.CNGV Promotion (mainly via economic way)	Promotion	Vehicle taxation	The system of vehicle taxation would have to be radically changed over time to reflect the emissions profile, with factor of 10 differences between the high and low charges for clean and dirty vehicles (Revised Bands AAA to D).
I-2.CNGV Promotion (mainly via economic way)	Promotion	Tax incentives	Tax incentives to encourage purchase of clean vehicles and tax disincentives to purchase vehicles with high CO2 emissions.
I-2.CNGV Promotion (mainly via economic way)	Promotion	Fuel prices	Fuel prices to reflect carbon content and to rise in real terms by 20%, but as most vehicles will be more efficient the actual fuel costs of travel will reduce.
I-2.CNGV Promotion (mainly via economic way)	Promotion	CNG infra	In order to supply CNG to vehicles, CNG infra such as CNG station is necessary.

[1] These policy packages and components are based on “Visioning and Backcasting for UK Transport Policy (VIBAT) DfT Horizons Research Programme, 2006”.

I-3.Hybrid Mass Supply

Policy Package		Policy Name	Contents
I-3.Hybrid mass supply	Development	R&D	Research and development on hybrid technology and lighter materials, together with improved battery design.
I-3.Hybrid mass supply	Development	Vehicle Design	Design of vehicles to improve with light materials and aerodynamic design, especially for freight vehicles.
I-3.Hybrid mass supply	Development	On vehicle diagnostics	On vehicle diagnostics systems will give information to drivers that their vehicles are operating at optimal efficiency and within the accepted emissions range.
I-3.Hybrid mass supply	Development	Programmes to raise awareness	Programmes to raise awareness of CO2 profiles and to label vehicles according to various eco dimensions.

I-4.Hybrid Promotion (mainly via economic way)

Policy Package		Policy Name	Contents
I-4.Hybrid Promotion (mainly via economic way)	Promotion	Strong Incentive	Strong incentives to the motor industry to dramatically increase the output of diesel and petrol hybrid cars and LGVS/HGVs/buses.
I-4.Hybrid Promotion (mainly via economic way)	Promotion	Vehicle taxation	The system of vehicle taxation would have to be radically changed over time to reflect the emissions profile, with factor of 10 differences between the high and low charges for clean and dirty vehicles (Revised Bands AAA to D).
I-4.Hybrid Promotion (mainly via economic way)	Promotion	Tax incentives	Tax incentives to encourage purchase of clean vehicles and tax disincentives to purchase vehicles with high CO2 emissions.
I-4.Hybrid Promotion (mainly via economic way)	Promotion	Fuel prices	Fuel prices to reflect carbon content and to rise in real terms by 20%, but as most vehicles will be more efficient the actual fuel costs of travel will reduce.

I-5.EV Mass Supply

Policy Package		Policy Name	Contents
5.EV mass supply	Development	R&D	Research and development on hybrid technology and lighter materials, together with improved battery design.
5.EV mass supply	Development	Vehicle Design	Design of vehicles to improve with light materials and aerodynamic design, especially for freight vehicles.
5.EV mass supply	Development	On vehicle diagnostics	On vehicle diagnostics systems will give information to drivers that their vehicles are operating at optimal efficiency and within the accepted emissions range.
5.EV mass supply	Development	Programmes to raise awareness	Programmes to raise awareness of CO2 profiles and to label vehicles according to various eco dimensions.
5.EV mass supply	Development	Fuel demand availability	In order to increase the number of EVs, there should be enough electricity to meet the demand.

I-6.EV Promotion (mainly via economic way)

Policy Package		Policy Name	Contents
I-6.EV Promotion (mainly via economic way)	Promotion	Strong Incentive	Strong incentives to the motor industry to dramatically increase the output of diesel and petrol hybrid cars and LGVS/HGVs/buses.
I-6.EV Promotion (mainly via economic way)	Promotion	Vehicle taxation	The system of vehicle taxation would have to be radically changed over time to reflect the emissions profile, with factor of 10 differences between the high and low charges for clean and dirty vehicles (Revised Bands AAA to D).
I-6.EV Promotion (mainly via economic way)	Promotion	Tax incentives	Tax incentives to encourage purchase of clean vehicles and tax disincentives to purchase vehicles with high CO2 emissions.
I-6.EV Promotion (mainly via economic way)	Promotion	Fuel prices	Fuel prices to reflect carbon content and to rise in real terms by 20%, but as most vehicles will be more efficient the actual fuel costs of travel will reduce.
I-6.EV Promotion (mainly via economic way)	Promotion	Electricity station	In order to supply electricity to EVs, electricity station is necessary.

I-7.FCV Mass Supply

Policy Package		Policy Name	Contents
I-7.FCV mass supply	Development	R&D	Research and development on hybrid technology and lighter materials, together with improved battery design.
I-7.FCV mass supply	Development	Vehicle Design	Design of vehicles to improve with light materials and aerodynamic design, especially for freight vehicles.
I-7.FCV mass supply	Development	On vehicle diagnostics	On vehicle diagnostics systems will give information to drivers that their vehicles are operating at optimal efficiency and within the accepted emissions range.
I-7.FCV mass supply	Development	Programmes to raise awareness	Programmes to raise awareness of CO2 profiles and to label vehicles according to various eco dimensions.
I-7.FCV mass supply	Development	Fuel demand availability	In order to increase the number of EVs, there should be enough FCV stations to meet the demand.

I-8.FCV Promotion (mainly via economic way)

Policy Package		Policy Name	Contents
I-8.FCV Promotion (mainly via economic way)	Promotion	Strong Incentive	Strong incentives to the motor industry to dramatically increase the output of diesel and petrol hybrid cars and LGVS/HGVs/buses.
I-8.FCV Promotion (mainly via economic way)	Promotion	Vehicle taxation	The system of vehicle taxation would have to be radically changed over time to reflect the emissions profile, with factor of 10 differences between the high and low charges for clean and dirty vehicles (Revised Bands AAA to D).
I-8.FCV Promotion (mainly via economic way)	Promotion	Tax incentives	Tax incentives to encourage purchase of clean vehicles and tax disincentives to purchase vehicles with high CO2 emissions.
I-8.FCV Promotion (mainly via economic way)	Promotion	Fuel prices	Fuel prices to reflect carbon content and to rise in real terms by 20%, but as most vehicles will be more efficient the actual fuel costs of travel will reduce.
I-8.FCV Promotion (mainly via economic way)	Promotion	Electricity station	In order to supply electricity to EVs, electricity station is necessary.

I-9.Biofuel Development

Policy Package		Policy Name	Contents
I-9.Biofuel Development	Development	R&D	Research and development on biofuels and renewable energy sources and their suitability for transport – to include issues relating to storage and distribution.
I-9.Biofuel Development	Development	Encourage the production of biofuels and renewables	Encourage the production of biofuels and renewables within the UK to achieve EU targets for 2010 and later.

I-10.Biofuel Promotion

Policy Package		Policy Name	Contents
I-10.Biofuel Promotion	Promotion	Promotion of biofuels	Promote the use of biofuels in city transport, for taxis and buses, and for the freight sector (including local distribution).
I-10.Biofuel Promotion	Promotion	Tax incentives	Use the taxation system to maintain the attractiveness of biofuels and renewables, making it economically beneficial to switch to fuels with a low carbon content.

I-11.Rail Electrification

Policy Package		Policy Name	Contents
I-11.Rail electrification	Development	Promotion of electrification	Promote the percentage of electrification of rails

I-12.Ecological Driving

National System

Policy Package		Policy Name	Contents
I-12.Ecological Driving	Development	Speed limitation	There is a maximum speed limit on all roads of 80km/h with lower speed limits where appropriate.
I-12.Ecological Driving	Development	Monitoring systems for speed limitation check	Monitoring systems to be set up to ensure speed limits are respected with fines for those that exceed them.
I-12.Ecological Driving	Development	Driving license test for ecological driving	Ecological driving skills as part of the driving license test.

National and Local System

Policy Package		Policy Name	Contents
I-12.Ecological Driving	Development	Speed limitation	There is a maximum speed limit on all roads of 80km/h.
I-12.Ecological Driving	Development	Speed limitation in certain local area	Local schemes encouraged with speed limits of 20 km/h in residential areas and other sensitive locations (e.g. schools and shopping streets).
I-12.Ecological Driving	Development	Monitoring systems for speed limitation check	Monitoring systems to be set up to ensure speed limits are respected with fines for those that exceed them, increased use of ICT to facilitate reduced speeds.
I-12.Ecological Driving	Development	Design low speeds into layouts	Local authorities encouraged to design low speeds into layouts of town centres, residential and shopping areas.
I-12.Ecological Driving	Development	Driving license test for ecological driving	Ecological driving skills as part of the driving license test.

I-13.Congestion Relief

Policy Package		Policy Name	Contents
I-13.Congestion Relief	Development	Low speed zones in residential areas.	Low speed zones (20-40 km/h) in residential areas.
I-13.Congestion Relief	Development	Environmental zones reserved for clean, slow speed vehicles	Environmental zones reserved for clean, slow speed vehicles.
I-13.Congestion Relief	Development	Parking supply	Supply parkings

I-14.Air Fuel Efficiency Improvement

Policy Package		Policy Name	Contents
I-14.Air fuel efficiency improvement	Development	Air fuel efficiency improvement	Enhance air fuel efficiency

I-15.Ship Fuel Efficiency Improvement

Policy Package		Policy Name	Contents
I-15.Ship fuel efficiency improvement	Development	Ship fuel efficiency improvement	Enhance ship fuel efficiency

B.1.2 Shift Policy Packages

S-1.Bus/BRT Usage Promotion (Passenger) and S-2.Bus/BRT Infra Development (Passenger)

Long Distance Travel Substitution - High Speed Train and Coach

Policy Package		Policy Name	Contents
Car Ownership	Development	Improved public transport and taxi services	Improved public transport and taxi services.
ICT and Travel		Integration of public transport	Improved integration of public transport, semi-public transport (taxis, etc.), car rental, car sharing and car pooling with the help of integrated information, booking and payment systems.
Long Distance Travel Substitution	Development	Better interconnectivity of public transport modes	Full integration of booking and ticketing of all public transport modes to allow better interconnectivity.
Long Distance Travel Substitution	Development	Coach lanes	Exclusive coach lanes on the motorway network.
Long Distance Travel Substitution	Development	Restrictive policies concerning airport expansion	Further restrictive policies concerning airport expansion.

Short Distance Travel Substitution - High Speed Train and Coach

Policy Package		Policy Name	Contents
Car Ownership	Development	Improved public transport and taxi services	Improved public transport and taxi services.
ICT and Travel		Flexibility in local public transport	More flexibility in local public transport (responsive buses, etc.) with the help of information systems.
ICT and Travel		Integration of public transport	Improved integration of public transport, semi-public transport (taxis, etc.), car rental, car sharing and car pooling with the help of integrated information, booking and payment systems.
Long Distance Travel Substitution	Development	Coach lanes	Exclusive coach lanes on the motorway network.
ICT and Travel		Separated lanes and absolute priority	Separated lanes and absolute priority for public transport in traffic regulation.
Liveable Cities	Development	Improved conditions for walking, cycling and public transport	Radically improved conditions for walking, cycling and public transport.
Liveable Cities	Development	Land-use planning supporting decentralised concentration, functional mix, neighbourhood services and public transport	Land-use planning supporting decentralised concentration, functional mix, neighbourhood services and public transport.

S-3.Rail/LRT Usage Promotion (Passenger) and S-4.Rail/LRT Infra Development (Passenger)

Long Distance Travel Substitution - High Speed Train and Coach

Policy Package		Policy Name	Contents
Car Ownership	Development	Improved public transport and taxi services	Improved public transport and taxi services.
ICT and Travel		Integration of public transport	Improved integration of public transport, semi-public transport (taxis, etc.), car rental, car sharing and car pooling with the help of integrated information, booking and payment systems.
Long Distance Travel Substitution	Development	Better interconnectivity of public transport modes	Full integration of booking and ticketing of all public transport modes to allow better interconnectivity.
Long Distance Travel Substitution	Development	Restrictive policies concerning airport expansion	Further restrictive policies concerning airport expansion.
Long Distance Travel Substitution	Development	Linking airports with the rail network	Linking airports with the rail network to allow substitution of air by rail.
Long Distance Travel Substitution	Development	Investment in UK high speed rail network	Investment in UK high speed rail network and in upgrading existing lines.

Short Distance Travel Substitution - High Speed Train and Coach

Policy Package		Policy Name	Contents
Car Ownership	Development	Improved public transport and taxi services	Improved public transport and taxi services.
ICT and Travel		Flexibility in local public transport	More flexibility in local public transport (responsive buses, etc.) with the help of information systems.
ICT and Travel		Integration of public transport	Improved integration of public transport, semi-public transport (taxis, etc.), car rental, car sharing and car pooling with the help of integrated information, booking and payment systems.
ICT and Travel		Separated lanes and absolute priority	Separated lanes and absolute priority for public transport in traffic regulation.
Liveable Cities	Development	Improved conditions for walking, cycling and public transport	Radically improved conditions for walking, cycling and public transport.
Liveable Cities	Development	Land-use planning supporting decentralised concentration, functional mix, neighbourhood services and public transport	Land-use planning supporting decentralised concentration, functional mix, neighbourhood services and public transport.
Long Distance Travel Substitution	Development	Investment in UK high speed rail network	Investment in UK high speed rail network and in upgrading existing lines.

S-5.Ship Usage Promotion (Passenger) and S-6.Ship Infra Development (Passenger)

Long Distance Travel Substitution – Ship

Policy Package		Policy Name	Contents
Long Distance Travel Substitution	Development	Better interconnectivity of public transport modes	Full integration of booking and ticketing of all public transport modes to allow better interconnectivity.

S-7.Rail Usage Promotion (Freight) and S-8.Rail Infra Development (Freight)

Long Distance Travel Substitution - High Speed Train and Coach

Policy Package		Policy Name	Contents
Long Distance Travel Substitution	Development	Investment in UK high speed rail network	Investment in UK high speed rail network and in upgrading existing lines.
Long Distance Travel Substitution	Development	Better interconnectivity of public transport modes	Full integration of booking and ticketing of all public transport modes to allow better interconnectivity.
Long Distance Travel Substitution	Development	Restrictive policies concerning airport expansion	Further restrictive policies concerning airport expansion.
Long Distance Travel Substitution	Development	Linking airports with the rail network	Linking airports with the rail network to allow substitution of air by rail.

S-9.Ship Usage Promotion (Freight) and S-10.Ship Infra Development (Freight)

Long Distance Travel Substitution – Ship

Policy Package		Policy Name	Contents
Long Distance Travel Substitution	Development	Better interconnectivity of public transport modes	Full integration of booking and ticketing of all public transport modes to allow better interconnectivity.

B.1.3 Avoid Policy Packages

A-1.Pricing Regimes

Pricing Regimes - City and Motorway Road Pricing

Policy Package		Policy Name	Contents
Pricing Regimes	Pricing	Parking charge	Parking charges to relate to location and activity with zero charges for off-road parking at home and increasing rates for all other activities.
Pricing Regimes	Pricing	Congestion charge	Promotion of a congestion charge in cities and selected motorways.
Pricing Regimes	Pricing	Incentives to high occupancy and load factors	Incentives to increase occupancy and load factors to offset the costs of road pricing to user.
Pricing Regimes	Pricing	Revenue neutral scheme	Reductions in other forms of charges for using the car to ensure that the scheme is revenue neutral.

Pricing Regimes - National Road Pricing Scheme

Policy Package		Policy Name	Contents
Pricing Regimes	Pricing	Parking charge	Parking charges to relate to location and activity with zero charges for off-road parking at home and increasing rates for all other activities.
Pricing Regimes	Pricing	CO2 emission charge	Promotion of a CO2 emissions charge related to type of vehicle and distance travelled.
Pricing Regimes	Pricing	Incentives to high occupancy and load factors	Incentives to increase occupancy and load factors to offset the costs of
Pricing Regimes	Pricing	Revenue neutral scheme	The national scheme would be revenue
Long Distance Travel Substitution	Development	Tax on air fuel	Tax on air fuel, moderate, but increasing over time.

A-2.ICT

Use of ICT and Travel (Passenger Travel)

Policy Package		Policy Name	Contents
ICT		Communication systems	Promotion of integrated logistical systems - an IT system is established for facilitating the exchange of logistics related information. It should serve as an infrastructure for the operation of integrated logistics systems by companies or networks. This will be particularly important for the survival of small transport companies and the logistic efficiency of small producing companies.
ICT		Mileage-related taxes	Introduction of mileage-related taxes for freight vehicles - tax levels that effectively raise road transport costs. Taxes may depend on time of the day or geographical area. Realised directly through Policy Package of Pricing Regimes, but technically this can be realised with ICT developments such as GPS.
ICT		Public investment in additional infrastructure	Public investment in additional infrastructure (tracks and intermodal nodes).
ICT		Local traffic regulation	Local traffic regulation, giving priority to professional home-delivery and coordinated urban distribution with clean vehicles.

Use of ICT and Travel (Freight Travel)

Policy Package		Policy Name	Contents
ICT		Communication systems	Promotion of integrated logistical systems - an IT system is established for facilitating the exchange of logistics related information. It should serve as an infrastructure for the operation of integrated logistics systems by companies or networks. This will be particularly important for the survival of small transport companies and the logistic efficiency of small producing companies.
ICT		Mileage-related taxes	Introduction of mileage-related taxes for freight vehicles - tax levels that effectively raise road transport costs. Taxes may depend on time of the day or geographical area. Realised directly through Policy Package of Pricing Regimes, but technically this can be realised with ICT developments such as GPS.
ICT		Public investment in additional infrastructure	Public investment in additional infrastructure (tracks and intermodal nodes).
ICT		Local traffic regulation	Local traffic regulation, giving priority to professional home-delivery and coordinated urban distribution with clean vehicles.

A-3.Teleactivities

Policy Package		Policy Name	Contents
Teleactivities		Internet and mobile technology	Encouragement of the use of the internet and mobile technology to help reduce travel frequency and distance.
Teleactivities		Awareness raising campaigns	Awareness raising campaigns to inform users about the substantial potential benefits.
Teleactivities		Involvement of industry	Involvement of industry in looking at ways to use the technology creatively to reduce the overall level of transport activity to all types of facilities.

A-4.Travel Plans

Policy Package		Policy Name	Contents
Travel Plans	Development	Travel plans ・Workplace travel plans ・Teleworking ・School travel plans ・Individual marketing ・Car clubs ・Better cycling facilities ・Incentive to walk more	Travel plans established for all major traffic generating and attracting activities in local authority areas, with clear targets and means to achieve them - travel plans are focused on achieving travel reduction and CO2 reduction targets.
Travel Plans	Development	Discussion for travel plans	Individuals are also included through local discussion forums to explore the potential for travel blending and personalised travel planning to reduce CO2 emissions.
Long Distance Travel Substitution	Development	Promotion of local destinations for leisure travel	Promotion of local destinations for leisure travel.

A-5.Car Ownership

Policy Package		Policy Name	Contents
Car Ownership	Development	Efficient niche cars	Continued growth in car ownership with efficient niche cars dominating multi-car ownership households.
Car Ownership	Development	Car ownership reduction	Reduced levels of car ownership, particularly in towns and cities.
Car Ownership	Development	Replacement of ownership with car clubs, rental and sharing schemes	Replacement of ownership with car clubs, rental and sharing schemes. Priority access and parking for those participating in car clubs, rental and sharing schemes.
Car Ownership	Development	Car free area	Certain areas of the city to become car free.
Car Ownership	Development	Investment in high quality cycling facilities and networks	Investment in high quality cycling facilities and networks to reduce the need to own and use a car in the city.
Car Ownership	Development	Improved public transport and taxi services	Improved public transport and taxi services.

A-6.Improved Travel Awareness

Policy Package		Policy Name	Contents
Improved Travel Awareness	Development	Travel awareness initiative	Much more ambitious funding and resources are required for travel awareness initiative.
Improved Travel Awareness	Development	Education programmes on grobal warming	Education programmes at schools designed to raise awareness about issues relating to global warming – this should be a key element in the national curriculum.
Improved Travel Awareness	Development	Education programmes on choices and options available of transport.	University courses on sustainable urban development and transport – to educate urban planners, transport planners, decision makers and business people about the choices and options available.
Improved Travel Awareness	Development	CPD programmes	CPD programmes for NGOs and community groups as well as refresher courses for those involved in city planning and transport.
Improved Travel Awareness	Development	Evening classes and serious TV (and internet) programmes	Evening classes and serious TV (and internet) programmes to raise awareness and help people gain skills to reorganise their activities with lower levels of CO2 use.
Improved Travel Awareness	Development	Research and development to reduce energy input to production	Research and development to reduce energy input to production and the use of energy in the lifetime of that product, and to ensure recycling at the product life end.

A-7.Freight Transport Subsidiarity

Policy Package		Policy Name	Contents
Freight Transport Subsidiarity	Development	Promotion of ‘regional’ consumer markets	Promotion of ‘regional’ consumer markets - Governments at all levels can promote regional consumer markets by improving public awareness and information, by introducing the notion of flexible subsidiarity in internal market regulations, and by promoting adequate distribution structures through land use planning.
Freight Transport Subsidiarity	Development	Promotion of company networking and industrial districts	Promotion of company networking and industrial districts - Networking and local sourcing can be encouraged by development policies at all levels. Incentives, facilitation and the provision of specialised infrastructure (technology and training centres for example) can be promoted.
Freight Transport Subsidiarity	Development	Information system on the “CO2 content” of all goods	Information system on the “CO2 content” of all goods - Parallel to the introduction of EMAS3, a European system for tracing and declaring the embedded transport costs in terms of the CO2 in all products (in tkm by different modes) would be established within 10 years.
Freight Transport Subsidiarity	Development	Labels with declaration of regional origin	Labels with declaration of regional origin - Easier to introduce would be a labelling of end consumer products concerning their regional origin. Such labelling could be made compulsory within five years.
Freight Transport Subsidiarity	Development	Environmental impact assessment for major political decisions	Environmental impact assessment for major political decisions – This could be introduced at all political levels and include statements of the lifetime use of CO2 in the project.
Freight Transport Subsidiarity	Development	Differentiated road pricing and increases in road transport costs	Differentiated road pricing and increases in road transport costs (policy package 3) would allow the costs of road freight transport in particularly sensitive areas or corridors to be substantially raised.
Freight Transport Subsidiarity	Development	Exchange of knowledge and information	Public procurement could be revised so that the exchange of knowledge and information is favoured, while flows of goods would be contained in the spirit of subsidiarity.

A-8.Freight Dematerialisation

Policy Package		Policy Name	Contents
Freight Dematerialisation	Development	Incentives for rental and sharing of goods and services	Give incentives for rental and sharing of goods and services: tax and other polices aimed at encouraging hardware investments should be linked to incentives for organisational forms that allow most intensive use of equipment. Legal frameworks for service contracting could be improved.
Freight Dematerialisation	Development	Shift tax burden from labour to materials, energy and emissions of CO2.	Shift tax burden from labour to materials, energy and emissions of CO2. Moves in this direction can already be observed in various other European countries. European co-ordination in this respect, especially concerning taxes on energy and co-ordinated waste policies could be very helpful.
Freight Dematerialisation	Development	Shift development policy priorities towards human resources	Shift development policy priorities (including structural funds) towards human resources: Improving the capability of mutual learning, of cooperation and of thinking in terms of optimal service delivery would become the main focus of development policies at all levels. To enhance cross-cultural learning in this respect and to pioneer in setting new priorities could be an important contribution of European Structural Funds.
Freight Dematerialisation	Development	Responsibility of manufacturers	Introduce product responsibility of manufacturers for the whole life cycle: Manufacturers of all kinds of end products should be made responsible for all recycling, dismantling or disposal costs of their products also after use. This would lead to more responsible technology development and to more service-oriented marketing strategies.
Freight Dematerialisation	Development	Revision of standards affecting material consumption	Revise standards which affect material consumption (cars and building).

A-9.Urban and Landuse Planning

Liveable Cities – Avoid

Policy Package		Policy Name	Contents
Liveable Cities	Development	Strategic urban planning and design	Strategic urban planning and design.
Liveable Cities	Development	Urban design focused on reducing the need to travel	Urban design focused on reducing the need to travel.
Liveable Cities	Development	Progressive reduction of space available for cars	Progressive reduction of space available for cars.
Liveable Cities	Development	Promotion of car-pooling, car sharing and car rental	Promotion of car-pooling, car sharing and car rental.
Liveable Cities	Development	Land-use planning	Land-use planning supporting decentralised concentration, functional mix, neighbourhood services and public transport.
Liveable Cities	Development	Upgrading of local urban facilities, amenities and recreational areas	Upgrading of local urban facilities, amenities and recreational areas.

Liveable Cities – Shift

Policy Package		Policy Name	Contents
Liveable Cities	Development	Strategic urban planning and design	Strategic urban planning and design.
Liveable Cities	Development	Improved conditions for walking, cycling and public transport	Radically improved conditions for walking, cycling and public transport.
Liveable Cities	Development	Land-use planning supporting decentralised concentration, functional mix, neighbourhood services and public transport	Land-use planning supporting decentralised concentration, functional mix, neighbourhood services and public transport.
Liveable Cities	Development	Upgrading of local urban facilities, amenities and recreational areas	Upgrading of local urban facilities, amenities and recreational areas.

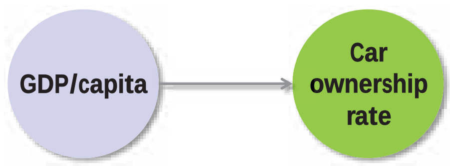
A-10.Fuel Price (10%) and A-11.Fuel Price (25%)

Policy Package		Policy Name	Contents
Fuel price	Development	Oil prices $60 a barrel	Oil prices $60 a barrel Pump price per litre = 100p
Fuel price	Development	Oil prices $80 a barrel	Oil prices $80 a barrel Pump price per litre = 135p
Fuel price	Development	Oil prices $100 a barrel	Oil prices $100 a barrel Pump price per litre = 170p

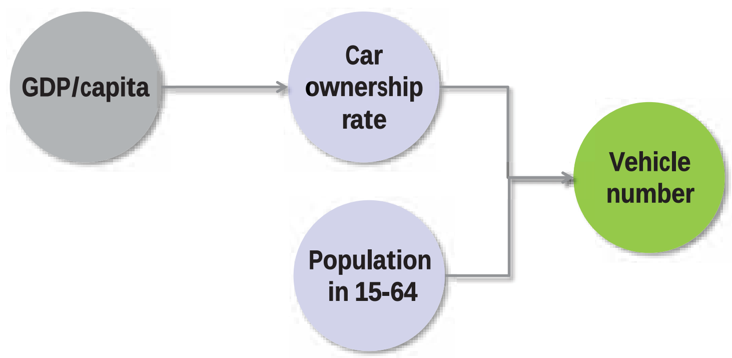
B.2 Causal Relationship between Societal Factors and Transport

B.2.1 Trend for Future Transport

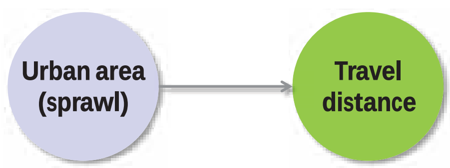
Car ownership rate



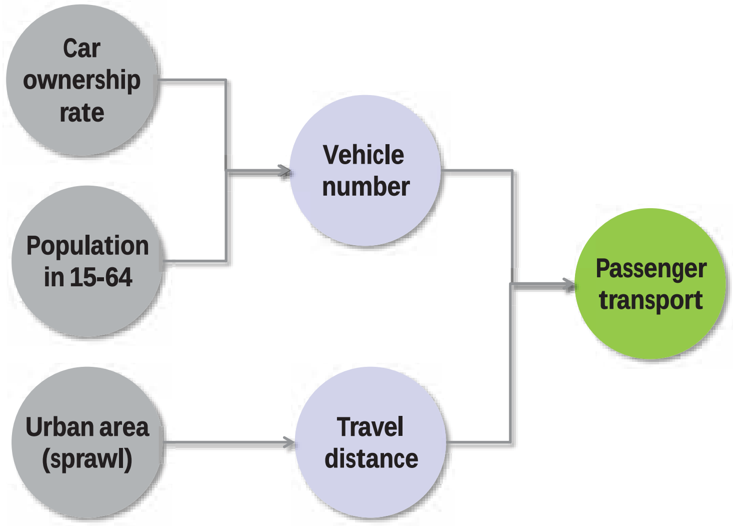
Vehicle number



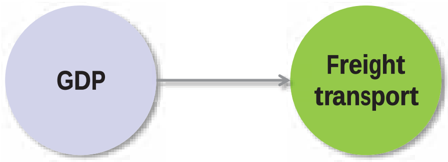
Travel distance



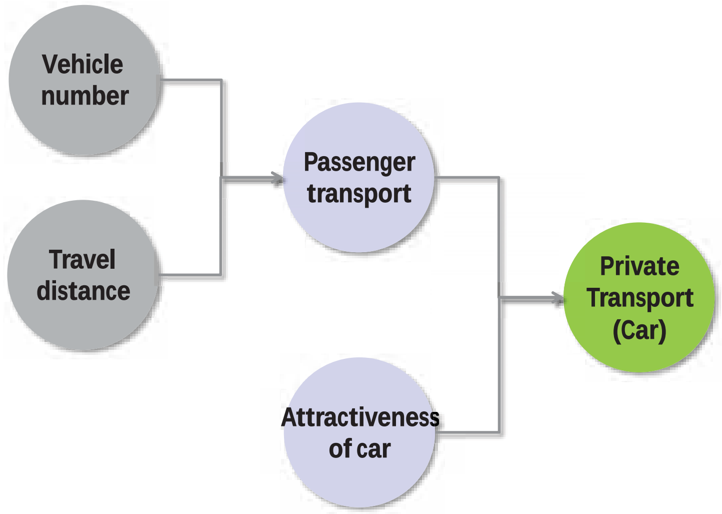
Passenger transport



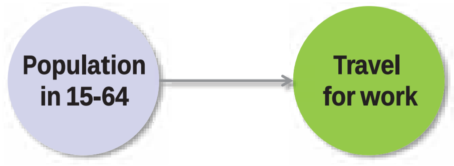
Freight transport



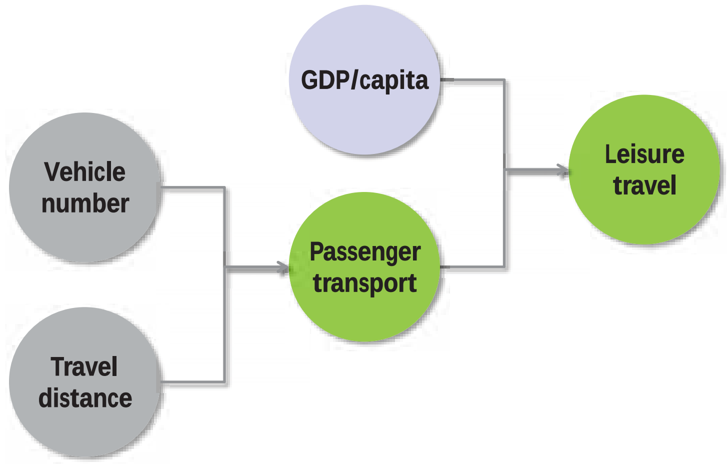
Private transport (Car)



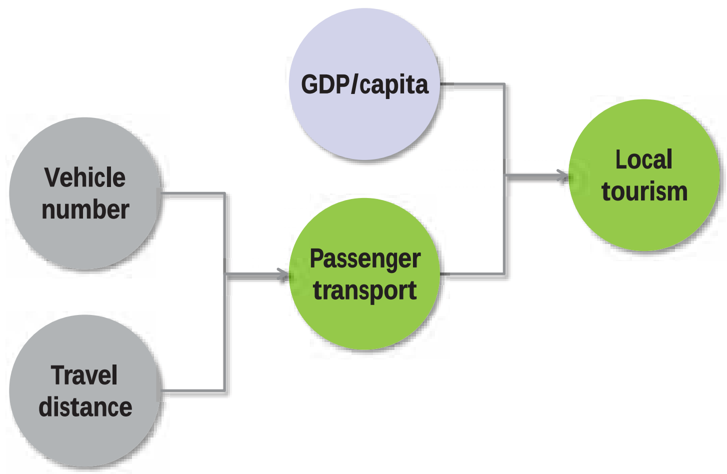
■ Travel for work



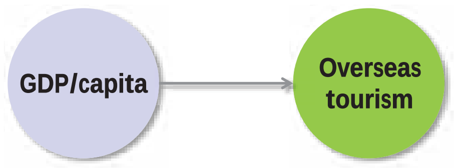
■ Leisure travel



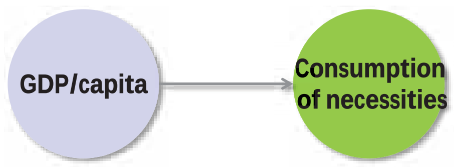
■ Local tourism



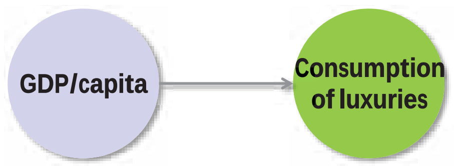
■ *Overseas tourism*



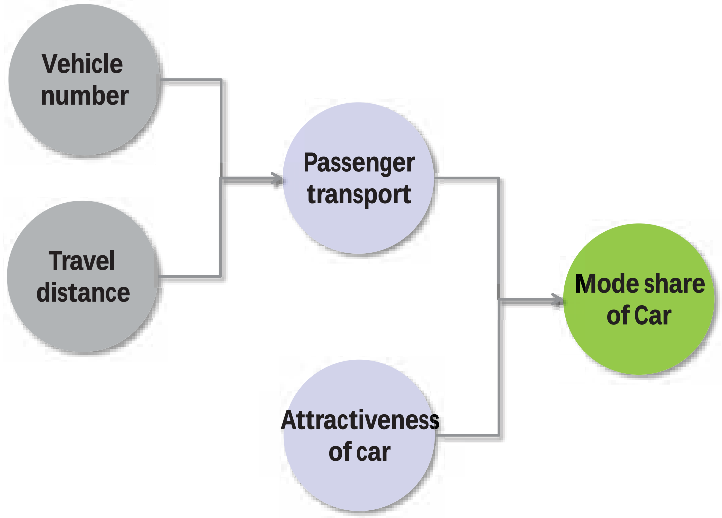
■ *Consumption of necessities*



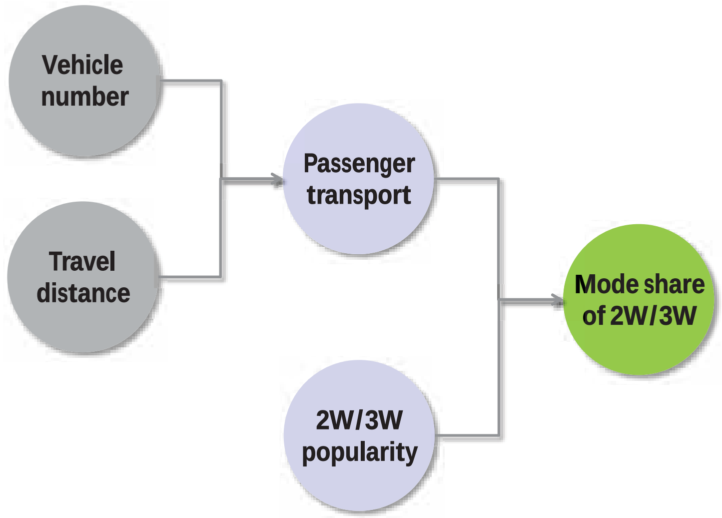
■ *Consumption of luxuries*



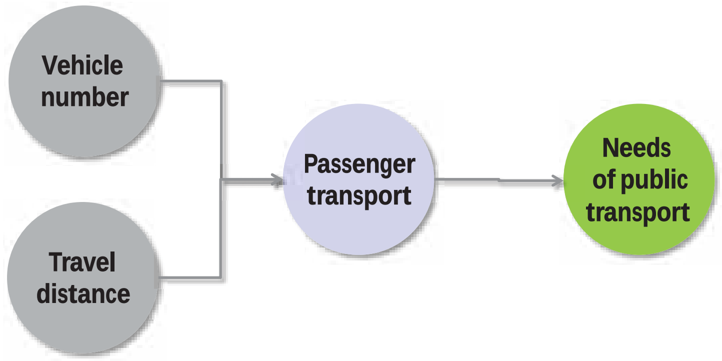
■ *Mode share of Car*



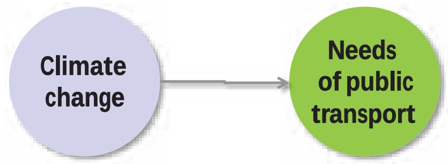
■ *Mode share of 2W/3W*



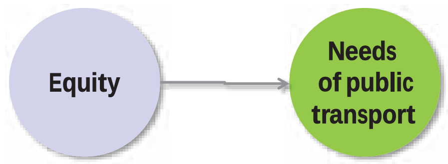
■ *Needs of public transport (efficiency)*



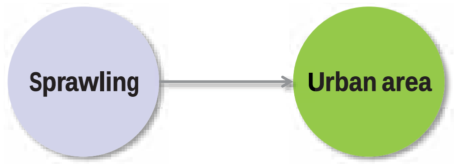
■ *Needs of public transport (environment)*



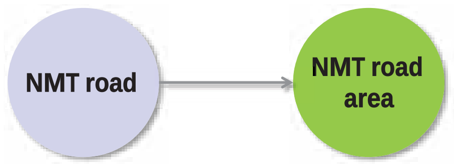
■ *Needs of public transport (equity)*



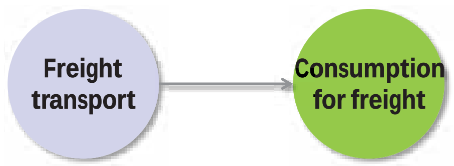
■ Urban area



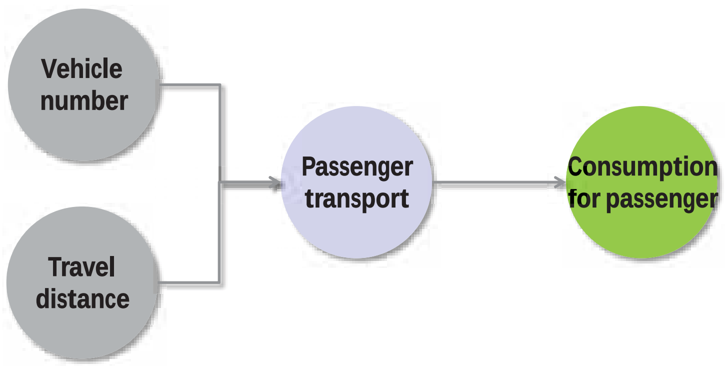
■ NMT road area



■ Consumption for freight

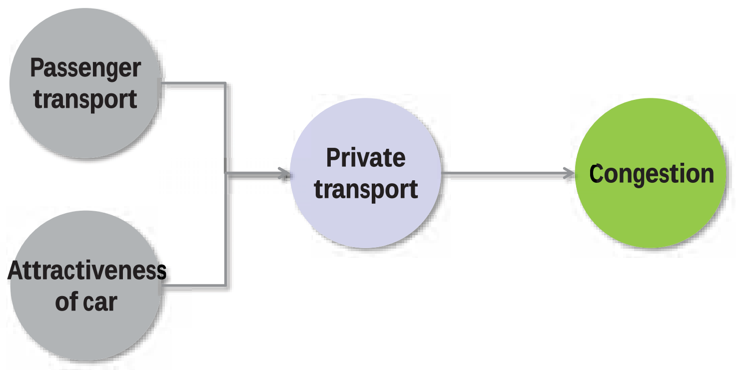


■ Consumption for passenger

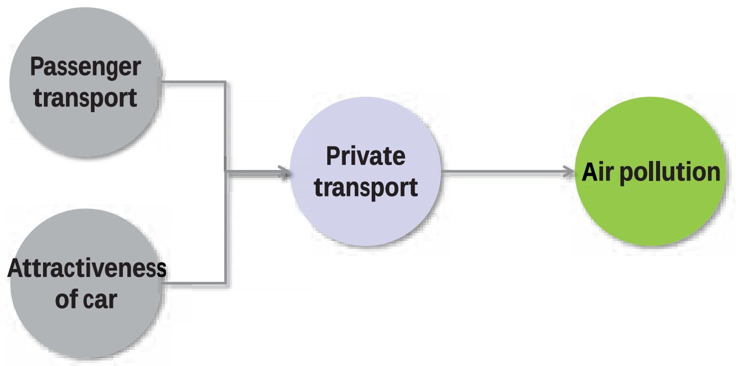


B.2.2 Issues and Challenges of Future Transport

■ *Economic efficiency (Congestion)*

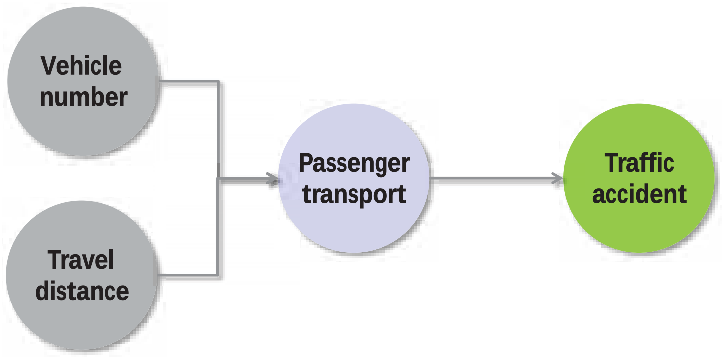


■ *Environment (Air pollution)*

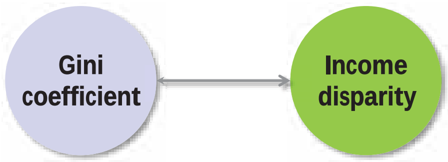


■ *Livelihood*

■ Traffic accident



■ Equity

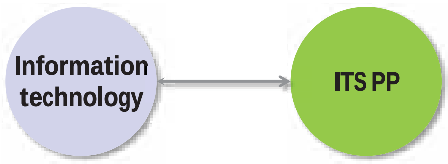


■ Economic growth

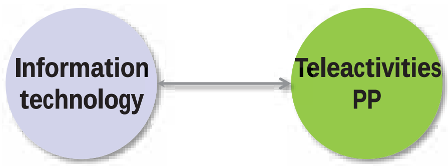
B.2.3 Avoid Policy Packages

■ *Pricing Regimes PP*

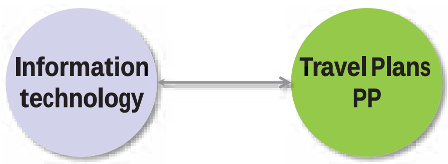
■ *ITS PP*



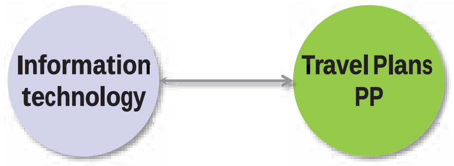
■ *Teleactivities PP*



■ *Travel Plans PP*



Travel Plans PP



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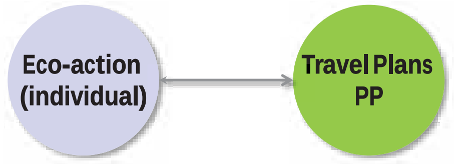
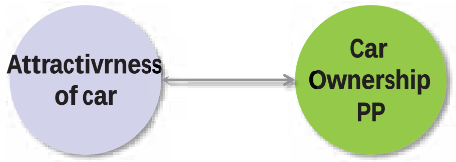
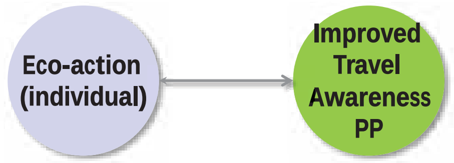


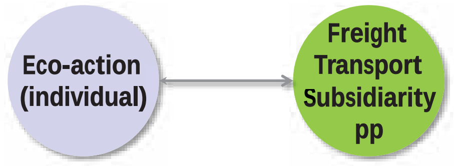
Car Ownership PP



Improved Travel Awareness PP

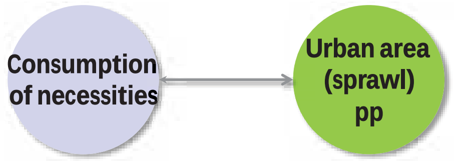


Freight Transport Subsidiarity PP



Freight Dematerialisation PP

Urban and Landuse planning PP



Appendix C

Country Report
(Full Report)

Indonesia

Prepared by
Prof. Danang Parikesit
Mr. Damantoro
Mr. Yusa Cahya Permana

LIST OF ABBREVIATIONS

ASEAN:	Association of South East Asian Nation
BAU:	Business as usual
CAA:	Clean Air Asia
EV:	Electric vehicle
GDP:	Gross Domestic Product
GHG:	Green House Gas
ITPS:	Institution for Transport Policy
MP3EI:	Economic Masterplan
MP3KI:	Poverty Reduction Masterplan
NAMA:	National Appropriate Mitigation Action
RAD GRK:	Provincial Action Plan for Reducing Green House Gases
RAN GRK:	National Action Plan for Reducing Green House Gases
RPJMN:	National Medium Term Development Plan
RPJPN:	National Long Term Development Plan
TTW:	Tank to Wheel
UNFCCC:	United Nations Framework Convention on Climate Change

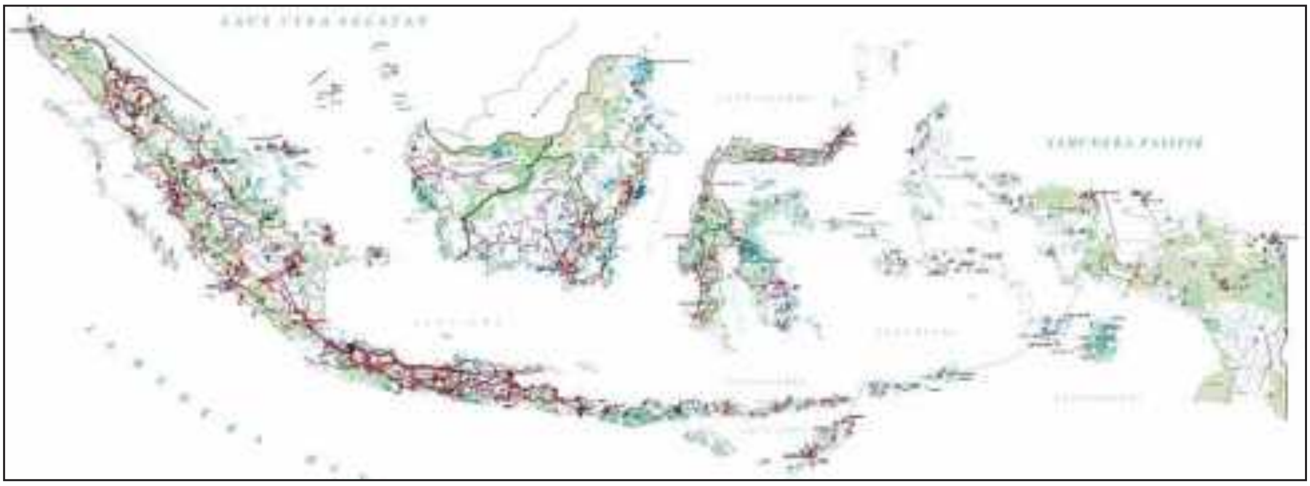


Figure 1. Indonesia

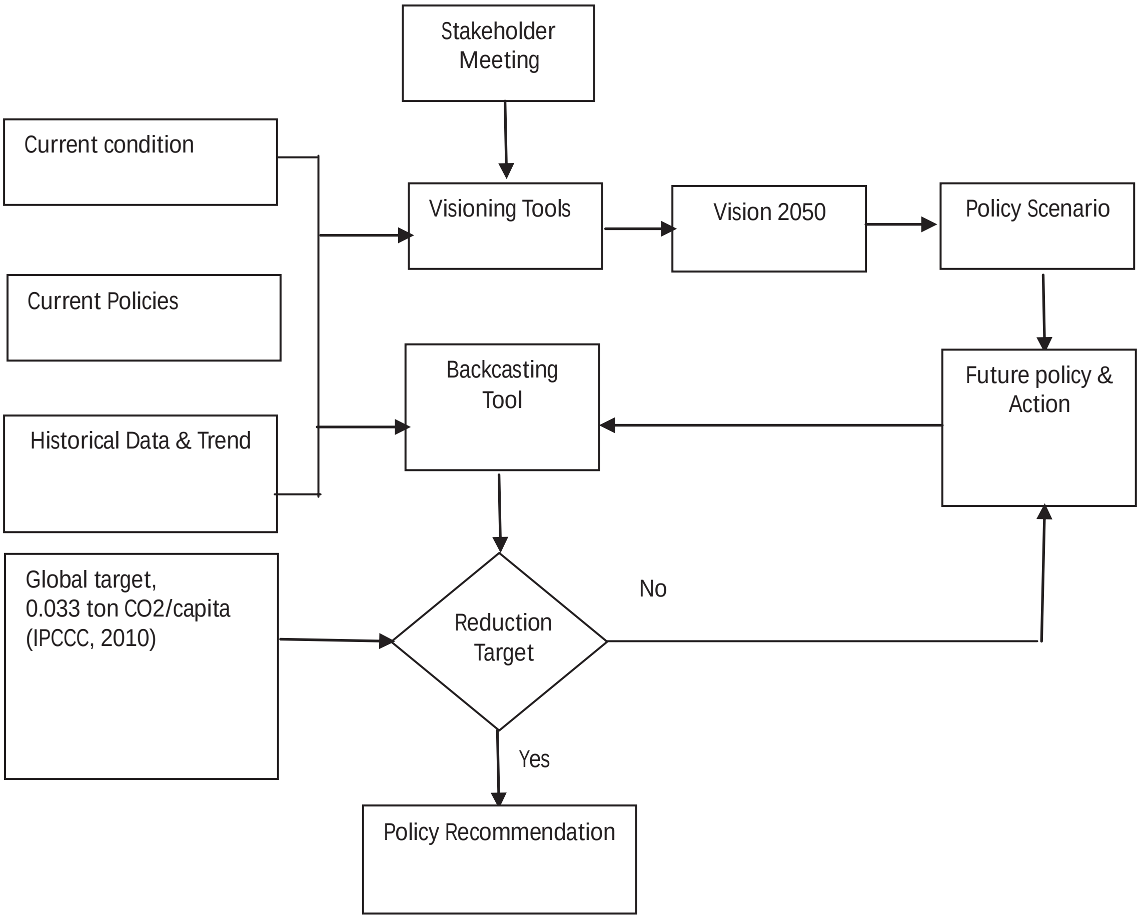


Figure 2. Explanation of Methodology (Flowcharts) Used in the Development of the Action Plan

1. Society

1.1 Present Situation

1.1.1 Economy

High economic growth over the past decade that supported by strong domestic consumption and developing service sector was mainly taken place in Java which in turn attracting more investment and employment to the island.
In 2012, Indonesia is the biggest economy in ASEAN region and 17thbiggest in the world by GDP, dominated by household expenditure (MGI, 2013, BPS, 2013). Economy grew by average 5.2 percent per year from 2000 to 2010 with service sector becoming dominating engine of growth (MGI, 2012). Since 2005, the domination of industry sector in the economic growth has been replaced by service industry (Bappenas, 2013). Java continues as the economic center contributing 57.63 percent of GDP, which dominated by secondary and tertiary economic sector.

Source: BPS, 2013

Source: McKinsey Global Institute, 2012

Figure 3. GDP by Expenditure and by Contributing Sector

As a result, growing number of middle income class and decreasing trend of poverty and unemployment rate. Indonesia now has 135 million middle income class or equal to 60 percent of total population with average income of USD 3.850 per capita (BI, 2013). Unemployment rate continue to decrease to 6 percent in 2012 from total 121 million work force (BPS, 2013), with informal sector absorbing 54 percent of total working force.

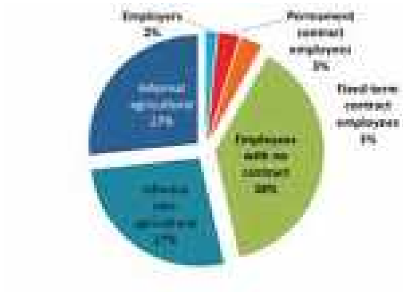
Table 1. Percentage of National GDP Distribution by Region/Island

Region/Island	(%)		
	2010	2011	2012
Sumatera	23.12	23.56	23.77
Java	58.06	57.59	57.63
Bali and Nusa Tenggara	2.73	2.56	2.51
Kalimantan	9.15	9.55	9.30
Sulawesi	4.52	4.61	4.73
Maluku and Papua	2.42	2.13	2.06
Indonesia	100.00	100.00	100.00

Source: BPS, 2012

Source: BPS, 2013

Figure 4. Decreasing Poverty and Unemployment 2006-2012

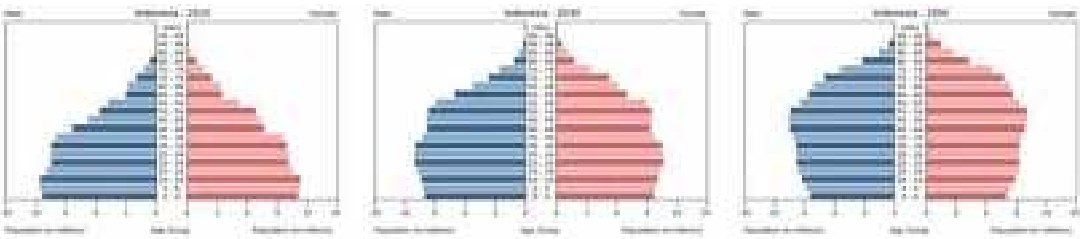


Source: Bappenas, 2013

Figure 5. Employments by Sector

1.1.2 Demography

Indonesia is the fourth largest country by population in the world after China, India and USA with 243.740 million people in 2011 and average growth rate of 1.4 percent from 2000-2010 (BPS, 2013). In term of age, it has young and productive population with 66.13 percent of the people is 15-64 years of age group. Average family size is 4-5 person (BPS, 2013). In 2011, Indonesia reached 72.37 of HDI (BPS, 2013).



Source: Business Innovation partner, 2012 from BPS Data

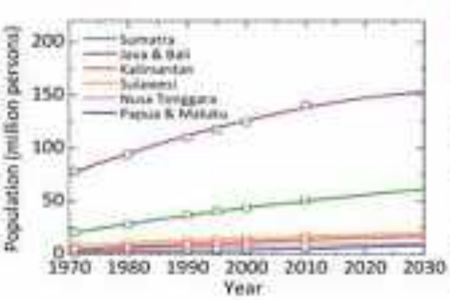
Figure 6. Population Pyramid

Population are concentrated mostly in Java in where 58 percent of total population and creates highest density rate followed by Sumatera with 21 percent of population. Since 2010 more people are living in urban area which in 2012 reaching 54 percent of total population (Kompas, 2012).
Domestic long lifetime migration in urban (17.2) is three times as high as migrant in rural area (6.3) that mostly are men. Riau, Jakarta and East Kalimantan are among provinces with highest rate of long lifetime migration. According to national census in 2010, most of the reasons for this type of migration were better employment, job seeking, and school opportunity.

Table 2. Population Distribution in Main Islands

Island	Percent Area	percent Population
Java	6.8	57.5
Sumatera	25.2	21.3
Sulawesi	9.9	7.3
Papua	21.8	1.5
Maluku	4.1	1.1

Source: BPS 2013



	1999 - 2010	2010-2020	2020-2030
Sumatra	1.4%	1.1%	1.0%
Java	0.9%	0.7%	0.4%
Kalimantan	1.6%	1.3%	1.1%
Sulawesi	1.2%	0.9%	0.7%
Nusa Tenggara	1.2%	0.9%	0.7%
Papua	2.5%	2.4%	2.2%

Source: PSE UGM, 2013 from BPS data

Figure 7. Population Growth Projection by Sub-Region

Most of populations participate in the basic education, leaving only 2 percent of Illiteracy. However, in term of quality of education, Indonesia is still facing challenge to improve school participation rate by reducing number of population above 15 years old who do not finish primary school from 2012 figure of 18.78 percent (BPS, 2012). This can be done by improving school participation rate among 7-18 age group from current level of 61 percent (BPS, 2013). Indonesia has very high school year participation rate for age group 7-15 years old that reach up to 90 percent, but sharply decrease to only 60 percent for age group of 16-18 year old (equal to secondary school level). This is indicating that majority of population only finishing junior high school level (BPS, 2013).

In 2012, the Gini coefficient was 0.4 indicating relatively high inequality of income distribution (BPS, 2013). In 2010, Indonesia people have life expectancy as high as 70.7 years (BPS, 2013).

1.1.3 Social and Culture

According to the stakeholder meeting that study team organized, in addition to economic and demographic variables mentioned above, another important societal aspect would be political stability, social value, rule of law, social cohesiveness, and human capital.

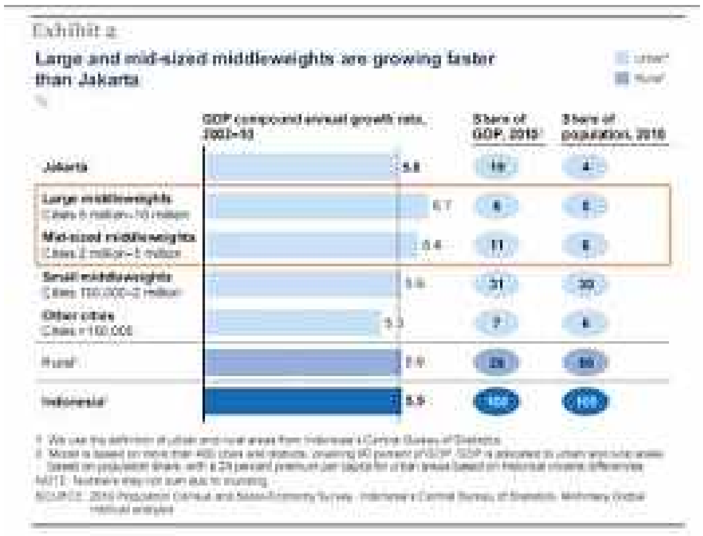
As an impact to change in political landscape, euphoria for freedom among people is escalating and is translated into more open and more egalitarian society. Based on its assessment, Indonesia is among country with poor rule of law performance. In 2010, the World Bank studied that 84 percent of manufacturer companies find difficulty to fill their managerial position, while 69 percent troubled in finding other skilled workers. Indonesia got average 65 percent from maximum score of social cohesiveness according OECD (2012).

1.2 Future Social Scenario

Future Demography

According to the most recent study done by University of Indonesia, in 2050 this country is predicted to have similar rate of population growth reaching approximately 300 million population with big portion of young and productive age group. Due to decline in family planning program, household size will remain between 3 or 4 persons. Though many Indonesian will reach retirement, and phenomenon of aging population will start to take place, such population will likely to be an active group considering their education level and saving. Positive migration from rural to urban will still take place and majority of population live in urban area. With the same population growth rate as of now, Java Island will continue to be the most populated island in Indonesia. The education rate of population will continue to growth with bigger portion of people finishing higher education due to more accessible education.

Due to the length of time horizon vision and many uncertainties along the way. In addition, not all demographic indicators are not utilized in visioning analysis due to availability data to support the correlation between future demography and future transport. There are two possible scenarios for demographic dynamic related to mobility that mainly divided based on geographic distribution of the population. First demographic scenario is business as usual which, population would still concentrated mainly in Java-Bali- Sumatera which are inhibited by 80% of total population. The second scenario would be more well-distributed population across the country. Following the trend on GDP growth rate disparity between Jakarta and medium and small sized cities, it can be predicted that 50% of total population would be live outside Java Bali, and Sumatera. As for total number and urbanization rate, both scenarios will create similar absolute number of total population that would be approximately 300 million people and with 60% of total population are going to live in urban area.



Source: MGI, 2012 from National census 2010

Figure 8. GDP Growth Comparisons between Jakarta and Mid-Small Sized Cities

Future Economy

Given large and productive population, in 2050 Indonesia economy will continue to growth with similar rate as of now. More and more investments is necessarily drowned into manufacturing industry as a balance for extracting industries that still play significant role in current economy and to strengthen income level growth. When Indonesia can escape from middle-income trap situation, the economy will be among the 10th biggest economy in the world with 70 percent of middle income among 300 million populations. Domestic consumption will dominate national

GDP. Due to the decentralization, the distribution of economy activities will be spread across archipelago more evenly. Java will remain as an island with biggest economic activity and locomotive of economic growth. Income per capita may vary from the existing prediction at USD 20.000 to more optimistic prediction at USD 60.000 depending on the distribution of economic activities.

Future Society

As a country, Indonesia will still have its current being as one big archipelago country consists of thousands of island. Absolute social condition will be improved especially in term of health, education, and life expectancy. People will have more capability to access health and education abroad as income growth. Dynamic and mobile urban lifestyle is common lifestyle for the most of population. Technology will continue to develop and enhance social interaction and activity instead of replacing it. Motorized travel activities will continue to growth as income increase. Private vehicle and property remain as social and economic symbols for most of the population except for only a little number of people with high education and experience living abroad.

Disparity in term of income and welfare will remain and become social challenge but with smaller gap due to steady growth of employment opportunity. Due to unique nature of Indonesia people, social cohesiveness will be as strong as it is now. Most people will live in urban area as a result of rapid domestic migration.

Environment awareness will be embraced by people and it is a common practice to protect the environment. Due to land space constrain, urban sprawling will be more intensified with more people will live in high raised residential buildings.

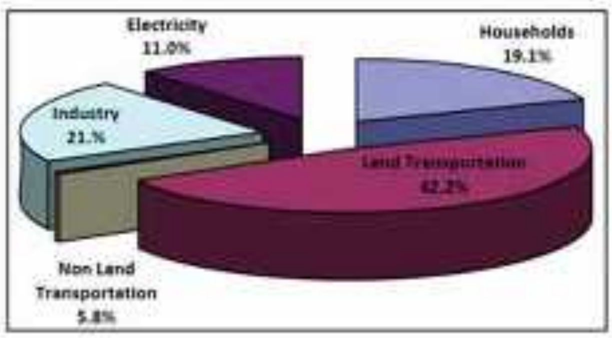
2. Transport

2.1 Present Situation

Economic development across its geographic area. According to the latest National O-D Survey, 81 percent of total national freight movement originated from Java, with 70 percent out of it is intra-Java movement. To change this condition will not only need substantial change in economic and social development pattern but also will take a very long time with very consistent implementation of such agenda.
Therefore, this section focus on transport condition in national level with still bearing in mind that Java and Sumatera are the two dominant islands for the nation. An analysis on regional situation is given as an illustration to show the magnitude transport volume and carbon emission in primary city. In the calculation we use data from Jabodetabek area.

2.1.1 Transport Energy

Transport sector consume 48 percent of total national energy consumption (ICSSR, 2010). While land transport sector absorbs 95.5 percent of oil fuel (Reforminer, 2012). Using 2006 data, Bappenas estimated in 2010 that by 2029, 63.3 percent of total transport emission will be from regional trips, while urban trip will contribute to 24.8 percent total transport emission.



Source: ICCSR, 2010

Figure 9. Energy Consumption by Subsector

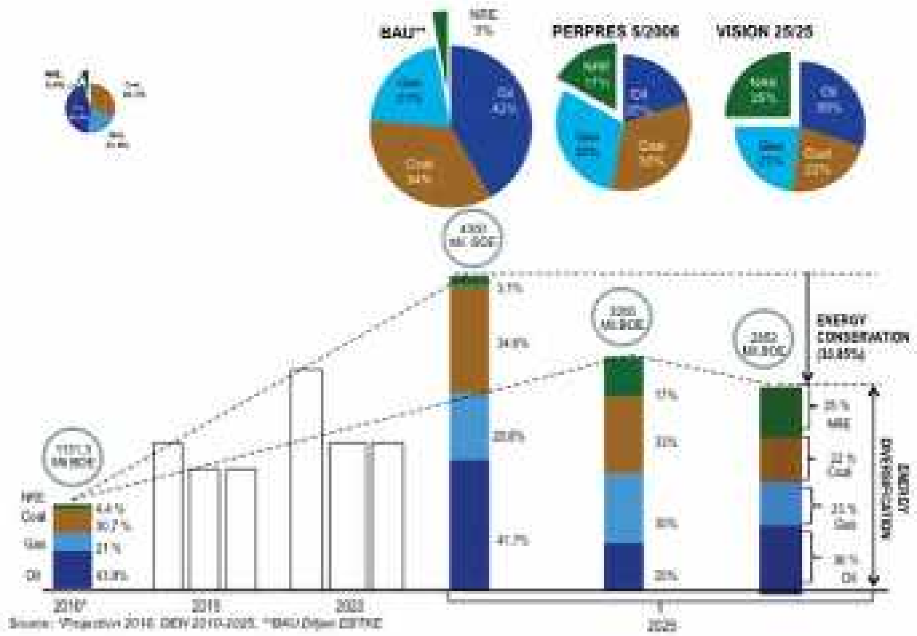


Figure 10. Energy Share Projection

Table 3. Estimation of CO2 Proportion Based in Travel Type in Indonesia (2006 data)

Type	Remarks	CO2 proportion	
		2006	2029
Regional Trips	Based on estimation using transport network model and national origin destination data	80.1%	63.3%[1]
Urban Trips	Derived from Jabodetabek transport network and up scaled for all 23 main cities in Indonesia	15.8%	24.8%
Others	Local transport and idle vehicle	4.1%	12.0%
	Total	100%	100%

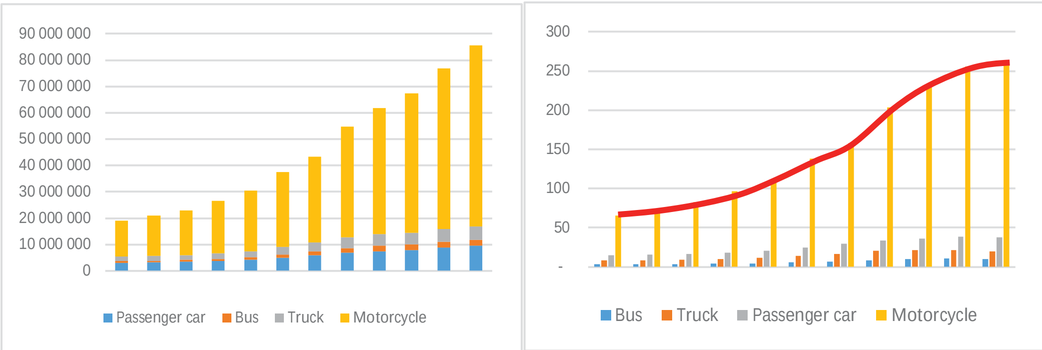
Source: ICCSR, 2010

2.1.2 Land Transport Magnitude and Performance

Indonesia has been experiencing rapid motorization for the past decade as income and urban population increase. Motorcycle built up 82 percent of total 85 million vehicles consist of 9.5 million of passenger car and 68.8 million motorcycle by 2011 (BPS, 2011). In 2012, car sales increased by 24.8 percent from 2011 with total sales was 1.16 million units with MPV and other <1.500 cc class dominating sales (Gaikindo, 2012a; Gaikindo 20120b, GAIKINDO, 2013). This sales trend leads to issuance of new tax cut policy for low cost green car (car less than 1.000 cc) that was expected to generate more car sale (Kemenperin, 2013).

On the other hand, growth of motorcycle sales slowed for the first time. Motorcycle sales in 2012 dropped by 12 percent from 2011 with only 7.06 million sales (AISI, 2013).

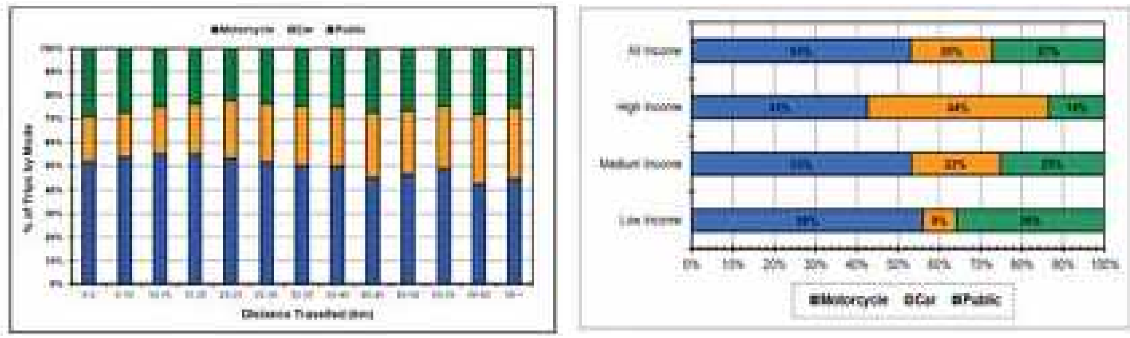
[1] Table 3 shows proportion of CO2 estimated by Bappenas in 2010 based on specific emission modeling design. Each CO2 proportion does not necessarily represent trip proportion of each category since the report did not provide information on vehicle type, fuel type, and especially total trip number and trip km of each trip category.



Source: BPS, 2012

Figure 11. Growth of Vehicle Number and Motor Vehicle Ownership 2000-2011

In term of passenger transport, motorcycle dominates the mode share. From Jabodetabek case, motorcycle dominates all distance trips and is particularly used by low middle income group.



Sourse: JAPTrapis 2011

Figure 12. Daily Mode Share by Distance Travelled and Daily Mode Share by Income Group

Performance

Suhadi (2006) studied vehicle trip distance in four cities and found that what VKT in Indonesian cities is fairly similar to cities in other developing countries. Second finding was that car has longer average distance than motorcycle.

Table 4. Average Annual Trip Distance (km) by City

City	2W	3W	Car	Taxi	Bus	Truck
Jakarta	8,202	17,577	15,000*	46,685	73,172	25,805
Yogyakarta	7,627		15,000*		109,500*	17,413
Medan	5,300		12,791		49,302	28,789
Manado	4,380		15,000*		109,500*	15,216

Source: Suhadi, 2008 * Adjusted

Study by JICA in 2011 assesed average annual trip distance by mode and income groupin Jabodetabek. The study showed increase in trip distance as income raise with car as the longest mode travel.

Table 5. Trip Length (km) Distribution by Mode of Travel (Intra Jabodetabek Trip)

Mode of Travel	Average Trip Length of Inter-zonal Trips (km)			
	Low Income	Medium Income	High Income	All Income Groups
Motorcycle Trips	15.9	13.8	13.3	14.3
Car	17.6	16.6	16.1	16.6
Public Transport	15.2	13.6	13.3	14.1
Small Trucks				23.4
Large Trucks				25.0

Source: JAPTraPIS, 2011

In 2012, MoT surveyed average vehicle speed in 55 cities. Bandung has the lowest speed with only 14.3 0 km/h. The data also confirm that speed decrease as city grows bigger.

Table 6. Peak Hour Average Speed (km/hr)

City	Bandung	Bogor	Depok	Bekasi	Tangerang	Bodetabek
Km/h	14.3	15.32	21.40	21.86	22.00	20.12
City	Surabaya	Medan	Makassar	Semarang	Palembang	Metro City
Km/h	21.00	23.40	24.06	27.00	28.54	24.80

Source: Perhubungan dalam Angka, 2013

2.2 Future Transport Scenario (Accordance with Economic and Societal Scenario)

Development of technology will be adapted to fulfill the future mobility demand but may not radically change the pattern of the mobility itself. Thus, future mobility pattern will not extremely differ from current conditions even though the distance, frequency and the mode of transportation may change due to technology development.

More efficient urban mobility as a result of integration between public transport infrastructure and land use development, less dependency on road base transportation mode and more usage of environmental friendly private vehicle technology with stringent emission and fuel economy standard.
Given the size of urban population and economic agglomeration, future transport should be dominated by efficient urban and interisland transport.
In the urban transport, in order to have more efficient mobility, public transport system and sufficient transport infrastructure should be sufficiently provided in urban area. Considering current rapid motorization, Indonesia will likely to have much higher car ownership rate in 2050. However, due to current severe congestion and chocking air pollution, awareness and general practice of environment protection will increase in the future, resulting of increasing demand for more environmental friendly vehicle technology such as higher emission and fuel economy standard.

In term of interisland movement, to serve escalating interisland economic activity, freight transport should be dominated by more efficient domestic rail and sea transport. The use of freight railway system across main islands (Java, Sumatera, Kalimantan, Sulawesi, and Papua) should have bigger portion than what it is now. Domination of sea transport toward more efficient interisland freight transport.

Considering the current share of transport emission, dilapidating domestic oil reserve and increase of international oil price, share of renewable energy should be increased up to more than 25 percent from total transport energy mix which is higher than current government target for 2025. In order to do so, the development of renewable energy and other energy alternative for oil should be supported by more appropriate energy pricing policy toward more equal playing field for all type for transport energy. Long before 2050, fuel subsidy will be replaced by fuel tax.

Table 7. Present and Vision Transport Condition

No	Item	Present	Vision
1	Transport Energy	Dominated by oil fuel	25 percent share of renewable energy
2	Urban Transport Performance	High fuel inefficiency, high accident rate, high transportation cost 10-17 km average urban daily trip 10-21 km/h average speed Declining share of public transport Low average vehicle speed	More efficient transport 10-15 km >30 km/h average speed More efficient mobility
3	Transport Emission*	80% Regional transport, 15% Urban transport, 4% others	63% Regional transport, 24% Urban transport, 12% others
4	Transport mode share	Domination of motor cycle	Domination of motor cycle but smaller proportion to total caused by increase number of car
5	Transport system	Dominated by road based transport	Increase role of rail, sea, and air transport
6	Transport infrastructure	Dominated by road infrastructure	More development of rail infrastructure, sea port, and airport
7	Vehicle Technology	Domination of fuel combusting engine technology	Higher use of hybrid and electric vehicle for both car and motorcycle
8	Inter-island movement	Dominated by road based transport	More integrated multi modal inter-island transport
9	Freight Transport	90% road based transport domination	Increase of rail and sea transport in freight movement

*ICCRS, 2010

3. Policies to Reduce CO2 Emission and Long Term Action Plan

The Indonesia country study report focus on two objectives. First objective is to develop visioning tool based on the existing data to better understand future condition of Indonesia society as a basis for visioning Indonesia transport condition in 2050. The second objective is to develop backcasting tool to evaluate mitigation policy by simulating its impact on transport carbon emission reduction.

Climate change issues have been addressed as major national challenge and its mitigation actions have been included in all development agendas (RPJP, RPJMN, and MP3EI). As a consequence, the study incorporates all development policy related to mitigation action in the business as usual (BAU) scenario.

On the other hand, the Government of Indonesia pledge to mitigate GHG emission by 26 percent by 2020 in 2009, and issued RAN GRK in 2011 followed by RAD GRK in 2012. Both RAN and RAD GRK was developed based on current development agenda/program and serve as a center piece of mitigation scenario for Indonesia.

RAN GRK serve as national policy which was developed by central government, and RAD GRK serve as sub-national policy developed by provincial government based on RAN GRK actions and local development agenda. Both policies are complementary and together will achieve the ultimate reduction target of 26 percent.
Given the fact that Indonesia government has issued RAN and RAD GRK, the study team use backcasting tool to evaluate reduction impact of these policies on future transport GHG emission. Since both policies were designed to achieve national target, it is more strategic to focus backcasting tool simulation and analysis on national level. Thus the result can be used to assess whether the RAN/RAD GRK will achieve national target. Based on the result, the study will determine whether improved mitigation scenario (additional to RAN/RAD GRK) is needed.

While RAN GRK will influence the reduction scenario. as for emission from the region, the analysis will use RAD GRK. In this case DKI Jakarta was selected as the region that can further complete its action under “Improved RAN” scenario as the ultimate scenario of mitigation.

In addition to national level assessment, study team also provides assessment for sub-national region. Again, this analysis objective is to assess reduction impact of policy taken. The study team selected Jakarta as a region representative due to its transport condition and its capacity to implement all mitigation actions in the RAN GRK. Similar to the national level, the result will determine required improved mitigation scenario.

3.1 National

3.1.1 Policy: RPJP and RPJMN, MP3EI, and RAN GRK

RPJP & RPJMN

RPJP and RPJM are development plan that covers guidance and target for long term (25 years, RPJP) and medium term (5 years, RPJM) period driven by political agenda. One of the targets is addressing climate change issues including in transport sector, thus it pose significant influence to carbon emission level.

The five year planning period of RPJMN will create interruption on the mitigation action. Especially for the five yearly RPJMN, the political agenda of the elected president will significantly influence target, priority, and implementation of mitigation action. Therefore, it is important not only to review the carbon emission level in the 2005 and 2050. It is also important to review it every 5 years (to accommodate RPJMN) and every 25 years (to accommodate RPJP).

This sequential economic development also underlined the importance of BT ability to accommodate sequential policy application.

Table 8. Possible Impact of RPJM 2010-2014

No	Policies	Possible Effects
1	Economic growth 6.3 – 6.8% p.a	- Increase of transport demand and activity
2	Development of urban public services infrastructure in the metropolitan and large cities.	- Increase urban mobility - Improve urban transport efficiency - Reduce urban transport pollution
3	Development of medium cities and their surrounding small cities	- Increase urban economy - Increase urban and commuting transport
4	Development of Trans Sumatra, Java, Kalimantan, Sulawesi, West Nusa Tenggara, East Nusa Tenggara, and Papua (19,370 km of road infrastructure)	- Increase on private vehicle population and volume (passenger) - Increase on road based public transport population and volume(passenger) - Increase on road based logistic system (population and volume)
5	Construction of integrated inter-mode and inter-islands transportation infrastructure networks	- Increase in inter-island people and goods transportation - Increase of sea transport
6	Implementation of Multimode Transportation Blueprint of the national Transportation System	- Increase of transport efficiency - Reduce transport fuel consumption
7	Enhancement of transportation system and netwo rk in 4 large cities (Jakarta, Bandung, Suraba ya, and Medan)	- More efficient urban transport system - Increase in urban mobility
8	Urban electric railway transportation development (MRT and Monorail)	- Increase in urban public transport trips - More efficient commuting trips
9	Energy savings measures in transport sector	- Increase the use of energy efficiency vehicle - Decrease fuel consumption
10	the use of natural gas as fuel material for urban public transportation in Palembang, Surabaya, and Denpasar	- Increase the use of CNG - Increase number of CNG vehicle
11	Development of transportation infrastructure in Maluku and Nusa Tenggara to support maritime industry	- Increase in sea transport activity - Increase freight movement

Source: Bappenas 2010

MP3EI

MP3EI (Master Plan to Expand and Accelerate Economic Development in Indonesia) is the Indonesian government plan to enhance and promote infrastructure development to speed up economic growth. The overreaching goal of this policy is to develop infrastructure for Indonesia as a developed country by 2025.

Based on this policy, Indonesian government marks several important point to be developed in the transportation sector which should be concerned due to their possible effects on the Indonesia emission level. The policies are as follow:

Table 9. Possible Effect of MP3EI Policies

No	Policies	Possible Effects
1	Promoting the construction and growth of road infrastructure	- Increase on private vehicle population and volume (passenger) - Increase on road based public transport population and volume(passenger) - Increase on road based logistic system (population and volume)
2	Revitalization and promotion of the development of sea and river based transportation for passenger	- Increase on water based transportation volume and modal use
3	Revitalization and promotion of the sea and river based transportation for logistics	- Increase on air transportation volume and modal use (logistic)
5	Increasing and betterment of service in the air transportation sector	- Increase on air transportation volume and modal use (passenger and logistic)
6	Development of rail based transportation system for people's movement and logistic	- Increase on rail based logistic system (population and volume) - Increase on rail based transport population and volume (passenger)
7	Reduction of cost for logistic system	- Higher growth on logistic sector (all modes: road, rail, water and air)

In transportation sector, the MP3EI policy focus on achieving national vision of LOCALLY INTEGRATED, GLOBALLY CONNECTED. This vision is based on the Indonesian government policy to position the transportation sector to

1. Connects economic activities and development centers to maximize the integrated economic development based on inter-modal supply chains systems.
2. Broaden the economic growth by increasing the accessibility from the development centers to the hinterland area.
3. Further spread the benefits of inclusive and welfare based economic development by increasing the accessibility and connectivity to hinterland and international border area.

RAN GRK

The RAN GRK is a national level policy of Indonesian Government to reduce greenhouse gas from five major development sector. The Policy itself covers multiple policies and projects created to improve the reduction of greenhouse gas in concert with the Indonesia's long term development plan.

The policy itself can be explained in the following tables

Table 10. Possible Effect of RAN GRK Policies

No	Policies	Effects
1	Development and implementation of ITS	- Better fuel consumption efficiency - Better travel plan
2	Traffic Impact Control	- Congestion reduction - Emission reduction
3	Congestion Charging and Road Pricing	- Lower private car usage - Reduction of fuel consumption
4	Revitalization of public transport system	- Public transport promotion - Reduction of private vehicle use
5	Development and Application of BRT system	- Increase of BRT infrastructure - Better Passenger share for BRT - Reduction of private vehicle use
6	Development, Application and Promotion of Non-Motorized Transport	- Reduction of fuel consumption - Reduction of motorized vehicle use
7	Revitalization, development and Electrification of railway system	- Reduction of private vehicle use - Reduction of fuel consumption
8	Private car emission standardization, labeling and emission based tax and	- Control over fuel consumption - Better monitoring of energy use
9	Development and application of CNG converter kits	- Reduction of CO2 emission - Promoting the use of CNG
10	Promotion of eco driving and application of speed limitation	- Better fuel efficiency - Better travel awareness

3.1.2 National BAU Perspective

Indonesia, as a developing country with unique socio economic and political condition poses a specific characteristic in term of carbon emission. While some countries may can use historical data for BAU scenario, for Indonesia an adjustment is needed to get more realistic future condition for BAU setting. In addition, since the BAU is using 2010 as a baseline year, this scenario should also consider existing development policies and action plans taken by government that might contribute to GHG emission reduction. Historical data adjustment and policies/actions incorporation in the BAU scenario is very important because as a developing country the growth rate of carbon emission depend so much on government economic development plant that its result will significantly influenced.

Based on this understanding, the Indonesia BAU scenario will be based on the historical data that already set in the Backcasting Tool with some adjustment to incorporate ongoing development policies and actions BAU. This dedicated BAU scenario will be based on the Indonesia's Long and Medium term economic development program. For the Indonesia's case, the BAU is based on the RPJP/RPJMN (Indonesian Long Term and Medium Term Development Plan and MP3EI.

3.1.3 National Reduction Scenarios

There are three packages of policy used for simulation of Indonesia's Condition. Each corresponds to one type scenario explained earlier. It is necessary to recalculate BAU condition due to ongoing short and medium term development plan. The following scenarios and respective policy list for them.

For each packages, the result will be presented according to the policy application sequencing as is provided in the Backcasting Tool. The sequencing are:

a. Shift then Avoid sequence (S->A)

In this sequence the result of shift policies are firstly implemented with keeping BAU transport volume and secondly the result of avoid policies are implemented to reduce transport volume.

b. Avoid then Shift sequence (A-> S)

In this sequence the result avoid policies are firstly implemented to reduce BAU transport demand and then secondly the shift policies are implemented

In the simulation of Backcasting tool, improved policy is assumed as prerequisite policy. Therefore, it always be implemented prior to both shift and avoid policies.

The following table shows comparison of three scenarios used in the simulation i.e. BAU, RAN, and improved RAN. Differences of target and starting implementation year for each action in the policy package can be clearly seen.
The BAU scenario only contains two components of avoid policy package, as this scenario does not put high concern on the reduction of transportation demand. Likewise, it also does not include improvement policy in vehicle energy efficiency through introduction of new vehicle and behavioral change.

The RAN scenario covers five components of avoid policy package and introduction of new vehicle type for improve policy package.

The IMPROVED RAN scenario, which is radical improvement of RAN scenario contain the most advance policy package covers all components of policy package in each scenario. The rationale was that the simulation result of RAN scenario cannot meet reduction target of CO2.

Table 11. Policies List for Each Scenario

POLICY LIST	Year Start			Time lag before effect			Period before full target reached			Target year		
Improve Policies	BAU	RAN	RAN IMP	BAU	RAN	RAN IMP	BAU	RAN	RAN IMP	BAU	RAN	RAN IMP
CNGV mass supply	2010	2010	2010	5	5	5				2015	2015	2015
CNGV Promotion (mainly via economic way)	2015	2015	2015	5	5	5				2020	2020	2020
Hybrid mass supply	2015	2015	2015	5	5	5				2020	2020	2020
Hybrid Promotion (mainly via economic way)	2015	2015	2015	15	15	15				2030	2030	2030
EV mass supply	-	2015	2015	-	5	5				-	2020	2020
EV Promotion (mainly via economic way)	-	2015	2015	-	15	15				-	2030	2030
Biofuel Development	2010	2010	2010	0	0	0				2010	2010	2010
Biofuel Promotion	2010	2010	2010	5	5	5				2015	2015	2015
Rail electrification	2015	2015	2015	30	30	30				2035	2035	2035
Ecological Driving	-	2010	2010	-	-	5	-	-	5	-	-	2025
Ecological Driving	-	2010	2010	-	-	5	-	-	5	-	-	2025
Ship fuel efficiency improvement	2015	2015	2015	5	5	5	30	30	30	2050	2050	2050
Air fuel efficiency improvement	-	-	2015	-	-	5	-	-	30	-	-	2050
Shift Policies	BAU	RAN	RAN IMP	BAU	RAN	RAN IMP	BAU	RAN	RAN IMP	BAU	RAN	RAN IMP
Bus/BRT usage promotion (Passenger)	2005	2005	2005	5	5	5				2010	2010	2010
Bus/BRT infra development (Passenger)	2010	2010	2010	10	10	10				2020	2020	2020
Rail/LRT usage promotion (Passenger)	2010	2010	2010	5	5	5				2015	2015	2015
Rail/LRT infra development (Passenger)	2015	2015	2015	10	10	10				2025	2025	2025
Ship usage promotion (Passenger)	2015	2015	2015	5	5	5				2020	2020	2020
Ship infra development (Passenger)	2015	2015	2015	10	10	10				2025	2025	2025
Rail usage promotion (Freight)	2010	2010	2010	5	5	5				2015	2015	2015
Rail infra development (Freight)	2015	2015	2015	10	10	10				2025	2025	2025
Ship usage promotion (Freight)	2015	2015	2015	5	5	5				2020	2020	2020
Ship infra development (Freight)	2015	2015	2015	10	10	10				2025	2025	2025
Avoid Policies	BAU	RAN	RAN IMP	BAU	RAN	RAN IMP	BAU	RAN	RAN IMP	BAU	RAN	RAN IMP
Pricing Regimes	-	2015	2015	-	5	5		10	10	-	2030	2030
ICT	2015	2015	2015	0	0	0	-	-	10	2025	2025	2025
Teleactivities	-	-	2015	-	-	0	-	-	0	-	-	2015
Travel Plans	-	-	2015	-	-	5	-	-	0	-	-	2020
Car Ownership	-	-	2015	-	-	5	-	-	0	-	-	2020
Improved Travel Awareness	-	2015	2015	-	5	5	-	5	5	-	2025	2025
Freight Transport Subsidiarity	-	-	2015	-	-	5	-	-	0	-	-	2020
Freight Dematerialization	2015	2015	2015	5	5	5	-	5	5	2020	2025	2025
Urban and Land use planning	-	2015	2015	-	5	5	-	-	5	-	2020	2025
Fuel price (10%)	-	-	2015	-	-	0	-	-	0	-	-	2015
Fuel price (25%)	-	-	2025	-	-	0	-	-	0	-	-	2025
Bioethanol mixing ratio target	BAU	RAN	RAN IMP	BAU	RAN	RAN IMP	BAU	RAN	RAN IMP	BAU	RAN	RAN IMP
5%	2015	2015	2015	0	0	0				2015	2015	2015
10%	2020	2020	2020	5	5	5				2025	2025	2025

Table 12. Energy Share for Each Scenario

MODAL SHARE	Shift Into	Year Start			Target Share			Target year
Modal		BAU	RAN	RAN IMP	BAU	RAN	RAN IMP	All Scenarios
Car	HV-Gasoline	2020	2020	2020	10%	20%	20%	2050
Car	CNG	2030	2030	2030	30%	40%	40%	
LV	HV-Gasoline	2035	2035	2035	10%	20%	20%	
LV	CNG	2020	2020	2020	25%	40%	40%	
SUV	HV-Gasoline	2035	2035	2035	5%	20%	20%	
SUV	CNG	2020	2020	2020	30%	30%	30%	
Bus	HV-Diesel	2035	2035	2035	5%	20%	20%	
Bus	CNG	2020	2020	2020	30%	30%	30%	
BRT	HV-Diesel	2035	2035	2035	20%	20%	20%	
BRT	CNG	2020	2020	2020	60%	60%	60%	
Rail	Electricity(Rail)	2015	2015	2015	30%	30%	30%	
Car	EV	-	2035	2035	-	10%	10%	
LV	EV	-	2035	2035	-	10%	10%	
SUV	EV	-	2035	2035	-	10%	10%	
2W/3W	EV	-	2035	2035	-	30%	50%	
Truck	HV-Diesel	2035	2035	2035	10%	10%	10%	
Truck	CNG	2020	2020	2020	30%	30%	30%	
Trailer	HV-Diesel	2035	2035	2035	5%	5%	5%	
Trailer	CNG	2020	2020	2020	30%	30%	30%	

The table above explains target of energy share for each scenario. These targets were made based on the assumed results from the implementation of each scenario's policies. Some important points from the table are:

1. The EV energy share in the BAU does not exist because there is no policy mentioning about electric vehicle in the BAU scenario.
2. There is almost no difference between RAN and IMPROVED RAN scenario; this is based on the assumption that the conversion of energy is largely dependent on the socio economic condition. Based on the assumption that social economic condition between RAN and RAN IMPROVED scenario is relatively similar then it is assumed that energy share will be relatively similar.
3. The significant difference between RAN and RAN IMPROVED scenario is in 2W/3W. This was based on the assumption that government will take extra effort to promote electric 2W/3W vehicle as more affordable conversion, and the fact that 2W/3W have the highest population growth which then pose potentially high CO_2 emission if it is not being handled properly.

Shown below is target for modal share for each BT scenario. From the people's mobility point of view, the target for the modal share was to lower the share of private vehicle and increase the public transport share. The private vehicle is represented by 2W/3W, Car, LV, SUV while the public transport represented by rail, bus, BRT. From the freight perspective, the target is to lower the dependency on land and air transport, thus the modal share target are shifts from land or air transport to sea or rail transport.

Table 13. Modal Shift and Share for Each Scenario

MODAL SHIFT		Target Percentage			Target Year
From	To	BAU	RAN	RAN IMP	
Car, LV, SUV	Rail	10%	15%	45%	2050
Car, LV, SUV	Bus, BRT	4%	8%	20%	2050
2W/ 3W	Rail	6%	10%	45%	2050
2W/ 3W	Bus, BRT	8%	8%	20%	2050
Bus/BRT	Rail	15%	30%	40%	2050
Truck/ trailer	Ships	10%	15%	25%	2050
Truck/ trailer	Train	10%	10%	35%	2050
Air	Ships	-	6%	10%	2050
Air	Train	-	6%	10%	2050

As can be seen from the table above, there are gradual improvements of shift from BAU to RAN scenario. The modal shift in BAU scenario is using relatively conservative prediction with relatively low percentage of change from private vehicle to public transport , for example the   Car, LV, SUV to Rail is set at 10% which is quite optimistic value for current condition.

The RAN scenario in other hand is the improvement of BAU scenario, but due to the nature of RAN scenario which does not provide radical change of the condition thus the predicted modal share is not significantly different from BAU scenario.

The RAN IMPROVED scenario is devised as radical improvement over BAU scenario to meet the reduction target. The high percentage of modal share is set as a required target if the per capita and total CO2 reduction is to be able to meet the target (0.33 Ton for per capita emission).

3.1.3.1 Scenario I BAU (RPJP/RPJMN+MP3EI)

Even though the MP3EI and RPJP/ RPJMN only cover 25 years planning, for the BT simulation we put the vehicle sharing target in 2050 assuming that the effects of 2025 policy can be sustained without any new policy required.

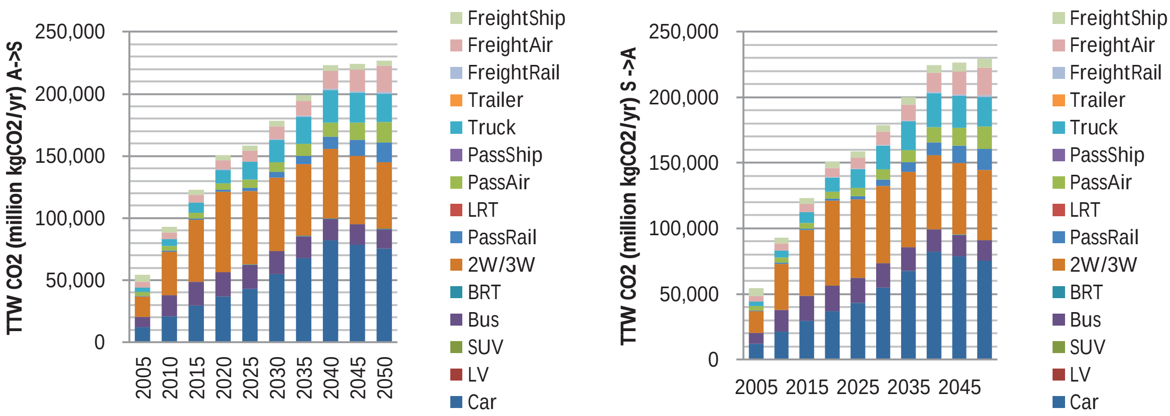


Figure 13. Scenario I Estimation of Total CO2 Emission

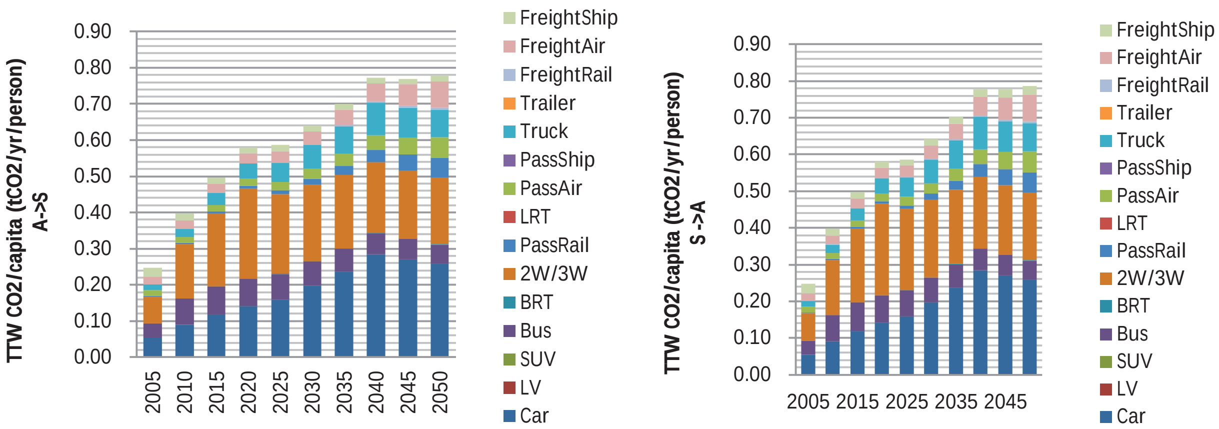


Figure 14. Scenario I Estimation of CO2 Emission per Capita

Important points from the BAU scenario Backcasting Tool simulation are as followed:

1. The Total CO2 emission level wass estimated to get around 158.5 MTon CO2 in 2025 , a threefold higher compared to 2005 figur of about 50 MTon CO2. The figure in 2050 rose to between 227 Mton CO2 and 229 MTon CO2 or almost fivefold compared to 2005 level. The first lower figure is the result of A-> S sequence. Difference in reduction number caused by the implementation of current policies as avoid policy that reduce transportation demand.
2. In general the total CO2 emission rose significantly from 2005 up to 2035 with the emission growth between 10-30 Mton CO2 every five years before entering saturation period where the increase rate of emission is somehow much reduced to around 2 MTon CO2 every five years.
3. Similar emission growth pattern affect CO2 emission per capita. It is predicted that the per capita emission level for the BAU scenario will reach around 0.586 Ton CO2 in 2025 or about twice as high of 2005 level which remain around 0.25 Ton CO2. The figure rose to around 0.78 Ton CO2 per capita in 2050 or three times higher than 2005 level.

3.1.3.2 Scenario II RAN GRK

Similar to MP3EI and RPJP/ RPJMN policies, RAN GRK policy also only cover 25 years of time horizon. In the simulation of BT simulation, the study team put vehicle sharing target in 2050 assuming that the effects of 2025 policy can be sustained without any new policy required. As for 2050 result, we will use the simulation result from 2025.

The main differences between RAN GRK and BAU scenario is the addition of avoid policy and the better share of renewable/ cleaner energy source for travel. For example, HV Gasoline was set at 10% for BAU scenario and 20% for RAN GRK scenario. This addition is based on assumption that people will have much better awareness and government do much better promotion for the use of cleaner energy source.

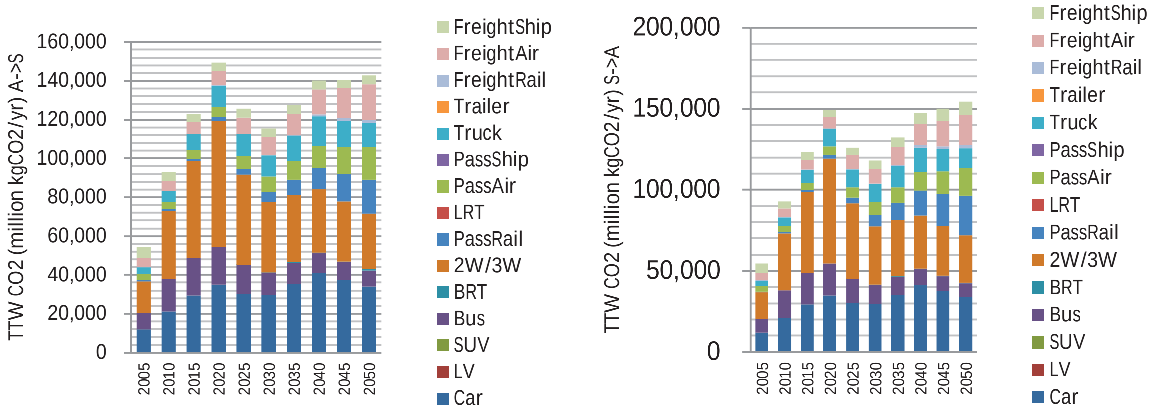


Figure 15. RAN GRK Scenario Estimation of Total CO2 Emission

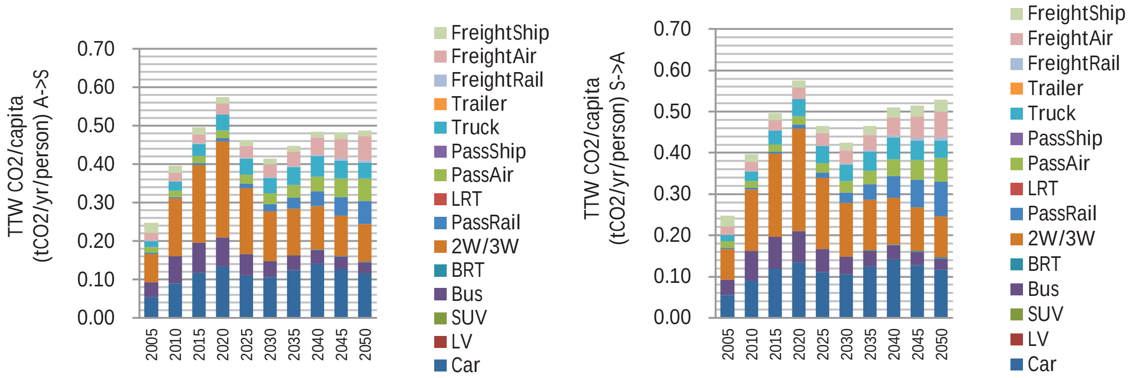


Figure 16. Scenario II CO2 Emission per Capita

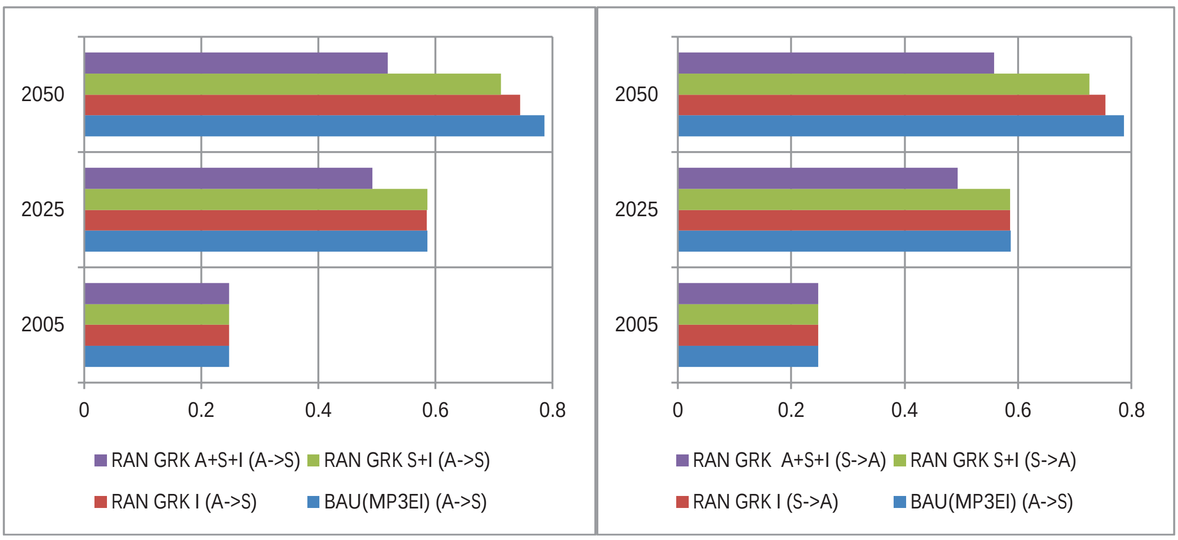


Figure 17. Scenario II A+S+I Implementation Comparison for per Capita Emission

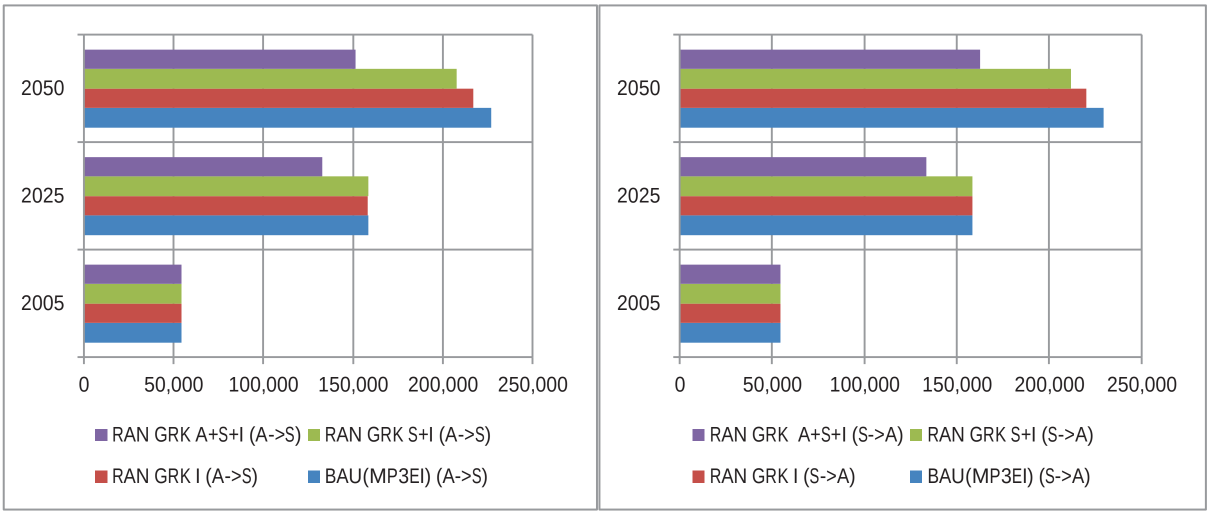


Figure 18. Scenario II A+S+I Implementation Comparison for Total Emission

Important points from the RAN GRK scenario simulation are as followed:

1. By 2025 the RAN GRK will reduce about 26 MTon of CO2 emissions from around 158 MTon down to 133 MTon. Despite of the reduction, the 2025 figure was actually almost three times as high compared to 2005 level at 54 MTon.
2. The 26 MTon reduction of total CO2 emission by 2025 was calculated to be around 16% compared to 2025 BAU. This means that by using current policy package, the RAN GRK scenario will not achieve its 26% reduction target by 2025.
3. RAN GRK will reduce the percapita emission by about 0.1 Ton from 0.58 down to 0.49 Ton.
4. By 2050 , due to increase in people and vehicle population, the total emission level in RAN GRK will increase to around 151- 161 MTon or about the same level of 2025 BAU level . The percapita emission level will increase to around 0.52-0.57 Ton CO2 which is slightly lower to 2025 BAU percapita emission level.
5. There were relatively significant difference of result between A->S and S->A sequence. The avoid first implementation shown better potential in reducing bothin absolute and per capita level.
6. It can be seen in those two scenarios (both A->S and S->A sequence) that the improvements alone will not significantly reduce CO2 emission. It is shown in the graph that the CO2 emission level will only drop significantly after the implementation of avoid and shift policies.

3.1.3.3 Scenario III IMPROVED RAN GRK

In this third scenario the shift from private vehicle to public transport was significantly increased, assuming that the government wills radically improve RAN GRK policies.

The main difference between IMPROVED RAN and RAN scenario was target share for public transportation system that set in higher fashion and much more avoid policies to reduce transportation demand. Such reduction presumably will be achieved through efficiency improvement in energy consumption, reduction of unnecessary travel, and optimization of mobility.

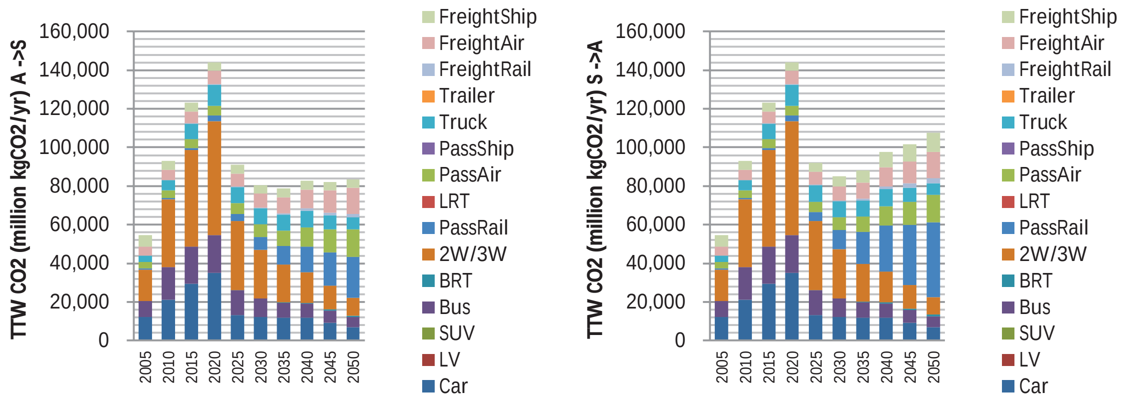


Figure 19. Scenario III Estimation of Total CO2 Emission

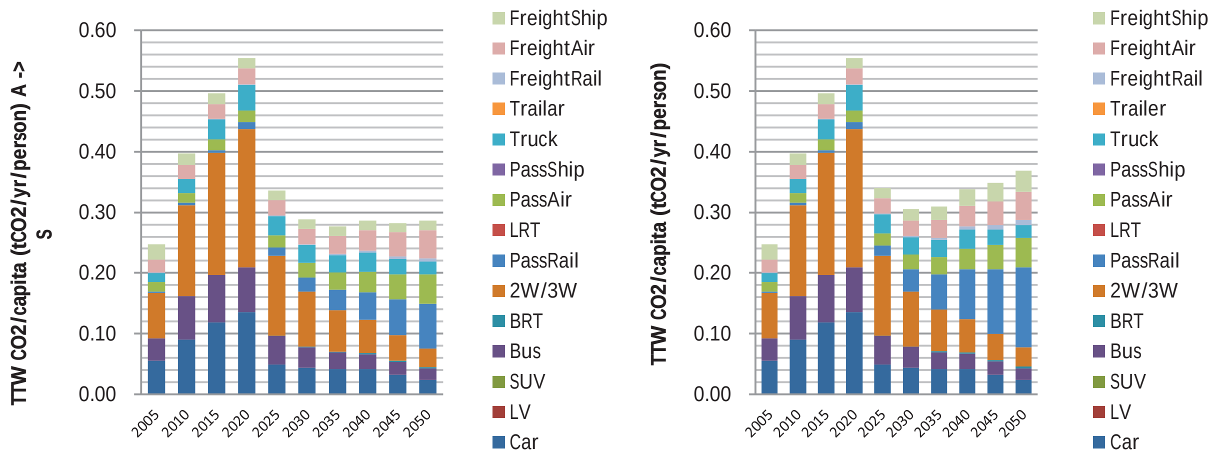


Figure 20. Scenario III Estimation of CO2 Emission per Capita

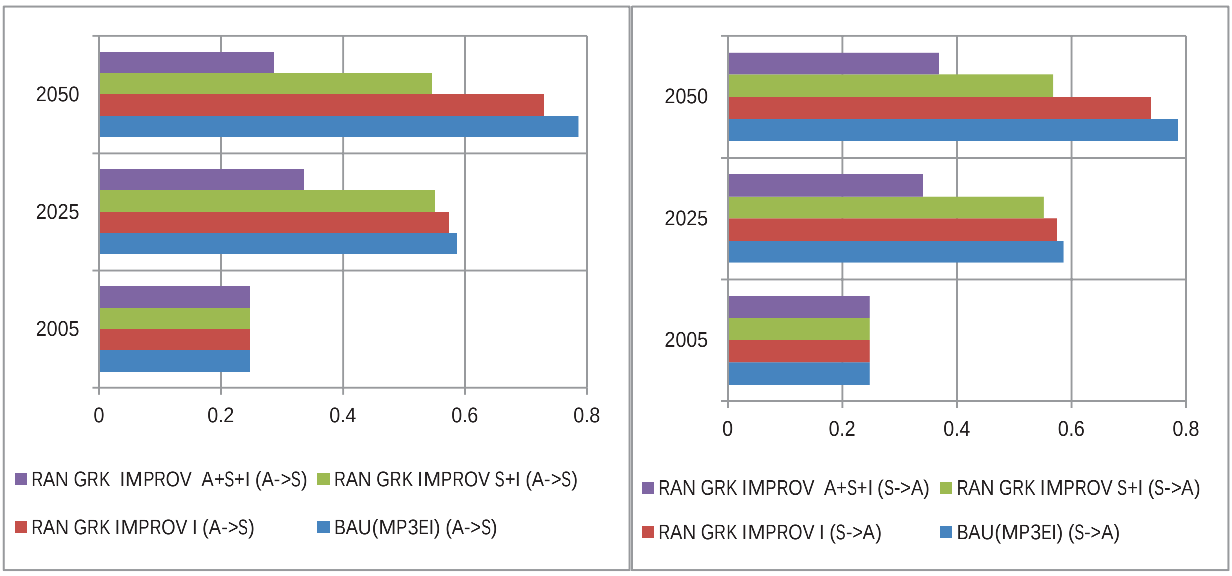


Figure 21. Scenario III A+S+I Implementation Comparison for per Capita Emission

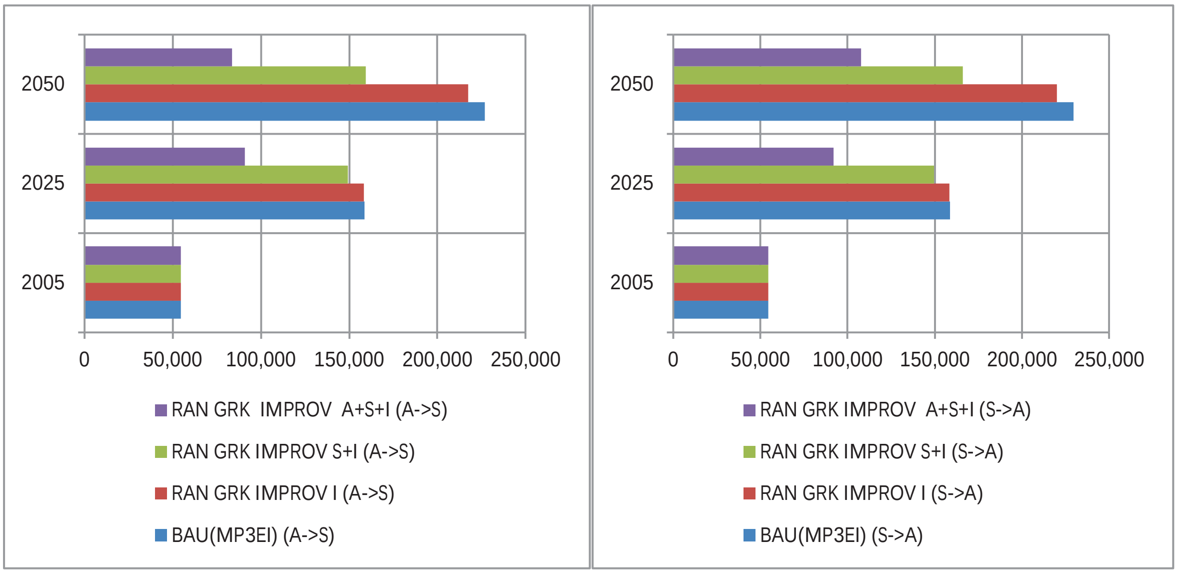


Figure 22. Scenario III A+S+I Implementation Comparison for Total Emission

Important points from the IMPROVE RAN scenario simulation are as followed:

1. IMPROVED RAN scenario should reduce both absolute and percapita CO2 emission by 2025 and 2050.
2. Total CO2 emission decreased significantly to around 83-107 MTon depending on the sequence of avoid –shift policies implementation.
3. Similar to previous scenarios, A->S implementation sequence shows better potential in reducing CO2 emission. Compared to previous scenario, IMPROVED RAN scenario showed higher difference of reduction between A->S and S->A sequence. A->S sequence has 20 MTon lower compared to S->A sequence.
4. An important reminder for this scenario is high patronage of public transportation system for this scenario as major cause of significant CO2 emission reduction.

3.2 Regional

The analysis for region in this country report is using DKI Jakarta Province as the case study for following reasons:

- DKI Jakarta is the only Province that can apply all policy options given in the backcasting tool so the existing RAD GRK can be refined into Improved RAD GRK following Improved RAN GRK scenario.
- Among other cities in Indonesia that may vary in term of actual condition, Jakarta is the only city that can represent the size and the population of primary city to get simulation results.
- The relatively stable local socio, economic and political conditions should enable the scenario policies to be thoroughly applied in the future.

3.2.1 Policy: RAD GRK of DKI Jakarta Province

As is explained previously, the Indonesian Central Government devises the RAN GRK as the national guideline for the national wide greenhouse gas reduction plan. This national level policy needs to be interpreted by the local government for the emulation of local government level greenhouse gas reduction plan. RAD GRK is the results of the local government level interpretation of RAN GRK.
For the DKI Jakarta Province, the interpretation of the RAD GRK during the input on the back casting tool can be

explained in the following table:

Table 14. Possible Impact of RAN GRK

No	Policies	Backcasting Interpretation
1	Congestion Charging	- Pricing regime related policies
2	Monorail and Monorail Related Development	- Railway/ LRT/ Monorail infrastructure development - Railway/LRT/Monorail usage promotion - Urban and land use planning policies
3	Railway and Railway Related Revitalization & Development	- Railway/ LRT/ Monorail infrastructure development - Railway/LRT/Monorail usage promotion - Urban and land use planning policies
4	Improvement of Freight Transport	- Freight transport subsidiary and dematerialization
5	Natural Gas Converter Kit	- Promotion for the use of CNG Vehicle - Supporting policy for CNG Vehicle mass supply -
6	NMT	- Travel plans related policies
7	Traffic Impact Control	- Travel awareness and travel plan related policies - Urban and land use planning policies
8	Intelligent Transport System	- Travel plans and ICT related policies
9	Parking	- ICT related policies
10	Public Transport Improvement	- Promotion on the use of multiple public transport modals including bus, BRT and railway
11	BRT and BRT related development	- Promotion on the use of BRT
12	Smart/ eco driving	- Improved travel awareness policies

As can be seen, the RAD GRK is relatively similar with the central government's RAN GRK Scenario. Indeed, there are some locally applied policies which are not actually planned in the RAN GRK. Those are the travel plan, freight subsidiaries and teleactivity related policies. It is predicted though, that due to the relatively simple and restricted nature of the existing policies, the policies can be omitted to prevent bias in the simulation results.

3.2.2 Regional Business as Usual

The regional Business as Usual condition, which in this case is for the DKI Jakarta Province are based upon the regional definition of the central government's RPJMN/RPJP + MP3EI policies. Due to this condition then the regional BAU for DKI Jakarta Province will use the similar BAU scenario policies with the national level BAU scenario.

3.2.3 Regional Reduction Scenarios

For the regional scope, there are just two scenario, the BAU and Improved RAD scenario. The reason behind this preference is that in order for Indonesia to meet the national level CO2 reduction target the government will need to apply the improved RAN scenario down to regional level. Even though the regional level (RAD GRK) may already able to reach the CO2 reduction down to 33 Ton/capita by 2050, the same may not happened for the national level. Thus it is important for the local government to emulate the regional interpretation of the improved RAN GRK in order to help the central government reaching the national level CO2 reduction target.

3.2.3.1 BAU Scenario

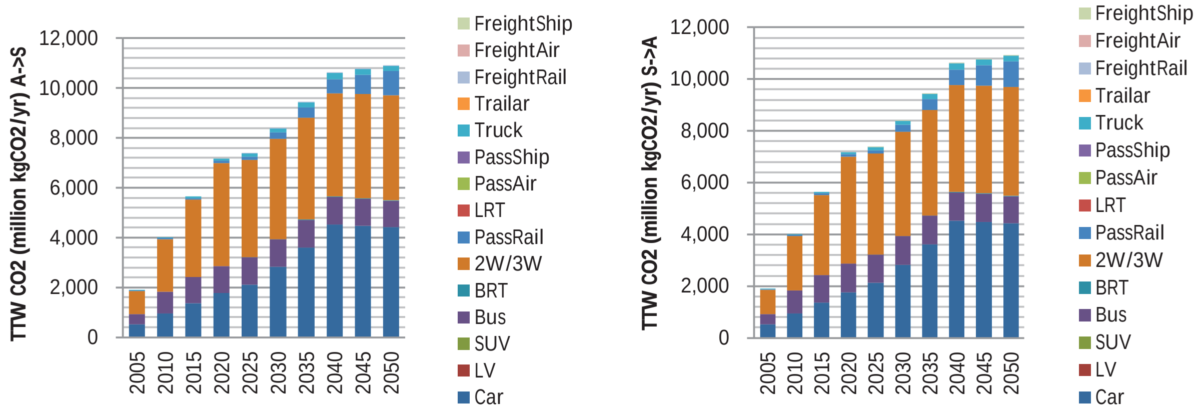


Figure 23. Regional BAU Estimation of Total CO2 Emission

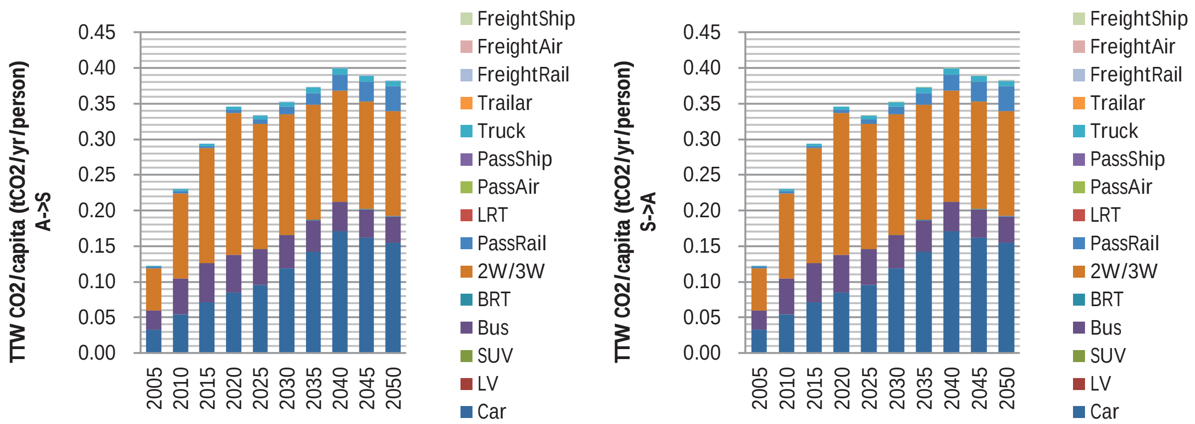


Figure 24. Regional BAU Estimation of CO2 Emission per Capita

As can be seen in the simulation result that:

1. Even in the BAU scenario the per capita emission level is relatively low by 2020 reaching at around 0.34-0.35 Ton per capita.
2. In 2050 the per capita emission level is predicted to stay at around 0.38 Ton per capita

3.2.3.2 Improved RAD GRK Scenario

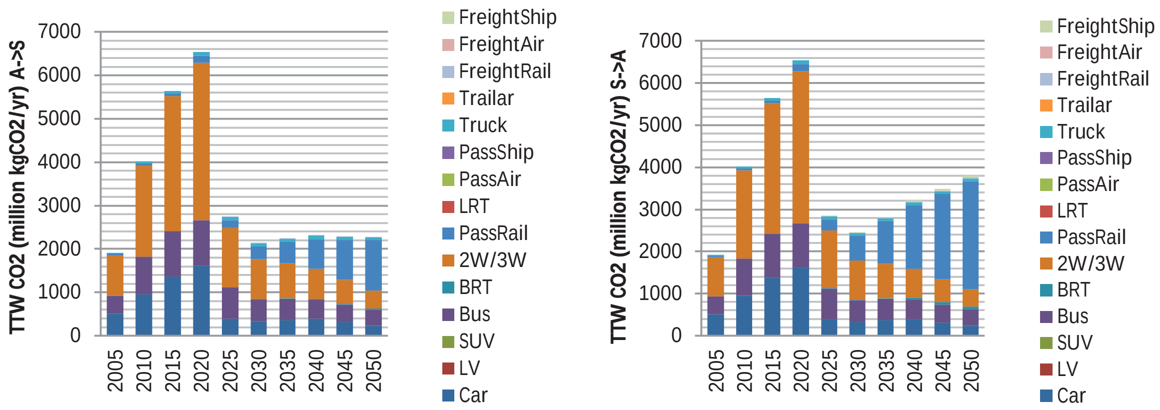


Figure 25. Regional Improved RAD Estimation of Total CO2 Emission

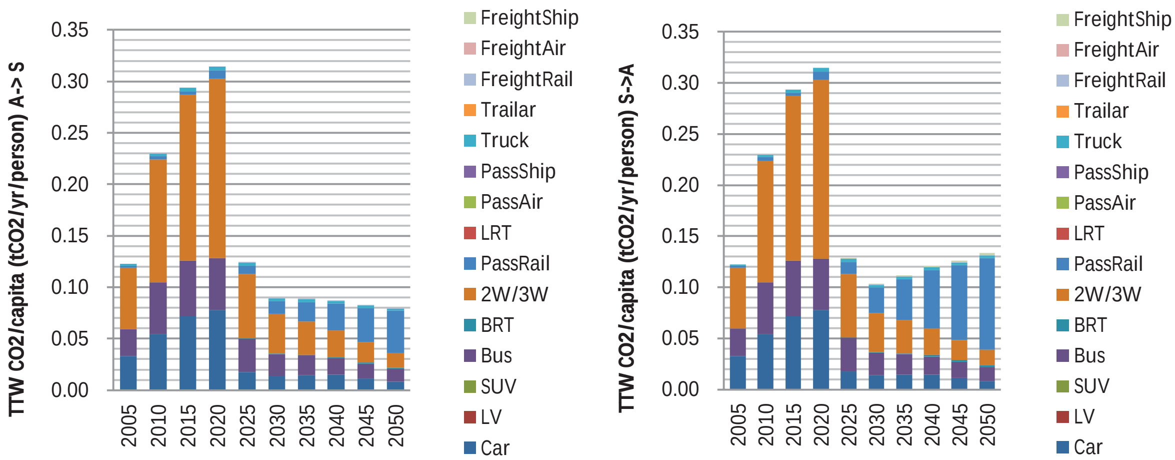


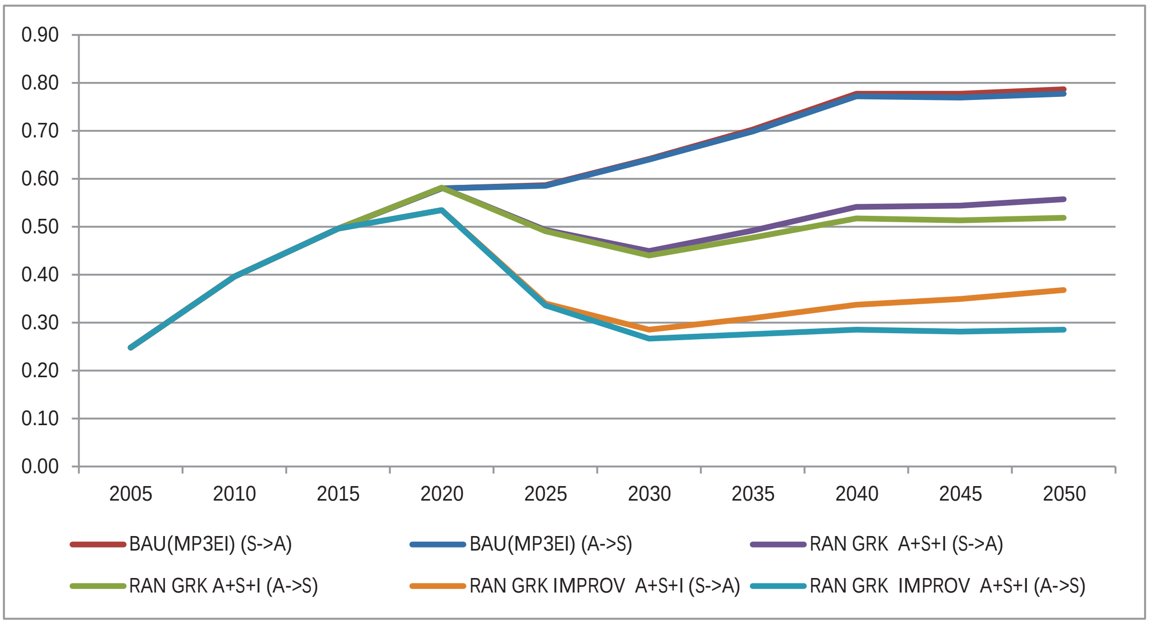
Figure 26. Regional Improved RAD Estimation of CO2 Emission per Capita

As can be seen in the simulation result that by applying the improved RAD:

1. By 2020 the per capita emission level can be hold at around 0.345 Ton per capita
2. The per capita emission level should be able be cut down to around 0.079 - 0.135 Ton per capita in the 2050

3.3 Scenario Comparisons

3.3.1 National

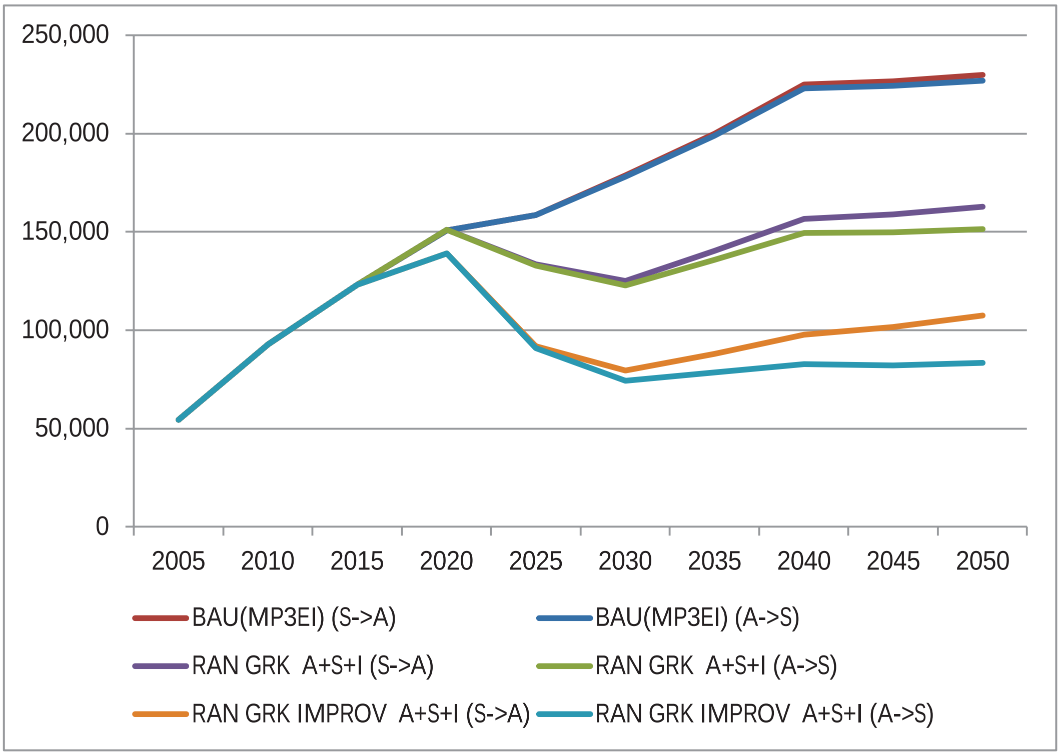


	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
BAU(MP3EI) (A->S)	0.248	0.397	0.497	0.580	0.586	0.640	0.700	0.772	0.770	0.777
BAU(MP3EI) (S->A)	0.248	0.397	0.497	0.580	0.586	0.642	0.703	0.778	0.777	0.786
RAN GRK A+S+I (A->S)	0.248	0.397	0.497	0.582	0.492	0.441	0.478	0.518	0.514	0.519
RAN GRK A+S+I (S->A)	0.248	0.397	0.497	0.582	0.493	0.449	0.493	0.542	0.545	0.557
RAN GRK IMPROV A+S+I (A->S)	0.248	0.397	0.497	0.535	0.336	0.267	0.277	0.286	0.282	0.286
RAN GRK IMPROV A+S+I (S->A)	0.248	0.397	0.497	0.536	0.340	0.286	0.310	0.338	0.349	0.368

Figure 27. TTW CO2/Capita (tCO2/yr/person)

Comparison of reduction policy scenario for national CO2 emission per capita shows following results:

1. The significant reduction of CO2 emission per capita for both RAN and IMPROVED RAN scenario will only take place after 2020-2025. This result will arrive at the same time with the finishing of many transport infrastructure development and system improvements when its effects start to appear.
2. RAN scenario reduced per capita emission by around 16% in 2025 and around 30% in 2050 compared to BAU level. In comparison, the IMPROVED RAN reduced per capita emission by around 42% in 2025 and around 50%-60% (depends on the A&S sequence) in 2050.
3. All scenario shows that A->S scenario implementation sequence has better performance than S->A scenario. This result shows that it is imperative to prioritize action to reduce total transport volume before implementing policy to encourage shifting.

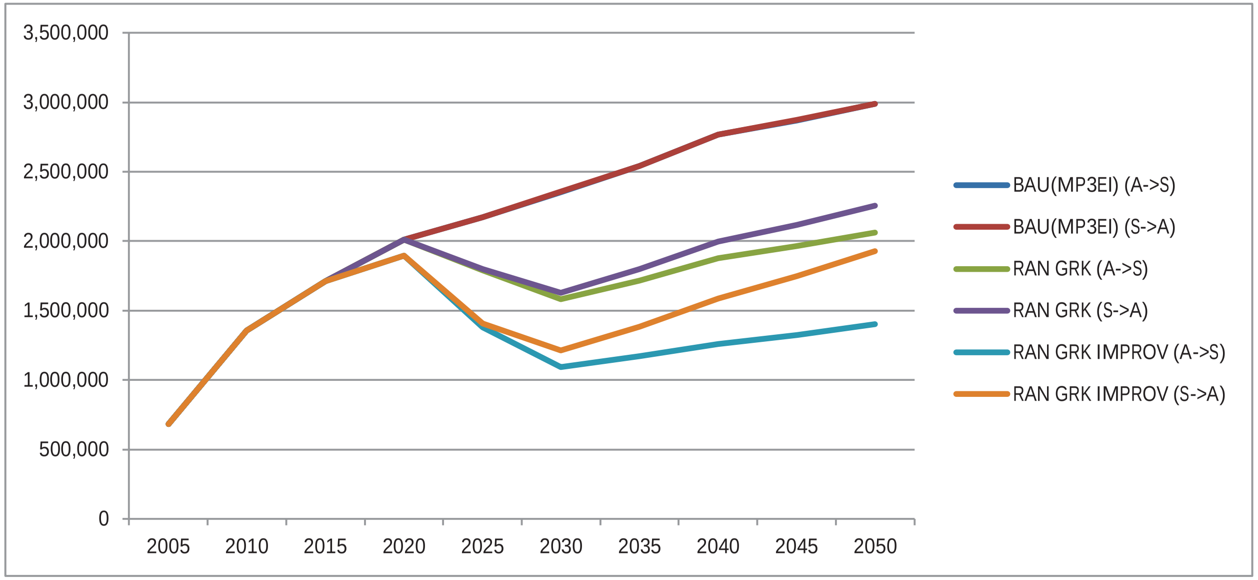


	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
BAU(MP3EI) (A->S)	54,484	92,944	123,025	150,744	158,543	178,203	198,983	223,020	224,209	226,994
BAU(MP3EI) (S->A)	54,484	92,944	123,025	150,744	158,650	178,653	199,951	224,737	226,412	229,678
RAN GRK A+S+I (A->S)	54,484	92,944	123,025	151,069	132,990	122,673	135,845	149,527	149,645	151,453
RAN GRK A+S+I (S->A)	54,484	92,944	123,025	151,069	133,394	124,975	140,198	156,486	158,719	162,684
RAN GRK IMPROV A+S+I (A->S)	54,484	92,944	123,025	139,068	90,959	74,430	78,664	82,621	82,243	83,542
RAN GRK IMPROV A+S+I (S->A)	54,484	92,944	123,025	139,132	92,017	79,513	88,091	97,630	101,697	107,549

Figure 28. TTW CO2 (million kgCO2/yr)

The analyses for scenario comparisons for total emission are as follow:

1. Similar with the emission figure for per capita emission, the results from total emission also show that IMPROVED RAN scenario have better performance compared to RAN GRK .
2. The RAN GRK will reduce the total emission by about 25 Mton CO2 to about 132 Mton in 2025 compared to BAU. On the other hand, IMPROVED RAN scenario will further reduce total CO2 emission by about 67 Mton to only 90 Mton by 2025.
3. The significant difference of results between A->S and S->A sequence for all three (BAU, RAN & IMPROVED RAN) can be seen in 2050. Significant difference especially can be seen in IMPROVED RAN scenario where the A->S sequence can reduce the total emission down to 80 Mton (lower that 90 Mton in 2025). At the same time, the S->A sequence cannot even hold the emission causing rebound of total emission to 107 Mton by 2050.

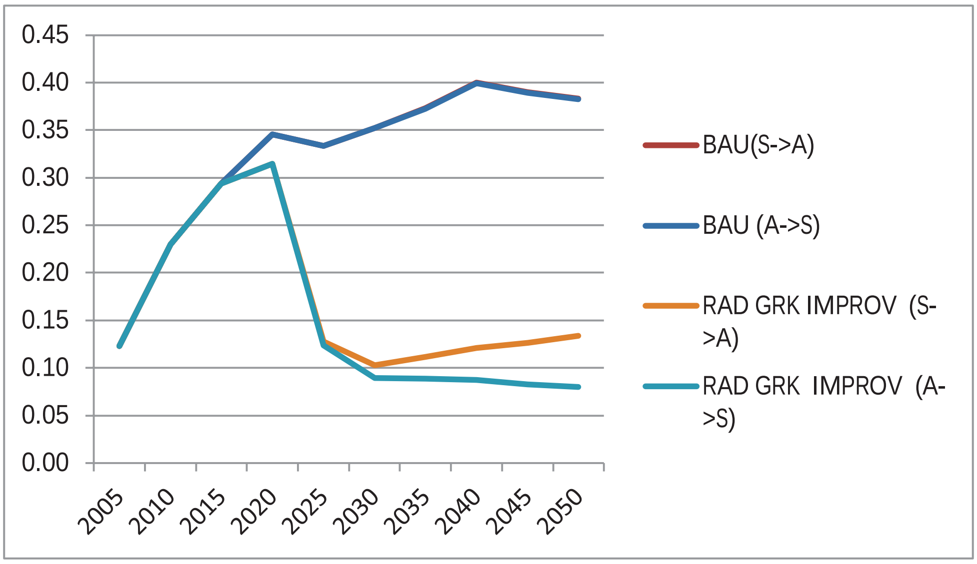


	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
BAU(MP3EI) (A->S)	684,171	1,355,985	1,709,041	2,009,418	2,173,464	2,354,897	2,542,874	2,768,447	2,871,376	2,987,752
BAU(MP3EI) (S->A)	684,171	1,355,985	1,709,041	2,009,427	2,173,518	2,355,064	2,543,215	2,769,046	2,872,149	2,988,706
RAN GRK (A->S)	684,171	1,355,985	1,709,041	2,009,418	1,790,523	1,583,488	1,717,678	1,879,195	1,964,196	2,062,283
RAN GRK (S->A)	684,171	1,355,985	1,709,041	2,009,427	1,798,973	1,629,645	1,797,495	1,997,047	2,118,140	2,253,725
RAN GRK IMPROV (A->S)	684,171	1,355,985	1,709,041	1,894,031	1,378,315	1,094,125	1,169,939	1,260,241	1,325,798	1,402,367
RAN GRK IMPROV (S->A)	684,171	1,355,985	1,709,041	1,895,920	1,404,679	1,214,547	1,383,092	1,587,436	1,750,372	1,928,113

Figure 29. Transportation Volume (million pkm)

Analysis of total transport volume (Pkm) shows similar result as analysis of CO2 Emission total and per capita. The simulation shows that IMPROVED RAN scenario will reduce 53 percent of total volume of transport activity from BAU scenario. Particularly the A->S scenario sequence, it shows more permanent result than S->A sequence.

3.3.2 Regional

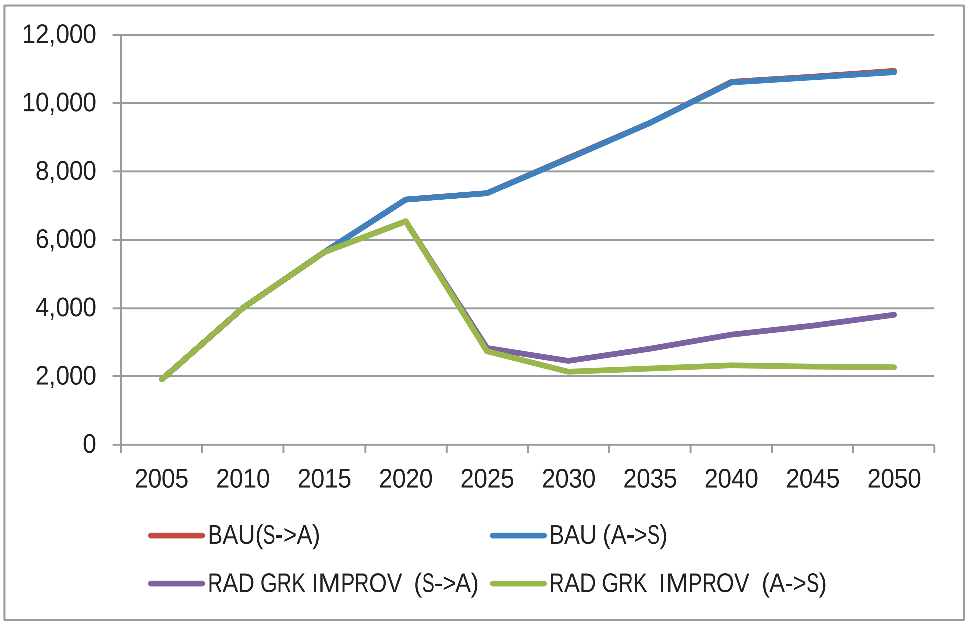


	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
BAU (A->S)	0.123	0.230	0.294	0.346	0.333	0.352	0.373	0.400	0.389	0.382
BAU(S->A)	0.123	0.230	0.294	0.346	0.333	0.352	0.373	0.400	0.390	0.383
RAD GRK IMPROV (A->S)	0.123	0.230	0.294	0.315	0.124	0.089	0.089	0.087	0.083	0.080
RAD GRK IMPROV (S->A)	0.123	0.230	0.294	0.315	0.128	0.103	0.112	0.121	0.126	0.133

Figure 30. TTW CO2/Capita (tCO2/yr/person)

Comparisons analysis of DKI Jakarta CO2 emission per capita result as follow:

1. The simulation show that the BAU scenario for GHG emission per capita in DKI Jakarta will only 0.35 Ton CO2 per capita in 2020 or only slightly higher than UNFCCC target at the 0.33 Ton CO2 per capita. Even in 2050, CO2 emission per capita in DKI Jakarta will only get slightly higher at 0.38 Ton CO2 per capita.
2. IMPROVED RAD GRK will only slightly reduce per capita emission in 2020 from 0.35 of BAU to only 0.32 Ton CO2 per capita. Extreme reduction will be achieved in 2050, when the IMPROVED RAD GRK will reduce from 0.38 of BAU to only 0.08 or 0.133 Tons CO2 per capita (depend on A &S application sequence). This means that Improved RAD GRK can reduce per capita emission at around 10% in 2020 to around 65.3%-79.3% in 2050 compared to BAU scenario respectively.



	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
BAU (A->S)	1914	4017	5646	7181	7373	8386	9419	10607	10762	10912
BAU(S->A)	1914	4017	5646	7181	7374	8390	9428	10624	10784	10940
RAD GRK IMPROV (A->S)	1914	4017	5646	6534	2738	2128	2238	2314	2282	2274
RAD GRK IMPROV (S->A)	1914	4017	5646	6538	2830	2450	2818	3219	3490	3809

Figure 31. TTW CO2 (million kgCO2/yr)

The analyses for scenario comparisons for total CO2 emission are as follow:

1. The simulation shows that the BAU scenario of total CO2 emission in DKI Jakarta will be around 10.912 -10.940 Million kg CO2/year.
2. According to the simulation, the application of IMPROVED RAD scenario will create 9% reduction of total CO2 emission in 2020, down to around 6.5 million kg CO2 from 7.2 million CO2 of BAU. By the 2050 the total emission further reduced to around 2.3-3.8 million kg CO2 or around 65.2%- 79.2% reduction compared to BAU emission in 2050.

4. Co-Benefit

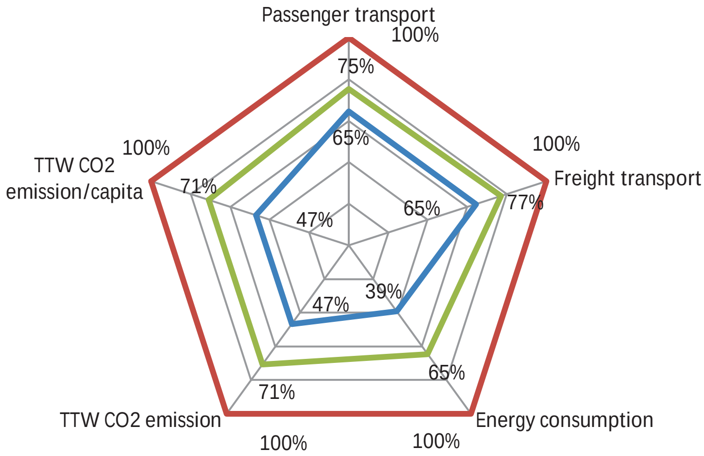


Figure 32. Co-Benefit Due to Transportation Efficiency Percentage Compared to BAU (Red Line) in 2050

Based on two graph above it can be seen that

1. The emission reduction scenario will have positive effect on the reduction of energy consumption. The IMPROVED RAN scenario will reduce energy consumption up to 65 percent while RAN scenario will reduce up to 39 percent compared to BAU in 2050.
2. Despite of reduction in energy consumption, both scenarios still allow for transportation volume continue to growth (as the sign of economic development. Passenger transport volume for IMPROVED RAN will only reduce to 65% compared to 2050 BAU or relatively similar to BAU 2020 figure.
3. Most reduction in transportation demand was take place during mid-phase of scenario time horizon or around 2020-2025 where most physical and system development just finished and starting to show their effects.
4. The emission reduction scenario also serves as a new indicator and target for development agenda. Rather than unilateral sector by sector, the reduction target will create need of coordination and harmonization of development agenda toward national target being set. This particularly will improve development planning process and implementation coordination.
5. The emission reduction actions stated in RAN and RAD GRK will create opportunity for new and greener economy to develop. Soon the government will give more incentive for green economy or industry to attract investments.
6. As void scenario proven to be the most effective policy to reduce GHG emission, the implementation of such policy will bring more opportunities for policies to integrate land use and public transport development to be integrated into long term development agenda. Investment for both sectors can be coupled in on development program.

5. Conclusion

The study has accomplished several simulation exercises comparing the Business-As-Usual scenario of the country's economic development documents and the Do-something scenario coming from the National Action Plan for GHG reduction. The simulation results demonstrate several conclusions as follows:

1. The simulation is conducted using two scenarios, which are similar in their policy interventions and program investments. The two scenarios are the RAN-GRK and RAN-GRK Improved. The Ran GRK-Improved reflects the proposed improvement of the existing National Action Plan for Mitigation of GHG. The workshop organized by the study team confirmed that the national action plan for reducing GHG is a re-packaging of the existing economic development plan. Only a marginal difference between the national economic development plan and the national plan for GHG reduction can be interpreted, either for the policy intervention or the investment plan.
2. Most of projects and policies to reduce GHG are implemented during the period of 2009 -2014 and will take several years before they can produce a significant result. The software is currently allowing a gradual policy implementation. Hence, a certain policy can now introduced in a sequence, with higher intensity in the future time interval. Based on the existing decision-making and implementation effectiveness, most policy and projects will yield GHG reductions only in 2020 – 2025. This condition pose compliance issues in meeting the 2020 GHG emission reduction target, since the Indonesian government has declared a unilateral 26% emission reduction target by 2020.
3. In the BAU Scenario, transport volume (in PKm) is expected to rise, although at the decreasing rate reflecting the increasing demand for mobility due to growth in population and purchasing power on the one hand, and the successful program in introducing a shift policy in all modes of transport. The BAU also has a limited option in avoiding physical travel, by having ICT and freight dematerialization as two policies implemented.
4. Using RAN-GRK Improved, in 2020 will be able to reduce GHG in transport sector by 7.70 – 7.75%, which is still below the nation target. The marginal reduction of GHG is predominantly due to the long lead-time in the implementation schedule. However, by continuing the policy intervention suggested by the study team, the further reduction of GHG will enjoy in 2025 where we have 41.96 – 42.67% reduction compared with the BAU. In the same analysis year (2025), the RAN-GRK scenario produces 15.86 – 16.17% reduction in GHG.
5. By 2050, the BAU scenario will produce GHG annual emission per capita of 0.78 – 0.79 Tons eCO2/person, while the do-something scenario will produce between 0.29 – 0.31 Tons eCO2/person (RAN-GKR Improved) and between 0.52 – 0.56 Ton eCO2/person. The results of this scenario demonstrate that using the RAN-GRK, without improving its intensity of the policies will not meet UNFCCC requirements of 0.3 Ton eCO2 per year per person.
6. Improving the national action plan will further reduce the GHG emission in a significant level. Therefore if the Indonesian government wants to meet both target of national action plan and UNFCCC, the policy measures and transport investment should be more progressive, for example a rapid change toward electric vehicle and a significant reduction in the number of motorized travel. The government requires an introduction of various "avoid" scheme and providing options for energy supply in transport. This intervention calls for a policy to influence behavioral changes.
7. It is recognized that transport policies are not only devised to reduce GHG. The study team indicated that the shared-benefit of the policy intervention will be in the form of improving the efficiency of passenger and freight transport, thus competitiveness of the transportation system; and reducing energy consumption.
8. The analysis shows that the largest benefit of the policy measures is actually on the energy consumption (61% reduction). The congestion level is expected to reduce by 35%. The figure

is calculated based on the year 2050. Combining the transport competitiveness, energy efficiency and GHG emission reduction will help the Indonesian government achieving global climate change commitment as well as improving the economic and local environmental condition.

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The Philippines

Prepared by
Prof. Jose Regin F. REGIDOR
Ms. Sheila Flor D. JAVIER

LIST OF ABBREVIATIONS

ADB	Asian Development Bank
ADMU	Ateneo De Manila University
ASEAN	Association of South East Asian Nations
CAA	Clean Air Asia
CCC	Climate Change Commission
DENR	Department of Environment and Natural Resources
DOE	Department of Energy
DOTC	Department of Transportation and Communications
DPWH	Department of Public Works and Highways
IMF	International Monetary Fund
ITPS	Institution for Transport Policy Studies
LGU	Local Government Unit
LTFRB	Land Transport and Franchising Regulatory Board
LTO	Land Transportation Office
MMDA	Metropolitan Manila Development Authority
NCTS	National Center for Transportation Studies
NEDA	National Economic and Development Authority
NSCB	National Statistical Coordination Board
NSO	National Statistics Office
PCA	Partnership for Clean Air
PIA	Philippine Information Agency
UN	United Nations
UP	University of the Philippines
USAID	United States Agency for International Development
WB	World Bank

1. Society

1.1 Present Situation

- Background
    - This section presents the present situation in the Philippines using key societal factors. These are key social, economic and cultural factors that have significant relationship with its transportation system. That is, such factors affect the development of transportation, while at the same time are influenced by the transportation system in place and in the future.
    - The key societal factors include population, economy and industry, land use, culture, and energy. These are discussed in the following subsections.

- Population
    - The population of the Philippines based on May 2010 census is 92.34 million (NSO, 2012) and is to be about 98.92 million in 2013 (PIA, 2012), not counting millions more abroad who are overseas foreign workers and their families.
    - The annual growth rate from 2000 to 2010 is 1.90 percent. This is lower by 0.44 percentage point from the 1990 to 2000 annual growth rate, which by far the lowest annual population growth rate recorded for the Philippines since the 1900s.
    - The top three regions in terms of population count are Region IV, National Capital Region (NCR) and Region III. The combined population of these three regions comprises the 40.45 % of the total Filipino population.
    - The population is relatively young with senior citizens comprising only about 6.8% of the population and more than 50% comprising the working population. The structure of the population according to age is shown in Figure 1.

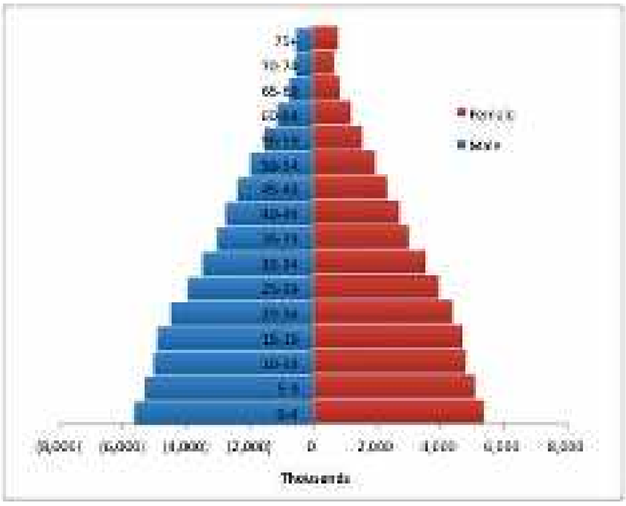


Figure 1. Population Structure in 2010

- Economy and Industry
    - Urban areas are the centers of economic growth in the Philippines. This will continue because most of the manufacturing establishments are located in metropolitan cities and their adjacent cities and municipalities.
    - Through the years, the number of businesses and industries is increasing in the whole country and a greater portion is engaged in the manufacturing sector. However, there is significant growth in the services sector particularly in Business Process Outsourcing (BPO) where the country among the top in the world.

- o Per capita GDP in terms of purchasing power parity is estimated at USD 4,660 while per capita nominal GDP is at USD 2,792 (IMF, 2013). Gini coefficient for the country is estimated as 43.0 (WB, 2012) and the Human Development Index was at 0.654 (UN, 2011).
- o Motorization is still on the rise in the Philippines with higher rates in metropolitan areas or highly urbanized cities. Part of this is the rapid increase in the number of motorcycles.
- o GDP per capita for the Philippines is steadily increasing and the country hopes to achieve newly industrialized status soon. Efficient interregional transportation systems will be needed (such as expressways, long haul rail systems, interregional airports) to sustain economic growth.
- o International access plays a role in supporting the thrust to develop the country as a leisure and travel destination.

- Land Use
  - o The Philippines is an archipelago of 7,107 islands and is generally divided into 3 major regions: Luzon (Northern Philippines), Visayas (Central Philippines) and Mindanao (Southern Philippines).
  - o Administratively, there are 17 regions including the Metro Manila, which is designated as the National Capital Region (NCR). These regions each have a regional center, which is usually a highly urbanized city. The country's 80 provinces have their own capitals that are the economic and administrative center of each province.
  - o Major transport infrastructures are generally found in these cities including airports and seaports (if not land-locked). Figure 2 shows the map of the Philippines with the regional and provincial centers, as well as an illustration of the major transport links for each center.

Figure 2. Regional and Provincial Centers, and Primary and Secondary Transport Links

- Culture
  - o The current paradigm of transport planning does not take into consideration the various daily tasks of women. This results to facilities and carriers that do create difficult and even dangerous situations for women.

Manifestations of this lack of consideration include the high step-board, inadequate spaces for cargoes, and overloading of jeepneys, which has created opportunities for harassment for women.
  - o Implementation of equitable transport system in key urban and rural areas.
  - o The connection between transport and health is not well understood in the Philippines. Thus, non-motorized transport is not often considered as modal alternative for work or school trips. Moreover, pedestrian facilities are not given priority for infrastructure development. Non-motorized facilities considered in transport planning.

- Energy
  - o Imported petroleum and indigenous new and renewable energy resources dominate the supply of the energy in the Philippines. Other forms of indigenous energy supply are hydro and geothermal energy, which is mainly used in power generation.
  - o The primary energy mix for the country in 2011 as shown in Figures 3 and 4 show that approximately 51 % is imported energy, of which 31 % is imported oil and 20 % is imported coal. The percent share of the natural gas is very small, amounting only to 8 %. The estimated energy self-sufficiency of the country is about 60%.

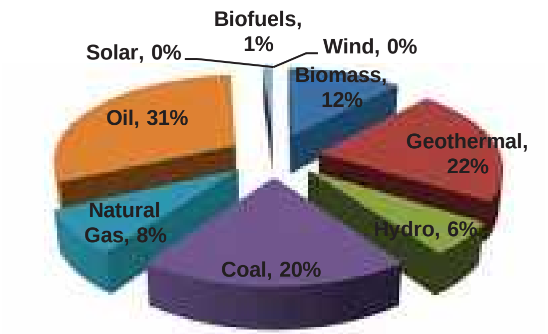


Figure 3. Philippines Energy Mix in 2011 (DOE, 2012)

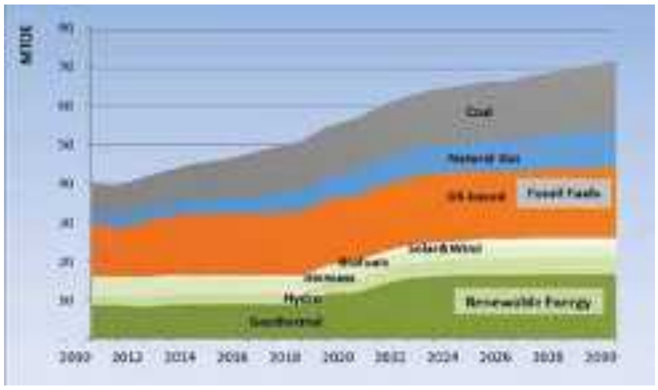


Figure 4. Total Primary Energy, by Fuel (DOE, 2012)

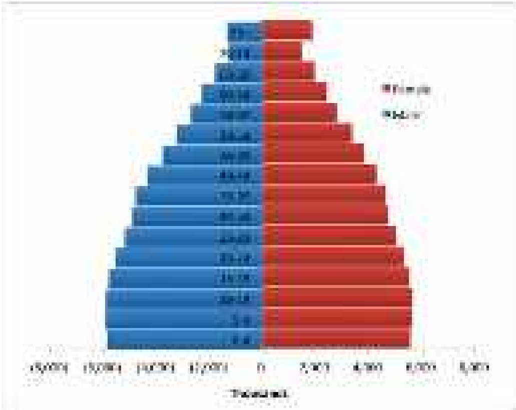
1.2 Future Scenario for Society

- Background
  - o This section presents the future scenario for the Philippines according to the key societal factors identified in the previous section.
  - o This future scenario is based on the available data on projections or estimations culled from various sources such as the UN, WB, government agency reports, and other available documents. The scenario also takes into account the outcomes of the stakeholder workshops and consultations conducted in Manila in 2013.

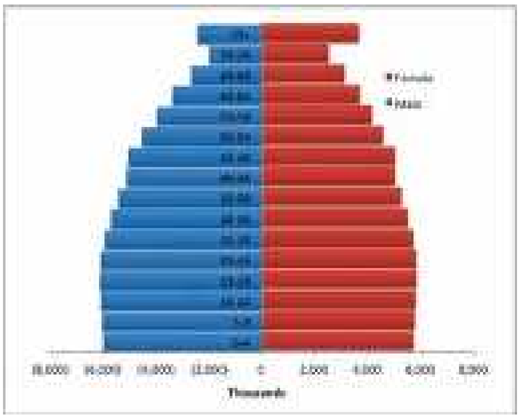
- Population
  - o The country's population is projected to grow from 92.34 million to about 153 million in 2050. With the increase in population size, there will be changes in the age structure. There will be increase in the percentage of elderly and working population. The challenge would be for the country to find ways to support the growing consumption of the elderly in the future. Figure 5 shows the Philippines population by age range.
  - o The Philippines will have a large working population based on the age range. This growth of the working population from 2010 will be sustained by the significant population growth rate bringing the working population up to more than 53% by 2030 and more than 54% by 2050. Meanwhile, the number of senior

citizens is also expected to grow in part due to improved health services to more than 11% by 2030 and more than 15% by 2050.

- o The lack of development in most rural areas in the Philippines acts as a push factor for urban migration. This contributes to the rapid increase of urban population, resulting to increased need for mobility. Efficient and environmentally sustainable mass transportation are needed in cities in order to address issues on mobility. Figure 6 shows the projected urban and rural populations as well as the % urban population



a. 2030



b. 2050

Figure 5. Breakdown of Philippine Population by Age (NSCB, 2013 and UN)

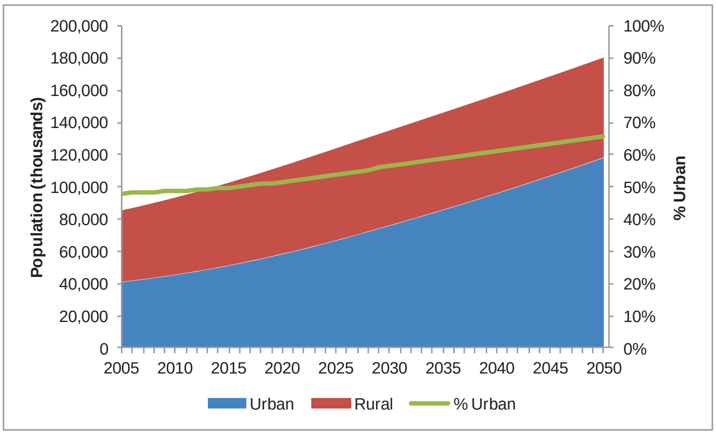


Figure 6. Projected Urban and Rural Populations for the Philippines (UN)

- Economy and Industry
  - o The annual GDP growth rate of 4% in the long-term is achievable and the country is expected to be able to achieve middle-income status by 2050 (i.e., ~10,000 USD per capita).
  - o Economic growth will be boosted by tourism and industrial development while growth in the services sector particularly in Business Process Outsourcing (BPO) will be sustained. The country will continue to have a significant number of its workers abroad but in more high value or high-income jobs including technical positions in information technology, engineering, and maritime transport.
  - o In order to achieve "developed country" status, good governance will be essential or the main factor for growth. This is necessary to have an enabling environment for development.

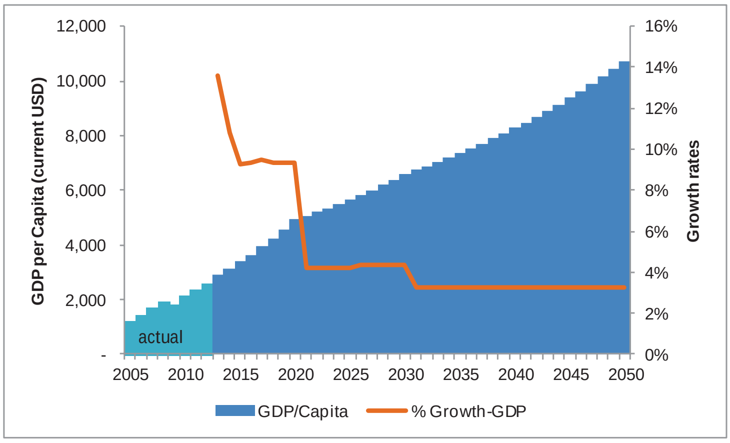


Figure 7. Projected GDP per Capita and GDP Growth Rates for the Philippines

- o Stakeholders have indicated that industry should grow or at least remain the same but for agriculture to preferably grow more compared to the services sector. One reason cited for this is that the country should pursue more agriculture to ensure food security. This growth in the agriculture sector should be achieved through the modernization of agriculture including mechanization.
- o The country will pursue the industry roadmaps that are currently being drafted with manufacturing being a sector that will be aggressively pursued. The service sector particularly business process outsourcing will offer high value services such as engineering design and not just technical support.

- Land Use
  - o Multiple urban centers will emerge as a response to the growing population density in current urban centers. Efficient inter-regional transportation systems will be needed (such as expressways, long haul rail systems, interregional airports).
  - o Most stakeholders agreed that while other regions will develop, most development will be around Metro Manila, Cebu and Davao, which are the centers of Luzon, Visayas and Mindanao, respectively.
  - o The regional capitals (e.g., Iloilo for Region 6, Tacloban for Region 8, Cagayan de Oro for Region 10, etc.) are expected to develop and urbanize more rapidly. People will continue to be attracted to these major cities due to the opportunities for work and education. The growth of these cities will ease the pressure or burden from metropolitan Manila, Cebu and Davao as the main centers of the country.
  - o Properly planned living and activity centers would reduce the need for transportation systems as effectively planned areas would encourage non-energy consuming transportation as distances between activities areas would enable such modes to be used (e.g. walking, bicycle, etc.).
  - o People will continue to gravitate to urban areas and will be attracted by cities with the following characteristics: efficient public transport, clean air and water, security or low criminality, effective sanitation (i.e., waste management), modern communications and effective health care.
  - o Cities and towns will have improved land use and transport systems over the long term and facilities for walking and cycling over short distances should complement motorized public transport.

- Culture
  - o With the sustained growth in the economy, it is expected that consumption of necessities will increase and so will the consumption of luxury items considering people will have more disposable income.
  - o It is expected that people will be working harder in order to gain more wealth and to sustain their lifestyles (i.e., high consumption or consumerism) but then this will also lead to an increased desire for leisure.
  - o Increased leisure will naturally lead to increased local tourism and this will be consistent with the country's push to be a major tourism destination with the development of attraction throughout the country. Meanwhile, overseas tourism will also increase as people will have the resources as well as the interest to travel abroad mainly for leisure.

- o Awareness in environmental issues may increase but is not necessarily indicative of increase in response or actual implementation towards environmental management and conservation. It is expected that Use of high CO2 emission transport mode will still remain or be prevalent.
- o If the public is aware of the environmental problem i.e. air pollution, it is easier to introduce clean technology strategies.
- o Mobility, access to goods, services and opportunity, safety and pollution from transport have been identified by stakeholders as the top concerns or priorities with efficiency and CO2 impacts of transport a notch lower. In the latter case, there seems to be an appreciation and understanding of pollution but less for CO2.

- Energy
  - o Philippine government estimates are only until 2030 (unpublished Philippine Energy Plan) with an alternative fuels roadmap also until 2030.
  - o Increasing fuel costs would provide a strong motivation for developing and utilizing technologies that use cheaper fuel sources or make use of fuel more efficiently.
  - o Increasing fuel costs related to transportation will be an impetus for transportation systems to be more fuel efficient or less reliant on traditional fuels.
  - o Biofuels will continue to be developed with the country now shifting from 2% biodiesel/coco methyl esther (B2) to 5% (B5). Also shifting from 10% ethanol (E10) to 20% ethanol (E20). The alternative fuels roadmap for the Philippines is shown in Figure 8.
  - o The EPIRA Law prevents government from putting up new power plants so the country will rely on the private sector for power generation.

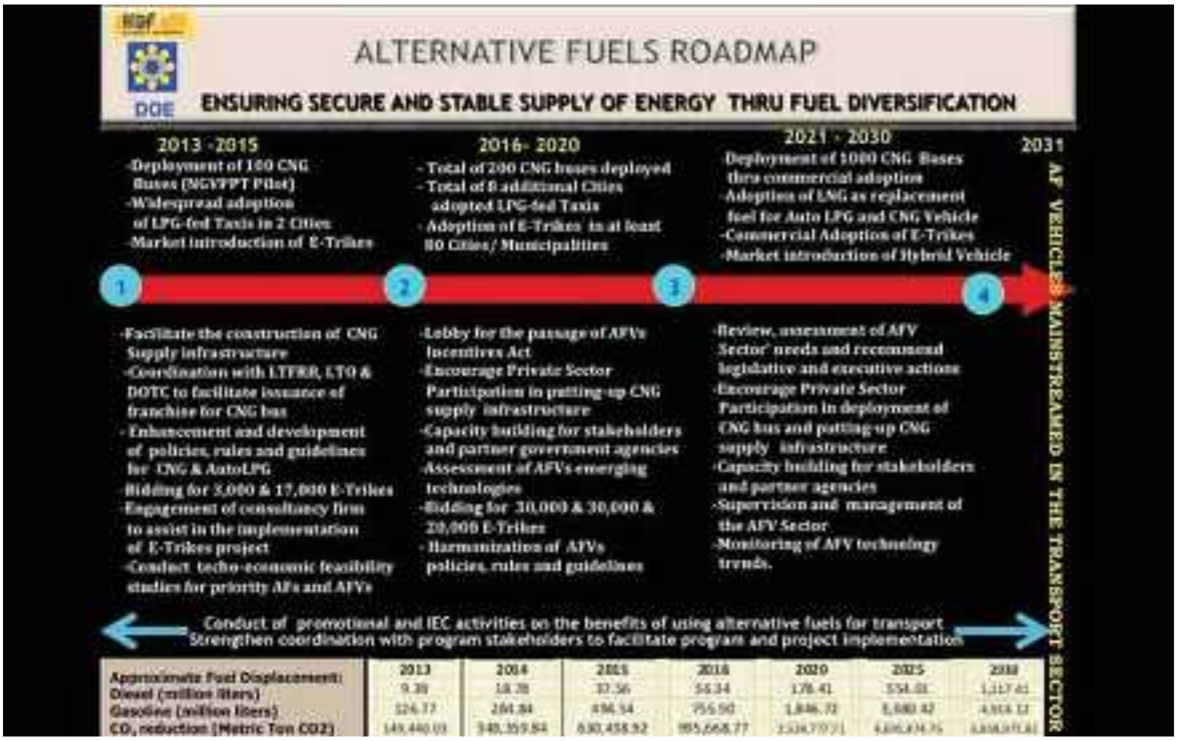


Figure 8. Alternative Fuels Roadmap of the Philippines (DOE)

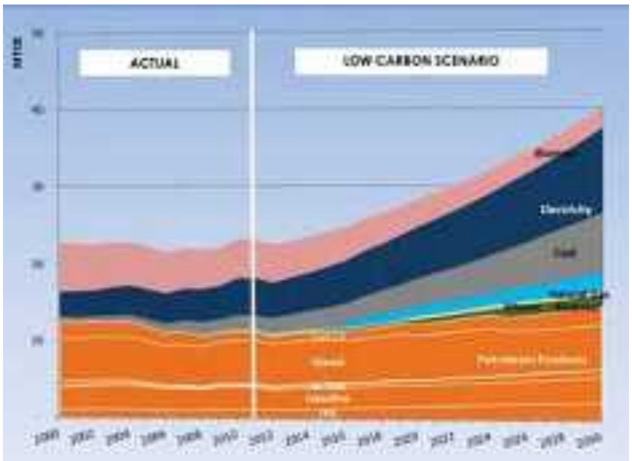


Figure 9. Total Final Energy Consumption, by Fuel (DOE, 2012)

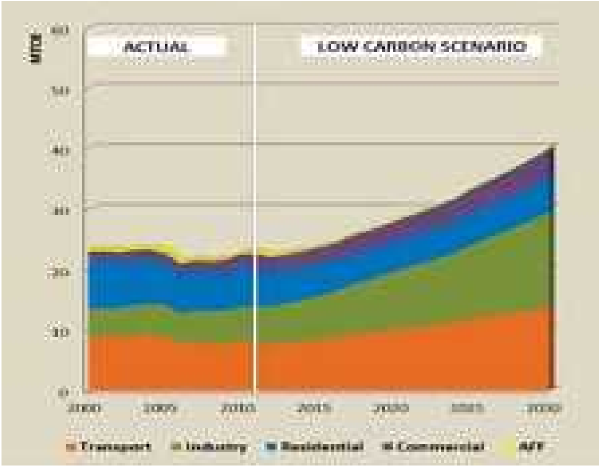


Figure 10. Total Final Energy Consumption, by Sector (DOE, 2012)

- Others
  - Developed and emerging transport-related technologies (i.e., Intelligent Transport Systems) will enable or hinder other transport initiatives. Transport systems deployed will be based on technology available.

2. Transport

2.1 Present Situation

This section presents the present state of transportation in the Philippines by mode. These include descriptions of the current state of road, rail, air and maritime transport in the country.

- Road transport
  - The total length of roads in the Philippines is 215,088.3 km. These are classified as national, provincial, city, municipal and barangay roads. Statistics on these are shown in Table 1.

Table 1. Length of Roads in the Philippines by Classification (Source: DPWH, 2013)

Classification	Total	Unpaved	Paved*	% Paved*
National	31,597.7	6,154.2	25,443.4	80.52
Provincial	31,233.2	21,457.6	9,775.6	31.30
City	14,739.4	5,537.6	9,201.8	62.43
Municipal	15,816.0	10,422.0	5,394.0	34.10
Barangay	121,702.0	113,682.0	8,020.0	6.59
Total	215,088.3	157,253.5	57,834.8	26.89

*As of the year 2012.

  - The vehicle fleet in the Philippines continues to grow rapidly. For 2012, total registered vehicles were already 7.5 million units, which is almost 4.5 times as that of vehicles registered in 1990. Of these registered vehicles, more than 50% were motorcycle/tricycle and most number of registered vehicles (27%) can be found at the National Capital Region (NCR). Vehicle registrations, by type and per region, are shown in Figures 11 and 12, respectively.

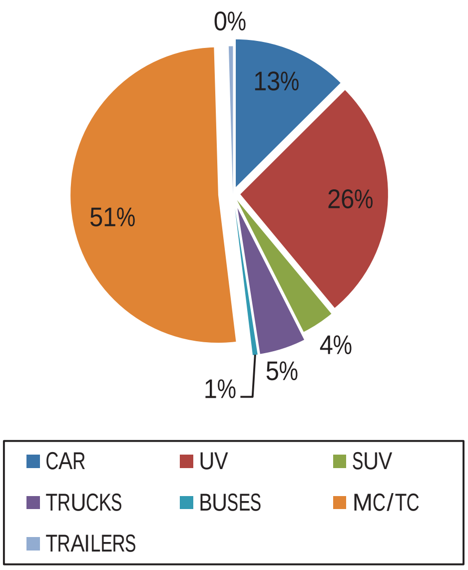


Figure 11. Vehicle Registration per Type in 2012 (LTO)

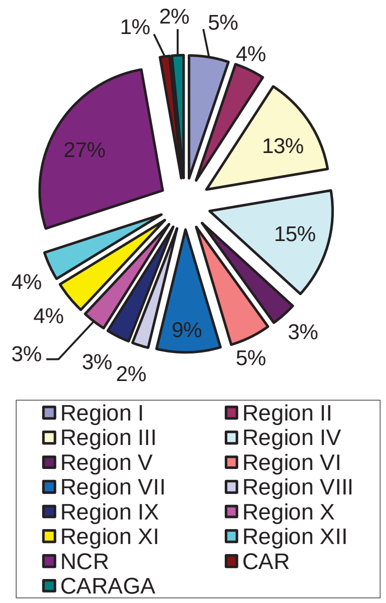


Figure 12. Vehicle Registration per Region in 2012 (LTO)

- Rail Transport
    - The Philippines only has four operation railway lines including the three LRT/MRT lines in Metro Manila (LRT Lines 1 and 2 and EDSA-MRT 3). The other railway line is the Philippine National Railways, which is comprised of a commuter service and a long distance rail service to the Southern regions of the main island of Luzon.

- Air Transport
    - The main government agency in charge of policy-making body and infrastructure investment is the DOTC. Other government agencies involved in safety and security, industry promotion and system operation are: Air Transportation Office (ATO) and Office of the Transport Security (OTS). Devolved localized bodies includes: Manila International Airport Authority (MIAA) Mactan-Cebu International airport authority (MCIAA) and Clark International Airport Authority (CIAC) and Subic Bay Metropolitan Authority (SBMA). Economic regulation is handled by the Civil Aeronautics Board (CAB).
    - The Philippines has a total of 85 national airports, which are classified as international, trunkline, secondary and feeder airports. There are eight (8) international airports designated as major gateways to the country. There are also twelve (12) trunkline airports served by jet aircraft. The rest of the domestic airports are classified either as secondary or feeder airports serviced by mainly turbo-propeller type aircraft.
    - There are three (3) domestic air carriers, which dominate air transport services in the country, namely: Philippine Airlines, Cebu Pacific Airways and Air Philippines. The Philippine Airlines (PAL) was the only airline carrier allowed to operate in the Philippine Airports until 1986, when the air transport policy on airline liberalization was adopted leading to the de-monopolization of PAL.

- Maritime Transport
    - Several departments of the Philippine government have a participation in running the maritime transportation industry, with its own functions and powers. The main government authority with respect to policy formulation and infrastructure investment is the Department of Transportation and Communications (DOTC) and the Philippine Ports Authority (PPA). Other government agencies involved in safety and security, industry promotion, and system operation are: Maritime Industry Authority (MARINA), Philippine Coast Guard (PCG) and Office of Transport Security (OTS). There are also devolved localized bodies, which include the Cebu Ports Authority (CPA), Subic Bay Metropolitan Authority (SBMA), Cagayan Export Zone Authority and Phividec Industrial Authority (PIA).
    - The development of ports in the Philippines was carried out before through different port administrative system. Today, the structure of the Philippine Port System can be divided into four categories: (1) the PPA port system consisting of public and private ports; (2) ports under the jurisdiction of independent port authorities; (3) public ports devolved to the local government units (LGUs); and (4) the recently-established Road RO-RO Terminal System (RRTS).

2.2 Key Transport Data

This section presents key information used in the analysis performed for this study. These data include inputs to the Backcasting Tool employed to estimate carbon reduction for the alternative scenarios to the business-as-usual (BAU) cases presented in the succeeding chapter of this report.

- Trip Length Data is Limited
    - As far as Metro Manila is concerned, the average trip length for private transport is 13.2km while for public transport it is 10.2km. These were derived from the MMUTIS (1999) report. In the same report, they estimated that these averages would increase by 1.4 times by 2015 (i.e., private 18.48 km and public 14.28 km).
    - The MMUTIS Final Report that states the average trip length for bus and jeepney in Metro Manila are 10km and 3km respectively accounting for the different routes. For the adjoining provinces, it is 31.3 km for bus and 6 km. The data for public transport is quite tricky because unlike private transport, public transport

vehicles have several trips per day. The average number of trips (or roundtrips as we call it here) is about 5 per day for buses and 6 for jeepneys for Metro Manila and only about 4 and 5 per day elsewhere (outside Metro Manila) based on recent studies in (MMPTPSS, 2012). Thus, the total trip length per day of buses and jeepneys can be estimated as follows:

- Metro Manila: bus= 50 km/day; jeepney=18 km/day
- Outside Metro Manila=125.2 km/day; jeepney=30 km/day
- Cars = 18.48km/day

- Vehicles Emissions
  - o Vehicle emission factors are very useful especially for estimating and/or modeling the impacts of transport on the environment. Unfortunately, the Philippines does not have up to date emission factors and the source for these remain the data published by the ADB back in 1992.

Table 2. Vehicle Emission Factors for Metro Manila, g/km (Source: ADB, 1992)

Fuel Type	Vehicle Type	Pollutant Type					
		PM	CO	HC	SOx	Pb	NOx
Gasoline	Car	0.1	49.5	6.0	0.011	0.073	2.7
	Utility Vehicle	0.12	60.0	8.0	0.014	0.092	3.0
	Motorcycle	2.0	26.0	18.6	0.004	0.028	0.2
Diesel	Taxi	0.6	1.9	0.65	0.081	0	2.0
	Jeepney	0.9	2.5	0.7	0.121	0	1.4
	Utility Vehicle	0.9	2.5	0.7	0.115	0	1.4
	Truck	1.5	12.4	3.7	0.374	0	12.5

- Motor Vehicle Registration
  - o Motor vehicle registration is under the jurisdiction of the Land Transportation Office (LTO). The LTO's mission is to rationalize the land transportation service and facilities and to implement effectively the various transportation laws, rules and regulations. Basically, their mandate and main functions are: inspection and registration of motor vehicles, issuance of licenses and permits, enforcement of Land Transportation Rules and Regulations, adjudication of traffic cases and collection of revenues for the Government.
  - o Registered motor vehicles are classified into seven groups, namely: cars, utility vehicles (UV), sports utility vehicle (SUV), trucks, buses, motorcycles/tricycles (MC/TC) and trailers. Based on the data obtained from the Land Transportation Office (LTO), all types of vehicles have more or less steadily increased in the past 22 years as shown in Figure 13.
  - o The average growth per year from 1990-2012 is 2.99% for cars, 5.01% for UV, 16.18% for SUV, 4.54% trucks, 3.11% for buses, 11.47% for MC/TC, and 3.53% for trailers. Vehicle per population also tripled over the span of 22 years.

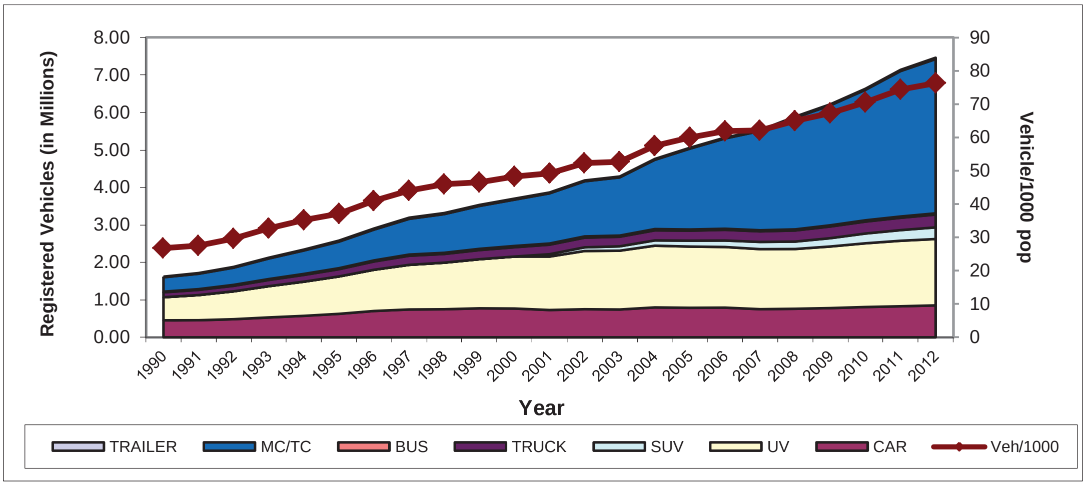


Figure 13. Vehicle Registration and Ownership in the Last 22 Years (LTO, 2013)

- Maritime Transport
  - o There is no accurate statistical number of ports in the Philippines since there are various types of ports ranging from big international ports to extremely small, which is catering to local fishing and passenger movements.
  - o There are around 2,451 ports in the country. There are 423 private ports, mostly ports belonging to private enterprises for their own exclusive use. There are 421 fishing ports, most of which are under the administration of the Philippine Fisheries Development Authority. The Philippine Port Authority (PPA) operates 239 public ports, which consists of 25 base ports and 214 secondary ports or terminal ports. In addition, around 1,369 ports, which are handled by the LGUs.
  - o Passenger and cargo movement data come from the Philippine Ports Authority (PPA). The following Figures 14 to 15 shows the cargo and passenger movements, respectively, in the Philippines from 2001-2012.

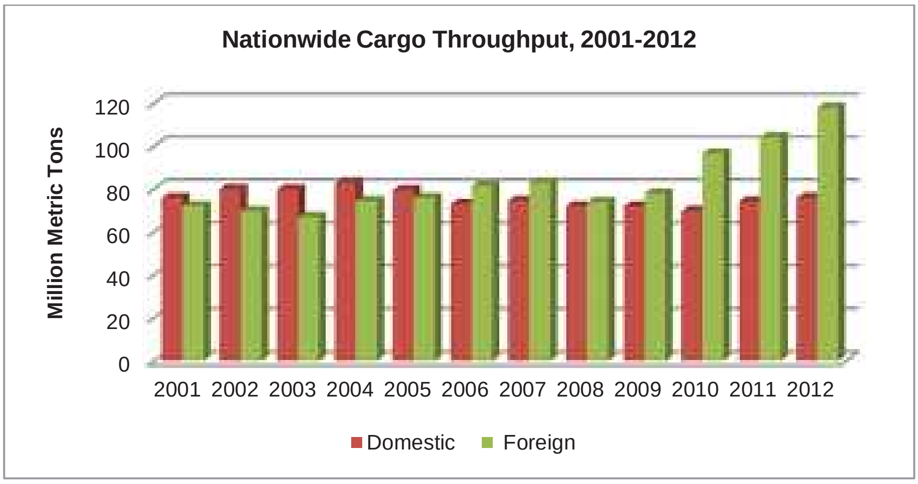


Figure 14. Cargo Movements in the Philippines, 2001-2012 (PPA, 2013)

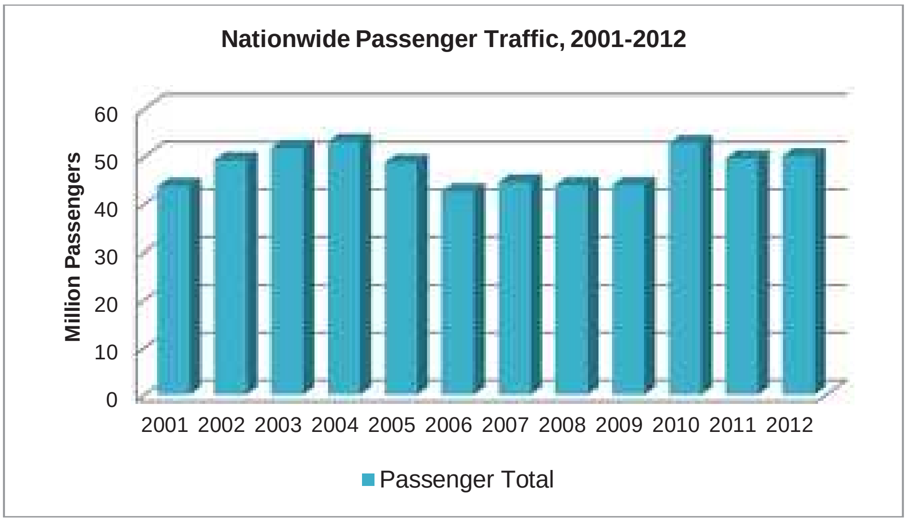


Figure 15. Passenger Traffic in the Philippines, 2001-2012 (PPA, 2013)

- Air Transport
  - The data source for aircraft, passenger and cargo movements is the Air Transportation authority (ATO). Table 3 shows the summary of movements by region in 2006. The highest number of movements is observed in NCR.

Table 3. Summary of Aircraft, Cargo and Passenger Movements by Region (CAAP, 2011)

Region	Aircraft	Cargo	Passenger
NCR	255,154	390,046,753	29,779,126
CAR	471	1,335	1,607
I	10,677	2,248,482	192,592
II	8,336	2,415,245	194,724
III	54,019	1	6,003
IV	15,120	12,437,789	1,334,977
V	5,087	2,181,425	771,354
VI	35,913	35,002,546	5,357,799
VII	69,749	60,249,782	7,219,205
VIII	15,676	7,044,561	1,125,315
IX	9,211	12,480,049	1,181,782
X	8,095	19,496,640	1,671,915
XI	13,202	50,653,573	3,121,254
XII	1,582	1,588,979	192,017
XIII	2,629	4,032,840	482,697
Total	504,921	599,880,000	52,632,367

- Rail Transport Statistics
  - The summary of rail transport statistics is shown in Table 4. It will be observed that the route length decreases from 523 to 85 km in 2006. This is so because the PNR Main Line South became non-operational for some time.

Table 4. Summary of Rail Transport Statistics, 2004-2007 (DOTC)

AREA/ITEM	2004	2005	2006	2007
TRAFFIC DATA				
Number of Passenger (million)	244	278	2969	317
Passenger-Kilometers (million)	2,267	2,459	2,637	2,714
Freight (million)	N/A	N/A	N/A	N/A
Freight-Km (million)	N/A	N/A	N/A	N/A
RAILWAY INFRASTRUCTURE				
Route Length (km)	523	523	85	85
Double Track Length (km)	76	76	76	76
Electrified Route Length (km)	45	45	45	45
Number of Locomotives (PNR)	14	13	12	11
Number of Passenger Coaches	259	252	300	300
Number of Freight Wagons (PNR)	213	213	151	151
Urban Rail Length (km)	101	101	85	85

- Energy Consumption
  - Based on actual energy supply and demand and using the low carbon scenario, the total primary energy and total energy consumption by fuel and by sector was projected up to 2030. Results are shown in Figures 16 to 17.
  - The important sectors when it comes to energy demand are agriculture, transport, residential, commercial and industry. Based on the DOE forecast of energy demand, transport, residential and industry sectors are with the highest demand for energy.
  - For the industrial sector, it may not be possible to reduce the use of oil and be replaced by natural gas since they principally use oil as a raw material to manufacture other products.
  - For the transport and residential sectors, the utilization of natural gas is possible. Thus, the government developed the Natural Gas Vehicle Program for Public Transport (NGVPPT) with the objective of enhancing the energy supply security in the transport sector through fuel diversification using indigenous natural gas.

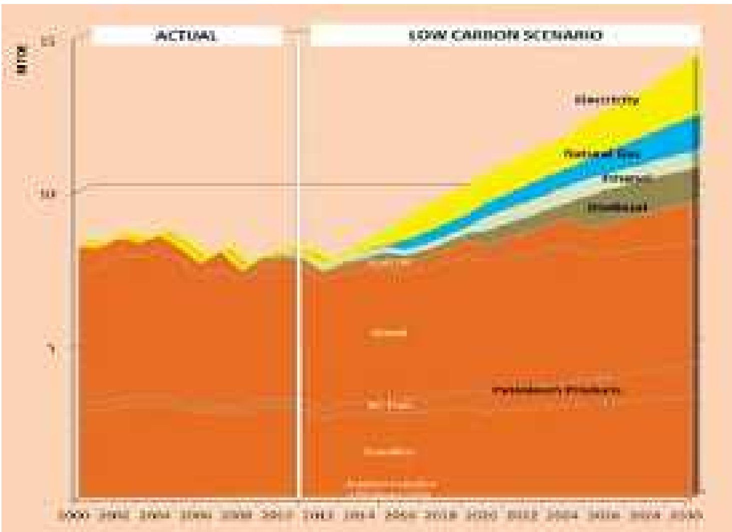


Figure 16. Transport Energy Demand, by Fuel (DOE, 2012)

Figure 17. Transport Energy Demand, by Subsector Total (DOE, 2012)

- Based on the Philippine Energy Plan 2012-2030, 30 percent of all public utility vehicles are expected to run on alternative fuels nationwide by 2030. The projected number of vehicles using alternative fuels (CNG, LPG, Electricity) are summarized in Table 5 and illustrated in Figure 18.

Table 5. Projected Number of Vehicles Using Alternative Fuels (DOE)

Type	2011	2015	2016	2020	2025	2030
CNG						
Bus	61	1,000	5,000	6,900	9,200	15,000
Taxi		100	1,000	6,000	16,000	
Auto-LPG						
Taxi	19,052	20,200	20,500	21,700	23,200	23,000
Electricity						
E-trikes	630	50,170	80,730	106,000	150,000	230,000
Biofuel Blending						
Ethanol	10%	10%	10%	20%	20%	20%
CME	2%	5%	5%	10%	20%	20%

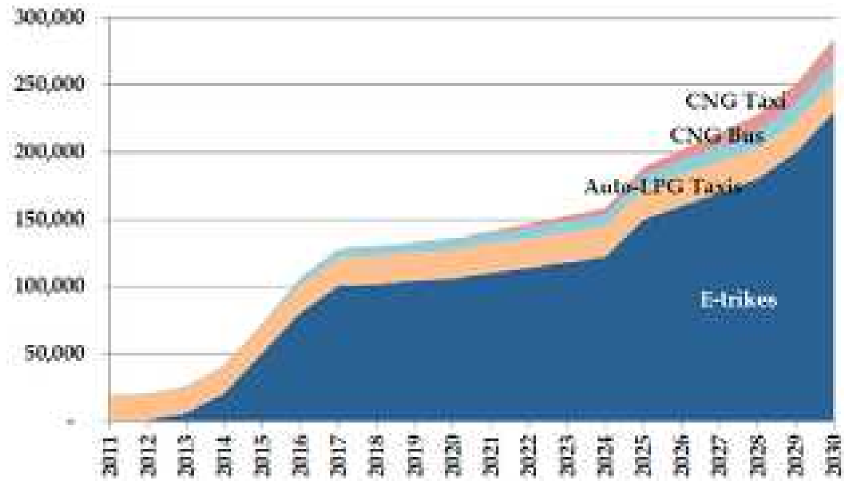


Figure 18. Projected Number of Vehicles Using Alternative Fuels (DOE, 2012)

2.3 Future Transport Image in Accordance with Societal Scenario

This section presents the future transport images for the cases of the primary city (Metro Manila), major cities, other cities, municipalities (non-cities), and others, corresponding to the future scenario for society described in Chapter 1.

- Transport Image in Primary Metropolitan Area: Metro Manila
  - Current mode share in Metro Manila is 70% taking public transport and 30% taking private transport. In other cities or towns, it is probably 80% taking public transport. However, the share of road space in Metro Manila is only 20% for public transport vehicles while private vehicles occupy 80% of road space.
  - In the future, it is desirable to have 80% to 90% of people taking public transport. Participants see that the current 70/30 shares will not worsen especially as it is expected that public transport will improve in the future (e.g., more mass transit systems that are better than present ones).
  - Passenger automobiles will remain a viable mode of transport in Metro Manila and it is expected that these will employ the latest technologies that would allow them to be more fuel-efficient and have low emissions. These technologies include hybrid engines and electric motors.
  - Railway lines will be the main mass transit modes for Metro Manila, which will have at least 5 MRT/LRT lines by 2030 and an upgraded PNR commuter rail service.
  - Both conventional buses and bus rapid transit (BRT) will be present in Metro Manila but while BRT will function similarly as MRT or LRT along high demand corridors, conventional buses will serve feeder routes to the higher capacity modes. These buses will run on clean diesel, CNG or electricity, with the latter technology rapidly improving over the next 10 years.
  - The number of jeepneys will be significantly reduced by 2030 and will serve only feeder routes where they are suitable. These will be using cleaner and more fuel-efficient technologies such as LPG and electricity.
  - Other modes of transport such as motorcycles will continue to increase in numbers but the numbers will plateau once efficient mass transit systems are in place and operational (i.e., providing high level and quality of service). Tricycles and non-motorized pedicabs will serve only residential areas and are limited to local streets not already served by jeepneys. Cycling and walking will become more popular and facilities for these will be provided by the cities comprising Metro Manila.

- Transport Image in Million Plus Urban Area: Metro Cebu and Davao
  - Automobile usage will steadily increase in the major urban areas like Cebu and Davao. This is expected with the increasing incomes of residents of these cities and due in part to lower motorization compared to Metro Manila. Hybrid and electric cars will also be popular in these cities though there will be a significant number of conventional cars.
  - Cebu and Davao will have rail transit services but not as many lines as Metro Manila.
  - Bus transit services will be replaced the jeepney and multicabs that currently serve most routes in these urban areas.
  - Jeepneys and multicabs will serve feeder routes to mass transit modes but these vehicles will be powered by LPG engines or electric motors.
  - Informal transport modes including motorized and non-motorized three-wheelers will still be in operation but services will be along local roads. Also, motorized tricycles will be mostly electric if programs to phase out conventional tricycles can be implemented.

- Transport Image in Other Urban Areas
  - Automobile technology and usage will be similar to those in million plus urban areas.
  - Rail will not be viable in urban areas with populations significantly less than one million.
  - Buses and BRTs will most likely be the suitable transport modes for high capacity or high demand corridors in these urban areas.
  - Other modes will serve transport demand including jeepneys, multicabs and motorized and non-motorized three-wheelers. Future versions of these vehicles will utilize LPG and electricity as the foundations are already being laid at present with LPG and electric jeepneys, and electric tricycles.

- Transport Image in Rural Areas
  - Automobile usage in rural areas will be similar to that of urban areas. Technology may lag as older model vehicles will be used in rural areas.
  - Rail and bus transport in rural areas will be limited to long distance or inter-city or inter-regional transport services.
  - Other modes like jeepneys, multicabs and motorized and non-motorized three-wheelers will continue to be popular but using cleaner technologies like electricity.

- Transport Image in Inter-Urban Areas
  - Automobile usage will be significant for long distance trips but bus transport services will continue to have a significant and majority share for inter-urban transport in the country. Both bus and car transportation can be sustained even at the national level as RORO facilities are improved, which links road transport with maritime transport.
  - Rail transport infrastructure will eventually be developed starting with the Main Line South of the Philippine National Railways. This will take time to develop and expand but may have significant impacts on the movement of people and goods depending on the rail alignment.
  - Air transport will be most popular in long distance inter-urban trips especially because of the islands comprising the Philippines. Air transport will continue to grow particularly for the low cost carriers, which make travel affordable to people. Correspondingly, airports will be improved or expanded to be able to handle passenger growth.
  - Maritime transport between urban areas in different islands will be served by both RORO and fast ferry vessels. These will serve trips of all purposes including recreational or tourism-related trips.
  - Road, rail, air and maritime transport will have a significant and steady increase attributed to tourism growth. This tourism growth is expected and likely due to the increased propensity to travel for leisure as the economy grows and people have more disposable income available for luxuries. This is also a result of increased consumption in conjunction with affordable fares for traveling domestically as well as internationally.

- Freight
  - Heavy duty trucks will continue to use diesel engines. Hybrid diesel or low emission trucks will eventually be used as fleets are modernized but this is dependent on private sector (i.e., trucking companies) initiatives.
  - It is highly uncertain at this time if the Philippines will have a comprehensive railway system in the future. There are studies currently being undertaken for the island of Luzon but conditions are not strongly indicative of the system being constructed. As such, freight rail is not expected until maybe further into the future.
  - Maritime freight will continue to be significant between the islands comprising the Philippines. These will be carried by RORO ferries, and various other vessels like tankers and container ships. Most of these vessels, however, will be old and will still be using conventional fossil fuels.

- Future Mode Shares
  - Figure 19 shows estimates of mode shares for the Philippines considering four possible scenarios including baseline (i.e., BAU), car-oriented, promotion of biking/walking and transit oriented until the year 2030. Of the four cases, the transit oriented case is deemed the most desirable for the future were bus will have a high share of transport by passenger-km. Note that the share of rail is insignificant in all cases considered. These are estimates in an ongoing World Bank study that was commissioned by NEDA. There are no official government estimates of mode share in the future.

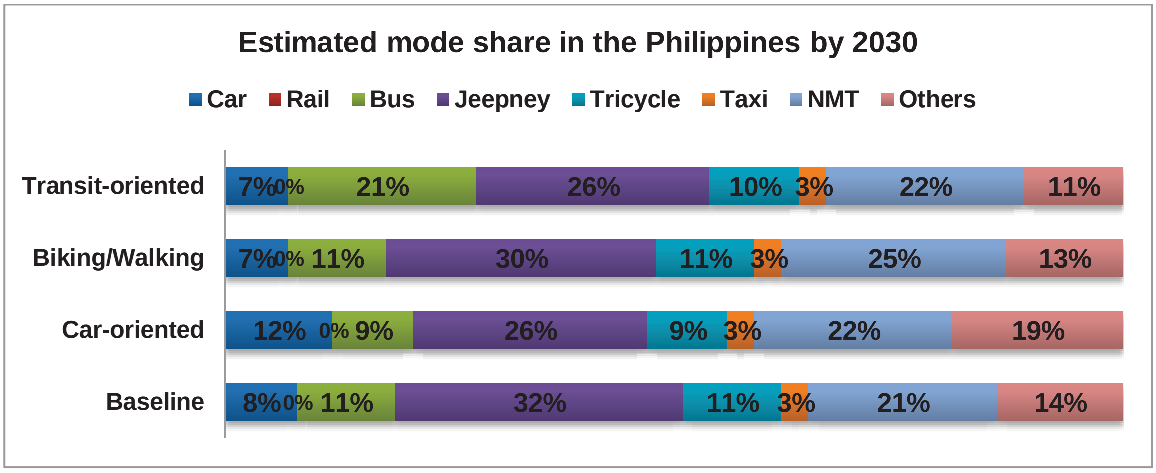


Figure 19. Future Mode Share Estimates for Different Scenarios in the Philippines (WB, 2013)

3. CO2 from Transport

3.1 BAU (Business as Usual)

- The Philippine government currently does not have its own estimates of GHG or CO2 emissions for the transport sector. The DOTC's "National Implementation Plan on Environment Improvement in the Transport Sector" does not have estimates despite its being part of the ASEAN-Japan Action Plan on Environment Improvement in the Transport Sector.

- Expected outcomes of the National Implementation Plan are as follows:
  - o PM10 reduction by 30% in 2011 (DENR vows 30% cleaner air by 2011 in Metro Manila. The Philippines start August 25, 2010)
  - o Reduction by PM10 by around 12 to 16 tons per day due to MVIS and operation of 4 stroke by tricycles
  - o Reduction of PM10 by around 11 tons per day due to Urban Rail Expansion
  - o 10% reduction of VKT of CO2 by public transport route rationalization (by 2015)
  - o 30% reduction in VKT of CO2 through Demand Management Measure and improving public transportation (by 2015)
  - o 20% reduction in VKT of CO2 through better freight and logistics management (by 2015)

- A World Bank study in 2010, "A Strategic Approach to Climate Change in the Philippines, An Assessment of Low Carbon Interventions in the Transport and Power Sectors," estimated the baseline GHG emissions for the power and transport sectors. These estimates are shown in Figures 20 and 21 together with the projected results of low and medium carbon scenarios.

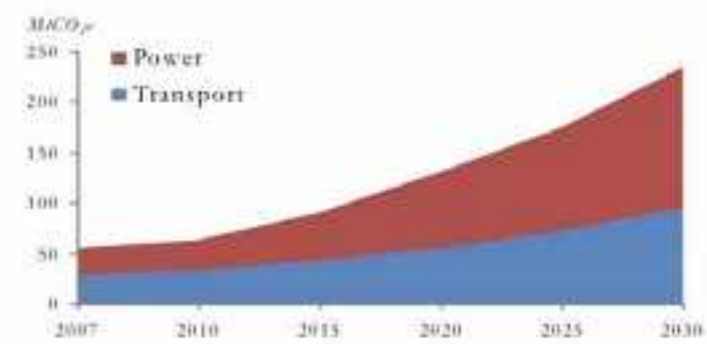


Figure 20. Baseline GHG Emissions Estimates for Power and Transport Sectors (WB, 2010)

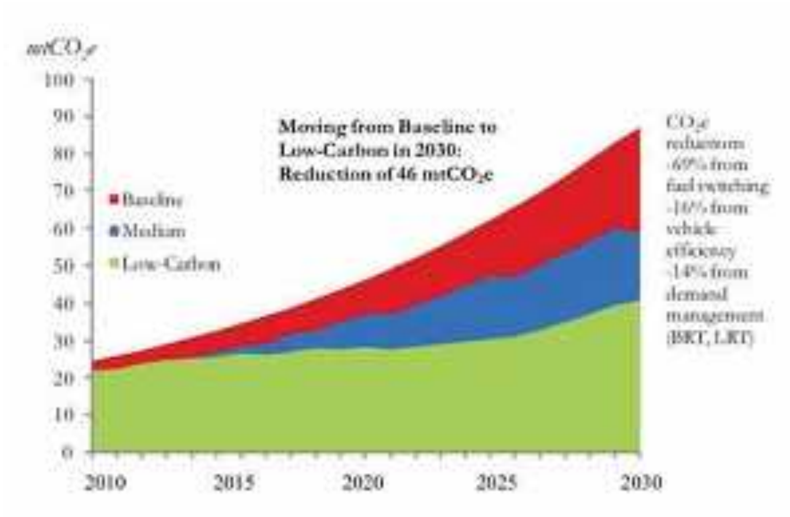


Figure 21. Transport Sector Emission Scenarios (WB, 2010)

- Based on the Philippine Energy Plan 2012-2030, sectoral target is 10% energy savings on the total annual energy demand of all economic sectors.

Table 6. Projected Energy Demand for the Philippines (DOE, 2012)

Sector	2012	2015	2020	2025	2030
Agriculture	16	17	20	25	30
Industrial	157	197	283	408	583
Commercial	127	164	241	345	482
Residential	140	179	265	401	588
Transport	408	516	689	894	1,169
TOTAL	**848**	**1,073**	**1,499**	**2,072**	**2,850**
MW Deferred Capacity	**384**	**486**	**679**	**938**	**1,291**
CO2 Equivalent, tons CO2	**1,413,303**	**1,786,955**	**2,496,928**	**3,451,188**	**4,747,802**

3.2 Selected Policy List

3.2.1 National

- Table 7 shows the selected avoid, shift and improve policies applied for the national case. The details for these policies are shown in Table 8, particularly for the ‘shift’ and ‘improve’ policies adopted. In the case of ‘avoid’ policies, application is from the present to 2050.

Table 7. Selected Avoid, Shift, and Improve Policies for Analysis at the National Level

AVOID POLICIES	SHIFT POLICIES	IMPROVE POLICIES
• Pricing regimes • ICT • Teleactivities • Travel plans • Improved travel awareness	• Bus/BRT usage promotion • Bus/BRT infrastructure development • Rail/LRT usage promotion • Rail/LRT infrastructure development • Rail usage promotion for freight • Rail infrastructure development	• CNGV promotion • Hybrid promotion • EV mass supply • EV promotion • Biofuel development • Biofuel promotion • Ecological driving • Air fuel efficiency improvement • Ship fuel efficiency improvement

Table 8. Details of Introduced Policies for the National Case

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)							
	2015	2020	2025	2030	2035	2040	2045	2050
Shift (Passenger)								
Bus/BRT usage promotion and infra development								
from Car, LV, SUV to Bus	0%	1%	1%	2%	5%	9%	12%	15%
from 2W/3W to Bus	0%	0%	0%	2%	3%	4%	5%	6%
from Car/LV/SUV to BRT	0%	0%	0%	0%	1%	3%	4%	6%
from 2W/3W to BRT	0%	0%	0%	0%	1%	3%	4%	6%
Rail/LRT usage promotion and infra development								
from Car/LV/SUV to Rail	0%	0%	0%	0%	1%	3%	4%	6%
from 2W/3W to Rail	0%	0%	0%	0%	1%	1%	2%	2%
from Car/LV/SUV to LRT	0%	0%	0%	2%	3%	4%	5%	6%
from 2W/3W to LRT	0%	0%	0%	2%	3%	4%	5%	6%
Shift (Freight)								
Rail usage promotion and infra development								
from Truck/Trailer to Rail	0%	0%	1%	3%	4%	7%	8%	10%
from Air to Rail	0%	0%	0%	0%	1%	2%	4%	6%
Improve								
CNGV mass supply and promotion								
Bus	0%	1%	6%	16%	19%	21%	24%	26%
Truck	0%	0%	0%	1%	2%	3%	3%	4%
Hybrid mass supply and promotion								
Car (to hybrid-gasoline)	0%	1%	3%	4%	6%	7%	9%	10%
LV (to hybrid-diesel)	0%	1%	6%	16%	19%	21%	24%	26%
Truck (to hybrid-diesel)	0%	0%	1%	1%	2%	4%	5%	6%
EV mass supply and promotion								
LV	0%	3%	5%	7%	9%	11%	13%	15%
2W/3W	0%	1%	2%	2%	3%	3%	4%	4%

- The result of calculations using the Backcasting Tool for the country is shown in Figure 22 with potential carbon reduction from 1.400 tCO2/year per capita to 0.457 tCO2/person/year (still above the target of 0.33 tCO2/person/year) by 2050. Figure 23 shows carbon reduction from 1.360 tCO2/person/year to 0.317 tCO2/person/year (below the target of 0.33 tCO2/person/year) by 2050 for the case minus international transport.
    - This is the possible outcome of aggressive implementation of policies throughout the country but likely focused on urban areas especially Metro Manila and highly urbanized cities.

- This assumes the realization of what seems to be very optimistic targets set by government agencies for infrastructure development and the adoption of alternative fuels and vehicles including electric-powered jeepneys and tricycles, and hybrid and electric cars.

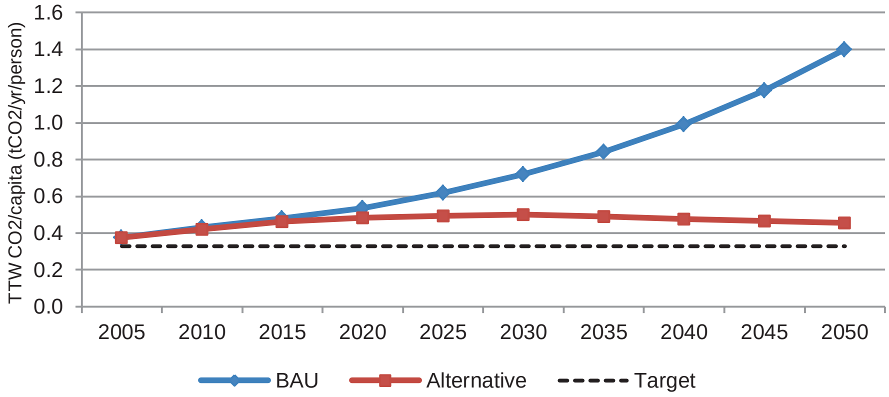


Figure 22. Comparison of BAU and ASI Cases for the Philippines

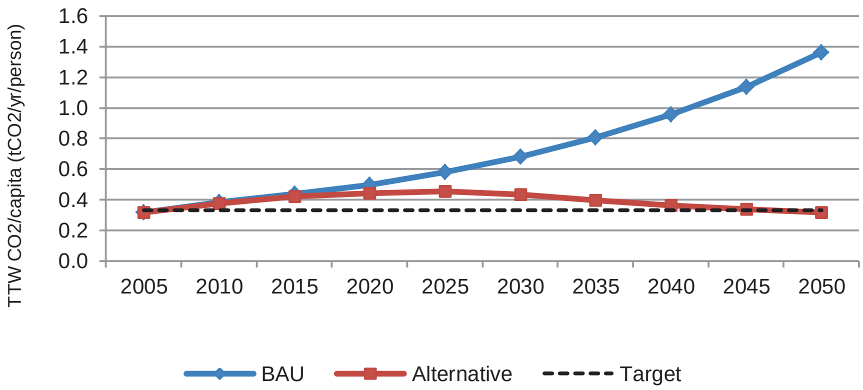


Figure 23. Comparison of BAU and ASI Cases for the Philippines Except International Transport

3.2.2 Primary Metropolitan Area

- Table 9 shows the selected avoid, shift and improve policies applied for the primary city case. The details for these policies are shown in Table 10, particularly for the 'shift' and 'improve' policies adopted. In the case of 'avoid' policies, application is from the present to 2050.

Table 9. Selected Avoid, Shift, and Improve Policies for Primary Metropolitan Area

AVOID POLICIES	SHIFT POLICIES	IMPROVE POLICIES
• Pricing regimes • ICT • Teleactivities • Travel plans • Improved travel awareness	• Bus/BRT usage promotion • Bus/BRT infrastructure development • Rail/LRT usage promotion • Rail/LRT infrastructure development	• Hybrid promotion • CNGV promotion • EV mass supply • EV promotion • Biofuel promotion • Ecological driving

Table 10. Details of Introduced Policies for the Primary City Case

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)							
	2015	2020	2025	2030	2035	2040	2045	2050
Shift (Passenger)								
Bus/BRT usage promotion and infra development								
from Car, LV, SUV to Bus	0%	1%	3%	5%	8%	10%	13%	15%
from 2W/3W to Bus	0%	1%	3%	4%	6%	7%	9%	10%
from Car/LV/SUV to BRT	0%	1%	2%	3%	3%	4%	5%	6%
from 2W/3W to BRT	0%	1%	2%	3%	3%	4%	5%	6%
Rail/LRT usage promotion and infra development								
from Car/LV/SUV to Rail	0%	1%	2%	3%	4%	5%	6%	6%
from Car/LV/SUV to LRT	0%	1%	2%	3%	4%	4%	5%	6%
from 2W/3W to LRT	0%	1%	3%	4%	6%	7%	9%	10%
Improve								
CNGV mass supply and promotion								
Bus	0%	1%	6%	16%	19%	21%	24%	26%
Truck	0%	0%	0%	1%	2%	3%	3%	4%
Hybrid mass supply and promotion								
Car (to hybrid-gasoline)	0%	1%	1%	2%	3%	4%	4%	5%
LV (to hybrid-diesel)	0%	1%	6%	16%	19%	21%	21%	26%
Truck (to hybrid-diesel)	0%	0%	1%	1%	2%	4%	5%	6%
EV mass supply and promotion								
LV	0%	3%	5%	6%	7%	8%	9%	10%
2W/3W	0%	1%	6%	11%	14%	16%	19%	21%

- The result of calculations using the Backcasting Tool for Metro Manila is shown in Figure 24 with potential carbon reduction from 0.516 tCO2/person/year to 0.076 tCO2/person/year by 2050.
  - This is the possible outcome of fairly aggressive implementation of policies throughout the country but likely focused on urban areas especially Metro Manila and highly urbanized cities.
  - This assumes the realization of what seems to be very optimistic targets set by government agencies for infrastructure development, and the promotion and adoption of alternative fuels and vehicles including electric-powered jeepneys and tricycles, and hybrid and electric cars.

3.2.3 Million plus urban area

- Table 11 shows the selected avoid, shift and improve policies applied for the large city case. The details for these policies are shown in Table 12, particularly for the 'shift' and 'improve' policies adopted. In the case of 'avoid' policies, application is from the present to 2050.

Table 11. Selected Avoid, Shift, and Improve Policies for Large City (Population >1 million)

AVOID POLICIES	SHIFT POLICIES	IMPROVE POLICIES
• Pricing regimes • ICT • Teleactivities • Travel plans • Improved travel awareness	• Bus/BRT usage promotion • Bus/BRT infrastructure development • Rail/LRT usage promotion • Rail/LRT infrastructure development	• CNGV promotion • Hybrid promotion • EV mass supply • EV promotion • Biofuel promotion • Ecological driving

Table 12. Details of Introduced Policies for the Large City Case

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)							
	2015	2020	2025	2030	2035	2040	2045	2050
Shift (Passenger)								
Bus/BRT usage promotion and infra development								
from Car, LV, SUV to Bus	0%	1%	2%	3%	3%	4%	5%	6%
from 2W/3W to Bus	0%	0%	0%	1%	3%	4%	5%	6%
from Car/LV/SUV to BRT	0%	0%	1%	2%	3%	4%	5%	6%
from 2W/3W to BRT	0%	0%	1%	2%	3%	4%	5%	6%
Rail/LRT usage promotion and infra development								
from Car/LV/SUV to Rail	0%	0%	1%	2%	3%	4%	5%	6%
from Car/LV/SUV to LRT	0%	0%	0%	0%	1%	1%	1%	1%
from 2W/3W to LRT	0%	0%	0%	0%	1%	1%	1%	1%
Improve								
CNGV mass supply and promotion								
Bus	0%	0%	1%	4%	6%	8%	9%	11%
Truck	0%	0%	0%	0%	1%	2%	3%	3%
Hybrid mass supply and promotion								
Car (to hybrid-gasoline)	0%	0%	2%	3%	5%	7%	8%	10%
LV (to hybrid-diesel)	0%	0%	1%	4%	6%	8%	9%	11%
Truck (to hybrid-diesel)	0%	0%	1%	1%	2%	4%	5%	6%
EV mass supply and promotion								
LV	0%	0%	3%	5%	8%	10%	13%	15%
2W/3W	0%	0%	6%	11%	14%	16%	19%	21%

- The result of calculations using the Backcasting Tool for large cities such as Cebu and Davao, which have populations of more than 1 million people is shown in Figure 25 with potential carbon reduction from 0.688 tCO2/person/year to 0.084 tCO2/person/year by 2050.
  - o This is the possible outcome of fairly aggressive implementation of policies for major urban areas especially highly urbanized cities that will have 1 million populations before 2050.
  - o This assumes the realization of what seems to be very optimistic targets set by government agencies for infrastructure development, and the promotion and adoption of alternative fuels and vehicles including electric-powered jeepneys and tricycles, and hybrid and electric cars.

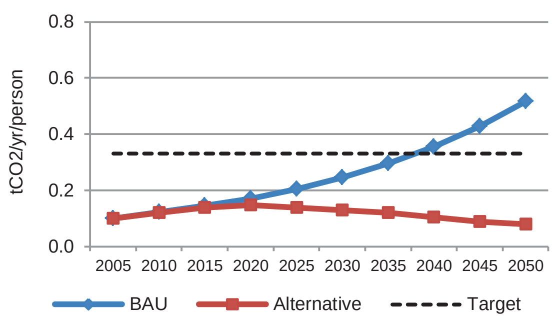


Figure 24. Comparison of BAU and ASI Cases for Metro Manila

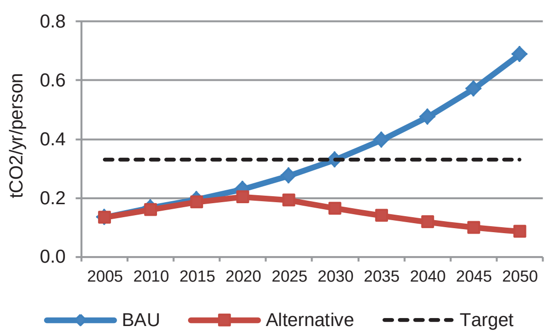


Figure 25. Comparison of BAU and ASI Cases for Large City

3.2.4 Other Urban Area

- Table 13 shows the selected avoid, shift and improve policies applied for the small city case. The details for these policies are shown in Table 14, particularly for the 'shift' and 'improve' policies adopted. In the case of 'avoid' policies, application is from the present to 2050.

Table 13. Selected Avoid, Shift, and Improve Policies for Cities with Population < 1million

AVOID POLICIES	SHIFT POLICIES	IMPROVE POLICIES
• Pricing regimes • ICT • Teleactivities • Travel plans • Improved travel awareness	• Bus usage promotion • Bus infrastructure development	• CNGV promotion • Hybrid promotion • EV promotion • Biofuel promotion • Ecological driving

Table 14. Details of Introduced Policies for the Small City Case

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)							
	2015	2020	2025	2030	2035	2040	2045	2050
Shift (Passenger)								
Bus/BRT usage promotion and infra development								
from Car, LV, SUV to Bus	0%	0%	0%	1%	3%	4%	5%	6%
from 2W/3W to Bus	0%	0%	0%	1%	3%	4%	5%	6%
from Car/LV/SUV to BRT	0%	0%	0%	1%	3%	4%	5%	6%
from 2W/3W to BRT	0%	0%	0%	1%	3%	4%	5%	6%
Improve								
CNGV mass supply and promotion								
Truck	0%	0%	0%	0%	1%	2%	3%	3%
Hybrid mass supply and promotion								
Car (to hybrid-gasoline)	0%	0%	1%	2%	3%	3%	4%	5%
Truck (to hybrid-diesel)	0%	0%	1%	1%	2%	4%	5%	6%
EV mass supply and promotion								
LV	0%	0%	1%	1%	2%	4%	5%	6%
2W/3W	0%	0%	6%	11%	14%	16%	19%	21%

- The result of calculations using the Backcasting Tool for other cities such as those with less than 1 million is shown in Figure 26 with potential carbon reduction from 0.688 tCO2/person/year to 0.086 tCO2/person/year by 2050.
  - o This is the possible outcome of fairly aggressive implementation of policies throughout the country that includes these smaller cities that are not classified as highly urbanized cities.
  - o This assumes the realization of what seems to be very optimistic targets set by government agencies for infrastructure development, and the promotion and adoption of alternative fuels and vehicles including electric-powered jeepneys and tricycles, and hybrid and electric cars that apply to smaller cities.

3.2.5 Non-City

- Table 15 shows the selected avoid, shift and improve policies applied for the non-city case. The details for these policies are shown in Table 16, particularly for the 'shift' and 'improve' policies adopted. In the case of 'avoid' policies, application is from the present to 2050.

Table 15. Selected Avoid, Shift, and Improve Policies for Non-City

AVOID POLICIES	SHIFT POLICIES	IMPROVE POLICIES
• Pricing regimes • ICT • Teleactivities • Travel plans • Improved travel awareness	• Bus usage promotion • Bus infrastructure development	• CNGV promotion • Hybrid promotion • EV promotion • Biofuel promotion • Ecological driving

Table 16. Details of Introduced Policies for the Non-City Case

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)							
	2015	2020	2025	2030	2035	2040	2045	2050
Shift (Passenger)								
Bus/BRT usage promotion and infra development								
from Car, LV, SUV to Bus	0%	0%	0%	1%	3%	4%	5%	6%
from 2W/3W to Bus	0%	0%	0%	1%	3%	4%	5%	6%
Improve								
CNGV mass supply and promotion								
Truck	0%	0%	0%	0%	0%	0%	1%	1%
Hybrid mass supply and promotion								
Car (to hybrid-gasoline)	0%	0%	1%	2%	3%	3%	4%	5%
Truck (to hybrid-diesel)	0%	0%	1%	1%	1%	2%	2%	2%
EV mass supply and promotion								
LV	0%	0%	1%	1%	1%	2%	2%	2%
2W/3W	0%	0%	4%	6%	9%	11%	14%	16%

- The result of calculations using the Backcasting Tool for non-cities (i.e., municipalities) is shown in Figure 27 with potential carbon reduction from 0.688 tCO2/person/year to 0.090 tCO2/person/year by 2050.
  - This is the possible outcome of fairly aggressive implementation of policies throughout the country that should include even municipalities. Many of these municipalities though, despite development through the long-term, currently have very good air quality and are probably in the best position to address potential deterioration and increase CO2 levels.
  - This result assumes the realization of what seems to be very optimistic targets set by government agencies for the promotion and adoption of alternative fuels and vehicles including electric-powered jeepneys and tricycles, and hybrid and electric cars that are applicable to municipalities.

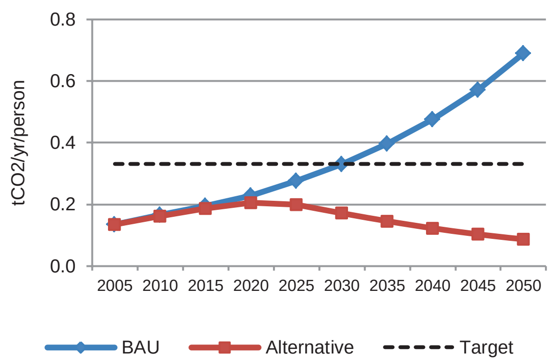


Figure 26. Comparison of BAU and ASI Cases for Small City

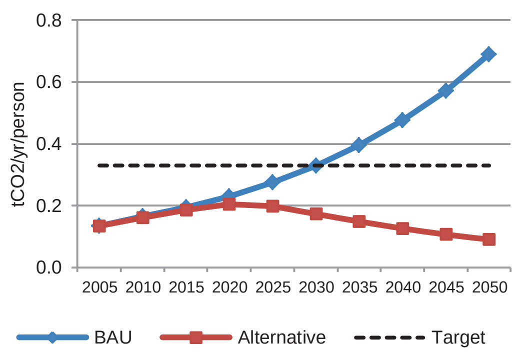


Figure 27. Comparison of BAU and ASI Cases for Non-City

3.2.6 Others

- Table 17 shows the selected avoid, shift and improve policies applied for the inter-regional transport case. The details for these policies are shown in Table 18, particularly for the 'shift' and 'improve' policies adopted. In the case of 'avoid' policies, application is from the present to 2050.

Table 17. Selected Avoid, Shift, and Improve Policies for Inter-Regional Transport

AVOID POLICIES	SHIFT POLICIES	IMPROVE POLICIES
• Pricing regimes • ICT • Teleactivities • Travel plans • Improved travel awareness	• Bus usage promotion • Bus infrastructure development • Rail infrastructure development	• CNGV promotion • Hybrid promotion • EV promotion • Biofuel promotion • Ecological driving • More efficient air transport • More efficient ships

Table 18. Details of Introduced Policies for the Inter-Regional Case

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)							
	2015	2020	2025	2030	2035	2040	2045	2050
Shift (Passenger)								
Bus/BRT usage promotion and infra development								
from Car, LV, SUV to Bus	0%	1%	1%	4%	7%	10%	12%	15%
Rail/LRT usage promotion and infra development								
from Car/LV/SUV to Rail	0%	0%	0%	1%	3%	4%	6%	8%
Shift (Freight)								
Rail usage promotion and infra development								
from Truck/Trailer to Rail	0%	0%	2%	3%	7%	11%	14%	18%
from Air to Rail	0%	0%	0%	0%	2%	3%	5%	6%
Improve								
CNGV mass supply and promotion								
Bus	0%	1%	6%	16%	19%	21%	24%	26%
Truck	0%	0%	0%	1%	2%	3%	3%	4%
Hybrid mass supply and promotion								
Car (to hybrid-gasoline)	0%	1%	3%	4%	6%	7%	9%	10%
LV (to hybrid-diesel)	0%	1%	6%	16%	19%	21%	24%	26%
Truck (to hybrid-diesel)	0%	0%	1%	1%	2%	4%	5%	6%
EV mass supply and promotion								
LV	0%	0%	3%	5%	6%	8%	9%	10%

- The result of calculations using the Backcasting Tool for inter-regional transport is shown in Figure 28 with potential carbon reduction from 0.693 tCO_2/person/year to 0.215 tCO_2/person/year by 2050.
  - o This is the possible outcome of fairly aggressive implementation of policies throughout the country that are applicable to inter-regional transport for both passenger and freight.
  - o This assumes the realization of what seems to be very optimistic targets set by government agencies for infrastructure development, and the promotion and adoption of alternative fuels and vehicles including electric-powered jeepneys and tricycles, and hybrid and electric cars, and trucks using clean diesel technology if not CNG or LPG.
  - o The CO_2 values can be significantly higher if more detailed and reliable data for aircraft and ships were available.

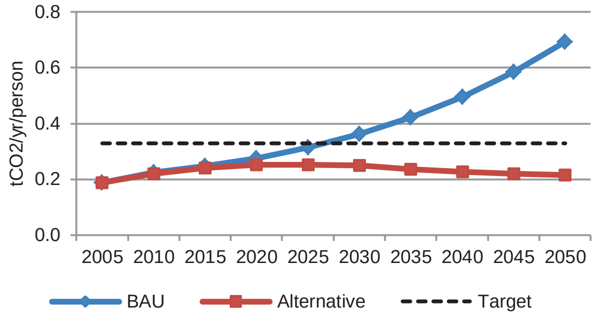


Figure 28. Comparison of BAU and ASI Cases for Inter-Regional Transport

- Table 19 shows the selected improve policies applied for the international transport case. The 'improve' policies adopted are applied from the present to 2050 where aircraft efficiencies are improved due to the re-fleeting of local and foreign airlines. The same is assumed for maritime transport.

Table 19. Selected Avoid, Shift, and Improve Policies for International Transport

AVOID POLICIES	SHIFT POLICIES	IMPROVE POLICIES
Not applicable	Not applicable	• Improved efficiency of air transport • Improved efficiency of ships

- The result of calculations using the Backcasting Tool for international intra-ASEAN transport is shown in Figure 29 with potential carbon reduction from 0.0202 tCO2/person/year to 0.0167 tCO2/person/year by 2050. Figure 30 shows the result for international except intra-ASEAN
  - o The CO2 values are quite low due to the poor quality of data available for the estimation using the backcasting tool.
  - o This can be improved with more detailed data for aircraft and ships.

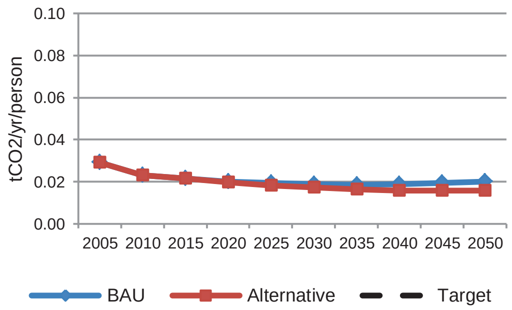


Figure 29. Comparison of BAU and ASI Cases for International Intra-ASEAN

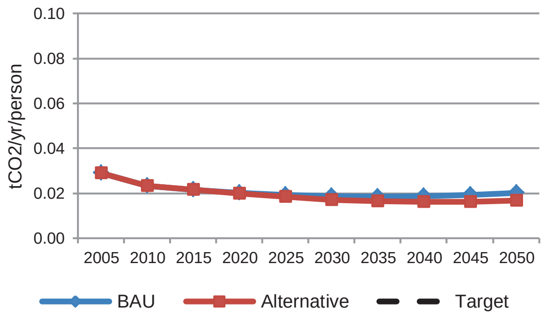


Figure 30. Comparison of BAU and ASI Cases for International EXCEPT Intra-ASEAN

3.3 Action plan

- This section presents the action plans derived from the application of the Backcasting Tool for the various cases (i.e., national, primary city, large city, city, non-city, etc.). Indicated in each table are the packages for avoid, shift and improve policies for each case as well as the target for each set of policies. These targets were the inputs to the Backcasting Tool application that generated the outcomes shown in the preceding Section 3.2.

- Note that for each case, the full range of applicable policies in terms of cost, ease of implementation and time requirement were used. In the tool, this means a setting of [$-$$$] for cost, [E-EEE] for ease of implementation, and [T-TTT] for time requirement.

- Illustrative action plans for the Philippines and Metro Manila are shown in Tables 20 and 21, respectively. Action plans for other cities (i.e., large cities with more than 1 million population, cities with less than 1 million population, etc.) and municipalities (i.e., non-cities) would be patterned after Metro Manila. Perhaps the only notable difference would be regarding rail transit infrastructure development, which will likely be applicable for large cities. Smaller cities will be served by buses or even BRT, but modern jeepneys and tricycles (or paratransit) will continue to have a significant mode share even until 2050.

Table 20. Action Plan for the Philippines

Policy package	2015	2020	2025	2030	2035	2040	2045	2050
Avoid			Pricing regimes					
	ICT, teleactivities, travel plans, improved travel awareness							
Shift	Bus/BRT usage promotion							
	Bus/BRT Infrastructure development							
	Rail/LRT usage promotion							
	Rail/LRT Infrastructure development							
	Rail usage promotion for freight							
	Rail infrastructure development							
Improve	CNGV promotion for bus							
	Hybrid promotion for car and bus							
	EV mass supply for car, 2W, 3W							
	EV promotion for LV, 2W, 3W							
		EV promotion for car						
		Hybrid promotion for trucks						
	Biofuel development for land vehicles							
	Biofuel promotion for land vehicles							
	Ecological driving for land vehicles							
	Air fuel efficiency improvement for aircraft							
		Ship fuel efficiency improvement for sea craft						

Table 21. Action Plan for Metro Manila

Policy package	2015	2020	2025	2030	2035	2040	2045	2050
Avoid			Pricing regimes					
	ICT, teleactivities, travel plans, improved travel awareness							
Shift	Bus/BRT usage promotion							
	Bus/BRT Infrastructure development							
	Rail/LRT usage promotion							
	Rail/LRT Infrastructure development							
Improve	CNGV promotion for bus							
	Hybrid promotion for car and bus							
	EV mass supply for car, 2W, 3W							
	EV promotion for LV, 2W, 3W							
		EV promotion for car						
		Hybrid promotion for trucks						
	Biofuel development for land vehicles							
	Biofuel promotion for land vehicles							
	Ecological driving for land vehicles							

Table 22 shows a summary of characteristic policies at the city, municipality and regional level and the corresponding future image of transport based on stakeholder consultations and current data on government policies and projects and in accordance to Section 2.3 of this report.

Table 22. Summary of Characteristic Policies and Corresponding Future Image for Transport

Case	Characteristic Policies	Future Image for Transport
Primary City	A. Rail transit such as MRT to form a comprehensive network. B. BRT and bus transit for other major routes and as feeders to MRT. C. Electric jeepneys and tricycles as feeders to bus and rail. D. Hybrid and electric cars will be dominant over conventional cars. 	Metro Manila will be like the present Hong Kong because of policy A and B. CBDs of high-density developments including high-rise condominiums will be served by mass transit systems comprised by rail and bus. These will be complemented by modern 4- and 3-wheeled paratransit, which will evolve from today's jeepneys and tricycles. Most cars will be hybrid or electric by 2050.
Large City	A. Rail transit (MRT or LRT) introduced starting 2025, targeting perhaps at least 2 lines for each city by 2050. B. BRT and bus are introduced starting 2020 and 2015, respectively. C. EV is pursued as dominant mode for modern jeepneys and tricycles. D. Hybrid and electric cars will replace conventional cars though not as widely as in Metro Manila. 	Large cities such as Metro Cebu and Metro Davao will eventually have their own mass transit systems including BRT and rail systems because of A and B. However, these will not be as extensive as Metro Manila's. Modern jeepneys and multicabs will serve feeder routes to buses and rail, and electric tricycles will serve residential areas and local streets. A significant number of cars will be hybrid or electric.
City	A. Bus introduced by 2020 to serve main routes. B. Promotion of electric and LPG jitneys C. Promotion of electric tricycles D. Promotion of hybrid and electric cars. 	Smaller cities will have buses serving main routes because of A. Mix of modern and conventional jeepneys and tricycles serve minor roads and residential areas due to B and C. Significant NMT and pedestrian facilities in most small cities.
Non City	A. Major routes to be served by jitneys with capacities similar to present day jeepneys. B. Promotion of electric tricycles C. Promotion of NMT paratransit D. Provision of pedestrian facilities 	Major transport routes in municipalities will be served by jitneys instead of tricycles because of A. Tricycles will still provide motorized transport in many areas but those in the CBDs will include many e-trikes due to B. Many areas will be
Inter Regional	A. Incentives for upgrade of truck fleets B. Incentives and investments for regional rail transport infrastructure 	Rail transport will become the backbone of land-based freight and passenger transport by 2050 because of B, primarily for Luzon Island. Trucks will run on hybrid-diesel and natural gas if B is effective.
International	A. Airlines, particularly low cost carriers, are given incentives including deregulation B. Maritime transport companies are given incentives to upgrade their vessels. C. Easing of travel restrictions such as visa requirements across ASEAN as well as other countries 	As the Philippines is an archipelago that is physically detached from mainland Asia, international transport will be dominated by air (for passengers) and maritime (for freight) transport. There will be more travel between ASEAN countries as restrictions across the region are eased.

4. Conclusion

- In the previous sections, a future vision for the Philippines was presented according to available information on forecasts for the economy and population of the country.
  - o By 2050, the country will have a large population with more than 150 million people, 54% of whom would be of working age and 15% comprised of senior citizens.
  - o It is envisioned to become a developed country but with a middle income equivalent to 10,000 USD per capita, which is about the current GDP/capita of Malaysia and almost 4 times the present income per capita.
  - o A vision for future society considering factors like industry, land use, energy and values or culture indicate increased consumerism and consumption with continued urbanization but with major dependence on fossil fuels overall.
- In terms of transportation, the future vision is for a higher share for public transport modes. These shares do not include walking and cycling, which stakeholders stated as also desirable for the future and for which facilities should also be provided.
  - o However, based on the plans and current rate of implementation of such plans and projects by the government the ideal vision cannot be achieved as indicated in the Backcasting Tool application outcomes. This, despite the involvement of the private sector in public-private partnership (PPP) schemes that seek to accelerate transport infrastructure development including mass public transport projects for large cities.
  - o In the future, transport in large and smaller cities will still have significant share by road transport particularly jitney-sized vehicles and 3-wheelers instead of rail or bus. However, these vehicles will use CNG, LPG or electricity instead of current inefficient surplus diesel engines.
- The results of the application of the Backcasting Tool for the Philippines indicated a possible significant carbon reduction for the entire country as well as the primary metropolitan area that is Metro Manila.
  - o Results for the application for the national case and the primary city case show that it is possible for this reduction to be realized if suitable policies are formulated and implemented properly (i.e., strictly). This appears to be related to the unanimous view of stakeholders that good, strong governance is required in order to implement plans and programs.
  - o Figure 31 shows the comparison of BAU and two ASI cases at the national level. The first ASI case (colored red) shows the previous result where a value of 0.457 tCO/person/year was obtained for 2050. The second case (colored green) shows the outcome (0.330 tCO2/person/year – achieving the target) for a scenario where the mode share for rail transport is significantly increased for both urban and inter-regional transport. In addition, an increased and significant number of LV, 2W and 3W vehicles utilize electricity.

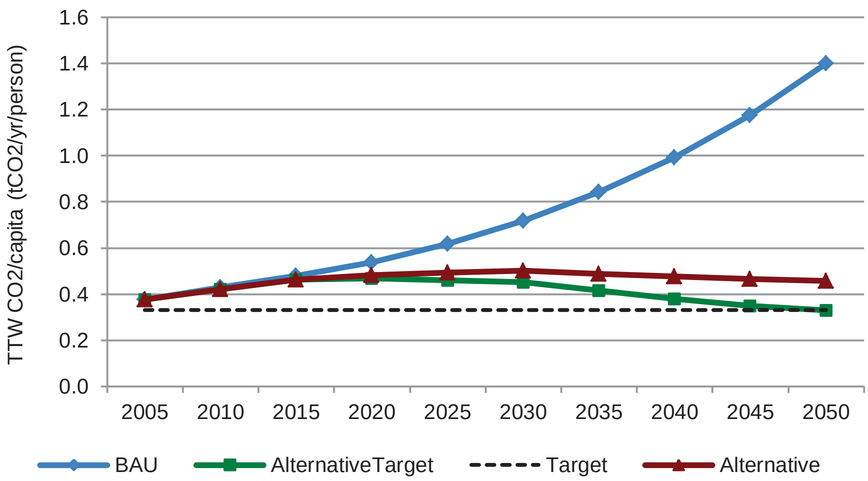


Figure 31. Comparison of Result of More Aggressive Policies and Projects at the National Level

- The details for the policies for the second ASI case are shown in Table 23, particularly for the 'shift' and 'improve' policies adopted. In the case of 'avoid' policies, application is from the present to 2050. Indicated in bold type are target values that were increased from the values shown previously in Table 8. The difficulty of reducing the national average from 0.457 tCO2/person/year to the target of 0.33 tCO2/person/year (a difference of 0.127 tCO2/person/year) is emphasized, as further reduction requires, for example, more than doubling passengers shifting from 2W/3W to bus and rail. Moreover, such requires a significant shift of freight transport from truck and air to rail. All these are hinged on the assumption that the country can carry out infrastructure development to meet the target.

Table 23. Details of Introduced Policies for the National Case (Meeting the Target)

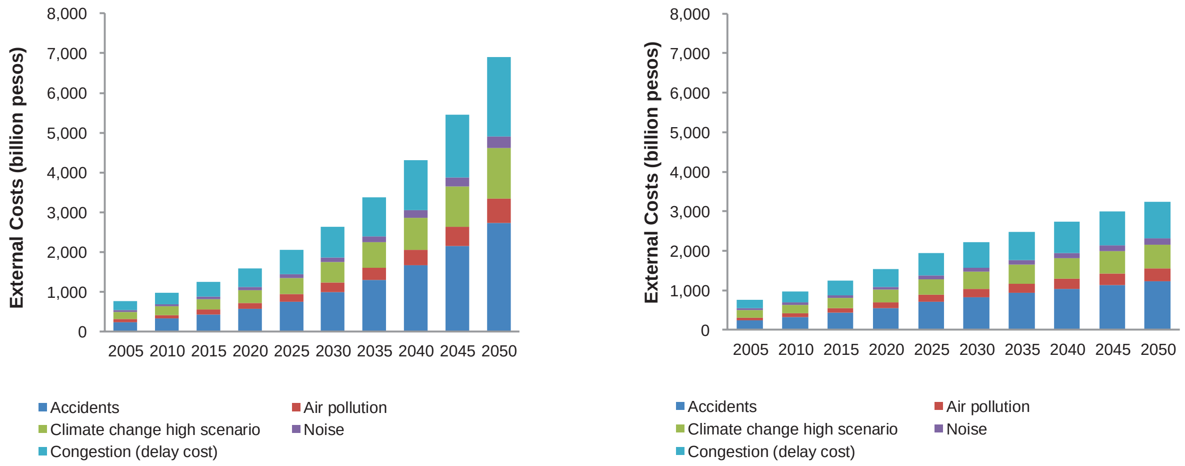
Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)							
	2015	2020	2025	2030	2035	2040	2045	2050
Shift (Passenger)								
Bus/BRT usage promotion and infra development								
from Car, LV, SUV to Bus	0%	1%	1%	2%	5%	9%	12%	15%
from 2W/3W to Bus	0%	1%	2%	**5%**	**7%**	**10%**	**13%**	**15%**
from Car/LV/SUV to BRT	0%	0%	0%	0%	**3%**	**6%**	**10%**	**13%**
from 2W/3W to BRT	0%	0%	0%	0%	**3%**	**6%**	**10%**	**13%**
Rail/LRT usage promotion and infra development								
from Car/LV/SUV to Rail	0%	0%	0%	0%	**3%**	**6%**	**10%**	**13%**
from 2W/3W to Rail	0%	0%	0%	0%	1%	1%	2%	2%
from Car/LV/SUV to LRT	0%	1%	2%	5%	**7%**	**10%**	**13%**	**15%**
from 2W/3W to LRT	0%	1%	2%	5%	**7%**	**10%**	**13%**	**15%**
Shift (Freight)								
Rail usage promotion and infra development								
from Truck/Trailer to Rail	0%	0%	1%	3%	4%	**15%**	**25%**	**35%**
from Air to Rail	0%	0%	**1%**	**2%**	**3%**	**7%**	**11%**	**15%**
Improve								
CNGV mass supply and promotion								
Bus	0%	1%	6%	16%	19%	21%	24%	26%
Truck	0%	0%	0%	1%	2%	3%	3%	4%
Hybrid mass supply and promotion								
Car (to hybrid-gasoline)	0%	1%	3%	4%	6%	7%	9%	10%
LV (to hybrid-diesel)	0%	1%	6%	16%	19%	21%	24%	26%
Truck (to hybrid-diesel)	0%	0%	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**
EV mass supply and promotion								
Car	0%	0%	**3%**	**7%**	**10%**	**13%**	**17%**	**20%**
LV	0%	**10%**	**20%**	**28%**	**36%**	**44%**	**52%**	**60%**
2W/3W	0%	**5%**	**10%**	**15%**	**20%**	**25%**	**30%**	**35%**

- In the case of inter-regional transport, the reality is that trucks using conventional diesel fuel engines will remain as the main mode for freight. In order to reduce emissions from these trucks, fleets would have to be upgraded for hybrid, CNG or LPG engines. Such requires the government to actively engage the trucking sector. The other scenario is for the Philippines will need to invest heavily in long distance rail transport to achieve a significant shift from road to rail. This assumes also that incentives for rail are put in place.
- However, to attain significant reduction requires the construction of a comprehensive network of public transport systems (i.e., like Japan's or Singapore's) including rail and BRT and a shift from tricycles, jeepneys to bus and rail transit. This is required for immediate implementation.
  - The Philippines needs to invest in rail and BRT to achieve 1.6% and 15.7% national share by 2030, and 10.5% and 26.6% passenger-km share by 2050, respectively, while decreasing the share of cars and jeepneys throughout the country.
  - The Philippines needs to aggressively implement programs that seek to increase infrastructure spending to 5-6% of its GDP by 2016. However, this amount of spending may not be enough for the long term

considering the backlog of transport projects particularly to address mobility and transport efficiency in cities and at the inter-regional level. As such, the country must commit more resources for transportation while maintaining a balance for the other needs of the country.

- o The Backcasting Tool requires data to support the calculations in the worksheets. As such, policy packages that can be added are limited by the availability and quality of data to support the policies.
- o Implementation of policies is very dependent on the assumption of good governance that was emphasized during stakeholder workshop conducted in Manila in September 2013. This is perceived as a major obstacle in the realization of many transport plans and projects, especially those that will have major impacts on carbon reduction (e.g., mass transit).

- The Climate Change Commission (CCC) stated that GHG mitigation is already in the national agenda. However, they have no tools or methodology (e.g., NAMAs) for quantitative assessment of mitigation.
  - o The CCC is promoting awareness on environmental concerns and welcomes the development of a tool that they can use to determine and evaluate what policies need to be developed and implemented at the national and local levels.
- The DOTC has a National Implementation Plan (NIP) for the transport and the environment. This NIP identifies mitigation options and mentions the use of tools to measure the impacts of these options. Unfortunately, the agency and the country have not yet adopted this plan.
  - o The DOTC states that there is no specific tool that was provided to them by the consultants who formulated the NIP. Therefore, the tool can be useful to the agency for assessing impacts of policies and projects in different cities.
- Finally, it is important to explain the benefits of the CO2 reduction using the co-benefits approach. The stakeholder workshop in Manila showed less appreciation or concern about CO2 compared with other factors such mobility, pollution and safety.
  - o Economic benefits not limited to carbon reduction but associated parameters like reduced traffic congestion, improved road safety, reduced air pollution, reduced noise energy efficiency, and overall climate change.
  - o Studies such as those by the WHO (2011) have established the health benefits of good public transport combined with pedestrian and cycling infrastructure. Independent studies such as those published by Litman (2012) provide in-depth analysis of the valuating climate change and other co-benefits such as congestion, road crashes, air pollution and noise.
  - o Figure 32 shows an illustrative application of the co-benefits approach in evaluating the impacts of carbon reduction. In the figure, the second graph shows the reduction of external costs due to other parameters that have been found to have a direct relationship with CO2 reduction. It is clear that the co-benefits of carbon reduction, particularly the reduction of traffic congestion and road crashes, and addressing climate change results in huge savings that can be translated into overall benefits to society that will contribute to improved well-being.



a. BAU Case   b. ASI Case

Figure 32. Comparison of Co-Benefits of BAU and ASI Cases for the Philippines

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Malaysia

Prepared by
Mr. Alvin Mejia
Mr. Mark Tacderas
Ms. Kathleen Dematera
Supported by
Prof. Mohamed Rehan Karim
Mr. Sudhir Gota

LIST OF ABBREVIATIONS

2W	Two-Wheelers (motorcycles)
3W	Three-Wheelers (tricycles)
ADBI	Asian Development Bank Institute
AJTP	ASEAN-Japan Transport Partnership
APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
BAU	Business-As-Usual
BRT	Bus Rapid Transit
CAA	Clean Air Asia
CNG	Compressed Natural Gas
CNGV	Compressed Natural Gas Vehicle
CO2	Carbon dioxide
ECER	East Cost Economic Region
EPU	Economic Planning Unit
ERL	Express Rail Link
EST	Environmentally Sustainable Transport
EV	Electric Vehicle
GDP	Gross Domestic Product
GTP	Government Transformation Program
ICAO	International Civil Aviation Organization
ICCT	International Council on Clean Transportation
ICT	Information and Communication Technology
JBIC	Japan Bank for International Cooperation
KTMB	Keretapi Tanah Melayu Berhad
LPG	Liquefied Petroleum Gas
LRT	Light Rail Transit
LV	Light Vehicle (passenger)
MOT	Ministry of Transport
MRT	Metro rail Transit
NAMA	Nationally-Appropriate Mitigation Actions
NCER	Northern Corridor Economic Region
NKEA	National Key Economic Areas
NLPTM	National Land Public Transport Master Plan
PKM	Passenger-Kilometer
RM	Malaysian Ringgit
SCORE	Sarawak Corridor Renewable Energy
SDC	Sabah Development Corridor
SUV	Sports Utility Vehicle
TEU	Twenty-foot Equivalent Unit
TKM	Ton-Kilometer
TOE	Tons of oil Equivalent
UNCRD	United Nations Centre for Regional Development
UNFCCC	United Nations Framework Convention on Climate Change
USD	US Dollar
VAPIS	Vehicular Air Pollution Information System
WB	World Bank
WRI	World Resources Institute

1. Society

1.1 Present Situation

This section presents key social, economic and cultural factors in Malaysia that were looked at in this study, particularly in defining future transportation scenarios. This section briefly provides an overview of the geography, society and the demography of Malaysia, as well as its economy and energy use.

1.1.1 General

- With a total land area of 330,290 sq. km., Malaysia is composed of 13 states and three federal territories. The federal Kuala Lumpur, covering an area of 243 sq. km., serves as the capital city of Malaysia.
- The country is divided by South China Sea into two regions: the Peninsular Malaysia consisting 11 of the states and two of the federal territories, and the East Malaysia consisting the two remaining states and one federal territory.
- The governance structure of Malaysia is divided between the federal government and the state governments (Table 1). The 13 states each have their own unicameral State Legislative Assembly, while the federal territories are directly governed by the federal government of Malaysia which consists of executive, legislative and judiciary branches.
- Responsibilities concerning transportation are divided between the State and Federal government. The Federal government is generally responsible for national plans and guidelines, and has limited control over privately owned transit systems and expressways. The State government, on the other hand, implements projects and policies such as the improvement of walkways or bus stations within their jurisdiction. The Ministry of Transport (MoT) oversees all matters related to land, air and maritime transport, under which the Civil Aviation Department, Road Transport Department, Road Safety Department, and Marine Department belong to. MoT also oversees Railway Assets Corporations (RAC), a Federal statutory body tasked to develop the railways and finance its infrastructure development through rental and government allocation.
- The Land Public Transport Commission (Malay: Suruhanjaya Pengangkutan Awam Darat, or SPAD), directly administered by the Prime Minister, presently functions as the primary agency responsible for the planning of public transport, the regulation of trains, buses and taxi services, including land freight. SPAD is likewise taking over the role of the now defunct Commercial Vehicles Licensing Board, Department of Railways and the tourism vehicles licensing function of the Ministry of Tourism in Peninsula Malaysia, although these three institutions continue to operate in Sabah and Sarawak in East Malaysia.

Figure 1. Map of Peninsular Malaysia and East Malaysia
Source: Statistics Yearbook, Malaysia, 2012

Table 1. States and Territories of Malaysia

Name	Governance	Location
Johor	State	Peninsular Malaysia
Kedah	State	Peninsular Malaysia
Kelantan	State	Peninsular Malaysia
Kuala Lumpur	Federal territory	Peninsular Malaysia
Labuan	Federal territory	East Malaysia
Malacca	State	Peninsular Malaysia
Negeri Sembilan	State	Peninsular Malaysia
Pahang	State	Peninsular Malaysia
Penang	State	Peninsular Malaysia
Perak	State	Peninsular Malaysia
Perlis	State	Peninsular Malaysia
Putrajaya	Federal territory	Peninsular Malaysia
Terengganu	State	Peninsular Malaysia
Sabah	State	East Malaysia
Sarawak	State	East Malaysia
Selangor	State	Peninsular Malaysia

1.1.2 Population

- The population of Malaysia is estimated at 28 million according to the 2010 census of the Department of Statistics. In 2013, it was estimated to have reached 29.7 million (UN, 2012). It has grown at an average of 2.15% per annum in the period 1990-2013.
- The urban population of Malaysia in 2010 reached 72% of the total population, increasing from the estimated 62% in 2000 (Figure 2).
- The inhabitants of Putrajaya and Kuala Lumpur are 100% urbanized, while those of Penang and Selangor are about 91% (Department of Statistics, 2012). The urbanization rate in Malaysia has been an increasing trend since 1950s according to a JBIC/ADB/World Bank Joint Study, and it was estimated to be 63% in 2005 (NRE, 2011).
- The most populous states are Selangor, Johor and Sabah, hosting about 42% of the total population of Malaysia.
- Malaysia has a population density of 86 persons per sq. km. in 2010. A large fraction of the population lives in Peninsular Malaysia. The most densely populated areas are Kuala Lumpur, Penang and Putrajaya While Selangor is the most populous state, it only has a population density of 674 persons per sq. km. (Department of Statistics, 2010).
- About 8.2% of the total population is non-Malaysian citizens, while 91.2% are Malaysian citizens. Malaysian citizens are comprised of various ethnic groups where 67.4% are Bumiputera, 24.6% are Chinese, and 7.3% are Indians. Various smaller ethnic groups form the remaining 0.7% (Department of Statistics, 2010).

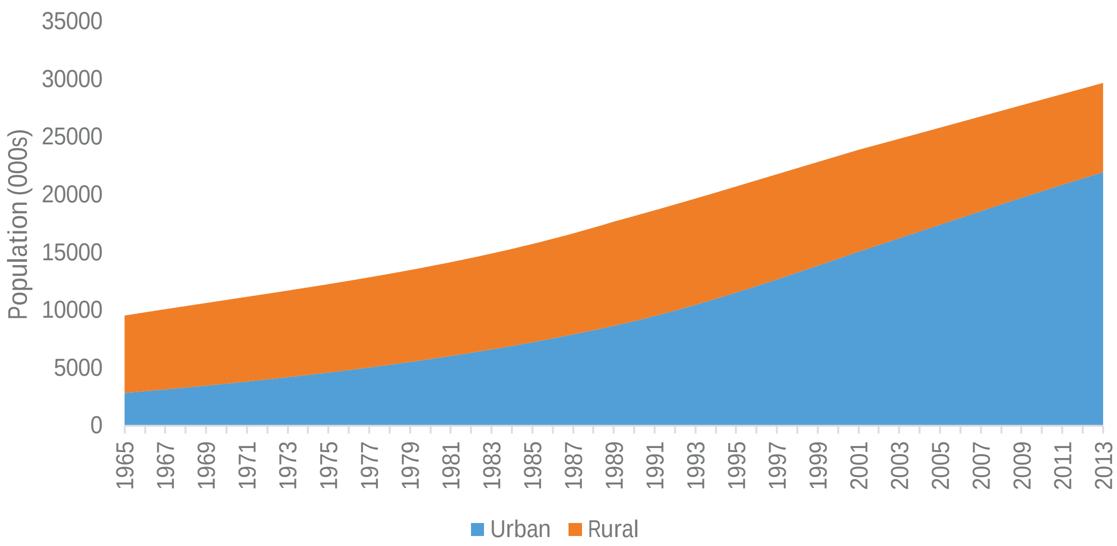

Figure 2. Population (000s), 2010
Source: UN, 2012 and UN, 2011

- 55.4% of the population are 20-64 years or age, 40.2% are below 20 years of age, while 4.4% are 65 years and over (Figure 3). The total labor force as of 2012 was 13 million (Department of Statistics, 2012; Economic Planning Unit, 2013), of which the 33.6% belongs to the 25-34 age bracket. On the other hand, the average unemployment rate during the period 2008-2012 is about 3.3% (Department of Statistics, 2012). According to the Human Resources Minister, about 46% of the workforce was female. Only 4.54% of the population are aged 65 and above.

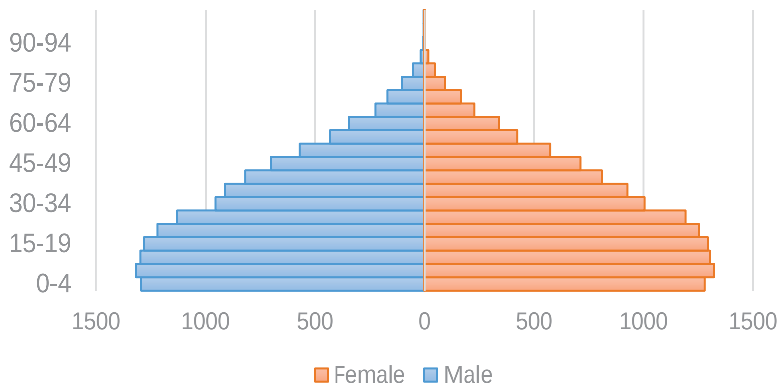

Figure 3. Population by Age (000s), 2010
Source: UN, 2012

1.1.3 Economy and Industry

- The development to the current state of Malaysia's economy can be attributed to Malaysia's Third Outline Perspective Plan where the government highlighted their sector of emphasis in three phases for the period 2001-2010 in accordance with the Capital Market Master Plan, where the period 2001-2003 would focus on strengthening the domestic capacity, 2004-2005 would focus on strengthening key sectors and liberalizing market access, and 2006 onwards would aim for the full development of their capital market.

- GDP per capita is about USD 10,221 in 2013 (2005 Constant USD) and is increasing at an average of 6.48% from 1990 to 2013 (Figure 4). Among the states and federal territories that have the highest GDP are Selangor, Kuala Lumpur, Johor and Penang.
- The largest contributors to the Malaysian GDP were the services sector and the manufacturing sector; similarly, the two sectors employ a large fraction of the total labor force. The services sector includes the repair of motor vehicles and motorcycles. They have been increasing together with the agricultural, mining and quarrying, and construction sectors.
- Malaysia's export orientation makes the country one of the largest exporter of electrical and electronic products globally. Its other major exports are manufactured goods and articles, palm oil and palm oil-based products, liquefied natural gas, and petroleum products (Department of Statistics, 2012).

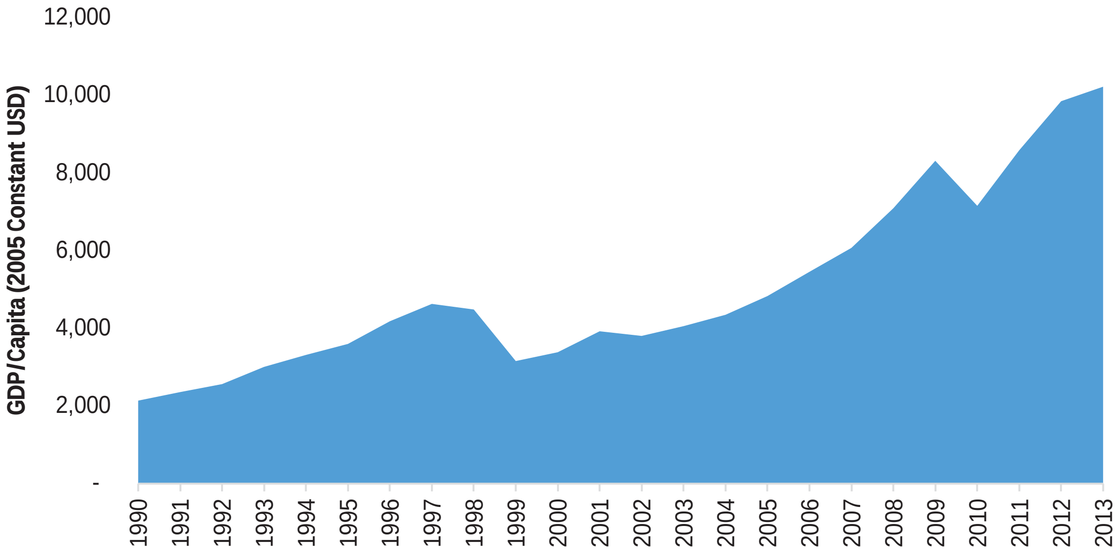

Figure 4. GDP/Capita (2005 Constant USD)
Source: World Bank 2013, UN, 2012

1.1.4 Energy

- Malaysia is endowed with several sources of indigenous primary energy sources such as coal, natural gas, oil and also renewable energy. According to the estimate of Economic Planning Unit (EPU) in 2011, Malaysia has current reserves of 5.9 billion barrels of oil and 2.5 trillion cubic meters of natural gas which can last up to the next 25 and 39 years respectively. Malaysia instituted the National Depletion policy, which restricts the production of crude oil and natural gas, in order to conserve the resources.
- According to Malaysia Energy Information Hub, the energy demand in 2011 was estimated at 1.5 tons of oil-equivalent (TOE) per capita, while the energy supply was 2.74 TOE per capita.
- At the end of 2010, Malaysia had 0.4% of the world's crude oil reserves, producing an average of 664,800 barrels of crude oil per day (PEMANDU, 2012). Malaysia is highly dependent on fossil fuels, mainly oil, coal and gas; however, the supply of non-fossil fuel source of hydropower is being increased (NRE, 2011).

1.2 Future Scenario for Society

This section presents the future scenario for Malaysia according to the key societal factors identified in the previous section. This future scenario is based on the available data on projections or estimations culled from various sources such as local projections and plans, databases and projections from international organizations such as the UN, WB, APEC, among others.

1.2.1 Population

- As a result of the urbanization, increasing high-technology-based industries, and deregulation policies, Malaysia is expected to continually grow. The future scenario of Malaysia will largely be driven by Vision 2020 which seeks to narrow the ethnic income gap and aspires that no particular ethnic group will be inherently economically backward by 2020, including the Bumiputeras of Sabah and Sarawak.
- It is estimated that there will be 43 million people in 2050 (Figure 5). The population will grow at an average of 1.16% per annum from 2005-2050.
- In 2050, 27% of the population will be below 20 years of age, 58.4% of the population will be aged 20-64, and 15% will be 65 years of age and over (Figure 6).

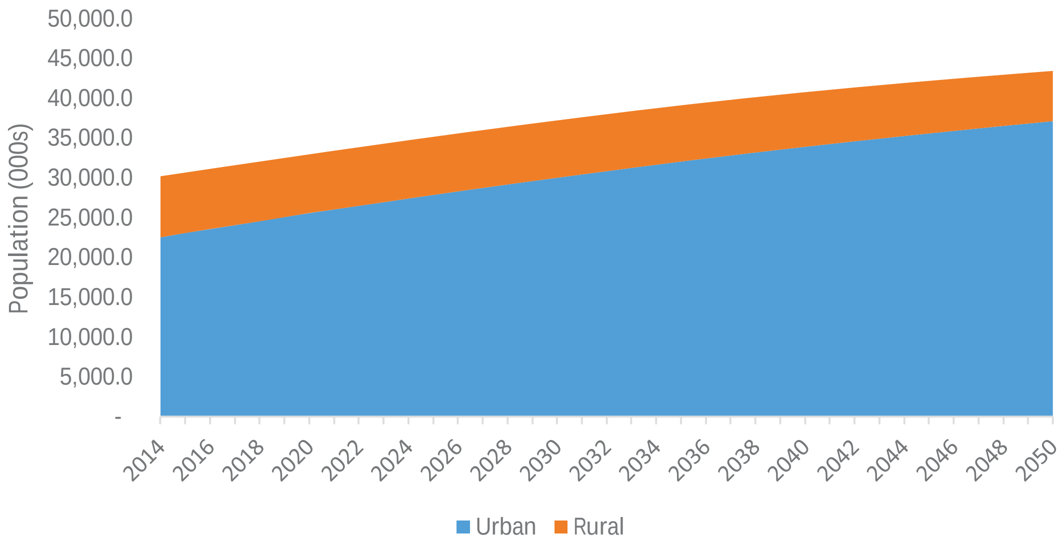

Figure 5. Population (000s), 2050

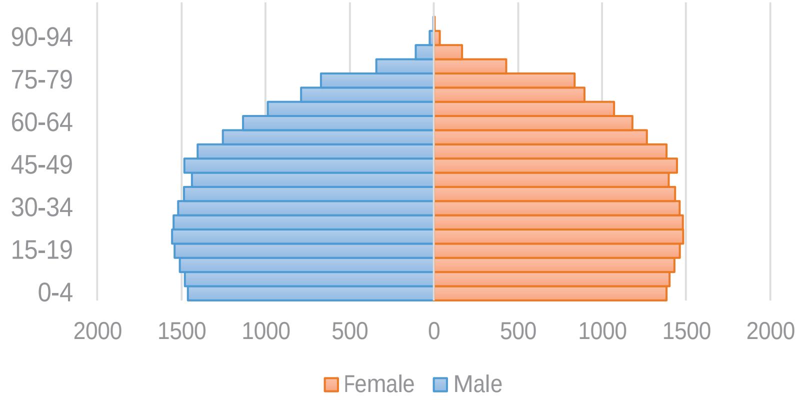

Figure 6. Population by Age, 2050
Source: UN, 2012

1.2.2 Urbanization

- The urban population will grow at an average of 1.69% over the same period and 86% of the population will be living in urban areas by 2050 (UN, 2011).
- Given the historical growth rates, the study team estimates that Kuala Lumpur will be a city with more than 2 million people from 2021. It is estimated that, in 2050, there will also be 8 cities with more than 1 million people (excluding Kuala Lumpur).

Table 2. Number of Cities Grouped According to Population
Source: Study Estimates

	2010	2050
>2 million	0	1
>1 million	1	8

1.2.3 Economy and Industry

- Vision 2020 sets realistic economic targets up to 2020, which includes, firstly, making GDP 8 times larger in 2020 than it was in 1990, i.e. about RM 920 billion, requiring an average growth of about 7% annually in real terms until 2020.
- Estimates from AIDB (2012) show that in the long-run, Malaysia will likely to have a per capita GDP of USD 35,564 (2005 constant USD) in 2050. It is projected to grow at an average of 4.54% per annum in the period 2005-2050.
- According to the government of Malaysia, with the implementation of Malaysia's various blueprints and plans, their GDP is expected to reach USD 376 billion (RM 1.2 trillion) in 2020.

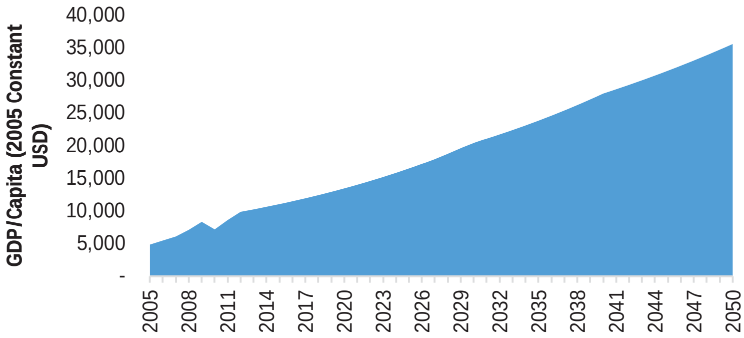

Figure 7. GDP/Capita Projections up to 2050
Source: Computed based on UN population estimates and ADBI projections

- The national vision seeks to diversify its growth, and to balance the development in the industrial, agricultural and services sectors, with an economy that is self-reliant, export-led, and technology intensive and has cohesive industrial linkages, has high productivity with regard to every factor of production, and has a low inflation and a low cost of living. The vision also emphasized the need to rely on the private sector as a primary engine of growth, and the continued implementation of deregulation.
- The growing economy of Malaysia is fuelled further by Vision 2020 to achieve the goal of making Malaysia a fully developed self-sufficient country, as well as by the 10th Malaysia Plan, which builds on the 9th Malaysia Plan by accelerating the development in the said urban conurbations, as well as the National Economic Policy (1970-1990), National Development Policy (1991-2000), and the National Vision Policy (2001-2010).
- Five economic corridors have been identified in the 9th Malaysia Plan and refined in the 10th Malaysia Plan to propel the economic growth of Malaysia, as follows:

Figure 8. Economic Corridors
Source: MyCorridor Strategic Investment Zone

Table 3. Economic Corridors According to 9th Malaysia Plan

Corridors	Industries
Iskandar Malaysia in Southern Johor	manufacturing, properties, utilities, tourism, and logistics
Northern Corridor Economic Region (NCER) covering Kedah, Penang, Perlis, and the four northern districts in Perak	agriculture, manufacturing and tourism and logistics
East Coast Economic Region (ECER) covering Kelantan, Pahang, Terengganu and the district of Mersing in Johor	tourism, oil, gas and petrochemical, manufacturing, agriculture, education
Sarawak Corridor Renewable Energy (SCORE)	hydropower
Sabah Development Corridor (SDC)	tourism, livestock, food crops, oil and gas, etc.

- Focusing on key growth engines by building urban agglomerations, focusing corridors around clusters and developing National Key Economic Areas (NKEAs), which consist of 11 sectors and one geographic area of focus of the Economic Transformation Plan: oil and gas; palm oil and related products; financial services; wholesale and retail; tourism; information and communications technology; education; electrical and electronics; business services; private healthcare; agriculture; and emphasizing the importance of the Greater Kuala Lumpur area.

1.2.4 Energy

- Estimates suggest that given the remaining reserves and the extraction rates for oil, it is expected that Malaysia will be a net importer of oil in 2025. Increased production for natural gas from newly discovered sources is a positive prospect for Malaysia, particularly in the medium term. Primary energy consumption is expected to increase by 2.1% per year up to 2035 (APEC, 2012).
- The electricity generation mix, which is also important to look into when talking about potential transportation energy, is planned to be shifted towards higher shares of renewable energy and natural gas, at the expense of the shares of coal and oil (APEC, 2012).
- Small-scale renewable energy generation will continue to increase in its share in the grid generation mix (even if it is still relatively small in 2050). Additional capacities for larger scale hydro plants are expected to shift generation towards being less carbon intensive.

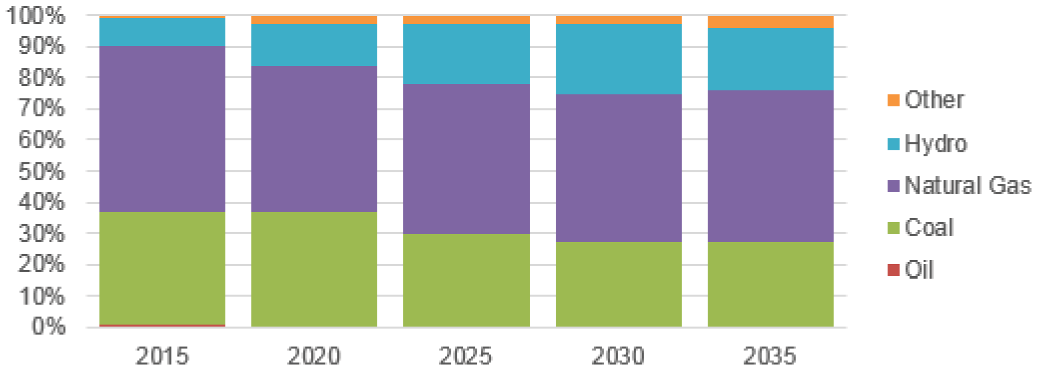

Figure 9. Electricity Grid Mix by Fuel Type
Source: APEC, 2013

2. Transport

2.1 Present Situation

- This section presents the present state of the different modes of transportation in Malaysia and their current trends and issues.
- *Passenger transport:* Privately owned four-wheeled cars and SUVs dominate the travel demand in Malaysia, totaling 57% of the total passenger-kilometer. Meanwhile, two- and three-wheelers cover 24% of the total travel demand (Figure 10). Motorcycles and cars are the most preferred modes of transport in Malaysia. By contrast, public transport accounts for a small share in the vehicles registered. The rest of the vehicles include tractors, buses and taxis.
- *Freight transport:* Goods vehicles presently comprise close to 5% of the total motor vehicles. Land freight grew by 9.9% from 2004 to 2010, and hit 302.5 billion ton-kilometers (Figure 11).

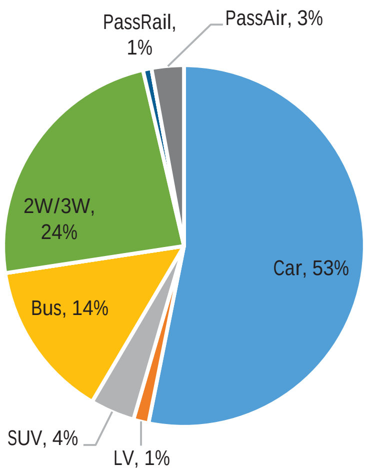

Figure 10. Passenger Transport Mode Share (% of PKM), 2010
Source: Study estimates

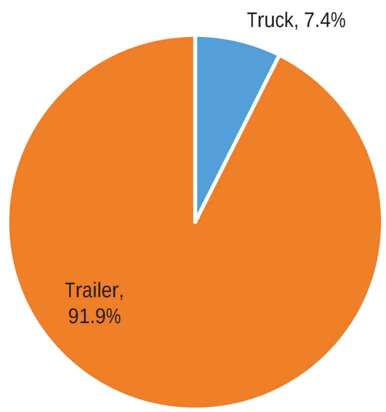

Figure 11. Freight Transport Mode Share (% of PKM), 2010
Source: Study estimates

2.1.1 Road Transport

The growth of the road transport sector is evident by the increase in road lengths and in the number of vehicles (Figure 12). The whole of Malaysia has a total of 155,426 km. of roads as of 2011, 125,776 of which are paved.

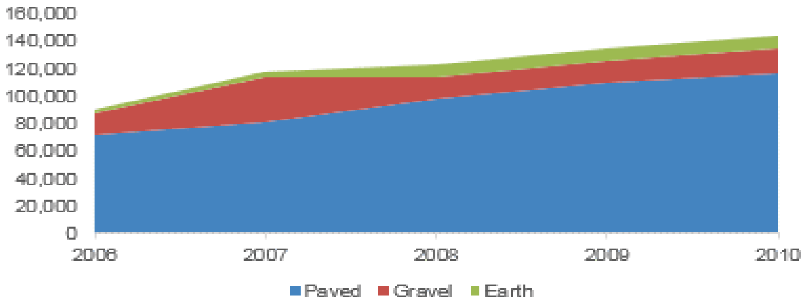

Figure 12. Road Length (km), 2006-2010

The 20-year National Land Public Transport Master Plan (NLPTM) notes that, in general, travel vehicle demand grew from 13 million trips per day in 1991 to 40 million in 2010. Wilayah Persekutuan represents the three Federal Territories of Kuala Lumpur, Labuan and Putrajaya, and has a high vehicle market. Johor had the largest share of the total motorcars and motorcycles in 2012. Only in Sabah, Sarawak, and Kuala Lumpur are the motorcars greater than motorcycles.
Table illustrates the population of road vehicles in 2010 according to study estimates. The number of the total motor vehicles in 2012 reached close to 23 million (MOT, 2012).

Table 4. Population of Road Vehicles, 2010

Mode	No. of Vehicles	Percent
Passenger		
Cars	9,114,293	45.1
LV	102,961	0.5
SUV	493,451	2.4
Bus	69,149	0.3
Motorcycles	9,441,907	46.8
Freight		
Truck	512,074	2.5
Trailers	454,103	2.2

Alongside the increase in road lengths are the increase in motor vehicle registration. Figure 13 illustrates the trend and share analysis over the period 1977-2012. Furthermore, the figure shows that roughly 90% of the total motor vehicles are closely equally divided between motorcars and motorcycles, both privately owned.

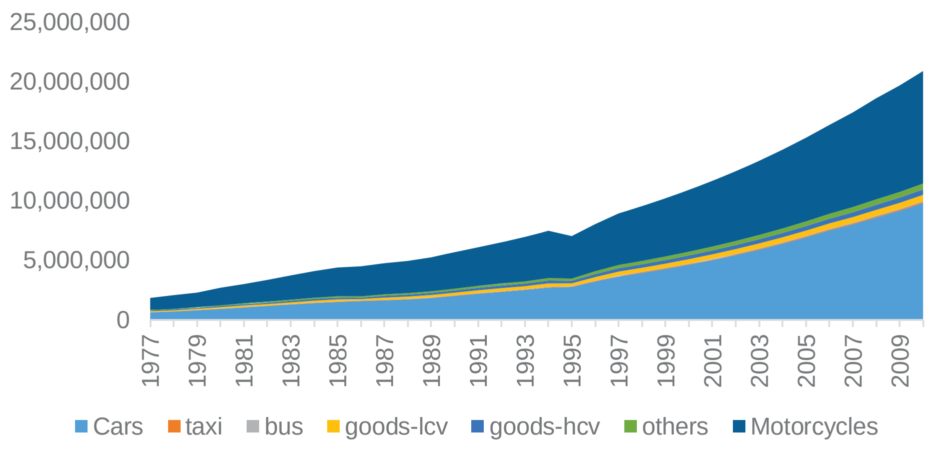

Figure 13. Number of Registered Motor Vehicles, 1977-2012
Source: Ministry of Transport

- Privately owned passenger motorcycles and motorcars account for a significantly large fraction of the total registered vehicles (95% of the road fleet in 2010).
- The buses cover almost all cities of Peninsular Malaysia and hence have become a popular mode of intercity transport (Roza, Koting, & Karim, 2013).
- The population of goods vehicles has likewise been increasing across Malaysia, presently comprising close to 5% of the total motor vehicles. According to the NLPTM, land freight grew by 9.9% from 2004 to 2011, and hit 382,701 million ton-km. Malaysia is served by numerous haulers and freight forwarders.
- In Kuching, the gap in bus system is filled by the "*van sapu*" (unlicensed taxis) believed to be utilized mostly by illegal workers crossing the Kalimantan-Malaysia border as they do not have legal documents to use the legal buses (The Ant Daily, 2013). In Kota Kinabalu, public transport is dominated by mini-vans, which have poor safe record. As a result of low public transport mode share, the revenue of the private bus operators, for instance, hampers their capacity to reinvest.
- Tax exemption for fully imported hybrid cars has just been discontinued for the reason that it was unable to attract enough investments for local production. Tax cuts for locally assembled hybrid units will continue until Dec. 31, 2015 while that of electric vehicles will continue until Dec. 31, 2017 (Nee, 2014). This is a significant incentive as the excise tax for completely built units could reach 65% to 105%, depending on the engine displacement of the car (The Malaysian Reserve, 2014).
- The revised National Automotive Policy 2014, however, now enables foreign makers of energy efficient vehicles to obtain licenses to manufacture in Malaysia to be able to compete with Indonesia and Thailand, and likewise offers roughly RM 2.1 billion (USD 633 million) soft loans and grants to foreign companies that set up plants in Malaysia (Lim, 2014), targeting to approve three to four manufacturing licenses for energy efficient vehicles by 2018 (Nee, 2014). It is anticipated that, by 2020, 85% of all the locally produced vehicles will be energy efficient.

2.1.2 Rail Transport

- Malaysia is served by heavy rail transit, light rail, mono rail and a funicular system. There are a total of 1,792 km of railway tracks in Malaysia operated mainly by four groups. The national railway operator and the most popular is Keretapi Tanah Melayu Berhad (KTMB) which serves Peninsular Malaysia with its KTM Intercity passenger trains as well as KTM Komuter which serves Kuala Lumpur and Klang Valley suburbs. KTMB transports passenger and goods, and so does Sabah State Railway, a state department operating a line in East Malaysia. The two other major operators are Express Rail Link (ERL) SdnBerhad and RapidKL. Figure 14 to Figure 16 illustrate the rail networks in Sabah and Peninsular Malaysia, as well as the rail network routes in Klang Valley.

- The rail network is shared by the transport of passenger and goods. The railways in Malaysia run at low speeds, and there is a shortage in locomotives and crews, and, as a result, have longer travel times on certain routes (Roza, Koting, & Karim, 2013) and are preferred less.
- As for the goods transport, freight via rail is growing gradually (Table), but NLTPTM highlights the continued inadequacy of railway use which is more efficient and cost-effective. NLPTM cites The World Bank's "Connecting to Compete 2012" survey that placed Malaysia 29th in Logistics Performance Index out of the 155 countries. Port Kelang, the largest port in Malaysia located in the state of Selangor and 38 km. southwest of Kuala Lumpur, is among the world's leading maritime ports by cargo weight and by twenty-foot equivalent unit (TEU) handled.

Table 5. Characteristics of Rail Networks

Year	Length of railway (km)	Passenger-km ('000)	Total ton-km ('000)
2006	1949	1247630	1337102
2007	1792	1316834	1355530
2008	1792	1385576	1350629
2009	1792	1525568	1384380
2010	1792	1532185	1482799

Figure 14. Rail Transport Network of Sabah
Source: Transport Statistics 2012,
Ministry of Transport

Figure 15. Rail Transport Network of Peninsular Malaysia
Source: Transport Statistics 2012,
Ministry of Transport

Figure 16. Rail Transport of Klang Valley
Source: Transport Statistics 2012, Ministry of Transport

2.1.3 Air Transport

- As a result of liberal aviation policy and immense investment in aviation infrastructure (Figure 19), Malaysia was ranked 16th in the world in terms of freight tons and 21st in passenger-kilometers performed in 2012 (MOT, 2013), with total passenger traffic reaching 68.6 million, and with freight volume reaching 890,104 metric tons (MOT, 2012). Figure 17 and Figure 18 show the increasing trend of air traffic passengers from Peninsular Malaysia, Sabah and Sarawak.

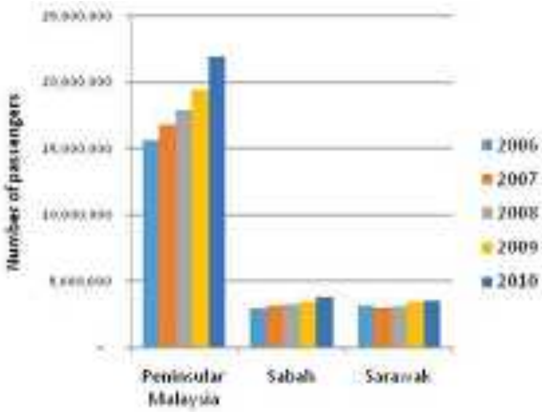

Figure 17. Number of Passengers, Embarkation, 2006-2010
Source: Ministry of Transport

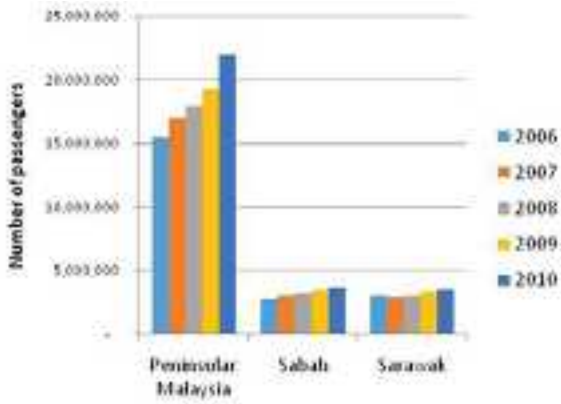

Figure 18. Number of Passengers, Disembarkation, 2006-2010
Source: Ministry of Transport

- Malaysia has air service agreements with 96 countries of which 18 are open-skies, hence enhancing accessibility and increasing competition. 67 foreign airlines operate to Malaysia. There has been an increase of air traffic passengers in terms of embarkation and disembarkation over the period 2006-2011 (The Star, 2013).
- Furthermore, the airport in Kuala Lumpur is among the world's top international air freight by tons handled, according to a publication of US Department of Transportation on freight highlights (2010).

Figure 19. Airport Location of Peninsular Malaysia, Sabah, and Sarawak[1]
Source: Transport Statistics 2012, Ministry of Transport

2.1.4 Water Transport

- The maritime industry in Malaysia has grown in recent years alongside its growing trade with other countries. The country's well-maintained road networks linking the seaports from the major corners of Malaysia (Figure 20), as well as the developed infrastructure, continue to attract business from large shipping lines. The major

[1] Note: Yellow represents international airports, red represents domestic airports, blue represents airstrips.

seaports are Kelang, George Town, Penang and Kuantan, and Kota Kinabalu and Kuching. Seaports and rail transit systems will continue to be added and upgraded.

Figure 20. Federal Ports Location of Peninsular Malaysia, Sabah, and Sarawak[2]
Source: Transport Statistics 2012, Ministry of Transport

- The World Shipping Council ranked Port Kelang 12th and Tanjung Pelepas 19th among the world' top 50 container ports in terms of volume (World Shipping Council). It has been estimated that about 95% of the country's international trade is carried through its international seaports (Khalid, 2006).
- In 2012, the cargo throughput by ports reached close to 496 million freight weight tons (Figure 21). Port Kelang handled 196 million while Tanjung Pelepas handled 116 million. General cargo and bulk carriers account for a fraction of the totality, while containerized cargo accounts for 320 million.
- In order to ensure the safety and security of its waters, the Malaysian Maritime Enforcement Agency was formed in February 2005. Most of the major ports in Malaysia have been privatized in accordance with Port Privatization Act 1990.

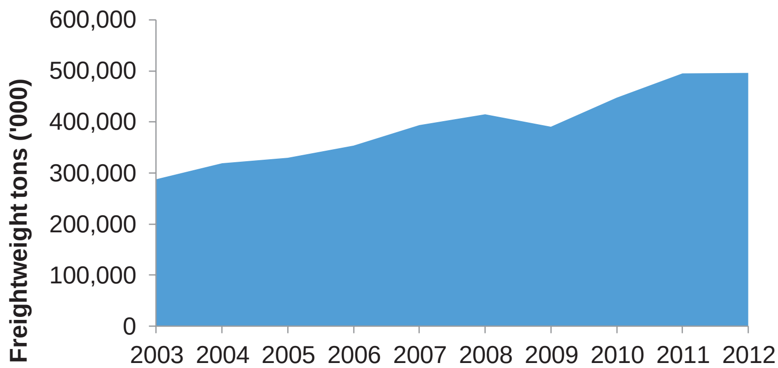

Figure 21. Total Cargo Throughput by Ports, 2003-2012
Source: Transport Statistics 2012, Ministry of Transport

2.2 Key Transport Data

This section presents key information used in the analysis performed for this study. These data include inputs to the Backcasting Tool employed to estimate carbon reduction for the alternative scenarios to the business-as-usual (BAU) cases presented in the succeeding chapter of this report.

[2] Note: Yellow represents federal port while red represents state port

2.2.1 Road Transport

- Vehicle Numbers
  - The projection of the number of road vehicles for the baseline scenario is crucial in projecting the emissions from road transportation. The study utilizes gompertz functions which forecasts the number of vehicles based on historical data on GDP/capita and in-use vehicles (each road vehicle type) per 1000 people. Due to the unavailability of in-use vehicle numbers, the study utilizes the official registered vehicles data (historical) from official statistics. The projections for the GDP per capita are explained in the section on the future vision of society. The parameters of the gompertz functions were estimated based on the GDP/capita and the vehicle/1000 data, where in the parameters which resulted in estimations with the lowest squared deviations from the actual data were selected. Reality checks were made in order to ensure that the projections can actually happen.
  - The results for Malaysia indicate that in 2050, the motorization index (vehicle/1000) for motorcycles is 546, while cars are at 576 and goods vehicles are at 68.[3] The total number of vehicles (including motorcycles) is expected to more than double from 2005 to 2050 (from 14 million to 39 million) (Figure 22). The figure below reflects the do-nothing scenario in the future.

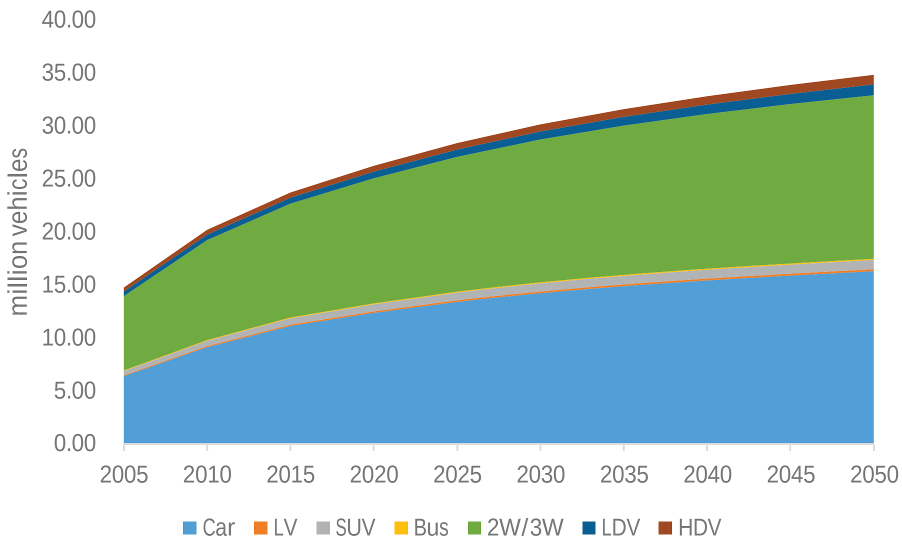

Figure 22. Number of Road Vehicles up to 2050

  - The figure below shows the movement between the shares of the total vehicle fleet in the country up to 2050.

[3] These numbers stood at 248 per 1000 people ,226 per 1000 people and 29/1000 people in 2005, respectively.

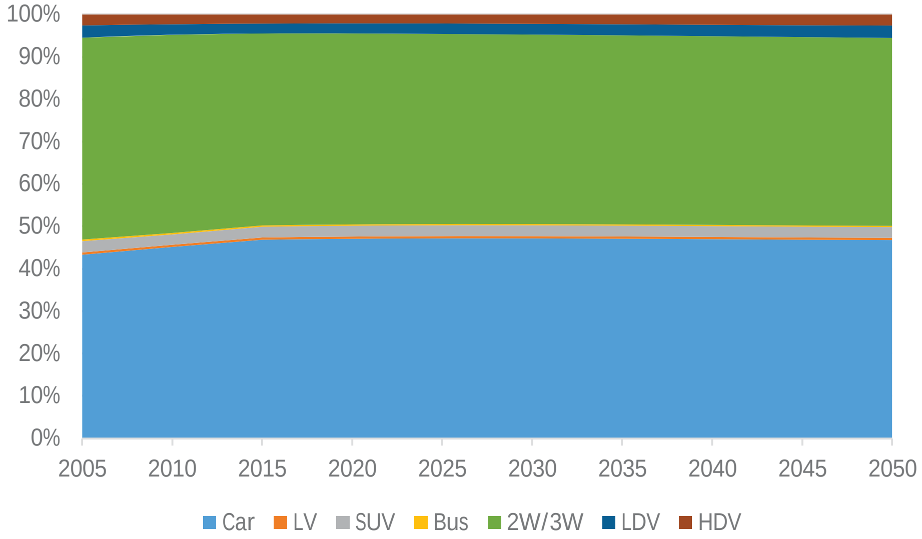

Figure 23. Composition of Road Fleet (% per Type of Vehicle)

- o The growth from 2005-2050 is highest for the trucks, if we put 2005 values as in index =1.

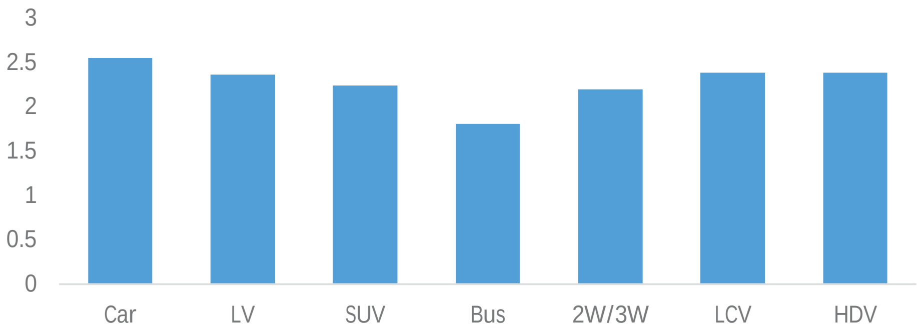

Figure 24. Road Vehicle Growth Index (2005=1)

- Fuel Efficiencies
  - o Assumed base fuel efficiencies were taken from existing studies (e.g. Clean Air Asia, 2012) for road transport. These were adjusted based on the fuel efficiencies of the new vehicles that are expected (based on external projections) and assumed retirement age of the vehicles.
  - o The figure above gives an example of the average base fuel efficiencies that were assumed in the calculations. The fuel efficiencies for the other fuels (e.g. CNG, LPG),are taken directly from the values in the backcasting tool.

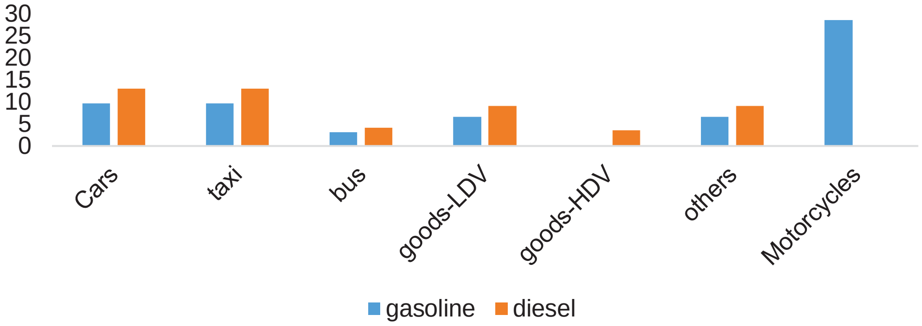

Figure 25. Fuel Efficiencies per Vehicle Type (km/liter)

- Vehicle Activity
  - o The assumptions on the base annual vehicle-kilometers travelled by each of the mode were taken from existing studies as well. The figure below shows the comparison between the different modes (km/year).
  - o Average occupancies (number of people per trip) and average loading figures were also taken from existing studies for Malaysia.

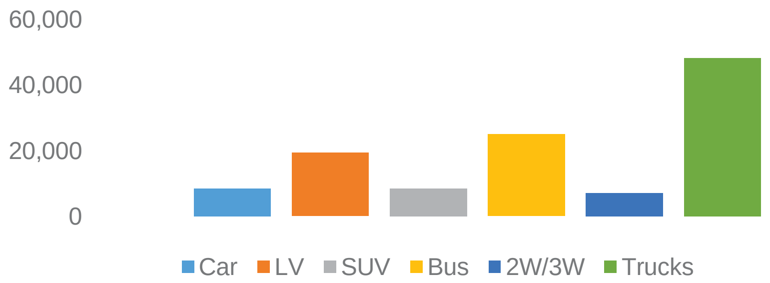

Figure 26. Vehicle Kilometers per Year per Vehicle

- Emission Factors
  - o The emission factors used were based on standard international practice of 2.4 and 2.6 for gasoline and diesel (kgCO2/liter). The emission factors for electric vehicles were based on the generation mix of the grid (and projected mix). No projected % mix was available beyond 2035; therefore, it was assumed that the mix in 2035 will continue.
  - o The figure below shows the resulting emission factors for the Malaysian electricity grid (kgCO2/kwh).

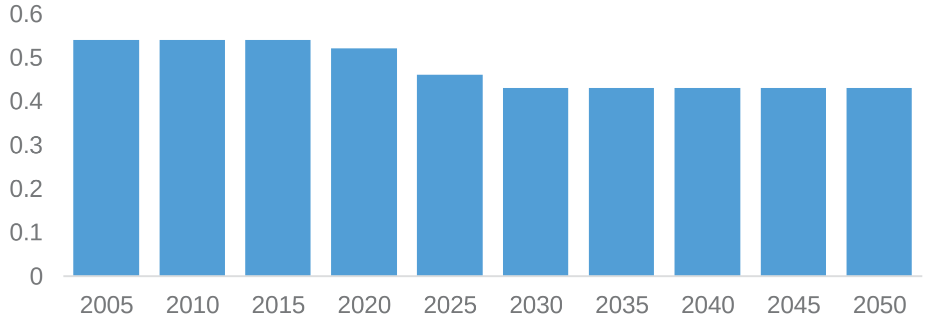

Figure 27. Electricity Grid CO2 Emission Factor (tonCO2/mwh)

2.2.2 Rail Transport

- The base railway transportation volume data for passenger and freight (PKM and TKM) were taken and extrapolated from the World Development Indicators Dataset and movements in the GDP/capita.
- The increase in passenger-km is expected to be higher than in the freight ton-km for railways, as based on historical data. In 2050, passenger rail is estimated to service 5.5 billion passenger-km (1.1 billion in 2005). Railways are estimated to service 2.5 billion ton-km in 2050 (1.1 billion in 2005).

Figure 28. Passenger-km and Ton-km for Railways (2005=1)

2.2.3 Air Transport

- The base air transportation volume data for passenger and freight (PKM and TKM) were taken and extrapolated from the ICAO database. The increase was assumed to be proportional to the movement in the GDP/capita.
- The rate of increase in tons-km is expected to be higher than in the passenger-km, but both are expected to increase significantly in the future (averaging approximately 4.5% and 4.4% annual growth in the period).

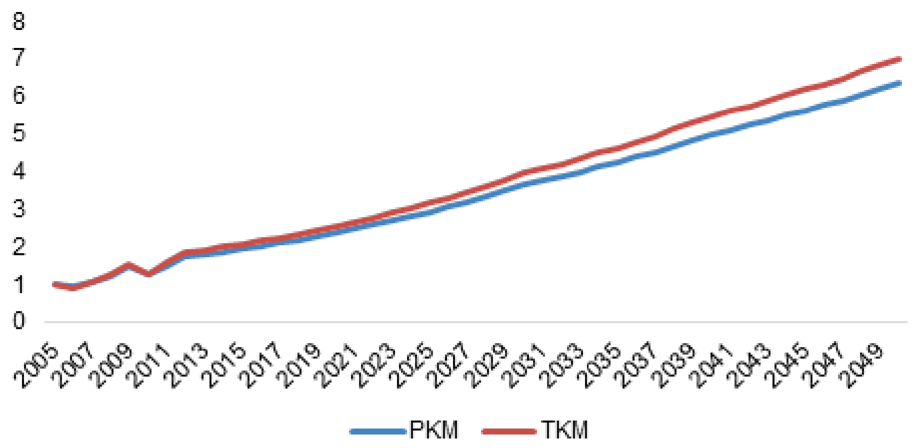

Figure 29. Passenger-km and Ton-km for Air Transport (2005=1)

2.2.4 Water Transport

- The emissions from water transport were computed directly from energy consumption values that were taken from IEA. This was done due to the lack of readily available and reliable data for water transport.

2.3 Future Transport Scenario

This section presents the future transport images for the cases of the primary cities (more than 2 million population), major cities (more than 1 million population), other cities (200 thousand population), municipalities (non-cities), and others, corresponding to the future scenario for society described in Chapter 1. This section presents the images of transport for both the Business-as-usual scenario and the alternative (low carbon) scenarios.

Box 1: Summary - BAU Scenario

Passenger Transport

- Passenger travel would reach 546 billion passenger-kilometers under the BAU scenario
- In the baseline scenario for 2050, there will be 34.8 million vehicles, 47% of these are passenger cars.
- There will be 576 passenger cars/1000 people, 546 motorcycles/1000 and 68 trucks/1000 people in 2050. The highest growth rates during the period is still with the cars, averaging an 2.1% increase per year

Freight Transport

- Meanwhile, freight travel is expected to increase to 606 billion ton-kilometers by 2050 under the BAU scenario (252 billion ton km in 2005).
- Virtually all of the total ton-km will be serviced through road trucks and trailers.
- The truck population are estimated to increase by 1.95% per year.

2.3.1 Summary Transport Images

This section presents the summary of the transportation images for the different regions of analysis. These are based on the alternative (low carbon scenario) that is further explained in section 3.2. These are images of how the transportation systems will look like in these regions of analysis once the policies in the alternative scenario are put in place.

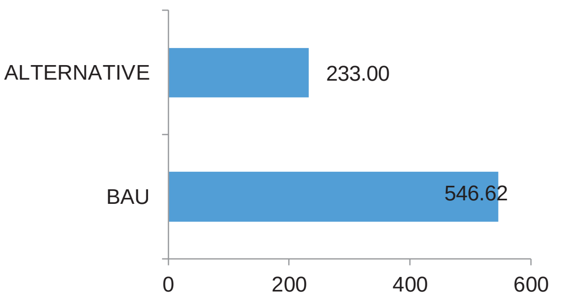

Figure 30. Passenger Travel Length (billion PKM), 2050

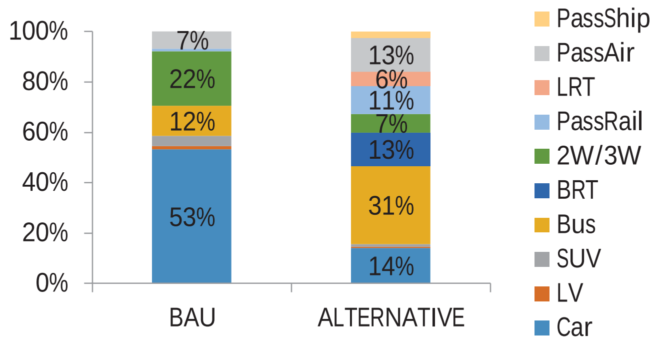

Figure 31. Passenger Transport Mode Share (% of PKM), 2050

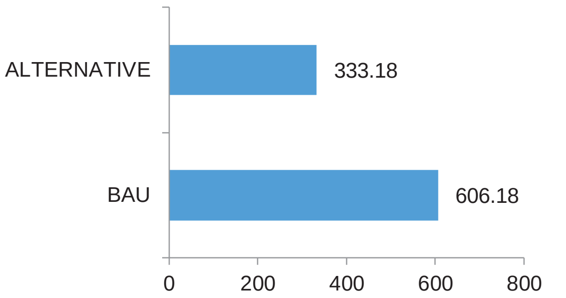

Figure 32. Freight Travel Length (billion TKM), 2050

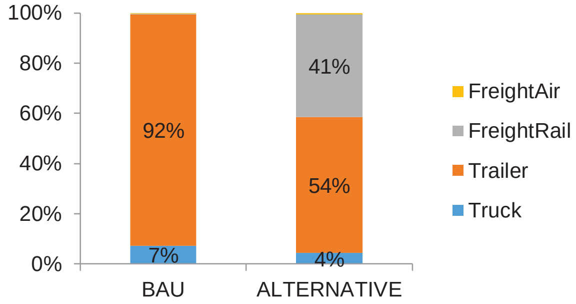

Figure 33. Freight Transport Mode Share (% of TKM), 2050

- By 2050, in the ideal scenario, public transport will cover 61% of all passenger travels in Malaysia. Buses will be the primary mode choice for passenger transport, especially with the development of important economic corridors on both peninsular Malaysia and Malaysian Borneo.
- Freight shall be composed mostly of cargo trailers, but will also be largely accommodated by an expansive freight rail that covers 53% of freight transport.

2.3.2 Transport Image in Primary Metropolitan Areas (2 Million Plus Population)

- It is seen that in the ideal future, public transport would cover 73% of all passenger travels in Kulala Lumpur. The current level of car use would shift towards a more public transport-oriented capital city. About 27% of travels will be on rail/LRT.
- Meanwhile, freight share of travel would remain the same between BAU and alternative scenarios, although the transport volume would be significantly reduced from 3.5 to 1.9 billion ton-kilometers between scenarios.
- Currently, in accordance with GTP 2.0, Malaysia is aiming at a public transport modal share of 25% in Kuala Lumpur and its surrounding areas, ensuring that 75% of the population resides within 400 meters of urban public transport nodes, and 25% of Greater KL taxis are on par with the best-in-class of ASEAN cities, and 750,000 peak morning ridership is achieved by 2015.
- The Greater KL / Klang Valley Land Public Transport Master Plan is the first of the regional plans comprised of a series of subsidiary plans (2013):
  - ✓ Bus Transformation Program
  - ✓ Taxi Transformation Program
  - ✓ Land Use Plan
  - ✓ Travel Demand Management Plan
  - ✓ Interchange and Integration Plan
- The Urban Rail Development Plan for Greater Kuala Lumpur and Klang Valley also notes that, in 2020, the morning peak hour travel demands would increasingly come from the Petaling Jaya, Shah Alam, and Klang corridors towards the central Kuala Lumpur. In Penang, given that its population and the job opportunities are expected to grow, it is anticipated that 335,000 person trips will be made in the morning peak hour. Without any changes to its public transport system, its mode share in the morning peak hour will stay low, at only 3.8%.
- Among the various modes of land transport, cars are projected to grow the fastest. For every increase in GDP per capita, it appears that the cars per 1,000 people will grow by 0.059, representing a more significant increase than the bus.

2.3.3 Transport Image in Major Urban Areas (Million Plus Population)

- The major urban areas will have similar characteristics with the primary urban areas in terms of the composition of the transportation systems in 2050.
- Ideally, passenger transport will be hinged on reliable and high level of service public transportation modes (e.g. buses) which are well integrated with other modes.

- The penetration of technologies for road transport vehicles will be similar to the primary urban areas.

2.3.4 Transport Image in Other Urban Areas (200 Thousand to 1 Million Populations)

- Large cities are envisioned to be served primarily by bus services, although the rail services will also play a substantial role in providing public transport services. In the alternative scenario, bus networks will be expanded to support increases in travel demand. The high share of public transport in terms of serving the motorized trips will be similar to the total of public transport mode shares for motorized trips in current day Tokyo.
- Meanwhile, light duty trucks will remain the main mode for freight transportation in these areas

2.3.5 Transport Image in Non-Urban Areas

- It is envisioned that transport in rural areas will largely be untouched towards 2050. Cars will prevail, but in general, people will travel at short distances in rural areas.
- While it is seen that motorcycles will remain prevalent mode of travel in rural areas, overall travel distance in 2050 would be much shorter.
- Meanwhile, inland freight on rail would become quite prominent, halving the overall freight travel that would have been covered by cargo trailers and trucks. Freight travel in non-urban areas would potentially be reduced from 12.9 billion ton-kilometers in the BAU scenario to 6.9 billion ton-kilometers in the alternative.

2.3.6 Transport Image in Inter-Regional Areas

- Just as well, the interregional passenger travel will be largely covered by bus services, especially at important economic corridors. It is seen that about 40% of interregional passenger travels would be by bus while only 11% of passenger travels would be on rail.
- Meanwhile, rail is seen to link the prime industrial zones to the trading hubs at the city outskirts, providing fast means for freight transport. Trailers will remain, however, although a good number of these vehicles will have converted to CNG.
- Freight rail would cover 44% of interregional freight transport, while 50% will continue being carried by cargo trailers.

2.4 Issues and Challenges

- Malaysia is one of the highest in the region when it comes to current levels of motorization rates (estimated at 521 vehicles per 1000 in 2005). Curbing the “car-oriented culture” will be a challenging task for the government if it wants to shift passenger transport into public modes.
- A high level of freight transport activity proves to be a major point of consideration for the government in looking at CO2 emissions in the future.
- Malaysia will be a net fuel importer within the next 25 years, alternative sources of energy for transport have to be developed in order to mitigate the social, environmental and economic costs of this impending reality.

3. Transport CO2

This section provides the details of the policy assumptions that were taken into the Backcasting tool as well as the resulting CO2 emissions both for the business-as-usual scenario and the alternative scenario.

3.1 Business-as-usual Scenario

- The national transport CO2 emission as of 2005 in Malaysia is at 43 million tCO2. By 2030 the number will increase threefold to 71.8 million tCO2 and by 2050, Malaysia's transport sector will have emitted 90.5 million tCO2.
- Largest emitters from passenger transport are private vehicles, particularly cars and motorcycles. Largest overall emitters are freight transport modes, especially cargo trailers. **Figure 34** shows the contribution to transport emissions per mode at the national level.
- Freight transport in Malaysia is seen to increase in emissions from 21.8 million to 53.3 million tCO2 towards 2050, or about 3% annual increase in emissions per year.
- Overall transport emission is expected to increase at an average of 2% annually, while road transport alone will grow an average of 1% annually.

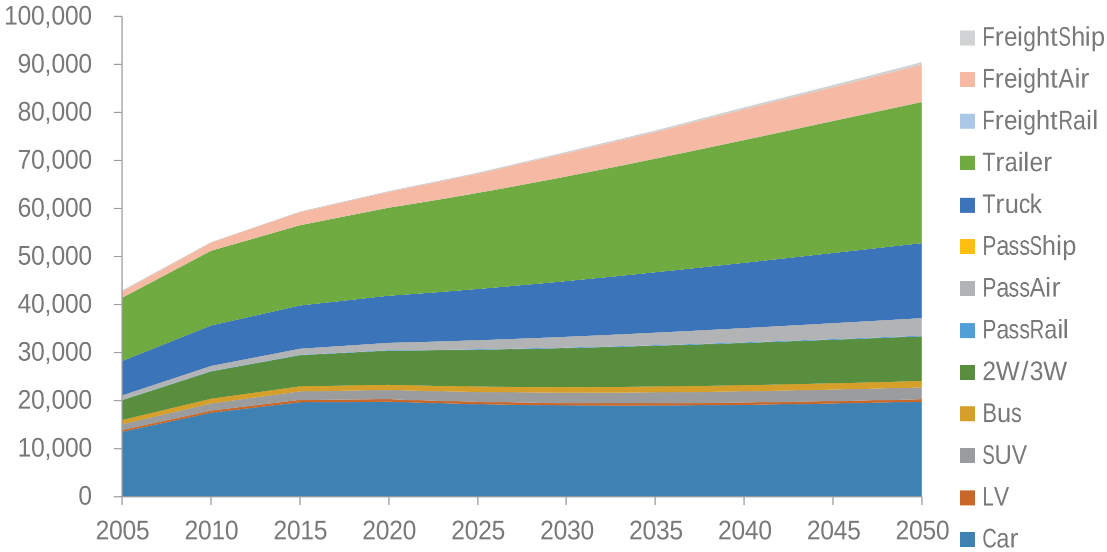

Figure 34. Total CO2 by Mode (million kgCO2/year)

- The per capita emissions for transport under the BAU scenario will increase from 1.66 tons in 2005 to 2.15 tons per capita in 2050.

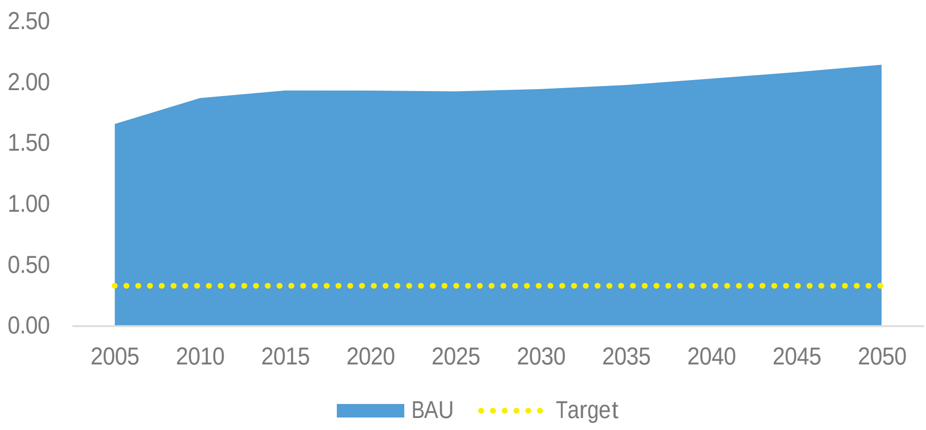

Figure 35. BAU per Capita Transport CO2 Emissions (tonCO2/ capita)

- Passenger cars are the largest emitters for passenger transport modes in Malaysia, contributing 31% of CO2 emissions in 2005 (22% in 2050 BAU). Cars are still seen to be growing quite high as compared to the other passenger transport modes at 2.1% (passenger-km) annual average from 2005-2050.
- Heavy duty trucks will contribute the highest in terms of freight emissions, contributing 32% of the total emissions in 2050 (31% in 2005).

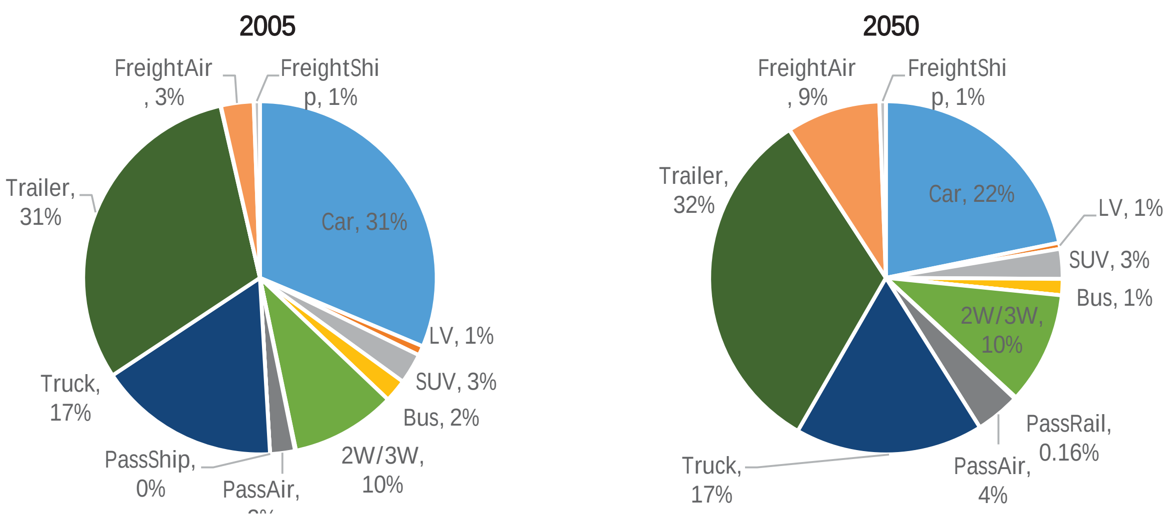

Figure 36. CO2 Contribution per Mode, 2005 and 2050

The section below shows the summary of the indicators for the relevant regions for analysis.

PRIMARY URBAN: Urban agglomerations with 2 million or plus population
2025: 1.4 million tCO2
2050: 1.6 million tCO2
Largest emitters: Cars and motorcycles will emit 50% of total transport emissions by 2050. Cargo trailers will contribute 22%.

MAJOR URBAN: Urban agglomerations with population between 1 to 2 million
2005: 0.92 million tCO2
2050: 6.6 million tCO2

Largest emitters: 44% cars, 27% motorcycles and 11% trailers by 2050

<u>OTHER URBAN AREAS</u>
2005: 8.9 million tCO2
2050: 12.7 million tCO2
Large emitters: 44% cars, 27% motorcycles by 2050

<u>NON-URBAN AREAS</u>
2005: 5.3 million tCO2
2050: 5.8 million tCO2
Large emitters: 44% cars, 28% motorcycles by 2050

<u>INTER-REGIONAL TRANSPORT</u>
2005: 30.2 million tCO2
2050: 63.7 million tCO2,
Large emitters: Freight transport, particularly cargo trailers

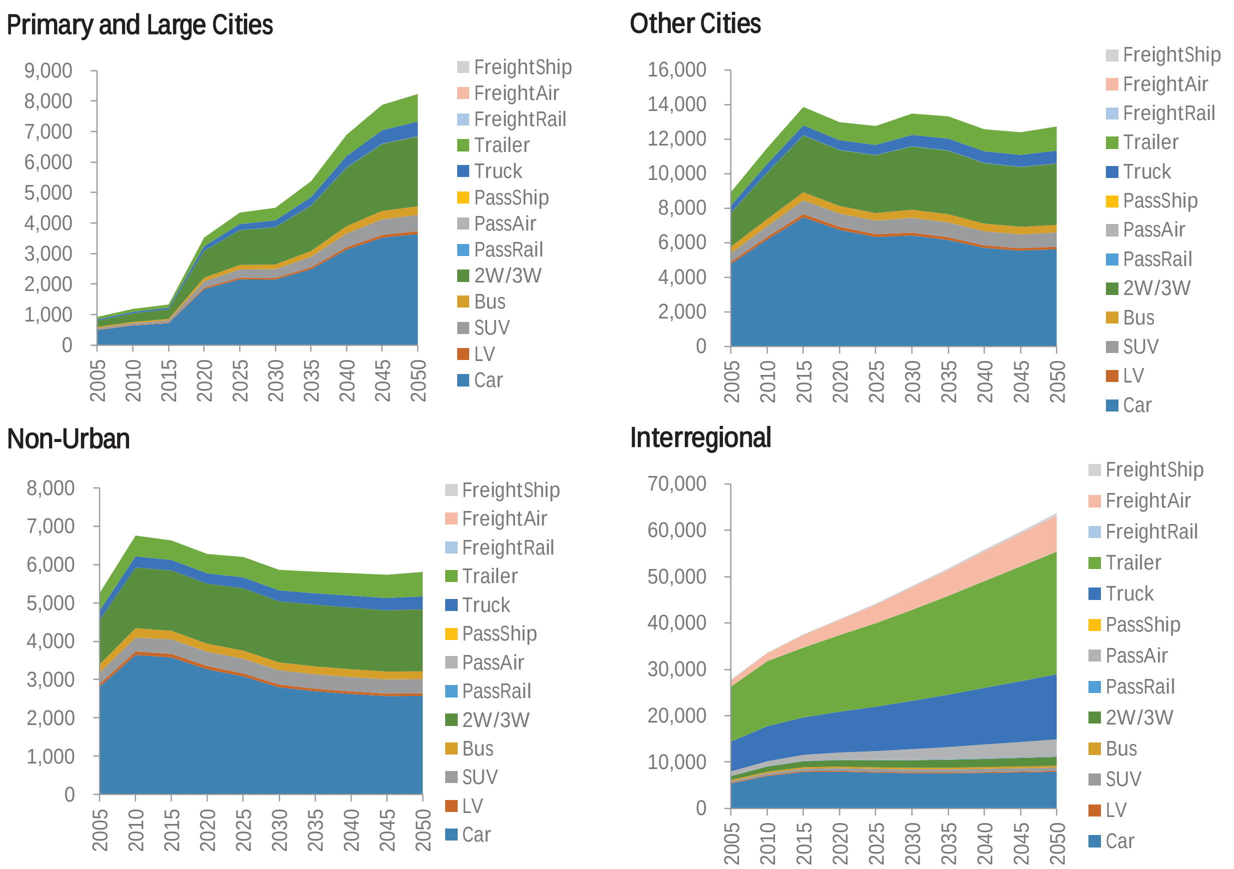

Figure 37. Transport CO2 per Region – BAU Scenario[4]

[4] Movements in the emissions are affected by the categorization of the cities/municipalities from one area of analysis to another. E.g. as non-urban areas become urbanized, the tool re-categorizes their emissions into the "other urban areas," thus explaining the drop in the emissions for the "non-urban" areas leading up to 2050.

3.2 Alternative Scenario

- The following section discusses the policies and relevant assumptions that were considered in the development and simulation of the alternative scenario for Malaysia. A review of the existing policies in the pipeline was done in order to properly assess which of the policies included in [the backcasting tool are applicable for the different regions.
- The government recognizes that Vision 2020, which aims for Malaysia to be a self-sufficient fully developed country by 2020, has major implications for the transportation sector. With the recent and the foreseen economic growth, increase in income, and rapid urbanization of Malaysia, the government recognizes the need to adapt quickly and transform the public transportation to reduce the pressure of industrialization on the current road infrastructure and traffic, which remains to be significantly comprised of private vehicles.
- The National Urbanization Policy released in 2006 turned to the urban centers and placed an emphasis on the development of an integrated public transportation system, and on the integration of both transportation and land use planning.
- The second phase of Government Transformation Program (GTP 2.0), launched in January 2010, identified seven National Key Result Areas (NKRAs) in support of the vision, one of which is to improve the urban public transport, aiming at a public transport mode share of 25% by 2015 in Kuala Lumpur and surrounding areas. The GTP roadmap is divided into three milestones: GTP 1.0 (2010-2012), GTP 2.0 (2013-2015), and GTP 3.0 (2016-2020). Consequently, the 10th Malaysian Plan 2011-2015, a comprehensive blueprint prepared by the EPU, places more emphasis on moving people via public transport and as supported by non-motorized transport-friendly networks and seamless connectivity.
- SPAD released the 20-year National Land Public Transport Master Plan (NLPTM) to support the development of land transport of passenger and goods with the objective of increasing the mode share of public transport in urban areas by 40% in 2030. The government has similarly prepared policies and initiatives in other sectors to achieve these goals of ensuring that sustainable transport modes will be preferred, such as a nationwide introduction of B10 biodiesel program and the development of alternative energy.
- NLPTM states the need for state-level regional master plans to be developed, i.e. one per state, including one for Greater Kuala Lumpur and Klang Valley, to provide directions on the development of intra-regional mobility, in addition to inter-regional master plan in order to explore the opportunities for linkages between conurbations, and define the roles of rail and inter-urban express buses.
- The development of a sustainable transport sector is getting a tremendous boost from the master plans that are in place. The public transport is envisioned to be seamless and integrated, affordable, reliable, and accessible even to rural areas. As described by the NLPTM, there is projected annual growth of 6%, with new jobs reaching 3.3 million, and urbanization reaching 75% by 2020. NLPTM predicts that travel vehicle demand could reach 133 million trips per day in 2030 from 13 million in 1991, and, likewise, expects a car population growth of 7% per year. Given this situation, without accounting the initiatives of the government to curb the private vehicle ownership, the population of motorcars per 1,000 people could reach 800.
- Transport development in Malaysia is highly focused on its peninsular region, and a large number of projects and plans are being implemented primarily in the major urbanized areas especially the Greater Kuala Lumpur region.
- The GTP has identified 11 initiatives as National Key Result Area for improving transport in Malaysia as follows:
    - ✓ Building new and upgrading some 1000 bus stops in the Klang Valley
    - ✓ Imposing performance standards on operators
    - ✓ Increasing capacity for all the Kelana Jaya and Ampang LRT Lines
    - ✓ Reorganizing bus network
    - ✓ Introducing common smart ticketing
    - ✓ Increasing capacity of the KL Monorail
    - ✓ Improving bus journey times by introducing Bus Expressway Transit services and studying the feasibility of bus lanes and Bus Rapid Transit systems
    - ✓ Stepping up enforcement
    - ✓ Building integrated transport terminals at the edge of the city to prevent bus congestion in the city center

- ✓ Increasing capacity of the KTM Komuter
- ✓ Improving physical integration of stations

- Other key national transport policies and documents that reflect the current state of sustainability in transport of Malaysia are as follows:
  - ✓ The National Automative Policy (NAP), currently being updated with a 2014 version
  - ✓ National Renewable Energy Policy
  - ✓ National Land Transport Master Plan

3.2.1 Primary Urban Areas

Policy Packages

- According to the NLPTM, the government aims to reach a land transport mode share of 40% in urban areas by 2020. This is not so easily met for all cities, however, as it entails bus improvements and expansive LRT projects.
- The table below shows the policy packages that were applied to the primary urban areas in the analysis.

Table 6. Summary of Policy Packages for Primary Urban Areas

AVOID	SHIFT	IMPROVE
• Pricing Regimes • ICT • Teleactivities • Car Ownership • Improved Travel Awareness • Freight Transport Subsidiarity • Freight Dematerialisation • Urban and Landuse planning	- Passenger Transport - • Bus/BRT usage promotion • Bus/BRT infra development • Rail/LRT usage promotion • Rail/LRT infra development	• CNGV mass supply • CNGV Promotion (mainly via economic way) • EV mass supply • EV Promotion • Biofuel Development • Biofuel Promotion • Rail electrification • Ecological Driving

- The specific shift rates and the assumptions on the fuel and vehicle targets are explained in the tables below

Table 7. Shift Rates – Primary Urban Areas

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Bus/BRT usage promotion (Passenger)										
Bus/BRT infra development (Passenger)										
from Car/LV/SUV to Bus	0%	0%	0%	4%	9%	13%	17%	21%	26%	30%
from 2W/3W to Bus	0%	0%	0%	4%	7%	11%	14%	18%	21%	25%
from Car/LV/SUV to BRT	0%	0%	0%	0%	2%	3%	5%	7%	8%	10%
from 2W/3W to BRT	0%	0%	0%	0%	2%	3%	5%	7%	8%	10%
Rail/LRT usage promotion (Passenger)										
Rail/LRT infra development (Passenger										
from Car/LV/SUV to Rail	0%	0%	0%	0%	0%	5%	20%	20%	20%	20%
from 2W/3W to Rail	0%	0%	0%	0%	0%	5%	15%	20%	20%	20%
from Car/LV/SUV to LRT	0%	0%	0%	2%	4%	6%	9%	11%	13%	15%
from 2W/3W to LRT	0%	0%	0%	1%	3%	4%	6%	7%	9%	10%
Ship usage promotion (Passenger)										
Ship infra development (Passenger)										
from Car/LV/SUV to Ship	0%	0%	0%	1%	1%	1%	1%	1%	1%	1%
from 2W/3W to Ship	0%	0%	0%	1%	1%	1%	1%	1%	1%	1%

Table 8. Vehicle Technology and Fuel – Primary Urban Areas

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
CNGV mass supply										
CNGV Promotion (mainly via economic way)										
LV(HV-Gasoline)	0%	0%	0%	0%	3%	5%	8%	10%	13%	15%
Truck(HV-Diesel)	0%	0%	0%	0%	5%	10%	10%	10%	10%	10%
Biofuel Development										
Biofuel Promotion										
Bioethanol	0%	1%	2%	4%	6%	8%	10%	11%	13%	15%
Biodiesel	0%	0%	1%	1%	2%	3%	3%	4%	4%	5%

Results

- The total emission from travel activity occurring in the primary urban areas will be reduced by 63% from 1.59 million tons (BAU 2050) to 0.58 million tons in the alternative scenario.
- The per capita emissions from travel activity occurring in the primary urban areas will be reduced from 0.64 tCO_2 per capita (BAU 2050) to 0.23 tCO_2 per capita (alternative 2050).
- The contribution of cars will be lowered from 44% in the BAU to 11% in the alternative scenario. This is mainly due to the reduction in the % share of car travel in the total passenger-kilometers (from 52% in the BAU to 14% in the alternative scenario.

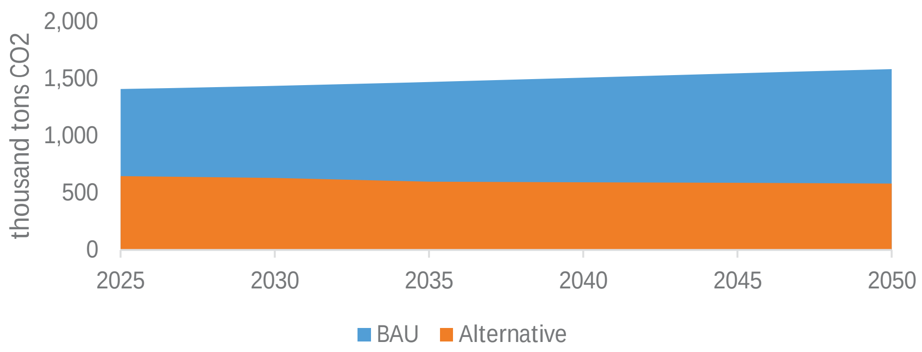

Figure 38. Primary Urban Areas: Transport CO2 Emissions (000 tons CO2)[5]

3.2.2 Major Urban Areas

- Major urban areas refer to agglomerations with population between 1 million to 2 million people.
- The table below shows the policy packages that were assumed for these areas.

Table 9. Summary of Policy Packages for Major Urban Areas

AVOID	SHIFT	IMPROVE
• Pricing Regimes • ICT • Teleactivities • Car Ownership • Improved Travel Awareness • Freight Transport Subsidiarity • Freight Dematerialisation • Urban and Landuse planning	- Passenger Transport – • Bus/BRT usage promotion • Bus/BRT infra development	• CNGV mass supply • CNGV Promotion (mainly via economic way) • EV mass supply • EV Promotion • Biofuel Development • Biofuel Promotion • Ecological Driving

- The specific shift rates and the assumptions on the fuel and vehicle targets are explained in the tables below.

Table 10. Shift Rates – Major Urban Areas

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Bus/BRT usage promotion (Passenger)										
Bus/BRT infra development (Passenger)										
from Car/LV/SUV to Bus	0%	0%	0%	4%	9%	13%	17%	21%	26%	30%
from 2W/3W to Bus	0%	0%	0%	4%	7%	11%	14%	18%	21%	25%
from Car/LV/SUV to BRT	0%	0%	0%	0%	2%	3%	5%	7%	8%	10%
from 2W/3W to BRT	0%	0%	0%	0%	2%	3%	5%	7%	8%	10%

5 The figures only start from 2025 as this is the period when KL is estimated to have more than 2 million population.

Table 11. Vehicle Technology and Fuel – Major Urban Areas

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
CNGV mass supply										
CNGV Promotion (mainly via economic way)										
LV(HV-Gasoline)	0%	0%	0%	0%	3%	5%	8%	10%	13%	15%
Truck(HV-Diesel)	0%	0%	0%	0%	5%	10%	10%	10%	10%	10%
Biofuel Development										
Biofuel Promotion										
Bioethanol	0%	1%	2%	4%	6%	8%	10%	11%	13%	15%
Biodiesel	0%	0%	1%	1%	2%	3%	3%	4%	4%	5%

Results

- The total emission from travel activity occurring in the major urban areas will be reduced by 64% from 6.6 million tons (BAU 2050) to 2.4 million tons in the alternative scenario.
- The per capita emissions from travel activity occurring in the primary urban areas will be reduced from 0.63 tCO_2 per capita (BAU 2050) to 0.23 tCO_2 per capita (alternative 2050).
- The contribution of cars will be lowered from 44% in the BAU to 7% in the alternative scenario. This is mainly due to the reduction in the % share of car travel in the total passenger-kilometers (from 52% in the BAU to 9% in the alternative scenario.

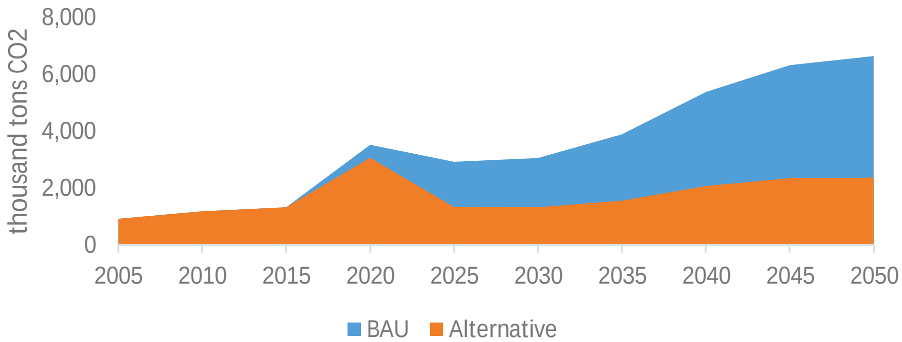

Figure 39. Major Urban Areas: Transport CO2 Emissions (000 tons CO2)[6]

3.2.3 Other Urban Areas

- The other urban areas refer to areas with populations between 200,000 to 1 million.
- The table below shows the policy packages that were assumed for the other urban areas.

[6] Movements in the total emissions are influenced by the re-categorization of cities from one category to another (e.g. from "other urban" to "major urban") as brought about by the projections in their populations.

Table 12. Summary of Policy Packages for Other Urban Areas

AVOID	SHIFT	IMPROVE
• Pricing Regimes • ICT • Teleactivities • Travel Plans • Car Ownership • Improved Travel Awareness Urban and Landuse planning	- Passenger Transport - • Bus/BRT usage promotion • Bus/BRT infra development	• CNGV mass supply • CNGV Promotion (mainly via economic way) • FCV mass supply • FCV Promotion (mainly via economic way) • Biofuel Development • Biofuel Promotion • Ecological Driving

- The table below shows the shift rates that were applied in simulating the future alternative scenario for the other urban areas.

Table 13. Shift Rates – Other Urban Areas

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Bus/BRT usage promotion (Passenger)										
Bus/BRT infra development (Passenger)										
from Car/LV/SUV to Bus	0%	0%	0%	3%	6%	9%	11%	14%	17%	25%
from 2W/3W to Bus	0%	0%	0%	4%	7%	11%	14%	18%	21%	25%
from Car/LV/SUV to BRT	0%	0%	0%	0%	2%	3%	5%	7%	8%	10%
from 2W/3W to BRT	0%	0%	0%	0%	2%	3%	5%	7%	8%	10%

Table 14. Vehicle Technology and Fuel – Other Urban Areas

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
CNGV mass supply										
CNGV Promotion (mainly via economic way)										
LV(HV-Gasoline)	0%	0%	0%	0%	3%	5%	8%	10%	13%	15%
Truck(HV-Diesel)	0%	0%	0%	0%	5%	10%	10%	10%	10%	10%
Biofuel Development										
Biofuel Promotion										
Bioethanol	0%	1%	2%	4%	6%	8%	10%	11%	13%	15%
Biodiesel	0%	0%	1%	1%	2%	3%	3%	4%	4%	5%

Results

- The total emission from travel activity occurring in the other urban areas will be reduced by 75% from 12.7 million tons (BAU 2050) to 3.1 million tons in the alternative scenario.
- The per capita emissions from travel activity occurring in the other urban areas will be reduced from 0.64 tCO2 per capita (BAU 2050) to 0.12 tCO2 per capita (alternative 2050).

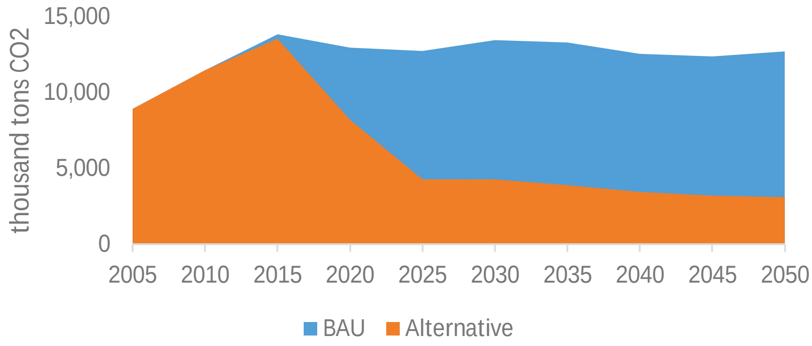

Figure 40. Other Urban Areas: Transport CO2 Emissions (000 tons CO2)

3.2.4 Non-Urban Areas

- The non-urban areas refer to agglomerations with population less than 200,000.
- The table below shows the main policy packages assumed for these areas.

Table 15. Summary of Policy Packages for Non-Urban Areas

AVOID	SHIFT	IMPROVE
• Pricing Regimes • Improved Travel Awareness • Freight Transport Subsidiarity • Freight Dematerialisation • Urban and Landuse planning	- Passenger Transport - • Bus usage promotion	• CNGV mass supply • CNGV Promotion (mainly via economic way) • EV mass supply • EV Promotion • Biofuel Development • Biofuel Promotion • Rail electrification • Ecological Driving

- For this simulation, national policies were assumed to have some downstream effect on non-urban areas. In the long term, some of the trucks that reach outwards to the rural areas will also run on CNG. Rail will also be partly accessible to some areas for freight transport (related to inter-regional transportation of freight, mainly).

Results

- The total emission from travel activity occurring in non-urban areas will be reduced by 73% from 5.8 million tons (BAU 2050) to 1.6 million tons in the alternative scenario.
- The per capita emissions from travel activity occurring in the non-urban areas will be reduced from 0.67 tCO2 per capita (BAU 2050) to 0.24 tCO2 per capita (alternative 2050).

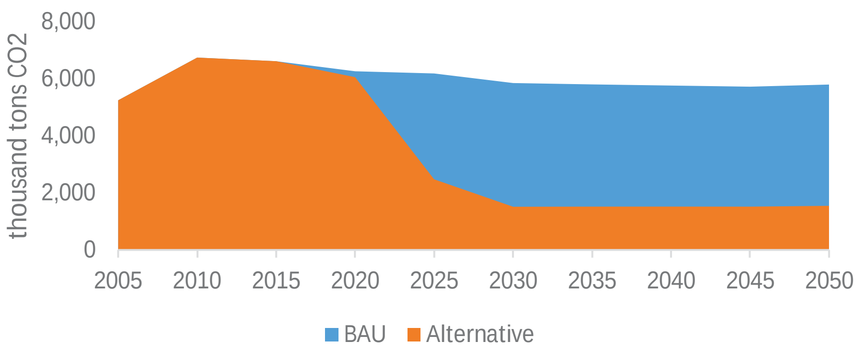

Figure 41. Non-Urban Areas: Transport CO2 Emissions (000 tons CO2)

3.2.5 Inter-Regional Transport

- Inter-regional transport refers to the transport that occurs while traveling between the aforementioned regions (primary urban, major urban, other urban, non-urban).
- The table below shows the policy packages that were assumed for the other urban areas.

Table 16. Summary of Policy Packages for Inter-Regional Transport

AVOID	SHIFT	IMPROVE
• Pricing Regimes	- Passenger Transport -	• CNGV mass supply
• ICT	• Bus/BRT usage promotion	• CNGV Promotion
• Teleactivities	• Bus/BRT infra development	• EV mass supply
• Improved Travel Awareness	• Rail/LRT usage promotion	• EV Promotion
• Freight Transport Subsidiarity	• Rail/LRT infra development	• Hybrid Promotion
• Freight Dematerialisation	- Freight Transport –	• Biofuel Development
• Urban and Landuse planning	• Rail usage promotion	• Biofuel Promotion
	• Rail infra development	• Rail electrification
		• Ecological Driving

- Freight transport is the primary source of emission at the interregional level. Under the BAU scenario, freight transport contributes 77% of the transport CO2 emissions in 2050. Freight is a main area of concern when it comes to Malaysia's transport CO2 emissions, as it is also the country that has the highest trucks/1000 people among the countries that were analyzed.
- Results suggest that by shifting 45% of freight transport from road to rail can in fact reduce freight emissions by 72%. However the implication is a massive investment in rail of rail infrastructure, including capacity increase through additional freight cars, and would entail the country billions of dollars.
- Another policy option for freight is to increase CNG trailers by 20% towards 2050.
- Meanwhile, passenger transport at the interregional level is assumed to shift to bus.
- The table below shows the shift rates that were applied in simulating the future alternative scenario for inter-regional transport.

Table 17. Shift Rates – Inter-Regional Transport

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Bus/BRT usage promotion (Passenger)										
Bus/BRT infra development (Passenger)										
from Car/LV/SUV to Bus	0%	0%	3%	6%	9%	13%	16%	19%	22%	25%
from 2W/3W to Bus	0%	0%	4%	7%	11%	14%	18%	21%	25%	25%
from Car/LV/SUV to BRT	0%	0%	0%	0%	2%	6%	11%	16%	20%	25%
from 2W/3W to BRT	0%	0%	0%	0%	2%	6%	11%	16%	20%	25%
Rail/LRT usage promotion (Passenger)										
Rail/LRT infra development (Passenger)										
from Car/LV/SUV to Rail	0%	0%	0%	0%	0%	0%	7%	9%	11%	13%
from 2W/3W to Rail	0%	0%	0%	0%	0%	0%	2%	9%	11%	13%
from Car/LV/SUV to LRT	0%	0%	0%	1%	1%	2%	3%	4%	4%	5%
from 2W/3W to LRT	0%	0%	0%	1%	1%	2%	3%	4%	4%	5%
Rail usage promotion (Freight)										
Rail infra development (Freight)										
from Truck/Trailar to Rail	0%	0%	0%	4%	9%	13%	21%	29%	37%	45%

Table 18. Vehicle Technology and Fuel – Inter-Regional Transport

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
CNGV mass supply										
CNGV Promotion (mainly via economic way)										
Trailer(CNG)	0%	0%	0%	3%	6%	9%	11%	14%	17%	20%
LV(HV-Gasoline)	0%	0%	0%	0%	3%	5%	8%	10%	13%	15%
Truck(HV-Diesel)	0%	0%	0%	0%	5%	10%	10%	10%	10%	10%
Biofuel Development										
Biofuel Promotion										
Bioethanol	0%	1%	2%	4%	6%	8%	10%	11%	13%	15%
Biodiesel	0%	0%	1%	1%	2%	3%	3%	4%	4%	5%

Results

- The total emission from inter-regional transport will be reduced by 55% from 63.7 million tons (BAU 2050) to 28.6 million tons in the alternative scenario.
- The per capita emissions from inter-regional transport will be reduced from 1.51 tCO2 per capita (BAU 2050) to .68 tCO2 per capita (alternative 2050.

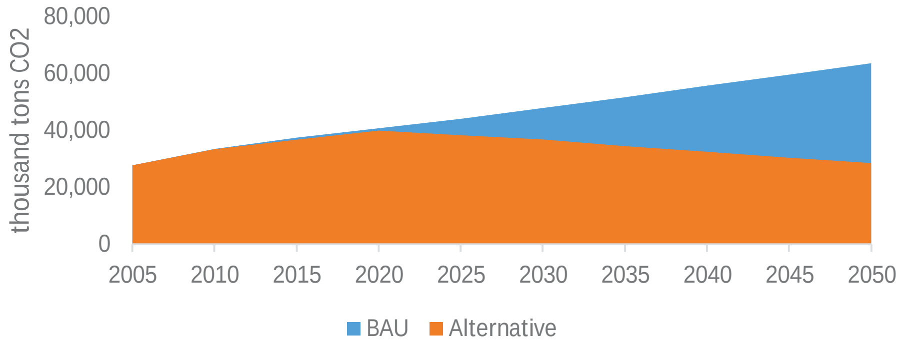

Figure 42. Inter-Regional Transport: Transport CO2 Emissions (000 tons CO2)

3.2.6 Summary Results

- The application of the policies mentioned in the section above resulted in the reduction of total CO2 emissions in 2050 from 90.5 million tons (BAU) to 36.3 million tons, a reduction of 60%.
- The application of the policy packages resulted in notable changes in the transportation volume. For passenger transport, the annual growth rate in passenger kilometer is limited to 0.1% in the alternative scenario, while the BAU postulates a 2% increase per year. The reduction of passenger activity is mainly hinged on the avoid policies, particularly the impacts of land use planning. A similar case is the same for freight transport activity, as the growth is limited to 0.6% in the alternative scenario, while the BAU also has an annual growth rate of 2%.
- For passenger transport, the alternative scenario emphasizes the use and development of public modes such as buses and rail-based transport. Buses will serve 31% of the total passenger-km in 2050 (vs 12% in the BAU) and rail will serve 11% of the total passenger-km (as compared to less than 1% in the BAU).
- For freight transport, the rail systems are much more utilized in the alternative scenario, contributing 41% of the total ton-km in 2050 (as compared to less than 1% in the BAU).

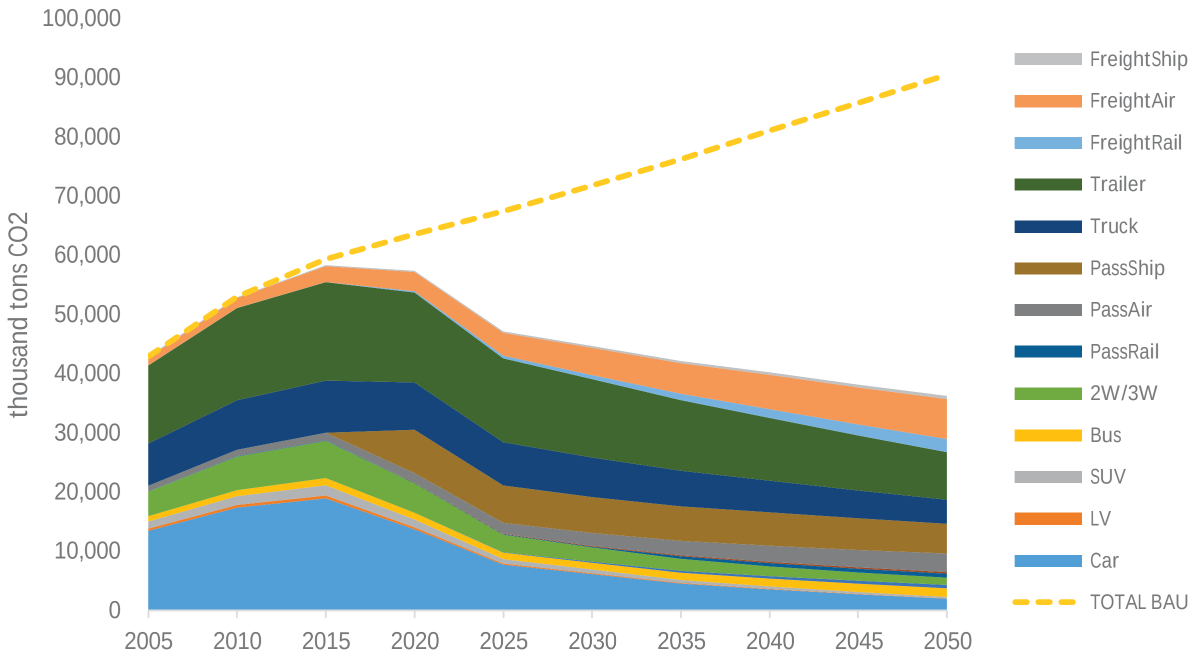

Figure 43. Total Transport CO2 by Mode -Alternative vs Total BAU (thousand tons CO2)

- The impacts of the policies resulted in a 2050 per capita CO2 value of .86 tons per capita (as compared to 2.15 in the BAU scenario.

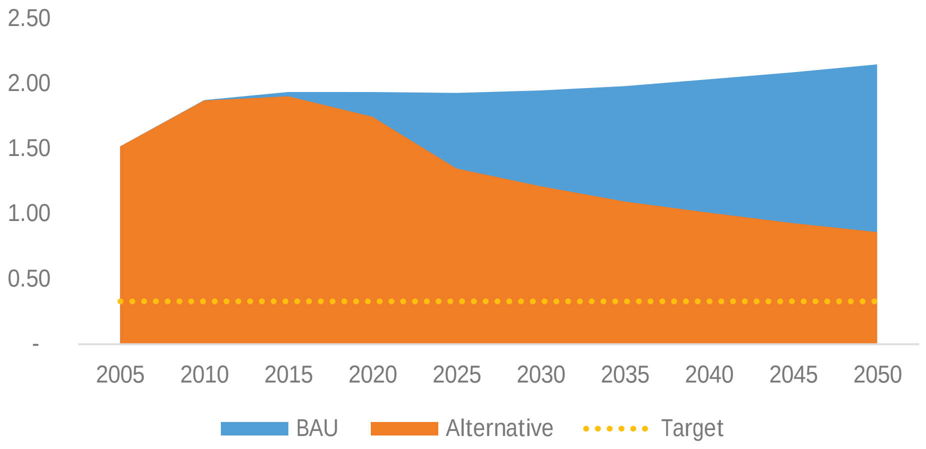

Figure 44. Per Capita Transport CO2 (tons CO2/capita)

- The alternative scenario suggests less emission from car, LV and SUV use such that the contribution is limited to 6% in 2050 (as compared to 26% in the BAU). The contribution of buses will increase (due to higher bus volumes and usage) to 6% (as compared to 1% in the BAU). Rail-based passenger transport will contribute 2% of the CO2 emissions in the alternative scenario (as compared to .16% in the BAU).
- Emissions contributions from freight trucks (LDVs and HDVs) are limited to 33% in 2050 as compared to 50% in the BAU scenario. This is the result of the diversification of the freight system in the country. In the BAU scenario 99% of the total ton-km in 2050 will be done through the road trucks, while in the alternative scenario, this is reduced to 57%. Majority of the ton-km has been shifted to rail which will constitute 41% of the total ton-km in 2050.

3.3 Action Plan

- The figures below show a summary of the actions that have been taken into consideration in building the alternative scenario for Malaysia: urban area example and Malaysia as a whole.

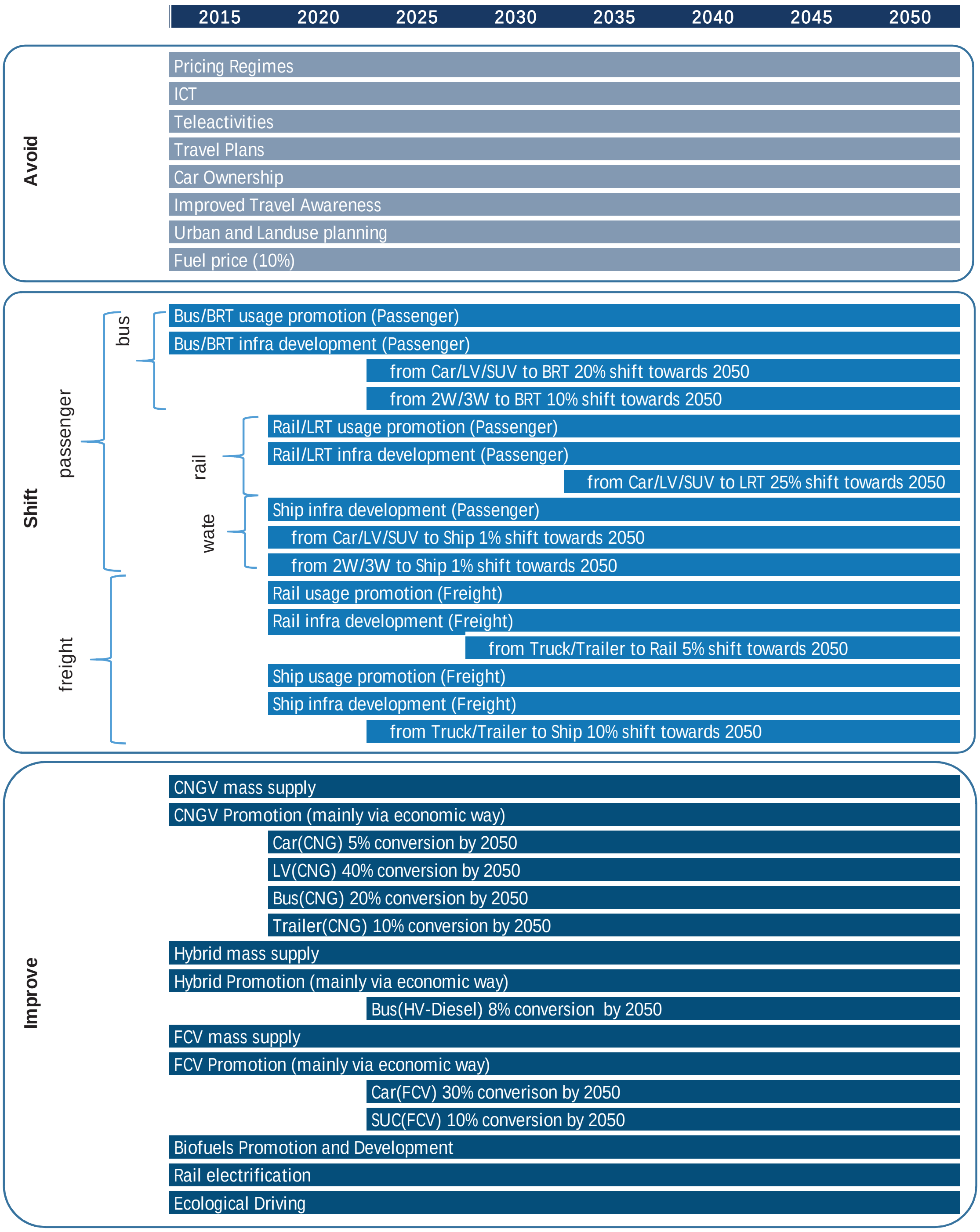

Figure 45. Illustrative Action Plan for the Urban Areas

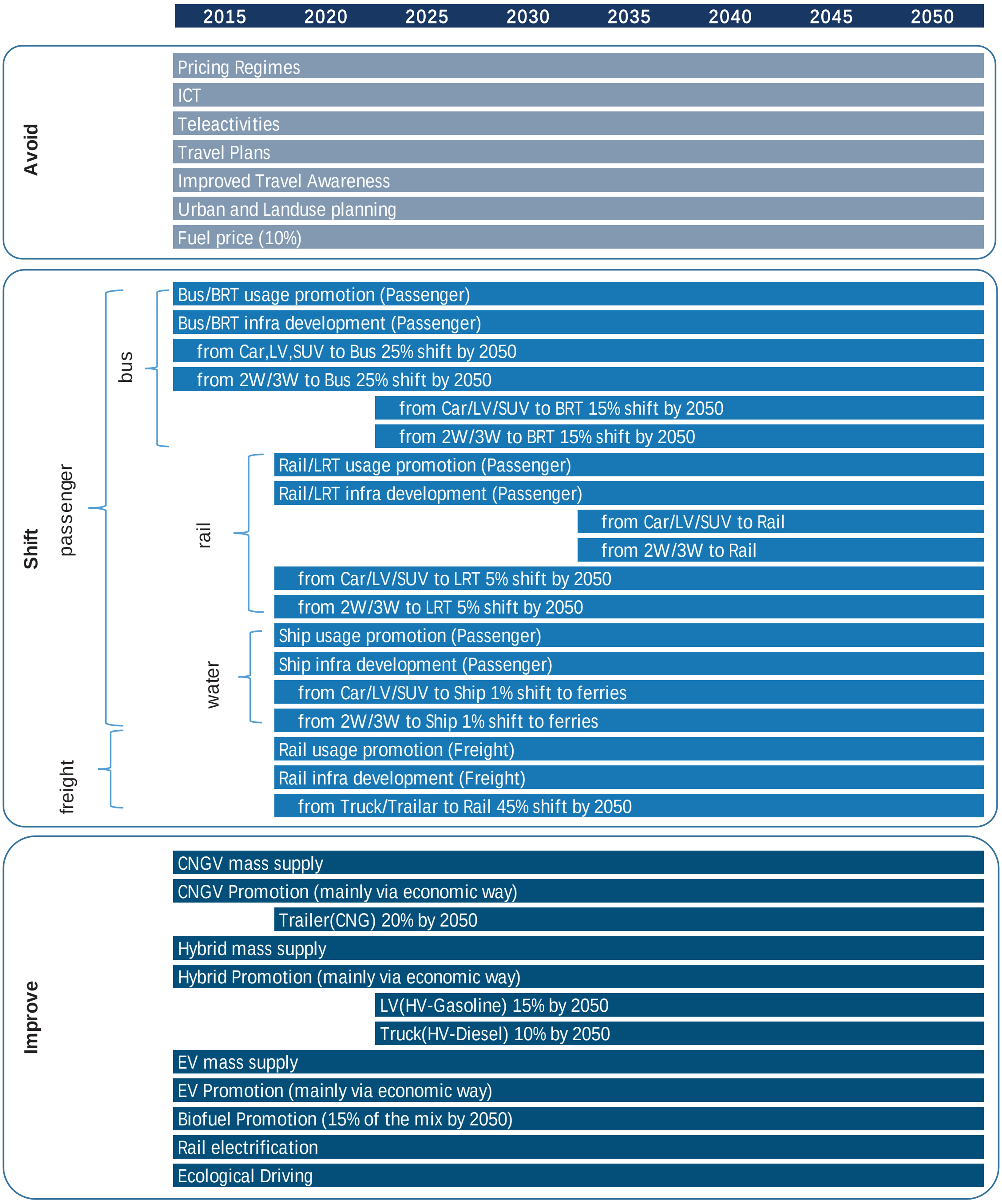

Figure 46. Summary Action Plan for Malaysia

4. Conclusions

- The BAU scenario estimates that the total transport CO_2 emissions will increase 2.1 fold from 42.9 million tons in 2005 to 90.5 million tons in 2050. In terms of per capita emissions, it will increase from 1.66 tons per capita in 2005 to 2.15 tons in 2050.
- The estimates projects that interregional transport will be a significant aspect to look into in terms of mitigation policies. It is estimated to contribute 79% of the total transport emissions in 2050 in the BAU scenario.
- In terms of the different modes, the heavy duty trucks (32%), cars (22%) and light-duty trucks (17%) will contribute the most in 2050.
- The study presents future societal factors for Malaysia based on available information on forecasts for the economy and population characteristics of the country.
  - By 2050, the population of Malaysia will be 42.1 million, 59% of whom will be within the working age, 15% will be senior citizens. The population will growth at an annual growth rate of 1.16% from 2005-2050.
  - 86% of the population in 2050 will be living in urban areas
  - The GDP per capita will be at 35,563 USD/capita, growing at an average of 4.54% annually.
- Policies were analyzed in order to come up with an alternative scenario which embodies realistic and context-specific policies that are applied in the different regions of analysis.
- The alternative scenario postulates the following main characteristics of the future transportation image in the country:
  - Passenger transport in the primary urban, major urban, other urban, non-urban areas and inter-regional transport will utilize bus systems more in the future, forming a significant portion of the transportation mode share in 2050 (31% of passenger-km as compared to 12% in the BAU).
  - 4-wheeled vehicle-based transport activity growth will have a negative rate of change in the alternative scenario (average of -0.73% per annum).
  - Buses would need to serve 24% of the total passenger-km by 2030.
  - Freight transport will be more diverse. Shifting substantial freight activity towards rail freight will be important (41% of total t-km in 2050).
- Based on the simulations using the Backcasting tool, the current assumptions on the policy packages and their impacts will only reduce the tCO_2 per capita to 0.86 (compared to 2.15 tons per capita in BAU 2050), still well above the 0.33 tCO_2 per capita target. Further reduction in transport CO_2 will require a complete paradigm shift towards embracing public transportation as the backbone of the passenger transport in Malaysia, as well as more aggressive policies that will shift more freight activity into railways. Malaysia will be in a position in the future to adopt more advanced vehicle technologies for its road transport fleet, such as hybrids and electric vehicles.

5. References

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Thailand

Prepared by

Mr. Alvin Mejia

Mr. Mark Tacderas

Ms. Kathleen Dematera

Supported by

Dr. Mongkut Piantanakulchai

Mr. Sudhir Gota

LIST OF ABBREVIATIONS

2W	Two-wheelers (motorcycles)
3W	Three-wheelers (tricycles)
ADBI	Asian Development Bank Institute
AEDP	Alternative Energy Development Plan
AJTP	Asean-Japan Transport Partnership
APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
BAU	Business-As-Usual
BMA	Bangkok Metropolitan Authority
BMR	Bangkok Metropolitan Region
BRT	Bus Rapid Transit
BTS	Bangkok Mass Transit System
CAA	Clean Air Asia
CNG	Compressed Natural Gas
CNGV	Compressed Natural Gas Vehicle
CO2	Carbon dioxide
DEDE	Department of Alternative Energy Development and Efficiency
EPPO	Energy Planning and Policy Office
EST	Environmentally Sustainable Transport
EV	Electric Vehicle
GDP	Gross Domestic Product
GSO	General Statistics Office, Government of Vietnam
HCMC	Ho Chi Minh City
ICAO	International Civil Aviation Organization
ICCT	International Council on Clean Transportation
ICT	Information and communication technology
LPG	Liquified Petroleum Gas
LRT	Light Rail Transit
LV	Light Vehicle (passenger)
MOT	Ministry of Transport
MRT	Metro Rail Transit
NAMA	Nationally-Appropriate Mitigation Actions
NEPO	National Energy and Policy Office
NESDP	National Economic and Social Development Plan
PKM	Passenger-Kilometer
SRT	State Railway of Thailand
SUV	Sports Utility Vehicle
tCO2	ton Carbon dioxide
TDSI	Transport Development and Strategy Institute
THB	Thai Baht
TKM	Ton-kilometer
UNCRD	United Nations Centre for Regional Development
UNFCCC	United Nations Framework Convention on Climate Change
USD	US Dollar
VAPIS	Vehicular Air Pollution Information System
WB	World Bank
WRI	World Resources Institute

1. Society

1.1 Present Situation

This section presents key social, economic and cultural factors in Thailand that were looked at in this study, particularly in defining future transportation scenarios.

1.1.1 General

This section briefly provides an overview of the geography, society and the demography of the Kingdom of Thailand, as well as its economy and energy use.

- Thailand covers a land area of over 513,120 sq. km. and is bordered by Lao PDR and Myanmar to the north, by Lao PDR and Cambodia to its east, by the Gulf of Thailand (an inlet of the South China Sea) and occupying a part of Malay Peninsula to its south, and by Andaman Sea to its west.
- The land used for agriculture is approximately 40% of its total land area (NESDB). Thailand is composed of 76 provinces and the specially administered areas of Bangkok and Pattaya. These provinces are grouped and divided into six geographical regions comprising of many provinces:

Table 1. Regions in Thailand

Six regions of Thailand	Notable places and characteristics
1. Northern Thailand	Chiang Mai; mountainous; farming
2. Northeastern Thailand (Isan)	Khon Kaen; plateau; rice, sugar cane, silk
3. Eastern Thailand	Chon Buri (Pattaya); mountain ranges
4. Southern Thailand	Songkhla, and Phuket; rolling mountains; rubber, rice, coconut, tourism
5. Western Thailand	mountains, river valleys
6. Central Thailand	Metropolitan Bangkok; wet rice agriculture

- Bangkok covers a land area of 1,568.7 sq. km. An urban conglomeration which comprises Bangkok, Nakhon Pathom, Pathum Thani, Nonthaburi, Samut Prakan and Samut Sakhon is called the Bangkok Metropolitan Region (BMR), or Greater Bangkok, covering an area of approximately 7,760 sq. km. (MOT, 2013).

1.1.2 Population

- The population of Thailand was recorded at 66 million persons in 2010. This indicates an average annual growth of 0.74% over the period 1993-2013. Meanwhile, the urban population has grown at an average rate of 1.48% during the same period. It is estimated that at present, 34% of the population are in urban areas (Figure 1). The Bangkok Metropolitan Region (BMR) has a population of over 17.5 million (MOT, 2013).
- Among the regions, the Northeastern region had the highest share of population (28.7%), followed by the Central region (27.6%), the North region (17.7%), the South region (13.4%) and Bangkok at 8.30 million persons (12.6 %).
- From 2000 to 2010, Bangkok recorded the highest annual population growth rate at 2.68%, followed by the Central Region at 2.46%, while the North (0.19%) and Northeastern (-0.94%) are relatively low.
- The country has a population density of 128.6 persons per sq. km. in 2010, and that of Bangkok is about 77

times higher than that of the North with 5,294.3 persons per sq. km.

- About 75% of the population is ethnically Thai, 14% is of Chinese origin, and 3% is ethnically Malay. According to Central Intelligence Agency, Thailand attracts 2.5 million migrant workers from neighboring countries.
- A large fraction of the population belongs to the working age group (62%). Currently, only 8% of the populations are 65 years old and over (Figure 2). Despite Thailand being predominantly an agricultural country, a large fraction of those in the working age are employed in non-agricultural sector.

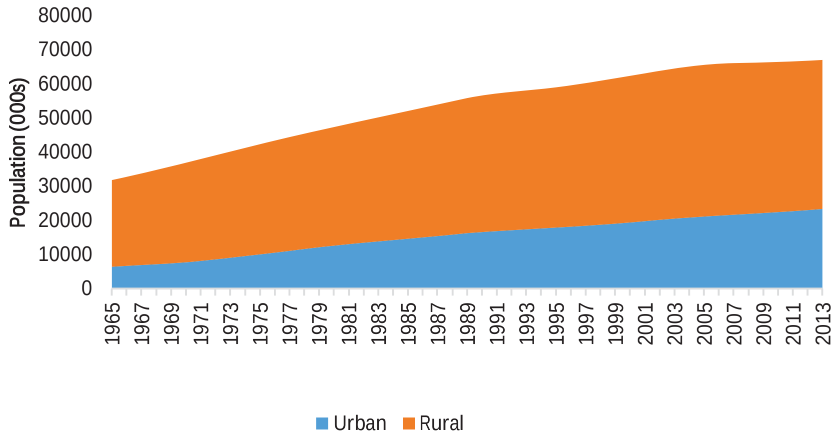

Figure 1. Population (000s)
Source: UN, 2012 and 2011

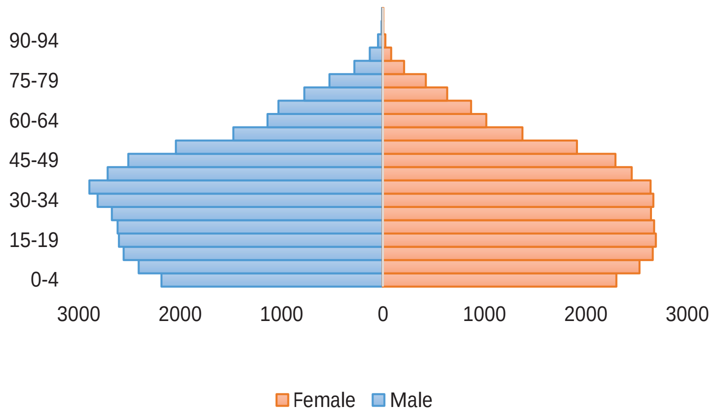

Figure 2. Population by Age (000s), 2010
Source: UN, 2012

1.1.3 Economy and Industry

- Thailand is among the four "tiger cub economies" of Southeast Asia together with Indonesia, Malaysia and the Philippines, so named as their economies are similar to that of those tiger economies which are export-driven albeit on a slower rate.
- Gross domestic product (GDP) per capita in Thailand is at USD 5,409 (2005 constant USD) and is increasing at an average of 6.48% from 1990 to 2013. The period of 2002-2010 saw an increasing GDP per capita level, averaging an annual growth rate of 10.31% (Figure 3).

- The country relies heavily on its exports which accounts for 60% of its GDP. The emergence of their economy is attributed to the exports from the industrial and agricultural sectors, such as electronics, automobile and parts, computer parts, and agricultural commodities.[1]
- A large fraction of Thailand's income is driven by the services sector. Agricultural products were reported to be having a declining output and to have contributed only THB 300-400 billion (about USD 9-12 billion) to Thailand's real GDP in 2009, while the service sector contributed THB 2 trillion (about USD 60.6 billion) (Koonnathamdee, 2013).

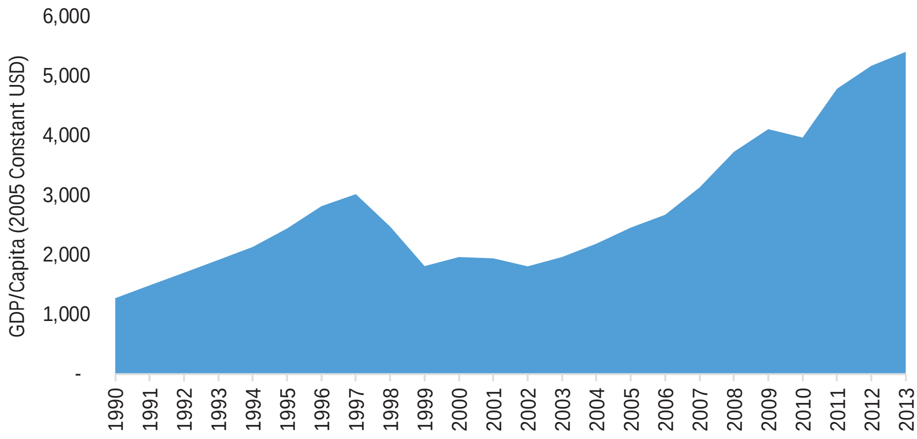

Figure 3. GDP/Capita (2005 Constant USD)
Source: World Bank 2013, UN, 2012

1.1.4 Energy

- The total energy consumption of Thailand in 2012 was 1,981 thousand barrels per day of crude oil equivalent while the production was 1,082 thousand barrels per day of crude oil equivalent. Of the energy consumed in 2012, the largest type was natural gas, followed closely by petroleum products (Figure 4) (EPPO, 2013).
- The demand for bioenergy from crop production is also increasing in Thailand. Existing biomass power plants produce 2,800 megawatts of alternative energy while demand for biodiesel almost doubled from 2008 to over 2 million liters per day at the present (Australian Trade Commission, 2013). The daily demand for natural gas in 2012 was 4,534 million standard cubic feet (about 90.68 ktoe) and is increased by 9.8% from 2011 (EPPO, 2013).

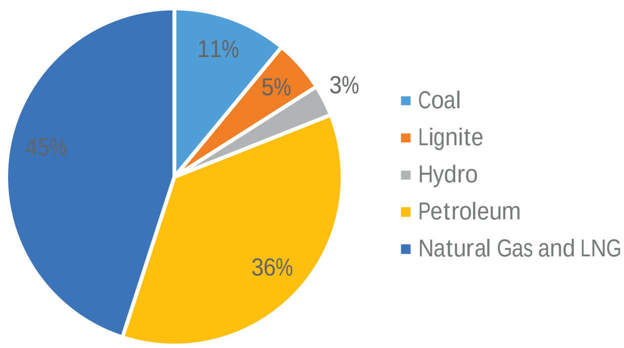

Figure 4. Energy Consumption by Type, 2012
Source: EPPO, 2013

[1] Thailand's Low-Carbon Society Vision 2030.

1.2 Future Scenario for Society

- This section presents the future scenario for the Thailand according to the key societal factors identified in the previous section. This future scenario is based on the available data on projections or estimations culled from various sources such as local projections and plans, databases and projections from international organizations such as the UN, WB, APEC, among others.
- Thailand envisions a “happy society with equity, fairness, and resilience by 2027.” Efforts will be made to : improve the quality and provision of all basic social services, including housing and public utilities; enhancing social interaction and public administration; developing human resources aimed at increasing resilience for change; strengthening the agriculture sector to increase food security and also to provide energy; developing its science and technology and making it as a driving force for sustained and inclusive growth; enhancing the country’s competitiveness by improving its financial and capital markets, as well as the workforce; improving regional connectivity through regional cooperative agreements; improving the environmental situation through awareness, international cooperation and resilience enhancement.
- The emergence of the other areas in terms of population growth and economic activity contribution is expected in areas such as Chonburi, Nonthaburi, Pathumtani, Phuket and Rayong. Multiple urban centers, connected by quality public transportation and freight transportation systems are envisioned for Thailand.

1.2.1 Population

- In 2050, it is estimated that there will be 61.7 million people in Thailand. The population is expected to show a declining growth rate at an average of -0.13% per annum from 2005-2050. Meanwhile, urban population is expected to grow by 1.09% annually from 2005 to 2050. Population is expected to peak at around 2025 at 67.8 million and will experience decline up to 2050. 56% of the population will be living in urban areas in 2050 (Figure 5).
- 53% of the population will be 20-64 years of age in 2050. Thailand will be an ageing society by 2050 as 30% of their population will be 65 years and over (Figure 6).
- The 11th National Economic and Social Development Plan acknowledges that, by 2025, Thailand will be an ageing society. The government of Thailand is anticipating a shift in the population structure by age by 2040, saying that a quarter of its population could be over 65 years of age, with the average age of males being 75.3 years while that of the females being 81.9 (The Nation, 2013).

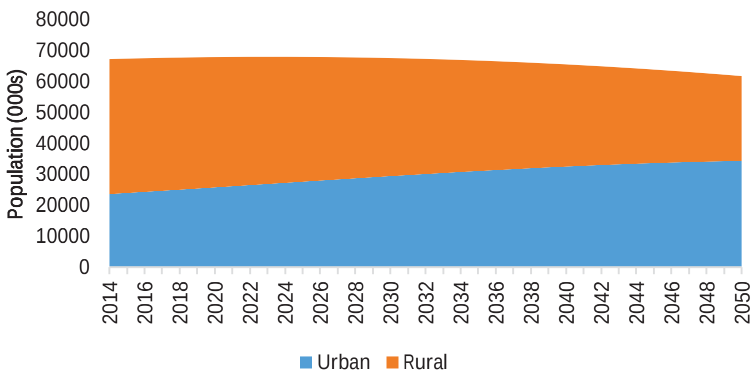

Figure 5. Population Projection to 2050 (000s)
Source: UN, 2012 and UN, 2011

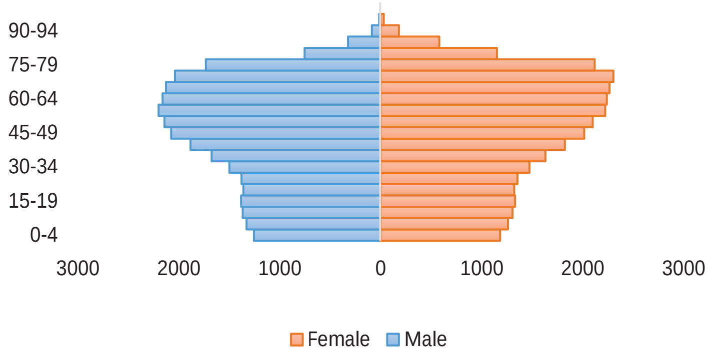

Figure 6. 2050 Population by Age (000s), 2050
Source: UN, 2012 and UN, 2011

1.2.2 Urbanization

- 55.7% of the population is expected to live in urban areas by 2050 (UN, 2011).
- The rate of urban population growth will be at 1.09% per annum, as compared to the -0.13% negative growth rate of the total population.
- Recent population growth trends (2007-2012) indicate that the fastest growing provinces are: Pathumthani (2.88% per annum), Phuket (2.73%) and Nonthabur (2.2%).

1.2.3 Economy and Industry

- The Asian Development Bank Institute (ADBI, 2012) estimates the growth in Thailand to be sustained at around 5% per annum up to 2030. This is expected to taper off in the longer term, stabilizing at 4% to 3% from the periods 2030-2050.
- GDP per capita is projected to increase to USD 26,178 (2005 constant USD). It is forecasted to grow at an average of 5.39% per annum during the period 2005-2050 (Figure 7).
- Economic development in Thailand is usually concentrated in urban areas, primarily in BMR. Those remote from BMR have lower incomes and have more limited access to government services.

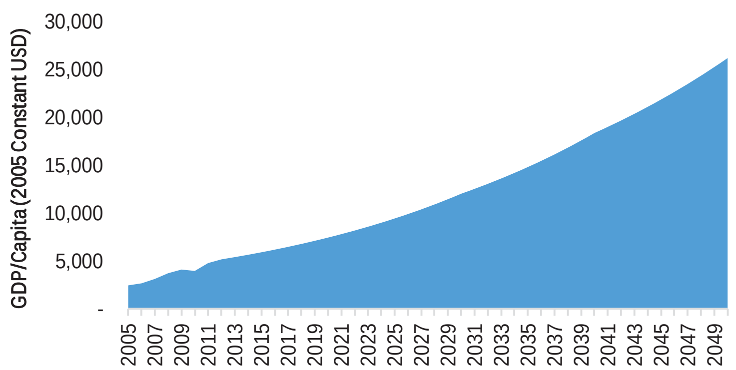

Figure 7. GDP/Capita (2005 Constant USD)
Source: Computed based on UN population estimates and ADBI projections

1.2.4 Energy

- The Asia-Pacific Economic Cooperation (APEC,2012) estimates that the primary energy demand in Thailand will grow at an average of 2.6% per annum up to 2035, to be driven primarily by industries, non-energy use and transportation.
- Thailand is expected to move towards being more energy efficient as it strives to meet its own target of 25% energy intensity reduction by 2030 as compared to 2010 levels.
- Industrial energy growth will be driven by demand for food and beverages, chemicals and non-metallic minerals (APEC, 2012).
- New and renewable energy resources are expected to grow rapidly and will comprise 19% of the 2035 total energy supply (APEC, 2012); nuclear power is also a possibility that can be realized in Thailand.

2. Transport

2.1 Present Situation

- This section presents the present state of the different modes of transportation in Thailand and their current trends and issues.
- *Passenger transport:* Between 2005 and 2010, passenger travel in Thailand has increased by 4.5% annually. As of 2010, passenger travel is at 773.27 billion passenger-kilometers. Its road transport is largely dominated by motorcycles, cars/sedan and vans or sports utility vehicles and pick-up trucks. As for the public transport sector, the bus is the primary mode. Bus rapid transit was launched in Bangkok in 2010 and is locally called Bangkok Rapid Transit (BRT)
- *Freight transport:* Freight travel in 2010 was 52.9 billion ton-kilometers, increasing by about 1% per year from 2005 to 2010 (Figure 9).

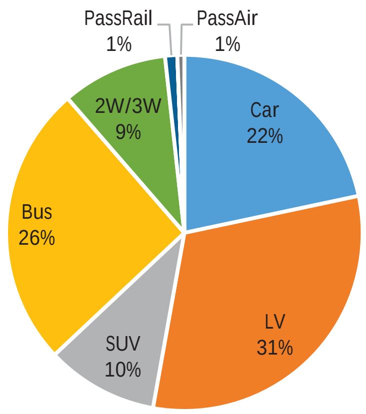

Figure 8. Passenger Transport Mode Share (% of PKM), 2010
Source: Study estimates

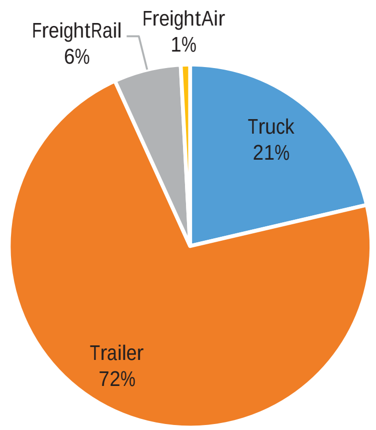

Figure 9. Freight Transport Mode Share (% of PKM), 2010
Source: Study estimates[2]

2.1.1 Road Transport

- The major roads and highways of Thailand, which are under the responsibility of the Department of Highways, are the core of the transport sector in the country. Generally, the information on transport infrastructure, fleet sizes and transport activities are gathered from various resources or are estimated from basic data.
- The total road network in Thailand totals 202,000 km, 98% of which are paved (ADB, 2011). The ASEAN-Japan Transport Partnership (AJTP), likewise harmonizing data platform across Southeast Asian countries, however notes that there are 114,437 km. as of 2011, 95% of which are paved. These figures include the highways, including those that connect Thailand to its neighboring countries, including the rural roads, which are maintained by the Department of Rural Roads.
- Between 2005 and 2010, passenger travel in Thailand has increased by 4.5% annually. As of 2010, passenger travel is at 773.27 billion passenger-kilometers. The population of road vehicles in Thailand in 2010 was 21.6

[2] The study was limited in incorporating travel activity from water transport. These were incorporated directly into the emissions, utilizing figures from energy balance sheets that have information on water transport energy and emissions.

million. In 2012, the total registered vehicle population reached 32.5 million. The road transport sub-sector is largely dominated by motorcycles, cars or sedan, and vans and pick-up trucks (Table 2). For the period 1997-2007, privately owned vehicles in Thailand were growing approximately 8%-10% annually. Sedans and pick-up trucks remain to be the prevalent modes of transport in the capital city of Bangkok while motorcycle has the highest share among all vehicles in areas outside of Bangkok (ADB, 2011).

Table 2. Population of Road Vehicles, 2010

Mode	No. of Vehicles	Percent
Passenger		
Cars	4,223,992	19.5
Light Vehicles	4,439,929	20.5
SUV	328,454	1.5
Bus	137,943	0.6
2W/3W	11,691,746	54.0
Freight		
HDV	726,194	3.4
LDV	83,238	0.4

- The large number of pick-up trucks can be attributed to the low excise tax and to the fact that these are normally utilizing diesel engines. Diesel and LPG are being subsidized by the government. According to the Energy Fund Administration Institute, the fuel subsidies cost Thailand 5 million USD per day. As a result, traffic congestion is a recognized concern especially in Bangkok where the average vehicle speed during the morning rush hours is 17.2 km/hour, and 24.2 km/hour during the evening (The World Bank). Thailand also had a First-Time Car Buyer Tax Rebate Program that offered cash rebates of up to THB 100,000 per vehicle (Wijayasinha, 2013). The incentive scheme not only resulted to an increased number of vehicles on the road and an emphasis on private vehicle ownership, but also to 100,000 indebted buyers defaulting, forcing auto finance companies to seize the vehicles and sell them as used cars (Lefevre, 2013).
- As for the public transport sector, the bus, particularly that of the Bangkok Mass Transit Authority (BMTA), is the primary mode of passenger transport for both short and long trips. From 2003 to 2006, the Traffic Police reported that among the top offenses committed by the bus operator and drivers are: running buses with emissions above the allowable standards, violation of traffic rules, and poorly maintained fleets (The Nation, 2012).
- The launch of the bus rapid transit in Bangkok in 2010, locally called Bangkok Rapid Transit (BRT) as owned by the Bangkok Metropolitan Administration (BMA) and maintained by Krungthep Thanakhom, was envisioned to transform the bus system with its level boarding, low emission vehicle technology, running on compressed natural gas (CNG), and intelligent transportation system such as real-time information on the arrival time of buses. The total BRT route length is about 16 km., occupying the median lanes and serving a total of 12 stations, with an average distance of 1.3 km between stations (Kodukula, 2010).
- Transport activities in both passenger transport and freight have been increasing. (Figure and Figure), indicating the increasing consumption of energy in the transport sector. Demand for the use of natural gas in the transport sector as natural gas vehicles (NGV) grew by 20.8% from 2011 to 2012. Natural gas was firstly used as a fuel for transport in Thailand only in 2001 (EPPO, 2013).
- The price of CNG remains to be much lower and more stable than other fuels (EPPO, 2013). The price of natural gas is now 50% of the price of diesel. It is exempted from all taxes except value-added tax. Additionally, low interest rate and loans have been arranged by the National Energy and Policy Office (NEPO) together with PTT, a Thailand state-owned oil and gas company, for taxi conversion (NGV Global Knowledge Base, 2005).

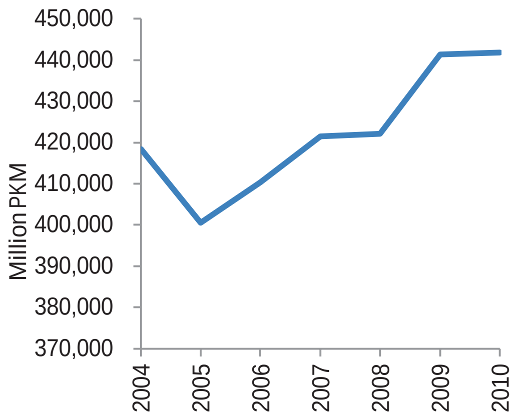

Figure 10. Road Passenger-kilometer, 2004-2010
Source: AJTP, 2013

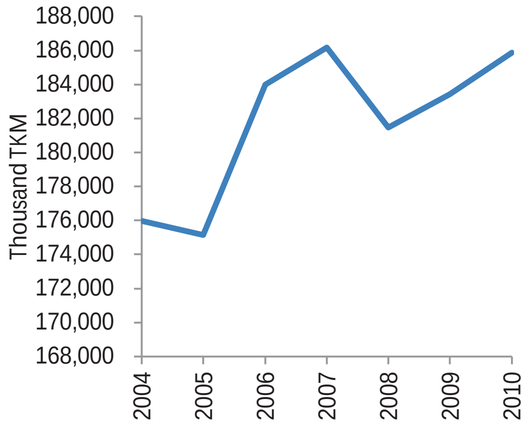

Figure 11. Freight, ton-kilometer, 2004-2010
Source: AJTP, 2013

2.1.2 Rail Transport

- The railway infrastructure of Thailand is managed solely by the State Railway of Thailand (SRT) and spans approximately 4,034 kilometers as of 2011, 2.2% of which are double track, and with an urban railway route length totaling 85 kilometers. Various rail network lines run through Thailand, with the major lines generally radiating from Bangkok and running through the Northeast, East and South corridors. Several other networks bring passengers to neighboring countries such as Malaysia, Lao PDR, and, more notably, connects Thailand to Singapore and Malaysia (via the Eastern and Oriental Express). The primary station in Bangkok is the Hua Lamphong Railway Station.
- The Bangkok Mass Transit System (BTS) or the BTS Skytrain, an elevated light rail transit (LRT), and the mass rapid transit (MRT), which is the subway, are two of the primary rail transit network in Bangkok, whereas the Airport Link transports those traveling to and from Suvarnabhumi Airport.
- An estimated 41 million passenger traffic was carried by the rail network in 2011, transporting 7.5 million passenger-kilometers, according to AJTP. The rail network is also utilized for the transport of goods with 6,016 freight wagons concentrated mostly in Bangkok as well as facilitating transport from its ports (e.g. Laem Chabang, Lad Krabang). The goods transported in 2011 were 2.46 million ton-kilometers, mostly comprised of petroleum products, cement and other building materials, and containers (ADB, 2011). However, there has been a declining trend from 2004-2010 (Figure 12.).

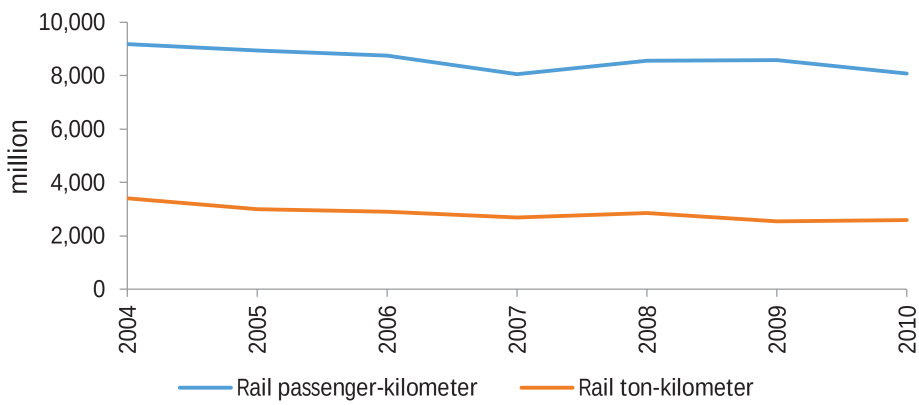

Figure 12. Rail Movement of Passenger and Freight, 2004-2010 (million PKM and TKM)
Source: AJTP, 2013

2.1.3 Air Transport

- Thailand has five main airports, namely Suvarnabhumi, Chiang Mai, Chiang Rai, Phuket, and Songkhla. Suvarnabhumi Airport, located east of Bangkok and having begun operation in September 2006, is among the busiest airports in the world, having a capacity to accommodate over 40 million passengers, and among the world's best airport overall (National News Bureau of Thailand, 2013).
- Data from the ASEAN-Japan Transport Partnership Information Center shows that international air passenger traffic in 2010 reached 35.1 million passengers, representing a 23% increase from the 2004 count of 28.6 million (Figure). Domestic air passenger traffic also recorded a comparable 24% increase for the same period with an estimated 26.9 million passengers. There are also a total of 247 commercial fleets in 2010, housed in 6 international airports and 29 domestic airports. Air cargo has also recorded a relatively similar increase over the same period (Figure).

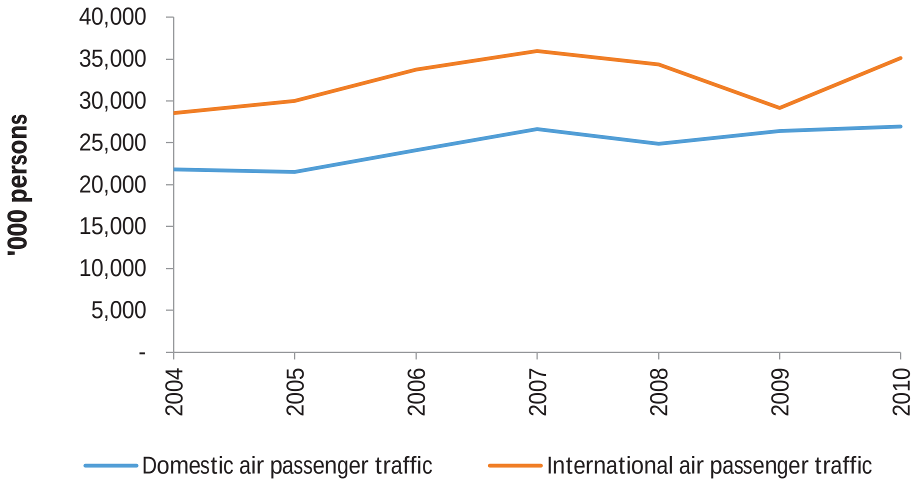

Figure 13. Air Passenger Traffic, 2004-2010 ('000 persons)
Source: AJTP, 2013

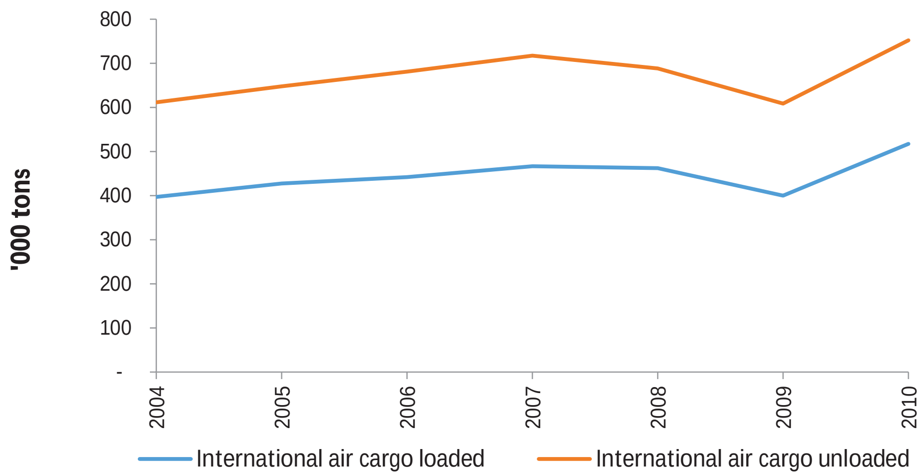

Figure 14. Air Cargo Loaded and Unloaded, 2004-2010 ('000 tons)
Source: AJTP, 2013

2.1.4 Water Transport

- Water transport is commonly used in Thailand for the transport of passengers daily, i.e. commuting to and from work, with "*khlong*" boats crossing canals and rivers. In 2012, about 38 million passenger journeys were made, or around 100,000 per day (The Straits Times, 2013).
- In terms of freight, the major ports of Thailand are the Bangkok Port, which serves the Central Region, and the Laem Chabang Deep Sea Port, which is the gateway to the Asia-Pacific Region. Other important ports in Thailand include Chiang Saen Port to serve the North and facilitate trade with south China, Ranong Port to facilitate trade with Andaman coastal area, Songkhla Port, Sriracha, Phuket, Maptaphut.
- A total of about 47.7 million tons of imports and exports passing through Thailand's ports were recorded in 2008, facilitated by 135 domestic and international ports. In 2010, the country had a domestic passenger fleet of 9,485 and a domestic cargo fleet of 3,234, while international merchant fleet and container vessel fleet totaled 916 (AJTP).
- Although maritime transport in Thailand is comparatively small, the government recognizes its potential to become of the regional hubs in Southeast Asia.
- Thailand takes marine pollution prevention measures such as the adoption of Marpol 73/78 Convention, which requires all tankers to have a double hull from 2012 onward, and specifies that tankers that are 25 years and older must be converted according to their standards or be scrapped.

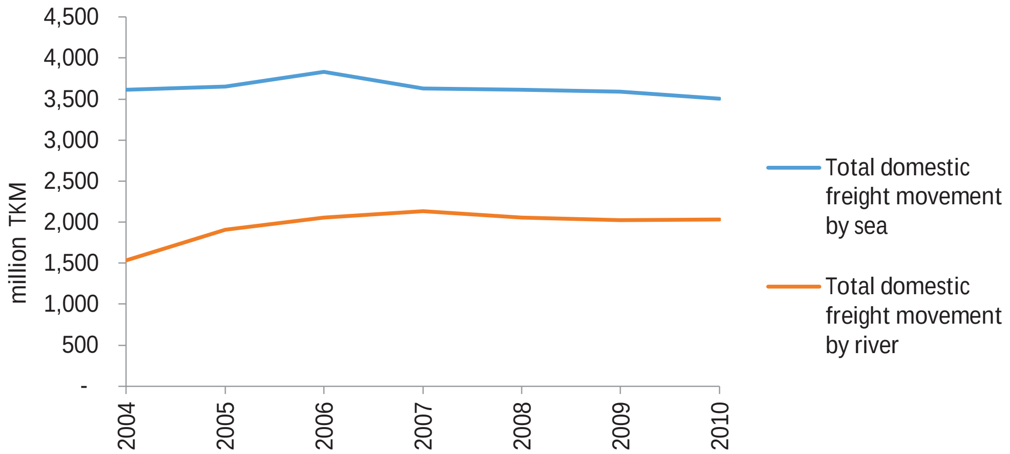

Figure 15. Freight Water Transport TKM (million tkm)
Source: AJTP, 2013

2.2 Key Transport Data

This section presents key information used in the analysis performed for this study. These data include inputs to the Backcasting Tool employed to estimate carbon reduction for the alternative scenarios to the business-as-usual (BAU) cases presented in the succeeding chapter of this report.

2.2.1 Road Transport

- Vehicle Numbers
  - The projection of the number of road vehicles for the baseline scenario is crucial in projecting the emissions from road transportation. The study utilizes gompertz functions which forecasts the number of vehicles based on historical data on GDP/capita and in-use vehicles (each road vehicle type) per 1000 people. Due to the unavailability of in-use vehicle numbers, the study utilizes data on registered vehicles

data (historical) from official statistics[3].

- o The projections for the GDP per capita are explained in the section on the future vision of society. The parameters of the gompertz functions were estimated based on the GDP/capita and the vehicle/1000 data, where in the parameters which resulted in estimations with the lowest squared deviations from the actual data were selected. Checks were made in order to ensure that the projections are reasonable.
- o In the baseline scenario for 2050, there will be 37.8 million vehicles, 60% of these are motorcycles and three-wheelers.

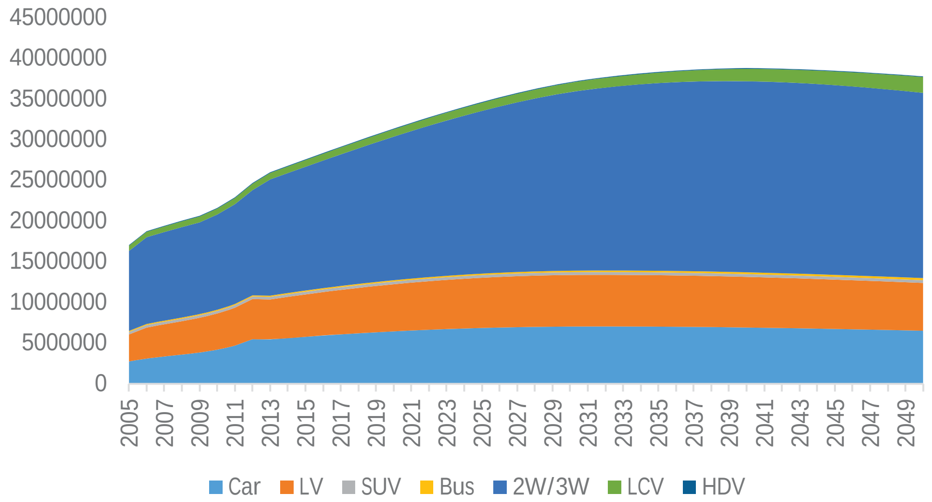

Figure 16. Total Number of Vehicles[4]

- o There will be 206 cars, lv, suv passenger cars/1000 people, 369 motorcycles/1000 people (including 3-wheelers) and 32 trucks/1000 people in 2050. The motorization index (including motorcycles) will be at 612 vehicles/1000 people in 2050 (260 in 2005).
- o The figure below shows the movement in terms of the % composition of the fleet.

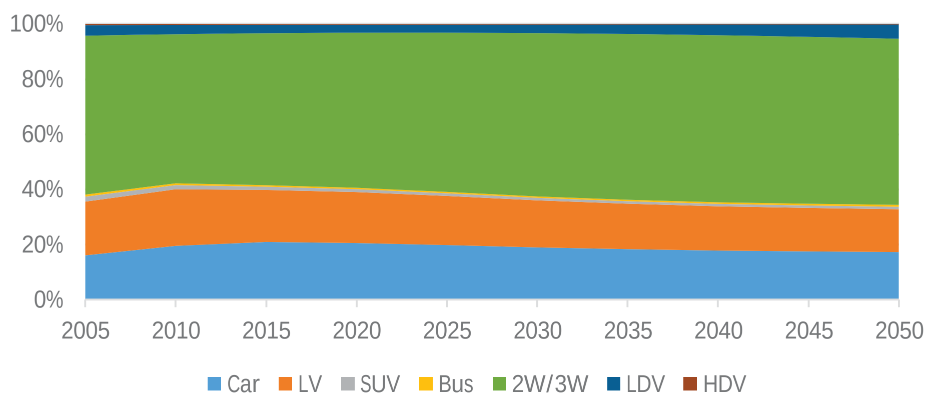

Figure 17. Shares of Vehicle Types in the Road Fleet
Source: Calculated

[3] The study utilizes official data based on vehicle tax payments, rather than the total registered vehicles.
[4] For the purpose of brevity, "Car" refer to sedans and taxis, LV refers to vans and pickups, SUV refers to "passenger vans and microbuses"

- Cars will be growing at an average of 1.94% per annum, while motorcycles will grow at 1.88%. light duty trucks will grow at an annual average of 2.46%.

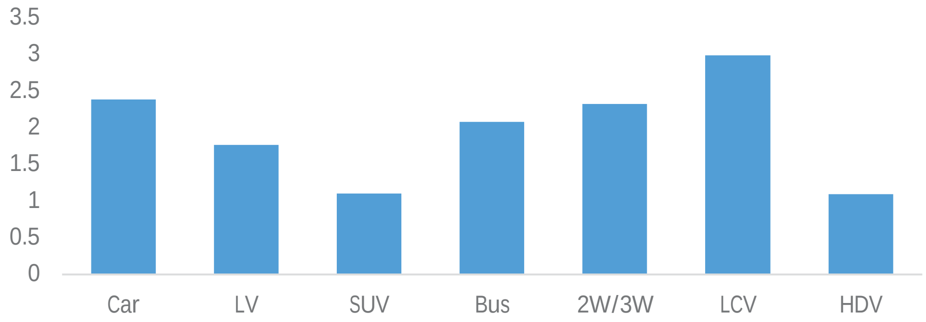

Figure 18. Vehicle Growth Index (2005=1)

- Fuel efficiencies
  - Assumed base fuel efficiencies were taken from existing studies (e.g. CAA, 2012) for road transport. These were adjusted based on the fuel efficiencies of the new vehicles that are expected (based on external projections) and assumed retirement age of the vehicles. The fuel efficiencies for the other fuels (e.g. CNG, LPG), are taken directly from the values in the back casting tool.

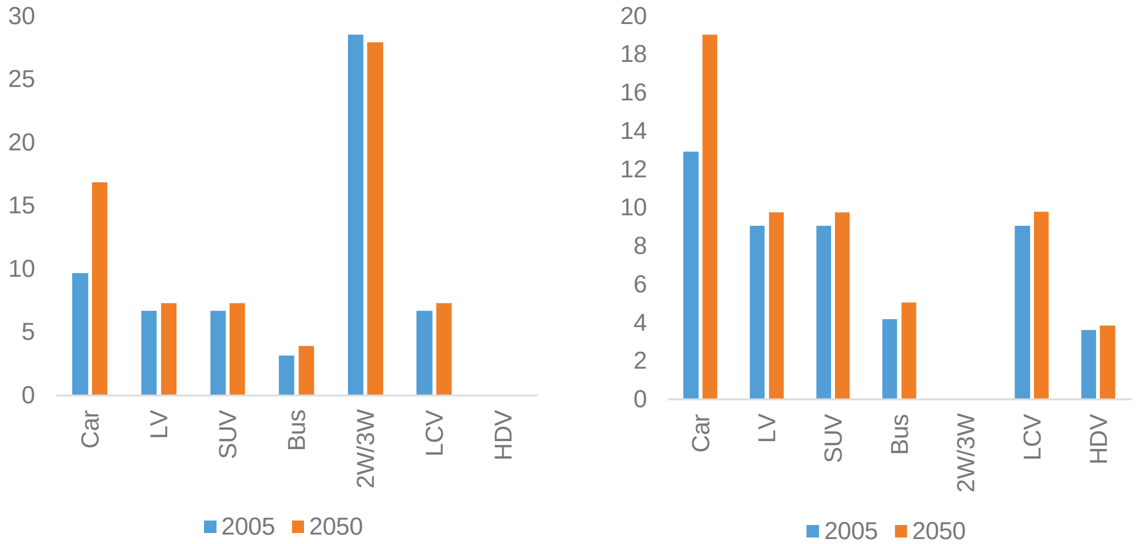

Figure 19. Fuel Efficiencies of Gasoline (Left) and Diesel Vehicles (Right), 2005 and 2050

Source: Calculated[5]

- Vehicle Activity
  - The assumptions on the base annual vehicle-kilometers travelled by each of the mode were taken from existing studies as well. The figure below shows the comparison between the different modes (km/year).
  - Average occupancies (number of people per trip) and average loading figures were also taken from existing studies for Thailand.

[5] Calculated using the VAPIS model developed by Dr. Sarath Guttikunda of urbanemissions.info and utilizing data from Segment Y and ICCT (Global Roadmap Model).

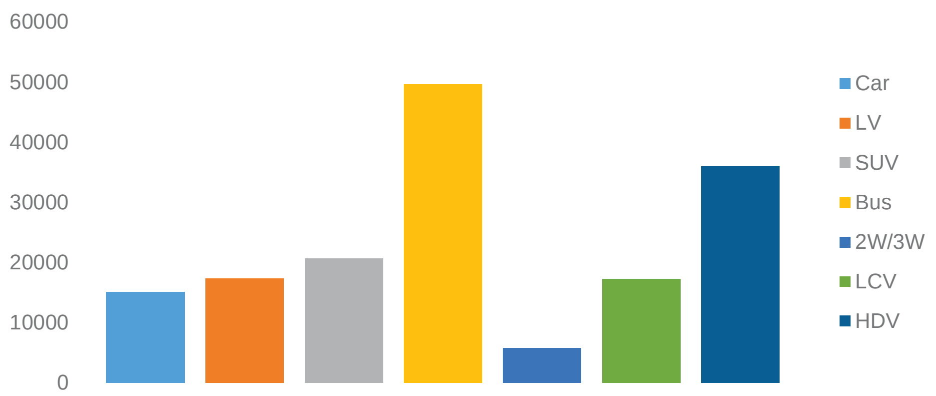

Figure 20. Vehicle Kilometers/Year

- Emission Factors
  - The base emission factors used were based on standard international practice of 2.4 and 2.6 for gasoline and diesel (kgCO2/liter), but were internally adjusted by the backcasting tool (taking into consideration biofuel mix, for example). The emission factors for electric vehicles were based on the generation mix of the grid (and projected mix). No projected % mix was available beyond 2035, therefore, it was assumed that the mix in 2035 will continue.
  - The figure below shows the resulting emission factors for the Thailand electricity grid (kgCO2/kwh).

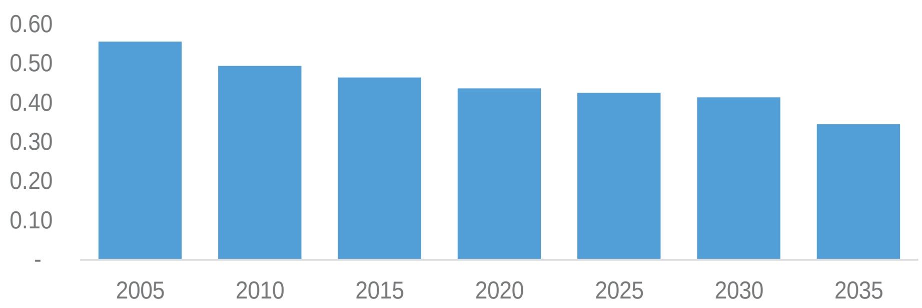

Figure 21. Electricity Emission Factor (kgCO2/kwh)
Source: Calculated using projected generation mix by APEC, 2012

2.2.2 Rail Transport

- The base railway transportation activity for passenger and freight (PKM and TKM) were taken and extrapolated from the World Development Indicators Dataset and movements in the GDP/capita.
- The historical data on the rail PKM shows that it has been at a declining rate since 1992, at an average of -3% per annum. The railway TKM has been relatively stable since 1980. Due to the lack of concrete policies at present on the railway development in Thailand, these trends are expected to continue in the baseline scenario.

Figure 22. Passenger-km and Ton-km for Railways (millions)

2.2.3 Air Transport

- The base transportation volume data for passenger and freight (PKM and TKM) were taken and extrapolated from the ICAO database. The increase was assumed to be proportional to the movement in the GDP/capita.
- From 2005 to 2050, air transport passenger-km will increase by an average of 3.6% per annum, while freight-tkm will increase by 3.8% per annum. They are expected to more than triple in 2050 from their respective volume in 2005.

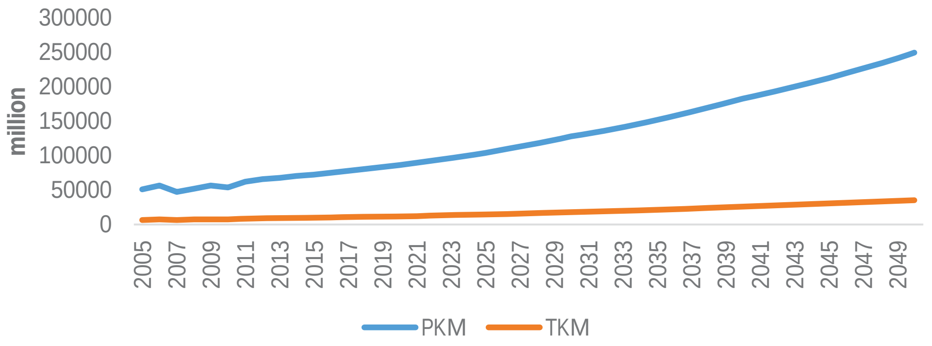

Figure 23. Passenger-km and Ton-km Air Transport

2.2.4 Water transport

- The study was limited in incorporating water transport straight into the energy consumption, rather than in the transport activity. The resulting CO2 emissions from water transport are estimated to grow annually at 1.4% (5.4 million tons in 2005 to 10.1 million tons in 2050).

2.3 Future Transport Scenario

This section presents the future transport images for the cases of the primary cities (more than 2 million population), major cities (more than 1 million population), other cities (200 thousand population), municipalities (non-cities), and others, corresponding to the future scenario for society described in Chapter 1. This section presents the images of transport for both the Business-as-usual scenario and the alternative (low carbon) scenarios.

Box 1: Summary - BAU Scenario

Passenger Transport

- Passenger travel would reach 1.2 trillion passenger-kilometers under the BAU scenario, and can potentially be reduced to 468 billion passenger-kilometers in the alternative scenario.
- In the baseline scenario for 2050, there will be 37.8 million vehicles, 60% of these are motorcycles and three-wheelers.
- There will be 331 passenger cars/1000 people, 368 motorcycles/1000 people (including 3-wheelers) and 32 trucks/1000 people in 2050. The values for these motorization indexes in 2005 are 97, 150 and 11 respectively. The highest growth rates during the period is in the SUV (microbuses and passenger vans), averaging an 8% increase per year, light duty trucks will grow at an annual average of 2.46%, followed by cars (sedans and taxis) at 2.02%.

Freight Transport

- Meanwhile, freight travel is expected to increase to 72 billion ton-kilometers by 2050 under the BAU scenario (46 billion ton km in 2005).
- 92% of total ton-km will be serviced through road trucks and trailers.

2.3.1 Summary Transport Images

This section presents the summary of the transportation images for the different regions of analysis. These are based on the alternative (low carbon scenario) that is further explained in section 3.2. These are images of how the transportation systems will look like in these regions of analysis once the policies in the alternative scenario are put in place.

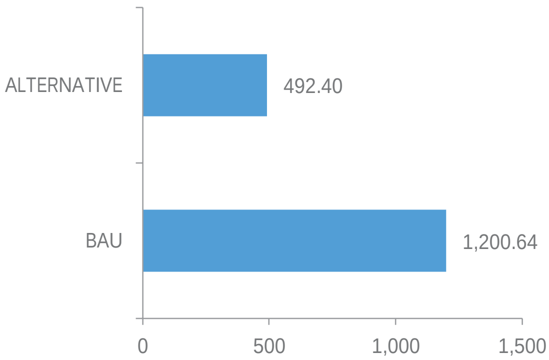

Figure 24. Passenger Travel Length (billion PKM), 2050

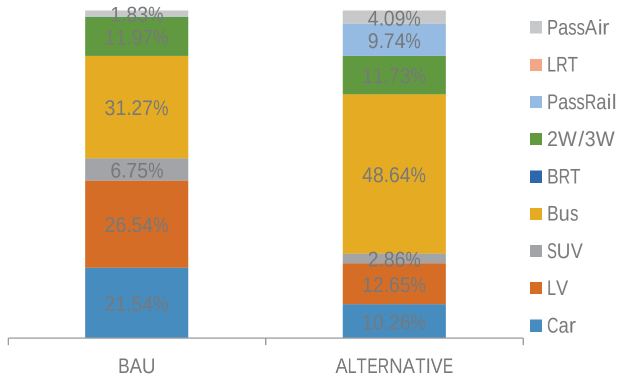

Figure 25. Passenger Transport Mode Share (% of PKM), 2050

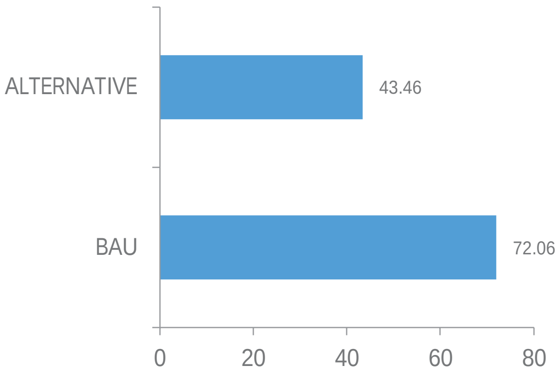

Figure 26. Freight Travel Length (billion TKM), 2050

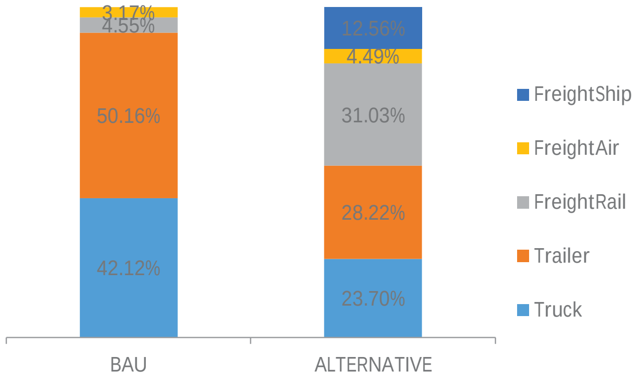

Figure 27. Freight Transport Mode Share (% of TKM), 2050

2.3.2 Transport Image in Primary Metropolitan Areas (2 Million Plus Population)

Buses are expected to be the primary passenger mode by 2050 in the primary urban areas (62% of passenger kilometers in 2050), running on integrated transport networks that seamlessly link people to and from their origin and destination. This also implies that for this to happen, private passenger travel activity would have to growth at a negative rate up to 2050.
Due to the gravity of Bangkok Metropolitan Region in terms of its economic activity, commerce, education and services, it is seen that the surrounding areas will continue to expand within the BMR. Inter-regional transport linking the main urban areas is needed to be hinged on public transport (e.g. bus systems will contribute 32% of the inter-regional passenger-km in 2050).
Technological advancements (adoption of alternative fuels and better vehicle technologies) are seen to penetrate the primary urban areas in 2050.

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- Technological advancements (adoption of alternative fuels and better vehicle technologies) are seen to penetrate the primary urban areas in 2050.

2.3.3 Transport Image in Major Urban Areas (Million Plus Population)

- The estimate in the study shows that no areas will be under this category up to 2050.

2.3.4 Transport Image in Other Urban Areas (200 Thousand to 1 Million Population)

- As with the primary urban area, the future vision for the other urban areas is that the backbone of the passenger transport systems will be the buses (63% of passenger-km in 2050).
- Motorcycle transport activity is still seen to grow at a positive rate in the cities (.51%) and will contribute 15% of the passenger-km in these areas in 2050.
- More sustainable forms of feeder modes to the main public bus lines will be needed (e.g. promotion of

non-motorized transport and integrating it to the public transport system).
- Technological advancement penetration will be there, but at a slower adoption rate than in the primary urban areas.

2.3.5 Transport Image in Non-Urban Areas

- The bus will be the prime source of public transport as a result of strong bus promotion and infrastructural development to link rural areas to the metro. Buses will cover 61% of travel demand in non-city areas.
- The use of more efficient models for alternative public transport (e.g. song taew) is envisioned in the non-urban areas as well. Also, there is a good potential for the non-urban areas to properly integrate non-motorized transport into the planning process leading up towards urbanization.

2.3.6 Transport Image in Inter-Regional Areas

- There will be some slight shift from private cars to rail by 2050, rail covering 18% of all travel demand. This could be attributed to the planned 2,563-km rail network with a speed a 250 km per hour (Railway Gazette International, 2013) which will travel across regions, covering the following corridors:
    - ✓ Bangkok – Chiang Mai (745 km)
    - ✓ Bangkok – Nong Khai/Laos border (615 km)
    - ✓ Bangkok – Rayong via Pattaya (221 km)
- Bangkok – Padang Besar/Malaysian border via Hua Hin (982 km)
- Private 4-wheeled vehicles (car, LV, SUV) will prevail as the primary mode choice, however, and will cover 40% of travels.
- Passenger rail will be significant for regional transport, and will contribute 13% of the passenger-km in 2050.

2.4 Issues and Challenges

- There is increasing pressure in decongesting BMR, but its gravity in pulling people due to its economic importance, quality of services and life, will most likely continue the trend of sprawl within the area.
- Thailand is still continuing in its increase in vehicle motorization rates, partly due to some of the policies of the government to encourage consumers to buy new vehicles.
- The government is still subsidizing the use of fossil fuels (e.g. diesel). The removal of which may pose problems in the future.
- The freight sector is highly dependent on road transport.
- The issue of an ageing society is a real concern for Thailand. From a transport perspective, access is a key concern that has to be integrated into the future systems to be adopted in Thailand.
- Growth in the secondary cities will be faster in the future, and thus, much attention is needed in putting sustainable, low emission transport modes and systems in these areas.

3. Transport CO2

This section provides the details of the policy assumptions that were taken into the Backcasting tool as well as the resulting CO2 emissions both for the business-as-usual scenario and the alternative scenario.

3.1 Business-as-usual Scenario

- The total transport emissions (including domestic air and sea transport) in 2005 were at 51.8 million tCO2.
- By 2050 Thailand will have already reached 91.2 million tCO2, or approximately 1.48 tCO2 per capita (.79 tons per capita in 2005).
- This implies a 1.3% increase in total emissions per year.

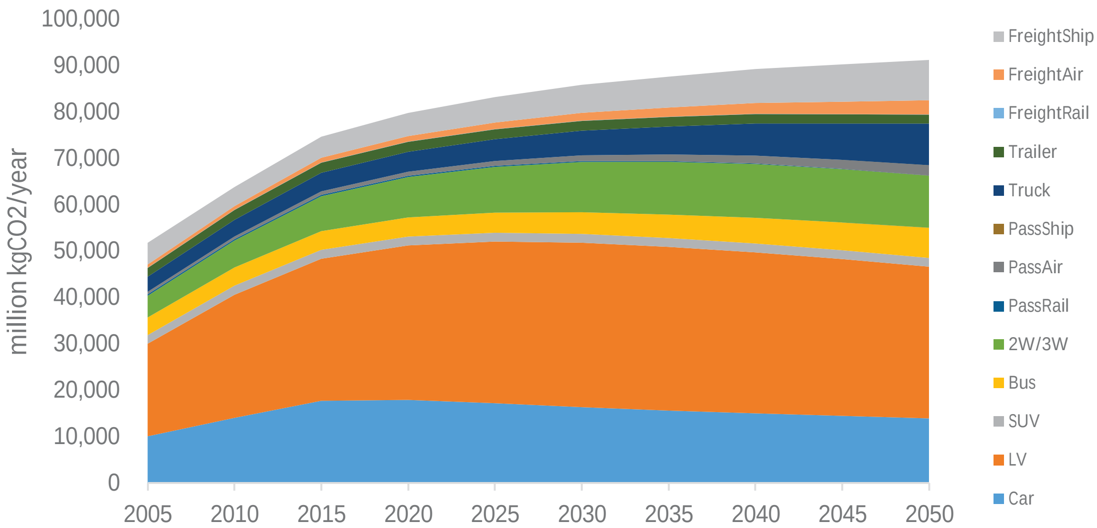

Figure 28. Total CO2 by Mode (million kgCO2/year)

- The per capita emissions for transport under the BAU scenario will increase from 0..79 tons in 2005 to 1.48 tons per capita in 2050.

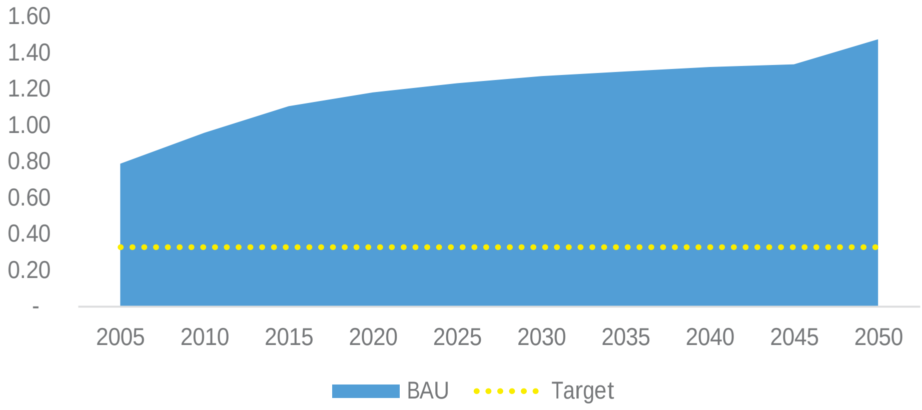

Figure 29. BAU Per Capita Transport CO2 Emissions (tonCO2/ capita)

- Passenger 4-wheeled vehicles are the largest emitters in Thailand, contributing 62% of CO2 emissions in 2005 (53% in 2050 BAU). Cars are still seen to be growing quite high as compared to the other passenger transport modes at 1.9% (passenger-km) annual average from 2005-2050.
- Light and heavy duty trucks will contribute the highest in terms of freight emissions, contributing 12% of the total emissions in 2050 (from 10% in 2005).

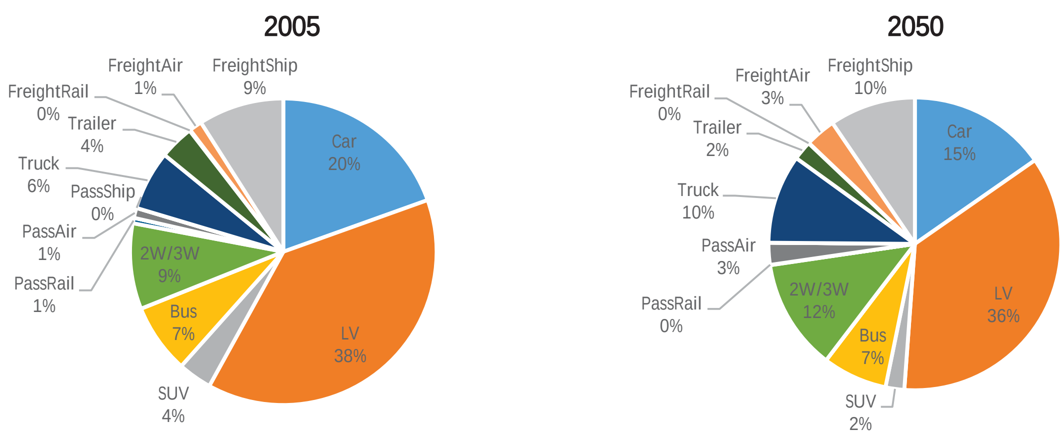

Figure 30. CO2 Contribution per Mode, 2005 and 2050

The section below shows the summary of the indicators for the relevant regions for analysis.

<u>PRIMARY URBAN: Urban agglomerations with 2 million or plus population in 2050</u>
2005: 2.3 million tCO2
2050: 4.3 million tCO2 (average increase of 1.4% annually)
Major emitters: 68% contribution from cars, LVs of 2005, seen to contribute similar % in 2050

<u>OTHER URBAN AREAS</u>
2005: 6.2 million tCO2
2050: 20.2 million tCO2 (average increase of 10% annually)
Major emitters: Similar as primary urban

<u>NON-URBAN AREAS</u>

2005: 17.8 million tCO2
2050: 19.5 million tCO2 (average increase of 0.2% annually)
Major emitters: Similar to urban areas

INTER-REGIONAL TRANSPORT
2005: 25.5 million tCO2
2050: 47.3 million tCO2 (average increase of 1.3% annually)
Major emitters: 39% CO2 from cars and LVs in 2050, 21% from trucks and trailers

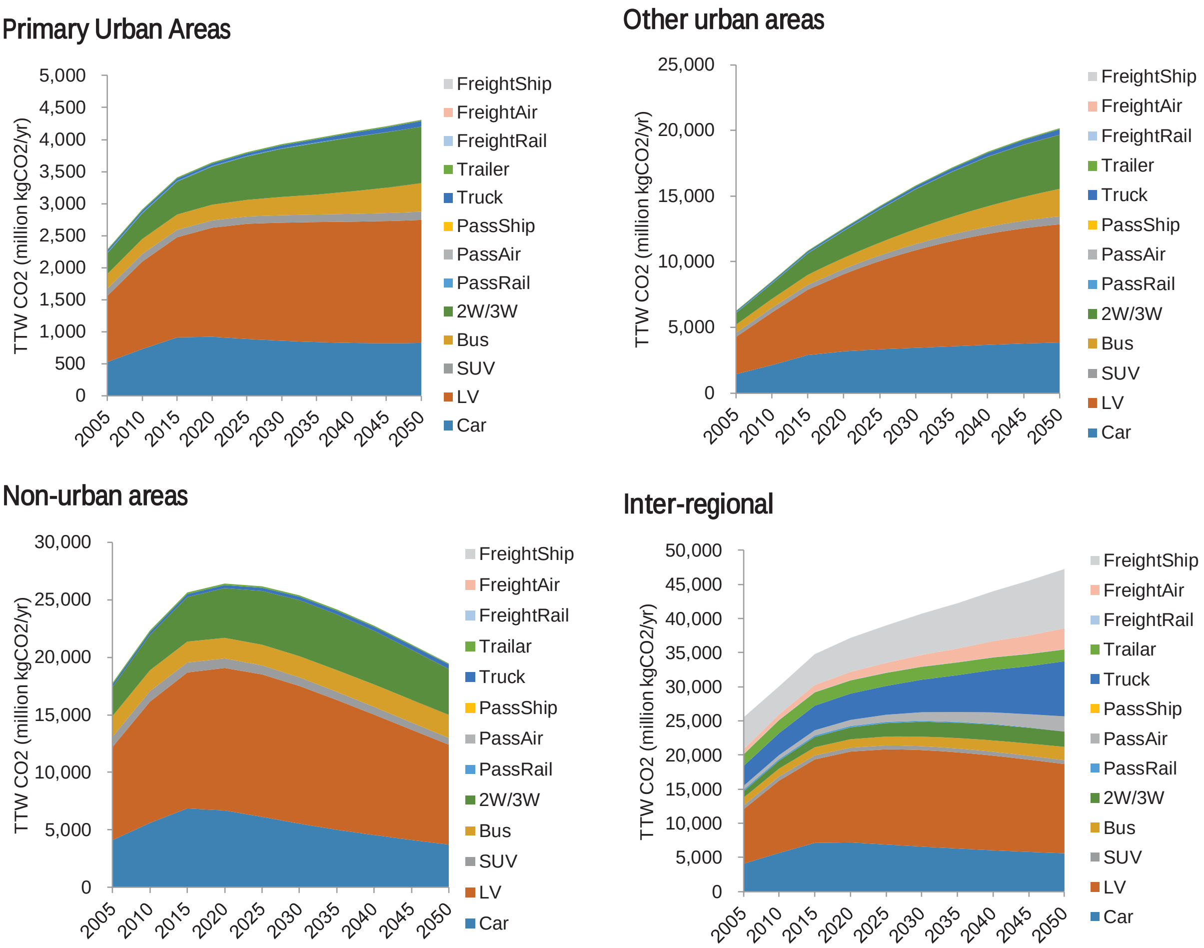

Figure 31. Transport CO2 per Region – BAU Scenario[6]

3.2 Alternative Scenario

- The following section discusses the policies and relevant assumptions that were considered in the development and simulation of the alternative scenario for Thailand. A review of the existing policies in the pipeline was done in order to properly assess which of the policies included in [the backcasting tool are applicable for the different regions.

[6] As non-urban areas become urbanized, the tool re-categorizes their emissions into the "other urban areas," thus explaining the drop in the emissions for the "non-urban" areas leading up to 2050.

- The 11th National Economic and Social Development Plan (NESDP 2012-2016) envisions that the Thailand's transport sector will : move towards multi-modal transportation; shift towards energy efficient transportation and logistics; there will be an expansion of the coverage of the public transport network and; the development of infrastructures integrating roads, railways, and water and air transport for both domestic and international uses.
- The draft environmentally-sustainable master plan for Thailand envisions "an efficient transport model that is environment-friendly, appropriate for the development of sufficient and sustainable socio-economic infrastructure for Thailand." The master plan comprises short-term programs (up to 2017) and a long-term plan (up to 2030) with the reduction of greenhouse gas emissions in the transport sector as the primary aim.
- The said EST master plan outlines the following strategies in moving towards low emissions transport : a) upgrading of the capacity of agencies and personnel for the development of an EST system; b) establishment of appropriate plans and mechanisms for interfacing and monitoring of transport and traffic work plans/measures/projects and move them forward to implementation; c) establishment of a comprehensive and inter-connected transport infrastructure; d) efficient transport management for sustainability and greenhouse gas reduction; e) promotion of transport R&D and the adoption of environmentally-friendly innovations and technologies; f) promotion of public awareness of the environment.
- Environmentally friendly transport sector is likewise being supported by the Renewable and Alternative Energy Development Plan (AEDP 2012-2021).
- While still relatively in the early stages, government expenditures are going to the expansion of rail transport system, allocating 78% of the THB 2-trillion infrastructure budget for railway development, according to NESDP 2012-2016, among which are the high-speed train linking Bangkok to the north, south, northeast, and east, and the expansion of the Skytrain (LRT).
- Transit routes will be added to the Skytrain to extend its coverage from central Bangkok to surrounding provinces as well as the airports. In 2014, six more Skytrain projects covering 62.7 km will be in discussion, while five projects covering 53.6 km will be in discussion after 2014. Once all projects are completed, there is an anticipated total of 464 km of Skytrain transit routes (Pattaya Daily News, 2012), and reflecting government's plan of having a station every 500 meters as well as linking the city to the provinces of Nonthaburi and Pathum Thani (The World Bank). New roads will be built to facilitate travel to and from the six countries of the Greater Mekong Sub-region, namely southern China, Thailand, Myanmar, Laos, Cambodia and Vietnam, according to Bombay Chamber of Commerce and Industry.
- With regards to the improvement of existing fleets, plans of purchasing 3,183 new buses (NGV) are also in discussion. BMTA hopes that the minimal cost of operation and maintenance of the fleets will ease their THB 76 billion debt. NGV in Thailand is subsidized by the government, and ethanol is locally produced from energy crops in Thailand already (Bangkok Post, 2013). The goal of having environmentally friendly transport sector is likewise supported by the Renewable and Alternative Energy Development Plan for 25% in 10 years (AEDP 2012-2021) which targets the following production by 2021:

Table 3. Biofuel Targets

Biofuel Targets	Present Capacity	2021
Ethanol (as fuel to substitute benzene)	1.3 million liters/day	9 million liters/day
Bio Diesel (as fuel to substitute diesel)	1.62 million liters/day	5.97 million liters/day
New fuel for the future diesel substitution, e.g. crop development (jatropha), using ethanol for blending to substitute diesel oil, development of oil conversion technology	-	25 million liters/day

- In June 2007, the Board of Investments launched "eco-car policy" whereby car assembly and key parts manufacturing projects will be offered a corporate income tax exemption of 8 years along with duty-free importation of machinery. Eco-car manufacturers also have 17% excise tax rate on eco-cars that have engines smaller than 1,300cc for petrol engines and 1,400cc for diesel engines, much lower than the the excise tax rate that is being applied for standard passenger cars is between 30% and 50% (The Board of Investment of Thailand, 2007). The recent news on the Phase II of the eco-car policy is expected to attract an investment of THB 40 billion, and with the combination of the two phases of the policy, could result to a combined production capacity of 930,000 eco-cars in 2018 (Pussayanawin, 2013).

- The Department of Alternative Energy Development and Efficiency (DEDE), Thailand's Ministry of Energy, also presented a strategic plan on hydrogen and fuel cells technology to shift from the present fossil fuel-based economy to hydrogen-oriented economy by around 2030. From the present up to about 2020, private efforts on fundamental research, demonstration, field tests will be encouraged, and from then on until 2030, DEDE (Hydrogen and Fuel Cells Development Road Map) seeks to aim for large-scare commercialization of hydrogen and fuel cell technologies. Fuel cell vehicles rely mainly on hydrogen, which is produced from a variety of energy sources such as biomass. This is recognized as a feasible undertaking as the utilization of natural gas in vehicles is established.
- Thailand's ageing population – hence decrease in driving-age population – will also influence the transport sector in the future. While it will not be significant enough to shrink private vehicle ownership, it will influence land use planning for safer access to the public transport services. Infrastructures such as curb ramps and amenities such as elevator services will have to be in place to ensure inclusiveness. The public transport systems themselves will have to accommodate the ageing population. For instance, in the development of BRT systems, devices such as boarding bridges that eliminate the bus-to-platform gaps for all passengers, low-floor buses and platform-level boarding will also have to be required to ensure safety for all passengers.
- With regard to emissions, Thailand is also in the process of formulating an action plan devised under the National Appropriate Mitigations Actions (NAMAs) that is expected to be submitted to United Nations Framework Convention on Climate Change (UNFCCC) in 2014. This is in support of their recent commitment to reduce their greenhouse gas emissions by 7-20% by the end of 2020. Without significant changes to the current transport (The Bangkok Post, 2013).
- As for freight, the government also recognizes that the railways will have to be upgraded with the addition of dual-track rail lines along major routes and of a high-speed railway for regional connectivity to further trade and investment. As acknowledged in Vision Thailand 2030 Transport infrastructure development plan, rail and maritime transport are of high priority, such as the Dawei deep seaport project. The plan of the government is to "reduce logistics costs to less than 15% of GDP, and increase the share of rail transport to 5%" from the current 3%.
- The government of Thailand is considering alternatives to road transport. In early 2013, it was reported that the use of "khlong" boats, Thailand's public boats, along the canals in town (Citrinot, 2013) will be encouraged as they are fairly cheap and there is no widespread water congestion. However, its infrastructure is extremely poor (The Straits Times, 2013). Bangkok also committing to make traveling by public boats less pungent with sewage and waste water treatment. As for the road transport, congestion charging has been in discussion for Inner Bangkok (The Straits Times, 2013). Then again, such schemes will only be supported when the public transport system is in excellent and pleasant condition.

Table 4. Assumptions – National Level

AVOID	SHIFT	IMPROVE
• Pricing Regimes • ICT • Urban and Land use planning	- Passenger Transport - • Rail/LRT infra development • Ship infra development - Freight Transport – • Rail/LRT infra development • Ship infra development	• CNGV mass supply • CNGV Promotion (mainly via economic way) • FCV mass supply • FCV Promotion (mainly via economic way) • Biofuel Development • Biofuel Promotion • Ecological Driving

3.2.1 Primary Urban Areas

Policy Packages

- Traffic congestion is most prevalent in Bangkok partly due to policies that favored the use of private cars such as the First-Time Car Buyers Scheme, which was reported to have encouraged 1.2 million first-time car buyers in 2012, according to the Excise Department (Citrinot, 2013). This has been resulting to excessive fuel consumption and demand, a loss of 3 million person-hours each day in the metropolitan region (Cervero, 2000), as well as an economic loss of THB 10 million a year (The Bangkok Post, 2013).
- According to the Traffic and Transport Policy and Planning Office, the average speed of vehicles in Bangkok's main roads is 15.7 km per hour (Saengpassa, 2013). Moreover, as a result of the inefficiencies in the freight sector such as shipment delays, the warehousing and inventory-carrying costs have become relatively high (ADB, 2011). The increased motorization in Bangkok has also resulted to polluting emissions, albeit having one of the most stringent policies (Euro 4; diesel sulfur limits of 50 ppm) (Chambliss, Miller, Façanha, et al., 2013). Its fuel economy standards are likewise being formulated. Congestion is made worse with insufficient infrastructure to support transit from the suburbs (Saengpassa, 2013).
- Policy references mentioned in the previous section were considered, such as the reports on Environmentally Sustainable Transport of Thailand to 2020 (EST) and the Transport Master Plans pertinent cities. The EST specifies 10 priority targets by 2020, including an ambitious 30-45% mode share from public transport, especially from the Urban Rail System. National policy assumptions are based from these priority policies.

Table 5. Summary of Policy Packages for Primary Urban Areas

AVOID	SHIFT	IMPROVE
• Pricing Regimes • ICT • Teleactivities • Travel plans • Car ownership • Improved Travel Awareness • Urban and Land use planning	- Passenger Transport - • Bus/BRT use promotion • Bus/BRT infra development • Rail/LRT use promotion • Rail/LRT infra development • Ship infra development - Freight Transport – • Rail/LRT infra development • Ship infra development	• CNGV mass supply • CNGV Promotion (mainly via economic way) • FCV mass supply • FCV Promotion (mainly via economic way) • Biofuel Development • Biofuel Promotion • Ecological Driving

- As seen in the table above, additional policies have been assumed alongside the pipeline policies.

Table 6. Shift Rates – Primary Urban Areas

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Bus/BRT usage promotion (Passenger)										
Bus/BRT infra development (Passenger)										
from Car/LV/SUV to Bus	0%	0%	0%	0%	0%	20%	20%	20%	20%	20%
Rail/LRT usage promotion (Passenger)										
Rail/LRT infra development (Passenger)										
from Car/LV/SUV to Rail	0%	0%	0%	0%	0%	3%	9%	14%	20%	25%
from Car/LV/SUV to LRT	0%	0%	0%	0%	0%	5%	9%	14%	20%	25%

Table 7. Vehicle Technology and Fuel – Primary Urban Areas

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
CNGV Promotion (mainly via economic way)										
Car(CNG)	0%	0%	0%	3%	5%	5%	5%	5%	5%	5%
LV(CNG)	0%	0%	0%	13%	27%	40%	40%	40%	40%	40%
Bus(CNG)	0%	0%	0%	0%	10%	20%	20%	20%	20%	20%
Truck(CNG)	0%	0%	0%	2%	3%	5%	7%	8%	10%	10%
FCV mass supply										
FCV Promotion (mainly via economic way)										
Car(FCV)	0%	0%	30%	30%	30%	30%	30%	30%	30%	30%
SUV(FCV)	0%	0%	0%	1%	3%	4%	6%	7%	9%	10%
Biofuel Development										
Biofuel Promotion										
Bioethanol	0%	0%	0%	20%	20%	20%	20%	20%	20%	20%
Biodiesel	0%	0%	0%	15%	15%	15%	15%	15%	15%	15%
Biogas	0%	0%	0%	10%	10%	10%	10%	10%	10%	10%

Results

- The total emission from travel activity occurring in the primary urban areas will be reduced by 82% from 4.3 million tons (BAU 2050) to 0.78 million tons in the alternative scenario.
- The per capita emissions from travel activity occurring in the primary urban areas will be reduced from 0.40 tCO_2 per capita (BAU 2050) to 0.12 tCO_2 per capita (alternative 2050).

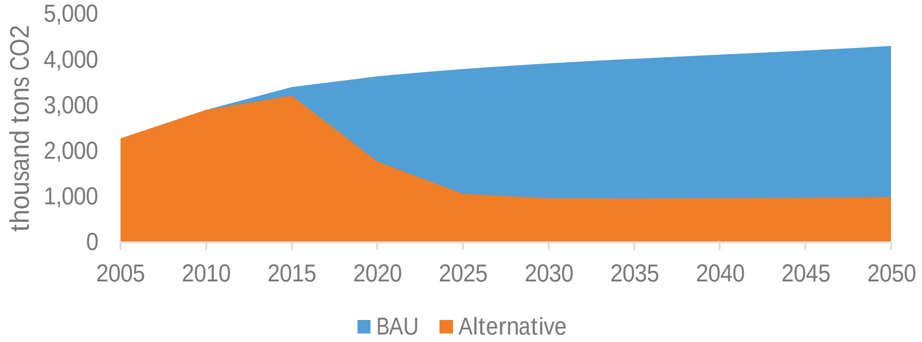

Figure 32. Primary Urban Areas: Transport CO_2 Emissions (000 tons CO_2)

3.2.2 Other Urban Areas

- The other urban areas refer to areas with populations between 200,000 to 1 million.
- The table below shows the policy packages that were assumed for the other urban areas.

Table 8. Summary of Policy Packages for Other Urban Areas

AVOID	SHIFT	IMPROVE
• Pricing Regimes • ICT • Teleactivities • Travel Plans • Car Ownership • Improved Travel Awareness • Urban and Landuse planning	- Passenger Transport - • Bus/BRT usage promotion • Bus/BRT infra development • Ship usage promotion • Ship infra development - Freight Transport – • Ship infra development[7]	• CNGV mass supply • CNGV Promotion (mainly via economic way) • FCV mass supply • FCV Promotion (mainly via economic way) • Biofuel Development • Biofuel Promotion Ecological Driving

- The table below shows the shift rates that were applied in simulating the future alternative scenario for the other urban areas.

Table 9. Shift Rates - Other Urban Areas

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Bus/BRT usage promotion (Passenger)										
Bus/BRT infra development (Passenger)										
from Car/LV/SUV to Bus	0%	0%	0%	0%	0%	20%	20%	20%	20%	20%
Rail/LRT usage promotion (Passenger)										
Rail/LRT infra development (Passenger)										
from Car/LV/SUV to LRT	0%	0%	0%	0%	0%	5%	9%	14%	20%	25%
Rail usage promotion (Freight)										
Rail infra development (Freight)										
from Truck/Trailer to Rail	0%	0%	0%	0%	0%	1%	2%	3%	4%	5%
Ship usage promotion (Freight)										
Ship infra development (Freight)										
from Truck/Trailer to Ship	0%	0%	0%	0%	5%	10%	10%	10%	10%	10%

[7] The use of ships in this case refers to higher utilization of the inland waterways.

Table 10. Vehicle Fuel and Technology - Other Urban Areas

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
CNGV Mass Supply										
CNGV Promotion (mainly via economic way)										
Car(CNG)	0%	0%	0%	3%	5%	5%	5%	5%	5%	5%
LV(CNG)	0%	0%	0%	13%	27%	40%	40%	40%	40%	40%
Bus(CNG)	0%	0%	0%	0%	10%	20%	20%	20%	20%	20%
Truck(CNG)	0%	0%	0%	2%	3%	5%	7%	8%	10%	10%
FCV mass supply										
FCV Promotion (mainly via economic way)										
Car(FCV)	0%	0%	30%	30%	30%	30%	30%	30%	30%	30%
SUV(FCV)	0%	0%	0%	1%	3%	4%	6%	7%	9%	10%
Biofuel Development										
Biofuel Promotion										
Bioethanol	0%	0%	0%	20%	20%	20%	20%	20%	20%	20%
Biodiesel	0%	0%	0%	15%	15%	15%	15%	15%	15%	15%
Biogas	0%	0%	0%	10%	10%	10%	10%	10%	10%	10%

Results

- The total emission from travel activity occurring in the other urban areas will be reduced by 82% from 20.2 million tons (BAU 2050) to 3.5 million tons in the alternative scenario.
- The per capita emissions from travel activity occurring in the other urban areas will be reduced from 0.67 tCO2 per capita (BAU 2050) to 0.17 tCO2 per capita (alternative 2050).

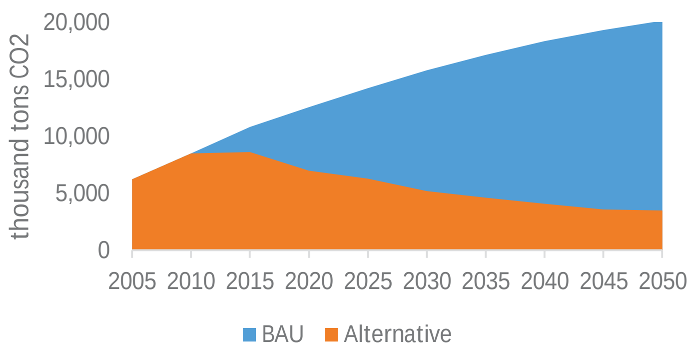

Figure 33. Other Urban Areas: Transport CO2 Emissions (000 tons CO2)

3.2.3 Non-Urban Areas

- The non-urban areas refer to agglomerations with population less than 200,000.
- The table below shows the main policy packages assumed for these areas.

Table 11. Summary of Policy Packages for Non-Urban Areas

AVOID	SHIFT	IMPROVE
• Pricing Regimes • ICT • Teleactivities • Travel plans • Car ownership • Improved Travel Awareness • Urban and Land use planning	- Passenger Transport - • Bus/BRT use promotion • Bus/BRT infra development • Ship usage promotion • Ship infra development - Freight Transport – • Ship infra development	• CNGV mass supply • CNGV Promotion (mainly via economic way) • FCV mass supply • FCV Promotion (mainly via economic way) • Biofuel Development • Biofuel Promotion • Ecological Driving

- The table below shows the shift rates that were applied in simulating the future alternative scenario for the non-urban areas.

Table 12. Shift Rates - Non-Urban Areas

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Bus/BRT usage promotion (Passenger)										
Bus/BRT infra development (Passenger)										
from Car/LV/SUV to Bus	0%	0%	0%	0%	3%	6%	9%	12%	15%	15%

Table 13. Vehicle Technology and Fuel – Non-Urban Areas

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
CNGV mass supply										
CNGV Promotion (mainly via economic way)										
Car(CNG)	0%	0%	0%	3%	5%	5%	5%	5%	5%	5%
LV(CNG)	0%	0%	0%	0%	10%	20%	30%	30%	30%	30%
Truck(CNG)	0%	0%	0%	2%	3%	5%	7%	8%	10%	10%
Hybrid mass supply										
Hybrid Promotion (mainly via economic way)										
Bus(HV-Diesel)	0%	0%	0%	0%	0%	10%	20%	20%	20%	20%
FCV Promotion (mainly via economic way)										
Car(FCV)	0%	0%	3%	5%	8%	10%	15%	20%	25%	30%
Biofuel Development										
Biofuel Promotion										
Bioethanol	0%	0%	0%	20%	20%	20%	20%	20%	20%	20%
Biodiesel	0%	0%	0%	15%	15%	15%	15%	15%	15%	15%
Biogas	0%	0%	0%	10%	10%	10%	10%	10%	10%	10%

Results

- The total emission from travel activity occurring in non-urban areas will be reduced by 83% from 19.5 million tons (BAU 2050) to 3.4 million tons in the alternative scenario.
- The per capita emissions from travel activity occurring in the non-urban areas will be reduced from 0.67 tCO_2 per capita (BAU 2050) to 0.12 tCO_2 per capita (alternative 2050).

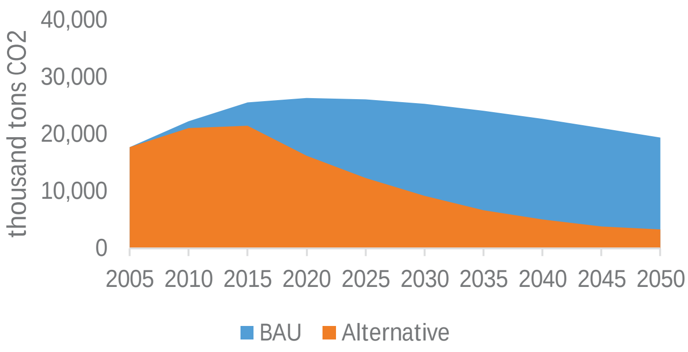

Figure 34. Non-Urban Areas: Transport CO2 Emissions (000 tons CO2)

3.2.4 Inter-regional transport

- Inter-regional transport refers to the transport that occurs while traveling between the aforementioned regions (primary urban, major urban, other urban, non-urban).
- The table below shows the policy packages that were assumed for the other urban areas.

Table 14. Summary of Policy Packages for Inter-Regional Transport

AVOID	SHIFT	IMPROVE
• Pricing Regimes • ICT • Teleactivities • Travel plans • Car ownership • Improved Travel Awareness • Urban and Land use planning	- Passenger Transport - • Bus/BRT use promotion • Bus/BRT infra development • Rail/LRT use promotion • Rail/LRT infra development • Ship infra development - Freight Transport – • Rail/LRT infra development • Shift usage promotion • Ship infra development	• CNGV mass supply • CNGV Promotion (mainly via economic way) • Hybrid mass supply • Hybrid Promotion (mainly via economic way) • FCV mass supply • FCV Promotion (mainly via economic way) • Biofuel Development • Biofuel Promotion • Ecological Driving • Rail electrification

- The table below shows the shift rates that were applied in simulating the future alternative scenario for inter-regional transport.

Table 15. Shift Rates – Inter-Regional Transport

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Rail/LRT usage promotion (Passenger)										
Rail/LRT infra development (Passenger)										
from Car/LV/SUV to Rail	0%	0%	0%	0%	0%	3%	9%	14%	20%	25%
Rail usage promotion (Freight)										
Rail infra development (Freight)										
from Truck/Trailer to Rail	0%	0%	0%	0%	0%	6%	12%	18%	24%	30%
Ship usage promotion (Freight)										
Ship infra development (Freight)										
from Truck/Trailer to Ship	0%	0%	0%	0%	1%	4%	7%	9%	12%	15%

Table 16. Vehicle Technology and Fuel – Inter-Regional Transport

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
CNGV Mass Supply										
CNGV Promotion (mainly via economic way)										
Car(CNG)	0%	0%	0%	3%	5%	5%	5%	5%	5%	5%
LV(CNG)	0%	0%	0%	13%	27%	40%	40%	40%	40%	40%
Bus(CNG)	0%	0%	0%	0%	10%	20%	20%	20%	20%	20%
Truck(CNG)	0%	0%	0%	2%	3%	5%	7%	8%	10%	10%
FCV mass supply										
FCV Promotion (mainly via economic way)										
Car(FCV)	0%	0%	30%	30%	30%	30%	30%	30%	30%	30%
SUV(FCV)	0%	0%	0%	1%	3%	4%	6%	7%	9%	10%
Biofuel Development										
Biofuel Promotion										
Bioethanol	0%	0%	0%	20%	20%	20%	20%	20%	20%	20%
Biodiesel	0%	0%	0%	15%	15%	15%	15%	15%	15%	15%
Biogas	0%	0%	0%	10%	10%	10%	10%	10%	10%	10%

Results

- The total emission from inter-regional transport will be reduced by 51% from 47.2 million tons (BAU 2050) to 23 million tons in the alternative scenario.
- The per capita emissions from inter-regional transport will be reduced from 0.62 tCO2 per capita (BAU 2050) to 0.37 tCO2 per capita (alternative 2050.

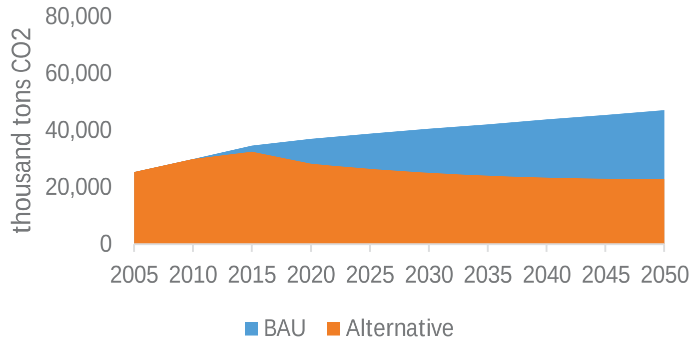

Figure 35. Inter-Regional Transport: Transport CO2 Emissions (000 tons CO2)

3.2.5 Summary Results

- The application of the policies mentioned in the section above resulted in the reduction of total CO2 emissions in 2050 from 91.2 million tons (BAU) to 30.7 million tons.
- The alternative scenario posits a negative growth rate in emissions at -1.0% average annual rate of change, as compared to the BAU scenario which has a 1.3% annual average growth rate in transport CO2 emissions.
- The application of the policy packages resulted in notable changes in the transportation volume, as the alternative scenario results in a -0.6% rate of change in transport volume from 2005-2050, as compared to the BAU scenario where total transport volume is increasing at 1.5% per year.
- For passenger transport, the alternative scenario emphasizes the use and development of public modes such as buses and rail-based transport, while the private modes are growing at a negative rate. Buses will serve 49% of the total passenger-km in 2050 (vs 31% in the BAU) and rail will serve 10% of the total passenger-km (as compared to less than 1% in the BAU).
- For freight transport, the rail systems are much more utilized in the alternative scenario, contributing 31% of the total ton-km in 2050 (as compared to only 5% in the BAU).

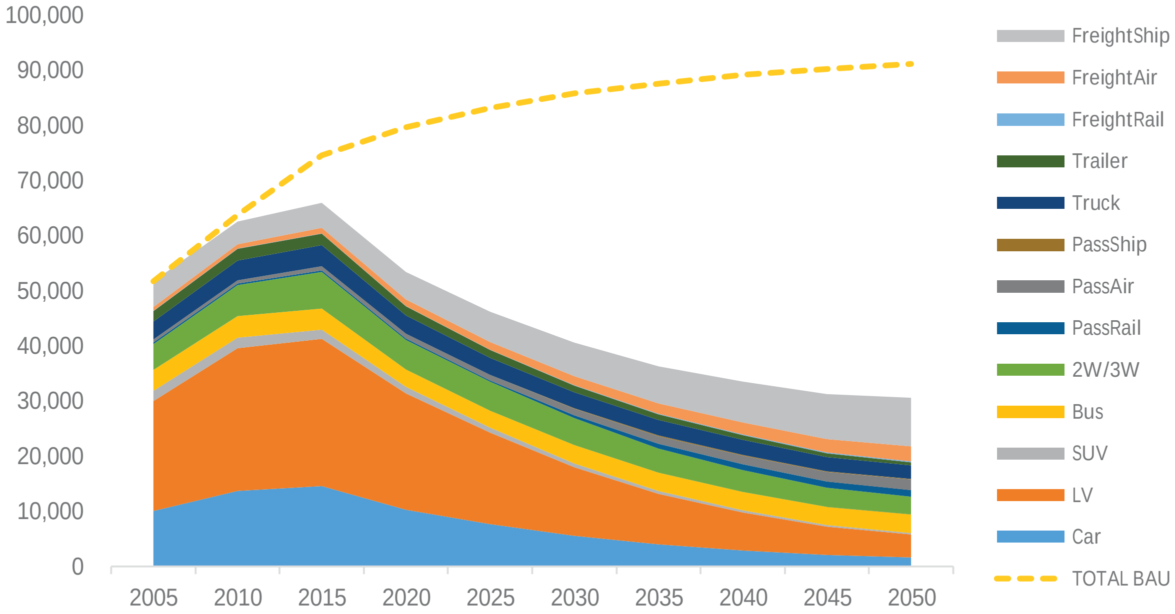

Figure 36. Total Transport CO2 by Mode -Alternative vs Total BAU (thousand tons CO2)

- The impacts of the policies resulted in a 2050 per capita CO_2 value of 0.50 tons per capita (as compared to 1.48 in the BAU scenario.

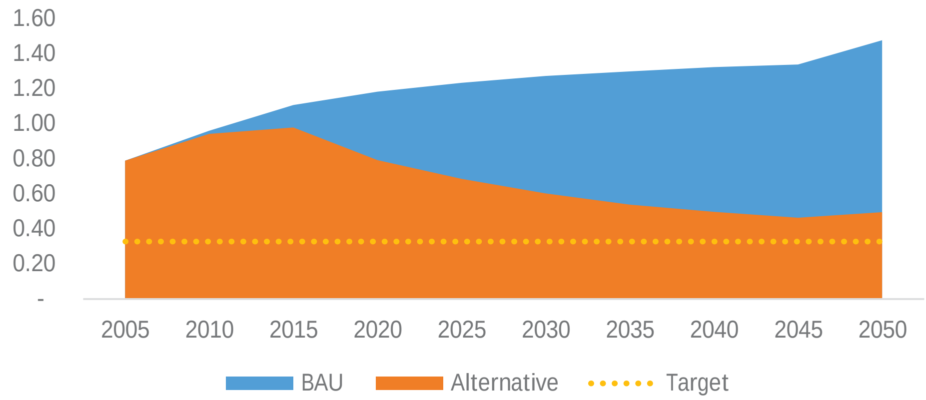

Figure 37. Per Capita Transport CO2 (tons CO2/capita)

- The alternative scenario suggests less emission from car, LV and SUV use such that the contribution is limited to 20% in 2050 (as compared to 53% in the BAU). The contribution of buses will increase (due to higher bus volumes and usage) to 11% (as compared to 7% in the BAU). Rail-based passenger transport will contribute 4% of the CO_2 emissions in the alternative scenario (as compared to .03% in the BAU).
- The alternative scenario results in a larger contribution from freight water transport (29% in the alternative vs 10% in the BAU) as the alternative scenario postulates shifting of freight activity towards water transport.

3.3 Action Plan

- The figures below show a summary of the actions that have been taken into consideration in building the alternative scenario for Thailand: primary cities example and Thailand as a whole.

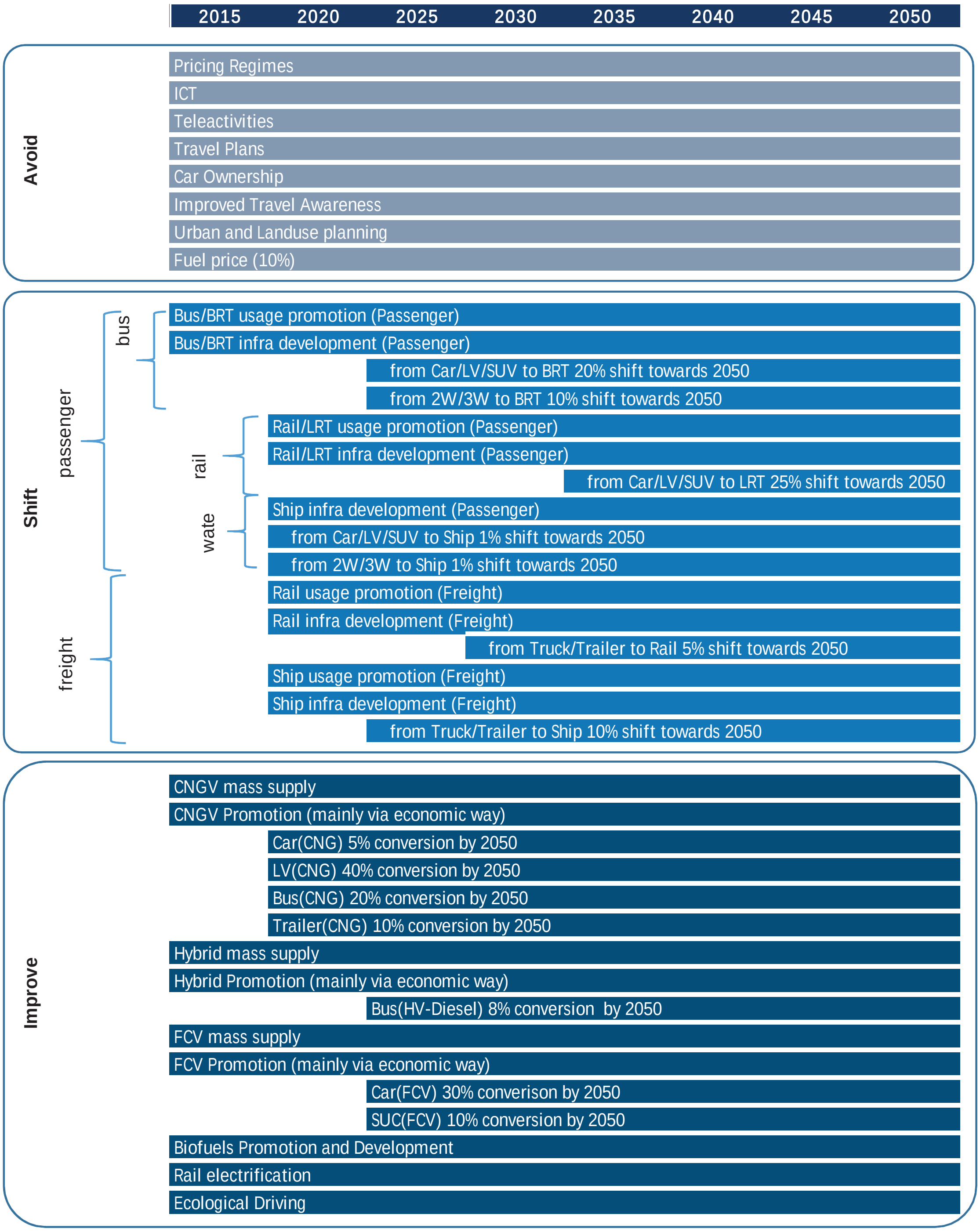

Figure 38. Action Plan for the Primary Urban Areas

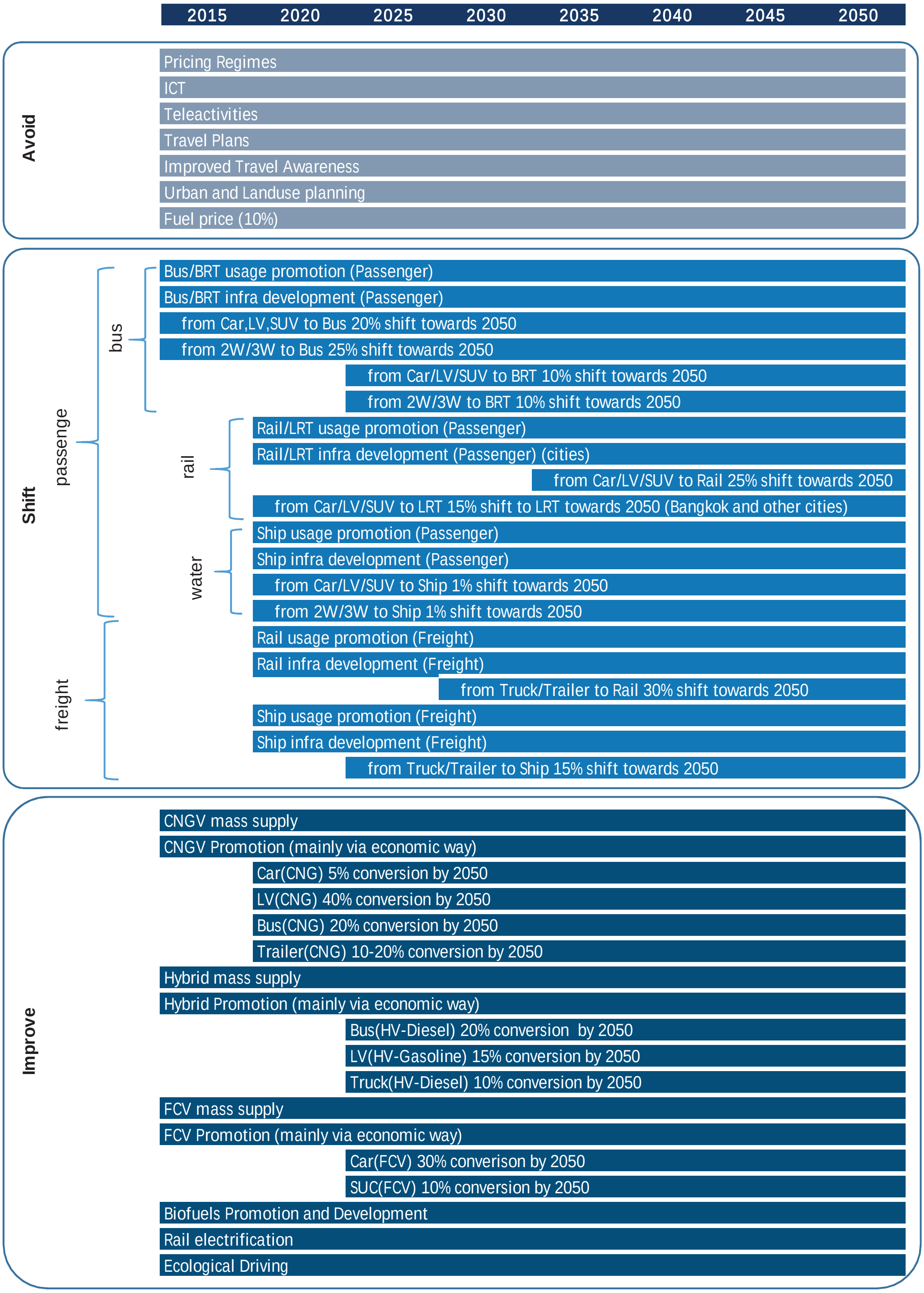

Figure 39. Summary Action Plan for Thailand

4. Conclusions

- The BAU scenario estimates that the total transport CO2 emissions will increase 1.76 fold from 51.8 million tons in 2005 to 91.2 million tons in 2050. In terms of per capita emissions, it will increase from 0.79 tons per capita in 2005 to 1.48 tons in 2050.
- The estimates projects that interregional transport will be a significant aspect to look into in terms of mitigation policies. It is estimated to contribute 52% of the total transport emissions in 2050.
- In terms of the growth in % contribution to the total transport CO2 emissions, the "other" urban areas shows the greatest potential as it will contribute 22% of the emissions in 2050 according to the BAU scenario (from 12% in 2005). Policies to mitigate the impending increase in emissions in these areas are much needed today.
- In terms of the different modes, light passenger vehicles are estimated to be the highest contributor in 2050, emitting 53% of all transport CO2 emissions.
- The study presents future societal factors for Thailand based on available information on forecasts for the economy and population characteristics of the country.
    - By 2050, the population of Thailand will be 61 million, 54% of whom will be within the working age, 30% will be senior citizens. Thailand is unique in the region, as the projections point to a negative population growth rate (-0.13%) from 2005-2050.
    - 55.7% of the population in 2050 will be living in urban areas
    - The GDP per capita will be at 26,178 USD/capita, growing at an average of 5.39% annually.
- Policies were analyzed in order to come up with an alternative scenario which embodies realistic and context-specific policies that are applied in the different regions of analysis.
- The alternative scenario postulates the following main characteristics of the future transportation image in the country:
    - Passenger transport in the primary urban, other urban, non-urban areas and inter-regional transport will utilize bus systems more in the future, forming a significant portion of the transportation mode share in 2050 (49% of passenger-km).
    - 4-wheeled vehicle-based transport activity growth will have a negative rate of change in the alternative scenario (average of -2.7% per annum).
    - Buses would need to serve 34% of the total passenger-km by 2030, and rail-based systems would need to serve 12% of the passenger-km in the same year.
    - Freight transport will be more diverse. Shifting substantial freight activity towards freight will be important (31% of total t-km in 2050).
- As described in the previous chapter, energy efficient cars and the use of renewable energy must be incentivized. After all, a large portion of its land is used for agriculture, and the Alternative Energy Development Plan seeks to increase biofuel production to five billion liters by 2022. Trucks could also have more fuel-efficient engines. Thailand must do this by balancing food and energy crop production, i.e. without threatening its food security and its agricultural export output. Still, the eco-cars could continue to contribute to Bangkok's gridlocked roads. The primary environmental benefit of energy efficient vehicles is the reduced dependency on crude oil and reduced emissions. Their effectiveness in cutting down vehicular emissions substantially depends on the source of power and the emission intensity of the fuel used, but not very much on reducing the number of vehicles on the road.
- Bus-based systems must then be developed accordingly as it remains to be relatively more cost-effective than rail-based transit. Planning bus systems in more corridors of Thailand would involve a multitude of stakeholders such as national government agencies, city governments, the many private bus operators, drivers, to name a few, and may result to the restructuring of the existing bus industry. A good feeder system is also a crucial component of its integration into the whole public transport system. It is important that infrastructure for non-motorized transport be developed so that motorcycles or informal transport will not become part of subsequent concerns surrounding the station corridors.
- The future of transport in Thailand, without such barriers and when projects will proceed as planned, can be characterized by decreased travel distance as BMR becomes denser, and the densification is supported by LRT and rail, increased eco-cars on a national level through the eco-car policy, expanded railway linkages between

rural and urban areas, balanced spatial planning with transit-oriented development as developments tend to sprawl around the planned railway networks.

- Based on the simulations using the Backcasting tool, the current assumptions on the policy packages and their impacts will only reduce the tCO_2 per capita to 0.50, still above the 0.33 tCO_2 per capita target.

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Vietnam

Prepared by
Mr. Alvin Mejia
Mr. Mark Tacderas
Ms. Kathleen Dematera
Supported by
Dr. Ly Huy Tuan
Mr. Sudhir Gota

LIST OF ABBREVIATIONS

2W	Two-wheelers (motorcycles)
3W	Three-wheelers (tricycles)
ADBI	Asian Development Bank Institute
APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
BAU	Business-As-Usual
BRT	Bus Rapid Transit
CAA	Clean Air Asia
CNG	Compressed Natural Gas
CNGV	Compressed Natural Gas Vehicle
CO2	Carbon dioxide
EST	Environmentally Sustainable Transport
EV	Electric Vehicle
GDP	Gross Domestic Product
GSO	General Statistics Office, Government of Vietnam
HCMC	Ho Chi Minh City
ICT	Information and Communication Technology
ICCT	International Council on Clean Transportation
kg	kilogram
km	kilometer
kwh	kilowatt-hour
LPG	Liquified Petroleum Gas
LRT	Light Rail Transit
LV	Light Vehicle (passenger)
PKM	Passenger-Kilometer
SUV	Sports Utility Vehicle
tCO2	ton Carbon dioxide
TDSI	Transport Development and Strategy Institute
TKM	Ton-Kilometer
UNCRD	United Nations Centre for Regional Development
USD	US Dollar
VAPIS	Vehicular Air Pollution Information System
WB	World Bank

1. Society

1.1 Present Situation

This section presents key social, economic and cultural factors in Vietnam that were looked at in this study, particularly in defining future transportation scenarios. This section briefly provides an overview of the geography, society and the demography of Vietnam, as well as its economy and energy use.

1.1.1 General

- Vietnam is bordered by China to the north, South China Sea to the east and to the south, Cambodia to the southwest, and Lao PDR to the northwest.
- Vietnam has a land area of 330,951 sq. km. The river network of Vietnam covers 42,000 km., 8,000 km. of which are utilized for inland water transport.
- Administratively, there are 3 regions (Northern, Central, Southern). There also exist socio-economic regional clusters (Northern Midlands, Red River Delta, North and South Central Coast, Central Highlands, Southeast, Mekong River Delta).
- Figure shows the large proportion of agricultural production land as well as forestry land in the overall land use distribution in Vietnam and its main cities.

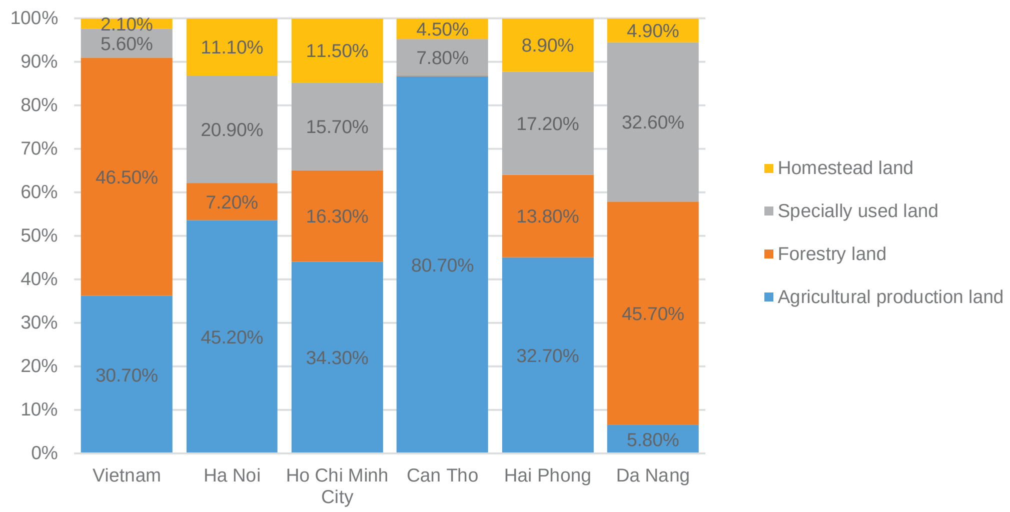

Figure 1. % Distribution of Land
Source: General Statistics Office, Government of Vietnam

1.1.2 Population

- Currently, Vietnam has an estimated population of 89.6 million people, with a population density of 286.94 persons per sq. km., one of the highest in Southeast Asia. It has grown at an average of 1.25% per annum from 1990 to 2013. The urban population has grown at an average of 3.32% over the same period. It is estimated that about 32% of the population are in urban areas.

- Despite having a dense population, Vietnam only has the second lowest population growth rate in the region. Tabl shows that, during the period 1999-2009, the Southeast region of Vietnam (where Ho Chi Minh City is) has experienced the highest population growth rates in the country.
- Vietnam has a young population base. 56% of the population is in the age of 20-64, and 38% are below 20. Only 7% of the population are 65 years and over.

Table 1. Regional Population Growth Rates (%), 1999-2009

Region	Population Growth Rate (%)
Northern Midlands	1%
Red River Delta	0.90%
North and South Central Coast	0.40%
Central Highlands	2.30%
Southeast	3.20%
Mekong River Delta	0.60%

Source: General Statistics Office, Government of Vietnam

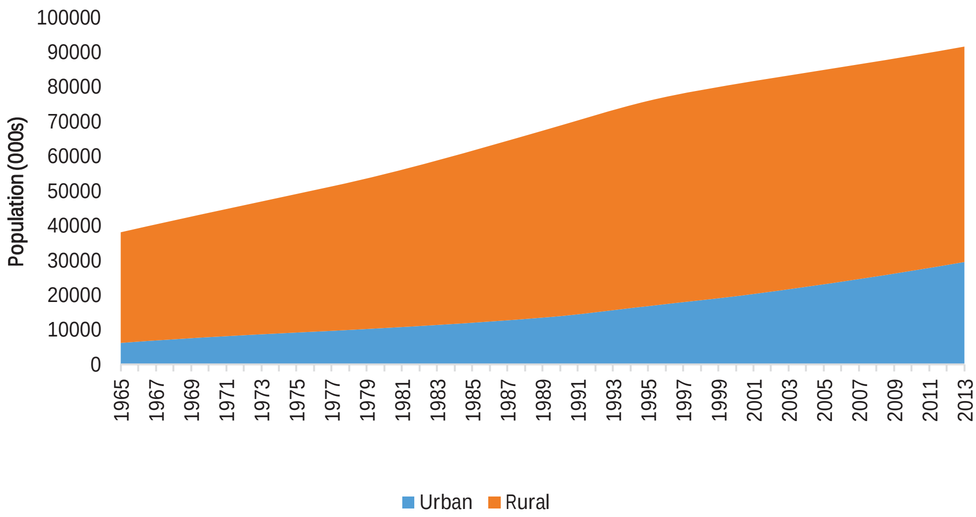

Figure 2. Population (000s)
Source: UN, 2012 and 2011

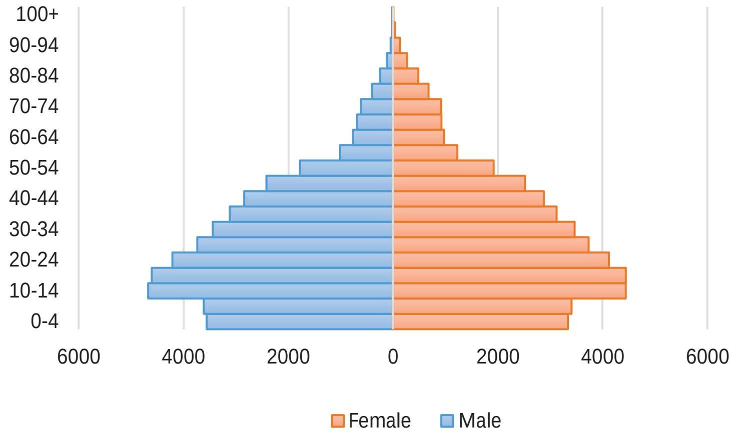

Figure 3. Population by Age (000s), 2010
Source: UN, 2012

- As expected, the highest population densities in Vietnam are found within its five major cities, with a large difference from national to city level. As the former French colonial capital Saigon and the largest city in Vietnam, Ho Chi Minh City leads greatly in comparison to Ha Noi and the rest of the cities at 3,756.08 persons per sq. km. Rapid industrialization and economic policy promulgation within Ho Chi Minh City and Ha Noi have led to the high population growth rates within these cities. Outside the cities, Vietnam retains a relatively low population density.

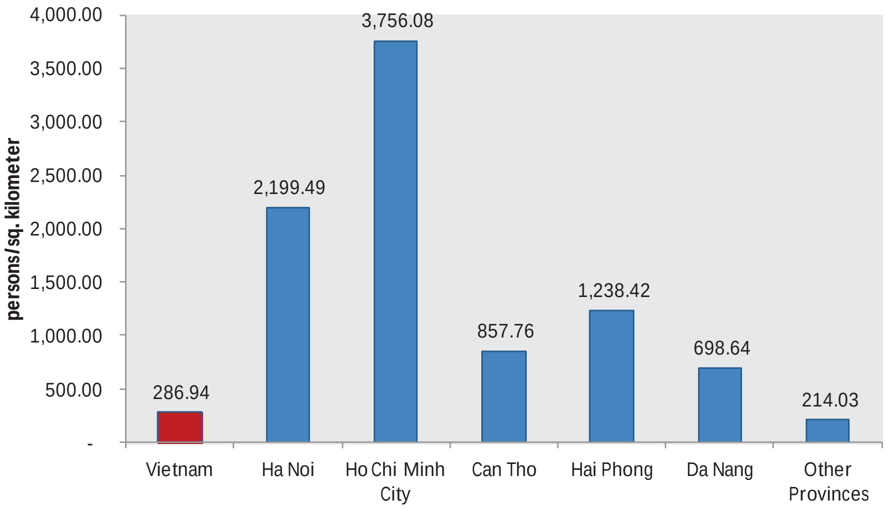

Figure 4. Population Density, National vs. Main Cities
Source: General Statistics Office, Government of Vietnam (2012)

1.1.3 Economy and Industry

- The Doi Moi platform was established in 1986, 11 years after the reunification of North and South Vietnam. In its inception, Vietnam's economy has gone towards a more market-based orientation while development has been pushed for equal distribution among the citizens consistent with its socialist foundation. Economic reform has been guided by the Socioeconomic Strategy for 2001-2010 and reinforced by continuous updates to the Socioeconomic Development Strategy.

- Vietnam has become one of the fastest growing economies in Southeast Asia. The government, through the Socioeconomic Development Plan for 2011-2015, has aimed for an annual growth rate of 6.5-7% annually.
- Its GDP per capita currently stands at USD 967 (2005 constant USD) and increased at an average rate of 5.92% from 1990 to 2013.[1] It has grown particularly strong during the period 2002-2010, averaging an annual growth rate of 6.32%.

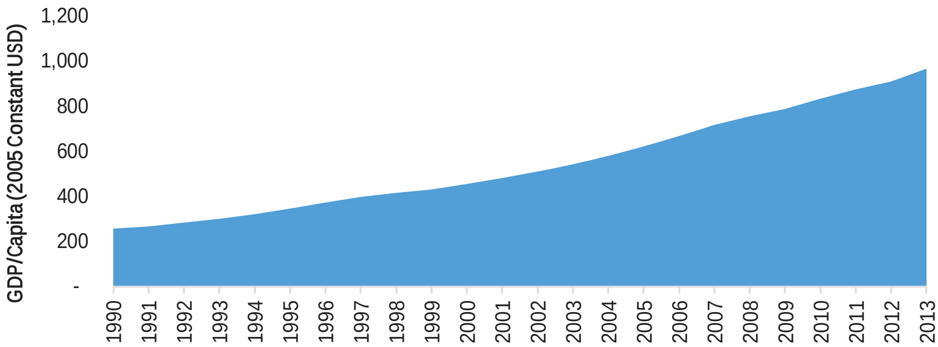

Figure 5. GDP/Capita (2005 Constant USD)
Source: World Bank 2013, UN, 2012

- In accordance with the initial 10-year Socioeconomic Strategy, Vietnam aimed for the following economic structure by 2010: 16-17 % agriculture, 40-41 % industry, and 42-43 % services. Figure shows the most current GDP structure of Vietnam as reported by the Government. While Vietnam is still generally regarded as an agricultural country, the contribution of the agriculture sector to the overall GDP has been gradually decreasing over the years (Figure) as a result of the Doi Moi platform.
- This resulted to a shift to services and industry sectors when the government encouraged urbanization and promoted the growth of the manufacturing industry to reach its targets. The two main cities, Hanoi and Ho Chi Minh City, played vital roles to achieving this, as well as Da Nang (Figure).
- Despite the industrialization, 54% of the labor force is still engaged with agricultural activities (Figure). Rapid urbanization may change this proportion in the future if the economy shifts to the industrial sector, and if rural-urban migration continues within the country.

[1] Calculated using figures from World Bank, 2013 and UN, 2012

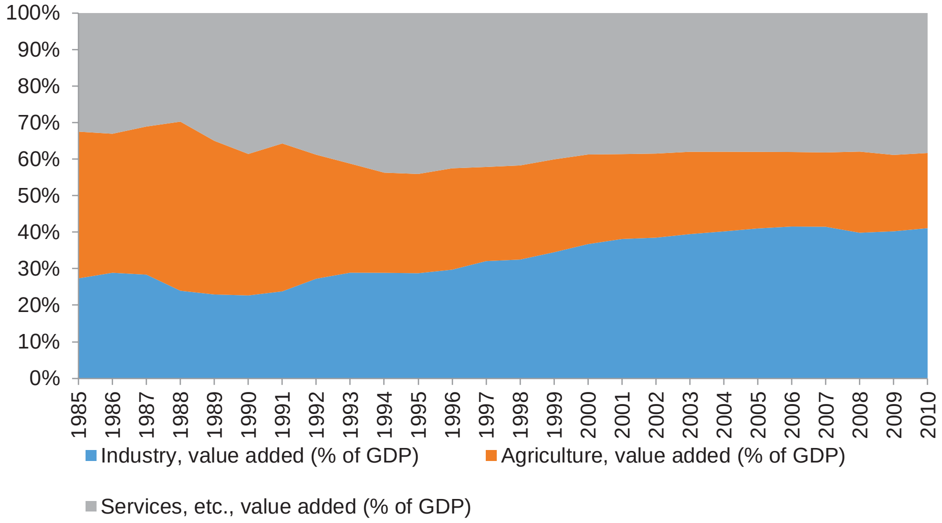

Figure 6. % Contribution of Sectors to the GDP
Source: World Bank, 2013

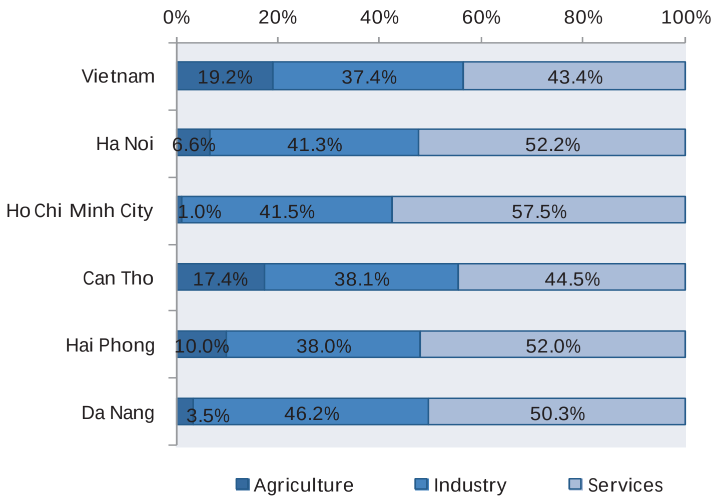

Figure 7. Economic Structure, National vs. Primary Cities
Source: General Statistics Office, Government of Vietnam

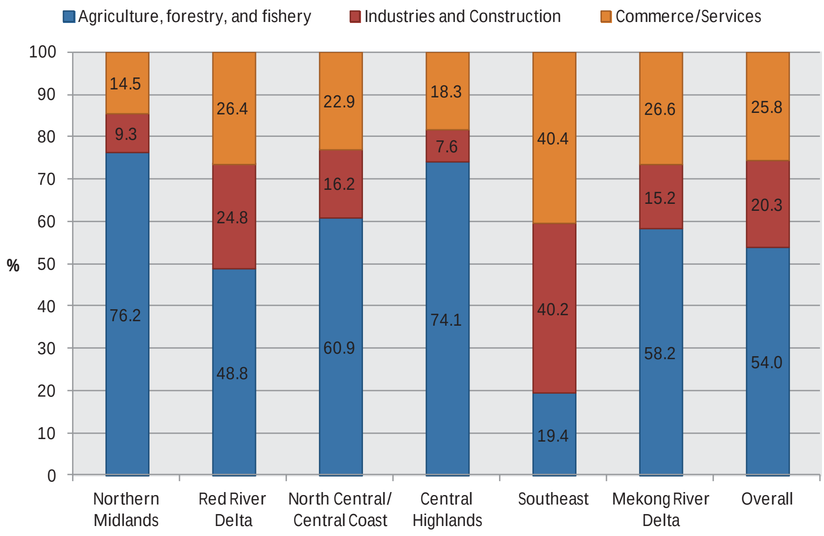

Figure 8. Employment Structure in Vietnam

Source: General Statistics Office, Government of Vietnam

- On international trade, Vietnam is a net exporter and 20% of its exports go to USA. Meanwhile, 19.9% of its imports come from its neighboring country, China, although the trade relationship between the two countries has always been asymmetric, generally favoring China. China is Vietnam's largest source of technology products.
- Very few of ASEAN member countries contribute to trade in Vietnam, and its only primary partners in trade from the ASEAN region are Singapore and Thailand due partly to geographic advantages. The table below shows the summary of trade relationships of Vietnam.

Table 2. Vietnam's Primary Trade Partners (Export and Import)

Export Trade Partners		Import Trade Partners	
Country	Percent**	Country	Percent**
US	20.8	China	19.9
Japan	12.5	Singapore*	12.1
Australia	7.3	Taiwan	11.0
China	6.9	Japan	9.9
Singapore*	4.5	South Korea	8.5
		Thailand*	6.0

*ASEAN Member Countries

**Figures are based from 2007 data, as indicated in the report of Vietnam Education Foundation 2009.

Source: Vietnam Education Foundation 2009

1.1.4 Energy

- Vietnam has its own reserves and resources of fossil fuels such as crude oil and natural gas. Exports for oil have grown at an average annual rate of 10.4% from 1995-2010.
- The country has also invested in a refinery, which became operational in 2009, in order for it to export final oil products. Vietnam is estimated to have an annual supply of 7-8 million cubic meters of natural gas from proven and probable reserves. It also has its coal reserves estimated at 6,141 million tons (APEC, 2012).
- Vietnam is a net exporter of energy with an average rate of -51% energy import dependency from the period 1990-2006.

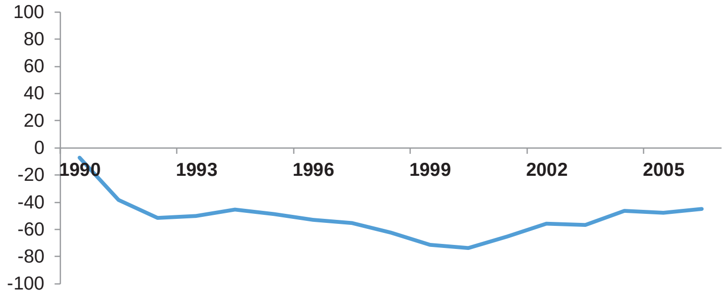

Figure 9. Energy Dependency Ratio
Source: Asian Development Bank, 2010

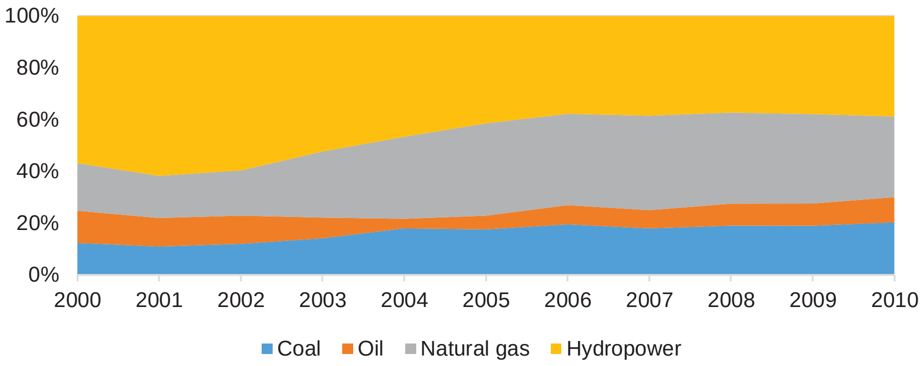

Figure 10. Electricity Generation Mix
Source: Clean Air Asia and World Bank, 2012

1.2 Future Scenario for Society

This section presents the future scenario for the Vietnam according to the key societal factors identified in the previous section. This future scenario is based on the available data on projections or estimations culled from various sources such as local projections and plans, databases and projections from international organizations such as the UN, WB, APEC, among others.

1.2.1 Population

- The country's population is projected to grow to 104 million people by 2050. The population is expected to grow at an average of 0.44% per annum from 2005-2050.
- The urban population growth rate is expected to slow down gradually, growing at an average of 2.06% during the same period. Nevertheless, 55.9% of the population will be living in urban areas by 2050 (Figure).
- In 2038, the urban population in Vietnam is expected to surpass the rural population in the country. In 2050, two additional primary cities (i.e. cities with more than 2 million people) may emerge in Vietnam: Hai Phong (by 2020) and Bien Hoa (by 2041). Urban agglomerations (i.e. with over 200,000 people) will almost double, from 17 in 2010, to 30 in 2050.

- With the increase in population size, there will be changes in the age structure. 59% of the population is expected to be 20-64 years of age in 2050. By 2050, 23% of the population of Vietnam will be aged 65 and over (Figure).

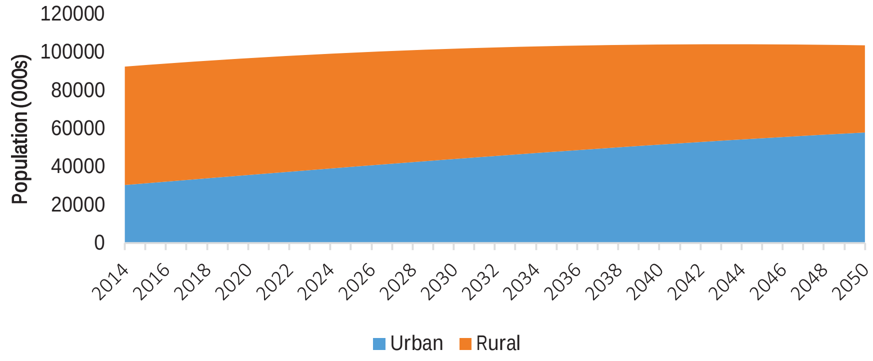

Figure 11. Population Projection to 2050(000s)
Source: UN, 2012 and UN, 2011

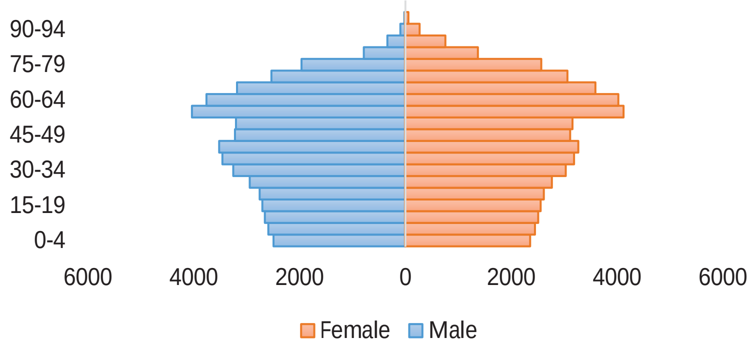

Figure 12. Population by Age (000s), 2050
Source: UN, 2012 and UN, 2011

1.2.2 Urbanization

- Rural-urban migration has played a major role towards Vietnam's economic growth, especially on the rapid expansion and growth of the country's major cities. Ho Chi Minh and Da Nang in particular had high migrant shares in their population, and this trend is expected to continue.
- Multiple urban centers will emerge as a response to the growing population density in current urban centers. Efficient inter-regional transportation systems will be needed (such as expressways, long haul rail systems, interregional airports). Vietnam is one of the fastest urbanizing countries in the region, with urban population growing at about 3.3% annually, much faster than the Southeast Asian region (2.5% annually). However, there is an apparent concentration of urbanization to certain regions of the country particularly going nearer the peripheries of the major cities. Currently, the five centrally controlled cities account for 62% of the total urban population in Vietnam (General Statistics Office, 2009).

- In 2050, two additional primary cities (i.e. cities with more than 2 million people) may emerge in Vietnam: Hai Phong (by 2020) and Bien Hoa (by 2041). Urban agglomerations (i.e. with over 200,000 people) will almost double, from 17 in 2010, to 30 in 2050.

1.2.3 Economy and Industry

- The Asian Development Bank Institute (ADBI, 2012) estimates the growth in Vietnam to be sustained at around 7% per annum up to 2030. This is expected to taper off in the longer term, stabilizing at 4% to 3% from the periods 2030-2050.
- Given the assumptions in terms of GDP growth and population growth, the GDP per capita in 2050 for Vietnam will be at around USD 5,621 (constant 2005 prices). It is forecasted to grow at an average of 5.01% per annum during the period 2005-2050 (Figure).
- Projections based on historical data shows labor force trends going towards the services and manufacturing sectors. Agriculture hosted 48% of the labor force in 2011, 21% are in manufacturing and 31% are in the services sector. In 2050, this is simulated to be 28% agriculture, 32% manufacturing and 38% service sector.

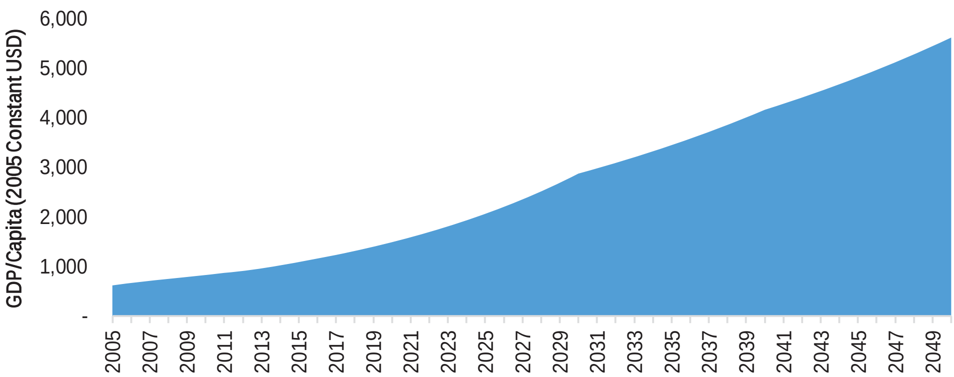

Figure 13. GDP/Capita (2005 Constant USD)
Source: Computed based on UN population estimates and ADBI projections

1.2.4 Energy

- Vietnam's energy consumption has tripled in the last decade. APEC (2012) estimates that the annual total final energy consumption will increase at an average of 3.6% up to 2035.
- Vietnam is expected to be a net energy importer by 2020. While there is currently energy resources in Vietnam from fossil fuels, natural gas and hydropower, among others, their supply will have to meet the continuing energy demand from economic growth. Oil import dependency is expected to commence in 2014 and will reach 66% in 2035 (APEC, 2012).
- Coal will be the primary contributor to the primary energy supply in 2035 (35%) according to APEC.
- The Vietnam power development plan 2011-2020 states targets towards increasing the share of renewable energy to 4.5% in 2020and 6% in 2030 and this is seen to be realized in the future image of society.
- Vietnam is gearing towards the use of nuclear energy and is expected to have its first nuclear power plant go on-line in 2020. Nuclear power is expected to contribute as much as 30% in the total electricity supply by 2050 (APEC, 2012).

2. Transport

2.1 Present Situation

This section presents the present state of transportation in Vietnam by mode. These include descriptions of the current state of road, rail, air and maritime transport in the country.

- *Passenger transport:* Since 2005 up to 2010, passenger transport has been increasing by 1.3% per year in Vietnam and in 2010 travel has reached 538.3 billion passenger-kilometers (307.4 in 2005).96% of on-road vehicles in Vietnam are motorcycles, and these two-wheelers cover 77% of passenger travel as of 2010 (Figure 14).Despite being one of the most densely populated countries in Southeast Asia, Vietnam maintains favorable passenger urban mobility for its citizens due to three major factors (World Bank 2011):The nearly universal use of the motorcycle as the primary means of transportation; mixed land use neighborhoods of Vietnamese cities, and; the prevalence of shop houses, where many people live above or behind their stores.
- *Freight transport:* Freight transport has grown by 1.9% per year between since 2005 and has reached an estimated 162.5 billion ton-kilometers in 2010 (68.6 in 2005). Trucks and trailers cover 95% of all freight travels (Figure).

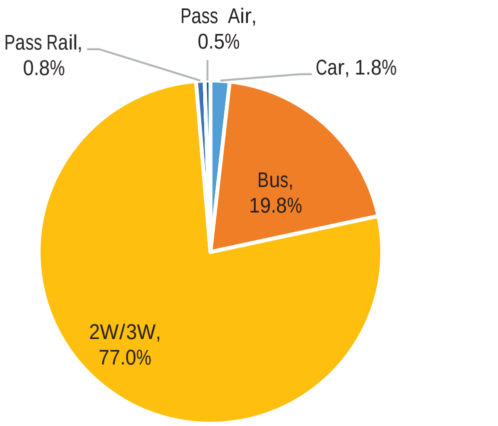

Figure 14. Passenger Transport Mode Share (% of PKM), 2010
Source: Study estimates

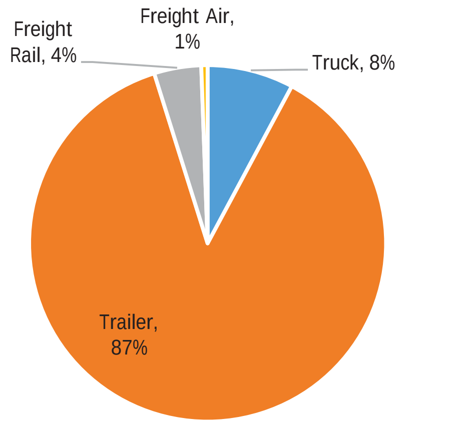

Figure 15. Freight Transport Mode Share (% of TKM), 2010
Source: Study estimates[2]

2.1.1 Road Transport

- Vietnam has 210,000 km of roads, 62% of which are rural. 8% of the total road length is national roads, and 84% of the national roads are paved.
- Road transport covers 97% of all travels in Vietnam, and currently the motorcycle dominates road transport (Figure 14). The Vietnamese generally favors the motorcycle for its size, price, and maneuverability on the streets (Table). The numbers are much higher within cities, where motorcycles are being used on 80% of all travels. This is true especially for Hanoi and Ho Chi Minh City. As an example, Figurerepresents the mode share

[2] The study was limited in incorporating travel activity from water transport. These were incorporated directly into the emissions, utilizing figures from energy balance sheets that have information on water transport energy and emissions.

in Hanoi, and illustrates the increase of the mode share of motorcycles. The motorcycle continues to dominate as the prime mode choice even outside the cities.

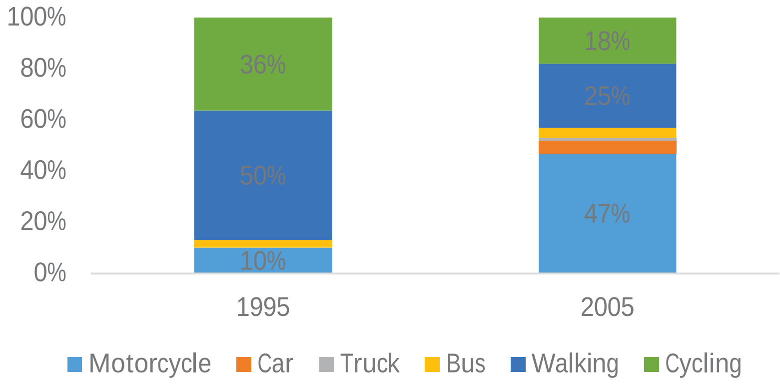

Figure 16. Mode Shares (Person Trips) in Hanoi
Source: Schipper, et al. 2008.

- The lack of integrated public transport infrastructure has prompted citizens to take the motorcycle as their primary mode choice. This two-wheeler motorized vehicle has dominated the streets of Vietnam alongside its rapid development. In 2012, it was estimated that there were 38.4 million vehicles that were registered in Vietnam, 96% of which were motorcycles. The vehicle fleet has grown at an average of 16% per annum from 2000-2012. The growth in cars was highest at 18% during the same period.
- Some policies, however, have been put in place. From the period 2010 to 2013, Decision No.909/2010/QD-TTg aims to achieve 20% of the people using automobiles in Hanoi and Ho Chi Minh City to comply with regulations on verification, maintenance and repairing of motorcycles to meet emission standards, and to build a network of motor vehicle emission-testing centers (at least 100 in Hanoi and 150 in Ho Chi Minh City).

Table 3. Population of Road Vehicles, 2010

Mode	No. of Vehicles	Percent
Passenger		
Cars	546,690	1.7
Bus	102,713	0.3
Motorcycles	31,155,154	96.3
HDV	420,376	1.3
LDV	125,567	0.4
Freight		
HDV	420,376	1.3
LDV	125,567	0.4

- Road safety has become a major issue in Vietnam. Speed and maneuverability do not mix well with irresponsible driving, and in Vietnam, 59% of road traffic collisions involves motorcycles. The World Health Organization (WHO, 2014) reports of approximately 16.1 deaths per 1000 population each year or 14,000 people dead from road accidents each year.
- Overall there is still a lack of public transport in Vietnam, and this applies to Hanoi and Ho Chi Minh City. Despite having the density to be able to support mass transit, the two large cities lack public transport.

Currently, overall mobility is still unaffected largely because Vietnam's major cities have become dense and mixed land use characterizes its cities.

- In Ho Chi Minh City, increased number of vehicles and lack of public transport has worsened the traffic conditions, leading to road congestion and exacerbating levels of air pollution (Vu Hai Luu, 2014). Although the government has pushed for developing bus routes and increasing the number of servicing buses, UNESCAP reports that buses only serve 10% of the local transport demand.
- Meanwhile, cargo trailers dominate freight transport at a national level, with about 89% of all freight transport activity (ton km) are done by trailers or heavy duty trucks (2010), 8% are done by light-duty trucks and only 2% are serviced by rail. 90% of cargo trailer transport is inter-regional.

2.1.2 Rail Transport

- Rail transport in Vietnam is solely being provided by the Vietnam Railway Cooperation.
- The railway network in Vietnam is 2,347 km. long (Figure).
- The contribution of rail in servicing the total tonnage of freight volume is only 1% (GSO, 2013) and has historically been reducing.
- The total tonnage carried by freight was 7,295 thousand tons in 2011. It has grown at an annual average of 3% from 1995 to 2011. However, during the last five years of the same period, it has declined at an annual average rate of -3% (Figure).
- The railways in Vietnam carried 11.9 million passengers in 2011, a mere 0.48% of the total. It has grown at an average of 2% per annum from 1995 to 2011, but similar to the situation for freight transport, it has experienced an average decline (-1%) during the period 2006-2011 (Figure).

Figure 17. Railway Network in Vietnam
Source: Ward, et. al., 2011

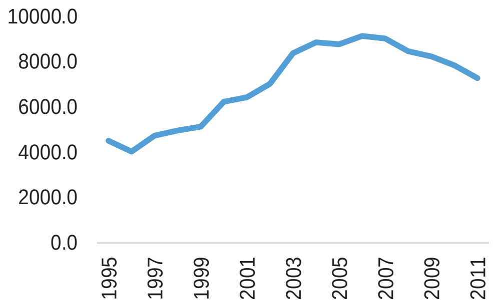

Figure 18. Thousand Tons Transported
Source: General Statistics Office

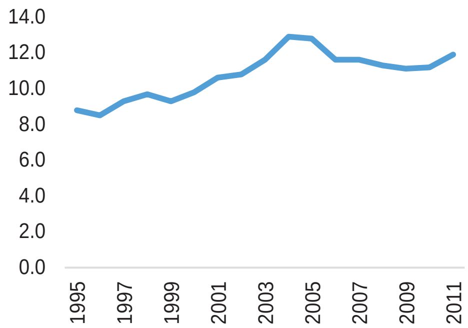

Figure 19. Million Persons Transported
Source: General Statistics Office

2.1.3 Air Transport

- There are 21 airports, 9 of which are international and 56 airline companies operating in the country (AJTP, 2013).
- The data from the General Statistics Office reveal a sharp increase in both air passenger and freight travel activities from 1995 to 2011. Passenger-km is growing at 12% per year during the period 1995 to 2011, while ton-km is growing at 10% per annum.
- Air transport has carried 15.1 million passengers, growing at an average of 13% per annum from 1995- 2011.

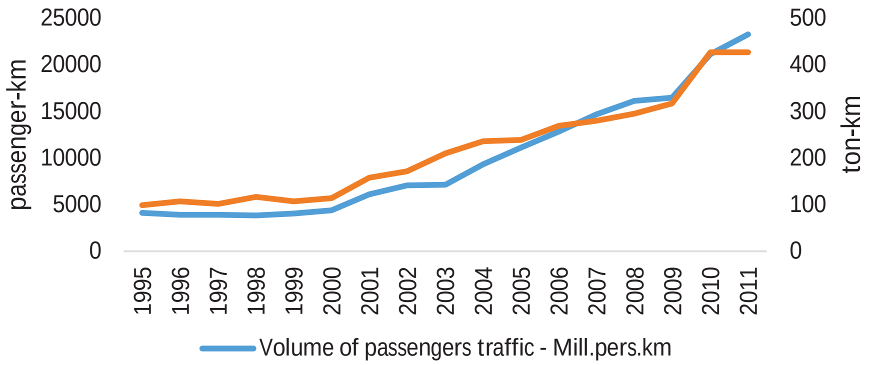

Figure 20. Air Transport PKM and TKM
Source: International Civil Aviation Organization

2.1.4 Water Transport

- The river network of Vietnam is extensive at 42,000 km., 8,000 km. of which are utilized for inland water transport (Ward et al, 2011).
- The data on inland water transport for freight reveal that Red River Delta, Mekong River Delta and southeast regions have the highest volumes of water-transported goods.

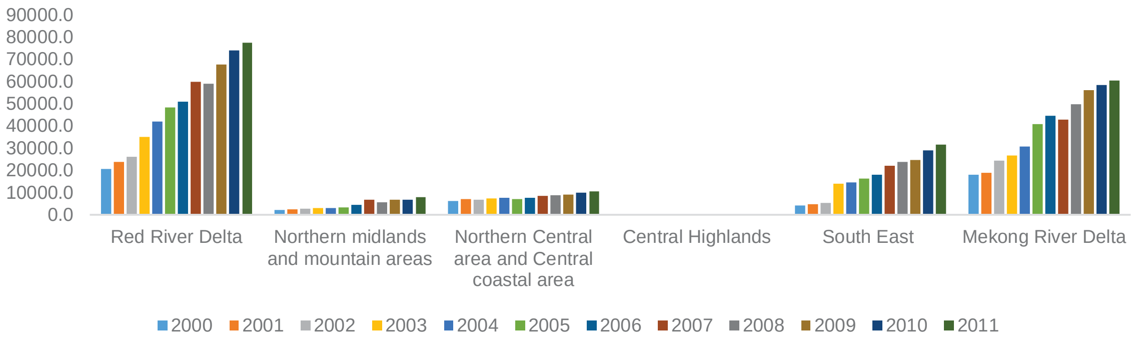

Figure 21. Inland Water Freight Volume (thousand tons)
Source: General Statistics Office

- Inland water transport carried a total of 160 million tons of goods in 2011, while maritime transport carried 64 million, contributing 18% and 9% of the total volumes, respectively (GSO, 2013).
- The volume of freight carried through water transport has been experiencing a steady increase in the past years. The data show that the volume of freight transported through inland water ways is growing at an average of 15% per annum from 1995 to 2011, while maritime freight transport volume is growing at an average rate of 10% per annum. From the total water transport freight volume, 73% is being serviced by inland water transport while 27% is by maritime. However, maritime freight is gaining more traction as its share is only 16% in 1995.

2.2 Key Transport Data

This section presents key information used in the analysis performed for this study. These data include inputs to the Backcasting Tool employed to estimate carbon reduction for the alternative scenarios to the business-as-usual (BAU) cases presented in the succeeding chapter of this report.

2.2.1 Road Transport

- Vehicle Numbers
  - o The projection of the number of road vehicles for the baseline scenario is crucial in projecting the emissions from road transportation. The study utilizes gompertz functions which forecasts the number of vehicles based on historical data on GDP/capita and in-use vehicles (each road vehicle type) per 1000 people. Due to the unavailability of in-use vehicle numbers, the study utilizes data on registered vehicles data (historical) from official statistics.[3]
  - o The projections for the GDP per capita are explained in the section on the future vision of society. The parameters of the gompertz functions were estimated based on the GDP/capita and the vehicle/1000 data (per mode), where in the parameters which resulted in estimations with the lowest squared deviations from the actual data were selected. Reality checks were made in order to ensure that the projections can actually happen. For the case of Vietnam, a saturation limit for motorcycles ownership (550/1000 people)[4] was used in the calculation.
  - o The results of the projections show that Vietnam will reach 550 motorcycles/1000 people by 2037. The results also show that the cars per 1000 people will be 292 (higher than current levels in Malaysia).

[3] Data from the Clean Air Asia Study done for the World Bank entitled WB Indicators were utilized as a basis. The data was provided by the Transport Development and Strategy Institute (TDSI) of the Ministry of Transport.
[4] Based on Taiwanese levels, which is currently highest in the region.

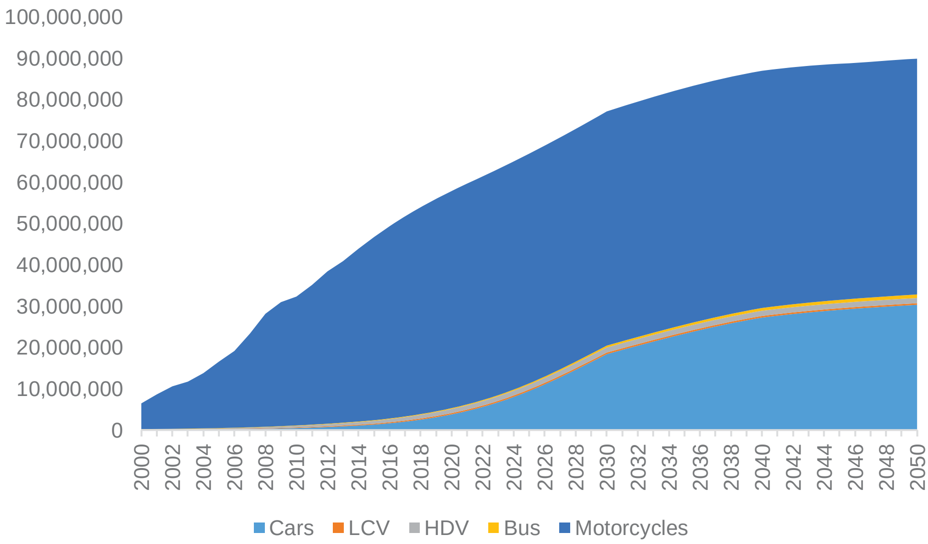

Figure 22. Total Number of Vehicles

- In the baseline scenario for 2050, there will be 89 million vehicles, 57 million of which will be motorcycles. The share of the motorcycles in the total fleet will be lower at 63% as compared to the 97% share in 2005. This is mainly due to the increase in the cars in the fleet.

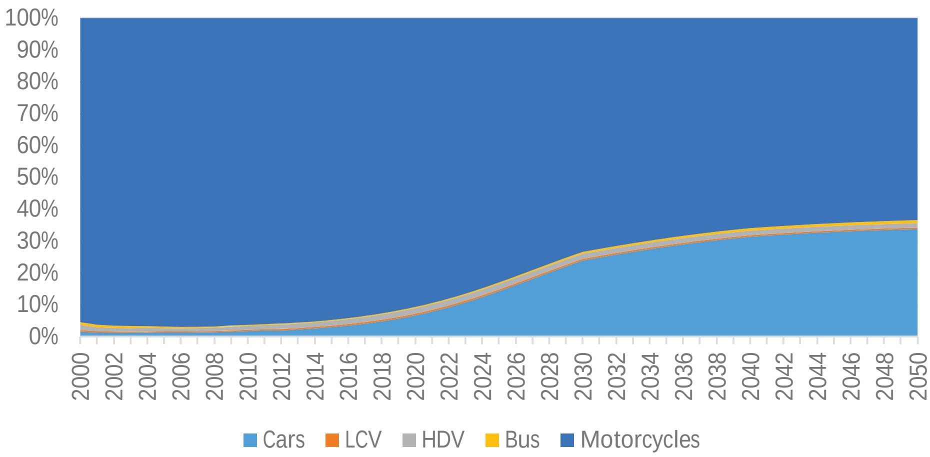

Figure 23. Shares of Vehicle Types in the Road Fleet

Source: Calculated

- Growth in the cars will be the highest at an annual average of 12% from 2005-2050, while motorcycles will be at 3%. The graph below shows the growth in the different modes if we put 2005 = 1.

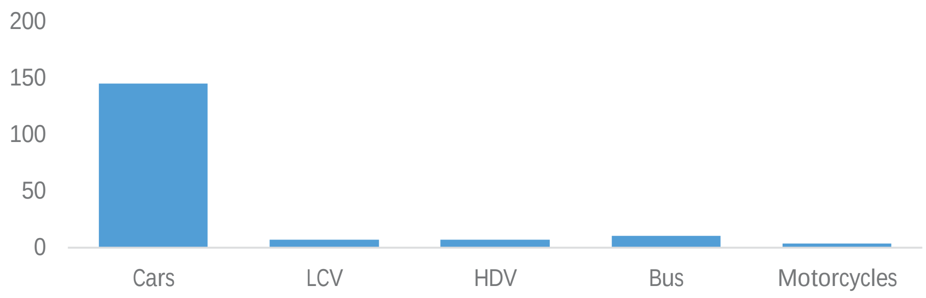

Figure 24. Vehicle Growth Index (2005=1)
Source: Calculated

- Fuel Efficiencies
  - Assumed base fuel efficiencies were taken from existing studies (e.g. CAA, 2012) for road transport. These were adjusted based on the fuel efficiencies of the new vehicles that are expected (based on external projections) and assumed retirement age of the vehicles. The fuel efficiencies for the other fuels (e.g. CNG, LPG) are taken directly from the values in the back casting tool.

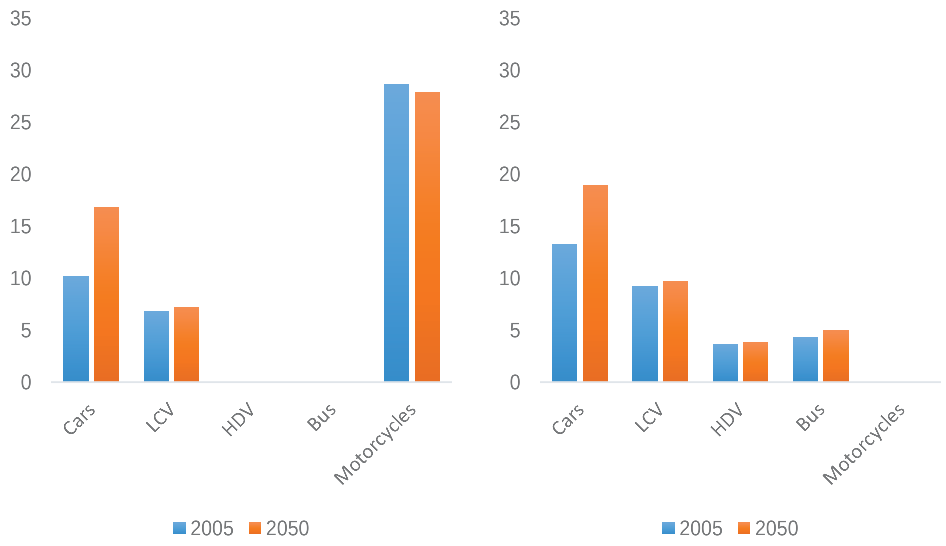

Figure 25. Fuel Efficiencies of Gasoline (Left) and Diesel Vehicles (Right)
Source: Calculated[5]

- Vehicle Activity
  - The assumptions on the base annual vehicle-kilometers travelled by each of the mode were taken from existing studies as well. The figure below shows the comparison between the different modes (km/year).
  - Average occupancies (number of people per trip) and average loading figures were also taken from existing studies.

[5] Calculated using the VAPIS model developed by Dr. Sarath Guttikunda of urbanemissions.info and utilizing data from Segment Y and ICCT (Global Roadmap Model).

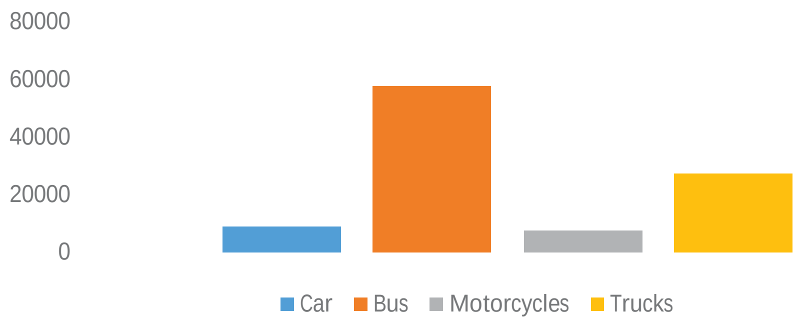

Figure 26. Vehicle Kilometers/Year
Source: Clean Air Asia, 2012

- Emission Factors
  - o The base emission factors used were based on standard international practice of 2.4 and 2.6 for gasoline and diesel (kgCO2/liter), but were internally adjusted by the backcasting tool (taking into consideration biofuel mix, for example). The emission factors for electric vehicles were based on the generation mix of the grid (and projected mix). No projected % mix was available beyond 2035; therefore, it was assumed that the mix in 2035 will continue.
  - o The figure below shows the resulting emission factors for the electricity grid (kgCO2/kwh).

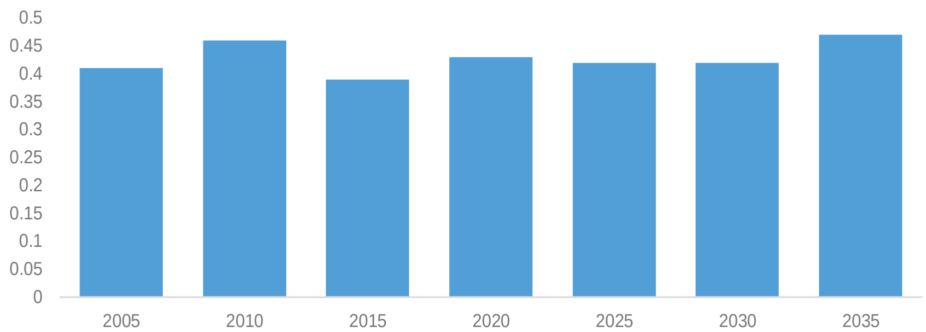

Figure 27. Electricity Emission Factor (kgCO2/kwh)
Source: Calculated using projected generation mix by APEC, 2012

2.2.2 Rail Transport

- The railway transportation volume data for passenger and freight (PKM and TKM) were taken and extrapolated from the World Development Indicators Dataset and movements in the GDP/capita.
- The increase in passenger-km is expected to be higher than in the freight ton-km for railways, as based on historical data. The freight travel activity for rail will be growing at an average of 5% for the period of 2005 to 2050, while passenger activity will grow at 3%.

Figure 28. Passenger-km and Ton-km for Railways (millions)

2.2.3 Air Transport

- The base transportation volume data for passenger and freight (PKM and TKM) were taken and extrapolated from the ICAO database. The increase was assumed to be proportional to the movement in the GDP/capita.
- The increase in passenger-km is simulated to be at the same level with the increase in the freight ton-km for air travel, reaching as much as 14 times the level in 2005.

Figure 29. Passenger-km and Ton-km Air Transport (millions)

2.2.4 Water Transport

- Official data from the GSO was used in the calculation of the emissions from the water transport sector. The projections were done using the relationship between historical GDP growth and the growth in the water transport activity (PKM, TKM). The results show potential high growth in maritime freight. A recent report from the World Bank concludes that water transport will play a big role in facilitating the growth in Vietnam (World Bank, 2013).

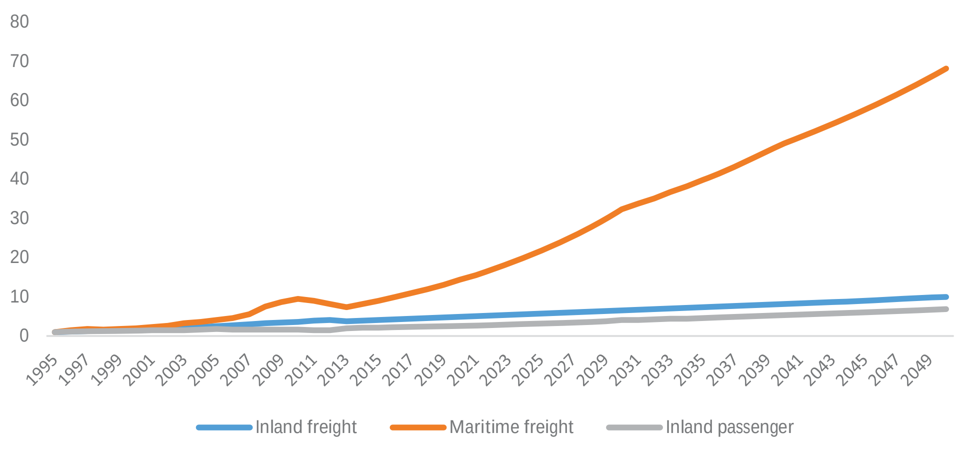

Figure 30. Maritime Travel vs Inland Travel (million pkm and tkm)

2.3 Future Transport Scenario

- This section presents the future transport images for the cases of the primary cities (more than 2 million population), major cities (more than 1 million population), other cities (200 thousand population), municipalities (non-cities), and others, corresponding to the future scenario for society described in Chapter 1. This section presents the images of transport for both the Business-as-usual scenario and the alternative (low carbon) scenarios.
- The reference plans and policy documents used in the analyses such as the following:

    - ➢ The Vietnam power development plan 2011-2020 states targets towards increasing the share of renewable energy to 4.5% in 2020and 6% in 2030 and this is seen to be realized in the future image of society.
    - ➢ Updates on the environmentally sustainable transport policies of Vietnam to 2020 (EST) as reported to the UNCRD EST forums. The EST specifies 10 priority targets by 2020, including an ambitious 30-45% mode share from public transport, especially from the Urban Rail System
    - ➢ Available transport master plans for cities.
    - ➢ Other specific policies related to transportation

2.3.1 Summary Transport Images

This section presents the summary of the transportation images for the different regions of analysis. These are based on the alternative (low carbon scenario) that is further explained in section 3.2. These are images of how the transportation systems will look like in these regions of analysis once the policies in the alternative scenario are put in place.

Box 1: Summary - BAU Scenario

Passenger Transport

Passenger travel in 2050 will be 2,235.49 billion passenger-kilometers under the BAU scenario.

The results of the projections show that Vietnam will reach 550 motorcycles/1000 people by 2037. The results also show that the cars per 1000 people will be 292 (higher than current levels in Malaysia) in 2050.

The baseline scenario for 2050 suggests that there can be 89 million vehicles, 57 million of which will be motorcycles. The share of the motorcycles in the total fleet will be lower at 63% as compared to the 97% share in

2005. This is mainly due to the increase in the cars in the fleet.
Growth in the cars will be the highest at an annual average of 12% from 2005-2050, while motorcycles will be at 3%.

Freight Transport
The freight travel activity for rail will be growing at an average of 5% for the period of 2005 to 2050, increasing to 510 billion ton-kilometers under the BAU scenario.
Heavy duty trucks will continue to use diesel engines.
Given the historical trends in rail freight, it is still expected to increase in the future (average annual growth rate in ton-km at 5%), given that continuous capacity additions are materialized.
Air freight will continue to grow at an average of 4% per annum in terms of million ton-km.

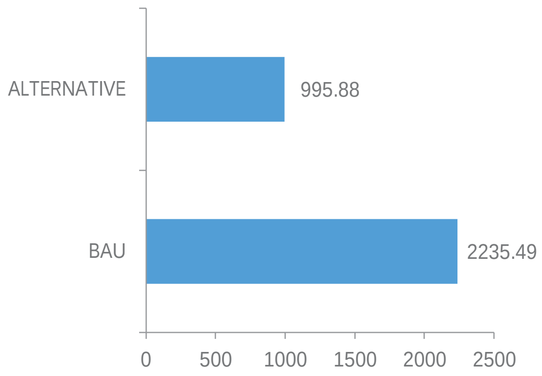

Figure 31. Passenger Travel (billion PKM), 2050

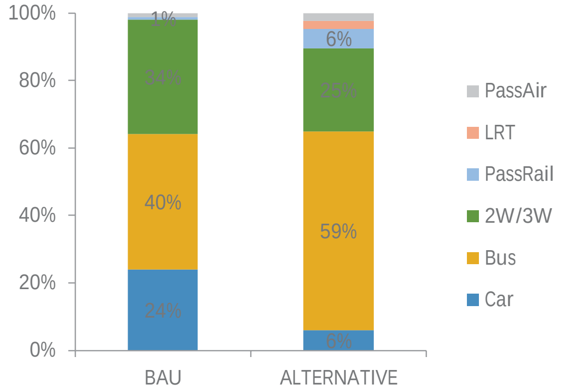

Figure 32. Passenger Transport Mode Share (% of PKM), 2050

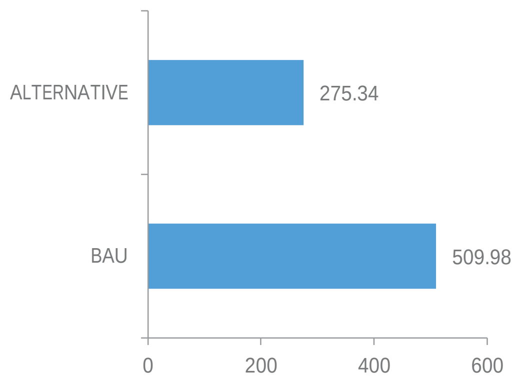

Figure 33. Freight Travel (billion TKM), 2050

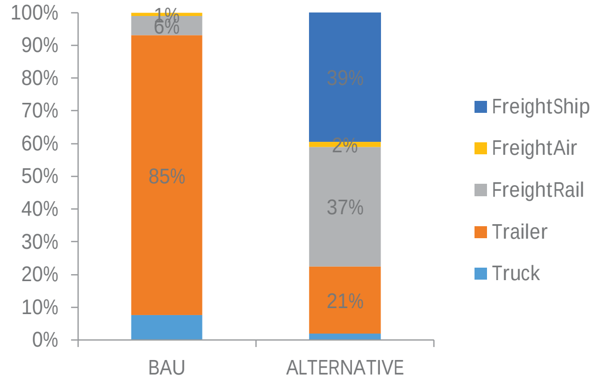

Figure 34. Freight Mode Shares (%TKM), 2050[6]

2.3.2 Transport Image in Primary Metropolitan Areas (2 Million Plus Population)

- In the future, it is desirable to have at least 60% of the passenger kilometers in the primary urban areas to be done with public transport. Currently, for example, public transport (mainly buses) only constitutes 25% of total passenger-kilometers in the primary cities.
- Motorcycles will still play a significant role for transport in primary cities, but due to economic growth, passenger cars will also constitute a significant share of the private motorized fleet. It is envisioned that the private fleet, particularly the motorcycles, will employ the latest technologies that would allow them to be

[6] Trailer = Heavy duty trucks; trucks = light duty trucks

more fuel-efficient and have low emissions. These technologies include hybrid engines and electric motors.

- Metro systems will play a much more significant role in commuting in the primary cities, particularly in Hanoi and in Ho Chi Minh.
- BRT systems will have expanded operations in the primary cities. These buses are envisioned to run on alternative fuels such as CNG or even electricity-driven, with the latter technology rapidly improving over the next 10 years.
- Cycling and walking infrastructure will be improved dramatically, enabling integration with the major public transport systems such as the MRT and the BRT. This will not only increase the walking and cycling trips, but will pull private trips towards public modes.

2.3.3 Transport Image in Major Urban Areas (Million Plus Population)

- Automobile usage will steadily increase in the major urban areas like Can Tho and Da Nang. This is expected with the increasing incomes of residents of these cities and due to the fact that the motorization rates are currently lowers than the primary urban areas. Hybrid and electric cars will also be popular in these cities, as the country will strive to lower the costs of owning such vehicles as compared to conventional ones, though there will be a significant number of conventional cars.
- Light rail lines may be existent in some of these urban areas, but with very less penetration rates as in the primary areas.
- Bus transit services will be strengthened as the main mode of public transport and will serve the majority of the population in these areas.
- The emergence of bike-sharing schemes integrated with the BRT systems is envisioned to serve as the feeders to the trunk lines.

2.3.4 Transport Image in Other Urban Areas (200 Thousand to 1 Million Populations)

- Public buses will be available for the public, constituting a high % of the mode share in 2050, but the motorcycle will still play a key role in personal mobility.
- Automobile technology and usage may be similar to those in million plus urban areas.
- Rail will not be viable in urban areas with populations significantly less than one million.
- Bus transit or BRT system will most likely be the suitable transport mode for high capacity or high demand corridors in these urban areas.
- Integration of public transport and non-motorized modes will be crucial in curbing the motorization rates in these cities.

2.3.5 Transport Image in Non-Urban Areas

- Public buses will be available for the public, constituting a high % of the mode share in 2050, but the motorcycle will still play a key role in personal mobility.
- Automobile technology may lag as older model vehicles will be used in rural areas.
- Rail will be limited to long distance or inter-city or inter-regional transport services. Bus-based public transport may be pursued in non-urban areas as a primary means of public transport.
- Cleaner technologies will be adopted, but at a lower rate than in the bigger urban agglomerations.

2.3.6 Transport Image in Inter-Regional Areas

- Bus transport will be strengthened in order to serve a much higher proportion of the inter-regional travel. This will lead to reduced accidents on the highways and safer travel for commuters.
- Rail transportation services will be expanded, particularly connecting the major cities.

- Air transport will still be more popular as a major mode for traveling between the regions, particularly between the main cities. International travel, in particular, is expected to grow continuously due to the increased capacity of people to incur the costs of leisure travel.
- Natural gas-driven trucks will eventually be used as fleets are modernized, particularly through the initiatives of the private sector (i.e., trucking companies) initiatives.
- Water freight will expand and will be a major factor for the country's development, particularly in the regions where inland waterways will be maintained and developed.

2.4 Issues and Challenges

- Multiple urban centers will emerge as a response to the growing population density in current urban centers. Efficient inter-regional transportation systems will be needed (such as expressways, long haul rail systems, airports).
- Increased consumption driven by the growing economy will drive the increase in freight demand. Vietnam is strategically located in the region, and with its ports and land access to the other Southeast and East Asian countries, it can be a regional hub for freight as well as a hub for the manufacturing sector. As average wages go up in China, investors and businesses will look into other alternatives such as Vietnam.
- The use of private motorized transport will be prevalent. The use of cars, in particular, will gain more traction as people gain more access to these vehicles due to higher incomes.
- Vietnam is expected to be a net energy importer by 2020. While there is currently energy resources in Vietnam from fossil fuels, natural gas and hydropower, among others, their supply will have to meet the continuing energy demand from economic growth. Oil import dependency is expected to commence in 2014 and will reach 66% in 2035 (APEC, 2012).

3. Transport CO2

This section provides the details of the policy assumptions that were taken into the backcasting tool as well as the resulting CO2 emissions both for the business-as-usual scenario and the alternative scenario.

3.1 Business-as-usual Scenario

- The total transport emissions (including domestic air and sea transport) in 2005 were at 20.3 million tCO2. The national road transport emissions totaled 16.8 million tCO2.
- By 2050 Vietnam will have already reached 144.7 million tCO2, or approximately 1.4 tCO2 per capita. Road transport will reach 126 million tCO2 or 1.22 tCO2 per capita.
- This implies a 4.5% increase in emissions per year.

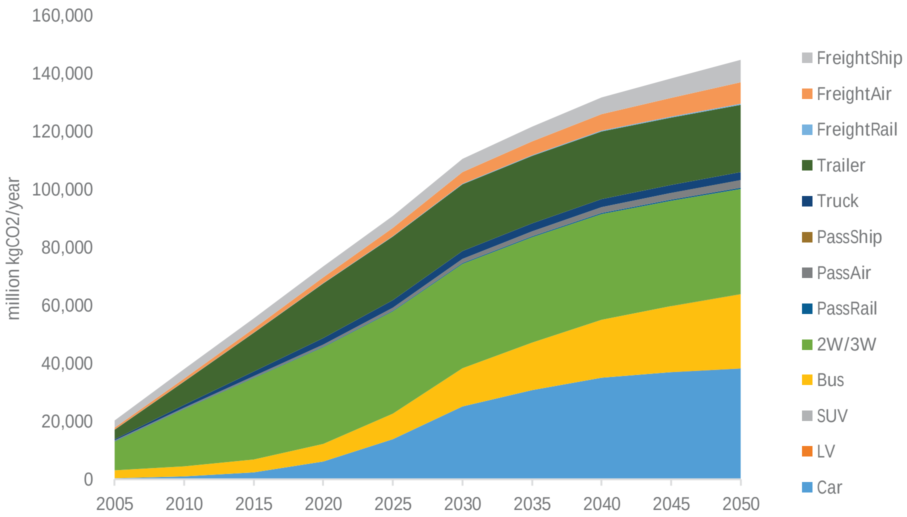

Figure 35. Total CO2 by Mode (million kgCO2/year)

- The per capita emissions for transport under the BAU scenario will increase from 0.24 tons in 2005 to 1.4 tons per capita in 2050.

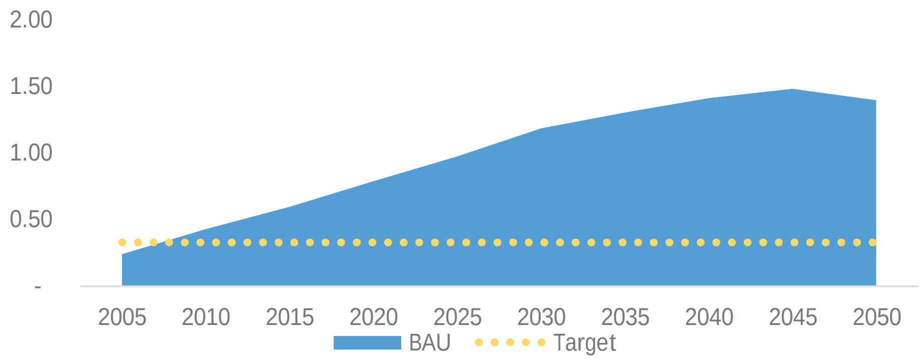

Figure 36. BAU Per Capita Transport CO2 Emissions (tonCO2/ capita)

- Motorcycles are the largest emitters in Vietnam, contributing 53% of CO2 emissions in 2005. However, car use is seen to increase significantly from 2005 to 2050, averaging at 12% increase in car travel per year versus a mere 3% increase in motorcycle travel per year.
- By 2050, under the BAU scenario, the contribution of cars to the total emissions will be almost at part with motorcycles (26% and 25% respectively).

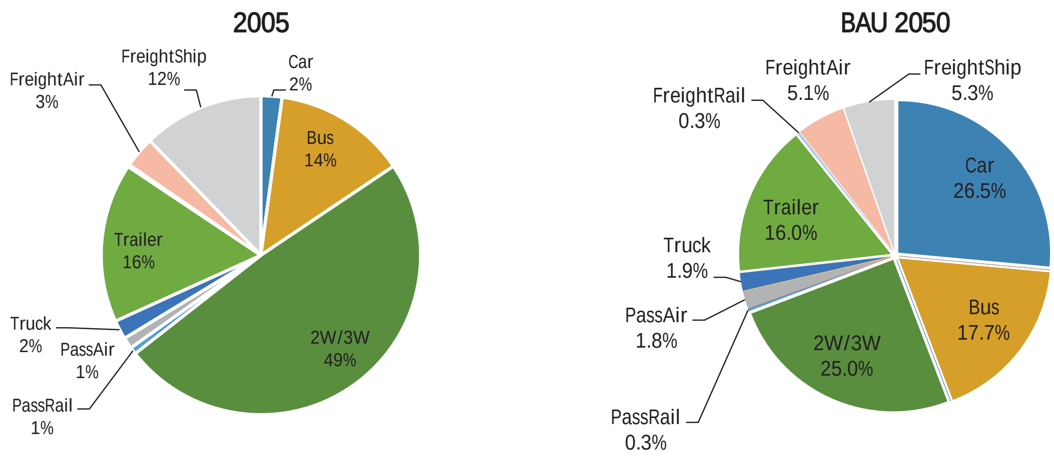

Figure 37. CO2 Contribution per Mode, 2005 and 2050

The section below shows the summary of the indicators for the relevant regions for analysis.

PRIMARY URBAN: Urban agglomerations with 2 million or plus population in 2050[7]
2005: 1.6 million tCO2
2050: 27.9 million tCO2 (7% increase per year)
Largest Emitters: 32% cars, 40% motorcycles, 25% buses
Note: Car travel is seen to increase fastest in Hanoi and Ho Chi Minh City

MAJOR URBAN: Urban agglomerations with population of 1 million to 2 million in 2050[8]
2005: 360 thousand tCO2
2050: 1.8 million tCO2 (4% increase per year)
Largest Emitters: 32% cars, 40% motorcycles, 25% buses
Note: Car travel seen to surge towards 2050 as characteristic of Vietnam's urban areas (11% per annum). Bus travel seen to increase at 5% per year

OTHER URBAN AREAS: 200 thousand to 1 million population agglomerations
2005: 1.2 million tCO2
2050: 10.9 million tCO2 (9% increase per year)
Largest Emitters: As characteristic of Vietnam's urban areas, motorcycles will remain the largest emitters in urban areas (40% in 2050).

NON-URBAN AREAS
2005: 7.3 million tCO2
2050: 32 million tCO2
Largest Emitters: 40% motorcycles, 32% cars, 25% buses

INTER-REGIONAL TRANSPORT
2005: 9.8 million tCO2

7 Such as Hanoi Capital Region and Greater HCMC Area, Bien Hoa in 2050
8 E.g. Can Tho and Da Nang

2050: 72.1 million tCO_2 (4.5% increase per year)
Largest Emitters: Heavy duty trucks will contribute 29% of emissions in 2050.

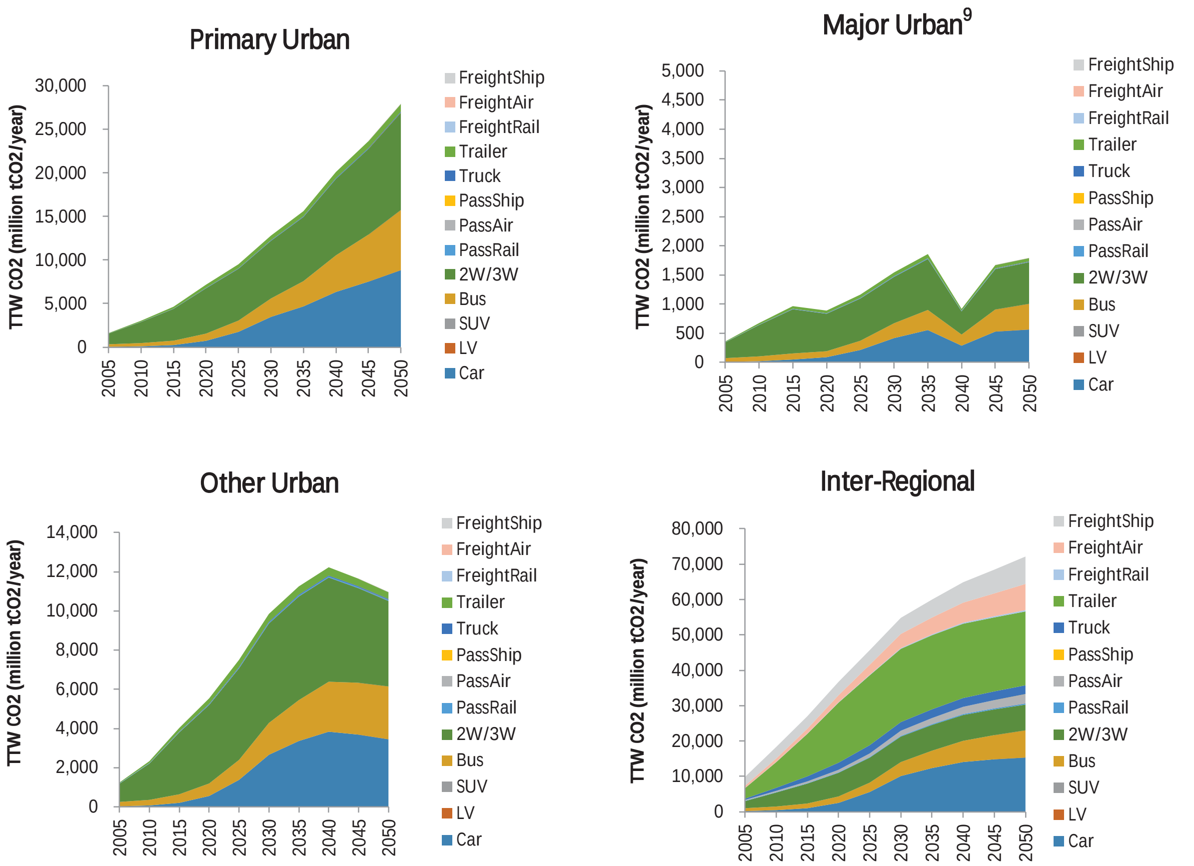

Figure 38. Transport CO2 per Region – BAU Scenario

3.2 Alternative Scenario

- The following are the policies that were selected for the application of the backcasting process in Vietnam. A review of the existing policies in the pipeline was done in order to properly assess which of the policies included in the backcasting tool are applicable for the different regions.
- The table below provides a summary of the policy packages that were simulated for the different regions. Detailed explanations of the policy packages applied for each region are given in the succeeding sections.
- The table below provides a summary of the assumptions that were applied across the board (all regions) and reflect national level policy impacts.

[9] The drop in 2040 was driven by the re-categorization of Bien Hoa from a major urban to a primary urban area.

Table 4. Assumptions – National Level

Policy	Target Value									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
CNGV Promotion (mainly via economic way)										
LV(CNG)	0%	0%	20%	20%	20%	20%	20%	20%	20%	20%
Bus(CNG)	0%	0%	10%	20%	20%	20%	20%	20%	20%	20%
Truck(CNG)	0%	0%	0%	3%	7%	10%	13%	17%	20%	20%
Biofuel Development										
Biofuel Promotion										
Bioethanol	0%	1%	2%	3%	4%	6%	7%	8%	9%	10%
Biodiesel	0%	1%	2%	3%	4%	6%	7%	8%	9%	10%

- The specific policy packages applied for each region of analysis (primary urban, major urban, urban, non-urban, inter-regional) are explained below.

3.2.1 Primary Urban Areas

Policy Packages

- In Vietnam, focus of policy implementation for urban transport lies in the primary cities, especially Hanoi and Ho Chi Minh City, and even more focus are directed at road transport.
- Policy references mentioned in section 2.3 were considered, such as the reports on Environmentally Sustainable Transport of Vietnam to 2020 (EST) and the Transport Master Plans pertinent cities. The EST specifies 10 priority targets by 2020, including an ambitious 30-45% mode share from public transport, especially from the Urban Rail System. National policy assumptions are based from these priority policies.
- The Urban Transport Master Plans for some relevant cities specify targets for the Urban Rail System construction. In Hanoi, two of six lines planned for the Urban Rail Network are under construction, while in Ho Chi Minh City, one line is under construction.
- National targets for biofuel promotion and development have also been considered from the Biofuels Act.

Table 5. Summary of Policy Packages for Primary Urban Areas

AVOID	SHIFT	IMPROVE
o Pricing Regimes o ICT o Teleactivities o Car Ownership o Improved Travel Awareness o Freight Transport Subsidiarity o Freight Dematerialisation o Urban and Landuse planning	- Passenger Transport - o Bus/BRT usage promotion o Bus/BRT infra development o Rail/LRT usage promotion o Rail/LRT infra development	o CNGV mass supply o CNGV Promotion (mainly via economic way) o Biofuel Development o Biofuel Promotion

- The table below shows the shift rates that were applied in simulating the future alternative scenario for the primary urban areas.

Table 6. Shift Rates – Primary Urban Areas

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Bus/BRT usage promotion (Passenger)										
Bus/BRT infra development (Passenger)										
from Car/LV/SUV to Bus	0%	0%	0%	0%	0%	5%	10%	10%	10%	10%
from 2W/3W to Bus	0%	0%	0%	5%	5%	5%	5%	5%	5%	5%
Rail/LRT usage promotion (Passenger)										
Rail/LRT infra development (Passenger)										
from Car/LV/SUV to Rail	0%	0%	0%	0%	1%	2%	3%	3%	4%	5%
from 2W/3W to Rail	0%	0%	0%	0%	1%	2%	3%	3%	4%	5%
from Car/LV/SUV to LRT	0%	0%	0%	0%	2%	8%	15%	17%	18%	20%
from 2W/3W to LRT	0%	0%	0%	0%	2%	3%	5%	7%	8%	10%

Results

- The total emission from travel activity occurring in the primary urban areas will be reduced by 65% from 27.9 million tons (BAU 2050) to 9.5 million tons in the alternative scenario.
- The per capita emissions from travel activity occurring in the primary urban areas will be reduced from 0.70 tCO2 per capita (BAU 2050) to 0.21 tCO2 per capita (alternative 2050).

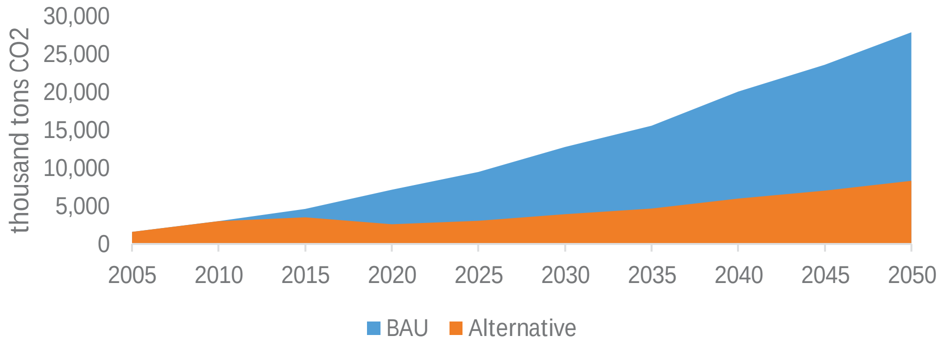

Figure 39. Primary Urban Areas: Transport CO2 Emissions (000 tons CO2)

3.2.2 Major Urban Areas

- The major urban areas refer to cities that have populations of 1 million to 2 million.
- The table below shows the policy packages that were considered in the simulations for the large urban areas.

Table 7. Summary of Policy Packages for Major Urban Areas

AVOID	SHIFT	IMPROVE
o Pricing Regimes o ICT o Teleactivities o Car Ownership o Improved Travel Awareness o Freight Transport Subsidiarity o Freight Dematerialisation o Urban and Landuse planning	- Passenger Transport - o Bus/BRT usage promotion o Bus/BRT infra development	o CNGV mass supply o CNGV Promotion (mainly via economic way) o Biofuel Development o Biofuel Promotion

- The table below shows the shift rates that were applied in simulating the future alternative scenario for the major urban areas.

Table 8. Shift Rates– Major Urban Areas

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Bus/BRT usage promotion (Passenger)										
Bus/BRT infra development (Passenger)										
from Car/LV/SUV to Bus	0%	0%	0%	0%	0%	5%	10%	10%	10%	10%
from 2W/3W to Bus	0%	0%	0%	5%	5%	5%	5%	5%	5%	5%

Results

- The total emission from travel activity occurring in the major urban areas will be reduced by 69% from 1.79 million tons (BAU 2050) to .54 million tons in the alternative scenario.
- The per capita emissions from travel activity occurring in the major urban areas cities will be reduced from 0.70 tCO_2 per capita (BAU 2050) to 0.21 tCO_2 per capita (alternative 2050).

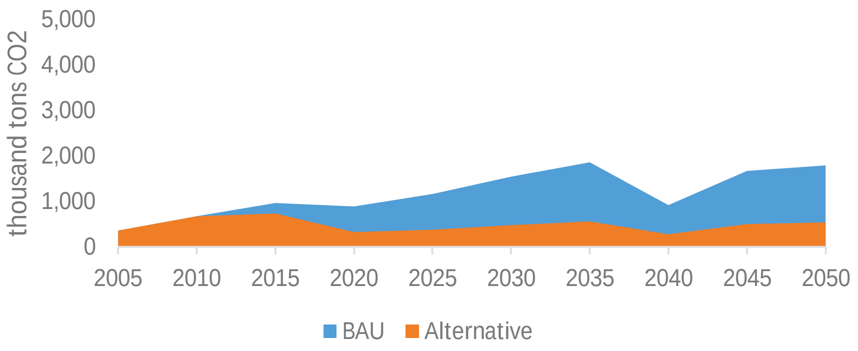

Figure 40. Major Urban Areas: Transport CO2 Emissions (000 tons CO2)[10]

[10] The drop in 2040 is due to the recategorization of Bien Hoa from major urban to primary urban areas

3.2.3 Other Urban Areas

- The other urban areas refer to areas with populations between 200,000 to 1 million.
- Tablehe table below shows the policy packages that were assumed for the other urban areas.

Table 9. Summary of Policy Packages for Other Urban Areas

AVOID	SHIFT	IMPROVE
o Pricing Regimes o ICT o Teleactivities o Car Ownership o Improved Travel Awareness o Freight Transport Subsidiarity o Freight Dematerialisation o Urban and Landuse planning	- Passenger Transport – o Bus usage promotion o Bus infra development	o CNGV mass supply o CNGV Promotion (mainly via economic way) o Biofuel Development o Biofuel Promotion

- The table below shows the shift rates that were applied in simulating the future alternative scenario for the other urban areas.

Table 10. Shift Rates - Other Urban Areas

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Bus usage promotion (Passenger)										
Bus infra development (Passenger)										
from Car/LV/SUV to Bus	0%	0%	0%	0%	1%	7%	13%	13%	14%	15%
from 2W/3W to Bus	0%	0%	0%	0%	1%	7%	8%	8%	9%	10%

Results

- The total emission from travel activity occurring in the other urban areas will be reduced by 69% from 10.9 million tons (BAU 2050) to 3.3 million tons in the alternative scenario.
- The per capita emissions from travel activity occurring in the other urban areas will be reduced from 0.70 tCO_2 per capita (BAU 2050) to 0.22 tCO_2 per capita (alternative 2050).

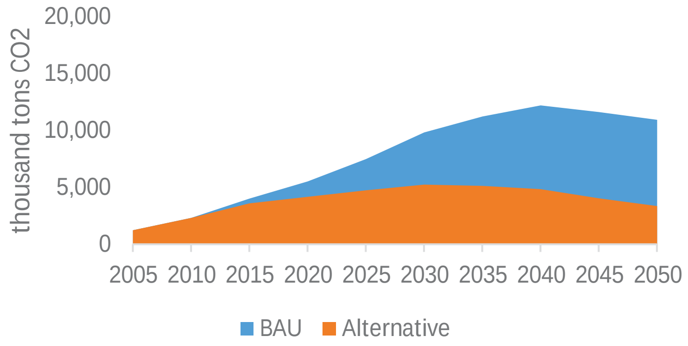

Figure 41. Other Urban Areas: Transport CO2 Emissions (000 tons CO2)

3.2.4 Non-Urban Areas

- The non-urban areas refer to agglomerations with population less than 200,000.
- Tablehe table below shows the main policy packages assumed for these areas.

Table 11. Summary of Policy Packages for Non-Urban Areas

AVOID	SHIFT	IMPROVE
o Pricing Regimes o ICT o Teleactivities o Car Ownership o Improved Travel Awareness o Freight Transport Subsidiarity o Freight Dematerialisation o Urban and Landuse planning	- Passenger Transport - o Bus usage promotion o Bus infra development	o CNGV mass supply o CNGV Promotion (mainly via economic way) o Biofuel Development o Biofuel Promotion

- The table below shows the shift rates that were applied in simulating the future alternative scenario for the non-urban areas.

Table 12. Shift Rates – Non-Urban Areas

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Bus usage promotion (Passenger)										
Bus infra development (Passenger)										
from Car/LV/SUV to Bus	0%	0%	0%	0%	1%	7%	13%	13%	14%	15%
from 2W/3W to Bus	0%	0%	0%	0%	1%	7%	8%	8%	9%	10%

Results

- The total emission from travel activity occurring in non-urban areas will be reduced by 69% from 31.9 million tons (BAU 2050) to 9.8 million tons in the alternative scenario.
- The per capita emissions from travel activity occurring in the non-urban areas will be reduced from 0.69 tCO_2 per capita (BAU 2050) to 0.21 tCO_2 per capita (alternative 2050).

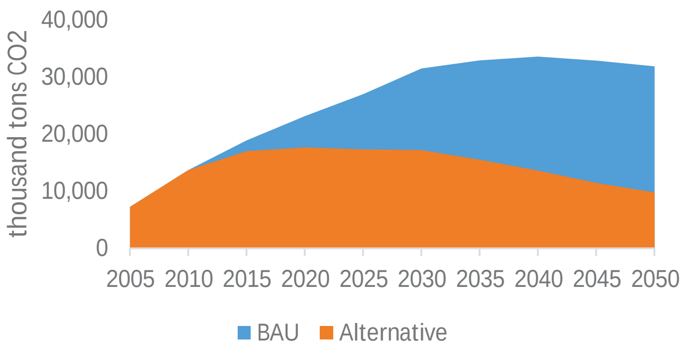

Figure 42. Non-Urban Areas: Transport CO2 Emissions (000 tons CO2)

3.2.5 Inter-Regional Transport

- Inter-regional transport refers to the transport that occurs while traveling between the aforementioned regions (primary urban, major urban, other urban, non-urban).
- The table below shows the policy packages that were assumed for the other urban areas.

Table 13. Summary of Policy Packages for Inter-Regional Transport

AVOID	SHIFT	IMPROVE
o Pricing Regimes o ICT o Teleactivities o Car Ownership o Improved Travel Awareness o Freight Transport Subsidiarity o Freight Dematerialisation o Urban and Landuse planning	- Passenger Transport – o Bus/BRT usage promotion o Bus/BRT infra development o Rail/LRT usage promotion o Rail/LRT infra development - Freight Transport – o Rail usage promotion o Rail infra development o Ship usage promotion o Ship infra development	o CNGV mass supply o CNGV Promotion (mainly via economic way) o Biofuel Development o Biofuel Promotion

- The table below shows the shift rates that were applied in simulating the future alternative scenario for inter-regional transport.

Table 14. Shift Rates – Inter-Regional Transport

Policy	Target value (e.g., shift from car/LV/SUV to bus, % of fleet using EV, etc.)									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Bus/BRT usage promotion (Passenger)										
Bus/BRT infra development (Passenger)										
from Car/LV/SUV to Bus	0%	0%	0%	30%	30%	32%	34%	36%	38%	40%
from 2W/3W to Bus	0%	0%	0%	10%	10%	10%	10%	10%	10%	10%
Rail/LRT usage promotion (Passenger)										
Rail/LRT infra development (Passenger)										
from Car/LV/SUV to Rail	0%	0%	0%	3%	7%	14%	18%	22%	26%	30%
from 2W/3W to Rail	0%	0%	0%	3%	7%	10%	10%	10%	10%	10%
Rail infra development (Freight)										
from Truck/Trailer to Rail	0%	0%	0%	0%	1%	8%	15%	21%	28%	35%
from Air to Rail	0%	0%	0%	0%	1%	2%	3%	3%	4%	5%
Ship infra development (Freight)										
from Truck to Ship	0%	0%	0%	0%	1%	2%	3%	3%	4%	5%

Results

- The total emission from inter-regional transport will be reduced by 58% from 72.1 million tons (BAU 2050) to 30.2 million tons in the alternative scenario.
- The per capita emissions from inter-regional transport will be reduced from 0.51 tCO_2 per capita (BAU 2050) to 0.15 tCO_2 per capita (alternative 2050).
- The largest emitters at the interregional level are freight transport vehicles, especially cargo trailers. This prompted a freight-oriented policy assumption based on plans to improve the National railways that would link Hanoi and Ho Chi Minh City in the future.

3.2.6 Summary Results

- The application of the policies mentioned in the section above resulted in the reduction of total CO_2 emissions in 2050 from 144 million tons to 52 million tons.
- The alternative scenario limits the annual increase in total CO_2 emissions for transport to 2.1% per year, as compared to 4.5% in the BAU scenario.
- The application of the policy packages resulted in notable changes in the transportation volume, e.g.: reduction of the annual growth in car transport volume to 6.4% as compared to 11.7% in the BAU, higher annual rates of increase in passenger rail usage (5.9% vs 2.9% in the BAU) and freight rail usage (8.2% vs 2.9% in the BAU).

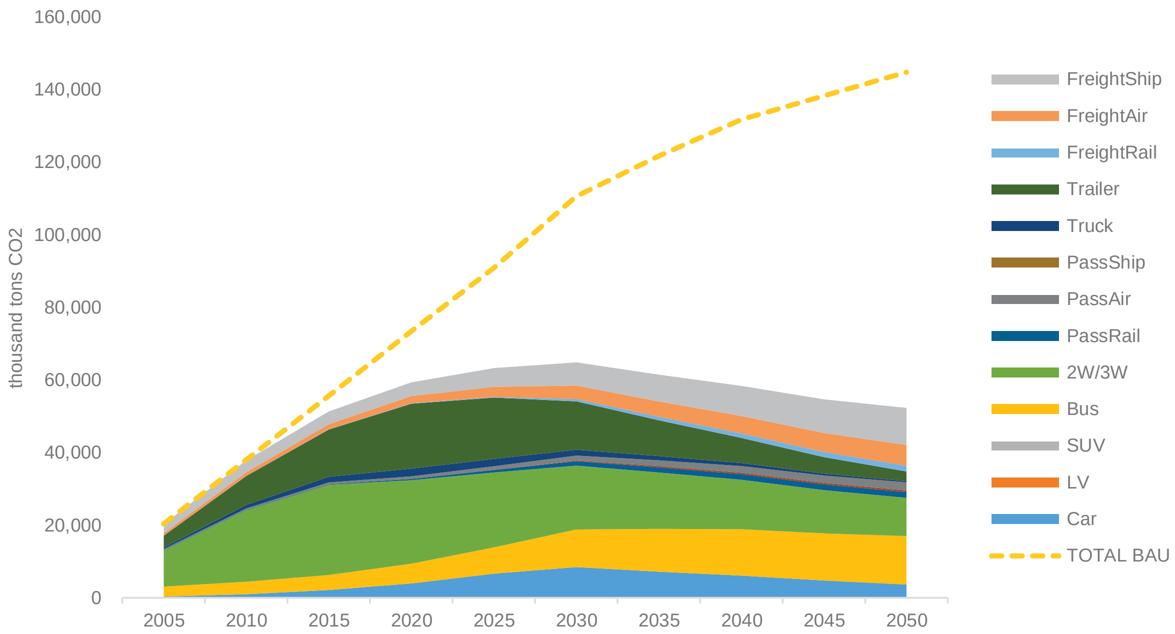

Figure 43. Total Transport CO2 by Mode -Alternative vs Total BAU (thousand tons CO2)

- The impacts of the policies resulted in a 2050 per capita CO2 value of 0.51 tons per capita (as compared to 1.40 in the BAU scenario.

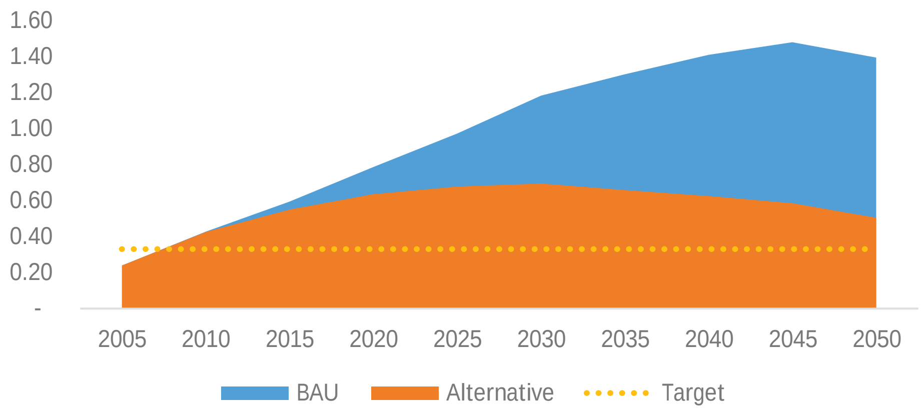

Figure 44. Per Capita Transport CO2 (tons CO2/capita)

- The alternative scenario suggests less emission from car use such that the contribution is limited to 7.1% in 2050 (as compared to 26% in the BAU). Meanwhile it is expected that motorcycles will continue to contribute a large portion of transport emissions at 20% (25% in BAU). The contribution of buses will increase (due to higher bus volumes and usage) to 26% (as compared to 18% in the BAU).
- The alternative scenario results in a larger contribution from freight water transport (20% in the alternative vs 5% in the BAU) as the alternative scenario postulates shifting of freight activity towards water transport. It is anticipated that with the growth of port cities in Vietnam, water freight transport from north to south would increase, slightly reducing road freight emissions but increasing ship emissions.

3.3 Action Plan

- The figures below show a summary of the actions that have been taken into consideration in building the alternative scenario for Vietnam: primary cities example and Vietnam as a whole.

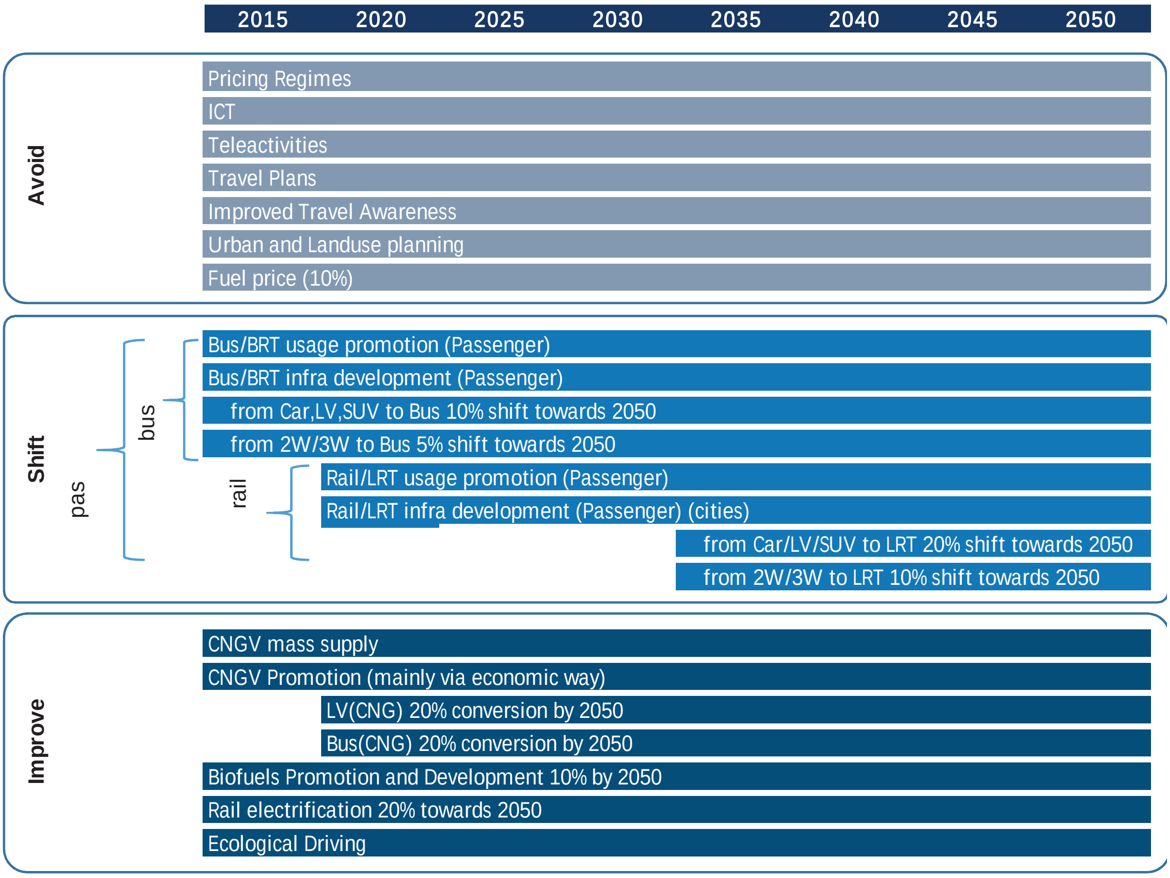

Figure 45. Action Plan for the Primary Urban Areas

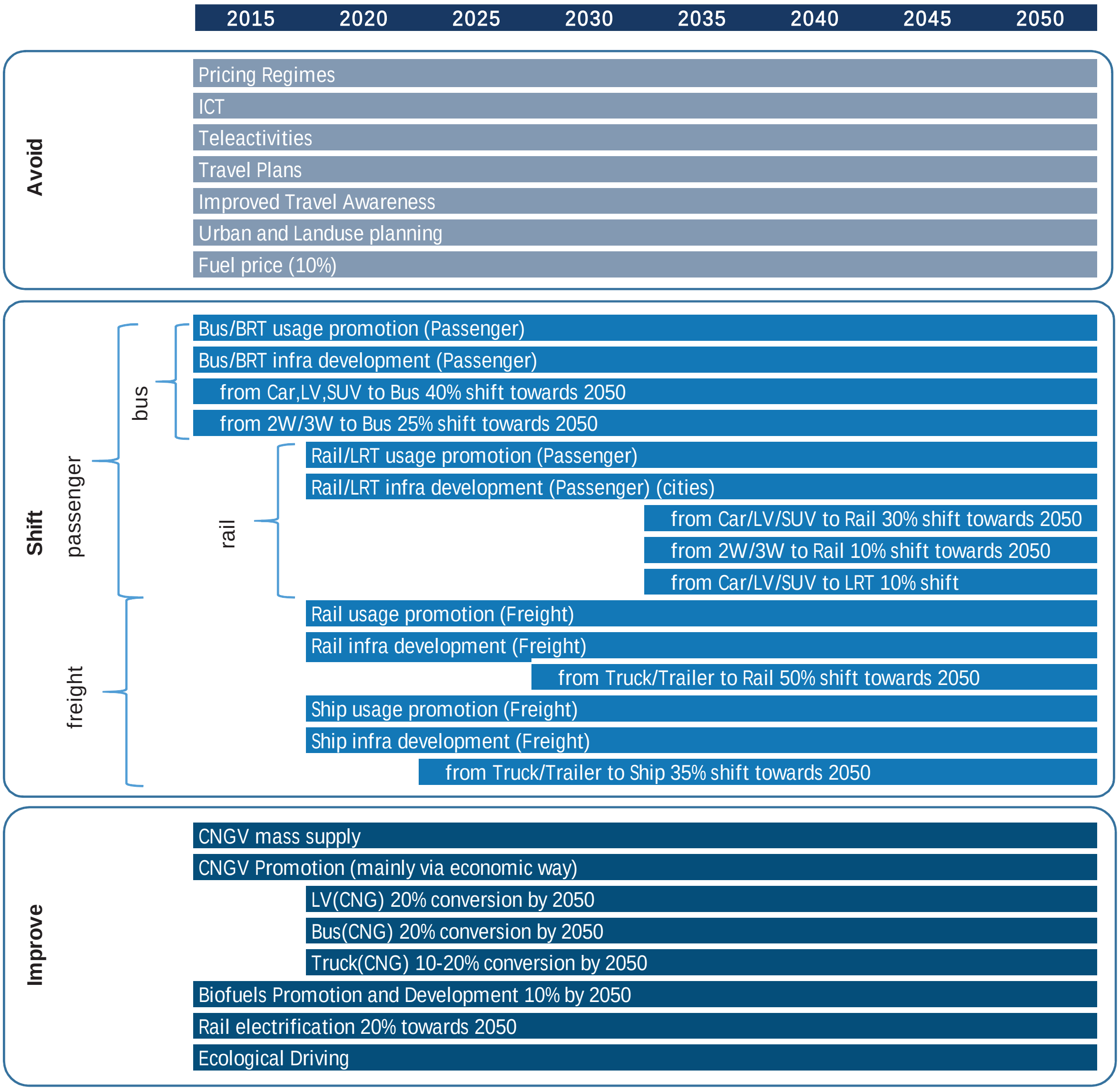

Figure 46. Summary Action Plan for Vietnam

4. Conclusions

- There is now a high dependence on private motorized transport in Vietnam as a result of the increase in incomes during the last decade and the increase in travel demand, as well as the inadequacy of the public transport infrastructure to accommodate the rapidly increasing travel demand. It has been presented in earlier chapters that cars will greatly contribute to future transport emissions.
- The BAU scenario estimates that the total transport CO_2 emissions will increase 7-fold from 20.3 million tons in 2005 to 144.7 million tons in 2050. In terms of per capita emissions, it will increase from 0.24 tons per capita in 2005 to 1.4 tons in 2050.
- The estimates suggest that further development of mitigation policies in interregional transport would be a significant matter of consideration. Interregional transport is projected to contribute 57% of the total transport emissions in 2050, with heavy-duty trucks contributing the highest.
- In terms of the different modes, the car is estimated to be the highest contributor in 2050, emitting 26% of all transport CO_2 emissions.
- The study presents future societal factors for Vietnam based on available information on forecasts for the economy and population characteristics of the country.
  - By 2050, the population of Vietnam will be 103.6 million, 59% of whom will be within the working age, 23% will be senior citizens.
  - 55.9% of the population in 2050 will be living in urban areas
  - The GDP per capita will be at USD 5,621, growing at an average of 5.01% annually.
- Policies were analyzed in order to come up with an alternative scenario which embodies realistic and context-specific policies that are applied in the different regions of analysis.
- The alternative scenario postulates the following main characteristics of the future transportation image in the country:
  - Passenger transport in the primary urban, major urban, other urban, non-urban areas and inter-regional transport will utilize bus systems more in the future, forming a significant portion of the transportation mode share in 2050.
  - Car transport activity growth will be lower than the business-as-usual scenario.
  - The dominance of motorcycle will be alleviated due to the penetration of public transport systems, particularly buses.
  - Freight transport will be more diverse, with the higher utilization of rail networks and water transport for transporting goods.
- Based on the simulations using the Backcasting tool, the current assumptions on the policy packages and their impacts will only reduce the tCO_2 per capita to 0.51, still above the 0.33 tCO_2 per capita target. It is recommended that additional policies on mitigating emissions from the primary urban areas, particularly the ones that are likely to join the 2 million plus population category in the future (e.g. Bien Hoa and Hai Phong) be put in place as these areas will be fastest in terms of growth in the contribution to the total CO_2 emissions from transport.
- For passenger transport, the main challenge for Vietnam is in curbing the impending emissions increase from passenger cars. As the country moves towards higher economic development, private cars will be more accessible to the citizenry. In the BAU scenario, cars will contribute 26% of the total transport CO_2 emissions, from 2% in 2005. The introduction and strengthening of better quality and higher level of service public transportation systems, particularly in the primary urban areas will be crucial in limiting the enormous increase in emissions from private car travel in the future.
- Freight is an important theme of policy design and adoption in the near future. Implementation of advanced rail that can reduce the number of cargo trailers on the road is an option. It is highly recommended that rail development be prioritized from 2020 onwards to support increase in freight travel demand resulting from a growing manufacturing industry. The development and utilization of water transport facilities will play a key role in the future of freight transport in Vietnam.
- Vietnam is strategically located in the region, and with its ports and land access to the other Southeast and East Asian countries, it can be a regional hub for freight as well as a hub for the manufacturing sector. As

average wages go up in China, investors and businesses will look into other alternatives such as Vietnam. With the sustained growth in the economy and increased consumption driven by the growing economy, increase in freight travel demand is expected, i.e. demand for moving goods from economic zones will increase.

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Institution for Transport Policy Studies (ITPS)

3-18-19, Toranomon, Minato-ku, TOKYO (Japan)

TEL: +81-3-5470-8420 FAX: +81-3-5470-8421

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