Thailand Stocktaking Report on Sustainable Transport and Climate Change

Data, Policy and Monitoring

asean
german cooperation
DEUTSCHE ZUSAMMENARBEIT
Implemented by:
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
สนข
สำนักงานนโยบายและแผนการขนส่งและจราจร

Thailand Stocktaking Report on Sustainable Transport and Climate Change

«Thailand Stocktaking Report»

Acknowledgement

The Transport and Climate Change project (TCC) would like to express our appreciation to those who have contributed invaluable supports and inputs to the Thailand stocktaking report. First of all, best gratitude to Dr. Sorawit Narupiti, and Dr. Atit Tippichai, national experts who have provided an in-depth knowledge and information on transport data and policy as well as analysis of the knowledge and the current status of land transport issue in Thailand. Secondly, we would like to thank the Office of Transport and Traffic Policy and Planning (OTP), Dr. Rudolf M. Petersen, Dr. Axel Friedrich and Sudhir Gota, for their review and suggestions. Furthermore, we appreciate the kind cooperation on information sharing and updating of the current work from various sectors whether governmental organisations, inter-governmental organisations, international donors, public enterprises, privates or academia. Last but not least, we would like to express our thankfulness to the generosity of our host organisation, the Office of Natural Resource and Environmental Policy and Planning (ONEP), for hosting and supporting the TCC project.

Authors: Dr. Sorawit Narupiti
Dr. Atit Tippichai
Papondhanai Nanthachatchavankul
Mattawan Sutjaritthanarak
Stefan Bakker

Contact: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Lake Rajada Office Complex
(16th floor)
New Ratchadapisek Road, Klongtoey,
10110 Bangkok
Thailand

www.TransportAndClimateChange.org

Manager: Stefan Bakker
Editing: Piya Kerdlap
Cover photo: Mattawan Sutjaritthanarak
Further Info: Stefan Bakker
Bangkok, September 2014

Table of Contents

TABLE OF FIGURES

TABLE OF TABLES

Abbreviations and Acronyms

ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
ASIF	Activity-Structure-Intensity-Fuel
ATRANS	Asian Transportation Research society
BMA	Bangkok Metropolitan Administration
BMTA	Bangkok Mass Transit Authority
BTS	Bangkok Mass Transit System
CAA	Clean Air Asia
cm^3	Cubic centimetre
CNG	Compressed Natural Gas
CO_2	Carbon dioxide
CO_2-eq	Carbon dioxide equivalent
DEDE	Department of Alternative Energy Development and Efficiency
DLT	Department of Land Transport
EPPO	Energy Policy and Planning Office
EU	Delegation of the European Union to Thailand
g	Grammes
GDP	Gross Domestic Product
GHG	Greenhouse gas
GIZ	German International Cooperation
GMS	Asian Development Bank Greater Mekong Subregion
h	Hour
IGES	Institute for Global Environmental Strategies
IIE	The institute of Industrial Energy
JGSEE	The Joint Graduate School of Energy and Environment
JICA	Japan International Cooperation Agency
KMITT	King Mongkut's Institute of Technology Thonburi
km	kilometre
km^2	Square kilometre
l	Litre
LPG	Liquid Petroleum Gas
MJ	Megajoule
MNRE	Ministry of Natural Resources and Environment
MOE	Ministry of Energy
MOI	Ministry of Industry
MRTA	Mass Rapid Transit Authority of Thailand
MRV	Measurement, reporting, and verification
Mt	Million tonnes
NAMA	Nationally Appropriate Mitigation Action
NMT	Non-motorized transport

NRCT	National Research Council of Thailand
ONEP	Office of Natural Resources and Environmental Policy and Planning
OTP	Office of Transport and Traffic Policy and Planning
PCD	Pollution Control Department
PKT	Passenger-kilometre travelled
PT	Public Transport
SRT	State Railway of Thailand
t	Tonne
Tg	Teragramme
TAI	Thailand Automotive Institute
TKT	Ton-kilometre travelled
TOD	Transit Oriented Development
TRF	Thailand Research Fund
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNEP	United Nations Environment Programme
USAID/RDMA	The United States Agency for International Development Regional Development Mission for Asia
VKT	Vehicle-kilometre travelled

Executive Summary

The transport sector is a major consumer of energy and with 59 Mt CO_2, or 17% of total greenhouse gases, the 2nd largest emitter in Thailand. This translates into 0.88 tonnes per capita. Freight and passenger transport are almost equal in their contribution to energy use and GHG emissions. The Bangkok metropolitan area is responsible for about 44% of emissions.

In order to reduce energy consumption, emissions and other externalities, sustainable transport policies and strategies are being developed and implemented. This report reviews existing data, policies and international donor activity in the area of sustainable transport, in order to provide policy-makers, researchers, international donors and other stakeholders a reference document for sustainable transport and climate change.

We apply the Activity-Structure-Intensity-Fuel (ASIF) approach to investigate the data availability on energy use and GHG emissions in the transport sector. Existing studies, literature and databases contain many key transport figures and data, however the available data are scattered, and often come from project-based studies and research rather than regular, institutionalised collection and reporting. It is observed that transport data such as Vehicle-kilometre travelled (VKT), Passenger-kilometre travelled (PKT), modal split, vehicle speeds, travel behaviour, load factor, fuel economy and emission factors are not regularly collected; or in some cases, are not in the public domain. Such data are essential for the use of indicators to characterise, model and monitor the transport system, and would also facilitate compilation of the Biennial Update Reports to the UNFCCC.

The Ministry of Transport is responsible for infrastructure and transport planning, and has strategies in place that contribute to climate change mitigation. The mandate for improving energy efficiency of vehicles and setting fuel prices is with Ministry of Energy. The Ministry of Industry is a key actor as well, given the large car manufacturing industry, while the Ministry of Finance is responsible vehicle taxation. The Ministry of Natural Resources and Environment plays a key role by setting the overall strategy for mitigation in The Climate Change Master Plan. At the sub-national level, the Bangkok Metropolitan Area also considers measures to reduce emissions from transport. There is room for better alignment of the different strategies and interests of the ministries in order to streamline mitigation actions in the transport sector. Development and implementation of nationally appropriate mitigation actions (NAMAs) could provide a framework and vehicle to integrate the transport and climate change policy agendas. Institutional options, such as creation of a sustainable transport body that integrates all relevant policies and has climate change mitigation as one key performance indicator, can also be considered.

Based on the Avoid-Shift-Improve approach we compile a comprehensive overview of existing policies in passenger and freight transport. In passenger transport, most of the potential policies and measures are being considered, planned or implemented, though in some cases only for a limited scope or a pilot phase. In the freight transport sector, policy activity is much lower, and key policy areas such as efficient tyres or vehicle policies are not (yet) considered. We also found that many of the existing policies and plans are unlikely to be applicable in the implementation

level. Thus, the policies need to be more specific on the scope as well as on the budget management.

International organisations current provide support for sustainable transport mainly in relation to urban transport, and to some extent freight and energy efficiency as well as GHG calculations. Further international assistance could further help gaps of sustainable transport knowledge, climate mechanisms including NAMAs, monitoring (MRV) of policies, green freight, fuel economy and urban transport.

1. Introduction

A certain level of transport creates benefits for economic and social development. However, current trends in the transport sector in ASEAN countries are unsustainable for the environment and society. With the 2nd largest vehicle fleet in Asia just after China, the ASEAN region already faces serious problems including congestion, fossil fuel consumption, air pollution and road safety. In addition, transport in ASEAN is a significant emitter of CO_2 and black carbon emissions (Clean Air Asia, 2012).

The 'Energy Efficiency and Climate Change Mitigation in the Land Transport Sector in the ASEAN Region' project[1], in short 'Transport and Climate Change', aims to contribute to the development, implementation and monitoring of strategies and action plans towards the improvement of energy efficiency and the reduction of greenhouse gas emissions. At the regional level this includes development of an ASEAN policy or strategy as well as guidelines and templates for national policies and action plans for member states. At the national level, it aims at development of action plans and measures in five countries, and implementation of these according to national plans in at least three ASEAN Member States, as well as improvement of the measurement, reporting and verification (MRV) system in five countries: Indonesia, Malaysia, the Philippines, Thailand and Vietnam.

This report aims to provide an up to date picture of transport and climate change mitigation in Thailand for the project team, policymakers, and international donors, as well as identify gaps, needs and potential areas for assistance. It covers the full land transport sector, including passenger and freight, and discusses existing data based on the ASIF approach (Chapter 2), policies and monitoring for sustainable transport and climate (Chapter 3), barriers towards low-carbon transport (Chapter 4), stakeholders and international donors (Chapter 5), and finally recommendations for further action on capacity building. The report is based on existing literature and policy documents, interviews with policymakers and experts and a Thailand Kick-off workshop held in March 2013.

[1] www.TransportAndClimateChange.org

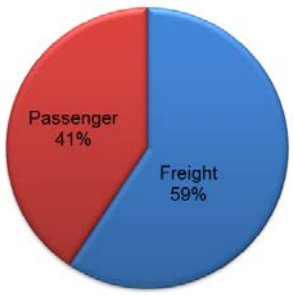
2. Transport and Climate Data

This chapter overviews key trends of transportation and its environmental-related issues in Thailand, such as vehicle numbers and kilometres, emissions, modal split in passenger and freight, average vehicle-kilometres travelled (VKT) by vehicle and fuel type, vehicle population by vehicle and fuel type, average speed; emission factors, fuel characteristics, GDP, total population, average occupancy, and average load. Relevant data and emission indicators of the transport sector are crucially needed for policy and decision makers to track the progress of policies that aim to increase energy efficiency and to reduce GHG emissions. The need for better governmental data is expected to increase considerably as climate negotiations and communications for a measurement, reporting and verification (MRV) mechanism would be used to assess emissions pledges and obligations.

2.1 GHG Emissions from the Transport Sector

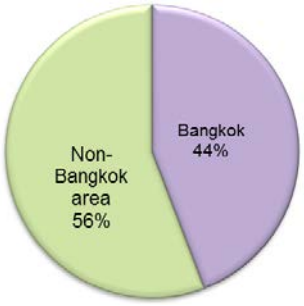
Based on Thailand's Greenhouse Gas Inventory studied by the Joint Graduate School of Energy and Environment (JGSEE, 2010), which is referred to in the 2nd National Communication submitted to UNFCCC, Thailand's emissions of greenhouse gases (GHG) in 2000 totalled to 229.08 Mt of CO_2-eq. The energy sector emitted a total of 159.39 Mt of CO_2-eq accounting for 69.6% of the total emissions as shown in Figure III-1 in annex III. The transport sector was the second largest emitter of greenhouse gases (GHG) within the energy sector, behind the energy industry sector. In 2000, the transport sector emitted about 44.7 Mt of CO_2-eq of GHGs accounting for 28.0% of the total emissions in the energy sector and 19.5% of the total emissions in Thailand. The trend of CO_2 emissions was estimated from energy consumption from 2008-2012 by the Department of Alternative Energy Development and Efficiency (DEDE), the Ministry of Energy (DEDE, 2012). Estimated CO_2 emissions from energy consumption in Thailand in 2012 were 215.0 Mt CO_2-eq and the transport sector shared about 27.5% or 59 Mt of CO_2-eq. The average annual growth rate of CO_2 emissions from 2008 to 2012 was 12.9%. In the transport sector, road transport mode was the largest contributor to GHG emissions, about 97% as shown in Figure III-2 in annex III.

The source of GHG emissions was revealed by two criteria, the type of services and geographical area. As shown in Figure 2.1(a), freight transport accounted for 59% of the total GHG emissions in the transport sector while passenger transport was responsible for 41% in 2005. It is important to note that this data refers to the study carried out for the project "Low carbon society mission 2020" (Limmechokchai B., 2012). This study focused on the energy sector of Thailand in which transport was included as its sub-sector. As shown in Figure 2.1(b), Bangkok Metropolitan Region accounted for 44% of the transport emissions in 2010 while the remaining 56% of the emissions were from the other 76 provinces. The data of the GHG emissions in the transport sector based on geographical area was from the Environmental Sustainable Transport study conducted by the Office of Transport and Traffic Policy and Planning in 2012.



a) By type of services 2005

Source: Limmechokchai B., 2012; Freight may include pickup trucks, which are also used for passenger transport



b) By geographical area in 2010

Source: Office of Transport and Traffic Policy and Planning, 2012

Figure 2.1, *Source of GHG emissions from transport sector*

2.2 Transport Activity

Transport activity (A) is a primary cause of fuel consumption and GHG emissions. "Movement of people and goods depends on many factors including demographics, age, gender, and income. As trip rates and distances tend to rise with higher income, the economy and its composition may influence the demand for different trip types. Urban form and size may affect the distribution of activities and total travel distances" (Zegras, 2007). Therefore, this section will review the status of data related to activity demands such as population, income, and demographics. Generally, transport activity is measured in units of passenger-kilometre travelled (PKT) for passenger transport and ton-kilometre travelled (TKT) for freight transport. Both transport activity units are not recorded or surveyed regularly. Many studies therefore started to analyse transport activity at the vehicle level in units of vehicle-kilometre travelled (VKT) since data of vehicle movement is easier to record and forecast than personal movement. Then, PKT and TKT can be reversely calculated with occupancy rates of passengers and load factors respectively. A model developed by Pongthanaisawan (2011) to predict VKT by vehicle types in Thailand will also be reviewed in the sections of the ASIF approach. In addition, there is an attempt to harmonize the transport data platform in ASEAN countries supported by the government of Japan called the ASEAN-Japan Transport Partnership (AJTP) project2. Based on this project, many indicators of the transport sector in Thailand are acquired either from original source data or estimation. Since there is no agency fully responsible for data collection in the transport sector of Thailand, some of the indicator data collected did not cover all data-owned organizations. It can be said that the collection of transport data in Thailand has not been stabilised but only standardised.

[2] Statistical data of common transport indicators of ASEAN countries can be downloaded at www.ajtpweb.org

2.2.1 Key Indicators

Passenger-kilometre travelled (PKT)

The total amount of kilometres travelled in each year by a particular mode of transport such as water, rail, air, or road in a given area or region, and other statistical data of transport activities are currently not recorded officially by a governmental organisation. Home interview surveys that asked about travelling information of each person living in a house can be found for particular areas or cities that have been studied for developing a transportation master plan by the Office of Transport and Traffic Policy and Planning (OTP). Figure IV-1 in annex IV shows data of PKT by highways that fall under the responsibility of the Department of Highway (DOH). Figure IV-2 in annex IV also shows data of PKT by railways excluding urban mass transit electric railways. The trend of PKT on highways is gradually increasing, while the trend of PKT by railways is decreasing.

Ton-kilometre travelled (TKT)

The volume of freight in Thailand has been fluctuating from 2004 to 2010 as seen in Figure IV-3, annex IV. It is clear that road was the major mode of freight transport in Thailand. As shown in Figure 2.2, TKT of freight was also mainly shared by road transport, almost 97%.

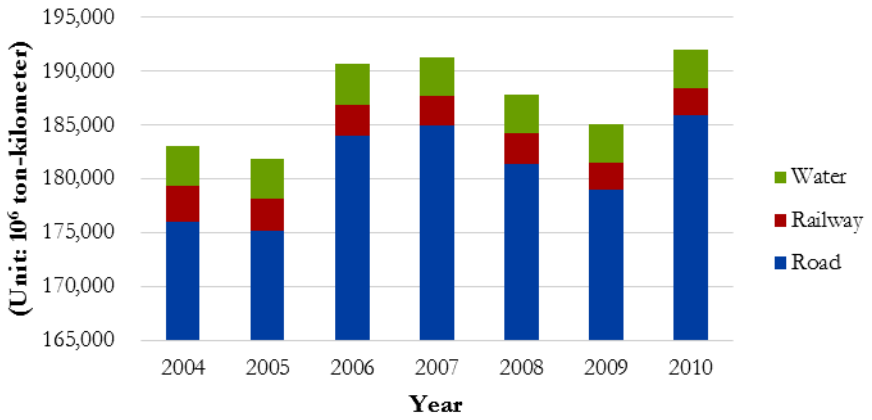


Figure 2.2, *Ton- kilometre of freight transport in Thailand during 2004 – 2010*

Source: AJPT 2013

Vehicle-kilometre travelled (VKT)

Official data of vehicle-kilometre travelled (VKT) by vehicle types in Thailand is not regularly recorded by a governmental organisation. Only basic transport data such as vehicle speeds (only for Bangkok; see Section 2.4) and number of vehicles are available. There is only data of VKT from previous studies estimated by transport models. However, there are many researches on the VKT available from academic and research institutions.

Tansport activity data in terms of passenger-kilometres or tonne-kilometres can be derived from other basic data such as the number of vehicles on the road, vehicle occupancy rates and load factors (Pongthanaisawan, 2011). Generally, VKT of a vehicle is affected by several factors such

as vehicle characteristics, land use and socio-economic characteristics. The data of VKT collected by the origin-destination survey method has not been found. Only information about vehicle characteristics, such as vehicle age, and their impact on the VKT could be found from survey data in 1997 by KMITT (KMITT, 1997). The detailed data is shown in Table IV-3 in annex IV. However, there are two studies that were conducted by the Thailand Office of Transport and Traffic Policy and Planning that provide VKT data for Thailand, based on transport modelling. These two studies are the Environmental Sustainable Transport Master Plan (OTP, 2012) and Transport Data and Logistics (OTP, 2011). Moreover, there was a study on annual average VKT of on-road vehicles in Bangkok and major provinces in Thailand supported by the Asian Transportation Research Society (ATRANS) in 2009 (Thirayoot et al, 2009). The VKT of both studies were rather different since vehicle age was one of the significant factors to VKT. Thirayoot et al (2009) also developed a VKT model to predict VKT by vehicle types according to the age of the vehicle.

What is needed is a conclusion on the VKT data and reflection on what is available. Therefore, it is very important for the government or an agency to start systematically collecting and estimating data of VKT and certifying this data annually. VKT is one of the most important key parameters used for transport policy and planning since VKT is one of the most meaningful indicators to represent travel demand in particular areas. VKT together with the number of vehicles and fuel economy data in different areas will help make calculations of fuel consumption and GHG emissions to be more reliable. Policy makers could utilize the data to design and implement suitable measures for particular types of vehicles in different areas.

2.2.2 Related Parameters

Number of vehicles

The number of vehicles in Thailand as of 31 December 2012 was about 32.48 million that have been registered by the Department of Land Transport, Ministry of Transport, as shown in Table 2.1. There are three major vehicle types under the Motor Vehicle Act which share more than 96% of the total vehicle fleet in Thailand, namely motorcycles, vans & pick ups, and sedans. With a total number of 19 million vehicles, motorcycles make up the largest share (60.5%) in Thailand's vehicle fleet, and only 15% of them are registered in Bangkok. The number of registered passenger cars, mostly sedans, and small pick-up trucks is rather close, 5.9 and 5.4 million, respectively. About 51% of sedans are registered in Bangkok, but only 20% of pick-ups are registered in Bangkok. It should be noted that the number of pick-up trucks is quite high because the excise tax for pick-up trucks is low. Additionally, most pick-up trucks operate on diesel fuel which is heavily subsidized by the Thai government. The price of diesel fuel is controlled to not be higher than 30 Baht per litre. There is no study available about the characteristic use of pick-ups, which is one of the main vehicle types in Thailand.

Table 2.1, *Number of Vehicles Stock Registered in Thailand as of 31 December 2012*

Source: DLT, 2012

Type of Vehicle	Number of Vehicle	Share (%)
Grand Total	**32,476,977**	
A. Total Vehicle under Motor Vehicle Act	**31,439,643**	**96.8**
A.1) Sedan (Not more than 7 Pass.)	5,856,454	18.6
A.2) Microbus & Passenger Van	417,529	1.3
A.3) Van & Pick Up	5,437,988	17.3
A.4) Motor-tricycle	1,477	0.0
A.5) Interprovincial Taxi	3	0.0
A.6) Urban Taxi	109,281	0.3
A.7) Fixed Route Taxi	3,293	0.0
A.8) Motor-tricycle Taxi (Tuk-Tuk)	20,716	0.1
A.9) Hotel Taxi	1,975	0.0
A.10) Tour Taxi	1,099	0.0
A.11) Car For Hire	88	0.0
A.12) Motorcycle	19,023,751	60.5
A.13) Tractor	334,292	1.1
A.14) Road Roller	10,872	0.0
A.15) Farm Vehicle	94,551	0.3
A.16) Automobile Trailer	2,800	0.0
A.17) Public Motorcycle	123,474	0.4
B. Total Vehicle under Land Transport Act	**1,037,334**	**3.2**
B.2) Truck	898,214	86.6
B.2.1) Non Fixed Route Truck	201,389	22.4
B.2.2) Private Truck	696,825	77.6
B.3) Small Rural Bus	1,511	0.1

Figure 2.3 shows the trend of vehicle growth during last 20 years based on the vehicle registration data from the Department of Land Transport (DLT). It should be noted that there was a big drop in the number of vehicles registered in 2003-2004 since the DLT had modified the inventory system of vehicle stocks by cutting very old vehicles that had not made the annual registration for more than a certain number of years. During 1989-2003, personal cars, which included sedans, vans, and pick-ups, and motorcycles had a similar growth rate of about 10% per year. For the last decade, the average growth rate of the number of motorcycles is significantly lower, about 5% per year, while the average growth rate of the number of personal cars was about 8% per year. The vehicle registration data is reliable since it is from an online system of registrations at every provincial office of DLT.

With the current growth rates, this could project a picture that the number of personal cars would be equal to the number of motorcycles someday in future. It is in line with a study by Pongthanaisawan and Sorapipatana (2013) that analysed the relationship between motorcycle and car ownerships and level of economic development in Thailand. Since the growth of overall private vehicle ownership is driven by per capita GDP growth, the car ownership in Thailand is expected to be equal to motorcycle ownership when per capita GDP of Thailand is about 15,600 US dollar before the year 2050. The detailed graphs can be found in Figure IV-5 in annex IV.

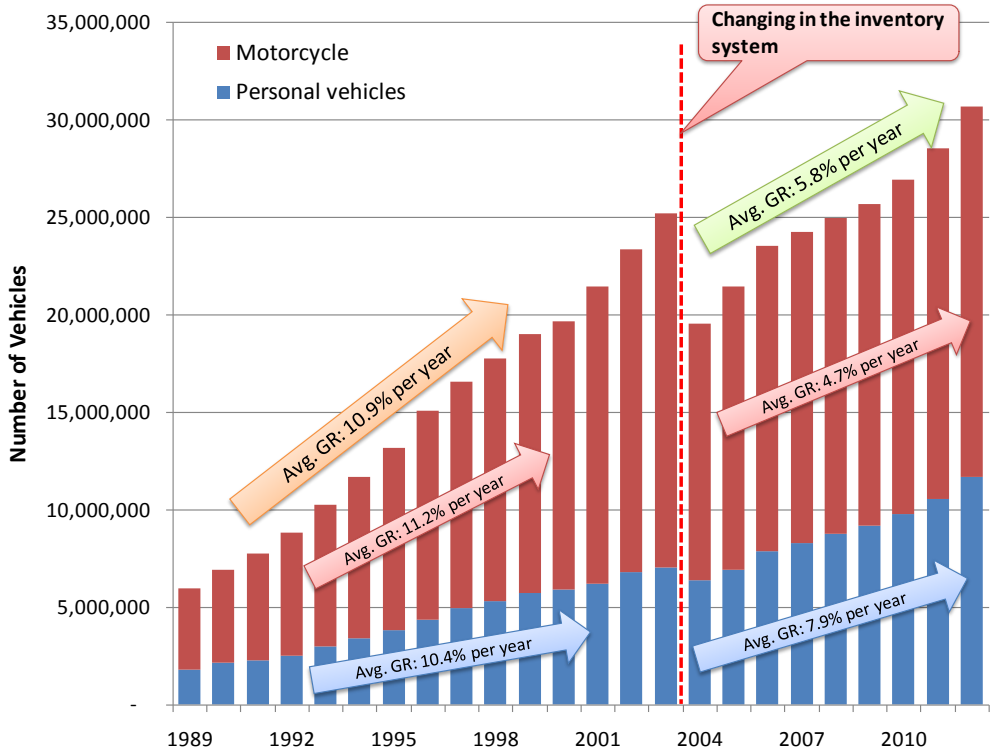


Figure 2.3, *Trend of number of motorcycles and passenger cars in the last 20 years*

Source: Pongthanaisawan and Sorapipatana, 2013

In order to predict the number of vehicles in the future, Pongthanaisawan (2011) developed a vehicle stock turnover model for Thailand. The model, based on the statistical data of energy consumption, calculated vehicle stock in each year by predicting vehicle sales and remaining vehicles in each year by using GDP and population, and the survival rate of each vehicle type as they age as parameters. The model can also simulate emissions from the road transport sector under different scenarios such as biodiesel and ethanol implementation measures.

As mentioned, there are also other parameters that affect travel and transport demand, such as population and GDP. As the population and economy grows, there will be a growth in activities and mobility of people and goods. Greater activity and mobility will contribute to the increase in the number of vehicle ownership and number of trips. Thus, population and GDP are often used as independent variables to predict transport activity or vehicle ownership.

From 1990-2010, the average GDP growth of the Thai economy was 4.5% annually and the transport sector contributed to around 10% of the total GDP (MOE, 2011). The National Institute of Development Administration together with the Office of the National Economic and Social Development Board (NESDB), and the Energy Policy and Planning Office (EPPO) expected that during 2010-2024, Thailand would have an annual economic growth rate of about 4.27%. For the transport sector, it is expected to have an annual growth rate of 3.69%. There is some uncertainty in these growth rate values since the NESDB recently made adjustments to the methodology used to calculate the GDP in Thailand.

As for population, in the last decade Thailand experienced an increase of 0.9% annually. Currently, the population of Thailand is approximately 63.5 million people. The population in the future, based on the data of National Statistical Office and Department of Provincial Administration, is expected to be 68 million people in 2020 with a growth rate at 0.5% annually.

Table 2.2, *Thailand's average freight cost by modes of transport (per TKT)*

Source: Sukmanop, 2013

Average Transportation Cost	
Road	Baht 1.72 / Ton-km.
Rail	Baht 0.93 / Ton-km.
Water	Baht 0.64 / Ton-km.

From Table 2.2 (Office of Transport and Traffic Policy and Planning, 2013), freight by road cost Baht 1.72/ton-km and was significantly higher than that of rail and water. According to the NESDB, the transport cost in the year 2009 was 0.75 trillion Baht accounting for 8.3% of GDP. The transport cost from the road sector was 0.39 trillion Baht. Full details of the logistic cost can be found in Figure VI-1 annex VI.

According to statistical data from the Transport statistics Sub-Division, Planning Division, Department of Land Transport, 5 million cars are used daily on the roads in Bangkok. However, according to the BMA, the actual road spaces are only 156 km2 which can service only 2 million cars. This means that the facilities in the Bangkok Metropolitan Area, which includes roads, pathways, bridges, flyovers, and public transport, are inadequate to accommodate all vehicles in the city.

2.3 Modal Split

Modal share (S) influences transportation energy use and GHG emissions because different travel modes have different emission rates. For example, human-powered transportation does not produce any direct emissions. There are multiple factors that play important roles in modal share. For example, income influences people's value of time and demand for speed, comfort, and privacy. This results in vehicle ownership, determined by the availability of different modes. Provision of transport infrastructure can affect the willingness to choose walking or cycling options. Moreover, availability and reliability of public transit systems can affect modal attractiveness (Zegras, 2007). Therefore, structural changes of transportation infrastructure will impact energy consumption and GHG emissions of a country significantly.

Modal share of passengers

Data on modal share by passenger-trips or passenger-kms in Thailand have not been found. Statistical data of modal share of passengers in the Bangkok Metropolitan Region in 2000 and 2011, measured in total number of passengers using a certain mode of transport in a given year, was collected by the Information and Communication Technology (ICT) Centre, Ministry of Transport (MOT, 2013).

This data is shown in Figure IV-7 in annex IV. It was found that the number of passengers significantly decreased, particularly passengers of buses from the Bangkok Mass Transit Authority (BMTA) and railway from the State Railway of Thailand (SRT). In contrast, the number of passengers of the electrified railway, such as the Bangkok Mass Transit System (BTS) and the Mass Rapid Transit Authority of Thailand (MRTA), has increased gradually. According to the OTP, people shift to use more private vehicles instead of public transport systems. It should be noted that the share of passengers of BMTA buses has been reduced largely, while shares of other public modes such as BTS and MRTA have become bigger. Travelling by airplane is also increasing in share. Figure IV-7 in annex IV shows the illustrated detail of modal share of passengers.

Modal share of freight

Road transport is the dominant mode of freight transport followed by water, rail and air transport. Figure IV-9 in annex IV shows comparison of shares of freight transport by modes in 2001 and 2011. Share of road transport has slightly decreased while the share of water transport has increased.

As shown in the OTP report in Figure 2.4, more than 85% of freight transport in Thailand was mainly shared by road while water and rail accounted for 12% and 2% respectively. This means that Thailand's freight sector relies heavily on road, which is the least cost effective among all modes. More detail of freight data from road and rail mode can be found in Table IV-1 and IV-2 Annex IV.

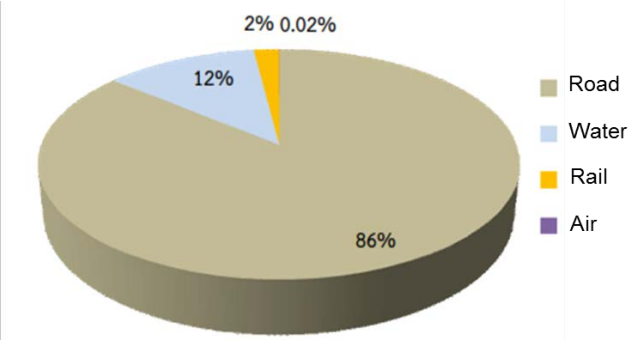


Figure 2.4, *Share of freight sector by mode*
Source: OTP, 2013

2.4 Energy Intensity

Fuel intensity (I) is the consumption of fuel per work such as passengers or goods moved. It depends on technological factors including engine type, technology and vehicle age. Driving conditions also affect fuel intensity.

Fuel economy of vehicles

Fuel economy is an average vehicle-distance travelled per unit of fuel used. It is generally presented in terms of vehicle-kilometre per litre. In developed countries such as the U.S.,

European countries, Japan and Korea, fuel economy data of new vehicles can be obtained from fuel economy or emissions standards program. With this program, all new models of vehicles have been tested with an appropriated standard driving cycle in order to pass a minimum fuel economy or emissions standard before getting certification to be sold in the market. For Thailand, only light-duty vehicles, such as private cars and pick-up trucks have been tested with the European driving cycle to pass pollution standards (Pongthanaisawan, 2011).

However, the fuel economy of existing vehicles also can be obtained from a survey. There were two studies: KMUTT (1997) and EPPO (2007), which surveyed data of on-road fuel economy. From the studies, Pongthanaisawan (2011) derived the fuel economy of all vehicle types for Thailand as shown in Table IV-5 in annex IV.

Many studies on fuel economy were conducted by governmental organisations and institutions but most of them were not publicly available due to the business confidentiality. However, a study from Pollution Control Department (PCD) was distributed to the public. The study was applied to the model in the Environmental Sustainable Transport Master Plan from the Ministry of Transport (OTP, 2012).

Fuel economy standards for motorcycles in Thailand are currently enforced under the Ministry of Industry. This industrial standard for energy efficiency of motorcycles was enforced since 28 January, 2014. More information about this can be found in annex VII.

Vehicle speed

Fuel intensity depends on other factors besides fuel economy such as speed and driving behaviour. In the Bangkok Metropolitan Region (BMR), the daily average travel speed is about 28.3 km/h (BMA, 2012) and is projected to reduce to 13.6 km/h by 2020. In order to estimate fuel consumption and emissions from vehicles in Bangkok, a study by the Ministry of Land, Infrastructure and Transport (MLIT) in Japan and Japan Transport Cooperation Association or JTCA (JTCA, 2004) was done in 2003 to develop driving cycles and emission factors for vehicles in Bangkok. Figure IV-10 in annex IV shows the average speeds of passenger cars and buses in Bangkok, which have been surveyed by the study.

2.5 Fuel emission factors

Fuel choice (F) influences GHG concentration in exhaust since the emissions differ by fuel type. Natural gas has different GHG emissions than diesel, gasoline, and other types of fuel. In the case of electric-powered transport electric vehicles, GHG emissions depend on the fuel sources for generating electricity, combustion technologies, and transmission and distribution losses.

Vehicle and fuel technology

There is a relationship between vehicle and fuel technology. Each type of vehicle can use multiple types of fuels as shown in Table IV-5 in annex IV. Recently, the DLT, Ministry of Transport has recorded the number of newly registered vehicles separately by fuel types as shown in Table V-5 in annex IV. This would be useful for tracking shares of vehicle and fuel technologies which affect fuel consumption and GHG emissions. Based on an energy end-use

model developed by Pongthanaisawan (2011), shares of vehicular fuel consumption are determined by fuel types and vehicle types are derived as shown below in Figure 2.5 and Figure V-2 in annex V, respectively.

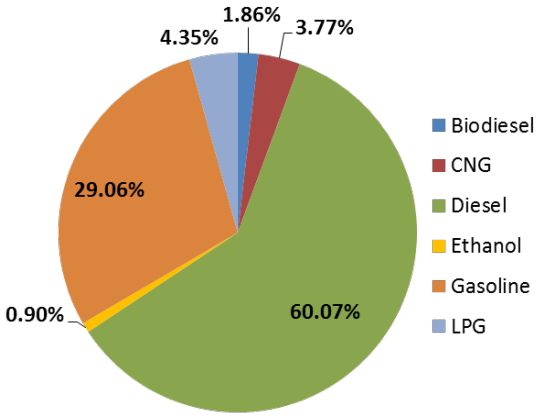


Figure 2.5, *Shares of vehicular fuel consumption by fuel type in 2008*

Source: Pongthanaisawan, 2011

Emission factors

Emission factors are important parameters to estimate emissions at the final stage. Emission factors are relatively dependent on each country due to different vehicle technologies, fuel characteristics, and driving characteristics. There were two comprehensive studies done by MLIT, Japan (JTCA, 2004) and the World Bank DIESEL project (ESMAP, 2009) that aimed to develop emission factors in Thailand. MLIT provides fuel economy data as well as emission factors. However, there is no data provided in the DIESEL report. Recently, based on data from previous studies, the Pollution Control Department (PCD) developed emission factors for different vehicle types, engine model year, fuel types and also calculated the CO_2 emission factors and fuel consumption. The examples and most updated emission factors by different speed and vehicle types are shown in Table V-1, V-2, V-3 in annex V.

Major emission pollutants at the tail pipe, such as carbon dioxide (CO_2), nitrogen oxide (NO_x), carbon monoxide (CO) and total hydrocarbons (THC) are collected and analysed by using approaches of the gas continuous sampling and the gas bag sampling. Particular matter (PM) is tested by using a filter while recording other conditions such as ambient temperature and relative humidity in the testing room. Then, fuel consumption can be calculated by using the concept of carbon balance as the equation below (see the equation V-1 in annex V).

Fuel economy, measured in km/litre, for different vehicle types can be used to calculate fuel consumption, if the VKT for different vehicle types is known. Besides the PCD laboratory, there are also other agencies that have their own testing laboratory for emissions, such as the Thailand Automotive Institute, under Ministry of Industry, and PTT Company. These may have fuel economy and emission data as well, although not necessarily in the public domain.

Currently, the necessity to mitigate climate change and local air pollutants is becoming increasingly important. The international society requires quantifying these emissions. Therefore it is important to develop vehicle emission factors. Countries within the EU, the US and Japan have developed driving cycles that reflect the actual driving patterns in their cities, and from using these driving cycles, they have done emission tests to develop vehicle emission factors for in-use vehicles. In Thailand, based on the Japan-funded project, the OTP had conducted a study to develop the Bangkok Driving Cycles with the support of the PCD, and continue vehicle emission tests and development of vehicle emission factors. The results of the updated driving cycles were applied in the Environmental Sustainable Transport Master Plan (OTP, 2012) for the planning of the policies and measures. It is necessary to update emission factors with the improvement of vehicle technologies. Also, it is important to update driving cycles if driving patterns in Thailand or Bangkok will significantly change in the future. Quantification of emissions enables policy makers to plan appropriate mitigation measures and to monitor and manage these measures.

2.6 Transport system indicators

Besides the transport data, other parameters should also be taken into consideration to make transport policies more effective and comprehensive. In this part, fuel price, logistic cost, and technology of the car fleet will be highlighted to give supplementary information for the decision of transport policy planning.

World Bank Indicators

Table 2.3, *2011 indicators for Thailand*

Source: World Bank, 2014

Indicator	Unit	Value 2011
Motor vehicle index	Vehicles/1000 capita	172 (375; 330*)
Transport energy use	koe/capita	306
CO_2	tCO_2/capita	0.88
Urbanisation	%	34.5

Note: * Other sources: ASEAN Strategic Transport Plan, 2010; Clean Air Asia, 2012

Fuel prices

Gasoline ULG 95, gasoline ULG91 and high speed diesel are the three main fuel types used for transportation in Thailand. Figure 2.6 below shows that from 1997 to 2007, the price of the three fuels gradually rose without great differences. However, the 2007 oil crisis resulted in a leap in fuel price. The Thai government decided to subsidise the price of diesel and since then it remained lower than 30 Baht/litre while the price of gasoline ULG 95 and ULG 91 continuously increased to 40 and 45 Baht (1.15 and 1.29 US dollar[3]) respectively. Another method that the Thai government used to overcome the oil crisis was mixing alcohol and palm oil into gasoline

[3]Exchange rate: 34.68 Baht/US dollar (DEDE, 2013)

and diesel. The historical data in Table V-4 annex V shows that E10, E20 and E85 was introduced in Thailand in 2007, 2008 and 2009 respectively. This method not only shows the government's intention to tackle the oil price crisis, but also serves as evidence of the government growing more concerned about energy security and alternative energy sources.

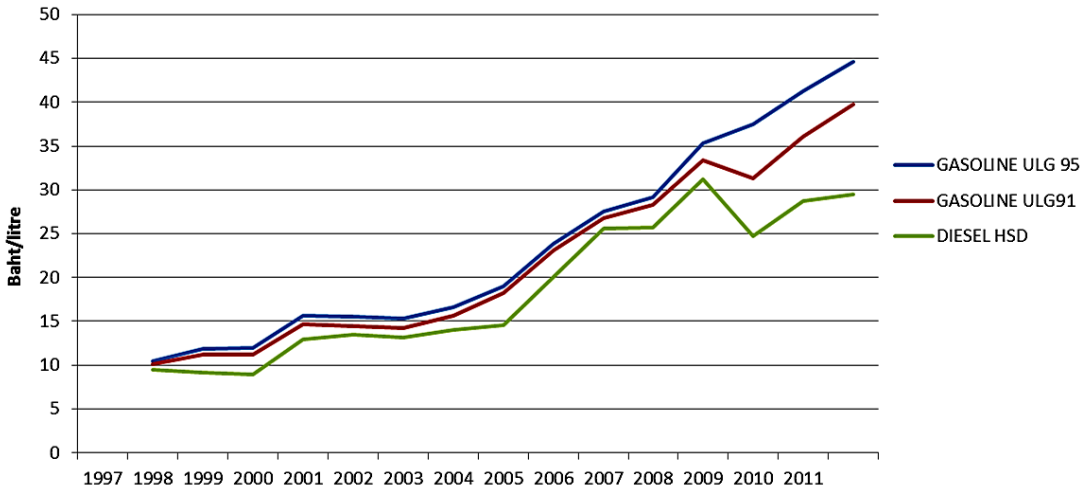


Figure 2.6, *Historical fuel price in Thailand during 1997 to 2011*

Source: EPPO, 2012

Fuel consumption

In the year 2012, energy consumption in transport was around 26,230 ktoe or 35.8% of the total energy consumption in the country. From Figure 2.7, the historical fuel consumption from the transport sector continuously increased during 1982 to 2012. There were two significant drops in fuel consumption in the year 1998 and 2008. The drop in the year 1998 was due to the impact of Asian financial crisis or "Tom Yum Goong" which affected the national economy. During the year 2008, the "oil price shock" impacted the price of energy. The highest price was at 140 US dollar/barrel of oil. This led to a decrease in demand as a result of anxiety from fuel consumers. However, once the oil price was stabilised in the range of 80-110 US dollar/barrel. The users finally adapted to the higher level and demand started picking up again.

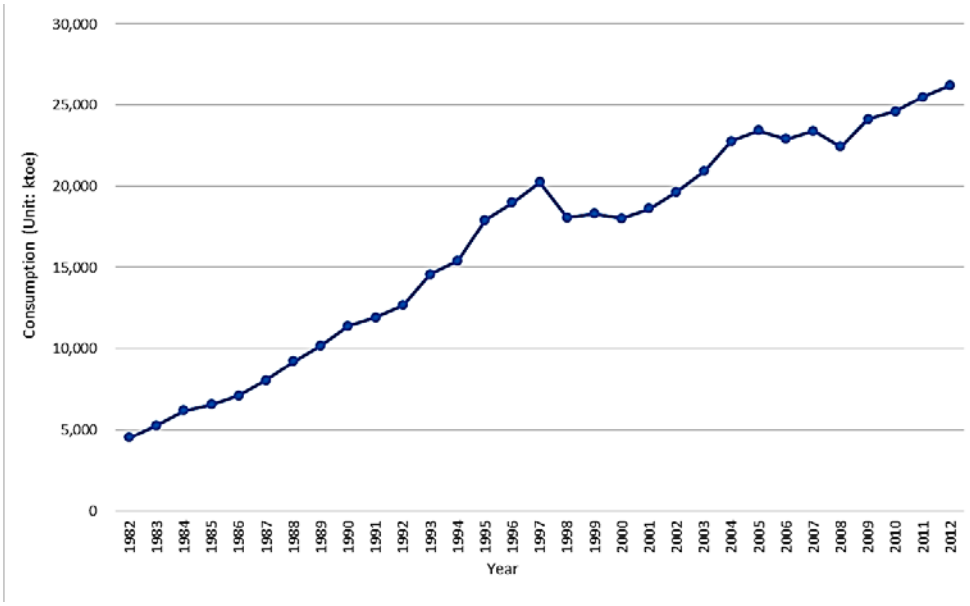


Figure 2.7, *Historical data of fuel consumption from transport sector during 1982-2012*

Source: DEDE, 2013

Logistics costs

Thailand's logistics costs comprises of three elements as shown if Figure 2.8. These include transportation costs, inventory holding costs and logistics administration costs. The main costs were derived from transportation and inventory holding, which accounted for 49% and 42% respectively, while logistic administration costs contributed to only 9% of the total costs. Road transport had the largest contribution of 52% to the total transportation costs as shown in Annex VI Table VI-1. In total, logistics costs summed up to 16.8% of the total GDP and a World Bank Logistics Index of 3.1 on a scale of 5. If improving energy efficiency in transport were to be pursued as a method to reduce the logistics cost, Thailand would have co-benefits in lower costs of production, higher GDP growth and a more sustainable environment. Detailed information can be found in Figure VI-1 in annex VI.

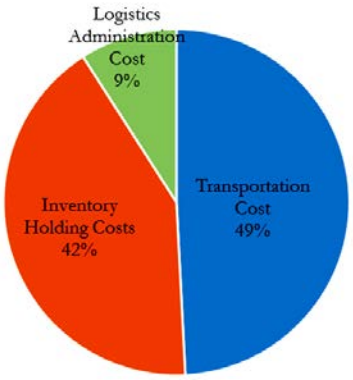


Figure 2.8, *Share of logistic cost in Thailand 2009*

Source: NESDB, 2010

Emission control technology of car fleet

Currently, more than 50% of 5 types of vehicles in Bangkok and area in the vicinity use the EURO III engine vehicle standard, except passenger cars with more than 7 seats, tricycles, and trucks, as shown in Table 2.4. At the country level, the EURO I standard engine accounted for more than half of the vehicle population, except for the passenger cars with no more than 7 seats. 48% of passenger cars at the country level were changed to EURO III standard. This means that the technology of the car fleet in Thailand still has some room to improve from the low tier standard (EURO I and EURO II) to the higher efficiency engine standard (EURO III or IV). However, there was an effort from the governmental sector to improve energy efficiency of the new vehicle engine standard. Since 1 January 2013, new passenger vehicles sold have to comply with EURO IV standards (TISI, 2012).

Table 2.4, *The ratio of vehicle according to EURO standard*

Source OTP, 2012

The Type of Vehicle	Bangkok and Vicinity areas			Country Level		
	EURO I	EURO II	EURO III	EURO I	EURO II	EURO III
Passenger cars (not more than 7 seats)	31%	17%	52%	36%	16%	48%
Passenger cars (more than 7 seats)	54%	12%	34%	68%	11%	21%
Pickup Cars	33%	17%	50%	52%	15%	34%
Motorcycles	13%	17%	70%			
Car Rental	6%	26%	68%			
Tricycle	84%	1%	15%			
Buses	38%	12%	50%	55%	18%	26%
Trucks	46%	20%	34%	51%	19%	30%

The type of fuels used by vehicles in Thailand can be seen in Figure 2.9 below from the 2013 Annual Report from the Department of Land Transport, Ministry of Transport. A total of 23,993,768 vehicles using gasoline accounted for 70% of all vehicles in Thailand, followed by vehicles using diesel accounting for 25% of the total. More detailed information can be found in Figure V-2 in annex V.

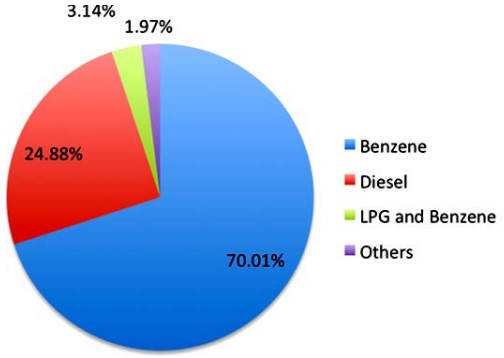


Figure 2.9, *Fuel split by number of vehicles of all vehicles in Thailand in 2013*

Source: DLT, 2013

3. Policies and Institutions

The transport sector in Thailand has recently given attention to climate change issues. An estimate of GHG emissions from the transport sector initially indicated the importance of climate change measures in the sector. Significant consideration did not take place until recent years where the national policy direction on climate change led the transport policy in this regard.

3.1 Climate change policy and legal framework

As of August 2014, the draft of the draft Climate Change Master Plan for the year 2013-2050 has been prepared and should be endorsed by the government within 2014. The Ministry of Natural Resources and Environment (MNRE) is the focal point of the climate change policy in Thailand and other ministries such as Ministry of Transport (MOT), Ministry of Energy (MOE) and Ministry of Agriculture (MOA) are also responsible for climate change related policies within their fields of work. GHG reduction is one of the three main strategies in the draft Climate Change Master Plan (ONEP, 2013), along with climate change adaptation and capacity building for the government officials. Thailand aims to reduce GHG emissions in the energy (including electricity, industry, building and waste) and transport sectors between 7-20% in the year 2020 compared to the BAU case (ONEP, 2013). The transport sector is concerned as part of the GHG reduction strategy.

Since the draft Climate Change Master Plan will be endorsed in the near future, the Thai Government is preparing to pledge the GHG emission reduction target to the UNFCCC at COP20. Moreover, the studies of potential national appropriate mitigation actions (NAMA), MRV, and mitigation scenario have been initiated already.

Three measures of GHG reduction included in the draft Climate Change Master Plan (ONEP, 2013) within the transport sector are:

- Efficiency improvement in passenger and freight transport
  - This includes creating incentives towards energy efficient vehicles, setting up fuel economy standards and car labeling, improving the efficiency of the logistic system.
- High efficiency and low carbon transport infrastructure development
  - This includes developing urban transport systems to be more comprehensive and well connected, promoting NMT, land use zoning and transit-oriented development.
- Travel demand management
  - This includes modal shift and reduction of travel demand.

NAMAs and MRV are mentioned in the draft master plan as a mechanism to support low carbon development and studies of potential NAMAs and MRV have been initiated. Mitigation scenarios have also been provided by the MOE. Additionally, the Thai government is preparing to pledge the GHG emission reduction target to the UNFCCC at COP20.

3.2 Institutional structure

The Ministry of Transport is solely responsible for developing transport policy, but the implementation can be done at inter-ministerial levels. The process of developing transport

policies follows the process of policy and plan making. The policy can be drawn from policy makers as well as comprehensive consideration and policy recommendations through studies and reports. The direction of the policies from the MOT is focused on construction and infrastructure plans, which will lead to multi-modal transport. Other issues like fuel economy, alternative fuels are also included in transport policy but the Ministry of Energy is the organisation responsible for those issues. Other ministries are also involved in certain transport policies, as shown in Figure 3.1.

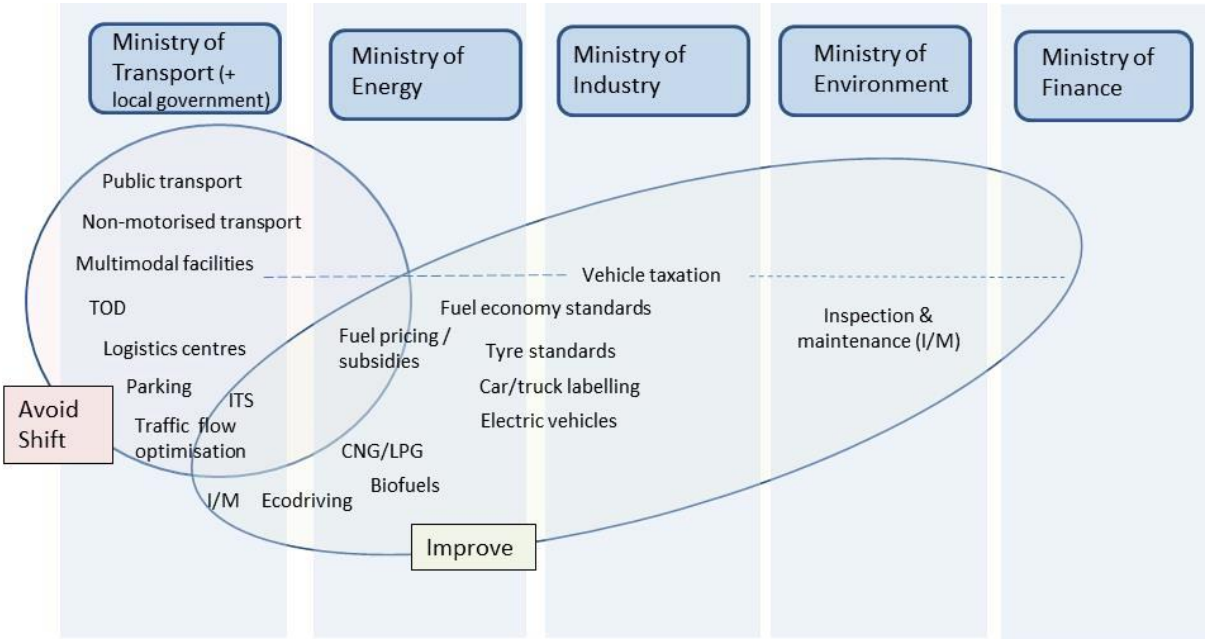


Figure 3.1, *Overview of responsibilities for transport policymaking*

Source: Authors

The Office of Transport and Traffic Policy and Planning (OTP) is the planning office of the Ministry of Transport. The OTP has developed several national transport policies and plans. Some key transport plans includes:

- National Transport Master Plan: the current one is for the years 2011-2020 (OTP, 2011)
- Environmental Sustainable Transport Master Plan (OTP, 2012)

The National Transport Master Plan (2011-2020) was developed by the OTP under a contract to consultant joint ventures. The plan started from collecting internal and external factors. A SWOT analysis of Thailand's transport sector was carried out and then scenarios of transport by all modes were drawn and the vision and objectives of transport system development were created. This Master Plan considered all modes of transport and thus each mode also developed its Modal Master Plan. The draft of the Master Plan was brought into discussion with stakeholders. A series of seminars and workshops were carried out to ensure the transparency and completeness of the plan. Finally the Master Plan was adopted and reported to the government.

The Environmental Sustainable Transport Master Plan (OTP, 2012) was also developed by the OTP. The intention of the plan was to specifically address greenhouse gas reduction as the objective of the plan. The plan was developed using a similar technique for developing strategic master plans. The process started from a SWOT analysis, scenario analysis, identifying the vision, mission, and objectives strategies, and finally a master plan and budget plan. During the alternative selection, scenarios were built and analysed by applying the transport model mentioned in section 3.5. The final set of alternatives was selected by expert judgment. Planned projects by the Ministry of Transport under the selected scenarios were analysed to yield the calculated GHG reductions.

At the time when the Master Plan for developing a Sustainable Transport System and Reducing Climate Change was developed, the National Transport Master Plan was already developed and adopted. Thus, the list of transport system development was brought into consideration. The Environmental Sustainable Transport Master Plan (OTP, 2012) seeks additional policies, measures, and projects that could enable the reduction in GHG emissions. However, not all projects listed in the Master plan were considered in the economic analysis. The study projects did not perform cost effective analysis and only operational projects were analysed by a cost-benefit analysis. It is noted that the benefits from sustainable transport operating projects were estimated from lessons learned and best practices around the world. The master plan is meant to be the determinant of policy decision. In the plan making process the consideration is made by all stakeholders. To complete the plan, the MOT invited all relevant stakeholders into the development process of the master plan. This plan will be used to guide Thailand towards reducing GHG emissions in the transport sector. It should be noted that it is a transport-oriented plan in the sense that includes no energy-efficiency or alternative energy policies. Ministry of Energy (MOE) also pays attention to energy consumption in transport sector and its impact. They consider the greenhouse gas as an output from transport sector. Ministry of Energy developed a Master Plan called National Energy Efficiency Plan or 20-years Energy Efficiency Plan (EE Plan) to consider the roadmap for Thailand towards more efficient energy use. Transport is one of the sectors that use a lot of energy and have room for energy efficiency improvement. In the plan, three groups of measures were proposed; 1) Improve fuel efficiency of vehicles, 2) More energy-efficient travel by mode shifts, and 3) Transport Demand Management (TDM) Section 3.3 goes into more detail on existing policies and plans. Apart from the Ministry of Transport, several organizations are also involved in policies in the transport sector as long as those policies fall under their authority. For example, the Bangkok Metropolitan Administration considers the measures to reduce GHG emissions from transport. Several measures within its capacity and authority are introduced. The excise department in the Ministry of Finance introduced a car tax scheme based on carbon emissions. Figure 3.2 gives an overview of how the different strategies are related.

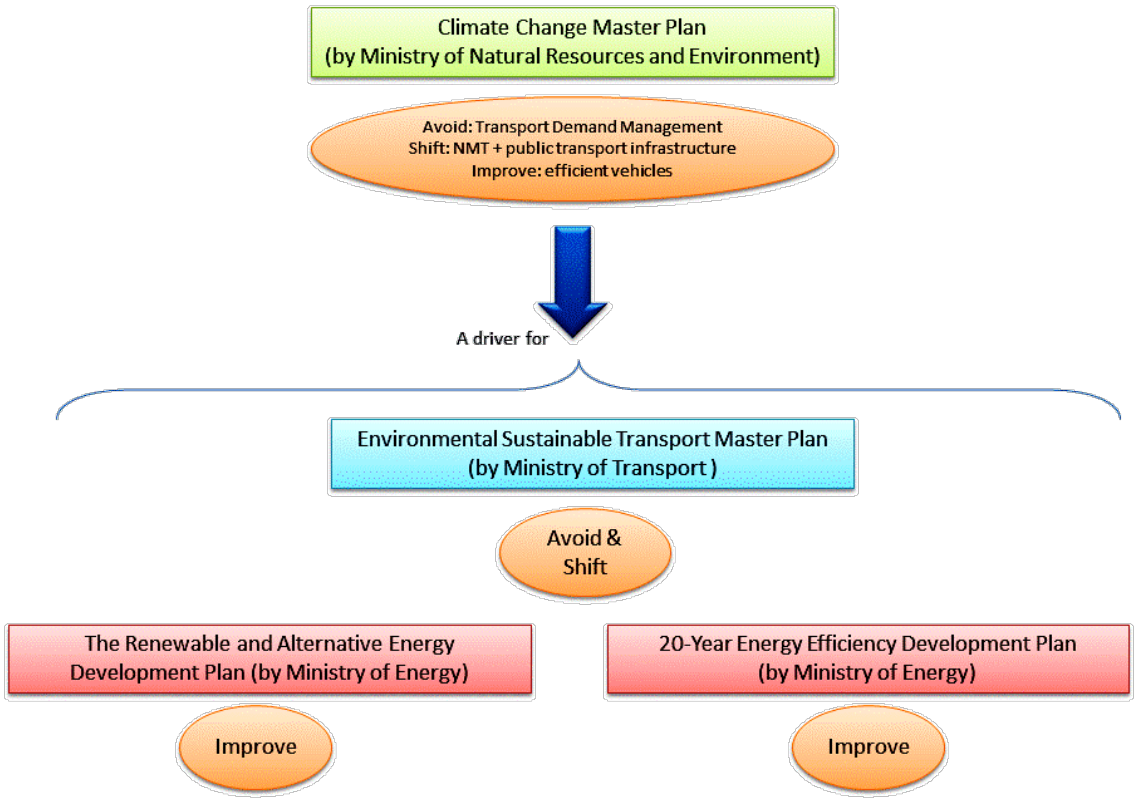


Figure 3.2, *Ttransport and climate change related strategies*

Source: Authors

3.3 Existing policies

Parts 3.1 and 3.2 reveal that many line ministries such as the MOT, the MNRE and the MOE are involved in the conjoined topic of transport and climate change. Being addressed by many organisations, studies and policies are dispersed even though synergies between those ministries exist at a certain level. This section aims to provide all the existing transport related policies and their current status. Two tables below were extracted from the full policy table in Table IX-1 in annex IX. The tables below separately present policies for passenger and freight transport in Tables 3.1 and 3.2 respectively. Each table categorises policy types into avoid (A), shift (S), improve (I) and general (G). Table 3.1 shows that most passenger policies are focused on infrastructure which are mostly financed by the 3 trillion Baht project (see annex VIII) while Table 3.2 shows that freight policies are focusing on improvement.

Table 3.1, *Passenger transport policies and measures: status as of mid-2014*

	Existing and enforced policies /measures	Implementation Status	Remarks
A	Transit-oriented development	Partially implemented	The TOD concept has been used for the design of new urban rail transit stations.
	Intelligent transport systems	Partially implemented	In 2013, the MOT drafted a plan to adopt ITS for relieving traffic congestion.
S – incentives / regulation/ information	Low prices for some public transport options	Implemented	From 2008, the government announced free selected buses in Bangkok and trains throughout the country. BRT reduced fare to attract more riders.
	Cycling campaigns	Ongoing, Planned	Several organizations made campaigns for reducing solo car usage, and promote public transport usage
	Integrated ticketing for public transport	Implementation	A common electronic ticket is planned for major public transport in Bangkok. A single ticket can be used on most public transport.
S - infrastructure	High-speed rail	Planned and cancelled	High-speed rail is intended on 4 routes covering 1,500 km. (This plan was cancelled in March 2014.[1])
	Improvement of intra-urban rail	Planned	Existing railway is subject to be improved; doubling tracks, provision of train units, train interior and service improvement.
	MRT (mostly planned)	Partially implemented	Urban rail transit network is planned in Bangkok. Twelve lines of PT have the total length of 467 km.
	Walking (partially)	Partially implemented	Walking paths and PT supported facilities are a regulation for building and public utilities code. In the 2000s, there was an attempt to revise the building code PT promotion.
	Bike sharing Bangkok	Partially implemented	Bike sharing introduced in downtown Bangkok through "Punpun" project. There are currently 50 stations (planned 1000) with a total 500 bicycles.
	Park-and-ride	Partially implemented	Park and Ride facilities are planned and constructed at many urban rail transit stations. Existing park and ride facilities attract rail usage.
	Cycling lanes	Partially implemented	Bike lanes were introduced on some streets in Bangkok and other cities. Moreover, the Government Cabinet acknowledged the resolution on Systems and Structures for Promotion of Walking and Cycling in Daily Life.
I - efficiency	Tax incentives for efficient vehicles	Partially implemented	The eco-car scheme will be a key driver supporting Thailand's goal to produce 3 million cars by 2017[2]. The vehicles have tax incentive and result in low purchase prices.
	Car labelling (planned)	Planned	In 2006, EPPO studied the fuel efficient label. Currently, the Excise Department has studied the car labelling indicating the fuel efficiency and/or CO_2 emissions.
	Fuel efficiency standards	Partially implemented	A standard setting for fuel economies of vehicles such as motorcycles was enforced in 2014.

	Existing and enforced policies /measures	Implementation Status	Remarks
			Standards for other types of vehicles are going to be developed.
	Efficient tyres	Not intended in near future	
I - operation	Real-time traffic information (Bangkok)	Implemented	Information about bus routes can be reached from internet and mobile devices. The next generation of buses will have bus tracking, which could allow better transit management and traveller information.
	Traffic flow improvement (partially)	Partially implemented	Traffic control is installed by municipalities, and traffic control is operated by traffic police. Currently, 6 cities have this urban traffic control (UTC).
	Inspection and maintenance	Implemented	Private vehicle inspection tests vehicle safety, and emission (CO, HC) after 7 years of purchase. Public transport vehicles and taxis are inspected twice a year.
I - fuel	Incentives for electric vehicles and two-wheelers	Partially implemented	Currently the Thai government does not have any policy to support nationwide electric vehicle or two-wheeler production and sales. Six charging stations exist in Bangkok and its vicinities.
	Standards for biofuels	Implemented + planned	The Alternative Energy Development Plan (AEDP 2012-2021) has a new consumption target for ethanol, biodiesel, and new fuels for diesel substitution at 9 million liters/day, 5.97 million liters/day, and 25 million liters/day respectively.
	CNG/LPG for taxis and buses	Partially implemented	
	CO_2 based taxation for new vehicles	Planned	New excise tax for passenger cars, vans, and pick-up trucks will be based on CO_2 emissions. The range of the tax has changed from 17%-50% to 10%-50%.
G	Fuel price reform	Studied	The government fixed the LPG for domestic use at 18.13 Baht, diesel at 29.99 Baht. Within 2013, the price of LPG for transport sector will gradually increase to reflect the cost of production.

Note: A: avoid; S: shift; I: improve; G: general

[1] *What's new in business news: March 12, 2014* (Bangkok Post, 2014)

[2] *10 companies sign up for eco-car plan* (Bangkok Post, 2014)

Table 3.2, *Freight transport policies and measures: current status*

	Existing and enforced policies /measures	Implementation Status	Remarks
A	Intelligence Transport system (ITS)	Planned.	Same as Table 3.1
	Empty hauling reduction	Partly implemented	DLT opened Thai truck centre website to promote customers matching with empty haul. FTI also promotes business cooperation and matching empty hauling among their alliance.
	Improve logistics centres and their location	Planned	Currently three truck terminals are around the Bangkok area. The DLT has a plan to construct 15 more logistics centres throughout the country.
S –regulation	Lorry restrictions	Implemented	Heavy trucks (lorry) are not prohibited in Bangkok city during 6:00-21:00. Six-wheeled trucks are prohibited during 6:00-9:00 am and 4:00-8:00 pm.
S - infrastructure	Master planning for rail and water	Planned	A part of Vision Thailand 2030 Transport infrastructure development plan includes regular train with double tracks, high speed trains, and urban rail transit. The water transport focuses on the river and coastal transport (port construction).
	Multimodal facilities/dry ports	Partly Implemented	Inland Container Depot (ICD) is situated between Bangkok city and a major port/airport.. ICD serves customs and quarantines, and can accommodate 1 million TEUs.
I-efficiency	Tax incentives for efficient vehicles	Studied	
	Import restriction for inefficient vehicles	Not intended in the near future	
	Fuel economy/ emission standard	Not intended in the near future	
I-operation	Vehicle scrapping/fleet replacement	Not intended in the near future	
	Inspection and maintenance	Implemented	Motorcycles, taxis, and other vehicles under the Motor Vehicle Act are inspected by the DLT at private inspection stations.
	Speed limits/management	Implemented	Same as Table 3.1
	Eco driving	Partly Implemented (Pilot)	The institute of industrial energy promotes efficient use of energy in transport sector. The promotion includes incentive on energy efficient equipment, assistance on logistics operation management, training on fuel-saving driving, backhaul management. The pilot project has been implemented for 2 phases. 100 freight companies participated in each phase.
	Traffic control/ traffic flow improvement	Partly Implemented	Same as Table 3.1
	Tyre standards	Not intended in the near future	
	Aerodynamics standards	Not intended in the near future	
I-fuel	Low carbon fuel (1st/2nd gen Biofuel, CNG, LPG) incentives	Partially implemented	Same as Table 3.1
G	Fuel subsidy reduction	Not Intended	Same as Table 3.1
	Inspection and maintenance	Implemented	Same as Table 3.1

3.4 Financial structure

National government organizations require funds from the national budget. The budget plans have been developed and approved by the cabinet. The MOE is one of the sources of funding for energy conservation, which includes energy efficiency in the transport sector. Sources of funding came from the Energy Conservation Promotion (ENCON) fund, government budget, and investment of the private sector. The ENCON fund functions to provide grants and subsidies for the operation of energy conservation programs for both governmental and private organisations. The fund would support three programmes, which are the energy efficiency improvement programme, the renewable energy development programme and the strategic management programme. The fund is also available for research, studies, and capacity building. The Ministry of Energy targets to reduce energy intensity by 25% within 2030 comparing to the 2010 level by implementing the 20-year Energy Efficiency Development Plan (EEDP)[4]. 2,289 million Baht will be put into the transport sector to achieve the 15,323 ktoe energy saving under EEDP. The ENCON fund it is now in the 4th phase (2012-2016). For the transport sector, this program will only be applicable for projects that focus on the pilot demonstration and research study. There will be a budget of 7,000 million Baht/year from the government during 2012-2016 for supporting the ENCON fund. If any projects want to apply for the fund, they should comply with the above-mentioned three programmes of the ENCON fund or green growth plan.

Local governments such as Bangkok city, Pattaya, and municipalities have their own budget that comes from both the national budget allocation and their own revenue. The local governments have authority in several transport matters within their own jurisdiction. For example, the investment of road infrastructure in their areas can be done by the local government.

The private sector is responsible for investing in their private operations. The logistics sector is a good example in that all companies operate their business with their own expenses. The private sector can become involved in infrastructure development through a public-private partnership (PPP). The new laws have just passed recently to regulate and promote the joint venture between the government and private sector.

Thailand aims to become the regional logistic hub and has come up with the 2.2 trillion Baht Borrowing Bill. The main objective is to improve and construct transport infrastructure within Thailand through double tracks rail systems, high-speed trains, multimodal facilities, and dry ports. More details can be found in Annex VIII.

3.5 Monitoring

A standardised and comprehensive system for monitoring climate change policy has not yet been established. For the transport sector, the OTP developed the Environmental Sustainable Transport Master Plan (OTP, 2012) aiming to specifically reduce the GHG emissions in the transport sector. Besides the Environmental Sustainable Transport Master Plan (OTP, 2012), one environmental and three other main national energy plans have targets to reduce energy consumption and to diversify to low-carbon energy sources and also lead to CO_2 emissions

[4] Ministry of Energy (MOE) is recently assigned to revise three policies strategic plans which are i) Thailand 20-Year Energy Efficiency Development Plan (EE), ii) The Renewable and Alternative Energy Development Plan (AEDP) and iii) Power Development Plan (PDP).

reductions in the future. Those plans are the National Master Plan on Climate Change Mitigation by the Office of Natural Resources and Environmental Policy and Planning (ONEP), the Alternative Energy Development Plan (AEDP), the Energy Efficiency Development Plan (EEDP), and the Power Development Plan (PDP). Each of those master plans will be individually monitored by each line ministry.

A single agency responsible for developing MRV systems does not currently exist. However, MRV systems have been discussed along with Thailand's NAMAs for several years. Main organizations, such as ONEP, TGO, DEDE and OTP have recently cooperated and tried to see how much CO_2 emissions can be pledged with possible NAMAs and to propose MRV systems for some measures and projects, mainly based on clean development mechanism methodologies. There is also another attempt at trying to develop MRV systems in the transport sector to support a Bilateral Offset Credit Mechanism (BOCM), which was initiated by Japan. However, it is still in an initial phase and the agreement has not yet been signed by Thailand and Japan as of mid-2014. Therefore, a development of a monitoring system for assessing climate change policies is crucially important, since a national plan on climate change has been under development and GHG emission reduction targets will likely to be pledged in the short term since it has been progressively discussed among related organizations. Table 3.3 describes the current status of the monitory system of each type of policy related to transport in Thailand.

Table 3.3, *Current status of monitoring system for each group of policy in Thailand*

	Current approach	Data availability	Modelling capacity
Energy efficiency (passenger)	Currently, there is no responsible agency to monitor indicators such as fuel economies of new and on-road vehicles, energy efficiency development in passenger transport and occupancy rates. Survey studies will be done once such data are needed.	There is no regularly recorded data of fuel economies of new vehicles and survey data of on-road vehicles. It is possible to authorize the DLT to record more data which is important to monitor energy efficiency, such as fuel economy, annual vehicle kilometre-travelled (VKT) which can be recorded together with an annual registration process.	Development of an energy efficiency improvement tracking model has been starting to be developed. An energy demand end-use model for the transport sector was developed by Pongthanaisawan (2011). However, those studies have limitation of reliable data and budget to conduct covered survey.
Energy efficiency (freight)	There is no official indicator to monitor energy efficiency of freight transport. However, there have been some recent studies that calculate energy intensities (energy consumed for a unit of transport, i.e, ton-kilometre travelled) by trucks transport, e.g. Chollacoop et al (2010). This indicator should be officially recorded and monitored by a government agency.	Some data of energy intensities by trucks can be obtained from research projects. See Chollacoop et al (2010).	Energy efficiency indicators should be included into transport and logistic models which are in-use in related organizations, e.g., eBUM (Extended Bangkok Urban Model) and NAM (National Area Model) models of OTP.
Urban transport including public transport, NMT, land-use policies, etc.	Distance per trip and share of trips categorized by travel modes for a particular city are important indictors to assess the efficiency of transport systems and urban land-use planning. There is no responsible agency to collect and monitor these indicators.	Most cities do not have official information of modal share. Some information of traffic and transport situation of regional cities might be derived from the traffic and transport master plan studies done by the OTP. At the present, the OTP has studied the traffic and transport master plan for regional cities for some provinces already. In each study, the traffic and transport status will be conducted and the	CUBE software package were applied for the transport demand forecasting, developed for the traffic and transport master plan studies of OTP. Although these models are based on 4-step model (i.e., trip generation, distribution, modal split, and assignment), however these models should be standardised and knowledge of model utilization should be transferred to local urban planner and engineers.

	Current approach	Data availability	Modelling capacity
		traffic and transport model are usually developed to forecast travelling demand. In order to develop the model, home interview survey to grasp detailed data of travelling of each person in a selected household will be conducted. Hence, some indicators can be derived from this kind of the study.	
Modal shift in non-urban transport	Share of travel modes between cities is normally not available. Modal share of non-urban transport between cities can be derived e.g. from household interviews.	There is data of traffic flow on highways connecting between cities which are categorized by vehicle types. This data can be used to present modal shift for non-urban transport.	Know-how of regional transport modeling is needed to deal with inter-city travelling.
Modal shift in freight	Share of goods movement (i.e., tonne-kilometre travelled) by transport modes is an important indicator to represent the efficiency of transport and logistics systems. However, data of modal share in volume unit (tonne) only is more reliable, since data of origin-destination of goods transport is rarely recorded. There is no officially responsible agency to monitor this indicator.	Data of freight by transport modes is collected by the Ministry of Transport and some information can be obtained from logistic studies by the OTP. Also, this data perhaps is derived from OTP's model.	Modelling skills with integration of multi-modal transport for freight is needed for comprehensive planning and monitoring.
Fiscal policies, e.g. fuel /vehicle taxes	There are several types of taxes which have been levied, e.g., excise taxes for different types of vehicle and fuel taxes. There will be new excise tax rates for vehicles based on CO_2 emission levels in 2015.	Information of taxes can be obtained from Department of Revenue.	Fiscal policies can be evaluated by a comprehensive energy end-use model which can deal with types of vehicles and fuel consumption which is necessary to develop.

3.6 Scenario development

As of now, the marginal abatement cost (MAC) of the transport sector is available only for the usage of 1st and 2nd generation biodiesel. For other sustainable transport policies, it is difficult to estimate their MAC. The current emission scenario of sustainable transport policies was simulated based on the Extended Bangkok Urban Model (eBUM) and the National Area Model (NAM) developed by the OTP. Those two models were adapted from the four steps model and data from Thailand was applied. It was estimated that if there were no sustainable transport policies implemented, the baseline of GHG emissions from the transport sector would be approximately 102 Mt CO_2 in the year 2030. According to the Environmental Sustainable Transport Master Plan (OTP, 2012), 120 measures or policies regarding sustainable transport were proposed to reduce the GHG emissions from the transport sector. 55 out of 120 of those policies need international financial support. Accordingly, the possible scenario of sustainable transport policies could help reduce the GHG emissions to 74 Mt CO_2 in 2030 if all of those policies can be implemented as shown in Figure 3.1.

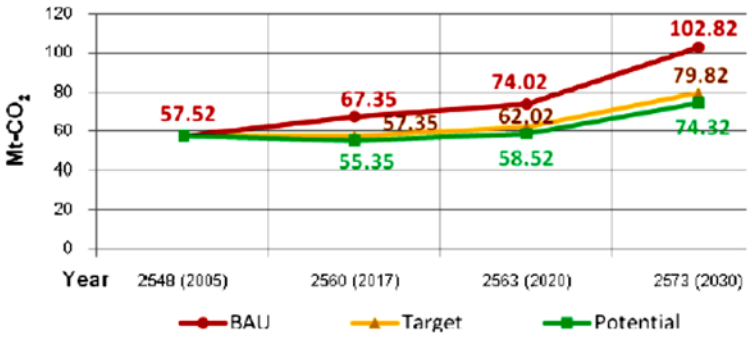


Figure 3.3, *GHG emissions baseline and scenarios of transport sector*

Source: OTP, 2012

4. Sustainable transport barriers

The review on current transport policies addressing sustainable transport and climate change reveals several points of considerations:

1. Financial barriers: The development of transport policies does not take account of some major constraints. For example, the Thailand Transport Infrastructure Development Strategy (2013-2020) describes what investments should be made to accomplish the economic growth objective and achieve mode shift, connectivity, and mobility. The source of investment budget, project details, and capacity, such as human, technical, and organizational resources, are not considered thoroughly. Thus, it is not ensured during the policy and plan development that the plan can be realized in practice. Most of the policy making process does not take the financial constraints into consideration. As a result, during the implementation the actual allocated budget is consistently less than what is in the plan.

2. Existing transport policies and plans describe mainly what to do. Although suitable projects are listed, there is not a strong mechanism to ensure that the plans can actually be realized. Many projects are not actually implemented according to the plan. There is no mechanism to monitor if the plan is strictly followed.

3. Many good operational and regulation measures are not implemented as these measures have some resistance or are difficult to implement. As a result, most of the implemented projects and measures are focused on transport infrastructure development. Perhaps, this is partly due to the organizational structure of existing agencies that do not include some initiatives or are not directly responsible. For example, under Ministry of Transport, the Sustainable Transport matter is under the safety division.

4. The monitoring of the transport system lacks some key data. The monitoring of the transport system performances and impacts including GHG emissions is not fully carried out. Basic data such as vehicle-kilometre of travel and modal split are not recorded.

5. Inter-ministerial cooperation and private-public cooperation are not strong. As a result, the implementation, which requires the pooled effort from several authorities, is not done successfully. The Ministry of Transport and Ministry of Energy and Ministry of Natural Resource and Environment do not develop policies together. Thus, the plan and implementation by the three ministries are fragmented. This raises questions regarding the lack of cooperation and if this results in conflicting policies that are not directed related towards sustainable transport.

5. Stakeholders

This section details the key parties in sustainable transport development in Thailand. The overview of roles and responsibilities of each organisation are listed in order to describe their roles in sustainable transport. Some sustainable transport activities or projects are exemplified to show which areas of sustainable transport development are active.

5.1 Key organisations

There are many organisations currently involved with the plans and projects in the area of land transport in Thailand. Types of organisations vary from governmental, public, academic to private sector and international support. This part will name such organisations, categorize them and provide details on their roles in the area of sustainable land transport.

- **Governmental organisations**: Necessary policies and plans for sustainable transport at the national level need to be enforced by the governmental side. In Thailand, it requires inter-ministerial cooperation among the Ministry of Natural Resources and Environment (MONRE), the Ministry of Transport (MOT), the Ministry of Industry (MOI), and the Ministry of Energy (MOE).
- **Public organisations**: Transport and climate change related public organisations in Thailand are mostly autonomous organisations. They play key roles in supporting and implementing those plans and polices at the practical level.
- **Academic and grant institutions for transport research**: Research and development is another crucial factor for the development of sustainable transport policies and plans. Studies in the transport sector have been carried out with the financial support from grant institutions during recent years for researchers in Thailand. The key funding organisations for the transport researches are shown below.
- **Private sector**: This sector is key to putting the policies and plans into practice.
- **International donors and development agencies**: International support and cooperation is highly vital to the development of sustainable transport. Various international donors offer financial and technical support to Thailand to tackle the crucial problems in the transport sector. International organizations are currently implementing sustainable transport projects and programmes as of 2013.

Without claiming comprehensiveness, details of the stakeholders in the transport sector can be found in Table X-1 Annex X.

5.2 Donors

International support is provided for Thailand in the form of funds and technical cooperation. In the land transport sector, most of the key international organisations are running their projects to assist Thailand with the development of the sustainable transport policies, plans, and projects as of 2013. Key donors are presented in Table 5.1 and Table 5.2.

Table 5.1, *Donor activities on transport policies:*

	Passenger			Freight		
	Org	**Activities**	**Website**	**Org**	**Activities**	**Website**
Travel Demand Management/ Modal shift	JICA:	Capacity development on climate change mitigation, granting soft loans for transport projects e.g. Mass Transit System in Bangkok	http://www.jica.go.jp/thailand			
	World Bank:	▪ Providing loan for "The Thailand Highways Management Project" giving financial support for the lane widening of five national highways ▪ Running the "Chiang Mai Sustainable Urban Transport Project" with the focus on climate change, municipal governance and institution building and regulation and competition policy TDM.	http://www.worldbank.org/en/country/thailand http://www.worldbank.org/projects/P121162/chiang-mai-sustainable-urban-transport-project?lang=en			
Energy efficiency	EU:	Capacity development on renewable energy (RE) and	http://eeas.europa.eu/delegations/thailand/documents	ADB, ADB/	Implementing "Green Freight Initiative" project with three	Website: http://www.adb.org/countries/gms/s

	Passenger			Freight		
	Org	**Activities**	**Website**	**Org**	**Activities**	**Website**
		energy efficiency (EE), Granting projects dealing with sustainable improvement of road traffic safety, Establishing EU-Asia road safety centre.	/thailande_eu_coop/project_fiche_255738_en.pdf	GMS:	main scopes: financial programme for freight SME, training for eco-driving, reduction of empty haul trip focusing on infrastructure development, climate change/energy efficiency and cross border transport between countries in the sub-region.	ector-activities/transport
	GIZ:	Provides technical assistance for transport policies, NAMAs in Thailand	http://www.transportandclimatechange.org	GIZ:	To provide technical assistance for transport policies, NAMAs in Thailand	http://www.transportandclimatechange.org
	USAID/RDMA:	Funding the Low Emissions Asian Development (LEAD) Program with the focus on financing mechanisms for GHG mitigation measures in the energy sector	http://lowemissionsasia.org			
	UNDP:	Running the project "Thailand's Low Emission Capacity Building (LECB):	http://www.undp.org/content/undp/en/home/ourwork/environmentandenergy/focus_areas/climate_strategies/undp_projects_thatcontributetogreenlecrds/national_sub-nationalstrategies/low_emission_capacitybuildingprogramme.html			
Fuel switch	IGES:	Previous research	http://www.iges.or.jp/en/r			

	Passenger			Freight		
	Org	**Activities**	**Website**	**Org**	**Activities**	**Website**
		programme focusing on Biofuels, providing capacity building and support research involving environmental issues, next phase focusing on climate and energy including NAMAs and MRV	esearch/index.html			

Table 5.2, *Donor activity on monitoring of policies:*

	Passenger	**Freight**
Transport Demand Management (TDM)	EU: ▪ Focusing on establishing of MRV system for climate change action	-
Modal shift	-	-
Energy efficiency	GIZ: ▪ Support for the development of a sectorial MRV system to monitor changes of transport activities and energy consumption in the land transport sector	GIZ: ▪ The scope will be decided ADB-GMS: ▪ MRV for the NAMAs in freight sector ▪ Monitoring of energy efficiency measures in trucks

Note: ***UNDP** is making inventory of transport sector in Thailand under the project "Thailand's Low Emission Capacity Building (LECB).

6. Need for action

According to the information presented from this report, there is much room for improvement for incorporating sustainability into the transport sector. Thus, the aim of this section is to answer the question of where does Thailand need support to develop sustainable, energy-efficient transport.

The following actions are recommended:

- Capacity building for sustainable transport knowledge:
  Good policies are impossible to achieve without the knowledge of sustainable transport. Although the governmental organisations obtain good knowledge of transport, they lack knowledge in the area of sustainability. Up until now, there has not been a transport organization working directly on climate change and awareness of this topic among policy makers is still low. Moreover, merely acquiring knowledge of transport is insufficient to make good policies. Knowing how to process this knowledge efficiently is as equally important as obtaining it. To fill up this gap, capacity building and know-how transferring should help the governmental organisations which are relevant to transport to better their work in sustainable transport such as NAMAs and MRV for transport, green freight, efficient tyres and fuel economy.
- Improve data availability and accessibility:
  Data availability and accessibility is another weak area of Thai governmental organisations. The data is not regularly collected. Currently, data is occasionally collected upon request such as when a study must be undertaken. As a result, data availability is not enough and is incomprehensive. Moreover, the accessibility of data and collection of data among organisations is low. Thus, an organisation that directly manages the relevant information might help improve data availability and accessibility. One of the options to overcome this problem is the National Transport Survey to improve the data gaps of the country, as well as increased cooperation with the National Statistics Office. The table below shows the list of missing information.

Table 6.1, *Required data for the improvement of transport monitoring system in Thailand*

No.	Data	Problem
1.	Passenger-kilometre travelled (PKT) and Ton-kilometre travelled (TKT)	PKT is only available from the Department of Highways, which covers only the activity on the highway.
2.	Vehicle-kilometre travelled (VKT)	VKT data is only collected when conducting a specific study or research.
3.	Modal share	There is no regular data collection. Nationwide modal share of passengers is not available.
4.	Average load, average occupancy	Data is unavailable.
5.	Fuel economy of vehicles of different classes	Data on fuel economies of vehicles are only collected when conducting a specific study or research.
6.	Fuel and tire standard	Data on fuel and tire standards is collected on a non-regular basis.

- Policy monitoring and MRV
  To improve the existing monitoring system, Thailand could establish an MRV working group to assess the current MRV system and develop a baseline and produce an MRV guideline and template. Moreover, capacity building for governmental officials should be provided in order to actualise the policy monitoring effectively. In addition, development and adoption of a set of key indicators to monitor the transport system, e.g. MJ/p-km and gCO_2/t-km, would be an essential component of an MRV system. Moreover, the establishment of a comprehensive Marginal Abatement Cost curve for GHG reduction in the transport sector can inform policymakers, help prioritising options and estimate emission reductions.

- Revision of policies:
  Many of the existing policies and plans are unlikely applicable at the implementation level. For example, the transport master plan is merely a sketch analysis based on lessons learned from other countries. The master plan may not be suitable for the context of Thailand and may not reflect the country's situation. Thus, the policies need to be more specific on the scope as well as budget management. Furthermore, many existing transport and relevant policies from each organisation might create duplicate works or confusion. To enable better policies, international organisations can come in and function as coordinating institutions that help align many existing policies to be more efficient.

  To overcome these barriers, a few ways are suggested:

  - Transport policy development should consider climate change explicitly. This consideration should be incorporated into the master plan since the current master plan does not have climate change as an objective when considering the integrated transport policies. Moreover, there are many master plans for transport systems. These plans focus on their own objectives and thus lose the overall goal of National Transport Master plan.
  - Constraints should be taken into account during the policy and plan development.
  - The plan must be strictly followed and carried out. Monitoring of plan implementation is needed.
  - Create multi-ministerial and multi-sector policy development and implementation.

- Encouraging cooperation between institutions:
  Cooperation between institutions on transport and climate change is low because the incentive for ministries to work together is little. In order to achieve the goal of policy enforcement for climate change and cooperation among institutions, the input must be done through the available institutional bodies such as the National Committee on Climate Change Policy (NCCC). If environmental and climate change issues can be mainstreamed through such an institutional body and if a key performance index (KPI) is set for the Ministry of Transport and Ministry of Energy, those ministries could cooperate with each other and cooperation within their internal organisations could also be present. Activities such as data collection, plan enforcement and policy implementation could then follow and the institutional framework could then improve. Support from donors or international organisations can help influence the NCCC to adopt the idea of a KPI as the NCCC is likely to pay attention to international technical support.

- Raising awareness of budget constraints:
  Financial management for two levels of projects, mega project[5] level and small project[6] level, need to be considered for the success of the implementation. Financial sources are not taken into consideration especially for the mega project in the initiation stage. Therefore, the budget allocation for each particular project should be earmarked during the planning stage. The smaller projects in the local area require coordination among local governments or municipalities. If each municipality can network their budget and build up the cooperation, then the project will be more feasible.
- Establishment of a sustainable transport institution that deals with climate change:
  Establishment of sustainable transport institutions may be the alternative to support and realize those gaps and barriers mentioned above. This institution should have the authority to be a central player that brings together the related governmental organisations.
- Use output from this report for the preparation of NAMAs
  This report could support the country in the preparation of Nationally Appropriate Mitigation Actions (NAMAs[7]) in the selection process. Data in this report are the key information required for the preparation of transport NAMAs but they are still inadequate and further studies are required.

[5] Mega projects refer to the projects, which are related to the infrastructure construction such as MRT, double tracks rail, expressway, etc.
[6] Small projects refer to the projects which are responsible by the local governments, municipalities, etc.
[7] NAMA(s), initiated by the United Nations Framework Convention on Climate Change (UNFCCC), is a new mechanism to provide financial, technical, and other necessary supports from the developed countries to the developing countries in order to reduce greenhouse gas emissions.

References

ASEAN – JAPAN Transport Partnership (AJTP, 2013): *Thailand Statistic.* http://www.ajtpweb.org/statistics/Thailand/index_html (accessed on 07.05.13)

Asian Development Bank (ADB). *Transport.* http://www.atransociety.com/2013/research.html (accessed on 07.05.13)

Asian Development Bank (ADB). *Thailand's Strategy.* http://www.adb.org/countries/thailand/strategy (accessed on 07.05.13)

Asian Development Bank (ADB). *Transport in Greater Mekong Sub-region.* http://www.adb.org/countries/gms/sector-activities/transport (accessed on 07.05.13)

Bangkok Metropolitan Administration (BMA). *BMA's Mission.* http://www.bangkok.go.th/th/page/?80 (accessed on 23.04.13)

Bangkok Metropolitan Administration (BMA). *Statistical Profile of Bangkok Metropolitan Administration (2011) Population in Bangkok Metropolis, Vicinity Area and Whole Kingdom: 2005-2011 Sorted by Population of 2011.* http://office.bangkok.go.th/pipd/02_Plan%20BMA/01_Plan%20Development%20BMA/plan%20development%2012%20year%20(%202552-2563).pdf (access on 13.11.13)

Bangkok Metropolitan Administration (BMA, 2012): *Traffic statistic 2011.* Bangkok: Traffic and Transport Department, Bangkok Metropolitan Administration.

Bangkok Post (2 March 2014). *10 companies sign up for eco-car plan.* http://www.bangkokpost.com/learning/work/399500/what-new-in-business-news-march-12-2014 (access on 5.05.14)

Bangkok Post (12 March 2014). *What's new in business news: March 12, 2014.* http://www.bangkokpost.com/business/marketing/402952/10-companies-sign-up-for-eco-car-plan (access on 10.05.14)

Center for Applied Economics Research (CAER), Faculty of Economics, Kasetsart University (2010): *Thailand's National Communication present to Office of Natural Resources and Environmental Policy and Planning.* Bangkok: Office of Natural Resources and Environmental Policy and Planning.

Chollacoop, N., Laoonual, Y., and Pongthanaisawan, J. (2010): *A Case Study on Energy and CO_2 Intensities in Thai Freight Transport by Trucks ATRANS Research Grant 2010*, Final Report. Bangkok: ATRANS.

Chula Sukmanop (2013): *Development Strategy of the Country Transportation Infrastructure (2013-2020).* Bangkok: Office of Transport and Traffic Policy and Planning.

Clean Air Asia (2012): *Air Pollution and GHG Emissions Indicators for Road Transport and Electricity [Sectors: Guidelines for Development, Measurement, and Use].* Manila, Philippines: Clean Air Asia.

Delegation of the European Union to Thailand. *Climate Change and MRV*. http://eeas.europa.eu/delegations/thailand/thailand_eu_coop/environment_energy_and_sustainable_development/climate_change_and_mrv/index_en.htm (accessed on 03.05.13)

Delegation of the European Union to Thailand. *Environment, Energy and Sustainable Development*. http://eeas.europa.eu/delegations/thailand/thailand_eu_coop/environment_energy_and_sustainable_development/index_en.htm (accessed on 03.05.13)

Delegation of the European Union to Thailand. *Thailand-EU Cooperation Facility Phase II*. http://eeas.europa.eu/delegations/thailand/thailand_eu_coop/index_en.htm (accessed on 03.05.13)

Department of Alternative Energy Development and Efficiency (DEDE, 2013): *Thailand Energy Statistics 2012 (Preliminary)*. Bangkok: Department of Alternative Energy Development and Efficiency (DEDE), Ministry of Energy.

Department of Land Transport (DLT). *DLT's responsibility*. http://www.dlt.go.th/th/index.php?option=com_content&view=article&id=71:2009-09-25-08-59-06&catid=38:2009-09-17-10-03-21&Itemid=80 (accessed on 23.04.13)

Department of Land Transport (DLT, 2011): *Strategy Plan of Department of Land Transport (2011-2015)*. Bangkok: Department of Land Transport (DLT), Ministry of Transport.

Department of Land Transport (DLT). *The Number of Vehicles Stock Registered in Thailand as of December 31, 2013*. http://apps.dlt.go.th/statistics_web/statistics.html (accessed on 08-09.10.13)

Department of Rural Roads (DRR, 2013): *Transport Infrastructure Investment and Development Plan (2013-2020)*. Bangkok: Department of Rural Roads (DRR), Ministry of Transport.

Energy Policy and Planning Office (EPPO, 2007): *"A Survey of Energy Consumption of Transport Sector in Thailand," Final Report*. Bangkok: Energy Planning and Policy Office (EPPO), Ministry of Energy.

Energy Policy and Planning Office (EPPO). *About EPPO*. http://www.eppo.go.th/admin/link_about-E.html (accessed on 23.04.13)

Energy Policy and Planning Office (EPPO, 2012). *Energy Statistic of Thailand 2012* . http://www.eppo.go.th/info/cd-2012/index.html (accessed on 21.11.13)

Energy Sector Management Assistance Program (ESMAP, 2009): *Developing Integrated Emissions Strategies for Existing Land Transport (DIESEL) Bangkok, Thailand*. Bangkok: United Nation of Development Programme (UNDP) and World Bank.

Institute for Global Environmental Strategies. *IGES strategic research programme*. http://www.iges.or.jp/en/research/index.html (accessed on 24.04.13)

Japan International Cooperation Agency (JICA). *JICA's Mission statement*. http://www.jica.go.jp/english/about/mission/index.html#vision (accessed on 24.04.13)

Japan Transport Cooperation Association (JTCA, 2004): *Summary of the CDM study report on F.Y. 2003: Study to Promote CDM Projects in Transport Sector in order to Resolve Global Environmental Problem (Bangkok Metropolitan Area Case).*

King Mongkut's Institute of Technology Thonburi (KMITT, 1997): *A Study of Strategies for Energy Conservation in Vehicles, Final Report Prepared to National Energy Policy Office, Ministry of Science and Technology*. Bangkok: King Mongkut's Institute of Technology Thonburi.

MBA Magazine (2009): *วิกฤตต้มยำกุ้ง เผ็ดร้อนแบบไทย.* MBA No. 120 Vol. 11 Pp 67-70.

Ministry of Energy (MOE, 2011): *20-Year Energy Efficiency Development Plan (2011-2030)*. Bangkok: Ministry of Energy.

Ministry of Energy (MOE). *Fuel Prices.* http://www.eppo.go.th/index-E.html (accessed on 04.10.13)

Ministry of Energy (MOE). *MOE's vision*. http://www.energy.go.th/?q=en/vision (accessed on 23.04.13)

Ministry of Finance (MOF, 2013): *Announcement of Ministry of Finance on Reduction and Exemption of Excise Tax (issue 109)*. Bangkok: Ministry of Finance.

Ministry of Foreign Affairs (2013): *Letter No. 0702/C.1371.*

Ministry of Transport (MOT, 2013). *Logistic Information Centre.* http://vigportal.mot.go.th/portal/site/PortalMOT/Static_Page/ (accessed on 04.10.13)

Ministry of Natural Resources and Environment (MNRE). *MNRE's vision.* http://webeng.mnre.go.th/ewt_news.php?nid=6 (accessed on 23.04.13)

National Economic and Social Development Board (NESDB, 2012): *Gross Domestic Product: Q2/2012*. http://eng.nesdb.go.th/ (access on 18.11.13)

National Economic and Social Development Board (NESDB, 2011): *Thailand logistics report 2010*. http://www.nesdb.go.th/Portals/0/tasks/dev_logis/report/Logistics%20Report%202020 08.pdf (accessed on 07.11.13)

National Economic and Social Development Board (NESDB, 2012): *The Eleventh National Economic and Social Development Plan (2012-1016)*. Bangkok: Office of the National Economics and Social Development Board (NESDB), Office of the Prime Minister.

National Research Council of Thailand (NRCT). *NRCT's Vision Mission and Strategy.* http://en.nrct.go.th/en/NationalResearchPolicyandStrategy.aspx (accessed on 15.05.13)

Office of Natural Resources and Environmental Policy and Planning (ONEP, 2013): *Thailand Climate Change Master Plan 2013 (draft)*. Bangkok: Office of Natural Resources and Environmental Policy and Planning (ONEP), Ministry of Natural Resources and Environment.

Office of Transport and Traffic Policy and Planning (OTP, 2011): *National Transport Master Plan 2011 - 2020*. Bangkok: Office of Transport and Traffic Policy and Planning (OTP), Ministry of Transport.

Office of Transport and Traffic Policy and Planning (OTP). *OTP's mission*. http://www.otp.go.th/index.php/introduce-otp/mission.html (accessed on 23.04.13)

Office of Transport and Traffic Policy and Planning (OTP, 2012): *Sustainable Transport Systems Development Master Plan for Mitigating Climate Change, Summary (in Thai)*. Bangkok: Office of Transport and Traffic Policy and Planning (OTP), Ministry of Transport.

Office of Transport and Traffic Policy and Planning (OTP, 2011): *Transport Data and Model Integrated with Multimodel Transport and Logistic (TDL), Executive Summary Report*. Bangkok: Office of Transport and Traffic Policy and Planning (OTP), Ministry of Transport.

Office of Transport and Traffic Policy and Planning (OTP), Ministry of Transport. *Logistic Costs*. www.otp.go.th (accessed on 07.10.13)

Office of Transport and Traffic Policy and Planning (OTP, 2013): *Transport and Traffic Statistic and Information Thailand*. Bangkok: Office of Transport and Traffic Policy and Planning (OTP), Ministry of Transport.

Pollution Control Department (PCD). *PCD's Mission Statement*. http://www.pcd.go.th/about/en_ab_mission.html (accessed on 23.04.13)

Pun Pun Bike Share. *Public bicycle sharing project by Bangkok*. http://www.punpunbikeshare.com/ (accessed on 15.05.13)

Schipper, L., Marie-Lilliu, C., and Gorham, R. (2000): *Flexing the link between transport and greenhouse gases: a path for the World Bank*. Paris: *International Energy Agency*.

Strategy and Evaluation Department, Bangkok Metropolitan Administration. *Bangkok's 12 years development Plan (2009-2013) Bangkok, sustainable megacity (2012)*. http://office.bangkok.go.th/pipd/02_Plan%20BMA/01_Plan%20Development%20BMA/plan%20development%2012%20year%20(%202552-2563).pdf (accessed on 10.10.14)

Sustainable Urban Transport Project. *Home*. http://www.sutp.org/ (accessed on 24.04.13)

Thai Common Ticket Program Management Services. *Home*. http://www.thaicommonticket.com/index.php/en/ (accessed on 29.05.13)

Thai Industrial Standards Institute (TISI). *Home*. http://www.tisi.go.th/index.php?option=com_content&view=article&id=47&Itemid=35 (accessed on 28.05.13)

Thai Industrial Standards Institute (TISI, 2012): *TISI Issues new passenger car standard imposing in 2013*. http://www.tisi.go.th/index.php?option=com_content&view=article&id=2921:2009-11-26-07-56-45&catid=2:2009-09-29-16-17-21&Itemid=73 (access on 18.09.2014)

Thailand Automotive Institute. *Vision and Mission*. http://www.thaiauto.or.th/2012/about-us/vision-and-mission.asp (accessed on 29.05.13)

Thailand Development Research Institute (TDRI, 1999): *Transport Master Plan (1999-2006)*. Bangkok: Ministry of Transport.

Thailand Greenhouse Gas Management Organization (TGO). *TGO's Mission*. http://www.tgo.or.th/index.php?option=com_content&view=article&id=22:tgo-role&catid=29:about-tgo&Itemid=28 (accessed on 28.05.13)

The Institute of Industrial Energy (IIE). *Energy saving project*. http://www.iie.or.th/iie2014/project.php accessed on 29.05.13)

The Joint Graduate School of Energy and Environment (JGSEE, 2010): *Thailand's Greenhouse Gas Inventory (Final Report)*. Bangkok: Office of Natural Resources and Environmental Policy and Planning and the Joint Graduate School of Energy and Environment (JGSEEE).

Thirayoot, L., Pongthanaisawan, J., Watthanaklang, D., and Sangphong, O (2009): *An Analysis of Vehicle Kilometers of Travel Major Cities in Thailand*. ATRANS Research Grant 2009, Final Report. http://www.atransociety.com/2013/pdf/pdfResearch2010/FR101116_-_VKT_EstimationDrThirayoot.pdf (accessed on date)

World Bank. *Thailand Project and Program*. http://www.worldbank.org/en/country/thailand/projects (accessed on 07.05.13)

World Bank (2014). *World Ban Indicators*. http://data.worldbank.org/indicator (accessed on 06.08.13)

Zegras, P. C. (2007): *As if Kyoto mattered: The clean development mechanism and transportation. Energy Policy 35*, pp. 5136-5150.

Annex I: CO_2 tax for vehicles

The Thai government has approved the new automobile tax structure that will be enforced in the year 2016. This new tax calculation will be based on CO_2 emissions and energy efficiency rather than engine size as in the current tax structure. According to this new scheme of taxation, a normal eco-car will be charged 17%. The rate falls to 12% for an E85-compatible eco-car. Cars with larger engine sizes of 3,000cc or more will be charged at the 50% rate. One-ton pickups will be taxed at 3% and the rate rises to 5% if emissions exceed 200 grammes per kilometre. The following chart shows the comparison of the current and new auto tax structure.

Table I-1, *Comparison of the current and new automobile excise tax rate structure*

Vehicle type	Engine size	Current Automobile Excise Tax Rate (%)			New Automobile Excise Tax Structure			
					CO_2 emission	Excise Tax Rate (%)		
		E10	E20	E85		E10	E20	E85
Passenger car	≤2,000 cc	30	25	22	≤100g/km	-	-	10
	2,001 – 2,500 cc	35	30	27	101 – 150g/km	30	25	20
	2,501 – 3,000 cc	40	35	32	151 – 200g/km	35	30	25
					>200g/km	40	35	30
	>3,000 cc	50	50	50	***	50	50	50
PPV* / DC* / Space Cab / Pick Up /Others*	≤3,250 cc	20 / 12 / - / 3 / 18			≤200g/km	25 / 12 / 5 / 3 / 18		
					>200g/km	30 / 15 / 7 / 5 / 18		
	>3,250 cc	50			***	50		
Eco Car (Petrol/Diesel) / E85	1,300 / 1,400 cc	17			≤100g/km	14 / 12		
					101 – 120g/km	17 / 17		
Electric Vehicle / Fuel Cell / Hybrid	≤3,000 cc	10 / 10 / 10			***	10 / ** / 10		
	>3,000 cc	50			***	50		
NGV-OEM	≤3,000 cc	20			***	**		
	>3,000 cc	50			***	50		

Note: * Pick-up Passenger Vehicle (PPV), Double Cap (DC)
Others are Pick Up vehicles (≤3,250 cc) that do not meet the specified criteria.
** The excise tax rate is based on CO_2 only.
*** The excise tax structure does not specify the CO_2 emission target.

Annex II: ASIF methodology

The relevant data and emissions in the transport sector will be reviewed according to a framework of emissions from transport named Activity-Structure-Intensity-Fuel (ASIF) approach proposed by Schipper et al. (2000). In this approach, transport emissions are dependent on the level of transport activity (A); the transport mode structure (S); the fuel intensity (I); and the carbon content of the fuel or emission factor (F). By using the ASIF approach, there are a lot of data related to each component of the ASIF framework depending on dimensions and levels of estimation details which can be achieved using either a top-down or a bottom-up approach based on fuel consumption or travel activity respectively. The ASIF framework provides a useful picture for understanding energy use and emissions. Multiple factors influence each of the ASIF components as shown in Figure 2.6.

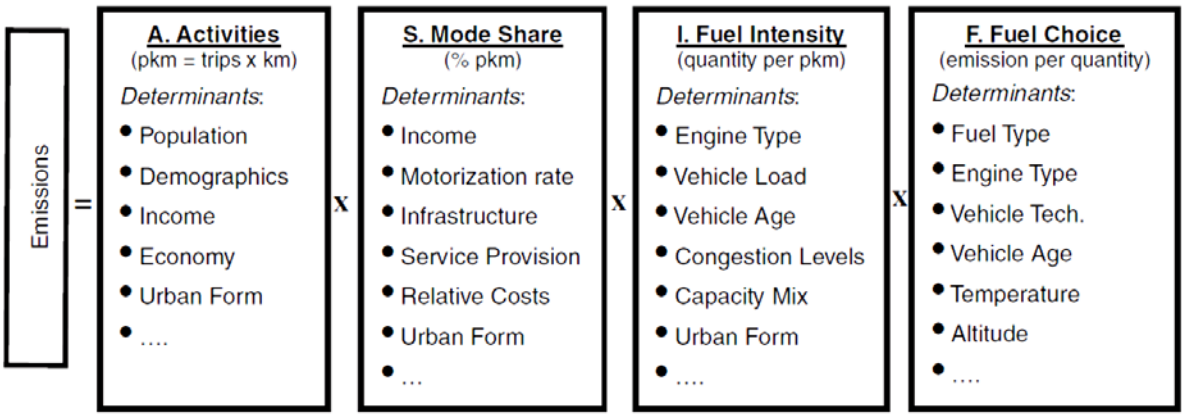


Figure II-1, *Factors under the ASIF component*

Source: Clean Air Asia, 2012

Recently, Clean Air Asia (Clean Air Asia, 2012) has published a guideline to identify air pollution and GHG emissions indicators for the road transport and electricity sectors. Based on the ASIF framework, data availability of input parameters for each country can be identified and then a measurement method for each indicator can be suggested. The figure below illustrates the calculation flowchart and related data used to estimate emissions using the ASIF approach.

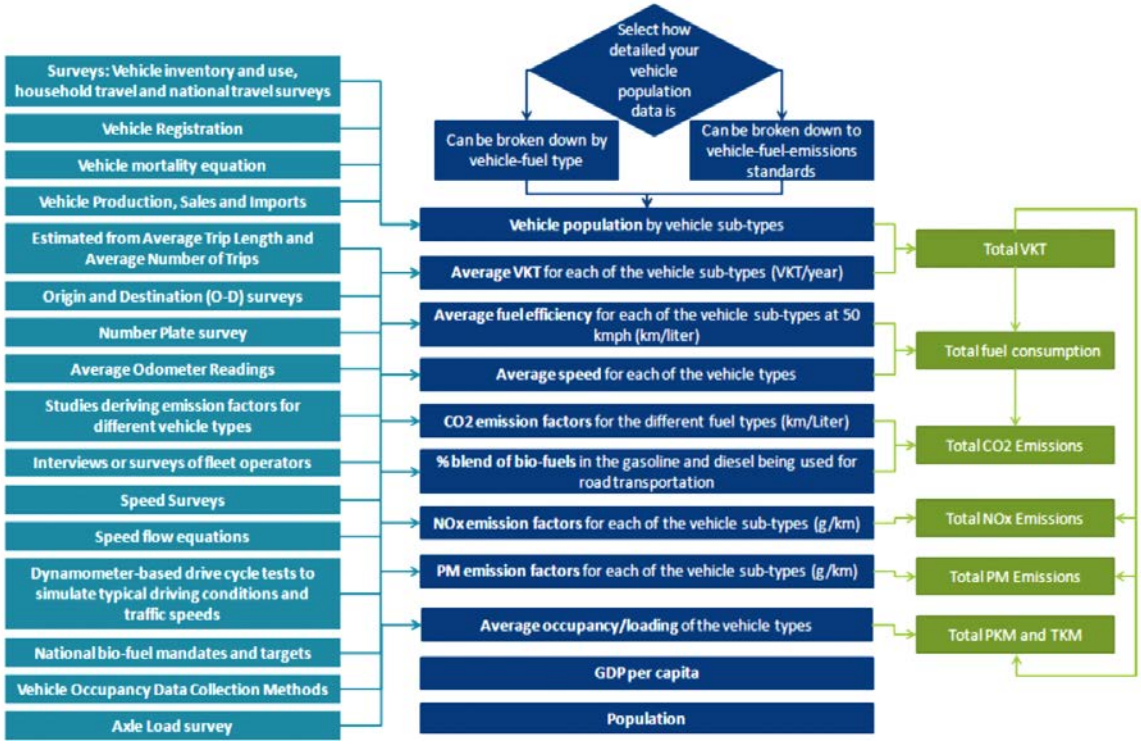


Figure II-2, *Flowchart to estimate emission from road transport*

Source: Clean Air Asia, 2012

Annex III: Climate change data

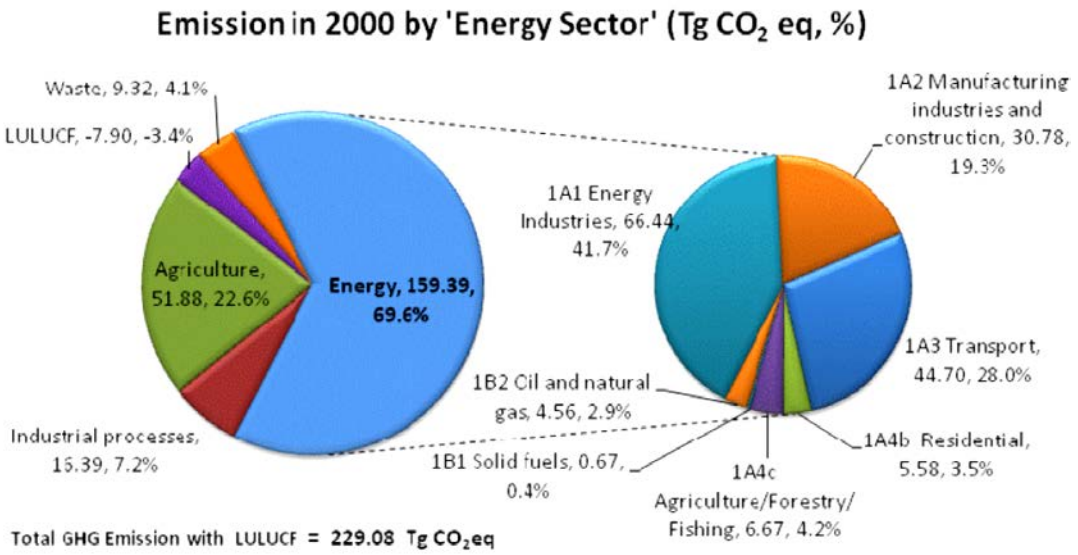


Figure III-1, *Thailand GHG emissions by sectors in 2000*

Source: The Joint Graduate School of Energy and Environment, 2010

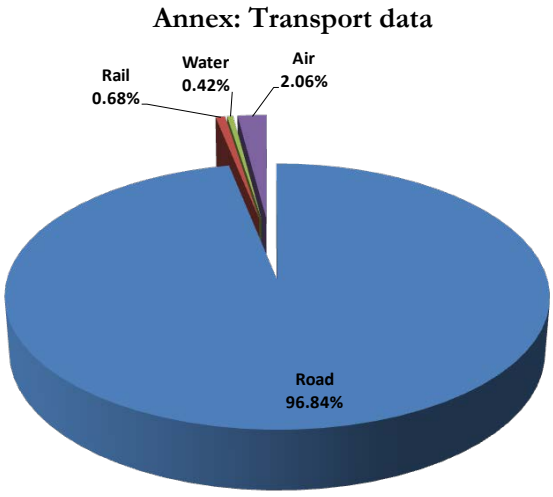


Figure III-2, *Share of GHG emissions from transport sector by modes*

Source: OTP, 2012

Annex IV: Transport activities data

Table IV-1, *Road transport data and freight data from road*

Source: AJTP, 2013

Indicator name	Unit/scale of measurement	2004	2005	2006	2007	2008	2009	2010	2011	2012	Activity source of data [regulatory/administrative reporting system, census, survey]	Institutional source of data [Official agency source]
Road transport measurement												
Number of public bus passengers	Thousand	1,067,493	1,012,586	978,390	1,106,344	1,036,007	833,098	823,427	786,311	759,378	Transport Statistics	DLT, BMTA
Road passenger-kilometer	Million passenger-kilometer	418,349	400,485	410,384	421,517	422,190	441,420	441,843	500,313	548,453		Department of Highways
Total operational mileage of public buses	Million kilometer	173	178	175	174	171	164	424	413	408		The Transport co., ltd, BMTA
Freight	Thousand ton	435,147	430,275	427,581	428,123	424,456	423,677	420,449	406,538	425,804	Transport Statistics	
Freight-kilometer	Thousand ton-kilometer	175,962	175,163	184,006	186,174	181,452	183,429	185,883	184,481	187,583	Transport Statistics	
Others (enterprises, logistics & economic performance)												
Total domestic freight volume by Road	Thousand ton	435,147	430,275	427,581	428,123	424,456	423,677	420,449	406,538	425,804	Transport Statistics	
Total domestic freight movement by Road	Million ton-kilometer	175,962	175,163	183,942	185,009	181,346	179,009	185,883	184,481	187,583	Transport Statistics	

Table IV-2, *Transport data from rail system*

Source: AJTP, 2013

Indicator name	Unit/scale of measurement	2004	2005	2006	2007	2008	2009	2010	2011	2012p
Railway transport infrastructure										
Total railway route length	Kilometer	4,043	4,043	4,043	4,044	4,043	4,034	4,034	4,034	4,034
Railway transport measurement; traffic										
Total number of rail passengers	Million persons	50	49	48	45	48	48	45	44	41
Rail passenger-kilometer	Million passenger-kilometer	9,190	8,954	8,746	8,051	8,570	8,578	8,083	7,504	7,566
Freight	Thousand ton	12,883	11,760	11,579	11,055	12,807	11,133	11,399	10,864	11,849
Freight-kilometer	Million ton-kilometer	3,414	3,002	2,904	2,688	2,857	2,533	2,582	2,455	2,586
Others (enterprises, logistics, and economic performance)										
Total domestic freight volume by Rail	Thousand ton	12,883	11,760	11,579	11,055	12,807	11,133	11,399	10,864	11,849
Total domestic freight movement by Rail	Million ton-kilometer	3,414	3,002	2,904	2,688	2,857	2,533	2,582	2,455	2,586

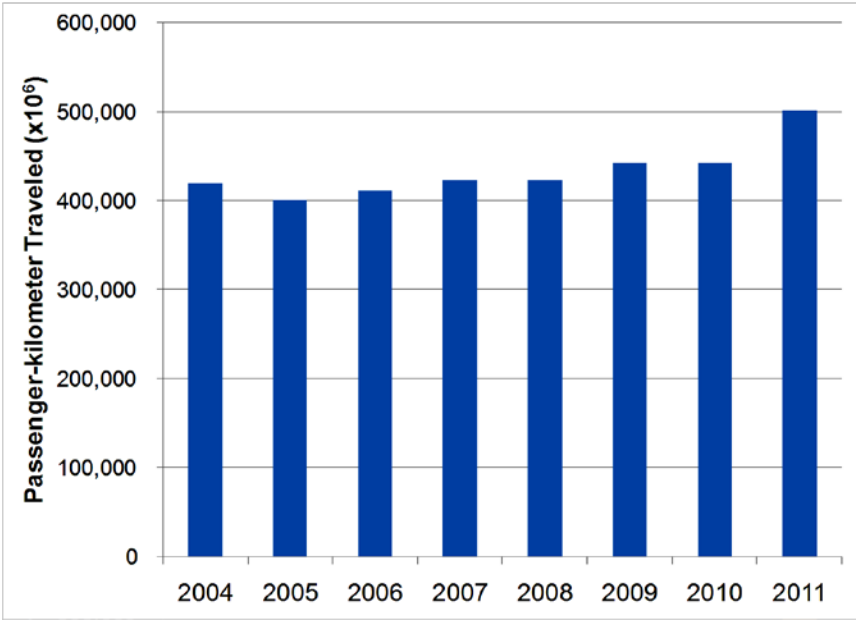


Figure IV-1, *Trend of passenger-kilometre travelled on highways*

Source: Department of Highway, 2011

Note: Data source is from the Department of Highways, based on the AJTP project.

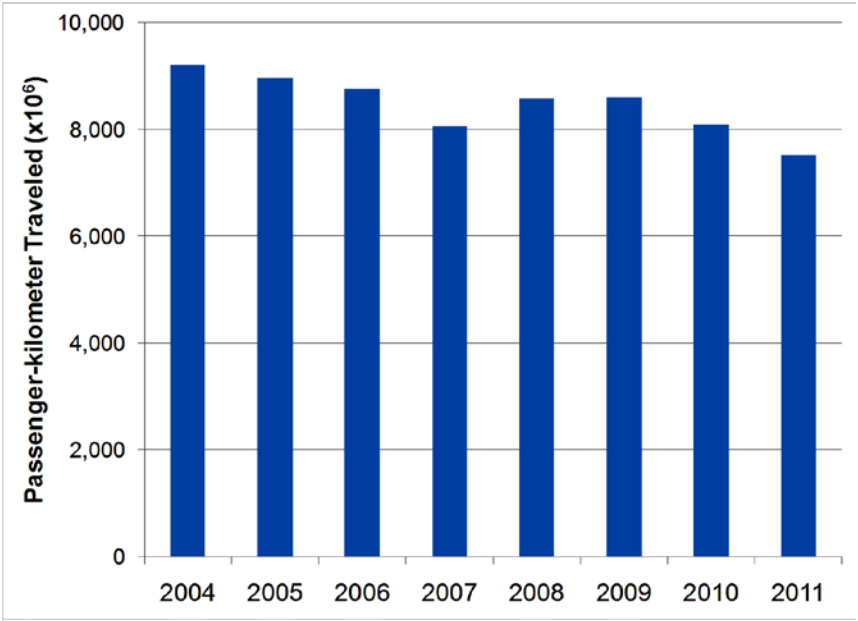


Figure IV-2, *Trend of passenger-kilometre travelled on railways*

Source: SRT, 2011

Note: Data source is from the State Railway of Thailand, based on the AJTP project.

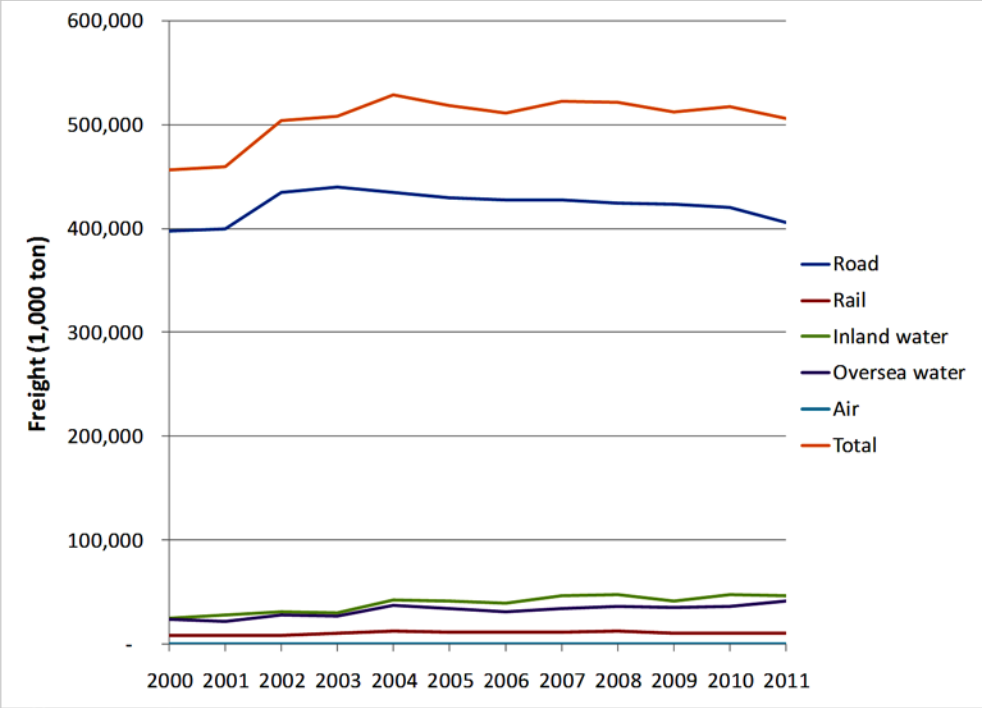


Figure IV-3, *Volume of freight by modes from 2001- 2011*

Source: MOT, 2012

Table IV- 3, *Annual averages VKT of new vehicles in 1997 by vehicle types*

Source: Pongthanaisawan, 2011

Vehicle type	Vehicle kilometre travelled (kilometre)
Passenger car	23,248
Pick-up	37,955
Taxi	72,154
Commercial car	26,758
3-wheel vehicle	13,766
Motorcycle	14,690
Bus	98,395
Truck	98,111

Table IV-4, *Average annual VKT of vehicles in Bangkok and Nakhonratchasima*

Source: Thirayoot et al, 2009

Vehicle Type	Average annual VKT (km)	
	Bangkok	Nakhonratchasima
Motorcycle	4,015	5,662
Motorcycle taxi	4,219	8,844
Tuk-tuk	40,351	40,382
Pick-up	32,475	18,140
Taxi	109,351	132,476
Car	31,368	15,640
Bus	48,627	28,579
Truck	40,989	59,115
Songtaew	54,702	40,591

Table IV-5, *Average fuel economy of vehicles by fuel types*

Source: Pongthanaisawan, 2011

Vehicle type	Fuel Economy (Vehicle-kilometre per liter)			
	Gasoline	Diesel	LPG	CNG*
Passenger Car	12.27	11.31	10.69	10.86
Pick-up	11.82	11.93	11.06	10.78
Motorcycle	28.71	-	-	-
Motor-tricycle	17.68	15.37	10.80	10.25
Commercial Car	13.50	10.00	9.66	11.16
Taxi	9.37	8.34	11.22	8.71
Bus	-	3.94	-	2.26
Truck	-	4.14	-	1.67

Note: * Unit of CNG fuel economy is vehicle-kilometre per kilogram.

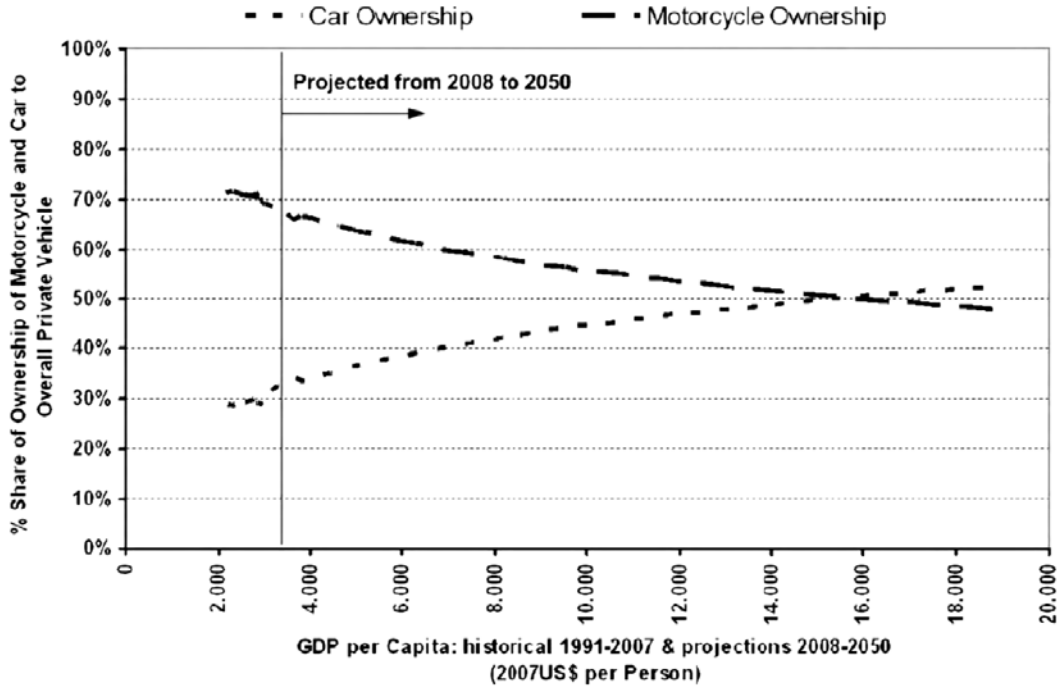


Figure IV-5, *predicted shares of motorcycles and personal cars up to 2050*

Source: Pongthanaisawan and Sorapipatana, 2013

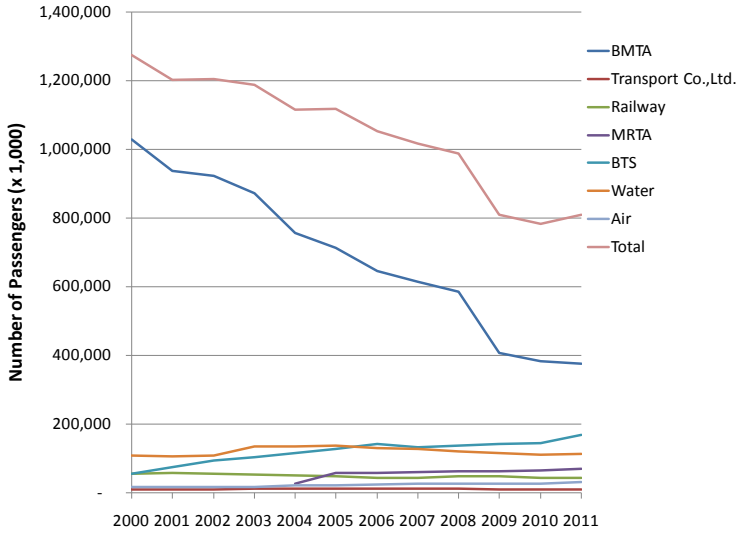


Figure IV-6, *Number of domestic passengers by modes from 2000-2011*

Source: MOT, 2012

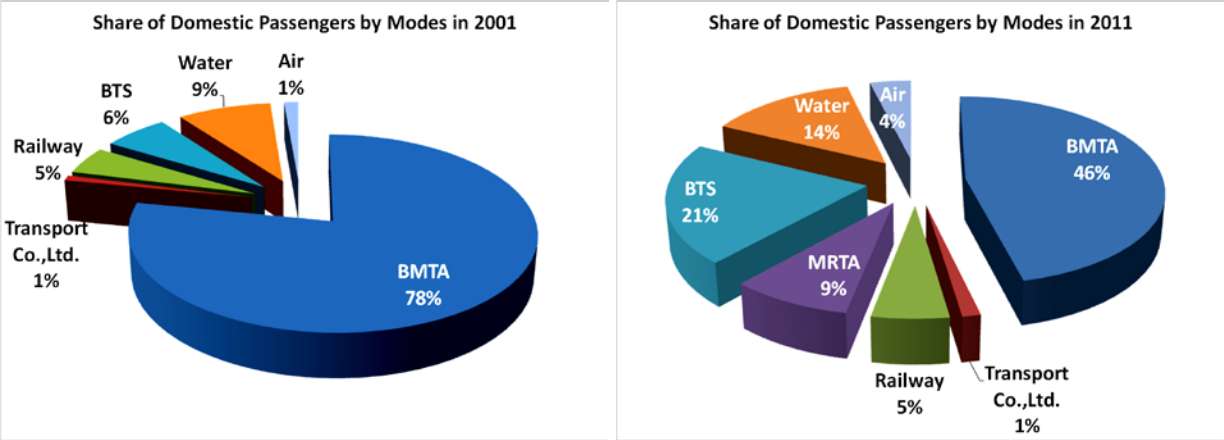


Figure IV-7, *Shares of domestic passengers by modes in 2001 and 2011*

Source: OTP, 2012

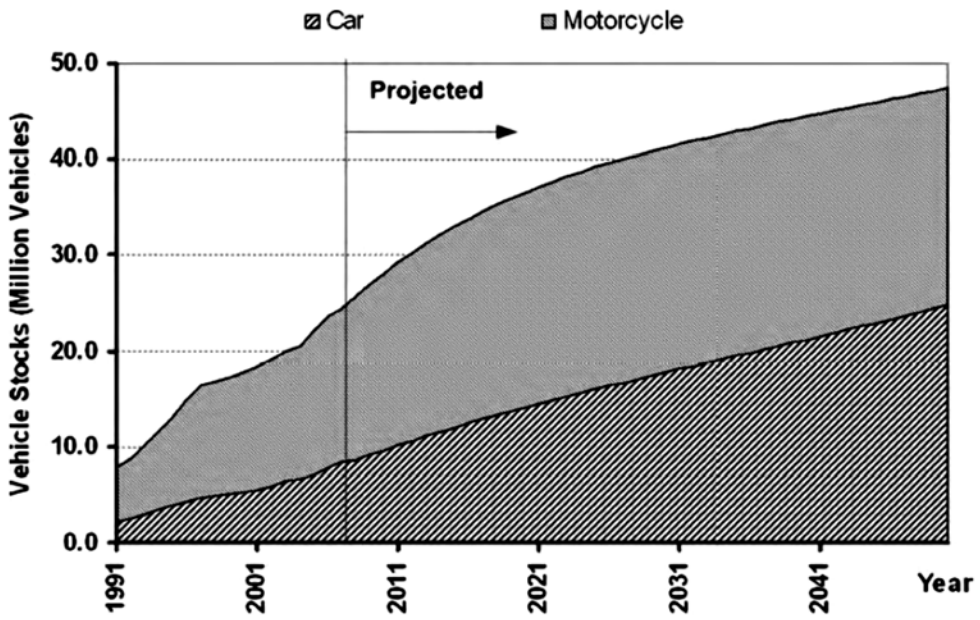


Figure IV-8, *Projected shares of motorcycles and personal cars up to 2050*

Source: Pongthanaisawan and Sorapipatana, 2013

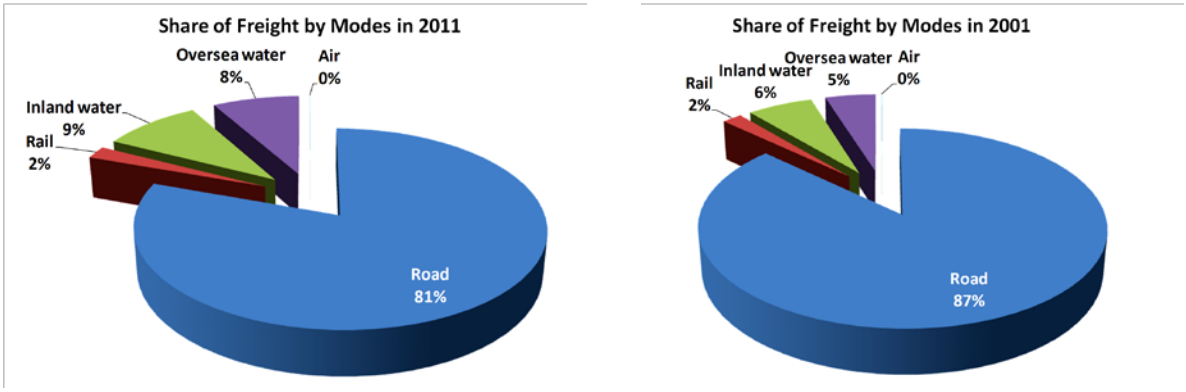


Figure IV-9, *Shares of freight by modes in 2001and 2011*

Source: OTP, 2013

Table IV-6, *Road vehicle classification and fuel used in Thailand*

Source: Pongthanaisawan, 2011

No	Type of Vehicles by Act	Group of Vehicles	Fuel Used					
			Gasoline	Gasohol	Diesel	Biodiesel	LPG	CNG
1	Sedan	Private Car (PC)	✓	✓	✓	✓	✓	✓
2	Microbus & Passenger Van							
3	Van & Pick Up	Pick-up (PU)	✓	✓	✓	✓	✓	✓
4	Urban Taxi	Taxi (TAXI)	✓	×	×	×	✓	✓
5	Hotel Taxi	Commercial Car (COMC)	✓	✓	✓	✓	✓	✓
6	Tour Taxi							
7	Car for Hire							
8	Motor-tricycle	Three-wheeler (3WL)	✓	✓	✓	✓	✓	×
9	Motor-tricycle Taxi (Tuk-tuk)							
10	Motorcycle	Motorcycle (MC)	✓	✓	×	×	×	×
11	Motorcycle Taxi							
12	Fixed Route Bus	Bus (BUS)	✓	✓	✓	✓	×	✓
13	Non-Fixed Route Bus							
14	Private Bus							
15	Small Rural Bus							
16	Non-Fixed Route Truck	Truck (TRK)	✓	✓	✓	✓	×	✓
17	Private Truck							

Table IV-7, *Number of new registered vehicles by fuel types in 2011*

Source: DLT, 2011

	Type of Fuels												Total
	Gasoline	Diesel	LPG	LPG & Gasoline	LPG & Diesel	CNG	CNG & Gasoline	CNG & Diesel	Hybrid EV	EV	Non-motorized	Other	
Grand Total	2,503,944	528,067	13,047	18,680	36	12,202	54,572	167	12,077	272	16,788	-	3,159,852
A. Total Vehicle under Motor Vehicle Act	2,503,811	471,229	9,426	18,464	12	3,957	51,448	73	12,077	272	480	-	3,071,249
A.1) Sedan (Not more than 7 Pass.)	356,011	134,976	6,515	4,583	2	7	27,550	7	12,021	9	-	-	541,681
A.2) Microbus & Passenger Van	1,191	19,911	54	890	1	62	2,832	21	-	-	-	-	24,962
A.3) Van & Pick Up	9,273	252,982	2,728	10,509	9	3,883	14,206	45	-	-	-	-	293,635
A.4) Motor-tricycle	65	1	8	8	-	4	-	-	-	-	-	-	86
A.5) Interprovincial Taxi	-	-	-	-	-	-	-	-	-	-	-	-	-
A.6) Urban Taxi	92	3	-	2,419	-	1	6,856	-	-	-	-	-	9,371
A.7) Fixed Route Taxi	86	-	13	3	-	-	-	-	-	-	-	-	102
A.8) Motor-tricycle Taxi (Tuk-tuk)	69	1	108	15	-	-	-	-	-	-	-	-	193
A.9) Hotel Taxi	36	111	-	10	-	-	4	-	56	-	-	-	217
A.10) Tour Taxi	22	7	-	27	-	-	-	-	-	-	-	-	56
A.11) Car For Hire	4	-	-	-	-	-	-	-	-	-	-	-	4
A.12) Motorcycle	2,134,114	-	-	-	-	-	-	-	-	263	-	-	2,134,377
A.13) Tractor	1	59,411	-	-	-	-	-	-	-	-	-	-	59,412
A.14) Road Roller	-	661	-	-	-	-	-	-	-	-	-	-	661
A.15) Farm Vehicle	15	3,164	-	-	-	-	-	-	-	-	-	-	3,179
A.16) Automobile Trailer	-	1	-	-	-	-	-	-	-	-	480	-	481
A.17) Public Motorcycle	2,832	-	-	-	-	-	-	-	-	-	-	-	2,832
B. Total Vehicle under Land Transport Act	133	56,838	3,621	216	24	8,245	3,124	94	-	-	16,308	-	88,603
B.1) Bus : Total	92	6,613	19	185	2	1,150	3,102	36	-	-	-	-	11,199
B.1.1) Fixed Route Bus	45	2,685	7	131	2	960	2,847	31	-	-	-	-	6,708
B.1.2) Non Fixed Route Bus	47	3,307	8	54	-	172	254	5	-	-	-	-	3,847
B.1.3) Private Bus	-	621	4	-	-	18	1	-	-	-	-	-	644
B.2) Truck : Total	41	50,043	3,602	31	22	7,095	19	58	-	-	16,308	-	77,219
B.2.1) Non Fixed Route Truck	2	8,175	33	1	4	3,146	2	27	-	-	6,960	-	18,350
B.2.2) Private Truck	39	41,868	3,569	30	18	3,949	17	31	-	-	9,348	-	58,869
B.3) Small Rural Bus	-	182	-	-	-	-	3	-	-	-	-	-	185

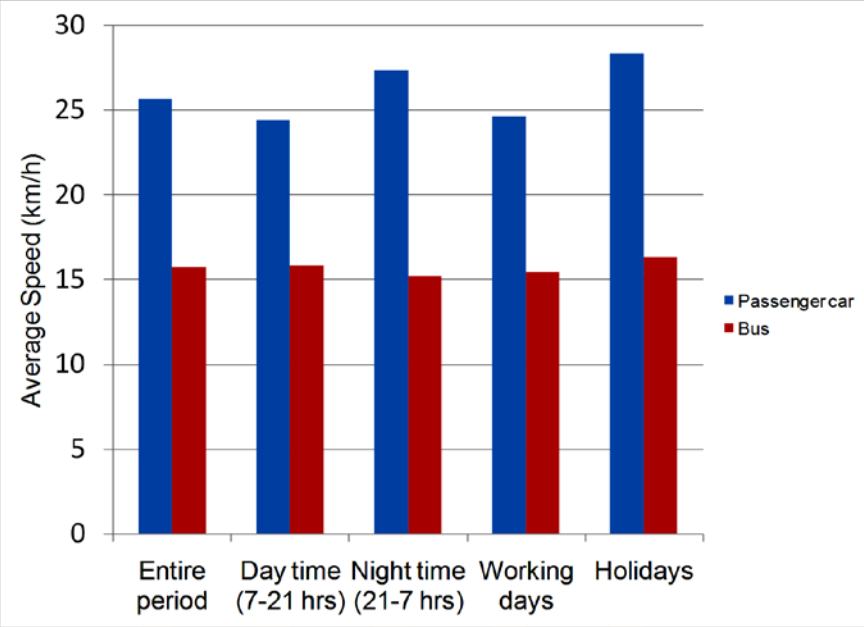


Figure IV-10, *Average speeds of passenger cars and buses in Bangkok*

Source: Ministry of Land, Infrastructure and Transport (MLIT) and Japan Transport Cooperation Association (JTCA)

Annex V: Energy data in the transport sector

Energy consumption in the transport sector is differentiated by regions of the country that is dependent on the regional economy, population, and geography. In 2010, fuel consumption in the transport sector in Thailand was 24,594 ktoe, which was disaggregated by region as shown in Figure V-1. The Bangkok Metropolitan Region (BMR) shared 44% of the total energy consumption in Thailand.

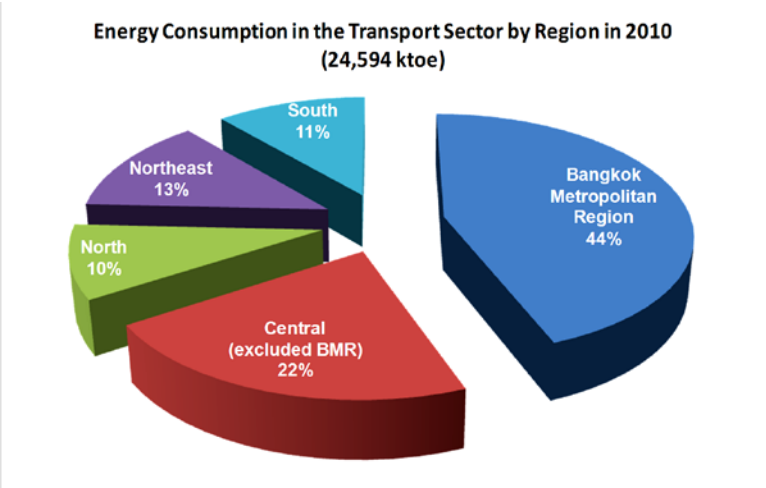


Figure V-1, *Energy consumption in the transport sector by region in 2010*

Source: OTP, 2012

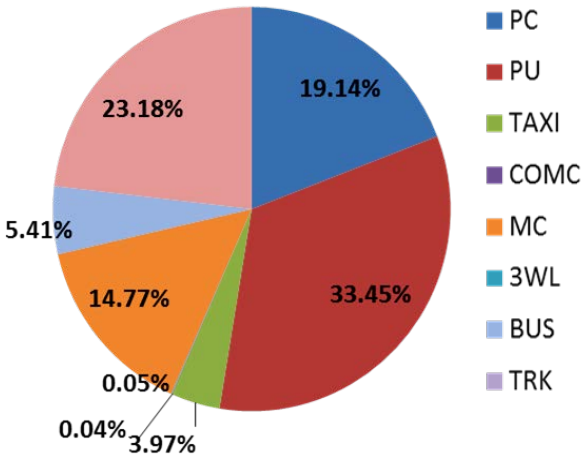


Figure V-2, *Shares of vehicular fuel consumption by vehicle type in 2008*

Source: Pongthanaisawan, 2011

Table V-1, *Emission factor for gasoline-based engine vehicles by different speed as of August 2011*

Source: OTP, 2012

Vehicle type	Average Speed (km/h)	THC (g/km)	NOx (g/km)	CO (g/km)	CO_2 (g/km)	Fuel economy (km/l)
Gasoline-engine Passenger Car (E-20)	7.76	0.068	0.014	0.108	470.592	4.62
	19.34	0.033	0.022	0.233	339.250	6.41
	23.13	0.016	0.005	0.137	272.666	7.98
	33.94	0.012	0.017	0.079	240.468	9.04
	46.77	0.010	0.042	0.303	225.805	9.62
	72.53	0.009	0.011	0.198	160.666	13.52
Gasoline-engine Passenger Car (E-85)	7.76	0.008	0.010	0.061	455.109	3.57
	19.34	0.002	0.021	0.063	332.397	4.88
	23.13	0.002	0.004	0.067	262.725	6.18
	33.94	0.002	0.017	0.053	232.363	6.98
	46.77	0.002	0.014	0.088	215.697	7.52
	72.53	0.002	0.002	0.019	154.891	10.48
Gasoline-engine Passenger Car (Gasoline 91)	7.4	0.027	0.033	0.159	320.413	7.380
	14.6	0.023	0.081	0.280	232.799	10.150
	23.4	0.014	0.041	0.221	189.713	12.460
	33.2	0.015	0.044	0.512	169.984	13.860
	42.9	0.028	0.066	0.732	166.941	14.080
	73.9	0.018	0.030	0.174	125.604	18.800
Gasoline-engine Passenger Car (Gasohol 91)	7.4	2.131	2.219	36.465	511.313	4.180
	14.6	1.501	2.551	24.867	335.086	6.340
	23.4	1.170	2.398	18.787	257.213	8.270
	33.2	1.051	2.631	15.496	232.309	9.240
	42.9	1.024	2.677	13.626	218.097	9.900
	73.9	0.801	1.979	7.893	169.544	13.020
Gasoline-engine Passenger Car (Gasohol 95)	7.4	0.058	0.155	0.255	256.508	9.030
	14.6	0.044	0.221	0.676	198.508	11.650
	23.4	0.016	0.091	0.213	164.279	14.090
	33.2	0.013	0.063	0.408	150.780	15.320
	42.9	0.019	0.079	0.549	144.800	15.920
	73.9	0.010	0.105	0.283	120.812	19.130
Gasoline-engine with CNG Passenger Car	7.76	0.678	0.189	0.108	259.687	6.850
	19.34	0.330	0.226	0.091	189.373	9.420
	23.13	0.069	0.048	0.089	156.313	11.450
	33.94	0.043	0.035	0.108	143.798	12.440
	46.77	0.034	0.029	0.174	137.774	12.980
	72.53	0.026	0.089	0.024	104.822	12.830
Gasoline-engine with LPG Passenger Car (LPG)	7.76	0.527	2.557	1.996	263.384	6.060
	19.34	0.407	1.951	1.996	187.113	8.490
	23.13	0.214	2.026	2.068	162.562	9.710
	33.94	0.148	2.438	0.801	146.248	10.990
	46.77	0.118	2.505	0.424	136.323	11.840
	72.53	0.072	1.827	0.088	115.182	14.070

Note: 1. Using BKK driving Cycle
2. Using the same vehicle

Table V-2, *Emission factor for diesel engine vehicle by different speed (as of June 2010)*

Source: OTP, 2012

Average Speed (km/h)	THC (g/km)	NOX (g/k)	CO (g/km)	CO_2 (g/km)	PM (g/k)	Fuel Economy (km/l)
7.7	0.091	1.359	0.566	325.492	0.160	8.070
14.6	0.104	1.299	0.403	269.543	0.112	9.740
23.1	0.027	0.855	0.059	176.907	0.186	14.880
33.6	0.035	1.061	0.070	181.454	0.111	14.510
42.7	0.028	0.383	0.020	157.799	0.054	16.690
72.9	0.042	0.750	0.113	210.456	0.184	12.500

Table V-3, *Emission factor and fuel economy for motorcycles by different speed (as of June 2010)*

Source: OTP, 2012

	Average Speed (Km/h)	THC (g/km)	NOX (g/km)	CO (g/km)	CO_2 (g/km)	Fuel Economy (km/l)
Motorcycle (2 stroke engine)	7.3	6.490	0.030	12.338	34.110	36.550
	22	7.190	0.027	10.123	34.144	37.160
	23.3	9.118	0.076	12.548	37.556	31.410
	33.5	6.704	0.088	9.518	33.514	38.820
	44.4	6.459	0.119	12.209	33.799	36.850
	Average Speed (Km/h)	**THC (g/km)**	**NOX (g/km)**	**CO (g/km)**	**CO_2 (g/km)**	**Fuel Economy (km/l)**
Motorcycle (4 stroke engine)	7.3	0.487	0.290	2.135	51.896	40.860
	22	0.566	0.313	1.402	54.487	39.670
	23.3	0.756	0.313	4.159	60.953	33.200
	33.5	0.797	0.313	5.418	50.836	37.500
	44.4	0.734	0.297	7.581	50.824	35.660

Equation V-I

$$C = \frac{[0.866\,(HC) + 0.429(CO) + 0.273(CO_2)}{\frac{SG}{0.1155}}$$

where

C = fuel economy (litre/100 km)

HC = Hydrocarbon emitting rate (g/km)

CO = Carbon Monoxide (g/km)

CO_2 = Carbon Dioxide (g/km)

SG = Specific gravity of fuel (km/m^3) (0.860 kg/m^3 for Thailand)

Table V-4, *Retail price of petroleum product*

Source: EPPO, 2012

Unit : Baht/Litre

Products	1. Gasoline						2. Kerosene	3. Diesel			4. Fuel Oil		5. LPG			
	GASOLINE ULG 95	GASOLINE ULG91	Gasohol 95			Gasohol 91		DIESEL HSD	B5	LSD	600	1500	Cooking	Industry	Automobile	
			(E10)	(E20)	(E85)						(2%S)	(2%S)	(Baht/kg)	(Baht/kg)	(Baht/kg)	(Baht/L)
1997	10.48	10.09					11.17	9.49		9.48	5.85	5.45	11.36		10.53	5.68
1998	11.86	11.2					11.7	9.19		9.54	6.79	6.42	12.7		11.94	6.45
1999	11.98	11.16					11.63	8.96		8.95	6.87	6.29	11.03		10.75	5.81
2000	15.63	14.68					15.1	12.95		12.77	9.68	9.22	10.7		10.57	5.71
2001	15.51	14.51					15.97	13.43		13.18	9.76	9.25	11.9		12	6.48
2002	15.29	14.29					15.56	13.12		12.83	9.91	9.24	13.77		13.98	7.55
2003	16.6	15.65					16.71	14.03		13.73	11	10.36	14.87		14.88	8.05
2004	19.05	18.26					19.5	14.59		14.37	11.75	10.98	16.46		16.46	8.9
2005	23.9	23.1					24.51	20.03		18.18	15.83	15.09	16.81		16.81	9.09
2006	27.58	26.79					28.42	25.59	25.09	25.37	18.11	17.29	16.81		16.81	9.09
2007	29.18	28.32	26.17			25.76	28.94	25.66	24.95	25.45	19.35	18.45	16.91		16.91	9.14
2008	35.33	33.43	28.97	27.37		28.16	38.34	31.26	30.39	33.2	24.3	22.9	18.13		18.13	9.79
2009	37.47	31.34	27.5	25.39	18.87	26.69	37.21	24.77	22.71	27.04	21.18	19.83	18.13		18.13	9.79
2010	41.26	36.1	32.35	29.96	19.21	30.85	37.51	28.69	27.55	27.04	23.59	22.04	18.13		18.13	9.79
2011	44.64	39.72	36.52	32.94	21.75	33.96	38.21	29.45	29.95	27.04	28.58	26.68	18.13	20.38	18.13	9.79

Table V-5, *Thailand vehicle statistics by type of fuel used as of 30 September 2013*

Source: DLT, 2013

สถิติจำนวนรถจำแนกตามชนิดเชื้อเพลิง สะสม ณ วันที่ 30 กันยายน 2556 ทั่วประเทศ

หน่วย : คัน

ประเภทรถ	รวม	เบนซิน	ดีเซล	LPG	LPG และเบนซิน	LPG และดีเซล	CNG	CNGและเบนซิน	CNG และดีเซล	ไฟฟ้า	ไม่ใช้เชื้อเพลิง	ไฮบริด	อื่นๆ
ก. รวมรถตามกฎหมายว่าด้วยรถยนต์	33,186,322	23,987,602	7,692,900	24,226	1,072,011	4,787	12,039	296,540	2,755	3,595	2,939	51,332	35,596
รย.1 รถยนต์นั่งส่วนบุคคลไม่เกิน 7 คน	6,602,119	3,912,879	1,583,017	2,751	878,747	1,496	176	163,048	807	24	-	51,180	7,994
รย.2 รถยนต์นั่งส่วนบุคคลเกิน 7 คน	428,528	33,029	350,521	297	21,560	503	180	15,364	358	-	-	1	6,715
รย.3 รถยนต์บรรทุกส่วนบุคคล	5,679,083	201,079	5,264,510	6,842	129,261	2,782	10,020	42,163	1,583	7	-	2	20,834
รย.4 รถยนต์สามล้อส่วนบุคคล	1,582	1,026	22	305	199	-	5	6	-	2	-	-	17
รย.5 รถยนต์รับจ้างระหว่างจังหวัด	3	2	1	-	-	-	-	-	-	-	-	-	-
รย.6 รถยนต์รับจ้างบรรทุกคนโดยสารไม่เกิน 7 คน	114,450	1,528	247	73	36,762	1	2	75,817	7	1	-	-	12
รย.7 รถยนต์สี่ล้อเล็กรับจ้าง	3,221	1,406	2	1,290	514	-	-	-	-	1	-	-	8
รย.8 รถยนต์รับจ้างสามล้อ	20,681	2,870	43	12,668	3,415	2	1,656	8	-	3	-	-	16
รย.9 รถยนต์บริการธุรกิจ	2,769	1,109	817	-	695	1	-	85	-	-	-	62	-
รย.10 รถยนต์บริการทัศนาจร	1,548	374	273	-	853	2	-	29	-	-	-	17	-
รย.11 รถยนต์บริการให้เช่า	92	35	32	-	5	-	-	20	-	-	-	-	-
รย.12 รถจักรยานยนต์ส่วนบุคคล	19,722,287	19,718,660	-	-	-	-	-	-	-	3,557	-	70	-
รย.13 รถแทร็กเตอร์	385,549	-	385,549	-	-	-	-	-	-	-	-	-	-
รย.14 รถบดถนน	11,179	-	11,179	-	-	-	-	-	-	-	-	-	-
รย.15 รถใช้ในงานเกษตรกรรม	96,687	-	96,687	-	-	-	-	-	-	-	-	-	-
รย.16 รถพ่วง 2,939	-	-	-	-	-	-	-	-	-	2,939	-	-	
รย.17 รถจักรยานยนต์สาธารณะ	113,605	113,605	-	-	-	-	-	-	-	-	-	-	-
ข. รวมรถตามกฎหมายว่าด้วยการขนส่งทางบก	1,085,854	6,166	833,674	1,452	3,937	715	49,385	17,168	2,638	42	160,193	1	10,483
รวมรถโดยสาร	**138,677**	**5,163**	**100,747**	**651**	**3,644**	**82**	**10,695**	**17,070**	**413**	**25**	**33**	**-**	**154**
แยกเป็น - ประจำทาง	87,909	1,482	58,033	511	2,681	59	8,891	15,767	348	4	20	-	113
- ไม่ประจำทาง	39,387	3,642	31,526	131	959	18	1,712	1,295	44	19	12	-	29
- ส่วนบุคคล	11,381	39	11,188	9	4	5	92	8	21	2	1	-	12
รวมรถบรรทุก	**945,893**	**680**	**732,004**	**797**	**268**	**633**	**38,690**	**91**	**2,225**	**17**	**160,160**	**1**	**10,327**
แยกเป็น - ไม่ประจำทาง	221,234	43	116,763	95	35	97	20,191	17	1,028	2	78,270	-	4,693
- ส่วนบุคคล	724,659	637	615,241	702	233	536	18,499	74	1,197	15	81,890	1	5,634
รถขนาดเล็ก	**1,284**	**323**	**923**	**4**	**25**	**-**	**-**	**7**	**-**	**-**	**-**	**-**	**2**
รวมทั้งสิ้น	**34,272,176**	**23,993,768**	**8,526,574**	**25,678**	**1,075,948**	**5,502**	**61,424**	**313,708**	**5,393**	**3,637**	**163,132**	**51,333**	**46,079**

Annex VI: Logistic data

Table VI-1, *Thailand Logistic cost during 2001-2009*

Source: Logistic Database Development Group, 2010

ตารางแนบ 1: ต้นทุนโลจิสติกส์ และสัดส่วนต้นทุนโลจิสติกส์ ต่อ GDP ของประเทศไทย ระหว่างปี พ.ศ. 2543 – 2552p

โดย คณะทำงานพัฒนาข้อมูลโลจิสติกส์ สศช. ณ วันที่ 15 ธันวาคม 2553

Appendix 1: Thailand's Logistics Cost and Logistics Cost to GDP from 2000-2009p

By Logistics Database Development Working Group as of December 15, 2010

หน่วย: พันล้านบาท Unit: Billion Baht

	2544	2545	2546	2547	2548	2549r	2550r	2551r	2552p	
ต้นทุนโลจิสติกส์	2001	2002	2003	2004	2005	2006r	2007r	2008r	2009p	Logistics Cost
ต้นทุนค่าขนส่งสินค้า	506.7	480.7	498.0	518.0	602.0	691.2	754.5	826.4	746.5	Transportation Cost
ทางท่อ	5.5	6.2	6.0	7.1	8.1	8.6	3.4	1.2	1.2	Pipeline
ทางราง	1.9	1.9	2.1	2.2	2.1	2.3	2.2	2.4	2.0	Rail
ทางถนน	266.4	240.7	241.2	240.5	288.4	336.3	382.5	430.4	391.0	Road
ทางน้ำ	92.0	97.3	107.2	120.7	133.4	151.6	159.6	173.4	165.0	Water
ทางอากาศ	22.2	21.7	23.3	24.4	26.8	28.1	28.3	35.9	21.1	Air
บริการที่เกี่ยวเนื่องกับการขนส่ง	114.2	107.9	111.5	115.7	134.6	154.8	167.7	172.7	155.8	Transport-related services
บริการขนส่งสินค้าทางไปรษณีย์	4.6	4.9	6.7	7.4	8.6	9.5	10.9	10.5	10.4	Postal services
ต้นทุนการเก็บรักษาสินค้าคงคลัง	405.0	417.4	455.5	501.0	573.5	668.1	702.5	708.5	633.3	Inventory Holding Costs
ต้นทุนการถือครองสินค้า	402.6	415.1	452.4	497.1	569.9	662.9	696.8	702.0	627.3	Inventory Carrying Cost
ต้นทุนบริหารคลังสินค้า	2.4	2.3	3.2	3.9	3.6	5.1	5.7	6.5	6.0	Warehousing Cost
ต้นทุนการบริหารจัดการ	91.2	89.8	95.4	101.9	117.5	135.9	145.7	153.5	138.0	Logistics Administration Cost
ต้นทุนโลจิสติกส์รวม	1,002.9	988.0	1,048.9	1,121.0	1,293.0	1,495.2	1,602.7	1,688.4	1,517.8	Total Logistics Cost
มูลค่าผลิตภัณฑ์มวลรวมในประเทศ ณ ราคาประจำปี	5,133.5	5,450.6	5,917.4	6,489.5	7,092.9	7,844.9	8,525.2	9,080.5	9,041.6	Gross Domestic Product (GDP)

หน่วย: ร้อยละ ต่อ GDP Unit: Percent to GDP

สัดส่วนต้นทุนโลจิสติกส์ ต่อ GDP ของประเทศไทย	2544	2545	2546	2547	2548	2549r	2550r	2551r	2552p	Proportion of Logistics Costs to GDP
ต้นทุนค่าขนส่งสินค้า ต่อ GDP	9.9	8.8	8.4	8.0	8.5	8.8	8.9	9.1	8.3	Transportation Cost to GDP
ต้นทุนการเก็บรักษาสินค้าคงคลัง ต่อ GDP	7.9	7.7	7.7	7.7	8.1	8.5	8.2	7.8	7.0	Inventory Holding Cost to GDP
ต้นทุนการบริหารจัดการ ต่อ GDP	1.8	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.5	Logistics Administration Cost to GDP
ต้นทุนโลจิสติกส์ ต่อ GDP	19.6	18.1	17.7	17.3	18.3	19.0	18.8	18.6	16.8	Logistics Costs to GDP

ที่มา สศช. Source: NESDB

หมายเหตุ Remarks

ปี 2549 - 2551 มีการปรับปรุงข้อมูลของผลิตภัณฑ์มวลรวมภายในประเทศและต้นทุนโลจิสติกส์ ตามข้อมูลรายได้ประชาชาติ พ.ศ. 2552 There has been some information adjustment for the year 2006 to 2008 in accord to the National Income Data for 2009

Annex VII: Fuel economy standards

The DEDE, under the Ministry of Energy, presented the draft of fuel economy standards (DEDE, 2013) conducted by the Thailand Automotive Institute (TAI), which the Ministry of Industry aims to enforce as voluntary and mandatory standard in the future. This draft has gone through a public hearing once already and is currently (mid-2014) undergoing the amendment process. Two types of energy efficiency standards in cars are used: 1) Minimum Energy Performance Standard (MEPS) and 2) High Energy Performance Standard (HEPS). If MEPS could be enforced as a mandatory standard, new passenger cars that cannot comply with this standard would not be allowed to be sold in the market. Further step is to encourage car manufacturers to produce vehicles that pass HEPS (voluntary standard).

The table below shows the draft details of the MEPS. Cars are sorted into 21 categories according to their weight. The lowest value of MEPS at the minimum mass of empty car (commercially sold in the market) for a gasoline engine is 13.49 km/l while that of diesel engine is 11.62 km/l. For these two standards, the Ministry of Energy plans to implement car labelling standards for passenger cars that will be sold in the market to encourage consumers to use the energy efficiency vehicles.

Table VII-1*, *Draft Minimum Energy Performance Standard (MEPS)*

Mass of empty car (Ton)		Energy Efficiency (km/l)	
Mass more than	**Mass less than or equal to**	**Gasoline Engine**	**Diesel Engine**
0	0.38	-	-
0.38	0.44	-	-
0.44	0.495	-	-
0.55	0.61	-	-
0.61	0.665	-	-
0.665	0.75	-	-
0.75	0.865	-	-
0.865	0.98	13.49	-
0.98	1.09	12.81	-
1.09	1.205	12.15	-
1.205	1.32	11.45	-
1.32	1.43	10.75	-
1.43	1.54	10.07	-
1.54	1.66	9.38	11.62
1.66	1.77	8.62	11.14
1.77	1.88	7.92	10.69
1.88	2	7.21	10.22
2	2.11	6.44	9.69
2.11	2.28	5.71	9.19
2.28	2.51	4.59	8.40
2.51	-	3.05	7.27

Note: *This table is a draft version and has not been complied to any law or regulation of Thailand yet.

On 28th January 2014, the Ministry of Industry (MOI) published a Government Gazette no. 4584 "industrial standard: energy efficiency of motorcycles". This gazette has been enforced since 13th November 2013. This industrial standard is enforced on motorcycles whose unloaded mass is below 400 kg, maximum designed speed is above 50 km/h and cylinder capacity is between 50 cm3 – 150 cm3.

Table VII-2, *Minimum requirement of energy efficiency in motorcycles*

Source: Ministry of Industry Government Gazette No.4584, 2014

Type of motorcycle	Cylinder capacity (cm^3)	Energy Efficiency (km/l)
Manual Transmission (MT)	Not more than 120	37.5
	More than 120 but less than 130	39.0
	More than 130 but less than 150	38.5
Automatic Transmission (AT)	Not more than 110	39.0
	More than 110 but less than 120	32.5
	More than 120 but less than 150	31.5

Annex VIII: Transport and climate change policy making

In the past national policies did not take climate change in the transport sector into consideration and instead focused on the development and management of transport infrastructure. During the eighth (1997-2001) to the tenth (2007-2011) National Economic and Social Development Plans, developed by National Economic and Social Development Board (NESDB), these national plans addressed energy efficiency in the transport sector, which could implicitly address the reduction of GHG in transport sector (Country Report, 2010). The eleventh plan (2012-2016) explicitly mentions the reduction of greenhouse gas emissions from the transport sector. One of the strategies in the eleventh plan is sustainable natural resource and environmental management. The main strategy related to transport is to improve energy efficiency to reduce GHG emissions from the transport sector. Three measures are listed: 1) to encourage people and goods to use highly energy efficient transport modes, 2) to promote cleaner vehicles and 3) build discipline and promote environmentally-conscious travel behaviours.

Problems related to GHG emissions have been addressed in many policy and strategy-making meetings by the Ministry of transport in recent years. As the mission of the Ministry of transport is to develop, regulate, operate, and integrate transportation systems, the country's transport system is aimed by the Ministry to become efficient, accessible, economical, and fair. The Ministry of Transport has many dimensions to consider, from provision of accessibility to transport, the mobility of people and goods, and the efficiency of transport systems. The consideration of climate change has been addressed in the development of Ministry's strategies. However, GHG reduction is still not a direct necessity for consideration in transportation system development and operations. The National Transport Master Plan (1999-2006) focused on the development and management of the transport system so that transport demand is balanced with supply. The current National Transport and Traffic Master Plan (2011-2020) has the vision of "towards sustainable transport" and explicitly addresses GHG reduction as one of the strategies to promote energy efficient and environmentally sustainable transport systems. Two strategies included: 1) to encourage and support mode shift to rail and water transport, and 2) to promote and develop technologies to provide and to use clean and environmentally friendly transport systems.

The Office of Transport and Traffic Policy and Planning (OTP) conducted the Master Plan for developing a Sustainable Transport System and Reducing Climate Change or an Environmental Sustainable Transport Master Plan (OTP, 2012). The plan lists measures to reduce greenhouse gases from the transport sector as core business towards sustainable transport. The report compiled all investment projects as well as operational measures that could reduce GHG emissions. Many of the measures are related to strengthening of management, while only a few projects imply the attempt of GHG reduction. The calculation of potential benefits is also carried out but at the sketch analysis level with several assumptions.

The most recent policy by Ministry of Transport is the Thailand Transport Infrastructure Development Strategy (2013-2020)*, known as the "2.2 Trillion Baht Borrowing Bill for the Government Infrastructure Project". The strategy focuses on the investment on several ambitious transport projects that would leverage a new face to Thailand. The strategy compiles

all development investments in transportation, covering all modes of transport. The biggest investment will be on rail transport: urban rail transit, doubling railway tracks, and new high speed train projects. The strategy mainly focuses on economic growth but the investment on rail transport has implication on GHG reduction (mode shift). Three basic strategies of the infrastructure plan are:

1) Shifting cargo and passengers from the land transportation toward rail and water transport. The investment budget for this strategy is 400 billion Baht (18% of the total).
2) Developing basic infrastructure and products/services that facilitate travel and transport via regional centers within Thailand and enhance connectivity among neighboring countries with the investment budget of 1 trillion Baht (52% of the total). This investment will help develop four high-speed train routes, and facilities enhancing cross-border trade.
3) Improving Thailand's transportation system and enhancing mobility with the investment budget of 600 billion Baht (30% of the total). This strategy includes developing electric-powered trains to improve mass transit in urban areas and developing connectivity and linkages between domestic centers for business and trade.

Thai government gives three reasons for using 2.2 trillion Baht Borrowing Bill Instead of the annual budget allocation.

1) Without 2.2 trillion Baht borrowing bill, the government is forced to increase the deficit in the regular budget. This will not allow the government to achieve the balanced budget, which the government is committed to attain by 2017.
2) The public debt to GDP ratio will remain under 60% under this bill.
3) The 2.2 trillion Baht borrowing bill will allow the infrastructure project to remain continuous and transparent during the 7 year investment schedule, which will help the private sector plan their future trade and investment. (Ministry of Foreign Affairs, 2013)

Ministry of Energy (MOE) also pays attention to energy consumption in transport sector and its impact. They consider the greenhouse gas as an output from transport sector. Ministry of Energy developed a Master Plan called National Energy Efficiency Plan or 20-years Energy Efficiency Plan (EE Plan) to consider the roadmap for Thailand towards more efficient energy use. Transport is one of the sectors that use a lot of energy and have room for energy efficiency improvement. In the plan, three groups of measures were proposed; 1) Improve fuel efficiency of vehicles, 2) More energy-efficient travel by mode shifts, and 3) Transport Demand Management (TDM)

*As of March 2014, the 2.2 Trillion Baht Borrowing Bill was rejected by the constitution court of Thailand. More information about this can be found at http://www.bangkokpost.com/learning/work/399500/what-new-in-business-news-march-12-2014. Moreover, National Council for Peace and Order (NCPO) approved 3 trillion Baht infrastructure development projects excluding high-speed trains for the years 2015-2022 on June, 2014. More information is described in http://englishnews.thaipbs.or.th/ncpos-economic-board-approves-3-trillion-baht-infrastructure-projects.

Annex IX: Overview of relevant existing transport policies and measures

Table IX-1, *Existing policies and measures, as of August 2014*

Category			Policy / measure	Implementation period	Main responsible organisation(s)	Description	Status ***	Assessment / remarks
ASI (G) *	Passenger/ Freight	Type of policy instrument **						
I/G	P/F	E	CO_2 based fuel pricing / taxation systems	1 January 2016	Excise Department	New excise tax for passenger cars, vans, and pick-up trucks will be based on CO_2 emission. Moreover, tax incentive is imposed to E85 and hybrid vehicle. The range of the tax has changed from 17%-50% to 10%-50%. Taxation base has also changed from engine sizes-based to CO_2 emission-based.[8]	Implemented. Law is passed and announced in 2013	This tax is for new purchase and does not apply to in-use vehicles. The range of CO_2 emission is fixed, thus may cause disincentives for further improvement. This CO_2 tax is imposed to new vehicle purchase.
G	P/F	E	Fuel subsidy reduction		Ministry of Industry	The government fixed the LPG for domestic use at 18.13 Baht, diesel at 29.99 Baht. In 2013, the price of LPG for transport sector gradually increased to reflect the cost of production.	Ongoing	Fuel subsidy benefits some consumers, including the poor. However, the wealthy are the greatest users of all types of subsidized fuels, which lead to overconsumption. A more economically approach would be to tax dirty fuels rather than subsidize clean fuels.
A	P	E	Road pricing		Ministry of Transport (MOT)	The inner area of Bangkok city is subject to entrance fees. This issue has long been mentioned but no further action takes place.	Not Intended in the near future	No definite policy and plan for road pricing in Thailand.

[8] See Annex 1

Category			Policy / measure	Implementation period	Main responsible organisation(s)	Description	Status ***	Assessment / remarks
ASI (G) *	Passenger/ Freight	Type of policy instrument **						
G	P/F	R	Integrated land-use planning		Bangkok Metropolitan Administration (BMA), Department of Town Planning, Ministry of Interior	Transport planning is carried out as a part of land use planning. However, the common practice does not much consider both transport and land use together. The results of land use and transport are not fully integrated.	Not Intended in the near future	The land use pattern and land use control is difficult and the transport/land use is not optimized.
G	F	I	Certification system for low-carbon companies (Voluntary carbon reduction program)		Thailand Greenhouse Gas Management Organization (TGO)	TGO is promoting the efficient carbon activities. At the moment the activities cover carbon footprint for products and companies. TGO has moved onto carbon offsetting. Lately, the carbon offset certification system is on-going. Although the current certification areas are not in transport, few transport certification projects are studied.	Studied	The voluntary carbon reduction in the transport sector with private companies was studied, mainly involved with truck companies.
G	P/F	I	Emissions monitoring system	Since 1999	Pollution Control Department	Emissions from transport are monitored. Laboratory tests on vehicle emissions are also conducted on a regular basis. Roadside monitoring is conducted at limited locations.	Implemented	The data are collected but the national statistics are not reported.
A	P	E/R	Parking management		Municipalities	Currently, parking is mainly provided by private developers. Commonly, parking space is provided as a part of the building construction. Parking is intended for customers of the development. Public parking garage is not common practice in Thailand. On-street parking is provided. This parking is	Not intended in the near future	Since parking is provided by private owners, the management of parking is little done. No major policy on parking management. For on-street parking, parking violation is often seen as enforcement is lacking.

Category			Policy / measure	Implementation period	Main responsible organisation(s)	Description	Status ***	Assessment / remarks
ASI (G) *	Passenger/ Freight	Type of policy instrument **						
						managed by municipalities. Parking is mainly banned on major streets and restricted on minor streets.		
A	P/F	I/Inv	Intelligence Transport system (ITS)		MOT, Municipalities, Automotive sectors	ITS is considered to increase safety and mobility of travellers and the movement of goods. An indirect benefit is to improve transport efficiency and thus reducing GHGs. ITSs that could contribute to GHG reduction includes traffic management (traffic control), traveller information (driving information), eco-driving, and traffic enforcement. To some degree, ITS is employed and assists travellers for their optimized travel decision. Traffic information lets drivers avoid congestion. Public transport information system increases quality of services. The usage of these information systems is increasing. Also, the improvement of traffic management increases mobility, and reducing traffic disruption. In 2013, MOT drafted a plan to adopt ITS for relieving traffic congestion. The ICT master plan of MOT aims at enhancing the accessibility of the traffic information via mobile platforms. Moreover, the Transport Single Window e-Logistics will be introduced to improve the import-export services.	Planned.	The scope of traffic information is limited to the Bangkok area. Through coordination with other non-government organizations, the service is advanced and expanded throughout the country. The service expansion is promising as the traffic information can be accessed through internet and mobile phone. The existing traffic control systems are employed in 6 cities and will expand more in the near future. Information about bus route can be reached from internet and mobile devices. The next generation of buses will have bus tracking, which could allow better transit management and traveller information.

Category			Policy / measure	Implementation period	Main responsible organisation(s)	Description	Status ***	Assessment / remarks
ASI (G) *	Passenger/ Freight	Type of policy instrument **						
A	P	R/E	Transit-Oriented Development (TOD)		Mass Transit Authority of Thailand (MRTA)	The common practice does not much consider both transport and land use together. The results of land use and transport are not fully integrated. The TOD concept has been used for the design of new urban rail transit stations.	Planning	The scope of the TOD is limited to only surrounding stations where land can be acquired by MRTA land acquisition law.
A	P	E	Parking pricing			Currently, the parking fee is set by individual parking facilities. Most major shopping and business offices pay parking to their customers some with minimum spending at their stores.	Not intended in the near future	This measure is not applied in Thailand, partly because there is not a direct regulation and authority to consider and implement it.
S	P	E	Public transport fare level/ structures		Bangkok Mass Transit Authority (BMTA), Mass Transit Authority of Thailand (MRTA)	Fare is regulated by the government or through an agreement. Fare is regulated on bus, subway, train, skytrain, boat, taxi, and BRT. Fares are regulated to maintain the level of fare for social equity. From 2008, the government announced free selected buses in Bangkok and trains throughout the country. BRT reduces fare to attract more riders.	New fare level is not intended in the near future	The free bus fare does not produce much demand shifted from private passenger travel. The low fare arguably causes low quality of service. Free transit is operated mainly for selected non-air conditioned buses Bangkok and on non-air conditioned trains. There is no perceivable benefit on GHGs due to free transit. Moreover, the fare is regulated on only conventional buses, rails, and boats, not other modes such as vans, motorcycle taxis. Although the fare level is constantly considered, there is no plan to systematically revise the

Category			Policy / measure	Implementation period	Main responsible organisation(s)	Description	Status ***	Assessment / remarks
ASI (G) *	Passenger/ Freight	Type of policy instrument **						
								entire public transport fare structure and incorporate informal modes into consideration.
S	P	E	Incentives for public transport (PT) investments (operations)		MOT	In Thailand, bus, van and boat are each owned and operated by the private sector.	Not intended in the near future	No specific incentive to promote PT. Currently, the private sector can invest in and operate taxis, city and intercity buses and van, and boat. They are fully regulated by the government. Informal transport such as motorcycle taxis and private taxis are not regulated and thus are not obligated to any incentive.
S	P	R/Inv	Bike sharing	Since 2012	Bangkok Metropolitan Administration (BMA)	Bike sharing introduced in downtown Bangkok through the "Punpun" project. There are currently 49 stations covering approximately km² area. Short-term rental is free for the first 15 minutes and subject to charge by time basis. In the initial stage, the total number of bikes is 500. The project aims to set up 1,000 stations in the next few years (Pun Pun, 2014).	Partially implemented	Currently the demand for bike sharing is not great. The purpose of the usage is mainly to connect activities in central business district.
S	P	R	Car sharing				Not intended in the near future	
S	P	R	Non-Motorised		BMA, Municipalities	Walking path and PT supported facilities are a regulation for building and public utilities	Not intended in the near future	Usage control on NMT facilities is crucial as the existing NMT is

Category			Policy / measure	Implementation period	Main responsible organisation(s)	Description	Status ***	Assessment / remarks
ASI (G) *	Passenger/ Freight	Type of policy instrument **						
			Transport (NMT), PT friendly building regulations			code. The development of road system needs to conform to the standard. However, the sub-standard walking path and PT facilities are often seen. Moreover, the usage control is minimal. In the 2000s, there was an attempt to revise the building code PT promotion. Buildings that were built near rail stations were subject to exempt from providing parking spaces. Moreover, taxi parking was required in new development. This revised regulation has not been successfully approved.		difficult to walk.
S	P	R	Three in one policy/high-occupancy vehicle lanes		BMA/Traffic Police	High-occupancy vehicle lanes were introduced	Implemented but discontinued	Cancelled because the police could not enforce restrictions.
A	P	E	Regulatory and physical restrictions on car use		Municipalities	Car uses are banned to pass a certain area.	Not intended in the near future	
S	P	I	Real-time public transport information		BMTA	Information about bus routes can be reached from the internet and mobile devices. The next generation of buses will have bus tracking, which could enable better transit management and traveller information	Partially implemented	The current public transport information is not real-time. The next generation should include real-time public transport information and multimodal connection with more meaningful information, such as

Category			Policy / measure	Implementation period	Main responsible organisation(s)	Description	Status ***	Assessment / remarks
ASI (G) *	Passenger/ Freight	Type of policy instrument **						
								arrivals. The public transport information is implemented only in Bangkok and only on BTMA owed buses.
A/S	P	I	Campaigns			Several organizations made campaigns for reducing solo car usage, and promote Public transport usage	Implemented	The amount of campaigns is not large. Some carried out campaigns but were not effective, as they are not constantly implemented.
S	P	R	Master planning for PT/NMT		MOT, BMA	A master plan for urban rail transit system in Bangkok was developed by the MOT. The BMA also developed a master plan for public transport and bicycle systems. Most cities have a transport master plan. A master plan on sustainable transport for Thailand has been studied.	Planned	Master plans mainly aimed at the infrastructure development of public transport. Future network of urban rail transit and Bus Rapid Transit (BRT) system in Bangkok are made.
S	P	R	Bus route optimisation and prioritisation		BMTA, BMA	Bus routes are developed and optimised by the BTMA. One 16-km BRT line in Bangkok also has priority at signal junctions.	Partially implemented	Although the bus network system was developed, it was not optimised. Buses have no priority system, unlike the BRT.
S	P	R	Integrated ticketing		MRTA, BMA, BMTA	A common electronic ticket is planned for major public transport in Bangkok. A single ticket can be used on most public transport.	Planned	Urban rail system in Bangkok is expected to have a common ticket. At the moments, the date of implementation is unknown.
S	P	R	Mixed-use		Department of Town	A concept of mixed-use planning is used in land use plans. Land use development in the	Intended	The mixed-use planning is limited due to current practice in land use control.

Category			Policy / measure	Implementation period	Main responsible organisation(s)	Description	Status ***	Assessment / remarks
ASI (G) *	Passenger/ Freight	Type of policy instrument **						
			planning		Planning	public transport area is planned around the green MRT line at Rangsit-Nakorn Naiyok.		The major development with mixed-use planning has not been realised.
S	P	Inv	Cycling infrastructure	Ongoing	Municipalities	Bicycle lanes are introduced on many streets in Bangkok and other cities. The lanes can be exclusive, shared with vehicles, or pedestrians. Many municipalities provide bicycle parking and bicycle racks on the selected areas. Moreover, the Government Cabinet acknowledged the resolution on *Systems and Structures for Promotion of Walking and Cycling in Daily Life* on November 19, 2013, and assigned relevant agencies to implement it.	Partially Implemented	Many of the bicycle lanes are virtually ineffective. They are not linked as a network and to major destinations. The enforcement is minimal. Many of them cannot be used due to on-street activities.
S	P	Inv	Park and ride		MRTA	Park and Ride facilities are planned and constructed at many urban rail transit stations. Existing park and ride facilities attract rail usage. Fare reduction is made for rail riders. Park and ride can be done at some shopping establishment, as people can connect to bus/van.	Implemented	Currently, park and ride is popular as observed from full parking space in most of day at some locations.
S	P	Inv	Walking infrastructure		Municipalities	Sidewalk is basic provision on most streets in cities. Walking paths are also provided as a basic access way in many areas.	Partially Implemented	Although many of sidewalks are in good condition, still many of them are not. The physical layout of the sidewalk with existing utilities can sometimes impossible to walk effectively. Many of streets, especially

Category			Policy / measure	Implementation period	Main responsible organisation(s)	Description	Status ***	Assessment / remarks
ASI (G) *	Passenger/ Freight	Type of policy instrument **						
								small streets do not have separate walking paths. The major impediment of walking is also the activities on the sidewalk. Vendors and uses by adjacent land owners are commonly seen.
S	P	Inv	Non-urban rail improvements		State Railway Authority of Thailand (SRT)	Existing railway is subject to be improved; doubling tracks, provision of train units, train interior and service improvement. Currently only 200 km out of 4000 km of railway line have double track. The train engines are lacking and result in irregular operations. In a longer term, some lines are extended to connect with neighbouring countries.	Planned	Although the national railway system with double tracks has been planned and approved for budget for some time, the improved system is realised due to slow process of improvement.
S	P/F	Inv	High-speed rail infrastructure		MOT	High-speed rail is intended on 4 routes covering 1,500 km. This is a new proposed scheme to promote prosperity of the nation. The 4 lines are introduced by policy makers. These investment projects are a part of Vision Thailand 2030 "2.2 trillion Baht investment plan" and the studies are underway.	Intended, Studied	The projects arguably need to accurately estimate demand for travel (passengers and freight) and cost in order to consider economic viability. The routes are parallel to existing railway and other major transport modes. See Annex VIII for more information about the 2.2 trillion Baht investment plan.
S	P	Inv	Urban PT infrastructure		MRTA, BMA	Urban rail transit network is planned in Bangkok. Twelve lines of PT have the total	Studied, Planned, Partially	Experience on the existing two lines show that the ridership is increasing

Category			Policy / measure	Implementation period	Main responsible organisation(s)	Description	Status ***	Assessment / remarks
ASI (G) *	Passenger/ Freight	Type of policy instrument **						
						length of 467 km. Currently, two lines and one Airport rail link are already in operation (80 km). The urban rail transit development is also a part of Vision Thailand 2030. Moreover, the BMA conducted studies on some rail transit, mainly monorail and light rail and extension of the existing rail system. The purpose of these lines is to supplement the planned network and increase circulation. A total of 5 lines are planned. The first BRT line has been operating since 2012. The other four lines in the BMA Action Plan on Global Warming Mitigation 2007-2012 are Mor Chit line, Don Muang line, Minburi line, and Bangan line.	implemented	although the amount is not as much as planned. The BMA BTS system is popular and becomes crowded on most days. The Blue line "subway" also experiences crowded operation during peak periods. The constructions of new lines are underway, but it is likely that the entire network is subject to delay.
I	P/F	E	Tax incentives for efficient vehicles		Ministry of Industry, Ministry of Finance	Ministry of Industry promotes efficient car or called "eco car". The eco cars are fuel efficient and low emission small passenger vehicles. The vehicles have tax incentives and result in low purchase prices. Another popular campaign from the Ministry of Finance is the "first car" program. People who buy the first car from a list of mostly eco cars and pick-up trucks are eligible for an income tax reduction. The reduction is as much as 100,000 Baht ($US 3,300)	Implemented	The eco car and first car program increase a lot of cars and create many new car users. The totals of 1.25 million vehicles are booked within one year of this program. The new cars arguably create captive drivers and traffic congestion. Moreover, it affects individual expenditure as many cannot find enough money to pay. Thus, tax incentives on vehicle purchase arguably worsen traffic

Category			Policy / measure	Implementation period	Main responsible organisation(s)	Description	Status ***	Assessment / remarks
ASI (G) *	Passenger/ Freight	Type of policy instrument **						
								condition and consequences. It also impedes the mode shift effort.
I	P/F	E/R	Import restriction for inefficient vehicles			Regulation, Tax, and other barriers not to favour inefficient vehicles/parts	Not intended in the near future	
I	P/F	E/R	Vehicle scrapping/fleet replacement			Planning for scrapping old or unused vehicles.	Not intended in the near future	Thailand has no policy on vehicle scrapping.
I	P/F	E	Fuel economy/ emission standard			A standard setting for fuel economy of vehicles. A standard setting for fuel economy of motorcycle has enforced in 2014. Standards for other type of vehicles are going to be developed.	Partially implemented/ planned	The improvement of fuel economy is listed in the energy efficiency master plan (2011-2030) but no actual effort is made now.
I	P/F	R	Inspection and maintenance		Department of Land Transport, MOT	Vehicles are subject to inspection. Each type of vehicle has a different period of inspection. Private vehicle inspection tests vehicle safety, and emission (CO, HC) after 7 years of purchase. Public transport vehicles and taxis are inspected twice a year. I/M is outsourced to private operators.	Implemented	Many operators are dishonest and produce insincere results. Lately, the government announced monitoring system to make sure that the vehicles are actually inspected and reported.
I	P/F	R	Speed limits/ management		Road authorities	Speed management is a routine operation by traffic police officers. Speed is managed to speed limit compliance. The violator is subject to a fine. Speed enforcement is conducted	Implemented	The speed limit is aimed for mainly safety. The scope of enforcement is still

Category			Policy / measure	Implementation period	Main responsible organisation(s)	Description	Status ***	Assessment / remarks
ASI (G) *	Passenger/ Freight	Type of policy instrument **						
						manually and routine checking is periodic. No automated speed enforcement in the national highway system. Only one automatic speed enforcement is installed on newly opened expressways.		limited. Speed violators are common and widely seen.
A	P/F	R	Low-emission zones		BMA	The high emission zones (pollution) were monitored and traffic was instructed to avoid those areas by traffic information signs.	Partially implemented. Discontinued	This was traffic campaign to avoid basically high air pollution area. The campaign has been discontinued for about 10 years.
I	F	I	Eco driving	2008-2012	Federation of Thai Industries/Ministry of Energy	The institute of industrial energy promotes efficient use of energy in the transport sector. The target is efficient truck operations. The promotion includes incentives on energy efficient equipment, assistance on logistics operation management, training on fuel-saving driving, backhaul management. The pilot project has been implemented for 2 phases. 100 freight companies participated in each phase. Pilot projects of both phases were funded by the ENCON fund.	Implemented	Several industries and logistics companies participated in this campaign. The fuel efficient driving implies eco-driving. The target is only truck operations.
I	P/F	I	Traffic information	2009-now	Intelligent Traffic Information Center Foundation	Traffic information is provided to travellers, in form of congestion map and incident information. Travellers can optimize their travel decision by avoiding congested areas and selecting proper route, mode, and	Implemented	The scope of the service is still limited to Bangkok and will spread to nearby and other big cities. The access to this information is easy. The service now is mainly for urban

Category			Policy / measure	Implementation period	Main responsible organisation(s)	Description	Status ***	Assessment / remarks
ASI (G) *	Passenger/ Freight	Type of policy instrument **						
						destination. The information can be accessed by in-vehicle devices or internet. Incidents impacting traffic conditions are also reported. This information is real-time as data come from several sources in a timely manner. The service is now in Bangkok but has gradually spread to major cities. The information is provided free-of-charge to travellers. The service utilizes available data from several organizations. The service is run by a non-profit organization.		travel. More area coverage of real-time data will benefit long-distance operations of passengers and freight.
I	P	I	Car labelling	2006-now	Ministry of Energy, and Ministry of Finance	In 2006, Energy Policy and Planning Office studied the fuel efficient label. Some cars displayed the labels but not all and the label was discontinued. Currently, the Excise Department has studied the car labelling indicating the fuel efficiency and/or CO_2 emission. The focus is on passenger car and pick-up trucks.	Studied/planned	The recent study is underway. If proceeded, the car labelling will be announced in 2016.
I	P/F	R	Traffic control/ traffic flow improvement		Municipalities, Traffic police	Traffic control is installed by municipalities and is operated by traffic police. Traffic control by signals is popular. However, the system is either pre-timed or manual control. Some big cities employ advanced traffic signal control and can optimise the flow. Currently, 6 cities have this urban traffic control (UTC). Bangkok used to	Implemented	UTC is a basic requirement for traffic management in urban areas. Investment in UTC is needed to cope with highly saturated and varying traffic conditions.

Category			Policy / measure	Implementation period	Main responsible organisation(s)	Description	Status ***	Assessment / remarks
ASI (G) *	Passenger/ Freight	Type of policy instrument **						
						have the UTC but now it is discontinued.		
I	P/F	E	EV/hybrid/ Hydrogen infrastructure			Metropolitan Electricity Authority and Provincial Electricity Authority have studied and partially implemented EV charging station infrastructure. Some EVs are acquired and charging stations are built. Hybrid vehicles are sold by few manufacturers. Some tax incentives are given. 16 public pilot EV charging stations in Bangkok and its vicinity were launched in 2013.	Not intended in the near future	Currently the Thai government does not have any policy to support nationwide electric vehicle production and sales. Six charging stations exist in Bangkok and its vicinities.
I	P/F	E	Low carbon fuel (1st/2nd gen Biofuel, CNG, LPG) incentives	2012-2021		The Renewable and Alternative Energy Development Plan for 25 Percent in 10 Years (AEDP 2012-2021) aims to promote renewable energy as one of the country's major energy sources. The strategy to promote this plan includes: encouraging the community to collaborate efforts; adjust incentive measures on investments relating to renewable energy; changing relevant laws; promoting public relation; and endorsing research and development.	Partially implemented	The Alternative Energy Development Plan (AEDP 2012-2021) has a new consumption target for ethanol, biodiesel, and new fuels for diesel substitution at 9 million liters/day, 5.97 million liters/day, and 25 million liters/day respectively.
A	F	R/Inv	Pipelines		PTT Plc.	PTT, a major energy company has expanded the gas pipeline to major development. Recently, a study was conducted on the expansion of the gas pipeline to CNG service	Partially implemented	This company expanded its CNG distribution. The pipelines along the major road network serving CNG gas stations are considered.

Category			Policy / measure	Implementation period	Main responsible organisation(s)	Description	Status ***	Assessment / remarks
ASI (G) *	Passenger/ Freight	Type of policy instrument **						
						stations.		
A	F	R	Empty hauling reduction	2004	DLT, FTI	DLT opens Thai truck centre website to promote customers matching with empty haul. The website includes basic information of truck companies, maps, accidents, and available empty hauling. FTI also promotes business cooperation and matching empty hauling among their alliance.	Implemented	A study indicated that the backhauling can result in reduction in empty haul, but the amount is not great, as the number of users is limited.
A	F	R	Improve logistics centres and their location		DLT	The private logistics centres are established by individual companies. Government owned truck and logistics centres are planned and developed. Currently three truck terminals are around Bangkok area. DLT has a plan to construct 15 more logistics centres throughout the countries.	Planned	The three truck terminals are utilized. They are successful to a certain degree, as Bangkok restricts heavy trucks to enter the city during the day. Another 15 logistics centres are a part of Vision 2030 Transport infrastructure development plan.
S	F	E	Lorry restrictions	2003	Traffic Police	Heavy trucks (lorry) are not prohibited in Bangkok city during 6:00-21:00. Six-wheeled trucks are prohibited during 6:00-9:00 am and 4:00-8:00 pm. Ten-wheeled trucks are prohibited during 6.00-10.00 am and 3.00-9.00 pm. Other trucks are prohibited during 6.00 am-9.00pm. Six- wheeled (or more) trucks that contain gas or other flammable substances are prohibited during 6.00 am – 10 pm	Implemented	The restriction lesson traffic congestion during the day. The scope is only in Bangkok inner city area.
S	F	R	Master			A part of Vision Thailand 2030 Transport	Planned	.

Category			Policy / measure	Implementation period	Main responsible organisation(s)	Description	Status ***	Assessment / remarks
ASI (G) *	Passenger/ Freight	Type of policy instrument **						
			planning for rail and water			infrastructure development plan, rail and water are put high priority. The rail transport includes regular train with double tracks, high speed trains, and urban rail transit. The water transport focuses on the river and coastal transport port construction. The aim is to shift mode from road to rail and water.		
S	F	Inv	Multimodal facilities/dry ports	1995		The Inland Container Depot (ICD) is situated between Bangkok city and a major port. It is also close to the airport. ICD transfers goods to and from ports and airports, and connects to roads and rails. ICD serves customs and quarantines, and can accommodate 1 million TEUs.	Implemented	
I	F	R	Tyre standards			Under development by DEDE	Not intended in the near future	
I	F	R	Aerodynamics standards				Not intended in the near future	

Note: * A: Avoid; S: Shift; I: Improve; G: General measures
** E: Economic; R: Regulatory: I: Information: Inv: Infrastructure investments
*** Status of current policies; scope could be expanded or standards tightened in the future

Annex X: Stakeholders

Table X-1, *Stakeholders in Thailand*

Type	Name	Role
Governmental organisation	Office of Transport and Traffic Policy and Planning (OTP)	▪ Proposes policies and plans in the transport and traffic sector and assesses the implementation of such policies and plans. ▪ Focuses on master plans for sustainable transport and climate change mitigation. ▪ Screens suitability of work plan and land transport system management project before submitting to the Office of the Commission for the Management of Road Traffic. ▪ Provide the report and conduct research concerning transport, traffic, safety and environment in the transport sector.
	Department of Land Transport (DLT)	▪ Systematize and organize land transport system by controlling, supervising, verifying and ensuring land transport users to act accordingly with transport law. ▪ Coordinate and plan for the connection between land and other transport systems in order to allow the land transport system to be more convenient, fast, accessible and safe. ▪ Cooperate and coordinate with relevant national and international organisations in the land transport sector as well as in topic-related conventions and international agreements.
	Energy Policy and Planning Office (EPPO)	▪ Transport related work of EPPO is to provide funding, such as the Energy Conservation and Promotion fund or ENCON fund, for energy efficiency, renewable energy and strategic management related activities for governmental and private organisations.
Governmental organisation	Department of Alternative Energy Development and Efficiency (DEDE)	Transport related works of DEDE: 1) To support and promote the clean energy production and consumption that is consistent with the situation of each area in a cost effective

Type	Name	Role
		and sustainable way. 2) Goal to reduce energy consumption in the land transport sector.
	Pollution Control Department (PCD), Ministry of Natural Resources and Environment	▪ To control, prevent, reduce and eliminate pollutions including air pollution in the land transport sector. ▪ Increase the efficiency of environmental law compliance and enforcement. ▪ Develop environmental quality management plans and measures to control, prevent, and mitigate environmental pollution.
	Office of Natural Resources and Environmental Policy and Planning (ONEP)	▪ Responsible for making appropriate policy concerning climate change issues ▪ Engaging with the national policy and short-term strategies on climate change, and has been developing a draft climate change master plan as a long-term strategy ▪ Co-working with the TGO on shaping the country's direction on NAMAs. ▪ Act as the national focal point of climate change to the UNFCCC
	Bangkok Metropolitan Administration (BMA)	▪ Ensure safety in transport and reduce negative effects on the environment in Bangkok. ▪ BMA has recently launched a public bicycle project "Pun Pun" which provides smart bikes services in the various areas of Bangkok.
Public organisation	Thailand Greenhouse Gas Management Organization (TGO)	▪ TGO is an autonomous governmental organization under the Ministry of Natural Resources and Environment with the specific purpose to act as an implementing agency on greenhouse gas emission reduction in Thailand. ▪ Enhancing the capacity building of the government and private sectors on greenhouse gas management ▪ Promoting and supporting all activities related to climate change mitigation

Type	Name	Role
	Mass Rapid Transit Authority of Thailand (MRTA), Ministry of Transport	▪ Operate the mass rapid transit in Bangkok and its vicinity ▪ Study, analysis and formulate the project and its plan in concerning to the mass rapid transit regarding to improve and modernize.
Private sector	Bangkok Mass Transit Authority (BMTA)	▪ Support and provide solutions for traffic and environmental problems occurring in Bangkok which includes using clean energy in mass transit system.
	The Institute of Industrial Energy (IIE)	▪ Provides services for its member and general industrial factories for the conservation of energy especially in medium and small industrial factories. ▪ IIE cooperates with ADB on the "Green Freight Initiative" project. Other initiatives from the IIE include "Reducing Energy Consumption in Transport Sector" project, a pilot project for "Logistic Cost-Saving". The two last projects are being developed and are funded by the ENCON fund. ▪ Another project is the Logistics and Transport Management (LTM) project. This project, funded by ENCON fund, provides technical advices to freight transport companies.
	Thailand Automotive Institute (TAI)	▪ The scope of responsibilities includes research and technology development, productivity improvement, product design standard and product testing, training and consultancy, guideline recommendation, policy, strategic planning, and measures to develop the automotive industry
	The Thailand Research Fund (TRF)	▪ Assist in the development of researchers and research-based knowledge through permitting research grants and assisting with research management including the transport sector
Academia/ grant institutions for transport research	National Research Council of Thailand (NRCT)	▪ Focuses on management of national research, supporting well-directed research, standardizing quality of research and connecting databases of researches within the country. NRCT also supports researches on transport which fall into its focuses.

Type	Name	Role
	Asian Transportation Research society (ATRANS)	▪ A non-profit research institution conducting empirical and pragmatic research approaches of various transportation related problems. ▪ ATRANS provides grants for researches falling into two criteria; 1. Transportation and safety 2. Social problem, energy and environment. "Development of Harmonized Energy Demand Model for Road Transportation with GHG Prediction in Thailand" and "Automatic Eco-Driving Behaviour Guide System in Motorcycle for Reduction of Emissions and Fuel Consumption" are examples of research supported by ATRANS.
	Academia	▪ Some academic institutions work on transport and climate related issues. These institutions include AIT, Chulalongkorn University, JGSEE, Kasetsart University, MTEC, Ramkamkeng University, SIIT

Annex XI Donor mapping

- ADB Thailand and ADB/GMS: Some on-going projects of ADB Thailand are: "Supporting railway sector reform" and "Improvement of railway passenger service". For ADB/GMS, a "Green Freight Initiative" will commence official activities plans in 2013. GMS will cooperate with the Institute of Industry Energy (IIE), part of the Federation of Thai Industries (FTI), to start the pilot project composing of three schemes focused on small and medium size enterprises (SME). These schemes are:

  1. Financial programme for freight SME: The programme provides financial support for purchasing equipment that can increase energy efficiency for trucks such as idle stop, tire, etc.
  2. Training for eco-driving: Training courses will be developed for truck drivers for better understanding of eco-driving.
  3. Reduction of empty haul trip: The project will initiate the load matching scheme to reduce empty trips.

  In the future, GMS aims to expand these schemes by submitting them to the ENCON fund from the Ministry of Energy for financial support. Moreover, GMS and local counterparts will establish "The Green Freight Center" to provide additional services to freight operating companies to make their operations fuel efficient and reduce operating costs and GHG emissions. A national steering group will be set up to direct the project and monitor the effectiveness in reducing fuels and carbon emissions.

- EU: Under the project "Sustainable Improvement of Road Traffic Safety by Establishment of the EU-Asia Road Safety Centre of Excellence in Thailand – "RoSCoE"" (2011-2013) EU commission focuses on:

  1. Establishment of road safety centre of excellence, a hub for education training and research on the issue at Prince of Songkla University, Southern Thailand;
  2. Granting scholarships for PhD students specializing in road safety;
  3. Sharing international technology and knowledge on highway design and developing six road design guidelines

- GIZ: Under the regional programme "Cities-Environment-Transport" (CET), the project "Energy Efficiency and Climate Change Mitigation in the Land Transport Sector in the ASEAN Region" or in short Transport and Climate Change (TCC) aims to provide support for the development, implementation and monitoring of strategies and action plans towards the improvement of energy efficiency and the reduction of greenhouse gas emissions in the land transport sector at the regional and national level.

- JICA: Related projects such as "Capacity Development on Climate Change Mitigation/Adaptation in the Southeast Asia Region" (2013-2015). The project cooperates with the Thailand Greenhouse Gas Management Organisation (TGO) with its aim to establish the Climate Change International training Center (CITC) that provides capacity development on the topic for relevant stakeholders in the ASEAN region. Other on-going projects involved with transport are loan projects such as "Mass Transit System Project in Bangkok (Purple Line) (I) with MRTA", "Mass Transit System Project in Bangkok (Red Line) (I) with SRT" and "Mass Transit System Project in Bangkok (Purple Line) (II) with MRTA".
- IGES: Promotes sustainable development in Asia and the Pacific, provides assistance for the effective operation of networks as well as coordinating collaborative research with international, regional and national organisations and research institutes. IGES provides capacity building involving with environmental issues as well as strategic research programme. The previous research programme focused on biofuels. IGES has a focus on climate and energy in the next phase of the strategic research programme.
- USAID/RDMA funds LEAD Program with the aim to help prepare developing Asian countries to access available financing and identify necessary elements of such preparations such as the improvement of GHG inventory systems and accounting, participation in carbon markets and MRV of emissions reductions.
- UNDP: Co-work with international and local partners on the project "Thailand's Low Emission Capacity Building (LECB): enhancing capacity and readiness for Nationally Appropriate Mitigation Actions (NAMAs)" with the aim to provide public and industry sector capacities to design and implement Low Emission Development Strategies.
- World Bank: Currently provides an additional International Bank for Reconstruction and Development (IBRD) loan to "The Thailand Highways Management Project (HMP)" that gives financial support for the widening of five national highway sections from two lanes to four lanes. Another on-going project concerning transport is the "Chiang Mai Sustainable Urban Transport Project" with the focus on climate change, municipal governance and institution building and regulation and competition policy.