Malaysia Stocktaking Report on Sustainable Transport and Climate Change

Data, Policy, and Monitoring

asean
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DEUTSCHE ZUSAMMENARBEIT
Implemented by:
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MOT

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The project context

The GIZ Programme on Cities, Environment and Transport (CET) in ASEAN seeks to reduce emissions from transport and industry by providing co-benefits for local and global environmental protection. The CET Project 'Energy Efficiency and Climate Change Mitigation in the Land Transport Sector in the ASEAN region' (Transport and Climate Change (TCC) www.TransportandClimateChange.org) aims in turn to develop strategies and action plans for more sustainable transport.

The project is funded by the German Federal Ministry for Economic Cooperation and Development and implemented by GIZ in cooperation with the ASEAN secretariat.

As presented to the ASEAN Land Transport Working group, TCC's regional activities are in the area of fuel efficiency, green freight and logistics, as well as data, indicators, and MRV. At the national level the project supports relevant transport and environment government bodies in Indonesia, Malaysia, the Philippines, Thailand, and Vietnam for the development of national action plans on sustainable transport. TCC also offers capacity building through different training courses.

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List of abbreviations and acronyms

ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
ASIF	Activity-Structure-Intensity-Fuel
BAU	Business As Usual (assumes no major changes in current trend)
BRT	Bus Rapid Transit
CAIT	Climate Data Explorer from World Resources Institute
CDM	Clean Development Mechanism
CET	GIZ Programme on Cities, Environment and Transport
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COMOS	Cohesive Mobility Solution
DDF	Diesel Dual Fuel system
DfT	Department for Transportation (UK)
DOE	Department of Environment
DNA	Designated National Authority
EIA	Energy Information Administration (a service of the US government)
EOL	End Of Life
EPA	Environmental Protection Agency
EPU	Economy Planning Unit
EQA	Environmental Quality Act
EST	Environmentally Sustainable Transport
ETS	Electric Train Service
EV	Electric Vehicle
GDP	Gross Domestic Product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
GHG	Green House Gas
GTFS	Green Technology Financing Scheme
HC	Hydrocarbon
HDV	Heavy Duty Vehicle
HEV	Hybrid Electric Vehicle
ICE	Internal Combustion Engine
IM	Inspection and Maintenance
INDC	Intended Nationally Determined Contribution
ITS	Intelligent Transportation System
JKR	Jabatan Kerja Raya
JPJ	Jabatan Pengangkutan Jalan or Road Transport Department
KeTTHA	Kementerian Tenaga, Teknologi Hijau dan Air or Ministry of Energy, Green Technology and Water
KL	Kuala Lumpur, also greater Kuala Lumpur/ Klang Valley
KLIA	Kuala Lumpur International Airport
KPKT	Ministry of Urban Wellbeing, Housing and Local Government
km	Kilometre
KWP	Ministry of the Federal Territories

LDV	Light Duty Vehicle
LNG	Liquid Natural Gas
LPG	Liquefied Petroleum Gas
M	Million
MAI	Malaysian Automotive Institute
MC	Motorcycle
MIGHT	Malaysian Industry-Government Group for High Technology
MIROS	Malaysia Institute of Road Safety Research
MITI	Ministry of Trade and Industry
MGTC	Malaysian Green Technology Corporation
Mt	Million Metric Tonnes
MNRE	Ministry of Natural Resources and Environment
MOF	Ministry of Finance
MOT	Ministry of Transport
MOW	Ministry of Works (KJR)
MPV	Multi-purpose Vehicle
MRT	Mass Rapid Transit
MRV	Measuring, Recording and Verification
NAMA	Nationally Appropriate Mitigation Actions
NGO	Non-government Organisation
NO_X	Nitrogen Oxide
NRE	Ministry of National Resources and Environment
NPP	National Physical Plan
NPPC	National Physical Council
NRE	Ministry of Natural Resources and Environment
PKT	Passenger-kilometre Travelled
PM	Particulate Matter
PMD	Prime Minister's Department
PTM	Centre for the Restructuring of Malaysia
PUSPAKOM	Pusat Pemeriksaan Kenderaan Berkomputer or Malaysian National Automobile Inspection Center
RFID	Radio Frequency Identification
RMG	Recommended Malaysian Air Quality Guideline
SEDAC	Socioeconomic Data Application Centre
SPAD	Suruhanjaya Pengangkutan Awam Darat or Land Public Transport Commission
SUV	Sports Utility Vehicle
TCC	Transport and Climate Change
TKT	Ton-kilometre Travelled
TNB	Tenaga Nasional Berhad
TOD	Transportation Oriented Development
VKT	Vehicle-kilometre Travelled
VTA	Vehicle Type Approval
Toe	Ton of Oil Equivalent
UK	United Kingdom
UKM	Universiti Kebangsaan Malaysia
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
VTA	Vehicle Type Approval
WRI	World Resources Institute

Executive summary

The transportation sector in Malaysia accounts for approximately 35% of the total energy consumed nationally, and produces nearly 50 million metric tons (Mt) of CO_2 per year (2015), second only to electricity power generation. The vast majority, 85.2% of transportation emissions, comes from road transport. Due to the high rate of personal automobile ownership, cars account for about 59% of the overall emissions from transport, while freight is responsible for 27%. Although there are a roughly equal number of cars and motorcycles on the roads, motorcycles account for only 11% of the CO_2 emissions from the transportation sector. As the economy continues to develop the rate of energy consumption rises, and corresponding Greenhouse Gas (GHG) emissions are also increasing, resulting in an almost constant rate of CO_2 emissions per Gross Domestic Product (GDP).

> Malaysia intends to reduce its greenhouse gas (GHG) emissions intensity of GDP by 45% by 2030 relative to the emissions intensity of GDP in 2005. This consists of 35% on an unconditional basis and a further 10% is condition upon receipt of climate finance, technology transfer and capacity building from developed countries.
>
> *Intended Nationally Determined Contribution (INDC) of the Government of Malaysia, Final, 27th November 2015*

Malaysia's environmental policy started in the 1970s, with significant additions in the early 2000s, including the creation of the Ministry of Natural Resources and Environment (NRE) in 2004 to oversee management of natural resources and environmental concerns, as well as implementing climate change and GHG emissions policies. Although energy usage and CO_2 emissions are acknowledged as important issues, and individual government projects and policies are aimed at curtailing energy consumption and GHG emissions, Malaysia lacks a coordinated strategy aimed at improving transport efficiency. This report reviews data and historical trends of energy consumption, emissions and related policies in Malaysia in order to highlight areas where policy changes could be made to have the greatest impact on both energy consumption and emissions in the transport sector in Malaysia. For the purpose of this report "Sustainable Transport" is defined as the freedom of mobility of both, people and goods, without sacrificing essential human or ecological values including affordability for socially disadvantaged groups and the long-term financial feasibility of transport systems. Generally, this infers efficient transportation at a reasonable cost with an acceptable level of safety, without generating emissions or waste products in excess of the environment's ability to absorb them.

Data is analysed using the Activity-Structure-Intensity-Fuel (ASIF) technique in order to quantify the GHG emissions of Malaysia's transport sector including transport activity in passenger-kilometre travelled (PKT) and ton-kilometre travelled (TKT), modal split, fuel intensity, and emission factors. Currently there is no single authority responsible for collecting all the relevant data, thus this report combines many disparate sources of information. A limited amount of primary field work was performed in order to establish reasonable boundaries on particularly elusive data, such as fleet age, ridership levels and personal vehicle kilometres travelled. The systematisation and automation of the collection of the appropriate data is highlighted as one of the areas needing improvement to insure the highest quality data required to steer policy in the most efficient manner.

Recommendations: Institutional strengthening

In terms of policy, the foremost need is to have a single government entity responsible for the collection and assessment of energy efficiency and emissions data on a consistent basis (CO_2

emissions per passenger kilometre or per ton kilometre of freight), as well as the responsibility for informing and educating others involved in the policy development process. Historically, policy has been oriented towards economic development, and environmental considerations are sometimes viewed as secondary priorities. Supporting and educating policy makers and those involved in policy implementation of the positive long-term economic effects of sustainable transportation development will help improve the rate of adoption of new policies. The policy makers require the appropriate information to allow them to make data driven policies. Additionally, policy promulgated at the federal level often requires enforcement by local authorities who may not have the resources required or understand the importance of enforcement, thereby reducing compliance and effectiveness of environmental policies. Thus, public education will be required for the success of this endeavour.

Transportation avoidance and shift strategies

Due to the large number, personal automobiles in Malaysia are responsible for approximately half of all transportation related CO_2 emissions. The single most significant reduction of transportation related emissions would be to reduce private car usage by shifting to more efficient modes such as electric trains or buses. Various measures can be taken to restrict personal automobile usage, including congestion road use pricing, increased road fees, and proliferation of multi occupant vehicle lanes. However, these needs to be coupled with the provision of alternative transportation options. In areas where other transportation options are not available, these need to be developed in the long term, but in the short-term policy can encourage increased ridership per vehicle, or less polluting fuels such as LPG or CNG, or alternatively a shift to electrification of personal vehicles. Two-wheeled vehicles are significantly more efficient than four-wheeled vehicles, and encouraging use of clean and efficient motorcycles could reduce transportation emissions by up to 17%, however motorcycle safety is an important concern which simultaneously requires addressing.

Rail infrastructure for freight already exists, however it is greatly underutilised, with as much as 95% of all domestic freight movement is by road. As road transportation of freight consumes more than ten times the energy of rail transportation, this single modal shift alone could reduce freight CO_2 emissions by 43%. Similarly, reduction of "empty back hauling" could reduce freight emissions by around 42%.

In the longer term, large gains can be made by appropriate urban planning and integrated infrastructure development. Malaysia has shown excellent integrated urban planning in the greater Kuala Lumpur/Klang Valley (KL/KV) area, and many of the lessons learned there urgently need to be applied country-wide to have the greatest impact.

Incremental transportation improvements

Along with shifting to the most efficient transportation mode available, significant gains can be made by improving the existing transportation situation. Bottlenecks and lack of alternatives are a major hindrance to efficient movement of both passengers and freight through the various transportation hubs. Many public transport hubs such as airports, train stations, and even bus stations, have insufficient public transport links to other hubs, thereby requiring the use of taxis (the highest CO_2 emitting transport mode of all) or personal automobiles (the second highest CO_2 emitter).

It has been shown that a significant proportion (close to 10%) of on-the-road vehicles are significantly mistuned, generally due to wear or breakage of some minor component, and subsequently consume more fuel and emit more CO_2 than properly tuned vehicles. Although an Inspection and Maintenance (IM) program exists for commercial trucks and public vehicles, it does not include loaded emissions testing necessary to detect polluting vehicles (vehicles are tested without loading the engines, i.e. at idle or revving the engine in neutral). This programme needs to be

enhanced to provide loaded testing, and extended to older automobiles as well in order to eliminate the extreme polluters. By singling out the small number of exceptionally dirty vehicles, owners can be made aware of the problems, potentially saving them money otherwise spent on fuel by rectifying the problems with their vehicle.

Comparison with other ASEAN countries

Common issues faced by Malaysia and other ASEAN member states include:

- Data collection for transportation is often sporadic and insufficient for the needs of policy development.
- Land use planning is a fundamental need for efficient transportation, however to date it has been largely overlooked as many cities have grown "organically" over time without master planning.
- Policy implementation is often left to local authorities who sometimes lack the required resources (financial, equipment, human or training) to properly fulfil the requirements of the policy.
- Freight exchange is by nature a "super company" responsibility in that individual freight companies generally do not have enough volume to take full advantage of fleet vehicles during back-hauls. There is a clear need for national, or even international, coordination of freight shipping to achieve maximum possible efficiencies.

Additionally, by comparison with other countries in the region, it can be seen that Malaysia has some distinct advantages and innovative transportation measures already in place:

- Kuala Lumpur (greater KL/ KV) area has benefited from integrated transportation and land use planning for several years, with noticeable results in terms of ease of transport compared with other cities of a similar size.
- The light rail system here is mature, reaching to the Thai border, and undergoing significant expansion.
- Malaysia leads the world in motorcycle-only infrastructure, increasing the ease and safety of commuting on two wheeled vehicles.
- The truck ban during major festive seasons. When millions of people return to their home towns for public holidays, trucks are banned from the roads for certain hours of certain days. The freight control tremendously eases the traffic situation, as the passenger vehicles already crowd the roads.

Going forwards there is a lot to be learned from each other, and there is a need for greater regional cooperation, especially in the area of transportation sustainability. Many of the lessons gleaned from other countries of the region can be applied here in Malaysia, and Malaysia undoubtedly has a lot to offer in return. The recently published *Kuala Lumpur Strategic Transportation Plan*, an ASEAN wide transportation development plan, is a good example of just such cooperative planning.

Potential impact of sustainable transport

With the implementation of a few of the most basic recommendations, it is calculated that Malaysia can reduce transport related emissions by up to 71Mt of CO_2 per year (representing a 50% reduction of transportation related emissions) by 2030. While this represents a significant improvement in the state of transportation sustainability, it will not be sufficient to achieve the stated goal of a 40% reduction in CO_2 emissions per GDP by 2020 without other measures taken simultaneously.

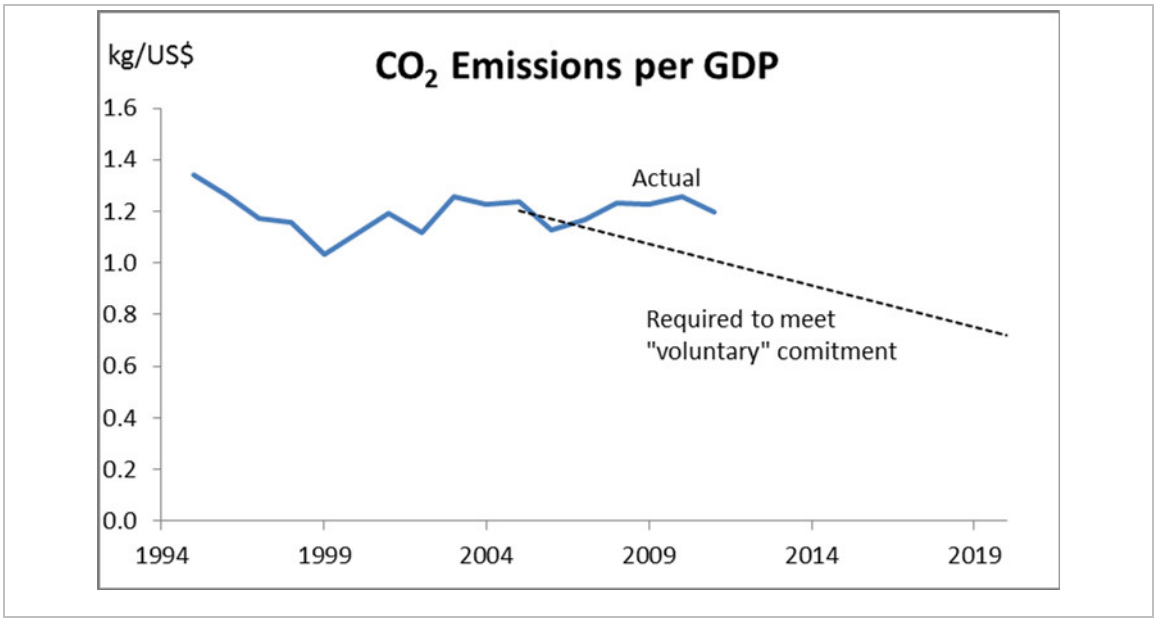

Figure 1: Actual Malaysian CO_2 emissions per GDP with trend (dotted line) required to meet the 40% reduction commitment (see box page 1) by 2020 (Source: World Data Bank, 2012).

Malaysia is well positioned to be an important local hub of environmental activity. Many of the requisite factors, such as mature infrastructure development, centralised policy, and standards development are already in place. Notably Malaysia has recently decided to develop rigorous standards for all classes of electric two-wheeled vehicles, taking a leading role in the dissemination of this highly efficient technology. By implementing the suggestions contained in this report, Malaysia can significantly reduce CO_2 emissions while maintaining a reasonable rate of economic development and standard of living. Along with the trend of increasing regional integration, this may allow Malaysia to take on a greater role in transportation systems planning and implementation within ASEAN.

1. Introduction

Malaysia has been one of the fastest growing ASEAN (Association of South East Asian Nations) countries since its independence. This is due to several factors including the relatively open market encouraging foreign investment, good macro-economic controls, and excellent infrastructure (Hill, 2003). Additionally, large-scale government and semi-government controlled companies such as PETRONAS (the national petroleum company, founded in 1974) and Proton (the first national car company, founded in 1983) have encouraged natural resource exploitation and increased personal car ownership. Other major (non-transportation) areas of development have focused on export oriented manufacturing sector, notably including semiconductor components and electrical goods. The government has had a stable and well-coordinated plan of development, sustained over several decades with the intention of converting the economy from a largely natural resource base to a more diversified, globally oriented mixed economy. To encourage external investment, political stability and infrastructure development have been key objectives of the Malaysian government. As a result, today Malaysia has one of the largest and best highway networks in the world, and is the home to many other major infrastructure works such as the Kuala Lumpur International Airport (KLIA), the PETRONAS Twin Towers and the government administrative centre of Putrajaya.

The focus on automobile manufacturing and petroleum resources development together with significant growth in prosperity has helped to increase the rate of car ownership in Malaysia, ranking now as 3rd globally (Nielsen, 2014)[1]. In terms of environmental impact, the economic advancement in Malaysia is a distinctly mixed blessing.

This report provides an up-to-date (2016) picture of the transport sector and transport-related greenhouse gas emissions and mitigation policies in Malaysia, and includes identification of "gaps" where policies and practices can be changed in order to improve overall transportation efficiency and sustainability. The focus of this report is primarily on land transport including both passenger and freight transport. Initially, background transportation and trend analysis is presented (Chapter 2), followed by a presentation and analysis of policies related to sustainable transport based on the ASIF approach (Chapter 3), barriers towards low-carbon transport (Chapter 4), and finally recommendations for further action on policy development and capacity-building (Chapter 5). The report is based on existing literature and policy documents, interviews with policymakers and experts and a limited amount of primary field work.

[1] Taken from The Star Online: http://www.thestar.com.my/business/business-news/2014/04/16/car-ownership-in-msia-third-highest-in-the-world/

2. Transport climate data

This chapter gives an overview of the key transportation trends and environmental related issues in Malaysia. It includes vehicle sales and annual registrations, transport demand statistics, average occupancy and load factors, modal distribution for passengers and freight, average vehicle-kilometre travelled (VKT), vehicle population by vehicle and fuel type, emissions factors of the various transportation modes, fuel characteristics. Additional demographic information is also included such as gross domestic product (GDP), total population, population growth rate and overall economic activity.

Good policy decisions are difficult to make without the appropriate data. Improved transportation and emissions data collection are crucially needed to track the progress of policies aimed at improving the energy efficiency and reducing overall GHG emissions of the transportation sector. This need is becoming more acute with increasing emphasis on international climate negotiations and communications for Measuring, Reporting and Verification (MRV), the standard emissions measurement and reporting protocol used internationally to assess emissions pledges and/or obligations.

Different exhaust emissions components have different global warming effects, for example N_2O, an eventual product of combustion NO_x emissions, has about 300 times the effect of CO_2 on global warming. To simplify this, we use the following fuel specific CO_2 emissions factors (kg CO_2/MJ) for the various fuel sources used for transportation in Malaysia:

Type of fuel	Emission factor (kg CO_2/MJ)
Coal	0.092
Diesel	0.069
Petrol	0.068
Propane	0.060
Natural Gas	0.050

Table 1: Fuel type and emissions factors (Source: US Energy Information Administration, 2015).

While the exact emissions of any given combustion system may vary, it is clear from the data in Table 1 that coal is by far the dirtiest fossil fuel, and natural gas is the cleanest. As these emissions factors are largely based on chemistry, they will hold true everywhere, with some variation in the emissions of coal, which is based on its exact composition. This can have significant impacts on the equivalent emissions of Electric Vehicles (EVs), as will be shown later. EVs charged from a predominantly coal powered grid are likely to contribute far more CO_2 emissions than EVs charged from a natural gas powered grid.

2.1. General country information

Malaysia is home to over 30 M people, with about 50% Malays, 23% Chinese, 12% natives of Sabah and Sarawak (the two eastern provinces on the island of Borneo), 7% Indians and 8% non-Malaysians (typically foreign guest workers). The current population growth rate is approximately 1.8% per year. The climate is tropical, with average temperatures around 28°C and rainfall of 2500mm anually. Malaysia is comprised of 2 major separate land masses: Peninsular West Malaysia, located just south of Thailand, and East Malaysia (Sabah and Sarawak), along the North and West coasts of Borneo, the rest of the island being the Indonesian state of Kalimantan. In both land masses, there are central highlands of mountains and ridges rising to over 2000m in West Malaysia, and over 4000 in East Malaysia (Aziz, 2015). These central highlands descend to relatively flat costal planes stretching to the sea. Originally covered by thick rain forests, overland travel was historically difficult and navigation and transportation of goods was predominantly via the many rivers. Most population centres developed along the river mouths near the sea, with a few located along the rivers further inland. Small scale agriculture, fishing, hunting and collecting of forest products persisted as the main economic activities for many centuries. The West coast of peninsular Malaysia developed larger cities, most notably Melaka, involved in international trade, while the East coast of peninsular Malaysia and the whole of East Malaysia remained relatively less developed.

As the economy shifted from a more agricultural base to manufacturing and services, the population has begun migrating into ever growing cities and towns. It is estimated that over 75% of the population now lives in urban settings (World Data Bank, 2014).

Along with the shift to higher value-add jobs, the GDP (313 billion USD in 2013) has had a long upward trend since the 1960s. This climb towards greater prosperity has only suffered a few setbacks, notably the Asian financial crisis of 1998-1999, and the global financial crisis in 2008. After each crisis, the Malaysian economy has been able to recover and continue the upward trend within a year or two.

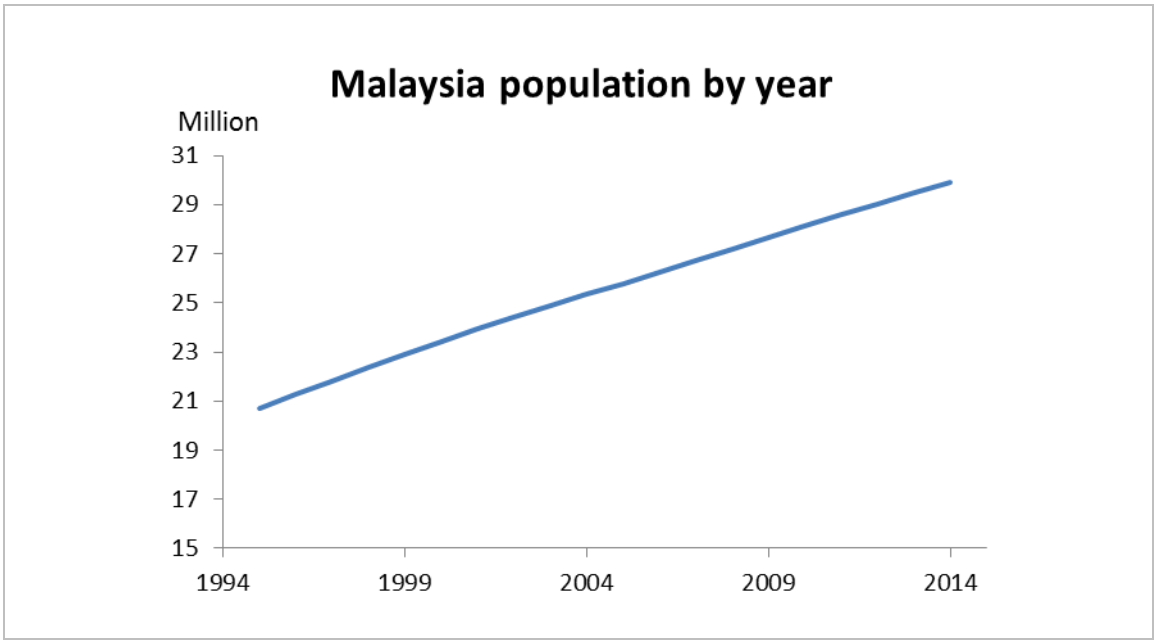

Figure 1: Malaysia's population by year (Source: World Data Bank, 2015).

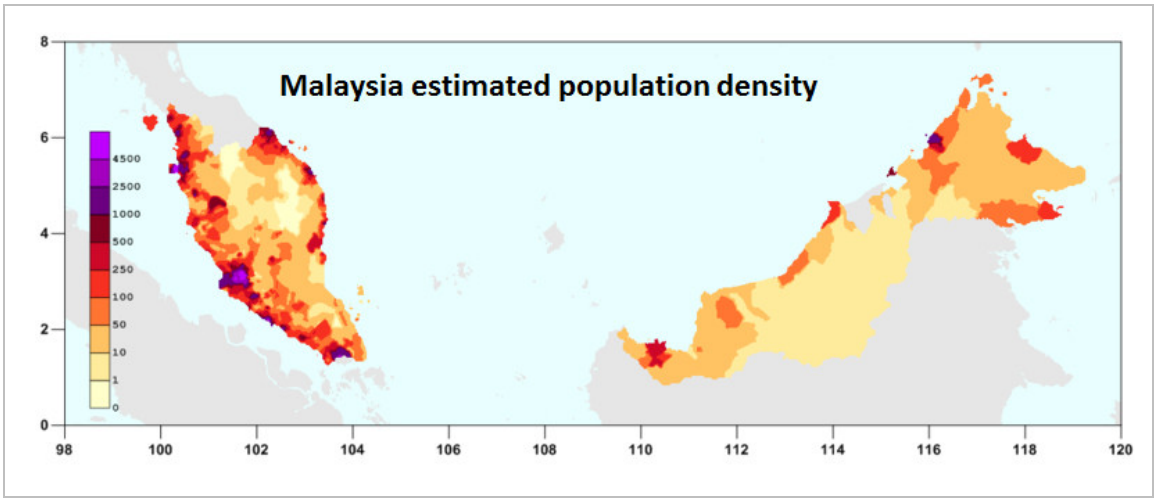

Figure 2: Malaysia estimated population density; scale is 0 to 4500 people per square kilometre (Source: Socioeconomic Data Application Centre (SEDAC), 2010).

2.2. Transportation

With increasing financial resources, the population has preferentially opted to purchase larger vehicles, moving from 50-cc and 70-cc motorcycles in the 1970's to 90-cc and 100-cc machines, then progressing to small passenger cars in the 1990s, and most recently Multi Passenger Vehicles (MPVs) and Sport Utility Vehicles (SUVs). During the Asian Financial Crisis of 1998-1999 the GDP per capita dropped nearly 20%. This strongly affected consumer's disposable income, which in turn reduced the new car purchases during the same period. The 20% reduction in GDP resulted in a greater than 50% reduction in new car purchases as consumers either put off buying a new car, or opted for buying a new motorcycle instead. As soon as the economy recuperated, new car purchases once again picked up. Today about half of the personal vehicles in Malaysia are motorcycles and half are cars.

Statistics on passenger car kilometres driven is available from PUSPAKOM (Pusat Pemeriksaan Kenderaan Berkomputer or Malaysian National Automobile Inspection Center), the organisation responsible for vehicle inspections, as well as the Malaysian Institute of Road Safety Research (MIROS). PUSPAKOM records the odometer mileage during periodic inspections and MIROS collects the data from vehicles involved in accidents. Their work indicates that passenger cars are driven about 24,000 kilometres per year during their first year of ownership. Ridership is not known, but estimated to be between 1.2 and 1.6 passengers per car, varying greatly by geographic region, with significantly lower numbers in urban rush hour traffic. This yields around 36,000 passenger km per year per car, and with a fleet of 11.7 M cars this works out to 420 billion car passenger kilometres annually for Malaysia (MIROS, 2013).

Goods vehicles, predominantly diesels, are measured by the same source to travel 70,000 km annually on average. They are used to distribute goods to retail outlets, move raw materials and finished goods to processing plants and shipping centres. There is a significant amount of container traffic to and from the various ports as well as running from Thailand to Singapore through peninsular Malaysia.

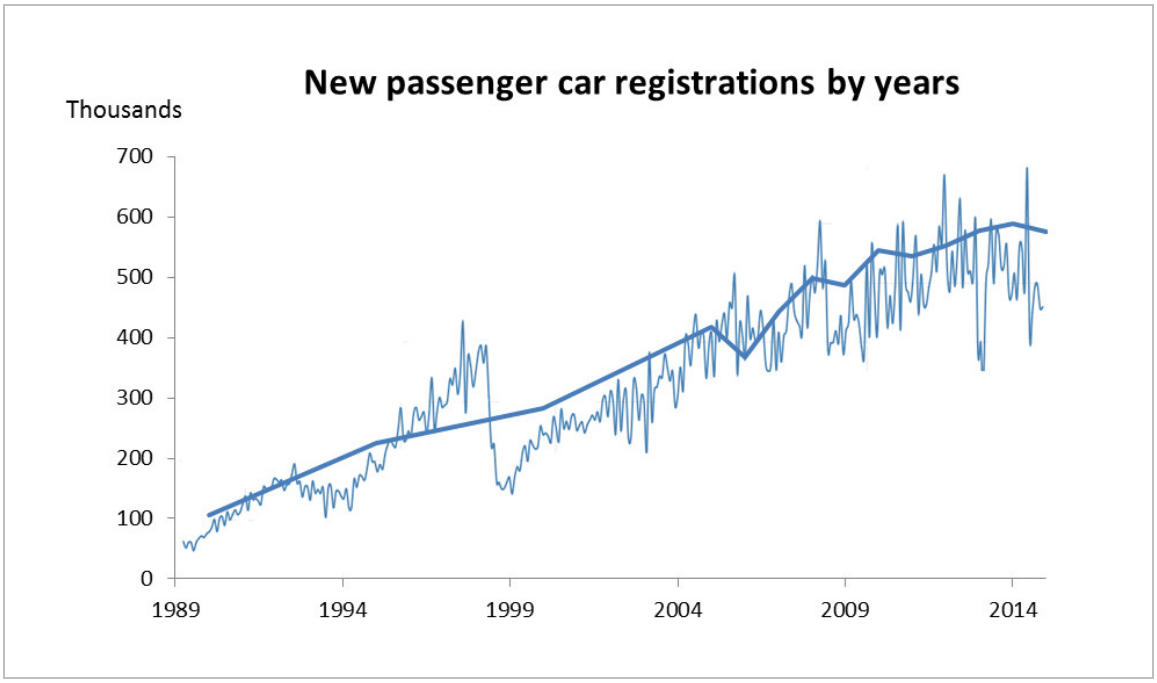

Figure 3: Number of car registrations by year (Source: Ministry of Transport Malaysia (MOT), 2015).

2.3. Rail

Since the British colonial era, there have been rail lines in West Malaysia, the West Coast Line runs from the Thai border to Singapore along the west coast of Peninsular Malaysia. The East Coast Line runs between Gemas south of KL to Kota Bharu on the north-east coast. It hauled freight, mostly bulk commodities such as cement and sugar, and some passengers with antiquated diesel electric engines.

Modern rail transport consists of heavy rail (KTM Komuter), light rapid transit (LRT), monorail and an airport rail link. The biggest change has been the addition of an electric light rail system, and to a lesser extent a monorail system, centred on Kuala Lumpur. These light rail systems have only come on line in the last two decades. Rail passenger kilometres took a large jump in 2011-2012 with the completion of Rawang – Ipoh electrified double track rail and addition of a KL – Ipoh Electric Train Service (KTM ETS). In 2014, the operation was extended to Padang Besar[2].

It is expected that the commuter rail system will continue to expand, and take over an increasing share of the passenger kilometres travelled.

[2] Ipoh – Padang Besar Electrified double track project was completed on October 2014, which provides ease of access to the Thai border.

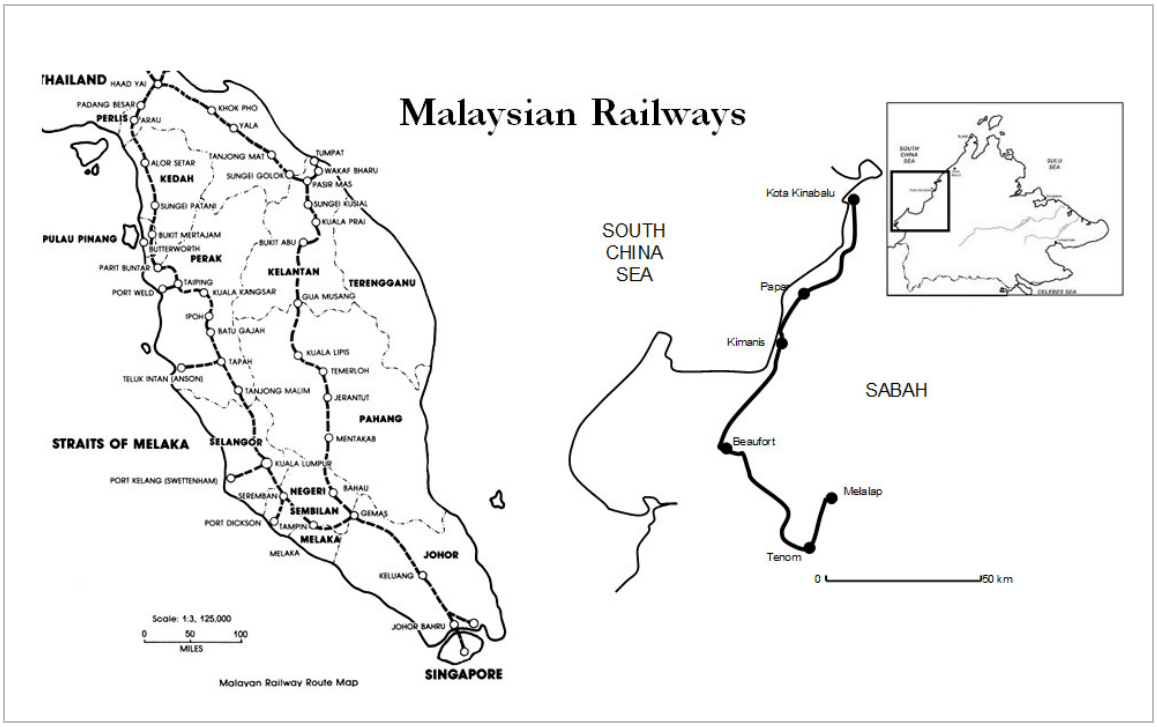

Figure 4: The rail line in Peninsular (left) and Sabah Malaysia (right). (Note the difference in scale) (Source: KTMB, 2013).

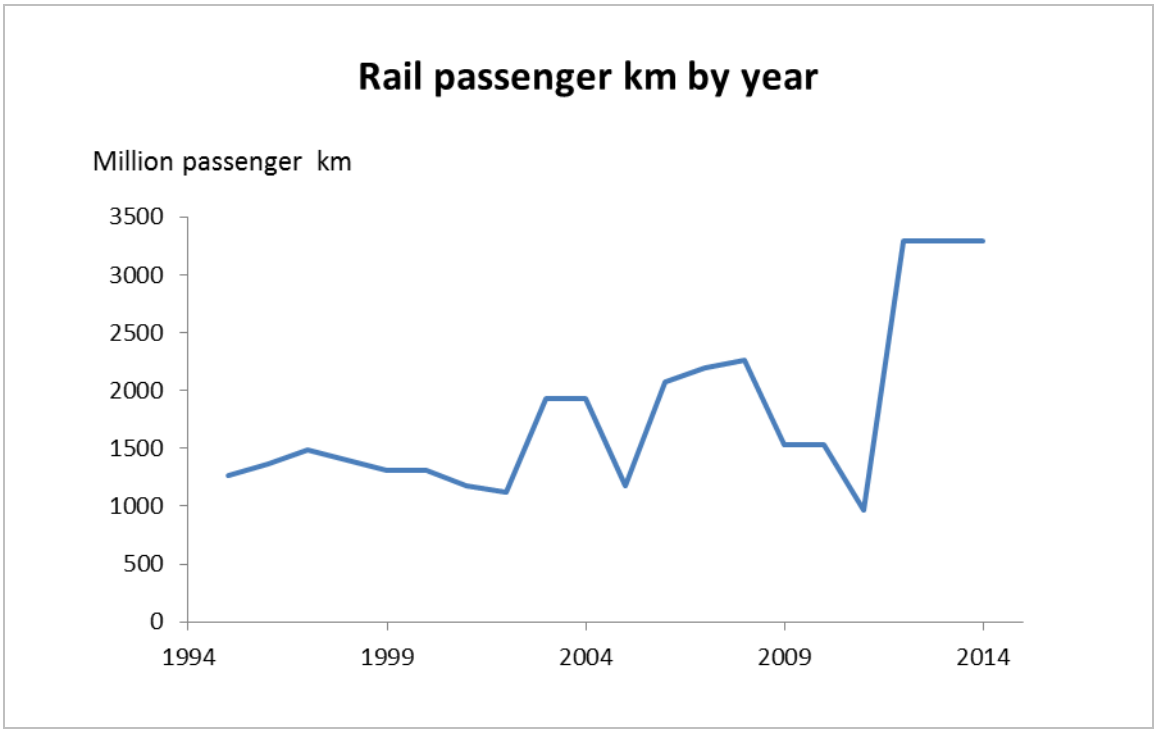

Figure 5: Rail passenger kilometre by year, Malaysia (Source: World Data Bank, 2014).

2.4. Freight

Overland freight in Malaysia is predominantly done via both large and small trucks, with some via rail and a very small amount transported by pipeline. Trucking accounts for the vast majority of freight, with approximately 95% of all freight kilometres transported by truck (Sqouris, 2003). The major overland freight corridor is north-south along the Thailand – Kuala Lumpur – Singapore axis on the western side of peninsular Malaysia. Shipment of goods between East and West Malaysia is done predominantly via sea, or air for some high value, time critical deliveries, as there is no land bridge between them. With expansion of the economy, the land based freight volume has been growing at 6.8% between year 2009 and 2013. (EPU; Logistics and Trade Facilitation Masterplan, 2015).

2.5. Energy consumption and GHG emissions from the transportation sector

Transportation is the second highest energy consumer in Malaysia after electric power generation. Transportation has historically been responsible for about 40% of the national energy consumption in recent years, and is currently contributing close to 50 Mt of CO_2 to the atmosphere each year (Energy Hand Book Malaysia, 2015).

Road transportation accounts for the vast majority, 85%, of transportation emissions, with about 59% thereof attributable to cars. Light Duty Vehicles (LDVs) and Heavy Duty Vehicles (HDVs) contribute 10% and 17% of the transportation CO_2 emissions respectively, while buses only contribute around 3%. The car and motorcycle fleet sizes are about equal; however, motorcycles are only responsible for about 11% of the CO_2 emissions from land transport. This is due to their lower energy consumption per passenger kilometre, as well as the lower number of kilometres driven per vehicle.

In 2014 the total registered road fleet size in Malaysia was estimated to be over 24M vehicles, consisting mainly of motorcycles (11.5M) and cars (11M) with goods vehicles a distant third at 1.1M units. The overall registered vehicle growth rate is about 5.38%, putting the current automotive fleet at around 11.7 M units (Transportation Statistic Malaysia, 2014).

Energy use by sector is summarised in Table 2, and the associated CO_2 emissions are shown in Figure 7. Figure 8 further indicates the various statistics related to transportation modes in Malaysia and their associated CO_2 emissions.

Sector demand (ktoe)	2008	2009	2010	2011	2012	2013
Agriculture	287	211	1074	916	1053	1051
Non-energy	2876	3868	3696	6377	7497	7277
Residential & commercial	6205	6336	6951	6993	7065	7403
Transport	16395	16119	16828	17070	19757	22357
Industrial	16205	14312	12928	12100	13919	13496
Total	41968	40846	41477	43456	49291	51584
Percentage of transport	39.07%	39.46%	40.57%	39.28%	40.08%	43.34%

Table 2: Final energy demand by sector (ktoe) (Source: Energy Hand Book Malaysia, 2015).

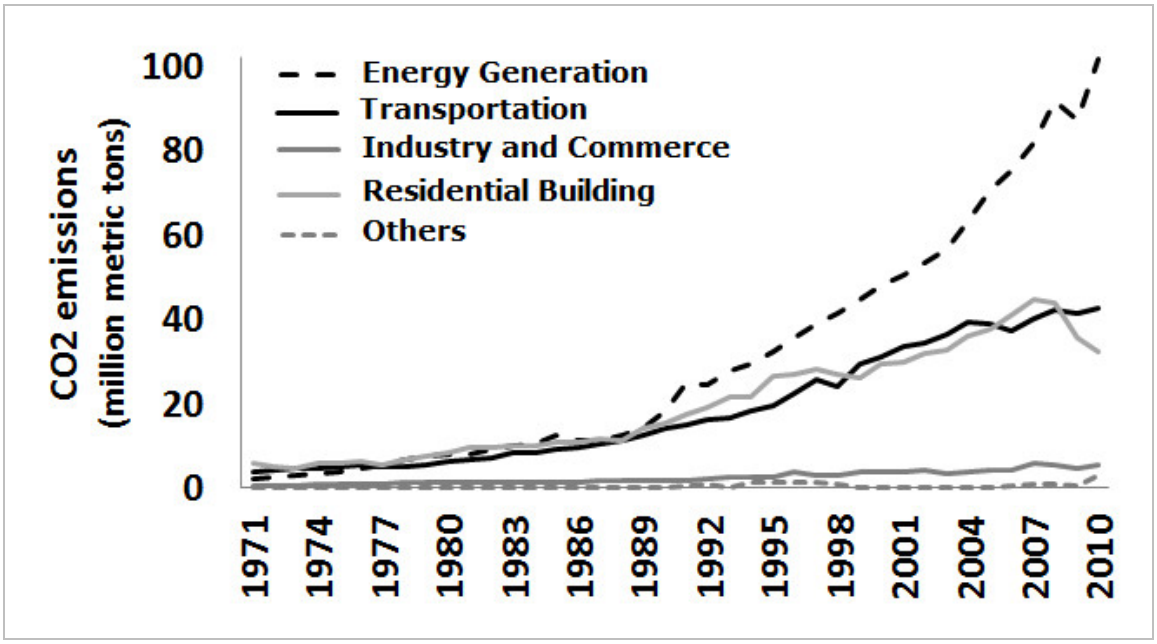

Figure 6: Trends in CO_2 emission by different sectors of Malaysia during 1971-2010 (Source: Shamsuddin, Anil, and Othman, 2014).

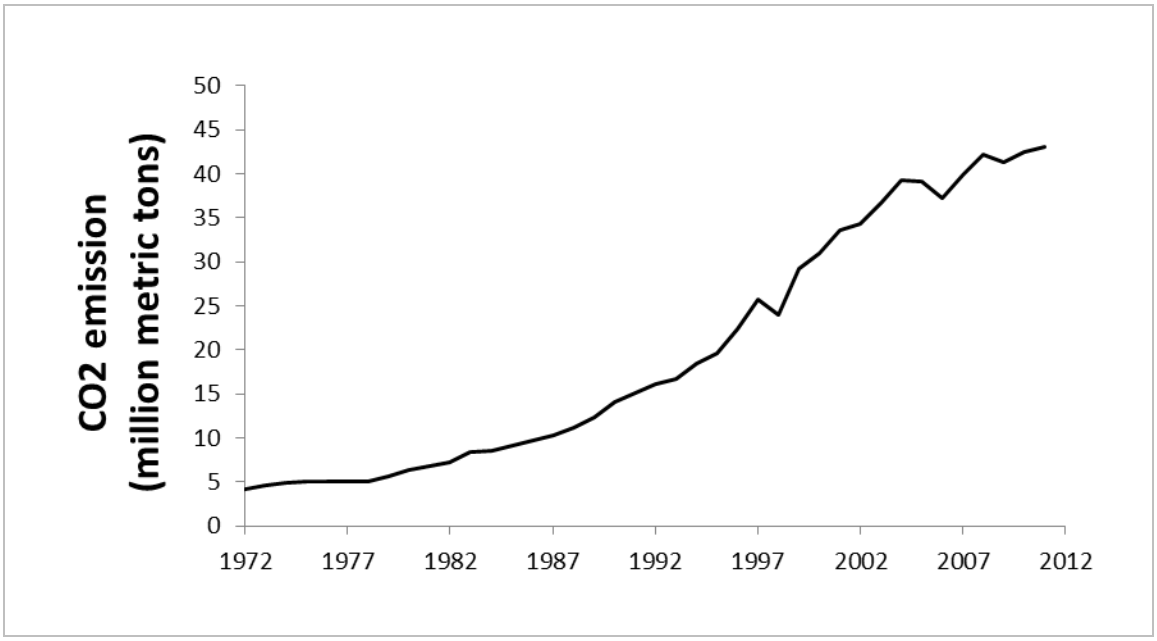

Figure 7: Trends in transportation CO_2 emission in Malaysia during 1971-2010 (Source: Shamsuddin, Anil, and Othman, 2014).

Transportation CO_2 emissions are broken out by mode in Figure 9, and Figure 10 gives the percentage contribution of CO_2 emissions from various road vehicles. The majority of transportation emissions come from road use, about 59% thereof are due to car usage. Trucking, both LDVs and HDVs, account for about 17% of road emissions.

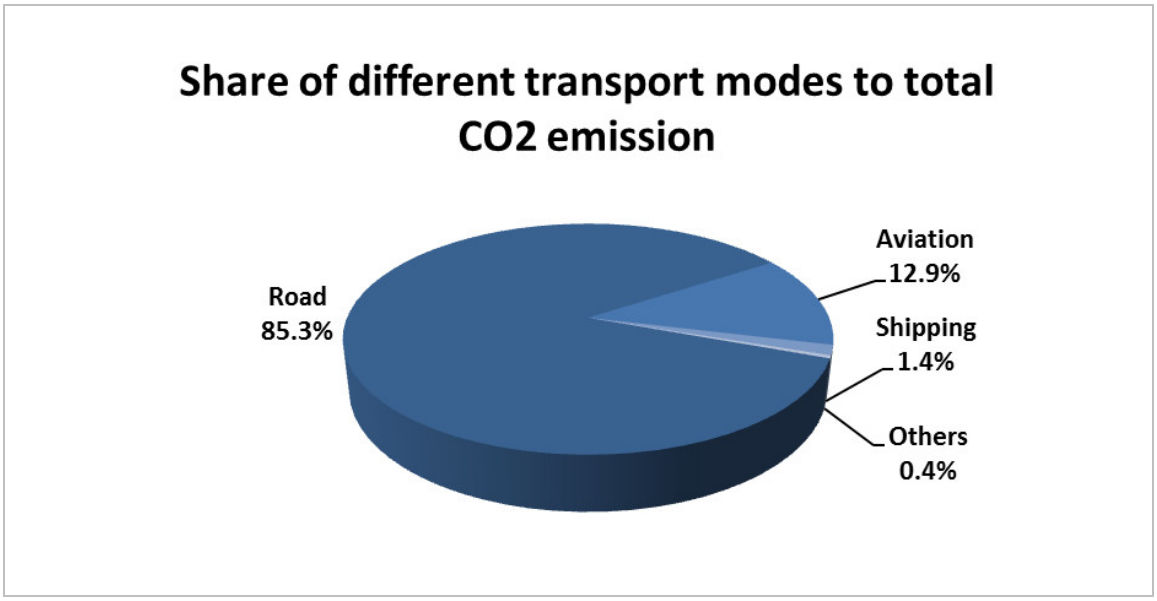

Figure 8: Share of different transport modes to total CO_2 emissions, year 2012 (Source: Hosseini et al., 2013).

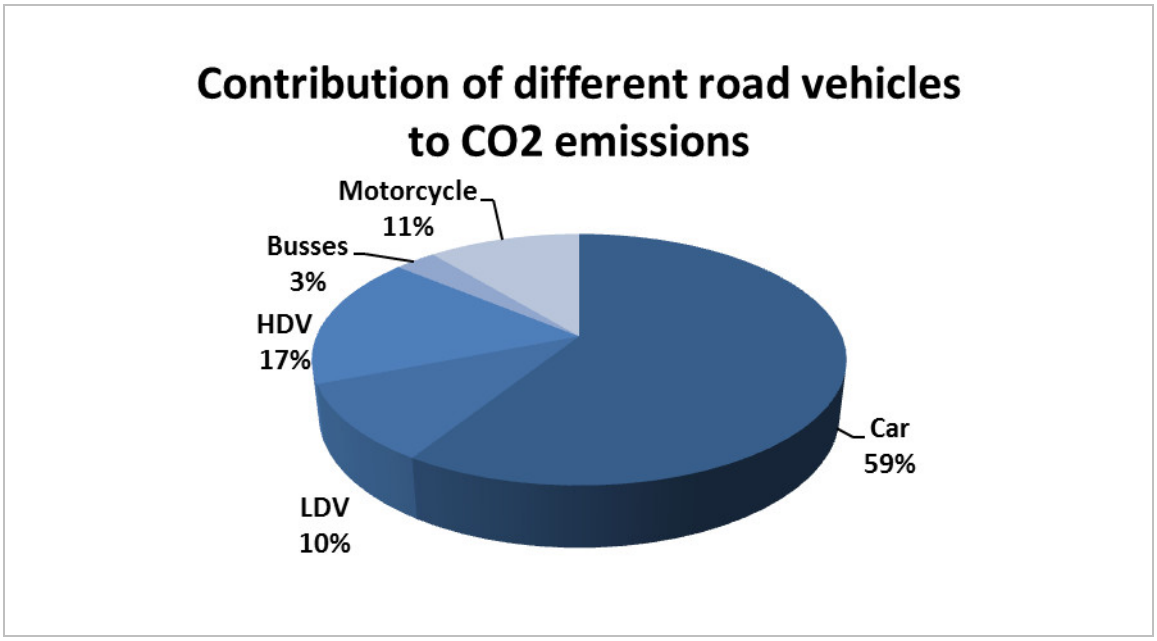

Figure 9: Contributions of different road vehicles to transportation CO_2 emissions for 2012 (Source: Hosseini et al., 2013).

Total vehicle registrations are broken out in Figure 11, indicating that 47% of registered vehicles are two-wheelers, and 44% are cars. Fuel type, given in Figure 12, indicates that most vehicles use petrol as all motorcycles and almost all passenger cars in Malaysia run on petrol.

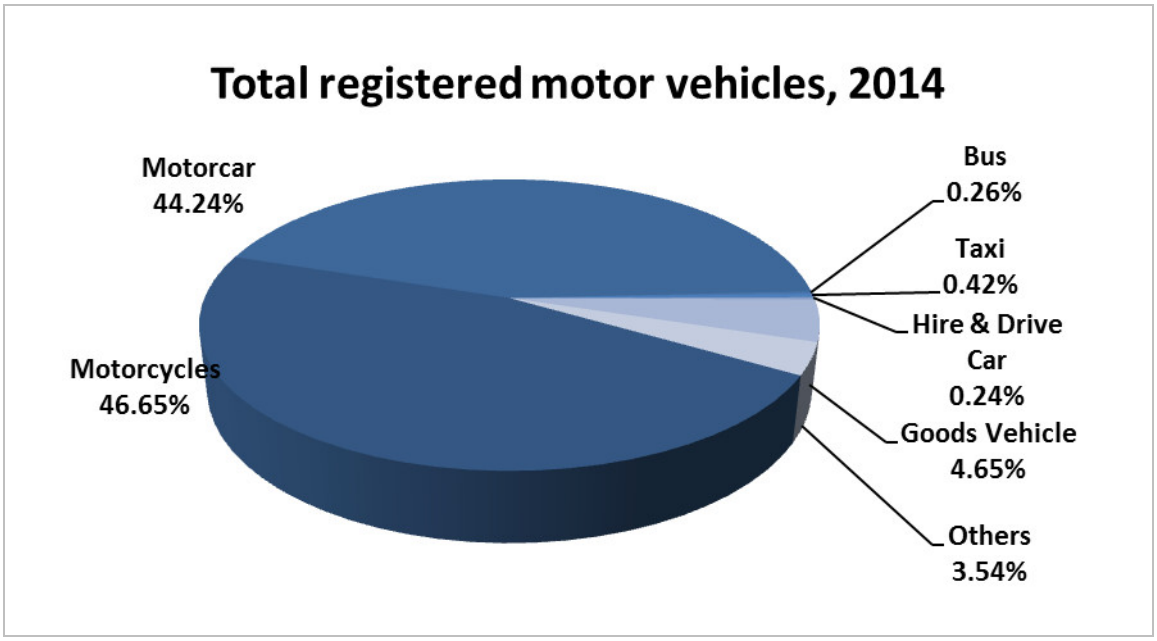

Figure 10: New registered motor vehicles in Malaysia (Source: Ministry of Transport, 2014).

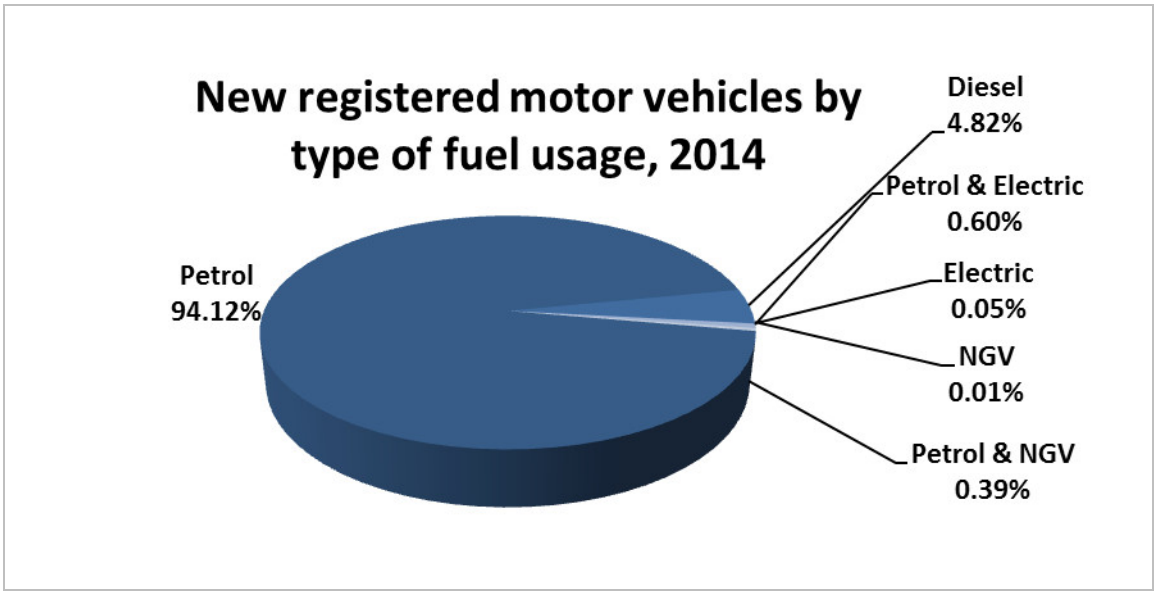

Figure 11: New registered motor vehicles by type of fuel usage in Malaysia (Source: Ministry of Transport, 2014).

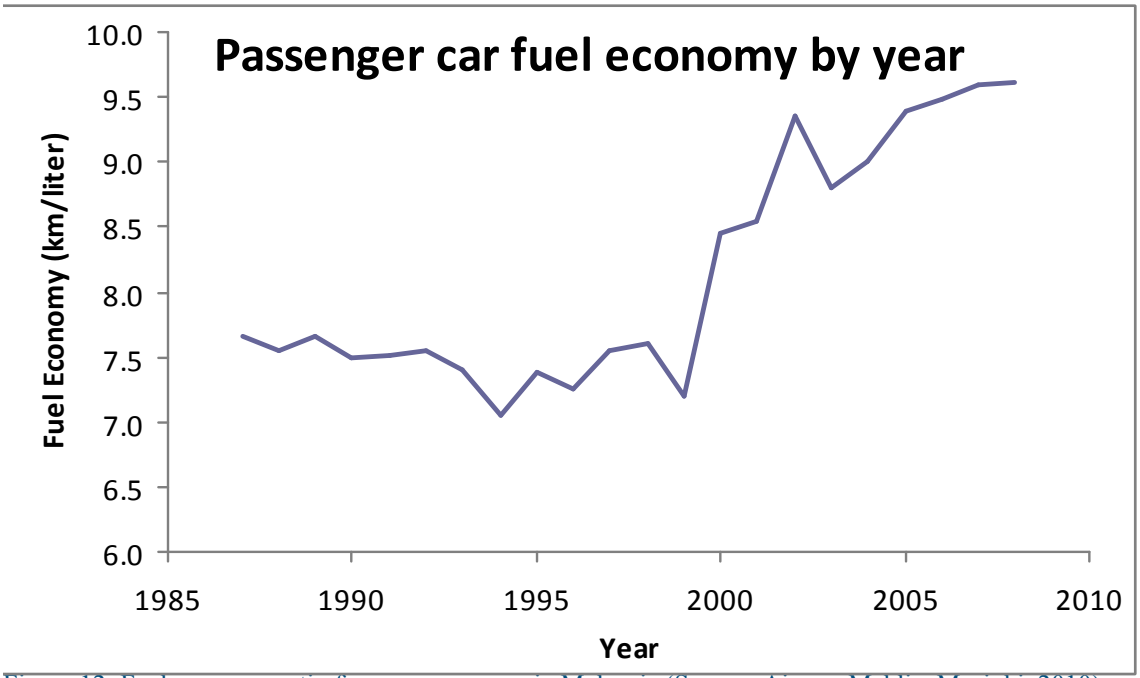

Figure 12: Fuel economy ratio for passenger cars in Malaysia (Source: Aizura, Mahlia, Masjuki, 2010).

Fuel consumption of various passenger cars was measured as a function of date of manufacture by the University of Malaya. It shows a general improvement in fleet efficiency starting in year 2000, from a former level of about 7 km/litre to nearly 9.5 km/litre by 2009 (Aizura, Mahlia, and Masjuki, 2010). This likely corresponds to the popularity of the relatively low-tech carburetted domestically produced Proton cars prior to 2000, and a preference for fuel injection cars after that, especially once the economy had rebounded from the economic depression of the Asian Financial Crisis of 1998-99.

Assuming the 2013 car fleet was 10.5M units, being driven 24k km per year with an average fuel economy of 9.5 km/litre (based on the work of Aizura et. al. 2012) we can calculate a total fuel consumption of about 2,500 litres of petrol per car, or about 1.8 toe per car. The total passenger car

fleet thus consumes about 20.2 Mtoe of petrol per year. This is significantly higher (64%) than the estimates coming from the Energy Commission, indicating an annual petrol consumption of 12.3 Mtoe of petrol (Shamsuddin, Anil, and Othman, 2014).

The most likely causes of the discrepancy are inaccuracies in the assumptions, specifically the vehicle kilometres travelled per year. The numbers recorded by PUSPAKOM are based largely on newer and public vehicles which undergo frequent inspections. These newer, safer, more reliable and efficient vehicles are generally driven more than older vehicles, thus accumulating higher mileage in their first few years, while the 10+ year old vehicles, (which comprise around 50% of the fleet) are generally driven much less.

Using the fuel CO_2 emissions factors stated earlier, and taking petrol, diesel and natural gas to be attributed to land transportation, we get total CO_2 emissions of 42Mt for land transport for 2014. This is higher than the 37Mt of Hosseini, Wahid and Aghili in 2012 (Hosseini et al., 2013).

Based on field work conducted in January 2016 including surveys of drivers, vehicle age, and odometer checks, typical annual passenger car mileage of around 15k km/year was established. Using this annual mileage gives 12.6 Mt of CO_2 emissions for the car fleet in 2013, very close to the number published by the Energy Commission of Malaysia in the Energy Hand Book 2013.

Looking at the passenger kilometres travelled by mode, we can analyse the relative importance of the various transport modes. As mentioned, in 2013 the total annual passenger km for passenger cars was approximately 420 billion. The corresponding motorcycle fleet of 11M units travelling 5,000km per year with a ridership of 1.5 would yield a total of 84 billion passenger km. The reported train passenger kilometres are 2.4 billion for the same year. Neglecting other passenger transport options, the ratio of rail passenger kilometres to total passenger kilometres is 0.5%. This is likely an over estimate of the relative importance of rail transport, however it is largely in line with the 0.4% of the CO_2 emissions attributable to rail (all transportation other than air, maritime or road) especially considering the emissions factor for rail travel will generally be significantly less than that of other modes.

Given the large private car fleet size in Malaysia, and the inherent inefficiency of automobile transport compared with most other forms, there is a lot of room for improvement.

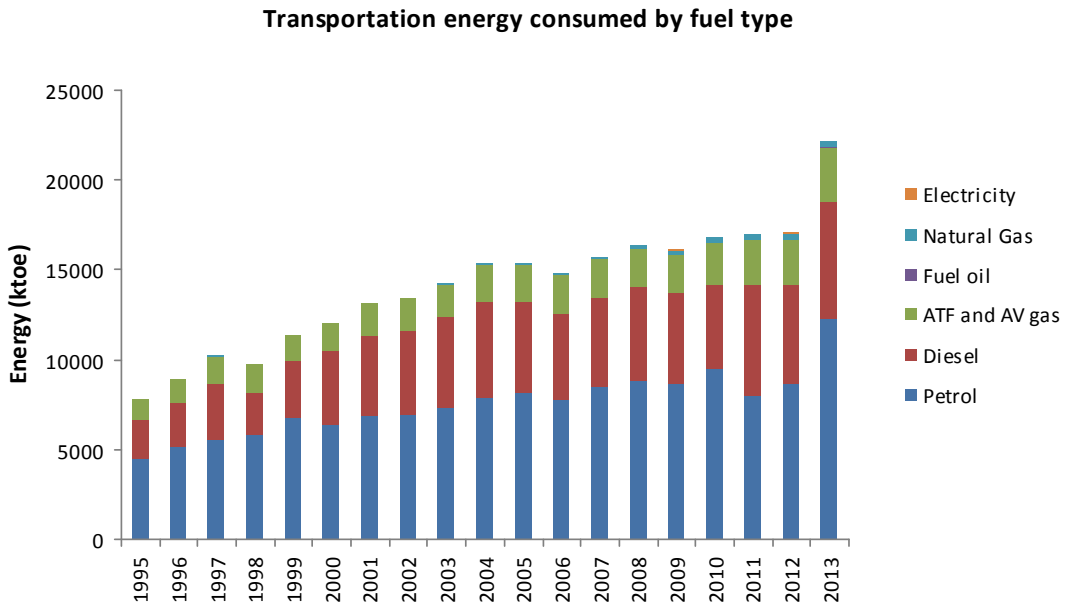

Figure 13: Energy consumption by transportation (Source: Energy Hand Book, 2014).

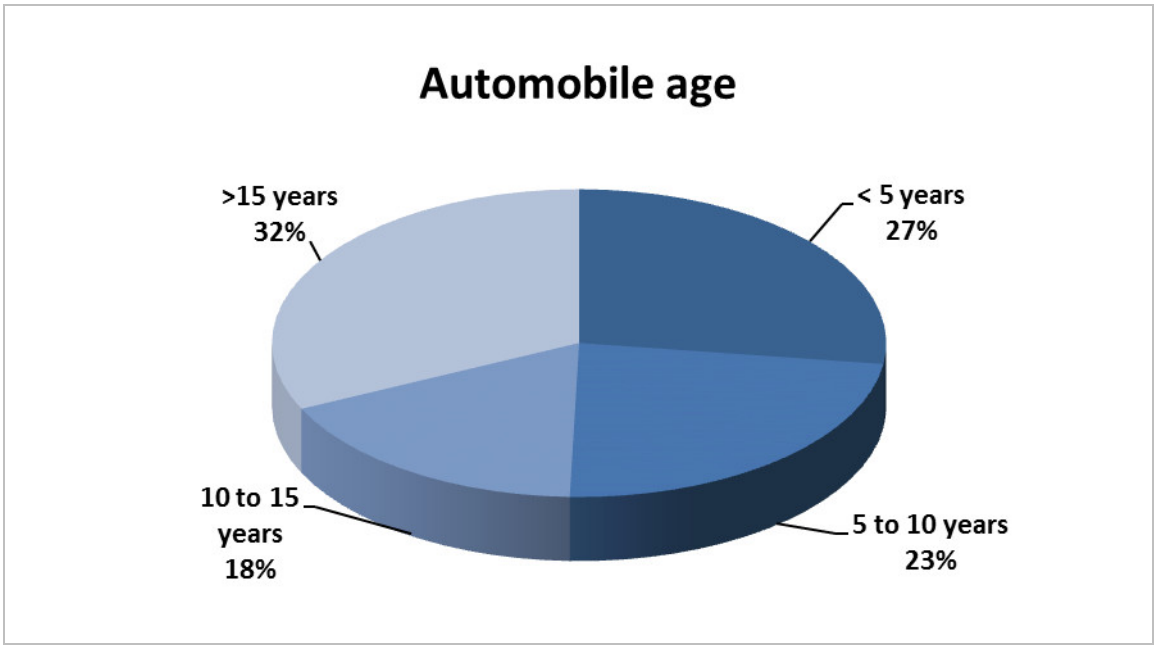

Figure 14: Age break down of cars in Malaysia (Dec 2012) (Source: Malaysia Automotive Institute, Automotive Roadmap Highlight, 2013).

2.6. Emissions reduction potential from the Malaysia transport sector (road)

Transportation emissions and fuel consumption reduction can be prioritised based on current estimates of CO_2 emissions. Road transport is responsible for the vast majority of transport emissions (85.2%) while rail accounts for no more than 1.4%. Privately owned passenger cars are the largest contributor to road based emissions (59%), followed by heavy duty trucks and buses (17%), motorcycles (11%) and light duty vehicles (10%) (Hosseini et al., 2013).

While many possibilities exist for emissions reductions, a few of the more tangible ones investigated here include:

- Modal Shift – Transfer people and goods by a more efficient transportation mode
- Aged Fleet Purging – Remove inefficient vehicles from fleet
- New Vehicle Efficiency – Encourage the market towards adopting improved efficiencies
- Vehicle Fuel/Propulsion Switch – Move to fuels that emit less CO_2 (see table 3)
- Avoidance – Reduce the need for unnecessary travel

Transport mode	Energy use (MJ per passenger-km)	Emissions (g CO_2 per passenger-km)
Petrol car	3.7	286
LPG car	3.7	256
Ethanol (E10) car	3.7	253
Electric tram	0.15	52
Diesel bus	0.28	22
Ethanol (E10) bus	0.28	19
Natural gas bus	0.28	18
Diesel train (V/Line)	0.2	16
Electric train	0.04	14
250cc motorcycle	1.6	124

Table 3: Emissions intensity and emissions figures for various transportation modes (Source: Australian Greenhouse Office, 2006).

2.6.1. Modal shift

To analyse the possible improvements attainable via modal shift we must measure the actual efficiency of each possible transportation mode. In the absence of such data on a country specific level, we can use some of the data gathered from the various non-Malaysian sources and adapt it to locally known data.

As passenger cars are responsible for 59% of the CO_2 emissions from the transport sector, they are the obvious place to start looking for improvements. Multiple sources indicate taxis as the worst polluters per passenger kilometre. While most taxis in Malaysia now operate on CNG, which marginally reduces the vehicle's CO_2 emissions *per kilometre* (about 8.5%), they still emit significantly more CO_2 *per passenger kilometre* than passenger cars. This is because taxi passenger kilometres only count when transporting a passenger. When a taxi is en route to/from a depot or pickup location, or returning from a passenger run "empty" (i.e. without a paying passenger) it is accruing emissions but not passenger kilometres. Taxis are also the most expensive way to travel, but are still heavily utilised due to their flexibility: They can pick up and drop off passengers almost anywhere at any time. Taxis emit more than four times the CO_2 of passenger cars on a passenger kilometre travelled basis.

Personal trucks, which are increasingly used as passenger vehicles in Malaysia, are less efficient than normal passenger cars due to their larger size and weight, however they comprise only a small, though rapidly growing segment of the current fleet. Passenger cars are estimated to consume 2.32MJ of energy per passenger kilometre, compared to just over 1MJ to 1.23MJ for passenger rail systems. This indicates a potential energy consumption reduction of 50% if passenger car occupants were shifted to rail. Passenger cars are responsible for 59% of the road CO_2 emissions, and road transport comprises 85.2% of the transport emissions, estimated to be around 50 Mt per year currently, thus passenger cars are accountable for approximately 25Mt of CO_2 emissions in Malaysia per year. A shift from individual passenger cars to rail travel would reduce transport emissions by 53%, thus possibly reducing total annual CO_2 emissions by approximately 13.3 Mt of CO_2.

By comparing general rail, bus, motorcycle (MC) and car relative efficiencies listed in Table 4, we can derive a *modal shift efficiency improvement schedule* as shown in Table 5. As mentioned shifting from cars to rail will save about 53%, going from a car to a bus saves 40% and a shift from a car to a motorcycle saves about 33%. This is likely an underestimate of the improvement gained by shifting to motorcycles, as the efficiency numbers are taken from the US where significantly larger motorcycles are used. However, the trend in Malaysia is toward larger capacity motorcycles, so we will use this figure in the following analysis. Shifting from motorcycles to rail saves around 30% of the energy, but shifting from a motorcycle to a bus saves only about 11%. Finally, shifting from a bus to a train may save around 21%.

If we assume the CO_2 emissions are reduced proportionally to energy reduction, and use the by-mode CO_2 emissions for Malaysia, we can then determine the CO_2 emissions reduction of various modal shift possibilities as shown in Table 6.

These numbers represent the maximum possible improvements based on the designated modal shifts. It assumes that 100% of the passenger kilometres travelled are transferred from the less efficient to the more efficient transportation mode, which is obviously an unlikely scenario. Actual adoption rates will depend on a number of factors, and we believe an adoption rate of 50% is an exceedingly optimistic assumption, with perhaps 20% more realistic in the near future.

Regardless of the probable adoption rates, this makes it very clear that a shift from passenger car trips to virtually any other mode will have the biggest effect, with rail being the preferred mode. Motorcycle emissions can only be significantly reduced by moving the riders into trains.

Mode	Passenger/ vehicle	MJ/ passenger kilometre
Taxi	1.55	10.26
Personal truck	1.84	2.40
Car	1.55	2.32
Aircraft	99.3	1.85
Motorcycle	1.2	1.56
Bus	18.4	1.39
Rail commuter	49.05	1.23
Rail transit	36.75	1.09
Rail- intercity	31.35	1.05

Table 4: Energy intensity of various transport options adapted for typical Malaysia passenger load factors from US data (Source: US Transportation Energy Book, 2010).

Percentage energy reduction moving from:				
To:	**Car**	**Motorcycle**	**Bus**	**Rail**
Rail	53%	30%	21%	0%
Bus	40%	11%	0%	
Motorcycle	33%	0%		
Car	0%			

Table 5: CO_2 reduction by modal shift, by percentage (Source: Author, 2015).

CO_2 reduction moving from:				
To:	**Car**	**Motorcycle**	**Bus**	**Rail**
Rail	13.3	1.4	0.3	0.0
Bus	10.1	0.5	0.0	
Motorcycle	8.3	0.0		
Car	0.0			

Table 6: Mt CO_2 reduction by modal shift from a baseline of 50 Mt total from the transport sector (Source: Author, 2015).

2.6.2. Fleet purge

Increasing prosperity promotes a shift towards larger engine capacities and indeed larger vehicles over time. While the engines of newer vehicles are often more efficient than older ones, the vehicle may actually consume more fuel per passenger kilometre as their size and power grow. This has been shown to be the case with motorcycles in Malaysia (Lee et. al, 2010), where 15+ year old vehicles achieved 60km/litre, whereas relatively new motorcycles of less than 5 years of age achieved 45km/litre on the same test due to the prevalence of larger engine sizes. The major improvement in efficiency for both conventional cars and motorcycles has come from the application of electronically controlled fuel injection. Fuel injection is generally expected to improve a vehicle's fuel consumption by around 10%. It has also been shown that a small percentage (7%) of on the road vehicles are grossly mistuned, and running significantly less efficient (up to 35% higher fuel consumption) than similar properly tuned vehicles (Liang, 2010). Purging the existing fleet of these "clunkers", or repairing them to operate near their originally intended efficiency could help reduce both fuel consumption and emissions.

Cars over 15 years old were shown to consume 27% more fuel than newer cars. If this still holds true and 32% of the fleet is still over 15 years old, then purging these older, less efficient cars could potentially save 2.2 Mt of CO_2 per year. This is likely to be an overestimate, as the older cars are generally driven less than newer cars. Purging of older motorcycles would be less likely to decrease the CO_2 emissions as newer motorcycles tend to be significantly larger than older ones, thus newer bikes tend to produce more CO_2, albeit with lower emissions of CO, hydrocarbons and NO_x, than older ones.

If the data from the improperly tuned motorcycles holds true for cars, then inspecting and correcting poorly tuned cars could possibly reduce CO_2 emissions by 35% on the 7% of the fleet, or about 0.65 Mt of CO_2 per year. For motorcycles the same effort would only save about 0.12 Mt of CO_2 per year. Additionally, the elimination of these poorly running vehicles will greatly reduce the emissions of other hazardous pollutants such as carbon monoxide (CO) and various hydrocarbon (HC) compounds. Removing two-stroke motorcycles from the roads would have about the same effect as the motorcycle fix-up programme, resulting in 0.13 Mt of CO_2 reductions per year.

Because of their low fuel consumption motorcycle manufacturers and customers alike have not historically been overly concerned with fuel efficiency. Motorcycles are simply considered "efficient" by comparison with cars. Most motorcycles sold in Malaysia to date are still carburetted and thus are significantly less efficient than equivalent fuel injected motorcycles. Malaysia intends to implement Euro-III emissions standards for motorcycles starting in 2017, which will require them to have fuel injection in order to pass. It has been shown that a typical small motorcycle's fuel consumption is reduced by 11% by converting to fuel injection (Teoh et. al, 2009).

This alone would save 0.52 Mt per year. If motorcycle manufacturers are pushed by new vehicle fuel efficiency standards to produce more efficient vehicles, there are many technologies available (roller follower rocker arms, compact combustion chamber design, dual spark, over expanded cycle, etc.) which are commonly used on cars and hybrids. Efficiency improvements of 10 to 20% are possible with these common technologies. Combining fuel injection with a few well-chosen efficiency enhancements could reasonably be expected to deliver a 20% improvement in motorcycle efficiency. These "fuel efficient" motorcycles could very conservatively account for a reduction of 1.03 Mt per year.

Adoption rates of 100% are unrealistic unless mandated, however as there is more of an immediate economic incentive to the vehicle owners to improve the efficiency of their vehicle, or "trade up" to

a newer more efficient vehicle a 50% adoption rate may not be as overly optimistic as the modal shift options.

2.6.3. Fuel switch

Each fossil fuel produces a different amount of CO_2 per unit of energy produced. This is because of the relative amounts of hydrogen and carbon in the fuel. Both carbon-carbon bonds and hydrogen-carbon bonds represent chemical energy storage in a fuel. Carbon partaking in combustion generally winds up as CO_2 whereas hydrogen produces H_2O, i.e. water. When a high-carbon fuel such as coal is burned, larger amounts of CO_2 are produced (per energy unit) than when a relatively hydrogen rich fuel like methane is burned. Thus, in order to reduce the CO_2 emissions from transport, one approach is to shift from CO_2 intensive fuels (such as diesel and petrol) towards lighter hydrocarbon fuels, like LPG and natural gas. Additionally, biofuels, such as biodiesel or bioethanol, are nearly "carbon neutral" as the CO_2 created during combustion came from atmospheric CO_2 in the creation of the fuel.

Fuel	CO_2 emissions pound/Btu	CO_2 emissions kg/MJ
Coal (anthracite)	228.6	0.098
Coal (bituminous)	205.7	0.089
Coal (lignite)	215.4	0.093
Coal (subbituminous)	214.3	0.092
Diesel fuel and heating oil	161.3	0.069
Petrol	157.2	0.068
Propane	139.0	0.060
Natural gas	117	0.050

Table 7: CO_2 emissions of various fuels (Source: US Energy Information Administration, 2015).

Currently (2016) the Malaysian government intends to mandate B10 biodiesel (a 10% blend of biodiesel and petro diesel) as the standard diesel fuel for all of Malaysia later this year. As most passenger vehicles are currently gasoline based it is not likely to have a major impact on automobile CO_2 emissions, but will affect the freight sector significantly. Other biofuels such as bioethanol and even biogas (i.e. Methane) are currently under investigation, but could become significant in the distant future.

Since 1991 the Malaysian government has had a programme (the Natural Gas for Vehicles Program) to encourage conversion of petrol vehicles to Compressed Natural Gas (CNG) as the countries reserves of gas significantly outweigh the liquid petroleum reserves (14.7 billion barrel equivalent of natural gas compared to four billion barrel of oil) (Conglin Xu, 2014). This programme has met with high adoption rates among taxis and secondarily buses. A large number of passenger cars have also been converted, but it currently represents a very small fraction of the passenger automobile fleet. Almost all of the cars are "bi-fuel" vehicles, meaning that they can be operated on either CNG or petrol, while the buses are generally CNG only vehicles.

Figure 15: This motorcycle has been converted to operate on CNG and can travel 200km for RM4 (about 1 USD) of fuel (Source: Author, 2016).

The cost of an automotive conversion kit ranges from about 1,000 USD to about 2,000 USD, and is considered a significant barrier. Utilisation of CNG generally saves the owner about 50% on the fuel costs, resulting in an ROI of three to six years for a passenger car owner, and perhaps six months to just over two years for a heavy or frequent user.

Cost (USD)	10	15	20	30	50	100	1000 km/year
1000	5.7	3.8	2.8	1.9	1.1	0.6	
2000	11.3	7.5	5.7	3.8	2.3	1.1	

Table 8: Years to breakeven of various CNG conversion cost (Source: Author, 2015).

Switching a car from petrol to CNG operation reduces CO_2 emissions by approximately 6 to 11% according to the Argonne National Laboratory in the US. Taking the average reduction to be 8.5%, and applying it to all passenger cars, a fleet switch to CNG could reduce Malaysia's fleet emissions by a maximum of 2.1 Mt of CO_2 per year. As Malaysia's natural gas reserves exceed its liquid petroleum reserves by a factor of around three, this would also greatly reduce the country's need for petrol, giving it a distinct economic advantage (EIA, 2014).

2.6.4. Propulsion switch: Hybrid electric vehicles

Due to their higher cost Hybrid Electric Vehicles (HEVs) are not yet popular in Malaysia despite their efficiency improvements. As a category taxis are the most likely group to realise an economic incentive from the utilisation of HEV technology.

For taxis operating in urban areas a major improvement in efficiency could be gained from hybridisation. The US Environmental Protection Agency (EPA) has measured the fuel efficiency of hybrid cars to be 17.7 km/litre compared to 11.5 km/litre for petrol vehicles (US EPA Light-Duty Automotive Technology CO_2 Emissions and Fuel Economy Trends: 1975 through 2015, 2015). If the taxi fleet were switched to hybrid CNG vehicles emissions might be reduced from 635,000 tons to about 414,000 tons, for a modest savings of around 0.222 t of CO_2.

Switching the passenger car fleet from standard gasoline engines to hybrid electric power trains could similarly reduce emissions from this sector by 8.8 Mt of CO_2.

2.6.5. Propulsion switch: Electric vehicles

Electric propulsion is another popular option. This is less likely as a retrofit, but is a possibility for new vehicles, both cars and motorcycles. However, while EVs have zero tail pipe emissions the upstream power generation emissions must be taken into account.

Data from the US electric production shows CO_2 production rate of about 0.61 kg/kWh, while Malaysia's electric grid is more dependent on fossil fuels producing about 0.63 kg of CO_2 per kWh[3].

Extrapolating from the calculated CO_2 emissions of 3,480 kg of CO_2 per EV per year in the USA, in Malaysia this would be 3,603 kg of CO_2 per vehicle based on the local power mix (figure 17 and side bar). A petrol vehicle tested under the same circumstances produces 6,734 kg of CO_2, for a net CO_2 reduction of 46% for EVs compared to petrol passenger cars in Malaysia. Thus if all the petrol cars in Malaysia were to be replaced with electric cars, it would result in a reduction of 11.7 Mt of CO_2 per year, somewhat better than the 8.8 Mt of CO_2 per year saved from hybridization.

The life cycle emissions of an EV depend on the sources of electricity used to charge it, which vary by region. In geographic areas that use relatively low-polluting energy sources for electricity production, plug-in vehicles typically have a life cycle emissions advantage over similar conventional vehicles running on petrol or diesel. In regions that currently depend heavily on conventional fossil fuels for electricity generation, EVs may not currently demonstrate a strong life cycle emissions benefit.

Carbon Dioxide Emissions from the Generation of Electric Power in the United States, 2000, available http://www.eia.doe.gov/cneaf/electricity/page/co2_report/co2report.html

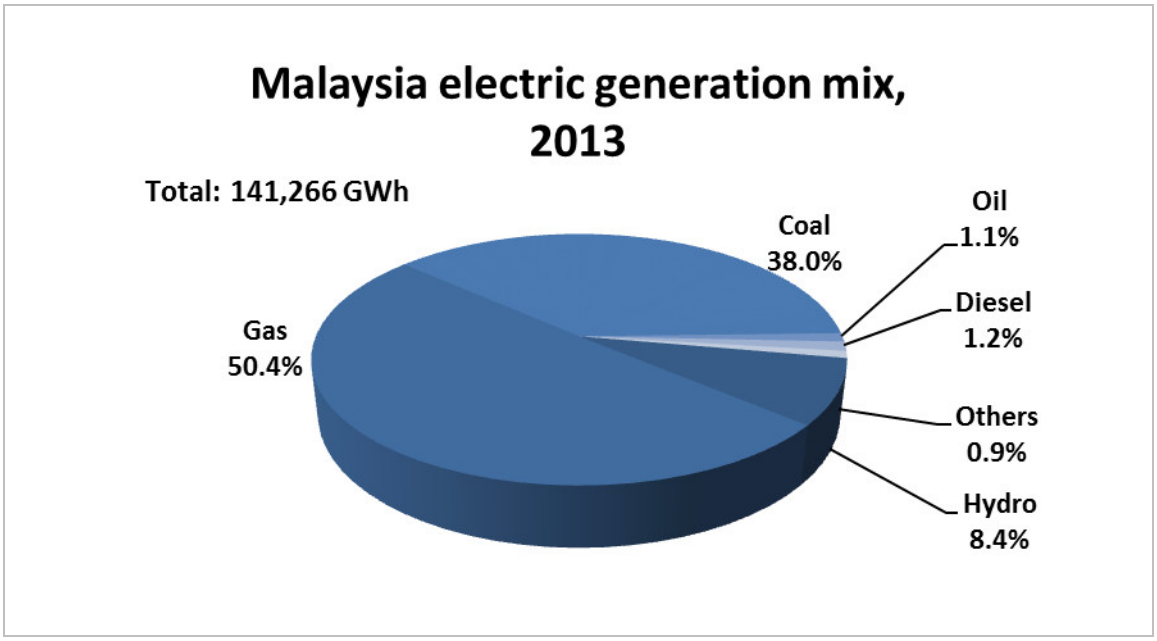

Figure 16: Electrical power generation in Malaysia (Source: Energy Hand Book, 2015).

Shifting motorcycles to electric propulsion will probably have a bigger effect on CO_2 emissions in relative terms, as the majority of motorcycles on the market are currently carburetted, and therefore emit significantly more CO_2 than fuel injected vehicles. Malaysia is scheduled to implement Euro-III emissions requirements for motorcycles starting in 2017, thus this additional advantage for electric motorcycles will not persist. Assuming a similar proportional reduction in CO_2 emissions for complete motorcycle replacement with electric motorcycles, 2.2 Mt of CO_2 per year would be avoided, along with a significant reduction in locally emitted pollutants, such as CO and HCs, and noise.

Figure 17: Electric "motorcycles" like this one are very popular in Malaysia, however their usage raises many safety concerns, such as underage drivers (Source: Author, 2014).

2.6.6. Avoid

Travel avoidance is probably the most effective, and also perhaps hardest to implement, mean of reducing CO_2 emissions. Many trips are considered mandatory, i.e. commuting to and from work or to school, and procuring provisions necessary for a family. Some travel can be considered "optional" such as travel for entertainment. The distances necessary to commute is effected by many factors, such as home site location, particulars of the job or company, and the interconnection transportation infrastructure.

In the short term, perhaps the best "avoidance" option would be to combine multiple mandatory trips, or at least combine optional trips with mandatory ones. For example, a parent commuting to work in the morning could potentially drop off children at school, assuming it is along the way, rather than having to make two separate trips. Shopping trips can be combined with commuting relatively easily. The problem with implementing this type of arrangement is that it depends on the volition of the individuals involved, and requires planning ahead of time, as well as a local alternative transport environment. Car-pooling has similar benefits and issues: The individuals involved must sacrifice convenience in order, generally, to save money. Obviously one thing that could be done to enhance the attractiveness of avoiding travel would be to make it relatively more expensive by including so-called 'externalities' of car ownership into its total cost, by for example raising the cost of automobile ownership (e.g. high permit fees such as in Singapore) or operation (e.g. fuel taxation). While both of these methods are likely to have some positive effect on CO_2 emissions, they will undoubtedly be unpopular as they increase cost and decrease convenience for the public.

In the long term, avoidance is likely to yield the largest CO_2 reductions by careful land use and transportation planning, especially that of urban settings. If residential areas can be designed so that schools are within easy biking distance, safe pedestrian/bicycle paths connect residences, schools, and rail transport hubs with offices, factories, and commercial centres, then the need for personal vehicle ownership can be largely reduced.

The upper limit of this is difficult to estimate; however, we need only look back a few years into the past to see Malaysia as a country that got by with much fewer cars per capita. With careful planning, efficient mass transit could potentially reduce the necessity of cars and motorcycles back down to the levels of year 2000, which would roughly cut the number of privately held vehicles in half.

An interesting local custom along these lines is the "pasar malam" or night market which brings various vendors of food, dry goods, fruit, vegetables and meat, clothing and etc. together in small villages or towns once a week on a designated day. Bringing in 50 vendors with their goods to the common distribution point is more efficient than the hundreds of villagers making several trips each to procure the various items purchased. Similarly, there has been success with "mobile libraries" which help connect people in rural areas with access to a wide range of knowledge stored in books. It is likely that this model could be expanded to include many other services such as postal and other governmental services (i.e. national identification registration and certificates, taxes and billing of utilities etc.).

Estimating the potential CO_2 emissions reduction of trip avoidance techniques is particularly dubious as it depends on too many uncontrollable factors, and a long-term evolutionary development of both infrastructure and society.

2.6.7. Summary

Ignoring avoidance strategies for the moment, we have the following best case scenario: All passenger car and motorcycle transportation is switched to electric rail, and taxis are converted to hybrids. This would reduce transportation sector CO_2 emissions by approximately 15.2 Mt of CO_2 per year. Obviously, this is an unlikely scenario. More probable is that a number of different strategies will be implemented simultaneously, improving the efficiency of the existing fleet, more efficient new vehicles, and a shift to train travel. An optimistic but achievable level of an adoption rate of 50% would give a maximum CO_2 reduction of 7.6 Mt of CO_2 per year. A more realistic goal might be a 20% adoption rate resulting in a 3 Mt of CO_2 reduction in the annual CO_2 emissions from transportation in Malaysia.

The following table takes 100, 50 and 20 percent adoption rates of the above-mentioned scenarios and applies them to an annual transportation emissions baseline of 50 Mt of CO_2 per year. The maximum possible reduction is based on shifting all passenger traffic to rail, and hybridisation of the taxi fleet.

Option	**Reduction (Mt of CO_2)**		
Rate of adoption	**100%**	**50%**	**20%**
Car to rail shift	13.3	6.7	2.7
Car to EV	11.7	5.9	2.3
Car to bus shift	10.1	5.0	2.0
Car to motorcycle shift	8.3	4.1	1.7
Car "clunker" scrapping	2.2	1.11	0.44
MC-EV	2.2	1.10	0.44
Car to CNG conversion	2.1	1.07	0.43
Motorcycle to rail shift	1.4	0.70	0.28
New Motorcycle	1.03	0.52	0.21
Car clunker repair	0.65	0.32	0.13
Motorcycle to bus shift	0.50	0.25	0.10
CNG Motorcycle	0.4	0.20	0.08
Bus to rail shift	0.27	0.14	0.05
Taxis to hybrid CNG	0.22	0.11	0.04
Motorcycle 2- to 4-stroke replace	0.13	0.07	0.03
Motorcycle clunker fix-up	0.12	0.06	0.02
Maximum potential reduction:	**15.2**	**7.6**	**3.0**

Table 9: Potential annual CO_2 emissions reduction from a baseline of 50 Mt of CO_2 total from transport sector (Source: Author, 2015).

Looking ahead these remediation measures could result in a reduction of CO_2 emissions from the transportation sector in Malaysia of about 30%, 15%, and 6% respectively for 100%, 50%, and 20% adoption rates.

2.7. Emissions reduction potential from the Malaysia land freight sector

Figures 9 and 10 show that land freight sector, mostly light and heavy duty trucks, contributes approximately 23% of the CO_2 emissions from the transportation sector (estimated to be 50 Mt of CO_2 in 2014), thus freight is responsible for approximately 11.5 Mt of CO_2 emissions per year. The freight infrastructure in Malaysia is quite mature, Malaysia having one of the largest sea ports in South East (SE) Asia, Port Klang ranking 17th in the world and second in SE Asia (American Association of Port Autorities, 2013). Additionally, Malaysia has several inland "dry" ports serving as hubs for freight haulage. Ipoh Cargo Terminal, Padang Besar Inland Container Depot and Nilai Inland Port are the major inland terminals which serve 95% of the cargo volume in Malaysia. Most of the seaports and inland ports in Malaysia are readily connected by both rail and highway. Even though some of the sea ports and inland ports have rail connectivity, the hinterland container transport movements are dominated by road (95%) with rail currently handling most of the remaining 5% (Sqouris, 2003).

Some of the options for improving the sustainability and reducing emissions from freight are similar to the options discussed above, with key possibilities enumerated in the following sections.

2.7.1. Freight- shift

By far the most effective way to improve the energy efficiency of land freight is the modal switch from trucks to rail and shipping as can be seen in table 10. Although rail freight consumes less than 10% of the energy required by trucking, a complete shift to rail is not possible as the dispersal of products over the first/last kilometre requires trucking to reach the closest rail hub.

Transport mode	Fuel consumption	
	BTU per short ton mile	kJ per tonne kilometre
Domestic waterborne	217	160
Class 1 railroads	289	209
Heavy trucks	3,357	2,426

Table 10: Fuel consumption of water, rail and truck freight (Source: Transportation Energy Data Book (US), 2011).

The rail accounts for approximately 5% of land freight movement, while trucks carry most of the rest, and a smaller amount of liquids is transported via pipelines (Sgouridis, 2003). Assuming CO_2 emissions proportional to energy consumption and taking the values from the above table, an increase in the modal share of rail from 5% to 40% could potentially reduce CO_2 emissions by as

much as 4.3 Mt of CO_2 annually. While this may represent an unachievable high level of rail transport, it represents an upper limit of the expected CO_2 savings from a modal shift to rail.

2.7.2. Freight- improve

Internationally a lot of attention is paid to the efficiency of freight hauling trucks as vehicle efficiency is a serious concern for most fleet owners. Newer trucks, for example, come with electronic systems advising drivers how best to optimise fuel consumption based on the terrain, including a cruise control system that automatically speeds up in anticipation of a hill climb, or reduces throttle in preparation for a decent, improving fuel economy by as much as 10%. While newer vehicles have very efficient engines, the existing fleet can still benefit from a number of common improvements such as usage of aerodynamic fairings and fuel efficient tyres. Together these simple improvements can potentially improve the efficiency of an existing vehicle of 5% to 10% (Oregon, 2015). In addition to improvements in driving technique, or so-called "eco driving" this could deliver a total of 20% decrease in fuel consumption from the trucking fleet.

2.7.3. Freight- fuel switch

Large diesel trucks can be converted to operate on CNG, or Liquid Natural Gas (LNG) for larger vehicles, and Diesel Dual Fuel (DDF) system, as it combusts both CNG and diesel at the same time. This is generally done to reduce the operating fuel cost. While the engine emissions of CO_2 is somewhat reduced, there is an increase in methane emissions, which is known to have even more GHG potential than CO_2 and therefore negate the CO_2 reductions (Marc et. al, 2016). This technology, consequently, is not currently favoured as a means of reducing the GHG emissions of freight.

While the CO_2 benefits of different bio fuels can vary widely, a fuel switch to biodiesel can have a significant effect on the CO_2 emissions from freight, as the CO_2 released from the bio fuel is largely being recycled via photosynthesis of the biological feed stock. While the current mandate (Aug 2016) in Malaysia is to establish 10% biodiesel (i.e. B10) as the standard diesel fuel, it is likely that B20 (i.e. 20% biodiesel, 80% petro diesel) is the upper limit of what can easily be implemented, more from supply side constraints than engine technology constraints. Assuming that all diesels are switched to B20, this would give a reduction of about 2.6 Mt of CO_2 reductions from a transportation baseline emission of 50 Mt of CO_2 annually.

2.7.4. Freight- avoid

As shipping of goods is crucial for economic development, the concept of avoidance of shipping freight is difficult to apply. What is easier to understand is that resource utilisation should be maximised by avoiding "empty back hauls" on a delivery vehicle. Freight forwarders are already economically motivated to reduce empty back hauls, as this is detrimental to their bottom line. Larger operators tend to be very sophisticated with fleet management systems in place, however smaller operators might be able to benefit from an industry wide "load share" system, similar to the cellular communications operators (by which one carriers overload is routed via a competitor as opposed to dropping the traffic, by mutual agreement). At least one service "Transport4U.com" exists specifically for this purpose in Malaysia and claims that up to 77% of trucks make return trips empty (Joseph, 2014). Another study in Europe concludes that 24% of all transport vehicle kilometres are performed empty (Demir, Bektaş, Laporte, 2014) but most reports give it as 40-60%

While an empty truck consumes less fuel and emits less CO_2 than a fully loaded truck, doubling the load on a truck does not necessarily double the fuel consumption, or CO_2 emissions, as the aerodynamic component and mass contribution from the vehicle remain constant. In general emissions of an empty truck are assumed to be 10 to 20% less than a half-loaded truck, and 36 to 40% less than a fully loaded truck (UK DfT, 2008). Thus, if we assume that 50% of all truck kilometres are performed empty, and the rest are full and that a full truck produces 38% more CO_2 than an empty truck, we get 42% as the upper bound on the potential CO_2 savings from reducing empty back hauling[4].

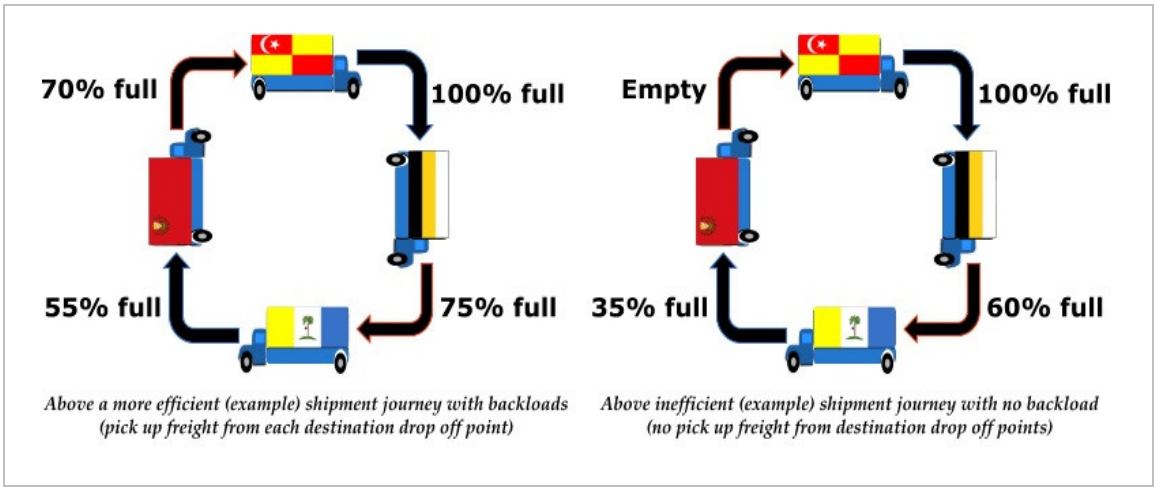

Figure 18: Freight exchange service offered by Transport4U (Source: Transport4U, 2015).

Other significant improvements for freight involve the location of hubs and improved inter-modal connectivity at ports and freight hubs. It has been estimated that poor traffic management around ports and other freight hubs can increase shipping distances by as much as 60%. Reducing queuing times, and thus engine idling times, can also help reduce CO_2. A conservative estimate for potential improvements in this area might be put at 30% maximum CO_2 reduction (Sani, 2012).

2.7.5. Freight- summary

Taking the contribution to emissions from land based freight to be 11 Mt of CO_2 per year, and using the above-mentioned factors, we can calculate the potential emissions reduction based on various levels of mitigation adoption. Here we assume that the maximum potential gain (i.e. 100% adoption) of shifting truck freight to rails (i.e. a 40% share for rail as a maximum) would result in a 31% reduction of CO_2, while freight port and hub location and intermodal efficiencies could improve CO_2 emissions by 30%, and elimination of empty back hauling could reduce CO_2 emissions from land freight by 42%. Use of B20 will reduce the emissions of the trucking fleet by 20%, and individual vehicle and driver improvements amount to a maximum of 20% reduction of CO_2 emissions as well. In these calculations, the intermodal efficiency improvements and reduction of empty back hauling, biodiesel and vehicle efficiency improvements are only applied to the trucking component of the resulting emissions.

[4] Full Load Emissions = 138% (of empty truck) per km. 50% empty back haul Emissions = 0.5 x 138%+ 0.5 x 100% for ½ km traveled, or 238% (of empty truck) emissions per km freight traveled. So moving from 50% empty trucks to full loads gives a CO_2 reduction of:100% - 138/238 = 42%

At the highest possible rate of adoption, freight emissions could be reduced by as much as 80%, for a total reduction of around 9.2 Mt of CO_2 per year. This is an unrealistic number, but it does represent an "ideal" scenario. More realistic is a 50% adoption rate scenario resulting in a reduction of 53% of emissions from the land freight sector, or a reduction of about 6.1 Mt of CO_2 annually. Even in the more pessimistic scenario of a 20% adoption rate emissions can still be reduced by 23%, or approximately 2.6 Mt of CO_2 per year. It can be noticed that with greater levels of adoption the emissions overall from trucking drop, while the emissions from rail increase. This is expected as greater adoption infers more rail traffic, and less truck traffic.

Option	**Reduction (**Mt of CO_2**)**		
Rate of adoption	**100%**	**50%**	**20%**
Reduction from truck to rail shift	4.27	1.86	0.41
Reduction from hub – intermodal improvements	2.17	1.45	0.67
Reduction of empty back-haul	2.13	1.72	0.88
Reduction from vehicle and driver improvements	0.59	0.65	0.38
Reduction from B20 fuel	0.47	0.58	0.37
Total emissions from rail	0.42	0.21	0.08
Total emissions from trucks	2.29	5.24	8.80
Total combined emissions	2.29	5.45	8.80
Maximum potential reduction:	**80%**	**53%**	**23%**

Table 11: CO_2 Emissions reduction from overland freight from a baseline of 11.5 Mt of CO_2 from the land freight sector (Source: Author, 2016).

3. Policies and institutions

3.1. Recent climate change prioritisation

In 2010, parallel to the preparation of the Second National Communication on Climate Change for UNFCCC that was published January 2011 (MNRE, 2011), the National Steering Committee on Climate Change and National Green Technology Advisory Council (steered by Ministry of Energy, Green Technology and Water (KeTTHA)) were combined into a single Council, the National Green Technology Council, which is chaired by the current Prime Minister of Malaysia, Najib Razak. The short-term goal of the Council was to see how Malaysia could voluntarily reduce GHG emissions by 40%, as announced by the Prime Minister at the UN Conference on Climate Change at Copenhagen, 2009. The target was reiterated in 2015 as a 45% reduction in CO_2 intensity per GDP output by 2030 (INDC, 2015). Pursuant to this, an inter-ministerial Transportation Taskforce/Working Group was recently established with the following objectives:

- To identify the development needs of the transport sector from the perspective of green technology and climate change
- To identify the strategic issues in green technology and climate change in developing the transport sector
- To identify, coordinate, and monitor projects and programmes in the transport sector at a national level from green technology and climate change perspectives
- To identify and recommend a framework for legal, regulation, and policies to increase the usage of green transport technologies
- To identify, monitor and evaluate the target area and setting the measurement, target limit and time frame for the usage of green technology and to reduce climate change impact of the transport sector
- To identify environmental friendly alternative energies to be introduced in transport sector
- To identify the mechanisms which include an incentive to minimise the climate change impact in transport sector by using green technology

The announcement by the Prime Minister Najib Razak, regarding a commitment "up to 40%" reductions of CO_2 per GDP by 2020 in Copenhagen 2009, and the recently submitted Intended Nationally Determined Contribution (INDC) in Paris to reduce GHG emissions intensity per GDP by 45% by 2030 relative to the emissions intensity of GDP in 2005 indicates the level of national commitment towards reducing its carbon footprint. Much "green" legislation to date has been focused on select niche technologies such as electric vehicles, in order to grow these industries.

3.2. Stakeholders

Malaysia has a highly centralised government; however, there are many different departments with responsibilities in the energy, environment and transport areas. For transportation systems in Malaysia, the authority of strategic planning resides with the Economic Planning Unit (EPU). The Ministry of Transport (MOT) is the primary ministry responsible for planning, formulating and implementing transport policies. The Road Transport Department (JPJ) acts as approval authority

agency under MOT and together with the Department of Environment (DOE) under the Ministry of Natural Resources and Environment (NRE). It has the sole responsibility for setting emissions limits. JPJ also regulates motor vehicles and road traffic safety as well as inspection of land public and commercial transportation with the support from MOT's concession agency, Malaysia National Automobile Inspection Centre (PUSPAKOM) via their road vehicle testing centres. The Land Public Transport Commission (SPAD) plans, regulates, and enforces all matters relating to land public transport and has jurisdiction over Peninsular Malaysia. The division of Environmental Management and Climate Change (BPASPI) under NRE is responsible for the policies relating to environmental and climate changes for and KeTTHA champions Green Transport initiatives.

In Malaysia, currently there are several different governmental bodies which have authority in the transportation and energy sectors. The main departments include the Ministry of Transport, the Road Transport Department, the Department of Environment, Land Public Transport Commission, Ministry of International Trade and Industry (MITI), Ministry of Energy, Green Technology and Water (KeTTHA), with support from other organisations including the Ministry of Finance (MOF), Ministry of Natural Resources and Environment (NRE), Prime Minister's Department (PMD), Ministry of Works (MOW), Economic Planning Unit (EPU), Ministry of Urban Wellbeing, Housing and Local Government (KPKT), CMS Consortium, Ministry of the Federal Territories (KWP), Ministry of Rural Development Malaysia (MRDev), Malaysia Automotive Institute (MAI), Malaysian Industry-Government Group for High Technology (MIGHT), Malaysia Palm Oil Board (MPOB), Malaysian Green Technology Corporation (MGTC) and Malaysian Investment Development Authority (MIDA). The roles and functions of each body are listed in Appendix 3.

3.3. Institutional structure and climate change policies

In the 1990s Malaysia committed itself, under the UNFCCC, to formulate, implement, publish, and regularly update national and regional programmes containing measures to mitigate climate change. To guide Malaysia's initial national communication to the UNFCCC, a National Steering Committee on Climate Change (NSCCC) was set up in 1994. This inter-ministerial body, presently chaired by NRE, is tasked to formulate and implement climate change policies including mitigation of GHG emissions and adaptation to climate change. The NRE was formed in 2004 as part of a comprehensive reform to tackle policy fragmentation by combining the separate environmental portfolios under a single authority. Aside from overseeing NSCCC, the ministry has been appointed as the Designated National Authority (DNA) for evaluating Clean Development Mechanism (CDM) projects and as the liaison to UNFCCC. Within the NRE is the Environmental Management and Climate Change Division which is tasked with establishing a holistic policy framework to ensure a healthy, clean, safe, and productive environment for sustainable development. This division is also responsible to ensure that the country's interests in global and regional environmental issues are protected.

The DOE under the NRE is mandated to prevent, control and abate pollution by enforcing the Environmental Quality Act (EQA) of 1974. The DOE also formulated the Recommended Malaysian Air Quality Guidelines (RMG) and manages the air quality monitoring network.

The MOT is the primary agency responsible for planning, formulating, and implementing policies on road, rail, maritime, and aviation transport and ports. It undertakes service provider licenses and concessionaires (for commercial and public vehicles), for domestic shipping lines. It also undertakes the issuance of drivers' licenses, vehicle registration and road tax administration, vehicle type approval, and formulation of vehicle regulations through the JPJ, the primary road vehicle authority under MOT.

Back in 2000, the Ministry of Science and Technology and Environment on behalf of the National Committee submitted the country's first national communication to UNFCCC which set the national inventory of GHGs and the assessment of the possible impacts of climate change. The report made suggestions for possible initiatives to address climate change.

Since the Government's *Third Malaysia Plan (1976-1980)*, environmental concerns have been progressively emphasised in the various development plans. Although the policies are generally treated within the bounds of particular sectors they also address, to some extent, the impacts of climate change. Similarly, the *Ninth Malaysia Plan (2006-2010)* and the *Tenth Malaysia Plan (2010-2015)* contained programmes that directly address or indirectly contribute to managing issues of climate change adaptation and mitigation. These programmes include furthering of policies on development of renewable energy sources, fuel pricing, enhancement of the role of public transportation systems and furthering sustainable development.

Due to the recognised challenges presented by climate change and the need for a comprehensive approach, in the 2005 the NRE, in collaboration with the Institute for Environment and Development (LESTARI) and the Universiti Kebangsaan Malaysia (UKM), initiated a Policy Study on Climate Change. The resultant *draft 2009 National Policy on Climate Change* consists of several key elements that include objectives, principles, strategic thrusts, and key actions aimed at ensuring climate-resilient development and low carbon economy (NRE 2009).

In parallel, the KeTTHA pursued relevant policies including support for alternative fuels and green technology and the formulation of a National Policy on Green Technology, including green vehicles.

Among the documents on which environmental policy is based on are: *The 1974 Petroleum Development Act, the 1975 National Petroleum Policy, the 1980 National Depletion Policy, the 1990 Electricity Supply Act, the 1993 Gas Supply Acts, the 1994 Electricity Regulations, the 1997 Gas Supply Regulation,* and *the 2001 Energy Commission Act*. The Department of Electricity and Gas Supply acts as the overall regulator of both electricity and gas supply. There are several other players in the energy sector including energy supply and service companies, and research and development institutions as well as the end consumers. Government-linked companies Petronas and Tenaga Nasional Berhad are major players in Malaysia's energy sector.

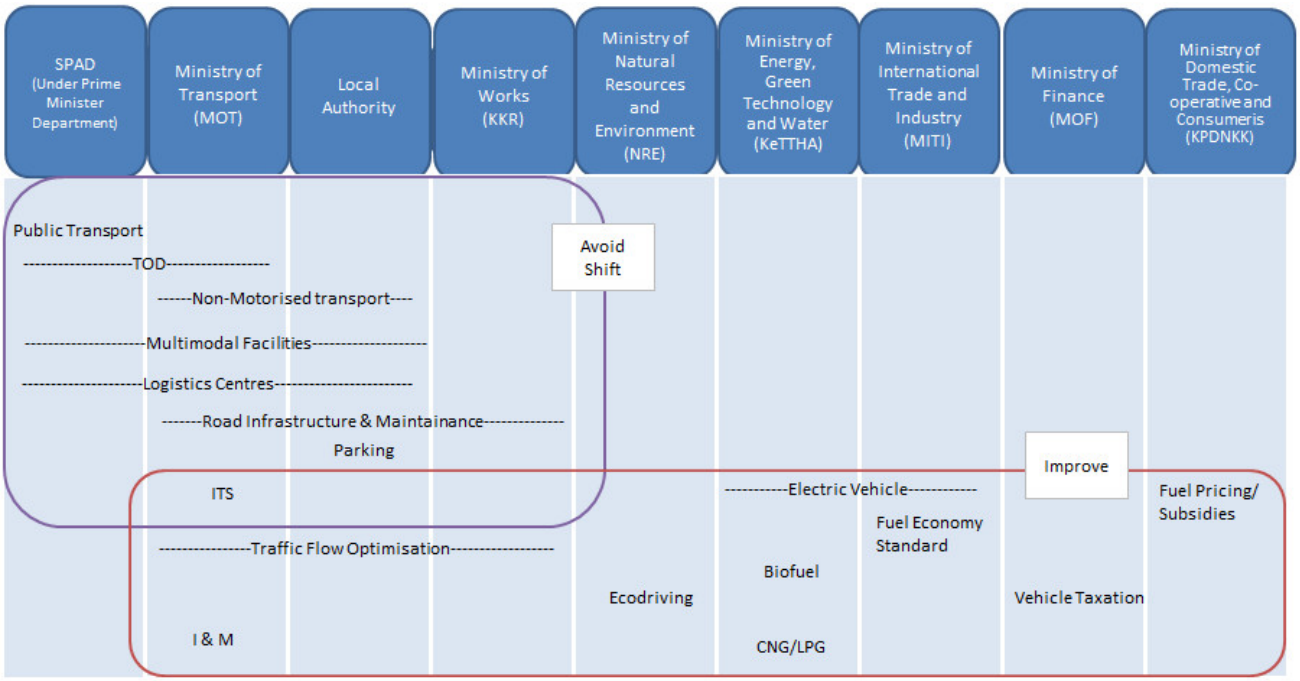

Figure 19: Overview of responsibility for transportation policy, adapted from institutional cooperation for sustainable transport in Malaysia workshop report, GIZ (Source: Author, 2016).

3.3.1. Malaysia national policy on climate change

In November 2009, the cabinet of Malaysia endorsed the Malaysia National Policy on Climate Change. The fundamental policy statement was that Malaysia is committed to "ensure climate resilient development to fulfil national aspirations for sustainability"[5].

Objective & principles of the national policy on climate change

The government of Malaysia has underlined three major objectives and five major principles with regard to this climate change policy.

Objectives:

- Mitigating climate change through wise management of resources and enhanced environmental conservation resulting in strengthened economic competitiveness and improved quality of life.
- Integration of response into national policies, plans, and programmes to strengthen the resilience of development from arising and potential impacts of climate change.
- Strengthening of institutional and implementation capacity to better harness opportunities to reduce negative impacts of climate change.

Principles, Strategic Trusts (ST) & key actions:

- Development of a sustainable path – Integrate climate change response into national development plans to fulfil the country's aspiration for sustainable development.

  ST1: Facilitate harmonisation of existing policies & institutions

  ST2: Implement measures on low carbon economy

[5] Sustainable Consumption and Production in Malaysia, EPU 2013

ST3: Support climate-resilient investment

- Conservation of environmental and natural resources – Strengthen implementation of climate change actions that contribute to environment conservation and sustainable use of natural resources.

  ST4: Strengthen environmental & resources conservation

  ST5: Consolidate the energy policy

- Coordinated implementation – Incorporate climate change consideration into implementation of climate change responses.

  ST6: Integrate cross-cutting issues

  ST7: Support knowledge-based decision making

- Effective participation – Improve participation of stakeholder and major groups for effective implementation of climate change responses.

  ST8: Improve collaboration

  ST9: Increase awareness & community participation

- Common but differential responsibilities and respective capabilities – International involvement on climate change will be based on the principle of common but differentiated responsibilities and respective capabilities.

  ST10: Strengthen involvement in international programmes

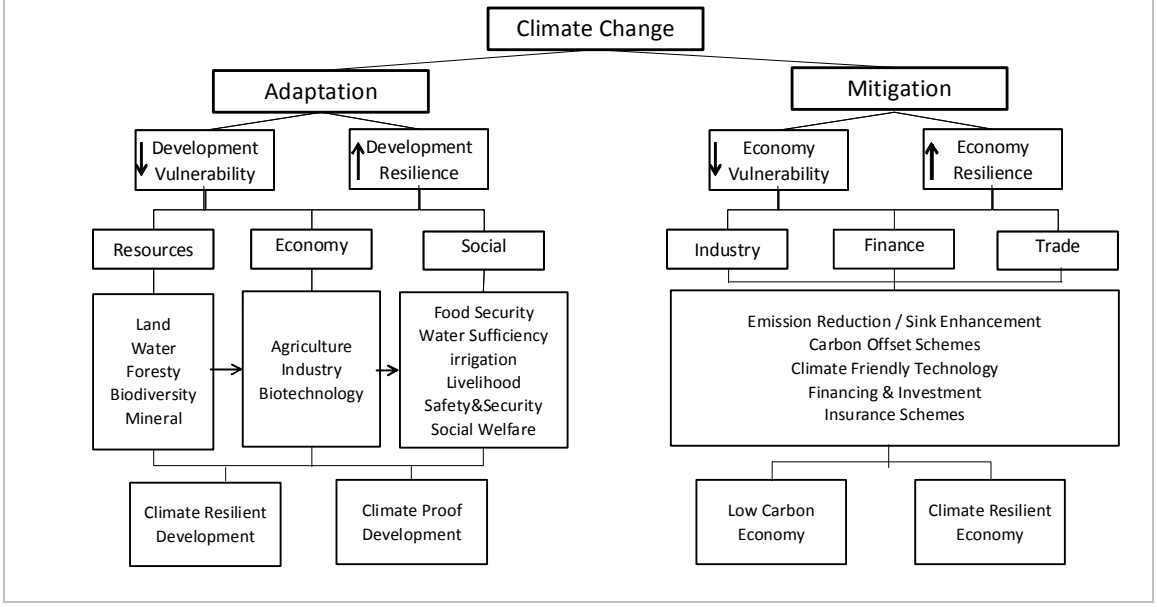

Figure 20: Overall framework on national policy of climate change (Source: UKM, 2008).

3.3.2. National green technology policy (renewable energy and efficiency for the transport sector)

Policy statement: Green technologies shall be a driver to accelerate the national economy and promote sustainable development.

Objectives:

- To minimise growth of energy consumption while enhancing economic development
- To facilitate the growth of green technologies industry & enhance its contribution to national economy
- To increase national capability and capacity for innovation in green technologies development & enhance Malaysia's competitiveness in the global arena
- To ensure sustainable development & conserve environment for future generations
- To enhance public education & awareness on green technologies and encourage its widespread use

Four Pillars

i) Energy – Seek to attain energy independence & promote efficient utilisation
ii) Environment – Conserve & minimise impact on environment
iii) Economy – Enhance national economic development through use of Green Technology
iv) Social – Improve the quality of life for all

Five Strategic Trusts

1. Strengthen the institutional frameworks
2. Provide conductive environment for green technologies development
3. Intensify human capital development in green technologies
4. Intensify green technologies research and innovations
5. Promotion and public awareness

Achievements to date:

- Restructure of Malaysia Energy Centre (PTM) as to Malaysian Green Technology Cooperation (MGTC)
- Development of the Green Technology Financing Scheme (GTFS)
- Develop Putrajaya & Cyberjaya as green technology cities

3.3.3. National Physical Plan (NPP)

The National Physical Plan is a written statement that summarises the strategic policies for direction of physical development and conservation for all Peninsular Malaysia. The NPP was approved by the National Physical Council (NPPC) in 2005. This plan has several formulated and proposed strategies, policies, direction and implementation mechanisms related to spatial planning, including aspects of integrated transportation planning and development.

The objective of this policy is to establish an efficient, equitable and sustainable national spatial framework to guide the overall development of the country towards achieving developed and high-income national status by 2020:

i) To rationalise and consolidate the national spatial planning framework supported by key strategic infrastructure for economic efficiency and global competitiveness
ii) To optimise utilisation of land and natural resources for sustainable development and biodiversity conservation
iii) To promote more balanced regional development for national economic integration and social unity
iv) To enhance spatial and environmental quality diversity and safety for quality of life

Themes and Policies:

Theme 1: Setting a national spatial framework
Theme 2: Enhancing economic competitiveness
Theme 3: Conserving agriculture resources & rural development
Theme 4: Sustainable tourism development
Theme 5: Managing changing human settlements
Theme 6: Conserving natural resources, biodiversity & the environment
Theme 7: Integrating national & urban transportation network
Theme 8: Providing appropriate infrastructure

Under theme 7, integrating national & urban transportation network, there are six policies involved:

1. Integrated transport network
2. Rail network
3. Road network
4. Airports & seaports
5. Transit oriented development (TOD)
6. Urban & public transport

3.4. Existing policies on transportation

Table 12 provides an overview of the key polices and measures in passenger transport and their status as of 2016. The major points of the Malaysian logistics policy are summarised in table 13. These tables are extracted from the comprehensive policy table in Appendix 5, which also includes the information sources. Status is assessed according to these categories:

- Implemented: The policy is implemented and enforced, or the transport plan (e.g. metro) is completed and functioning. However, it does not imply there can be no further implementation, e.g. if a certain fuel economy standard is implemented, a future, more stringent, standard can still be developed, or new standards be developed for other types of vehicles.
- Partially implemented: Some parts of the policy or transport plan have been implemented
- On-going: Implementation has started but not yet completed
- Pilot: May refer to a policy that is being implemented, but not yet on a large scale
- Planned: Clear policy signals, particularly published official documents, that a policy will begin implementation in a certain year in the future

- Intended: Evidence of policy discussions have been found (public information or personal communication)
- Not in discussion: No information on policy discussion has been found

The policies have been categorised according to Avoid, Shift, Improve or general policies: "Avoid" policies refer to those that reduce the need to travel or the length of travel; "Shift" policies refer to those that encourage a shift to more efficient modes of transport or those that promote a high share of such modes, and: "Improve" policies refer to those that increase energy and carbon efficiency of vehicles, their operation and fuels used in the different modes.

	Policies Measures	**Implementation Status**	**Remarks**
Avoid	TOD/ land-use planning	On-going	TOD was introduced in Greater KL/KV which is densely populated. Compact development and mixed-used planning are among main thrusts of the government as stated in the 10th Malaysia Plan, National Physical Plan and National Urbanisation Policy.
	Road pricing	Implemented	Toll Road Pricing based on vehicle type and size is a means of financing road infrastructure projects, but not for congestion charging.
	Restrictions on car use	Not in discussion	Pilot programme in the 1970's was suspended due to lack of alternative transport means at that time.
Shift – incentives regulation and information	PT management reform	Implemented	A 20-year *National Public Transport Master Plan 2012* stated the need of state-level master plans to be developed. The *Greater KL/KV Land Public Transport Master Plan* is supported by six subsidiary plans: *Urban Rail Development Plan, Bus Transformation Plan, Taxi Transformation Plan, Interchange & Integration Plan, Land Use Plan, and Travel Demand Management Plan.*
	Subsidy for PT options	Implemented in some areas	Penang, Selangor and Johor Baru have free limited route down-town shuttle buses.
	Cycling campaigns	Pilot in Penang and KL	Only at local levels (e.g. Penang State, George Town area and selected recreational sites in KL).
	Integrated ticketing for PT	On-going	Touch n Go ticketing system on RapidKL systems, KL Monorail, ERL/ KLIA Express and KTM Komuter. Although public transport in Malaysia is run by different operators, SPAD is working toward single cashless ticketing system.
	Real-time public transport info	On-going	A fleet tracking system monitors RapidKL Buses using GPS. Displays show information including estimated time of arrivals for next ride.
Shift – infrastructure	Improvement of intra-urban rail	On-going	The system is currently undergoing major expansions in the KL area.
	BRT	Implemented[6]	BRT Sunway Line has been operating since June

[6] The existing BRT system at Bandar Sunway is exceptionally expensive (elevated, isolated electric bus highway), and may not be effective or competitive with other transport options in the long-term. The proposed BRT system for Johor Bahru is expected to be a more conventional one with associated cost savings.

			2015. Its 5.4 km elevated bus rapid transit system operated by 15 electric buses. BRT Federal Line was proposed by Prasarana and planned to be operational by 2018. An additional line is planned in Johor Bahru.
	Sidewalks	On-going	In some high-pedestrian travel areas sidewalks are expanded and maintained properly.
	Cycling lanes	Piloted in Penang	*Penang Bicycle Lane Masterplan*, launched in 2012, is an initiative of the state to become more bikes friendly. The masterplan includes a total of 200 km of bicycle lanes for both mainland and island. The state government of Penang mandated that new housing projects will be equipped with bike lanes.
	Bike-sharing	Piloted in Penang	A contract to design, install, operate, and maintain a bike-sharing system in George Town, Penang, has been awarded in 2014. It will be in operation in May 2015 and the whole system will be fully completed by 2017.
	Park-and-ride	Implemented	P&R system was first implemented in KL Sentral area in 2001 and is ongoing in the rest of the KL area, but is yet to achieve wide implementation outside of KL.
Improve – efficiency	Incentives for efficient vehicles	On-going	100% import duty exemption for EVs
	Incentives for alternative fuels	On-going	NGVs are given a reduction of road tax, 50% road tax reduction for mono-gas vehicle, and 25% for bi-fuel vehicle (petrol and natural gas).
	CO_2-based taxation for new vehicles	Not implemented	
	Car labelling	Not implemented	
	Fuel economy standards	Not implemented	
Improve – operation	Intelligent transport systems	On-going	ITS was completed in 2005 to monitor traffic flow. It is operated by Kuala Lumpur City Hall (DBKL).
	Speed limits	Implemented	*National Speed Limit Order 1989* indicates that the default speed limit is 110km/h on intercity highways, 90km/h on federal and state roads, and differs for different categories of vehicles.
	Inspection and maintenance	Implemented	Only covers new car purchase and transfer of ownership. Commercial and public vehicles are inspected routinely by PUSPAKOM.
Improve – fuel	Incentives for low-carbon fuels	Implemented	As in year 2014, government of Malaysia subsidised 0.13 USD per litre equivalent for CNG, which reduced the retail price to 0.28 USD per litre equivalent.
	CNG/LPG for taxis and buses	On going	CNG vehicles are predominantly confined to taxis in Klang Valley and Penang. There were 3000 CNG bi-fuel taxis registered in 2013.

	EEV (energy-efficient vehicle. hybrid) incentives (2W/3W/car)	On going	Ministry of International trade and Industry (MITI) offers 100% import duty exemption for electrical or hybrid cars below 2200cc. This is granted by *National Automotive policy 2014*.
General	Fuel price reform	Implemented	In December 2014, subsidies were removed for RON95 petrol and diesel. Retail prices are fixed according to a managed flow mechanism.
	Ride calling applications	Implemented	Services like Grab and Uber are allowed to operate in Malaysia

For more detailed information on existing transportation related policies, please refer to the complete table in Appendix 5

Table 12: Passenger transport policies and measures: Current status (Source: Author, 2015).

	Policies/Measures	**Implementation Status**	**Remarks**
Avoid	Empty hauling reduction	Piloted	Transport4u, a private company has taken initiative on providing online 'freight exchange' and load matching service to reduce empty hauling.
	Improve logistic centres and their location, inland ports	On-going	*Third Industrial Master Plan 2006-2020* recognises the need for strategic logistics centres at the border area as well as in areas around Ipoh in Perak, Northern Johor-Melaka and East Coast of Peninsular Malaysia. It emphasises development of rail and freight distribution centres and distribution parks near major seaports and airports or in inland industrial location.
	Pipeline	Implemented	Peninsular Gas Utilisation is the longest (1,700km) pipeline in Malaysia connecting Kerteh refinery in Terengganu to other areas of Peninsula Malaysia.
Shift – regulation	Lorry restrictions	Partially implemented	Vehicles weighing 10,000kg and above are banned from North-South expressway between 6.30am and 9.30am on weekdays since 15 May 2010 (to reduce rush hour congestion) on major urban highways in KL and Penang bridge.
Shift - infrastructure	Master planning for rail and water	On-going	Rail Freight transport was identified as a key sector in *Third Industrial Master Plan 2006-2020* and *the Eleventh Malaysia Master Plan*.
	Multimodal facilities/dry ports	On-going	Infrastructure development was recognised as an important thrust in the *Logistics and Trade Facilitation*

			Masterplan (2015-2020), improving last mile connectivity to Port Klang, addressing bottlenecks at Padang Besar Terminal and creating integrated hub and spoke models are among the key action items.
Improve – efficiency	Import restriction for inefficient vehicles	Implemented	As stated in *National Automotive Policy*, import of used commercial and public vehicles will be prohibited, effective from 1 January 2016.
	Fuel economy/CO_2 emission standard	Planned	NRE is working with MAI to formulate appropriate policy measures and standards.
Improve – operation	Vehicle scrapping/fleet replacement	Planned	Currently, there are no restrictions on older commercial and public vehicles as long as they pass JPJ/PUSPAKOM inspection. MAI is investigating the possibility of implementing a mandatory program.
	Speed limits	Implemented	Special speed limits exist for heavy vehicle on expressways: 80-90km/h, and Federal and State roads: 70-80km/h
	Eco driving	On-going	Human Capital was identified as important in the *Logistics and Trade Facilitation Masterplan (2015-2020),* training will be provided to increase capabilities of goods vehicles drivers.
	Tyre standards	Implemented	Malaysia follows Malaysian and UN standards for tyres.
	Aerodynamic standards	Not intended in near future	Based on manufacturer design.
	Human capital development	Planned	Adoption of technology to reduce exchange of manual documentation and optimise transport movements is planned along with enhancement of human resources by attracting, and training people in the logistics industry.
	Integrated infrastructure Planning	On-going	Improve last mile connectivity to Port Klang and enhance road freight productivity, creating an integrated hub and spoke development model, with freight hubs at strategic locations, and establish Public Private Partnership for rail operations and infrastructure.
	Transport hub de-bottlenecking	On-going	Address bottlenecks in Padang Besar, establish national freight data program, promote efficient urban logistics
Improve – fuel	Low carbon fuel (1^{st}/2^{nd} gen Biofuel, CNG, LPG) incentive	Implemented	Malaysia implemented B7 (7% biodiesel) in 2014, and will mandate B10 by late 2016. The government has been funding infrastructure improvements required for higher levels of biofuels. NGV and mixed fuel

			vehicle are entitled to road tax reductions.
General	Inspection and maintenance	Implemented	Commercial and public vehicle undergo mandatory inspection by PUSPAKOM routinely, in order to certify compliance to the *Road Transport Act 1987*.

For more detailed information on existing transportation related policies, please refer to the complete table in Appendix 5

Table 13: Freight transport policies and measures: current status (Source: Author, 2015).

3.4.1. Policy summary

While Malaysia has a very mature and professional policy development mechanism, the gradually growing awareness of environmental issues has led to a proliferation of organisations with somewhat inconsistent goals and directions. Often well intentioned environmental measures are oriented towards manufacturers, rather than addressing the market demand directly. Policy measures relating to transportation are often focused only on the greater KL/KV area as it is the most heavily populated and congested area, essentially neglecting other areas. Finally, there are some very progressive policies being developed, but often these are on a project-by-project or technology specific basis, as opposed to being based on a more universal metric such as CO_2 emissions per passenger kilometre or per freight ton kilometre.

3.5. Environmental policy financing

Environmental policy related expenditures are financed similarly to all government programmes in Malaysia. Each year a federal budget is developed by the standing federal government, projecting government revenues and spending as well as forecasting the expected economic conditions for the coming year, and outlines the fiscal policy as promulgated by the EPU for the near future. Each year's budget contains estimates of incoming revenues and expenditures pursuant to the policies in effect during that year. Generally, the federal budgets are announced in October and the state budgets, which are dependent on the federal disbursements, are released shortly thereafter. Upon acceptance of the proposed budget, it is signed into law. The five major strategies focused on in the budget are: Strengthening economic resilience, ensuring inclusiveness, empowering human capital, enhancing productivity, innovation and green technology, and safeguarding the well-being of the population. Additionally, five zones have been identified for special economic development: Johor (Iskandar), the Northern Corridor (Perak, Penang, Kedah and Perlis), the East Coast Economic Region (Kelantan, Pahang, Terengganu and the district of Mersing in Johor), the Sarawak Corridor Renewable Energy located within the central region of Sarawak, and the Sabah Development Corridor.

The budget is developed initially based on estimates of expenditures of each of the departments, linked to the specific programmes and priorities set out by the current ruling coalition. The Treasury Board then compiles all these into an initial proposed budget. The Cabinet and Prime Minister's Department then adjust the budget based on economic, social and political factors.

The final budget must be passed by the House of Representatives (Dewan Rakyat) which contains opposition party as well as ruling coalition members. Failure to pass could result in the dissolution of

the ruling coalition, and re-formation of the government. Partially because of this any member of the ruling coalition who votes against the budget is generally dismissed from the party immediately.

Total federal revenue is projected to be almost 58 billion USD for 2016, with about 0.017% of this allocated to the KeTTHA for implementation of three Green Technology projects.

Environmental related funds are spent on administration of the DOE, NRE and KeTTHA, as well as educational campaigns, special projects, and various energy related centres around the country. (KeTTHA, National Energy Efficiency Action Plan, 2014). Industries are encouraged to improve energy efficiency via tax incentives for qualifying projects.

3.6. Monitoring

The DOE is responsible for environmental air quality measurements and maintains several ambient air quality measuring stations around the country. PUSPAKOM is responsible for measuring the emissions of road vehicles at their various test centres around the country. The DOE and JPJ can also enforce vehicular emission laws by ticketing obvious polluters, or requiring them to be re-measured by PUSPAKOM.

Commercial and public vehicles are regularly inspected and tested for emissions, however these tests are performed "static" with the vehicles engines at idle, or reviving but with no load applied to the vehicles. This fails to catch many of the polluting trucks as they only tend to emit smoke when significantly loaded on the road or on a dynamometer test bed. Exhaust and noise emission from petrol driven vehicles and motorcycles are controlled and inspected by DOE at occasional curb site inspection and operation throughout the country (DOE, Annual Report, 2014).

	Current approach	Data availability
Energy efficiency (passenger)	Vehicle Kilometre Travel (VKT) and Passenger Kilometre Travelled (PKT) data are taken by MIROS from vehicles involved in accidents	VKT and PKT data are update annually by MIROS, however only certain years are available from the online publications and the data does not match with survey results performed by the authors.
	Number of vehicle registered is published by MOT in *Yearly Transport Statistic Malaysia.*	Number of new vehicles, by type, by fuel type, number of actively in use vehicles, and traffic composition of selected roads are available in *Transport Statistic Malaysia* published by MOT annually.
	Fuel consumption and emission data of all vehicle models in Malaysia are collected by JPJ during Vehicle Type Approval (VTA). VTA conducted by National Committee for Type Approval chaired by JPJ.	Although fuel consumption and emission data of all vehicle models are recorded in VTA process, the data is not published and generally comes from the manufacturers declaration based on certified test reports.
Energy efficiency (freight)	Ton kilometre travel of rail, flight and marine are published through freight operator annually.	Ton kilometre travel of railway is updated by Malayan Railways Limited (KTMB) annually through *Transport Statistic Malaysia.*
	SPAD is responsible for monitoring road and rail freight transport. There is no official monitoring of energy	Total cargo handled by airport is available in *Transport Statistic Malaysia* as well.

	efficiency of road freight transport.	
Urban transport including public transport, NMT, land-use policies, etc.	Urban transport including public transport is the responsibility of SPAD which cooperates with private public transport service providers. Land-use policy, Transit Oriented Development, and Urban Transport infrastructure are monitored by SPAD, in cooperation with the MoW and KPKT.	Public transport statistics such as passenger kilometre or passenger per hour statistics are monitored and provided by public transport services. The statistics are available in the annual *Transport Statistic report*.
Modal shift in freight	Rail freight is monitored by Malayan Railways Limited (KTMB), the only rail freight service provider. Sea freight is monitored by Marine Department and port operator. Although road freight is monitored by SPAD, road freight data is not recorded systematically. A national freight data program was identified as a key action item in the Logistics and Trade Facilitation Master Plan (2015-2020).	Annual freight statistics of rail, air and marine are provided by service provider and are available in annual *Transport Statistic report*. Some road freight statistics are available through academic studies (Nasir, 2014).
Fiscal policies including fuel /vehicle taxes	MOF is responsible for taxes, incentive, subsidies related to transport and automotive sector.	The relevant information regarding vehicle taxes and incentives are available via the official portal of MOF.

Table 14: Monitoring system and data availability for each transport sector in Malaysia (Source: Author, 2015).

3.7. Future emissions projections

Population is steadily growing and projected to hit close to 40M by 2030[7]. Meanwhile GDP has been growing at a faster rate, indicating an improvement in the per capita GDP as the Malaysian economy matures. In the projection shown below, the GDP is trending towards 400 M USD by 2030, for a per capita GDP of around 10,000 USD. In this figure, the data points represent actual World Bank data, while the solid lines are trend lines.

[7] Official government estimate from www.statistics.gov.my estimated the population at 36M in 2030, however this likely omits up to several million undocumented people living in Malaysia

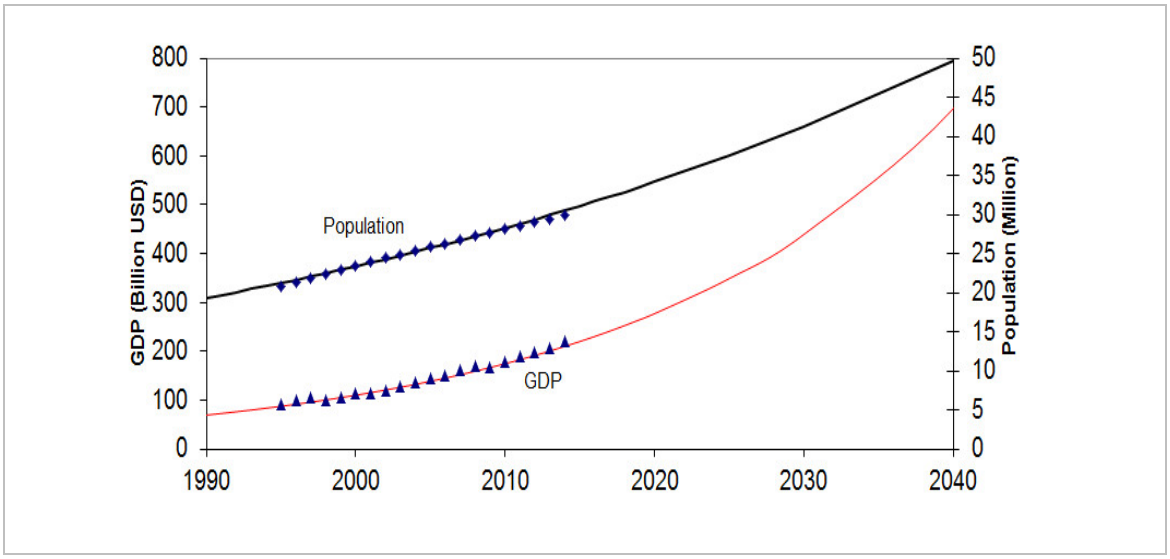

Figure 21: Projection of GDP and population growth of Malaysia to year 2040 (Source: Adapted from World Bank Data, 2013).

In section 2.6 and 2.7, it was hypothesised that through at a 100% adoption rate of the various measures (excluding avoidance strategies) the annual transportation emissions could be reduced by 15.2 Mt of CO_2 per year for cars, and 9.2 Mt of CO_2 per year for freight from a base line of 42 Mt of CO_2 per year for all road transport. This represents a 58% reduction in emissions from land transportation as the maximum potential based on the suggested measures. In the figure below, we project the trend of transportation and non-transportation CO_2 emissions by year. Along with the "Business As Usual" (BAU) case, we project the transportation CO_2 emissions trend with 50% and 100% adoption of the various measures outlined in section 2.6 and 2.7. The implementation is assumed to occur over a four-year period starting in 2016.

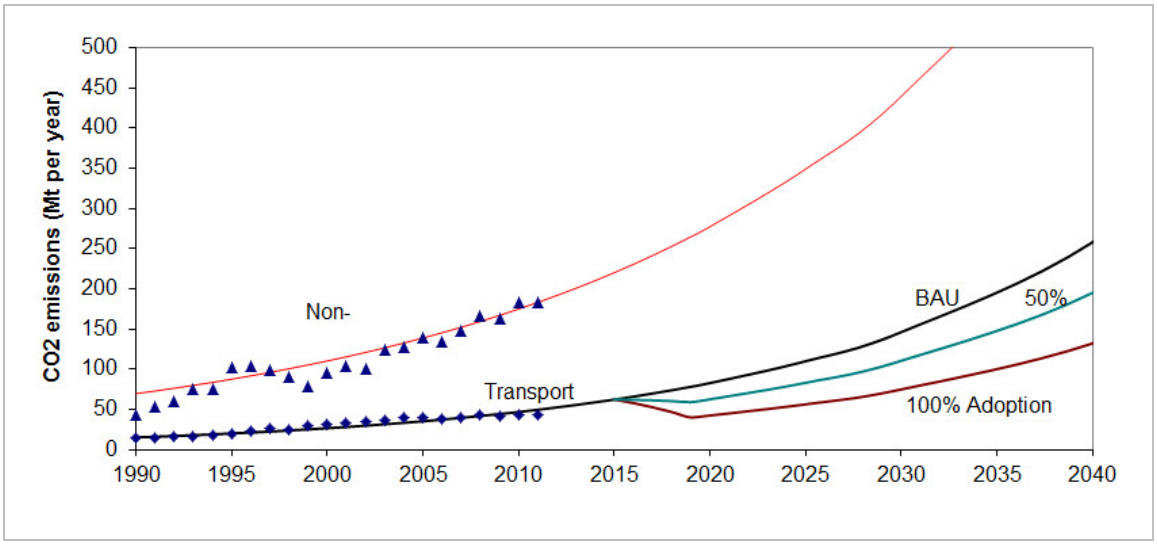

Figure 22: Projected CO_2 emissions at various rates of remediation adoption (Source: Author, 2015).

With 100% implementation, the annual transportation related CO_2 emissions are projected to drop from 146 Mt of CO_2 per year to about 75 Mt of CO_2 per year in 2030, a reduction of just about 71 Mt of CO_2 per year. This represents the best-case scenario implementation of a modal shift to electric trains, and conversion of taxis to CNG-electric hybrids, freight shift to rail, reduction of

empty back-hauling, intermodal freight improvements, use of B20 biodiesel, and truck efficiency improvements. A more realistic adoption rate of 50% results in a reduction of about 36 Mt of CO_2 per year emissions in 2030. Essentially this represents about a 24% reduction in transportation related emissions. By contrast, complete elimination of all car traffic via avoidance (a very unrealistic scenario) would result in a about a 50% reduction in transportation CO_2 emissions.

In terms of CO_2 emissions per GDP, even with the optimistic scenario of 100% adoption of the modal shift to electric trains and hybrid CNG-electric taxis and freight improvements, the projected CO_2 emissions intensity remains about the same in 2030 as it is today. Both World Bank data and the World Resources Institute climate data (CAIT) give similar numbers for total CO_2 emissions per GDP, while the WRI data has a slightly more optimistic trend in the last few years.

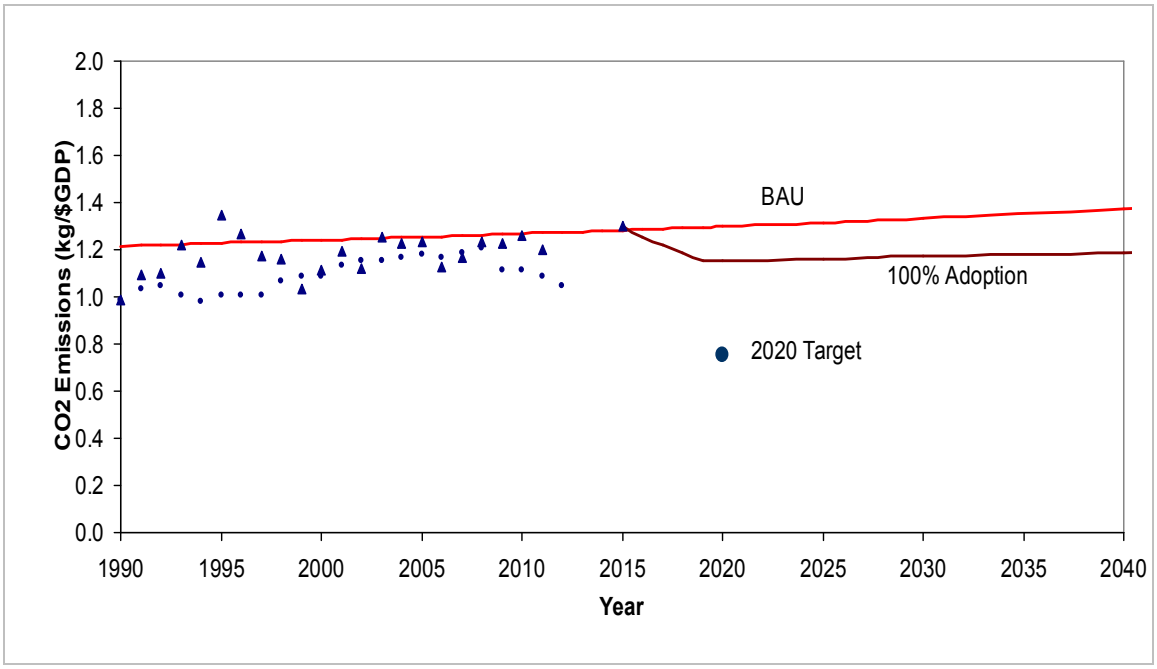

Figure 23: CO_2 emissions per GDP (triangles are World Bank data, small circles are CAIT data) with Business As Usual trend and 100% transportation remediation adaption (Source: Author, 2015).

The remediation actions discussed above are not the only measures possible and 100% adoption of the aforementioned transportation remediation measures is probably not a realistic scenario. However, it does highlight the fact that improvements in the sustainability of transportation could have a major impact on CO_2 emissions in the near future. While there are a lot of unknown factors which will influence the actual CO_2 emission intensity, it does indicate that the changes in transportation emissions analysed here are likely to fall far short of achieving the stated goal of a 40% reduction in CO_2 emissions on a per GDP basis by 2020 (without commensurate improvements in electric power generation, residential, commercial and industrial CO_2 emissions) as indicated by the solitary point in the graph above.

4. Barriers to sustainable transportation in Malaysia

Several different techniques were used to analyse transportation sustainability in Malaysia. Initial work was performed via interviews with various stakeholders, while later work focused on comparing and contrasting the situation in Malaysia with other countries in the ASEAN region. Results of these investigations are presented in the following sections. The various barriers have been broken into the following categories for analysis purposes:

- **Policy development barriers**

This category includes problems associated with the development of effective policies.

- **Physical and infrastructural barriers**

This category includes issues which require significant changes in infrastructure.

- **Behavioural and informational barriers**

This includes barriers related to information exchange, and behavioural practices.

4.1. Policy development barriers

The findings presented here were gathered through interviews with respondents from various sectors, directly or indirectly involved in transport policy formulation and implementation, and independent analysis of existing legislation as well as contrasting domestic policy with other ASEAN countries. A complete list of transportation policies is given in Appendix 2.

Complex interagency relations

There are many different organisations responsible for various, often overlapping, aspects of transportation. Communication of related policies to the appropriate authorities is sometimes insufficient. The lack of unified authority creates frictions between potentially competing interests of the various departments. Specifically, at regional and local levels there is some degree of confusion over the jurisdiction related to enforcement of certain legislation.

Absence of lead agency for sustainable transportation

There is a need for a strong federal agency which can lead sustainable transportation policy development and drive implementation down to the local level, analogous to the US Environmental Protection Agency. Currently policy development, standard limits, and implementation are left up to various different organisations, often with a technology-specific approach, rather than a consistent emphasis on overall energy efficiency and CO_2 emissions reduction (Raja Noriza Raja Ariffin, 2012).

Lack of carbon emissions emphasis in transport policy

Policy initiatives tend to be 'ad hoc' and often address individual technology aspects. There is a lack of coordinated sustainable transportation policy. Policies are often oriented towards providing incentives for manufacturers (of which there are very few in Malaysia) rather than focusing on consumers, which would have a greater effect on the overall market.

Lack of resources for implementation and monitoring

Currently there is an insufficient structural framework to guide policy development down to the implementation authorities responsible for enforcement. Also, once signed into law, there is a lack of follow through or feedback to policy makers on the effectiveness of the policy. Development, monitoring and enforcement of policy are often hampered by a lack of human resources and proper training and equipment. Additionally, the level of resources varies greatly from state to state. Often good policies are developed but not implemented effectively as development is at a federal level, whereas implementation is at local authority or implementing agency which may not have the required resources or priorities to properly enforce them.

Low awareness of sustainable transport

The concept of sustainable transport is not fully understood by many government officials. Generally economic goals and growth are viewed as the primary objective of policy, whereas environmental impact is secondary. There is low awareness of the positive long-term economic effects of sustainable transportation, thus sustainability may be sacrificed in favour of shorter term economic goals.

Summary of policy development barriers

The fragmented nature of multiple government agencies with overlapping areas of responsibility in the transportation field, and lack of integration from the federal policy development level to local enforcement hampers both the effective development and implementation of sustainable policies. In some cases, the implementing agencies do not have the required training, equipment or understanding of federal policy required for proper enforcement. Although sustainable transportation can greatly contribute to economic growth by saving resources, and reducing the economic burden of transportation, there is a perception that sustainable transportation conflicts with economic interests which may lead to a perpetuation of non-sustainable practices in the interest of shorter term economic gains.

4.2. Physical and infrastructural barriers to sustainable transport policy

This section highlights issues which require significant infrastructure or physical resource development, such as adding new railways or building new laboratory facilities. Improving these gaps will require a commitment of time and money, and may span many years.

Absence of central technical lab supporting vehicle type approval testing

As mentioned in the previous section, the policy makers lack sufficient technical knowledge required to develop competent policies relating to energy efficiency and sustainability. Ideally there should be a central test facility with complete Vehicle Type Approval (VTA) testing capabilities including emissions, fuel consumption, and road noise testing and resources to support the technical information requirements of the government today as well as developing core competencies required for future growth. Additionally, local automotive industries would benefit by being able to conduct these types of tests. As of 2016, this facility does not exist in Malaysia.

Upgrading PUSPAKOM inspection and testing facilities

Currently, PUSPAKOM performs "static" emission testing or "Free Acceleration Static Test" with no load applied to the vehicles for public and commercial vehicles, which are inspected and tested twice a year. However, this testing is not sufficient to identify polluting trucks as they only tend to emit smoke when significantly loaded on the road or dynamometer. Upgrading the current testing to the more accurate "Chassis Dynamometer Smoke Test" represents a major improvement in the ability to identify inefficient, polluting vehicles.

Integrated database system for sustainable transport management

Currently, all information from curb-side inspections is captured by DOE and, for commercial and public vehicles, by PUSPAKOM. However, vehicle owner and VTA information are captured by JPJ. This data is not yet integrated into a centralised database accessible by all parties. Establishing and expanding the scope of this type of database would allow improved analysis and decision making.

Integrated land use/urban area transport planning

The greater Kuala Lumpur area is currently the only region undergoing consistent urban transportation planning. This should be extended to the other major cities including Ipoh, Penang, Johor Bahru, etc.

Insufficient transport hub interconnectivity

Outside of the Kuala Lumpur, the individual transportation hubs are often poorly interconnected. For example, in Ipoh the express bus station is located near the highway, outside of town, with no direct link to the train station. Many towns, such as Sibu and Melaka have no public transport accessibility from the adjacent airport to town except from taxis. Also, parking is often grossly insufficient at major transportation hubs, such as the train station at Parit Buntar with space for about 10 cars and no link to other transportation sources at all. A similar situation exists for freight hubs as well: While all major ports have both road and rail links, there are numerous bottlenecks in the road system and within the port terminals themselves, causing significant inefficiencies. Dedicated freight routes should be expanded to prevent road freight – passenger traffic conflicts.

Underutilisation of inland port rail, port congestion and multi-modality

Rail transportation is seriously underutilised in the freight sector, despite the fact that all major ports, including inland "dry" port freight hubs have rail links. Currently SPAD and JPJ are in charge of freight regulation and enforcement. Within SPAD, however, there are separate divisions dedicated to road freight and rail freight. Bottlenecks and delays at the freight hubs put rail haulage at a disadvantage compared to road haulage. Additionally, there are passenger rail – freight conflicts on some lines resulting in delays for both freight and passenger trains.

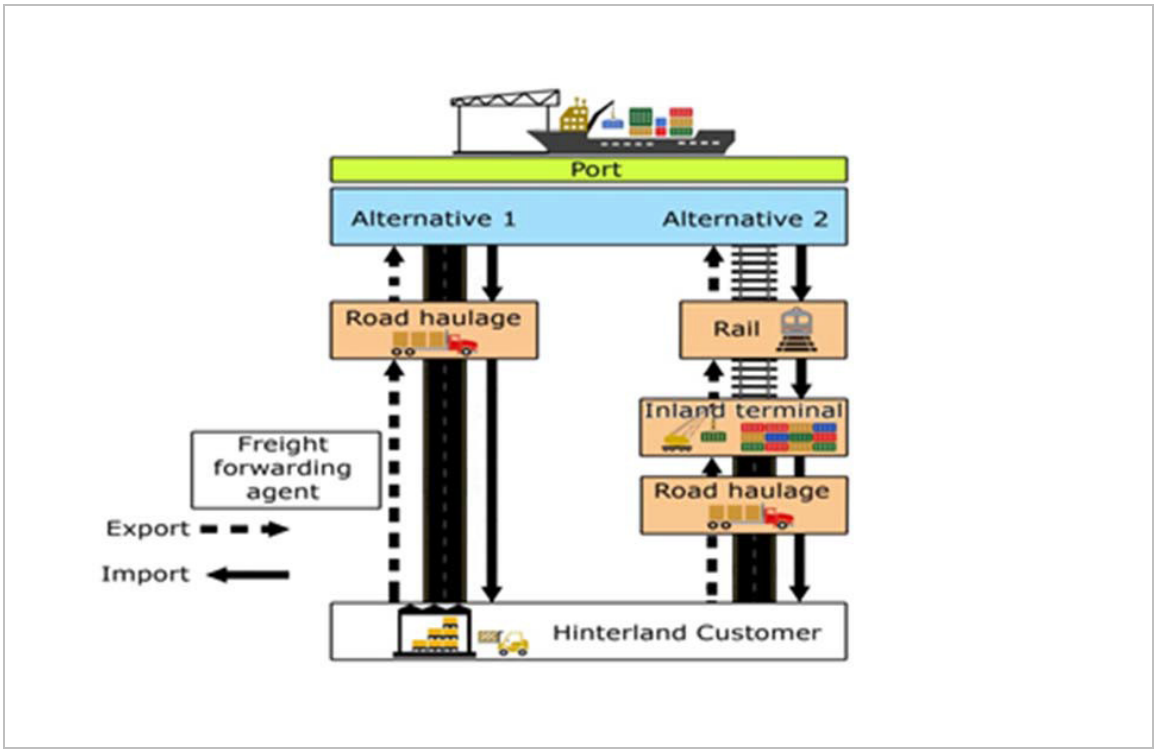

Figure 24: Explanation of intermodal container transportation (Source: Nasir, 2014).

Light commuter rail expansion

Recently (2015) the northern peninsular Malaysia "electrified double track" commuter rail project was opened, and is exceedingly popular. This convenient, efficient mode of transportation should be expanded, and perhaps subsidised at the expense of private vehicle ownership both between cities and within developed areas as well.

Alternative fuels

While the CNG infrastructure and fleet size are growing, LPG is virtually non-existent as an alternative fuel in Malaysia. LPG could form an important part of the "clean energy" picture for Malaysia, especially in areas not yet served by CNG stations. Local industries also tend to have a low awareness of alternative fuel technologies.

Insufficient parking

Parking is generally left up to local authorities. Issues with parking are regulation and enforcement, and parking spaces are frequently insufficient for the needs of a region, causing people to park on the roads, thereby interfering with traffic flow. "Park and Ride" at commuter rail and bus stations is well established in the KL area, but underexploited in other areas. Work is currently being performed in this area, the importance of which should be highlighted.

Non-motorised transport: Nascent

Walking infrastructure is being expanded in KL. Bicycling lanes and bike share programmes are only just beginning and need to be expanded, to become an integral part of all urban space planning.

4.3. Behavioural and informational barriers to sustainable transport policy

This section expounds upon various issues which predominantly require behavioural changes, and/or information sharing to overcome, with relatively little physical infrastructure development. Overcoming these barriers could happen relatively quickly, with much smaller investments of funds than major infrastructure projects.

Certification of corporate CO_2 emissions

Malaysia has implemented an innovative programme called "My Carbon" which allows companies to voluntarily report their CO_2 emissions in order to be eligible for various tax incentives. While this is a good start, the programme needs to be expanded, made mandatory, and utilise standard tools to be verified by third parties to insure legitimacy.

Green technology encouragement via taxation/subsidies

Current energy/emissions related taxation and subsidies are fragmented, often being applied on a project-by-project or technology specific basis. Ideally this would be converted to a CO_2 emissions basis and applied equally to all technologies. Inefficient or polluting vehicles should be taxed and the revenue could be applied towards subsidies of more efficient vehicles or transport modes.

Energy efficiency labelling (all classes)

Vehicle energy efficiency labelling is currently not mandatory. It should be applied uniformly to all classes of vehicles so end users can judge the relative efficiency of competing products for the best effect.

Road use (congestion) pricing

A pilot programme began back in the 1970's however it was abandoned as no other options existed. With the acute urban congestion in many cities, it may be time to look again at this as a way of reducing congestion, parking problems, fuel consumption, and improving the balance sheet for public transportation. This applies to trucks, passenger cars and even motorcycles.

Bus route optimisation

With ever changing development and transportation densities, bus routes require continual optimisation to maintain an effective alternative to private car ownership. This is just beginning to happen in the greater KL/KV, and should be expanded to the rest of the country.

Integrated ticketing

The KL train and bus systems now have almost fully integrated ticketing via the "Touch and Go" RFID cards. This could be expanded to all other public transport modes, and even taxis. Application to taxis may have the spill over effect of reducing fare "haggling".

Intelligent transport information systems

Since an on-line "Waze" type application with real time information would be of tremendous benefit to commuters, some train/bus stops in KL already feature this technology. Currently only major city centres have significant coverage. Improved bus timing reliability would be a major improvement even in remote locations where busses may only run once an hour. An excellent opportunity exists to integrate the existing traffic monitoring networks in the hands of the government agencies with commercial services such as "Waze" in order to cover a wide variety of transportation options all in one package.

Cars/truck restriction times/zones

A local and very successful example of this is the highway trucking banned during the Chinese New Year/Hari Raya (Ramadan) festive seasons when countless families travel back to their hometowns. A similar program could be implemented on a wider basis to improve traffic flow in other frequently congested areas.

Car share

One way to improve transport efficiency is via "car share" programs which eliminate the inefficiency inherent in taxis (where the vehicle is driven to or from a customer pickup/drop off point "empty"). There is currently only one "car share" programme with Electric Vehicles in the KL metro area, "COMOS". This system is really only useful for hub-to-hub transport where existing public transport already exists. Even in very congested traffic it can be observed that the vast majority of passenger cars have only one occupant. Every effort should be made to increase the number of passengers per car to reduce the number of cars on the road. Other "car share" programmes such as Uber and Grab are becoming more popular in urban centres despite occasional friction from traditional taxi. These can help improve efficiency by allowing an operator to pick up a paying passenger travelling in their same general direction they are going. Multi-passenger lanes or car pool lanes may also help to encourage car sharing

Freight "load share"

Many freight companies are operating with reduced overall efficiencies due to empty back hauling. This is caused by a lack of coordinated information sharing which would allow the various freight companies to work together in order to reduce empty back hauls. The concept is sometimes referred to as a "freight exchange" where various firms can post their available trucks and routs so as to exchange loads and minimise under loading of trucks on the road.

Inspection, maintenance and vehicle End of Life (EOL)

Passenger vehicles are only inspected when ownership is transferred, or when modified via the approved process[8]. Many of the older vehicles on the roads are in a poor state, and consume much more fuel than reasonable. A mandatory Inspection and Maintenance (IM) programme could be implemented to identify the worst polluters, and either have them fixed, or deny their renewal of road permit. Simultaneously a "clunker" scrapping programme should be initiated to insure the poorly operating vehicles are indeed recycled, and the owners compensated appropriately.

[8] Many vehicles undergo modifications which are not reported or inspected. Such modifications are illegal and owners of such vehicles may be subject to prosecution.

5. Recommendations for action

While Malaysia has a very mature policy development structure and advanced transportation infrastructure, there are still some areas which can be improved in order to reduce the fuel consumption and CO_2 emissions intensity to improve the overall sustainability of the transport sector in Malaysia. The following suggestions have been derived from careful analysis of existing governmental policy as well as in comparison with policies and practices in other countries. Additionally, GIZ has performed related work in a number of countries under the "Mobilise Your City" programme, which includes much useful information for comparison[9]. The resulting recommendations for action have been separated into institutional improvements and capacity building, avoidance strategies, suggestions to shift to another more efficient transport mode, and improvements for existing transport modes.

5.1. Strengthening institutions and capacity building

Paramount in effectively addressing the environmental concerns is to clearly define what organisation is responsible for implementing any environmental policy, and give the responsible party the appropriate training, funds and tools required to implement and monitor the policy.

Establish centralised authority for fuel efficiency and CO_2 assessment

What is lacking here in Malaysia is a **single central authority which oversees energy efficiency and CO_2 emissions,** similar to the US Environmental Protection Agency. Rather than creating yet another government organisation the recommendation is to strengthen the existing NRE by giving it the tools and training to be able to generate the required data and analysis in order to properly advise the policy makers in this area. The NRE should have the authority to develop appropriate policies, standards and dictate the overall direction of legislation relating to fuel consumption and emissions. As the NRE is already responsible for the collection of air quality data, it is believed that they are the appropriate organisation to head the overall CO_2 emissions assessment for the country.

Institutional and capacity improvements for the various stakeholders

Along with the responsibility for collecting data is the need to establish and maintain a laboratory with the appropriate tools for measuring the emissions and fuel economy/energy consumption of the various vehicles (including petrol, CNG, LPG, diesel, hybrid and electric vehicles) in use under local conditions. This is required for three reasons:

- To measure the fuel efficiency/energy consumption/emissions for policy purposes

[9] "Mobilise Your City" information available at: http://www.codatu.org/wp-content/uploads/MobiliseYourCity-A3-BD.pdf

- To verify the fuel efficiency and emissions of fleet vehicles
- To promote and establish new vehicle efficiency labelling

The responsibility for verification of new and in-use vehicles on an on-going basis should be left up to the existing PUSPAKOM organisation; however, it should be equipped with expanded capabilities, such as loaded dynamometer testing of vehicular emissions.

All the stakeholders and policy makers, especially within the EPU, should be provided with sufficient knowledge and the latest information and long-term financial returns of sustainable development. When the long-term returns on investments of sustainable policies are apparent, expenditures to this end are much easier to justify.

Use CO_2 emissions per passenger kilometre as the unit for comparison of all transportation modes

To consistently emphasise the fuel efficiency, **a consistent unit of measurement needs to be used**. Rather than creating technology specific legislations, taxation and subsidies should be made on the basis of CO_2 emissions per passenger kilometre, of per ton kilometre for freight.

Public education pertaining to sustainable transportation

Education on the importance of sustainable transportation should be implemented in primary and secondary schools, as well as reinforced through education of the general public. Specifically, the inefficiency of single-occupant cars and the inherent efficiency of two-wheeled transport and public transport should be stressed. Additionally, ecological driving practices should be highlighted and contrasted with inefficient practices. Currently there is very little understanding of efficient "eco" driving, and the effect of speed on efficiency. This could be emphasised via public education, including coverage in both primary and secondary education.

5.2. Avoidance strategies

Coordinate land use/urban planning on all municipalities

Even small and medium towns and cities should receive education about the importance of sustainable transportation and town planning. Standard practices should be explained and rigorously implemented in all urban locations above a given size, including all the major towns. Coordination of local development and federal transportation infrastructure is imperative for seamless, efficient transportation.

Single passenger cars should be restricted during peak transit hours

In especially congested areas **single passenger cars and/or unloaded trucks could be banned** during different times of the day (e.g. rush hour) or times of the year (e.g. Ramadan, Chinese New Year) in order to reduce traffic congestion. More generally, in areas where more efficient transportation options exist, road use costs can be increased, making it expensive to drive in already crowded metro areas.

Car-pooling

One of the most effective ways to improve transportation efficiency is to increase the number of passengers in existing passenger cars. Single rider cars should be discouraged, and car-pooling should be encouraged. Public education programmes, on-line "ride share boards" and corporate incentives for car-pooling should be implemented. Incentives could include "car share" vehicles at work for workers who car-pool. Prioritised "multiple passenger vehicle" parking at Mass Rapid Transit (MRT) stations may also have a positive impact on MRT ridership.

Restrict truck freight in congested areas

Unless the point of origin or destination of a truck is within the congested area, the truck should be kept out of that area. This can be done by scheduling "truck times" at off peak hours (as is done in the UK and elsewhere), or building in specific bypass routes (also called truck routes in some areas) to avoid urban centres altogether.

National or regional freight exchange database

The *Logistics and Trade Facilitation Master Plan* includes the development of a well organised and easily accessible freight exchange database to allow even smaller freight carriers to reduce empty back-hauling and improve overall efficiency. This should be implemented at a national level, and expanded internationally especially along the Singapore – Bangkok corridor through Peninsular West Malaysia.

5.3. Modal shift strategies

Interconnect all transportation hubs

New **transportation hubs require an interconnection plan**, for example from a train station to the local bus station, or from either of these to the town centre. Existing transport hubs, including train stations, bus stations, airports and ferry terminals should have interconnecting links retrofitted in. For example, many towns (Melaka, Sibu, etc.) have no public transport from the local airport to the town centre or other transportation hubs, requiring large number of passengers to use taxis.

This is especially true for freight link between trucks and rail lines. Despite the numerous benefits of rail transport to haul large quantities of long distance freight, utilisation of rail freight services throughout Malaysia is still limited. The underutilisation of existing rail freight is to some extent due to poor service and absence of last mile connectivity (EPU; *Logistics and Trade Facilitation Masterplan, 2015*).

Park and ride

Parking in urban centres needs to be handled on a consistent basis. While this is being done in the KL area, it is less common elsewhere. Sufficient parking should be provided, especially at transportation hubs. To encourage utilisation of alternative transportation modes, parking should be free at transportation hubs. Additionally, parking on the road, where it blocks traffic flow, should be strictly forbidden.

Encouraging use of energy efficient transportation

An increasing number of Energy Efficient Vehicles are becoming available including both two and four-wheeled electric and hybrid vehicles. EEV's should be encouraged in all forms. **Two-wheelers are significantly more efficient than cars** and they make an ideal first/last mile link in a mass transit commute, however they are at a much greater risk regarding accidents, with over 4,000 motorcyclists dying in crashes compared to about 2,800 other road users in 2010 (MIROS 2011). While many things can be done to encourage usage of two-wheelers, perhaps the most important changes involve making motorcycling safer. Motorcycle ridership and safety can be encouraged by:

- Expansion of motorcycle-only infrastructure
- Free, priority parking for motorcycles and helmet storage at all transportation hubs and government offices
- Subsidised road usage fees and insurance
- Continuing "Share The Road" public education underscoring the efficiency and vulnerability of two-wheelers

Encouragement of non-motorised transport in urban areas

This pertains both to urban/town planning as well as transportation hubs, and for retrofit into existing urban areas. Examples include bicycle paths and bike-share programmes, unobstructed sidewalks and covered walkways as well as pedestrian bypasses for busy roads as is common in

Singapore and South Korea. While this is being addressed in the KL area, it needs to be considered nationwide.

Expansion of the light-rail network

Light rail is the most efficient mass transportation mode; however, it requires large capital investments and many years of planning and construction. A consistent programme of expansion, as is currently happening in the Kuala Lumpur area, needs to be implemented in other urban areas as well, along the lines of the German Inter City Express (ICE) and S-Bahn model.

Optimise bus routes

With changes in developments **re-optimisation of bus routes and other transportation modes** has to occur. Bus routes can be changed quickly, whereas rail services require much more time. A rational and consistent bus route optimisation programme should be included in the expanding light rail development, helping point towards optimum rail routes as well as improving overall transportation efficiency.

Intelligent transportation information systems

An integrated approach to transportation information should be taken, including the local display boards at transport hubs, train and bus stations, but extending country wide via the internet, and incorporating real-time features such as those found in Waze. For example, a commuter ideally should be able to check on a smart phone and determine which public transpiration options exist in their vicinity, where the various vehicles are, and what their Estimated Time of Arrival (ETA) is at the closest stations. This is currently being used on only some transportation segments, such as the Sunway BRT.

Integrated ticketing

Malaysia had made major improvements in this area, using the "Touch and Go" ticketing system on toll roads, MTR, car parks and other systems. The existing "Touch and Go" integrated ticketing should be expanded to include transportation outside of the KL area, and applied to taxis and other modes of transport, such as bike share or car share programmes.

Rail freight share increase

SPAD and other concerned parties need to take a holistic approach to making freight hub to port interconnectivity more advantageous for rail transport. Increased frequency and reliability of freight trains, greater flexibility of loading, unloading and routing loads are key factors to making rail transport more attractive (EPU; Logistics and Trade Facilitation Masterplan 2015).

5.4. Improvement strategies

Make CO_2 assessment mandatory for all companies above a certain size, including transport

For non-transportation industries this would include making the "My Carbon" mandatory, and independently verified (by, for example, an organisation equivalent to PUSPAKOM, however with a non-transport orientation). For transport this would include fleets, and analysing the vehicles being used, loads and routes in order to help optimise fleet efficiency.

Efficiency label and standards

As is done in many other countries, all new vehicles and in fact any energy consuming product above a certain power rating, should be labelled as to depict relative efficiency in easily understandable terms. This would be the responsibility of the centralised energy efficiency laboratory of the NRE under the expansion outlined above. Additionally, this can form the basis of enacting Vehicle Efficiency Standards once the relevant laboratory capable of confirmation is established.

Fleet inspection and maintenance and scrapping programme

Exceptionally poorly tuned older vehicles account for a disproportionate amount of fuel consumption and emissions of both passenger vehicles as well as freight vehicles. Currently there is no existing mechanism to eliminate or enforce reparation of these vehicles. An inspection and maintenance programme for cars and motorcycles of say 10, 15 and 20 years old should be implemented to catch the very worst polluters. To avoid massive public backlash, the initial standards need not be particularly strict, and should include the option to repair the vehicle to conform to the standards. For vehicles that repeatedly fail a conservative CO_2 or fuel consumption specifications these vehicles should be scrapped, and the owners compensated in some manner so that they might acquire a newer, more efficient vehicle.

6. Conclusion

Road transportation accounts for approximately 85% of all transportation related CO_2 emissions in Malaysia. Of that by far the largest share, 59%, comes from cars while 27% is attributed to freight (including a small amount from buses), and 11% comes from motorcycles. In the intermediate term (the next decade or two) the largest improvements in transportation sustainability can be made from a modal shift away from personal cars and motorcycles to use of buses and commuter rail services. Improvements in the taxi fleet can be made by moving towards hybrid electric designs. Freight efficiency can be greatly improved by shifting from trucks (which carry 95% of all freight currently in Malaysia) to rail.

Additionally, "freight exchange" services which help reduce empty back-hauling, and freight hub intermodal connectivity and debottlenecking can make a significant contribution as well. Improvements in the efficiencies of individual freight trucks, as well as driver training in fuel efficient techniques, and the use of 20% biodiesel will also have a significant impact on transport related CO_2 emissions. While a large number of additional recommendations are presented in this paper, the few enumerated above could potentially reduce transportation CO_2 emissions by as much as 50% if fully adopted. This would reduce CO_2 emissions by approximately 71Mt per year by 2030.

Malaysia is well positioned to become a leader in transportation sustainability within South East Asia: It has a growing public transportation segment and long term urban planning and funding. There are, however, several ways which policy making could be enhanced to promote more efficient and sustainable transportation. Malaysia needs a single lead organisation with all the tools and resources required to get the appropriate data on fuel consumption and emissions of various technologies, and then to guide policy makers towards the most sustainable long-term policy decisions. Ideally, there should be a central laboratory with the proper facilities and human resources to support vehicle type approval, certification of energy consumption and emissions, and standards development and verification. Implementing authorities require resources and training to help them understand the importance of policies which they are responsible to enforce.

Public education in terms of transportation sustainability and energy efficiency will be an ongoing need so that end consumers can make more informed decisions before deciding to drive a car, or even buying one. Many of the recommendations presented do not require large government funding efforts, for example energy efficiency labelling on automobiles and motorcycle. Some suggestions, such as taxing inefficient vehicles, and using the funds to subsidise energy efficient vehicles can be a zero-sum game: The revenue from taxes should go directly to expenditures in subsidies. Finally, government policy should be based on energy efficiency, with a consistent metric of CO_2 emissions per passenger kilometre travelled, or per ton-kilometre of freight shipped.

International oil prices are currently at a relative low, making this perhaps the best time to take action. CO_2 emissions from transportation are growing at approximately 6% per year. If this trend is left unchecked, not only will Malaysia be emitting considerably more CO_2 then necessary, but its citizens will be burdened with an inherently inefficient system, requiring overdependence on personal automobiles and liquid petroleum fuels.

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Appendix 1: List of policies related to transportation in Malaysia

Malaysia pledged to reduce its greenhouse gas emissions intensity per GDP by 45% by the year 2030 relative to the emissions intensity in 2005. This consists of 35% on an unconditional basis and a further 10% that is condition upon receipt of climate finance, technology transfer and capacity building from developed countries. Malaysia's Intended National Determined Contribution (INDC) was developed through an inter-ministerial/agency working group. Stakeholder consultations were conducted to obtain inputs on possible measures to reduce greenhouse gas emissions. The projected outcomes from the 11th Malaysian Development Plan and the following policies and plans form the basis for the development of this INDC:

a. National Petroleum Policy (1975)
b. National Energy Policy (1979)
c. National Depletion Policy (1980)
d. Four-Fuel Diversification Policy (1981)
e. National Forestry Policy (1978, Revised 1992)
f. National Policy on Biological Diversity (1998)
g. Five-Fuel Policy (2001)
h. National Policy on the Environment (2002)
i. National Strategic Plan for Solid Waste Management (2005)
j. National Biofuel Policy (2006)
k. National Energy Policy (2008)
l. National Green Technology Policy (2009)
m. National Policy on Climate Change (2009)
n. New Economic Model, Government & Economic Transformation Programs (2010)
o. Renewable Energy Policy and Action Plan (2010)
p. Second National Physical Plan (2010)
q. Low Carbon Cities Framework (2011)
r. National Agro-food Policy (2011)
s. National Water Resources Policy (2012)
t. National Automotive Policy (2014)
u. National Energy Efficiency Action Plan (2014)

	Policy	Description
1	National Petroleum Policy (1975)	- Efficient utilisation of petroleum resources - Ensuring the nation exercises majority control in the management and operation of the industry
2	National Energy Policy (1979)	- Supply objective: Ensure adequate, secure and cost-effective energy supply - Utilisation Objective Promote efficient utilisation of energy and eliminate wasteful and non-productive usage - Environment Objective Minimise negative impact to the environment
3	National Depletion policy (1980)	- Formulated to prolong the life span of the nation's oil and gas reserves
4	Four-fuel Diversification Policy (1981)	- Aimed at ensuring reliability and security of supply through diversification of fuel (oil, gas, hydro and coal)

5	Five-Fuel Policy (2001)	- Encourage the utilisation of renewable resources such as biomass, solar, mini hydro etc. - Efficient utilisation of energy
6	National Policy on the Environment (2002)	Set out the principles and strategies for Malaysia to exploit its natural resources in sustainable way base on 8 principles - Stewardship of the Environment - Conservation Nature's Vitality and Diversity - Continuous Improvement in the Quality of the Environment, - Sustainable Use of Natural Resources - Integrated Decision Making - The Role of the Private Sector - Commitment and Accountability - Active Participation in the International Community
7	National Biofuel Policy (2006)	- Use of environment-friendly, sustainable and viable alternative source of energy in order to reduce dependency on depleting fossil fuels - Enhance prosperity and well-being of all the stakeholder in the agriculture and commodity-based industries, through stable and remunerative prices
8	National Energy Policy (2008)	- Ensure provision of adequate, secure and cost-effective energy supplies through developing indigenous energy resources both non-renewable and renewable resources - Promote efficient utilisation of energy and discourage wasteful and non-productive patterns of energy consumption - Minimise negative impact of energy production, transportation, conversion, utilisation and consumption on the environment
9	National Green Technology Policy (2009)	Green Technology shall be a driver to accelerate the national economy and promote sustainable development - To minimise growth of energy consumption while enhancing economic development - To facilitate the growth of GT industry & enhance its contribution to national economy - To increase national capability and capacity for innovation in GT development & enhance Malaysia's competitiveness in global arena - To ensure sustainable development & conserve environment for future generations - To enhance public education & awareness on green technology and encourage its widespread use
10	National Policy on Climate Change (2009)	Ensure climate-resilient development to fulfil National aspirations for sustainability 1. Mainstreaming climate change for strengthened competitiveness and improved quality of life 2. Integration of climate change responses into policies, plans and programmers 3. Strengthening of institutional and implementation capacity
11	New Economic Model,	NEM

	Government Transformation Programme and Economic Transformation Programme (2010)	i) To stimulate economic growth by improving worker productivity across all sector of society, in part through an improved system of affirmative action, with an eye toward sustainability GTP i) To transform the government to be more effective in its delivery of services and accountable for outcomes that matter most the rakyat. ii) To move Malaysia forward to become an advanced, united, and just society with high standards of living for all. ETP 12 National Key Economic Area (NKREs), representing sectors where growth will be focus on. These sectors were identified based on their potential to contribute to GNI and create multiplier effect across the economy. Government also factored in Malaysia competitive advantages such as its skilled workforce, abundance of natural resources, expertise in manufacturing and its potential to create a niche for itself in the selected sectors
12	Renewable Energy Policy and Action Plan (2010)	Enhancing the utilisation of indigenous renewable energy resources to contribute towards National electricity supply and sustainable socio-economic development - To increases RE contribution in the national power generation mix - To facilitate the growth of the RE industry - To ensure reasonable RE generation cost - To conserve the environment for future generation - To enhance awareness on the role and importance of RE
13	Second National Physical Plan (2010)	Establish of an efficient, equitable and sustainable national spatial framework to guide the overall development of the country towards achieving developed and high-income national status v) To rationalise and consolidate the national spatial planning framework supported by key strategic infrastructure for economic efficiency and global competitiveness vi) To optimise utilisation of land and natural resources for sustainable development and biodiversity conservation vii) To promote more balance regional development for national economic integration and social unity viii) To enhance spatial and environmental quality diversity and safety for a high quality of life and liveability
14	National Automotive Policy (2014)	- Ensure orderly development as well as long term competitiveness and capability of the domestic automotive industry as a result of market liberalisation - Create a conducive environment to attract new investment and expand existing opportunities - Enhance the competitiveness of the national car

		manufacturer through strategic partnerships - Foster the development of the latest sophisticated technology in the domestic automotive industry - Develop high value-added manufacturing activities in niche areas - Enhance Bumiputera participation in the domestic automotive industry - Improve safety standards for consumers and promote environment-friendly opportunities - Enhance the implementation of current NAP's policy instruments
15	National Energy Efficiency Action Plan (2014)	Promote energy efficiency to productive use of energy and minimise waste in order to contribute to sustainable development and increased welfare and competitiveness - Establish an overall long term national plan for energy efficiency - Strengthen implementation capacity to promote energy efficiency - Create adequate and sustainable funding mechanism for energy efficiency - Implement Energy Efficiency Programs - Enable commercial finance institutions to support energy efficiency

Remark:

i) The *Ninth Malaysia Plan (2006-2010),* Malaysia has started initiatives to increase the share of use of non-fossil fuel energy

ii) The *Tenth Malaysia Plan (2011-2015)* focused on sustainable growth and introducing mitigation strategies to reduce emissions of GHG. Three significant financial stools were introduced to promote sustainability measures

iii) The *Eleventh Malaysia Plan (2016-2020)* will further focus on pursuing green growth for sustainability and resilience. These include strengthening enabling environment for green growth, adoption of sustainable consumption and production, conserving natural resources and strengthening resilience against climate change and natural disasters. These actions will further reduce Malaysia's carbon footprint

Appendix 2: New vehicle registration data for year 2014 (Source: MOT)

Total motor vehicles by type and state in Malaysia, 2014

	Motorcycles	Motorcar	Bus	Taxi	Hire & Drive Car	Goods Vehicle	Others	Total
Perlis	4,603	1,604	2	0	0	33	24	6,266
Kedah	40,987	13,456	36	21	25	955	489	55,969
Pulau Pinang	47,203	40,053	267	201	65	2,973	743	91,505
Perak	41,577	26,699	174	11	25	2,273	1,053	71,812
Selangor	70,813	31,177	225	2,411	314	8,294	5,464	118,698
W.Persekutuan	80,606	191,012	756	2,363	4,214	11,419	3,252	293,622
N.Sembilan	18,869	10,127	51	11	3	1,988	211	31,260
Melaka	16,791	12,169	28	6	3	760	510	30,267
Johor	76,003	58,136	286	562	14	5,723	2,305	143,029
Pahang	23,344	12,309	23	6	1	1,215	513	37,411
Terengganu	16,833	7,951	15	5	1	417	50	25,272
Kelantan	27,311	12,402	39	5	1	583	95	40,436
Sabah	32,718	35,169	277	118	177	3,021	1,875	73,355
Sarawak	43,727	40,457	81	47	140	3,696	2,880	91,028
Malaysia	541,387	664,335	2,260	5,768	4,991	43,705	19,490	1,281,936

Total motor vehicles by type of fuel usage 2014

	Petrol	Diesel	NGV	Electric	Petrol & Electric	Petrol & NGV	Total
Motorcycle	540,791	48	1	545	0	2	541,387
Motorcar	654,425	2,129	1	20	7,657	103	664,335
Bus	74	2,160	2	0	0	24	2,260
Taxi	897	1	3	1	10	4,856	5,768
Hire & Drive Car	4,941	16	0	6	10	18	4,991
Goods Vehicle	3,938	39,543	174	7	0	43	43,705
Others	1,446	17,954	2	71	3	14	19,490
Total	1,206,512	61,851	183	650	7,680	5,060	1,281,936

Number of vehicles on the road by state, Malaysia, 2010-2014

	2010		2011		2012		2013		2014	
	Active	**Non-Active**	**Active**	**Non-Active**	**Active**	**Non-Active**	**Active**	**Non-Active**	**Active**	**Non-Active**
Perlis	63,743	18,045	66,618	19,373	68,853	22,593	71,505	25,730	74,580	26,502
Kedah	671,989	330,155	717,393	347,955	745,237	385,710	781,143	417,655	800,867	442,820
Pulau Penang	1,614,307	492,924	1,686,521	527,226	1,735,367	590,849	1,797,153	642,102	1,832,586	667,634
Perak	1,305,640	505,529	1,361,606	537,163	1,390,851	601,404	1,429,589	653,967	1,443,940	698,699
Selangor	1,582,587	679,296	1,636,011	727,322	1,663,026	803,089	1,709,452	867,564	1,753,950	926,005
W.Persekutuan	3,785,566	849,646	4,041,587	922,059	4,290,989	1,029,573	4,620,264	1,129,866	4,748,442	1,201,043
N.Sembilan	525,097	251,757	544,534	266,055	553,716	292,089	567,574	313,346	574,857	330,367
Melaka	487,240	185,188	509,414	196,547	524,690	217,297	543,866	234,797	554,993	245,759
Johor	2,003,475	764,791	2,105,420	818,478	2,185,121	909,835	2,283,489	984,923	2,341,035	1,044,689
Pahang	570,653	237,155	603,906	252,373	619,965	285,966	641,885	314,336	648,717	337,323
Terengganu	351,839	115,242	376,449	122,952	394,851	139,758	414,316	153,634	423,171	165,493
Kelantan	473,470	190,382	505,713	203,021	526,996	232,451	554,596	253,904	569,828	268,634
Sabah	649,911	213,270	712,093	230,344	770,272	256,595	784,487	272,211	873,124	292,177
Sarawak	968,255	301,413	1,039,390	323,746	1,100,360	364,718	1,168,915	400,397	1,214,427	427,524
Malaysia	15,053,772	5,134,793	15,906,655	5,494,614	16,570,294	6,131,927	17,368,234	6,664,432	18,026,509	7,074,683

Appendix 3: Functions of ministries and agencies related to transport and climate change

	Ministry or agency	Role and function
1	Ministry of Transport Malaysia www.mot.gov.my	1) To plan, formulate and implement policies for road vehicle, maritime transport, rail, ports and civil aviation. 2) Infrastructure projects, rail, maritime, ports and civil aviation 3) Coordinate the integration between transport modes to achieve seamless travel 4) Provides licensing services: I. License/permit the operation of the service provider and the holder of the concession II. Individual license-private/commercial and public vehicle drivers, pilot and others III. Domestic shipping license 5) Regulate the policies and operations of the concessionaire/government companies 6) Verification/monitoring service standards, security (service and safety standards) and legislation
2	Suruhanjaya Pengankutan Awam Darat (SPAD) http://www.spad.gov.my/	1) Policy and Planning Motivate public demand in public transport among the messes through user-friendly and sustainable public transport National Public Transport Policy Greater KL/KV Public Transport Master Plan 2) Enforcement - Carry out enforcement work derived from Land Public Transport Act 2010 - Inspection of public transport and freight vehicle to ensure road worthy, have valid licenses - Inspection of drivers and contractors and co-drivers - Inspection of travel tickets
3	Ministry of International Trade and Industry (MITI) http://www.miti.gov.my/	To plan, Legislate and implement international trade and industrial policies that will ensure Malaysia's rapid development toward achieving National Economic Policy and Vision 2020 - To plan, formulate and implement policies on industrial development, international trade and investment - To encourage foreign and domestic investment - To promote Malaysia 's exports of manufacturing products and services by strengthening bilateral, multilateral and regional trade relations and cooperation - To enhance national productivity and competitiveness in the manufacturing sector

4	Kementerian Tenaga, Teknologi Hijau dan Air (Kettha) http://www.kettha.gov.my/	To innovate and manage resources strategically, thereby ensuring availability, reliability and affordability of energy and water services and to champion the application of green technology to promote green economy and green living - Ensure the implementation of development policies in the power industry, water and green technology effectively - Ensure the provision of comprehensive infrastructure, an integrated, standards and quality - To provide a conducive environment for industrial development and technology - Provide research and development (R & D) continued to increase in the use of technology - Ensure service delivery system that is efficient, effective and affordable - Ensuring that the regulatory mechanisms implemented in accordance with the provisions of existing legislation and - Improving the ability of the organisation on an ongoing basis to achieve the industry and green technologies
5	Ministry of Finance (MOF) http://www.treasury.gov.my/	1) To formulate and implement fiscal and monetary policies in order to ensure effective and efficient distribution and management of financial resources 2) To formulate financial management and accounting processes, procedures and standards to be implement by all government 3) To manage the acquisition and disbursement of federal government loans for domestic and external sources 4) To monitor that minister of finance incorporated companies are managed effectively 5) To monitor the financial management of ministries, government department and statutory bodies 6) To formulate and administer policies related to be the management of government procurement 7) To formulate policies and administer government housing loans for public sector employees
6	Ministry of Natural Resources and Environment (NRE) http://www.nre.gov.my/	NRE was established on March 27, 2004 following the formation of new cabinet. NRE responsible for: 1) Natural resources management - Forest management - Irrigation and drainage management - Wildlife management - Minerals management 2) Conservation and management of environment and shelters - Environmental conservation - Marine park management 3) Management of land survey and mapping administration - Land management and administration - Land survey - Mapping processing
7	Prime Minister Department (PMD) www.jpm.gov.my	- Providing support services including administration, finance, human resource management, security, social and other services to staff of the prime minister's department, according to the rules and regulations, and directives that have been set - Management of all property owned by the federal government efficiently and effectively

		- Providing efficient, quality and effective services to the cabinet and the chief secretary who is also acting as secretary to the cabinet, as well as tracking and monitoring of implementation of government decisions - As a reference centre for all issues pertaining to security and protection encompassing physical security, documents and personnel formulating, issuing and establishing the security policy to be properly implemented - Establishing the coordination of the national economic development policies, strategies and programmes for the medium and long terms in a structured, planned, efficient and proper manner, in order to strengthen the country's competitiveness, to promote economic growth, to promote public-private sector cooperation, to intensify the k-economy, and to promote the country's socio-economic developments - Central agency that monitors implementation of policies, strategies, programmes and development projects, as well as resolves related issues efficiently and effectively, to ensure they are implemented in line with the national development goals - Ensuring the formulation and coordination as well as the implementation of policies relating to national security and the direction of the security measures undertaken by well-planned, comprehensive and integrated - Enforcement of law and order under any federal law
8	Ministry of Works (MOW) http://www.kkr.gov.my/en	The details of the functions of the MOW are as follows: 1) To plan the development of the federal road networks nationwide; 2) To coordinate and monitor the implementation of the federal road projects and other projects under the supervision of MOW; 3) To regulate the privatised maintenance work of federal roads and; 4) The development of Bumiputera entrepreneurs in the construction sector; 5) To monitor the construction, operation, toll handling and maintenance of the tolled expressways; 6) To plan and coordinate human resource and financial (administration and development) of MOW and PWD; 7) To monitor departments and agencies under its purview; 8) To monitor the implementation of the development projects of the client ministries carried out by PWD; 9) To give advice and support services to CIDB in the development of the country's construction industry and skilled workforce; 10) To give advice and support services to MHA, BEM, BAM and BQSM in the development of the professional services programmes for the domestic and international
9	Ministry of Housing and Local Government	At 15 May 2013, KPKT was restructured and known as the "Ministry of Urban Wellbeing, Housing and Local Government". The role and function involves the implementation of programmers and activities to

	(KPKT) http://www.kpkt.gov.my/	improve the quality of life for urban citizens 1) To provide affordable housing, regulate aspects of private housing of residential strata as well as solving housing disputes 2) Help guide local authority in providing municipal services, quality recreational and socioeconomic facilities to meet the needs of local residents 3) To provide and efficient and effective fire prevention services, firefighting and rescue operations to protect lives and properties 4) To provide policy and technical advice to the federal government, state governments and local authorities in relations to the planning, management, development and conservation of land in accordance with the National Physical Plan 5) To provide policy and technical advice to the federal governments and local authorities in relations to the planning, implementing and managing of lands capes, parks and recreational areas 6) To provide a more integrated, efficient and cost effective policy for development and overseeing the solid waste management services and public cleansing 7) To implement programmes and activities to enhance the liveability of cities and public participation in local authority governance 8) To develop and regulate the activities of money lenders and pawn brokers 9) To implement programmes and activities to eradicate urban poverty and improve the quality of life of the urban poor
10	Economic Planning Unit (EPU) http://www.epu.gov.my/en/home	To manage the country's socio- economic development in a strategic and sustainable manner - Comprehensive planning though formulation effective policy - Development programme through outcome base approach - Maximise the usage of finance resources through effective distribution of allocation - Strengthen human capital toward elevate efficiency and professionalism - Establish organisation capacity to effective services delivery
11	Malaysia Automotive Institute (MAI) http://mai.org.my/v3/	To act as strategic thinker for the Malaysia automotive industry and to develop and promote the competitiveness of the Malaysian automotive industry. - To transform the Malaysia automotive industry into a globally competitive sector, committed to wider application of research and technology in market driven niche areas, in efforts to widen the industrial base in enhancing the competitiveness of local automotive manufactured products and services and other related value added activities on world market - To harness and mobilise collective efforts amongst the automotive stakeholders in the planning and implementation of industrial strategy towards a common direction at national level and to promote collaboration, strategic alliances, partnerships and linkages for technology and market outreach including

		serves as focal point in providing the necessary support to various government and industry stakeholders - To undertake strategic research and studies for inputs and policy advice to the government through the combined effort of the public and private sectors, to promote capacity and capability building of the local automotive industry and in general to serve and work with the Ministry of International trade and Industry (MITI) in shaping a national industrial competitiveness in the automotive sector towards sustainable prosperity
12	National Corporate GHG Reporting (MyCarbon)	Objective of the programme 1. Set up a globally recognised, standard corporate GHG accounting and reporting programme in Malaysia 2. Data source for analysis and development of local emissions factors 3. Encourage corporate level carbon accounting and emission reductions 4. Provide standards, guidance and support measures
13	Malaysian Greentech Corporation (MGTC) http://www.kettha.gov.my/	- To minimise growth of energy consumption while enhancing economic development; - To facilitate the growth of the green technology industry and enhance its contribution to the national economy; - To increase national capability and capacity for innovation in green technology development and enhance Malaysia's competitiveness in green technology in the global arena; - To ensure sustainable development and conserve the environment for future generations; and - To enhance public education and awareness on green technology and encourage its widespread use.
14	Road Transport Department (JPJ)	1) To establish and regulate the vehicle regulations and formulate the type approval system. 2) To establish and regulate the registration and licensing of motor vehicles in systematic, reliable and innovative manner. 3) Establish and administer the road transport law with commitment to produce competent, law abiding and prudent drivers of motor vehicle. 4) To enforce and administer the road transport law with integrity and commitment to create a society that has culture of adherence to the rules of the road. 5) To monitor and administer motor vehicle safety standards with efficiency and integrity to meet needs of the environment and the country's automotive industry
15	Department of Environment (DOE) http://www.doe.gov.my/	The main function of the DOE is to prevent, eliminate, control pollution and improve the environment, consistent with the purposes of the *Environmental Quality Act 1974* and the regulations there under DOE is also responsible for the implementation of the resolutions decided by the conventions of the international environment such as *Vienna Convention for the protection of the Ozone Layer 1985*, *Montreal Protocol on Substances That Deplete the Ozone Layer 1987*, the *Basel Convention on the Transboundary Movement of Hazardous Waste and Their Disposal Act 1989* and other areas while the success of programmes of bilateral cooperation

		and multilateral cooperation between Indonesia, Singapore and other ASEAN countries on environmental management.
16	Malaysian Investment Development Authority (MIDA) http://www.mida.gov.my/	1. To promote foreign and local investments in the manufacturing and services sectors 2. To undertake planning for industrial development in Malaysia 3. To recommend policies and strategies on industrial promotion and development to the Ministry of International Trade Industry 4. To evaluate application for manufacturing licenses and expatriate posts; tax incentives; duty exemptions 5. Issuance of confirmation letter for the application of import duty and/or sales tax exemption on machinery, equipment, spare parts, consumables, prime movers and container trailers for manufactures in the principal customs area (PCA), companies engaged in a hotel business and haulage operates under the self-declaration mechanism 6. To assists companies in the implementation and operation of their projects and offer assistance through direct consultation and co-operation with the relevant authorities at both the federal and state levels 7. To facilitate the exchange of information and co-ordination among institutions engaged in or connected with industrial development

Appendix 4: Laws and regulations related to transportation in Malaysia

Department	Laws	Agreements and conventions
Department of Civil Aviation is an agency under the Ministry of Transport Malaysia that regulates civil aviation affairs especially pertaining to aviation security and standards.	Civil Aviation Act 1969 [Act 3] Carriage by Air Act1974 [Act 148] Aviation Offences Act1984 [Act 307] Act of Aviation Services (Operating Company) 1991 [Act 467 Aviation] Interest Act in Mobi le Equipment (Aircraft) 2006 [Act 659] Civil Aviation Regulations 1996	With 100 countries, Malaysia has A bilateral Air Services Agreement (ASA) is the basic document most often used by states to jointly regulate their international air services relationships. Most bilateral ASA cover only schedule international air services. Bilateral regulation is regulation undertaken jointly by two parties, most typically by two states. The goal of bilateral regulation in the international air transport field is typically the conclusion, implementation or continuance of some kind of intergovernmental agreement or understanding concerning air services between the territories of the two parties. A significant amount of intergovernmental bilateral regulatory activity involves formal consultation undertaken to conclude, interpret, expand or amend, or resolve a dispute under an intergovernmental agreement, arrangement or understanding concerning international air services. The bilateral regulation of international air services evolved over many decades. Although international air services were first developed in the 1920s, few bilateral intergovernmental agreements were concluded in those early decades due to the small volume of international air transport activities and then to the virtual cessation of many commercial flights during the 1939-1945 (World War II) period. Bilateral agreements now in force, which constitute the largest volume of international air transport regulatory documents, largely date after the 1944 International Civil Aviation Conference held in Chicago. This extensive use by states of bilateral agreements to regulate international air transport is a consequence of agreement in the Convention on International Civil Aviation on the principle of national sovereignty over territorial air-space, agreement on the requirement for special permission or other authorisation to operate scheduled international air services over or into the territory of a Contracting States, and the lack of success of efforts to establish a multilateral regulatory regime for the commercial aspects of international air transport. As a country that sits on the International Civil Aviation Organization (ICAO), Malaysia has ratified several International Convention as follows: 1929: Convention for the Unification of Certain Rules Relating to International

		Carriage by Air 1944: Convention on International Civil Aviation 1947: Convention on the Privileges and Immunities of the Specialized Agencies 1963: Convention on Offences and Certain Other Acts Committed on Board Aircraft 1970: Convention for the Suppression of Unlawful Seizure of Aircraft (Hague Convention 1970) 1971: Convention for the Suppression of Unlawful Acts against the Safety of Civil Aviation (Montreal Convention 1971) 2001: Convention on International Interests in Mobile Equipment
Road Safety Department (JKJR) was established on 15 September 2004 is an agency under the MOT to promote and facilitate the development of road safety in Malaysia. The Department will also act as a One Stop Agency to carry out all activities that encompasses education, enforcement, engineering and road safety. Among the main goals of RSD is to reduce accidents, injuries and deaths to a minimum level on par with developed countries through the coordination and management of road safety programs at both national and state levels. On 1 April 1946, the **Road Transport Department (RTD)** was established to coordinate all aspects relating	Road Transport Act 1987	The Ministry of Transport Malaysia is a signatory to the various international conventions and protocols. It is also actively involved together with the government of other counties as well as the relevant international associations and organisations in programs related to land transport and road safety. The purposes of such active involvements are: i)to coordinate, monitor and manage the land transportation industry efficiently and effectively, particularly within the ASEAN region; ii) to provide platform for discussions and negotiations at international level; iii) to coordinate and simplify procedures for the operation of transit transportation; iv) to keep update of the global changes in the legal framework governing the land transportation system; and v) to draft infrastructure development policies and review the domestic legal framework in order to adopt and adapt the best global practices. 1998: Cooperation at ASEAN level: The agreements/Protocols/MOUs ratified/signed are as follows: ASEAN Framework Agreement on the Facilitation of Goods in Transit (AFAFGIT) • Protocol 1 Designation of Transit Transport Routes and Facilities- The Negotiation Stage • Protocol 2 Designation of Frontier Posts – • Protocol 3 Types and Quantity of Road Vehicles • Protocol 4 Technical Requirements of Vehicles • Protocol 5 ASEAN Scheme of Compulsory Motor Vehicle Third-Party

to motor vehicle regulations, type approval system and drivers registration and licensing in the entire country. The JPJ is the main authority under the Ministry of Transport. It is responsible for the provision of counter services as well as e-services for the registration and licensing of vehicles and drivers and the enforcement of the Road Transport Act 1987 in order to ensure safe drivers and vehicles.		Liability Insurance • Protocol 6 Railways Border and Interchange Stations • Protocol 7 Customs Transit System • Protocol 8 Sanitary and Phyto-sanitary Measures • Protocol 9 Dangerous Goods ASEAN Framework Agreement on the Facilitation of Inter-State Transport (AFAFIST) ASEAN Framework Agreement on Multimodal Transport (AFAMT) MoU Between The Government of Brunei Darussalam, Indonesia, Malaysia and The Philippines on Cross-Border Movement of Commercial Buses and Coach. MoU Between The Government of Brunei Darussalam, Indonesia, Malaysia and The Philippines on Transit and Inter-State Transport of Goods MoU Between The Government of Brunei Darussalam, Indonesia, Malaysia and The Philippines on Transit and Inter-State Transport of Goods
Railway Assets Corporation (RAC) is a Federal Statutory Body under Ministry of Transport Malaysia.	Railways Act 1991	RAC was established under the Railways Act 1991 (Act 463), commenced officially as an organisation on 1st August 1992 and gazetted under Volume 36 No.16 on 30th July 1992. RAC was fully operated on 1st October 1992. In conjunction with the establishment of RAC, the railway operation service was corporatized and Keretapi Tanah Melayu (KTM), a public entity which exists since 1894 was dissolved and officially known as Keretapi Tanah Melayu Berhad (KTMB). At the same time, Department of Railway (DOR) was formed to ensure and promote safe, efficient and affordable railway transport system in Malaysia. RAC, DOR and KTMB will jointly concentrate their efforts to enhance the level and quality of railway services in the country.
Marine Department of Malaysia is a government department under the Ministry of Transport Malaysia. This department was created to administer the business of shipping and port and maritime affairs	Cargo Transport by Sea Act1950 [Act 527] Merchant Shipping Ordinance 1952 [Ord. 70/1952] Federal Fire Dues Act 1953 [Act 243] Penang Port Commission	Malaysia has concluded maritime transport agreements with a number of countries since the eighties to strengthen bilateral cooperation in the maritime sector. The main provisions of the agreement are: i) Special treatment clause; ii) Confirmation of ships and seafarers certificates; and iii) Bilateral consultation mechanism to strengthen cooperation. Malaysia has concluded a total of 12 agreements of bilateral shipping as indicated

of Malaysia.	Act 1955 [Act 140] Port Authorities Act 1963 [Act 488] Bintulu Port Authority Act 1981 [Act 243] Privatization Port Act 1990 [Act 422] Langkawi International Yacht Registry Act 2003 [Act 630] Government Gazette Gazette On The Exemption Of Foreign Cruise Vessels From The Domestic Shipping License Requirement	below: Malaysia has ratified several International Conventions adopted by the International Maritime Organization (IMO). The International Convention are as follows: 1971: International Convention on Load Lines (LL) 1966 1971: Convention on the International Maritime Organization 1948 1980: Convention on the International Regulations for Preventing Collisions at Sea (COLREG) 1972, as amended 1984: International Convention for the Safety of Life at Sea (SOLAS) 1974, as amended 1984: Protocol of 1978 relating to the International Convention for the Safety of Life at Sea 1974, as amended 1984: International Convention on Tonnage Measurement of Ships (Tonnage) 1969 1986: Convention on the International Mobile Satellite Organization (INMARSAT) 1976, as amended 1986: Convention on the International Mobile Satellite Organization (INMARSAT) 1976, as amended 1971 Convention on the International Maritime Organization 1948 1986: Operating Agreement on the International Mobile Satellite Organization 1976, as amended 1992: International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) 1978, as amended 1997: Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships (MARPOL) 1973, as amended (Annexes I and II) 1997: Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships (MARPOL) 1973, as amended (Annexes V) 1997: International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC) 1990 2004: Amendments Adopted in November 1991 to the Convention of the International Maritime Organization (Institutionalization of the Facilitation Committee) 2005: International Convention on Civil Liability for Oil Pollution Damage (CLC) 1992 2005: International Convention on the Establishment of an International Fund for

		Compensation for Oil Pollution Damage (FUND) 1992 2009: The International Convention on Civil Liability for Bunker Oil Pollution Damage, 2001 (Bunkers Convention 2001) 2009: The International Convention for the Limitation of Liability for Maritime Claims, 1976 as Amended by Protocol of 1996 (LLMC Convention 1996) 1978: International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (FUND) 1992: MARPOL 73/78, Annex III: Regulations for the Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form 2003: MARPOL 73/78, Annex IV: Regulations for the Prevention of Pollution by Sewage from Ships 2005: MARPOL 73/78, Annex VI: Regulations for the Prevention of Air Pollution from Ships. 2008: MARPOL 73/78, Annex VI: Regulations for the Prevention of Air Pollution from Ships. (Yet to Enter Into Force): The Control and Management of Ship's Ballast Water 2004

Appendix 5: Existing policies and measures on transport

Category			Policy / measure	Implementation period	Lead organisation(s)	Description	Status	Assessment/remarks
ASI (G)*	Passenger/ Freight	Type of policy instrument**						
G	F	I	Certification system for low-carbon companies	August 2013	Ministry of Natural Resources and Environment (NRE) United Nation Development Programme (UNDP)	NRE and UNDP Malaysia initiated a 2-year programme for a National Corporate Greenhouse Gas (GHG) Reporting Programme for Malaysia (MY Carbon) in collaboration with Bursa Malaysia[10]. National Corporate GHG Reporting Programme for Malaysia MY Carbon (Voluntary carbon reduction programme)	On-going	In Dec 2014, more than 20 companies have submitted their reports and nearly 100 participants have benefitted from the training[11].As a voluntary participation programme, support from industry is slow.
G	P/ F	I	Emissions monitoring system		PUSPAKOM/JPJ	Commercial and public vehicles are required to go through routine inspection for permit (inspection disk) renew. Emission test is one of the procedures during inspection. Vehicle will be tested under Free Acceleration Test and the emission have to below certain level	Partially implemented	Emission test only perform under free acceleration test and not loaded test, therefor the test result did not reflect on road performance.
G	P/ F	E	CO_2-based fuel pricing / taxation		Ministry of International Trade and Industry	The National Automatic Policy 2014[12] envisions Malaysia as regional automotive hub in Energy Efficient Vehicle (EEV). As Malaysia is using the Euro 2M fuel quality standard, the	Not Implemented	The fuel quality shall be upgraded in phases: • Euro 4M RON 97 petrol: September 2015 • Euro 4M RON 95 petrol: October 2018

[10] http://www.mycarbon.gov.my/web/index.php
[11] http://www.my.undp.org/content/malaysia/en/home/presscenter/speeches/2014/12/04/special-remarks-at-the-mycarbon-awards-ceremony-2014/
[12] http://www.maa.org.my/pdf/NAP_2014_policy.pdf

Category			Policy / measure	Implementation period	Lead organisation(s)	Description	Status	Assessment/remarks
ASI (G)*	Passenger/ Freight	Type of policy instrument**						
			systems		(MITI)	implementation of EEV will only be based on fuel consumption specification. Carbon emission will only be used once the EURO 4M fuel quality standard is introduced.		* Sulphur content reduced to 50 ppm * Delayed from initial 2012 plan due to large investments in upgrading infrastructure standards[13] * Challenges in pricing for Euro 4M petrol * Euro 3 emission standards for motorcycle will be implemented[14] * Emission standard Euro 1 to Euro 2 in 2015 for diesel driven engine.
G	P/ F	E	Fuel subsidy reduction	1 December 2014	Ministry of Finance Ministry of Domestic Trade, Cooperatives and Consumerism	Government removed the subsidies for RON95 petrol and diesel[15]. Retail prices will be fixed according to a managed float similar to the Automatic Pricing Mechanism (APM) for RON97 petrol price if the global oil prices stay at below US$80 a barrel[16]. Sulphur content of the fuel will be reduced from 500ppm to 50ppm	Implemented	At above US$80 a barrel, targeted subsidy rationalisation to be implemented i.e. multi-tiered fuel subsidy scheme based on household income levels, different quota limits scheme, sales tax or further financial assistance to households through the 1Malaysia People's Aid (BR1M) program, etc. This might see possible introduction in mid-2015 if the fuel price increase.
A	P/ F	E	Road pricing	18 November 2014	Ministry of Works	Road pricing in Malaysia is means of financing road infrastructure project, but not as congestion charging measure. However, Kuala Lumpur City Hall is planning to impose road pricing or congestion charges for private vehicles on 2017 in the capital's business district.	Implemented	The compensation based on a formula stipulated in the concession agreement and the actual amount would only be decided after the process of traffic verification by the Malaysian Highway Authority. Government pays RM 558 M in compensation to highway concessionaires following its plan not to raise toll rates at 20 highways in year 2015[17]. For congestion pricing, KL city mayor Amin Nordin Abdul Aziz state that, congestion pricing may implement after the completion of Mass Rapid Transit Line 1. To made the use of public transport in capital more enticing.

[13] http://paultan.org/2014/11/17/malaysia-get-euro-4-petrol-next-year-euro-5-diesel-delayed-2020-says-mustapa-mohamed
[14] http://www.uncrd.or.jp/content/documents/24608EST-Country-Report_Malaysia_ppt.pdf
[15] http://www.thestar.com.my/News/Nation/2014/11/21/no-more-petrol-subsidy-dec-1/
[16] http://dealer.affinhwang.com/Archive-CompanyFocus/Affin%20Research/6.%20Economy/201411%20NOV/Economy%20Fuel%20Subsidy%2020141124%20AffinHwang.pdf
[17] http://www.themalaysianinsider.com/malaysia/article/concessionaires-to-be-paid-rm558-million-for-toll-hike-delay-bernama

Category			Policy / measure	Implementation period	Lead organisation(s)	Description	Status	Assessment/remarks
ASI (G)*	Passenger/ Freight	Type of policy instrument**						
A	P/ F	P	Integrated land-use planning	2014 & 2015	*Federal Department Of Town And Country Planning Malaysia,* Ministry Of Urban Wellbeing, Housing And Local Government	National Physical Plan (NPP)[18,19] - Implementing an integrated national land use and transport system. - A national integrated high-speed rail system. - The national road network shall be further extended for regional travel and for local access.	On-going	Future Cities Initiative: Focuses on encouraging people to use public transport for commuting in city areas.
A	P	P/E	TOD/ compact development/mixed-use planning	-	TCPD MFT SA LA	TOD, compact development and mixed-use planning are among the main thrusts of the Malaysian government as stated in the Tenth Malaysia Plan [20], the National Urbanization Policy [21], National Physical Plan [22] and National Land Public Transport Masterplan[23]. State and local authorities are encouraged to emphasise this in their respective Structural and Local Plans[24].	Implementation on-going	TOD concept is introduced in KL Central, residential areas near transit nodes in Subang Jaya, public housing near Sentul, Mid Valley, while mixed-use planning is being applied at service apartments in KL, PJ, Subang Jaya. High-density development [25]
A	P	E/P	Parking pricing and management			Currently, the parking fee is set by private parking companies or city/local councils. Few shopping and business offices subsidies parking fee to their customers (some with minimum spending at their stores).	Not intended in the near future	This measure is not applied in Malaysia.
A	P	C	Telecommu	-	-	-	Not in discussion	-

[18] http://www.epu.gov.my/documents/10124/667951ff-f114-4f66-9777-ac948ef73299
[19] http://www.uncrd.or.jp/content/documents/24608EST-Country-Report_Malaysia_ppt.pdf
[20] http://www.epu.gov.my/epu-theme/RMKE10/img/pdf/en/chapt6.pdf (Chapter 6)
[21] http://www.kpkt.gov.my/kpkt_2013/fileupload/dasar/DPN_BI.pdf (page 70 for compact development, and page76 for TOD)
[22] http://www.epu.gov.my/documents/10124/667951ff-f114-4f66-9777-ac948ef73299
[23] http://www.spad.gov.my/sites/default/files/national-land-public-transport-master-plan-final-draft.pdf
[24] http://www.epu.gov.my/epu-theme/RMKE10/img/pdf/en/chapt6.pdf (Chapter 6)
[25] http://www.epu.gov.my/c/document_library/get_file?uuid=280f12a1-a3f7-4014-9eec-3bf4860c7687&groupId=283545

Category			Policy / measure	Implementation period	Lead organisation(s)	Description	Status	Assessment/remarks
ASI (G)*	Passenger/ Freight	Type of policy instrument**						
			nication promotion					
S	P	P/Infra	Bike-sharing	-	City Council of Penang Island (MPPP)	A contract to design, install, operate and maintain a bike-sharing system in George Town, Penang, has been awarded in 2014. It will be in operation in May 2015 and the whole system will be fully complete by 2017.	Pilot in Penang	The system will see at least 25 bike stations set up across George Town, with 1,000 bicycle docks and 500 bicycles.[26]
S	P	Infra	Cycling infrastructure	2012	City Council of Penang Island [27]	Penang Bicycle Lane Masterplan, launched in 2012, is an initiative of the state to become a bike state.[28] The state government of Penang mandated that new housing projects be equipped with bike lanes.[29] Kuala Lumpur city council has planned cycling infrastructure in Kuala Lumpur to promote healthy life style and last-mile transportation. The proposal was announced during 2013 and infrastructure will be located in the populated area connected with nearby rapid transit system	Piloted in Kuala Lumpur and Penang	For instance, there is an improvement of existing cycling path in Putrajaya involving 22.8km in length to connect the city centre with residential areas as a pilot project. In year 2014, Penang state has launch for completion of a RM 30 M coastal bicycle route that stretches 12.5km as first phase of Penang Bicycle Route Master Plan Kuala Lumpur has opened to the public its first dedicated bicycle path, a 5.5km stretch from Mid Valley to Dataran Merdeka, in April 2015.[30]
S	P	Infra	Walking infrastructure	-	Ministry of Housing and Local Government [31]	Moving people via public transport, supported by pedestrian-friendly streets and transit-oriented developments are covered in the Tenth Malaysia Plan 2011-2015, National Physical Plan-2 (with emphasis on interconnectivity between developments and rail stations).	Varies in level of implementation	A fully air conditioned pedestrian walkway at KLCC (Kuala Lumpur City Centre) has open to public since 2012. The elevated walkway is 1.173km stretch which links the KLCC area to Bukit Bintang area. Various walkways have been included in Kuala Lumpur MRT project as passenger last

[26] http://www.themalaymailonline.com/malaysia/article/penang-kicks-off-ambitious-transport-revolution-with-rm9.2m-bike-sharing-sy
[27] City Council of Penang Island. http://www.mbpp.gov.my/en/web/guest/home
[28] http://www.freemalaysiatoday.com/category/nation/2014/10/31/rm30-million-spent-on-12km-bicycle-route-in-penang/
[29] http://www.thesundaily.my/news/220582 . Laluan Basikal di Pulau Pinang. http://www.mppp.gov.my/png_mpp-theme/pdf/LALUANBASIKAL_905.pdf
[30] http://paultan.org/2015/04/15/kuala-lumpur-opens-first-bicycle-path-for-public-use/
[31] Ministry of Housing and Local Government. http://www.kpkt.gov.my/kpkt_2013/fileupload/dasar/NPP.pdf

Category			Policy / measure	Implementation period	Lead organisation(s)	Description	Status	Assessment/remarks
ASI (G)*	Passenger/ Freight	Type of policy instrument**						
								mile.
S	P	C	NMT friendly building regulations	2014 & 2015	Ministry of Transport and Local Government	Formulation of green neighbourhood initiative on construction of bicycle lane in housing and city centre areas. Pedestrian linkages/covered pedestrian walkaway in Kuala Lumpur. The state government of Penang mandated that new housing projects be equipped with bike lanes.[32]	Implemented	
S	P	P	Bus route optimisation and prioritisation	-	-	Stage Bus Transformation Scheme. Land Public Transport Commission (SPAD) introduced MyBas model to ensure bus operators deliver on the agreed service level performance. Private bus operators are paid on per-km rate based on the route's conditions and requirements and in return, government will keep the revenue from fares collected. The effectiveness of the bus services; frequency, operating hours and ridership is monitored by a centralised Performance Monitoring Hub System (GPS)[33].	Not in discussion	ISBSF, (Interim Stage Bus Support Fund) is an initiative by the government to meet the needs of NKRA for Urban Public Transport. ISBSF initiative is expected not only to ensure the continuity of bus services, but also to improve the quality of the bus services and increase the passengers[34].
S	P/ F	P	Low-emission zones	-	-	-	Not in discussion	
S	P	P	Master planning for PT/NMT	-	SPAD	The *20-year National Land Public Transport Masterplan*[35] was released in 2012. It also states the need for state-level regional master plans to be developed (i.e. one per state, including one for Greater KL/KV) in addition to inter-regional master plan to explore the opportunities for linkages between conurbations.	Studied	NMT is covered by the master plan as a component of interconnectivity between public transport nodes, and as a first- and last-mile travel.
S	P	P	Integrated ticketing	-	SPAD	There is Touch n Go ticketing system on RapidKL systems, KL Monorail, and KTM Komuter, though	Implementation ongoing in Klang	Touch n Go system was fully implemented through the 848km North South Expressway

[32] http://www.thesundaily.my/news/220582. Laluan Basikal di Pulau Pinang. http://www.mppp.gov.my/png_mpp-theme/pdf/LALUANBASIKAL_905.pdf
[33] http://www.thestar.com.my/News/Nation/2015/02/14/Govt-to-take-the-wheel-of-bus-services/
[34] http://www.spad.gov.my/isbsf
[35] http://www.spad.gov.my/sites/default/files/national-land-public-transport-master-plan-final-draft.pdf

Category			Policy / measure	Implementation period	Lead organisation(s)	Description	Status	Assessment/remarks
ASI (G)*	Passenger/ Freight	Type of policy instrument**						
						Touch n Go cards are mainly used for toll expressways and highways. Public transport in Malaysia is run by different operators, but SPAD is working toward a single cashless ticket for both buses and trains[36]. An integrated smart ticketing system is among the action plans mentioned in National Land Public Transport Master plan.	Valley; planned for integration with other modes.	on 15 November 1998. Made it one of the world's longest single stretches if expressway to have electronic toll payment system, from Kempas in Johor to Jitra in Kedah. Touch n Go was first implemented on stage bus service in 2000 in Klang Valley and later on Rapid KL in 2011 as an initiative to meet Urban Public Transport NKRA.
S	P	Infra	Non-urban rail improvements	September 2015	SPAD	The National Land Public Transport Master plan emphasised the need for better interconnectivity between rural growth centres[37]. Buses remain to be the primary mode of transport outside the cities.	Intended	Beside commuter service in Kuala Lumpur, a new northern KTM Komuter service (Komuter Utara) run from Gurun to Kamuting on 11th Sep 2015 and following by 2nd commuter rail service in north Malaysia, which run from Butterworth, Penang to Padang Besar, Perlis, starting on 1st January 2016.
S	P	Infra	Urban PT infrastructure		*SPAD;* Under purview of the Prime Minister	The Greater KL/Klang Valley Land Public Transport Master Plan is supported by six Subsidiary Plans: Urban Rail Development Plan for development of urban rail services and future corridors in the GKL/KV region, Bus Transformation Plan and Taxi Transformation Plan, Interchange & Integration Plan to link the modes for first and last mile and reduce barriers of using public transport, and Land Use Plan and Travel Demand Management Plan identify measures to assist the development of public transport in the Region[38].	Implementation ongoing	Urban rail journey is significantly longer than private cars. Reason identified is in-frequent and long route length of feeder buses and also the wide spread of housing areas. Among proposals is to introduce Tuk Tuk service promote non-motorised transport, vehicles with improved efficiency [39]
S	P	E	Regulatory and physical restrictions	-	-	-	Not in discussion	

[36] http://www.thestar.com.my/Lifestyle/Features/2014/01/20/Integration-is-the-key-to-public-transport/

[38] http://www.spad.gov.my/projects/national-master-plan/draft-greater-klklang-valley

[39] http://www.thesundaily.my/news/1294889

Category			Policy / measure	Implementation period	Lead organisation(s)	Description	Status	Assessment/remarks
ASI (G)*	Passenger/ Freight	Type of policy instrument**						
			on car use					
S	P	P	Car-sharing	August 2014	Malaysia Automotive Institute (under MITI)	COMOS is a car-sharing service using EV fleet (electric cars and bikes) integrated with EVSE (charging station) and parking reservation and management system as well as user mobile apps, allowing users to pick up or drop their EVs at any designated green parking bays within the city. This is operated by PPP between CMS Consortium, Malaysia Automotive Institute and Malaysian Green Technology Corporation.	Pilot in Klang Valley	30-40 EV units will be made available in a selected number of hot spots in KL. In November, operation is set to expand to Langkawi, with around 25 EVs. As for public charging stations, 60 locations will be introduced in line with the programme's introduction this year. The network will make its way to Penang, Melaka and Johor Bahru as the phases unfold. Eventually, the aim is have 3,500 EVs in the COMOS loop nationwide by 2020[40].
S	P	C	Three in one policy/high-occupancy vehicle lanes	-	-	-	Not in discussion	
S	P	I	Campaigns	21 September 2013	DBKL (Kuala Lumpur City Council)	Campaigns to shift to a more sustainable form of transport like bus or NMT are not done massively and consistently, but certain cities and organisations host campaigns. Kuala Lumpur City Hall (DBKL), for instance, initiated a Car-Free Morning programme but it is limited to first and second Sundays of the month.	Implemented	
I	P/ F	E	Tax incentives for efficient vehicles	2014	MITI	Tax incentives for fully imported hybrid vehicles and EVs were discontinued when it failed to attract investments and encourage production and local assembly. Malaysia competes with Indonesia and Thailand in auto industry. To be granted tax exemptions, car manufacturers must assemble the vehicles locally. The National Automotive Policy 2014 grants import tax and excise duty exemption to locally assembled hybrid vehicles and to EV until 31 December 2015 and 31 December 2017, respectively.	Implementation on-going	According to the policy, "Beyond these dates, the incentives will be customised based on the strategic level of the CKD investments as in the investment value, production volume, technology transfer, research and development activities, supply chain development, employment, exports programme and others".

[40] http://mai.org.my/ver2/index.php/34-local-automotive-news/2807-comos-ev-car-sharing-programme-to-launch-in-august-rent-a-twizy-zoe-or-leaf-in-kl-by-the-hour

Category			Policy / measure	Implementation period	Lead organisation(s)	Description	Status	Assessment/remarks
ASI (G)*	Passenger/ Freight	Type of policy instrument**						
I	P/ F	E	Fuel economy/ Fuel efficiency standard		MITI/ MAI/ JPJ	Fuels currently comply with Euro 2 standards. There were plans to make Euro 4 diesel available in Malaysia by June 2015 but was postponed to 2018[41]. Fuel consumption and emission information for every vehicle modal in Malaysia are tested and recorded by JPJ under the Vehicle Type Approval (VTA) system	Implementation on-going	
I	P/ F	I/Infra	Intelligent transport systems	2015	SPAD	Integrated Transport Information System was completed in 2005. It monitors traffic flow and it is operated by Kuala Lumpur City Hall, disseminating information via variable-message signs,[42] Performance Monitoring Hub System will be introduced to monitor performance of all bus operators in city centre by installation of GPS unit on board and control centre[43]. GPS-based centralised taxi service system (CTSS)[44] was also developed to direct the taxi driver to the closest waiting passenger, rather than have people call for a ride. Real-time traffic information, meanwhile, is provided to highway users through the Traffic Monitoring Centre developed by PLUS Expressways Berhad. The centre will also manage the ITS equipment like the Variable Message Sign and Automatic Vehicle Detection System. [45] [46]	Implementation on-going	Introduced to improve the frequency of public transport system in Malaysia.
I	P	I	Real-time public transport information		SPAD	MyRapid Journey Planner is a tool that allows commuters to view bus/rail routes, fares and interchanges within Klang Valley. Passenger Information system (PIS) was used in both rail public transport system and bus. The system included LED Panel	Implementation on-going in Klang Valley.	Syarikat Prasarana Nasional Bhd has setting up a Fleet Tracking System on 2012 for RapidKL's bus, including 59 LED. Installed at major transit hub in Klang Valley

[41] http://www.thestar.com.my/News/Nation/2014/05/03/Stop-postponing-Euro-Standard-4-Petroleum-firms-should-offer-higher-grade-diesel-without-delay-say-l/ http://paultan.org/2014/11/17/malaysia-get-euro-4-petrol-next-year-euro-5-diesel-delayed-2020-says-mustapa-mohamed/#ixzz3VYyENiXV

[42] http://www.apec-tptwg.org.cn/new/Archives/tpt-wg39/Intermodal/IIEG/07.%207-Economy%20Report-Implementation%20of%20ITS%20in%20Malaysia.pdf

[43] http://www.themalaymailonline.com/malaysia/article/spad-to-moot-contract-system-for-stage-buses-in-transport-overhaul

[44] http://www.spad.gov.my/sites/default/files/04_-_ctss_tender_briefing_deck_v1.0_0.pdf

[45] http://www.traffictechnologytoday.com/news.php?NewsID=11834

[46] http://www.spad.gov.my/journeyplanner

Category			Policy / measure	Implementation period	Lead organisation(s)	Description	Status	Assessment/remarks
ASI (G)*	Passenger/ Freight	Type of policy instrument**						
						displaying estimation time of arrivals for next ride.		
I	P/ F	I	Traffic flow improvement and traffic information	2008 in Subang	Private sector	For highway users, a USD 15M Traffic Monitoring Centre was opened by one of the largest Malaysian toll road operators, PLUS Expressways Berhad. The centre disseminates traffic information to users through radio stations, electronic message boards (VMS), the PLUSLine and the PLUSTrafik Twitter service[47].		
I	P/ F	C	Speed limits		Road Transport Department[48], Royal Malaysia Police[49]	*National Speed Limit Order 1989* indicates that the default is 110km/h on intercity highways, 90km/h on federal and state roads, but may be reduced in town areas[50] For trucks, an 80-90 km/hr speed limit is imposed on expressways, while 70-80 km/hr is imposed on federal and state roads, and 60 km/hr in urban areas.		
I	P/ F	I	Eco-driving	-	-	While there seems to be no mandates on eco-driving programmes, the government collaborates with the private sector to raise awareness on fuel-efficient driving methods.	Not in discussion	Malaysian-German Chamber of Commerce & Industry (MGCC) and TÜV Rheinland Malaysia Sdn. Bhd., in cooperation with GIZ, are running a 2-year project on Road Safety and Eco-Driving for Malaysian Logistic and Transportation Sector (2014-2015). This is a PPP project. [51] Those organised solely by the private sector include Honda Safety Driving Course as well as Eco-driving Techniques Course for Honda Customers[52],
I	P/ F	C	Inspection and maintenance	20 January 2014	MITI, Malaysia Automotive	In Malaysia, all commercial and public vehicles are mandatory for inspection[53] but not required for private vehicles. However, NAP 2014 seeks to introduce Voluntary Vehicle Inspection	Implementation on-going	VVI is offered by PUSPAKOM Inspection Centres[55]. PUSPAKOM's concession agreement (i.e. exclusive rights for commercial and public

[47] http://www.plus.com.my/index.php?option=com_content&view=article&id=90&Itemid=114

[48] http://www.jpj.gov.my/web/eng/kejara

[49] http://www.rmp.gov.my/faq ---I see Laser Speed Detector. Please confirm. One of the police's mandates is also to assist MOT. Also, POL 170A is a notice issued for offenses committed by vehicles

[50] http://www.theborneopost.com/2015/03/20/no-plans-to-increase-speed-limit-on-highways/#ixzz3VT5TZ1F2 , http://www.who.int/violence_injury_prevention/road_safety_status/2009/laws/speed_malaysia.pdf

[51] http://www.malaysia.ahk.de/fileadmin/ahk_malaysia/CR_Competence_Ctr/Road_Safety/Road_Safety_E_Flyer_20141211.pdf

[52] http://www.honda.com.my/microsite/eco_safety/

[53] Road Transport Act 1987; http://www.agc.gov.my/Akta/Vol.%207/Act%20333.pdf

Category			Policy / measure	Implementation period	Lead organisation(s)	Description	Status	Assessment/remarks
ASI (G)*	Passenger/ Freight	Type of policy instrument**						
					Institute (MAI)	programme through an annual vehicle inspection for passenger vehicles aged 5 years and above to ensure roadworthiness of vehicles and compliance to Road Transport Act 1987[54].		vehicle inspection) is valid until 2024[56]. The monopoly is causing allegations of corruption and underperformance[57]. Other improvement strategies includes introduction of international standard for inspection and increased smoke inspection standards by the Department of Environment (DOE) to meet with the requirement of UNR83 For Emission[58]
I	P/ F	E/C	Vehicle scrapping/fleet replacement	-	-	The government prioritises the roadworthiness of the vehicles over the age of the vehicles.[59] An end-of-life vehicle policy (12-year limit on cars) was proposed but was eventually not included in the NAP 2014 due to public opposition.[60]	Intended	The policy regarding End-of-Life Vehicle (ELV) is under development by MAI
I	P/ F	E	Incentives for low-carbon fuel (1st/2nd gen Biofuel, CNG, LPC)		MPIC	Malaysia launched National Biofuel Policy in 2006; low-interest loan and grants for research and development and demonstration projects were granted but there is no direct incentive for usage of biofuels.	On-going	The biofuel industry benefits from incentives offered by Promotion of Investments Act 1986, and biodiesel projects are eligible to be considered for Pioneer Status or Investment Tax Allowance,[61] but actual incentives like tax exemption are difficult to assess.[62] As in year 2014, government of Malaysia subsidised RM0.50 per litre of CNG, which reduced the rental price to RM1.05 per litre.

[55] http://www.puspakom.com.my/en/inspections-a-services/types-of-inspection/voluntary-inspection.html
[54] http://www.maa.org.my/pdf/NAP_2014_policy.pdf
[56] http://www.freemalaysiatoday.com/category/highlight/2014/11/08/end-puspakoms-monopoly-on-commercial-vehicle-inspection/
[57] http://www.freemalaysiatoday.com/category/highlight/2014/11/08/end-puspakoms-monopoly-on-commercial-vehicle-inspection/
[58] http://www.uncrd.or.jp/content/documents/24608EST-Country-Report_Malaysia_ppt.pdf
[59] http://paultan.org/2014/01/21/nap-2014-voluntary-vehicle-inspection/
[60] http://paultan.org/2015/01/30/vehicle-end-of-life-policy-public-not-ready/
[61] http://www.biomass-asia-workshop.jp/biomassws/04workshop/presentation_files/05_Lunjew.pdf
[62] http://www.iisd.org/gsi/sites/default/files/final_malaysia_2.pdf

Category			Policy / measure	Implementation period	Lead organisation(s)	Description	Status	Assessment/remarks
ASI (G)*	Passenger/ Freight	Type of policy instrument**						
								Beside exempted from import duty and sales tax for NGV conversion kits, NGV was given reduction on road tax, 50% reduction of road tax for monogas vehicle, 25% for bi-fuel (petrol and natural gas) vehicle
I	P	E	CNG/LPG for taxis and buses		-	CNG is predominantly confined to taxis in Klang Valley and Penang. PETRONAS, Malaysia's state-owned oil enterprise, has a monopoly on CNG sector.	Implementation on-going	Up to 2013, there are 37,000 taxies in capital Kuala Lumpur use natural gas
A	F	P	Empty hauling reduction		-	Transport4u, a private company has taking initiative on providing online 'stock exchange' and load matching service to reduce empty hauling[63].	Piloted	
A	F	P	Improve logistics centres and their location		MITI	The logistics sector is identified as a key sector in the *Third Industrial Master Plan 2006-2020*[64] which recognises the need for strategic logistics centres at the border areas as well as in areas around Ipoh in Perak, Northern Johor-Melaka and the East Coast of Peninsular Malaysia. It placed emphasis on the development of rail and freight distribution centres, and distribution parks near major seaports and airports or in inland industrial locations. Infrastructure development was recognise as important strategic in *Logistics and Trade Facilitation Masterplan (2015-2020),* improve last mile connectivity to Port Klang, address bottlenecks at Padang Besar Terminal and creating integrated hub and spoke model are among the key action items in masterplan	Implementation on-going	
S	F	E	Lorry restrictions	15th May 2010	SPAD/ JPJ	Vehicle weighing 10,000 kg and above are banned from North-South Expressway between 6.30 am and 9.30 am on weekdays since 15th May 2010. However, this restriction is means to reduce rush hour congestion.	Implemented	Lorry restriction in this discussion is mean for reduce congestion

[63] http://www.transport4u.my/

[64] http://www.miti.gov.my/cms/documentstorage/com.tms.cms.document.Document_879bae59-c0a81573-1bef1bef-926c5327/chapter14_25.pdf

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ASI (G)*	Passenger/ Freight	Type of policy instrument**						
S	P/ F	Infra	High-speed rail infrastructure	Estimated at 2022	SPAD	The Kuala Lumpur – Singapore High Speed Rail (HSR) project was announced by Malaysia Prime Minister Najibin September 2010 and it is proposed to connect Kuala Lumpur and Johor Bahru and Singapure. The construction will be monitored by SPAD, the commencement of work to be in 2017 and completion in 2022. The construction cost will be RM43 billion[6566]	Intended	The estimated length of Kuala Lumpur – Singapore HSR is 375km and the travel time will be 90 minutes
S	F	P	Master planning for rail and water / Logistic planning		MITI	The logistics sector is identified as a key sector in the *Third Industrial Master Plan 2006-2020*[67] and the *Tenth Malaysia Plan*. Rail freight transportation	Implementation on-going	
S	F	E	Rail incentives		-	-	Not in discussion	
S	F	E	NMT freight incentives		-	-	Not in discussion	
S	F	Infra	Multimodal facilities/dry ports			Multimodal transport network is among the action plans stated in the *Tenth Malaysia Plan*. Investments are made to build roads and rails that lead to key ports and airports.	Implementation on-going	
S	F	I	"Branding" campaigns		-	-	Not in discussion	
I	F	E	CO_2 based vehicle taxation/registration fees		-	Malaysia vehicle taxation was based on vehicle type and engine capacity. However, government officers showing intension on setting up CO_2 base taxation mechanism during internal meeting in stocktaking report preparation	Not in discussion	
I	F	C	Tyre standards		JPJ	Enforcement of tyre standard is based on Malaysian Standard (MS), UN regulations.	Implemented	

[65] http://www.railway-technology.com/projects/kuala-lumpur-singapore-high-speed-rail/
[66] http://www.myhsr.com.my/
[67] http://www.miti.gov.my/cms/documentstorage/com.tms.cms.document.Document_879bae59-c0a81573-1bef1bef-926c5327/chapter14_25.pdf

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ASI (G)*	Passenger/ Freight	Type of policy instrument**						
I	F	C	Aerodynamic standards		-	-	Not in discussion	
I	F	I	Driving information		-	-	Not in discussion	

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