Chapter 11

Malaysia Country Report

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CHAPTER 11

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1. Background

Malaysia is located in Southeast Asia. Its 330,803 square kilometres of territory consist of Peninsular Malaysia and the Sabah and Sarawak States on the island of Borneo. Malaysia has a tropical, humid climate with temperatures averaging 86^{o}F (30^{o}C). The total population of Malaysia was 29.3 million in 2012. GDP grew at an average of 5.5 percent per year from 1990 to 2012. After experiencing a sluggish growth in 2009, the economy recovered and continued its strong growth momentum, expanding by 5.6 percent in 2012. The overall growth performance was driven by higher growth in domestic demand, which outweighed the negative impact from the weak external environment. Domestic demand recorded the highest rate of expansion over the recent decade, underpinned by higher demand and investment spending. Despite the uncertainties in the external environment, domestic consumer confidence picked up amidst positive income growth, continued strength in the labour market, the low inflation environment and supportive financing conditions.

Total population was 28.9 million in 2011 and increased to 29.3 million in 2012 with increasing population density. About 68.4 percent of the population is within the 15-64 age brackets. The urbanization rate is expected to continue to increase. Life expectancy at birth also showed an upward trend. This improvement can be attributed to the extensive network of health care services in Malaysia, mainly provided by the government. Income per capita increased from RM 29,661 in 2011 to RM 30,809 in 2012. GDP for 2012 was made up as follows: services (55.3

percent), manufacturing (27 percent), agriculture, livestock, forestry and fishing (7.4 percent), mining and quarrying (8.6 percent), and construction (3.4 percent). Unemployment decreased to 3.0 percent in 2012 from 3.1 percent in 2011.

Malaysia is well endowed with conventional energy resources such as oil, gas, and coal, as well as renewables such as hydro, biomass and solar energy. As of January 2012, reserves included 5.95 billion barrels of crude oil, 92.12 trillion cubic feet of natural gas and 1,483 million tons of coal. Malaysia is a net energy exporter. In terms of energy equivalent, Malaysia has gas reserves, which are four times the size of its crude oil reserves. Natural gas reserves off the east coast of Peninsular Malaysia are dedicated for domestic demand while those in Sarawak are allocated as revenue earner in the form of liquefied natural gas (LNG) exports. In 2011, Malaysia generated 123.6 terawatt hours (TWh) of electricity. Coal has become the largest fuel input in the power sector with a share of 46.6 percent, followed by natural gas at 39.3 percent, hydro at 6.6 percent and oil at 7.5 percent. In 2010, Malaysia had 28 gigawatts (GW) of installed generation capacity.

The role energy plays in achieving the goals of sustainable development in Malaysia had been recognised many years ago. The sustainability of energy resources have been strategically planned over the years with energy policies that have been developed after careful evaluation of the current and future energy needs and supply of energy. Malaysia's energy policies can be traced back to as early as the 1970s. The major energy policies implemented in the country are as follows:

(i) National Petroleum Policy (1975)
(ii) National Energy Policy (1979)
(iii) National Depletion Policy (1980)
(iv) Four Fuel Diversification Policy (1981)
(v) Five Fuel Policy (2001)
(vi) Biofuel Policy (2006)
(vii) New Energy Policy (2010)

2. Modelling Assumptions

The econometric approach is the method applied in forecasting the final energy demand. The historical correlation between energy demand as well as macroeconomic and activity indicators were derived by regression analysis using Microfit. Microfit is an interactive software package written for microcomputers, and is designed for the econometric modelling of time series data. It has powerful features for data processing, file management, graphic display, estimation, hypothesis testing, and forecasting under a variety of univariate and multivariate model specifications.

The future energy demand for various energy sources were estimated using assumed values of the macroeconomic and activity indicators. Future values of these indicators were also derived using historical data depending on the sufficiency for such analysis. In the model structure, energy demand is modelled as a function of activity such as income, industrial production, number of vehicles, number of household, number of appliances, floor area of buildings etc. In the residential sector for example, the demand for electricity could be a function of number of households, disposable income and penetration rate of electrical appliances. In the commercial sector, energy demand could be driven by building floor arrears, private demand and other factors that encourage commercial activities. However, due to unavailability of information on the activity indicators, the macroeconomic parameter i.e. the Gross Domestic Product (GDP) was the best variable to utilise in establishing the relationship with the energy demand trend. These macroeconomic indicators were mainly used to generate the model equations. In some cases where regression analysis was not applicable due to insufficiency of data or there was failure to derive a statistically sound equation, other methods, such as share of percentage approach, were used.

One of the main drivers of the modelling assumption is GDP growth rates. Based on a study carried out by Economic Planning Unit (EPU) under the Prime Minister Office of Malaysia, the assumption growth rates of future GDP was applied. Most of all the demand equations for Malaysia were using GDP as the key factor to determine future projections. The assumption of GDP growth rates are found below:

Table 11-1: GDP Growth Assumptions by Sector to 2035

Period	Growth Rates (%)
2010-2015	4.5
2015-2020	4.3
2020-2025	3.5
2025-2035	3.4

Source: Economic Planning Unit

Besides GDP future growth rates, the annual average population growth was also considered as one of main key driver for future energy growth. The assumption of future growth rates of population was obtained from the United Nations website. The future assumption of population growth rates as below:

Table 11-2: Population Growth Assumption to 2035

Period	Growth Rates (%)
2010-2015	1.57
2015-2020	1.43
2020-2025	1.29
2025-2030	1.15
2030-2035	0.99

Source: United Nations

As part of the government initiative to ensure the security of energy supply and at the same time conserve the environment and promote green technology, the introduction of feed in tariff (FiT) is an effort towards that direction. With a lot of renewable energy sources potential, Malaysia can fully utilise it resources by converting it to electricity. The implementation of FiT will promote and ensure that

renewable energy supply can be part of Malaysia's future generation mix. Furthermore, this action will support the achievement of the Government's target to reduce up to 40 percent of the C02 emission intensity by 2020 from 2005 level. The introduction of biodiesel in the market gradually by region starting June 2011 is one of the other actions to meet the target. There is a target for biodiesel use to go nationwide by 2014. The implementation could not be made sooner because there were no enough blending facilities for the alternative fuel. The 2400 MW Bakun dam is expected to commercially produce its first 300 MW in July 2011. This definitely will increase hydro share in the fuel mix for Malaysia. As part of alternative energy for future, nuclear power was also considered to be a part of the future supply mix for power generation around 2023.

Improving energy efficiency is one of the most cost effective means of matching supply and demand. In Malaysia, there are additional reasons for focusing on energy efficiency. In residential sector, regulatory instruments in the form of Minimum Energy Performance Standards (MEPS) and appliance labelling will be developed for major domestic appliances (including refrigerators and air conditioners). The fiscal instruments in the form of tax incentives for manufacturers and importers of energy efficient appliances will be used as an interim measure until such time as MEPS and labelling standards are ready to be implemented. In the commercial sector especially the building sector, energy efficiency performance standards will form part of the building standard for new buildings and for significant retrofits. Training programs for architects and building equipment specifications will be used as a means of helping improve the long term efficiency of building stock. While for industrial sector, educational or training initiatives aimed at industry, consultants and suppliers will be implemented as a means of fostering efficiently configured industrial systems. Furthermore, mandatory energy efficiency audits will be introduced as a means of identifying opportunities to improve energy efficiency performance in particular applications. Barriers to development of co-generation (e.g. the ability to sell power to the grid) will be addressed as a means of facilitating its development. Under the Greater Kuala Lumpur plan, the new route of Mass Rapid Transportation (MRT) is now being undertaken by the Government to increase more public transportation in Klang Valley. The National Automotive Policy (NAP) was introduced on 22 March

2006 by the Ministry of International Trade and Industry (MITI) as the main thrust for the formulation of the strategic directions of the industry under the Third Industrial Master Plan (IMP3), 2006-2020. As transport is highlighted as one of the sector under the green technology policy, MITI launched the Review of National Automotive Policy (NAP) in early 2010 to review the existing NAP to foster more competitive market for local and international companies. In order to promote high value and green technology, the revised policy highlights the development of related Infrastructure to promote Hybrid and Electric Vehicles as the main agenda. The NAP Review assigns Ministry of Energy, Green Technology and Water to draw up a roadmap to develop the infrastructure for electric vehicles.

The details of future assumptions based on their respective scenarios as mentioned in table below:

Table 11-3: Energy Efficiency Assumptions

SCENARIOS	ASSUMPTIONS
Energy Efficiency (EEC)	1. Electricity Demand in Industrial Sector (INEL)
	Potential reduction of electricity demand in industrial sector from the year 2015 until 2035 by 0.8 percent per year.
	2. Total Energy Demand in Industrial Sector (INTT)
	Potential reduction of total energy demand (electricity + petroleum products + coal + natural gas) in industrial sector by 1.0 percent per year from
	3. Total Energy Demand in Commercial Sector
	Potential reduction of total energy demand in commercial sector by 1.0 percent per year from 2015 until 2035.

Table 11-4: Alternative Energy Assumptions

<table>
<tr><th>SCENARIOS</th><th>ASSUMPTIONS</th></tr>
<tr><td>Renewable Energy (RE)</td><td>1. By 2030, Malaysia will be expected to have these renewable energy (RE) capacities in power generation. The breakdown of the capacity based on type of fuels type are showed below:
Cumulative Capacity (MW)
<table><tr><th>Year</th><th>Biomass</th><th>Biogas</th><th>Mini-Hydro</th><th>Solar PV</th><th>Solid Waste</th><th>Total</th></tr><tr><td>2015</td><td>330</td><td>100</td><td>290</td><td>55</td><td>200</td><td>975</td></tr><tr><td>2020</td><td>800</td><td>240</td><td>490</td><td>175</td><td>360</td><td>2065</td></tr><tr><td>2025</td><td>1190</td><td>350</td><td>490</td><td>399</td><td>380</td><td>2809</td></tr><tr><td>2030</td><td>1340</td><td>410</td><td>490</td><td>854</td><td>390</td><td>3484</td></tr></table>2. In 2014, 5 percent of Malaysia’s share of diesel demand in transport sector will come from biodiesel.</td></tr>
<tr><td>Nuclear energy</td><td>2000 MW will be commissioned in 2023.</td></tr>
</table>

3. Outlook Results

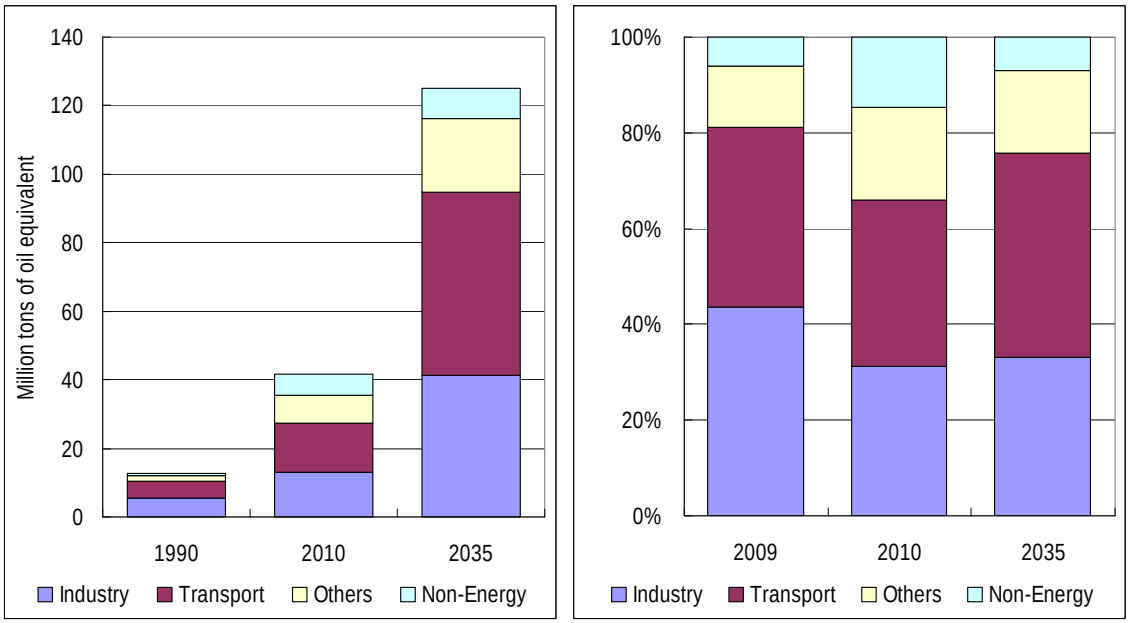
3.1. Business-as-Usual (BAU) Scenario

Final Energy Demand

Total final energy demand in the BAU scenario will increase from 41.6 Mtoe in 2010 to 125.0 Mtoe in 2035. This illustrates an average growth rate of 4.5 percent per year. Natural gas demand will experience the highest growth over the same period at an average growth of 5.1 percent per year. Electricity demand will grow from 9.5 Mtoe in 2010 to 29.1 Mtoe in 2035 or 4.6 percent per year. Oil demand will

increase at an average annual growth rate of 4.4 percent from 2010 until 2035. The final demand of coal that was usually consumed by cement industry will grow from 1.8 Mtoe in 2010 to 4.0 Mtoe in 2035 or 3.2 percent per year.

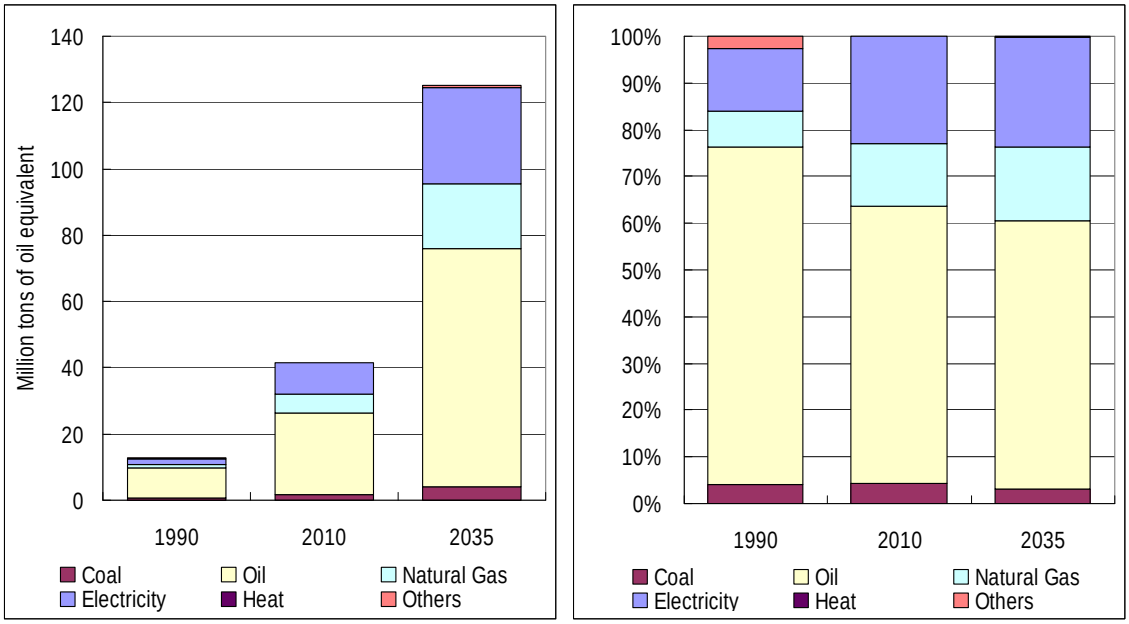
Figure 11-1: Final Energy Demand by Fuels, BAU



Analysis by share showed that oil will still dominate the country's total demand with 57.4 percent in 2035 as compared to 59.2 percent in 2010 followed by electricity with 23.3 percent in 2035 from 22.9 percent in 2010. The share of natural gas will increase to 15.8 percent as compared to13.5 percent in 2010. While the share of coal will decline from 4.4 percent in 2010 to 3.2 percent in 2035.

Final energy demand by sector showed that the transport sector will lead the growth with 5.4 percent per year from 2010 until 2035 followed by the industrial sector, growing from 13.0 Mtoe in 2010 to 41.3 Mtoe in 2035 or 4.7 percent growth per year. The other sectors will increase at an average rate of 4.0 percent per year from 2010 until 2035. Non-energy consumption is expected to increase from 6.1 Mtoe in 2010 to 8.7 Mtoe in 2035 or growth rate of 1.4 percent per year.

Figure 11-2: Final Energy Demand by Sectors, BAU

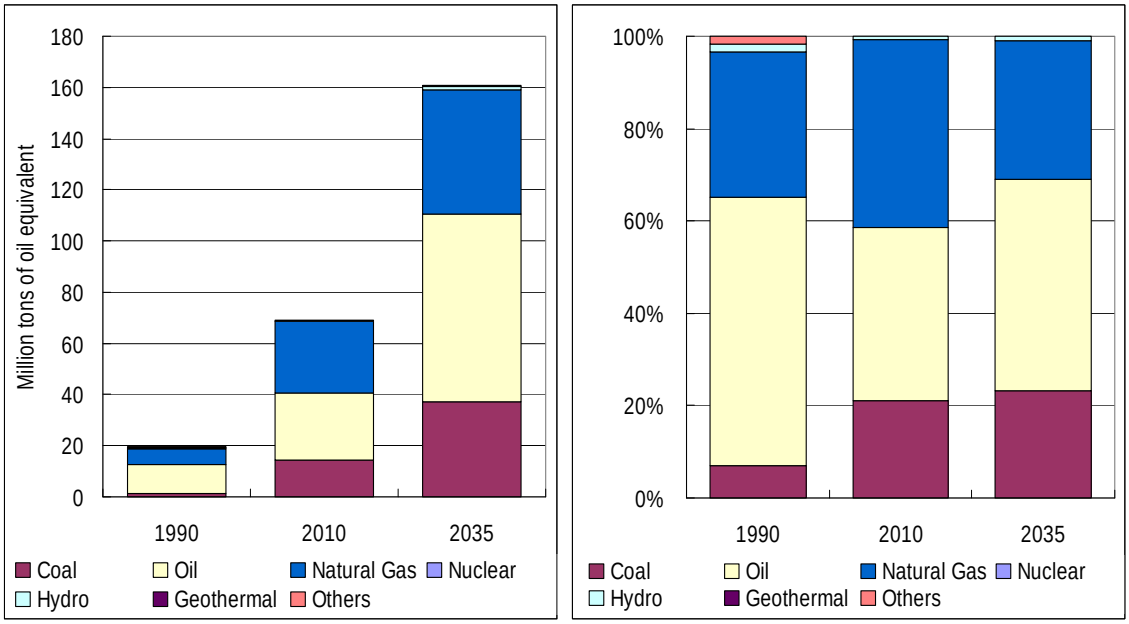


Analysis by share showed that the transport sector will still dominate the energy usage in 2035 with 42.7 percent as compared to 34.7 percent in 2010 followed by the industry sector with its share at 33.0 percent in 2035. Other sectors will consume around 17.3 percent of the total final energy demand in 2035 while the share of non-energy consumption is about 7.0 percent.

Primary Energy Demand

Total primary energy demand in the BAU scenario registered a growth at 6.5 percent per year from 1990 until 2010. The outlook results showed that the total primary energy demand is projected to increase by 3.4 percent per year from 2010 until 2035. Hydro will increase from 0.56 Mtoe to 1.6 Mtoe over the same period with an average annual growth rate of 4.3 percent. Oil supply will increase at 4.2 percent per year from 2010 until 2035. The supply of coal that was consumed mainly for power sector will be expected to increase by 3.8 percent per year from 2010 until 2035. Natural gas will experience an increase from 28.1 Mtoe in 2010 to 48.2 Mtoe in 2035 at an average annual growth rate of 2.2 percent.

Figure 11-3: Primary Energy Demand, BAU



In terms of share by fuel type, oil will have an increasing share from 37.6 percent in 2010 to 45.7 percent in 2035. The share of coal will also increase from 21.1 percent in 2010 to 23.2 percent in 2035. Hydro will increase from 0.8 percent in 2010 to 1.0 pecent in 2035 while natural gas share will decline from 40.5 percent in 2010 to 30.0 percent in 2035.

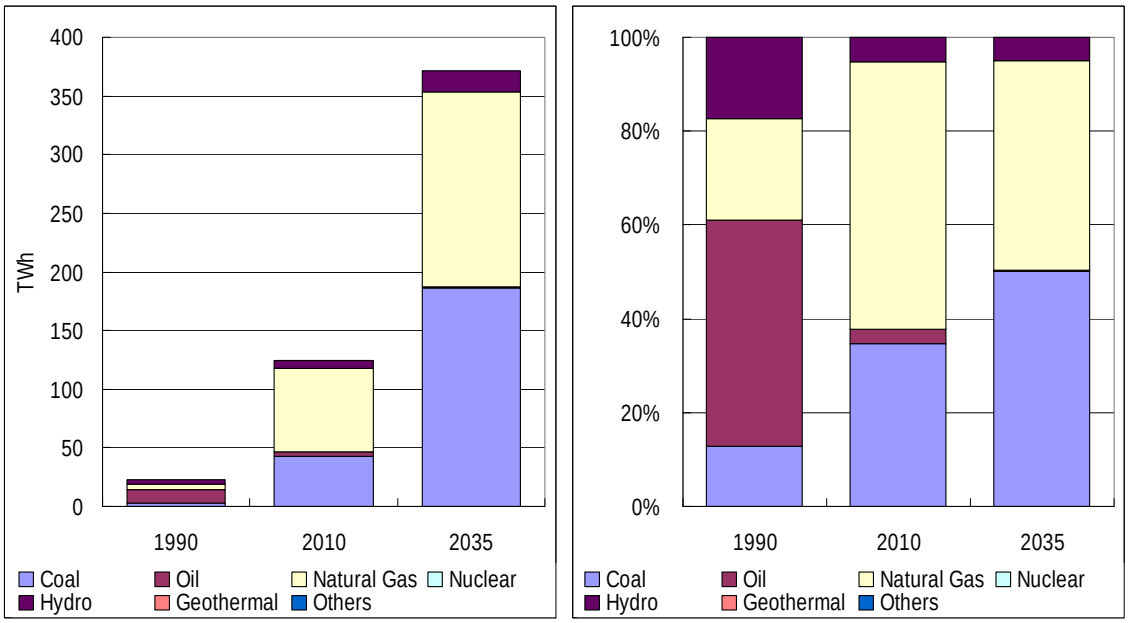
Power Generation

In the BAU scenario, total power generation is expected to grow around 4.5 percent per year from 2010 until 2035 reaching 371.8 TWh. Coal will experience the fastest growth at 6.0 percent per year over the projected period. This will be followed by hydro at 4.3 percent per year, increasing from 6.5 TWh in 2010 to18.4 TWh in 2035. Electricity generation from natural gas will increase at an average annual growth rate of 3.5 percent per year from 2010 until 2035. Generation of electricity from oil is expected to decline by 5.1 percent per year from 3.7 TWh in 2010 to 1.0 TWh in 2035.

In terms of share, the power generation mix will be dominated by coal in 2035 with share of 50.1 percent compared to 34.7 percent in 2010. This will be followed by natural gas with a share of 44.6 percent in 2035 as compared to 57.1 percent in 2010. Share of hydro will be 4.9 percent of the total power generation in 2035. The

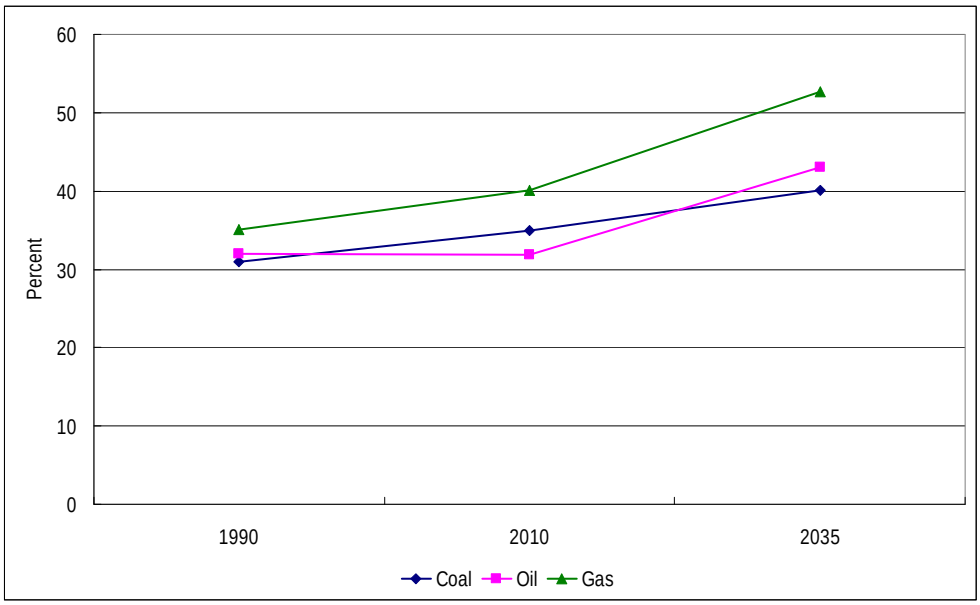
share of oil and others will be very small, only 0.3 percent and 0.1 percent respectively.

Figure 11-4: Power Generation Mix, BAU



In the BAU scenario, the thermal efficiency of coal power plant will be expected to improve to 40.0 percent in 2035 compared to 35.0 percent in 2010. Oil power plant is projected to improve its efficiency to 43.0 percent in 2035 compared to 31.8 percent in 2010 while gas power plant will further improve to 52.7 percent by 2035 as compared to 40.0 percent in 2010.

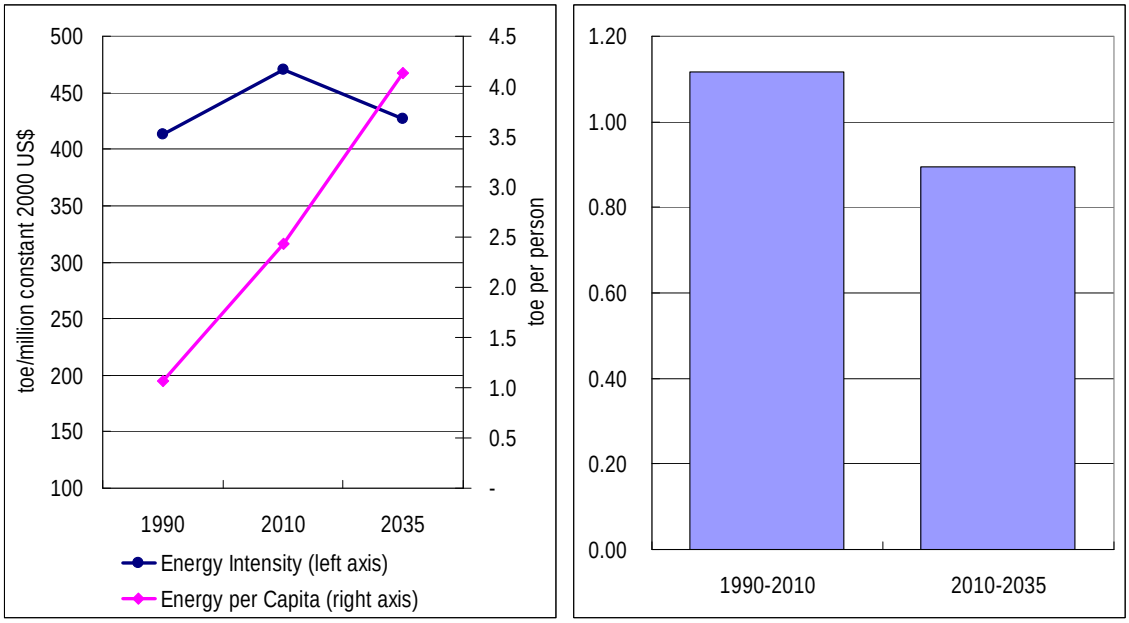
Figure 11-5: Thermal Efficiency by Fuels, BAU



Energy Intensity, Energy per Capita and Energy Elasticity

Malaysia energy intensity will be expected to decline to 427 toe/million USD in 2035 from 470toe/million USD in 2010. However, energy per capita will be increasing from 2.4 toe/person in 2010 to 4.1 toe/person in 2035.

Figure 11-6: Energy Intensity, Energy per Capita and Energy Elasticity, BAU



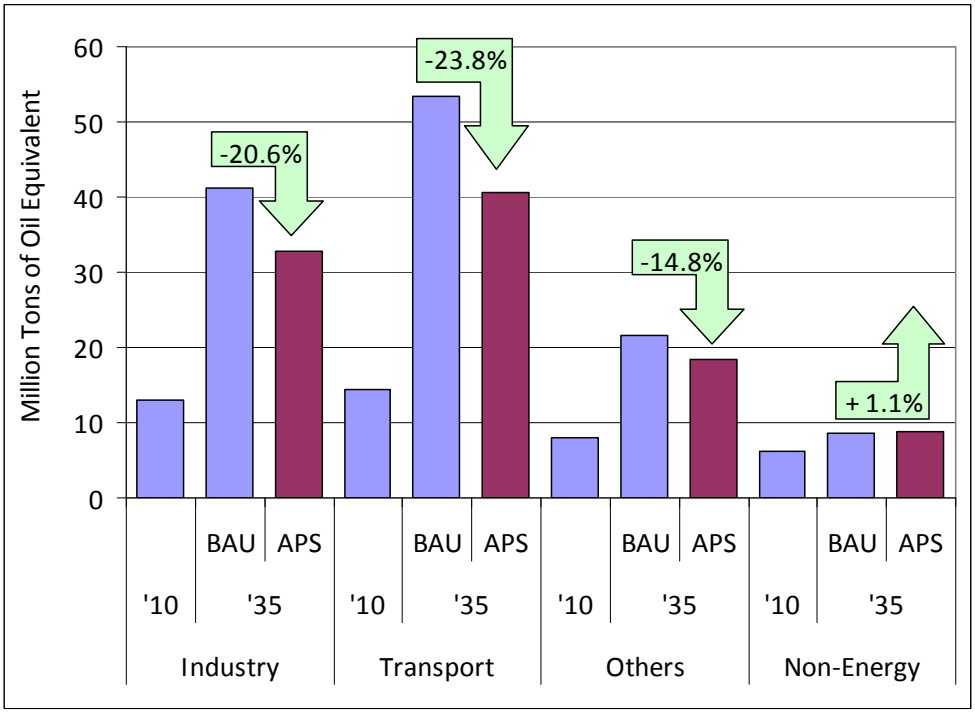
Energy elasticity, which is defined as the growth in energy consumption divided by the GDP growth for certain of time period, shows that from 1990 until 2010, Malaysia's energy elasticity was at 1.1 indicating the growth in energy consumption outpaced the growth in GDP. From 2010 to 2035, energy elasticity will improve to 0.9, indicating that energy consumption will grew at a slower rate that the growth in GDP.

3.2. Energy Saving and CO_2 Reduction Potential

In the Alternative Policy Scenario (APS), the growth in final energy demand will be 3.6 percent per year, slightly lower compared to that of the BAU scenario from 2010 level until 2035. The slower rate of increase in the APS is projected to be the result of improvements in manufacturing technologies as well as efforts to improve energy efficiency, particularly in the industrial sector. This, as a result, is equivalent to savings of 20.6 percent in industry sector in 2035. There is a potential saving of 23.8 percent in transportation sector in 2035 due to improvement of public transportation such as the expansion of electric train system and introduction of electric buses. Furthermore, the introduction of green vehicle such as electric vehicle (EV) and hybrid vehicle will contribute to the potential savings. In the "Others"

sector, the growth rate of energy demand is projected to have a lower growth rate of 3.4 percent per year in the APS as compared to to 4.0 percent per year in the BAU scenario. The potential saving of 14.8 percent in 2035 can be achieved through the implementation of energy efficiency measures (Figure 11-7).

Figure 11-7: Final Energy Demand by Sector, BAU and APS

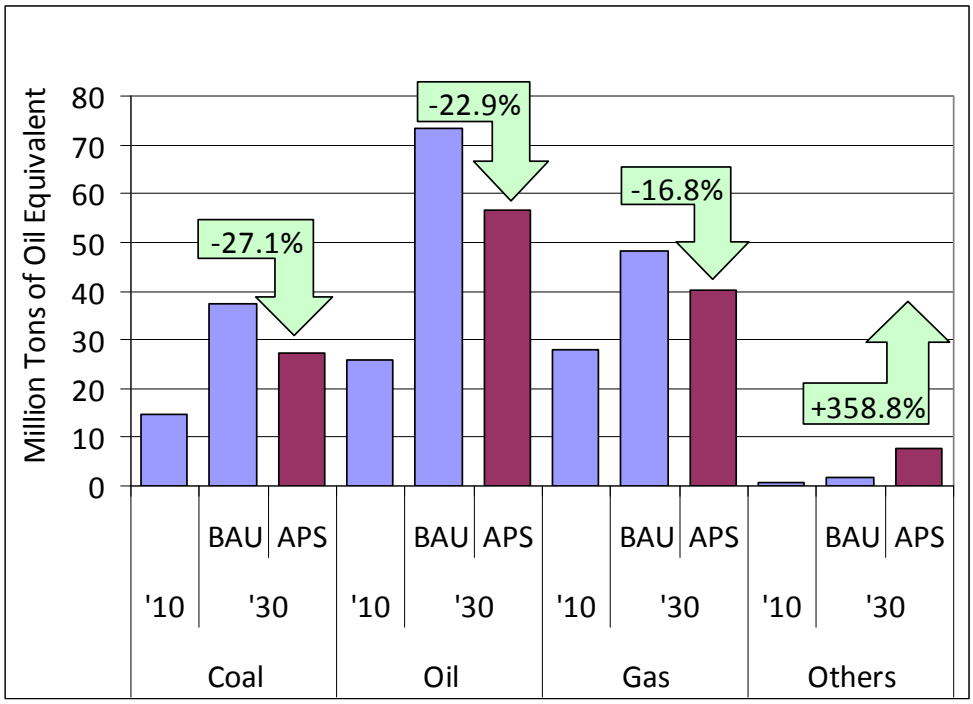


Primary Energy Demand

In the APS, the net primary energy supply is projected to increase at a slower rate than in the BAU scenario at 2.6 percent per year from 69.2 Mtoe in 2010 to 131.7 Mtoe in 2035. Hydro will be growing the fastest at 4.8 percent per year followed by oil at 3.2 percent between 2010 and 2035. The implementation of FiT in power generation has a big impact to the primary energy demand in 2035 as more power plants running on renewable energy are expected to be commissioned. On the other hand, coal and natural gas will have slower growth rates of 2.5 percent and 1.4 percent, respectively (Figure 11-8). The decline in the growth rate is mainly achieved as a result of energy efficiency and conservation measures on the demand side as well as the assumed higher contribution new and renewable energy to the primary energy mix. Nuclear power is also another future energy option that is

projected to figure in the future primary energy mix.

Figure 11-8: Primary Energy Demand by Source, BAU and APS

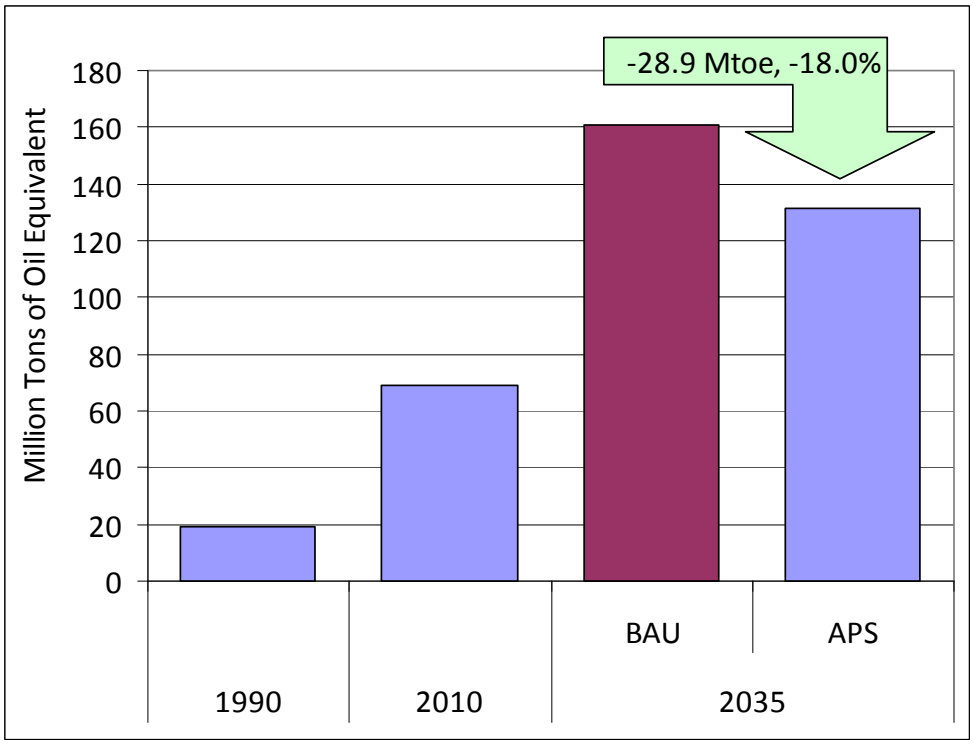


3.3. Projected Energy saving

The energy savings that could be achieved under the APS, relative to the BAU scenario, as a result of energy efficiency efforts in industrial and commercial sectors and fuel switching in transportation sector are estimated at about 28.9 Mtoe in 2035 (Figure 11-9).

The major saving that can be achieved from that total is from switching coal to renewable energy. While for the final energy demand, the saving of 24.3 Mtoe can be achieved in 2035 and would consist of 8.5 Mtoe in the industrial sector, 12.7 in transport sector and 3.2 Mtoe in the commercial sector.

Figure 11-9: Total Primary Energy Demand, BAU and APS



3.4. CO_2 Emissions from Energy Consumption

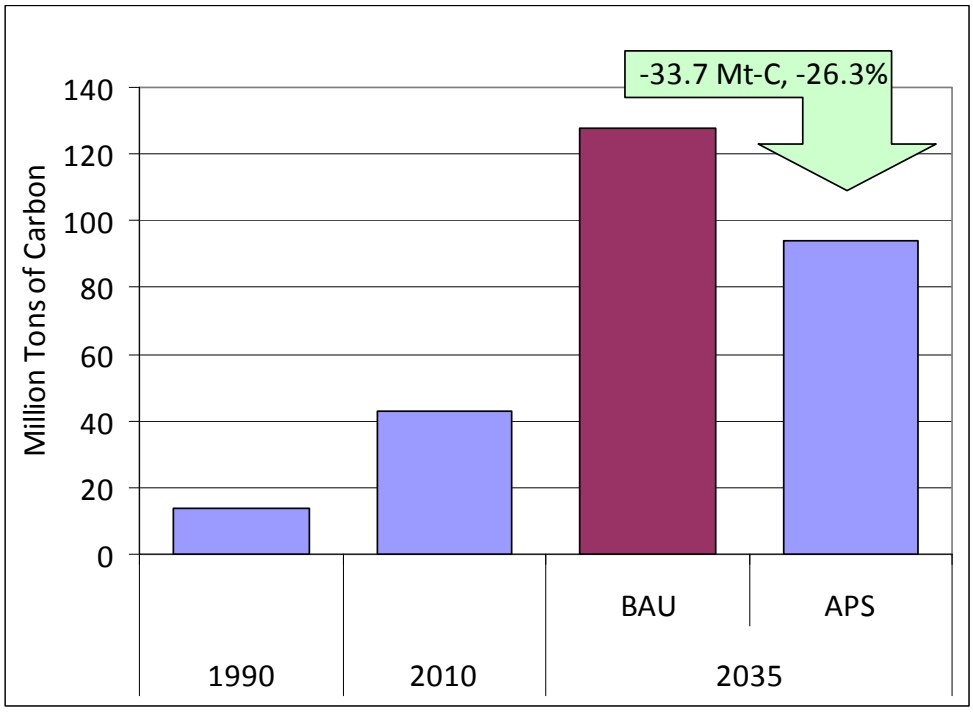
In the BAU, total carbon dioxide (CO_2) emissions from energy demand are projected to increase by 4.5 percent per year from 2010 level until 2035. In 2010, the CO_2 level was at 42.8 million tons of carbon (Mt-C) and is expected to increase to 127.9 Mt-C in 2035 under the BAU scenario.

In the APS, the annual increase in CO_2 emissions from 2010 to 2035 will be lower than in the BAU scenario at 3.2 percent per year, which is fairly consistent with the growth in primary energy demand. The reduction in CO_2 emissions in the APS of 33.7 Mt-C or 26.3 percent relative to the BAU scenario is also due to a significant decrease in coal demand for power generation in the APS, relative to the BAU scenario, as coal demand is being replaced by natural gas and other clean energy sources such as nuclear and renewable energy. Furthermore, the lower energy usage in industrial and fuel switching in transport sector have also contributed to the reduction.

This indicates that Malaysia's energy saving effort and renewable energy action

plan would be effective in reducing CO_2 emissions.

Figure 11-10: CO_2 Emissions from Energy Combustion, BAU and APS



4. Conclusions

Malaysia has potentials to save energy in the BAU and APS scenario based on the future GDP and selected scenario assumptions. One of the interesting finding from the outlook result is that the transport sector will have the highest average annual growth rate (AAGR) in the BAU scenario at 5.4 percent from 2010 to 2035. This raised concerns since the sector will still consume mainly gasoline (petrol) and diesel which has become more costly and will definitely impact the emissions.

Due to that, the National Land Public Transport Master Plan of Malaysia has been developed to look into the development of future planning of public transport in short, medium and long term. The plan will surely reflect the usage of energy in the transport sector thus reducing the road congestion.

Furthermore, to promote of usage of better energy efficient vehicle, the

Government is now implementing full tax exemption for imported hybrid cars in the country until the end of 2013. As a result, many imported hybrid cars are now in the market. This policy should be continued in order to promote the usage of hybrid car in the country.

The development of Electric Vehicle (EV) Roadmap is now entering the 3rd phase of its implementation. By 2014 Malaysia will be expected to commercialize EV in the market. There will be around 100,000 EV on the road by 2020 or 10 percent of the market.

In order to reduce CO_2 emissions in the transport sector, the Government will introduce biodiesel (B10) in the market nationwide as currently, B5 has already been commercialized in the central region since November 2011. The Government is also planning to implement the usage of B40 into the power generation on a trial basis. The trial will be expected to be commissioned in power plants in Sabah.