CHAPTER 11

MALAYSIA COUNTRY REPORT

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1. Introduction

Malaysia is in Southeast Asia. Its 329,847 square kilometres of territory comprise Peninsular Malaysia and the Sabah and Sarawak States on the island of Borneo. Malaysia has a tropical, humid climate with temperatures averaging 30°C. Its gross domestic product (GDP) grew steadily over the last 26 years, growing at an average of 5.7% per year from 1990 to 2016, except for sluggish growth in 1998 due to the Asian financial crisis and in 2001 due to slow growth of export demand for electronic products. The country also experienced the latest downward economy trend in 2009 due to the world economic crisis.

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. Crude oil and condensates reserves in the country stood at 5.03 billion barrels or 21 years of lifespan as of 1 January 2016, supported by the rising reserves from the deep-water discoveries in offshore Sabah. Meanwhile, natural gas reserves are at 87.76 trillion standard cubic feet (Tscf), enough to cover 37 years of gas output at current production levels. As of January 2015, reserves of coal stood at 1,983.37 million tons. In terms of energy equivalent, Malaysia's gas reserves are four times the size of its crude oil reserves. Natural gas reserves off the east coast of Peninsular Malaysia are dedicated for domestic consumption while those in Sarawak are allocated as revenue earner in the form of liquefied natural gas (LNG) exports. Malaysia is a net energy exporter.

During the last 10 years, some of the barriers to the uptake of energy efficiency and renewable energy have been removed. But there is room for further improvement and progress. The challenge would be to give renewable energy the necessary lift to greater heights in the next 5 years. Efforts to promote energy efficiency should be intensified. In addition, climate change, which is inextricably linked with energy use, has become increasingly important, as people begin to appreciate the implications of an increased risk of unpredictable, severe weather and rapid changes to the ecosystem. Thus, the need to work towards a truly sustainable energy future becomes more compelling. A sustainable energy system is central to meeting the economic goals of Malaysia. Malaysia's levels of energy use per unit of production (intensity) are high compared to other nations. A national strategy aimed at reducing energy intensity must be drawn up. Energy planning must recognise that the place to begin is not only with supply but also the management of demand for energy services, by increasing energy efficiency and the use of renewable energy sources to meet any remaining demand. To pursue the green growth stated in the Eleventh Malaysia Plan, KeTTHA[1] launched the Green Technology Master Plan (GTMP) in 2017 to earmark green growth as one of the six game changers that would alter the trajectory of the economy's growth. The GTMP creates a framework for facilitating the mainstreaming of green technology into the planned development of Malaysia while encompassing the four pillars set out in the plan.

Throughout the years, the government of Malaysia has formulated some policies and programmes on energy to ensure the long-term reliability and security of energy supply for sustainable socio-economic development in the country. The major energy policies implemented in the country are:

- Petroleum Development Act (1974)
- National Petroleum Policy (1975)
- National Energy Policy (1979)
- National Depletion Policy (1980)
- Four-Fuel Diversification Policy (1981)
- Fifth Fuel Policy (2000)
- Biofuel Policy (2006)
- National Green Technology Policy (2009)
- National Renewable Energy Policy and Action Plan (2010)
- New Energy Policy and 10th Malaysia Plan (2010)
- Eleventh Malaysia Plan (2015)
- Green Technology Master Plan (2017)

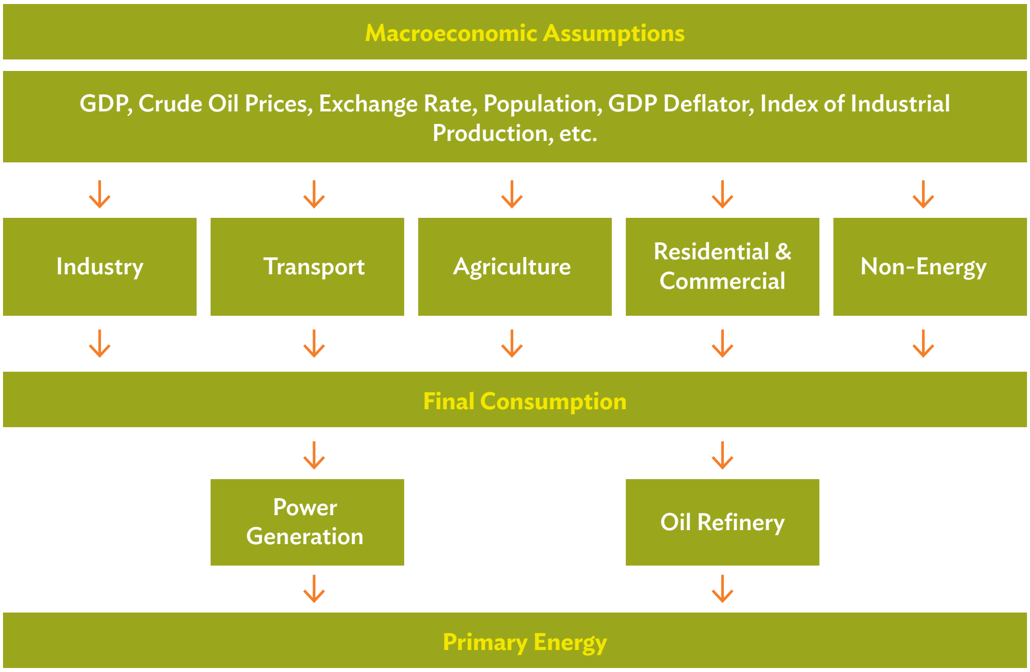
2. Modelling Assumptions

The energy demand projections up to 2040 were estimated using the econometric approach. Historical energy demand data were taken from the National Energy Balance published by the Energy Commission of Malaysia. The economic indicators used in

[1] Formerly the Ministry of Energy, Green Technology and Water. Now it is the Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC).

energy modelling such as GDP were taken from the World Bank's World Development Indicators. Energy modelling involved the estimation of final energy consumption and the corresponding primary energy requirements or supply. Figure 11.1 shows the model structure for final energy demand projection and estimation of transformation inputs to arrive at the primary energy requirements.

Figure 11.1: Modelling Structure



GDP = gross domestic product.

Source: Author.

The econometric approach is the method applied in forecasting 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 especially 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 various 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 households, number of appliances, floor area of buildings, etc. In the residential sector, for example, the demand for electricity could be a function of the number of households, disposable income, and penetration rate of electrical appliances. In the commercial sector, energy consumption could be driven by building floor arrears, private consumption, and other factors that encourage commercial activities. However, due to unavailable information on the activity indicators, macroeconomic data, which is GDP, was the best variable to search for the relationship with the energy demand trend. GDP information was broken down into industry GDP, commercial GDP, agriculture GDP, and manufacturing GDP. These macroeconomic indicators were mainly used to generate the model equations. In some cases, where regression analysis is not applicable due to insufficiency of data or there is failure to derive a statistically sound equation, other methods such as share of percentage approach are used.

One of the main drivers of the modelling assumption is GDP growth rates. The GDP growth rates assumption forecast was based on IHS[2] data from a study conducted by the Economic Planning Unit (EPU) of Malaysia (IHS Energy Insight, 2014). Most of the energy demand equations for Malaysia use GDP as the key factor in determining future projections. This is due to the high correlation between energy demand and GDP. Table 11.1 shows the assumptions of GDP growth rates by sector.

Table 11.1: GDP Growth Assumptions by Sector to 2040 (% per year)

GDP Growth Rate, %	2016–2020	2021–2025	2026–2030	2031–2035	2036–2040
Agriculture	2.16	2.26	2.09	1.91	1.74
Mining & Quarrying	0.01	1.01	3.03	3.74	5.17
Manufacturing	3.55	3.16	2.77	2.47	2.3
Construction	3.44	3.01	2.54	2.26	2.09
Services	4.41	4.42	3.67	3.07	2.67
Total GDP	**3.88**	**3.77**	**3.19**	**2.74**	**2.43**

GDP = gross domestic product.

Source: IHS data from Economic Planning Unit (EPU) (2016).

2 IHS Markit Ltd is a London-based global information provider that was formed in 2016 when IHS Inc. and Markit Ltd. merged.

Besides future GDP growth rates, the annual average population growth was also a key driver for future energy growth. In 2015, Malaysia's population was 31.0 million; it is projected to increase by 10.5 million (33.9%) to 41.5 million in 2040. However, annual population growth rate would be decreasing from 1.15% in 2016–2020 to 1.02% in 2021–2025, 0.87% in 2026–2030, 0.74% in 2031–2035, and 0.63% in 2036–2040. This situation is in tandem with the targeted decline in fertility rate and international migration. The assumption of future growth rates of population was obtained from the Department of Statistics Malaysia (Table 11.2).

Table 11.2: Population Growth Assumption to 2040

	2016–2020	2021–2025	2026–2030	2031–2035	2036–2040
Population (million)	33.8	36.0	38.1	39.9	41.5
Population growth (%)	1.15	1.02	0.87	0.74	0.63

Source: Department of Statistics (2016).

In accelerating its socio-economic development, supported by its current position as a net energy exporter, Malaysia subsidises energy use for various users. The energy subsidies offered to various energy users in the country have been growing from year to year, corresponding with the volatility of global energy prices and growing demand for energy. The subsidies have reached a worrisome level that the government expenditure capacity has been stretched beyond its ability and has taken the share of other developmental budget allocations. This situation has prompted the Malaysian government to review its policies related to energy subsidies and to act to mitigate growing energy subsidies. In this regard, energy efficiency offers a sound solution to mitigate the effects of the gradual removal of energy subsidies.

In promoting energy efficiency, the Ministry of Energy, Green Technology and Water (MEGTW) had enacted several legal instruments. The main legal instrument on energy efficiency promotion is the Electricity Supply Act (Amendment) 2001, or Act A1116. This empowers the MEGTW, under Sections 23A to 23C, to promote efficient use of electricity in the country. Deriving from Act 1116, the MEGTW issued the Efficient Management of Electrical Energy Regulation 2008. Under this regulation, all installations that consume or generate 3 million kilowatt-hours (KWh) or more of electricity over 6 months will be required to engage an electrical energy manager who shall, amongst others, be responsible to analyse the total consumption of electrical energy, advise on the development and implementation of measures to ensure efficient management of electrical energy, and monitor the effectiveness of the measures taken. The Energy Commission is empowered to enforce the energy efficiency regulations.

A lack of holistic and long-term policy for demand-side management (DSM) has been identified as a main barrier in implementing energy efficiency initiatives in Malaysia, even though it is an important element in the country's energy plan and policy. Energy efficiency initiatives are set to receive renewed attention under the Eleventh Malaysia Plan through a reinvigoration of the DSM. This is intended to be achieved by formulating a comprehensive DSM master plan. The EPU will initiate a study on DSM, which covers the whole spectrum of the energy sector.

Malaysia has developed a reasonably well-designed renewable support mechanism that includes a set of legislation: published feed-in tariffs (FiT) with annual digression rates from 2013 onwards, quota mechanisms, a Renewable Energy Master Plan, and an implementing agency (the Sustainable Energy Development Authority or SEDA). Malaysia has opted for FiT to drive the development of renewable capacity. FiT is guaranteed by the Renewable Energy Act 2011 and the levels are set by SEDA. The scheme is intended to provide a reasonable level of return for investors over a fixed period to give a level of certainty. FiTs are available for biogas, biomass, solar photovoltaic (PV), and small hydro. Support of 16 years is given for biomass and biogas and 21 years for small hydropower and solar PV. A capacity quota system is in place to manage the new capacity added to the system. This mechanism enables Malaysia to shape the amount of new capacity to be added to the system from the different technologies and make it economically sustainable. Similar systems have been applied, for example, for solar PV in deregulated markets, including Italy and Spain, in response to a rush for new installations. FiT levels adjust to the cost of the technology. Except for small hydro, FiTs have been revised every year per different digression rates from 2013 onwards. This system is used in countries like Germany to adjust the level of remuneration to technology cost evolutions. However, these digression rates must be correctly calculated to avoid a slowdown in capacity buildup. Such a mechanism has proven to work well only in relatively experienced markets, with more track records and know-how.

To complement the current FiT mechanism, a new instrument termed net energy metering (NEM) will be implemented in the Eleventh Malaysia Plan. NEM aims to promote and encourage more solar PV generation by prioritising internal consumption before any excess electricity generated is fed to the grid. NEM is expected to encourage manufacturing facilities and the public to generate clean electricity. This will further assist the government's effort to increase the contribution of renewable energy in the generation mix. NEM, which was started on 1 November 2016, is regulated by the Energy

Commission and implemented by SEDA. The total quota allocated for the 5-year period (2016–2020) is 500 megawatts (MW).[3]

The new NEM scheme is only applicable to Peninsular Malaysia and applicants must be a registered TNB customers. NEM is executed by the Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC), regulated by the Energy Commission (EC), with Sustainable Energy Development Authority (SEDA) Malaysia as the implementing agency.

As a continuation of the government's effort to boost solar PV market in the economy, the EC has been tasked with implementing the large-scale solar (LSS) programme, which is based on a bidding process. The total quota allocated for the LSS from 2017 to 2020 is 1,250 MW. Of this, 250 MW was granted direct award under the fast-track programme. As of 2018, there are 91.5 MW solar operated from five LSS projects from an open bidding exercise. While in Sabah, there are 50 MW solar operated from direct award projects. The remaining 1,000 MW fall under the bidding mechanism. In August 2017, the Energy Commission announced the bid open price for LSS PV plants for 2019–2020. The bid was divided into three categories based on capacity: 1 MW–5.99 MW; 6.00 MW–9.99 MW; and 10 MW–30 MW. The results showed that the lowest bid received was in the 10 MW–30.00 MW category, with a tariff of RM0.3398/kWh (US$0.079/kWh).

The implementation of the Nuclear Power Infrastructure Development Plan and the Nuclear Power Regulatory Infrastructure Development Plan would be an important step in developing nuclear power to supply electricity in the future. This will support the multiple goals of improving energy security, spurring economic development, and reducing greenhouse gas (GHG) emissions. A new independent atomic energy regulatory commission will be established. The 10-Year Comprehensive Communication Plan and Strategies on Nuclear Power for electricity will be continued to increase awareness and public acceptance.

3 The Ministry has introduced several solar PV initiatives to encourage Malaysia's renewable energy (RE) uptake. From the RE townhall held on 12 July 2018, one of the key issues highlighted by the PV industry is the need to change the concept of NEM from the existing net billing to true net energy metering. This is will help improve the return of investment of solar PV under NEM.

Effective from 1 January 2019, NEM will be improved by adopting the true net energy metering concept and this will allow excess solar PV generated energy to be exported back to the grid on a 'one-on-one' offset basis. This means that every 1kWh exported to the grid will be offset against 1kWh consumed from the grid, instead of at the Displaced Cost previously.

The quota allocation for NEM is 500 MW up to year 2020. Quota allocation will be divided into domestic and non-domestic category. Agriculture will be a new category to be added to the NEM scheme. The NEM category has been divided into four categories – Residential, Commercial, Industrial, and Agriculture.

In setting up the scenarios for this project, several assumptions or scenarios have been identified (Table 11.3).

Table 11.3: Potential Mitigation Scenarios

Scenario	Mitigation Actions
Energy Efficiency and Conservation	**1. Improve final energy consumption of all energy types by 8% in 2016 and reach 16% by 2040.**
Renewable Energy	**1. Implement renewable energy in the power sector by 2036:**
	a. Hydro: 8,543 MW
	b. Solar: 2,679 MW
	c. Biomass: 916 MW
	d. Biogas: 194 MW
	e. MSW: 39 MW
	Total: 12,372 MW
	2. Increase the share of biodiesel from 5% to 7% from 2020
Energy Efficiency in the Power Sector (EEP)	1. Improve the efficiency of power plants:
	a. Natural gas at 55% by 2040
	b. Coal at 45% by 2040
Nuclear (NUC)	**Commission 2,000 MW of nuclear in 2036**
Alternative Policy Scenario	**Combination of all scenarios:**
	APS = EEC + RE + EEP + NUC

MSW = Municipal Sold Waste, MW = megawatt.

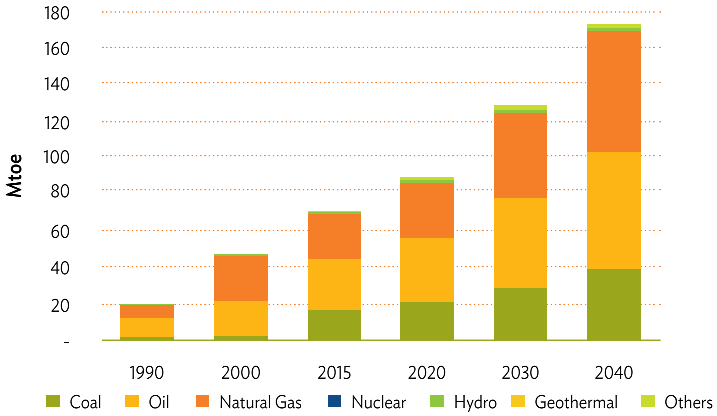
Source: Author's assumptions.

3. Outlook Results

3.1. Business-As-Usual Scenario

Total primary energy consumption (TPEC) in the Business-As-Usual (BAU) scenario registered a growth at 5.2% per year from 1990 until 2015. The outlook results showed that the TPEC is projected to increase by 3.6% per year from 2015 until 2040. Hydro will increase from 1.22 million tons of oil equivalent (Mtoe) in 2015 to 2.05 Mtoe with average annual growth rate (AAGR) of 2.1%. Oil supply will increase at 3.5% per year in 2015–2040. The supply of coal consumed mainly by the power sector is expected to increase by 3.3% per year in 2015–2040. Natural gas will experience an increase from 24.60 Mtoe in 2015 to 66.11 Mtoe in 2040, or an AAGR of 4%. Biomass for power generation will increase at an average annual rate of 8% in 2015–2040 while biofuel use for land transportation will increase at 1% per year (Figure 11.2).

Figure 11.2: Primary Energy Consumption by Fuel Type, BAU (1990–2040)

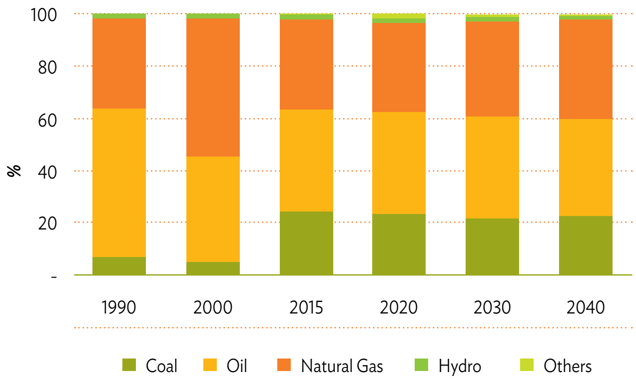


BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

Source: Author's calculation.

In terms of share by fuel type, oil share will decrease from 38.7% in 2015 to 37.2% in 2040. However, the share of natural gas will increase from 34.9% in 2015 to 38.3% in 2040. Coal will have a decreasing share over the projection period, from 24.6% in 2015 to 22.6% in 2040. The share of hydro will decrease from 1.7% in 2015 to 1.2% in 2040 (Figure 11.3).

Figure 11.3: Share of Primary Energy Supply by Fuel Type, BAU (1990–2040)

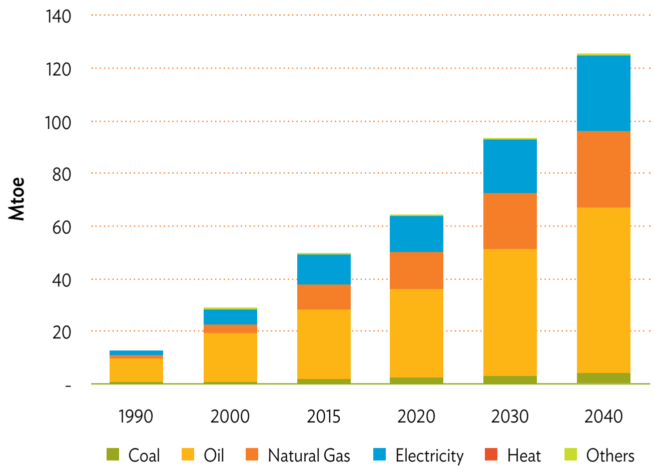


BAU = Business-As-Usual.

Source: Author's calculation.

Total final energy demand in the BAU scenario will increase from 49.52 Mtoe in 2015 to 125.14 Mtoe in 2040, illustrating an AAGR of 3.8% per year. Final demand of natural gas and electricity will experience the highest AAGR of 4.6% and 3.7% per year, from 2015 to 2040, respectively. Oil demand will grow from 26.39 Mtoe in 2015 to 62.52 Mtoe in 2040, or 3.5% per year. Coal demand will increase 3.5% per year from 2015 until 2040 and other fuels will grow from 0.39 Mtoe in 2015 to 0.50 Mtoe in 2040, or 1% per year (Figure 11.4)

Figure 11.4: Final Energy Consumption by Fuel Type, BAU (1990–2040)

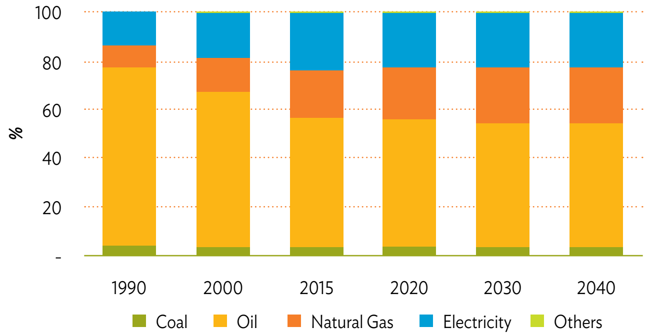


BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

Source: Author's calculation.

Analysis by share showed that oil, with 50%, will still dominate in 2040, slightly lower than that in 2015 (53.3%). This will be followed by natural gas (23.4%) and electricity (22.8%) in 2040. Share of coal will decrease from 3.6% in 2015 to 3.4% in 2040 (Figure 11.5).

Figure 11.5: Share of Final Energy Consumption by Fuel Type, BAU (1990–2040)

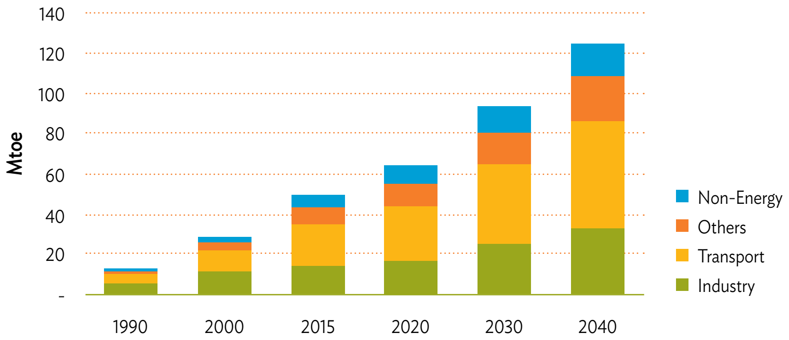


BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

Source: Author's calculation.

Final energy demand by sector showed that the non-energy use sector will lead the growth with 4.2% per year from 2015 until 2040. This will be followed by the 'others' sector growing from 8.53 Mtoe in 2015 until 22.29 Mtoe in 2040 or 3.9% per year. The transport sector is expected to increase from 21.10 Mtoe in 2015 to 53.03 Mtoe in 2040, or 3.8% per year. The industry sector will have an average annual growth of 3.5% per year from 2015 until 2040 (Figure 11.6).

Figure 11.6: Final Energy Consumption by Sector, BAU (1990–2040)

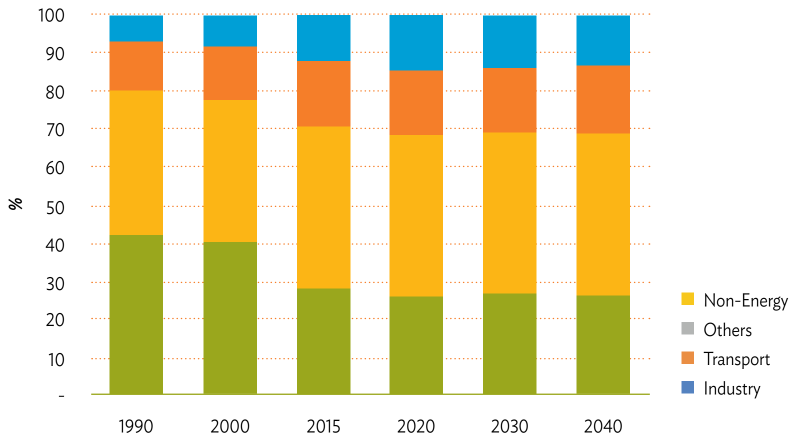


BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

Source: Author's calculation.

Analysis by share showed that the transport sector will still dominate energy use in 2040, with 42.4% compared to 42.6% in 2015. This will be followed by the industry sector with 26.6% share in 2040 compared to 28.2% in 2015. The share of non-energy use is 13.2% of total final energy demand in 2040, to increase in 2015 at 12%. The share of the 'others' sector is expected to be at 17.8% in 2040 (Figure 11.7).

Figure 11.7: Share of Final Energy Consumption by Sectors, BAU (1990–2040)

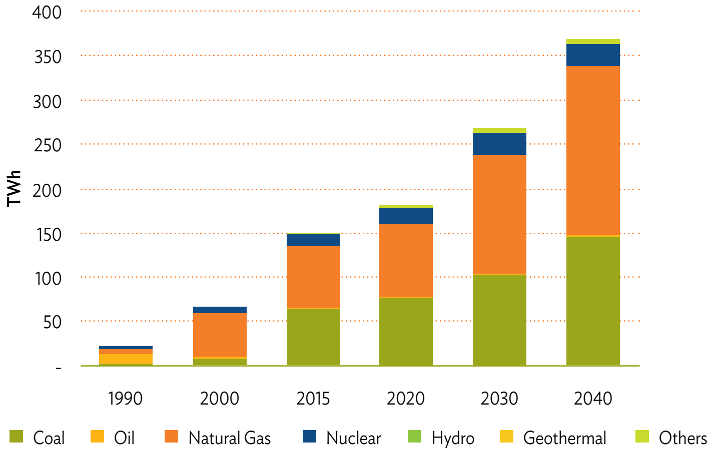


BAU = Business-As-Usual.

Source: Author's calculation.

In the BAU scenario, total power generation is expected to grow around 3.6% per year from 2015 until 2040, reaching 368.13 terawatt-hours (TWh). Power generation from other types of fuel (others) will have the fastest growth at 7% per year during the same period. Power generation from natural gas is projected to increase to 191.40 TWh in 2040 from 69.96 TWh in 2015. Power generation from coal will grow 3.4% per year from 63.47 TWh in 2015 to 145.83 TWh in 2040. Electricity generation from hydro will increase by 2.1% per year during the same period. Power generation from oil is expected to decline by 0.3% per year to register at 1.60 TWh in 2040 compared to 1.74 TWh in 2015 (Figure 11.8).

Figure 11.8: Power Generation by Fuel Type, BAU (1990–2040)

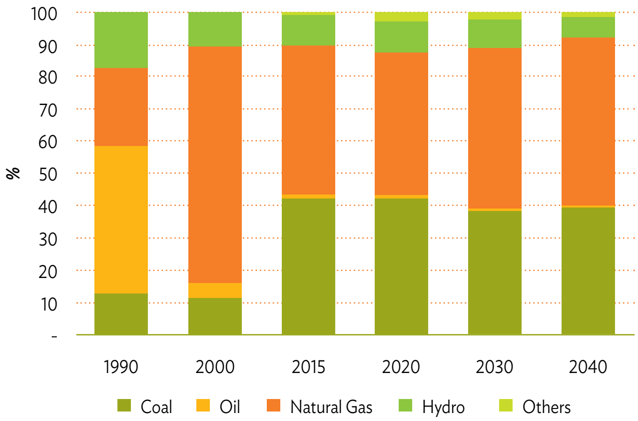


BAU = Business-As-Usual, TWh = terawatt-hour.

Source: Author's calculation.

In terms of share, power generation mix will be dominated by natural gas and coal in 2040 with share of 52.0% and 39.6%, respectively, followed by hydro with a share of 6.5% in 2040 compared to 9.4% in 2015. Share of others will be at 1.5% of the total power generation in 2040. Oil share will be at 0.4% in 2040 compared to 1.2% share in 2015.

Figure 11.9: Share of Power Generation by Fuel Type, BAU (1990–2040)

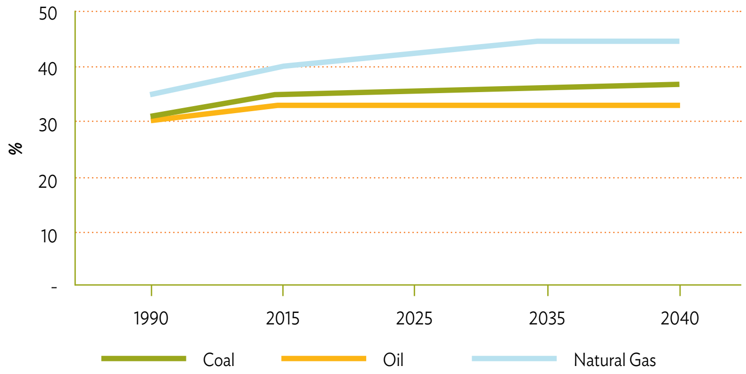


BAU = Business-As-Usual.

Source: Author's calculation.

In the BAU scenario, the thermal efficiency of coal power plants is expected to improve to 36.1% in 2040 from 35.0% in 2015. That of oil power plants is projected to remain the same over the same period at around 33%. Thermal efficiency of natural gas power plants will further improve to almost 44.8% by 2040 from the 2015 level of 40.0% (Figure 11.10).

Figure 11.10: Thermal Efficiency by Fuel Type, BAU (1990–2040)

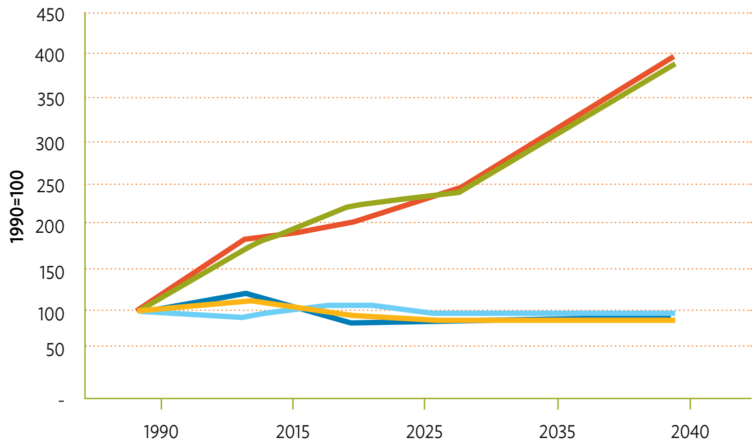


BAU = Business-As-Usual.

Source: Author's calculation.

Malaysia's primary energy intensity is expected to increase to 223 toe/million US$ in 2040 from 214 toe/million US$ in 2015, while final energy intensity is expected to increase to 161 toe/million US$ in 2040 compared to 150 toe/million US$ in 2015. Primary energy per capita is projected to increase to 4.37 toe/person in 2040 compared to 2.30 toe/person in 2015.

Figure 11.11: Energy Indicators, BAU (1990–2040)



BAU = Business-As-Usual.

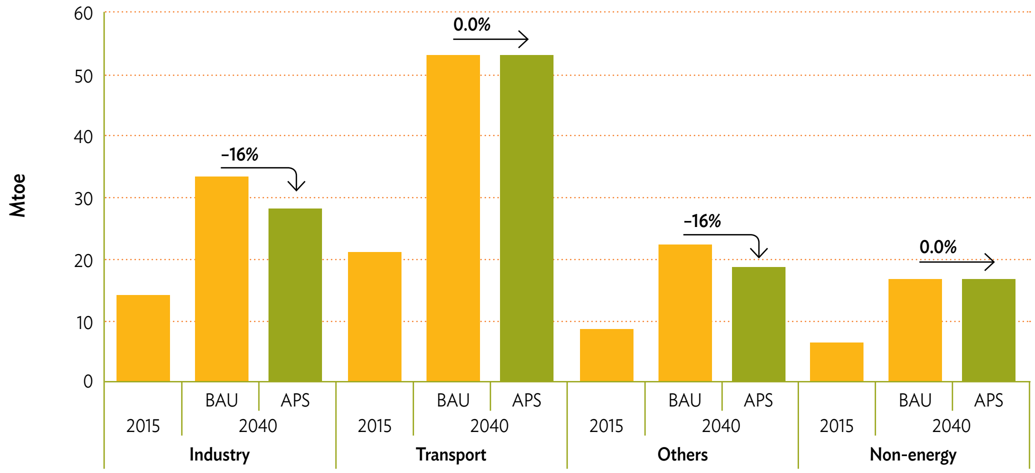
Source: Author's calculation.

Carbon dioxide (CO_2) intensity is expected to decrease to 150 t-C/million US$ in 2040 from 157 t-C/million US$ in 2015. CO_2 per primary energy would slightly decrease in 2040 at 0.67 t-C/toe from 0.74 t-C/toe in 2015.

3.2. Alternative Policy Scenario

In the Alternative Policy Scenario (APS), growth in final energy demand will be at 3.5% from 2015 until 2040, slightly lower than that of the BAU scenario. 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 industry and the 'others' sectors. Thus, savings of 16% in the industry sector in 2040 could be expected. In the 'others' sector, the growth rate of energy consumption is projected to be slower than the BAU scenario at 3.2% per year compared to 3.9% per year in the BAU scenario. The potential saving of 16% in 2040 can be achieved through the implementation of energy efficiency measures (Figure 11.12).

Figure 11.12: Final Energy Consumption by Sector, BAU and APS (2015 and 2040)

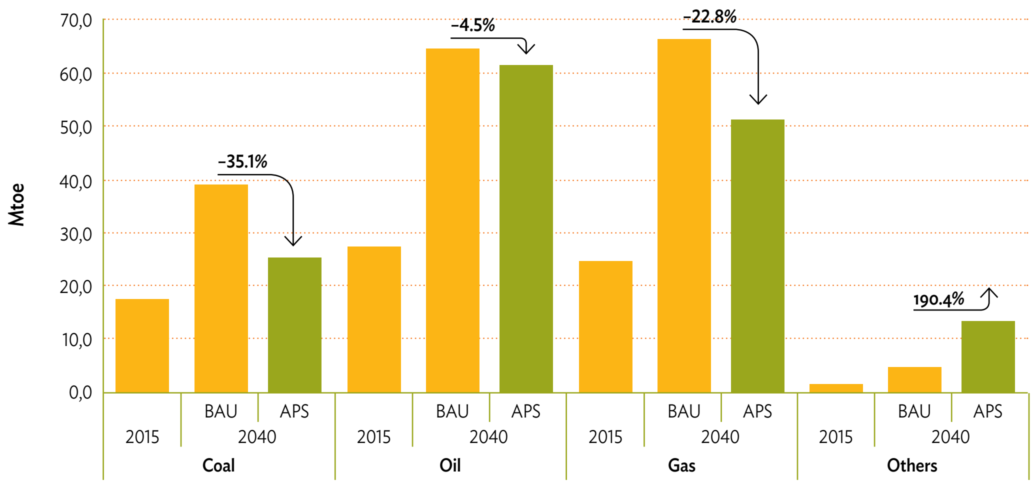


APS = Alternative Policy Scenario, BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

Source: Author's calculation.

In the APS, primary energy consumption is projected to increase at a slower rate than in the BAU scenario at 2.9% per year from 70.58 Mtoe in 2015 to 145.21 Mtoe in 2040 (Figure 11.13). Solar and biomass will be growing the fastest at average rates of 12.1% per year and 8.7% per year, respectively. This is due to the implementation of FiT, NEM, and LSS in power generation that largely impact on primary energy consumption in 2040 as more renewable energy for power generation is expected to be commissioned. Hydro will also increase fast but at a slower rate of 2.4% per year between 2015 and 2040. Oil will have slower growth rates of 3.3% per year in 2015–2040 from the BAU scenario. Natural gas and coal are projected to increase at 3.0% per year and 1.5% per year, respectively. Nuclear power as a future energy option will be introduced after 2036 (Figure 11.13).

Figure 11.13: Primary Energy Supply by Source, BAU and APS (2015 and 2040)



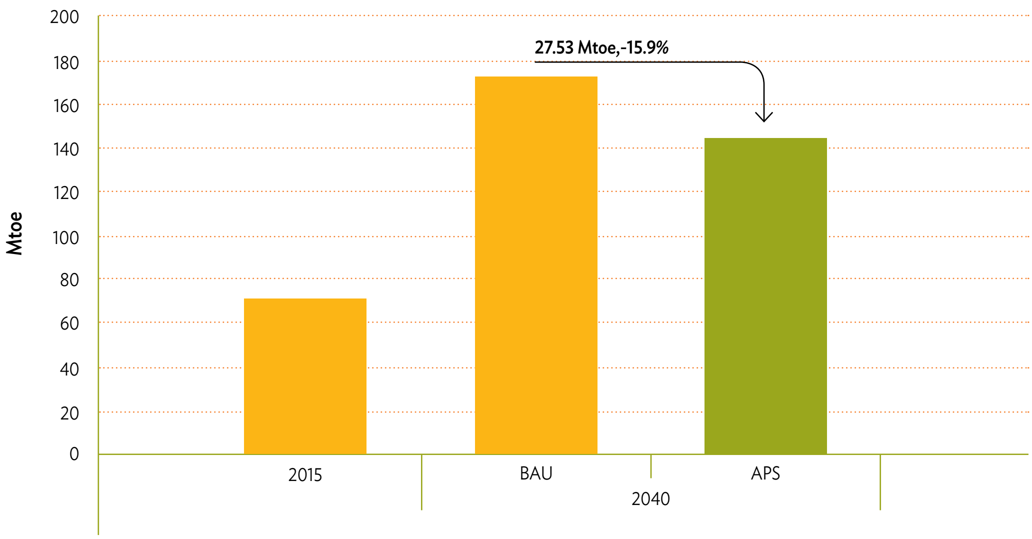
APS = Alternative Policy Scenario, BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

Source: Author's calculation.

3.3. Projected Energy Savings

The energy savings that could be achieved under the APS because of energy efficiency efforts in the industry and the 'others' sectors, more efficient thermal power supply, and higher contribution from renewable energy are estimated at 27.53 Mtoe in 2040 or 15.9% (Figure 11.14).

Figure 11.14: Total Primary Energy Supply, BAU and APS (2015 and 2040)



APS = Alternative Policy Scenario, BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

Source: Author's calculation.

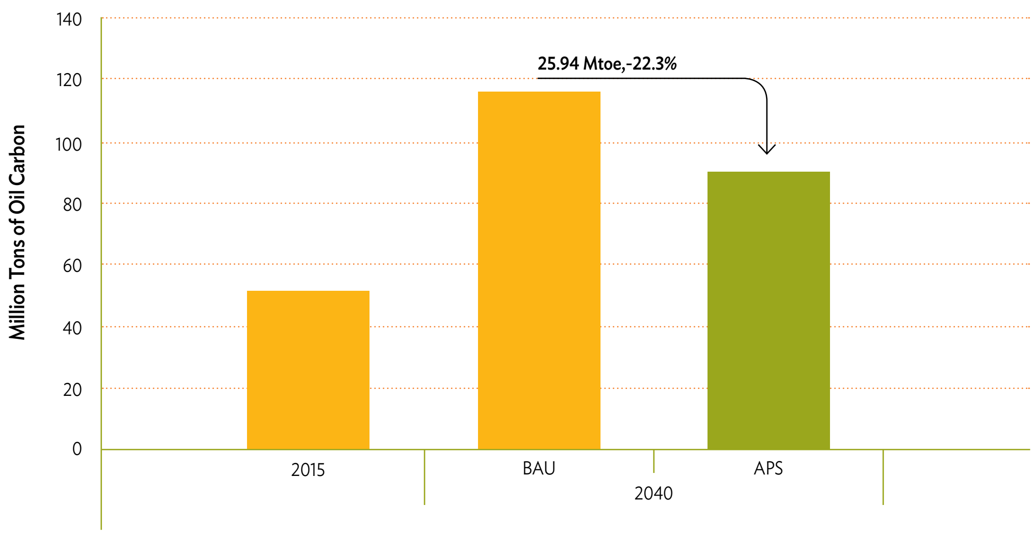
Major savings can be achieved by switching from coal or natural gas to renewable energy and nuclear power. While for final energy demand, savings of 8.9 Mtoe – comprising savings of 5.3 Mtoe in the industry sector and 3.6 Mtoe in the 'others' sector – can be achieved in 2040.

3.4. CO_2 Emissions from Energy Consumption

In the BAU scenario, total CO_2 emissions from energy consumption are projected to increase by 3.3% per year in 2015–2040. In 2015, the CO_2 level was at 52.0 million tons of carbon (Mt-C) and was expected to increase to 116.3 Mt-C in 2040 under the BAU scenario.

In the APS, the annual increase in CO_2 emissions from 2015 to 2040 will be lower than in the BAU scenario at 2.2% per year, which is consistent with the growth in primary energy consumption. Reduced CO_2 emissions in the APS of 25.94 Mt-C or 22.3% relative to the BAU scenario is also due to a significant decrease in coal consumption for power generation in the APS. This is because coal consumption is being replaced by natural gas and other clean energy sources such as nuclear and renewable energy. Furthermore, the lower energy usage in the industry and the 'others' sectors has also contributed to the reduction. This indicates that Malaysia's energy-saving efforts and renewable energy action plan would be effective in reducing CO_2 emissions (Figure 11.15).

Figure 11.15: CO_2 Emissions from Energy Combustion, BAU and APS (2015 and 2040)



APS = Alternative Policy Scenario, BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

Source: Author's calculation.

3.5. Review of Intended Nationally Determined Contributions of Malaysia

In 2013, parties to the United Nations Framework Convention on Climate Change (UNFCCC) were invited to initiate domestic preparations for and submit their Intended Nationally Determined Contributions (INDC) by 2015. The INDC submission aimed to facilitate the UNFCCC negotiations for adopting relevant instruments under the convention that are applicable to all parties towards achieving the objectives of the convention as per Article 2. Countries were expected to outline in their INDC the post-2020 climate actions they intend to take under an international agreement. During the 21st Conference of the Parties (COP21) of the UNFCCC in Paris in December 2015, the parties adopted the Paris Agreement, a historic international climate agreement aimed to keep the global average temperature to well below 2°C. It also aimed to pursue efforts to limit the increase to 1.5°C, and to achieve net zero emissions in the second half of this century.

Malaysia submitted its INDC to the UNFCCC in November 2015. Its INDC stipulates that Malaysia intends to reduce its GHG emissions intensity of GDP by 45% by 2030 relative to that in 2005. This consists of 35% on an unconditional basis and a further 10% conditional upon receipt of climate finance, technology transfer, and capacity building from developed countries. Malaysia's INDC was developed by a participatory process through an inter-ministerial and government agencies working group. A stakeholders' workshop was conducted in 2015 to obtain inputs on possible measures to reduce GHG emissions.

Based on results calculated from the APS, Malaysia already achieved its unconditional target of 35% of GHG emissions intensity of GDP by 2030 relative to that in 2005 by 40.8% (Table 11.4).

Table 11.4: Current Results of Key Indicators from APS

	2016–2020	2021–2025
GDP (billions of 2010 US$)	204.862	582.879
CO2 emissions (Mt-C)	42.400	71.391
Carbon intensity	0.207	0.122
Total reduction (%)	(40.82)	

APS = Alternative Policy Scenario, GDP = gross domestic product, Mt-C = million tons of carbon.

Source: Author.

To achieve the 45% conditional target upon receipt of climate finance, technology transfer, and capacity building from developed countries, Malaysia needs to exert further efforts to reduce its carbon emissions. New targets under the EEC scenario have been identified as the best solution to achieve this target (Table 11-5).

Table 11.5: Newly Proposed Mitigation Scenario

Scenario	Mitigation Actions
Energy Efficiency and Conservation (EEC)	**1. Improve final energy consumption of all energy types by 8% in 2016 and reach 17% by 2040.**
Renewable Energy (RE)	**1. Implement RE in the power sector by 2036:**
	a. Hydro: 8,543 MW
	b. Solar: 2,679 MW
	c. Biomass: 916 MW
	d. Biogas: 194 MW
	e. MSW: 39 MW
	Total: 12,372 MW
	2. Increase the share of biodiesel from 5% to 7% from 2020
Energy Efficiency in the Power Sector (EEP)	1. Improve the efficiency of power plants:
	a. Natural gas at 55% by 2040
	b. Coal at 45% by 2040
Nuclear (NUC)	**Commission 2,000 MW of nuclear in 2036**
Alternative Policy Scenario (APS)	**Combination of all scenarios:**
	APS = EEC + RE + EEP + NUC

MSW = Municipal Sold Waste, MW = megawatt.

Source: Author.

Table 11.5 shows that the new target for EEC is improvement of final energy consumption in all energy types by 8% in 2016 and reach 17% by 2040. The old target of 16% under the APS will be reached by 2040. Table 11.6 shows the INDC results.

Table 11.6: Results for INDC Scenario

	2005	2030
GDP (billions of 2010 US$)	204.862	582.879
CO2 emissions (Mt-C)	42.400	63.800
Carbon intensity	0.207	0.109
Total Reduction (%)	(47.11)	

GDP = gross domestic product, INDC = Intended Nationally Determined Contributions.

Source: Malaysia INDC Report.

4. Conclusions

The TPEC in the BAU scenario registered a growth at 5.2% per year from 1990 until 2015. The outlook results showed that the TPEC is projected to increase by 3.6% per year from 2015 until 2040. In the APS, primary energy consumption is projected to increase at a slower rate than in the BAU scenario at 2.9% per year, from 70.58 Mtoe in 2015 to 145.21 Mtoe in 2040. Total final energy demand in the BAU scenario will increase from 49.52 Mtoe in 2015 to 125.14 Mtoe in 2040. This illustrates an AAGR of 3.8% per year. In the APS, growth in final energy demand will be at 3.5% in 2015–2040, slightly lower compared to that of the BAU scenario. 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 industry and the 'others' sectors.

There is still room for improvement in reducing energy in Malaysia. The potential of reducing energy in the industry sector should consider not only electricity but also other fuels, such as oil and gas, especially for heating purposes. Potential saving or target for the transport sector in Malaysia still cannot be quantified due to lack of information. Malaysia needs to collect energy data on the transport sector to identify accurate potential savings. It also needs to develop a comprehensive policy study to identify potential energy savings in the transport sector. The power sector should continuously use renewable energy to minimise carbon emissions. Introduction of new technology that can generate electricity more efficiently can contribute to potential savings. Nuclear power is a possible energy option in Malaysia.

Clear action plans and targets for each sector will help formulate energy potential savings in Malaysia. Government policy in terms of laws and regulations is needed to ensure that all related initiatives in reducing energy is moving forward. Furthermore, financial support from developed countries will speed up the whole process in meeting the target of reducing energy. Since climate change has become a global issue, identifying the potential energy saving will be very important. This effort needs cooperation from all stakeholders such as policymakers, the private sector, and others.

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