CHAPTER 11

Malaysia Country Report

Zaharin Zulkifli

This chapter should be cited as:
Zulkifli, Z. (2023), 'Malaysia Country Report', in Kimura, S., H. Phoumin, and A.J. Purwanto (eds.), *Energy Outlook and Energy-Saving Potential in East Asia 2023*. Jakarta: ERIA, pp.239-260

1. Background

Malaysia has two (2) main areas separated by the South China Sea, namely Peninsular Malaysia (bordered with Thailand in the north and Singapore in the south) and West Malaysia (the northern part of Borneo Island, which is bordered with Indonesia in the South and Brunei in the North). Malaysia is located close to the equatorial line, with the Latitude of 1o and 7o North and Longitudes of 100o and 119o East Malaysia. The land area of Malaysia covers 330,534 square kilometres.

As of 1 January 2019, Malaysia's crude oil reserve stood at 4.675 billion barrels. Sarawak constituted about 36% and the rest lies in Sabah and Peninsular Malaysia at 32% each. The ratio of current reserves over production in 2019 showed that Malaysia can sustain its crude oil production, including condensates, for the next 21 years.

As of 1 January 2019, total natural gas reserves were 79.168 trillion standard cubic feet (Tscf), of which 58% are found in Sarawak, 27% in Peninsular Malaysia, and the other 15% in Sabah. Total associated gas reserves stood at 9.901 Tscf, while non-associated gas reserves stood at 69.267 Tscf in 2019. Natural gas could be sustained for another 32 years.

The latest reserve of coal in Malaysia as of 2019 was 1.918 million tonnes. Of the total amount, about 80% is found in Sarawak, 19% in Sabah, and only 1% in Peninsular Malaysia. In Sarawak, coal is produced from the areas of Merit-Pila, Silantek, and Mukah Balingian.

2. Modelling Assumptions

Gross domestic product (GDP) is commonly used as a basic assumption in energy modelling to project energy demand. Malaysia's energy demand has correlated with GDP growth, as its economy depends on energy-intensive industries, such as manufacturing. Since energy demand increases in tandem with the country's economic growth, information on future GDP growth is key in projecting its energy demand. Future GDP growth data by sector can be obtained from the Economic Planning Unit (EPU) office.

Malaysia's GDP in 2020 dropped by 5.54% from 2019 due to the coronavirus disease (COVID-19) pandemic. In this modelling assumption, GDP will grow by 3.44% per year from 2020 until 2030. This growth illustrates the economic recovery programme carried out by the Government of Malaysia to stimulate the economy. Following a similar trend, the total GDP will continue to grow at 2.89% per year from 2030 to 2040 and 2.43% per year from 2040 to 2050. Table 11.1 shows details of the GDP assumption growth rates.

Table 11.1 Assumptions, Gross Domestic Product Annual Growth Rate

(%)

Parameter	ID Name	Growth Rates (%)			
		2019–2020	2020–2030	2030–2040	2040–2050
GDP (constant 2015 US$)	GDP	-5.54	3.44	2.89	2.43
Industry (including construction), value added (constant 2015 US$)	INGDP	-6.46	4.12	2.35	2.09
Services, value added (constant 2015 US$)	CSGDP	-5.39	3.33	3.27	2.67
Agriculture, forestry, and fishing, value added (constant 2015 US$)	AGGDP	-2.46	1.25	1.96	1.74
Manufacturing, value added (constant 2015 US$)	MGGDP	-2.69	5.63	2.57	2.30

AGGDP = Agriculture GDP; CSGDP = Services GDP; GDP = gross domestic product; INGDP = Industrial GDP; MGGDP = Manufacturing GDP.

Source: Author's estimation based on World Bank data.

Population growth is also a parameter used with GDP as the main driver for energy demand growth for the future. In Malaysia's case, the information of population projection is based on the data published by Department of Statistics Malaysia (DOSM). The population Projections (Revision), Malaysia, 2010–2040 presents the data revised population projections at the Malaysian level for the years 2010-2040 based on recent changes in birth, death, and migration components. Method used to project the population in this publication is according to guidelines from Manual III: Methods for Population Projections by Sex and Age, United Nations (1956), and Manual VIII: Methods for Projections of Urban and Rural Population, United Nations (1974). As shown in Table 11.2, the projected growth of the Malaysian population is 1.28% per year in 2021–2025, 1.09% per year in 2026–2030, 0.92% per year during 2031–2035, and 0.79% per year in 2036–2040.

Table 11.2 Assumptions, Population Annual Growth Rates

Parameter	ID Name	Growth Rates (%)					
		2018–2019	2019–2020	2021–2025	2026–2030	2031–2035	2036–2040
Population	POP	1.41	1.37	1.28	1.09	0.92	0.79

Source: Author's estimation based on Department of Statistics of Malaysia (DOSM) data.

3. Outlook Results

3.1. Business-as-Usual Scenario

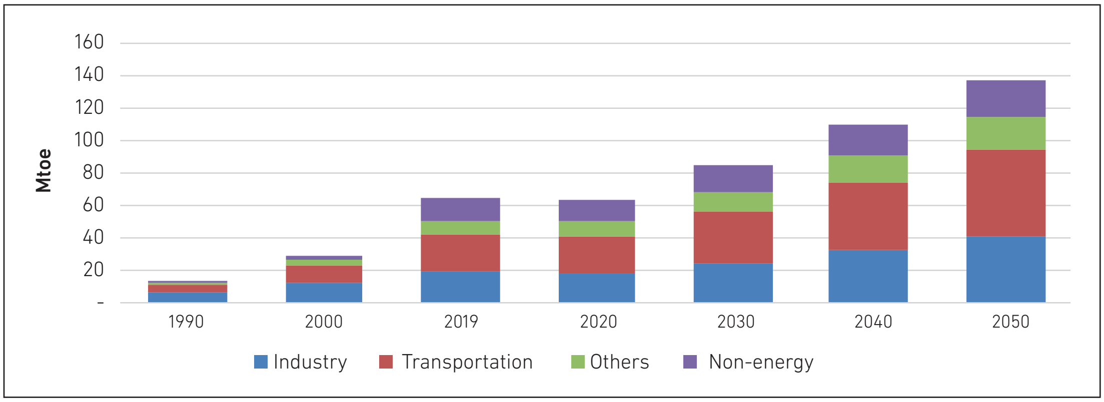
The business-as-usual (BAU) scenario is based on previous energy consumption data provided by the Energy Statistics and Training Office (ESTO) of the Asia Pacific Energy Research Centre (APERC). The set of data from 1980 until 2019 is in the unit of kilo tonnes of oil equivalent (ktoe). By using Microfit, a software for determining the demand equations, the regression analysis was conducted using GDP and population parameters as the main driver. In addition to GDP and population, energy prices, provided by the Institute of Energy Economic of Japan (IEEJ) were also used as parameters. The BAU scenario does not include any intervention elements such as mitigation to reduce energy or carbon emissions. It is only derived from historical trends correlated with GDP and population growths. Using the LEAP software, energy, and carbon emissions under the BAU scenario were projected until 2050.

3.1.1. Final Energy Consumption

Under the BAU scenario, the final energy consumption for Malaysia is expected to increase at 2.5% per year from 2019 until 2050. During this period, transport will lead the growth at 2.9% per year, followed by the 'others' sector at 2.6% per year, industry at 2.5% per year, and non-energy sector at 1.8% per year. Overall, the total final energy consumption will register at 137.74 Mtoe in 2050 under the BAU scenario.

In terms of the share, transport will have the largest share with 39.0% in 2050. It was followed by the industry sector at 29.5%, non-energy at 17.0%, and 'others' sector at 14.5%. As shown in Figure 11.1, in 2020, the total final energy consumption experienced a downward trend at -0.5% from 2019. This was due to lower consumption of energy, especially by the industry sector. Industry recorded a decrease of -5.5% in 2020 compared to 2019.

Figure 11.1 Final Energy Consumption by Sector, Business-as-Usual, 1990–2050
(Mtoe)



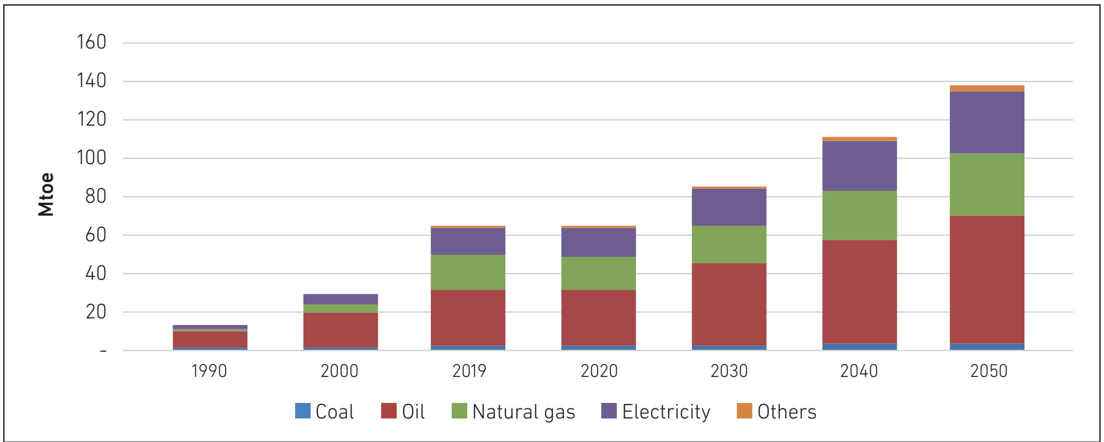
APS = alternative policy scenario; BAU = business-as-usual; Mtoe = million tonnes of oil equivalent.

Source: Author's calculations.

The average annual growth rate of total final energy consumption (TFEC) from 1990 until 2050 is lower than the GDP, which is at 2.6% per year. This shows that even under the BAU scenario, Malaysia can potentially be an efficient economy in terms of energy elasticity. The country can achieve higher savings by maintaining and enhancing current energy efficiency initiatives.

Figure 11.2 shows the final energy consumption by fuel under the BAU scenario from 1990 until 2050. In 2050, oil will still dominate the share at 47.9% as the majority of transport will use oil as the major fuel for the sector. Natural gas and electricity each have a 23.8% share in 2050 as electricity will grow by 2.9% per year compared to natural gas at 1.8% per year. Coal used mainly by cement manufacturers will be at 2.5% share from the total final energy consumption. 'Others' fuel (i.e. biodiesel) will constitute a 2.1% share in 2050.

Figure 11.2 Final Energy Consumption by Fuel, Business-as-Usual, 1990–2050
(Mtoe)



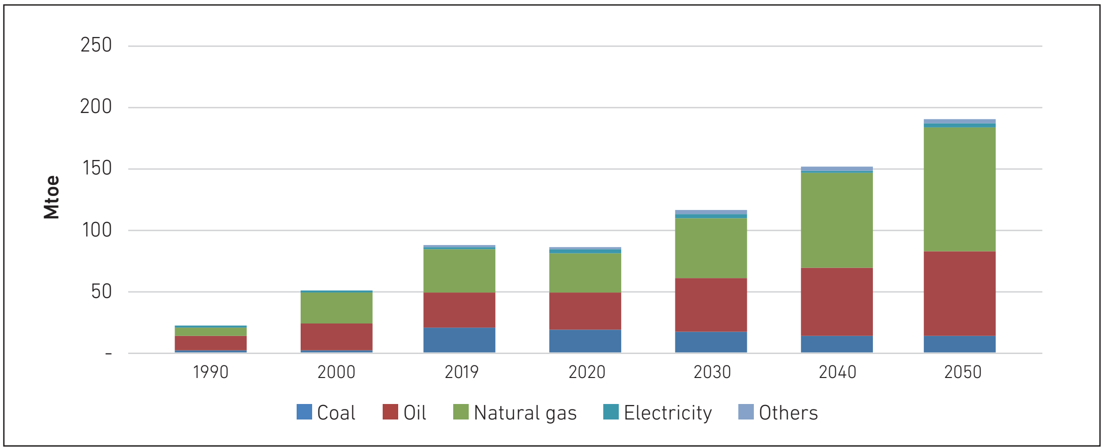
Mtoe = million tonnes of oil equivalent.

Source: Author's calculations.

3.1.2. Primary Energy Supply

Under the BAU scenario, the total primary energy supply (TPES) is expected to increase at 2.6% per year from 2019 until 2050. Figure 11.3 shows that, in 2050, the TPES will register at 190.50 Mtoe, more than double from 2019, which was at 86.36 Mtoe. In 2050, natural gas will cover about 53.4% of TPES with an average annual growth rate of 3.6% per year. Interestingly, the share of coal will be shrinking to 7.3% in 2050 compared to its share in 2019 at 22.5%. This was due to the government policy that stated that it will no longer build coal-fired power plants as the value of coal imports will have a sizeable impact, especially on the environment and national expenditure. Government and stakeholders understood that coal generation causes the emission of greenhouse gases which contributes to climate change. The second largest share of TPES in 2050 is oil at 35.6%. In the BAU scenario, the share of oil will remain dominant in 2050 as it is most convenient fuel that can used directly by the end user.

Figure 11.3 Total Primary Energy Supply by Fuel, Business-as-Usual, 1990–2050
(Mtoe)



Mtoe = million tonnes of oil equivalent.

Source: Author's calculations.

Since the introduction of the Biofuel Policy in 2006, fuel in the 'others' category, particularly biofuel or biodiesel, has increased significantly on TPES. This is because a higher blending of biodiesel has been observed. The Biofuel Industry Act 2007 was developed to make sure that the development of biodiesel in the country remains competitive and attractive. As a result, the share of biodiesel is expected to increase at 5.0% per year from 2019 until 2050. Under the BAU scenario, the projected share until 2050 is not much different expect for coal. The rest of energy sources will maintain their respective shares at their current rate.

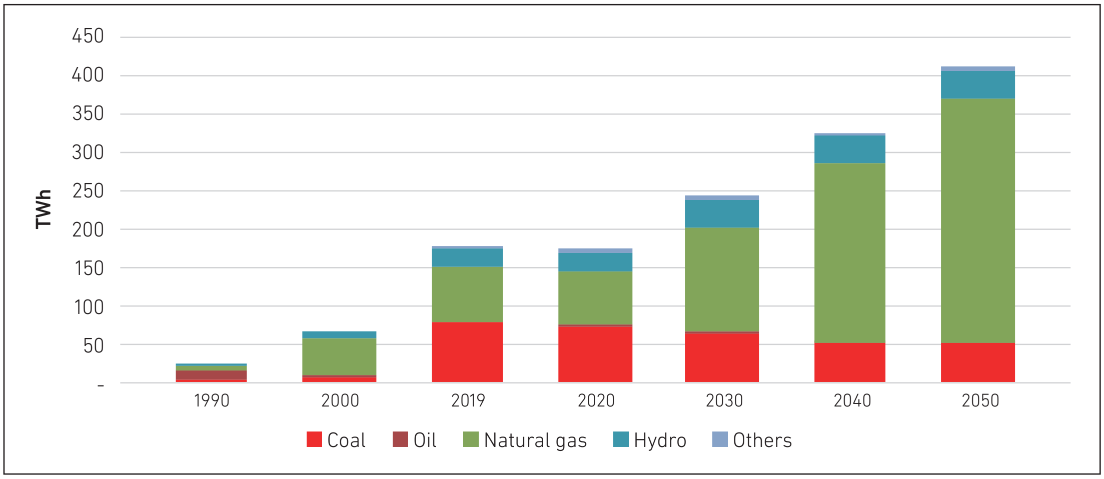
3.1.3. Power Generation

Total installed capacity in Malaysia for 2019 was 36,121 megawatts (MW). Natural gas and coal dominate the chart, making up three-quarters of the total installed capacity in Malaysia. Renewable energy (RE)capacity totalled 21.5%, with a 2.3% increase in energy capacity from 2018. This is a good indication that the national target of 31% RE by 2025 is achievable.

From 2019 to 2050, electricity generation is expected to grow at average annual rate of 2.7%. This growth is underpinned by a higher annual growth rate of 4.9% for natural gas. Further, with the government's new policy not to build new coal power plants, Malaysia is shifting to natural gas as a major fuel. In 2050, the share of electricity coming from natural gas plants will be at 77.7%, almost double from 40.5% in 2019. The share of electricity generation from coal plants will only be 11-9% in 2050, as compared to 42.8% in 2019.

Figure 11.4 shows that, in 2020, there was a 2.4% decrease in electricity generation from 2019. As expected, lower GDP growth affected the demand in 2020 with the onslaught of the COVID-19 global pandemic.

Figure 11.4 Electricity Generation by Fuel, Business-as-Usual, 1990–2050
(TWh)



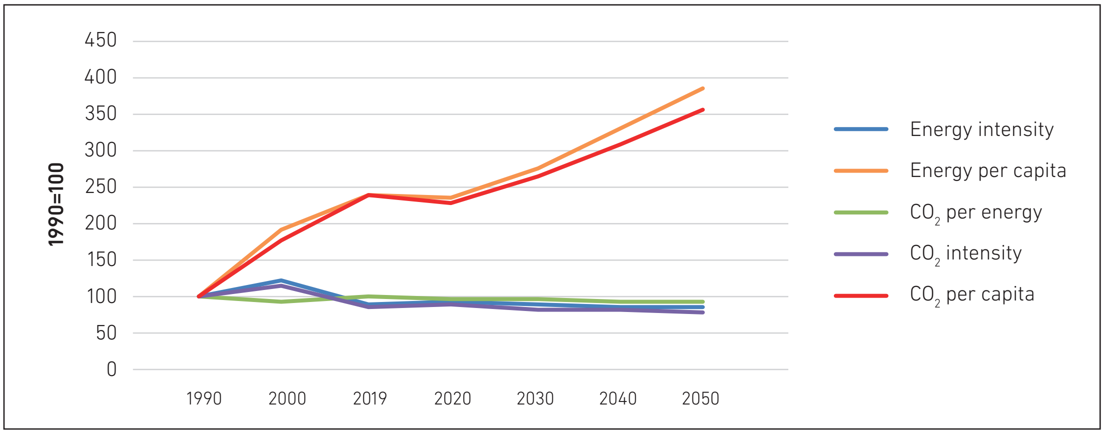
TWh = terawatt hour.

Source: Author's calculations.

3.1.4. Energy Indicators

Figure 11.5 shows the selected energy indicators under the BAU scenario. Only energy per capita and carbon dioxide (CO_2) emission per capita registered an upward trend until 2050. The CO2 emission intensity recorded a downward trend at average annual growth rate of 0.3% from 2019 until 2050.

Figure 11.5 Energy Indicators, Business-as-Usual, 1990–2050



CO_2 = carbon dioxide.

Source: Author's calculations.

3.2 Energy Saving and Carbon Dioxide Reduction Potential, Alternative Policy Scenario

Under APS1, Malaysia has initiatives to enhance demand-side management and energy efficiency, primarily focused on the electricity sector through the National Energy Efficiency Action Plan (NEEAP). The NEEAP targets an 8% electrical efficiency savings over a 10-year period between 2016–2025 through energy efficiency labelling, minimum efficiency performance standards (MEPS), energy audits and energy management, promotion of co-generation, and energy efficient buildings. These initiatives are supported by various enablers, including the Energy Audit Conditional Grant (EACG), which supports voluntary energy audits by industry players and the introduction of Registered Electrical Energy Manager (REEM) in the 2010s. By using the saving of 8% for electricity, the same amount was applied to all types of fuels, including coal, natural gas, and petroleum products until 2050. As for APS2, higher performance of power plants in generating electricity compared to their input fuels will be expected to increase by 2050.

Higher contribution of renewable energy is under APS3. In Malaysia, RE contribution was mainly for the power and transport sectors. The RE contribution for power sector was taken from Power Development Plan (PDP) 2020. The potential capacity of RE capacity was derived from various RE programmes currently being implemented in Malaysia, including Large Scale Solar (LSS), Feed in Tariff (FiT), Net Energy Metering (NEM), and Self Consumption Generators (Selco). For transport, Malaysia has a biodiesel programme that already being implemented. The B30 biodiesel programme will be implemented by 2030. Table 11.3 shows the respective scenarios in addressing all mitigation measures.

Table 11.3 Energy Saving and Carbon Dioxide Reduction, Alternative Policy Scenario

APS1	Improved Efficiency of Final Energy Demand
APS2	More Efficient Thermal Power Generation
APS3	Higher Contribution of Renewable Energy to Total Supply
APS4	Contribution of Nuclear Energy to Total Supply (not applied in Malaysia)
APS5	Combined Effects of APS1, APS2, APS3, APS4 and APS5

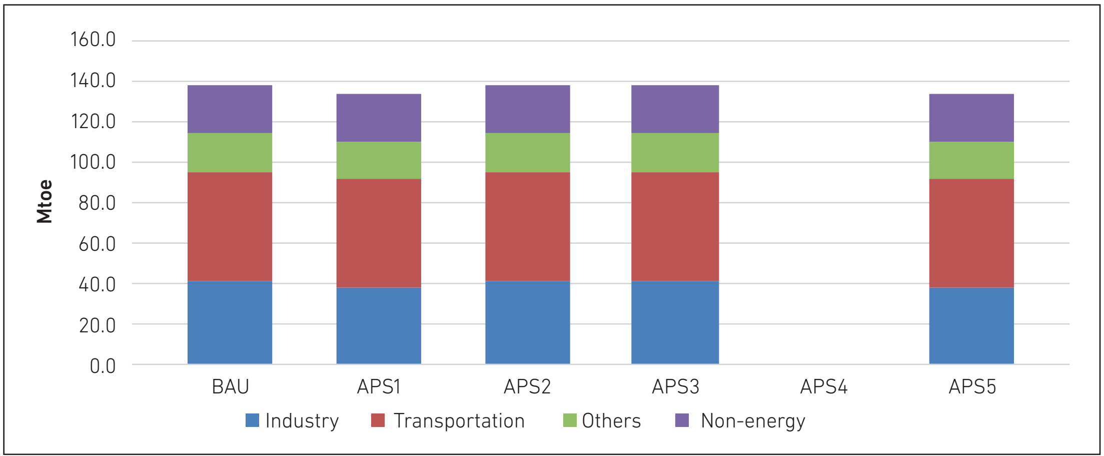
APS = alternative policy scenarios.

Source: Author's assumptions.

3.2.1. Final Energy Consumption

In 2050, the total final energy consumption for APS1 is at 132.89 Mtoe compared to BAU, APS2, and APS3 at 137.74 Mtoe each as shown in Figure 11.6. The reduction of energy consumption was observed for industry and others sector, while transportation and non-energy sector remained at the same level for all scenarios. The implementation of various energy efficiency initiatives under NEEAP has the potential savings of 8% compared to BAU scenario.

Figure 11.6 **Final Energy Consumption by Sector, Business-as-Usual and Alternative Policy Scenario, 2050**
(Mtoe)

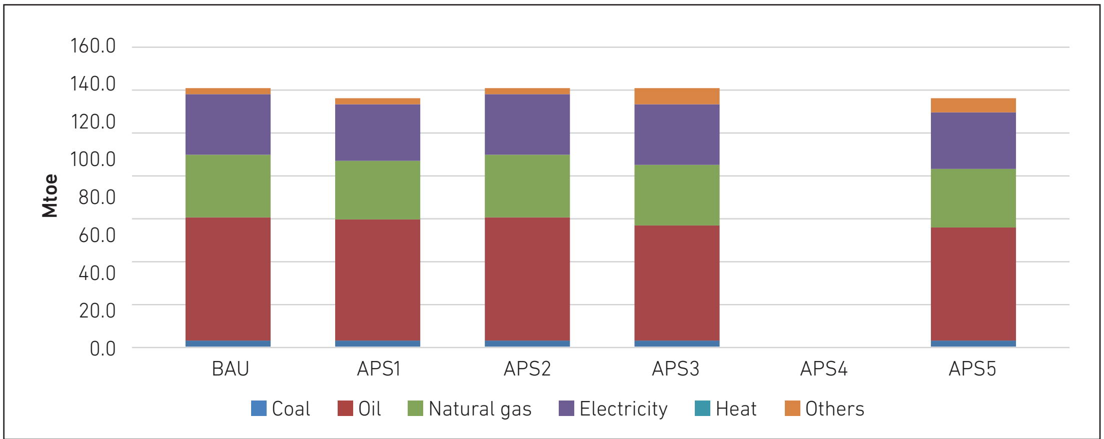


Mtoe = million tonnes of oil equivalent.

Source: Author's calculations.

Figure 11.7 shows the final energy consumption by fuels for BAU and APS in 2050. Under APS1, the total final energy consumption is much lower than all scenarios for all types of fuels. This was due to the early assumption that all types of fuels will have similar savings potential of 8% compared to the BAU scenario. While for APS5, the 'others' fuel (i.e. biofuel) is expected to increase in 2050 as an alternative for fuel switching from oil to biofuel.. The implementation of biodiesel programmes will maintain the level of usage due to the shift from diesel to biodiesel.

Figure 11.7 **Final Energy Consumption by Fuels, Business-as-Usual and Alternative Policy Scenario, 2050**
(Mtoe)



APS = alternative policy scenarios; BAU = business-as-usual; Mtoe = million tonnes of oil equivalent.

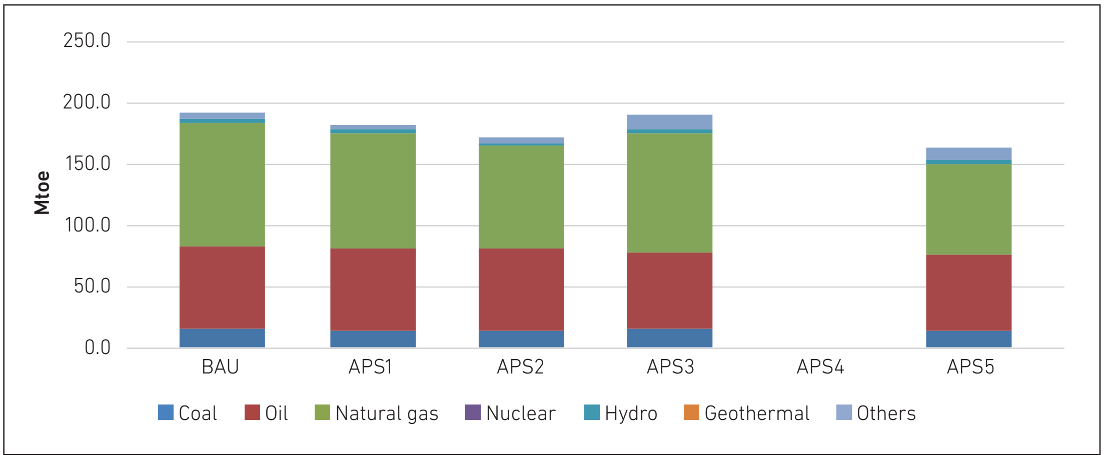
Source: Author's calculations.

3.2.2. Primary Energy Supply

As seen in Figure 11.8, all scenarios registered different total primary energy supplies in 2050. Under APS2, the total primary energy supply was 170.7 Mtoe in 2050, amongst the lowest compared to BAU, APS3, and APS1 scenarios. This indicates that by implementing more efficient power plants, it may produce a great amount of savings. However, this mitigation option requires a high amount of investment.

The energy efficiency measures implemented under APS1 registered a total primary energy supply of 181.2 Mtoe in 2050. Energy savings can be observed from the supply of coal, oil, and natural gas due to energy efficiency measures. The least energy saving scenario is APS3, where renewable energy programmes that promote the utilisation of Solar Photovoltaic (PV), Biogas, Biomass and Hydro, namely Self Consumption (SELCO), Net Energy Metering (NEM), Large Scale Solar (LSS), and Feed-in Tariff (FiT) are being implemented.

Figure 11.8 Primary Energy Supply by Fuels, Business-as-Usual and Alternative Policy Scenario, 2050



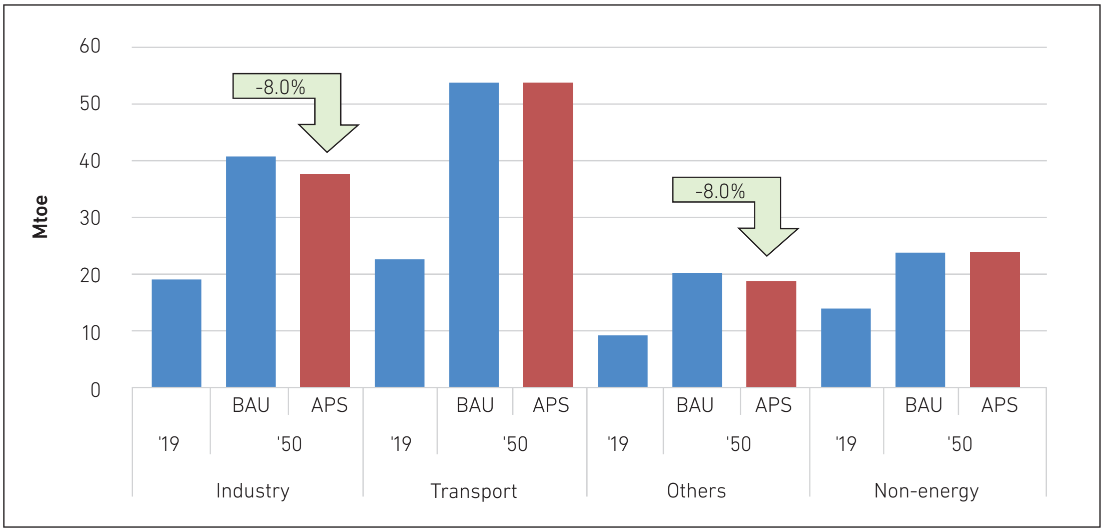
APS = alternative policy scenarios; BAU = business-as-usual; Mtoe = million tonnes of oil equivalent.

Source: Author's calculations.

3.2.3. Projected Energy Saving

Figure 11.9 shows the Final Energy Consumption by sectors for BAU and APSs in 2019 and 2050. The potential savings from industry and others sector is at 8%. The results are consistent with the assumption under APS1. The average annual growth rate for APSs is much lower at 2.4% per year compared to the BAU scenario at 2.5% per year. In 2050, the final energy consumption under APS is registered at 132.89 Mtoe, while it is at 137.74 Mtoe in the BAU scenario.

Figure 11.9 Final Energy Consumption by Sector, Business-as-Usual and Alternative Policy Scenario, 2019 and 2050
(Mtoe)



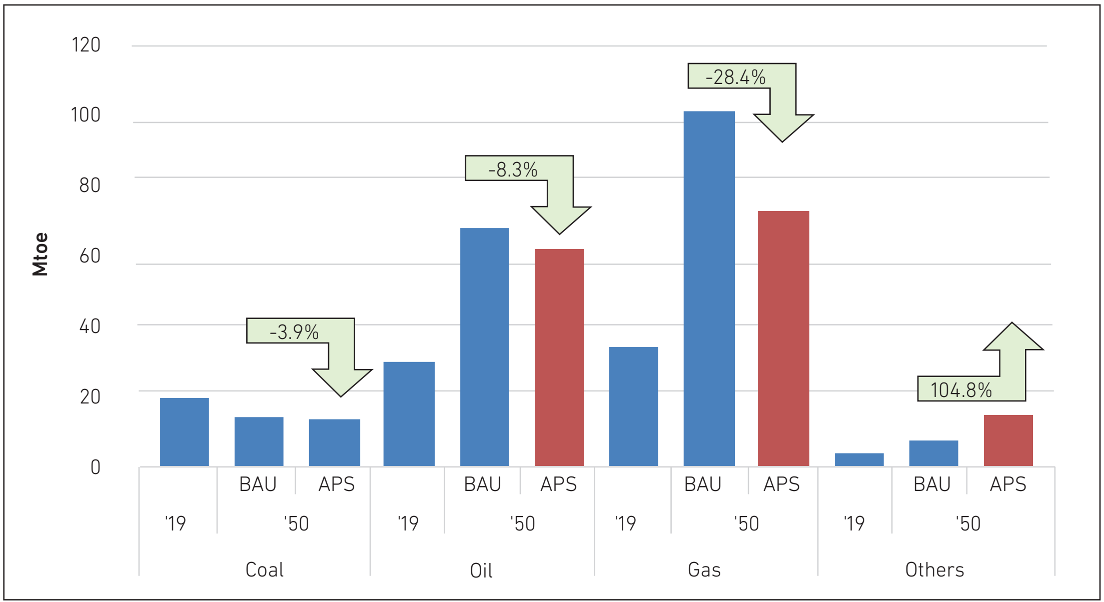
APS = alternative policy scenarios; BAU = business-as-usual; Mtoe = million tonnes of oil equivalent.

Source: Author's calculations.

Figure 11.10 illustrates the primary energy supply by source for BAU and APSs. In 2050, coal is expected to have a lower primary energy supply of 3.9% under the APSs than under BAU scenario. This was due to improved efficiency of coal usage in the industry sector and higher efficiency of coal power plants. Oil will register a total savings of 8.3% in APSs due to the shift from diesel to biodiesel and better energy efficiency measures adopted by the end user.

Figure 11.10 Primary Energy Supply by Source, Business-as-Usual and Alternative Policy Scenario, 1990 and 2050

(Mtoe)



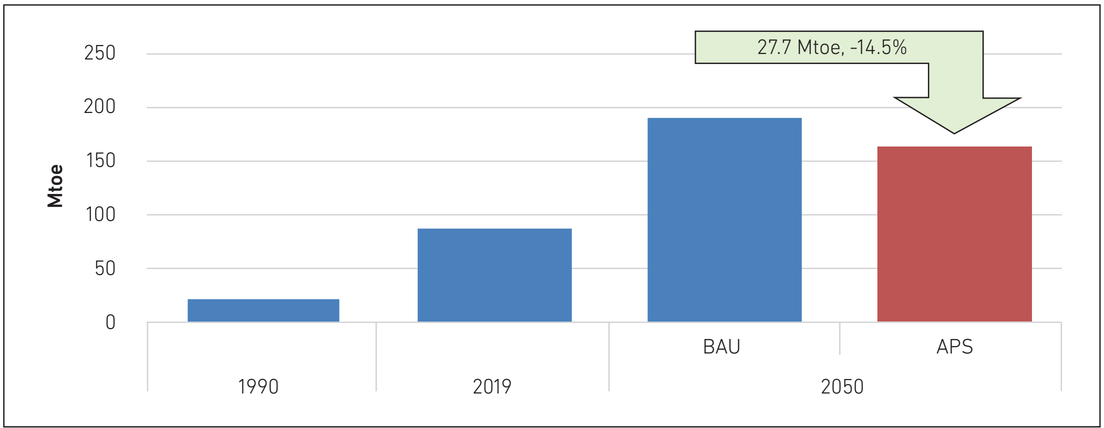
APS = alternative policy scenarios; BAU = business-as-usual; Mtoe = million tonnes of oil equivalent.

Source: Author's calculations.

Natural gas supply is expected to produce savings of 28.4% in APSs due to power plants with improved technology. This savings was also due to better energy efficiency measures conducted in the manufacturing sector. The implementation of the biodiesel programme can be illustrated through the 104.8% increase of fuel in the 'Others' category in the APS scenario compared to BAU. The growth showed that how big the impact of biodiesel programme utilisation in Malaysia.

As stated in Figure 11.11, the total primary energy supply for APSs in 2050 is at 162.8 Mtoe, a savings of 27.7 Mtoe from BAU scenario, which is at 190.5 Mtoe. The savings of 14.5% was achieved due to better efficiency from demand side management programme and higher efficiency of natural gas and coal power plants.

Figure 11.11 Total Primary Energy Supply, Business-as-Usual and Alternative Policy Scenario, 1990 and 2050
(Mtoe)



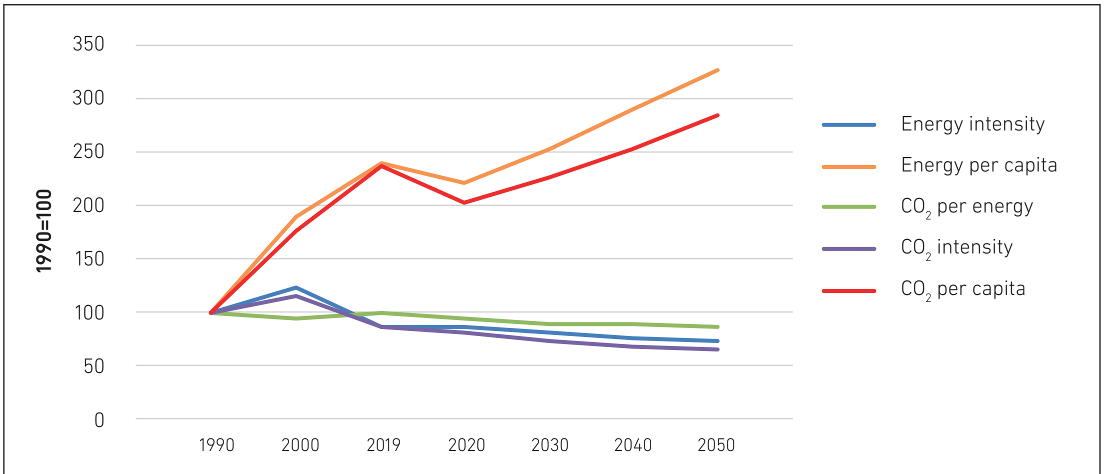
APS = alternative policy scenarios; BAU = business-as-usual; Mtoe = million tonnes of oil equivalent.

Source: Author's calculations.

3.2.4. Energy Indicators

Under the APS scenario, the projected energy intensity is expected to decrease at an average annual growth rate of 0.6% from 2019 until 2050. However, the energy per capita will expand to 1.0% per year during the same period. The CO_2 emission per energy will decrease by 0.4% per year, while CO_2 emission per capita will grow at 0.6% per year. The CO_2 emission intensity will be expected to decrease by 1.0% from 2019 until 2050, registering at 115 t-C/million 2015 US Dollars.

Figure 11.12 Energy Indicators, Alternative Policy Scenario, 1990–2050



CO_2 = carbon dioxide.

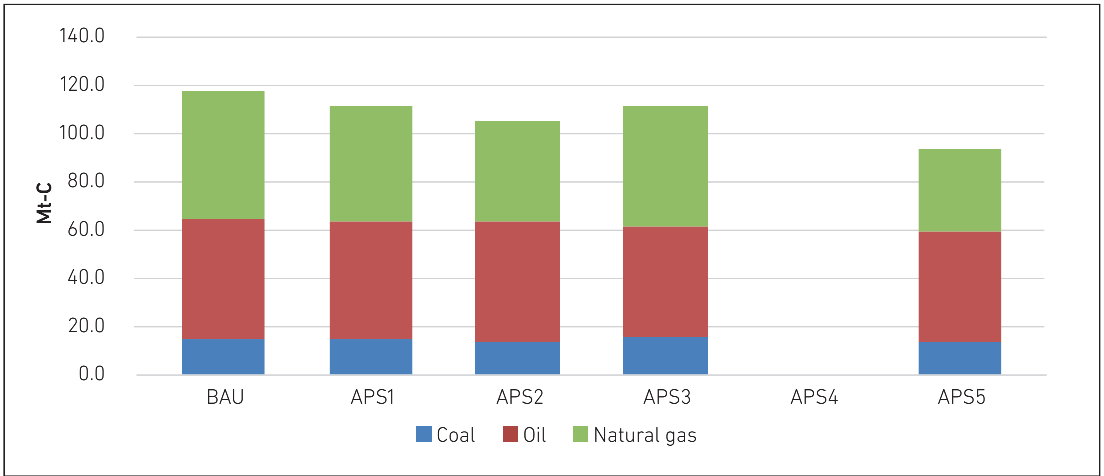
Source: Author's calculations.

3.2.5. Carbon Dioxide Emission Reduction

Figure 11.13 shows that APS5 registered the lowest CO_2 emission at 94.15 Mt-C, followed by APS2 at 104.85 Mt-C, APS3 at 111-28 Mt-C, APS1 at 111-63 Mt-C, and BAU scenario at 117.89 Mt-C. This indicates that if all scenarios are combined and implemented, the biggest potential savings in terms of CO_2 emissions can be generated.

Figure 11.13 Carbon Dioxide Emissions Reduction by Fuel, Business-as-Usual and Alternative Policy Scenario, 1990 and 2050

(Mt-C)



APS = alternative policy scenarios, BAU = business-as-usual, Mt-C = million tonnes of carbon dioxide.

Source: Author's calculations.

3.3. Low Carbon Energy Transition Scenario (Carbon Neutral)

The low-carbon energy transition (LCET) scenario was created to see the impact of energy supply and consumption and carbon emission if new technologies are introduced or fuel switching is implemented. A concept of carbon neutrality was formalised to observe how economies can move forward with development while conserving the environment.

Based on the Third National Communication (NC3) Report, in 2030 the projected Land Use, Land-Use Change and Forestry (LULUCF) Removals of greenhouse gas emissions under the BAU scenario are as follows: 254,962 Gg CO_2 equivalent (Gg CO_2 eq) for 2020; 250,841 Gg CO_2 eq for 2025; and 246,649 Gg CO_2 eq for 2030. While under the Third Biennial Update Report (BUR3) report, Malaysia's LULUCF Removals in 2016 totalled 259,146 Gg CO_2 eq. By applying the existing LULUCF data, the projected LULUCF removals until 2050 was projected. Figure 11.4 shows the potential removals of LULUCF under the LCET scenario from 1994 until 2050.

Table 11.4 **Potential Removals of LULUCF, Low Carbon Energy Transition Scenario, 1994–2050**

	Removals (Million MT CO_2 eq.)	Removals (Million MT C eq.)
1994	211-84	57.82
2000	235.24	64.20
2005	233.92	63.84
2011	242.59	66.21
2014	267.15	72.91
2016	259.15	70.72
2020	254.96	69.58
2025	250.84	68.46
2030	246.65	67.31
2040	238.47	65.08
2050	230.57	62.93

$MtCO_2e$. = million tonnes of carbon dioxide equivalent, Mt-C = million tonnes of carbon dioxide.

Source: Author's calculations.

The LCET scenario encompasses several initiatives, one of which involves incorporating CCUS technology in industries rely on natural gas and coal for combustion activities. It is projected that from 2041 until 2050, these industries will adopt CCUS technology at a utilisation rate of 50% in the market. Furthermore, from 2041 to 2050, road transport will shift from gasoline to new hydrogen fuel with a 50% utilisation rate.

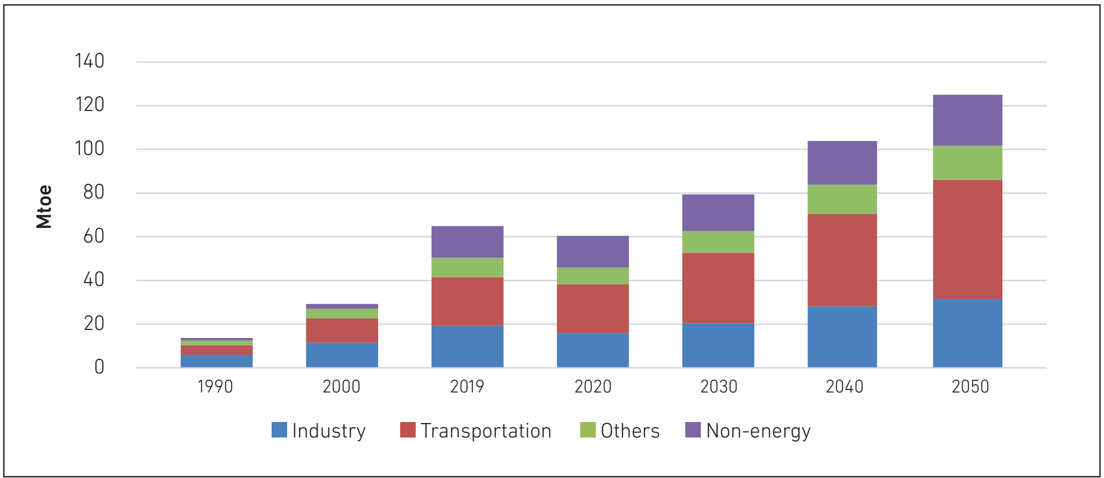
For demand side management, higher savings of Energy Efficiency at a rate of 16% from 2041 to 2050 is expected, especially for residential and commercial sectors. As for the power sector, the capacity of RE, which includes small hydro, biomass, biogas, and municipal solid waste will double compared to APS3 from 2041 until 2050. From 2041 until 2050, the power sector plans to implement the CCUS technology for coal and natural gas power plants operating at a 50% utilisation rate.

3.3.1. Final Energy Consumption by Sector

Figure 11.14 illustrates the final energy consumption by sector from 1990 until 2050 under the LCET scenario. The average annual growth rate is at 2.2% per year from 1990 until 2050. Lower final energy consumption in 2050 compared to APS5 scenario was due to greater savings of energy were expected under the residential and commercial sector.

Figure 11.14 **Final Energy Consumption by Sector, Low Carbon Energy Transition Scenario 1990–2050**

(Mtoe)



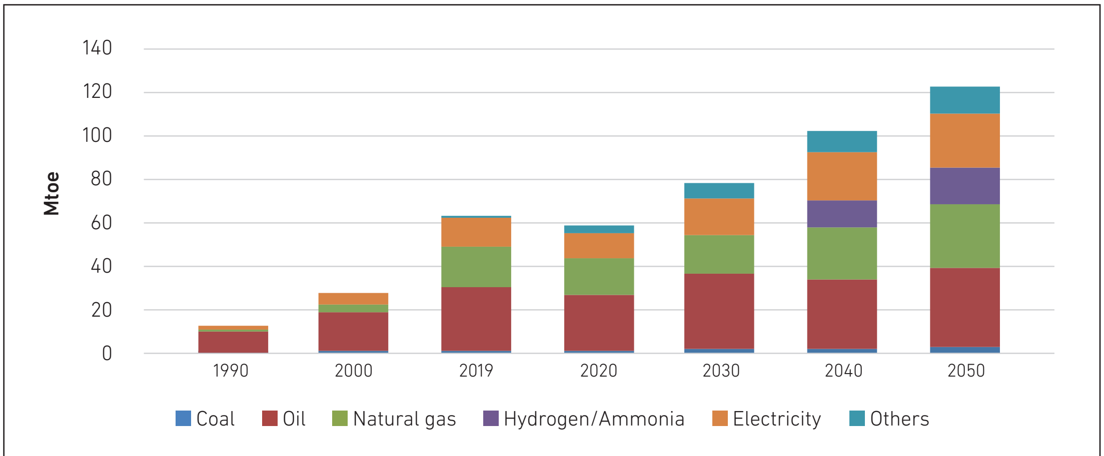
Mtoe = million tonnes of oil equivalent.

Source: Author's calculations.

The introduction of hydrogen fuel for transport from 2041 onwards impacts the consumption of gasoline. As a result, in 2050, there is a consumption of hydrogen at 16.63 Mtoe. The average annual growth rate of oil will reduce to 0.8% per year from 2019 to 2050, compared to 2.4% per year under the APS5. The final energy consumption by fuel under the LCET scenario is shown in Figure 11.15.

Figure 11.15 **Final Energy Consumption by Fuel, Low Carbon Energy Transition Scenario 1990–2050**

(Mtoe)



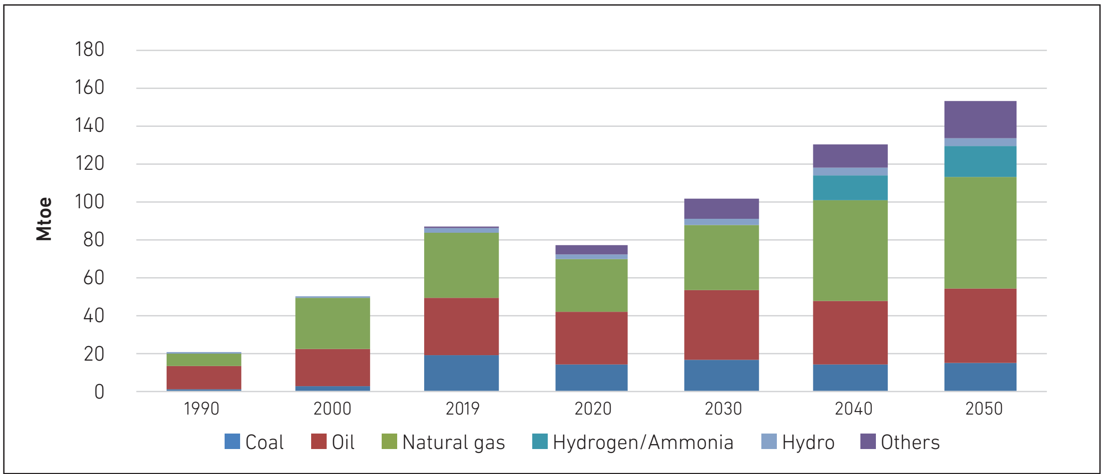
Mtoe = million tonnes of oil equivalent.

Source: Author's calculations.

3.3.2. Primary Energy Supply

In 2050, the total primary energy supply (TPES) under the LCET scenario registered at 152.54 Mtoe, much lower compared 162.84 Mtoe under the APS5. In terms of average annual growth rate, TPES was recorded at 1.9% per year from 2019 to 2050, while it was 2.1% per year under the APS5. Due to the government's decision to not incorporate any new coal plants into the system, coal is the only fuel with a negative average annual growth rate (-0.8%). Interestingly, by doubling renewable energy capacity in the power sector starting in 2041, other fuels will have a higher growth rate in TPES.

Figure 11.16 Primary Energy Supply by Fuel, Low Carbon Energy Transition Scenario 1990–2050
(Mtoe)



Mtoe = million tonnes of oil equivalent.

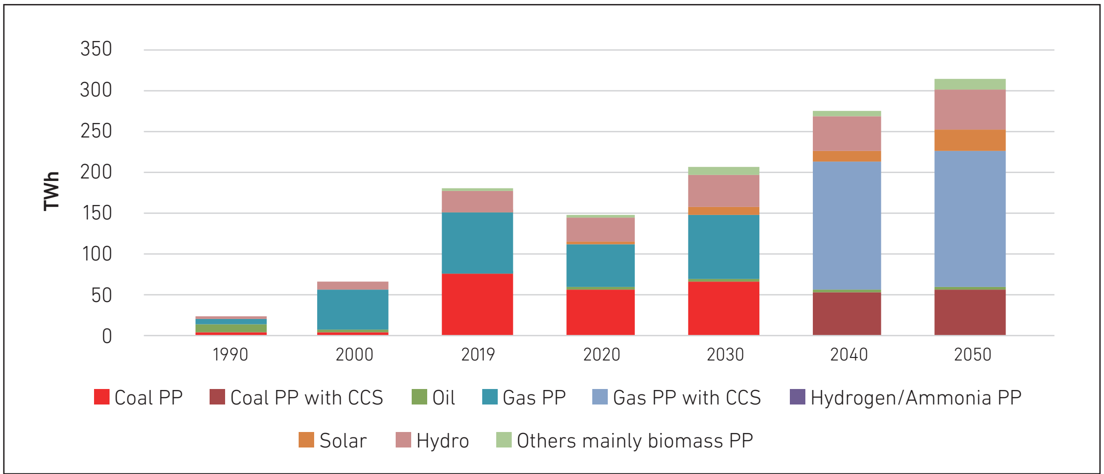
Source: Author's calculations.

3.3.3. Power Generation

From the Figure 11.17 shows the total electricity generation under LCET scenario in 2050 at 314.95 TWh compared to 379.80 TWh under the APS5 scenario. The reduction of electricity consumption due to EE initiatives has resulted the lower generation of electricity by 2050. By 2050, natural gas power plant will constitute 53.4% of share followed by coal at 18.2%, hydro at 14.7%, solar at 8.4%, biomass at 4.7% and oil at 0.7%.

Figure 11.17 Electricity Generation by Fuel, Low Carbon Energy Transition Scenario 1990–2050

(TWh)



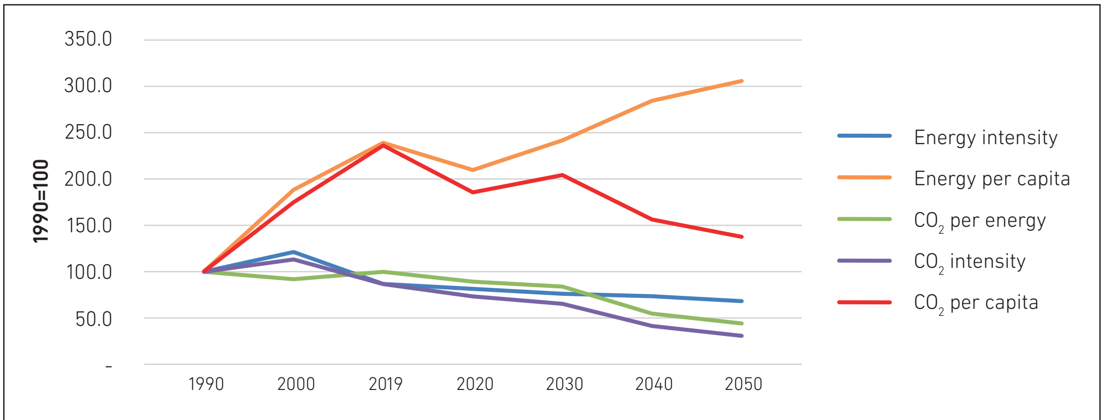
CCS = carbon capture and storage, PP = powerplant, TWh = terawatt hour.

Source: Author's calculations.

3.3.4. Energy Indicators

Figure 11.18 shows that only energy per capita registered a positive trend compared to all other energy indicators. The CO_2 emission per capita showed a downward trend from 2019 to 2050 at -1.8% per year. Energy intensity also showed a similar trend at -0.5% per year, while CO_2 emission intensity was marked at -3.4% per year.

Figure 11.18 Energy Indicators, Low Carbon Energy Transition Scenario, 1990–2050



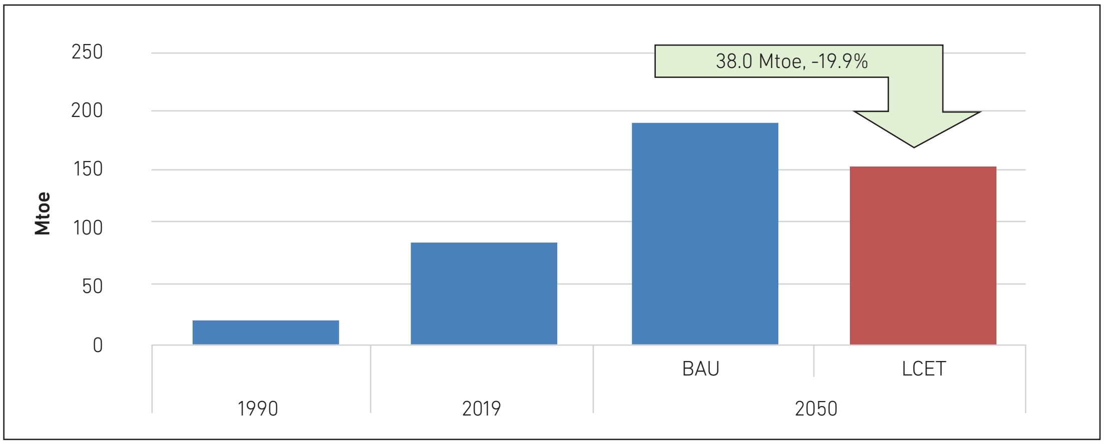
CO_2 = carbon dioxide.

Source: Author's calculations.

3.3.5. Fossil Fuel Consumption Savings and Carbon Dioxide Reduction

Figure 11.19 shows the potential savings of total primary energy supply in the LCET scenario at 38.0 Mtoe when compared to BAU. This potential savings of -19.9% would be met if all initiatives under the LCET scenario are implemented.

Figure 11.19 Primary Energy Supply, Business-as-Usual and Low Carbon Energy Transition Scenarios, 1990, 2019 and 2050
(Mtoe)

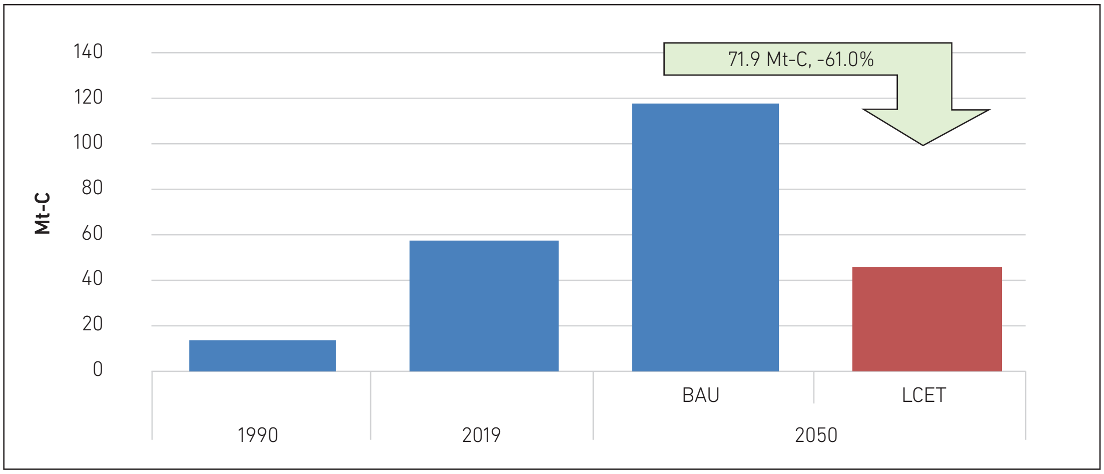


APS = alternative policy scenarios, BAU = business-as-usual, Mtoe = million tonnes of oil equivalent.

Source: Author's calculations.

The total CO_2 emission in 2050 under the LCET scenario was at 46.0 Mt-C, while it was 117.9 Mt-C under BAU. This reduction is about 71.9 Mt-C or 61.0% when comparing BAU and LCET scenarios. Further, the rate of total CO_2 emission in 2050 under the LCET scenario is lower than the total CO_2 emission registered in 2019 (see Figure 11.20).

Figure 11.20 Carbon Dioxide Emission Reduction, Business-as-Usual and Low Carbon Energy Transition Scenarios, 1990, 2019, and 2050
(Mt-C)



APS = alternative policy scenarios; BAU = business-as-usual; Mt-C = million tonnes of carbon dioxide.

Source: Author's calculations.

4. Implications and Policy Recommendations

As countries around the world work to rebuild their economies after the COVID-19 pandemic, the environmental conservation and climate change mitigation are taking center stage. While each country's approach may differ based on each country's unique economic structures and strategic plans, many have pledged to combat climate change by targeting carbon neutrality or net zero. New technologies and alternative fuels are being explored worldwide. However, the adoption of new technologies will require significant investments, long-term partnerships, and secure funding. It is essential for each country to prioritise and strategise their approach to combating climate change from an early stage. By implementing a well-crafted roadmap, economies can effectively address this complex problem, with the support of more advanced economies.

References

Department of Statistics, Malaysia (2016), *Population Projections (Revised) Malaysia, 2010–2040, November 2016*. https://newss.statistics.gov.my/newss-portalx/ep/epFreeDownloadContentSearch.seam?cid=300323 (Accessed 5 July 2023)

Ministry of Environment and Water, Malaysia (2018), *Malaysia Third National Communications and Second Biennial Report to UNFCCC, September 2018.* https://unfccc.int/sites/default/files/resource/Malaysia%20NC3%20BUR2_final%20high%20res.pdf (Accessed 5 July 2023).

Ministry of Environment and Water, Malaysia (2020), Malaysia Third Biennial Update Report to the UNFCCC, December 2020. https://unfccc.int/sites/default/files/resource/MALAYSIA_BUR3-UNFCCC_Submission.pdf (Accessed 5 July 2023)

Ministry of Plantation Industry and Commodities, Malaysia (2007), *The Malaysian Biofuel Industry Act, July 2007*. https://www.mpic.gov.my/mpi/images/mpi_polisi_dan_akta/Akta666_BiobahanApiMalaysia2007_BM.pdf (Accessed 5 July 2023)