

## CHAPTER 3

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# Brunei Darussalam Country Report



**Ministry of Energy, Brunei Darussalam**

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# 1. Background

Brunei Darussalam is on the northwest coast of Borneo in Southeast Asia, with a northern coastline of 161 kilometres along the South China Sea on the north. With a total land area of 5,765 square kilometres, it has four districts: Brunei–Muara, Tutong, Belait, and Temburong. The capital city, Bandar Seri Begawan, is in Brunei–Muara. The climate is equatorial, with high rainfall and humidity.

Gross domestic product (GDP) in 2019 was US\$13.3 billion,<sup>1</sup> the population 433,300, and per capita GDP US\$28,900 (Department of Economic Planning and Statistics, 2022). About 55% of GDP is generated by oil and gas. Crude oil, liquefied natural gas, and methanol account for more than 90% of total exports, primarily to Asia and the Pacific.

## 2. Energy Policies

### 2.1. Supply

Brunei Darussalam continues to strengthen upstream oil and gas activities to ensure long-term energy security and sustainability of oil and gas reserves. It is developing unexplored areas, such as deepwater fields. Rejuvenation of current upstream-producing assets is a priority to enhance recovery from existing fields and maximise production. The country is focusing on developing downstream energy industries by maximising economic spin-off potential from upstream production and assets.

Brunei Darussalam aims to reduce its energy intensity by 45% in 2035 from the baseline year of 2005, in line with its regional commitment to the Asia-Pacific Economic Cooperation. It has set a target to increase the share of renewable energy in its power generation mix, particularly from solar photovoltaic (PV), to 200 megawatts (MW) by 2025 and at least 30% from renewable energy.

To support the development of renewable energy sources, the government plans to introduce renewable energy policy and regulatory frameworks that will stimulate public and private investment to develop and deploy renewable energy. Renewable energy policies, such as the net-metering programme, which is intended for small- to medium-scale solar PV with less than 1-megawatt (MW) capacity; and the renewable portfolio standard policy, which will be introduced for large-scale solar PV to ensure that a certain percentage of energy consumption is powered by renewable energy. The 200 MW target by 2025 will mostly be from large-scale ground-mounted and floating solar PV.

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<sup>1</sup> Measured in constant 2010 values (with currency exchange rate of US\$1=BNS\$1.3)

## 2.2 Demand

Brunei Darussalam has implemented several initiatives and activities to achieve 45% energy intensity reduction by 2035. Government agencies and industry are collaborating to set up initiatives that promote energy efficiency and low energy-intensive industries. The role of industries includes identifying and implementing the latest technologies that may help reduce energy usage over time, whilst adopting consumption behaviour changes that include embracing energy-efficient appliances.

Efforts to achieve the energy efficiency and conservation (EEC) target are power efficiency improvement, setting standard and introduce labelling scheme for electrical appliances, deployment of electric vehicles, expansion of EEC building guidelines, and light-emitting diode (LED)-fitting system for streetlights, amongst others, through a whole-of-nation approach. The Department of Electrical Services and the Berakas Power Company play major roles in improving power efficiency of power stations, including establishing combined-cycle turbine and co-generation power plants, whilst phasing out single-cycle power stations and carbon-intensive diesel-powered plants.

## 2.3. Recent Energy Developments

As Brunei Darussalam aspires for greater economic development, the government has substantially invested in downstream oil and gas industries, including, since 2010, Brunei Methanol Company, and, since late 2019, Hengyi Industries Sdn Bhd. Further development in downstream activities is expected with the scheduled operation of Brunei Fertiliser Sdn Bhd in 2021 and the completion of the second phase of Hengyi Industries' refinery and petrochemical complex, which will drive gas demand.

## 2.4. Brunei Darussalam's Climate Change Commitments

In 2016, Brunei Darussalam joined the collective international effort to limit the global temperature rise to below 2° Celsius above pre-Industrial Revolution levels, and committed to pursuing efforts to limit the increase to 1.5° Celsius by signing the Paris Agreement. In 2020, the country marked a milestone with the launch of the Brunei Darussalam National Climate Change Policy, paving the way for a low-carbon and climate-resilient economy. In the same year, Brunei Darussalam submitted its nationally determined contribution (NDC), a commitment to reduce by 20% its national greenhouse gas (GHG) emissions by 2030 from the business-as-usual (BAU) level. At the 26th United Nations Climate Change Conference of Parties (COP26), Brunei Darussalam expressed interest in reaching net-zero emissions by 2050, primarily through energy transition and forest preservation.

## 3. Modelling Assumptions

Energy demand projections up to 2050, including macroeconomic parameters such as GDP and population, are forecast using the Long-range Energy Alternatives Planning system. Historical data are sourced from the Asia-Pacific Economic Cooperation Energy Database and the World Bank’s World Development Indicators for Brunei Darussalam (1990 and 2000).

### 3.1. Gross Domestic Product and Population

GDP and population trajectories through to 2050 will grow at an annual rate of 2.1% and 1.4%, respectively. Energy demand is expected to be driven by GDP and population, as the oil and gas sector continues to be the main economic pillar.

**Table 3.1 Brunei Darussalam – Gross Domestic Product and Population Projection (2020–2050)**

	Historical Data		2019–2050					AAGR (%) 2019–2050
	1990	2000	2019	2020	2030	2040	2050	
GDP (billion US\$)	9.6	12.0	13.3	14.0	17.5	21.6	26.6	2.1
Population (million)	0.26	0.37	0.46	0.44	0.50	0.58	0.67	1.4

AAGR = annual average growth rate, GDP = gross domestic product.

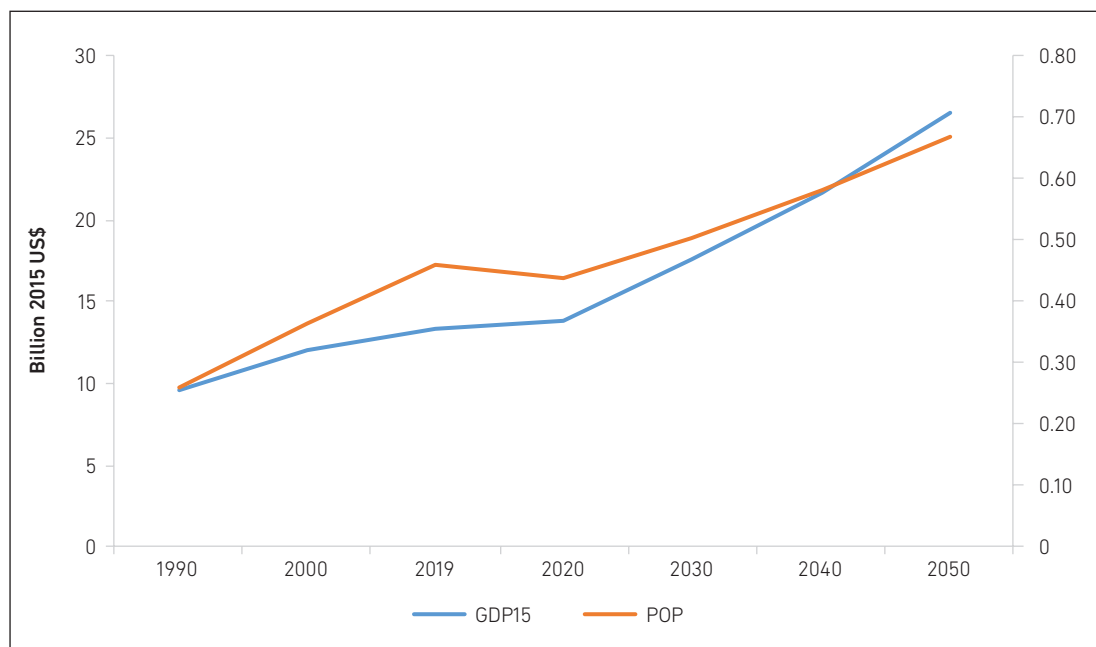
Source: Author; and World Bank, 2022. World Development Indicators for historical data.

### 3.2. Business as Usual, Alternative Policy Scenario, and Low-carbon Energy Transition

The study examines energy savings potential and energy efficiency improvement, carbon dioxide (CO<sub>2</sub>) emission reduction, and renewable energy development throughout the forecast period (2020–2050) through several scenarios:

- i. BAU reflects current trends in energy and demand and existing energy policies. It presents a basis against which other scenarios can be compared.

**Figure 3.1** Brunei Darussalam – Gross Domestic Product and Population Growth Rate, Business as Usual



GDP = gross domestic product, POP = population.

Source: Author.

- ii. The alternative policy scenario (APS) analyses different possible energy initiatives:
  - a. APS1. Implement and promote EEC initiatives, with 10% energy consumption reduction in 2019–2050.
  - b. APS2. Increase number of energy-efficient thermal power plants, with thermal efficiency of 30% for coal-fired power plants and 48% for natural gas-powered power plants.
  - c. APS3. Contribute more renewable energy to total energy supply.
  - d. APS4. Omitted as the country has no nuclear energy plans.
  - e. APS5. Combine APS1, APS2, and APS3.
- iii. The low-carbon energy transition (LCET) scenario has the most aggressive emission-reduction initiatives and programmes. It assumes alternative pathways where the country uses new technologies, such as carbon capture, utilisation, and storage (CCUS), in new gas-fired power plants. The scenario considers high use of electric vehicles.

### 3.3 Energy Supply and Consumption in 2019

Oil and natural gas remain the primary sources of total primary energy supply (TPES). In 2019, natural gas contributed most of TPES, or 3.60 million tonnes of oil equivalent (Mtoe) or 79%; oil contributed 16.4%. Coal entered the mix, accounting for 4.3%, as feedstock to the new power station for downstream industry (Hengyi Phase I), which started operating in late 2019. Use of renewable energy was minimal, accounting for only 0.003% of TPES.

Total final energy consumption (TFEC) was 1.66 Mtoe in 2019. Transport accounted for the largest share (34%), followed by non-energy at 32%. 'Others' and industry contributed about 23% and 11%, respectively. Oil remains the dominant fuel, accounting for 49% of TFEC, followed by natural gas at 32.3% and electricity at 18.7%.

The two major public utilities are owned by the Department of Electrical Services and the Berakas Power Company. All public utility power plants use natural gas to fuel the electricity grid. In 2019, the installed power generation capacity of public utility power plants was 890 MW, including solar PV at 1.3 MW. Natural gas and coal were used for energy industries' self-production. Total electricity production in 2019 was 5.17 terawatt-hours (TWh).

**Table 3.2 Brunei Darussalam – Energy Supply and Consumption (2019)**  
(Mtoe)

Supply and Consumption	Coal	Oil	Natural Gas	Electricity	Renewable Energy	Total
<b>Primary energy supplies</b>						
Indigenous production	-	6.40	10.95	-	0.00013	17.35
Net import and others	0.19	-5.66	-7.35	-		-12.81
<b>Total primary energy supply</b>	<b>0.19</b>	<b>0.74</b>	<b>3.60</b>	<b>-</b>	<b>0.00013</b>	<b>4.54</b>
<b>Final energy consumption</b>						
Industrial sector	-	0.12	-	0.12	-	0.24
Transport	-	0.56	-	-	-	0.56
'Others' a	-	0.06	0.02	0.31	-	0.39
Non-energy	-	0.01	0.52	-	-	0.53
<b>Total final energy consumption</b>	<b>-</b>	<b>0.75</b>	<b>0.54</b>	<b>0.43</b>	<b>-</b>	<b>1.72</b>

Mtoe = million tonnes of oil equivalent.

a Includes the residential and commercial sectors.

Source: Author.

## 4. Outlook Result

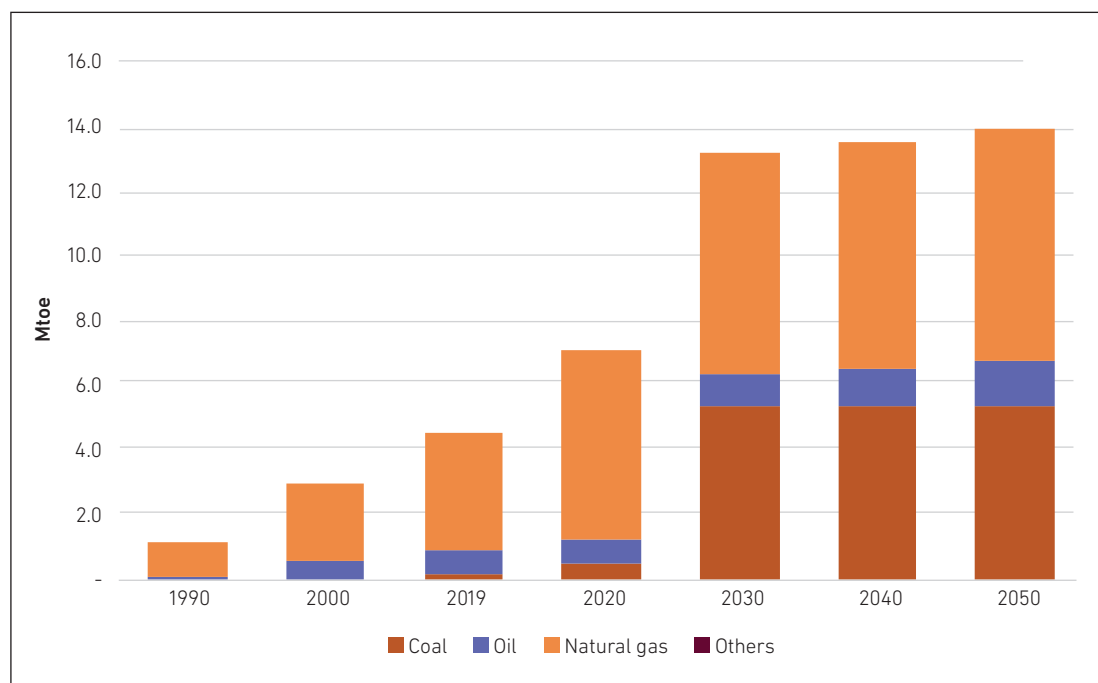
### 4.1. Business-as-Usual Scenario

The section describes the trends in energy production and utilisation with the current and existing policy intervention in reducing energy demand and CO<sub>2</sub> emissions.

#### 4.1.1. Primary Energy Supply

TPES is projected to reach 13.92 Mtoe in 2050, increasing by 3.7% per year from 4.54 Mtoe in 2019. Historically, TPES has been dominated by natural gas, at 79.6% in 2019. However, that share is expected to decline to 51.5% in 2050, with coal entering the mix through imports for the operation of the Hengyi Industries refinery and petrochemical complexes. Crude oil imports are expected to supplement the limited domestic oil supply, as a feedstock to Hengyi's refineries.

**Figure 3.2** Brunei Darussalam – Total Primary Energy Supply by Fuel, Business as Usual (1990–2050)



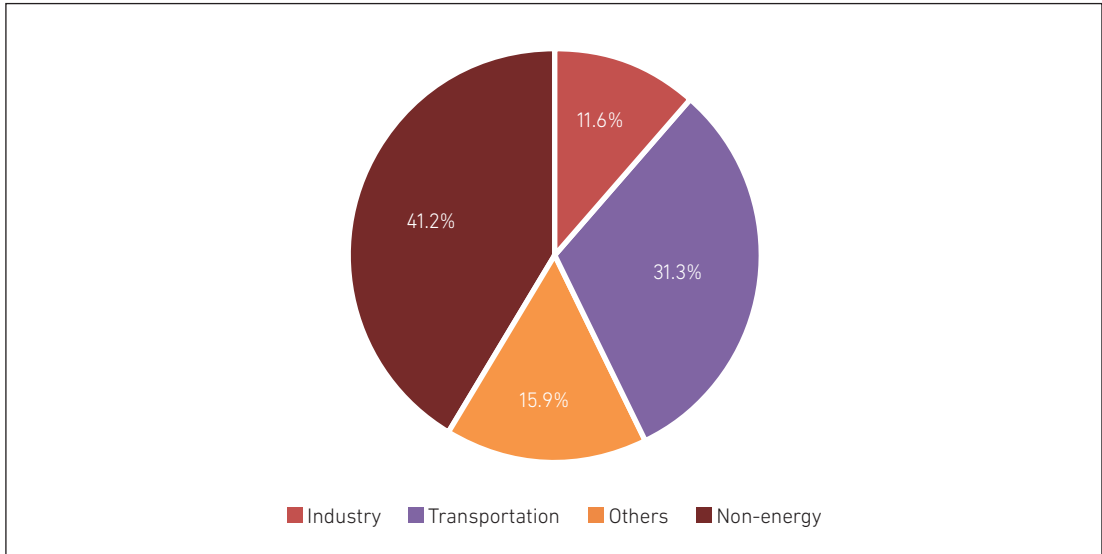
Mtoe = million tonnes of oil equivalent.

Source: Author.

### 4.1.2. Final Energy Consumption

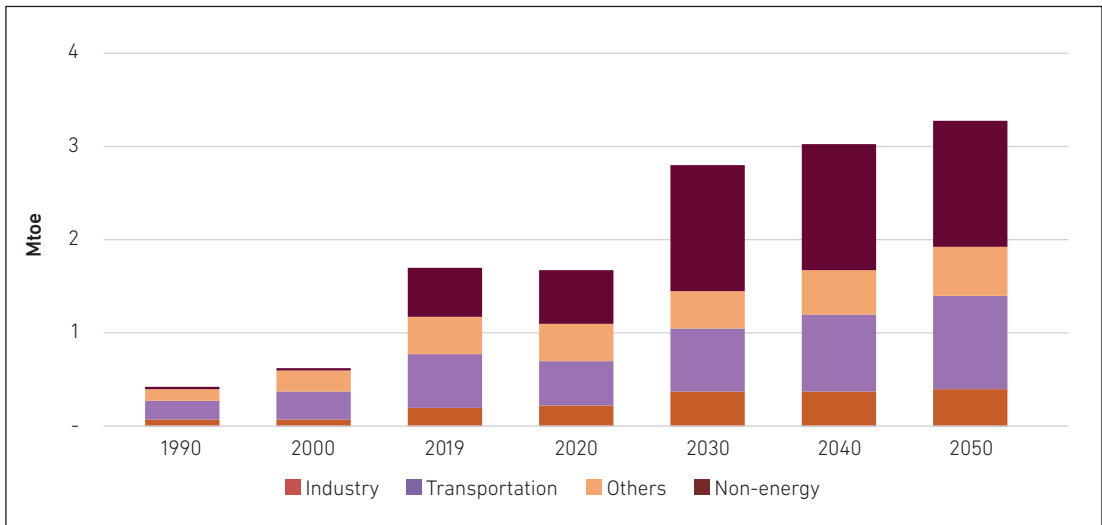
TFEC will increase by 2.1% annually to 3.2 Mtoe in 2050. The trend in TFEC is set to change as the non-energy sector is expected to contribute the largest share in 2050, at 41.2%, whilst the share of transport is expected to drop marginally from 33.8% to 31.3%, with 'others' declining from 23.3% to 15.9%.

**Figure 3.3** Brunei Darussalam – Final Energy Consumption by Sector, Business as Usual



Source: Author.

**Figure 3.4** Brunei Darussalam – Final Energy Consumption by Sector, Business as Usual



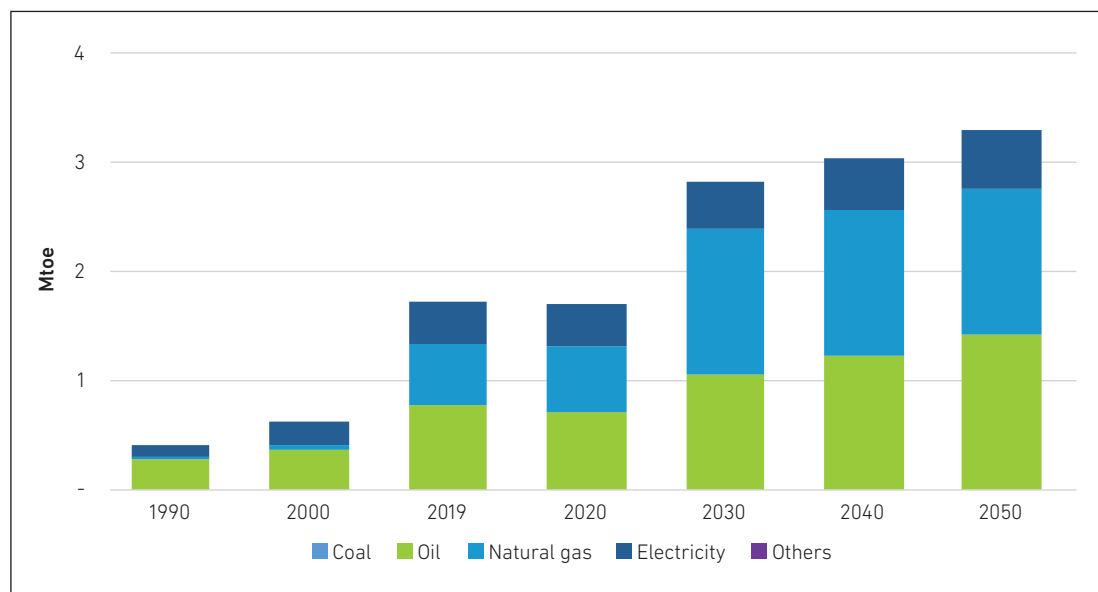
Mtoe = million tonnes of oil equivalent.

Source: Author.



Whilst oil has been the dominant fuel historically, attributed to growth in demand from transport, natural gas demand is expected to grow significantly over the outlook period. The share of natural gas will increase to 40.6% in 2050, compared with 32.6% in 2019, and the oil share will decrease from 60.1% to 43.1% in 1990–2050. The trend is driven mainly by new downstream facilities, such as the Brunei Methanol Company and the Brunei Fertiliser Industries (Figure 3.5). Demand for oil is expected to continue increasing, whilst demand for electricity is expected to increase marginally.

**Figure 3.5 Brunei Darussalam – Final Energy Consumption by Fuel, Business as Usual**



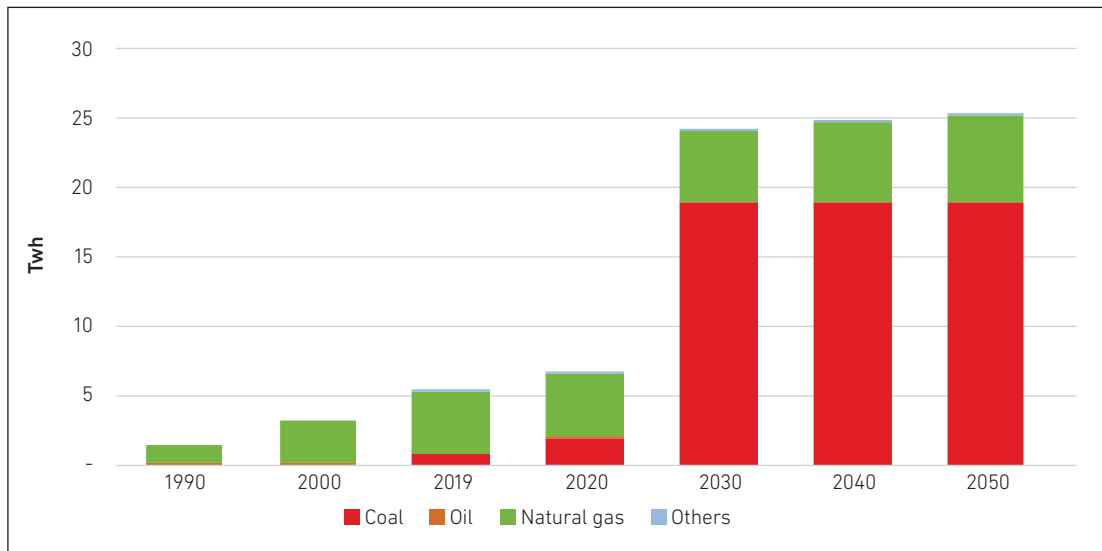
Mtoe = million tonnes of oil equivalent.

Source: Author.

### 4.1.3. Electricity Generation

Power generation from public utilities is dominated by natural gas whilst major downstream facilities are highly dependent on coal. The fuel mix throughout the outlook period mostly reflects changes in the power sector. Coal-fired power generation is expected to increase about 30-fold, with about 18.75 TWh of electricity generated in 2050, 6.20 TWh from natural gas and 0.033 TWh from renewable energy. Diesel power plants are expected to be phased out from 2023 onward.

**Figure 3.6 Brunei Darussalam – Electricity Generation by Fuel, Business as Usual**



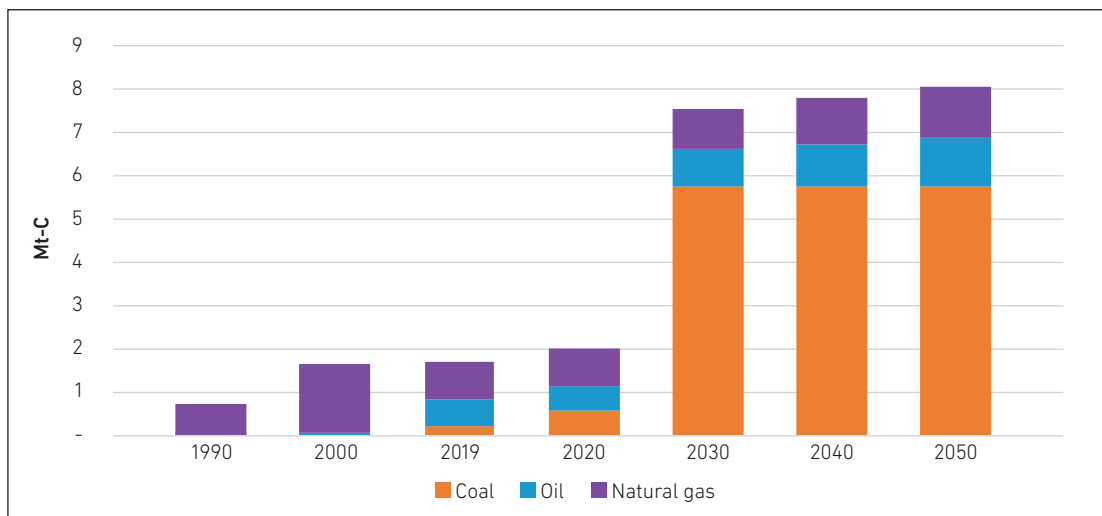
TWh = terawatt-hours.

Source: Author.

#### 4.1.4. CO<sub>2</sub> Emissions

Energy-related CO<sub>2</sub> emissions correlate to TPES. With minimal use of renewable energy, CO<sub>2</sub> emissions will increase from 1.7 million tonnes of carbon (Mt-C) in 2019 to 8 Mt-C in 2050 in BAU. Coal is projected to be the largest emission source, accounting for 71.5% of total CO<sub>2</sub> emissions, followed by natural gas at 14.6% and oil at 13.9%.

**Figure 3.7 Brunei Darussalam – Carbon Dioxide Emission by Fuel, Business as Usual**



Mt-C = million tonnes of carbon.

Source: Author.

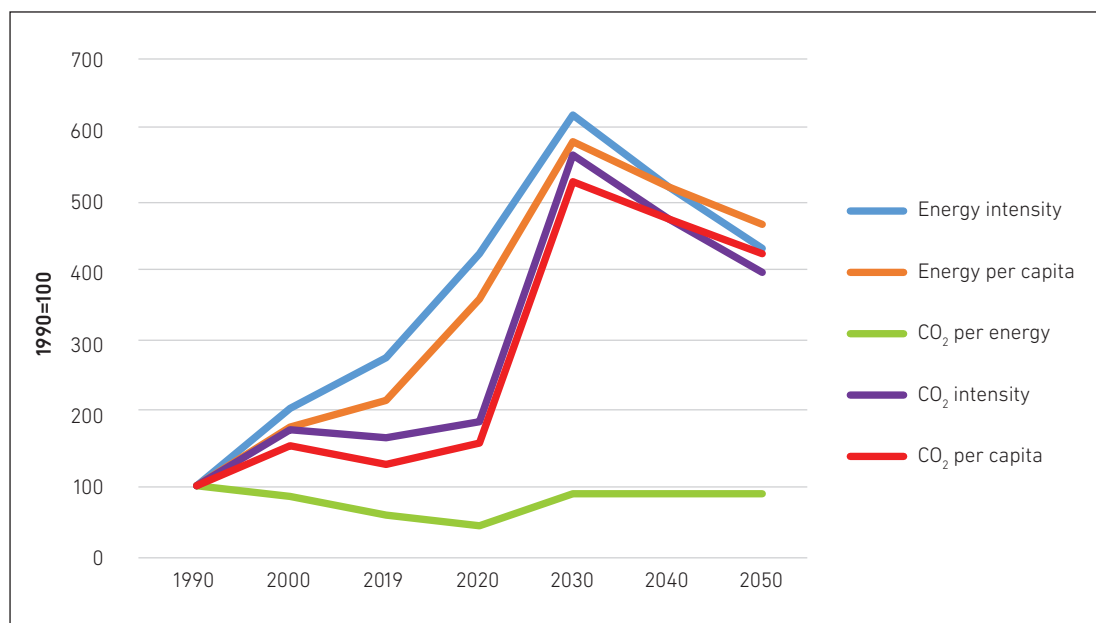
### 4.1.5. Energy Indicators

In 1990–2019, energy intensity showed an increasing trend. TPES doubled from 121 toe/US\$ million (in constant 2010 values) to 324 toe/US\$ million (in constant 2010 values) in 1990–2019. TFEC increased from 41 toe/US\$ million (in constant 2010 values) to 119 toe/US\$ million (in constant 2010 values) in 1990–2019. The trend is related to stable economic growth and the emergence of new power plants (Hengyi) in 2019. TPES and TFEC will increase until 2030 before they start decreasing in 2030–2050, to 524 toe/US\$ million (in constant 2010 values) and 120 toe/US\$ million (in constant 2010 values) in 2050, respectively. The trend is related to increased use of coal for Hengyi Phase 2 until 2030 and the phasing out of Hengyi Phase 2 after 2030.

Primary energy per capita increased from 4.5 toe/person in 1990 to 5.1 toe/person in 2019 and will continue to increase to 26.1 toe/person in 2030 but will fall to 20.9 toe/person in 2050.

CO<sub>2</sub> intensity reflects the increasing trend of energy intensity, from 75.1 t-C/US\$ million (in constant 2010 values) in 1990 to 118 t-C/US\$ million (in constant 2010 values) in 2019, then to 242.6 t-C/US\$ million (in constant 2010 values) in 2030 and 299.4 t-C/US\$ million (in constant 2010 values) in 2050. Per capita CO<sub>2</sub> significantly increased from 2.8 t-C/toe in 1990 to 5.6 t-C/toe in 2019 and will continue to increase to 11.9 t-C/toe in 2050 (Figure 3.8).

**Figure 3.8 Brunei Darussalam – Energy Indicators, Business as Usual**



Source: Author.

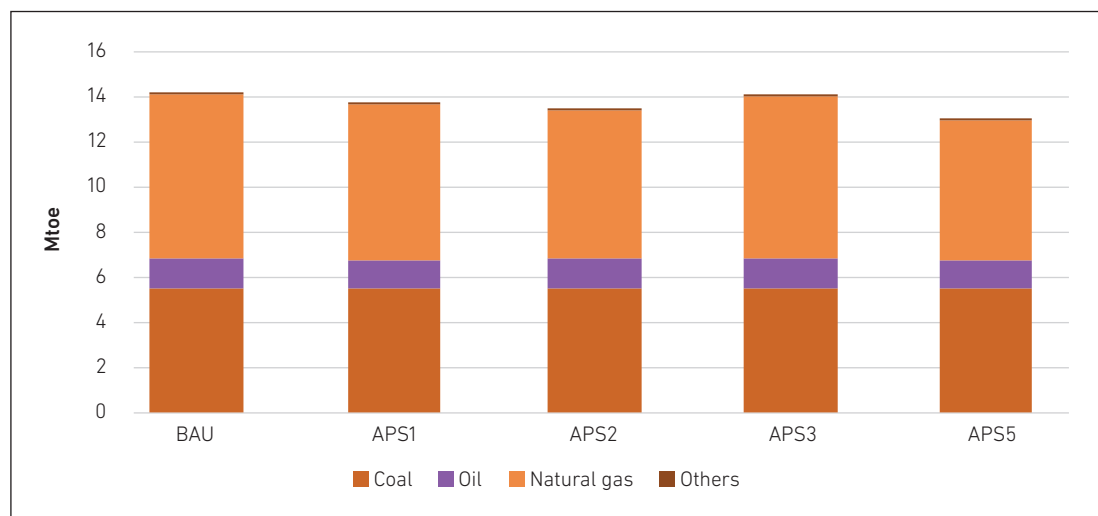
## 4.2. Alternative Policy Scenario

The APS was developed to estimate the energy-saving potential of Brunei Darussalam to achieve its energy intensity-reduction targets by deploying advanced technologies for energy saving and enforcing relevant initiatives.

### 4.2.1. Primary Energy Supply

TPES for coal remains the same in BAU and APS. Oil supply in 2050 under the APS is projected to be 10% lower than BAU as a result of implementing EEC measures. Natural gas supply in APS is also predicted to be about 10% lower than in BAU. However, renewable energy supply will increase significantly, particularly from solar PV sources.

**Figure 3.9** Brunei Darussalam – Reduction of Primary Energy Supply, Business as Usual and Alternative Policy Scenario



APS = alternative policy scenario, Mtoe = million tonnes of oil equivalent.

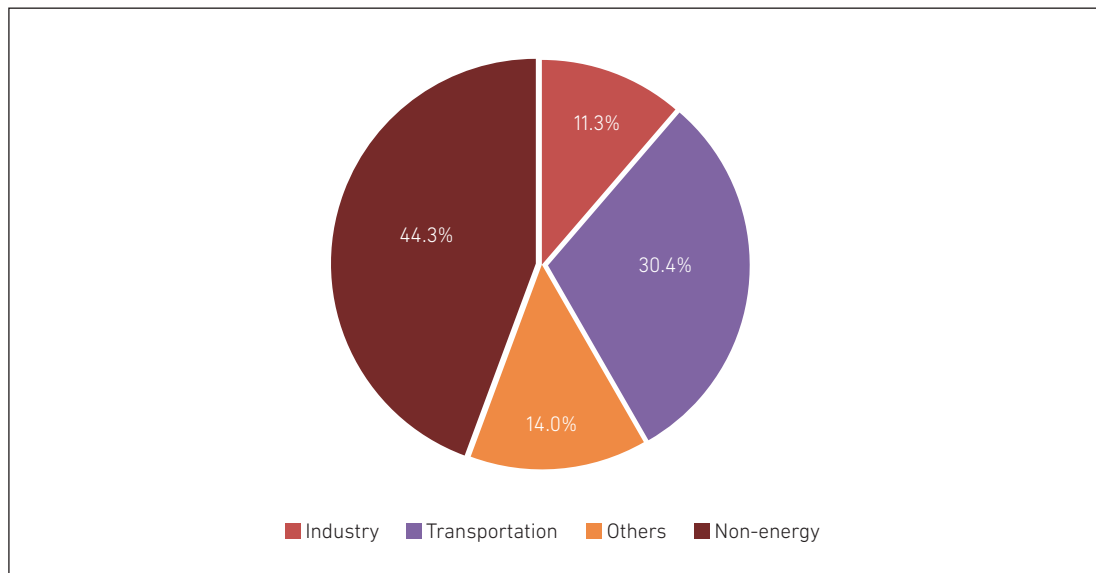
Source: Author.

The energy that could potentially be saved by implementing EEC measures and by developing renewable energy is about 1.1 Mtoe of TPES or equivalent to a reduction of 4.1% from BAU in 2050 (Figure 3.9).

### 4.2.2. Final Energy Consumption

Overall TFEC in 2050 will be 3 Mtoe. In 2050, 11.3% of energy demand will be required by industry, followed by 'others' at 14.0% and transport at 30.4%. Demand by the non-energy sector will be at 44.3% (Figure 3.10).

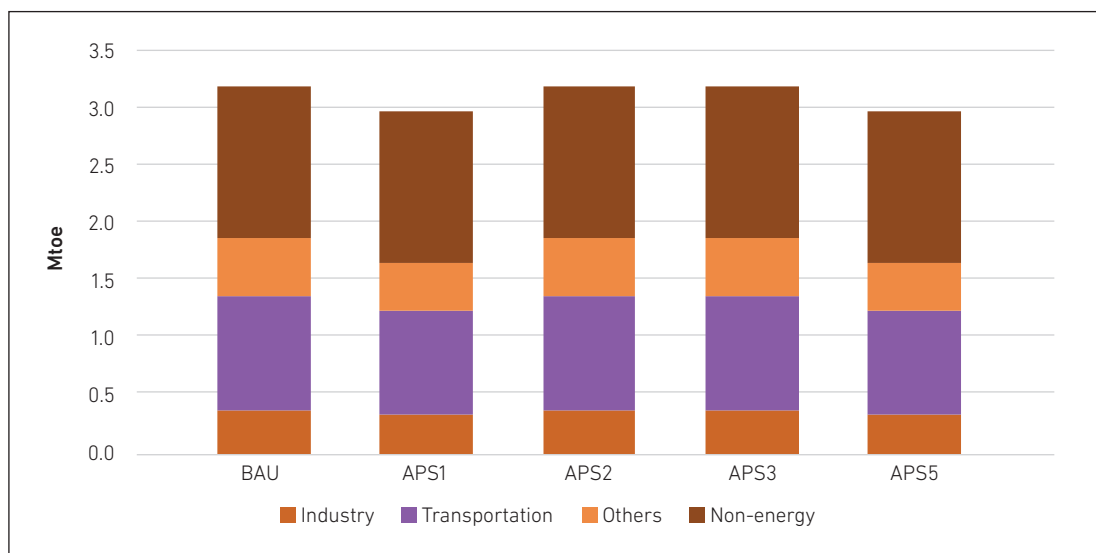
**Figure 3.10** Brunei Darussalam – Final Energy Consumption Share by Sector, Alternative Policy Scenario



Source: Author.

TFEC is projected to remain the same in APS against BAU in the non-energy sector, at 1.32 Mtoe in 2050. However, TFEC will be reduced by 7% by 2050 (Figure 3.11) with EEC initiatives in place.

**Figure 3.11** Brunei Darussalam – Final Energy Consumption by Sector, Business as Usual and Alternative Policy Scenario

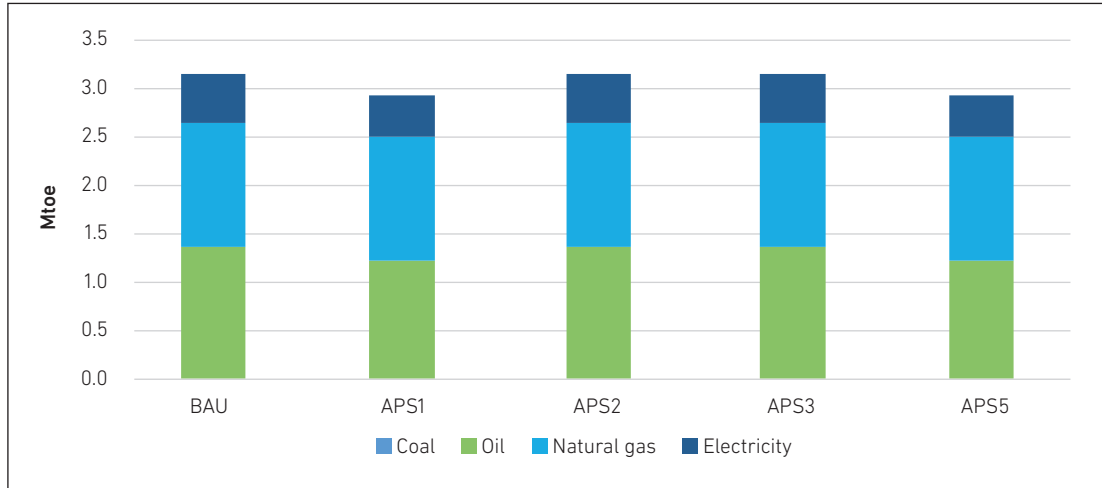


APS = alternative policy scenario, Mtoe = million tonnes of oil equivalent.

Source: Author.

TFEC is projected to remain the same in APS and BAU, at 1.3 Mtoe for natural gas in 2050. With the implementation of the EEC programme, TFEC will be reduced by about 10% or 1.24 Mtoe for oil and by about 18% for electricity (0.43 Mtoe) in 2050 in scenarios against BAU (Figure 3.12).

**Figure 3.12 Brunei Darussalam – Final Energy Consumption by Fuel Type, Business as Usual and Alternative Policy Scenario**



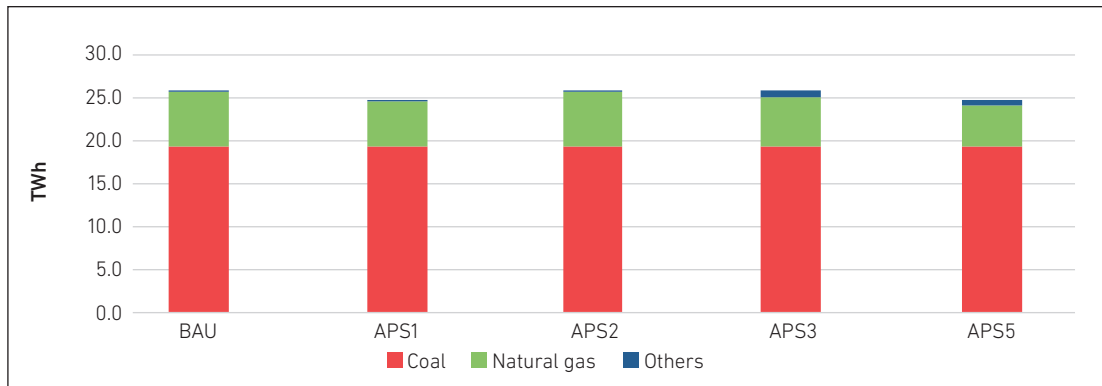
APS = alternative policy scenario, Mtoe = million tonnes of oil equivalent.

Source: Author.

### 4.2.3. Power Generation

Power generation is projected to decline by 4% to 23.88 TWh from 24.98 TWh in BAU owing to the increase in renewables. As coal-fired generation remains unchanged across all scenarios, the share of renewables will increase slightly in APS, 2% compared with 0.1% in BAU (Figure 3.13).

**Figure 3.13 Brunei Darussalam – Power Generation, Business as Usual and Alternative Policy Scenario**



APS = alternative policy scenario, Mtoe = million tonnes of oil equivalent.

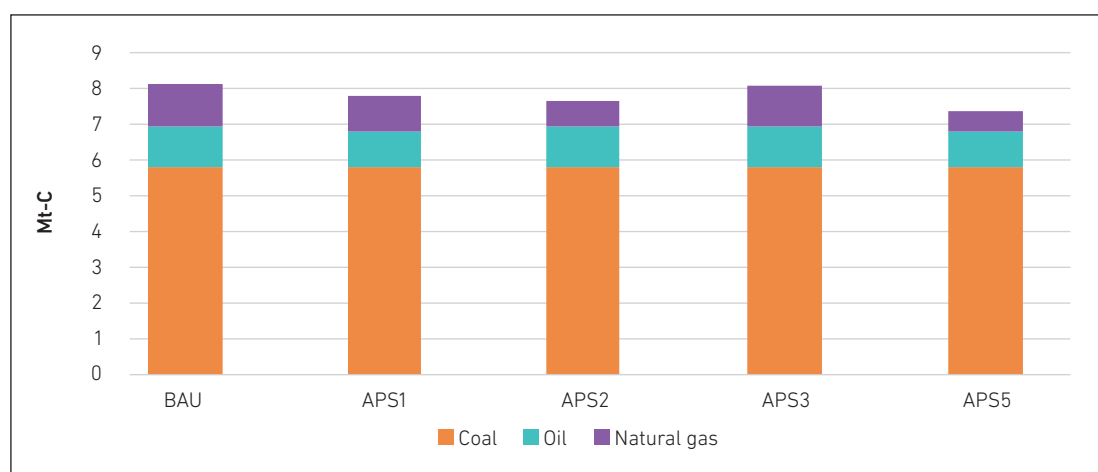
Source: Author.

#### 4.2.4. CO<sub>2</sub> emissions

CO<sub>2</sub> emissions from coal will remain unchanged in 2050 compared with BAU (Figure 3.14), at 5.69 Mt-C. CO<sub>2</sub> emissions from oil against BAU in 2050 will be reduced by 10% once energy-saving initiatives are implemented.

Results of the model show a significant reduction against BAU, with a total of 0.46 Mt-C by 2050. The decrease in CO<sub>2</sub> is significantly attributed to more efficient power generation plants. CO<sub>2</sub> emissions from natural gas will remain unchanged even after the introduction of renewable energy in 2050. Improved efficiencies in power generation plants, coupled with energy-saving initiatives, will further reduce overall CO<sub>2</sub> emissions by 0.72 Mt-C in 2050 (Figure 3.14).

**Figure 3.14 Brunei Darussalam – CO<sub>2</sub> Emissions in Energy Consumption, Business as Usual and Alternative Policy Scenario**



APS = alternative policy scenario, Mtoe = million tonnes of carbon.

Source: Author.

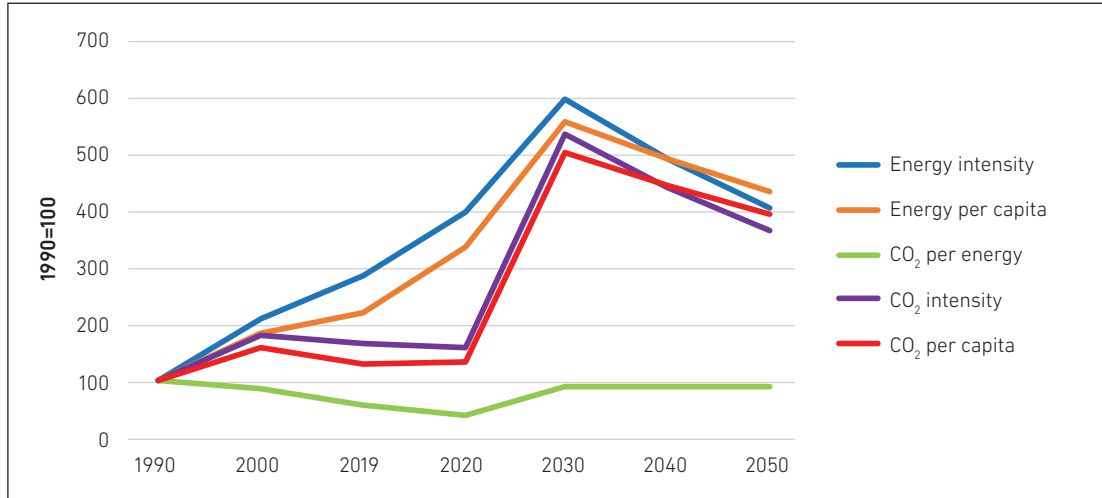
#### 4.2.5. Energy Indicators

Energy intensity shows an increasing trend in 2019–2030 as TPES doubled from 324 toe/US\$ million (in constant 2010 values) to 712 toe/US\$ million (in constant 2010 values), and TFEC significantly increased from 119 toe/US\$ million (in constant 2010 values) in 2019 to 152 toe/US\$ million (in constant 2010 values) in 2030. The increasing trend is related to stable economic growth. TPES and TFEC will start to show a decreasing trend in 2030–2050, at 483 toe/US\$ million (in constant 2010 values) and 112 toe/US\$ million (in constant 2010 values) in 2050, respectively.

Primary energy per capita will increase to 24.7 toe/person in 2030 from 5.1 toe/person in 2019 and will drop to 19.2 toe/person in 2050.

CO<sub>2</sub> intensity will reflect the increasing trend of energy intensity, from 118 t-C/US\$ million (in constant 2010 values) in 2019 to 399 t-C/US\$ million (in constant 2010 values) in 2030 before dropping to 272 t-C/US\$ million (in constant 2010 values) in 2050 (Figure 3.15).

**Figure 3.15 Brunei Darussalam – Energy Indicators, Alternative Policy Scenario**



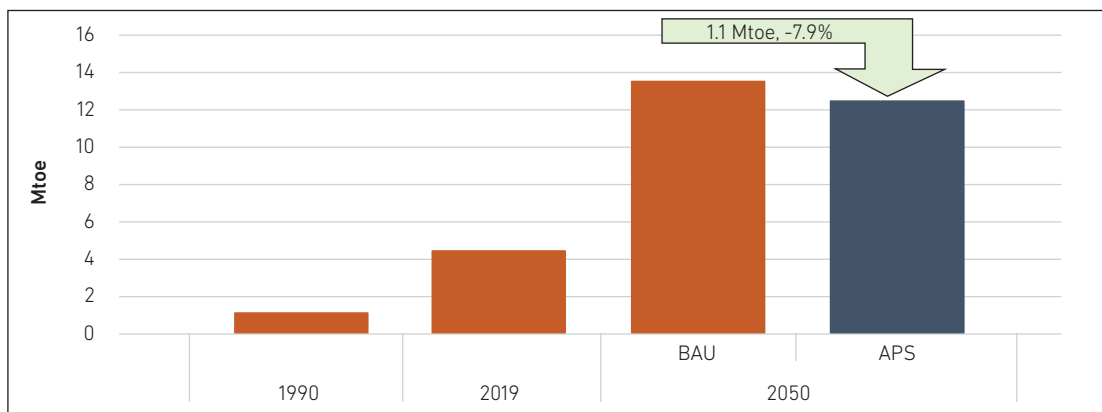
Source: Author.

## 4.2.5. Projected Energy Saving

### 4.2.5.1. Primary Energy Supply

Implementing EEC initiatives, improving thermal efficiency in power generation plants, and integrating renewables will reduce TPES by 1.1 Mtoe or 7.9% from BAU in 2050.

**Figure 3.16 Brunei Darussalam – Total Primary Energy Supply, Business as Usual and Alternative Policy Scenario**



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

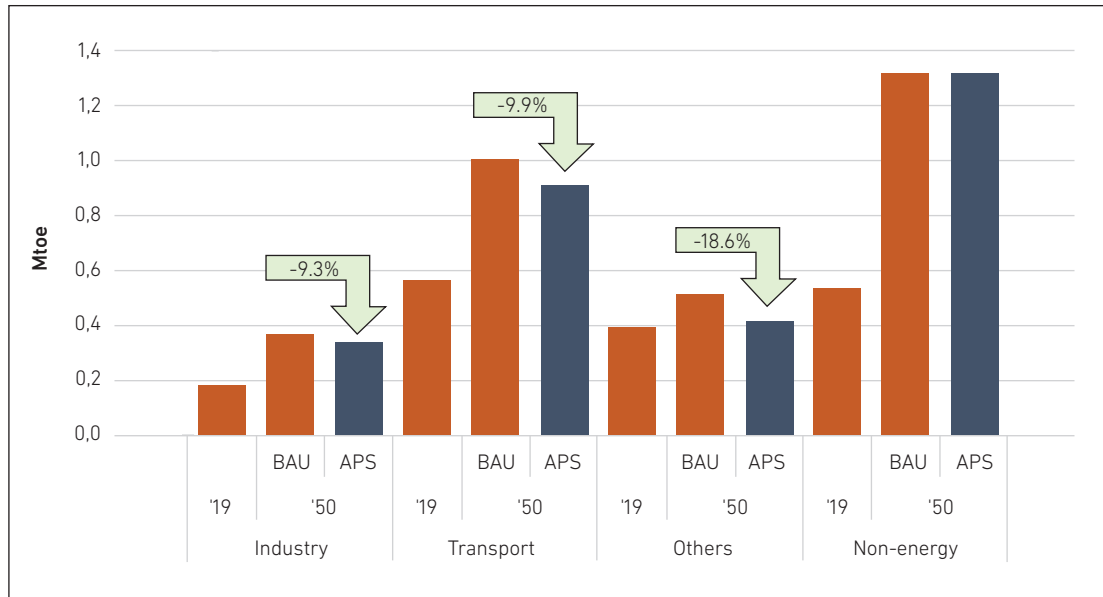
Source: Author.



#### 4.2.5.2. Final Energy Consumption and Primary Energy Supply

Contributions from improved fuel efficiency in transport are projected to result in the decline in TFEC in APS. TFEC in transport could decrease by 9.9% in 2050 compared with BAU. 'Others' will show significant potential reduction by 18.6% with implementation of more EEC such as standards and labelling in the residential and commercial sectors. Industry's demand will be 9.3% lower in 2050.

**Figure 3.17 Brunei Darussalam – Total Final Energy Consumption by Sectors, Business as Usual and Alternative Policy Scenario**

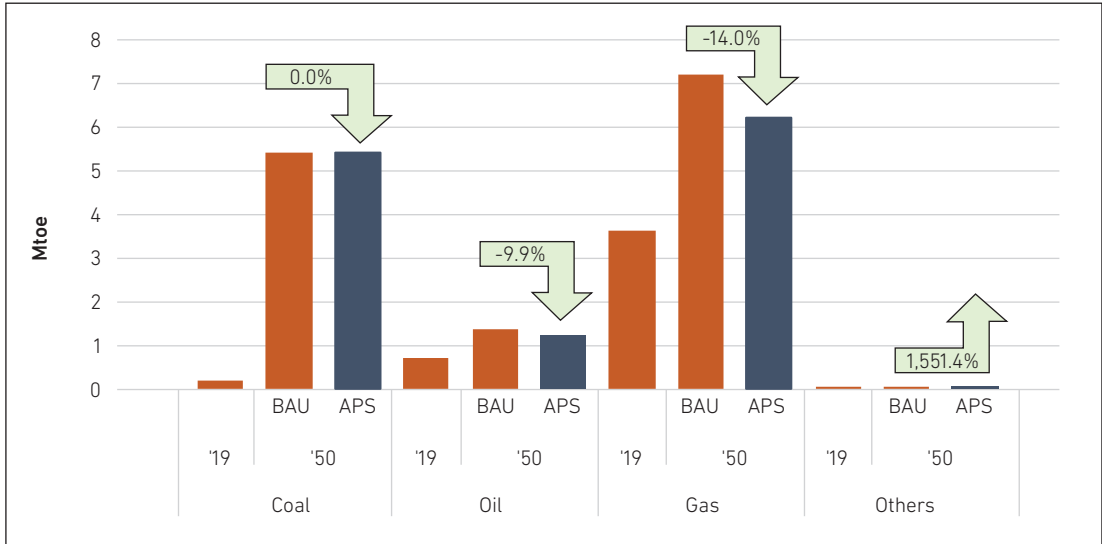


APS = alternative policy scenario, BAU= business as usual, Mtoe = million tonnes of oil equivalent.

Source: Author.

In 2050, 0.05 Mtoe solar PVs will be deployed as part of the programme to increase renewable energy share in generating electricity. Oil consumption will reduce with improvements in fuel economy standards, with savings of 9.9% in 2050. Natural gas is projected to decline with increased efficiency in power plants, contributing to about 14% savings. Coal demand will remain consistent. Figure 3.18 is comparison of primary energy supply between BAU and APS.

**Figure 3.18** Brunei Darussalam – Total Primary Energy Supply by Fuel Type, Business as Usual and Alternative Policy Scenario



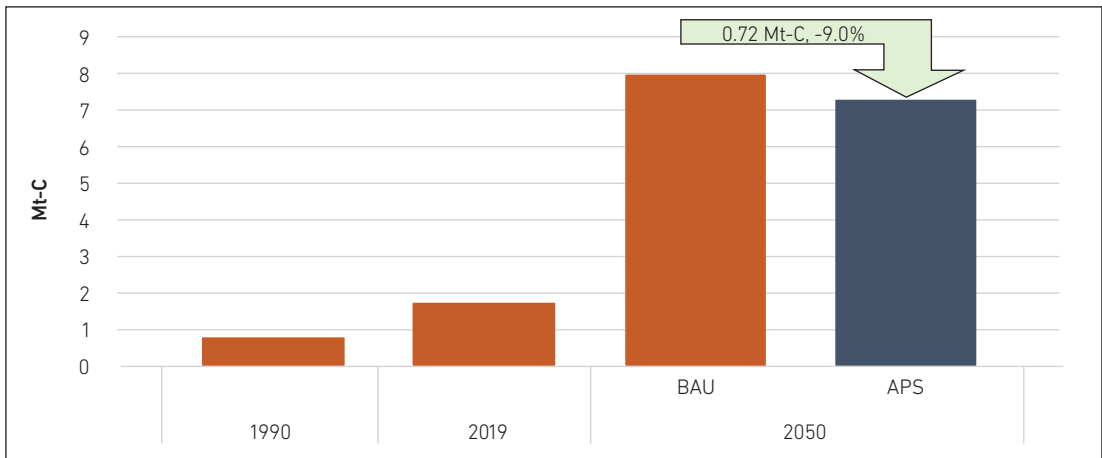
APS = alternative policy scenario, BAU= business as usual, Mtoe = million tonnes of oil equivalent.

Source: Author.

#### 4.2.5.3. CO<sub>2</sub> Emissions

Reduction of fossil fuel consumption will be the main driver of CO<sub>2</sub> emission reduction in 2050. The largest reduction will come from natural gas, with 50%. Overall CO<sub>2</sub> emissions are 9% lower in 2050 compared with BAU (Figure 3.19).

**Figure 3.19** Brunei Darussalam – CO<sub>2</sub> Emissions, Business as Usual and Alternative Policy Scenario



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

Source: Author.

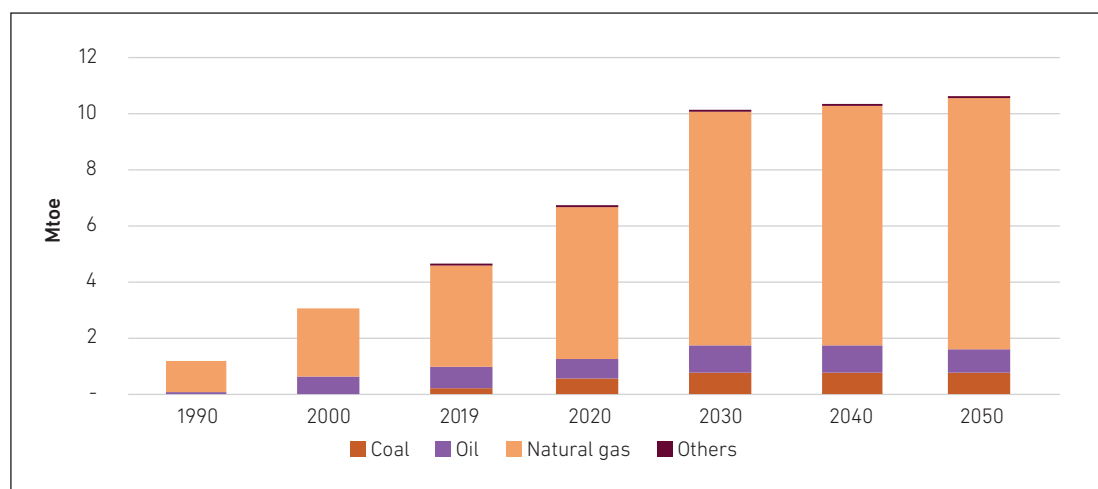
### 4.3. Low-carbon Energy Transition Scenario

LCET is underpinned by emission-reduction targets of Brunei Darussalam’s two aspirational goals: NDC by 2030 and net-zero emission commitment by 2050. LCET explores the impact on energy supply and demand of new technologies, such as CCUS, for energy own-use, particularly on natural gas, from 2040. The scenario introduces significant penetration of electric vehicles.

#### 4.3.1. Primary Energy Supply

LCET sees a decline in TPES by 19.2% to 10.4 Mtoe compared with APS. The share of natural gas is projected to increase to 84.3% in 2050 and the shares of coal and oil to decline to 7.4% and 7.6%, respectively. The trend is assumed to be attributed to the switch from natural gas to coal in the second phase of the Hengyi petrochemical complex.

**Figure 3.20 Brunei Darussalam – Total Primary Energy Supply, Low-carbon Energy Transition**



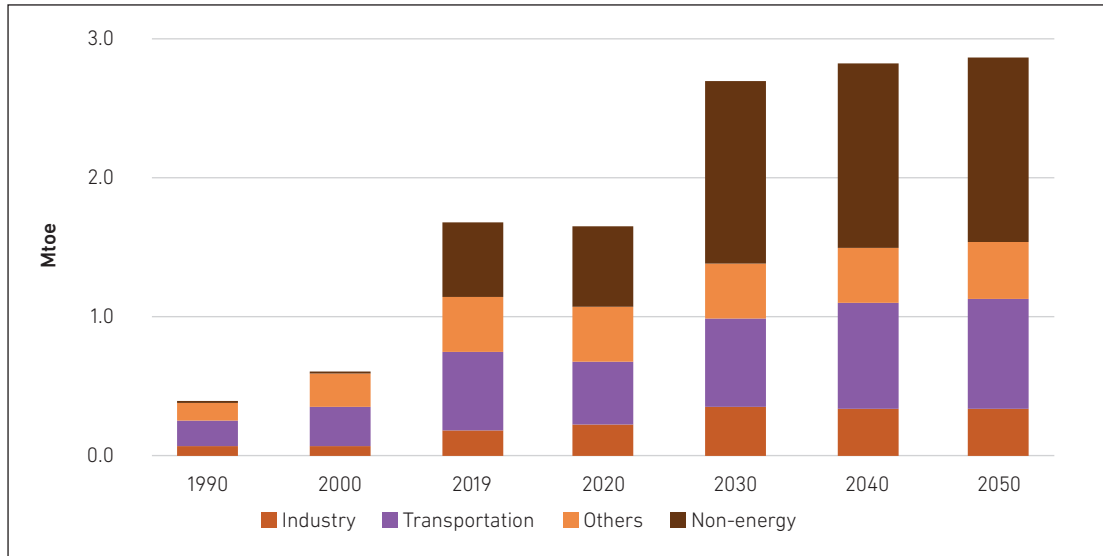
Mtoe = million tonnes of oil equivalent.

Source: Author.

#### 4.3.2. Final Energy Consumption

The highest reduction in TFEC is expected to occur in transport: 13.6% in 2050 compared with APS. The drop is primarily the result of stricter fuel efficiency regulations and the introduction of electric vehicles. 'Others' will see further demand reductions by 1.5% if stringent EEC measures for buildings are implemented.

**Figure 3.21** Brunei Darussalam – Total Final Energy Consumption by Sector, Low-carbon Energy Transition

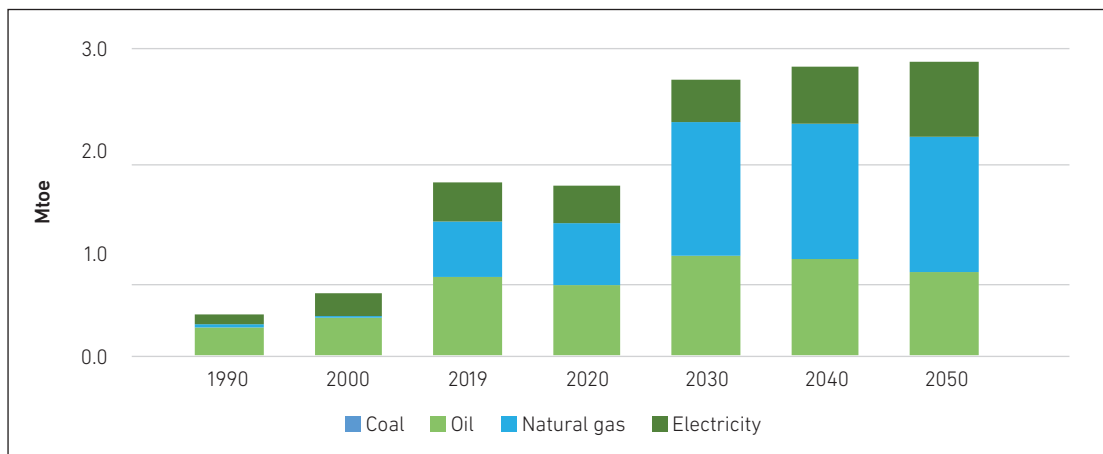


Mtoe = million tonnes of oil equivalent.

Source: Author.

In 2050, electricity's share of 25.3% will be noticeably higher in TFEC than the 14.4% share in BAU, in line with anticipated electricity demand for electric vehicles. Whilst the share of oil will decline to 28.5%, the share of natural gas is expected to increase to 46.2% as demand for natural gas will continue to surge with the expansion of downstream industry. Total TFEC is projected to drop from 3 Mtoe to 2.8 Mtoe in APS in 2050.

**Figure 3.22** Brunei Darussalam – Total Final Energy Consumption by Fuel Types, Low-carbon Energy Transition



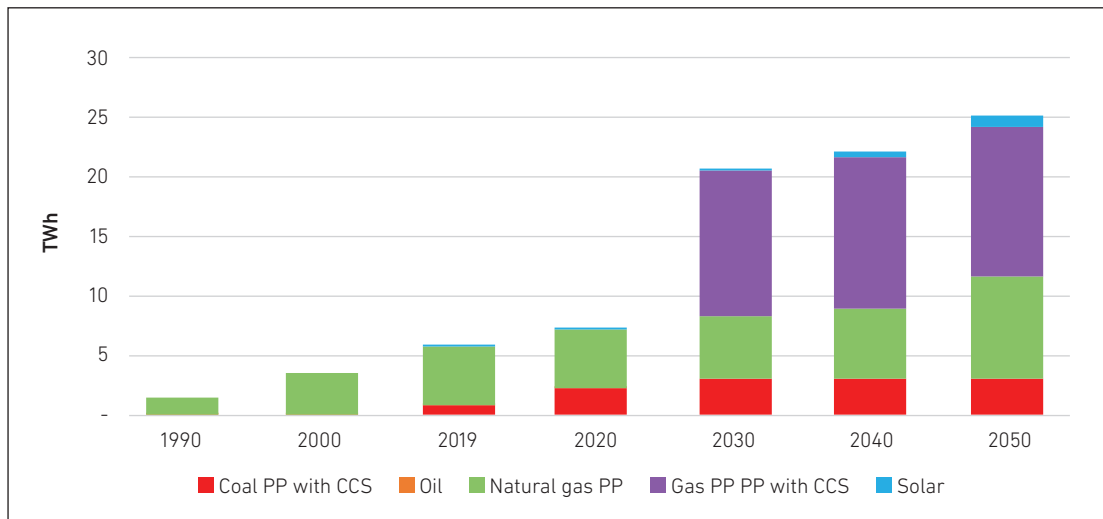
Mtoe = million tonnes of oil equivalent.

Source: Author.

### 4.3.3. Power Generation

Power generation is expected to remain largely from fossil fuels, with an increase of natural gas share to 81.3% compared with 14% in APS, whilst the share of coal will drop to 18.7%. It is assumed that the own use of coal to operate Hengyi Phase I is not affected in LCET and will remain the same as in BAU and APS. However, LCET will assume that Hengyi Phase II will transition to gas-fired power generation, including CCUS, from coal. The transition will result in a moderate reduction in electricity generation to 22.6 TWh in 2050 from 23.98 TWh in APS.

**Figure 3.23 Brunei Darussalam – Power Generation, Low-carbon Energy Transition**



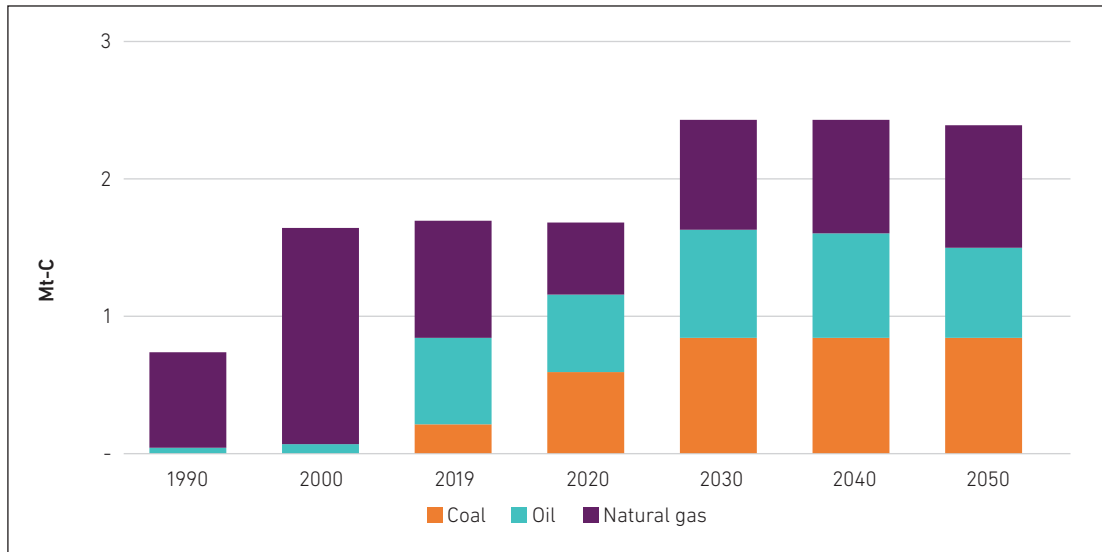
CCS = carbon capture and storage, PP = power plant, TWh = terawatt-hour.

Source: Author.

### 4.3.4. CO<sub>2</sub> Emissions

Total CO<sub>2</sub> emissions will peak in 2030 and show a declining trend of about -0.17% per year to reach 2.3 Mt-C in 2050, as less demand for oil is expected. Natural gas will become the major source of CO<sub>2</sub> emissions, with a 37.6% share in 2050, followed by coal with 35.2%. Oil is projected to emit the least, with 27.2%. Using a CCUS unit in natural gas power plants will reduce CO<sub>2</sub> emissions by 67.6% in LCET compared with APS.

**Figure 3.24 Brunei Darussalam – CO<sub>2</sub> Emissions, Low-carbon Energy Transition**



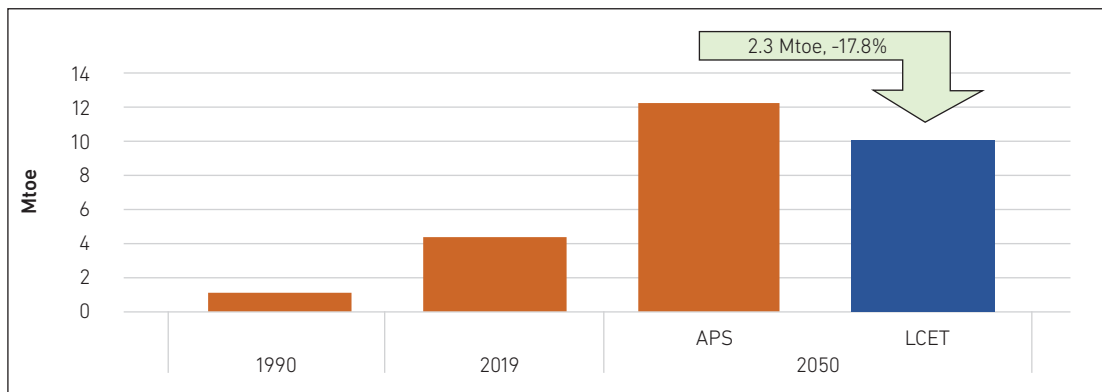
Mt-C = metric tonne of carbon.

Source: Author.

#### 4.3.5. Saving of Fossil Fuel Consumption and CO<sub>2</sub> Emission Reduction

At 10.5 Mtoe in 2050, TPES in LCET is 2.3 Mtoe less than in BAU, with fuel saving of 17.8%. CO<sub>2</sub> emissions are expected to be 67.6% lower than in APS. Projected carbon removal of about 3.8 Mt-C and CO<sub>2</sub> emissions of 2.3 Mt-C in 2050 will result in a net sink of -1.5 Mt-C. Hence, the NDC and net-zero emission target is assumed to be achieved in LCET, which means that ambitious measures are required to put the economy on a sustainable energy pathway to realise net-zero emission by 2050.

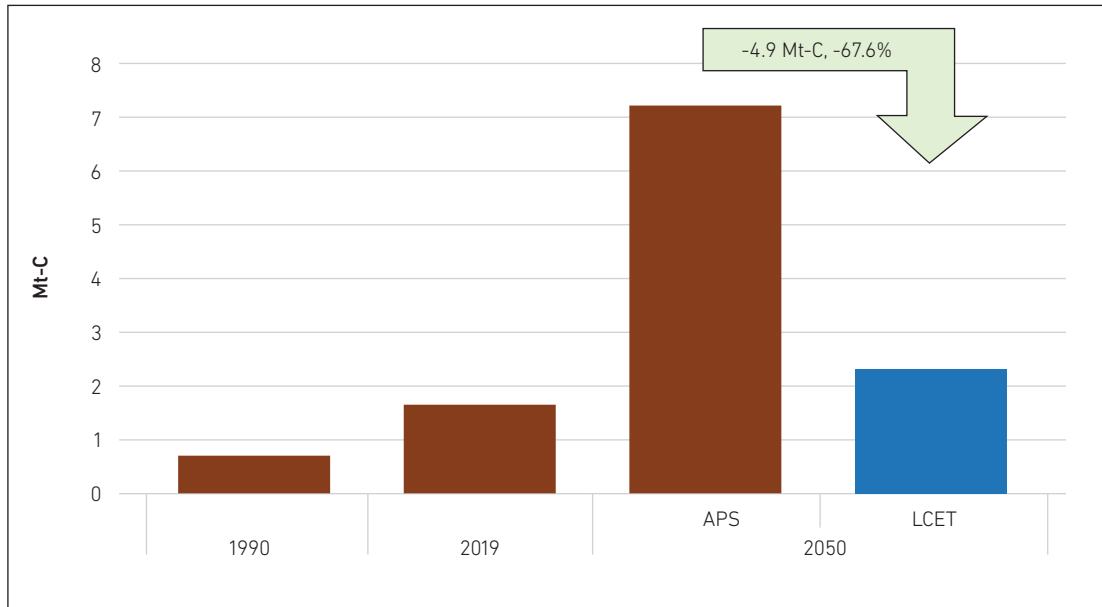
**Figure 3.25 Brunei Darussalam – Saving of Fossil Fuel Consumption, Alternative Policy Scenario and Low-carbon Energy Transition**



APS = alternative policy scenario, LCET = low carbon energy transition, Mtoe = million tonnes of oil equivalent.

Source: Author.

**Figure 3.26** Brunei Darussalam – CO<sub>2</sub> Emission Reduction, Alternative Policy Scenario and Low-carbon Energy Transition



APS = alternative policy scenario, LCET = low carbon energy transition, Mt-C = million tonnes of carbon.

Source: Author.

## 5. Key Findings

- Brunei Darussalam will remain heavily reliant on fossil fuels to meet growing energy demand in all scenarios, with increasing dependency on oil imports.
- The non-energy sector will drive energy demand as a significant volume of natural gas will be needed to expand downstream industries as the economy diversifies.
- Transport will offer the greatest savings in the net-zero emission scenario, with improved vehicle efficiency and greater use of electric vehicles.
- Although renewable energy is the fastest-growing energy source after coal, growth is considered moderate as coal will take the lead.
- Energy-related CO<sub>2</sub> emissions will decrease significantly in the net-zero emission scenario compared with APS. Current policies are not sufficient to meet NDC as emissions continue to rise in BAU and APS.
- The power sector must be decarbonised through CCS or higher shares of renewable energy.

## 6. Policy Recommendations

To increase renewable energy sources and EEC, Brunei Darussalam will continue to explore and promote low-carbon measures through several initiatives:

### i) Setting sustainable energy development targets

- a) The energy sector aims to reduce energy intensity by 45% in 2035 from the baseline year of 2005. Energy intensity can be reduced by improving EEC and diversifying the economy with high value-added but less energy-intensive industries.
- b) The country can adopt and use renewable energy technologies that focus on increasing the total share of renewable energy to 200 MW by 2025 and to at least 70% of total capacity in the power generation mix by 2050. That could be achieved by public and private investments in the technologies. Measures include policies enabling installation and integration of renewable energy such as the net-metering programme, renewable portfolio standards, reverse bidding through public-private partnerships, improvement of grid infrastructure to allow integration of renewable energy into the grid through rooftop solar PV, and large-scale solar PV as well as floating solar PV. Other renewable energy such as wind energy and hydropower imports can be explored.

### ii) Promoting energy efficiency and conservation

- a) Improving supply- and demand-side efficiency  
On the supply side, Brunei Darussalam is pursuing a strategy to improve efficiency of existing open-cycle gas turbines whilst more efficient combined-cycle gas turbines are being used for new capacity expansion. Reduction of electricity consumption from the user side (demand side) will enhance energy savings further by increasing public awareness.
- b) Managing electricity and fuel demand  
Demand management is one of the strategies to reduce the use of fossil fuels in electricity generation and transport, and can be achieved by improving energy efficiency of the stock of energy technologies and increasing the utilisation efficiency of existing and future technologies.
  - **Standards and labelling order (SLO).** Rolled out in 2021, standards and labelling order for electrical appliances are regulatory frameworks that allow only efficient technologies to be used in residences and only efficient electrical appliances to be sold in the market. Regulation has started with air conditioning systems and will cover refrigerators, lighting systems, and water heaters.
  - **EEC guidelines for non-residential buildings.** The guidelines aim to establish EEC standards for buildings. The EEC building guideline is mandatory for all government buildings. The Department of Energy, Prime Minister's Office, in collaboration with the Ministry of Development, is planning to make the guidelines mandatory in the commercial sector.
  - **Energy management.** Brunei Darussalam is considering adopting an energy management system that is compatible with ISO 50001. Building owners will be encouraged to introduce management systems that include equipment to monitor energy consumption, such as building automation systems, demand controllers, and building energy management systems. Deploying energy managers in buildings is crucial to monitor and manage the energy efficiency of a facility or organisation by implementing conservation measures, monitoring energy consumption, assessing business decisions for sustainability, and seeking out opportunities to increase energy efficiency.



- **Tariff reforms for the residential sector.** The progressive electricity tariff structure, introduced in 2012, is a tool to ensure the efficient use of energy by providing a financial disincentive for higher energy consumption. The reform's main objective is to help low-income citizens by charging them BN\$0.01/kWh for basic electricity consumption, thus promoting energy saving and avoiding energy wastage. Tariff reforms will be extended to the commercial sector to further promote EEC.

### iii) Decarbonisation of the power sector

- **Hydrogen.** Hydrogen is a potential energy source that could serve as feedstock and storage; decarbonise energy, transport, and industry; and generate power. Hydrogen technologies can contribute to carbon neutrality by producing hydrogen from natural gas or methane via steam-reforming processes (grey hydrogen), fossil fuel with CCS (blue hydrogen), and renewable energy (green hydrogen).
- **Coal-to-gas switch.** Fuel switching is recommended to meet environmental or climate change challenges. Switching from coal – the largest emitter of CO<sub>2</sub> – to natural gas may not be a long-term answer, but it can significantly improve air quality. The emissions offset from fuel switching can support electric vehicles running on zero-carbon electricity.

### iv) Decarbonisation of transport

- **Deployment of electric vehicles.** The strategy is to increase the share of electric vehicles to 100% of total annual sales by 2050. The target of electric vehicle deployment is subject to future development of electric vehicle technologies and infrastructure. Brunei Darussalam rolled out a pilot project for electrical vehicles in 2021 by providing public charging infrastructure.

### v) Introduction of new technologies

- **CCS.** Capturing and storing up to 90% of CO<sub>2</sub> from burning fossil fuel for electricity generation and in industrial processes can reduce GHG emissions, lessen the impacts of climate change, and help achieve the net-zero emission target.

To achieve the objectives of Wawasan Brunei 2035, all economic sectors, including energy, must significantly boost their activity. Despite the growing emphasis on EEC, energy demand is expected to continue its steady ascent. Thus, the country will continue to rely on fossil fuels as its primary source of energy to meet rising domestic demand.

