

CHAPTER 3

BRUNEI DARUSSALAM COUNTRY REPORT

Ministry of Energy and Industry, Brunei Darussalam

1. Background

Brunei Darussalam (Brunei) is a small nation on the northwest coast of the island of Borneo. It is located in Southeast Asia and has a coastline of 161 kilometres along the South China Sea in the north. The East Malaysian state of Sarawak completely surrounds Brunei on all other sides. The country has a total land area of only 5,765 square kilometres and comprises four main districts: Belait, Tutong, Temburong, and Brunei-Muara. Its capital city is Bandar Seri Begawan located in the Brunei-Muara district. Because of its proximity to the equator, the country experiences a hot and wet climate throughout the year.

Brunei Darussalam is an economy with great economic potential. Its gross domestic product (GDP) in 2015 was US\$13.9 billion at constant year 2010. With a population of 416,500, Brunei's GDP per capita was US\$33,340 at constant year 2010. About 60% of Brunei's GDP is generated by the energy sector. This reflects the significant contribution of this sector to the country's economy. The energy sector also dominates Brunei's export value as crude oil, natural gas (in the form of liquefied natural gas), and methanol exports account for more than 90% of its total exports, which are primarily destined to Japan, the Republic of Korea, India, China, and (ASEAN) countries.

To drive the economy into a sustainable future, the country supports the implementation of three strategic goals set out in the Brunei Darussalam's Energy White Paper launched in March 2014. The White Paper sets out strategic goal 2, which is specifically for energy supply and demand, i.e. to ensure a safe, secure, reliable, and efficient supply of energy in Brunei Darussalam. Strategic goal 1 focuses on strengthening oil and gas upstream and downstream activities while goal 3 focuses on maximising economic spin-off from the energy sector.

2. Energy Supply and Consumption in 2015

Oil and natural gas remain the main sources of energy for Brunei Darussalam. In 2015, the total primary energy supply (TPES) of the country for both energy sources was 3.26 million tons of oil equivalent (Mtoe) in total, with 3.07 Mtoe or 94.3% from natural gas (Table 3.1).

Brunei Darussalam has 922 MW of installed capacity in power generation of public utilities, including a solar photovoltaic (PV) at 1.2 MW. Electricity production from the public utilities in 2015 was 3.78 terawatt-hours (TWh). In the same year, the installed capacity of auto producers was 116.99 MW, which produced 0.39 TWh of electricity.

Table 3.1: Energy Supply and Consumption 2015 (Mtoe)

Supply and Consumption	Oil	Natural Gas	Electricity	Total
Primary energy supply				
Indigenous production	8.88	11.19	-	20.07
Net import and others	-8.69	-8.12	-	-16.81
Total primary energy supply	0.19	3.07	-	3.26
Final energy consumption				
Industry sector	0.18	-	0.02	0.20
Transport sector	0.31	-	-	0.31
Others sector ^a	0.02	0.02	0.24	0.28
Non-energy	0.02	-	-	0.02
Total final energy consumption	0.53	0.02	0.26	0.81

Mtoe = million tons of oil equivalent.

^aThe 'others' sector includes the residential and commercial sectors.

Source: Author's calculation.

The total final energy consumption (TFEC) of Brunei Darussalam in 2015 was 0.81 Mtoe, with the transport sector having the highest energy demand at 0.31 Mtoe or 38.27% of the TFEC. This is followed by the 'others' sector (34.57%), industry sector (24.69%), and non-energy use (2.47%). In terms of energy source, oil accounted for 65.43% of final energy consumption, followed by electricity at 32.10% and gas at 2.47%.

3. Energy Policies

3.1. Supply

Brunei seeks to expand exploration areas to increase reserves and ensure long-term sustainability and conservation of oil and gas reserves. A core focus as well is to rejuvenate the current producing assets to enhance recovery from the field and maximise production, which are aligned with the national vision, *Wawasan Brunei 2035*. The country is also maximising its potential for economic spin-off from upstream production and assets. In this regard, Brunei Darussalam has set strategies to strengthen and grow the upstream and downstream activities of oil and gas, with the targets set as follows:

- 1) To sustain a reserve replacement ratio of greater than 1 also means ensuring that Brunei continues to benefit from production in the energy sector in the long term;
- 2) To increase production of oil and gas to 650,000 barrels of oil equivalent per day by 2035;
- 3) To grow revenue from domestic downstream industries and reach at least B\$5 billion by 2035 through the development of infrastructure and facilities, including chemical and petrochemical plants and a refinery.

Despite its aspiration to increase oil and gas production to 650 kboe per day by 2035, the country acknowledges the importance of reducing energy intensity by 45% by 2035 in line with its commitment to the Asia-Pacific Economic Cooperation. Brunei has also targeted to increase the share of its power generation mix from renewable energy to at least 10% by 2035. It has considered and started to develop renewable energy, particularly solar PV and waste-to-energy, which are deemed feasible at this stage. To support the development of renewable energy sources, the government plans to introduce renewable energy policies and regulatory frameworks that will stimulate investment from both the public and the private sectors in developing and deploying renewable energy.

3.2. Consumption

Brunei has been actively improving energy efficiency and conservation (EEC) to reduce energy intensity by 2035. In achieving the energy intensity target, relevant government agencies and industries have been collaborating to set up legislation and to introduce financial and fiscal policy measures that promote energy efficiency and low energy-intensive industries. Industries' roles include identification of technical levers that may assist the reduction of energy use over time while individuals shift consumption behaviour towards energy efficiency that include making choices on highly energy-efficient appliances.

Efforts towards achieving EEC targets were through power generation efficiency, standard and labelling, fuel economy regulation, EEC building guidelines, street lighting alternate switching off, and LED-fitting lighting for street lights.

The Department of Electrical Services and Berakas power management company play major roles in setting out plans to increase power generation efficiency. The plan will emphasise the implementation of combined-cycle turbine and cogeneration power plants, reduction of partial load operation, and improvement of transmission and distribution losses.

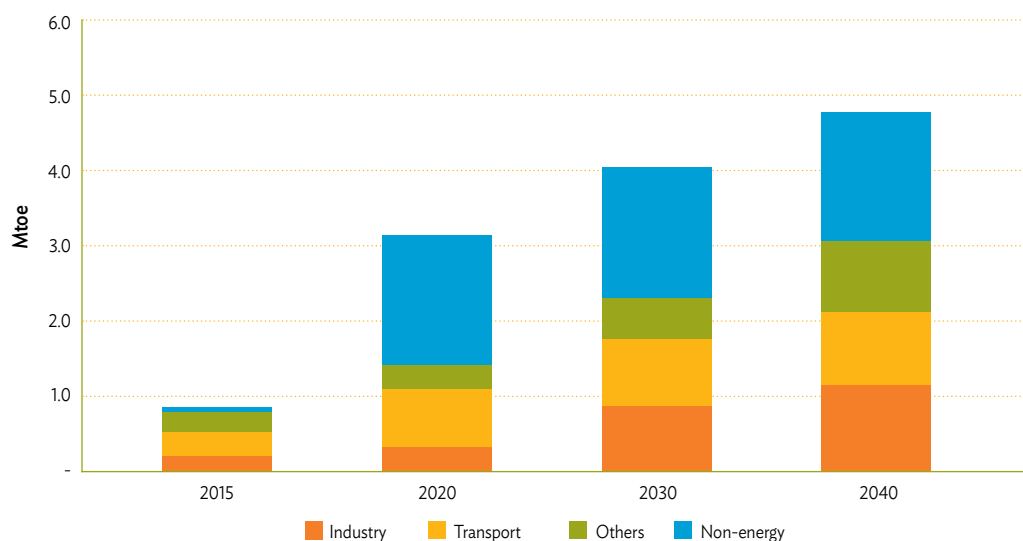
4. Outlook Result

4.1. Final Energy Consumption

Business-As-Usual Scenario

Under the Business-As-Usual (BAU) scenario, the projected TFEC in the year 2040 is 4.78 Mtoe. The increase of projected TFEC is linked to the GDP growth rate which, in the model, is set at a constant rate of 5.6% per year over the projection period. The high GDP growth rate is supported by the country's aspiration to strengthen its economic structure to develop the commercial, services, and industry sectors. For instance, as per projection from the BAU scenario, industry TFEC in 2040 is expected to grow to 1.13 Mtoe, compared with 0.20 Mtoe in 2015.

In 2040, the share of oil in the country's total demand will be 65%, mainly to be consumed as transportation fuel. In 2015, the TFEC of oil was 0.52 Mtoe and is projected to increase to 1.75 Mtoe in 2040. The model also predicts that the demand for electricity will increase at an average of 6.6% per year, from 0.26 Mtoe in 2015 to 1.26 Mtoe in 2040 (Figure 3.1).

Figure 3.1: Final Energy Consumption by Sector, BAU

BAU = Business-As-Usual.

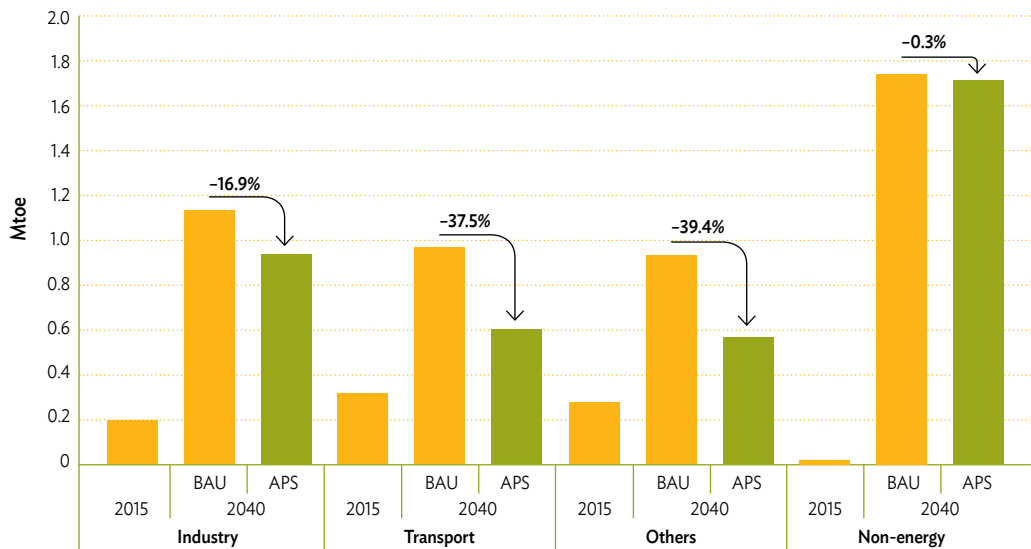
Source: Authors' calculation.

Alternative Policy Scenario

An Alternative Policy Scenario (APS) was developed as a basis to estimate the energy saving potential for Brunei Darussalam to achieve the energy intensity reduction targets through the deployment of advanced technologies for energy saving and enforcement of relevant initiatives. Under the APS, the overall TFEC in 2040 will be 3.86 Mtoe. In 2040, the 'others' sector will require about 14.8% of energy demand, followed by the transport sector at 15.5% and the industry sector at 24.4%. Demand of the non-energy sector will be at 45.1%.

The improvement in vehicle fuel efficiency in the future due to proposed fuel economy regulations would be the main factor for the declining growth rate of demand in the transport sector. For the period 2015–2040, the TFEC will grow at 2.7% per year on average. Referring to the results of the LEAP¹ model for energy outlook, the TFEC under the APS will be reduced by 19.2% compared to the BAU scenario. The 'others' sector (residential and commercial sectors) will decrease by 39.4%; transport, by 37.5%; and industry, by 16.9% from the BAU scenario. Meanwhile, non-energy use will also decline by 0.3% (Figure 3.2).

¹ LEAP stands for Long-range Energy Alternative Planning System.

Figure 3.2: 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.

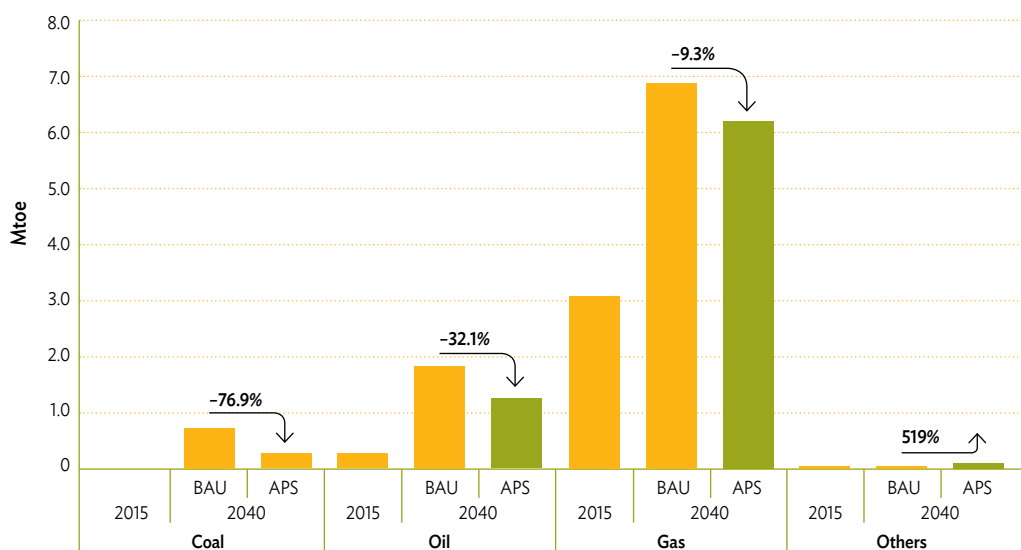
Source: Authors' calculation.

4.2 Primary Energy Supply

Business-As-Usual Scenario

Under the BAU scenario, the TPES of Brunei is projected to reach 9.39 Mtoe in 2040, increasing at 4.3% per year from 3.26 Mtoe in 2015. Its TPES was dominated by natural gas at 94.2% in 2015, while oil share was about 5.8%.

The TPES for natural gas is expected to increase at 3.3% per year from 3.07 Mtoe in 2015 to 6.86 Mtoe in 2040. The country will continue to be a net exporter of energy in the future.

Figure 3.3: 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: Authors' calculation.

Alternative Policy Scenario

A significant decrease in the TPES for oil and natural gas is projected between the BAU scenario and the APS in 2040. In 2040, oil supply under the APS will be 1.25 Mtoe against the BAU scenario at 1.84 Mtoe, or 32.1% lower. Natural gas supply under the APS is also predicted to be lower by 9.3% compared to the BAU scenario. However, supply from renewable energy, particularly from solar and waste-to-energy sources, will significantly increase (Figure 3.3).

4.3 Power Generation

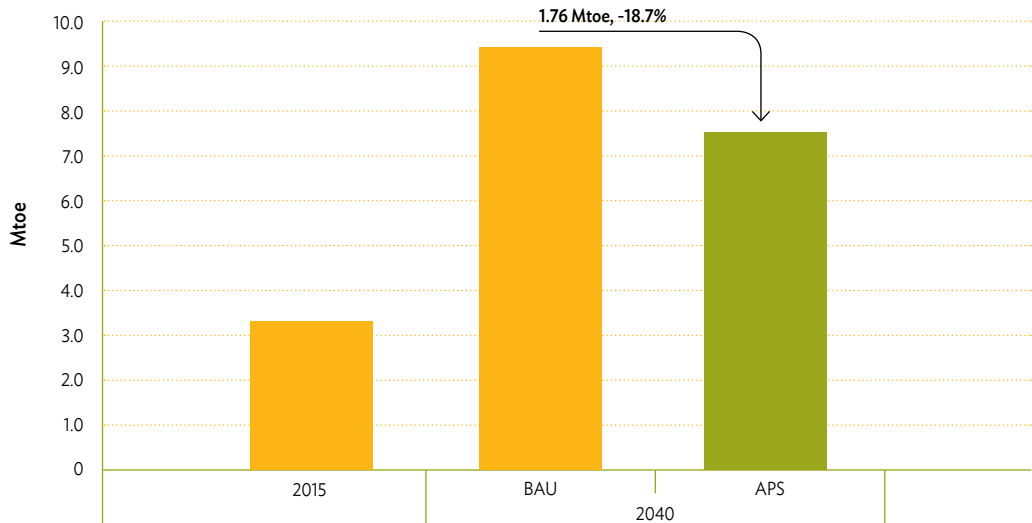
In Brunei Darussalam, power generation capacity from public utilities is dominated by natural gas. From 806.2 MW of installed capacity (including 1.2 MW solar PV), diesel contributes only 12 MW. In addition to the public utilities capacity, autoproducers' capacity in 2015 was 116.9 MW. Based on the model projection under BAU, about 17.74 TWh of electricity will be generated in 2040 from both public utilities and autoproducers, including from renewable energy of 0.05 TWh. Under the APS, electricity generation in 2040 is projected at about 13.08 TWh, a decrease of 26.3% in electricity generation from the BAU scenario, which includes renewable energy at 0.9 TWh. The decrease is due to the decommissioning of the diesel power plants in Temburong in 2021. As planned in the

APS, all thermal power plants in Brunei Darussalam will be combined-cycle gas turbines (with improved efficiency of 45%) and cogeneration power plants.

4.4 Projected Energy Savings²

The energy saving potential that could be achieved through the implementation of legislative measures on EEC, as well as the development of renewable energy in Brunei Darussalam, is about 1.76 Mtoe of the TPES, or equivalent to a reduction of 18.7% from the BAU scenario in 2040.

Figure 3.4: Reduction of Primary Energy Supply, BAU and APS (2015 and 2040)



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

Source: Authors' calculation.

4.5 Carbon Dioxide Emissions

Business-As-Usual Scenario

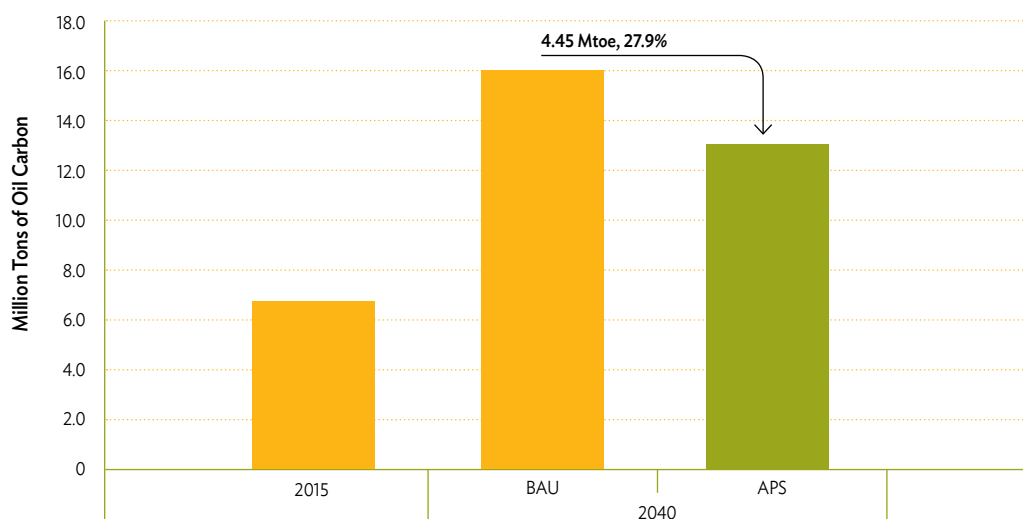
The percentage increase in carbon dioxide (CO₂) emissions correlates to the increase in the TPES. This is expected because the energy mix for Brunei Darussalam is 99% dependent on fossil fuels. In 2015, the LEAP model shows 6.7 million tons of carbon (Mt-C). An increase of 3.6% per year is expected with an eventual value of 16.0 Mt-C in 2040 (Figure 3.5).

² The difference between primary energy consumption in BAU and the APS.

Alternative Policy Scenario

As of this writing, Brunei Darussalam is still finalising the Nationally Determined Contributions (NDC) target, which will be reported before 2020. Therefore, the current APS is equal to the target of the NDC. In the APS, CO₂ emissions could decrease by 27.9% in 2040 compared to the BAU scenario. The results of the model show that a total of 10.6 Mt-C will be emitted by 2040. The decrease in CO₂ is significantly attributed to improved efficiencies of power generation plants (Figure 3.5).

Figure 3.5: CO₂ Emissions from Energy Consumption, BAU and APS (2015 and 2040)



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

Source: Authors' calculation.

5. Policy Implications

Based on Brunei's second national communication submitted to the United Nations Framework Convention on Climate Change in November 2017, major mitigation efforts of the energy sector mainly focused on the following:

- a) Setting Sustainable Development Targets for the Energy Sector
 - i) The energy sector aims to reduce energy intensity by 45% in 2035 from the baseline year of 2005. Energy intensity can be reduced through energy efficiency improvements and energy conservation as well as by diversifying the economy to high value-added but less energy-intensive industries.

- ii) Deployment of renewable energy technologies is targeted to increase by 10% by 2035. This could be achieved by both public and private sector investments on these technologies. At present, policy frameworks that incentivise private sector investments are being prepared.
- b) Promoting EEC
- i) Improving supply-side efficiency. The government is pursuing a strategy to improve efficiency of existing open-cycle gas turbines through the installation of heat recovery steam generators while more efficient combined-cycle gas turbines are being used for new capacity expansion.
- ii) Managing electricity demand. Demand management is one strategy to reduce the use of fossil fuels in electricity generation. This could be achieved by improving energy efficiency of the stock of energy technologies and increasing the efficiency of the use of existing technologies.
- EEC building guidelines and standards and labelling scheme. The Building Guidelines and the soon-to-be implemented standards and labelling order for electrical appliances are regulatory frameworks that allow only efficient technologies to be used in new buildings, and only efficient electrical appliances to be sold in the market.
 - Energy management. The planned energy management scheme will ensure that existing equipment and technologies are operating at efficiency levels consistent with industry's best practices.
 - Tariff reforms. The progressive electricity tariff structure, which was introduced in 2012, is an economic tool to manage efficient use of energy by providing a financial disincentive to higher energy consumption.
- iii) Managing transport energy demand. Among the end-use sectors, the contribution of the transport sector in the overall emissions is significant. Road transport energy demand management is key to reducing fossil fuel consumption of the sector. The strategies outlined in the Land Transport Master Plan could be categorised as follows:
- Efficient transport technologies. Promoting the deployment of efficient and less-polluting vehicles and fuel technologies is outlined in the 4th strategy of the Land Transport Master Plan. The implementation of measures under this strategy will improve the overall efficiency of the road transport fleet.
 - Improving fuel economy through traffic flow improvement. Vehicles often reach their optimal fuel economy at specific speeds. Vehicles have lower fuel economy at slower speeds. Managing traffic volume and reducing road congestion would improve fuel economy of the vehicle fleet.

- Managing private transport demand. The strategy to reduce car dependency through the development of public transport systems would eventually reduce individual transport demand and consequently reduce fuel consumption. In addition, strengthening the management of the transport infrastructure and services would further encourage a shift from individual travel towards a mass transport system.

Along with economic development to achieve the objectives of Wawasan Brunei 2035, a significant increase in the activity level of all economic sectors, including the energy sector, is expected. Despite the increased focus on EEC, energy demand of Brunei Darussalam is projected to increase steadily. In meeting the growing domestic energy demand, fossil fuels will remain as the primary source of supply for the country.

The results of the model used by this study show the improvement in energy efficiency, when coupled with the implementation of appropriate legislative measures and development of renewable energy, contributing to the reduction in the TPES and the TFEC at 18.7% and 19.2%, respectively. The model also shows that improvement in energy efficiency will help reduce CO₂ emissions by 27.9%.