Chapter 3

Brunei Darussalam Country Report

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1. Background

Brunei Darussalam is an independent sovereign constitutional Sultanate, headed by His Majesty Sultan Haji Hassanal Bolkiah. Brunei Darussalam is situated on the north-east coast of Borneo Island in South-east Asia, occupying 1 percent, 5,765 square kilometres, of the land area on the island of Borneo. It is divided into four administrative districts namely Brunei-Muara, Tutong, Belait and Temburong. The capital city, Bandar Seri Begawan, is located in the Brunei-Muara district and is where the government operations and major business activities take place.

The development policy of Brunei Darussalam is based on the principle of prudent use of natural resources. His Majesty the Sultan of Brunei has placed great emphasis on environmental protection and conservation. This resulted in the conservation of the rainforest which currently makes about 65 percent of the land area.

1.1. Socio-Economic Situation

Brunei is an energy exporting country in Southeast Asia, exporting about 17.4 Mtoe of oil and natural gas in 2007. With a population of just about 400 thousand, Brunei Darussalam enjoys a high standard of living with positive social indicators, like literacy rates and life expectancy. The 2011 per capita GDP PPP for Brunei Darussalam is 45,707[1]. Brunei Darussalam's Real GDP growth was at 2.2 percent in

[1]World Bank, World Development Indicator April 2013.

2011 and the population growth at 2.0 percent[2].

In the long-term development plan called Wawasan 2035[3], Brunei Darussalam has set out to achieve:

- A first class education system to meet the requirements of a changing economy and one that encourages life-long learning.
- Top 10 in the world in living standards as defined by the United Nations Human Development (UNHD) Index.
- A dynamic and sustainable economic growth.

1.2. Energy Supply-Demand Situation

The main energy sources in Brunei Darussalam are natural gas and oil. The primary energy consumption for these two sources of energy in 2010 was 3.1 Mtoe and 2.7 Mtoe for gas. The use of natural gas is mainly for the generation of electricity and town gas. In mid-2010, the production of methanol came on line using natural gas as feedstock. The use of oil is primarily for petroleum products.

In the electricity sector, 3,792 GWh was generated in 2010. The installed generation capacity in 2010 stands at 888 MW, 99.7 percent of it came from natural gas. The efficiencies of power plants commissioned before 2005 are estimated to be around 25.0 percent and the combined cycle power plant around 45.0 percent.

1.3. Energy Policies

1.3.1 Supply

Brunei Darussalam has sufficient reserves of gas and oil. In 2007, Brunei Darussalam produced 20.2 Mtoe of gas and oil, 17.4 Mtoe of which was exported. The potential for the use of alternative energy sources are currently being studied. Likewise, policies pertaining to the use of renewable energy are still being studied. The study covers amongst others: wind, hydro, waste to energy, tidal, bio-energy, and solar. In the meantime, a 1.2 MWp solar photo-voltaic demonstration plant has

[2]Department of Economic Planning and Development, Prime Minister's Office 2011
[3]Department of Economic Planning and Development. Development Board, http://www.depd.gov.bn/productservice.html

been commissioned. The solar PV implementation study is over a period of 3 years. The PV plant has six (6) types of PV modules installed. Other renewable energy demonstration/research plants may come on-line in the near future.

1.3.2. Consumption

Brunei Darussalam has been active in implementing energy conservation initiatives. These energy conservation initiatives are being championed by the Energy Department, Prime Minister Office (EDPMO). EDPMO has been actively promoting energy conservation since 2007, where EDPMO's campaigns had lead to the declaration of 24th May as the National Energy Day.

Early last year, His Majesty the Sultan and Yang Di-Pertuan of Negara Brunei Darussalam has consented for the review of the electricity tariff structure in the residential sector which has taken into effect on the 1st January 2012. The main objective of the introduction of the new electricity tariff is to correct the old tariff, which suits today's environment. In the old structure, those who consumed less were charged at a higher rate and were paying more on average per kWh compared to those who consumed more. The new tariff structure moves to being progressive from regressive.

Brunei Darussalam is committed in achieving a target of 45.0 percent improvement in energy efficiency by 2035, relative to 2005 levels.

1.3.3. Energy Market Reforms, new energy policies under consideration, etc

The energy market in Brunei Darussalam is state regulated. Energy prices are subsidized. However, it has increased considerably the price of motor gasoline (Premium 97) and diesel for vehicles and vessels not registered in Brunei Darussalam in the wake of increased smuggling of fuels to neighbouring economies. The government is concerned about the increasing cost of maintaining fuel subsidies, and in 2008 began a Subsidy Awareness Campaign.

2. Modelling Assumption

In this study, Brunei's GDP is assumed to grow at an average annual rate of 2.7 percent for the period 2010-2035. Growth is expected to be faster for the period 2010-2020 at 2.9 percent annually. Meanwhile, population is expected to grow at an average rate of 1.8 percent yearly. By end of 2035, it is expected that the country's population will be around 0.6 million.

In the APS, the model is dictated by energy conservation policy, whereby a 25.0 percent reduction from 2005 level is targeted. Also in the APS, efficiencies of natural gas power plants were improved to 40.0 percent while there is no improvement assumed for diesel generators.

3. Outlook Results

3.1. Business-as-Usual Scenario

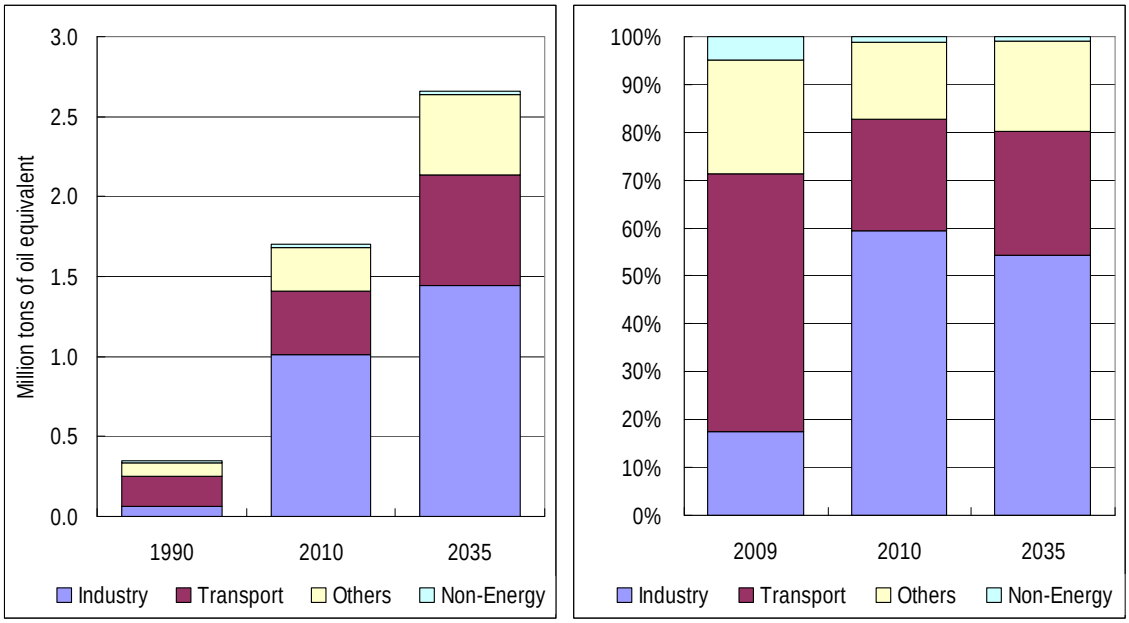
3.1.1 Final Energy Demand

Energy consumption of Brunei Darussalam is increasing over the years. The final energy demand increased from 0.3 Mtoe in 1990 to 1.7 Mtoe in 2010. The projected average annual increase from 2010 to 2035 is 1.8 percent. The projection is linked to GDP growth. The GDP is expected to grow at annual average rate of 2.7 percent over the period 2010 to 2035.

The transportation sector is expected to grow at an average annual growth of 2.3 percent over the period from 2010-2035. The final energy demand in the residential and commercial sectors[4] is foreseen to grow at an average rate of 2.4 percent per year. This is in-line with the population increase of 1.8 percent per year and the increase in economic activities in the commercial sector. Figure 3-1 shows the final energy demand levels and shares by sector in 1990, 2010 and 2035.

[4]Residential and commercial consumption are grouped as "Others"

Figure 3-1: Final Energy Demand by Sector



Under the BAU, the industrial sector is foreseen to comprise bulk of the country's energy demand followed by the transportation sector. However, by end of 2035, the industrial sector consumption will decrease to 54.3 percent of the total final energy demand of the country from 59.4 percent in 2010. The transportation sector's share is expected to increase up to 26.0 percent from its 23.2 percent share in 2010.

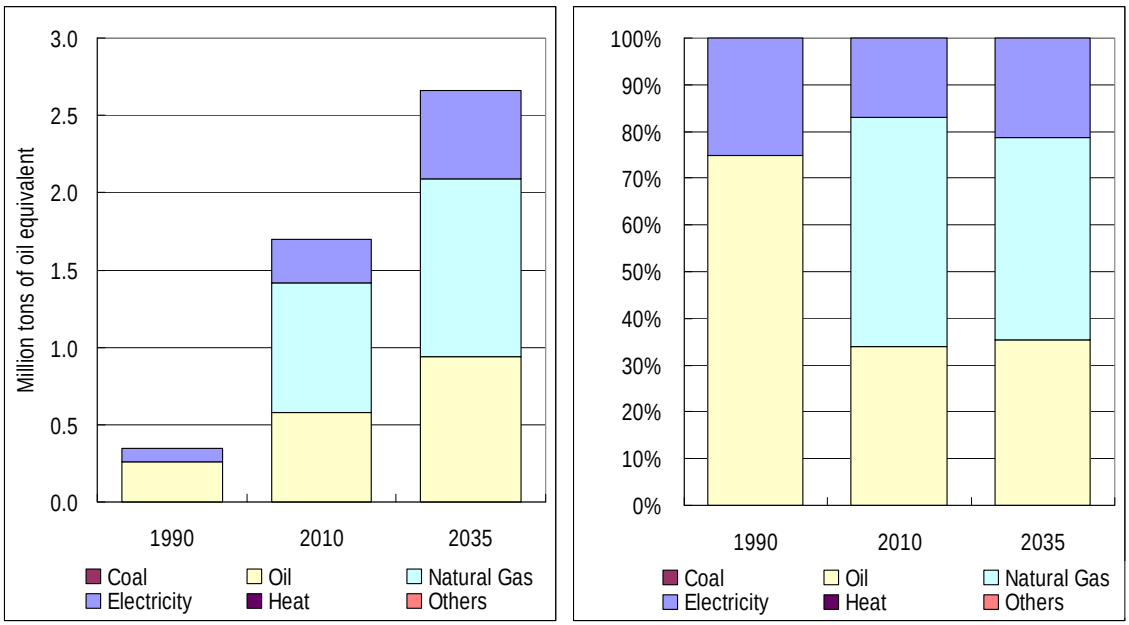
Similarly, the "others" sector's share in the total final energy demand for the period 2010 to 2035 is expected to decrease to 18.8 percent from its 16.3 percent share in 2010.

By fuel type, electricity demand had the fastest growth over the 1990 to 2010 period, at an average rate of 6.1 percent per year. Oil on the other hand, grew by 4.0 percent over the same period. For the period 2010-2035, electricity will still be the fastest growing fuel of the economy followed by oil and natural gas. Increase in oil consumption is due to the increasing demand in the transport sector.

For 2010, final consumption of natural gas reached 0.8 Mtoe corresponding to around 49.3 percent of the total energy consumed due to the increasing demand in domestic industries. Oil consumption was 0.6 Mtoe in 2010 corresponding to around 33.9 percent of the total fuel consumed. By 2035, final energy demand for oil is expected to be 0.9 Mtoe. The increase in oil consumption is mainly attributed to the

increase in the number of road vehicles. Figure 3-2 shows the final energy demand by fuel type and their shares in 1990, 2010 and 2035.

Figure 3-2: Final Energy Demand by Fuel



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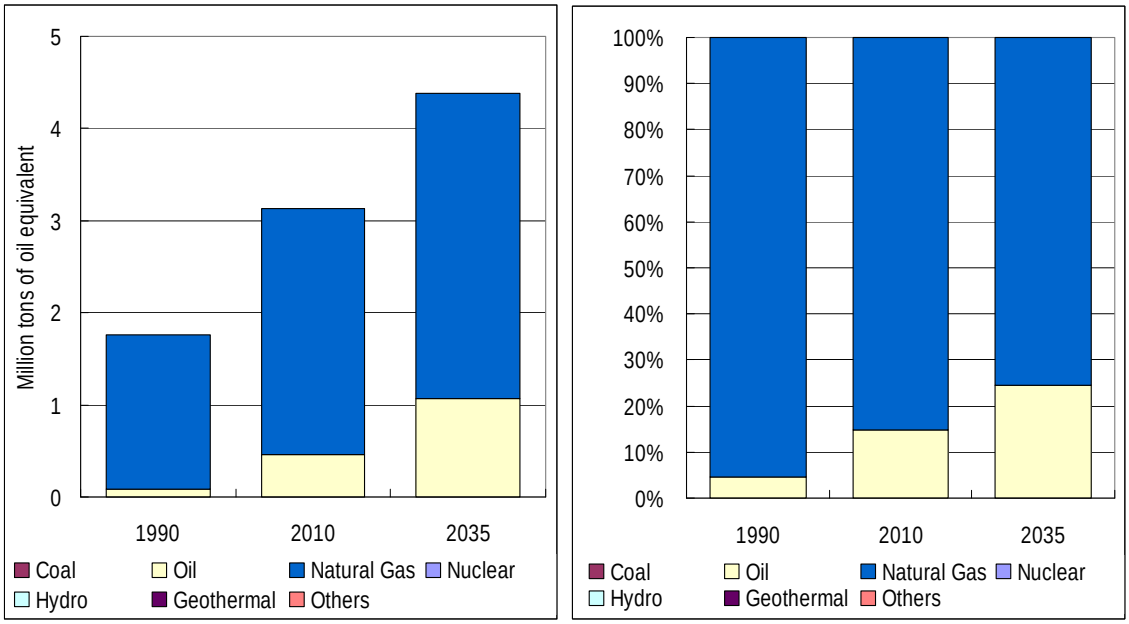
3.1.2. Total Primary Energy Supply

Primary energy consumption in Brunei grew slowly than final energy demand at about 2.9 percent per year from 1.8 Mtoe in 1990 to 3.1 Mtoe in 2010. The country relies on two major fuels namely, natural gas and oil. Natural gas comprised more than 95.0 percent of the country energy resource in 1990 and more than 85.0 percent

by year 2010. The decreasing share of natural gas is due to the increasing demand for oil which comprised around 14.7 percent of the country's energy supply in 2010.

In the BAU, oil is expected to grow at an average annual rate of 3.4 percent over the study period (2010-235). By 2035 oil is expected to reach 1.1 Mtoe from 0.5 MTOE in 2010. Relatedly, natural gas is expected to grow at average annual rate of 0.9 percent reaching 3.3 Mtoe in 2035. Figure 3-3 shows the primary energy consumption and shares by source in 1990, 2010 and 2035.

Figure 3-3: Total Primary Energy Supply, BAU

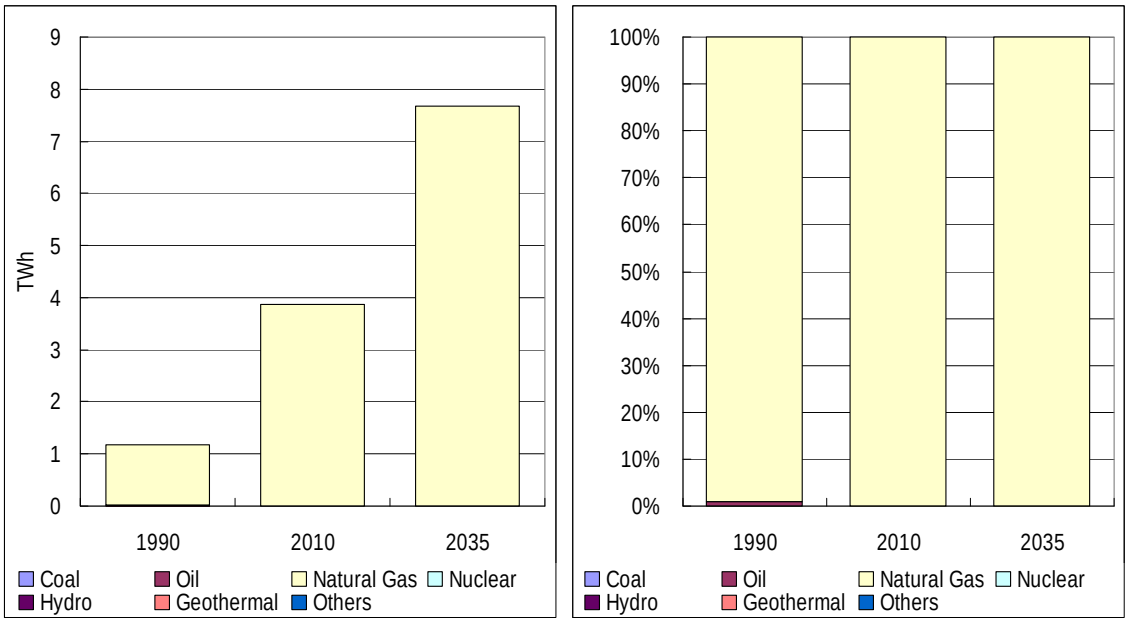


Natural gas constituted the largest share of total primary energy consumption but declining from 95.3 percent in 1990 to 85.3 percent in 2010. By end of 2035, around 75.0 percent of the country's total primary energy supply will still come from natural gas while around 24.5 percent will be sourced from oil.

3.1.3. Power Generation

Power generation output increased at an average rate of 6.2 percent per year over the past two decades, from 1.2 TWh in 1990 to almost 3.9 TWh in 2010. By 2035, 7.7 TWh of electricity will be needed. This corresponds to an average annual increase of 2.8 percent for the period 2010-2035. Figure 3-4 shows the power generation mix in 1990, 2010 and 2035.

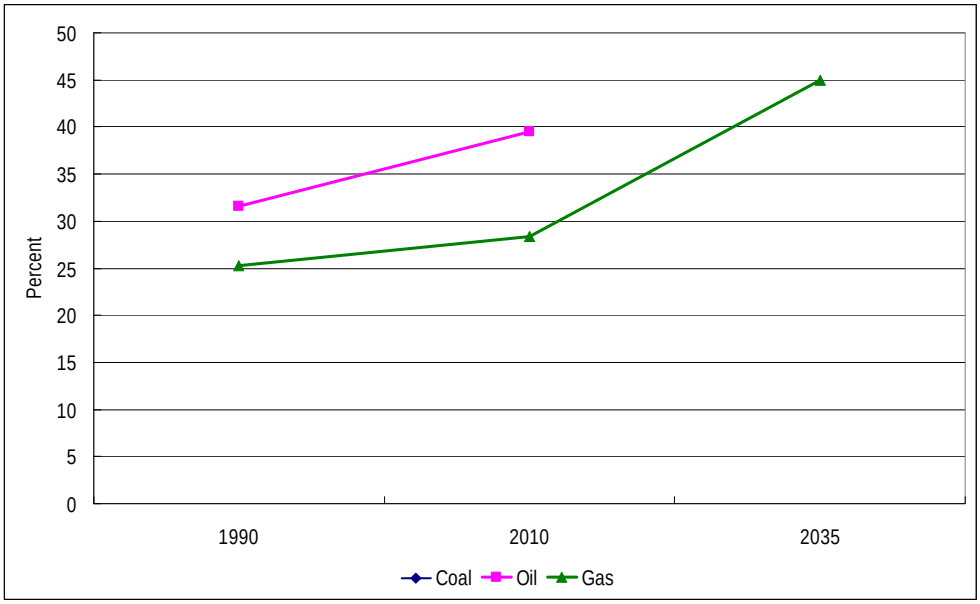
Figure 3-4: Power Generation by Type of Fuel (TWh)



In Brunei Darussalam, power generation is dominated by natural gas; only a negligible percentage is contributed by diesel.

Relatedly, for this study, the model assumes an improvement in thermal efficiency of electricity generation. The efficiency is set to improve from at 28.4 percent in 2010 to 45.0 percent in 2035. Figure 3-5 shows the thermal efficiency of electricity generation in 1990, 2010 and 2035.

Figure 3-5: Thermal Efficiency, BAU



3.1.4. Energy Indicators

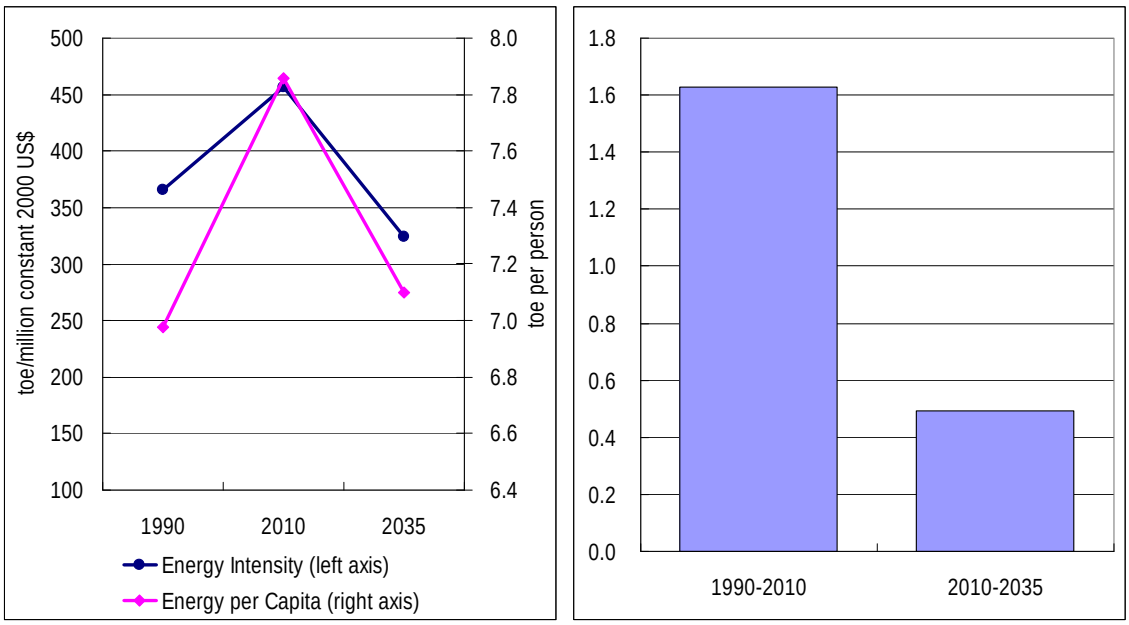
Brunei's primary energy intensity (TPES/GDP) been increased abruptly in 2010 when the methanol plant started operation. This increase in energy intensity does not mean that Brunei energy efficiency worsened. The increase in energy intensity is due to the accounting of natural gas used as feedstock in methanol production as part of total energy consumption.

By end of 2035, energy intensity is expected to decline at an average annual growth rate of 0.4 percent from 456 toe/million 2000 USD to around 324 toe/million 2000 USD by 2035. Thus, the energy intensity ratio is expected to improve by almost 29.0 percent in 2035 as compared to 2010. This is an indication that energy stakeholders had started to effectively use energy through the implemetation of energy conservation measures and greater utilization of more efficient energy technologies.

Meanwhile, the per capita energy consumption, which is measured as the ratio of total primary energy consumption to the total population, has been increasing since 1990 from around 7.0 toe/person to 7.9 toe/person in 2010. By end of 2035 energy consumption per capita will decrease down to 7.1 toe/person. The decrease is an indication of a more efficient use of energy, though this level is much higher compared to other developing countries in the East Asia region.

Figure 3-6 shows the energy intensity, per capita energy consumption and energy elasticity in the period 1990 to 2010 and 2010 to 2035.

Figure 3-6: Energy Intensity and Energy per Capita, BAU



Elasticity of final energy consumption over the 1990-2010 was 1.6 indicating that energy consumption increased faster that the GDP. Implementation of the EEC programs and action plans will reduce the elasticity making the country to be more efficient in the utilization of energy.

In the BAU scenario, the elasticity of final energy consumption is expected to continue to reach 0.5 in 2035. Elasticity below 1.0 is an indicator that growth in final energy consumption will be slower than growth in GDP over the period 2010-2035.

3.2. Energy Savings and CO_2 Reduction Potential

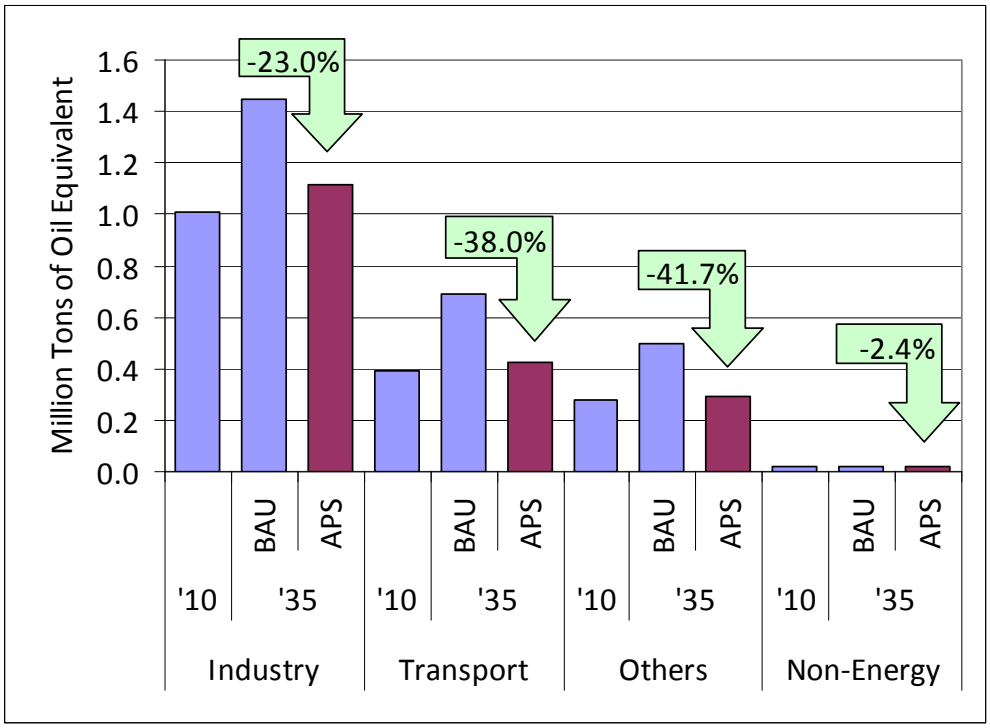
3.2.1. Total Final Energy Demand

In the APS, final energy demand is projected to increase at a slower rate than in the BAU scenario, increasing at an average rate of 0.3 percent per year from 1.7 Mtoe in 2010 to 1.9 Mtoe in 2035. This is equivalent to a reduction of 6.7 percent from the BAU. The APS model is dictated by the energy conservation policy,

whereby a 25.0 percent reduction from 2005 level is targeted. However, the model does not show a significant decrease in total FEC since only 2.4 percent decrease is observed between the total FEC in 2035.

The shift in the energy mix may be changed if alternative energy sources are considered in the APS. It is appropriate to assume at this juncture that oil and gas remain as the main sources of energy as there was no strong indication of alternative energy policies to be implemented in the near future. Changes to this scenario maybe realized once an indication of policies on alternative energy are introduced. Figure 3-7 shows the final energy demand by sector in 2010 and 2035 in both the BAU and APS.

Figure 3-7: Final Energy Demand by Sector, BAU and APS



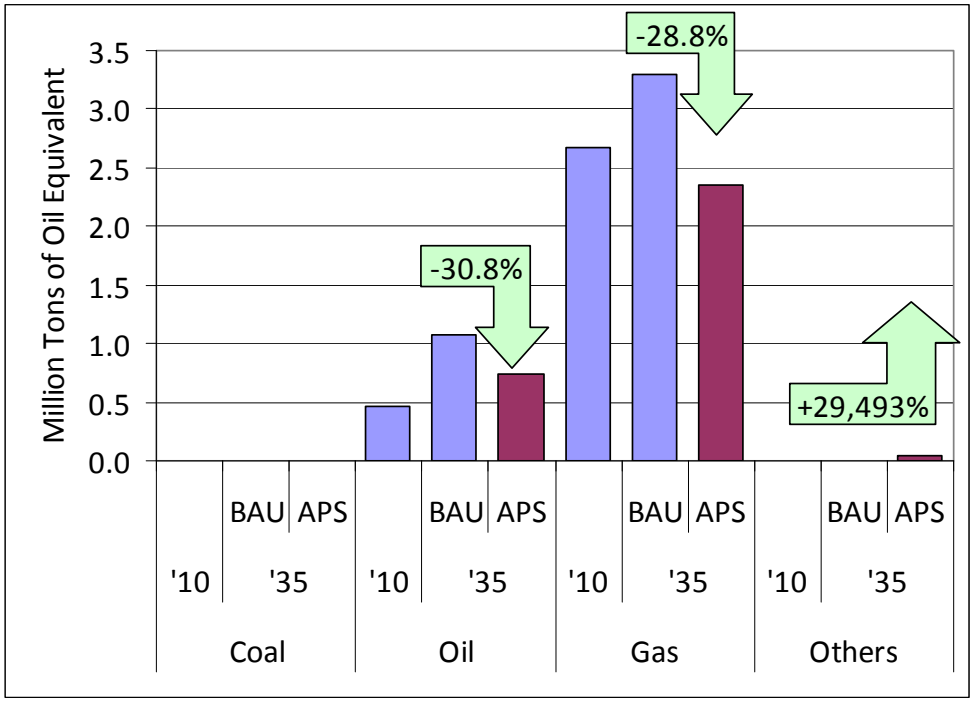
3.2.2. Primary Energy Demand

The primary energy demand (PES) for 2010 is primarily sourced from natural gas at 85.3 percent. PES is expected to increase at an annual average rate of 1.3 percent per year for the period of 2010 to 2035, and in absolute values of 3.1 Mtoe to 4.4 Mtoe.

Under the BAU, PES for oil and natural gas is expected to increase at a rate of 3.4 percent and 0.9 percent, respectively. Brunei Darussalam will continue to be a net exporter of energy.

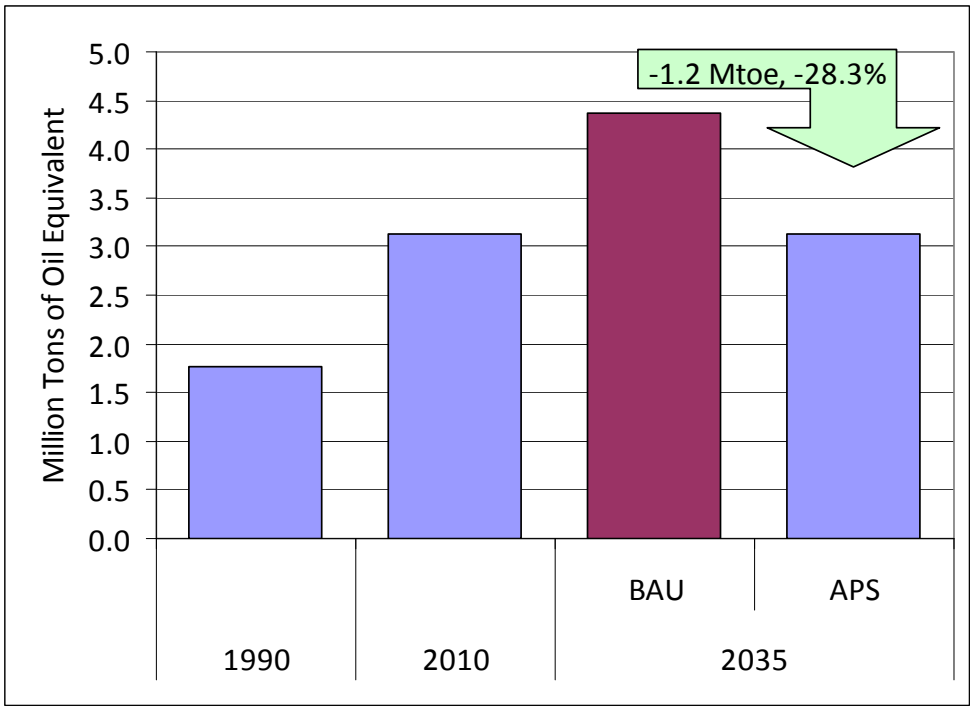
A significant decrease in PES is observed between the BAU and the APS in year 2035. The difference between the two scenarios is 1.2 Mtoe which corresponds to 28.3 percent reduction. In the intermediate year of 2020, the difference between BAU and APS in absolute value is 0.4 Mtoe which corresponds to a decrease of 11.3 percent.

Figure 3-8: Primary Energy Demand, BAU and APS



The energy savings (the difference between primary energy demand in the BAU scenario and the APS) that could be achieved through the energy efficiency and conservation goals and action plans of Brunei is about 1.2 Mtoe, equivalent to 28.3 percent reduction from the BAU in the year 2035 (Figure 3-9).

Figure 3-9: Evolution of Primary Energy Demand, BAU and APS

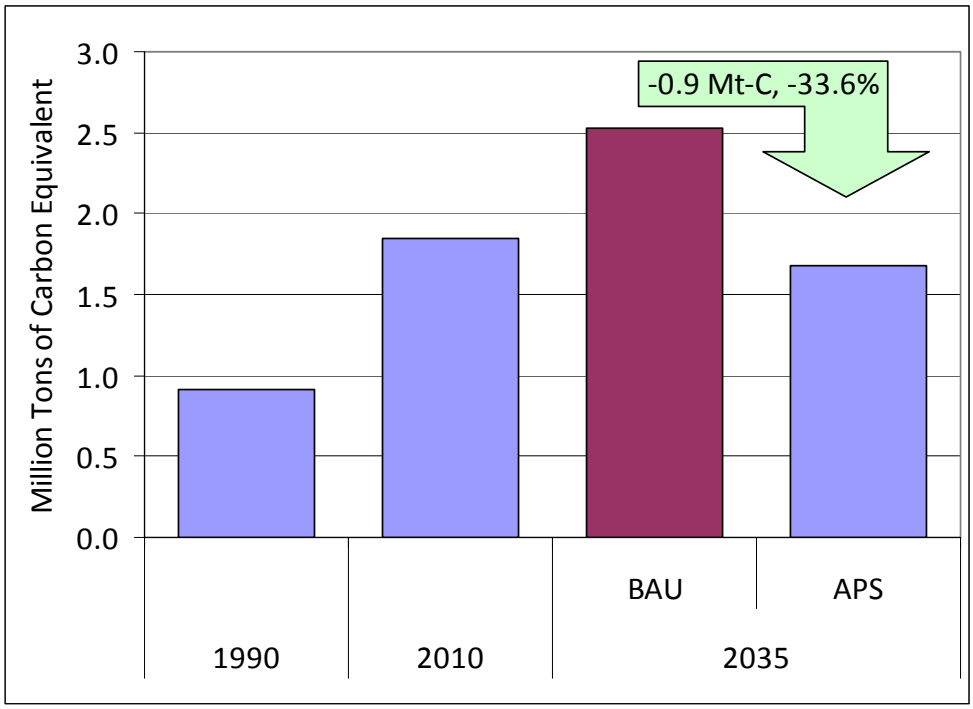


3.2.3. CO_2 Reduction Potential

The percentage increase in carbon dioxide emission correlates strongly to the increase in total primary energy demand (TPES). This is expected because the energy mix for Brunei Darussalam is 99.0 percent dependent on fossil fuel. From the year 2010 level of 1.8 Mt-C, CO_2 emission will at a steady rate of 1.3 percent per year to 2.5 Mt C in year 2035. This growth rate is the same as the growth rate of primary energy demand.

In the APS, carbon dioxide emission is expected to decrease by 33.6 percent in 2035 as compared to BAU (Figure 3-10). The reduction is equivalent to 0.9 Mt-C emissions by 2035. The decrease in carbon dioxide emission is significantly attributed to the improvements in the efficiencies of power generation plants. Carbon dioxide per TPES in BAU and APS will decrease to 0.58 t-C/toe and 0.54 t-C/toe in 2035, respectively. This is due to the introduction of renewable energy in Brunei's energy mix during the period 2010-2035.

Figure 3-10: CO_2 Emission from Energy Demand, BAU and APS



4. Findings and Policy Implications

4.1. Findings

Brunei Darussalam is highly dependent on fossil fuel. The energy profile remains predominantly gas and oil based. The introduction of non-fossil fuel will not be cost effective, and therefore, the most significant way to reduce carbon dioxide emission is to improve on energy efficiency. The model also shows that the improvement in energy efficiency not only reduces carbon dioxide emission but also improves energy intensity, where a decrease from 274.1 toe/Million 2000 US$ in BAU to 179.4 toe/Million 2000 US$ in the APS for the year 2035.

The BAU and the APS only placed emphasis on EEC. The result is significant showing significant reduction in carbon dioxide emission (33.6 percent) and TPES (28.3 percent).

The result of the study also shows that EEC improvement on generation plants have significant impact on TPES and CO_2 emission.

Meanwhile, more emphasis should be given in the reduction of fuel consumption in the transport and others sector (residential and commercial) since these sectors consumed more energy based on the results of the study conducted. Initiatives in these sectors are necessary if significant decrease in TFEC is to be expected. An improved transport network could also play an important role in reducing TFEC and CO_2 emission.

Furthermore, the transport sector which is one of the largest consumers of oil in the country will be crucial in achieving energy savings as well as in reducing CO_2 emissions. Policies to tackle this problem should involve moving away from private to public transport. Currently, there is a proposal to introduce light-rail transit (LRT) to the capital which is still under discussion. Measures to introduce more energy efficient vehicles should also be looked into. Another way to reduce consumption of fuel would be to educate the public and promote techniques for energy saving driving or eco-driving.

4.2. Policy Implications

The projected increase in final energy demand requires urgency for Brunei Darussalam to reduce its final energy demand. The government shall continue to promote and practice energy efficiency and conservation. Various efforts have already been placed in motion such as adopting energy efficiency and conservation (EEC) techniques and technologies within the nation. Having only oil and natural gas for its main sources for energy, it is also imperative for Brunei Darussalam to intensify the EEC initiatives to further strengthen its energy efficiency guidelines and regulations as well as accelerating the adoption of the EEC best practices and advanced technologies.