CHAPTER 12

Myanmar Country Report

Tin Zaw Myint

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CHAPTER 12

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1. Background

1.1 Country Profile

Myanmar is the largest country in mainland Southeast Asia, with a land area of 676,577 square kilometres (km) and a border 5,858 km long, which it shares with Bangladesh and India to the northwest, China to the northeast, and Thailand to the southeast. Approximately 48% of the total land area is covered with forest, and most of the land is utilised for agriculture. Myanmar had a population of 56 million in 2019 with an average annual population growth rate of 1.0% from 1990 to 2015.

Myanmar is located in the western part of the Indochina Peninsula and has three distinct seasons. It enjoys 3–4 months of heavy monsoon and abundant sunshine year-round, making it ideal for accumulating water resources for hydropower and agriculture. Its topographic features include numerous rivers, mountain ranges, and sedimentary basins where mineral deposits and energy resources have abundantly accumulated. The delta regions where the country's two major river systems enter the Bay of Bengal as well the 2,832 km coastal strip in the south are good areas for the development of marine ecosystems and an abundant source of marine products and chemicals.

Myanmar is endowed with rich natural resources for producing commercial energy. Currently, the available energy sources in Myanmar are crude oil, natural gas, hydropower, biomass, and coal. Wind energy, solar, geothermal, bioethanol, biodiesel, and biogas are other potential energy sources. In 2017, Myanmar's proven energy reserves comprised 105 million barrels of oil, 5.56 trillion cubic feet of gas, and 542.56 million metric tonnes of coal. The country is a net exporter of energy, exporting substantial amounts of natural gas and coal to neighbouring countries. However, it imports around 90% of its total oil requirements.

1.2 Socioeconomic Status

Myanmar's population grew at 1.0% per year from 41.3 million in 1990 to 52.4 million in 2015. Myanmar's gross domestic product (GDP) was $70.5 billion in 2015, and its GDP per capita grew from around $200 in 1990 to $1,300 in 2015.[1] To enhance economic development in Myanmar, four short-term 5-year plans were formulated and implemented during 1992–2013. Under the first plan (1992–1995), GDP saw an average annual growth rate (AAGR) of 7.5%, followed by 8.5% under the second plan (1996–2000), 12.8% under the third plan (2001–2005), and 12.0% under the fourth plan (2006–2010). The most recent Myanmar Sustainable Development Plan (2018–2030) has been formulated to achieve an AAGR of 7.0% in GDP.

1.3 Energy Consumption in the Base Year

In 2017, Myanmar's total primary energy supply (TPES) was 20.12 million tonnes of oil equivalent (Mtoe). Natural gas is mainly used for electricity generation and in industry. In the power sector, Myanmar has 5,848 megawatts (MW) of installed generation capacity, and produced almost 22 terawatt-hours (TWh) of electricity in 2018. In the same year, thermal power (coal, natural gas, and oil) accounted for 44% of total electricity generation and hydropower accounted for 56%.

Table 12.1. Installed Capacity and Power Generation by Fuel Type, 2018–2019

	Type of Fuel	Installed (MW)	Generation (GWh)
1	Hydropower	3,259	12,395
2	Gas and steam	2,352	9,294
3	Coal	120	
4	Diesel	117	562
	Total	**5,848**	**22,298**

GWh = gigawatt-hour, MW = megawatt.

Source: Myanmar Ministry of Electricity and Energy.

[1] All United States dollars in this report are in constant 2010 values unless specified.

2. Modelling Assumptions

2.1. Gross Domestic Product and Population Growth

Based on data from the Ministry of Labour, Immigration and Population, this report assumes that Myanmar's GDP will grow at an average annual rate of around 5.8% from 2017 to 2050, slowing from 9.1% during 1990–2015. The population is assumed to increase by about 0.71% per year from 2017 to 2050.

2.2. Energy Consumption and Electricity Generation

Hydropower and natural gas dominate the electricity generation mix in Myanmar; other fuels such as oil and coal contributed less than 13% in 1990. The government plans to increase the share of natural gas, coal, hydropower, and other renewables further and decrease that of oil. Myanmar also plans to export electricity from its hydropower plants to neighbouring countries such as Thailand and China.

Myanmar's yearly plan for the construction of power plants from 2018 to 2022 (Table 12.2) mostly covers gas-based power plants (including liquefied natural gas), along with some hydropower and solar power plants. The yearly plan excludes coal-based power plants, of which the country currently has 120 MW of installed capacity.

Based on the Energy Masterplan of Myanmar, three scenarios are considered (Table 12.3).

In this masterplan, the shares differ between scenarios. The lowest are seen in the power resource balance scenario (Scenario 3), under which total installed capacity will reach 23,594 MW by 2030, with hydropower accounting for 38%, coal 33%, and gas 20% of the total, with the remaining 8% provided by renewables (such as solar and wind).

Table 12.2. Yearly Plan for the Construction of Power Plant Projects (MW)

No.	Project Name	2018	2019	2020	2021	2022	Total
1	Thahtone CCGT (World Bank)	118					
2	MyinGyan CCGT (Sembcorp)	225					
3	Minbu Solar (Green Earth)		40	40	40	50	
4	Baelin Gas Engine (Rental)		135				
5	Myingyan Gas Engine		90				
6	Myanaung Gas Engine (Japan Grant)			20			
7	Pahtoelon CCGT (JICA)			12			
8	Ahlon LNG to Power (Toyo Thai)			356			
9	Kyaukphyu CCGT (Sinohydro)			135			
10	Melaunggyaing LNG to Power (Zhefu)				1,390		
11	Kanbauk LNG to Power (Total and Siemens)				820	410	
12	Ywama (W.B.) (gas)				150	75	
13	Upper Kyaingtaung (hydropower)				51		
14	Upper Yeywa (hydropower)				280		
15	Middle Paunglaung (Energize)					152	
16	Dee Dote (Andritz)					60	
	Total	**343**	**265**	**563**	**2,731**	**747**	**4649**

CCGT = combined cycle power plant, JICA = Japan International Cooperation Agency, LNG = liquefied natural gas.

Source: Department of Electric Power Planning, Myanmar Ministry of Electricity and Energy.

Table 12.3. Installed Capacity and Power Supply in Three Scenarios for 2030

	Scenario 1 **(Domestic energy consumption)**			*Scenario 2* **(Least cost)**		*Scenario 3* **(Power resource balance)**	
	Energy resources	Installed capacity		Installed capacity		Installed capacity	
		(MW)	%	(MW)	%	(MW)	%
1	Hydropower (large)	12,147	42	12,147	43	1,412	6
2	Hydropower (small and medium)	6,891	24	6,891	24	7,484	32
3	Gas	4,986	17	2,484	9	4,758	20
4	Coal	2,760	10	5,030	18	7,940	34
5	Renewable	2,000	7	2,000	7	2,000	8
	Total	**28,784**		**28,552**		**23,594**	

MW = megawatt.

Source: Myanmar Energy Master Plan.

2.3. Energy and Climate Change and Environmental Policies

Myanmar's energy policy generally strives to maintain energy independence by increasing indigenous production of available primary energy resources through intensive exploration and development activities. It also addresses electric power as the main driving power source for economic development and the need to generate and distribute in terms of volume, density, and reliability. It also advocates the utilisation of water resources, a renewable resource for generating electricity, to save non-renewable sources of energy such as fossil fuels for alternative and future use. Energy efficiency and conservation is emphasised to save energy through effective energy management and reduce energy consumption so as to minimise harmful environmental impacts. Use of new and renewable energy sources is encouraged, especially solar and wind, which are abundant in Myanmar. The policy also accepts that people will still need to use traditional energy sources such as wood and charcoal. Regulations and anticipatory actions are necessary to sustain the harvesting of these primary energy sources.

Myanmar can save energy by implementing energy efficiency programmes in all energy-consuming sectors. In the industry sector, improved manufacturing technologies are expected to generate energy savings of at least 14% from BAU by 2020. In the residential and commercial ('others') sector, efficient end-use technologies and energy management systems are also projected to yield significant savings. In the transport sector, improved vehicle fuel economy and more effective traffic management will improve efficiency.

Although Myanmar still lacks a national strategy and action plan for mitigating and adapting to climate change, several ministries have been implementing sector-specific initiatives relevant to climate change. The government is already encouraging the use of biofuel in the transport and agriculture sectors to reduce oil dependency and curb carbon dioxide (CO2) emissions, although the amount of biofuel used in the country remains low. The Ministry of Electricity and Energy (MOEE) has initiated a Clean Fuel Program to reduce CO2 emissions by increasing the use of natural gas in the industrial sector and for power generation; this includes converting gasoline, diesel, and liquefied petroleum gas (LPG) vehicles to compressed natural gas vehicles.

The Ministry of Natural Resources and Environmental Conservation, formerly the Ministry of Forestry, and the designated national clean development mechanism authority, has submitted one hydropower project to the United Nations Framework Convention on Climate Change for consideration. The National Environmental Conservation Committee was formed in 2004 and re-formed in April 2011, replacing the National Commission for Environmental Affairs, and now serves as the focal organisation for environmental matters. It is chaired by the Ministry of Natural Resources and Environmental Conservation, and its membership includes 19 ministries.

The Environmental Conservation Law enacted in March 2012 provides a legal basis for implementing a range of enhanced environmental management measures. In addition, a draft Environmental Conservation Rule, containing regulations and technical guidelines and creating enabling conditions for their effective implementation, is being drawn up and will be submitted to the authorised body.

2.4 National Efficiency Policies

According to the 2015 Asian Development Bank report 'National Energy Efficiency and Conservation Policy, Strategy and Roadmap of Myanmar', electricity consumption in all sectors and achievable energy saving potential should reach 12% by 2020, 16% by 2025, and 20% by 2030. In the industry sector, the energy savings are expected to reach 5.34% in 2020, 5.31% in 2025, and 6.63% in 2030. In the commercial sector, savings are expected to reach 1.99% in 2020, 2.98% in 2025, and 3.98% in 2030. In the residential sector, savings are expected to reach 0.68% in 2020, 1.02% in 2025, and 1.36% in 2030; and in the 'others' sector, savings are expected to reach 0.68% in 2020, 1.02% in 2025, and 1.36% in 2030. Relative to 2012, biomass savings should reach 2.3% in 2020, 5.0% in 2015, and 7.0% in 2030.

These goals can be achieved through the following strategies. For the residential sector, (i) introduce energy efficiency performance standards and labelling for appliances, testing and certification facilities for appliances; (ii) introduce incentives for energy efficiency equipment; (iii) phase out inefficient appliances from the market; (iv) promote efficient biomass cooking stoves; (v) increase consumer awareness of the benefits of using LPG for cooking; (vi) introduce an energy efficiency labelling scheme for LPG cooking stoves; and (vii) conduct regular energy efficiency awareness campaigns in the national media. For the commercial sector, the activities include (i) energy audits, (ii) energy performance standards for appliances, (iii) the incorporation of energy efficiency in the design of new buildings, (iv) the implementation of an energy efficiency building code and refurbishment guidelines, and (v) energy efficiency guidelines for commercial buildings.

Under Action Plan 2018–2021, harmonised energy efficiency performance standards for air conditioning units and lighting will be implemented and implementation activities conducted step by step. The following measures are also considered important to achieve these goals: (i) high-efficiency lighting and refrigeration, and cooking with LPG in the residential sector; (ii) cogeneration; energy-efficient boilers, kilns, and motors; and waste heat recovery in the industrial sector; and (iii) high-efficiency lighting and air conditioning units, cooking with LPG, solar water heating, standard labelling equipment of appliances, and light-emitting diode lights in the commercial sector.

2.5 Internationally and Nationally Determined Contributions

Mitigation actions and policies in the energy sector include the following:

(i) Renewable energy—including mini-hydropower; biomass; and solar, wind, and solar minigrid technologies—should account for 30% of electricity in rural areas.
(ii) Approximately 260,000 energy-efficient cooking stoves should be distributed to encourage clean cooking and heating during 2016–2031.
(iii) Hydropower should generate 9.4 gigawatt-hours of electricity by 2030.
(iv) Energy efficiency should contribute to electricity savings of 20% of the total forecast electricity consumption by 2030.
(v) Renewable energy—including small and mini-hydropower, biomass (rice husk and municipal solid waste), wind, and solar—should account for 12% of the national energy mix (>2000 MW) by 2030.

2.6 Alternative Policy Scenarios

Previous studies have formulated two scenarios to analyse the impact of policy interventions on the energy sector: BAU, which serves as the reference case to project energy demand and CO2 emissions; and the alternative policy scenario (APS), which makes it possible to evaluate the impacts of policy interventions on the development and utilisation of energy resources in the country. The APS includes policies to increase energy efficiency and conservation targets, expedite the penetration of new and renewable energy, and introduce cleaner technology, including an option for nuclear power plants. To understand the impact of individual policy interventions further, this year's study formulated the following five APSs:

(i) APS 1: greater energy efficiency of final energy consumption;
(ii) APS 2: more efficient thermal electricity generation;
(iii) APS 3: higher contribution of new and renewable energy (electricity generation and biofuels in the transport sector are assumed);

(iv) APS 4: the introduction or higher contribution of nuclear energy; and
(v) APS 5: the combined impact of APSs 1, 2, and 3.

As Myanmar has no plan to introduce nuclear energy for power generation, this analysis does not consider APS 4; thus, APS 5 only includes APSs 1, 2, and 3. In APS 3, which includes more renewable energy in Myanmar's power generation mix by 2030, the additional installed capacity of coal- and gas-based power plants is replaced by renewable energy capacity, including that of hydropower plants. Beside the APSs, this study also considers the emission plans and targets of East Asia Summit member countries under the internationally and nationally determined contributions for the energy sector.

3. Outlook Results

3.1. Business as Usual Scenario

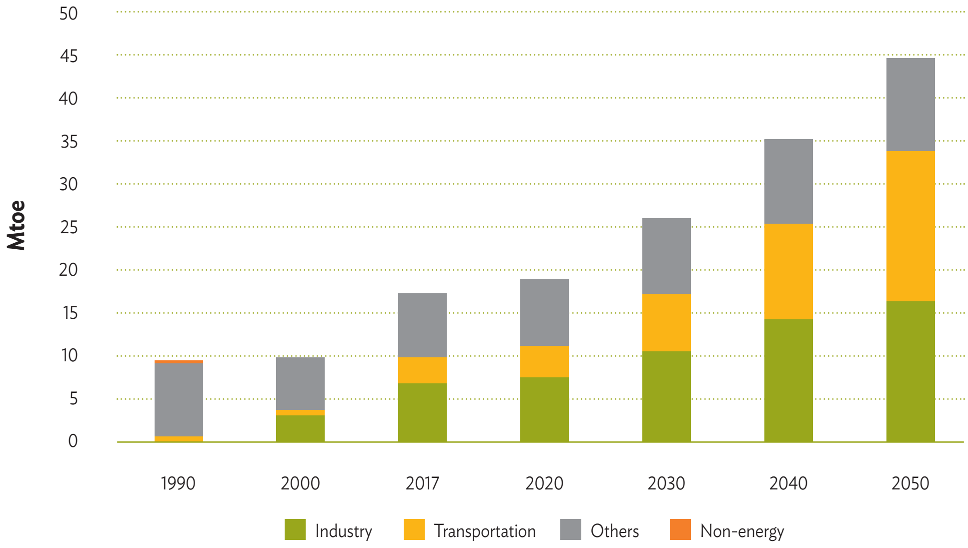
3.1.1 Final Energy Consumption

Myanmar's total final energy consumption (TFEC) increased by about 2.3% per year from 9.4 Mtoe in 1990 to 17.46 Mtoe in 2017. The transport sector grew the fastest with an AAGR of 7.5% between 1990 and 2017. Consequently, this sector's share of the TFEC increased from around 4.7% in 1990 to almost 17.8% in 2017. Industry was the second fastest growing sector, with an AAGR of 11.2% over the same period, from 4.2% in 1990 to 39.5% in 2017.

The 'others' sector, which comprises the commercial, residential, and agricultural sectors, was the largest contributor to the TFEC. However, this sector's share declined from 90.1% in 1990 to 42.8% in 2017, indicating that annual demand growth in this sector was slower than in industry and transport. The AAGR of the demand in this sector decreased by 0.5% between 1990 and 2017.

Based on these socioeconomic assumptions, final energy consumption in Myanmar is projected to grow at an annual rate of 2.9% under BAU to 44.70 Mtoe in 2050. The transport sector is still projected to experience the fastest growth in final energy consumption during 2017–2050, but this growth rate is lower than in 1990–2015. The final energy consumption of the transport sector will increase at an average rate of 5.4% per year, while demand in the industry sector will grow at a rate of 2.7% per year. In the 'others' sector (mainly the residential and commercial sectors), final energy demand is projected to grow at an annual average rate of 1.1%, slower than in the past. This is mainly because of reduced demand for biomass, which represents the majority of the fuel consumed by this sector. Figure 12.1 shows the final energy consumption by sector to 2050 under BAU.

Figure 12.1. Final Energy Consumption by Sector, Business as Usual



Mtoe = million tonnes of oil equivalent.

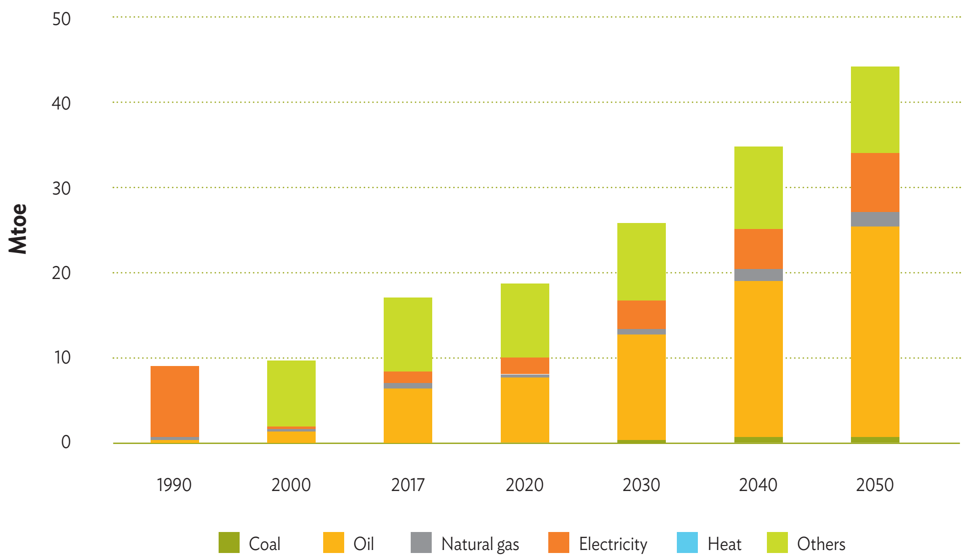
Source: Author's calculation.

Sector growth under BAU will result in the continuous increase of the transport, industrial, and non-energy sector shares in the TFEC, and a decline in that of the 'others' sector. The share of the transport sector is projected to increase to 39.1%, and that of the industrial sector to 36.6% in 2050. Meanwhile, the 'others' sector share will decline from 42.8% in 2017 to around 24.4% in 2050.

By fuel type, 'others' (mostly biomass) was the most consumed fuel in 1990, accounting for 89.2% of the TFEC of the country. Its share decreased to 50.3% in 2017 due to the increased growth of other fuels. From 1990 to 2017, natural gas demand increased from 0.23 Mtoe to 0.43 Mtoe, while oil demand increased from 0.59 Mtoe to 6.50 Mtoe over the same period, an AAGR of 9.3% (the fastest of all the fuel types).

Under BAU, the share of 'other' fuels will decline to 22.5% by 2050, indicating that its future use will grow more slowly than that of other fuels. In contrast, the share of oil will continue to increase, from 37.2% in 2017 to 55.7% in 2050, an AAGR of 4.2%. This is because of the rapid increase in transport sector activities from 2017 to 2050. Figure 12.2 shows final energy consumption by fuel type to 2050 under BAU.

Figure 12.2. Final Energy Consumption by Fuel, Business as Usual



Mtoe = million tonnes of oil equivalent.

Source: Author's calculation.

From 2017 to 2050, coal is projected to see an AAGR of 4.0%, slower than that of natural gas at 3.8%; while electricity demand will grow the fastest at an AAGR of 4.9%, from 8.4% to 16.1%.

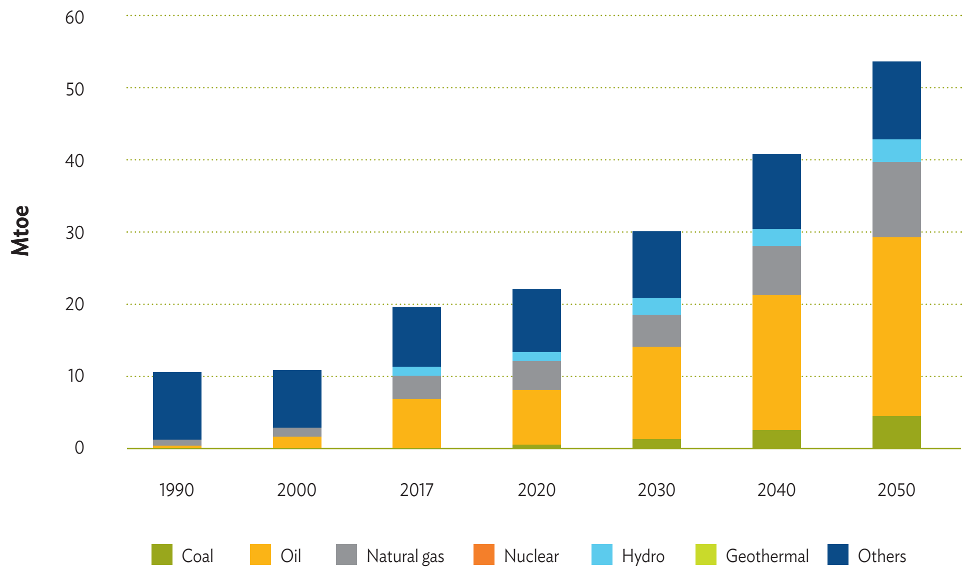
3.1.2 Primary Energy Supply

Primary energy supply in Myanmar grew at an average annual rate of 2.4% from 10.68 Mtoe in 1990 to 20.12 Mtoe in 2017. Among the major energy sources, the fastest growing were hydropower and oil, with AAGRs of 9.1% (hydropower) and 8.4% (oil). Over the same period, natural gas consumption grew at an average annual rate of 5.6%, and coal consumption increased by 8.0% per year, on average. 'Other' fuels, such as biomass, dominated the primary energy supply mix in 2017, with a 43.0% share, followed by oil with 32.4%, and natural gas with 16.5%.

Under BAU, Myanmar's primary energy supply is projected to increase at an annual average rate of 3.0% per year to 53.95 Mtoe in 2050. From 2017 to 2050, it is expected that hydropower will grow at an average annual rate of 3.4%, natural gas at 3.5%, coal at 6.9% (the fastest), and oil at 4.1%.

From 2017 to 2050, the share of oil in Myanmar's total primary energy mix will increase from 32.4% to 46.2%, and that of hydropower from 5.4% to 6.0%. The share of coal will also increase from 2.7% to 9.0%, and that of natural gas from 16.5% to 19.1%. Notably, the share of biomass will decrease from 43.6% to 19.6% due to its slow growth, which is driven by the growth of the rural population.

Figure 12.3. Primary Energy Supply by Source, Business as Usual



Hydro = hydropower, Mtoe = million tonnes of oil equivalent.

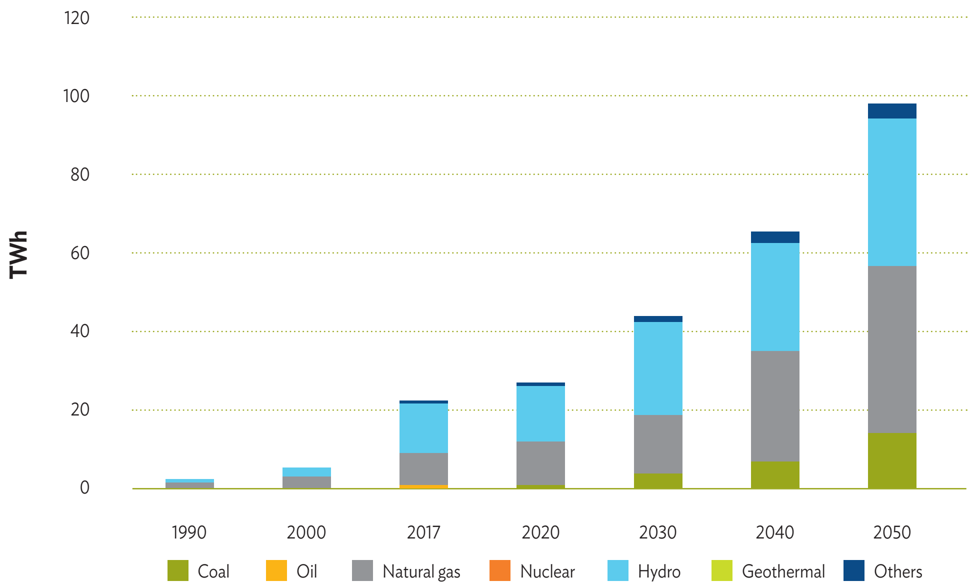
Source: Author's calculation.

Power Generation

Hydropower and natural gas dominate Myanmar's power sector fuel mix. In 2017, the share of hydropower in the power generation mix reached 59.0%, while that of natural gas was 39.0%. The remaining 2.0% was accounted for by coal and oil.

Under BAU, oil-based power plants will cease operating by 2030 while both hydropower and natural gas will continue to contribute to the power sector mix. However, their shares will change: hydropower-based power plants will have a 38.0% share while that of natural gas will be 43.0%. The other fuel types will increasingly play a role in the future. The share of coal-based power generation will increase to 15% of the total fuel mix by 2050, becoming the dominant power generation sector, while other renewables (solar, wind, and biomass) will reach 4%. Total electricity generation will grow at an average annual rate of 4.7% over 2017–2050, with natural gas-based power plants growing at an average annual rate of 5.1%.

Figure 12.4. **Power Generation Mix, Business as Usual**



Hydro = hydropower, TWh = terawatt-hour.

Source: Author's calculation.

Hydropower generation will increase but at a slower average annual rate of 3.4% over the same period.

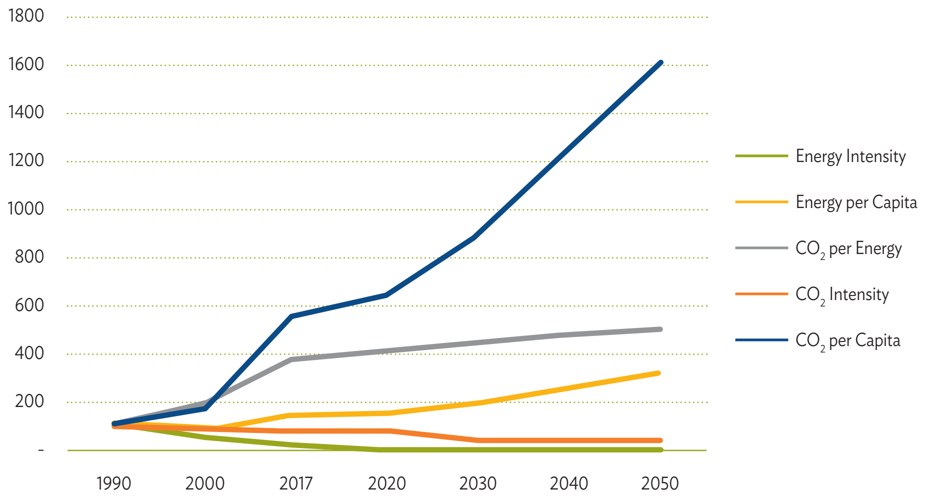
3.1.3 Energy Intensity, Energy per Capita, and Energy Elasticity

Myanmar's primary energy intensity (TPES/GDP) has been declining since 1990. In 2017, the primary energy intensity was 253.1 tonnes of oil equivalent per million dollars (toe/$ million), lower than 1990 when it was 1,333 toe/$ million. It is projected that the intensity will continue to decrease to 105.6 toe/$ million by 2050 at an average rate of 3.0% per year. Energy consumption per capita grew from 0.3 toe in 1990 to 0.4 toe in 2017, and will increase to 0.8 by 2050, an AAGR of 2.3%. CO2 intensity decreased from 140 tonnes of carbon per million dollars (t-C/$ million) in 1990 to 100.3 t-C/$ million in 2017, and is projected to decrease to 55.6 t-C/$ million by 2050, at an AAGR of -1.7%. Figure 12.5 shows the evolution of these energy indicators from 1990 to 2050.

3.2 Energy Saving Potential (Alternative Policy Scenario)

The APSs were analysed separately to determine the individual impacts of the policy interventions assumed in APSs 1, 2, and 3. The combination of all these policy interventions was further analysed in APS 5. Figure 12.6 shows the changes in TPES in all of the scenarios.

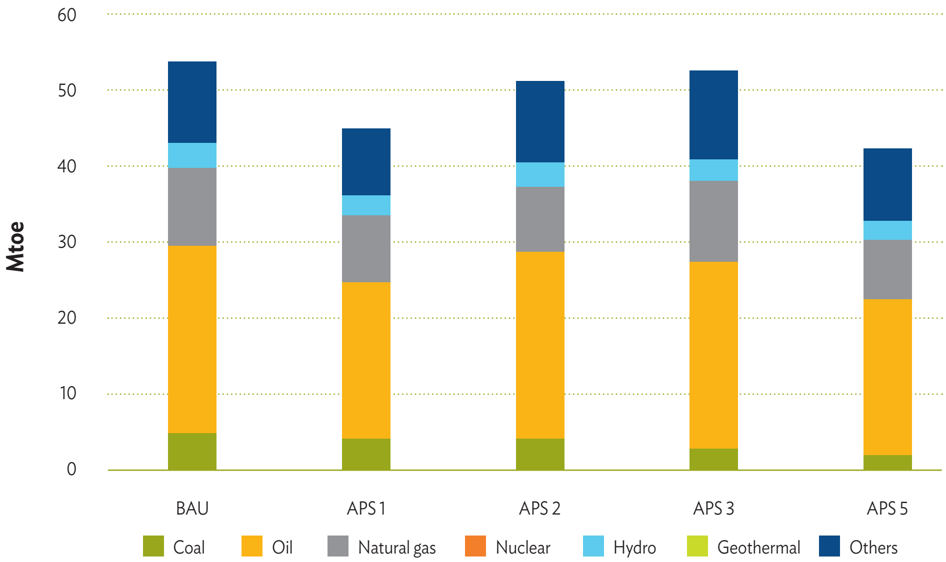
Figure 12.5. Energy Intensity, Carbon Dioxide Intensity, and Energy per Capita



CO_2 = carbon dioxide.

Source: Author's calculation.

Figure 12.6. Comparison of Scenarios to Total Primary Energy Supply by 2050



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

Source: Author's calculation.

In Figure 12.6 above, APS 5 sees the largest reduction in TPES due to the implementation of energy efficiency and conservation action plans, improved thermal efficiency of fossil-fueled power plants, and higher penetration of new and renewable energy in the country's supply mix. The AAGR of the TPES under APS 5 will be around 1.8% over the projection period. In 2050, the primary energy supply in APS 5 will be reduced by 11.24 Mtoe (20.8%) from BAU.

Individually, the implementation of energy efficiency targets and a masterplan as defined in APS 1 will reduce Myanmar's TPES by 7.69 Mtoe or 14.2% in 2050 compared to BAU. The AAGR of the primary energy supply in APS 1 will be 2.5%, higher than in APS 5. APS 2, which assumes greater efficiency in thermal electricity generation, will reduce the TPES by 2.51 Mtoe, or 4.6% compared to BAU. The country's TPES under APS 2 will grow at an annual average rate of 2.9%, slightly slower than under BAU. Since no final energy consumption efficiency measures were assumed for APS 2, the impact on the primary energy supply will be lower than in APS 1 or APS 5. Of all the fossil fuels considered, the implementation of greater efficiency in thermal power generation will reduce the use of coal and natural gas for power generation. For coal use in the power sector, thermal efficiency could reduce coal consumption by almost 15% from BAU to the APS.

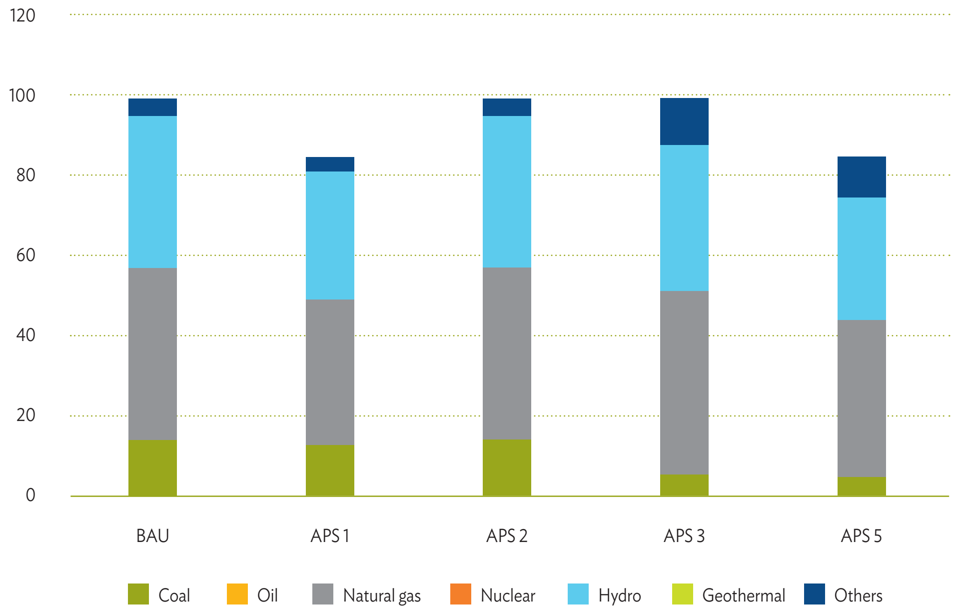
Implementation of a policy to encourage higher penetration of new and renewable energy will also reduce the TPES compared to BAU by 1.03 Mtoe or 2%. By fuel type, coal consumption will decline while use of renewable energy will increase by 7.69 Mtoe or 65%. Implementing policy interventions will also impact the country's power generation capacity. Figure 12.7 shows the total electricity generation in 2050 in all scenarios. In APSs 1 and 5, lower electricity demand will reduce power generation by 14.55 Mtoe or 15% compared to BAU. This reduction will come from natural gas, coal, and hydropower plants, with the highest reduction from coalpower plants (12.54 Mtoe in APS 1 and 4.79 Mtoe in APS 5).

Under APSs 2 and 3, the total amount of electricity generated will be similar to BAU because no efficiency measures were imposed on the final energy consumption sector. However, the differences lie in the power generation fuel mix under APS 3. More renewable power plants using 'other' sources such as solar, wind, and biomass will be in operation over the planning period.

In terms of CO2 emission reduction, energy efficiency in APS 5 is expected to reduce emissions by around 22.8 million tonnes of carbon (Mt-C), a decrease of 20% from BAU. This indicates that the energy saving goals, action plans, and policies, including switching to less carbon-intensive technologies such as renewable sources in the supply mix, will be effective in reducing CO2 emissions. Figure 12.8 shows the projected CO2 emissions in 2040 in all scenarios.

In APS 1, the TFEC will be lower, reducing CO2 emissions from energy consumption to 23.8 Mt-C, a reduction of around 15 Mt-C, and an around 38% decrease compared to BAU. In APS 3, higher contributions from renewable energy could reduce emissions by 27% compared to BAU. Total CO2 emissions under APS 3 will be around 28.6 Mt-C. This decrease in CO2 indicates that increasing renewable energy shares in the total supply will reduce CO2 emissions further.

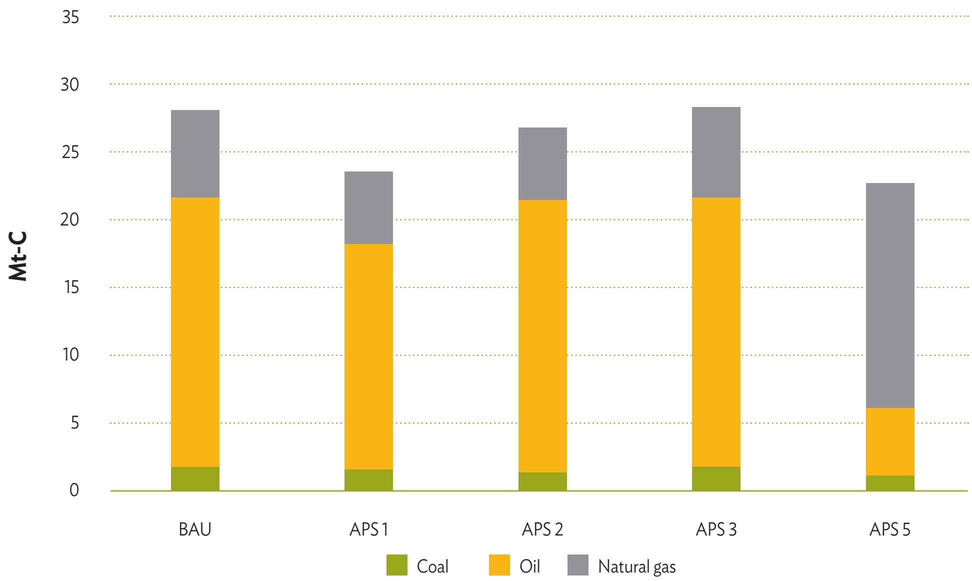
Figure 12.7. Comparison of Scenarios of Electricity Generation by 2050



APS = alternative policy scenario, BAU = business as usual, Hydro = hydropower, TWh = terawatt-hour.

Source: Author's calculation.

Figure 12.8. Comparison of Scenarios or Carbon Dioxide Emissions by 2050



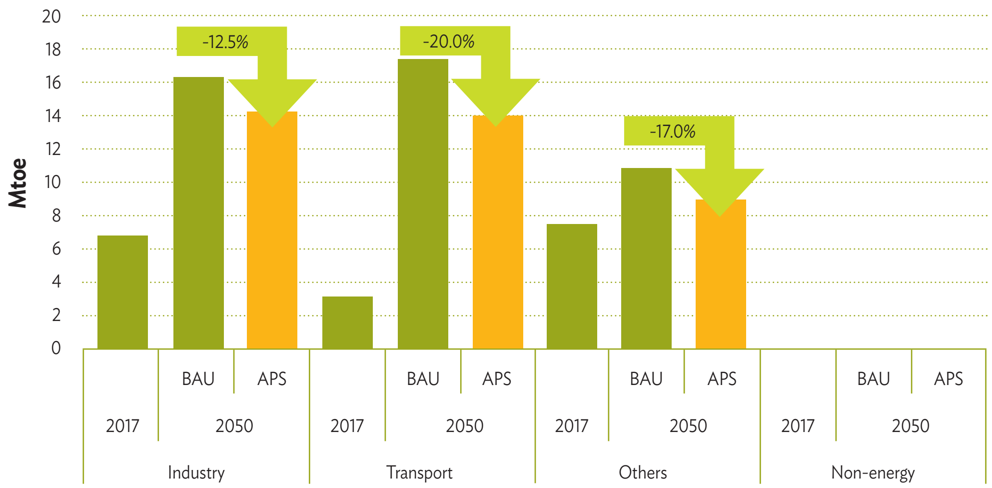
APS = alternative policy scenario, BAU = business as usual, Mt-C = million tonnes of carbon.

Source: Author's calculation.

3.2.1 Final Energy Consumption

In APS 5, final energy consumption is projected to grow at a lower average annual rate of 2.3%, compared to the 2.9% annual growth under BAU. This is the result of technological improvement in manufacturing processes and a reduction in final energy consumption of electricity and oil in the residential and commercial ('other') sector. Figure 12.9 shows the differences in final energy consumption in 2050 by sector under BAU and in the APS.

Figure 12.9. Final Energy Consumption by Sector, Business as Usual and Alternative Policy Scenario



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

Source: Author's calculation.

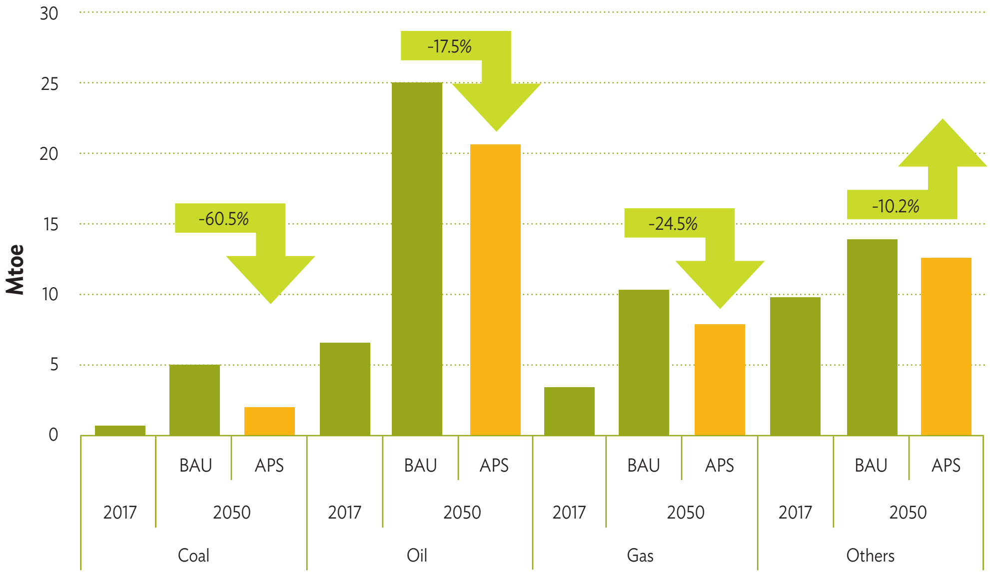
Primary Energy Supply

In the APS, Myanmar's primary energy supply is projected to increase at a slightly lower rate compared to BAU from 20.12 Mtoe in 2017 to 42.71 Mtoe in 2050, an AAGR of 1.8%. From 2017 to 2050, it is expected that coal will grow the fastest at 3.9% per year, followed by oil at 3.5%, hydropower at 2.7%, and natural gas at 2.6%. Figure 12.10 shows the primary energy supply by source in 2050 under BAU and in the APS.

Projected Energy Savings

In Myanmar, commercial energy consumption is projected on the basis of the energy requirements of major sectors (industry, transport, and agriculture)). Choice of fuel type is determined by available supply, since energy demand must be met mainly by domestic

Figure 12.10. Primary Energy Supply by Source, Business as Usual and the Alternative Policy Scenario



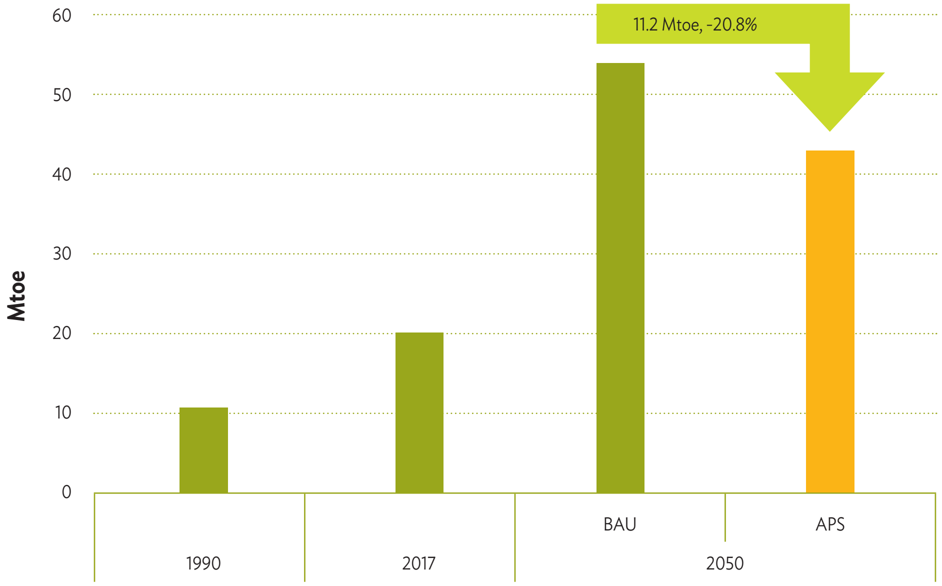
APS = alternative policy scenario, BAU = business as usual, Mtoe = million tonnes of oil equivalent.

Source: Author's calculation.

sources. Although there is a gap between demand and supply, demand is much higher than the actual requirement. Due to these constraints, coefficients derived from time series regression are applied to allocate energy. These allocations are made in accordance with the priorities of state organisations and enterprises. For the private sector, allocations are made in accordance with the registered licensed capacity of the firm.

Future energy savings can be achieved through savings in the primary energy supply in the residential, commercial, transport, and industrial sectors. To this end, Myanmar has implemented a range of energy efficiency and conservation goals and action plans targeting energy savings in all sectors of the economy and in cooperation with both the private and public sectors. These will yield estimated savings of 11.2 Mtoe by 2050 in the APS, relative to BAU, equivalent to 20.8% savings in the primary energy supply by 2050 under BAU (Figure 12.11). Myanmar also plans to limit the growth of the primary energy supply by implementing a range of energy efficiency and conservation measures on the demand side.

Figure 12.11. Evolution of Primary Energy Supply, Business as Usual and the Alternative Policy Scenario



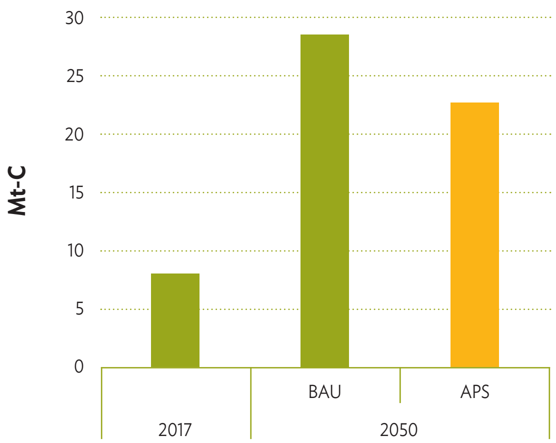
APS = alternative policy scenario, BAU = business as usual, Mtoe = million tonnes of oil equivalent.

Source: Study outcome.

3.2.2 Carbon Dioxide Reduction Potential

In the APS, Myanmar's energy efficiency policy is projected to reduce the growth in CO2 emissions from energy consumption. By 2050, in the APS, CO2 emissions from energy consumption are projected to reach about 5.6 Mt-C, about 19.8% less than BAU (Figure 12.12).

Figure 12.12. Carbon Dioxide Emissions from Energy Consumption, Business as Usual and the Alternative Policy Scenario



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

Source: Study outcome.

3.3 Internationally and Nationally Determined Contributions

The current energy outlook model considers the mitigation actions and policies of Myanmar in the energy sector, as specified above. These include potential savings of 12% with respect to electricity and 20% in the transport sector by 2050. The following energy sector mitigation actions and policies are represented in the APS:

(i) Energy savings in various final sectors (industry, transport, residential, commercial, and others) as a result of the introduction of more efficient technologies (APS 1). These savings were projected as follows:

(a) a 12% reduction in electricity demand compared to BAU,

(b) 20% savings in the oil sector compared to BAU, and

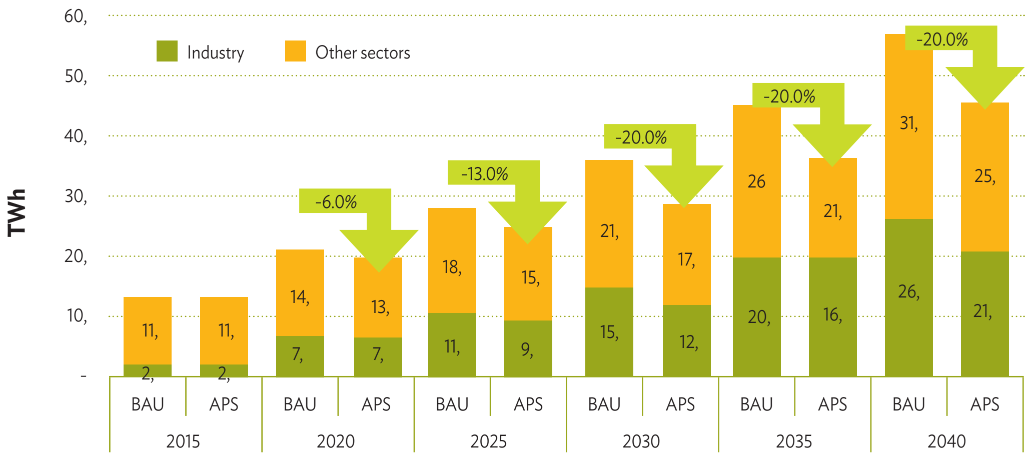
(c) a 7% reduction in biofuel demand compared to BAU.

(ii) The introduction of high-efficiency technologies for fossil fuel use in the power sector (APS 2).

(iii) An increased share of renewable energy in the power generation mix (APS 3), with solar, wind, and biomass (excluding hydropower) at 12.0%.

By 2050, the electricity demand was expected to reach 98.79 TWh under BAU, compared to only 84.24 TWh in the APS, a difference of 15%age points. This electricity saving is assumed to continue to 2050 as no additional target is available after 2050. Figure 12.13 shows the electricity demand of the final sectors from 2015 to 2040. Other sectors include residential, commercial, agriculture, and construction. The current outlook excludes electricity demand in the transport sector.

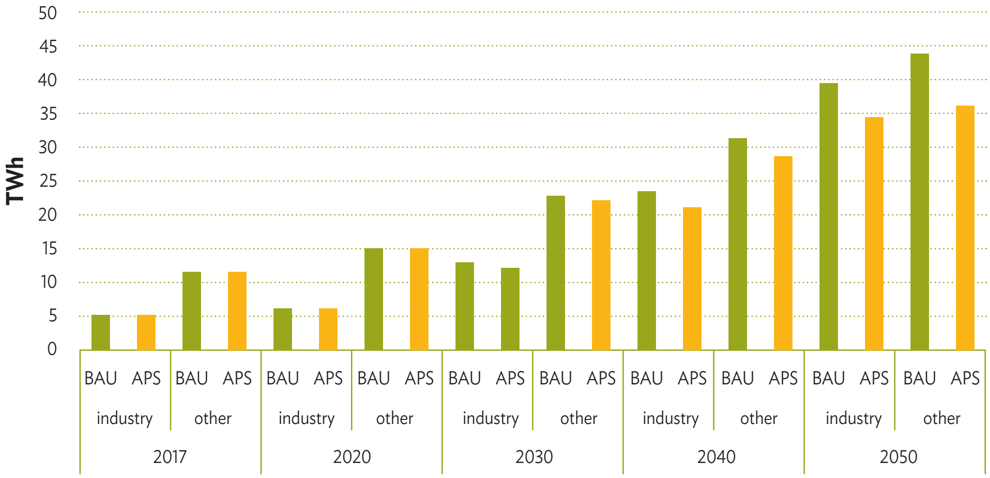
Figure 12.13. Electricity Demand, Business as Usual and the Alternative Policy Scenario



APS = alternative policy scenario, BAU = business as usual, TWh = terawatt-hour.

Source: Author's calculation.

Figure 12.14. Electricity Demand by Sectors, Business as Usual and the Alternative Policy Scenario

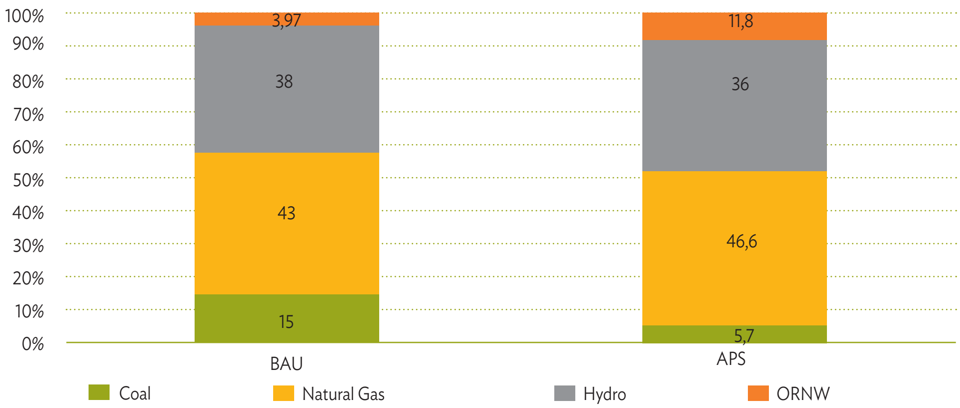


APS = alternative policy scenario, BAU = business as usual, TWh = terawatt-hour.

Source: Author's calculation.

In the APS, generation capacity will lean more towards renewable energy, compared to BAU (Figure 12.14). As explained above, the APS excludes some of the additional capacity from coal and natural gas after 2025, while more will be made available from renewable energy sources. Hydropower resources will reach a capacity of 9.4 gigawatts by 2030 as stipulated in the mitigation actions and policies for Myanmar's energy sector. These include not only large but also mini- and micro-hydropower plants. The hydropower share reached 36.0% under the APS, compared to 38.0% under BAU, while that of other renewable sources such as solar, wind, and biomass will also increase compared to BAU (4.0% compared to 11.8%).

Figure 12.15. Share of Power Generation Capacity in 2050, Business as Usual and the Alternative Policy Scenario



APS = alternative policy scenario, BAU = business as usual, Hydro = hydropower, ORNW = other renewable sources.

Source: Study outcome.

Considering the lower final energy consumption and greater share of renewables in the APS, the impact of the APS on the environment would be lower CO2 emissions. Total CO2 emissions under BAU will be 28.43 Mt-C by 2050. In the APS, CO2 emissions will be around 22.80 Mt-C in 2050, a reduction of 5.63 Mt-C compared to BAU, or approximately 20%. As previously shown, in the APS, CO2 emissions will decrease by 38% by 2040, a reduction of around 32.8 million tonnes of carbon equivalent (or 8.9 Mt-C).

4. Conclusions and Policy Implications

Although energy intensity will decline, energy consumption is still increasing because of economic, population, and vehicle population growth. Myanmar should increasingly adopt energy-efficient technologies to mitigate growth in energy consumption and should also diversify energy availability. The energy saving programme will target the residential, commercial, transport, and industry sectors. The current energy supply has been kept below its potential because of the scarcity of the technical and financial resources needed to reverse the decline and subsequently accelerate the development and production of natural gas and oil.

The country has been experiencing serious energy shortages, which will become more acute in the absence of further energy sector investment. First, there should be more aggressive exploration of the upstream energy sector, as well as more financial and technical assistance in each energy subsector to secure the national energy supply, increase electricity production, rehabilitate existing electricity transmission and distribution, expand rural electrification, build coal- or gas-fired power plants, and promote renewable energy in Myanmar's fuel mix as secure energy sources. The framework would list all potential renewable energy projects in the country, outlining priorities and sequencing, along with funding requirements based on completed studies.

In this regard, the following points are proposed for consideration:

(i) In promoting coal-fired power generation, the MOEE should be mindful of the need to apply clean coal technologies.

(ii) The continuous use of biomass will fully depend on the MOEE's support, which should provide efficient biomass cooking stoves to households (especially in rural areas) at reasonable prices.

(iii) There is a need for a detailed policy mechanism for the renewable energy sector to implement potential programmes and projects. This mechanism should be developed and planned in conjunction with external stakeholders who can offer experience, advanced technologies, new markets, and investment.

(iv) The MOEE should seek international cooperation with entities such as the Asian Development Bank and the International Renewable Energy Agency to support the increase in variable renewable energy in Myanmar.

(v) There is a need to improve energy management practices in the industrial and commercial sectors.

(vi) A dedicated energy efficiency body should be established to oversee Myanmar's energy efficiency programme.

(vii) The current energy efficiency target should be refined to include all sectors' numerical targets and detailed action plans.

(viii) Myanmar needs to establish a comprehensive integrated energy plan to guide the development of the energy sector, including an energy efficiency labelling programme for energy service companies and appliances.

(ix) The government needs to formulate schemes to enhance private participation, including by foreign companies, to accelerate power sector development, including transmission and distribution systems to ensure the reliable supply of electricity to consumers.

(x) The Ministry of Planning, Finance and Industry should set specific targets for each sector on energy efficiency, and the government should implement the committed energy policy to achieve these targets.

(xi) Importing liquefied natural gas in the form of floating terminals should be considered in the short term to meet the projected rapid growth of electricity demand while new domestic natural gas resources are being explored.