Chapter 12

Myanmar Country Report

September 2016

This chapter should be cited as

Myint" T, (2016), 'Myanmar Country Report' in Kimura, ɳ, and ɲ, Han (eds.) in *Energy Outlook and Energy Saving Potential in East Asia 2016.* ERIA Research Project Report 2015-5, Jakarta: ERIA, pp.237-259.

Chapter 12

Myanmar Country Report

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1. Background

1.1. Country Profile

Myanmar is the largest country in the mainland of Southeast Asia. Its territorial area covers 676,577 square kilometres and it shares a border of 5,858 km with Bangladesh and India to the northwest, China to the northeast, and Thailand to the southeast. Approximately 48 percent of the total land area is covered with forest, and most of the land area is utilised for agriculture. Myanmar had a population of 53 million in 2013, with an average annual growth rate of 1.0 percent per year from 1990 to 2013.

Myanmar is geographically located at the tip of the Southeast Asia Peninsula and has three distinct seasons. It enjoys three to four months of heavy monsoon and abundant sunshine all year round, which makes it ideal for accumulating water resources for hydropower and for agriculture. Its topographic features favour the existence of numerous rivers, mountain ranges, and sedimentary basins where mineral deposits and energy resources have abundantly accumulated. The delta regions where the two major river systems enter the Bay of Bengal and the 2,832 km coastal strip along the southern part is also a good area for the development of marine ecosystems and an abundant source of marine products and mineral resources.

Myanmar is endowed with rich natural resources for production of commercial energy. The available current sources of energy found in Myanmar are crude oil, natural gas, hydroelectricity, biomass, and coal. Besides these, wind energy, solar, geothermal, bio-ethanol, bio-diesel, and biogas are Myanmar's potential energy sources.

Myanmar's proven energy reserves comprise of 141.98 million barrels of oil, 10.66 trillion cubic feet of gas, and 540.31 million metric tons 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 70 percent of its total oil requirements.

1.2. Socio-economic Status

The population of Myanmar grew at 1.0 percent per year between 1990 and 2013, to 53 million in 2013. Myanmar's gross domestic product (GDP) was US$[1]24.9 billion (constant 2005) in 2013 and its GDP per capita grew from around US$100 in 1990 to US$470 in 2013. With the objectives of enhancing economic development in Myanmar, 5-year short-term plans were formulated and implemented from 1992 to 2013. The first (1992–1995), second (1996–2000), third (2001–2005), and fourth plan (2006–2010) achieved average annual GDP growth rates of 7.5 percent, 8.5 percent, 12.8 percent, and 12.0 percent, respectively. The last 5-year plan (2011–2016) was formulated to achieve an average annual GDP growth rate of 7.6 percent.

1.3. Energy Consumption in the Base Year

Myanmar's total primary energy supply (TPES) was 16.46 million tons of oil equivalent (Mtoe) in 2013. Natural gas is mainly used for electricity generation and in industry. Myanmar has 4,145 megawatts (MW) of installed generation capacity and produced about 11.89 terawatt-hours (TWh) of electricity in 2013. In

[1] All US$ in this report are in constant 2005 values unless otherwise specified.

the same year, thermal (coal, natural gas, and oil) and hydro accounted for 25.3 percent and 74.7 percent of total electricity generation, respectively.

2. Modelling Assumptions

2.1. GDP and Population Growth

In this report, Myanmar's GDP is assumed to grow at an average annual rate of around 6.2 percent from 2013 to 2040, slowing from 1990–2013's growth of 9.2 percent. The population is assumed to increase by about 0.8 percent per year from 2013 to 2040.

2.2. Energy Consumption and Electricity Generation

Hydro and natural gas have dominated electricity generation in Myanmar. Other fuels such as oil and coal also contributed in the country's generation mix, but in total only less than 13 percent in 1990. It is assumed that the share of coal in the generation mix will be more than 14.7 percent in 2040. The government's plan is to increase further the shares of natural gas, coal, hydro, and other renewables in the total generation mix and decrease oil's share. Myanmar also has plans to export electricity from its hydro power plants to neighbouring countries such as Thailand and China.

2.3. Energy and Climate Change/Environmental Policies

Myanmar's energy policy in general strives towards maintaining the status of 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 energy resource for generating electricity to save non-renewable sources of energy such as fossil fuels for alternative and future use. Energy

efficiency and conservation (EEC) is emphasised to save energy through effective energy management and to reduce energy consumption so as to minimise harmful environmental impacts. Utilisation of new and renewable energy sources, especially solar and wind, which are abundant under Myanmar's climatic condition, is encouraged. It also accepts the fact that utilisation of traditional energy sources such as fuel-wood and charcoal still needs to be practiced. Regulations and anticipatory actions are necessary for the sustained harvesting of this primary energy source.

Savings in Myanmar's energy consumption can be attained through the implementation of energy efficiency programmes in all energy-consuming sectors. In the industry sector, energy savings of at least 14 percent from Business-as-Usual scenario (BAU) levels are expected from improvement in manufacturing technologies by 2020. In the residential and commercial ('others') sector, efficient end-use technologies and energy management systems are also projected to induce significant savings. In the transport sector, efficiency improvements will be achieved by improved vehicle fuel economy and more effective traffic management.

Myanmar still lacks a national strategy and action plan for mitigating and adapting to climate change, but several ministries have been implementing sector-specific initiatives relevant to climate change. The government is encouraging the use of biofuel in the transport and agriculture sectors to reduce oil dependency and curb carbon dioxide (CO_2) emissions. These efforts are already in place, although the amount of biofuel used in the country remains small for the time being. The government through the Ministry of Energy has initiated the Clean Fuel Program to reduce carbon dioxide 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 (CNG) vehicles.

The Ministry of Natural Resources and Environmental Conservation (MONREC), the designated national authority for clean development mechanism (CDM) has submitted one hydro-power project to UNFCCC for consideration. The National Environmental Conservation Committee was formed in 2004 and re-formed in

April 2011, replacing NCEA, and now serves as the focal organisation for environmental matters. It is chaired by MONREC, formerly the Ministry of Forestry. The Committee's membership includes 19 ministries.

The Environmental Conservation Law was enacted by the government in March 2012. The law provides the legal basis for implementing a range of enhanced environmental management measures. Simultaneously, the draft Environmental Conservation Rule, which embodies regulations and technical guidelines, and creates the enabling conditions for their effective implementation is being drawn up and submitted to an authorised body for approval.

Myanmar's primary energy saving goal is to reduce energy consumption by 5 percent in 2020 and by 10 percent in 2030, relative to the BAU. Specifically, the goals could be achieved by the following strategies:

- In the industrial sector, improve energy efficiency by 10 percent against BAU and reduce energy related greenhouse gases by 2020.
- In the transport sector, have biofuel (E85, biodiesel) substitution of at least 8 percent by 2020.
- Increase the total installed power capacity of renewable energy to 15 percent by 2020.
- Improve energy efficiency in the commercial/residential sector by 8 percent by 2020.

In addition, the following measures are considered important in achieving the goals:

- To develop energy statistics and support systems to help improve energy efficiency in all sectors by encouraging information dissemination and cooperation between the public and private sectors.
- To develop voluntary action plans for the private sector by 2010–2015.
- To develop labelling systems for appliances and buildings by 2015.
- To increase research and development.
- To develop an energy management system through the Association of Southeast Asian Nations (ASEAN) Energy Manager Accreditation Scheme (AEMAS) Program by 2010–2015.

On a sectoral basis, the EEC measures in Myanmar are listed below:

- In industry, gradual replacement of low efficiency equipment with higher efficiency alternatives will be encouraged.
- In the transport sector, the state will encourage fuel switching in the transport sector to biofuels and natural gas as alternative fuels. The state also aims to achieve energy saving through exploiting more efficient transportation networks, including road, waterways, rail, air, and seaway and develop high-capacity transport with greater volume capacity for freight and passenger. Improvement in fuel efficiency in the transport sector is also considered.
- In the residential and commercial sectors, the following measures will be implemented:
  - Encourage the use of alternative energy and improvement in energy efficiency in existing buildings in the public and private sectors.
  - Promote the use of more energy efficient appliances and energy saving equipment in the residential and commercial sectors.
  - Launch the use of bio-diesel (B 100) in rural communities.
- In the electricity sector, the following measures will be implemented:
  - Develop and expand the energy mix and supply sources through utilisation of the full energy potential of the country, including frontier exploration and development and intensive research on oil, natural gas, coal, hydropower, geothermal, EEC, and new and renewable sources of energy.
  - Replace transformers and install capacitor banks in the main sub-stations. Optimise the voltage, conductor size, and loading of transformers.

2.4. The National Efficiency Policies

To achieve the National Target for EEC plans and programmes, the government should implement the following actions:

- Disseminate knowledge about EEC to communities and encourage the use of local renewable energy resources instead of fossil fuels.

- Conduct workshops and seminars regarding EEC to increase public awareness.
- Market promotion of energy efficient equipment and labelling of energy saving appliances such as air-conditioners, motors and pumps, electric appliances, etc.
- Encourage the private sector to implement the EEC programmes on a voluntary basis through recognition programmes.
- Provide financial assistance for transferring advanced technology.
- Adoption of best practices is an effective action plan for energy saving in the transport, residential, and commercial sectors.
- To consider EEC on both the demand and supply sides of electricity.
- There should be proper policy measures and action plans to achieve energy savings targets.

2.5. Action Plan

The energy efficiency initiatives of Myanmar covered buildings, households, and the industrial and transport sectors. They are as follows:

Table 12-1. Energy Efficiency Initiatives

Sectors	EEC Initiatives
Industrial	- Promote the introduction of equipment and facilities with high-energy conservation capacity. - Develop energy statistics - Develop goals for voluntary action plans - Develop R&D and AEMAS programme
Transportation	- Raise the fuel efficiency in terms of passenger-km, and km/litre - Fuel substitution with biofuels
Electricity	- Develop technology transfer and renewable energy, knowledge in rural areas - Assist sustainable, renewable energy application in electricity generation
Household	- Labelling systems for buildings and appliances - Develop demand side management programmes - Thorough management of energy and other resources

EEC = energy efficiency and conservation; R&D = research and development; AEMAS = ASEAN Energy Manager Accreditation Scheme.
Source: Author's compilation from various sources of the Ministry of Electricity and Energy, The Union of Myanmar, 2015.

2.6. Alternative Policy Scenarios (APS)

In the previous studies, two scenarios were formulated to analyse the impact of policy interventions to the energy sector. The Business-as-Usual scenario (BAU), which serves as the reference case to project energy demand and carbon dioxide (CO_2) emission and the Alternative Policy Scenario (APS) to evaluate the impacts of policy interventions in the development and utilisation of energy resources in the country. The APS as such can include policies to increase EEC targets, expedite penetration of new and renewable energy, and introduce cleaner technology including opting for a nuclear power plant. To understand further the impact of individual policy interventions, this year's study formulated five alternative policy scenarios as follows:

1) APS1: Improved energy efficiency of final energy consumption
2) APS2: Higher efficiency of thermal electricity generation
3) APS3: Higher contribution of new and renewable energy (NRE) (here NRE for electricity generation and biofuels in the transport sector are assumed)
4) APS4: Introduction or higher contribution of nuclear energy
5) APS5: Combined impact of scenarios APS1 to APS4

In the case of Myanmar, there is no existing plan to introduce nuclear energy for power generation. As such, the APS4 has not been considered in the analysis. Thus, APS5 would only consist of APS1, APS2, and APS3.

3. Outlook Results

3.1. Business-as-Usual (BAU) Scenario

Final energy consumption

Total final energy consumption (TFEC) in Myanmar increased by about 2.1 percent per year from 9.4 Mtoe in 1990 to 15.23 Mtoe in 2013. The industrial sector was the fastest growing sector with an average annual growth of 7.1 percent between 1990 and 2013. Consequently, the share of this sector in TFEC increased from around 4.2 percent in 1990 to 12.4 percent in 2013. The transport sector was the second fastest growing sector with an average annual growth rate

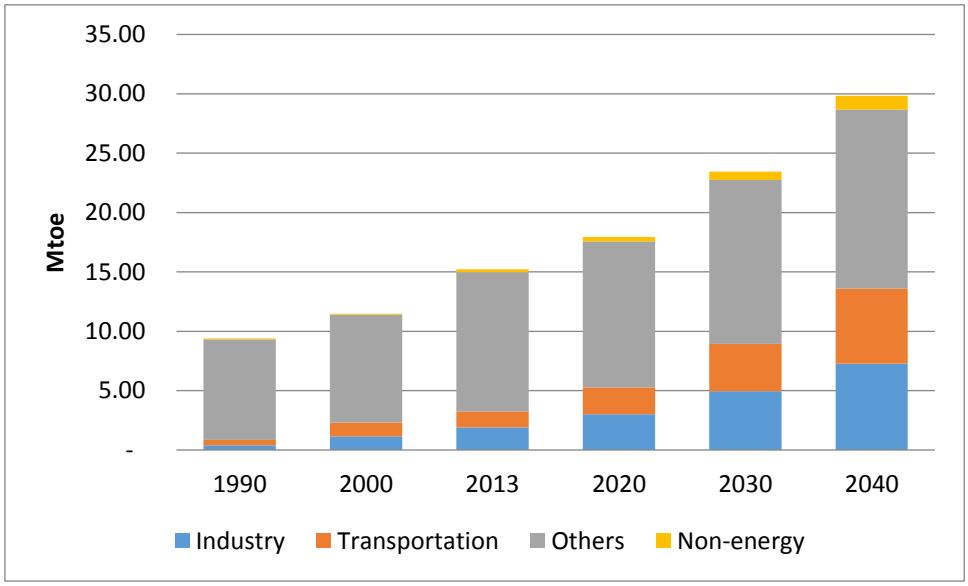
of 5.0 percent over the same period and the share of this sector in TFEC increased from 4.7 percent in 1990 to 9.0 percent in 2013.

The 'others' sector, which comprises the commercial, residential, and agricultural sectors, was the major contributor to TFEC. The shares of this sector, however, declined from 90.1 percent in 1990 to 77.0 percent in 2013. This indicates that annual growth of demand for this sector was slower than the industry and transport sector. The average annual growth rate of the demand of the 'others' sector was 1.4 percent between 1990 and 2013. Non-energy consumption grew gradually at an average annual rate of 4.2 percent over the same period from almost 0.1 Mtoe in 1990 to 0.24 Mtoe in 2013. Although the share of this sector in demand was only 1 percent in 1990, it increased slighly to 1.6 percent in 2013.

Using the socio-economic assumptions stated above, final energy consumption in Myanmar is projected to grow at an annual rate of 2.5 percent under the BAU, reaching 29.84 Mtoe in 2040. The industrial sector, which experienced the fastest growth in final energy consumption during the 1990–2013 period, is expected to slow in the future. Final energy consumption of the industrial sector will increase at an average rate of 5.1 percent per year while tranport sector demand will grow faster at 5.8 percent per year. Final energy consumption of the other sectors (mainly the residential and commercial sectors) is projected to grow at an annual average rate of 0.9 percent, slower than in the past. This is mainly because of the fall in biomass demand, which represents the bulk of fuel consumed by the sector. Figure 12-1 shows the final energy consumption by sector to 2040 under the BAU.

The respective growth of the sectors under the BAU will result in a continuous increase of the transport, industrial, and non-energy sector shares in TFEC and a decline in the 'others' sector's share. The transport, industrial, and non-energy sector share is projected to increase to 21.3 percent, 24.4 percent, and 3.9 percent, respectively, in 2040. The 'others' sector's share will decline to 50.5 percent from 77.0 percent in 2013.

Figure 12-1: Final Energy Consumption by Sector, BAU



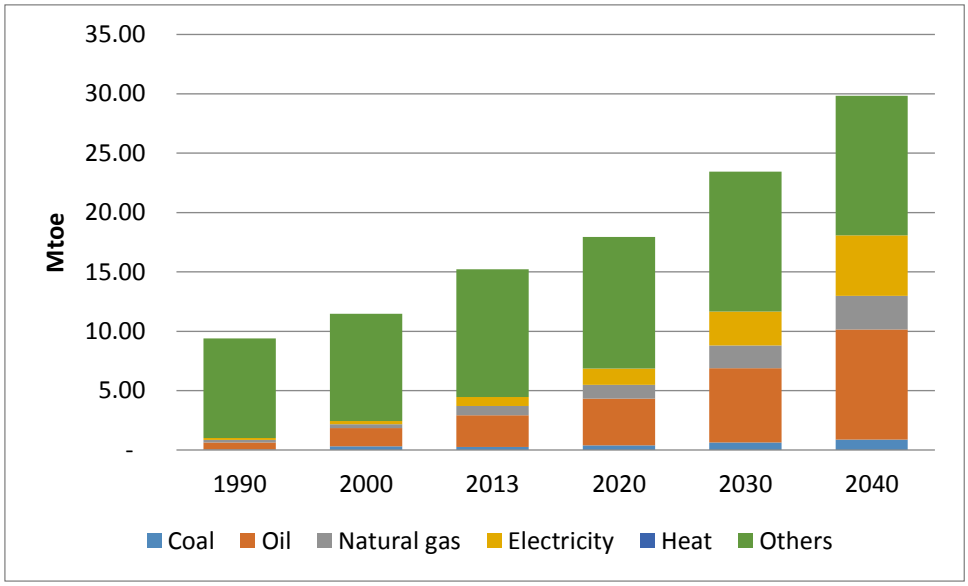
BAU = Business-as-Usual scenario; Mtoe = million tons of oil equivalent.
Source: Author's calculations.

By fuel type, 'others,' which is mostly biomass, were the most consumed fuel in 1990 with a share of 89.2 percent in Myanmar's TFEC. Its share decreased to 70.8 percent in 2013 due to the higher growth of the other fuels. The demand for natural gas increased from 0.23 Mtoe in 1990 to 0.77 Mtoe in 2013 while for oil it increased from 0.59 Mtoe to 2.69 Mtoe over the same period. Electricity demand increased fastest at an average growth rate of 7.3 percent per year over the 1990 to 2013 period.

Under the BAU, the share of other fuels will decline to 39.4 percent in 2040, indicating that its future use will grow slower than for the other fuels. In contrast, the share of oil will continue to increase and reach 31.1 percent in 2040 from 17.7 percent in 2013, with an average growth of 4.7 percent per year. This is due to the rapid increase of transport sector activities over the 2013 to 2040 period. Figure 12-2 shows the final energy consumption by fuel type to 2040 under the BAU.

Coal is projected to grow at an average annual rate of 4.8 percent from 2013 to 2040, still slower than natural gas (5.0 percent).

Figure 12-2. Final Energy Consumption by Fuel, BAU



BAU = Business-as-Usual scenario; Mtoe = million tons of oil equivalent.
Source: Author's calculations.

Electricity demand will still grow fastest, at an average annual rate of 7.4 percent over the same period, its share increasing from 4.9 percent in 2013 to 17.1 percent in 2040.

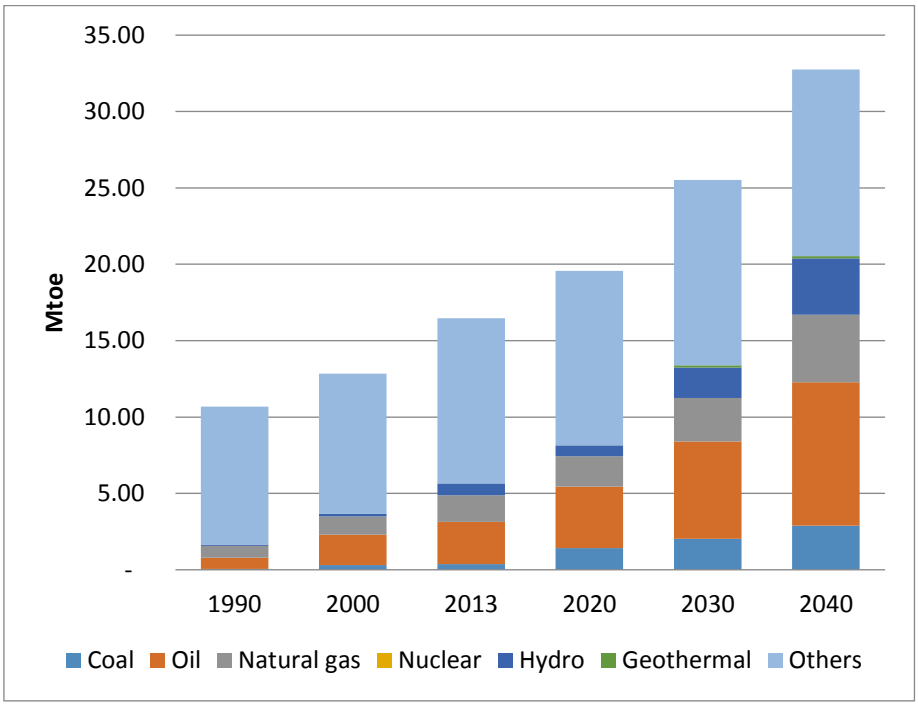
Primary energy supply

Primary energy supply in Myanmar grew at an average annual rate of 1.9 percent from 10.7 Mtoe in 1990 to 16.5 Mtoe in 2013. Among the major energy sources, the fastest growing were hydro and coal with average annual growth rates of 9.1 percent and 7.7 percent, respectively. Natural gas consumption grew at an average annual rate of 3.7 percent over the same period. Oil consumption increased at 6.0 percent per year on average over the same period. Others, such as biomass, dominated the primary energy supply mix in 2013 with a share of 65.7 percent. Oil and natural gas, with respective shares of 16.8 percent and 10.6 percent, had the next largest shares among the major fuels over the same period.

In the BAU, Myanmar's primary energy supply is projected to increase at an annual average rate of 2.6 percent per year to 32.7 Mtoe in 2040. Hydro and natural gas are expected to grow at average annual rates of 6.0 percent and 3.5 percent, respectively. Coal will grow faster at 7.9 percent from 2013 to 2040 and oil will grow at 4.6 percent per year.

The share of oil and hydro in the total primary energy mix of Myanmar will increase to 28.7 percent and 11.2 percent, respectively, in 2040. Coal's share will also increase, from 2.3 percent in 2013 to 8.8 percent in 2040. Natural gas' share will remain more or less the same at around 13.5 percent over the projection period. Notably, the share of biomass will decrease due to its slow growth that is driven only by the growth of the rural population. From 65.7 percent in 2013, its share will decline to 36.1 percent in 2040.

Figure 12-3. Primary Energy Supply by Source, BAU



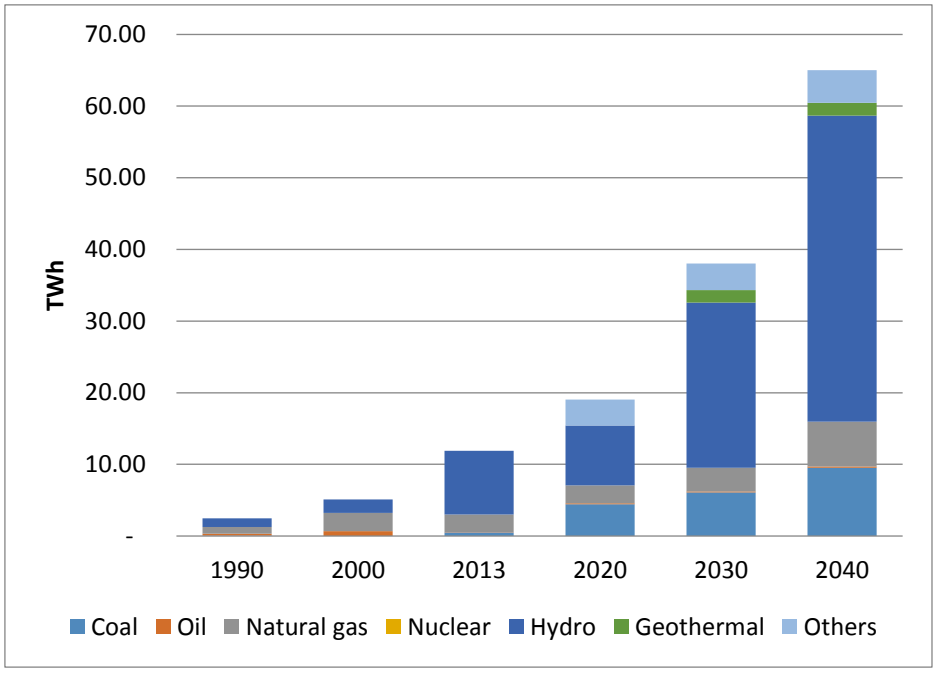
BAU = Business-as-Usual scenario; Mtoe = million tons of oil equivalent.
Source: Author's calculations.

Power generation

Hydro and natural gas dominated the power sector fuel mix in Myanmar. In 2013, the share of hydro in the power generation mix reached 74.7 percent, while the natural gas share was 20.5 percent. The remaining fuels (coal and oil) accounted for only 4.8 percent of the total generation mix.

Under the BAU, oil-based power plants will cease operation after 2040 and natural gas-based power plants' share will decrease to around 10 percent in 2040. Consequently, coal-based power plants will have increasing roles.

Figure 12-4. Power Generation Mix, BAU



BAU = Business-as-Usual scenario; TWh = terawatt-hour.
Source: Author's calculations.

The share of electricity generated from coal-based power plants will increase to 14.7 percent in 2040. Hydro will continue to dominate the power sector fuel mix, but with its share decreasing to 65.7 percent in 2040 from 74.7 percent in 2013.

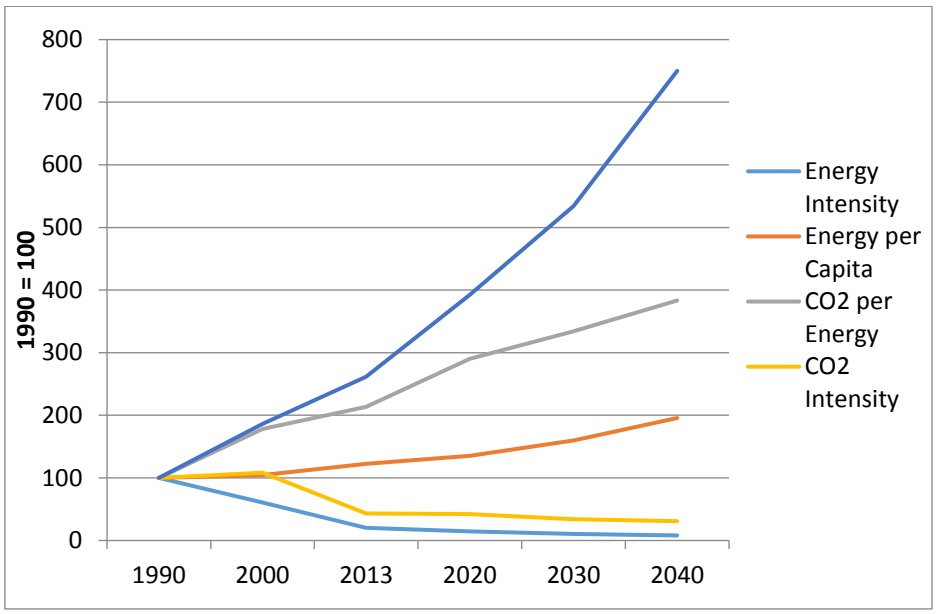
Total electricity generation from the different plants will grow at an average annual rate of 6.5 percent and coal-based power plants will grow at an average annual rate of 11.4 percent. Hydro-power generation will also increase, at an average annual rate of 6.0 percent from 2013 to 2040, and natural gas based power plants are forecast to grow by 3.5 percent.

Energy intensity, energy per capita, and energy elasticity

Myanmar's primary energy intensity (TPES/GDP) has been declining since 1990. In 2013, the primary energy intensity was 660 toe/million 2005 US$, lower than in 1990 when it was 3,243 toe/million 2005 US$. It is projected that the intensity will continue to decrease, to 262 toe/million 2005 US$ by 2040, at an average rate of 3.4 percent per year. Energy consumption per capita rose from 0.25 toe in 1990 to 0.31 toe in 2013 and will increase to 0.50 by 2040, at an average annual growth rate of 1.7 percent. The CO_2 intensity was 340 t-C/million 2005 US$ in 1990 and

decreased to 148 t-C/million 2005 US$ in 2013. It is projected to increase to 105 t-C/million 2005 US$ in 2040 at an average annual growth rate of 1.3 percent. Figure 12-5 shows the evolution of these energy indicators from 1990 to 2040.

Figure 12-5. Energy Intensity, CO_2 Intensity, and Energy per Capita



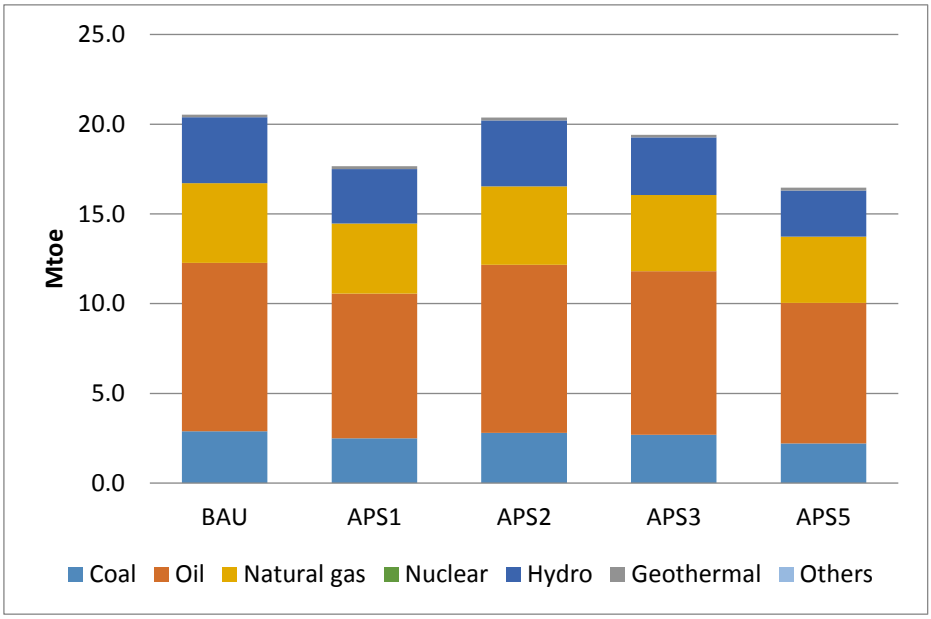
CO_2 = carbon dioxide.
Source: Author's calculations.

3.2. Energy Saving Potential (APS)

The Alternative Policy Scenario (APS) was analysed separately to determine the individual impacts of the policy interventions assumed in APS1, APS2, and APS3. The combination of all these policy interventions was further analysed in APS5. Figure 12-6 shows the changes in TPES in all the scenarios.

APS5 has the largest reduction in TPES due to the implementation of EEC action plans, improvement of thermal efficiency of fossil-fueled power plants, and higher penetration of new and renewable energy in the country's supply mix. The average annual growth rate of TPES under APS5 will be around 2.1 percent over the projection period. In 2040, the reduction of primary energy supply in APS5 as compared with the BAU will be 3.8 Mtoe, or 11.6 percent.

Figure 12-6. Comparison of Scenarios to Total Primary Energy Supply in 2040



BAU = Business-as-Usual scenario; APS = Alternative Policy Scenario; Mtoe = million tons of oil equivalent.
Source: Author's calculations.

Individually, implementation of only energy efficiency targets and masterplan, as defined in APS1, will reduce the TPES of Myanmar by 3.5 Mtoe or 10.5 percent in 2040 as compared with the BAU. The average annual growth rate of primary energy supply in APS1 will be 2.2 percent, slightly faster than APS5. APS2, which assumes higher efficiency in thermal electricity generation, will reduce the TPES by 0.16 Mtoe or 0.8 percent compared with the BAU. The country's TPES under APS2 will grow at an annual average rate of 2.6 percent, similar to the BAU. Since no final energy consumption efficiency measures were assumed for APS2, the impact on the primary enegy supply will be lower than for APS1 or APS5. Of all the fossil fuels considered, implementation of this higher efficiency of thermal power generation policy intervention will reduce the use of coal and natural gas for power generation. As the result of high efficient thermal power generation, it could achieve a higher reduction in coal use of almost 3.6 percent in 2040.

If policy for higher penetration of new and renewable energy (NRE) is implemented, there will also be a reduction in TPES compared with the BAU by 0.2 Mtoe or 0.7 percent. By fuel type, there is a reduction in coal and natural gas consumption, but the use of renewable energy is increasing, mainly hydro by 13 percent (0.5 Mtoe).

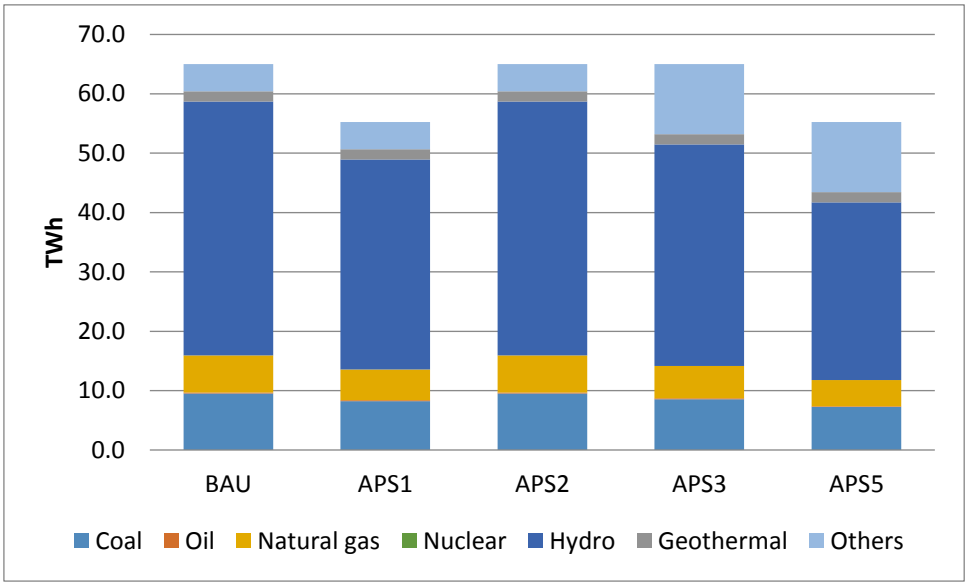
The impacts of implementing policy interventions will also be reflected in the country's power generation. Figure 12-7 shows total electricity generation in 2040 in all scenarios. In both APS1 and APS5, due to the lower electricity demand, power generation will be reduced by 9.75 Mtoe or 15.0 percent as compared with the BAU. The reduction in power generation will be from natural gas, coal, and hydro plants, with the highest reduction in hydro-power plants (7.3 Mtoe in APS1 and 12.8 Mtoe in APS5).

Under APS2 and APS3, the total amount of electricity generated will be similar to the BAU because no efficiency measures were imposed on the final end-use sector. The differences, however, lie in the fuel mix for power generation under APS3. More 'others' renewable power plants such as solar, wind, biomass, etc., will be in operation over the planning period, replacing some of the fossil-fueled power plants, (natural gas fueled plants), which are supposed to be in operation up to 2040.

In terms of CO2 emission reduction, the energy efficiency assumption in APS5 is expected to reduce emissions by at most around 2.48 million metric tons of carbon (Mt-C), which is 18.8 percent lower than the BAU. The decrease in CO2 indicates that the energy saving goals, action plans and policies in the promotion of programmes, and 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 APS1 and APS5, TFEC will be lower so that CO_2 emissions from energy consumption will also be lower, reaching only around 11.3 Mt-C. This is a reduction of CO_2 emission by around 1.9 Mt-C, which is around 14 percent lower than the BAU. In APS3, higher contributions from renewable energy could reduce emissions by 4.2 percent as compared with the BAU. Total CO_2 emissions under APS3 will be around 12.6 Mt-C, which is around 0.6 Mt-C lower than the BAU. The decrease in CO_2 indicates that increasing renewable energy shares in total supply will reduce CO_2 emissions, although not by as much as under APS1 or APS5.

Figure 12-7. Comparison of Scenarios of Electricity Generation in 2040



BAU = Business-as-Usual scenario; APS = Alternative Policy Scenario; TWh = terawatt-hour.
Source: Author's calculations.

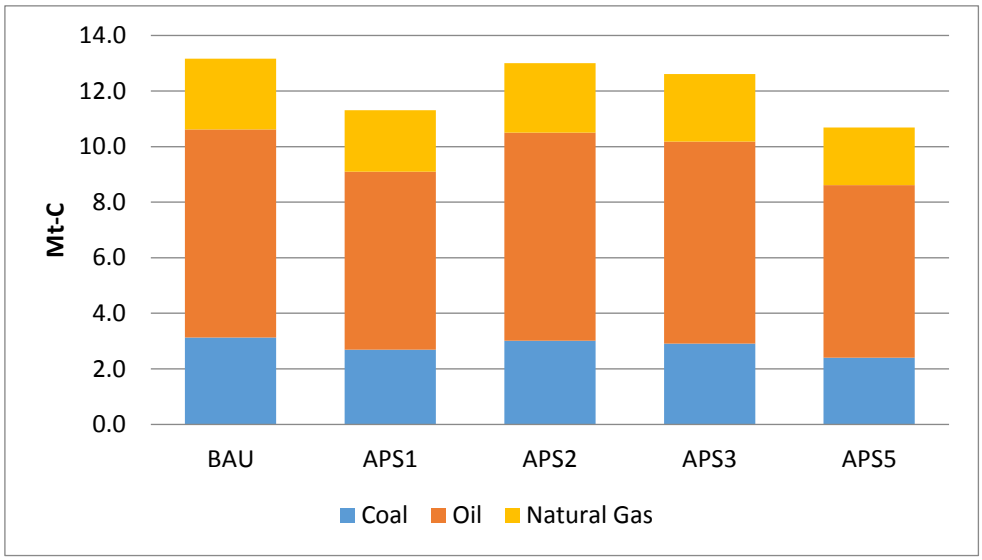
3.2.1. Final energy consumption

In the APS, which is the combined APS (APS5), final energy consumption is projected to grow at a lower average annual rate of 2.1 percent as compared with the 2.5 percent annual growth in the BAU. The reason for the slower growth rate is technological improvements in manufacturing processes and the reduction of 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 2040 by sector in the BAU and the APS.

Primary energy supply

In the APS, Myanmar's primary energy supply is projected to increase at a slightly lower rate than in the BAU, at 2.1 percent per year from 16.46 Mtoe in 2013 to 28.93 Mtoe in 2040. Coal will be the fastest growing at 6.8 percent per year followed by oil at 3.9 percent per year between 2013 and 2040.

Figure 12-8. Comparison of CO_2 Emission in all Scenarios in 2040



CO_2 = carbon dioxide; Mt-C = million tons of carbon; BAU = Business-as-Usual scenario; APS = Alternative Policy Scenario; Mtoe = million tons of oil equivalent.
Source: Author's calculations.

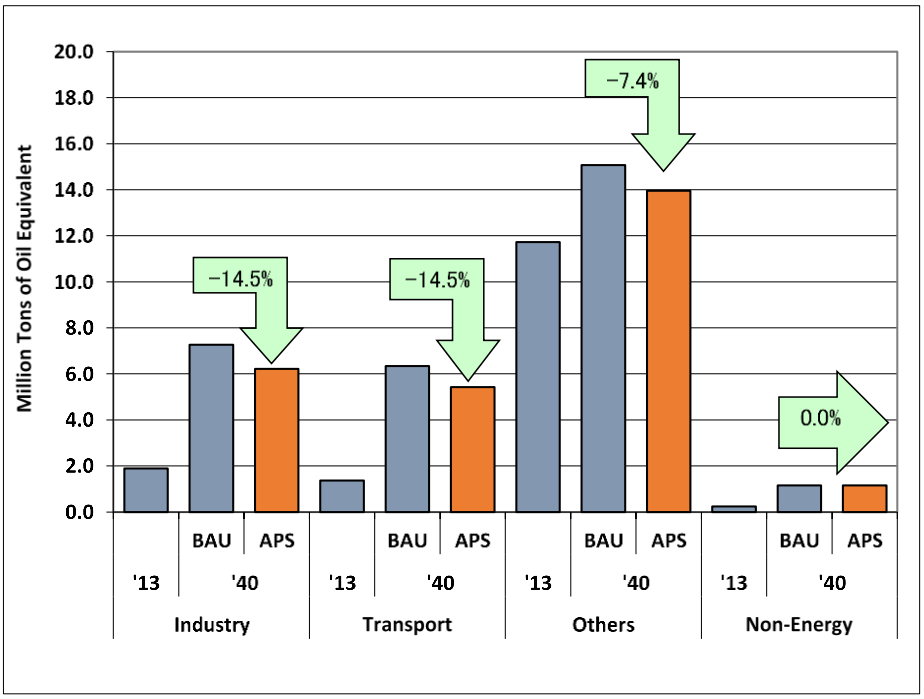
Natural gas is expected to grow at average annual rate of 2.8 percent over the same period, lower than hydro, which is expected to grow at 4.6 percent per year. Figure 12-10 shows the primary energy supply by source in 2040 under the BAU and the APS.

Projected energy savings

In Myanmar, commercial energy consumption is projected on the basis of energy requirements of the major sectors (industry, transport, agriculture, and households).

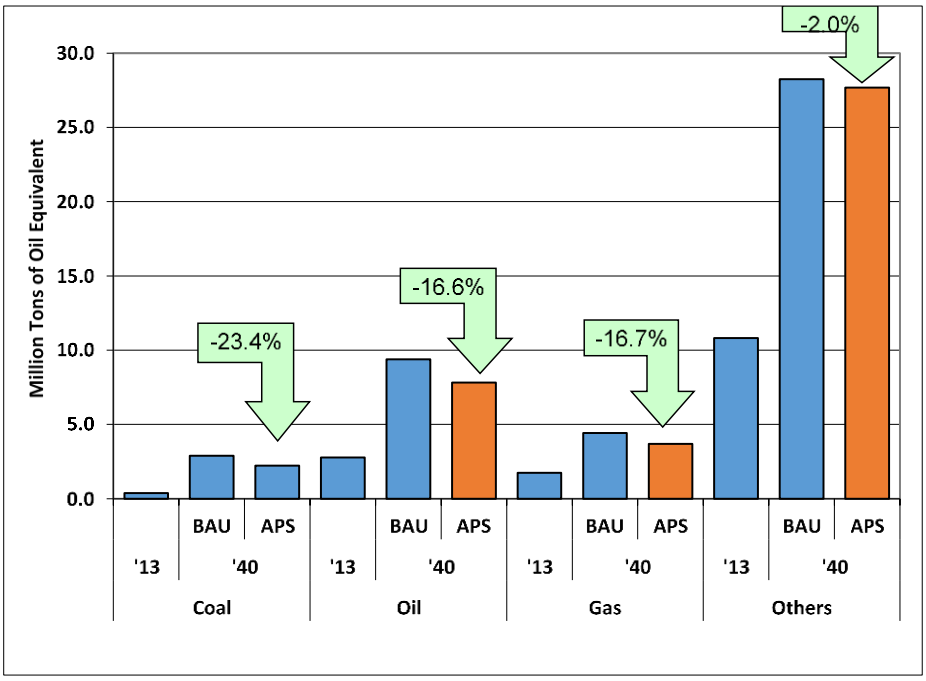
The choice of fuel type is determined by available supply, since energy demand has to be met mainly by domestic sources. Obviously, there is a gap between demand and supply, but demand is much higher than the actual requirement. Due to these constraints, coefficients, derived by time series regression, have been applied to allocate energy. These allocations are made based on the priorities of the state organisations and enterprises. For the private sector, allocations are made based on the registered licensed capacity of the firms.

Figure 12-9. Final Energy Consumption by Sector, BAU and APS



BAU = Business-as-Usual scenario; APS = Alternative Policy Scenario
Source: Study outcome.

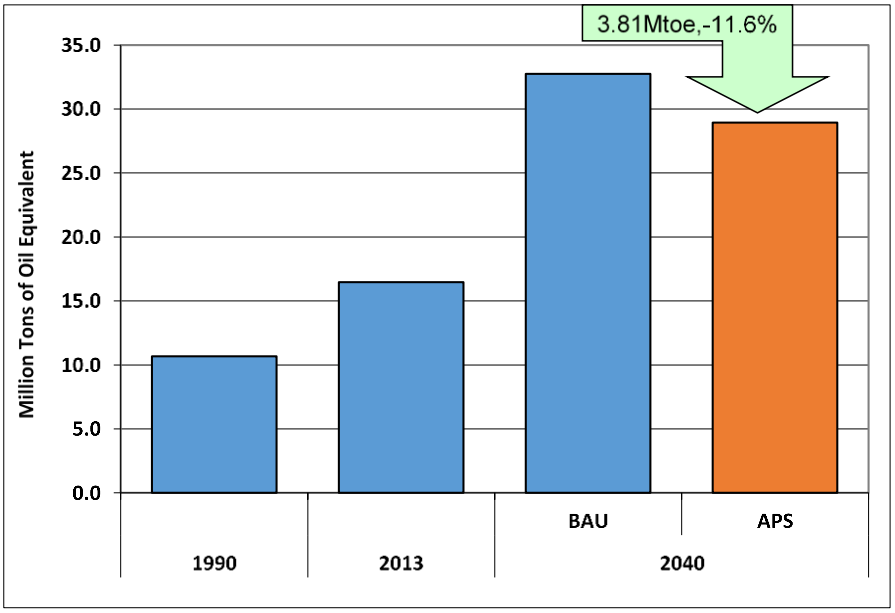
Figure 12-10. Primary Energy Supply by Source, BAU and APS



BAU = Business-as-Usual scenario; APS = Alternative Policy Scenario.
Source: Author's calculations.

Future savings in energy could be made through savings in primary energy supply in the residential, commercial, transportation, and industrial sectors. In view of this, Myanmar has implemented a range of EEC goals and action plans, which target energy savings in all sectors of the economy and in cooperation with both the private and public sectors. There is an estimated saving of 3.81 Mtoe in 2040 in the APS, relative to the BAU. This is equivalent to a 11.6 percent saving of the primary energy supply in 2040 of the BAU (Figure 12-11). Myanmar has plans to decrease the growth in primary energy supply by implementing a range of EEC measures on the demand side.

Figure 12-11. Evolution of Primary Energy Supply, BAU and APS

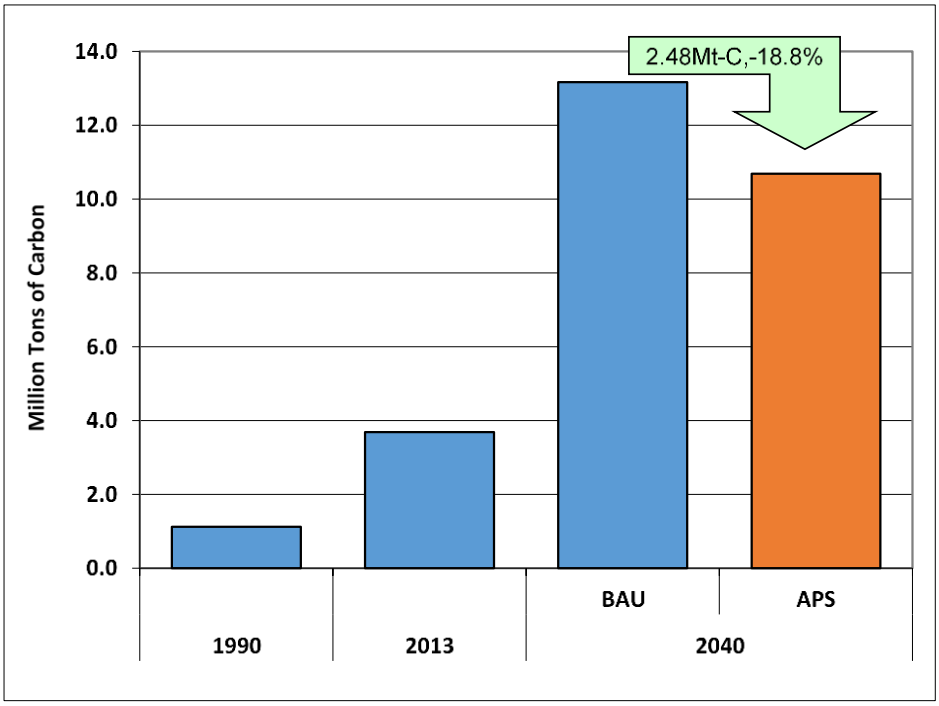


BAU = Business-as-Usual scenario; APS = Alternative Policy Scenario; Mtoe =
Source: Author's calculations.

CO_2 reduction potential

In the APS, the energy efficiency policy of Myanmar is projected to reduce growth in CO_2 emissions from energy consumption. In 2040, in the APS, CO_2 emissions from energy consumption are projected to reach about 2.48 million tons of carbon (Mt-C), which is about 18.8 percent below the BAU level (Figure 12-12).

Figure 12-12. CO_2 Emission from Energy Consumption, BAU and APS



BAU = Business-as-Usual scenario; APS = Alternative Policy Scenario; Mt-C =million tons of carbon.
Source: Author's calculations.

4. Conclusions and Policy Implications

Although energy intensity will decline, energy consumption is still increasing due to economic, population, and vehicle population growth. Myanmar should increase adoption of 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.

In this regard, the following proposed actions can be taken into consideration:

- An integrated national energy policy including energy efficiency will be formulated by the National Energy Management Committee (NEMC).
- Coordination mechanism and institutional arrangement and legal framework need to be adopted.
- Better energy statistics would be needed for better analysis of energy saving potential in Myanmar.

- Myanmar needs to conduct a demand side survey for energy consumption, which can be done by combining this survey with existing surveys.
- Due to the continuous dominance of the transport sector in final energy consumption, an energy efficiency target should be set for the transport sector in addition to those that have been calculated for the industrial, commercial, and household sectors.
- There is a need for a detailed policy mechanism for the renewable energy sector to implement the potential programmes and projects. This mechanism should be developed and planned in conjunction with external stakeholders, who offer experience, advanced technologies, new markets, and investment.
- There is a need to improve energy management practices for industrial and commercial sectors.
- A dedicated energy efficiency body needs to be established to oversee the energy efficiency programme of Myanmar.
- Refinement of the current energy efficiency target will be necessary to include all sectors' numerical targets and detailed action plans.
- Myanmar needs to establish a comprehensive integrated energy plan to guide the development of the sector, including an energy efficiency labelling programme for energy service companies and appliances.
- In view of the low electrification rate, the government needs to formulate schemes to enhance private participation, including by foreign companies, to accelerate power sector development including a transmission and distribution system to ensure reliable electricity supply to consumers.
- National Energy Management Committee (NEMC) should formulate a renewable energy policy to encourage the private sector and foreign investors to invest in renewable energy.
- NEMC should set specific targets for each sector on energy efficiency and the government should implement policies and programmes to achieve these targets.
- Consider the import of LNG in floating terminals for the short term to meet the projected rapid growth of electricity demand while exploration of new domestic natural gas resources is still being undertaken.

- Consider civilian nuclear energy policy and exploration of geothermal energy potential for electricity generation.
- Biomass consumption is increasing continuously; the government should remove taxes on LPG and kerosene to reduce the cost of LPG use in the residential sector.
- Encourage private companies to invest in new refinery capacities to meet domestic petroleum products demand.