Chapter 12

Myanmar Country Report

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CHAPTER 12

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TIN ZAW MYINT AND NAY AUNG

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1. Background

1.1. Country Profile

Myanmar is the largest country in mainland of South East Asia. Myanmar's territorial area covers 676,577 square kilometres and shares a border of 5,858 km with Bangladesh and India to the north-west, China to the north-east and Thailand to the south-east. Approximately 48 percent of the total land area is covered with forest, and most of the land area is utilized for agriculture. Myanmar has a population of 58 million with an average annual growth rate of 1.0 percent.

Myanmar is geographically located at the tip of the South East 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 resource 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 accumulated abundantly. The delta regions where the two major river systems enter the Bay of Bengal and the 2832 kilometre coastal strip along the southern part is also a good area for the development of marine ecosystems and an abundant source for marine products and chemicals.

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 the potential energy sources found in Myanmar.

Myanmar's proven energy reserves comprise of 210 million barrels of oil, 20

trillion cubic feet of gas and 711 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 50 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 2010 to 48 million in 2010. Myanmar's gross domestic product (GDP) was US$ 20.3 billion (constant 2000) in 2010 and its GDP per capita grew from US$ 0.1 thousand in 1990 to US$ 0.4 thousand in 2010. With the objectives of enhancing economic development in Myanmar, five-year short-term plans have been formulated and implemented during the years 1992 to 2011. The first (1992-1995), second (1996-2000) and third plans (2001-2005) achieved average annual growth rates in GDP of 7.5 percent, 8.5 percent and 12.8 percent respectively. The last five-year plan (2006-2010) has been formulated to achieve an average annual growth rate of 12.0 percent in GDP.

1.3. Energy Consumption in the base year

Myanmar's total primary energy consumption was 6.0 million tons of oil equivalent (Mtoe) in 2010. Natural gas is mainly used for electricity generation and in industry. Myanmar has 3,460 megawatts (MW) of installed generation capacity and generated about 7.5 terawatt-hours (TWh) of electricity in 2010. During the same year, thermal (coal, natural gas and oil) and hydro accounted for 32.3 percent and 67.7 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 7.0 percent from 2010 to 2035, slowing from 1990-2010's growth of 8.9

percent. Population is assumed to increase by about 1.0 percent per year from 2010 to 2035.

2.2. Energy Consumption and Electricity Generation

Hydro and natural gas dominated the 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 15 percent in 1990. The Government's plan is to increase further the share of natural gas and hydro and other renewables in the total generation mix and decrease oil and coal shares. Myanmar has also plans to export electricity to neighboring countries such as Thailand from its hydro power plants.

2.3. Energy and Climate Change/Environmental Policies

The Myanmar 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 utilization 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 is emphasized in order to save energy through effective energy management and to reduce energy consumption so as to minimize harmful environmental impacts. Encouragement is made to utilize new and renewable energy sources, especially solar and wind which are abundant under Myanmar's climatic condition. It also accepts the fact that utilization of traditional energy sources such as fuel-wood and charcoal still needs to be practiced. Regulatory and anticipatory actions are necessary for the sustained harvesting of this primary energy source.

Savings in Myanmar's energy consumption can be attained through implementation of energy efficiency programs in all energy consuming sectors. In the industry sector, energy savings are expected from improvement in manufacturing technologies by at least 10 percent 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 is still 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 Environmental Conservation and Forestry (MOECAF), the designated national authority for clean development mechanism has submitted one hydro power project to UNFCCC for clean development mechanism consideration. The National Environmental Conservation Committee was formed in 2004 and re-formed in April 2011, replacing NCEA, and now serves as the focal organization for environmental matters. It is chaired by MOECAF, formerly the Ministry of Forestry; the Committee's membership includes19 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 creating the enabling conditions for their effective implementation is being drawn up and submitted to authorized body.

Myanmar's primary energy saving goal is to reduce energy consumption by 5 percent in 2020 and 10 percent in 2030, relative to the BAU scenario. 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 – 2012.
- To develop labelling systems for appliances and buildings by 2015.
- To increase research and development.
- To develop an energy management system through the ASEAN Energy Manager Accreditation Scheme (AEMAS) Program by 2010 – 2015.

On a sectoral basis, the energy efficiency and conservation measures in Myanmar are listed below:

- In industry, gradual replacement of low efficiency equipment with higher efficiency alternatives will be encouraged.
- In the transportation sector, the state will encourage fuel switching in the transport sector to bio-fuels 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 transportation 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 are the measures that 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 higher 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 that will be implemented are:

- Develop and expand the energy mix and supply sources through utilization of the full energy potential of the country including frontier exploration and development and intensive research on oil, natural gas, coal, hydropower, geothermal, energy efficiency & conservation and new & renewable sources of energy.
- Replace transformers and install the capacitor banks in main sub-stations. Optimize the voltage, conductor size and loading of transformers.
-

2.4. The National Efficiency Policies

To reach a National Target for EE&C plans and programmes, the Government should implement the following actions:-

- Disseminate knowledge about EE&C to communities and encourage the use of local renewable energy resources instead of fossil fuels.
- Conduct workshops and seminars regarding EE&C to increase public awareness.
- Market promotion in energy efficient equipment and labelling of energy saving appliances such as air-conditioner, motor & pump, electric appliances, etc.
- Encourage the private sector to implement the EE&C programs on a voluntary basis through recognition programmes.
- Provide financial assistance on transferring advanced technology.
- Adoption of best practices is an effective action plan for energy saving in transport, residential & commercial sectors.
- To consider EE&C in both 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. These initiatives are listed as follows:

Table 12-1: Energy Efficiency Initiatives

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

3. Outlook Results

3.1. Business As Usual (BAU) Scenario

Final Energy Demand

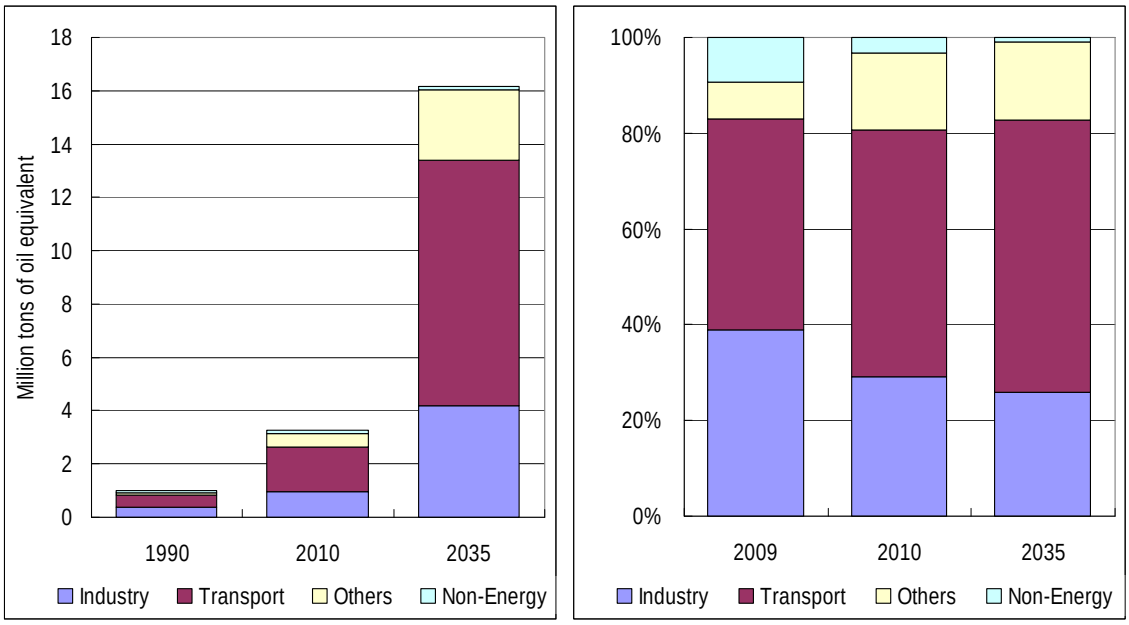
The total final energy demand in Myanmar increased by about 6.0 percent per year from 1.0 Mtoe in 1990 to 3.2 Mtoe in 2010. The 'others' sector, which comprises the commercial, residential and agricultural sectors, was the fastest growing sector with an average annual growth of 9.9 percent between 1990 and 2010. Consequently, the share of this sector in the total final energy demand increased from around 8 percent in 1990 to 16 percent in 2010.

The transport sector accounted for more than 44 percent of the total final energy demand of Myanmar in 1990. With an average annual growth rate of 6.9 percent between 1990 and 2010, the share of the transport sector increased to 51.5 percent in 2010. The industrial sector share in the total final energy demand was the second largest in 1990 (39 percent). Since this sector grew on average lower than the

transport and other sector (4.5 percent per year), the share of this sector declined to around 29 percent in 2010. Non-energy consumption grew at an average annual growth of 0.7 per year over the same period which resulted in a declining in its in the total final energy demand from 9.2 percent in 1990 to 3.3 percent in 2010.

Using the socio-economic assumptions stated above, final energy demand in Myanmar is projected to grow at an annual rate of 6.6 percent from 2010 to 2035 in the BAU scenario. Final energy demand is projected to grow the fastest to 2035 in the transportation sector with annual average growth of 7.1 percent. In the industry and others sectors, energy demand is projected to grow at an annual average rate of 6.1 percent and 6.7 percent, respectively. The non-energy sector will grow at an average annual rate of 1.3 percent (Figure 12-1).

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



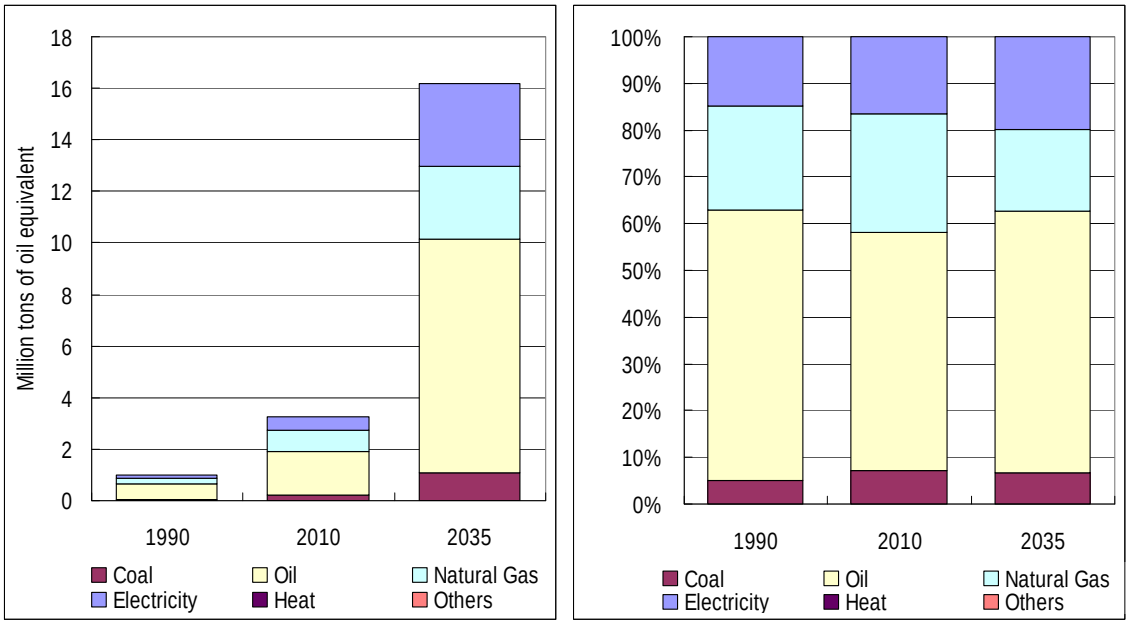
The respective growth of the sectors under the BAU scenario will result in a continous increase of the transport sector share in the total final energy demand and a decline in the industry and non-energy sector share. The transport sector share will increase to 57 percent in 2035 while the industry and non-energy sector share's will decline to 25.8 percent and 0.9 percent, respectively. The other sector share will remain at around 16 percent in 2035.

By fuel type, oil was the most consumed product in 1990 having a share of 58

percent in the total final energy demand of the country. Its share decreased to 51 percent in 2010 due to the higher growth of the other fuels. The sectoral consumption of natural gas increased from 0.2 Mtoe in 1990 to 0.8 Mtoe in 2010 while for electricity it increased from 0.1 Mtoe to 0.5 Mtoe over the same period. Coal demand increased the fastest at an average growth rate of 7.9 percent per year over the 1990 to 2010 period.

Under the BAU scenario, the share of natural gas will decline from around 25 percent in 2010 to 17.5 percent in 2035 indicating that its future use will grow slower than the other fuel. In contrast, oil share will continue to increase and will reach 56 percent in 2035 from around 51 percent in 2010 with an average growth of 7.0 percent per year. This is due to the rapid increase of the transport sector activities over the 2010 to 2035 period.

Figure 12-2: Final Energy Demand by Fuel, BAU

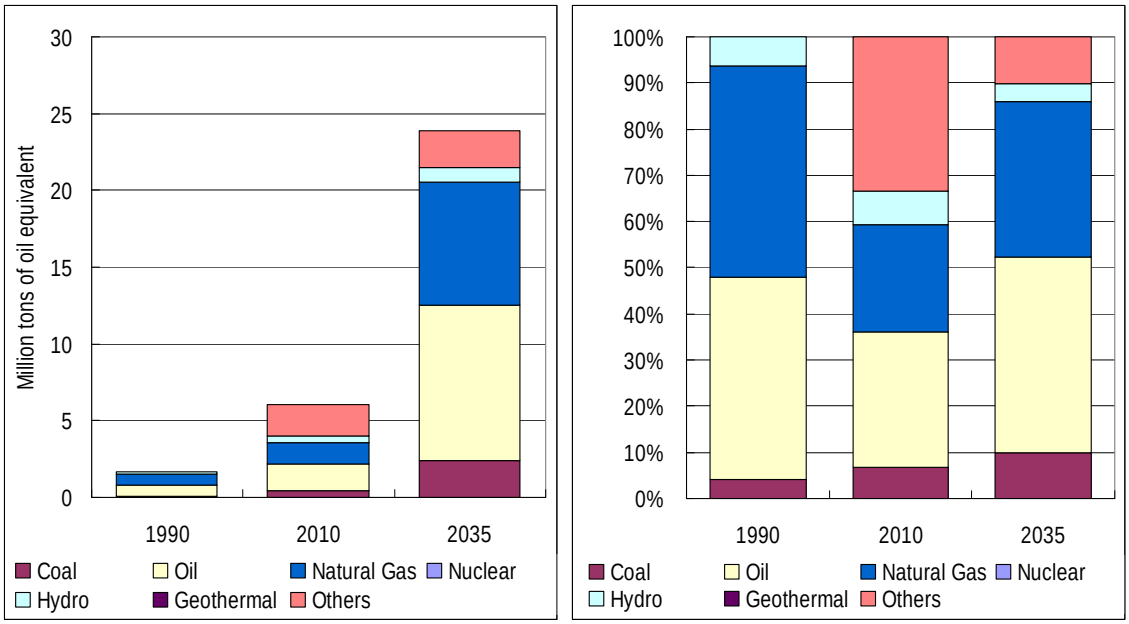


Coal is projected to have an average annual growth rate of 6.3 percent in the period 2010-2035, but not as fast as oil and electricity. Consequently, the share of coal will decrease from 7.2 percent in 2010 to 6.6 percent in 2035. Electricity demand will grow faster than oil and coal at an average annual growth rate of 7.4 percent per year during the same period. Its share will increase from 16.5 percent in 2010 to 19.8 percent in 2035.

Primary Energy Consumption

Primary energy Consumption in Myanmar grew at an average annual rate of 6.7 percent from 1.7 Mtoe in 1990 to 6.0 Mtoe in 2010. Among the major energy sources, the fastest growing were hydro and coal with average annual growth rates of 7.5 percent and 9.5 percent, respectively. Natural Gas consumption grew at an average annual rate of 3.1 percent over the same period. Oil consumption increased at 4.5 percent per year on the average over the same period. Oil and gas dominate the primary energy consumption mix in 2010 with respective shares of 29.2 percent and 23.4 percent, respectively.

Figure 12-3: Primary Energy Consumption by Source, BAU



In the BAU scenario, Myanmar's primary energy consumption is projected to increase at an annual average rate of 5.7 percent per year to 23.9 Mtoe in 2035. Coal, oil and natural gas are expected to grow at average annual rates of 7.2 percent followed by hydro at 3.1 percent and others at 0.7 percent over the period 2010-2035. The share of oil and natural gas will still dominate in the total primary energy mix of Myanmar, increasing to 42.4 percent and 33.6 percent respectively in 2035. Coal share will also increase from 6.8 percent in 2010 to 9.9 in 2035. Hydro share, on the other hand, will decline from and 7.3 percent in 2010 to 3.9 percent in 2035. This is due to the rapid increase of coal in the power generation.

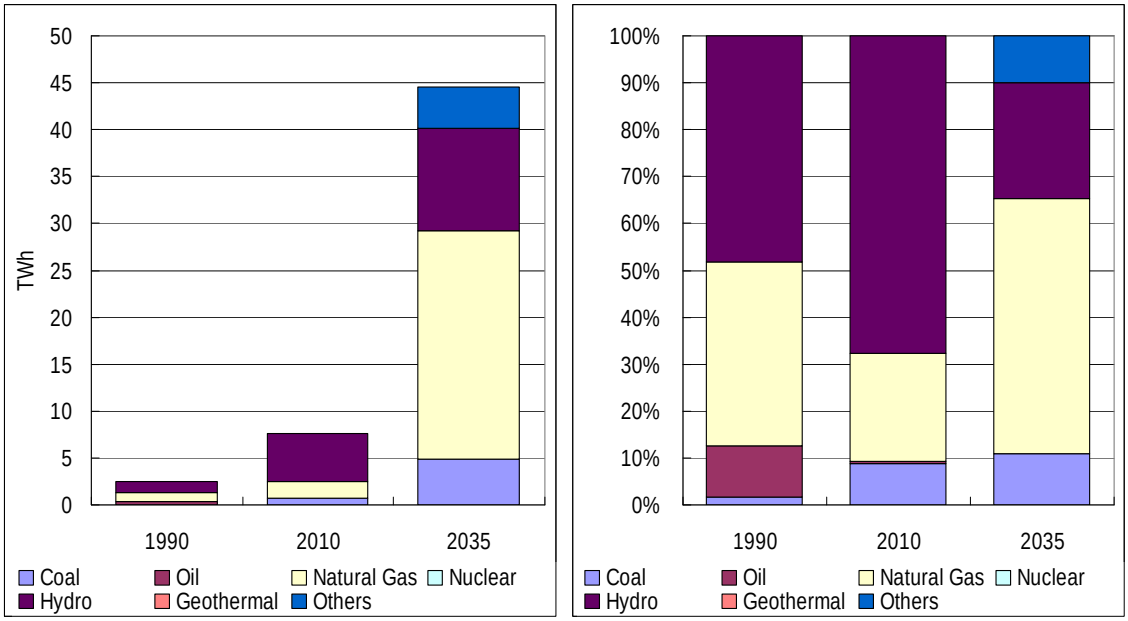
Power Generation

Hydro and natural gas dominated the power sector fuel mix in Myanmar. In 2010, the share of hydro in the power generatio mix reached 67.7 percent while natural gas share was 23.4 percent. The remaining fuel (coal and oil) accounted only 9.3 percent of the total generation mix.

Under the BAU scenario, oil-based power plant will cease operation by 2035 but coal-based power plant will have an increasing role as well as other new and renewable energy sources (wind, solar, etc.). The share of electricity generated from coal-based power plant will increase from 8.9 percent in 2010 to 10.9 percent in 2035 while other new and renewable energy share will reach 10 percent in 2035.

Electricity generation from hydro and natural gas will continue to dominate the generation mix of Myanmar. The share, however differs since generation of electricity from natural gas based plant will grow faster than those of the hydro plants over the 2010 to 2035 priod. Electricity from natural gas based plants will grow at an average annual rate of 11.1 percent while hydro power generation will increase at 3.1 percent.

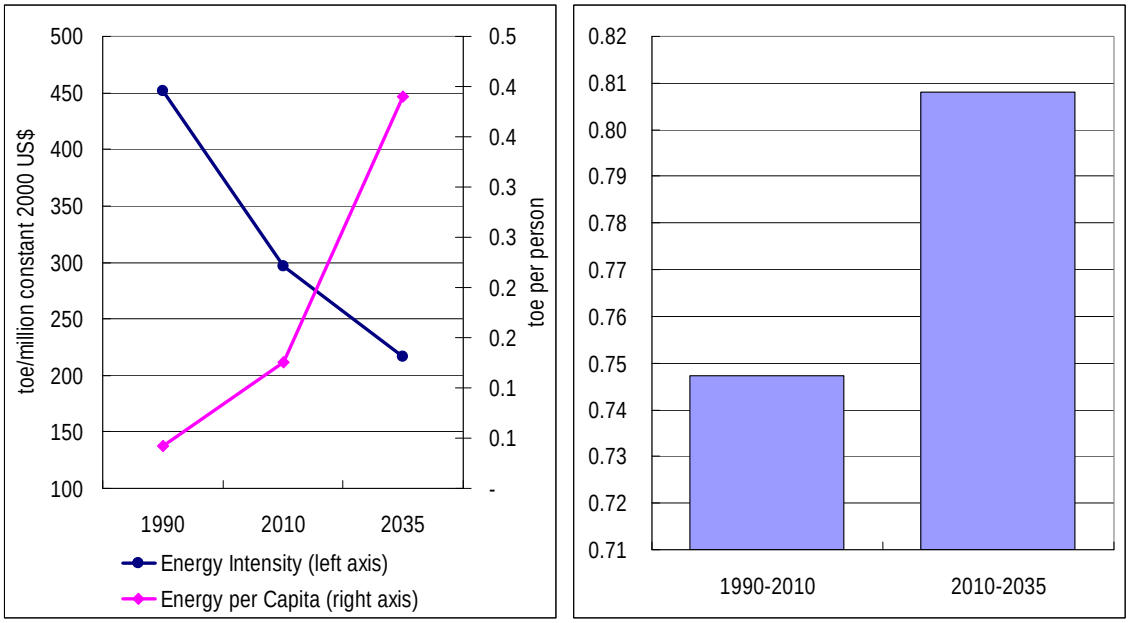
Figure 12-4: Power Generation Mix-BAU Case



Energy Intensity, Energy per Capita and Energy Elasticity

Myanmar's primary energy intensity (TPES/GDP) has been declining since 1990. In 2010, the primary energy intensity was 297 toe/million 2000 USD, lower than what it was in 1990 which was 451 toe/million 2000 USD. It is projected that the intensity will continue to decrease to 217 toe/million 2000 USD by 2035 at an average rate of 1.3 percent per year over the period 2010-2035. The energy consumption per capita grew from 0.04 toe in 1990 to 0.13 toe in 2010 and will increase to 0.39 by 2035, at an average annual growth rate of 4.6 percent. The energy elasticity was 0.7 from 1990 to 2010 and and will increase to 0.8 from 2010 to 2035.

Figure 12-5: Energy Intensity, Energy per Capita and Energy Elasticity



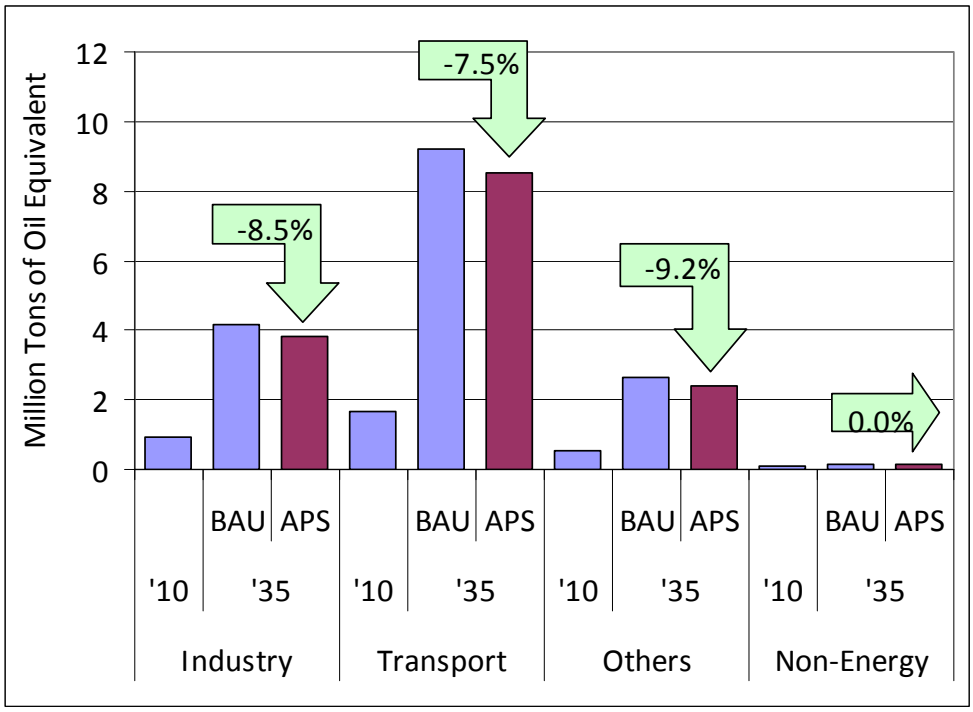
3.2. Energy Saving and CO_2 Reduction Potential

Final Energy Demand

In the APS, the growth in final energy demand is projected to grow at a lower average annual rate of 6.3 percent as compared to the 6.6 percent annual growth in the BAU. The reason for the slower growth rate is the result of technological

improvement in manufacturing processes and the reduction of final energy demand of electricity and oil in the residential and commercial (other) sector.

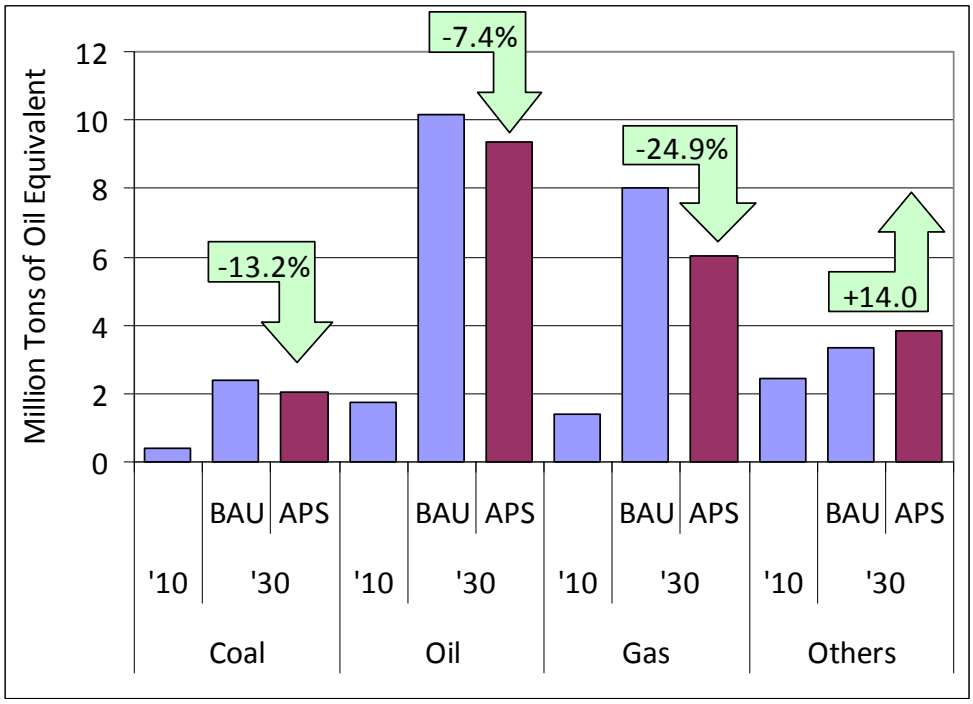
Figure 12-6: Final Energy Demand by Sector, BAU and APS



Primary Energy Consumption

In the APS, Myanmar's primary energy consumption is projected to increase at a slightly lower rate than the BAU's at 5.2 percent per year from 6.0 Mtoe in 2010 to 21.3 Mtoe in 2035. Oil will be the fastest growing at 6.9 percent per year followed by coal at 6.6 percent per year between 2010 and 2035. Hydro is expected to grow at average annual rate of 3.5 percent over the same period, lower than natural gas which is expected to grow at 6.0 percent per year.

Figure 12-7: Primary Energy Consumption by Source, BAU and APS



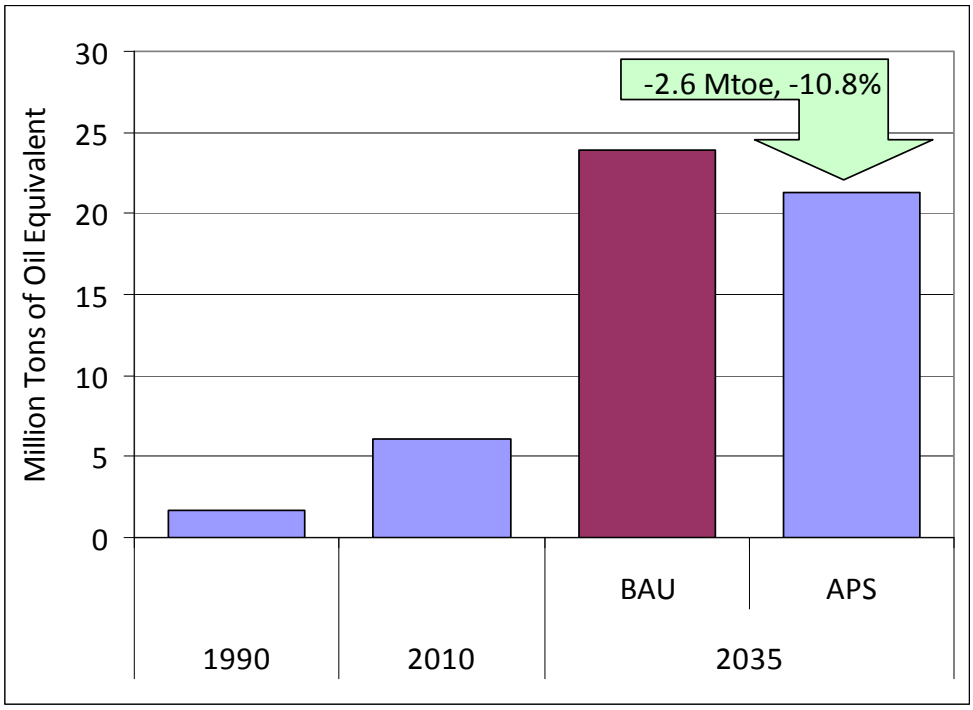
Projected Energy Savings

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 demands have to be met mainly by domestic sources. Obviously, there is a gap between demand and supply but on the other hand, the demand is much higher than the actual requirement. Due to these constraints, coefficients, derived by time series regression, had been applied to allocate energy. These allocations are made in accordance with the priority of the State organizations and enterprises. For the private sector, allocations are made in accordance with the registered licensed capacity of the firm.

Future saving in energy could be due to saving in primary energy consumption in the residential, commercial, transportation and industrial sectors. In this regard, Myanmar has implemented a range of energy efficiency and conservation goals and action plans which target on energy savings in all sectors of the economy and in cooperation with both the private and public sectors. There is an estimated saving of 2.6 Mtoe in 2035 in the APS, relative to the BAU scenario. This is equivalent to 10.8 percent saving of the primary energy consumption in 2035 of the BAU scenario.

Myanmar has plans to decrease the growth in primary energy consumption by implementing a range of energy efficiency and conservation measures on the demand side.

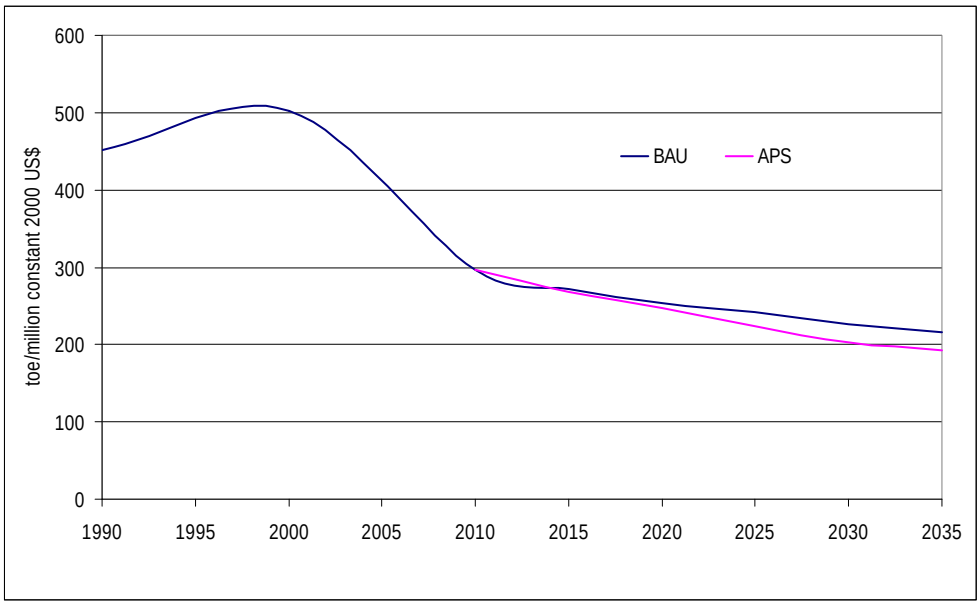
Figure 12-8: Evolution of Primary Energy Consumption, BAU and APS



Energy Intensities

The adaptation of the sectoral sectoral action plans and saving goals under the Alternative Policy Scenario (APS) will result in a faster declining rate for the primary energy intensity, 1.7 percent per year over the projection period.

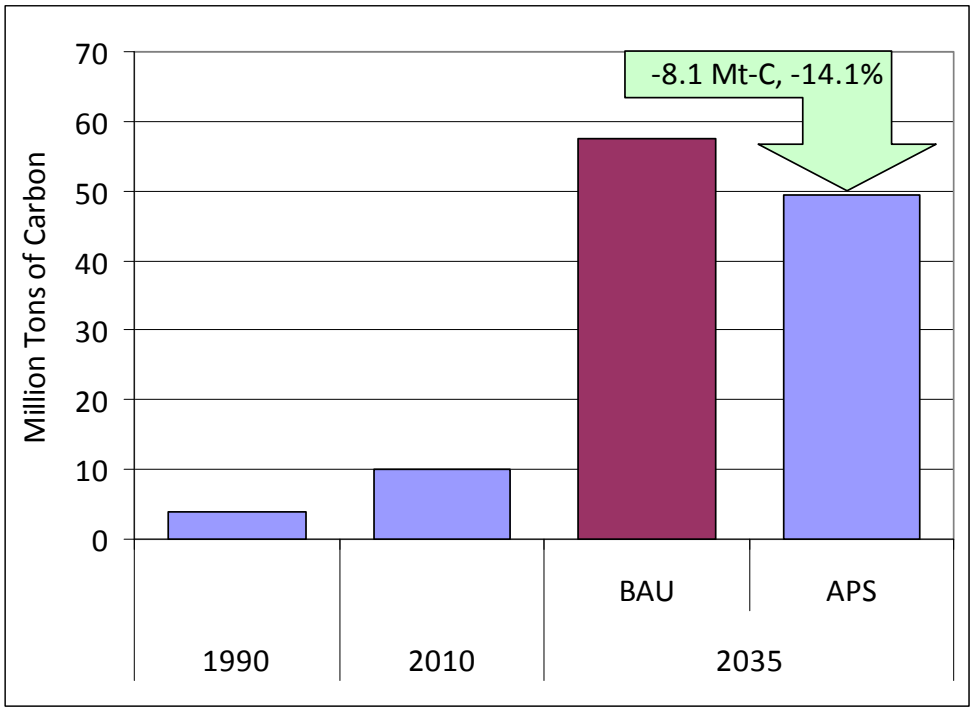
Figure 12-9: Energy Intensity, BAU and APS



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 2035, in the APS, CO_2 emissions from energy consumption are projected to reach about 13.5 million tons of carbon (Mt-C) which is about 14.1 percent below the BAU level.

Figure 12-10: CO_2 Emission from Energy Consumption, BAU and APS



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 will be targeted in the residential, commercial, transport and industry sectors.

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

- There is a need for a detailed and comprehensive energy sector assessment
- An integrated national energy policy including energy efficiency will be formulated by the National Energy Management Committee (NEMC)
- Due to the continuous dominance of the transport sector in final energy consumption, there should be an energy efficiency target for the transport sector in addition to those in industrial, commercial and household sectors
- There is a need for a detailed policy mechanism for the renewable energy sector

to implement the potential programs and projects

- Coordination mechanism and institutional arrangement and legal framework need to be adopted
- Needs to enhance private participation to ensure reliable electricity supply
- More aggressive exploration of the upstream energy sector needs financial and technical assistance in each energy subsector
- It should be developed and planned in conjunction with external stakeholders, who offer experiences, advanced technologies, new markets and investment.
- Better energy statistics would be needed for better analysis of energy saving potential in Myanmar
- Needs to improve energy management practices for industrial and commercial sectors
- Requires an energy efficiency labeling program for energy service companies and appliances