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Energy Consumption Analysis in Myanmar: the Past, Present and Future

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Abstract. Myanmar Energy Security is aiming towards the path of sustainable economic development by providing an affordable and reliable energy supply to all consumers, especially to those living in remote areas that are currently without electricity, to reduce poverty and to raise the quality of life of its people. Myanmar is also increasing foreign exchange earnings through energy exports after meeting the national demand and developing a community-based renewable energy development program. In this study, the energy consumption analysis compares a Business as Usual (BAU) scenario with Alternative Policy Scenario (APS) from 1990 to 2035, where 1990 is the base year and 2035 is the end year in terms of final energy demand by sector, final energy demand by fuel, primary energy consumption by resource and electricity generation. The results show the energy demand in the transportation sector is growing faster and the final energy demand in fuel has increased for oil and coal. In power generation, hydropower generation has increased the most, following new and renewable energy and coal-based power plants. The conclusions are divided into two criteria: energy consumption and electricity consumption. The first, to increase energy efficiency and conservation programs in industry and buildings, to revamp refinery and LPG plant maintenance, and to install a gas pipelines system and explore the upstream energy sector. The second, to rehabilitate existing electricity transmission and distribution, expand rural electrification, build coal-fired power plants or gas-fired power plants, and promote renewable energy in Myanmar's fuel mix as a secure energy source.

Keywords: BAU, APS, new power plant, rehabilitation, and diversification

1. Introduction

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 energy, ethanol, biodiesel and biogas are potential energy resources. Myanmar's proven energy reserves comprise of 210 billion 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. However, it imports around 50 percent of its total oil requirement. 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 2011. Thermal (coal, natural gas and oil) and hydro accounted for 32.3 percent and 67.7 percent of total electricity generation, respectively. Hydro and natural gas dominated the country's electricity generation mix. Other fuels, such as oil and coal, also contributed to the country's generation mix, but in total only less than one percent in 2012. The government's plan is to increase oil and coal shares as well as renewable energy. [1]

2. Methodology

In this study, the methodology is as follows:

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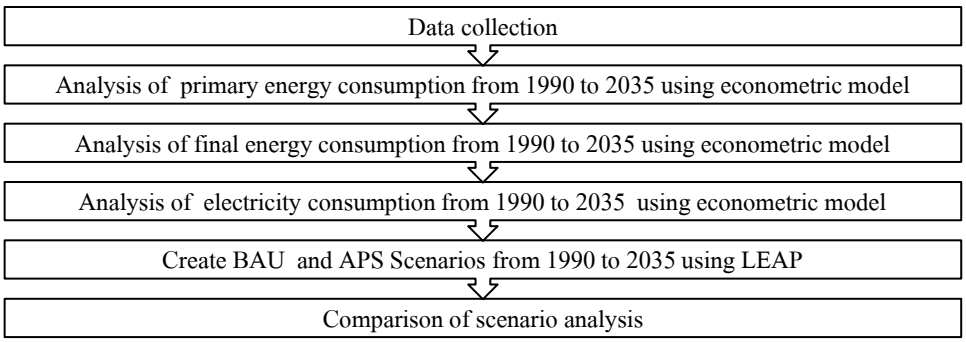

For the first step, to forecast energy consumption, final energy consumption and electricity consumption by using econometric model [2] and energy consumption could be referred to as dependent variables based on Gross Domestic Product (GDP) and population (Pop). The linear equation is as follows:

$$\text{Ln}\,(Y) = \text{A} + \text{B}.\ \ln(\,Pop\,) + \text{C}.\ \ln(GDP) \qquad (1)$$

Where Y is energy consumption (Mtoe) and electricity consumption (TWh), A is a constant, Pop is population (million people), GDP is gross domestic product (billion of 2000 USD dollars), B and C are constants that represent the elasticity of energy and electricity with GDP and population, respectively.

For the second step, energy consumption and final energy demand were forecasted in BAU and APS at 2030 by using a mathematical model of LEAP [3], [4] for energy prediction and, moreover, an APS scenario that is energy-saving from energy consumption in residential, commercial, transportation and industrial sectors decreased from 23.9 Mtoe at 2035 in BAU to 21.3 Mtoe at 2035 in APS.

3. Results and Discussion

3.1. Total final energy demand by sector

Total final energy demand by sector in Myanmar increased by about 6.0 percent per year from 1.0 Mtoe in 1990 to 3.2 Mtoe in 2010. The 'other' sector, which includes the commercial, residential and agriculture sectors, was the fastest growing sector with an average annual growth of 9.9 percent between 1990 and 2010. The transport sector showed an average annual growth rate of 6.9 percent between 1990 and 2010. The industrial sector share in the total final energy demand was the second largest in 1990 (3.9) percent. Since 1990, the sector grew less, on average, than the transport and 'other' sectors at (4.5) percent per year. The non energy sector grew at an average annual growth of 0.7 per year over the same period. Using the social economic assumption state above, final energy demand in Myanmar is projected to grow at annual rate of 6.6 percent from 2010 to 2035 in the BAU scenario. Final energy demand is projected to grow the fastest in the year 2035 in the transportation sector, with annual growth of 7.1 percent. In the industry and 'other' sectors, growth is projected at an average growth rate of 6.1 percent and 6.7 percent, respectively, and the non energy sector will grow 1.3 percent.

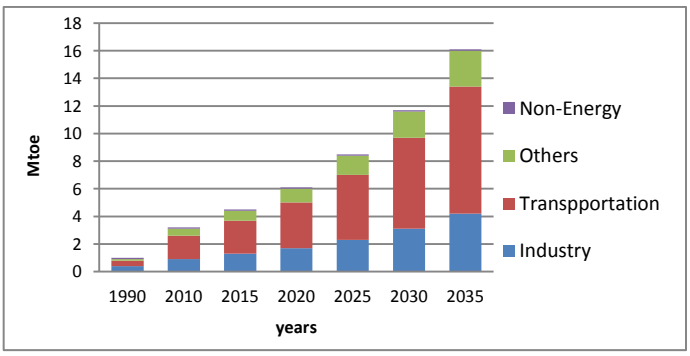

Fig. 1: Final energy demand by sector

3.2. Total final energy demand by fuel type

By fuel type, the highest consumption was oil, whose share decreased from 58 percent in 1990 to 51 percent in 2010 due to the higher growth of the other fuels. The second highest consumption was natural gas which 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 more slowly than the other fuels. In contrast, oil's share will not be decreasing as in the past; instead, it will increase to 56 percent in 2035 from around 51 percent in 2010 with an average growth of 7 percent per year. This is due to the rapid increase of the transport sector activities over the 2010 to 2035 period. Coal is projected to grow 6.3 percent in the time period 2010 to 2035, but not as fast growth 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 a growth rate of 7.4 percent per year over the period 2010-2035. Its share will increase from 16.5 percent in 2010 to 19.8 percent in 2035.

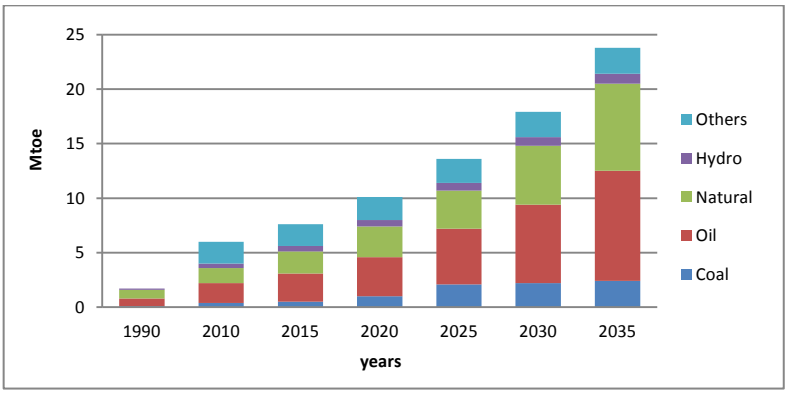

Fig. 2: Final energy demand by fuel

3.3. Primary energy consumption

Primary Energy consumption 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 rates of 7.5 percent and 9.5 percent, respectively. Natural gas grew at a rate of 3.1 percent and oil increased at the rate of 4.5 percent. In BAU scenario, energy consumption is projected to increase at an annual average rate of 5.7 per year to 23.9 Mtoe in 2035. Coal, oil and natural gas are expected to grow at an average rate of 7.2 percent, followed by hydro at 3.1 percent and others at 0.7 percent in the time period 2010 to 2035. The shares of oil and gas will continue to dominate the total primary energy mix, increasing to 42.4 percent and 33.6 percent, respectively, in 2035. Coal's share will also increase from 6.8 percent in 2010 to 9.9 percent in 2035. Hydropower's share, on the other hand, will decline from 7.3 percent in 2010 to 3.9 percent in 2035. This is due to the rapid increase of coal in power generation.

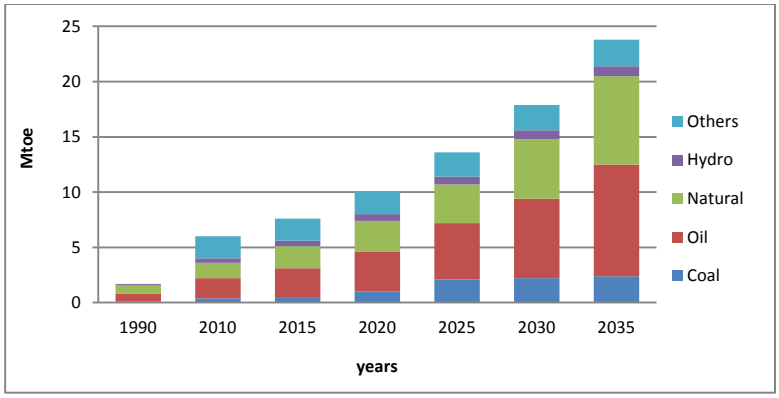

Fig. 3: Primary Energy Consumption

3.4. Power generation

Power Generation in hydro and natural gas dominated the power sector fuel mix in Myanmar. In 2010, the share of hydro in the power generation mix reached 67.7 percent, while the natural gas share was 23 percent. The remaining fuels (coal and oil) accounted for only 9.3 percent of the total generation mix. Under the BAU scenario, oil-based power plants will cease operation by 2035 but coal-based power plants will have an increasing role in power generation, as well as other new and renewable energy sources (wind, solar, etc.). The share of electricity generated from coal-based power plants will increase from 8.9 percent in 2010 to 10.9 percent in 2035, while other new and renewable energy source's 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, will differ because generation of 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

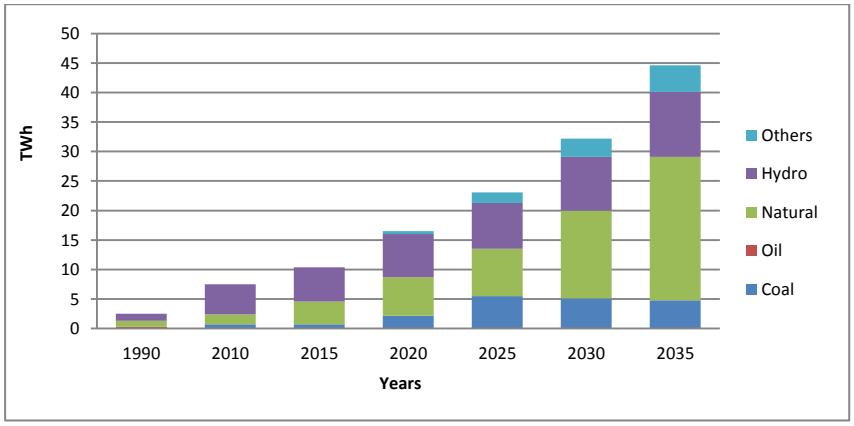

Fig. 4: Power Generation

3.5. Compare scenario analysis

Compare the scenario analysis of final energy demand in BAU and APS: APS growth is projected to grow at a lower average annual rate of 6.3 percent compared to the 6.6 percent annual growth in the BAU. The slower growth rate is the result of technological improvements in manufacturing processes and reduction of final energy demand of electricity and oil in the residential and commercial sectors.

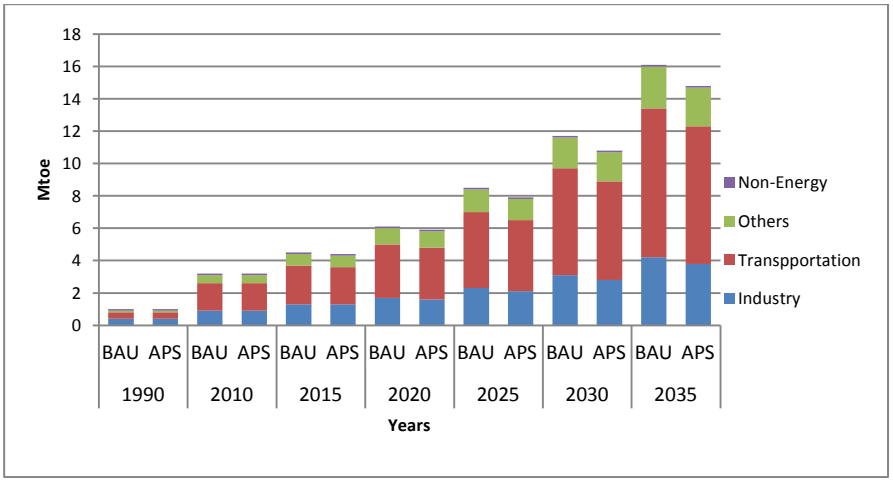

Fig. 5: Final energy demand by sector in BAU and APS

Between BAU and APS, APS primary energy consumption is projected to increase at a slightly lower rate than the BAU at 5.2 percent year from 6.6 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.

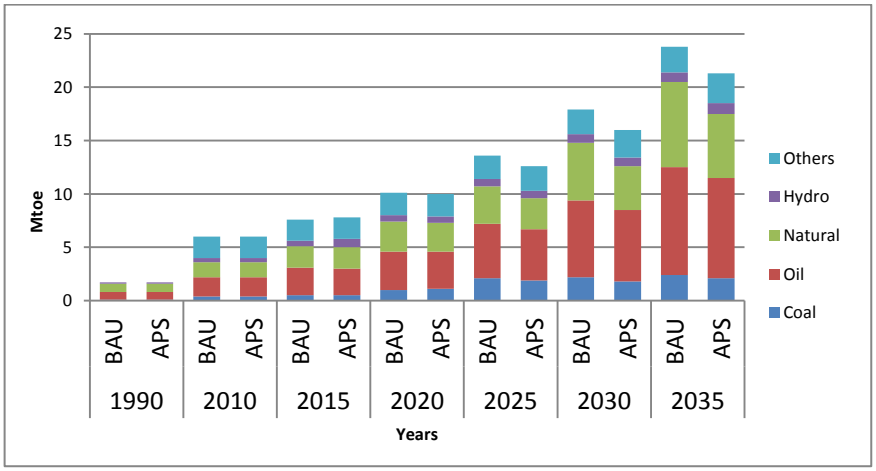

Fig. 6: Primary Energy Consumption

There is an estimated savings of 2.6 Mtoe in 2035 in the APS, relative to the BAU scenario. This is equivalent to 10.8 percent savings in primary energy consumption due to implementing a range of energy efficiency and conservation measures on the demand side.

4. Conclusion

There are two conclusions in this study: the first is based on energy consumption and the second is based on electricity consumption. In the former, due to the continuous dominance of the transport sector in final energy consumption, as well as oil and coal increases in final energy demand, there should be an energy efficiency target for the transport sector in addition to those in the industrial, commercial and household sectors. There is a need for energy management practices for industrial and commercial sectors and a requirement for an energy efficiency labeling program for energy service companies and appliances. There should be more aggressive exploration of the upstream energy sector and more financial and technical assistance is needed in each of the energy subsectors to secure the national energy supply [5]. The latter conclusion is to rehabilitate existing electricity transmission and distribution, expand rural electrification, build coal-fired power plants or gas-fired power plants and promote renewable energy [6] (solar, wind, biomass, biogas etc.) in Myanmar's fuel mix as secure energy sources. There is a need for a detailed policy mechanism for the renewable energy sector to implement the potential program and projects.

5. References

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