

Chapter 4

Cambodia Country Report

Lieng Vuthy

Department of Energy Technique Ministry of Industry, Mines and Energy (MIME),
Cambodia

June 2013

This chapter should be cited as

Lieng, V. (2013), 'Cambodia Country Report' in Kimura, S. (ed.), *Analysis on Energy Saving Potential in East Asia*, ERIA Research Project Report 2012-19, pp.99-113. ERIA [online]. Available at:

http://www.eria.org/RPR_FY2012_No.19_Chapter_4.pdf

CHAPTER 4

Cambodia Country Report

LIENG VUTHY

*Department of Energy Technique
Ministry of Industry, Mines and Energy (MIME), Cambodia*

1. Background

The Kingdom of Cambodia is located in the Lower Mekong region of Southeast Asia. It has an 800 km border with Thailand in the west, with Lao PDR in the north, and Viet Nam in the east. The physical landscape is dominated by lowland plains around the Mekong River and the Tonle Sap Lake. Of the country's area of 181,035 km², approximately 49 percent remains covered by forest. There are about 2.5 million hectares of arable land and over 0.5 million hectares of pasture land. The country's gross domestic product (GDP) in 2010 was about US\$ 7.9 billion at constant 2000 prices with a substantial agriculture share of 34 percent. The population during the same year was 14.1 million.

Cambodia's conventional total primary energy demand in 2010 stood at 1.4 Mtoe. Oil represented the largest share of Cambodia's total primary energy mix at 90.4 percent; coal was third at 0.6 percent, followed by hydro (0.2 percent), and others (8.9 percent). Cambodia's final energy demand stood at 1.2 Mtoe. Cambodia is dependent on imports of petroleum products having no crude oil production or oil refining facilities. Its electricity supply is dominated by oil at 95 percent with hydro accounting for the rest.

Cambodia has 10,000 MW of hydropower potential; however, only 224.57 MW had been installed to date. Commercial quantities of coal have also been discovered in Cambodia but no official figures on recoverable reserves are available currently.

2. Modelling Assumptions

2.1. GDP and Population

In forecasting energy demand to 2035, it is assumed that the GDP of Cambodia will grow at an annual rate of 5.1 percent. Its population on the other hand is projected to grow at 1.8 percent per year resulting to a growth rate of GDP per capita of 3.2 percent per year up to 2035.

2.2. Electricity Generation

With regards to the future electricity supply, coal is expected to dominate Cambodia's fuel mix in 2035 followed by hydro. This is a big change from the current oil-dominated electricity generation. According to the Electricity Supply Development Master Plan from year 2010-2020, Cambodia will have a total additional installed capacity of 3173.2 MW, 900 MW of which will come from coal power plants to be installed from 2010 to 2018. Hydro will make up 1873.2 MW of the total.

From 2020 to 2035, the additional capacity requirements will still be met by coal and hydro. The gross electricity generation also assumes net export of electricity to neighbouring countries of 2600 GWh in 2020 that will gradually increase to 3080 GWh by 2035.

2.3. Energy Efficiency and Conservation Policies

Cambodia's energy efficiency and conservation programs aims to achieve an integrated and sustainable program that will facilitate energy efficiency improvements in the major energy consuming sectors and help prevent increased and wasteful fuel demand. To achieve these aims, the country realizes the need for market transformation towards more efficient energy use, increased access to energy efficiency project financing and the establishment of energy efficiency regulatory frameworks.

As a start, Cambodia is implementing the following pilot projects:

- Improving the efficiency of the overall supply chain for home lighting in rural areas by the provision of decentralized rural energy services through a new generation of rural energy entrepreneurs.
- Assisting in market transformation for home and office electrical appliances through bulk purchase and dissemination of high performance lamps, showcasing of energy efficient products, support to competent organizations for testing and certification of energy efficient products and establishment of “Green Learning Rooms” in selected schools to impart life-long education on the relevance of energy efficiency and conservation.
- Improving energy efficiency in buildings and public facilities.
- Improving energy efficiency in industries in cooperation with UNIDO and MIME to be implemented in the 4 sectors namely, rice mill, brick kiln, rubber refinery, and garment.

Cambodia has also embarked on preparing an action plan for energy efficiency and conservation in cooperation with the Energy Efficiency Design sub-working group created under the WG. Specific actions plans are being drafted for the industrial, transportation and other sectors. The initial estimates of sector demand reduction of existing consumers from these actions plans are 10 percent by 2035. These initial estimates were used in forecasting the energy demand in the APS.

In a close consultation process between Ministry of Industry, Mines and Energy (MIME) and EUEI-PDF that started in July 2011 it was concluded to launch a project support the Royal Government of Cambodia (RGC) in the elaboration of a National Energy Efficiency Policy, Strategy and Action Plan. The project started with an inception phase in August 2012 and will be concluded in April 2013 by a final workshop, where the recommendations and conclusion as elaborated in the document will be presented.

There are five sectors identified as priority areas for the national energy efficiency policy, strategy and action plan.

- 1- Energy efficiency in industry

- 2- Energy efficiency of end-user products
- 3- Energy efficiency in buildings
- 4- Energy efficiency of rural electricity generation and distribution
- 5- Efficient use of biomass resources for residential and industrial purposes.

3. Outlook Results

3.1. Business-as-Usual (BAU) Scenario

3.1.1. Total Final Energy Demand

Final Energy Demand by Sector

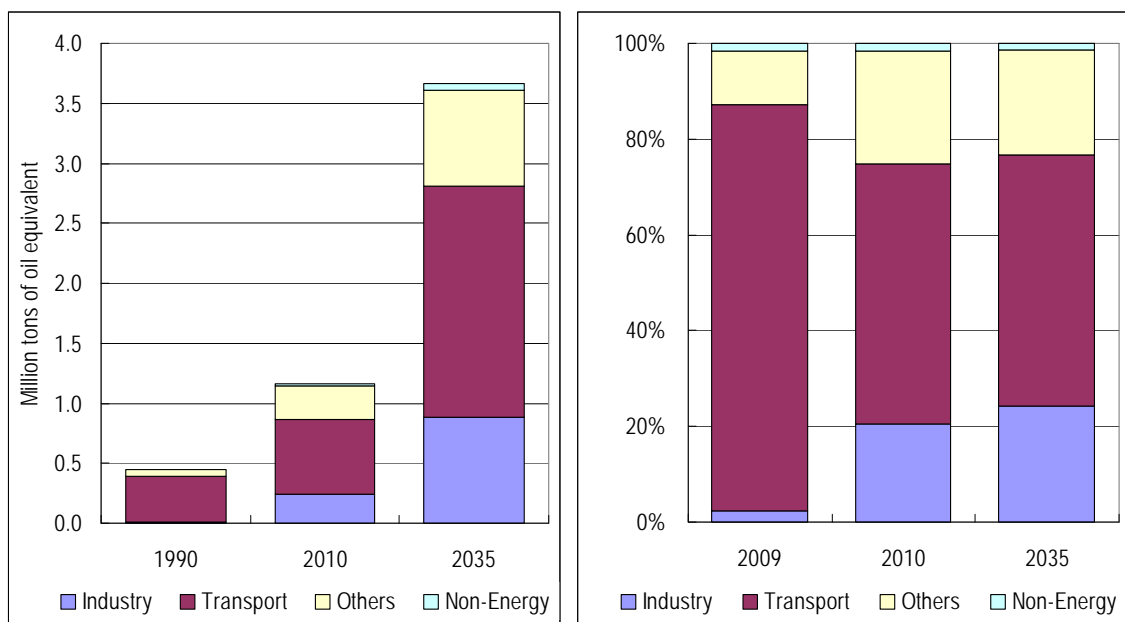
Cambodia's final energy demand (not including biomass) grew at an average annual rate of 6.5 percent per year or 2.57 times from 0.45 Mtoe in 1995 to 1.16 Mtoe in 2010. This growth occurred in the industrial sector which grew at a rapid rate of 23.5 percent per year followed by the residential/commercial (others) sector at 11.9 percent per year, non-energy sector 6.9 percent per year, and the transport sector 3.4 percent per year. Oil is the most consumed product, accounting for 97.8 percent of total final energy demand in 1995, declining to 84.9 percent in 2010. Electricity demand's share also rapidly increased from 2.2 percent in 1995 to 15.1 percent in 2010.

In the BAU scenario, driven by assumed 5.1 percent GDP growth and a rising population, final energy demand is projected to increase at an average rate of 4.7 percent per year or 2.1 times between 2010 and 2035. The strongest growth in demand is projected to occur in the industry sector that will increase by 5.4 percent per year to 2035. This is followed by the transport sector 4.6 percent per year and the residential/commercial (others) sector at 4.4 percent per year. Non-energy demand will increase by 4.1 percent per year.

The transport sector's share to the total final energy demand was the largest share in 2010 at of 54.3 percent. This share is projected to decline to 52.5 percent in 2035 in view of the faster growth of the industrial sector which will grow at 5.4

percent per year on average. The second largest share in demand is in the residential/ commercial (others) sector with the share of 23.6 percent in 2010. This is projected to decline to 21.9 percent due to the faster growth of the industrial sector. The industry sector with had the third largest share of 20.5 percent in 2010 would have a larger share in 2035 at 24.2 percent. Non-energy demand share will remain small from 1.6 percent in 2010 to 1.4 percent in 2035 (Figure 4-1).

Figure 4-1: Final Energy Demand by Sectors, BAU



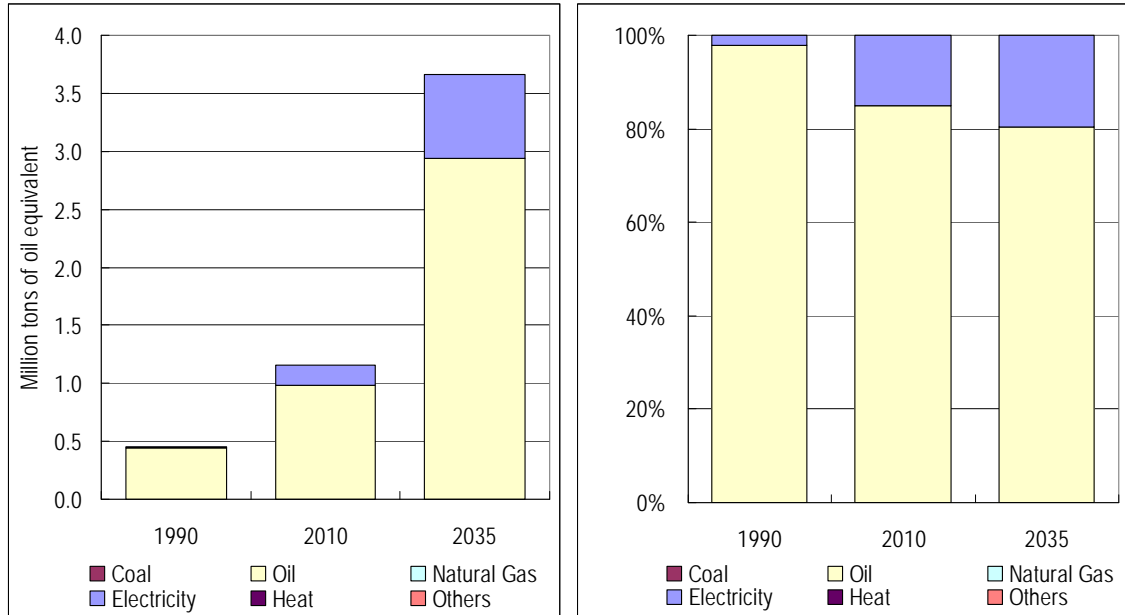
Final Energy Demand by Fuel

By fuel, electricity is projected to exhibit the fastest growth in final energy demand at 5.1 percent per year between 2010 and 2035. From 0.2 Mtoe in 2010, electricity demand is projected to increase to 0.7 Mtoe in 2035. Oil is projected to have a 4.0 percent annual growth rate per year, to increase from 1.0 Mtoe in 2010 to 2.9 Mtoe in 2035. Figure 4-5 shows the final energy demand by fuels in 1990, 2010 and 2035.

Oil products will continue to take the largest share in final energy demand. Its share will remain high from 84.9 percent in 2010 but is projected to decline to 80.4 percent in 2035. In contrast, electricity share will increase from 15.1 percent

in 2010 to 19.6 percent in 2035. Figure 4-2 shows the shares of various fuels in Cambodia's final energy demand in 1990, 2010 and 2035.

Figure 4-2: Final Energy Demand by Fuels, BAU

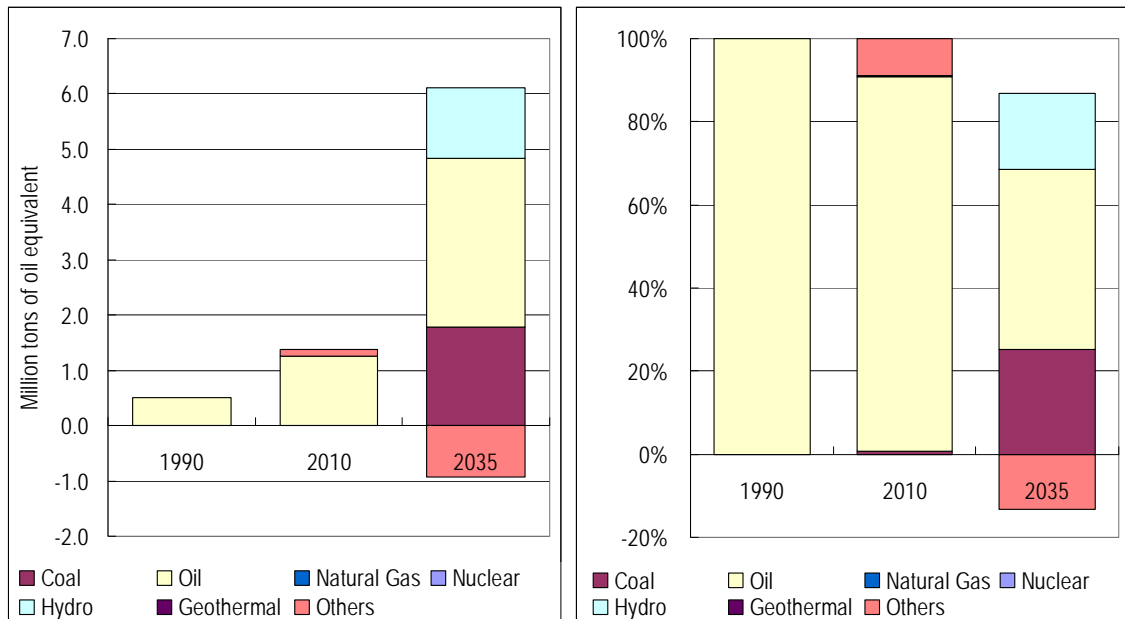


3.1.2. Total Primary Energy Demand

Primary energy demand in Cambodia (not including biomass) grew at 6.8 percent per year on average or 2.7 times from 0.51 Mtoe in 1995 to 1.37 Mtoe in 2010. Among the major energy sources, the fastest growing was oil. Oil demand grew at an average annual rate of 6.1 percent between 1995 and 2010.

In the BAU scenario, Cambodia's primary energy demand is projected to increase at an annual rate of 5.4 percent per year or 2.5 times from 1.37 Mtoe in 2010 to 5.19 Mtoe in 2035. The faster growth would be in hydro, increasing at annual average rate 28.9 percent between 2010 and 2035, followed by coal at 24.1 percent. Oil will have a slower growth rate of 3.6 percent per year on average. Figure 4-3 shows the primary energy demand in Cambodia in 1990, 2010 and 2035.

Figure 4-3: Primary Energy Demand



Despite the slower growth in oil demand, oil will remain as the major source of energy in Cambodia. However, its share to the total will decrease from 90.4 percent in 2010 to 58.9 percent in 2035. The share of hydro is projected to increase from 0.2 percent in 2010 to 24.7 percent in 2035. Coal will also increase its share from 0.6 percent to 34.2 percent during the same period.

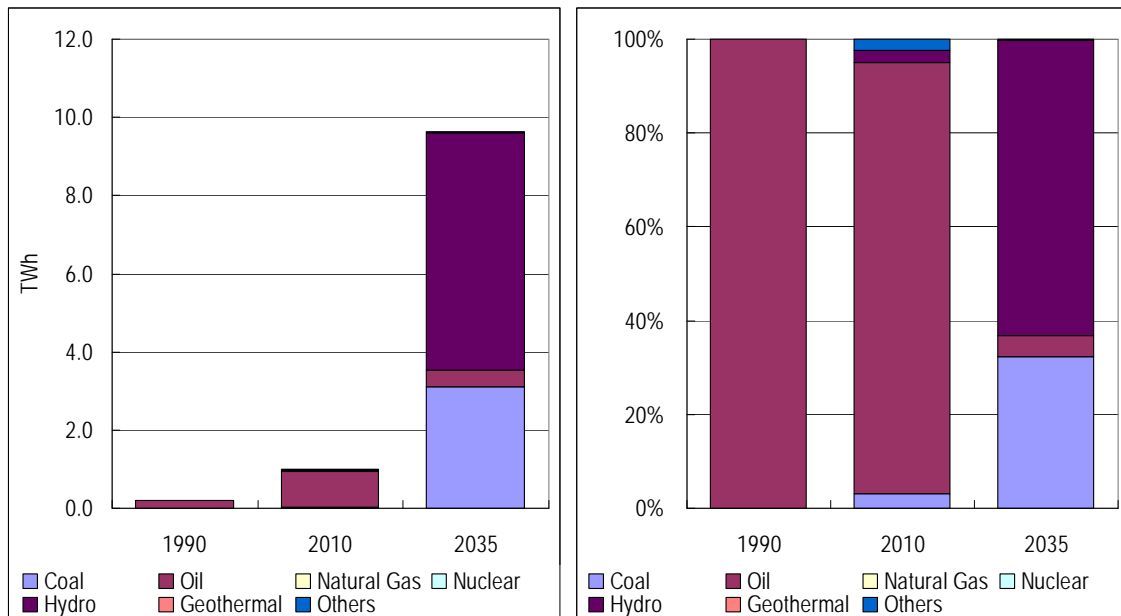
3.1.3. Power Generation

Power generation increased at 11.4 percent per year or 5 times from 0.2 TWh in 1995 to 1.0 TWh in 2010. Oil power plants were the main source of electricity in 1995 but in 2010, coal, hydro and other sources of electricity became parts of Cambodia's power generation mix. During the year, these sources had 3.1 percent, 2.6 percent and 2.3 percent contribution to Cambodia's power generation mix.

In BAU scenario, to meet the domestic demand for electricity and the export target of the government, power generation is projected to increase at an average rate of 13.2 percent per year or 22.3 times between 2010 and 2035. The fastest growth will be in hydro power generation (28.9 percent per year) followed by the

coal thermal power generation (24.1 percent per year) and others (0.1 percent per year). Figure 4-4 shows the power generation mix in Cambodia in 1990, 2010 and 2035.

Figure 4-4: Power Generation, BAU



Oil had the largest share of 92.0 percent in 2010 but this is projected to decline considerably to 1.7 percent in 2035. Hydro and coal, on the other hand will increase their shares to the power generation mix. The share of hydro will increase to 67.4 percent while that of coal will increase to 30.8 percent in 2035. Other sources, like solar, biomass and wind will also have a decrease in share and will reach a negligible 0.1 percent in 2035 from 2.3 percent in 2010. Figure 8 shows the power generation mix in Cambodia in 1990, 2010 and 2035.

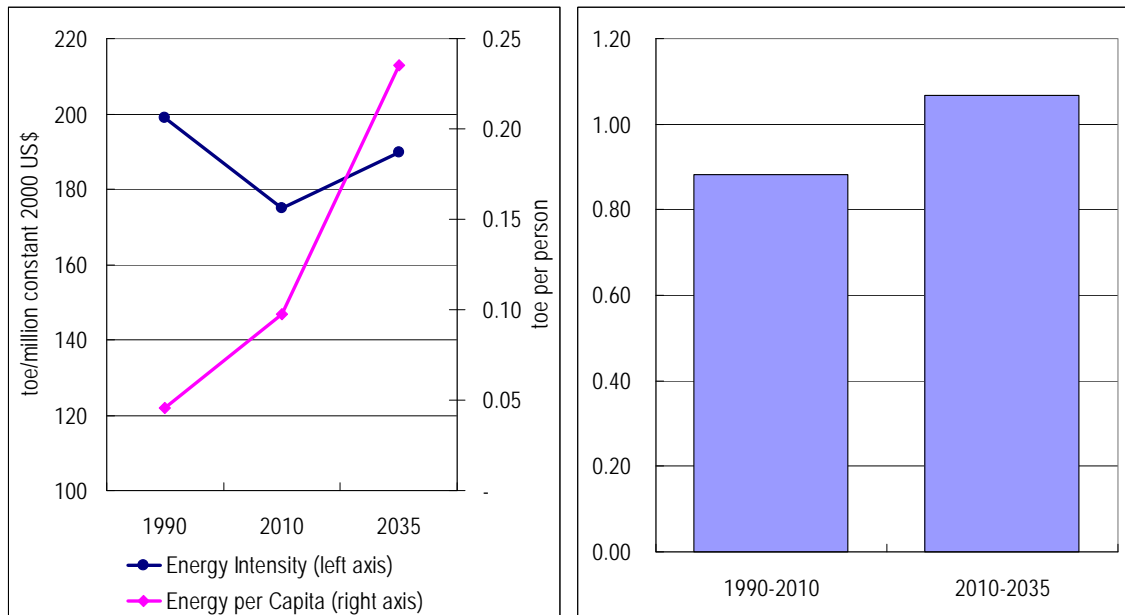
3.1.4. Energy Intensity and Energy Consumption per Capita

Energy intensity had decreased from with 199 toe/million 2000 US dollars in 1995 to 175 toe/million US dollars in 2010. The major reason is that textile and food industry, a non-energy intensive industry, was the most common industry that was developed during that period. In the BAU, the energy intensity will continue to have a decreasing trend and will reach 190 toe/million US dollars in

2035. The reason for the increasing energy intensity is the entry of more coal-fired generation in the power sector. In the past, Cambodia relied on electricity imports to meet a big part of its electricity demand.

In contrast with energy intensity, energy consumption per capita increased from 0.05 toe/person in 1995 to 0.10 toe/person in 2010. In the BAU, energy per capita will continue to increase and will reach 0.23 toe/person in 2035. Figure 4-5 shows the primary energy intensity and energy consumption per capita in from 1990 to 2035.

Figure 4-5: Energy Intensity and Energy Consumption per capita



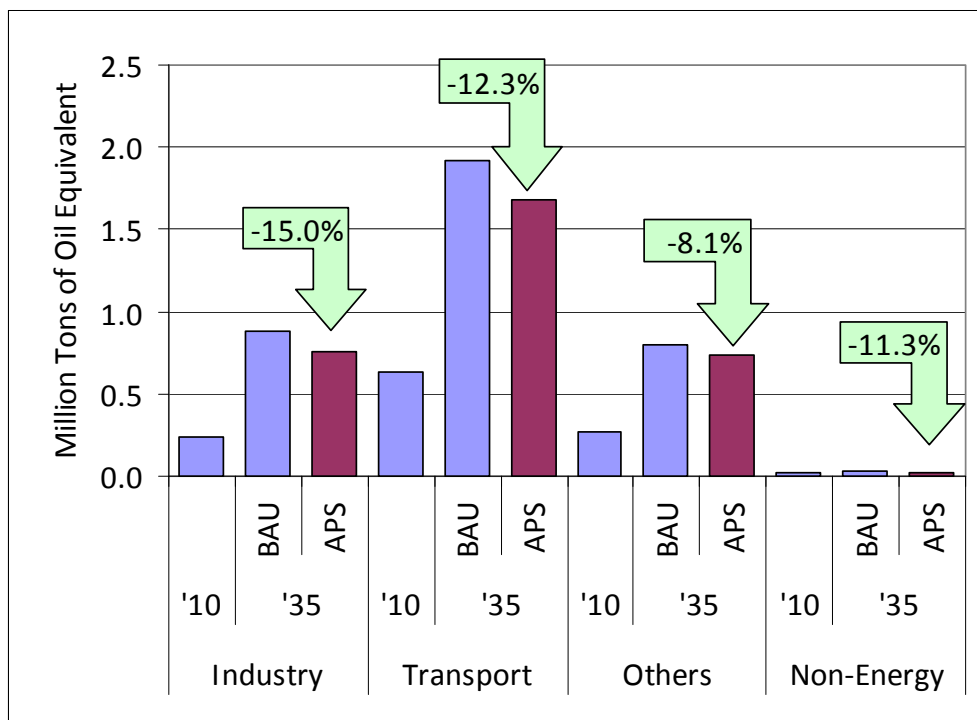
3.2. Energy Saving Potential

3.2.1. Final Energy Demand by Sector

In the Alternative Policy Scenario (APS), final energy demand is projected to increase at a slower rate 4.2 percent per year (compared with 4.7 percent per year in BAU) from 1.2 Mtoe in 2010 to 3.2 Mtoe in 2035, because of energy efficiency and conservation (EE&C) programs. The bulk of the savings are expected to occur in the transport sector (1.7 Mtoe), followed by the industry sector (0.8 Mtoe), and the residential/commercial (others) sector (0.7 Mtoe).

Improvement in end-use technologies and the introduction of energy management system is expected to contribute to the slower rate of demand growth, particularly in the transport, industry and others (residential and commercial).

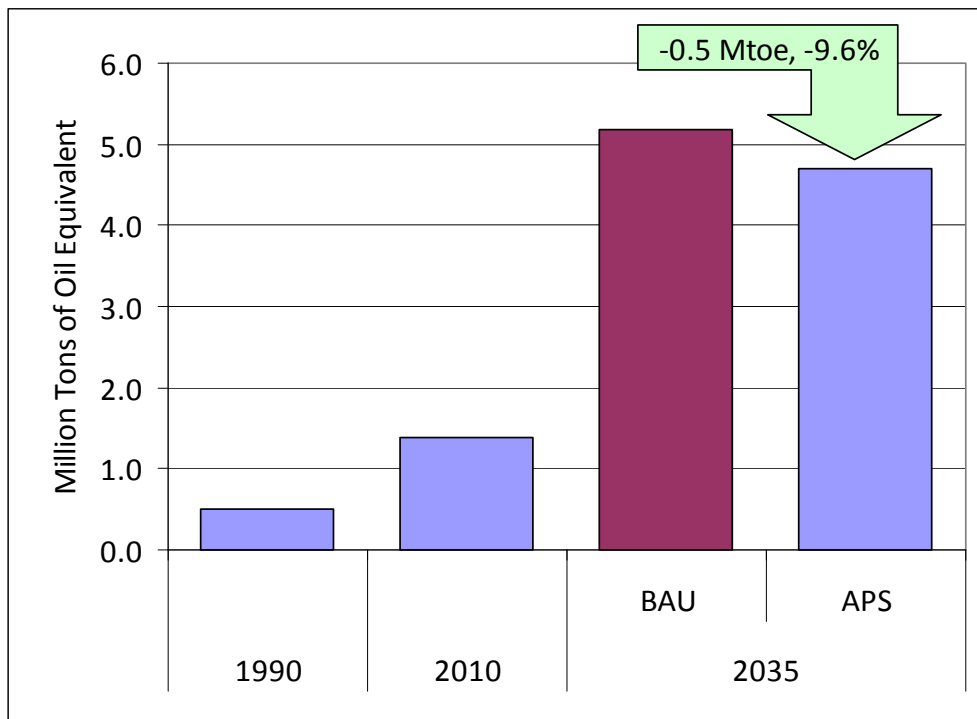
Figure 4-6: Final Energy Demand, BAU vs. APS



3.2.2. Primary Energy Supply

In the APS, primary energy demand is projected to increase at a slower rate of 5.0 percent per year from 1.4 Mtoe in 2010 to 4.7 Mtoe in 2035. The saving that could be derived (the difference between primary energy demand under both scenarios) from the energy saving and conservation goals and action plans of Cambodia is 0.5 Mtoe. This is equivalent to 9.6 percent of total Cambodia's primary energy demand in the BAU in 2035 (Figure 4-7).

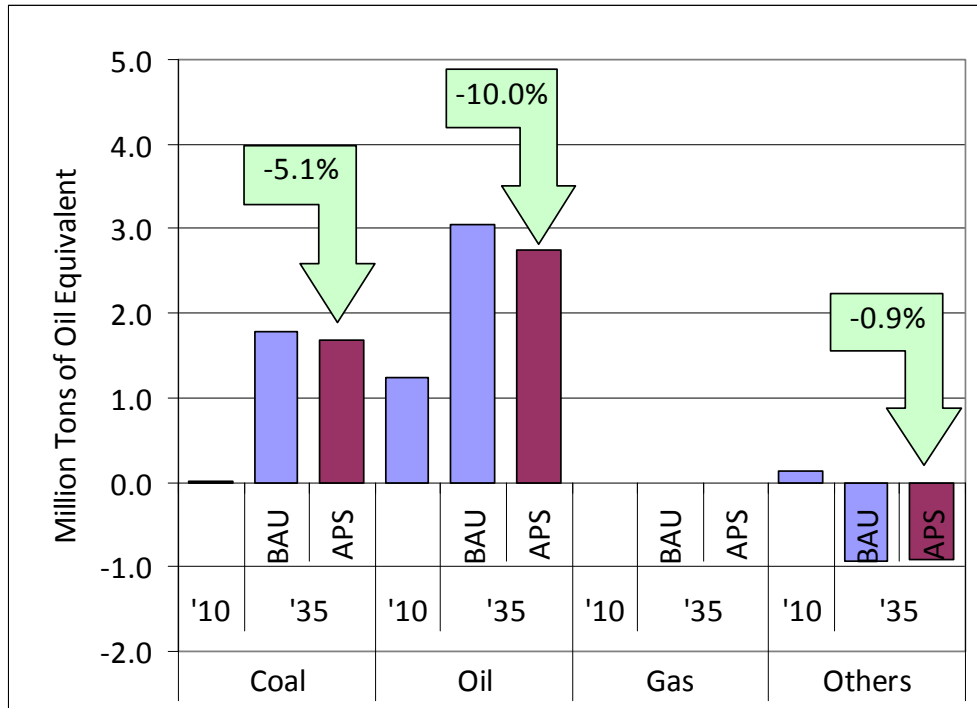
Figure 4-7: Evolution of Primary Energy Demand, BAU and APS



In the APS, hydro is projected to grow at an average annual rate of 28.5 percent compared with 28.9 percent in the BAU, followed by coal and oil with 23.8 percent and 3.2 percent (24.1 percent and 3.6 percent in the BAU), respectively over the same period. The slower growth in demand, relative to the BAU scenario, stems from EE&C measures on the demand side and the more aggressive uptake of renewable energy on the supply side. Coal has the highest energy saving

potential with 88.5 percent, followed by oil at 4.6 percent. Figure 4-8 shows the primary energy demand by source in 2010 and 2035 in both the BAU and APS.

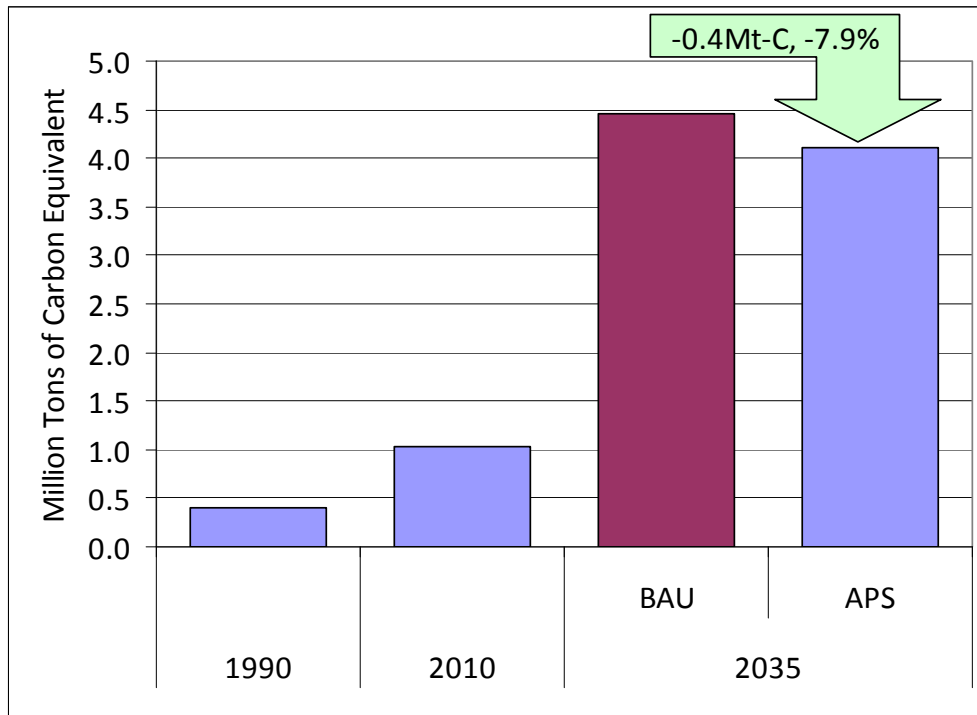
Figure 4-8: Primary Energy Demand, BAU vs. APS



3.2.3. CO₂ Emissions from Energy Consumption

CO₂ emissions from energy consumption are projected to increase by 6.0 percent per year from 1.0 Mt-C in 2010 to 4.5 Mt-C in 2035 under the BAU scenario. This growth rate is faster than that of the primary energy demand due to the increased contribution of coal to Cambodia's primary energy mix. Under the APS, the annual increase in CO₂ emissions between 2010 and 2035 is projected to be 5.7 percent. CO₂ emissions are 0.4 Mt-C lower (a 7.9 percent decrease) under the APS compared with the BAU scenario in 2035, indicating that the energy saving goals and action plans of Cambodia are effective in reducing CO₂ emissions (Figure 4-9).

Figure 4-9: Evolution of CO₂ Emissions, BAU and APS



3.2.4. Key Findings

From the above analysis on energy saving potential, the following are the key findings:

- Energy demand in Cambodia is expected to continue to grow at a significant rate, driven by robust economic growth, industrialization, urbanization and population growth. Energy efficiency and conservation is an option to meet higher demand in sustainable manner.
- Annual growth of energy of energy demand in industry sector is projected at highest rate of 5.4 percent in BAU and its share is increasing continuously from 20.5 percent in 2010 to 24.2 percent in 2035. This shows that energy efficiency and conservation measures are required in the industrial sector to curb the ever increasing demand.

- Electricity demand is increasing with highest annual growth rate of 5.8 percent in the BAU and is projected to be lower at 5.1 percent in the APS. The difference seems to be modest compared with its potential.
- Hydro power plants will be the major power generation source in Cambodia in coming years. Its share in the total of power generation output will increase from 2.6 percent in 2010 to 67.4 percent in 2035. Coal thermal power plants will be the second major power generation source in Cambodia also in coming years. Its share in the total of power generation output will increase from 3.1 percent in 2010 to 30.8 percent in 2035. This is an area with the largest energy saving as well as GHG mitigation potential in Cambodia.

4. Implications and Policy Recommendations

From the findings above and to be able to implement EE&C activities in Cambodia effectively, the following actions are recommended:

- Establishment of target and roadmap for EE&C implementation in Cambodia is necessary. The target for EE&C in Cambodia should be set up for a short, medium, and long term period and focused on buildings and industries sectors as priority sectors. The long term should be set up based on an assessment of energy saving potential for all energy sectors, including residential and commercial sectors, which have large potential on energy saving up to 2035.
- The growing demand in the residential and commercial sector requires compulsory energy labelling for electrical appliances. The compulsory energy labelling for electrical appliances is an effective energy management measure.
- Hydro and coal thermal power plants will be the major sources of power generation in Cambodia up to 2035. Therefore, advanced clean coal technologies should be used for coal power plants. For hydro, there should

be a careful review of all hydro development projects to ensure that local communities would not be adversely affected but would instead enjoy the economic benefits that the development would bring.

- Renewable energy is a supply side option that will increase energy independence, energy security and GHG abatement in Cambodia. There is a necessity to build up the strategy and mechanisms to support renewable energy development.

References

Ministry of Industry, Mines and Energy (2012), Annual Meeting Report.

Ministry of Planning (2010), National Statistic Institute.

National Policy, Strategy and Action Plan on Energy Efficiency in Cambodia (Adopted by Ministry of Industry, Mines and Energy-2013).