EXECUTIVE SUMMARY

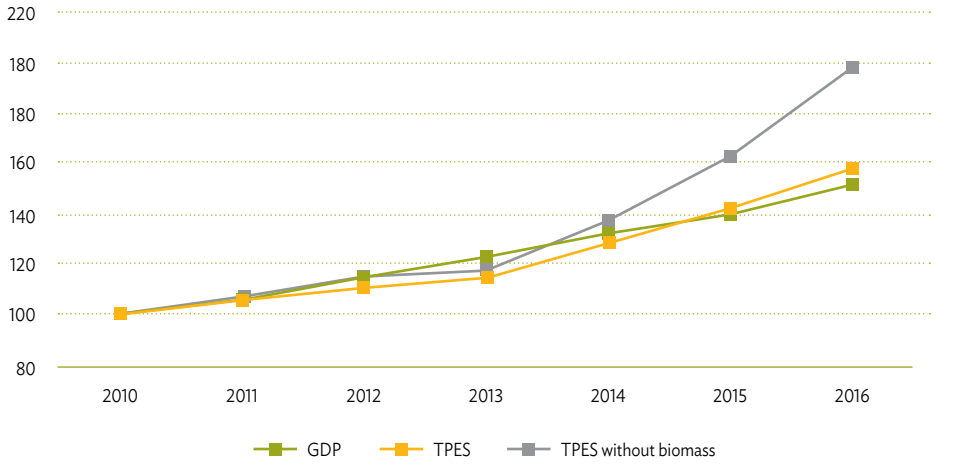
Background

During 2010–2016, the total primary energy supply (TPES) saw an increase similar to that of gross domestic product (GDP) in Cambodia, but the TPES without biomass increased by 2.0 times and was much higher than GDP (1.5 times) in the same period (Figure 1). Curbing coal, oil, and electricity demand to the GDP level is crucial (Figure 2). Cambodia has increased its imports of coal and petroleum from other ASEAN countries such as Indonesia and Singapore and this has affected Cambodian economic growth due to the following defined formula of GDP:

GDP = C + I + J + E – M
C: Private consumption + government consumption
I: Private capital formation + government capital formation
J: Stock change
E: Export
M: Import

Consequently, the Ministry of Mines and Energy (MME) needs an appropriate and comprehensive basic energy plan, and the Economic Research Institute for ASEAN and East Asia (ERIA) is supporting the MME to set up this plan. The basic energy plan should contribute two points: (a) saving conventional energy consumption, such as oil and electricity; and (b) utilising domestic energy, such as hydropower and biomass.

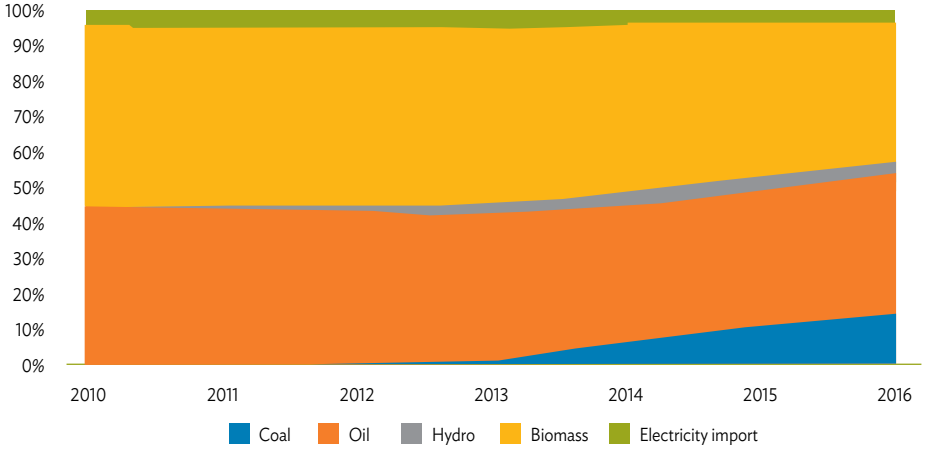
Figure 1. Historical Trend of GDP and TPES
(2010=100)



GDP = gross domestic product, TPES = total primary energy supply.

Source: Ministry of Mines and Energy, 2018.

Figure 2. Primary Energy Consumption Share by Fuel



Source: Ministry of Mines and Energy, 2018.

Objective

ERIA and the MME will prepare a Basic Energy Plan for Cambodia (BEPC) that is appropriate, comprehensive, feasible, and effective. In addition, the basic plan should have numerical targets for each energy issue covered by the plan, and the targets should be achievable.

Basic principle

The basic principle of the plan aims for an energy supply for Cambodia with the following conditions:

- Affordability
- Accessibility
- Security (sustainable security)
- Safety
- Transparency of the market

The catchphrase of the plan is 2A2S+T. In other words, the Cambodian energy policies described in the BEPC would contribute to an energy supply in the Cambodian market with affordability, accessibility, security, and safety + transparency. The target year of the plan is 2030, and the plan applies a rolling-plan method that will be reviewed every five years.

Energy issues covered by the BEPC

Recognising the current energy issues in Cambodia, the basic plan covers the following six energy fields: (i) oil, (ii) electricity supply, (iii) renewable energy, (iv) energy efficiency, (v) energy security, and (vi) the energy outlook brought by the BEPC.

Methodology

Each energy field applies a common approach:

(1) Extract the current issues.
(2) Set the appropriate targets for solving the issues.
(3) List the necessary action plans, polices, and roadmaps for achieving the targets.

Oil supply

In Cambodia, gasoline, diesel oil, and liquefied petroleum gas (LPG) demand has been increasing rapidly, and the demand has depended on imports. Also, according to Cambodia's energy outlook, which is a part of the East Asia Summit (EAS) energy outlook prepared by ERIA, these petroleum products will increase their demand continuously up to 2040. In this regard, the following countermeasures are recommended:

(1) The major use of gasoline and diesel oil as well as LPG is transportation (vehicle), so that Cambodia can shift to highly efficient vehicles under the appropriate regulations (reduction by **10%** from the business-as-usual [BAU] scenario).

(2) Petroleum products are convenient and useful, and they are used across the industry, transport, residential, and commercial sectors. If a petroleum supply disruption occurs, Cambodia will face serious damage on both the economic and social aspects. Therefore, appropriate stockpiling volumes, including commercial stocks, will be needed (at least **30 days** until 2030).

(3) Biofuel, especially bioethanol, is one of the options for reducing imports of gasoline. In addition, biofuel affects the economic growth of Cambodia, such as through agriculture and industry activities and reductions in CO_2 emissions. The General Department of Petroleum is seeking business opportunities for biofuel (**E3 gasoline** will be possible by 2025).

(4) The BEPC also states that the petroleum supply chain will be resilient through business activities under the appropriate petroleum policies and regulations.

Electricity supply

Electricity demand increased significantly by 18% per year during 2010–2016, and, in parallel, power generation increased by 19% per year in the same period. Previously, Cambodia fully depended on oil power generation and imports from neighbouring countries, but since coal and hydropower generation has increased rapidly, imports of electricity have largely decreased compared to 2010. The Cambodia energy outlook also reports that its electricity demand will increase by 7.5 times from 2015 to 2040. Based on this situation, the BEPC recommends the following countermeasures:

(1) The power generation mix in 2030 will be **coal (35%), hydro (55%), and renewable energy (10%)**, consisting of biomass and solar/photovoltaics (PV). This mix will maintain affordability and security.

(2) Resilience of the transmission and distribution networks will bring improvement of transmission and distribution losses (13% in 2016 to **8%** in 2030), decrease the System Average Interruption Duration Index and System Average Interruption

Frequency Index to less than **620** minutes and **7.3** times, respectively, and increase the household electrification ratio from the current 70% to **95%** in 2030 through connecting to the national grid. This will contribute to accessibility, security, and safety.

(3) Reforms of electricity tariffs, such as time-of-use and cross-subsidy systems, have to contribute to the levelisation of electricity demand and elimination of the price gap between urban and rural areas and maintain affordability and transparency.

Renewable energy

Renewable energy consists of hydro, biomass, and solar/PV in Cambodia. Wind is very hard to install due to insufficient wind conditions in Cambodia. Hydro will increase continuously as a major power source based on its affordability and security. Biomass and solar/PV are treated here.

(1) Traditional biomass will be phased out and replaced by LPG for its use for cooking in rural areas. However, highly efficient biomass cooking stoves are recommended. A biomass supply chain might be established to supply fabricated biomass such as wood chips to final users in rural areas.

(2) Another biomass use will be power generation to be applied in isolated areas (with no national grid). Its target will be 6.5% of total power generation in 2030.

(3) There are several policies to promote solar/PV systems, such as feed-in tariffs, Renewable Portfolio Standards, and net metering. However, the BEPC recommends not to apply these policies for the penetration of solar/PV. The MME will open the power generation market to local and foreign entities such as the Asian Development Bank and private companies to install solar/PV in Cambodia for supplying electricity to subscribers. Its target will be 3.5% in 2030.

Energy efficiency

Energy efficiency is crucial for Cambodia because the TPES without biomass has increased much more than GDP growth, as mentioned before. On the other hand, energy prices in Cambodia, such as for electricity and LPG, are fully marketed (no subsidies) and this brings incentives for energy consumers, such as saving energy costs through applying energy efficiency and conservation (EEC) activities. Thus, the necessary EEC policies, action plans, and targets of the industry, commercial, and residential sectors are specified here, especially for saving electricity consumption. The BEPC recommends the following:

(1) Apply the same energy saving target, a 10% reduction from the BAU, across sectors until 2030.
(2) Apply a standards and labelling system to appliances used by households. An inspection laboratory will need to be set up in Cambodia.
(3) The MME has to grow local energy managers and invite energy service companies, both local and foreign companies, for engaging in engineering EEC activities in the industry (factories) and commercial (buildings) sectors. In this regard, an association of energy managers or energy service companies, such as the Cambodia Chapter of the American Society of Heating, Refrigerating and Air-conditioning Engineers, will be established.
(4) Education and campaigns on EEC are important and will contribute to making Cambodian people aware of EEC.
(5) When EEC becomes popular in Cambodia, the MME will have to set up an EEC regulation under the electricity law. The regulation will support the EEC action plans mentioned above.

Energy security

There are many energy security issues, such as the diversity of energy supply sources outside Cambodia, the increase of domestic energy such as hydro and biomass, emergency preparedness and response (EPR), stockpiling, the resilience of the energy supply chain, and power grid interconnection in the Greater Mekong Subregion. Here, we introduce only EPR and grid interconnection.

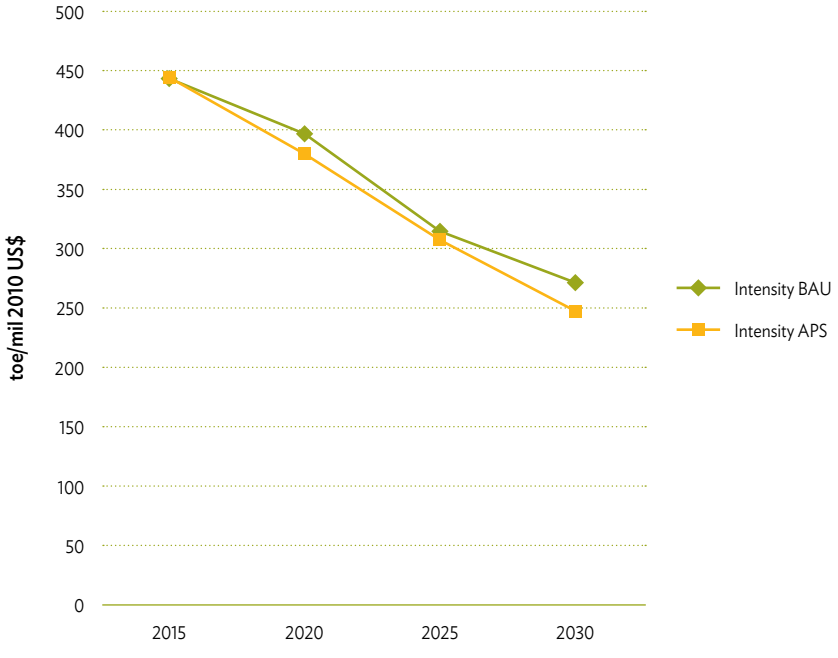
(1) EPR is a plan or procedure for when Cambodia faces an emergency. EPR clearly specifies three measures: short term, medium term, and long term. The short-term measure emphasises how to reduce energy consumption quickly, while the medium and long-term measures mention the diversity of energy supply sources, promotion of EEC, and stockpiling. The establishment of the National Emergency Supply Organization (NESO) is also very important. NESO consists of several ministries (energy, industry, commerce, transport) and large energy supply and consumption companies, and is headed by the prime minister. NESO works on the coordination, harmonisation, and prioritisation of a limited energy supply to final users under an emergency.
(2) Cambodia has imported electricity from Viet Nam and Thailand historically and will import it from Lao PDR soon. As such, Cambodia has already joined a grid interconnection network amongst the countries, but this is on a bilateral basis. According to the BEPC, 60% of power generation will come from hydropower plants, and this will depend on the volume of water flow, which is usually affected

by climate conditions. In order to secure electricity supply in Cambodia, a power trade system on a multilateral basis is recommended.

Energy outlook

Two energy outlooks, business as usual and the alternative policy scenario (applying targets specified by the BEPC), are projected up to 2030. Both outlooks show the trends of total final energy consumption (TFEC) and TPES up to 2030. Thus, the MME will surely monitor the actual TFEC and TPES from Cambodia's energy balance tables to be produced continuously after 2017 and compare them with the projected trends in the BEPC. If the actual TFEC or TPES differs from the trends, the MME will make checks (regarding why the difference is generated) and take action (revise action plans and policies) by applying a Plan-Do-Check-Action cycle. However, the TFEC and TPES can become volatile depending on the economic conditions, such as GDP, so that the intensity defined as TFEC/GDP and TPES/GDP is better than the TFEC and TPES themselves. The intensity of the TFEC is shown in Figure 3.

Figure 3. TFEC Intensity under the BAU and APS Outlooks



BAU = business as usual, APS = alternative policy scenario, TFEC = total final energy consumption.

Source: Author's calculation.