

## Executive Summary

The Economic Research Institute for ASEAN and East Asia (ERIA) has been supporting the Ministry of Energy and Mines (MEM), the Lao People's Democratic Republic (Lao PDR) to produce *Lao PDR Energy Statistics* since 2017 for analysing the historical energy demand supply situation. In addition, for analysing the future energy demand supply situation of the Lao PDR, ERIA started to support MEM in the development of the Lao PDR energy outlook model applying an econometric approach (economic activities influence to energy consumption) in 2018. The development of the Lao PDR's energy outlook model applied the following seven steps:

1. Preparation of macroeconomic data and energy demand supply data
2. Estimation of energy demand formulas using the ordinary least square method (regression analysis)
3. Development of future simulation models using the Long-range Energy Alternatives Planning System (LEAP) (sequential method and producing energy balance tables automatically)
4. Development of macroeconomic model assumptions for future economic growth and energy development plans
5. Finalization of the Business-As-Usual (BAU) scenario result
6. Conducting case studies
7. Evaluation of results of the BAU scenario and the case studies and extraction of policy implications

Consequently, ERIA held three working meetings with staff from the Department of Energy Policy and Planning, the Department of Planning and Corporation, as well as Électricité du Laos, and the Laos State Fuel Company. The first meeting covered steps 1–2, while steps 3–4 were covered at the second meeting using LEAP. The third meeting implemented steps 5–7. This energy outlook modelling of the Lao PDR also had the role of capacity building for staff of MEM. The major outcomes from the energy outlook modelling of the Lao PDR follow.

Total final energy consumption (TFEC) in the BAU scenario increased at an average 4.7% per year over 2015 to 2040 under the gross domestic product (GDP) assumption at 6.2% per annual in the same period. The industry sector grew the fastest (8.3%), followed by the transport sector (6%) and 'others' (1.3%). The low growth in the 'others' sector (consists of residential, commercial, agriculture, fishery and forest sectors) is due to the diversification of energy from traditional biomass to electricity, liquefied petroleum gas, and efficient biomass cooking stoves in the residential sector. In terms of the energy type, electricity will grow the fastest at 8.1%, followed by coal at 7.7%, and oil at 6.1%.

Electricity generation will increase to 70 terawatt hours (TWh) by 2040 from 17 TWh in 2015 at an average growth rate of 5.8% per year. Around 53% of the electricity generated will meet

the export target, particularly of Thailand. Hydropower sources will remain dominant in the country's power generation but with a declining share, accounting for around 77% in 2040 compared to 85% in 2015. The remaining share will be those of coal resources (22%) and other renewables (1%).

The total primary energy supply (TPES) will reach 13 million tons of oil equivalent (Mtoe) in 2040, increasing at an average rate of 4.4% per year from 2015. As a major supply for power generation, hydropower sources will increase at an average rate of 8.7% per year over the projection period. Coal will also have an important share in power generation as well as industry. Its growth rate will on average be 4.5% per year. Oil will grow at an average rate of 6.1% per year to meet particularly the fuel demand of road transport.

As a result, carbon dioxide (CO<sub>2</sub>) emissions of the BAU scenario in 2040 will be four times the 2015 level due to increases in coal consumption by industry and in power generation.

After the opening of the Hongsa coal-fired power plant, which uses domestic coal such as lignite, the import dependency of the Lao PDR has improved, but on the other hand, its CO<sub>2</sub> emissions have also increased. According to the BAU results, coal-fired power generation will increase by up to 22% of total power generation in 2040. Currently all electricity generated by the Hongsa power plant is exported to Thailand, so that if the Lao PDR stops the electricity export to Thailand, this CO<sub>2</sub> issue will be eliminated. But electricity to be generated by coal in 2040 will include some domestic use, so that CO<sub>2</sub> from coal-fired power generation in the future will be issued. The energy outlook results suggest a controversial issue of coal-fired power generation in the Lao PDR.

To avoid this issue, Energy Efficiency (EE) and Renewable Energy (RE) policies will be very important for the Lao PDR. According to the case studies, if the Lao PDR could achieve high EE targets, TFEC including electricity consumption will decrease 20% and CO<sub>2</sub> emissions will also reduce 15% compared to BAU. The promotion of EE will reduce coal demand in the industry sector and power generation through the reduction of electricity demand across the sectors as well as oil demand in the industry and transport sectors. If the Lao PDR could achieve high RE targets, CO<sub>2</sub> emissions will decrease 45% from the BAU scenario. This reduction will come from a decrease in coal-fired power generation as well as coal consumption (three times more due to thermal efficiency). The combination of EE and RE promotion policies will contribute to the mitigation of CO<sub>2</sub> emissions in the future.

The Lao PDR depends on the import of petroleum products from neighbouring countries such as Thailand. The main use of petroleum products are transport fuels such as gasoline, diesel oil, and jet fuel but the majority is gasoline and diesel oil. According to the energy outlook, the Lao PDR will still depend on petroleum products and its share to the TFEC will be more than 40% in 2040. One option for the Lao PDR to reduce the import of petroleum products such as gasoline and diesel oil will be the use of electric vehicles (EVs). If EVs use electricity from hydropower in the Lao PDR, the country will be able to reduce the import of gasoline and diesel oil as well as saving the outflow of the Lao PDR's national wealth. In addition, the

Lao PDR will also greatly reduce CO<sub>2</sub> emissions from a decrease in transport fuel consumption. But it is challenging for the Lao PDR because the investment needed in infrastructure to support EVs such as electricity charge stations will be huge. In addition, EVs need lots of additional electricity, so that the Lao PDR itself will have to construct hydropower plants for its own use. It will also need huge sums of money. In this regard, appropriate financial mechanisms provided by international financial institutions such as the World Bank, the Asia Development Bank, the Clean Development Mechanism, and the Joint Carbon Mechanism will be investigated.