

## Executive Summary

The Economic Research Institute for ASEAN and East Asia (ERIA) implemented the project ‘Feasibility Study on Transmission Highway in ACMECS (Ayeyawady-Chao Phraya-Mekong Economic Cooperation Strategy)’. The study aimed to carry out a cost–benefit analysis by utilising high-voltage cross-border interconnections for power trade. In this study, the concept of a high-voltage transmission network through ACMECS countries, called ‘Transmission Highway’, includes the cross-border interconnection and some domestic transmission lines in Thailand.

Presently, energy resources vary in ACMECS: huge hydro potential in the Lao PDR and Myanmar, large gas potential in Myanmar, and coal potential in Viet Nam. But the abundant resources, especially hydropower, are underutilised because ACMECS countries have no existing bulk transmission network covering their entire area. Some cross-border interconnections already exist in ACMECS. Most of them serve as dedicated transmission lines for power purchase agreements. Power trade is implemented mutually on a few cross-border interconnections, but their voltage is low and the transmission capacity is small. Thus, there is no 500 kV cross-border interconnection for mutual power trade.

The high-voltage transmission network can bring multiple benefits, including reduced fuel costs of thermal power generation, reduced CO<sub>2</sub> emission, improved electricity access, and the ability to consolidate higher shares of variable renewable energy.

This study focused on two main parts: cost estimation of the candidate cross-border interconnections and benefit analysis.

Selected as the Transmission Highway are six routes of cross-border interconnections and three routes of domestic transmission lines in Thailand. The voltage level and capacities of the candidate transmission lines were set based on the surge impedance loading and the amount of expected power trade. The total construction cost of the Transmission Highway is about US\$1,500 million.

The electric power trade to be transmitted from the Lao PDR through the candidate interconnections is expected to be from the increase in energy export volume from the domestic power grid of the Lao PDR and new export-dedicated independent power producers (IPPs) in the Lao PDR. In addition, the increase in power energy import from Thailand into the domestic power grid of the Lao PDR during the dry season is also expected. According to IRENA (2019, installing the hydropower plant in China has a unit cost of US\$1,264/kW, and that for installing the onshore wind power in China is US\$1,223/kW. Based on this price, the total installation cost of new IPPs is about US\$4,016 million.

Based on the expected power trade, this study carried out the benefit analysis. Power trade through cross-border interconnections can yield a lot of benefits. One is the fuel cost reduction of a thermal power plant. Fuel cost reductions for 25 years amount to US\$1,569 million in Thailand; US\$2,614 million in Viet Nam; US\$1,667 million in Myanmar; and US\$448 million in Cambodia. The total fuel cost reduction is expected to be US\$6,298 million.

The second benefit is a reduction in new investment of a thermal power plant. A new investment of US\$2,093 million with 1,504 MW of total thermal generation capacity can be reduced by power trade through the Transmission Highway.

The third benefit is reduced CO<sub>2</sub> emissions through decreased thermal power generation. This result is calculated as a social benefit. CO<sub>2</sub> emission reduction for 25 years totals 3 Mt-C in Thailand, 31 Mt-C in Viet Nam, 21 Mt-C in Myanmar, and 5 Mt-C in Cambodia. Total CO<sub>2</sub> emission reduction is expected to be 60 Mt-C. In addition, reduced thermal power generation yields the benefit of carbon pricing. No carbon pricing incentive exists in ACMECS countries. If carbon pricing incentive is introduced, we can expect carbon pricing benefits for 25 years of US\$46.2 million in Thailand; US\$1,984.1 million in Viet Nam; US\$1,294.1 million in Myanmar; and US\$365.7 million in Cambodia.

The fourth benefit, improved gross domestic product (GDP) through electricity access, is both social and economic. The electricity access ratios in Myanmar and Cambodia are still low. Thus, this study assumed that imported electricity reduces thermal power generation and improves electricity access in Myanmar and Cambodia. Using electricity imports from Thailand for electricity access will improve Myanmar's GDP by 0.7% in 2030 and 0.5% in 2035 and Cambodia's by 0.6% in 2030 and 0.3% in 2035, based on the ERIA's energy outlook report data (ERIA, 2019).

The fifth benefit is income from the wheeling charge. The study team roughly conducted a benefit analysis of wheeling charge, assuming a unit price of 1.0 cent/kWh for all candidate cross-border interconnections. The income from wheeling charge for 25 years in each candidate cross-border interconnection ranged from US\$446 million to US\$1,500 million. The total income from the wheeling charge is expected to be US\$5,545 million.

Based on these benefits, the study team analysed the financial internal rate of return (FIRR), economic internal rate of return (EIRR), and net present value (NPV) of the Transmission Highway. The FIRR is 15.9%. In the case of a discount rate of 8%, the estimated results for the Transmission Highway are an NPV of US\$859 million and a payback period of 8.9 years. For a discount rate of 10%, the results are an NPV of US\$557 million and a payback period of 10.1 years. The FIRR is higher than Myanmar's long-term interest rate (9.5%). Furthermore, the EIRR is 13.9%. For a discount rate of 8%, the estimated results for the Transmission Highway are an NPV of US\$2,170 million and a payback period of 9.9 years. For a 10% discount rate, the NPV is US\$1,249 million and with a payback period of 11.9 years. The EIRR is also higher than 9% of the standard adopted by the Asian Development Bank (ADB). From these results, the Transmission Highway is financially and economically feasible.

Through this study, the Transmission Highway greatly benefits ACMECS countries. Multilateral power trade should be realised in the Association of Southeast Asian Nations (ASEAN) region to maximise such benefits. The ASEAN Power Grid (APG) aims to expand power trade gradually and ultimately achieve a total integrated Southeast Asia power grid system. Multilateral power trade is envisioned to take place in three subregions. In this stage, the subregion closest to the realisation of multilateral power trade amongst these three regions is the northern part, ACMECS. ACMECS countries have been discussing multilateral power trade within the framework of the Greater Mekong Subregion (GMS) for many years, and they have accumulated knowledge. In addition, the Lao PDR and Thailand are included in the Laos-Thailand-Malaysia-Singapore Power Integration Project (LTMS-PIP) framework. Based on this experience, ACMECS as a pioneer will develop multilateral power trade on a subregional basis. The knowledge gained in ACMECS will be expanded to other subregions, the best way to realise the APG. After multilateral power trade is realised in the three subregions, it is expected to be developed throughout ASEAN as the APG. This study aims in that direction.