

## Preface

According to the East Asia Summit energy outlook being updated by the Economic Research Institute for ASEAN and East Asia (ERIA), the Association of Southeast Asian Nations (ASEAN) will continue to depend on fossil fuels, coal, and gas for power generation and oil for transport. Their ratio to total primary energy supply in 2050 is 87% in a business-as-usual scenario and 82% in an alternative policy scenario, resulting from aggressive energy efficiency and conservation promotion and renewable energy deployment policies. Many countries, including in ASEAN, that participated in the 2021 United Nations Climate Change Conference (COP26) in Glasgow, United Kingdom, 31 October–13 November 2021, announced their carbon-neutral scenarios until 2050 or 2060. ASEAN countries, however, might not easily achieve carbon neutrality because (i) they will continuously increase energy consumption to catch up economically with Organisation for Economic Co-operation and Development countries, and (ii) variable renewable energy such as solar and/or wind is not suitable because the ASEAN region has only two seasons – dry and rainy – and few areas where wind speed is stable. Variable renewable energy will not, ultimately, achieve carbon neutrality in the region. ERIA, in collaboration with the Institute for Energy Economics, Japan, must, therefore, seek carbon-neutral pathways for ASEAN countries by applying an optimisation approach, which is a linear programming model, to choose low- or zero-emission technologies under a carbon dioxide (CO<sub>2</sub>) emission constraint and cost minimum objective function. Innovative energy technologies, including hydrogen, ammonia, carbon capture utilisation and storage, and direct air capture and biomass energy with CO<sub>2</sub> capture and storage, will be added to conventional low-emission energy technologies, which include energy efficiency and conservation, hydropower, geothermal, nuclear power, and biomass, in the transition period. ASEAN countries vary in economic development, energy resource potential, land and population size, and such diversity must be respected. Each ASEAN country will pursue its own carbon-neutral pathway.

The model represents a long-term energy transition from 2020 to 2050 or 2060 and analyses the relationship between energy consumption and CO<sub>2</sub> emissions (energy technology cost or marginal abatement cost). The cost of energy technology will be extremely high for ASEAN countries, which will need to resort to international financing mechanisms such as Asia

Energy Transition Finance promoted by the Ministry of Economic, Trade and Industry, Japan.

I hope this report will help ASEAN countries forge their own carbon-neutral pathways.

A handwritten signature in black ink, appearing to read 'H. Nishimura'.

Professor Hidetoshi Nishimura

President

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## Acknowledgement

The publication was developed by a working team comprising two energy institutes: (i) the Economic Research Institute for ASEAN's East Asia Energy Unit, whose researchers are familiar with the energy situation of Association of Southeast Asian Nations (ASEAN) countries; and (ii) the Institute for Energy Economics, Japan, whose researchers have expertise on optimisation approaches and energy technologies. A working group consisting of energy policymakers of all ASEAN countries was formed to comment on the carbon-neutral scenarios produced by the working team, using the optimisation model.

We thank the working group members for their great contributions to the ASEAN carbon-neutral scenarios towards 2050 or 2060 produced by the working team. We appreciate the strong support from Takeshi Soda, director of the Oil and Gas Division, Agency of Natural Resources and Energy, Ministry of Economic, Trade and Industry, Japan.

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