Energy

1. Energy Outlook and Analysis of Energy Saving Potential in the East Asia Region – COVID-19 Impacts on Energy Demand and Energy-Saving Potential in East Asia, 2021

The Association of Southeast Asian Nations (ASEAN) and East Asia faces tremendous challenges in navigating the future energy landscape and in determining how the energy transition will embrace new architectures, including sound policy and technologies, to ensure access to energy that is affordable, secure, and sustainable. The East Asia Summit (EAS) economies have been hit hard by the coronavirus (COVID-19) pandemic, but energy demand growth is expected to bounce back strongly as the economies recover after 2022. All decisions and energy policy measures will need to be weighed against potentially higher energy costs and security risks in the post–COVID-19 era.

Applying East Asia Summit (EAS) energy outlook models to the 17 EAS countries (EAS17), the report analyses COVID-19's impact on industry, transport, and commercial and residential sectors' final energy consumption, focusing on the relationship between economic growth and energy consumption. The negative impacts of COVID-19 – lockdowns, work from home, disruption of industrial supply chains – are reflected in economic growth rates.

The special project report was published as ERIA Research Project Report in December 2022.

2. Decarbonisation of ASEAN Energy Systems Towards Net-Zero Emission Scenarios

ERIA and IEEJ are elaborating long-term net-zero emission scenarios for the energy systems of the 10 ASEAN Member States (AMS). A linear programming model that simulates the cost-optimal deployment of energy technologies under technical constraints is used for that purpose. The model encompasses the total energy system including energy transformation and all end-use energy service demand sectors in AMS. The work comprises of modelling and consultations with each of the AMS' energy ministry.

Policy Implications: The study will provide net-zero emission scenarios that the can use as inputs to develop their long-term energy system plans to achieve their net-zero emission or carbon neutrality pledges.

During the United Nations Climate Change Conference (COP26) in Glasgow, United Kingdom, many countries committed to achieving carbon neutrality by 2050 or 2060. ASEAN countries will find it very challenging to achieve carbon neutrality as: (i) ASEAN countries depend largely on fossil fuels, coal, and gas for power generation and oil for transport; (ii) ASEAN countries will continue to increase energy consumption to catch up economically with OECD countries, and (iii) variable renewable energy such as solar and wind is not suitable for use in ASEAN countries as the ASEAN region has basically two seasons – dry and rainy – and few areas where wind speed is stable. Variable renewable energy will not, therefore, ultimately contribute

to achieving carbon neutrality in the region. To help ASEAN countries achieve carbon neutrality, ERIA, in collaboration with the Institute for Energy Economics, Japan, has been seeking carbon-neutral pathways for ASEAN countries by applying an optimisation approach, i.e. a linear programming model, to choose low- or zero-emission technologies under a carbon dioxide (CO_2) emission constraint and cost minimisation objective function. Installation of zero-emission energy technologies – hydrogen/ammonia, carbon capture utilisation and storage (CCUS), direct air capture (DAC), and biomass energy with CO_2 capture and storage (CCS) – will show ASEAN countries pathways to achieving carbon neutrality, but they will incur a high marginal abatement cost (MAC) by 2050. Hence, innovation in energy technologies will be essential to lower MAC levels. An estimation of the amount of carbon offset by forests will be another important element in trying to achieve net zero emissions in the ASEAN region.

The results of this project were published as ERIA Research Project Report no.11 in July 2022.

3. Revisiting Electricity Market Reforms – Lessons for ASEAN and East Asia

The project combines the fundamentals of industrial organisation theories based on microeconomic foundations, applied econometrics, and environmental and natural resource economics in undertaking a comprehensive review of reforms of the power sector and its impact on industrial and socio-economic performance. The book provides the intellectual groundwork necessary for understanding the workings and interactions of today's reforming power markets such as in ASEAN and East Asia that are striving to achieve the energy policy trilemma of affordability, energy sustainability, and energy security. The topics addressed in this book include application of welfare theorems such as competition in energy markets, market failures such as lack of electricity access, analysis of forecasting models under volatility, energy resource allocation such as renewable energy, and competitive designs of energy markets. Country-specific and regional case studies are used to analyse the progress and outcomes of market-driven electricity reforms across the reforming and advanced electricity markets. Therefore, the book derives policy lessons and provides policy recommendations in reforming power markets for ASEAN and East Asia, taking stock of more than 3 decades of global experience with power sector reforms. The electricity markets case studies are carefully chosen and supported by extensive data analyses as appropriate. The energy economics and policy book are highly recommended to readers who seek an in-depth and up-to-date integrated overview about the evolving literature and status on electricity market reforms with a particular reference to Asia.

Policy Implications:

1. Energy policy reforms for free electricity market competition.
2. Step-by-step approaches to free electricity market.
3. Impacts of liquefied natural gas pricing mechanisms on the energy mix in ASEAN.
4. Electricity market reforms to accelerate development of renewables and clean energy.

The report of this project was co-published as a book with Springer in September 2022. It was edited by Han Phoumin, Rabindra Nepal, Fukunari Kimura, Gazi Salah Uddin, and Farhad Taghizadeh-Hesary.

4. Small Modular Nuclear Reactor Deployment

Small modular reactors (SMRs) are nuclear fission reactors smaller than conventional reactors. They can be manufactured at a plant and brought to and installed at site. SMRs allow less on-site construction, increased containment efficiency, and enhanced safety due to passive nuclear safety features and thus have been proposed as a way to bypass financial and safety barriers that have inhibited the construction of large conventional nuclear reactors in recent decades. This interest in SMRs is driven by a desire to reduce the impact of capital costs and provide power away from large grid systems. The study examines the applicability of SMRs in the context of the Association of Southeast Asian Nations (ASEAN). Since small reactors are envisaged as replacing fossil fuel plants in many advanced countries, the study reviews the market conditions and licensing requirements in those countries and the regulatory and safety imperatives needed in developing economies for the commercial deployment of SMRs.

The study also investigates international cooperation between the SMR-producing countries and potential newcomer countries in the fields of nuclear energy planning, conduct of feasibility studies, and new low-carbon infrastructure development.

Policy Implications:

1. Develop attractive business environments for SMR vendors and investors in energy-deficit countries.
2. Improve infrastructure provisions including regulations necessary for the deployment of SMRs.
3. Conduct open discussions on international cooperation in the countries about the future utilisation of nuclear energy, including SMRs.

The report of this project was published as ERIA Research Project no.10 in September 2022, titled: Small Modular Reactor (SMR) Deployment: Advantages and Opportunities for ASEAN.

5. Analysis of East Asia Summit (EAS) Future Mobility Fuel Scenario Considering the Sustainable Use of Biofuels and Other Alternative Vehicle Fuels

Greater efforts than ever before are being made to decarbonise transport in the Association of Southeast Asian Nations (ASEAN) and East Asia Summit (EAS) countries. With a quarter of total carbon dioxide (CO_2) emissions coming from transport energy use, three options can reduce emissions: reduce transport energy demand, improve vehicle fuel efficiency, and replace mobility fuel with low-carbon approaches such as use of biofuel and electricity. The report analyses the future scenario of mobility in selected EAS countries, which strongly contributes to the Sustainable Development Goals (SDGs) and considers the necessary balance between CO_2 reduction in transport, biofuel use, and mineral resource demand stimulated by electrification of vehicles. The policies and strategies for biofuels and mobility electrification are examined and the existing research on sustainable use of biofuels documented. Databases are created to evaluate the availability of mineral resources such as neodymium and cobalt as well as the potentials of reducing carbon emission of biofuel in India, Indonesia, Malaysia, the Philippines, and Thailand.

Policy Implications:

1. A combination of electrical vehicle introduction and biofuel utilisation is the most effective in reducing oil consumption and CO_2 emission. Electric vehicle penetration has a positive effect on promoting the use of biofuel in supporting agriculture.

2. Whilst electrical vehicle promotion will contribute mainly to gasoline reduction, the imbalance between gasoline and diesel fuel consumption remains an issue in Thailand since diesel fuel consumption is much higher than gasoline consumption. Hence, reducing diesel fuel consumption should be prioritised through an appropriate blend of biodiesel.
3. Effects of the introduction of biofuel to oil consumption and/or reduction of CO_2 emission are limited to new vehicles.

Reducing greenhouse gas (GHG) emissions in the transport sector is now attracting attention worldwide. To meet the Paris Agreement 2030 targets, East Asia Summit (EAS) countries have been making great efforts to introduce biofuels on a large scale and electrified vehicles (xEVs) as well. This report presents the results of future scenario analysis of EAS mobility, which greatly contributes to the Sustainable Development Goals (SDGs) in view of the balance between transport CO_2 reduction, biofuel use, and mineral resources demand.

It provides evaluation results of 'well-to-wheel' CO_2 emissions and reductions for producing and using biofuels, and for implementing xEVs based on the policies of six countries – Indonesia, Malaysia, Philippines, Thailand, Viet Nam, and India. Moreover, future demand for mineral resources such as neodymium (for permanent magnet motors) and cobalt (for lithium-ion batteries) was estimated considering those countries' mobility electrification.

The report of this project was published as ERIA Research no.16 in November 2022.

6. Pathways for Developing Countries to Achieve Carbon Neutrality

The G20 Rome Leaders' Declaration recognises the critical relevance of achieving global net zero greenhouse gas emissions by mid-century through acceleration of mitigation, adaptation, and finance activities. The Conference of the Parties (COP) 26 also reaffirms the long-term global goal to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels which requires rapid, deep, and sustained reductions in global greenhouse gas emissions and to net zero around mid-century. By focussing on developing countries of the Association of Southeast Asian Nations (ASEAN), this policy brief aims to provide developing countries in general with several pathways to achieve carbon neutrality and to recommend appropriate assistance and co-operation that can be expected from the Organisation for Economic Co-operation and Development (OECD) countries. This research will address four essential points: (i) the advantages of the ASEAN region in terms of its biomass richness, (ii) the potential for energy connectivity within the region, (iii) the adoption of new technologies such as carbon capture, use, and storage (CCUS) and new energy sources or carriers such as hydrogen and ammonia, and (iv) the relationship between decarbonisation and the economy. Deepened insights on the indicative pathways and research points will be derived by organising linking these research activities with those of the G20 Energy Transition Working Group (ETWG). The research team also intends to deliver its findings at the 40th ASEAN Ministers on Energy Meeting in September 2022.

The pillar of G20 Indonesia Presidency 2022 Energy Transition is 'Global Cleaner Energy Systems and Just Transitions', that aims at 'achieving global deal to accelerate energy transition'. G20 Indonesia Presidency defines its pathway to achieve carbon neutrality by endorsing international collaboration to accelerate

the reduction of energy-related greenhouse gas emissions through various decarbonisation methods. Accelerating the process of decarbonisation through international collaboration is the knowledge gap that is be being closed by this policy brief through its focus on the carbon neutral pathways for the developing countries whilst considering co-operation potential with the developed economies.

As carbon dioxide emission reductions become increasingly urgent to counter climate change, many nations have announced net-zero emissions targets. Achieving a net-zero economy will require the decarbonisation of electricity generation, massive expansion of low-carbon energy systems, and investment in net-zero-carbon technologies. These adjustments must consider the existing energy, economic, and social development imperatives of advanced and developing countries, while encouraging regional cooperation. This brief assesses energy transition challenges for the Association of Southeast Asian Nations and the Gulf Cooperation Council (GCC), and proposes new policy pathways towards an inclusive global net-zero economy.

The results of this project were published as an ERIA T20 Policy Brief and can be accessed both on the ERIA website and on the T20 website.

7. Policies and Infrastructure Development for the Wider Penetration of Electric Vehicles (EVs) in ASEAN Countries

The study conducts both quantitative and qualitative analysis with the focus on five ASEAN countries – Brunei Darussalam, Indonesia, Malaysia, Thailand, and Viet Nam. The proposed methodology consists of five elements: (i) an analysis of current policies and regulations aimed at wider diffusion of EVs in those ASEAN countries, EV enablers (such as policies, regulation, production basis, financing, and human resources) in relation to ownership, manufacturing, and development of charging infrastructure; (ii) an impact assessment of EV deployment on energy savings and CO_2 emissions reduction; and (iii) an analysis of the Total Cost of Ownership (TCO) for passenger vehicles, buses, trucks, and bikes from the use of EVs, and compare it with that of ICEVs, HEVs, and PHEVs. Finally, the study will elaborate on recommendations for ASEAN countries to formulate necessary policies to achieve wider diffusion of EVs, to develop infrastructure, and to coordinate EV batteries manufacturing supply chain.

Policy Implications:
The study provides ASEAN Member States, especially their Ministries of energy with a set of policy recommendations that could serve as an important input to formulate policy measures and strategies to achieve wider diffusion of electric vehicles.

The results of this projects were published as an ERIA Research Project Report in March 2023. This report provides well-to-wheel CO_2 emissions from the electrification of the transport sector, and identifies the strengths, weaknesses, opportunities, and threats (SWOT) for selected Association of Southeast Asian Nations (ASEAN) countries – Indonesia, Thailand, Malaysia, Viet Nam, and Brunei Darussalam. It also contains analysis of passenger vehicles' total cost of ownership for internal combustion engine vehicles, hybrid electric vehicles, plug-in hybrid electric vehicles, and battery electric vehicles. The report explores the tipping point for battery electric vehicles to become cost-competitive vis-à-vis internal combustion engine vehicles, for passenger vehicles, buses/trucks, and motorcycles. Finally, the report provides a set of recommendations for the different ASEAN countries concerning the choice of transport modes where electrification should be given priority and the policies needed in relation to countries' ambitions, such as Indonesia's and Thailand's goal of becoming EV production hubs in ASEAN.