

Energy Related Project



1. Evaluation of CO₂ Emission Reduction by Alternative Biofuel Introduction in East Asia Summit Countries

The East Asia Summit (EAS) region's fleet of light-duty vehicles is set to increase massively from about 850 million passenger cars in 2015 to over 1.5 billion by 2050. To meet the expanding energy demand in transportation, energy resources should shift from imported fossil fuels to renewable ones produced in East Asian countries. This study assesses production, trade, supply, and utilisation of transportation energy from biofuels according to (i) a potential study of diversified transportation energy mix, (ii) research on next-generation biofuels, and (iii) bio-methanol as an energy carrier. The study discusses

strategies of transport fuel, which makes up 23% of energy-related emissions. A combination of in-depth scenario analysis and country-level feasibility studies on next-generation fuels was carried out in India, Indonesia, and Thailand. An integrated report was prepared and submitted to the Energy Ministerial Meeting.

Policy Implications:

- A combination of electrical vehicle introduction and biofuel utilisation is the most effective in reducing oil consumption and CO₂ emission. Electric vehicle penetration has a positive effect on promoting the use of biofuel in supporting agriculture.

- 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.
- Effects of biofuel introduction on oil consumption and/or CO₂ emission reduction are limited to new vehicles.

The report was published on 11 November 2020.

2. Nuclear Safety and Effective Use

This study is a qualitative policy analysis of challenges to safety culture and security culture in advanced economies of Europe and the United States (US) and major economies in Asia, aimed at strengthening both cultures. The study analyses lessons, including strengths and limitations, that can be derived from advanced countries, given the long history of nuclear energy in the United Kingdom (UK), France, the US, India, the Republic of Korea, China, and Japan. The study will identify and examine the best practices in boosting nuclear security culture and their relevance for Southeast Asia. It is designed to accentuate the important role of the state as the regulator in adopting policy and regulatory frameworks and in institutionalising nuclear education and training programmes to deepen safety and security cultures. Policy Implications: It is important to develop, through international cooperation, the scientific, technological, and legal bases required for a safe,

environmentally friendly, and economical use of nuclear energy.

Authoritative assessments must be provided, and common understanding forged on key safety issues as input for government decisions on nuclear energy policy and for broader integrated industry analyses in areas such as energy and sustainable development.

Best practices in and challenges to developing a nuclear safety culture and security culture are being examined using three frameworks of analysis: (i) a comprehensive nuclear safety policy framework, (ii) a proactive and independent regulatory body, and (iii) holistic nuclear education and training programmes. The study is based on the hypothesis that states interested in harnessing nuclear energy must develop a comprehensive policy framework on developing safety and security cultures, a proactive regulatory body, and holistic nuclear training programmes that cover both technical and human factors. Such measures are crucial in mitigating human errors that may lead to radiological accidents and nuclear security crises. Key lessons from overseas as best practices and challenges can inform policy recommendations for Southeast Asia in enhancing safety and security cultures.

The report published in September 2020 stated that no industry is immune from accidents. In relation to nuclear power, safe use focuses on unintended conditions or events leading to radiological releases from authorised activities. A fundamental principle of nuclear power plant operation worldwide is that the operator is responsible for basic safety. This is facilitated first by the national regulator who is

responsible for ensuring the plants are operated safely by the operator. The second important safety principle is that safety regulations are meant to protect people and the environment, and regulations are made on sound technical grounds, taking into consideration the operation costs and benefits. Third, there are international standards for designing nuclear power plants and certification of its reactors with several sets of codes and standards related to safety. In this context, this report investigates the design and operational concepts of nuclear power plants to minimise the likelihood of accidents, or their consequences. The international analysis show that an optimum tolerable level of safety is feasible by applying an integrated deterministic method that incorporates the concept of probabilistic risk assessment. It concludes that safety is to be judged based on whether residual risks are within the tolerable range, which could also be regarded as the safety goal to be set by the regulators.

3. Energy Outlooks and Energy Saving Potential in East Asia Region

This project uses the national energy balance tables of 17 East Asia Summit (EAS) countries to estimate energy demand formulas. Using the newly estimated formulas, the EAS energy outlook and saving potentials are updated from 2017 to 2050. Based on the business-as-usual scenario and the alternative policy scenario, energy saving potentials are updated, and the scenario of large penetration of hydrogen is added. Policy Implications: Energy efficiency and renewable energy policies are aimed to improve energy intensity in the EAS region but are not designed to address CO₂ emission until 2050.

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ERIA published this project as a book on 29 January 2021, continuing the series of books on this project since 2016. This year the ERIA–EAS Energy Outlook was updated in 2019–2020 based on a revision of macro assumptions, such as economic and population growth as well as lower crude oil prices. The latest outlook also incorporates more recent information on the EAS17 member countries' energy-saving goals and action plans, and power development plans such as those regarding renewable electricity. The EAS17 Outlook 2020 includes an estimation of the investment cost required for power generation and the whole energy infrastructure, including liquefied natural gas (LNG) receiving terminals and oil refineries. The outlook again focuses on analysing the additional energy savings that might be achieved by the individual countries above and beyond the Business-as-Usual scenario (BAU) projection. It continues to examine two scenarios – BAU and the Alternative Policy Scenario (APS) – and predicts energy supply, consumption, and CO₂ emissions from 2017 up until 2050. The APS includes not only more ambitious energy-saving targets but also rapid advances in low-carbon energy technologies, especially renewable energy. The outlook also assesses the Intended Nationally Determined Contributions (INDC)/NDC reported by EAS17 countries. Energy supply security has become

a top priority energy issue for the EAS17 region. Implementing Energy Efficiency and Conservation measures and increasing renewable energy shares will certainly contribute to maintaining regional energy security through a reduction of imported fossil fuel consumption and an increase in the use of domestic energy. Regional energy networks, such as the Trans-ASEAN Gas Pipeline and the ASEAN Power Grid, and oil stockpiling are recommended to be set up and their use accelerated to maintain energy supply security. Nuclear power generation always remains one of the energy options for securing the region's energy supply.

4. Seeking for Feasible Solutions on Delivering LNG to Mid-sized and Large Islands in Indonesia

Indonesia has many islands that depend on diesel generators for electricity supply. Although the diesel generator is a well-established technology and is easy to maintain, its relatively high generation cost and high gas emission are a disadvantage. Liquefied natural gas (LNG) costs less and emits less CO₂ than diesel. Until recently, LNG's high cost and extremely low-temperature characteristic kept many countries from using it. However, technological development, particularly floating storage and re-gasification, has largely reduced such obstacles. Indonesia's large islands can enjoy LNG's economic and environmental benefits by adopting such technologies for power generation. The study assesses the opportunities by identifying possible configurations of small-scale LNG supply chains for power generation to contribute to Indonesia's development through stable, affordable, and sustainable supply of electricity. The study is

consistent with the strategic theme defined in the ASEAN Economic Community Blueprint 2025 and phase 1 of its subordinate paper, the ASEAN Plan of Action for Energy Cooperation (APAEC) 2016–2025. The study aims to contribute to regional energy policy and planning and the ASEAN Council on Petroleum framework.

The report, published on 29 January 2021, states that Indonesia's electricity demand will increase significantly, by about 4.5 times, from 2015 to 2040, according to the 2018 edition of the ERIA–EAS Energy Outlook under the business-as-usual scenario. This increase will be realised not only by big cities such as Jakarta and Surabaya but also on Indonesia's small and mid-sized islands. As Indonesia is also rich in coal and natural gas, given the global challenges posed by climate change, natural gas will become an increasingly interesting source of power generation for Indonesia. This study focuses on the eastern part of Indonesia, which is made up of Sulawesi and West Papua, and several groups of very diverse smaller islands. The report proposes a strategy for delivering small-scale LNG carrier vessels from LNG production sites to LNG power generation plants in Eastern Indonesia based on a personal computer-based dynamic simulation model. According to projected LNG demand at LNG power plants, forecast based on electricity demand at each demand site in Eastern Indonesia, the model seeks feasible solutions for delivering LNG from the origin to a destination using a computer simulation approach. The major outcomes of the dynamic simulation model are the necessary number of LNG ships, the maximum capacity of LNG receiving tanks and their costs, consisting of capital and operating costs. Several implications regarding LNG policies for Indonesia were presented.

5. Energy Efficiency Indicators for Mongolia

The Mongolian Energy Economics Institute conducted a detailed energy consumption survey on the industry, transport, residential, and commercial sectors in Mongolia to produce energy efficiency indicators. This first-time survey produced improvement points for the next survey. Policy Implications: As Mongolia's energy efficiency indicators are poor compared with that of OECD countries, more aggressive EEC policies are needed, especially in applying standard and labelling systems for appliances and the green building index approach in the residential and commercial sectors.

The report published on 22 January 2021 concluded that energy efficiency indicators (EELs) are different from energy intensities defined by energy consumption as a share of gross domestic product (GDP). Usually energy intensity is calculated as total primary energy supply (TPES)/GDP or total final energy consumption (TFEC)/GDP; it basically shows the energy performance nationwide and the result of socio-economic activities in a year. The energy intensities never suggest appropriate energy efficiency policies and action plans. Thus, we need EELs to plan appropriate energy efficiency and conservation (EEC) activities.

All energy is finally consumed by final users – industry, transport, commercial, and residential sectors. The agriculture, forest, and fishery sectors consume energy for their production activities but their energy consumption is very small compared with the four sectors mentioned above. In addition, an electricity-generation sector as a typical transformation sector consumes fossil fuels, such as coal, to generate electricity.

For transport, since the road transport sector is generally dominant in terms of fuel consumption, such as gasoline and diesel oil, we get the overall or national average of fuel economy defined as litre/100 km by each type of vehicle – car (mainly sedan), bus, and truck – as the EEL of the road transport sector. If we increase the number of more efficient cars, such as those with small internal combustion engines and hybrid cars, the EEL of the road sector surely improves.

The EELs of the residential and commercial sectors are defined as energy consumption (toe or kWh) as a share of floor area (m²). In addition, what kinds of energy are consumed for what purpose, and how electricity is consumed for what purpose (heating spaces, lighting, refrigerators, etc.) are important feedback from the survey. To get indicative EELs for each final sector, the Mongolian Energy Economics Institute (MMEI), with support from the Economic Research Institute for ASEAN and East Asia (ERIA), conducted a detailed energy consumption survey in the whole of Mongolia in 2019.

To evaluate the EELs of Mongolia, we need certain knowledge to analyse the relation between energy consumption, economic growth, industrial transition, and change of lifestyle. In addition, an international comparison of the EELs is also a good way to evaluate them. But these EELs are not well produced globally and we can refer only to the indicators of the Organisation for Economic Co-operation and Development. Through this project, the MEEI obtained its first experience and the technical skill for producing and assessing EELs. The EELs will change from year to year due to changes in social behaviour, economic growth, lifestyle, and

technology development. In this light, the MEEI should continue to produce EEIs every 3 to 5 years to reflect or improve current EEC 75 policies and action plans with greater effectiveness and that generate more economic benefits. ERIA would like to continuously support the MEEI technically to promote EEC in Mongolia.

6. Development of Energy Outlook Model for Myanmar

Forecasting future energy supply and demand is essential for policymaking on energy affairs. Case studies adding to business-as-usual scenarios as a baseline energy outlook, which include several scenarios such as promotion of energy efficiency and conservation, renewable energy, and reduction of CO₂, provide many energy policy options for the future. As Myanmar does not have a national energy outlook yet, the Ministry of Electricity and Energy has requested the Economic Research Institute for ASEAN and East Asia (ERIA) to help develop a national energy outlook model and sustainable energy development plan.

The project's purpose is to strengthen the capacity of the Ministry of Electricity and Energy and enable it to employ advanced techniques, methodologies, and modelling tools for the development, operation, and analysis of energy outlooks in Myanmar. The project will also enable the Ministry to establish and manage energy outlook modelling. Through this project, Myanmar is expected to establish an energy outlook modelling system that includes data preparation, understanding of an econometric approach and software tools, estimation of energy demand formulas, and simulation modelling for sustainable energy planning.

The report was published on 18 May 2020. To help Myanmar analyse the future energy demand and supply situation, the Economic Research Institute for ASEAN and East Asia (ERIA) has continued to support the Oil and Gas Planning Department (OGPD), Ministry of Electricity and Energy (MOEE) to produce the Myanmar Energy Outlook 2040 based on the Myanmar Energy Statistics 2019. ERIA has provided training on an econometrics approach to OGPD, MOEE staff members.

This approach consists of two parts: (i) estimation of energy demand formulas applying the ordinary least squares method using Myanmar Energy Statistics 2019, and (ii) development of future simulation models that forecast energy balance tables up to 2040 under several macro assumptions such as growth rates of gross domestic product (GDP) and population.

Myanmar's total final energy consumption (TFEC) (by industry, transport, commercial buildings, and residences) is forecast to increase by 3.0% per year on average up until 2040. Oil is projected to increase by 4.9% per year and electricity by 7.0% on average up until 2040.

Total primary energy supply (TPES) is forecast to increase by an average 3.5% per year up until 2040. The main imported fuel is oil, but by 2040 all fossil fuels will depend on imports because domestic production will decline. As a result, current import dependency (14% in 2016) is forecast to increase to 49%. As Myanmar's energy supply security will be vulnerable, the following policies are recommended: (i) prioritisation of an energy efficiency and conservation policy,

especially to mitigate electricity consumption mainly in commercial buildings; (ii) focusing on shifting from natural gas power generation to coal, using domestic coal and applying clean coal technology; (iii) promoting an increase in the use of biomass especially in rural areas with an efficient biomass cooking stove; and (iv), pushing the use of hydropower (especially during the rainy season) and solar/PV power (in the dry season), which can complement each other.

7. Study on the Biomass and Coal Co-Combustion in ASEAN (Phase II)

Biomass utilisation is an important issue for ASEAN Member States (AMS), where agriculture and forest industry remain crucial. Most biomass residues are treated as waste and either incinerated or sent to landfill, practices which may cause environmental degradation if continued. This waste, which varies in type, grade, and characteristic, is sufficient in quantity for co-combustion with coal. Biomass is expected to be one of the most promising renewable fuels for CO₂ emission reduction and for rural electrification, which is crucial for rural development. Phase I of the study highlighted the interest of AMS in biomass utilisation and co-combustion to improve renewable energy development and reduce CO₂ emission. Phase II will identify measures AMS may use to facilitate biomass utilisation focusing on co-combustion.

The report was published on 31 March 2021. The study suggests policy measures for AMS to achieve an appropriate biomass mixing rate with coal for co-combustion in power generation – a strategy that will help to abate emissions.

8. Study on Supply and Demand Potential of Hydrogen: Phase 2

Phase 2 of the study focuses on a review of hydrogen demand of fuel-cell vehicles and power generation up to 2040, the cost of hydrogen production, the cost of long-distance transportation of hydrogen, the application of methylcyclohexane and liquefaction technologies, and the search for breakthrough technologies that will reduce the costs of hydrogen production and transportation. Policy Implications: To reduce the cost of hydrogen, ramping up its production is recommended. Breakthrough technologies to reduce hydrogen production and transportation costs are examined through existing demonstration projects.

Throughout fiscal year 2019–2020 ERIA conducted the phase 2 study on hydrogen demand and supply potential in the East Asia Summit (EAS) region. The report was published on 31 December 2020. The study included: a) a review of future hydrogen demand through interviews with experts on fuel cell electric vehicles and hydrogen power generation; b) an introduction to Japan's hydrogen demonstration project being implemented in the southern part of Australia; c) holding workshops to introduce the outcomes of phase 1 and phase 2 of ERIA's hydrogen study; and d) setting up of a EAS hydrogen working group to discuss national hydrogen policies, setting up Japan's hydrogen demonstration projects being implemented in Australia and Brunei Darussalam, and creating a hydrogen supply chain. The phase 2 study also assessed how to reduce hydrogen supply cost through chemical and liquefaction processes. The hydrogen potential phase 2 study highlighted the following results: 1) Hydrogen demand to be used

for gas power generation (mixing hydrogen and gas) will be essential; 2) The cost of liquid hydrogen is expected to fall as much as liquefied natural gas; 3) Raising demand for hydrogen will be key to reducing hydrogen supply cost; and 4) Common understanding of hydrogen as zero carbon energy in future needs to be increased.

9. Temburong Eco Town Study Phase 4: Energy Efficiency Buildings and Clean Electricity Supply

This study focuses on the preparation of energy efficiency guidelines for new commercial buildings, clean electricity supply, and a clean transport system in Temburong Eco Town in Brunei Darussalam. The study emphasises the basic concepts of the Temburong Eco Town Master Plan: living laboratory, living tourism, and carbon neutrality. Main outcomes: Guidelines to build energy-efficient buildings in Temburong district, and advanced smart-grid technologies that support clean electricity supply and clean transport system.

The report published on 5 February 2021 states that Temburong district is famous for its rich nature and has become more attractive because of easy access from Bandar Seri Begawan since completion of the Temburong Bridge. If it is developed into an ecotown or smart city, Temburong will become one of the best examples of an ecotown or smart city in the ASEAN. The research study of the project conducted in 2019–2020 focused on concrete and applicable aspects to support Temburong's ecotown development – (i) preparation of energy efficiency and conservation guidelines for commercial buildings (both new buildings

and retrofiting) in Temburong district; (ii) clean electricity supply to Temburong district through applying smart-grid technology; and (iii) a proposal for a smart transport system. An overall road map for the development of an ecotown in Temburong district was also included. ERIA hopes the Ministry of Energy of Brunei Darussalam will initiate development of an ecotown in Temburong District with the collaboration of the Temburong District Development Authority (AKDT) and makes use of this report.

10. The Influence on Energy and Economy by Electrified Vehicles Penetration in ASEAN

ASEAN countries have policies to promote electric vehicles (xEVs). Such vehicles reduce oil consumption and air pollution but increase demand for electricity. However, depending on its power generation sector, a country might not be ready to achieve energy self-sufficiency or solve its environmental problems. Policy Implications: The results of the study will allow ASEAN governments to set their objectives on adopting electric vehicle technologies and to formulate policies to attain those objectives.

The report published on 4 November 2020 stating study analysed the effects of electric vehicle deployment in Indonesia, Malaysia, Thailand, and Viet Nam especially in terms of energy supply and demand, CO₂ emissions, the macroeconomy, and employment. The study points out that introducing electric vehicles into ASEAN countries would fulfil various policy purposes, but their massive deployment might have negative economic side effects. The study presents four recommendations.

Research

First, it is important to decarbonise the power supply along with the penetration of electric vehicles. Second, it is important to estimate the cost-effectiveness of subsidies with respect to the amount of CO₂ reduction. Third, it is important to pay attention to the ripple effects of electric vehicles. The production of battery electric vehicles with a small number of material parts may reduce

employment in the automotive industry compared to producing internal combustion engines and hybrid electric vehicles. Promoting e-motorcycles may stimulate job creation if the savings on fuel expenditure can be diverted into other goods and services. Finally, it is important to consider appropriate country-specific pathways to vehicle electrification.

Healthcare Unit



During fiscal year (FY) 2020, ERIA's Healthcare Unit published three books and two research project reports, one of them 'Ageing and Health in Viet Nam', which reports the result of the baseline survey of the Longitudinal Study of Ageing and Health in Viet Nam or LSAHV. To launch this report, ERIA

co-organised an ASEAN-wide workshop in Ha Noi in November 2020 to discuss population ageing in the region, together with the Ministry of Health of Viet Nam, the World Health Organization, and the United Nations Population Fund. The next LSAHV survey is scheduled for late 2021 or early 2022, and