Energy

A Review on Institutional Framework, Principles, and Key Elements for Integrated Electricity Market: Implications for ASEAN

Status: Ongoing
Geographic scope: ASEAN

ASEAN member countries are becoming large energy consumers and growing participants in the global energy market. Cross-border electricity trade becomes increasingly important in the context of fast-rising energy demand and growing urban population. This study attempts to set out the common principles, methodologies, institutions, and structure for designing an integrated cross-border electricity market and delivering practical policy implications for ASEAN. To allow cross-border electricity trade, the region will need a target model, common vision, and principles that govern electricity market and grid operation. Energy prices administratively determined by national governments should be shifted to market-oriented pricing mechanism. Integrated electricity market has enormous potential that can be realised at reasonable costs. When individual countries pursue

regional cooperation mechanism to secure their energy supply, investment comes in and contributes to optimising available energy resources throughout the region. The research uses questionnaire survey as the main methodology to determine the necessary and feasible institutional components in building an integrated ASEAN electricity market. This contributes primary data on the status and feasibility of electricity market integration in ASEAN and enables further analysis and insights on corresponding policy recommendations.

Achieving an Integrated Electricity Market in Southeast Asia: Addressing the Economic, Technical, Institutional, and Geo-political Barrier

Partners: Brunei National Energy Research Institute (BNERI); The Institute of Energy Economics, Japan (IEEJ); The University of Western Australia (UWA; and Nanyang Technological University (NTU) (Singapore)
Status: Completed
Geographic scope: ASEAN

The research was divided into four interdependent research clusters. Clusters 1 and 2 applied case studies on Brunei, Indonesia, Malaysia, and the Philippines (BIMP) using different methods. Cluster 1, led by the IEEJ, conducted dynamic linear programming model to simulate the development of power infrastructure, interconnection, and exchange of power in this subregion of ASEAN. It emphasised the economic rationale and feasibility of electricity market integration in the region. Cluster 2, led by BNERI, focused on the regulatory, institutional, and technical barriers in BIMP, and developed a roadmap to solve these issues. This study gave some insights on regional-specific barriers or issues for other regions based on an established understanding of the common issues from previous studies. Cluster 3 was conducted jointly by ERIA and the Energy Research Institute at NTU.

The study, mainly on the Nordic and European cases of electricity market integration, analysed both their business models and overall market design for grid interconnection and cross-border trading of electricity. In doing so, the study eventually tried to deliver implications on the possible business model and market design for ASEAN. The Cluster 4 study, carried out by a researcher from UWA, discussed political and institutional barriers to the formation of an integrated

ASEAN electricity market and derived several practical strategies in addressing such barriers as policy implications.

Addressing Energy Efficiency through Traffic Improvement

Partner: The Institute of Energy Economics, Japan
Status: Ongoing
Geographic scope: East Asia Summit region, Viet Nam

A related ERIA study conducted in FY 2015 analysed possible actions and policies that could maximise effectiveness of the planned bus rapid transit (BRT) system in Da Nang City, Viet Nam. The study analysed the effect of feeder-line busses for BRT use, considering the latent preference of citizens to use busses. Findings revealed that the existing plan cannot meet the modal share target of public transport in the city (35% in 2035). Thus, the city may be required to expand the BRT line, introduce a metro system earlier, or be redesigned for the city to be more MRT friendly.
Using Da Nang City as the case study for a second time, this research analyses what transportation system is necessary to achieve a targeted modal share, and thus quantify the amount of efficiency improvement. The study will also draw policy implications for both Da Nang City and the East Asia Summit region.

This study is consistent with the strategic theme of 'Energy Efficiency and Conservation' in the ASEAN Economic Community Blueprint 2025, and contributes to improving efficiency in the transport sector. It is also consistent with the goal of creating sustainable communities outlined in the ASEAN Socio-Cultural Community Blueprint 2025.

The study will have the following policy implications:

- While various measures contribute to improving traffic and energy efficiency, measures must be in accordance with the development of urban and transport infrastructure and motorisation stages.
- Since the development of transport infrastructure consumes so much time and cost, such development should be based on a forward-looking, long-term viewpoint.
- Investment from a long-term viewpoint may sometimes fail to bring about any major effects in the short term. Therefore, strong leadership and an integrated execution body are required for implementing such investment.

Building a Network on Collaborating Towards Social Acceptance of Nuclear and Coal Power in Asia

Partner: The Institute of Energy Economics, Japan
Status: Completed
Geographic scope: Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, Viet Nam

The radioactive disaster at the Fukushima Daiichi Nuclear Power Station, triggered by the tsunami following a major earthquake on 11 March 2011, seriously impacted the region. More than 100,000 local residents were forced to abandon their homes. People in emerging Asian economies were greatly shocked not only because it was one of the three most serious nuclear accidents, but also because it happened in Japan, known as one of the most advanced countries in technology and infrastructure. After the disaster, social acceptance of nuclear energy generally turned negative or non-supportive.

At the same time, economic efficiency should be considered when developing power stations in Asia. Thus, coal-fired power stations are appealing because of their supply stability and lower cost. Yet despite the availability of technologies that mitigate some of the environmental impact of coal, concern about emissions sometimes hampers the deployment of coal-fired power stations.

Therefore, cultivating mutual reliance and agreement among stakeholders such as government, licensees, and local municipalities is crucial in developing facilities that combine nuclear and coal power. Intense and practical research on issues, such as the specific features of nuclear/coal power, their role in energy security and climate change, social influence, and disclosure of risk information, would be highly valued. Collaboration and practical action supporting social acceptance of nuclear and coal power would provide substantial contribution to the smooth development and utilisation of these types of energy in Asia.

Thus, this study provides member countries considering nuclear/coal power a practical approach to achieve wider social acceptance. Also, the results of this study will serve as a model case for establishing social consensus on certain public issues.

Cooperation, Exchange of Information, and Assistance between East Asian Regulators in Nuclear or Radiological Incidents and Emergencies

Partner: Finland's Radiation and Nuclear Safety Authority (STUK)
Status: Completed
Geographic scope: Indonesia, Japan, Republic of Korea, Malaysia, Philippines, Singapore, Thailand, Viet Nam

Severe nuclear or radiological emergencies have direct or indirect global effects, as evidenced by the Fukushima Accident of 2011. A less severe emergency may affect several countries in a region. Several nuclear facilities already exist – and an even larger fleet of nuclear power plants are under construction or planned – in the East Asia Region. Thus, cooperation in preparedness for nuclear or radiological emergencies is increasingly important to ensure that the impact of any such emergency is minimised as much as possible. Regional collaborative frameworks complement established international conventions on this subject to enhance the safety and security of nuclear applications, as shown by the Nordic and European experiences. This research was a proposal for practical cooperation in case of, and in preparation for, nuclear or radiological emergency among ASEAN countries. It describes the formation, structure, communication methods, and coordination mechanisms of an East Asian coordination working group for cooperation in nuclear or radiological emergency and cooperation arrangements among its members. It reflects the vision of a comprehensive and effective regional collaboration mechanism, although a step-by-step approach may need to be taken for institutionally and politically easier items to be agreed first and the more difficult ones to be adopted later and in a gradual manner.

The study revealed the following:

- All member countries have a common awareness that every country should play a role in regional cooperation on nuclear emergency preparedness and response, irrespective of the development status of commercial nuclear power generation.
- East Asian countries can learn practices and guidelines from European countries, especially Nordic countries, on regional information sharing and collaborating systems in case of a radioactive emergency.
- It would be appropriate to make use of a relevant framework in East Asia, such as the ASEAN Network of Regulatory Bodies on Atomic Energy concept, to achieve the most effective emergency preparedness and response.

Cost Assessment of Energy Security Improvement in EAS Region

Partner: The Institute of Energy Economics, Japan
Status: Completed
Geographic scope: East Asia Summit

Energy security is a centre pillar of energy policy in all East Asia Summit countries. Self-sufficiency in energy supply forms the basis of energy security, and there are many policy options to improve it. These include enhancing oil production, increasing the use of domestically available renewable energy, and improving the efficiency of energy use.

Meanwhile, governments are requested to use their tax income economically and effectively by carefully assessing each policy option. This study attempts to assess and compare the costs and effects of different policy options to determine which is more economically effective. Such assessment is expected to help policymakers choose which option will improve self-sufficiency in energy supply, thus, the country's energy security.

The study has the following policy implications:

- Since the costs and benefits of each policy option to improve self-sufficiency differ, policymakers, by using this kind of assessment, can choose which is more economically efficient.
- A country-specific assessment will provide better indication for policymakers since the costs and benefits differ in each country.
- Economic efficiency, while part of the policy choice process, is not the only element that should be considered.

Creating Better Social Acceptance for Electric Power Infrastructure

Partner: The Institute of Energy Economics, Japan
Status: Ongoing
Geographic scope: Thailand

The East Asia Summit region needs to develop every kind of power plant to supply electricity for future demand. However, some types of power, including coal, nuclear, grid, and even renewable power sources such as wind are facing protest from surrounding residents or non-governmental organisations. Therefore, it is crucial to enhance social acceptance of electric power infrastructure for achieving stable electricity supply and well-balanced power supply mix.

This study focuses on a case study in Thailand where conflict continues between advocates and opponents of coal-fired power plants. The study will try to come up with a process in reaching consensus, which reflects the case's unique background. This is because that discussion in Thailand is thought as typical case, thus implication can be disseminated among the ASEAN region.

The study is consistent with the wide range of strategic themes in the AEC Blue Print 2025 and with the goal of creating a resilient society in the ASCC Blueprint 2025. It particularly corresponds to principles of 'D.5. ii ensure availability and accessibility of affordable energy services'.

Developing Sustainable Collaboration Model for Implementing Integrated Space-Based/Geospatial Disaster Management Infrastructure to Strengthen Resilience in the ASEAN Community

Status: Ongoing
Geographic scope: ASEAN and East Asia

Strengthening the resilience of natural disaster infrastructure in ASEAN countries – considered an important issue for economic development among East Asia and ASEAN countries – is urgently needed. The ASEAN Agreement on Disaster Management and Emergency Response (AADMER) developed the AADMER Work Program 2010–2015 to cover all aspects of disaster management.

The ERIA project 'Applying Space-Based Technology for Building Resilience in ASEAN Region' conducted in 2014 concludes that both space geospatial technologies have notable potential to strengthen this resilience. However, sustainable mechanisms to practically integrate the technologies into disaster risk management (DRM) have not been well established. The study points out the necessity of (i) trans-border mechanisms to deliver geospatial and space-based information from data providers to end users in disaster-affected areas with support of international activities; and (ii) financial schemes involving the private sector, or public–private partnerships (PPPs), to collaboratively integrate the technologies in a sustainable and practical manner.

To establish the trans-border mechanism with PPP scheme, the study proposes establishing a trans-border DRM platform as a DRM service infrastructure for public

disaster management agencies and private companies in the ASEAN region. The platform comprises the following: (i) data resources interoperable and expandable at regional and global scales; (ii) knowledge on how to apply the technologies to DRM; and (iii) human network of stakeholders that includes national and local governments, technology providers, and financing partners. To ensure sustainable operation, the platform collects operation fees from DRM service providers while these service providers develop businesses using the platform.

This study aims to (i) analyse the feasibility of the proposed platform in terms of technology and finance, (ii) design the platform based on the feasibility study, and (iii) lay out strategies to establish and operate the platform in a practical and sustainable manner.

Development of Eco Town Model in the ASEAN Region through Adoption of Energy-Efficient Building Technologies, Smart Grid, and Transportation, Phase 1

Partner: Brunei National Energy Research Institute
Status: Completed
Geographic scope: Brunei Darussalam

The recent economic growth in ASEAN has driven energy demand in the region to grow about 2.5 times since 1990 and is expected to triple by 2035. ASEAN will need to apply the concept of low-carbon city or eco town to curb increasing demand and mitigate emissions of greenhouse gases. Both could threaten the sustainability of future energy supply and negatively impact the environment, health, and tourism – i.e. the quality of life.

In this study, eco town model refers to a town, scalable to any size based on the geographical and socio-economic features of an ASEAN country, seeking to become low energy or low carbon. It targets to reduce its CO_2 emissions and has a concrete low-energy development plan irrespective of its size, characteristics, and type of development (greenfield or brownfield development).

The model aims to promote the development of eco towns in the region by providing basic principles that can assist government officials in planning effective energy-efficient policies and formulating appropriate combinations of low-energy measures while taking into account socio-economic conditions and city or town specific characteristics. Thus, this study focuses on the introduction of current and future energy-efficient technologies on buildings and road transport as well as smart grid technologies. Such technologies can be applied to any town in an ASEAN country.

Economic Impact of Removing Energy Subsidies in Malaysia

Partner: The Institute of Energy Economics, Japan
Status: Completed
Geographic scope: Malaysia

ERIA applied two approaches to analyse the economic impact of removing energy subsidies: (i) a price impact analysis using Malaysian I-O table 2010 and (ii) a macro impact analysis using the Malaysian macroeconomic model. Price impact analysis shows serious price hikes to other subsectors when subsidies are removed from both the gas and power sectors. Subsectors, such as hotel and restaurant, finance and insurance, water, and non-metal and mineral, will have a price increase of 4%–5% if the government removes subsidies from the gas and power sectors. This price hike is serious because Malaysia's wholesale price index increased to 9% in 2000–2012. Thus, the government should take care of these subsectors to mitigate the high price hike. On the other hand, macro impact analysis shows that GDP shrinks due to overall price hike. However, if the Malaysian government could expend surplus budget for capital formation, which results from stopping the subsidies, GDP could increase slightly. Thus, removing energy subsidies, especially electricity, could positively impact Malaysia's economy.

Electricity Supply Mix and Role of Policy in ASEAN

Partner: The Institute of Energy Economics, Japan
Status: Completed
Geographic scope: Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, Viet Nam

Increasing demand for electricity combined with lower income levels have prompted ASEAN Member States (AMSs) to develop large-scale power-generating capacity economically and efficiently. Mitigating environmental burdens is also becoming more important. Thus, simultaneously achieving the 3Es – energy supply security, economic efficiency, and environmental protection – in power development has become indispensable in the energy policy of ASEAN countries.

Each country has its policies and targets for future power supply mix; yet without appropriate implementation tools, such policies or plans are unlikely to be implemented. Every energy source has its own advantages and disadvantages; some effort is required to make full use of the advantages and minimise the disadvantages. Therefore, creating a system featuring a mixture of electricity sources is crucial to ensure a stable supply. This study aimed to suggest policy tools for policymakers to realise an appropriate power supply mix.

Once the optimal mix has been envisioned, the next step is to determine policies that could prompt the most effective implementation of such a mix. A key condition for successful implementation is to introduce market models that are most appropriate in light of each AMS's policy priorities.

The policy implications of this study are as follows:

- The applicable policy tool for achieving electricity mix target differs according to each country's development stage and market model.
- A simple 'copy and paste' system will not work effectively; therefore, every country or region needs to understand its own situation first.
- Every government and/or region is suggested to envision its future electricity supply mix to indicate a preferred direction for investment.
- On the industry side, a life-cycle cost evaluation of power station investment must encompass the true value of different investment options.

Energy Connectivity in Myanmar

Partner: University of Tokyo
Status: Ongoing
Geographic scope: Cambodia, Lao PDR, Myanmar, Thailand, and Viet Nam

Myanmar has achieved consistently high growth rates in the past several years, emanating from the need to find sustainable energy sources. In countries of the Mekong River Basin, the electricity and gas networks

or grids were the symbol of progress itself, with increasing numbers of grid-connected people a measure of economic development. Nevertheless, more than half of Myanmar's population do not have access to modern electricity.

Grid-based development has several imitations. Even with access, the grid in many regions is often unreliable, with power cuts being a common frustration. This study focuses on developing an energy road map for Myanmar as that of other Mekong River Basin countries. It will focus on the following themes which have been identified as significantly important in enhancing rural and national electrification in Myanmar: (i) comparison between mini-grids and national grid extension, (ii) possible financial mechanism to support rural electrification, (ii) potential of hydropower development focusing on small and midsized hydropower projects, and (iii) possible role of foreign investment, particularly from neighbouring countries.

The study also comprises a comparative analysis on common energy challenges of Mekong River Basin countries, such as rural electrification and connectivity.

This study uses the following methodologies: (i) simulation analysis that examines the economic rationale of the comparative advantage between mini-grids and the national grid extension to enhance the country's electrification; (ii) extensive fieldwork that filled the knowledge and information gaps to grasp the enabling conditions for the successful electricity development in the rural areas of Myanmar; (iii) stakeholder analysis to understand, from a regional perspective, Myanmar's affluent energy and resources, such as natural gas and hydros.

Energy Outlook and Analysis of Energy Saving Potential in East Asia Region

Partner: The Institute of Energy Economics, Japan
Status: Ongoing
Geographic scope: East Asia Summit region

Sustained population and economic growth in the East Asia Summit (EAS) region has significantly increased energy demand, with the Total Final Energy Consumption projected to double from 2012 to 2040. Demand in the transport sector is projected to grow most rapidly, followed by demand in the industry and commercial sectors, and, finally, that of the residential sector. Increasing energy demand threatens the energy

security of the region. Thus, potential energy saving is key to reducing energy demand and CO_2 emissions. This study presents an alternative policy scenario for the EAS region that could save energy consumption by 2040 compared to the business-as-usual scenario. Finally, the study proposes policy recommendations based on projected energy consumption trends to realise hidden fuel savings and contribute to sustainable growth.

This study is updated every 2 years, and involves (i) re-estimating energy demand formulas shifting from International Energy Agency data to national energy data, (ii) creating a new scenario to ensure that CO_2 emissions in 2040 are at the same level as 2013, (iii) summarising INDC (Intended Nationally Determined Contributions)/NDC of EAS countries. A new scenario could suggest that to maintain CO_2 levels, stricter energy efficiency and conservation goals and shifting to low-carbon energy sources such as solar are needed.

Energy Outlook in Thailand

Status: Ongoing
Geographic scope: Thailand

This project supports the Thai Energy Policy and Planning Office to develop an energy outlook model that applies an end-use approach, and the Chiang Mai University to analyse the energy consumption patterns in Thailand's household sector.

The research will assess (i) detailed issues in energy demand side, (ii) energy consumption pattern of the household sector in Thailand, and (iii) major critical points of power development in Thailand.

Energy Policy Road Map of Greater Mekong Region

Partners: University of Tokyo, University of California
Status: Ongoing
Geographic scope: Cambodia, Lao PDR, Myanmar, Thailand, Viet Nam

While the Greater Mekong Region has attracted increased international attention since its integration into the global economic system in the late 1990s, it still faces many energy development challenges. Such

challenges and opportunities are the focus of this study whose functional objectives are (i) a quantitative scenario analysis of major factors of rural electrification, including future electricity demand forecast, amount of needed power generation capacity in the off-grid areas, costs required for rural electrification, etc.; (ii) a qualitative analysis of obstacles in power development particularly in the border areas; and (iii) human resource development (HRD) in policymaking/implementation for energy policymakers and researchers.

This ongoing project has the following policy recommendations so far:

- Assuming that the national electrification target for universal energy access is in 2030, the integration of decentralised power systems into planned centralised systems might be a crucial aspect to make the target feasible.
- To facilitate integrated infrastructure development, public–private partnerships should be soundly coordinated with proper reforms to encourage foreign direct investment.
- For the relevant plan-do-check-act (PDCA) cycle, an HRD programme for governmental offices is necessary. It is also important to provide a common ground for energy-related ministries and other stakeholders to discuss and work together.

Formulating Policy Options for Promoting Natural Gas Utilisation in the EAS

Partners: The Institute of Energy Economics, Japan, Nomura Research Institute
Status: Ongoing
Geographic scope: ASEAN

The September 2016 Energy Ministers Meeting mandated ERIA to conduct a study on natural gas markets in the East Asia Summit (EAS) region.

The study aims to (i) clarify possible areas that can be shifted to natural gas in each field, such as power generation, industry, residential, and transportation; (ii) calculate potential gas demand in EAS countries; (iii) clarify challenges and issues to promote use of natural gas; (iv) propose optional gas distribution network and calculate the amount of funding required for investment; and (v) propose policy options essential to promote natural gas shifting and investment in related infrastructure and equipment in the region.

The study will investigate future gas demand potential in ASEAN countries and India, and clarify the necessary investment amount. By doing so, this study will raise awareness on the market size of natural gas in EAS countries, clarify the challenges to expand the natural gas market, and propose the policy options necessary to address such challenges.

Globalisation of Low-Carbon Technologies

Partner: ASEAN Centre for Energy
Status: Completed
Geographic scope: East Asia Summit countries (ASEAN +6)

In recent years, tremendous strides have been made to advance low-carbon energy systems – innovating, scaling up investment, bringing down system costs, implementing the right policy frameworks, and interconnecting large amounts of variable renewable energy supply into the grid. Reflecting this, many countries have put forward ambitious plans to increase low-carbon energy to generate power. Combined, the low-carbon renewable energy plans of China, India, and ASEAN will result in an increase from approximately 9,000 TWh in 2012 to 20,000 TWh in 2030.

In addition, several promising initiatives currently being implemented will buttress the Intended Nationally Determined Contributions (INDCs). Some 40 implementing agreements carry out technology programmers in the areas of renewable energy (solar, wind, bios, geothermal); fossil fuels (clean coal, enhanced oil recovery, carbon capture and storage); fusion power (tokamaks, materials, technologies, safety); and energy efficiency (building, electricity, industry, and transport). To find solutions, the public and the private sectors must work together. INDCs can provide an important impetus to enhance and achieve global efforts to mitigate carbon emissions, double the share of low-carbon energy in the supply mix, and accelerate green growth.

There is growing awareness of the urgent need to turn INDCs into analytical works and concrete actions. Yet despite energy-related goods accounting for more than 10% of international trade, policymakers, academics, and the business community perceive several barriers to the diffusion of these low-carbon technologies nationally and regionally. This study was designed to identify the opportunities and barriers in INDCs for diffusion of low-carbon energy technology

and to propose the incentive mechanisms at the local, national, and regional levels to the required scale.

The study revealed the following:

- Given the rapid increase in demand for a large and stable supply of electricity in rapidly industrialising countries in the region, low-carbon technologies provide a compromise solution to attain energy security and reduced emissions.
- To make low-carbon technologies and measures commercially viable, globalisation of technologies is needed. The cooperation of Asia, the European Union, Japan, and the United States on low carbon can speed up the commercialisation through demonstration, direct investment, joint venture, build-operate-transfer (BOT) schemes, financial aid, and capacity building.

Institutional Strategy and Economic Impacts by Energy Subsidy Removals in the EAS Region

Status: Completed
Geographic scope: East Asia Summit region

ERIA and the International Energy Agency (2013) estimate fossil fuel subsidies to amount to US$51 billion in Southeast Asia for 2012 alone. Fossil fuel subsidies encourage wasteful energy use, burden government budgets, defer investment in energy infrastructure and efficient technology, and further undermine renewable energy uptakes. Some ASEAN countries have taken actions to remove subsidies but these must be accompanied by careful strategy and steps as subsidy removal is often a politically sensitive subject. However, energy subsidies incentivise consumption and can increase energy demand. When these subsidies are inefficient, they can lead to fiscal pressure, harmful emissions, and potentially undermine sustainable green growth in East Asia countries. In theory, reduced subsidies will encourage more energy-efficient consumption, leading to a positive impact on international energy prices and energy security, and will make renewable energy and technologies more competitive. Reducing local pollution and cutting

down greenhouse gas emissions further benefit the environment and society.

This study presents recommendations on steps and approaches to energy subsidies that are acceptable to the public.

Integrating NER India with Regional Economies through Cross Border Energy Sector Development

Partners: The Institute of Energy Economics, Japan; Confederation of Indian Industries
Status: Ongoing
Geographic scope: Bangladesh, India, Myanmar

There is increasing policy and academic interest in strengthening economic connections between the North Eastern Region (NER) of India and major economic centres in South and Southeast Asia. This region has several critical and strategic advantages in jointly participating in the development process of the neighbouring countries of Bangladesh, Bhutan, Myanmar, and Nepal. These adjoining countries, along with other states of India, have been among the most dynamic in Asia and have produced highly impressive socio-economic development. Advantages of economic integration among these countries also emanate from politico-historical linkages, geographical proximity, socio-cultural cohesiveness, economic complementarities, and scope for further economic integration towards ASEAN and China.

However, progress of trade and investment as well as industrial development in the eight states of NER has been relatively limited by various infrastructure bottlenecks, policy misalignments, and information gaps. This study aims to (i) determine the energy sector development needs and potentials of electricity generation in NER; (ii) analyse the opportunities for cross-border energy trade between NER and other neighbouring countries such as Bangladesh, Myanmar, and Nepal; (iii) estimate the cost of such arrangements and investment possibilities; (iv) draw policy implications for prioritised investment needs, which cover regulatory reforms, financial flows, and institutional cooperation at the national and international levels.

Integrative Strategy and Policies for Promotion of Appropriate Renewable Energy Technologies in Lower Mekong Basin Region

Partner: Institute of Energy, Viet Nam
Status: Ongoing; Phase I completed in December 2016
Geographic scope: Cambodia, Lao PDR, Myanmar, Thailand, Viet Nam

Cambodia, the Lao PDR, Myanmar, Thailand, and Viet Nam – neighbouring countries in the Lower Mekong Basin Region – have great potential for cooperation and development. Exploitation of renewable energy (RE) sources is an appropriate option to meet rising electricity demand and to increase energy security and economic competitiveness.

This study aims to set up the strategy and policies for RE development for these countries. It attempts to identify what RE technologies should be prioritised and what their social, economic, and environmental benefits are. Major criteria in selecting these prioritised RE technologies are (i) reduced potential of greenhouse gas; (ii) abatement cost; (iii) government priorities; and (iv) sustainable development benefits on the economy, society, and the environment using cost–benefit analyses. The calculations of costs and benefits for each RE technology will be put in a long-term energy system. Outputs of calculations will be used as a base in selecting RE technologies and the appropriate future-installed capacity for each technology. Because of similar economic conditions and exploitation status of RE sources, but limited input data for modelling, cost–benefit calculations for RE technologies and their impact on low-carbon and sustainable development will be carried out for Viet Nam as a case study. RE policy instruments applied effectively in other countries will also be reviewed and analysed based on the country-specific financial conditions to determine the effective policies that could reduce the project costs of RE technologies.

Multilateral Joint Study for LNG Market

Status: Ongoing
Geographic scope: East Asia Summit countries

Energy demand in East Asia Summit countries is rising. The role of natural gas in energy supply becomes increasingly important in economic efficiency, diversification of energy, effective use of domestic resources, and reducing environmental burden arising from energy use, among others. At the same time, the

global liquefied natural gas (LNG) market has seen big changes in recent years. In terms of supply and demand, many new LNG importers are entering the market, yet LNG demand of large importers such as Japan, China, and Europe is becoming uncertain. At the same time, new liquefaction capacities are coming into operation in the next few years. Yet, both oil-linked and spot prices are experiencing a downward trend. Importing countries may welcome this trend but it would have side effects for supply-side investment.

The Asian LNG market cannot be insulated from these changes in the global market. Although recent price trends seem to indicate that the 'Asian premium' (higher LNG prices in Asia) has diminished, the essential problem has not been resolved. The 'Asian premium' will easily come back again depending on crude oil price. Therefore, substantive reform is needed to achieve sustainable and sound development of the East Asia LNG market.

This study has the following policy implocations:

- Private sector stakeholders are encouraged to pursue pricing mechanisms that most appropriately and timely reflect prevailing LNG market conditions, and can eventually serve as an alternative to oil indexation in structuring long-term contracts.
- The public sector should create an environment suitable for the development of a market that properly reflects regional supply and demand conditions by (i) liberalising end-user markets, (ii) supporting development of necessary infrastructure, and (ii) ensuring reasonable open access to relevant facilities.
- Private sector stakeholders are encouraged to eliminate destination restrictions in FOB (freight on board) LNG transactions and relax them in DES (delivered ex ship) transactions.
- Stakeholders should remain committed to the principle of mutual cooperation, which has been the core of sound development of the LNG industry.

Operationalising ASEAN Petroleum Security Agreement

Status: Ongoing
Geographic scope: Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, Viet Nam

This research examines the best ways to revise the existing ASEAN Petroleum Security Agreement (APSA)/Coordinated Emergency Response Measures to make it more effective. The study will recommend concrete actions to operationalise such ways, including defining executing bodies and establishing the permanent APSA secretariat.

Possible Cooperation Framework for Oil Stockpiling and Emergency Response System of East Asia

Partner: The Institute for Energy Economics, Japan
Status: Completed
Geographic scope: ASEAN

As the economies of ASEAN countries expand, energy demand has remarkably grown in the last decade. Oil demand particularly has recorded the largest increase. Due to stagnant indigenous oil supply in ASEAN, the growth in oil demand has resulted in increased oil import, which makes ASEAN countries more vulnerable to external supply disruption or highly volatile international oil prices.

As for sources of oil import for ASEAN countries, the share of Middle Eastern countries will continue to increase, suggesting that oil supply in ASEAN will contain more risk factors, given the persistent political instability in the Middle East. In addition, the oil supply security system in ASEAN in general is still at the development stage. Thus, international cooperation is needed to promote and invigorate oil supply security arrangements in the region. Given the global and integrated nature of the oil market, promoting regional cooperation for oil supply security arrangement in ASEAN benefits all East Asian countries.

This study aims to explore and evaluate potential cooperative actions among East Asian countries to secure their oil supply.

The study has three components: component 1 provides potential scenarios of oil supply disruption in ASEAN; component 2 explores options of oil stockpiling; and component 3 discusses how government and industry can form a collaborative relationship to secure oil supply.

The study found that:

- Unexpected oil supply disruption will catastrophically impact ASEAN countries through an energy price surge or increase in trade deficit, and increased social discontent and potential political instability.
- The most cost-effective option to start stockpiling is to expand existing storage capacity and set a stockpiling target. Tank leasing to commercial players will ease the burden of constructing storage facilities, and can be another cost-effective means.
- Recognising transparency and equity is important

to involve industrial players in stockpiling development efforts. Utilising other regional players that have an interest in the ASEAN oil business may be worth considering.

Preparation of Energy Statistics and Energy Balance Construction for Setting up a Sustainable Energy Development Plan in Cambodia

Partner: Ministry of Mines and Energy of Cambodia
Status: Completed
Geographic scope: Cambodia

Lack of information and inadequate capacity to carry out comprehensive planning are the main contributing factors to the current condition of the energy sector in Cambodia. The Ministry of Mines and Energy (MME) requested ERIA's support in developing energy statistics and energy balance for the country's sustainable energy development plan. The project aims to strengthen the MME to be sustainable and capable of (i) employing advanced techniques, methodologies, and modelling tools in institutionalising the collection, processing, and analysis of energy statistics; and (ii) establishing and managing an energy information system. Through this project, the country is expected to establish a systematic collection of energy data from various energy supply companies and other government agencies/corporations to enable it to compile accurate energy statistics for sustainable energy planning.

Sea Lane Security of Oil and LNG in the East Asia Summit Region

Partners: The Institute of Energy Economics, Japan; The Energy and Resources Institute, India
Status: Completed
Geographic scope: China, Indonesia, Malaysia, Singapore, Thailand, South China Sea, Strait of Hormuz, Western Indian Ocean

With robust demand yet modest supply growth of energy in the region, the East Asia Summit area is expected to rely more on imported oil and natural gas. However, without an international pipeline infrastructure, the region imports these products through sea transport. Sea lane security of oil and liquefied natural gas (LNG) is then vitally important to ensure energy supply in the region. This study firstly forecasts future oil and LNG import into the Asia-Pacific region to assess congestion in the Hormuz and Malacca/Singapore straits. Secondly, the study identifies various risks to sea lane

security in terms of key background elements (congestion, geography, geopolitics, climate change, poverty, and law and order) and trigger events (piracy, terrorism, regional conflicts, accidents, and extreme weather events). Trigger events, in turn, impact the energy security of the region in the form of supply disruptions, price volatility of traded goods, financial risks to the industry including increased insurance premium, and physical risks to human life. Finally, the study introduces countermeasures adopted by countries, such as China, Indonesia, and Thailand, to mitigate various risks.

The study highlights the (i) development of alternative routes to avoid choke points, (ii) creation of joint regional patrols to prevent maritime piracy, and (iii) adoption of measures to minimise the environmental impacts of oil spills.

Study of Renewable Energy Potential and its Effective Usage in EAS Countries

Partner: National Institute of Advanced Industrial Science and Technology (AIST), Japan
Status: Ongoing
Geographic scope: ASEAN, Japan

East Asian Summit (EAS) countries recently increased imports of crude oil and petroleum products to meet the corresponding increase in energy demand of the transport sector. Each country has promoted the introduction and uptake of biofuel produced from feedstock grown domestically. On the other hand, the fuel consumption of EAS countries predicted from the types of vehicle fleet is quite different from each other and does not always adjust to national policies that promote use of biofuel. From the viewpoint of effective use of resources and solution of the problem of oil refinery capacity, it is important to balance biofuel demand and supply through international trade.

This study has the following three components: (i) potential study of diversified transportation energy mix, (ii) research of next generation biofuels, and (iii) bio methanol as an energy carrier.

The study revealed the following:

- There exists a possibility for multilateral cooperation on renewable energy and its effective use based on the outlook simulated by energy consumption and vehicle registration in East Asia and ASEAN countries.
- In the transition towards a circular economy, refurbishment can be applied to regain value from used products, reduce waste, and improve resource efficiency. Indicators in the cities and

sectors need policy attention. East Asian and ASEAN countries should make their renewable energy policy target robust.
- R&D information of next generation biofuel and energy carrier technologies will decide the uptake of biofuels in the transport sector.

Study on Power Grid Interconnection and Electricity Trading in Northeast Asia

Partners: Asia Pacific Energy Research Centre, Mongolia's Ministry of Energy, Energy Systems Institute (Russia), Nanyang Technological University (Singapore)
Status: Completed
Geographic scope: China, Japan, Mongolia, Republic of Korea, East Russia

This study analysed the costs and benefits of power grid interconnection in the Northeast Asia region – covering north and northeast of China, Japan, Mongolia, East Russia, and the Republic of Korea – using a linear programming and optimisation model. Such analysis yielded several important observations on the feasibility and optimal plans of power infrastructure development for power grid interconnection in the region. Large-scale interconnections among Mongolia, Russia, and China were identified as needed and feasible in almost all scenarios. Savings in the total system cost of all countries vary at US$500 billion in total in about 30 years as a net present value, compared to the case of no power grid interconnection and thus no trade of electricity. This is equivalent to about 10% of total system cost for all countries involved. On the environment side, some 4 billion tons of carbon dioxide (CO_2) emissions – about 10% of total carbon emissions in the case of no interconnection – could be reduced during the same period. Solar photovoltaic, which has a better match with peak power demand, appears to be more competitive than wind power and to be developed at a large scale in Mongolia starting 2033 or 2038, depending on the scenario.

Study on the Advancement of an Energy Management System (EMS) in the EAS Region

Partner: Mitsubishi Research Institute
Status: Completed
Geographic scope: East Asia Summit region

This study aimed to (i) analyse the potential for deploying an advanced energy management system (EMS) in the East Asia Summit region, especially

focusing on ASEAN countries; and (2) propose, upon identifying the policy challenges common in the region, policy recommendations to promote EMS. The study was conducted for 2 years; its report outlines the results of the second-year study focusing on the applicability of EMS for factories. It is meant to complement the first-year study report (ERIA Research Project FY2014 No. 39, published in September 2015) on EMS for office buildings. It likewise proposes a set of policy recommendations promoting the deployment of EMS in the ASEAN region.

This second-year study report discusses the importance of deploying EMS from a practical viewpoint. Waste of energy is caused not only by using inefficient appliances but also by inefficiently using appliances. Energy efficiencies may be achieved without replacing energy-consuming appliances with more efficient ones by monitoring and analysing the operational data of these appliances and by optimising their operational setup. Installation of EMS, which provides visual information, can serve as the solution. However, because of this indirect role of EMS, the benefit of installing it may be unclear. Therefore, this study points out that a policy intervention is necessary to support the diffusion of EMS.

Several case studies focus more on factory energy management systems or FEMS and subsectors which showed how effective energy-saving measures differ, depending on industries. This study lists typical energy-saving measures, indicated effective measures for specific industries, and described specifically how these measures will be implemented.

Study on the Formation of the ASEAN Power Grid Generation and Transmission System Planning Institution (AGTP) and the ASEAN Power Grid Transmission System Operator Institution (ATSO)

Partner: Tokyo Electric Power Company, Heads of ASEAN Power Utilities/Authorities (HAPUA)
Status: Ongoing
Geographic scope: ASEAN

This project aims to provide technical and advisory services to HAPUA on the criteria, structures, roles, and requirements in forming two institutions necessary to advance the ASEAN Power Grid (APG). Such institutions are the AGTP and the ATSO. HAPUA will report the key findings of this study to the ASEAN Ministers of Energy Meeting in 2017/2018 as an implementation measure of the ASEAN Plan of Action on Energy (APAEC) Phase 1, 2016–2020, and to the ASEAN Secretariat as it monitors and facilitates the implementation of measures under the ASEAN Economic Community Blueprint 2025.

In an interconnected APG, the AGTP will (i) be responsible for regional power systems planning, (ii) be the key coordinating institution among ASEAN countries on investment decisions regarding power generation and transmission assets, and (iii) enable regional sharing of energy resources through the implementation of the APG and harness the full potential of benefits from multilateral trade of electricity among ASEAN Member States (AMSs).

ATSO, in charge of regional systems cooperation, will be the key institution that enables actual physical trade of electricity among the AMSs by maintaining and ensuring the balance, stability, and reliability of the interconnected power grids across borders.

Sustainability Assessment of Utilising Conventional and New-Type Geothermal Resources in East Asia

Partner: National Institute of Advanced Industrial Science and Technology (AIST), Japan
Status: Ongoing
Geographic scope: ASEAN, China, Japan, Republic of Korea, and New Zealand

In attempting to maximise the potential use of renewable energy sources, many Asian countries have been developing their geothermal resources, although the types of geothermal resources vary from country to country. Countries with rich high-temperature geothermal resources have utilised their potential by generating conventional steam power. Even in countries without volcanoes, heat extraction from deeper underground using EGS (Enhanced/Engineered Geothermal System) techniques and/or from shallow underground for direct use have been studied and pilot-schemed.

Geothermal technologies, such as reservoir engineering, monitoring techniques, scale-controlling techniques, and others, which are all essential for sustainable utilisation of geothermal resources for both power generation and direct use, pose both challenges and opportunities.

This study aims at identifying those challenges, developing country-specific solutions, and sharing information to improve technology for sustainable geothermal use in Asian countries.

This project envisages guidelines for sustainable use of geothermal energy. The guidelines will be formulated separately for (i) power generation and direct heat use and (ii) ground source heat pump (GSHP) since the necessary technologies are different for these two

categories. These guidelines shall be useful to practising engineers and managers with newly started geothermal business, or to researchers in related fields.

The propject also provides recommendations to policymakers for more intensive use of geothermal energy.

Major findings of the study are:

- The countries that achieved substantial geothermal development have in place a sound geothermal development plan explicitly stated in their energy policy, whereas others do only implicitly.
- Long-term engineering and financial programmes for geothermal power generation are necessary because geothermal development takes 5–7 years.
- For direct heat use, governments should incentivise to use thermal use of geothermal energy (such as the renewable heat obligation law in the Republic of Korea).
- For promotion and sustainable use of GSHP, governments should support R&D on hydrogeological studies, case studies, and long-term monitoring. Governments should also encourage international research collaboration on these topics.

Temburong Eco Town

Partners: Brunei National Energy Research Institute (BNERI), External urban design companies such as Nihon Koei
Status: Ongoing
Geographic scope: Brunei Darussalam

ERIA is working with BNERI to transform Temburong, Brunei Darussalam into a smart and eco-friendly city through the application of smart energy technologies. Phase 1 of the study focuses on energy efficiency technologies, which will be applied in Temburong. Phase 2 involves a simulation study based on daily climate data to seek the optimal capacity of solar photovoltaic cells, wind, and diesel generators.

Based on the results of Phase 2 and the basic concept of Temburong Smart City that the Brunei government prepared, ERIA will request an external urban planning company to design a blueprint of Temburong to constitute Phase 3.

Unlocking the Potentials of the Private Sector for Accelerated Low-Carbon Energy Transition

Status: Ongoing
Geographic scope: East Asia Summit countries (ASEAN +6)

While the ASEAN Economic Community (AEC) Blueprint aims to progressively liberalise the investment regime of ASEAN Member States (AMSs) to achieve free and open investment, it also recognises the importance of making such investments sustainable through mitigating greenhouse gas emissions by means of effective policies and market-based measures, among others. Recognising the limited global reserve of fossil energy and unstable world prices of hydrocarbon products as well as meeting the COP 21 Paris Agreement targets, AMSs should accelerate the transition to low–carbon energy, as well as promote open trade, facilitation, and cooperation in related low-carbon industries with the requisite infrastructure.

Following on the Paris Climate Agreement, Asia's attention is now firmly fixed on advancing viable, scalable low-carbon energy solutions at different levels. Most of the estimated investments required to scale up low-carbon energy systems will come from the national and international private sector. However, concerted and coordinate efforts by national and sub-national governments, public financing institutions, and international organisations are essential to unlock the potential of the private sector. Governments can accelerate this trend by targeting more of their funds to leverage private finance.

There are several reasons for leveraging private finance to accelerate the transition to low-carbon energy and to achieve the Nationally Determined Contributions (NDC) agreed as part of the Paris Agreement. First, advanced countries have not yet agreed on any clear plans to meet their commitment to provide US$100 billion annually by 2020 for developing countries to reach the NDC targets. Second, per current estimates, more than US$100 billion per year is needed to meet the low-carbon transition challenges that include not only investments in renewable energy but also energy efficiency and other strategies, such as deployment of clean coal and carbon capturing and storage technologies at a scale required. Third, government budgets of both advanced and emerging economies are often constrained by financial debts and other austerity policies, with little clarity on when and how public financial flows will be scaled up to meet the targets set for 2030.

The question for the prudent policymakers is to what extent emerging Asian economies can transition to the low-carbon economy, and how to deepen private sector stocks underpinning low-carbon energy solutions? Hence, this study aims to (i) examine the priority private sector investment needed for the region to attain the NDC targets; (ii) identify technical, fiscal, and market-based regulatory barriers to scale up private low-carbon investments in key sectors; and (iii) propose innovative policy solutions that will unleash the potentials of private finance to support the transition pathway.