

## Energy



### **Assessment of Resiliency for Fossil Fuel Import Disruption**

*Partner: The Institute of Energy Economics, Japan (IEEJ)*

The import dependency on fossil fuel for many developing countries in EAS is estimated to increase in the future. This means an increase of vulnerability in terms of energy security for these countries. Urgent necessity for those countries

are ; 1) understanding influence pass and impact of unexpected import disruption, 2) understanding how country can react, and 3) implement necessary policy to enhance energy security.

The study will select one of EAS member countries by considering the following criteria:

1. Fossil fuel import dependency is high;
2. Fossil fuel import dependency has been increasing rapidly in recent years;
3. Dependency on a single energy source is high.

Subsequently the impact of import disruption will be analysed in terms of two aspects:

- a. Availability of substitution imports  
For oil imports, analyse the availability of substitution imports by assuming that Organization of the Petroleum Exporting Countries (OPEC) spare capacity is the only available flexible option to fill a short-term supply–demand gap.

For gas imports, the spare capacity of liquefied natural gas (LNG) plants will be examined by comparing nameplate capacity and contracted volume; and the possibility of pipeline transaction will be examined.

For coal import, since the data for production and/or export capacity is not available, only a qualitative assessment will be made.

- b. Availability of substitution of domestic supply  
Analyse the possibility of substituting domestic supply. In a power generation sector, availability of capacity other than disrupted fuel will be examined. E.g. in case of natural gas disruption, the study will count the available power generation capacity that can be fueled by coal and oil.

## Comprehensive Analysis to Unlock Potential LNG Demand in EAS Region

*Partner: The Institute of Energy Economics, Japan (IEEJ)*

LNG, whose production capacity will see a ‘revolutionary’ expansion in the coming 3 years according to the International Energy Agency, will have a key role in enhancing natural gas use in Asia. By taking advantage of a significant expansion in supply capacity, Asia has a great opportunity to enhance its natural gas use through importing LNG in the future. This study explores how Asia can increase natural gas and LNG use and what kind of policy is required to achieve this objective.

This study aims to achieve the following objectives:

1. Develop LNG demand outlook and potential in Asian countries and supply capacities to the region
2. Understand the current obstacles to introducing and increasing LNG use in Asia
3. Consider and propose policy measures to address these obstacles and increase LNG use in Asia

The contents of the final report will reflect these objectives. As for item A), we will consult a US-based think tank that has an extensive knowledge of expertise on the international LNG market. As for items B) and C), since Asian gas and power companies and Japanese gas companies and trading companies

have extensive knowledge of and experience within these issues, we will conduct a workshop inviting those industry officials and ask them to explain what are the bottlenecks preventing an increase in LNG demand and how to overcome them.

#### Policy Implications:

1. Trading customs in the Asian LNG market will have to become more flexible to activate spot trading and create a gas-to-gas based natural gas price benchmark to reflect the physical gas supply and demand balance in East Asia.
2. Countries with extensive LNG use such as Japan should cooperate with other Asian countries to share their expertise in introducing and consuming LNG in an efficient manner.
3. Cost competitiveness is very important for LNG to secure markets in Asia. Governments and industry in EAS countries should work together more closely to minimise the costs associated with policy and regulation.

*Geographic Scope: East Asia Summit Region*

### Globalisation of Low-Carbon Technologies

*Partner: ASEAN Centre for Energy*

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. Many countries have put

forward ambitious plans to increase low-carbon energy in generating power. Combined, the low-carbon renewable energy plans of China, India, and ASEAN will result in an increase of about 9,000 TWh in 2012 to 20,000 TWh in 2030.

In addition, several promising new initiatives will buttress the Intended Nationally Determined Contributions (INDCs). Some 40 implementing agreements carry out technology programmes 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 serve as an 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 the fact that energy-related goods account for more than 10% of international trade, policymakers, academics, and the business community perceive several barriers to the diffusion of these low-carbon technologies at the national and regional levels.

This study is designed to identify the opportunities and barriers within INDCs for the diffusion of low-carbon energy technology and to propose the incentive mechanisms at the local, national, and regional levels to the required scale. The key findings are as follows:

1. 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.
2. To make low-carbon technologies and measures commercially viable, technologies should be globalised. The cooperation of Asia, the European Union, Japan, and the US on low carbon can speed up the process of commercialisation through demonstration, direct investment, joint venture, build-operate-transfer (BOT) schemes, financial aid, and capacity building.

*Geographic Scope: East Asia Summit countries (ASEAN+6)*

### **Institutional Framework, Principles, and Key Elements of an Integrated Electricity Market in ASEAN**

ASEAN countries still face many challenges in building an integrated market for electricity in the region. First, ASEAN will need a target model as the top-level design of the electricity market for ASEAN power grid interconnection. Second, the region needs to develop a common vision regarding the future needs of power infrastructure that translated into an integrated plan, which serves as an important basis for interconnecting cross-border energy infrastructure. Third, ASEAN needs to formulate common principles, rules, standards, and network codes that govern the grid operation and electricity trade. Fourth, the region has to ensure that new investors are allowed to enter the market. The last precondition for an integrated

electricity market is the adoption of a market-oriented pricing mechanism.

This study aims to firstly review and introduce the basic elements of an integrated electricity market, referring to the literature on the European electricity markets, the US electricity markets, and African electricity markets.

Subsequently, the Delphi method is adopted for conducting a survey amongst the ASEAN member countries. The survey covers the individual experts from utility companies, policy making agencies, and regulating agencies of the member countries. The purpose is to identify what components or elements of the design of a working market model are needed and feasible in ASEAN.

Eventually, the identified components or elements will be put together and analysed. This practice is to put up a market design based on these selected blocks and see if theoretically they are consistent and working to serve as a functioning market in the region.

### **Policy Implications**

Currently, the electricity market in ASEAN is mostly characterised by a single buyer model, except in Singapore and the Philippines. Generators and transmission and distribution system operators are also mostly bundled. When it comes to cross-border electricity trade in ASEAN, it is still limited to bilateral trading based on power purchase agreements. The possibility of multilateral trade of electricity in ASEAN is still under discussion and negotiation. To eventually

move to an integrated electricity market in the region, it is thus recommended to take a step by step approach. For the first phase of market integration, the following milestones should be reached:

- (1) Sharing data and information for coordinated planning and development of power infrastructure
- (2) Developing a compensation mechanism for third party access to the grid, and
- (3) Coordinating the allocation of available cross-border transmission capacity, perhaps using simple methods as a starting point

In the second phase, however, advanced levels of integration should be reached and a competitive regional electricity market should start to take its shape, especially reflected in the following aspects:

- (1) Deregulation, unbundling, and domestic market liberalisation
- (2) Harmonisation of technicalities, standards, and principles regarding the grid operations and allocation of transmission capacity
- (3) Mandating a minimum interconnection level for each country

### **Integrated Space-Based/Geospatial System to Strengthen the Resilience and Connectivity of ASEAN**

*Partner: The University of Tokyo*

Space and Geospatial Technology (SGT) had been developed as intelligence technology. Space infrastructure – such as satellite observation, positioning and tracking, and communications –

helps more effective decision-making by reducing uncertainties and risks through continuous monitoring and visualisation of contextual information of the real world, such as people mobility and activity, vehicle traffics, weather, oceanographic conditions, and disaster.

SGT-based integration supports the development of large-scale production–delivery systems integrating many enterprises over various industrial fields by reducing uncertainties caused by external factors. As a result, more products and services could be created and delivered more efficiently. In the ASEAN region, where many and diverse organisations, enterprises, and people operate over a large area, it is very important to achieve ‘unbundling’. Unbundling is a process as part of which many diverse communities and companies recognise their own unique roles and connect with each other to produce unique and diverse products and services more efficiently and effectively. SGT should be a critical infrastructure of information sharing for ASEAN’s unbundling.

On the other hand, ASEAN prioritises people’s safety and stable living standards. SGT also contributes to better resilience of the region – the most populated and disaster-prone area in the world – by providing proper dissemination and navigation against disaster risks. For SGT-based integration to proceed in the ASEAN region, public–private partnership (PPP) of space infrastructure development should be promoted and development of ground infrastructure supported. Another important issue is establishing data policies that facilitate trans-border data transfer and wise use under proper management. This study analysed the

strategies and frameworks of the development of ASEAN's data policy and space infrastructure.

The policy implications of this research are as follows:

1. GST has the potential to strengthen resilience although a sustainable mechanism for integrating the technologies has not been established yet.
2. There is a need for (i) a trans-border mechanism 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 PPPs to operate collaborative integration of the technologies in a sustainable and practical manner.
3. To implement such a mechanism, assessing the benefits of SGTs and its applications, and conceptualising necessary policies are important. It includes information on what technology and combinations of technologies are applied and how those contribute to ASEAN's resilience.

*Geographic Scope: ASEAN*

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

*Partners: The Institute of Energy Economics, Japan (IEEJ), and Confederation of Indian Industries (CII)*

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 participating in the development process of the neighbouring countries of Bangladesh, Bhutan, Myanmar, and Nepal. These countries, along with other states of India, have been amongst the most dynamic in Asia and have produced highly impressive socio-economic development.

The advantages of economic integration amongst these countries also emanate from politico-historical links, geographical proximity, socio-cultural cohesiveness, economic complementarities, and scope for further economic integration towards ASEAN and China. However, the progress of trade and investment as well as industrial development in the eight states of the NER has been relatively limited by various infrastructure bottlenecks, policy misalignments, and information gaps.

This study aims to (i) determine the development needs of the energy sector and potentials of electricity generation in the NER; (ii) analyse the opportunities for cross-border energy trade between the NER and other neighbouring countries; (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 national and international cooperation.

The policy implications of the study are as follows:

1. Preparing the enabling legal framework is critical for enhancing cross-border energy trade of the NER nationally and regionally.
2. The local and provincial communities and borderland areas should be 'sensitised' to support



cross-border energy trade ventures that promote and propagate provincial, national, and regional well-being.

3. A common energy platform and strategic planning and management exclusively for the NER is needed. Concerned ministries, independent power producers, multilateral institutions, national grid/private distributors, and other stakeholders could firm up the development of the cross-border energy sector.
4. The absorptive capacities of the neighbouring countries for electricity exports from the NER and other regions should be assessed in terms of market, transmission capacities, regulatory framework, investment destinations, and other institutional capacities.

*Geographic Scope: Bangladesh, India, Myanmar*

### **Nuclear Public Acceptance Improvement**

*Partner: The Institute of Energy Economics, Japan (IEEJ)*

A negative attitude toward introduction of nuclear power has spread in quite a few countries, including Japan, since the accident at Fukushima Daiichi Nuclear Power Plant. Not only Germany but also Taiwan and Switzerland have changed course and are moving toward abandoning nuclear power generation. In Asia, while China and the Republic of Korea are steadily pushing forward with boosting the number of nuclear power plants according to official energy policy, ASEAN member nations are still undecided. Negative

voices were raised in Viet Nam and the Philippines, which had already started their pre-implementation activities; a plan to construct a nuclear power plant has come to a halt in Viet Nam, and a similar plan that was promoted several times has been stopped in the Philippines. Introduction of nuclear power generation is being considered in countries outside Asia, but efforts to win over citizens are still only halfway through, and opportunities are not rife.

To improve public acceptance, it is important to hold an international symposium for experts from all over the world. All the more important, however, is to invite leaders of regions and opinion leaders of municipalities of developed countries where nuclear power facilities are located, such as European nations and the US, to hold discussions at a workshop, putting in order and gathering requirements necessary for improving public acceptance and coming up with policy proposals. The policy proposals are urgent because it takes quite a long time to complete nuclear power introduction and power plant construction.

1. Conditions common to and necessary for the public acceptance will be put in order and analysed. What the operator, central government, local government, residents of the municipality hosting a nuclear power plant, neighbouring residents, and the residents in the region consuming the electricity generated by the plant should do themselves and in cooperation with each other, as well as requirements for improving public acceptance, will be summarised and included in the policy proposal.

2. The policy proposal should include building nationwide public acceptance, while reflecting on the background of invitation to nuclear power plants in the major nations such as European countries and the US, coexistence of nuclear power generation and local economies, the present state of measures to prevent nuclear disasters, and how communication is carried out at each phase of the invitation, construction, and operation.

*Geographic Scope: ASEAN*

### **Seeking Optimal Solutions on Delivering LNG to Medium-sized and Large Islands in Philippines**

*Partner: The Institute of Energy Economics, Japan (IEEJ)*

The Philippines consists of many islands and their electricity supply mostly depends on diesel generators. Diesel generator are useful as they are a well established technology and oil is easy to care for. However, it has the disadvantage of relatively high generating costs and high emissions.

On the other hand, Liquefied Natural Gas (LNG) has the advantage of lower fuel costs and lower emissions as a fuel for power generation. Until recently, the challenges of LNG, such as larger up-front cost and extremely low temperature, has stopped countries from using it. But technological development, particularly floating storage and re-gasification, is removing such challenges. The Philippines can enjoy the economic and environmental benefit of LNG by adopting such

technologies to supply LNG for power generation on medium-sized and large islands.

The study analyses such opportunity on islands by identifying possible configurations of small-scale LNG supply chains for power generation, thereby contributing to a stable, sustainable, and affordable supply of electricity, an essential element of the Philippines' national development.

The study is consistent with all the strategic themes in the AEC Blueprint 2025 and its subordinate paper APAEC 2016-2025 phase 1, and contributes to 'Regional Energy Policy and Planning' which aims to enhance integration of energy policy and planning.

- a. There are some islands in the Philippines where electricity demand is high enough to run gas-fired Combined Cycle Gas Turbines (CCGT), which have the advantage of:
  - o supplying electricity stably
  - o supplying electricity at lower cost than diesel generators
  - o supplying electricity with lower emission than diesel generators
- b. Small-scale LNG delivery systems that are typically configured with small LNG ships, floating (or onshore) LNG storage and re-gasification unit (FSRU) are best suited to fuel such gas fired CCGT in islands.
- c. Security of demand, in this case gas-fired CCGT, is crucial to making investment decisions on small scale LNG delivery system. In this regard, it is suggested to form integrated development plan/ project organiser of gas-fired CCGT and small scale LNG delivery system.



- d. Government can support projects in the fields:
  - o Authorisation of project (fast-track)
  - o Land use
  - o Financial support (tax benefit, loan guarantee, etc.)
  - o Announcement to the public

*Geographic Scope: Philippines*

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

*Partner: Fuyuhiko Nishimura (TEPCO)*

This project aims to provide technical and advisory services to the Heads of ASEAN Power Utilities and Authorities (HAPUA), specifically HAPUA's Working Group No. 2(HWG2) on the criteria, structures, roles, and requirements for the formation of two institutions necessary to advance the ASEAN Power Grid (APG). The APG institutions that require assistance with their formation are: (i) the APG Generation and Transmission System Planning (AGTP), and, (ii) the APG Transmission System Operator (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, as well as to the ASEAN Secretariat as it monitors and facilitates the implementation of measures under the AEC Blueprint 2025.

Firstly, the project shall deliver the technical guidelines for the AGTP study by taking into consideration

the different processes and institutional structures of the existing national grid planning agencies of each AMS. Subsequently, the project shall deliver an implementation plan for the AGTP institution, professional advice, and recommendations, by taking into consideration the different processes and institutional structures of the existing national grid planning agencies of each AMS.

As the results of this project, the final deliverables include:

1. a literature report, which reviews the past studies on APG, updates on the progress of APG, summarises the key barriers and challenges faced by APG, and outlines the theoretical market design for power grid interconnection and trading of electricity in ASEAN
2. an implementation plan containing the principles, framework, and other technical arrangements for the establishment of the AGTP institution
3. a roadmap of actions and milestones in establishing the AGTP institution, and presentation slides that are to be presented to HWG2 and APG Consultative Committee (APGCC) for endorsement, before submission to the HAPUA Working Committee.

The 10 ASEAN countries' electricity market regulators, policymakers, transmission and distribution system operators, and power generators will thus benefit from the findings of this study by using it as a reference to develop specific guidelines or common protocols/codes for the AGTP.

*Geographic Scope: ASEAN*

## **Study on the Formation of the ASEAN Power Grid Transmission System Operator Institution (ATSO)**

*Partner: Hans-Arild Bredesen (Nord Pool Consulting AS)*

ERIA is currently working with HAPUA on two research projects concerning the criteria, structures, roles and requirements for the formation of ASEAN Power Grid (APG) Generation and Transmission System Planning (AGTP) Institution and the formation of ASEAN Power Grid System Operator (ATSO). These two projects are closely linked and they will have a significant influence on each other; and the deliverables needs to be harmonised to get the full potential out of these two new institutions.

The ATSO will be a key institution to enable multilateral trading of electricity amongst ASEAN countries while maintaining the balance, stability, and reliability of the interconnected power grids across borders and or harmonising operational standards across ASEAN.

This project aims to produce the criteria, structures, roles, and requirements for the formation of the ATSO. In the long run, this work will support the establishment of greater ASEAN Connectivity.

The projects will be implemented by ERIA, which will be responsible for coordinating the stakeholders of this study, also identifying and contracting two international consultant teams to carry out the two projects together with workshops with relevant experts and officials from ASEAN Member States.

The output and deliverables of the above activities will be four different documents to be developed by the project team assigned to this task. One of the important outputs here – also in connection with the fourth output – is to create a Gap analysis for each of the countries.

1. Questionnaire and dataset collected for ATSO
2. Guideline for ATSO
3. Literature report (interim, final) for ATSO
4. Implementation plan for ATSO
5. Road map for ATSO
6. Presentation slides will be developed for presenting the ATSO deliverables to a wider audience.

*Geographic Scope: ASEAN*

## **Sustainable Development of Transport Sector: Malaysia's Case**

*Partner: The Institute of Energy Economics, Japan (IEEJ)*

The transport sector accounts for a large part of oil consumption in many ASEAN countries. Although oil has high utility, it also has negative aspects such as a higher price and geopolitical concern of supply. Therefore, curbing oil consumption in the transport sector is an important element of energy security policy. This also applies to oil exporting countries because wasteful use of oil will harm oil export revenue in the long run. Needless to say, transition

to lower carbon transport systems is a prerequisite for every country in terms of meeting their CO<sub>2</sub> emission reduction goal, i.e. nationally determined contributions.

Meanwhile in ASEAN, where transport demand is likely to increase in future, if appropriate policy and corresponding action is failed to be implemented, countries may face serious problem such as health damage caused by pollution and economic loss caused by traffic congestion. Hence, ASEAN countries are urged to understand the sustainability of their transport systems, and identify the necessary policy actions for avoiding such negative scenarios.

Against this background, firstly the study will identify the policy gaps of selected nations, secondly it will try to evaluate the usefulness of different policy packages in a quantitative manner, and lastly it will formulate policy recommendations to mitigate CO<sub>2</sub> emission in the transport sector. Malaysia will be selected as a subject of study as it is strongly committed to improving its transport sector, and hence the government is likely to cooperate fully with the study.

The study is consistent with the strategic theme of 'Energy Efficiency and Conservation' in the AEC Blueprint 2025 and its subordinate paper APAEC 2016–2025 phase 1, and contributes to efficiency improvements in the transport sector in particular. In addition, the study is consistent with the goal of creating a sustainable society in the ASCC Blueprint 2025, particularly corresponding to the principles of 'C.2. Environmental Sustainable Cities', 'C.3. Sustainable Climate', and 'C.4. Sustainable Consumption and Production'.

1. The study will identify the gaps (strengths and weaknesses) of existing policy.
2. The study will identify the effects of different policy combinations to reduce CO<sub>2</sub> emission in the transport sector.
3. The study will provide policy recommendations for Malaysia to effectively, both in terms of amount and cost, reduce CO<sub>2</sub> emission in the transport sector.

*Geographic Scope: Malaysia*

### **Theoretical and Empirical Studies on Energy Poverty in ASEAN**

*Partner: Energy Research Institute, Nanyang Technological University*

The existing literature suggests that there are many factors leading to energy poverty resulting in detrimental impacts on health, gender inequality, education, and economic development. But, no study has provided country-specific sustainable and affordable solutions, which may differ from country to country depending on the socio-economic conditions, resource availability, and weather conditions.

This proposed paper's core objective is to make a significant contribution by providing an understanding of the country-specific driving factors of energy poverty in these four ASEAN countries and by suggesting commissioned climate friendly budget solutions to alleviate the problem in these regions. Based on the main factors of energy poverty in each region the degree of energy accessibility, and

affordability, we would suggest modified renewable energy solutions. A solution mix may be required according to various classified groups (1.2 – 2.2 in Table 1) and the prevailing socio economic conditions. It is also important to assess the gap between the current governmental policies and the policies needed to address the problem of energy poverty effectively.

Hence, we aim to study two main research questions:

1. Firstly, what is the measure of energy poverty in the four ASEAN countries – Philippines, Cambodia, Indonesia, and Lao PDR – and what are the social, economic, climatic, and resource availability dynamics which are responsible for energy poverty in these countries?
2. Secondly, what are the affordable and sustainable mechanisms or the solution mix suitable for each country which should be adopted to alleviate the energy poverty problem and what changes to the current governmental policies are needed?

Key recommendations emanating from the empirical results and possible solutions can be broadly categorised into five sets:

- o Energy efficiency – Targeting cost efficient and energy saving technologies largely involving renewables.
- o Awareness and education – Making people aware of the health hazards of using biomass as a source of energy and educating them about the cheap technologies available based on renewable resources
- o Regulation and legislation – Clearly define the role of the local authorities, regional authorities, and national authorities

- o Financing mechanisms – suggestions for a tariff plan and propositions of alternate financing schemes and requirement, and extent of subsidies.
- o Information – Providing information on tariff structure and energy-saving measures.

In addition to research projects and studies, ERIA researchers continued to actively share their expertise and thoughts outside ERIA as (i) keynote speakers, paper presenters, panellists, or discussants at various events organised by other institutions; (ii) resource persons or advisers on key policy issues to government officials or ministries; and (iii) as contributors of articles or opinion editorials in major journals, magazines, quarterlies, and newspapers in the region. These contributions not only helped promote the work and mandate of ERIA but they also provided important perspectives and insights for public discussions of policy issues. Annex G lists the outreach activities of ERIA researchers in FY2017.