

Energy



1. Assessment on Necessary Innovations for Sustainable Use of Conventional and New-Type Geothermal Resources and their Benefits

Partners: National Institute of Advanced Industrial Science and Technology, Japan

Against a backdrop of rising demand for sustainable energy solutions, there is a growing convergence in the role new types of geothermal technologies such a Ground Source Heat Pump (GSHP) can play in addressing energy security, generating local employment, and mitigating climate change. This

report critically examines technical, social, policy, legal, and fiscal barriers to geo-thermal power production, direct use, and GSHP, and the estimated benefits in China, Indonesia, Japan, the Republic of Korea, Malaysia, the Philippines, Thailand, and Viet Nam. The estimated benefits are multiple and vary across the countries. For example, with a target capacity factor of 70%, Indonesia is in a position save 232 billion barrels of oil, avoid 129 million tons of carbon emissions, and generate about 15,000 local jobs. There are potential net benefits on a similar scale in the Philippines, Japan, China, and the Republic of Korea. Amongst the five types of barriers, it was found that technical and policy barriers

dominate the Indonesian geothermal sector, while fiscal barriers are prevalent in the Philippines. Social barriers remain a challenge in Japan regarding direct use and GSHP.

Three main areas are recommended for immediate policy action. One, clarify precisely the role of each state entity in providing critical incentives and concessions at three different stages of geothermal power development. Second, the tariff setting and tax holidays for geothermal, direct use, and GSHP should be seen not as a one-time event, but as a process – based on a published methodology and stakeholder consultation. Third, the inability to develop new resources is often due to lack of information on the reserve capacity. More spending on research and development is recommended. Geographic scope: China, Indonesia, Japan, Republic of Korea, Malaysia, Philippines, Thailand, and Viet Nam

2. Cambodia Energy Basic Plan

Total Primary Energy Supply (TPES) increased at the same rate as Gross Domestic Product (GDP) in Cambodia but TPES without biomass increased 2.0 times and it was much higher than GDP (1.5 times) in the same period. Curbing coal, oil, and electricity demand to GDP level is crucial. Cambodia has been increasing import of coal and petroleum from other ASEAN countries such as Indonesia and Singapore and this has affected Cambodian economic growth. Consequently, the Ministry of Mines and Energy (MME) needs an appropriate and comprehensive basic energy plan now and the Economic Research Institute for ASEAN and East Asia (ERIA) supports

MME to set up the basic energy plan. Put simply, the basic energy plan should contribute two points: saving conventional energy consumption such as oil and electricity; and utilising domestic energy such as hydro-power and biomass.

ERIA and MME a basic energy plan for Cambodia in 2018 (BEPC2018) which is appropriate, comprehensive, feasible and effective. In addition, the basic plan should have numerical target per each energy issue covered by this plan and the target should be achievable.

The Basic principal of this plan seeks for energy supply to Cambodia with following conditions;

- a. Affordability
- b. Accessibility
- c. Security (Sustainable Security)
- d. Safety
- e. Transparency on market

Recognising current energy issues in Cambodia, the basic plan covers following 6 energy fields; a. Oil, b. Electricity Supply, c. Renewable Energy, d. Energy Efficiency, e. Energy Security and f. Energy Outlook.

Geographic scope: Cambodia

3. Comparative Analysis of Power Prices in the Philippines and Selected ASEAN Countries

Partner: IEEJ

This study compares the electricity supply costs in the Philippines with that in three ASEAN member countries – Indonesia, Malaysia, and Thailand. The study presents seven recommendations pertaining to



the Philippines' electricity supply chain, ranging from fuel supply to electricity distribution.

Recommendations to 'shift back to market-based load dispatch', 'adopt thermal efficiency standards for power generation', and 'create good business environment to reduce WACC' are identified with larger effects on cost reduction than the other recommendations. Thus, it is suggested that promotions should focus on the most impactful policy recommendations.

Geographic scope: ASEAN

4. Electricity Futures in the Greater Mekong Subregion: Towards Sustainability, Inclusive Development, and Conflict Resolution

Partner: The University of Tokyo

International energy markets are seeing a wave of innovations and the rise of new ideas and values, and the emerging economies of the Mekong sub-region should not be left behind. This report focuses on the electricity future of Myanmar and the Greater Mekong Subregion, emphasising rural electrification through renewable power generation by means of mini-grids as well as central-grid capacity expansion through sustainable power options. It analyses the current energy situation, including constraints in the region during this transitional stage, and proposes tangible policy recommendations that work towards energy security, environmental protection, and climate change mitigation. It recommends Myanmar takes advantage of the falling cost of solar electricity by making it a strategic priority in its power development plan; devises appropriate financial

support schemes and power purchase agreements to be provided to mini-grid developers as well as operators; actively participates in the regional power grid to expand its access to electricity and meet rising urban power demand; and minimises environmental and societal risks.

Geographic scope: Myanmar, Thailand, Viet Nam, Lao PDR, Cambodia

5. Electrification of Road Transport in ASEAN and Energy Security: Quantitative Analysis and Policy Implications

Electrification of road transportation (or electric mobility) has progressed beyond the demonstration stage. Many ASEAN countries express an increasing interest in it. This study starts with a survey of all ASEAN countries, regarding their existing vehicle fleets, fuel consumption and share, fuel mix in the power generation sector, and so on. The study estimates the potential of electrifying a certain country's various fleets, including passenger vehicles, buses, and trucks – the main contributor to fossil fuel consumption in road transport, in 2040 scenarios. It is subsequently assessed how electric mobility enhances energy security of ASEAN countries using the '4As' perspective that comprises the availability of energy, the applicability of energy, the acceptability of energy, and the affordability of energy. The findings reveal intensive interaction of electrification of road transport with the introduction of higher fuel economy standards and higher renewable integration in the power sector, in an ASEAN context.

Geographic scope: All ASEAN Countries

6. Energy Outlook and Energy Saving Potential in East Asia 2019

Sustained population and economic growth will significantly increase Total Final Energy Consumption (TFEC) by 1.6 times from 2015 to 2040. Total Primary Energy Supply (TPES) in the EAS17 region is projected to grow at a slightly slower pace, of 1.5% per year. TPES of EAS17 is projected to increase from 7,488 Mtoe in 2015 to 10,943 Mtoe in 2040. Coal will remain the largest share of TPES, but its growth is expected to be slower, increasing at 1.3% per year. Consequently, the share of coal in TPES is forecast to decline from 41.4% in 2015 to 38.9% in 2040. Increasing the use of Clean Coal Technology (CCT) and development of Carbon Capture Storage (CCS) technology will be critical for the coal power plants in this region to mitigate CO₂ emissions and become carbon free.

Fossil fuel energy consisting of coal, oil, and gas will still be dominant in 2040 and its share under the business-as-usual (BAU) scenario will be 84.1%. If EAS17 countries remain dedicated to implementing their energy efficiency and conservation (EEC) policies and increase low-carbon energy technologies such as nuclear power generation and solar photovoltaic (PV)/wind (alternative policy scenario, APS), the EAS17 region could achieve fossil fuel savings of 23.4% and the fossil fuel share could fall to 76.6%. CO₂ emissions would be reduced significantly by about 24.2% from BAU to APS as a consequence. In view of this, it is essential that EAS countries implement their EEC and renewable energy policies (energy saving targets and action plans) as scheduled. The targets and action plans that will be applied across sectors – industry, transport, residential, and commercial – should be appropriate

and feasible. It is encouraged for all Government in EAS17 countries to support EEC service companies (ESCO) activities as it is crucial to achieve energy efficiency and saving in all sectors.

Renewable energy such as hydro, geothermal, solar PV, wind, and biomass will also contribute to the expected reduction of fossil fuel consumption, which will result in a mitigation of CO₂ emissions. To increase the share of renewable energy in the primary energy mix, appropriate government policies will be crucial. Policies such as Net Metering, Renewable Portfolio Standards (RPS), and Feed-in-Tariff (FIT) have been implemented in some of the EAS17 member countries and have accelerated the deployment of renewable energy at appropriate levels.

Energy supply security has become a top priority energy issue for the EAS17 region. Implementing EEC measures and increasing renewable energy shares will certainly contribute to maintaining regional energy security through the reduction of imported fossil fuel consumption and increasing the use of domestic energy. In addition, regional energy networks such as the Trans-ASEAN Gas Pipeline (TAGP) and the ASEAN Power Grid (APG), and oil stockpiling are recommended to maintain energy supply security. Nuclear power generation is another option for securing the energy supply in this region.

This year the Energy Outlook includes an estimation of the investment cost required for power generation and the whole energy infrastructure including the LNG receiving terminals, and oil refineries. The analysis results indicate that the EAS17 region will need around US\$3.5 trillion for the BAU case, and US\$4 trillion in the APS for the power generation



investment to meet electricity demand by 2040. The required investment cost of refinery and LNG receiving terminals in EAS17 will be US\$367 billion and US\$132 billion, respectively, in the BAU case due to an increase in oil demand especially in the road transport sector and an increase in natural gas demand in the power generation sector.

Geographic scope: ASEAN and East Asia

7. Public Acceptance of Nuclear Power, Phase I

Partner: Institute for Energy Economics, Japan

Across countries and continents, public acceptance of nuclear power is a crucial factor when governments wish to set up a nuclear energy programme. Therefore, it is important to understand the determinants of public acceptance of nuclear power. This report examines the effects of knowledge, trust, risk, and benefit related factors on public acceptance of nuclear power in Europe, the United States, and Japan. Through field visits and interactive workshops different levels of public acceptance and related communication strategies to effect changes are identified. The report also identifies the effective communication role sub-regional authorities and non-governmental organisations could play. The cost of generating electricity and energy security concerns appear to have the strongest positive effect on public acceptance of nuclear power.

Geographic scope: Japan

8. Integrating NER India with Regional Economies through Cross Border Energy Sector Development, Phase I

Partner: Confederation of Indian Industry

Energy is common thread that connects multiple areas of sustainable development for countries and sub-regions in Asia. In the drive to trigger and consolidate inclusive development, the North Eastern Region (NER) of India offer great potential as an electricity trading hub. This report analyses the multiple benefits of connecting the NER with neighbouring economies through cross border energy trade. Supply demand analysis under different connectivity scenarios shows that not only will NER-India be able to fully utilise the economic benefits of energy connectivity, but also that neighbouring countries like Bangladesh, Bhutan, and Myanmar would be able to keep carbon emissions in check by importing reliable and cost-effective renewable energy sources. In addition, those countries can reduce the energy security risks of serious supply gaps arising in the dry seasons. To harness the untapped energy potentials and make NER into a robust economic growth pole, this report recommends to initiate multi-layered interdisciplinary dialogues on tariffs and consultations on investment cooperation amongst various stakeholders and development partners, both within NER states and outside India.

Geographic scope: India, Myanmar, Bangladesh, Bhutan

9. Natural Gas Master Plan for Myanmar

Partner: IEEJ

Natural gas will play a very important role in Myanmar in the future. Although Myanmar has been a major producer of natural gas in Asia, the country has not fully utilised natural gas for its own uses. Thanks to the sustained economic growth that has followed the 2011 economic reform, the demand for energy and natural gas has grown significantly. Demand for natural gas in Myanmar has increased 1.4 times since 2011, the second largest demand growth after oil. The primary driver of this growth has been demand for natural gas to generate power, which accounted for 72% of total natural gas consumption in 2017. Natural gas (compressed natural gas) is also used by the transportation sector as fuel, but demand from the industrial sector is limited, and there is no residential demand as of 2017.

Natural gas demand is forecast to grow from 457 million cubic feet per day (mmcf/d) in 2017 to 1,142 mmcf/d in 2040. Although demand from the power sector will continue to lead demand growth in the country, demand from the industrial sector and (after 2030) the residential sector is also expected to grow significantly.

Industrial demand for natural gas will be mainly observed in the Yangon and Mandalay regions. Thilawah Special Economic Zone (SEZ), in particular, is a prospective user of natural gas for manufacturing. Once the supply infrastructure is developed, city gas will become a more cost-competitive energy source than liquefied petroleum gas such as butane. Natural gas will be increasingly

demand by power plants that supply electricity to manufacturing factories in the SEZ. Because the SEZ is located close to the existing pipeline network, the cost of developing the necessary infrastructure will be limited. The investment cost of developing industrial demand in the Yangon region is estimated at US\$3.5 million.

Natural gas demand from the industrial sector in the Mandalay region will be developed in several locations. To develop industrial demand in Mandalay Industrial Zone, near downtown Mandalay, a pipeline network more than 40 km long needs to be constructed. Due to the high cost of such infrastructure development, some form of public support will be required to realise the pipeline development. Another potential demand area is Myotha Industrial Park City. Located near the existing natural gas export pipeline to China, it has good access to a natural gas supply and, given the size of the area, has significant potential to develop demand in the future. The required total investment to develop industrial demand in the Mandalay region is estimated at US\$24.5 million.

The Government of Myanmar should continue to play a pivotal role in developing the natural gas market. Since a market mechanism cannot fully reflect the benefits offered by natural gas, as a clean and low-carbon source of energy, the supply security advantages that it offers, and the convenience of its use, the government should provide policy support to promote the use of natural gas.

Geographic scope: Myanmar



10. Renewable Energy Potential and Its Effective Usage in East Asia Summit Countries

Partners: National Institute of Advanced Industrial Science and Technology, Japan

East Asian countries are actively promoting the introduction of first-generation biofuels such as bioethanol and biodiesel, but are constrained by several feedstock and production factors. To reduce the import of crude oil and energy consumption in the transportation sector, overarching action such as production of next-generation biofuels from nonconventional resources, improvement of fuel efficiency of vehicles, and maintenance of road infrastructure needs to be taken. Against this background, the report estimates the potential of a diversified transportation energy mix, analyses the techno-economic feasibility of next-generation biofuels, and scrutinises the advances that need to be made in the use of bio-methanol as a mainstream energy carrier. Country-specific recommendations on the introduction of alternate biofuels, fuel efficiency standards, and regional trade are provided for Indonesia, Thailand, Malaysia, and the Philippines.

Geographic scope: Indonesia, Thailand, Malaysia, and the Philippines

11. Seeking Optimal Solutions on Delivering LNG to Mid- and Large Islands in Philippines

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

The Philippines consist of a large number of islands and their electricity supply mostly depends on diesel generators. Diesel generators are useful as it is a well established technology and oil is easy to care for, although it has the disadvantages of relatively high generating cost and high emission.

Liquefied natural gas (LNG) has the advantage of lower fuel cost and lower emission as a fuel for power generation. New technologies such as floating storage and re-gasification have reduced the downsides of LNG and the Philippines should be able to enjoy the economic and environmental benefits of its use by adopting such technologies for power generation on its medium-sized to large islands.

The study analyses such opportunities on islands by identifying possible configurations of small- scale LNG supply chain for power generation, thereby contributing to a stable, sustainable supply of affordable electricity in the Philippines.

The study is consistent with all the strategic themes in the AEC Blueprint 2025 and the ASEAN Plan of Action on Energy Cooperation (APAEC) 2016–2025, Phase 1, and contributes to ‘Regional Energy Policy and Planning’, which is meant to enhance integration of energy policy and planning.

Geographic scope: Philippines

12. 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 requiring assistance in their formation are the APG Generation and Transmission System Planning (AGTP) and 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 will deliver the technical guidelines for the AGTP study by taking into consideration the different process and institutional structures of the existing national grid planning agencies of each AMS. Subsequently, the project will deliver an implementation plan for the AGTP institution, professional advice, and recommendations by taking into consideration the different process and institutional structures of the existing national grid planning agencies of each AMS.

Geographic scope: ASEAN

13. 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 will have a significant influence on each other, and the deliverables need to be harmonised to obtain the full potential from 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 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, and also for 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.

Geographic scope: ASEAN



14. 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 supply concerns. Therefore, curbing oil consumption in the transport sector is an important element of energy security policy. It is the same for oil exporting countries because wasteful use of oil will harm oil export revenue in the long run. Transition to a lower-carbon transport system is necessary for all countries to meet their CO₂ emission reduction goals (Nationally Determined Contributions).

Transport demand is expected to increase in ASEAN, and if the member countries fail to implement appropriate policies and take the necessary actions, they could face serious problems such as health damage caused by pollution and economic loss caused by traffic congestion.

The study will identify the policy gaps in selected countries, evaluate the usefulness of different policy packages quantitatively, and formulate policy recommendations to mitigate CO₂ emission in the transport sector. Malaysia will be selected as a subject of study because of its strong determination to improve its transport sector.

The study is consistent with the strategic theme of 'Energy Efficiency and Conservation' in the AEC Blueprint 2025 and the ASEAN Plan of Action on Energy Cooperation (APAEC) 2016–2025, Phase 1,

and should contribute to efficiency improvements in the transport sector in particular. It is also consistent with the goal of creating the sustainable society foreseen in the ASCC Blueprint 2025, particularly the principles of 'C.2. Environmental Sustainable Cities', 'C.3. Sustainable Climate', and 'C.4. Sustainable Consumption and Production'.

Geographic scope: Malaysia

15. Theoretical and Empirical Studies on Energy Poverty in ASEAN

Partner: Energy Research Institute @ NTU

The existing literature suggests that there are many factors leading to energy poverty, with detrimental impacts on health, gender inequality, education, and economic development. No study has yet 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 paper's core objective is to make a significant contribution by providing an understanding of the country-specific driving factors of energy poverty in four ASEAN countries and by suggesting commissioned climate friendly budget solutions to alleviate the problem in these countries. Based on the main factors of energy poverty in each region as well as the on the degree of energy accessibility as well as 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 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.

- 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 responsible for energy poverty in these countries?
- 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 are the policy changes required in the current governmental policies?

Geographic scope: ASEAN and India

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

Partner: Asian Development Bank Institute

A comprehensive assessment of the state of low-carbon investments in Asia is made by analysing the rationales, mandates, and public–private financing activities. Based on the experiences of several regional initiatives wherein public financing is catalysing private investments in low-carbon infrastructure, this book proposes a framework that can be used as a tool to identify factors that influence private investment decisions and policy instruments that can increase private capital.

Placing the Asian economies onto a low-carbon development pathway requires an unprecedented shift in investment. This book addresses this situation by asking questions such as: What is the central role of private finance in achieving the Paris Agreement targets?; What key policy levers and risk mitigation can governments use in an effort to unlock the potentials of private capital?; How can regionally coordinated actions hold significant promise for increasing private investment?

Geographic scope: ASEAN, East Asia and India

