Executive Summary

The recent economic growth in East Asia Summit (EAS) participating countries, especially emerging ones, has driven energy demand to rapidly rise. Although these countries have been introducing energy supply infrastructures such as power plants, some of them still face instability, high cost of energy supply, and high emission of greenhouse gases (GHGs). For example, islands, mountainous areas, and other remote off-grid areas mainly rely on diesel power and other energy sources, where high energy costs and reduced GHG emissions are the big challenge. Industrial and commercial zones of emerging countries of the Association of Southeast Asian Nations (ASEAN) are sometimes faced with unstable energy supply. This is likely to prevent companies from investing and providing goods and services. Distributed Energy Systems (DESs) can solve these challenges due to the increasing availability of small power generation and intelligent grid technologies. It is necessary to find what role DESs can play so that ASEAN participating countries could utilise these systems. The energy ministers, during the 9th EAS Energy Ministers Meeting, welcomed the DES study as they realised the role of DES in enhancing electricity access and providing solutions to energy problems for the well-being of both investors and consumers.

The DES concept is not new, and it has been applied since the start of power generation in the late 18th century when Thomas Edison built the first power plant to provide electrical and mechanical power at or near the point of use (Brandon, 2014). Now, the DES concept and application have been widely used to respond to increasing energy demand. The flexibility of DES at multiple locations makes it economically and technically viable, attracting many industrial, commercial, and residential units. Most widely installed DESs can be found in mountainous, island, and remote areas and in economic zones with microgrids because of their scale and flexibility.

Globally DES has gained popularity to provide secure, reliable, and affordable energy to customers. The wave of decentralised energy systems through DES applications is gaining market share because of their lower capital cost, thus making energy affordable in many parts of the world. The technological development of small and distributed generators from all types of energy sources (diesel, gas, coal slurry, wind, solar, geothermal, and mini-hydropower) has become more effective and less costly today

than they were a decade ago. DES creates a decentralised power system through which distributed generators meet local power demand. Because they are small and have lower capital requirements, they can be built and made operational faster with less risk than large power plants.

The ASEAN primary energy supply is projected to increase by almost threefold from 592 Mtoe in 2013 to 1,697 Mtoe in 2040 (Han and Kimura, 2016). This pattern of increasing energy demand threatens energy security, especially the provision of energy access, affordable price, and stable energy supply sources. The idea of transboundary grids is being promoted in the ASEAN Power Grid (APG). The APG is expected to significantly maximise ASEAN's benefit from avoiding power generation costs; however, they are expensive and it may take years to realise the connectivity. In contrast, DES can overcome cost constraints that typically inhibit the development of large capital projects and transmission and distribution lines.

Thus, this study will map out the current situation of DES in selected ASEAN Member States, and discuss the opportunities for DES in the ASEAN region to support and foster the convergence of the ASEAN Economic Community and sustainable economic growth by providing affordable, reliable, and better energy sources with less GHG emissions.

Chapter 1 introduces DES and discusses the methodology of DES in ASEAN. Chapter 2 estimates the potential of ASEAN's DES from renewable energy. Chapters 3 to 6 are studies of Indonesia, Malaysia, the Philippines, and Thailand on DES and policies. The book is the first of its kind to come up with DES in ASEAN and in specific countries. The findings are as follows:

ASEAN

The estimated power generation from combined renewable energy such as wind, solar photovoltaic, geothermal, hydropower, and biomass in ASEAN will increase significantly from the business-as-usual scenario (BAU) to the alternative policy scenario (APS), thus implying investment opportunities in this sector. Investment opportunities in BAU by 2040 for combined solar, wind, biomass, hydropower, and geothermal total about US$34 billion, and in the APS, about US$56 billion. Amongst DES-related renewable investment, that for solar and geothermal power is expected to double from BAU to the APS. Investment in wind power will increase more than threefold to meet the expected generation output by 2040. The introduction of DES application also implies reduced CO2 emissions of about 46.1–64.6 million metric tons from BAU to the APS, respectively.

Indonesia

DES can be implemented in regions like Indonesia where supply of grid-connected electricity is not available or not economically viable. It can also support electrification in a faster way rather than wait for grid-connected supply. DES is cost competitive compared to current diesel power plants. As DES projects use local energy resources, and are not necessarily technology intensive, these projects may also increase the involvement of local people in the construction and maintenance of the system, which may create jobs in the region.

As the potential of DES is huge in Indonesia, its development project can be even faster with the participation of local governments, for example, in providing lands for free for the site of the DES project. To optimise the development of DES projects and ensure their sustainability, government support – such as tax incentives, availability of low interest loan with longer tenor, and streamlined licensing process – is needed. Good electricity tariff for DES that considers the production costs and reasonable margins is also needed.

Malaysia

The implementation of DES is very important for the security of supply especially in remote areas where the connectivity is far from the grid. To ensure the stability of electricity supply without any disruption, equipment and other requirements for electricity generation should be properly installed and completed. It is costlier to install the transmission or distribution line to the national grid from remote areas. Using existing natural resources, such as biomass or biogas, DES can also reduce GHG emissions.

Through DES, a 100% electrification rate in rural areas can be achieved. Providing this basic amenity will help generate income for the economy. DES will also boost tourism on several islands of Malaysia. With some remote islands in the country located far from the national grid system, the implementation of DES will be a great solution.
Public and private funds are needed to ensure the success of DES' implementation. Government can offer attractive incentives to attract local and international investors.

Philippines

Evidently, the underlying principles of DES present substantial potentials that correspond to the current setting of the Philippine electric power industry, either through on-site embedded generation or stand-alone off-grid systems. As the

government aspires to bring inclusive economic development to the grassroots level, the concept of DES applications undeniably has an integral role in ensuring the security of energy supply in the flourishing economic and industrial zones of the country, and, more importantly, in the remote communities.

Government has recognised that the deployment of DES applications is an alternative platform to complement centralised and decentralised electrification initiatives. Harnessing the full potential of the cleaner set of fuels such as renewables is admittedly an effective mitigating measure to drastically reduce GHG emissions. This in the long run is foreseen to counter the adverse impacts of climate change. To take full advantage of this benefit, the country should pursue the development and increased use of indigenous renewable energy sources that are abundant in rural locations. However, strong policy support and mechanisms from the government are imperative.

Fundamentally, DES applications are intended to provide an affordable and reasonable source of electricity. But because the private sector lacks confidence to invest in the off-grid generation business, the national government assumes the responsibility of bringing the necessary electricity services to spur local economic development. To sustain the operations of DES in off-grid communities, government subsidises the costs of generating power. In turn, DESs have become costly compared to grid-connected power systems.

Thailand

DESs in Thailand are mainly used in the private industrial section and investment according to the Thai government's policy on subsidy. DESs in Thailand mainly promote solar and biomass. The on-grid DES of the country is expected to grow in the near future. Per the current policy on DES, about 10,000 MW of DES growth is expected. However, off-grid DES demand could skyrocket were the price of the self-generated electricity to be lower than that of retailed electricity.

The new Cabinet provided the direction of Energy 4.0. To accommodate the government's policy, the Ministry of Energy has placed the Energy 4.0 policy focused on the Thailand Integrated Energy Blueprint to drive energy innovation and to continue the desire of King Rama IX to strengthen families and communities. To enhance the power sector, the Ministry of Energy has set policies related to DES in two areas: for places where unbalanced fuel diversification and unstable renewable generation occurred, and for places where centralised generation and distribution systems are faced with high investment in the transmission system.