Renewable Energy Situation and Challenges in Asian Countries

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Abstract

More countries are aiming to achieve carbon neutral in 2050 and Japan's prime minister also pledged that the country would be carbon neutral by 2050 target on October 26, 2020. Renewable energy will be of even more importance. We can also expect that under the new 2050 target energy cooperation between Japan and developing countries will be increasingly focused on clean energy technologies, especially on applying Japanese technologies in these countries to help them reduce their GHG emissions. This paper is based on a study conducted on the status of energy and renewable energy, including a detailed study on renewable energy policy, in selected Southeast Asian (ASEAN) countries: Viet Nam, Thailand, Malaysia, Indonesia, and the Philippines.

These ASEAN countries, especially Viet Nam, Thailand and Malaysia, have seen substantial expansion of renewable energies. However, increasing PV and wind power generation may also lead to grid instability. Japanese technologies, such as battery, demand response (DR) and demand side management (DSM) can help to solve grid integration challenges. Financial and institutional design for supporting the introduction of renewable energies is also important in cooperation with these countries.

1. Introduction

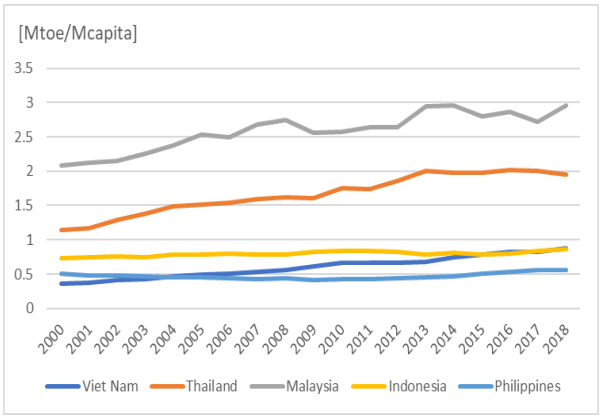
In recent years, Japan has been making progress on initiatives to increase the use of renewable energy. The Japanese government positions renewable energy as one of the main power sources, and it is also advancing efforts to expand the use of offshore wind power. A growing number of companies has also become members of the RE100 initiative, which aims to achieve 100% renewable electricity and implement initiatives toward the realization of net zero CO2 emissions by 2050 or earlier. In October 2020, Prime Minister Suga declared Japan's goal to achieve carbon neutrality by 2050, and this is expected to stimulate greater activity in the move to expand the use of renewable energy.

The Institute of Energy Economics, Japan (IEEJ) has, for many years, been engaged in projects commissioned by the Ministry of Economy, Trade and Industry (METI) to promote the adoption of renewable energy in ASEAN and other developing countries. It has also been involved in projects introducing Japan's clean energy technologies and systems to these target countries.

This paper focuses on the following five countries: Viet Nam, Thailand, Malaysia, Indonesia, and the Philippines. Based on a comparison of the energy situation in each country and an organization of information related to their renewable energy policies, the paper examines future renewable energy business development in this region.

2. Energy situation in the Southeast Asian countries

First, in order to understand the energy situation in the five countries, we summarized the relationships between GDP per capita and primary energy consumption and electricity consumption by country in Figure 1, based on data from the IEA.[1)] Energy consumption increases with GDP growth. To present this trend even more clearly, Figure 2 shows GDP on the horizontal axis, and primary energy consumption and electricity consumption on the vertical axis. It is clear that a positive correlation exists between these two factors.



a. Primary energy

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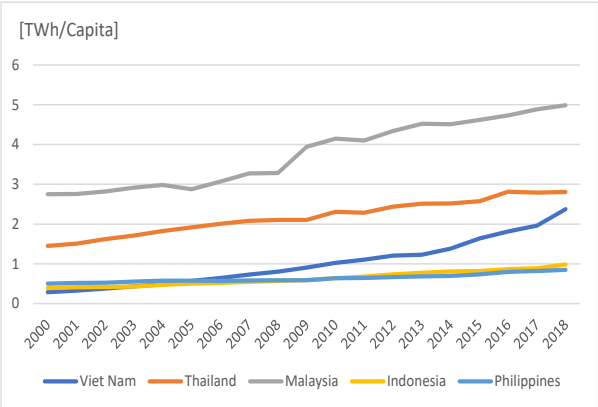


b. Electricity

Figure 1 Yearly energy consumption per capita

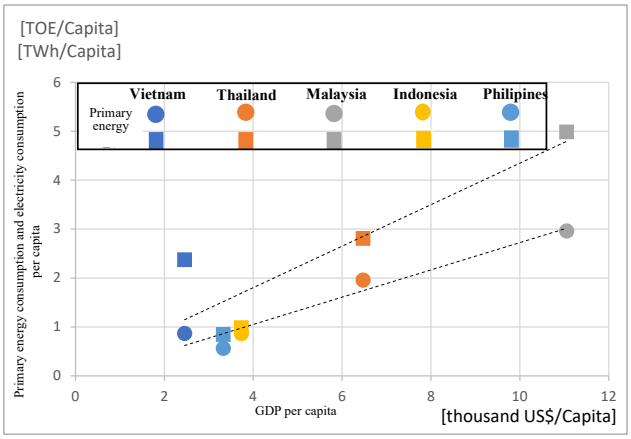


Figure 2 Relationship between per capita GDP and energy consumption

3. Status of the development of renewable energy

3.1 Overall status of the deployment of renewable energy

We also summarized the status of the deployment of renewable energy in each country. Figure 3 shows the share of renewable energy power generation in each country, including hydropower. In 2018, the country with the highest share was Viet Nam with approximately 35%, followed by the Philippines with approximately 23%. The share of renewable energy was about 17% in the remaining countries. Figure 4 shows the breakdown of the types of renewable energy power generation. Hydropower is the main source of renewable energy in most of the countries, particularly in Viet Nam and Malaysia. As for other types of renewable energy, geothermal power generation is an important source in the Philippines and Indonesia, while biomass power generation is popular in Thailand and Indonesia.

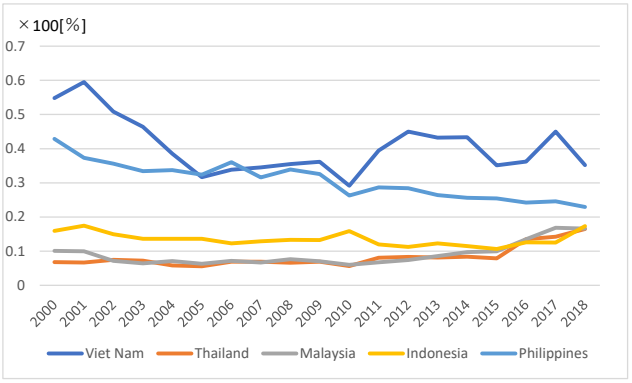


Figure 3 Changes in the market share of renewable energy (including hydropower)

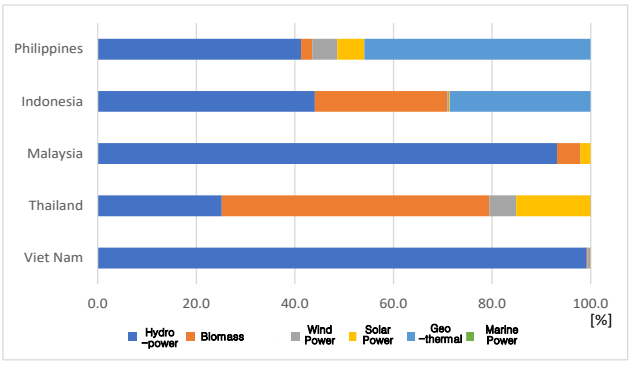


Figure 4 Breakdown of types of renewable energy (including hydropower)

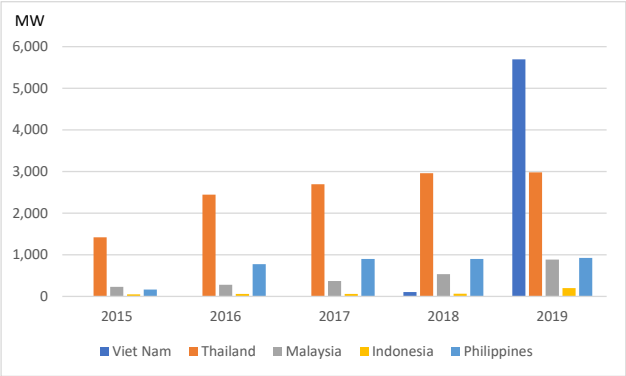
3.2 Status of the deployment of solar power and wind power generation

This section summarizes the status of the deployment of solar power generation, which has seen large cost reductions in recent years in tandem with its growing popularity worldwide, as well as wind power generation, for which offshore wind development is anticipated in Japan. Both solar power and wind power generation are variable power sources, the output of which varies depending on the condition of solar radiation and wind speeds. In Japan, system designs and grid stabilization technologies have been developed in order to accommodate expanding variable renewable energy sources. These designs and technologies can be applied in ASEAN countries where variable renewable energy will expand in the near future. This will drive needs for support measures and business development involving relevant technologies.

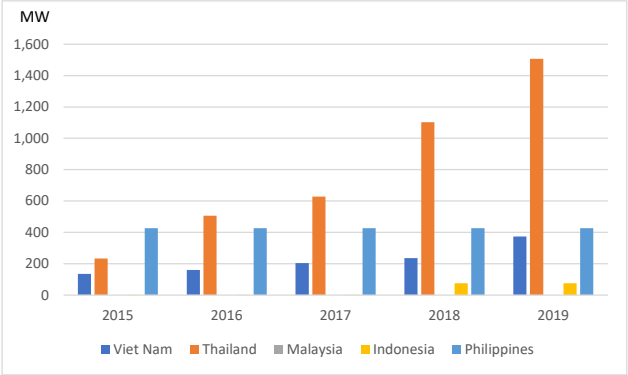
The power generation capacity of solar and wind power is summarized in Figure 5, based on consolidated data from IRENA[2)] on power generation capacity through 2019. In recent years, there has been significant growth in power generation capacity in Thailand for both solar and wind power generation.

Viet Nam also showed prominent growth in solar power generation in 2019.

No correlation was observed between increased deployment and GDP for renewable energy in general, or either for solar power generation or wind power generation Hence, economic development is not a key factor for the increase of renewable energy.



a. Solar power generation



b. Wind power generation

Figure 5 Changes in power generation capacity for solar power and wind power generation

4. Factors affecting the deployment of solar power generation

The potential for developing geothermal, biomass, and wind power generation varied greatly among the five countries because of widely varying potential, and various factors for the deployment of these technologies. However, with regard to solar power generation, there is little variation among the potential for each country as they are all located near the equator; and therefore, the level of deployment is greatly influenced by the policy of each country.

To identify factors leading to the current status of solar PV deployment and to examine the prospects for solar PV deployment, solar power policies and electricity prices in each country are evaluated in this section.

Table 1 summarizes the feed-in-tariff (FIT) system in each country.

Table 1 Overview of FIT scheme for solar power generation in each country

Country	Year of introduction	FIT rate [US cent/kWh]*
Viet Nam	2017	2017: 8.34 July 2019: 6.58-8.33
Thailand	2013	Rooftop: 19.7-22.3 Ground-mounted: 14.4-18.1
Malaysia	2011	Large-scale: 4.32-13.9** Other: 7.68-16.1**
Indonesia	2006	3.19-3.92***
Philippines****	2012	18.5

*Calculated based on the conversion rate in October 2020.

**Calculated based on the purchase prices from 2018 and after.

***Calculated based on 65%-80% of PNL power generation cost. Power generation cost is assumed to be 70% of commercial charges (7¢/kWh (study by JETRO)).

****Certification ended in February 2018

There are differences in the purchase prices and the initial introduction of FIT. To examine the impact of the FIT on the deployment of solar PV, the cost of solar power generation (or Levelized Cost of Electricity (LCOE)) [3] and the electricity tariff (tariff for the commercial use of electricity)[4] were evaluated for each country. The results are shown in Figure 6.

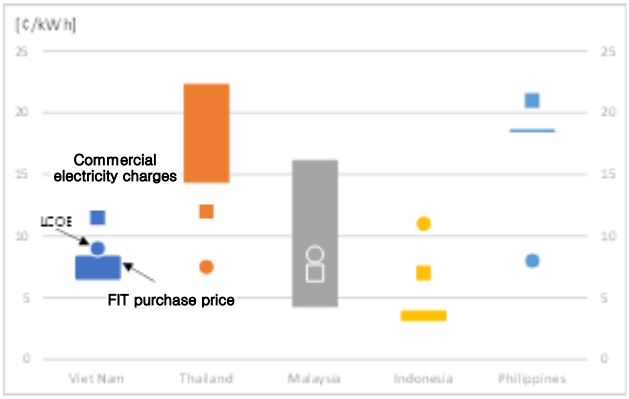


Figure 6 Relationship between FIT purchase price, LCOE, and commercial electricity charges

In Thailand, the FIT rate is more than double that of LCOE, and is also higher than the commercial electricity tariff. This

provides incentives to both developers as well as companies that wish to introduce on-site solar power generation systems, and is considered to be the reason for the fast growth of solar power in this country. On the other hand, although Indonesia introduced the FIT as early as 2006, it fixes the FIT rate at about 65%-80% of LCOE. This makes the FIT rate lower than LCOE and the electricity tariff, and therefore offers little incentive for adoption. This is presumably the reason behind the sluggish deployment rates. In the Philippines, the FIT pricing is higher than LCOE, thus incentivizing solar power generation developers. However, as the target deployment level was achieved in 2018, further FIT approval for solar power generation and wind power generation was suspended. As a result, the Philippines has seen little growth since then. In Viet Nam, although the FIT rate is lower than LCOE and the commercial electricity tariff, power generation capacity increased significantly in 2019 for reasons unclear. Malaysia has a wide range of FIT rates; and therefore, the deployment level of solar power generation is lower in comparison with Thailand. However, it has steadily increased the deployment rate year on year, recording particularly significant growth from 2018 to 2019.

5. Future deployment of renewable energy in the selected countries, and examination of Japan's contributions

We organized the energy situation and deployment status of renewable energy in each country, and examined the factors behind the growth of solar power with a focus on the FIT system. In this chapter, we consider the future development of renewable energy in the selected countries and Japan's contributions, as well as the potential for business development.

5.1 Viet Nam

5.1.1 Current situation and prospect for renewable energy

Viet Nam has recently registered prominent growth in both solar power and wind power generation. It revised the FIT rate for solar power generation in 2020 as shown in Table 2. FIT pricing varies depending on the installation form and region.

Table 2 FIT purchase prices from July 2020 to February 2021[5)]

Solar power generation technology	Purchase price	
	VND/kWh	US cent/kWh
Floating solar power	1,783	7.69
Ground-mounted solar power	1,644	7.09
Grid-connected solar power in the Ninh Thuan region	2,086	9.35
Roof-top solar power	1,943	8.38

In addition, the country has also made remarkable advancements in the development of wind power generation technology since 2019. An important factor behind this is the expansion of foreign capital into the Vietnamese wind power generation market (in particular, offshore wind power). Viet Nam and Denmark are deepening their cooperative relationship in the wind power generation sector, and estimates from both countries place the potential of offshore wind power at 160GW.[6)] In 2020, two European leading wind power generator manufacturers were actively engaged in business in Viet Nam.[7)] In July, Siemens Gamesa Renewable Energy (Spain) received an order for 36 wind power generators for two offshore wind farms (total output of 165MW) to be built in the southern part of Viet Nam, while Vestas Wind Systems (Denmark) delivered 50MW wind turbines to a wind farm in the southern part of Viet Nam. Similarly in July 2020, Copenhagen Infrastructure Partners (CIP), a Danish offshore wind power corporate group, concluded a basic agreement with regional partners in Viet Nam on a 3.5GW offshore wind power generation project.[8)]

In March 2016, the government of Viet Nam published a revision of the National Power Development Plan VII (hereafter, "PDP 7 rev."), which is drawn up every five years. The renewable energy targets set out in this plan are summarized in Table 3.

Ambitious targets have been established for wind power and solar power generation towards 2030. In addition, FIT rates have also been raised for wind power generation—from 7.8 US cents/kWh in 2018 to 8.55 US cents/kWh for onshore wind power, and to 9.85 US cents/kWh for offshore wind power[9)]. Rates for solar power generation were also raised as shown in Table 2. In these ways, the Viet Nam government is strengthening its support for the sector. Combined with the proactive entry of foreign capital into the market, the growth of renewable energy in Viet Nam is expected to accelerate in the future.

Table 3 Renewable energy targets set out in PDP 7 rev.

	2020	2025	2030
Hydropower（including micro hydropower）	21,600MW (29.5%)	24,600MW (20.5%)	27,800MW (15.5%)
Wind power	800MW (0.8%)	2,000MW (1%)	6,000MW (2.1%)
Solar power	850MW (0.5%)	4,000MW (1.6%)	12,000MW (3.3%)
Biomass	750MW (1%)	1,824MW (1.2%)	3,281MW (2.1%)

5.1.2 Potential for business development

In Viet Nam, projects related to solar power and wind power generation, among other forms of renewable energy, have become increasingly active in recent years because of the rise of FIT prices and other factors. However, some entities are advancing renewable energy projects that exceed the power transmission capability, so it would be desirable to improve technologies and systems in order to provide output control. It would also be desirable to strengthen and sophisticate the power transmission and distribution systems to match the rapid growth in power demand and the expansion of power generation. Technologies that are related to grid stabilization and smart communities should be an important area of cooperation for both Viet Nam and Japan.

While the World Bank and other organizations are providing support for studies on aspects such as the distribution of renewable energy resources in Viet Nam, in view of the fact that the height of required wind conditions also change alongside the increase in the size of wind turbines, and given the growing activity in the area of offshore wind power generation, it would be effective to re-evaluate the resource distribution in order to understand the latest situation and introduce the technologies necessary in the updated context.

5.2 Thailand

5.2.1 Current situation and prospect for renewable energy

The adoption of solar power in Thailand has been increasing rapidly thanks to the FIT scheme. The target for solar power (6,000MW by 2036) established in the Alternative Energy Development Plan (AEDP) 2015 (which is the development plan for alternative energy from 2015 to 2036) was revised upward to 15,574MW in AEDP 2018 (Alternative Energy Development Plan covering the years from 2018 to 2037). In order to achieve this new target, it will be necessary to implement measures for promoting increased deployment. Further growth of solar power is projected to cause increased cost burden related to grid stabilization. To solve the problem, there are plans to launch peer-to-peer (P2P) transactions of surplus electricity between solar power generation businesses in 2021, among other measures. In August 2018, BCPG Public Company Limited, a renewable energy corporation in Thailand, together with Power Ledger (Australia), began conducting P2P trials using blockchain technology in the T77 district of Bangkok. This initiative made use of rooftop solar power generation facilities with total capacity of 700MW, installed at schools, apartments, hospitals, and other buildings, making it the largest project of its kind in the world. It is also expected to be applicable to microgrid systems.[10)]

5.2.2 Potential for business development

Given its remarkable economic growth Thailand is no longer a developing country, but has reached the stage of a semi-developed country. Its energy demand is increasing rapidly driven by economic growth and urbanization, and it is becoming increasingly important for the country to harness renewable energies that will effectively serve to improve its energy self-sufficiency and counter global warming. Therefore, Thailand's needs in this sector are expected to grow rapidly.

Thailand aims to introduce more renewable energy with a focus on solar power generation. However, as it also faces challenges in power grid development and policy design for further facilitation of solar power installation, Japan's leading technologies and experiences in these fields are likely to be effective in business development.

Moreover, while initiatives in areas such as "smart grid" and "smart city" can be seen in Thailand, there are inadequacies in the details of policy design. Hence, consultations on the master plans for these initiatives should also be helpful.

5.3 Malaysia

5.3.1 Current situation and prospect for renewable energy

Since the introduction of the FIT scheme, the renewable energy sector in Malaysia has seen steady expansion. As of October 2020. the cumulative amount of renewable energy introduced as a result of the FIT has reached 604.44MW, of which solar power generation accounts for the largest portion at 380.24MW, followed by biomass power generation at 82.7MW, and biogas power generation (biogases from landfills and agricultural waste) at 62.94MW.

Various measures were rolled out for solar power generation,

including shifting to competitive bidding for large-scale solar power generation and launching the Net Energy Metering (NEM) from 2016. Malaysia is currently implementing a large-scale solar power generation project with a capacity of more than 1.6GW, of which 690MW started operation by the second quarter of 2020.

Policies supporting the solar power generation industry include subsidies for research and development, industry-government-academia cooperation, tax incentives, financing, and land adjustment for power plants. Malaysia ranks third in the world in terms of solar panel production (for both cells and modules).[11] Local governments have launched policies to attract investment from foreign solar panel manufacturers, and many world-leading manufacturers have set up manufacturing lines while using Malaysia as the production hub for the Asian market.

5.3.2 Potential for business development

Malaysia advocates the “Look East Policy” (learning about technologies, strong labor ethics, and work motivation from the countries of East Asia), the scope of which covers areas such as green technologies, renewable technologies, and biotechnologies.[12] “Japan-Malaysia Joint Statement on Strategic Partnership,”[13] issued after the Japan-Malaysia bilateral summit meeting held in May 2015, sets out clearly, "Both leaders affirmed the pressing need [...] to address climate change through the transfer of climate and environment-friendly low and zero-emission technologies for power generation from renewable sources and through the transfer of technologies needed to enhance energy efficiency across all sectors." Hence, technological support in the Malaysian renewable energy sector is an important area for Japan.

5.4 Indonesia

5.4.1 Current situation and prospect for renewable energy

Hydropower, biomass, and geothermal power generation account for a large part of the renewable energy sources in Indonesia. Solar power and wind power generation are limited, and the installed capacity of both of these energy sources is about 150MW in 2019. This is probably impacted by the price ceiling in regions where the regional LCOE rate exceeds the national average LCOE of Perusahaan Listrik Negara (PLN), the national electric power corporation. In such regions, the FIT rate must not exceed the LCOE of the region.

Little future growth is expected for hydropower, biomass, and geothermal power generation. On the other hand, solar power is expected to increase to 6.4GW by 2025 according to the Indonesian government. There is high potential for solar power on islands and in remote regions, where diesel power generation is currently the main power source and power generation costs are high.

5.4.2 Potential for business development

While islands and remote regions in Indonesia rely on diesel power generation, which is expensive, central regions such as Java and Bali have introduced large amounts of cheap coal-fired power; and therefore, the cost of power generation varies greatly among regions, depending on the local power generation mix. Due to changes made to regulations on the purchase of renewable energy in 2017, the upper limit of purchase prices has been kept below the average power generation cost of each region. However, this has resulted in higher purchase prices for renewable energy on islands and in remote regions, where power generation cost is high, compared to the Java and Bali regions. From the perspective of economic efficiency, islands and remote regions could be attractive destinations for investing in renewable energy.

On the other hand, in terms of technological constraints, the electric power load is small on islands and in remote regions, where the electricity supply systems are often independent. As a result, they are not suited to the large-scale introduction of renewable energy with rapid output fluctuations. Measures to address the output fluctuation issue include installing energy storage equipment, backup power supply system, as well as comprehensive grid management technologies. Moreover, from the perspective of realizing an independent, stable, and resilient energy supply for islands, systems combining renewable energy and hydrogen, which is ideal for relatively long-duration energy storage, are also effective. There is potential for the application of such innovative technologies.

In addition, the Ministry of Energy and Mineral Resources (MEMR) is also actively engaged in initiatives related to coal and biomass co-firing in order to promote the utilization of existing coal-fired thermal power generation facilities and renewable energy. Japanese power generation developers have rich experience in the operation of biomass co-combustion plants; and therefore, there are opportunities for cooperation between the two countries in the biomass-coal co-firing power generation-related area, including fuel production and the operation of power plants.

5.5 Philippines

5.5.1 Current situation and prospect for renewable energy

The Philippines has greatly increased the amount of solar power and wind power (as of 2019, solar power generation: 922MW, wind power generation: 427MW) thanks to the feed-in-tariff (FIT) scheme introduced at the recommendation of the National Renewable Energy Board (NREB). However, as the FIT ended after reaching its target in 2018, little growth has been recorded in recent years.

The key to further increase renewables in the future lies in reviewing the FIT scheme, and resuming the purchase mechanism.

5.5.2 Potential for business development

After the introduction of the FIT, sufficient advancements have been made in the deployment of variable renewable sources, such as solar power and wind power to achieve NREP targets. However, due to the weak power transmission lines between solar and wind power generation sites and the load center in Manila, it is difficult to control the fluctuation of electricity. Therefore, it would be desirable to strengthen the power transmission networks. In addition, as the Philippines is an island country, the introduction of microgrid systems can also be considered for securing electricity supply in small island regions. Japan's grid stabilization technologies and systems can also contribute to addressing the intermittency issue of variable renewable energy technologies.

6. Conclusion

This paper mapped out and set out in parallel the energy and renewable energy situations for five Southeast Asian countries. In particular, it examined the FIT policy's impact on the development of solar power generation. In addition, it also looked at the systems and the situation of renewable energy in each country in detail, and identified the implications for Japan's business development in these countries.

In response to the declaration by Prime Minister Suga on achieving carbon neutrality by 2050, UN Secretary-General Antonio Guterres issued the following statement: "The Secretary-General has no doubt that Japan has all the necessary technological, financial and engineering tools to get to net zero emissions by 2050. He is confident that Japan will also assist developing countries to reach that same objective, including through technological assistance and its public and private financing for renewable energy." Chinese and European manufacturers have been working on reducing the costs of solar power and wind power generation, and thus it is difficult for Japan to expand such technologies to developing countries. It is crucial to put effort into contributing to the roadmap for increasing renewable energy in the target country through proposing technology packages, including grid stabilization technologies, that meet the needs of the country, and providing low-interest loans and loan guarantees to promote investment in systems that contribute to grid stabilization, as well as investment in renewable energy sources that entail high initial investment costs but low operation and maintenance costs.

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