Chapter 2

Current Status and Policy of ASEAN Member States

2-1 Overview: Development of Solar Energy in ASEAN Member States

ASEAN Member States are in different stages of development for their solar energy adoption. Each country has established a national target for renewable energy (RE), including a dedicated target for solar PV. To achieve that target, numerous policies and supporting schemes have been initiated. Such policies related to solar energy are summarised in Table 2-1.

Table 2-1. Solar Policies and Incentive in ASEAN Member States

ASEAN Countries	Specific Solar PV Target	FiT for Solar	Net metering Scheme	Auction for Solar PV	Tax Incentives for Solar PV	Other type of Incentives for Solar PV
Brunei Darussalam	✔					
Cambodia					✔	✔
Indonesia	✔	✔	✔	✔	✔	
Lao PDR	✔				✔	
Malaysia	✔	✔	✔	✔	✔	
Myanmar					✔	
Philippines	✔	✔	✔		✔	
Singapore	✔		✔	✔		✔
Thailand	✔	✔	✔	✔	✔	
Viet Nam	✔	✔			✔	

FiT = feed-in-tariff; PV = photovoltaic.

Source: ASEAN Centre for Energy database (2017).

The challenges in meeting the solar energy targets also vary from one ASEAN country to another, depending on their current energy landscape and their stage of solar development. To enhance the solar capacity in the region, these nations need to overcome three types of challenges: regulatory, technical and financial challenges (Table 2-2).

Table 2-2. ASEAN Challenges in Developing Solar PV

Regulatory	Financial	Technical
• For AMS that are in the early phase of developing their solar market, the absence of a dedicated policy or financing support (i.e. FiT, solar PPA) for solar energy is a hindrance • For AMS that have a mature solar market, the challenge is in how to transition to more efficient schemes to further reduce the cost (i.e., from FiT to auction) • Inconsistent and unclear supporting policieson solar energy • Lack of policy support for solar energy as an option in rural electrification	• No clear investment guideline on solar energy • Lacks support from financial institutions to finance renewable energy projects, especially solar power	• Complicated certification process and presence of land acquisition issues in the construction of solar power plants • Land constraint in utility-scale solar power plants • Lack of technical expertise and experience in solar power in some AMS • No clear guidelines established for grid interconnection of solar projects

AMS = ASEAN Member States; FiT = feed-in-tariff; PPA = power purchase agreement.

Source: ASEAN Centre for Energy.

Should ASEAN Member States continue to pursue solutions to these aforementioned challenges, their established targets in solar energy are achievable. Moreover, at this stage of their solar power development, most of these nations have no significant need yet to consider storage systems for tackling intermittency issues from solar power facilities. Only countries with huge solar PV injection such as Thailand have experienced the need to amplify their energy storage to smooth out the power fluctuation and stabilise the grid.[1]

However, given the growing solar development in ASEAN, the region will eventually need storage systems to absorb the fluctuating power of solar PV. Pumped storage hydropower can be one of the options for storing energy from solar PV, since the ASEAN has potential of hydropower. The list of pumped storage hydropower plants in ASEAN in 2017 to 2036 is summarised in Table 2-3.

[1] By 2017, installed capacity of solar energy in Thailand had reached around 2,400 MW.

Table 2-3. Pumped Storage Hydropower in ASEAN From 2017 to 2036

AMS	PHES	Status	Capacity (MW)	Year
The Philippines	Kalayaan Pumped Storage Power Plant	existing	349	2015
	Wawa I & II Hydro Pumped Storage Power Plants	Planning	150	Indicative power plant planning
Indonesia	Upper Cisokan Pumped Storage Plant (Cisokan, West Java).	On-going project (World bank - PLN)	520 520	2021 2022
	Sumatra	Planning	1000	2025
	Java – Bali	Planning Planning	450 450	2023 2024
	Matenggeng Pumped Storage Hydro Power Plant (West Java)	Planning	4 X 225	Indicative power plant planning
Thailand	Lam Ta Khong Pumped Storage Plant phase 1	On-going	500	
	Lam Ta Khong Pumped Storage Plant phase 12	Planning	2 x 250	2018
	Chulabhorn Hydroelectrical Power Plant	Planning	2x400	2026
	Srinagarind Hydroelectric Power Plant	Planning	3 x 267	2028
Vietnam	Bac Ai Pumped Storage Power Plant	Planning	600 600	2023 2025
Malaysia	No hydro pumped storage data			
Singapore	No hydro pumped storage data			
Brunei Darussalam	No hydro pumped storage data			
Lao PDR	No hydro pumped storage data			
Myanmar	No hydro pumped storage data			
Cambodia	No hydro pumped storage data			
Total Installed capacity			8,140	

MW = megawatt.

Source: ASEAN Centre for Energy publication, AGEP Newsletter – October 2017 Edition.

The following sections present a detailed overview of the current development of solar PV in each member state, including their installed capacity, policies on solar energy and the challenges as well as plans and potential need of each country to accommodate storage system for solar PV output.

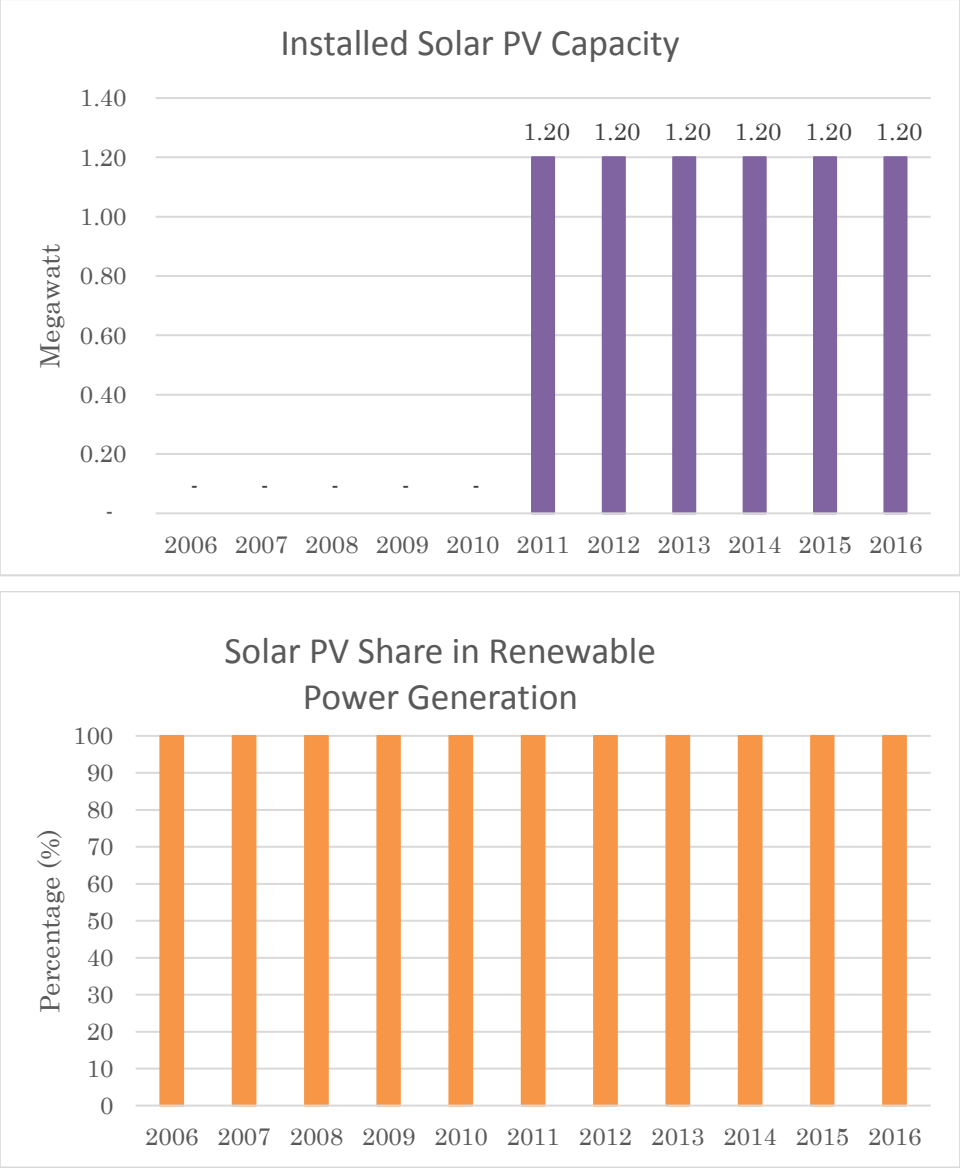
2-2 Brunei Darussalam

- Installed capacity and power generation of solar PV

Brunei Darussalam's energy sector still relies on natural gas. Its renewable energy (i.e. solar energy) accounts for around 1% of its total power generation; the total installed capacity reached

1.244 MW by 2015. Solar energy growth started since 2010 for on-grid installation, followed by off-grid installation in 2011 until 2014. However, in 2015, no solar PV installation was recorded in the country. The power generation from solar PV reached 1.12 GWh in 2015, with the biggest contribution come from the 1.2 MW Solar Park installed by Tenaga Suria Brunei.

Figure 2-1. Solar PV Capacity and Its Share in Renewable Power Generation, Brunei Darussalam



Source: ASEAN Centre for Energy database (2017).

- Promotion policy of solar PV

To achieve safe, secure, reliable and efficient supply and use of energy, the government aimed to reach 124 GWh of renewable power generation by 2017 and 954 GWh by 2035, which puts the share of RE at 10% of the total power generation mix, according to its Energy White Paper in 2014 (EDPMO, 2014). These targets are planned to be achieved through solar and waste-to-energy resources.

Currently, Brunei has not yet implemented any other supporting policies or incentives for renewable energy development, especially solar PV. It has, however, explored several supporting measures such as Voluntary Renewable Energy Certificate, net metering, and feed-in-tariff (FiT) for accelerating solar PV development. One Renewable Energy Certificate (REC) will be worth 1 MWh of renewable power generation, with the proposed fixed price at B$0.25 per kWh and B$250 per certificate REC. The RECs are open to individuals, communities, and corporate companies, but especially targeted at energy-intensive industries that generate high carbon footprints. This scheme is planned to be applied on a voluntary basis in the first five years before becoming mandatory. Current RECs originate from solar PV generation from Tenaga Suria Brunei. The government also plans to introduce fiscal incentives such as tax exemptions, rebates, subsidies as well as financial support (e.g., loans for public and private investors).

- Challenges in meeting future target

The identified challenges in meeting Brunei's target for solar PV mainly stem from the lack of clear, dedicated supporting policies and schemes. There is an observed competition from efficient gas plants, which are more appealing. A high subsidy in electricity price also becomes a factor since the solar energy price is too high to compete with a low electricity price that does not represent the true cost of generation. The price of electricity in Brunei is currently around US$0.05/kWh, while the true costs is around US$0.19–US$0.22/kWh. Geographically, Brunei is land-constrained to develop the solar panel installations. Moreover, there is a need to increase the awareness and understanding of the public and local financial institutions on RE to guarantee their support for the country's RE plans.

- Plan for absorbing fluctuating power output from solar

There is no further information on the country's strategy on how to accommodate the fluctuating solar power output, since Brunei is still in the early stage of developing its RE infrastructure and focusing on enhancing its policies first.

2-3 Cambodia

- Installed capacity and power generation of solar PV

Cambodia has developed some RE facilities in the country, mainly on hydropower and biomass, but a few are solar PV installations. The installed solar capacity in Cambodia reached 10 MW when the country's first utility-scale solar project in Bavet City (Svay Rieng Province) came online in August 2017 (Chea Vannak, 2017). Cambodia has also developed the Solar Home System programme for off-grid areas, whose systems have a capacity of 50 Wattpeak (Wp) and 5 Wp, respectively. The programme was funded by Electricite Du Cambodge and had approximately 11,240 units installation by 2016.

- Promotion policy of solar PV

Cambodia commits to increase its energy production by setting the following targets: by 2020, all villages in the country should have access to electricity; and by 2030, at least 70% of the total households in the country should have access to quality grid electricity. Consequently, the government realised that RE development has to be encouraged if it were to carry out its rural electrification plans, although no specific target for RE or solar energy has been set yet. According to its Power Development Plan 2008–2021, Cambodia aims to have 2,241 MW of renewable energy (approximately 80% of the total installed capacity) by 2020, excluding large hydro.

To date, the government has no Feed-in Tariff (FiT) scheme for solar PV. The selling tariff for off-grid renewable power generation (solar and biomass gasification) is determined by project investors and direct consumers. There was, however, a competitive bidding or auction enabled for a 10 MW solar project in 2016, which resulted in a 20-years power purchase agreement (PPA) with Electricite Du Cambodge in Bavet City.

Several fiscal and investment incentives were arranged for RE project developers, as introduced in 2003 Cambodia Investment Law. However, there were no specifics given regarding the procedure and the number of companies that can access these incentives. Those who have investments in Special Economic Zones have import duty exemption and value-added tax exemptions as privileges.

In terms of subsidy, the government allocates US$100 per system to help reduce capital investment for purchasing RE equipment. On top of that, Electricite Du Cambodge has earmarked US$6 million in 2014 as Renewable Energy Fund and for the implementation of three rural electrification development programmes: (i) Power to the Poor (P2P); (ii) Solar Home System; and (iii) Assistance to Develop Electricity Infrastructure in Rural Areas.

- Challenges in meeting future target

Cambodia does not have a structured policy yet on solar PV as it is still in its early phase of solar power development. There is also a lack of technical and financial support as well as gaps in the knowledge, experience and skills of personnel. With the first utility-scale solar farm in Bavet connected to the grid in 2017, Cambodia's natural next steps is to scale its solar energy development in the next years. However, clearer policies and financing schemes for solar PV development have to be continuously improved.

- Plan for absorbing fluctuating power output from solar

Cambodia's development of its solar PV system, particularly its utility-scale solar PV facility, is still in its early stage. The country is thus currently focused on growing the solar market. Looking into how to stabilise fluctuating output from solar power through storage energy systems is not yet the main priority.

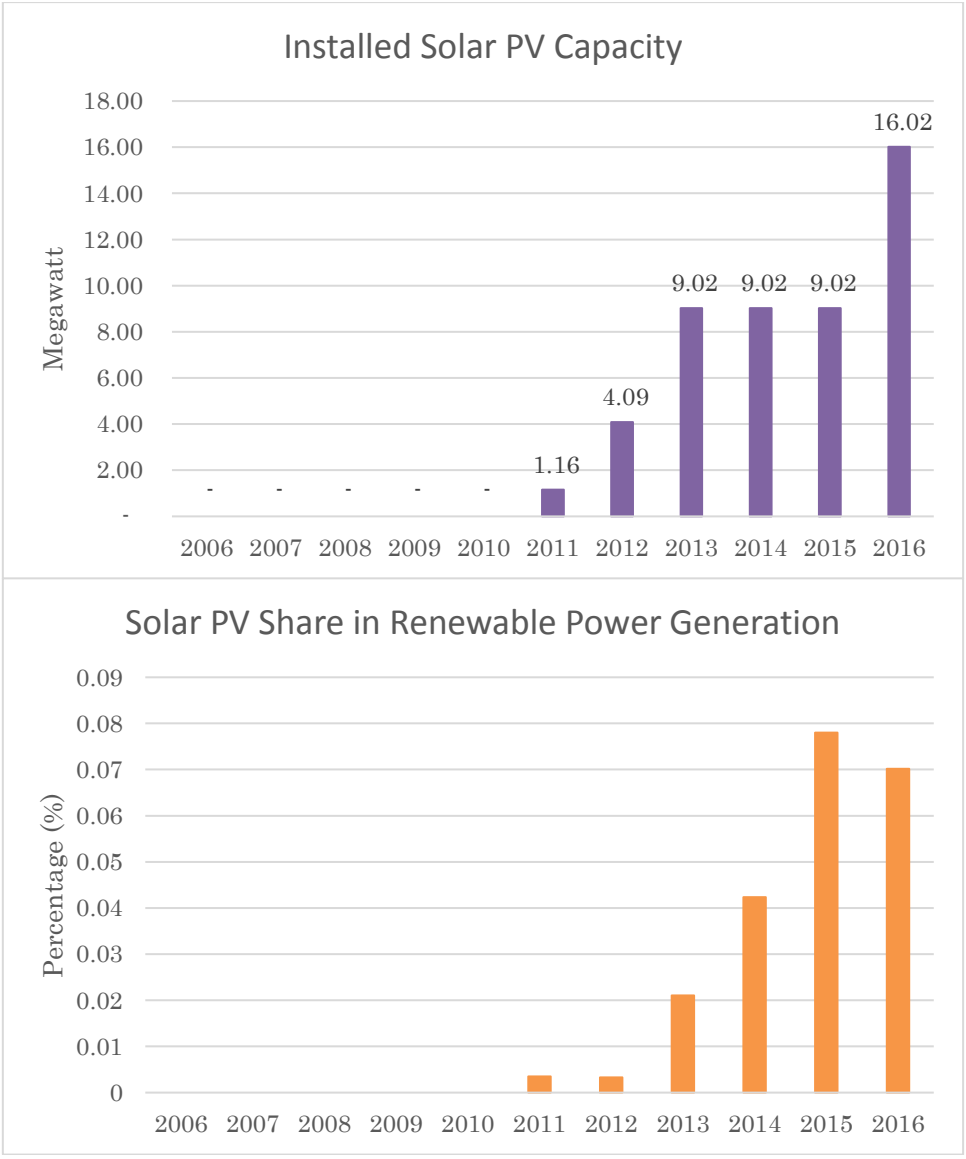
Solar batteries have been installed in solar home systems located in rural areas with the aid of several donors such as Japan International Cooperation Agency, the Korean International Cooperation Agency, the United Nations Industrial Development Organization, the Agence Francaise de Developpement, and other development organisations.

2-4 Indonesia

- Installed capacity and power generation of solar PV

Aided by various supporting policies, the growth in Indonesia's solar capacity started in 2010 at 0.19 MW and reached 16.02 MW by 2016. In the early days of its solar PV system, most solar panel installations were solar home systems in rural areas with a capacity of 50 Wp each.

Figure 2-2. Solar PV Capacity and Its Share in Renewable Power Generation: Indonesia



Source: ASEAN Centre for Energy database (2017).

The significant growth in solar PV in 2015 onwards started when Perusahaan Listrik Negara (PLN), a state-owned utility company, began purchasing solar PV energy in 2013. By 2016, solar power generation reached 21.09 GWh. Nonetheless, the share of solar in renewable power generation that year was less than 0.1% – miniscule compared to Indonesia's biggest RE source, which is hydropower.

- Promotion policy of solar PV

Indonesia's National Energy Policy (Government Regulation No. 79/2014) set the RE target for 2025 at 23% of Total Primary Energy Supply or about 92.2 Mtoe. This consists of 69.2 Mtoe for electricity use (~45.2 GW) and 23 Mtoe for non-electricity use. By 2050, the target share is expected to rise to 31% of the total RE. The RE target of around 45 GW installed capacity (around 33% of the total installed capacity) in 2025, is projected to come from various RE sources, including the solar energy target of 6.4 GW.

The government has also put in place various supporting policies and mechanisms for RE. For solar PV, the FiT tariff was implemented in 2013, with the rate adjusted in 2016. In 2017, the FiT mechanism was replaced by a new regulation that capped the incentives given to all RE, including solar, based on the local generation cost. Electricity generation from solar will be purchased at a maximum of 85% of the local generation cost if the price is higher than the national average generation cost. If the generation price is lower or equal to national average generation cost, the price will be determined by negotiations between PLN and the independent power producers. Furthermore, the solar plant generation cooperation between these parties will be under the *Built–Own–Operate–Transfer* scheme; that is, the power plant assets shall be transferred to PLN at the end of its lifetime.

The auction mechanism was also introduced for solar PV in 2013 by virtue of Ministry of Energy and Mine Regulation No 17/2013. Here, auctions are a procurement mechanism that sets ceiling prices for bidders. Prior to this regulation, electricity from solar PV installations was purchased by PLN through direct negotiations.

To support the use of solar PV, Indonesia has also introduced net metering policies since 2013 via Regulation 0733.K/DIR/2013. Under this regulation, PLN is obliged to credit electricity generated from a customer's account. The mechanism will offset the electricity consumed by

the electricity generated from solar facilities. In case the electricity generated by solar PV is greater than the energy consumed from PLN, the customer will receive the benefit as kWh deposit to be considered or consumed in subsequent months. That is, customers do not get the benefit as monetary payment.

Since it was enacted in 2013, however, the scheme has failed to be commercially attractive because of low electricity tariffs and either lack of information or unclear guidelines about the programme. The net metering procedure also depends on the local PLN and differs by region.

There are also fiscal incentives that support RE development. The comprehensive financial support includes income tax, value-added tax, import duty, and tax borne by the government. Related regulations on RE incentives are stipulated under the Ministry of Finance Regulation No. 21/PMK.011/2010 (on tax incentive) and Regulation No. 139/PMK.011/2011 (on government financial guarantee for RE plant projects through its cooperation with independent power producers in case of PLN's failure to pay).

- Challenges in meeting future target

Challenges that inhibited solar PV development in Indonesia include the complicated procedures on permits for ground-mounted solar projects. This can increase the project development cost, which further diminishes a project's attractiveness. Another relates to the unclear policies on net metering systems and lack of attractive tariffs for utility-scale solar farms.

In a net metering system, the policy did not provide compensation beyond (future) own consumption. This policy is also unattractive because of the minimum payment charged each month for grid connection.

Other challenges that inhibit the development of solar power plants in Indonesia are (PricewaterhouseCoopers, 2017; ASEAN Center for Energy Database, 2018):

a) Lack of appropriate regulatory support;
b) Weak multi-stakeholder (e.g., government, investors) coordination on permit issuance: e.g. lengthy process on permits for land acquisition and grid connectivity.
c) Limited infrastructure support such as ports and roads, particularly in rural and remote areas;

d) Lack of technical expertise and experience in Solar PV technology, including risk mitigation;
e) Additional restriction and requirement regarding locally produced/manufactured content, as stipulated by government policies.

- Plan for absorbing fluctuating power output from solar

There is no information on how the government of Indonesia plans to mitigate the fluctuating power output from solar power generation. However, small-scale solar PV batteries are increasingly being used and deployed as mini/micro grids to electrify rural areas in Indonesia. The system combining solar PV and storage is one of the suitable options in dealing with electrification of rural and remote places via distributed/ mini-grids.

Indonesia has started the construction of the nation's first pumped storage hydropower plant in Upper Cisokan, West Java, which has a total capacity of 1,040 MW (RambuEnergy, 2017). The funding from the World Bank at the amount of US$640 million has been disbursed since 2011 (The World Bank, 2017). Construction of the plant will begin in February 2017 and is expected to be completed within 50 months.

The Upper Cisokan Pumped Storage power project is aimed to significantly increase the peaking capacity of the power generation system in Java, Bali in a more sustainable way. Although this can be seen as the country's attempt to explore pumped storage hydropower as an alternative for energy storage, the project is not planned to be a solution to the intermittency issue from solar PV or other renewables.

2-5 Lao PDR

- Installed capacity and power generation of solar PV

Lao PDR's solar PV installed capacity is small when compared to the resource potential. Solar PV in Lao PDR is still confined to rural electrification and off-grid installations. There had been no official announcement on the solar PV installed capacity in the country until 2017 for on-grid or off-grid application. However, in 2017, Lao PDR's first utility-scale solar panel installation of 10 MW was brought online. In the first phase, the project is expected to generate 32–50 MW in total from 2017 to 2018. By 2020, the amount generated will rise to 100 MW (Xinhua News, 2017).

- Promotion policy of solar PV

Per Lao PDR's Renewable Energy Development Plan, the government aims to increase RE's share of the final energy consumption by 30% in 2025 (excluding that from large hydropower plants). The detailed target for solar PV is to reach 36 MW in 2016–2020 and 91 MW in 2021–2025 for electricity; and 22 ktoe in 2016–2020 and 109 ktoe in 2021–2025 for heat.

Lao PDR has not issued supporting policies and schemes for its RE other than tax incentives for investment promotion. The country is still in the process of preparing FiT tariffs for different types of RE. Thus, the FiT for grid-connected RE, especially for solar, is not yet in place. The selling tariff of the electricity generated from RE is currently based on negotiations between producers and the power utility.

Tax incentives for RE – duty-free import of production machinery, equipment and raw materials, and profit tax exemption and reduction at rates that are based on the investment zones – are stipulated under the Investment Promotion Law.

- Challenges in meeting future target

One of the technical challenges in the development of solar PV in Lao PDR is the country's lack of implementation standards for solar projects; hence, the country is still in its learning stage. Although a series of RE policies have been issued, most are for hydropower projects. Lao PDR has no policies and regulatory framework for solar PV development. Neither is there specific support for solar energy such as FiTs, and no access to loans that can finance solar projects.

- Plan for absorbing fluctuating power output from solar

The solar PV market in Lao consists mostly of solar home systems for rural electrification. The country is still in its early phase in terms of utility-scale solar development. Hence, it does not yet have concerns on wide-area intermittency from solar PV.

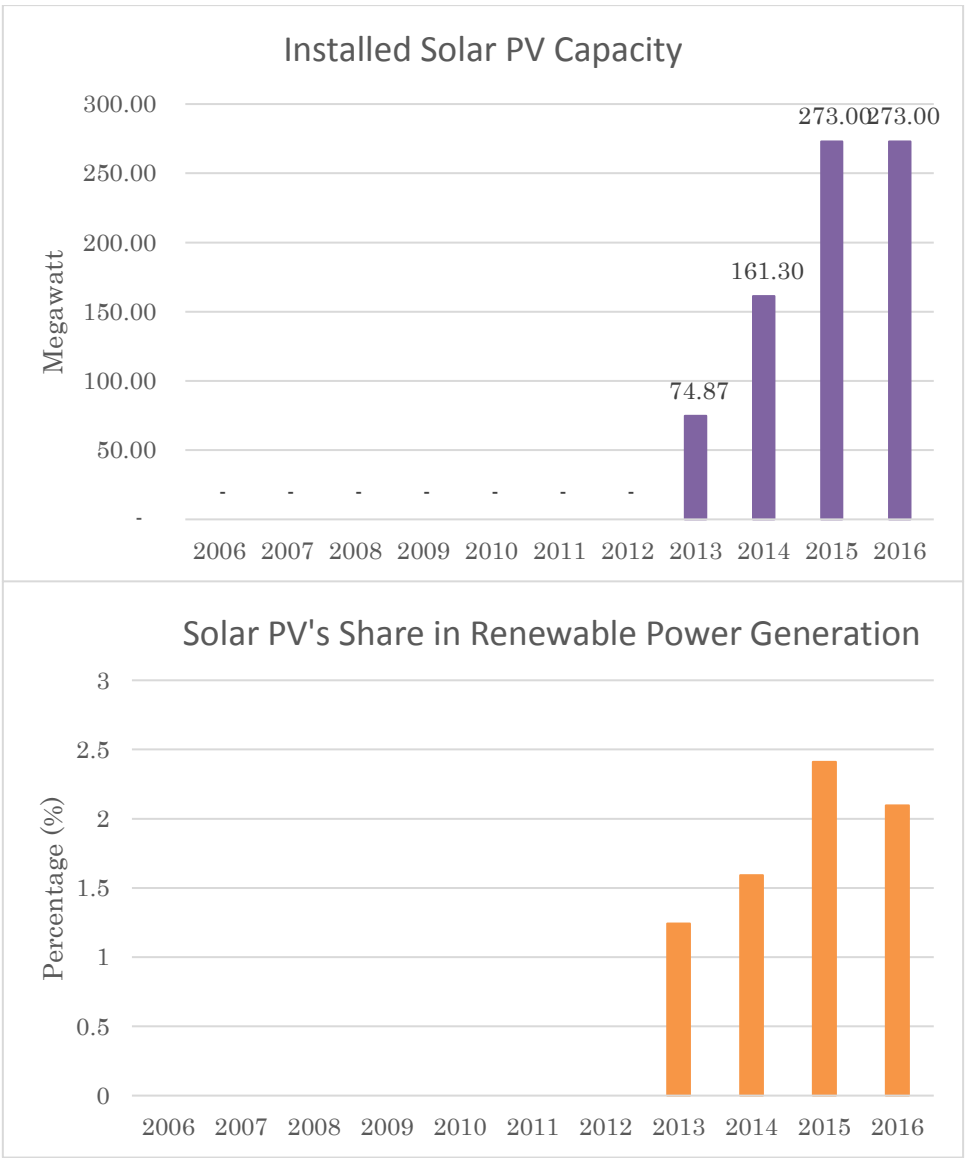
However, given the abundant resources for hydropower in Lao PDR, pump storage hydropower is a potential storage option that may be able to mitigate solar energy intermittency in the future.

2-6 Malaysia

- Installed capacity and power generation of solar PV

Prior to the introduction of the FiT mechanism in December 2011, the size of Malaysia's solar PV projects was deemed small. After the implementation of FiT, installed solar PV capacity began to rise from around 74.87 MW in 2013 to 273 MW in 2015.

Figure 2-3. Solar PV Capacity and Its Share in Renewable Power Generation: Malaysia



Note: 2016 data is a projection.

Source: ASEAN Centre for Energy database (2017).

This rapid increase is due to several support mechanisms, especially the FiT programme with its attractive rate. The power generation was recorded at 621.78 GWh by 2016, with solar PV accounting for around 2% of the total renewable power generated.

- Promotion policy of solar PV

Based on the National Renewable Energy Policy and Action Plan 2010, Malaysia has set targets for RE from 2015 to 2030. One of the targets is to achieve installed RE capacity (from various RE sources such as biomass, biogas, mini-hydro, solar PV, and solid waste) of 2,080 MW by 2020 and 4000 MW by 2030. For solar PV, the country targets 190 MW by 2020 and 1,370 MW by 2030.

Ever since the country committed to bring RE into its energy supply mix in 1999, a number of policies and supporting mechanisms have been put in place. Feed-in-tariff in the country is only applicable to RE technologies; rates for solar PV, were adjusted several times – in 2013, 2014, and 2015 – in response to the drop in the RE technology's cost. Since 2017, the quota for new solar PV project is no longer available due to limited RE Funds, which was used to pay for the FiT premium rates for solar PV.

However, the quota for other energy sources will still be in place based on the availability of the RE Fund. Since 2016, the country has moved from full amount purchase to the self-consumption scheme, including net metering (for the distributed PV system) and auctions (for the utility-scale PV system). This means, that there has been no FiT incentive given for new solar plant since 2016.

As of January 2018, the FiT rates for different RE in Malaysia are as follows (Sustainable Energy Development Authority, 2018):

Table 2-4. Solar FiT in Malaysia, 2018

Solar PV (Community)	FiT Rates (US cents/kWh)
a) Basic FiT rates having installed capacity of:	
(i) Up to and including 4 kW	17.09
(ii) Above 4 kW and up to and including 24 kW	16.67
(iii) Above 24 kW and up to and including 72 kW	11.34
b) Bonus FiT rates having the following criteria (one or more):	
(i) Use as installation in buildings or building structures	+3.21
(ii) Use as building materials	+2.17
(iii) Use of locally manufactured or assembled solar PV modules	+1.28
(iv) Use of locally manufactured or assembled solar inverters	+1.28
Solar PV (Individual)	
a) Basic FiT rates having installed capacity of:	
(i) Up to and including 4 kW	17.09
(ii) Above 4 kW and up to and including 12 kW	16.67
b) Bonus FiT rates having the following criteria (one or more):	
(i) Use as installation in buildings or building structures	+3.21
(ii) Use as building materials	+2.17
(iii) Use of locally manufactured or assembled solar PV modules	+1.28
(iv) Use of locally manufactured or assembled solar inverters	+1.28
Solar PV (Non-Individual)	
a) Basic FiT rates having installed capacity of:	
(i) Up to and including 4 kW	17.09
(ii) Above 4 kW and up to and including 24 kW	16.67
(iii) Above 24 kW and up to and including 72 kW	11.34
(iv) Above 72 kW and up to and including 1 MW	10.96
b) Bonus FiT rates having the following criteria (one or more):	
(i) Use as installation in buildings or building structures	+3.21
(ii) Use as building materials	+2.17
(iii) Use of locally manufactured or assembled solar PV modules	+1.28
(iv) Use of locally manufactured or assembled solar inverters	+1.28

FiT = feed-in-tariff; PV = photovoltaic.

Note: * Exchange rate: RM3.91/US$(6 March 2018).

Source: Sustainable Energy Development Authority website (2018).

The Energy Commission is the regulator for the net metering scheme, while the Sustainable Energy Development Authority–Malaysia is the implementing agency. The electricity generated by a customer will be purchased by utilities at below retail rates, which are determined based

on the utility's unit cost. This utility cost reflects the average cost of generating and supplying per kWh of electricity from other sources (excluding RE) through the supply line until the point of interconnection with RE installations. The net metering scheme will be introduced with a total capacity of 500 MW from 2016 and 2020 (with a 100 MW capacity limit each year, where 90% is allocated to Peninsular Malaysia and 10% to Sabah).

Meanwhile, the country enacted its first solar PV auction scheme for large-scale solar plants in 2016. The first and second auctions were completed in 2016 and 2017, respectively. Projects with a total target capacity of 1,250 MW have been awarded to large-scale solar plants with capacities of 1 MW to 50 MW per project. Two auctions were completed: The first auction awarded contracts with a total quota of 409 MW in 2016. A second auction, made in 2017, was for a total capacity of 557 MW.

The remaining 270 MW project was given via direct award. All these projects are to be completed by 2020.

Other incentives for solar PV were in the form of tax incentives. According to the Malaysian Investment Development Authority, qualified RE projects are eligible to apply for an investment tax allowance of 100% of qualifying capital expenditures and income tax exemption. For solar PV, a sales tax exemption of 10% is granted for PV modules that are manufactured in Malaysia.

Malaysia has also been provided a financing scheme for all renewable technologies available under its Green Technology Financing Scheme (GTFS) since 2010. The financing scheme is managed by the Malaysia Green Technology Corporation and Credit Guarantee Corporation Malaysia Berhad and open to companies that are predominantly Malaysian-owned. That is, if the company is an energy producer, then the minimum percentage of Malaysian shareholding should be 51% to qualify. If the company is an energy user, the minimum shareholding must be at least 70%.

- Challenges in meeting future target

Since Malaysia's solar energy sector is one of the most mature in the ASEAN, with the country already moving towards self-consumption and net metering schemes, one of its challenges is to determine the capacity and suitable tariff (or the displaced cost) of rooftop solar PV as such is not based on netting of energy as per the usual practice. The excess energy is paid at the

displaced costs, which are RM 0.31/kWh for low voltage and RM 0.238/kWh for medium voltage connections.

- Plan for absorbing fluctuating power output from solar

Malaysia has not yet experienced any issues with the intermittency behaviour of its solar power facilities. It is still in the process of determining the level of penetration that would justify the need for energy storage systems. At present, the share of RE in the total generation mix is less than 2% (excluding large hydropower facilities).

2-7 Myanmar

- Installed capacity and power generation of solar PV

Myanmar's RE sector is still in its early stage. Currently, its RE generation is limited to hydropower projects and small solar PV installations from solar home systems. Its solar home systems' installed capacity until 2014 is estimated at 14.55 MW.

- Promotion policy of solar PV

Myanmar is still in the process of crafting its policies and framework for RE. In the second draft of its RE policy, its RE installation target is set at 26.8% – or 3,995 MW of the total capacity of 14.9 GW – by 2030. No other information was found on the composition of such target by RE source.

Currently, Myanmar has no framework or supporting schemes for the development of RE other than tax incentives. Through the Foreign Investment Law, such incentives are in the form of income tax exemption for up to five years, depreciation, and additional tax deductions. The country also offers incentives to investors and developers located in special economic zones.

- Challenges in meeting future target

Myanmar is currently finding solutions to its electricity shortages and is focused on increasing the electrification ratio across the region. Financing the developing of its solar PV sector is another of its most challenging issues because of limited financing support. On the technical end, there is a lack of guidelines and clear policies on solar PV development. For instance, there is no incentive given to solar PV participants.

- Plan for absorbing fluctuating power output from solar

Because solar PV in Myanmar is still limited to rural electrification and solar home systems, there is no urgency to implement storage systems meant to mitigate intermittency issues on the grid. Instead, small-scale storage meant for solar home systems is needed to improve services in rural areas.

2-8 Philippines

- Installed capacity and power generation of solar PV

Solar energy development in the Philippine started in 2014 with the enactment of the Renewable Energy Act (RA 9513). The Act intends to accelerate the exploration and development of RE resources by achieving self-reliance, adopting clean energy and promoting socio-economic development in rural areas. In 2016, solar PV installation jumped from 165 MW in 2015 to 736 MW in 2016 surpassing the government's target for solar PV installation.

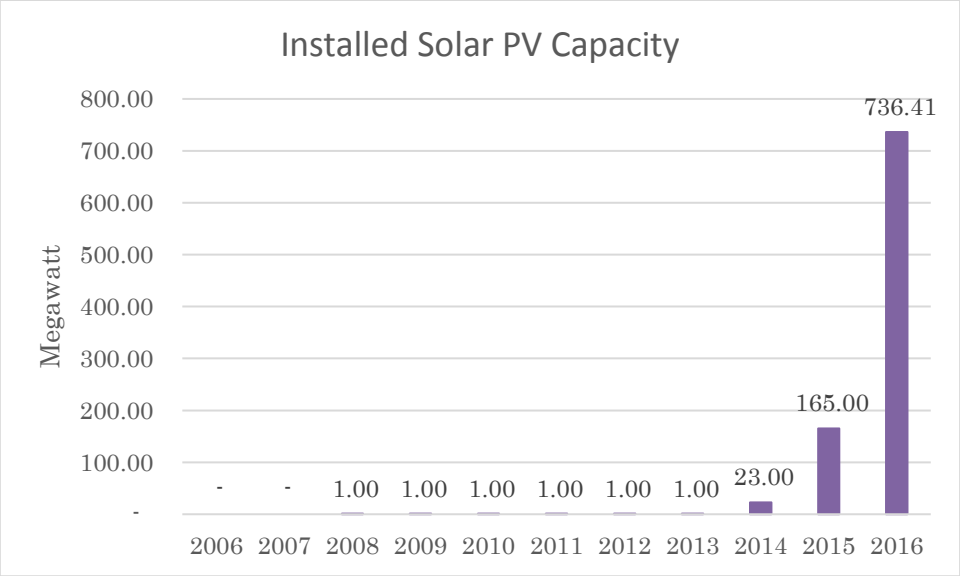
The increased capacity of solar energy facilities was also driven by the energy crisis in 2015. Most of the targets for RE (solar, wind, and biomass) in the Philippine National Renewable Energy Plan 2010–2030 have been achieved. Hence, the Department of Energy is now in the process of reviewing and setting a new target for National Renewable Energy Plan 2017–2040.

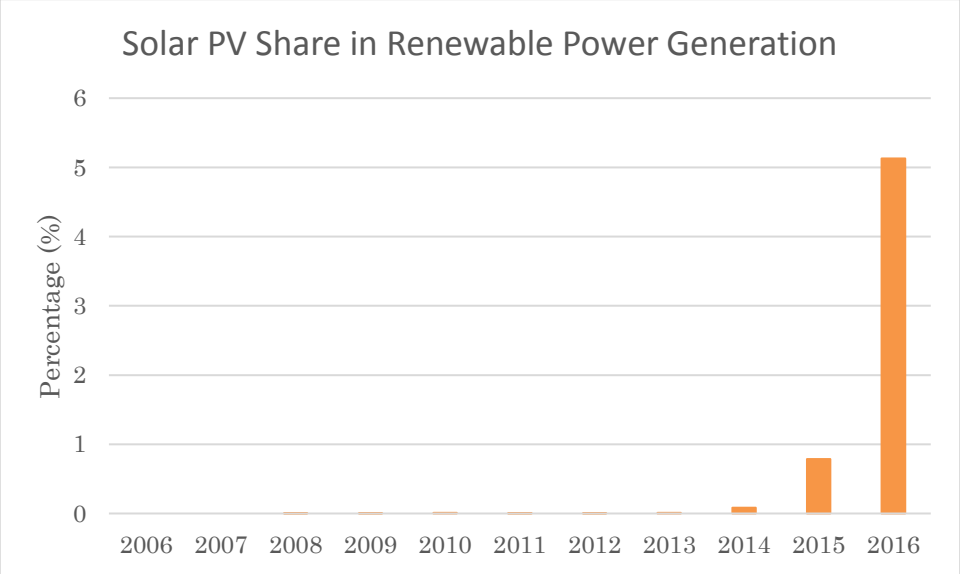
Power generated from solar PV in 2016 was 1,089 GWh, accounting for 5% of the total RE generation in the country.

- Promotion policy of solar PV

Under the Renewable Energy Act 9513 and the National Renewable Energy Plans and Programs 2011–2030, the Philippines identified strategies and targets to accelerate the exploration and development of RE resources. The regulations revised targets for installed RE capacity from its 2010 baseline level of 5,438 MW to 15,304.30 MW in 2030. For solar PV, the targets were (i) to achieve grid parity in 2020; and (ii) to hit 284 MW in installed solar PV capacity by 2030. However, due to the progressive efforts taken in developing solar PV, the target was already hit in 2016.

Figure 2-4. Solar PV Capacity and Its Share in Renewable Power Generation: Philippines





Source: ASEAN Centre for Energy database (2017).

Multiple policies favouring renewable energy were pursued since 2008. In 2017, the President's Executive Order No. 30 created the Energy Investment Coordinating Council, which was tasked to streamline the regulatory procedures affecting energy projects. Through the executive order, the government also created Energy Projects of National Significance (EPNSs).

The EPNSs are major energy projects for power generation, transmission, and/or ancillary services, including those required to maintain grid stability and security. These are identified and endorsed by Department of Energy for projects that possess the specific attributes mentioned in the executive order.

The executive order also created and mandated the Energy Investment Coordinating Council to assist in the regulatory process related to energy investments, mainly on EPNS. The council is directed to act upon applications for permits, including EPNS, within 30 days from the date of submission. This is expected to hasten the process of power project implementation in the country.

The Philippines has also provided several financing mechanisms and a framework for the development of solar PV. In 2012, it approved the FiT scheme. In 2015, it revised the FiT rates for solar PV generation. These rates include degressive rates across the years. The FiT rate for solar power is a fixed rate of US$0.1671/ kWh (at the exchange rate of ₱52.01/US$ as of 6 March 2018*).*

The country has also approved the net-billing framework in 2008 and implemented it in 2013. The excess electricity injected into the grid is purchased at 50% of the retail rate. The programme was well received, gathering 932 participants by May 2016, and continuously growing with a 7% month-to-month increase in installed capacity in 2016, influenced by the declining PV system cost and high electricity cost.

Under Republic Act 9513, the country gave RE projects several tax incentives such as income tax exemptions and reduction; duty exemption on RE machinery, equipment and materials; special realty tax rate on equipment and machinery; value-added tax exemption; accelerated depreciation; loss carry-over; tax exemption of carbon credit; and tax credit on domestic capital equipment and services. Moreover, RE projects that are supported or endorsed by the Department of Energy are given financial support by government financial institutions such as the Development Bank of the Philippines and Land Bank of the Philippines.

In addition, the Philippines is in the process of formulating Renewable Portfolio Standards and preparing the market for Renewable Energy Certification. In 2016, the final draft of the Renewable Portfolio Standards was released by the Department of Energy for approval.

- Challenges in meeting future target

The challenge for the Philippine government lies in how it will balance energy security with commercial project development. The surge in applications for solar PV projects due to the attractive FiT rate led the government to halt the programme in 2017. The country is now evaluating its FiT scheme vis-à-vis what it had attained for solar PV development and is, in fact, moving towards the auction scheme in the future.

Also, the country has not yet implemented its rural electrification project using solar PV since there is demand still for cheaper and more reliable off-grid electricity. Off-grid generation is still dominated by conventional sources, particularly diesel. The country is on its way toward formulating RE targets in its rural electrification plan.

- Plan for absorbing fluctuating power output from solar

There are not much details on how the Philippines plans to tackle the intermittency issues in solar PV generation, despite the remarkable growth of the solar energy sector. However, the country has explored the use of pumped storage hydropower plants since 1982 in Kalayaan as the energy storage option (CBK Power, 2018). Kalayaan has facilities, built in Laguna Lake, consists of Kalayaan I (168 MW) and Kalayaan II (174.3 MW), which serve as large peaking facility for the Luzon grid and more importantly, in balancing frequency. The Philippines has the potential to explore pumped storage hydropower plants as storage in its bid to solve the intermittency issues of utility-scale solar PV generation, since the hydropower potential is still abundant.

The country is also on its way towards establishing the biggest solar-battery microgrid in Paluan, Mindoro, which was started in the third quarter of 2017 with Solar Philippines as the developer. The solar-battery microgrid in Mindoro will operate with a capacity of 4 MW (Bussiness World, 2017).

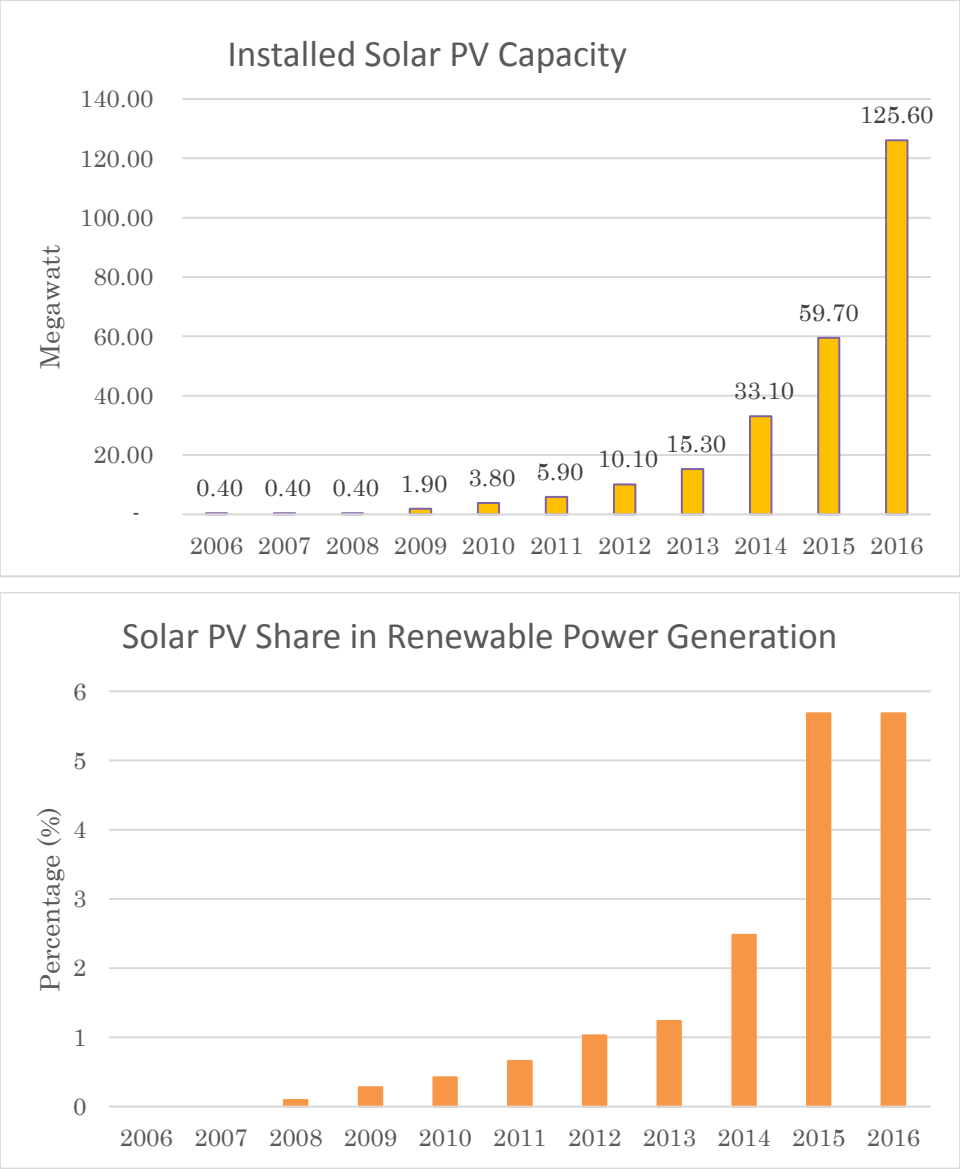
2-9 Singapore

- Installed capacity and power generation of solar PV

Due to its geographical constraints, the most feasible RE type for Singapore would be solar PV. From 2008 until the end of 2016, the country has seen a significant rise (from 30 to 1,826) in solar panel installations. For the same period, the total installed capacity grew from 0.4 MW to

125.6 MW. Although most of the solar panel installations are from residential consumers, there also has been a notable growth in installations from non-residential sectors since 2012. The trend is predicted to accelerate over the next few years due to the fall in prices and rapid improvement in the technology. Power generation from solar PV until 2016 is at 123.14 GWh, with solar PV accounting for 5.5% of the total RE generated.

Figure 2-5. Solar PV Capacity and Its Share in Renewable Power Generation: Singapore



Source: ASEAN Centre for Energy database, 2017.

- Promotion policy of solar PV

Because the RE options are limited by its geography, Singapore is focusing on tapping the potential of solar PV. Amongst its commitments as documented in the Singapore Sustainability Blueprint is to meet its RE consumption target of 350 MWp for solar power by 2020.

To support the adoption of solar PV systems in Singapore, the Energy Market Authority has improved the regulatory framework for intermittent generation sources (IGS) – which includes RE – by streamlining the process and regulating the payment in the delivery of excess electricity to the grid. The IGS framework adopts the net metering principle for embedded IGS. The IGS producers are not offered a FiT scheme; instead, market payments and charges are applied.

The IGS framework is applicable to contestable customers with less than 1 MWac embedded IGS. Meanwhile, there is no further information regarding the payment and charges for those with capacity of 1 MWac or more or for stand-alone IGS that sell electricity in the market. This study notes, however, that starting February 2016, solar retailers could directly sell electricity from solar PV systems to the grid at the market price, which then delivers power to interested customers.

To support the growth of RE, the Singapore Productivity and Innovation Credit provides tax deduction/allowance and/or cash payout to encourage research and development in green innovation. The allowance includes a 400% tax deduction on the first S$400,000 of qualifying Research and Development expenditure for each year of assessment, and 150% in excess of S$400,000. A non-taxable cash payout equivalent to 60% of up to S$100,000 of the qualifying expenditure has been made available to businesses since 2013. The government also extensively supports RE development by allocating funds and creating programmes to support research and development such as Clean Energy Research and Test-Bedding Programme, Energy Innovation Research Programme, Clean Energy Scholarship Programme, Market Development Fund, Energy Research Development Fund, and Energy Training Fund.

A government-led solar rooftop auction programme called ‘SolarNova’ was initiated in 2015 by Singapore Economic Development Board to spur solar PV development in Singapore. This programme targeted a 40 MW-capacity rooftop installation on 839 government buildings across the country. The installation was expected to be complete by the end of 2017. A second auction

was announced in late 2016, which aimed to install 40 MW of solar PV panels across nine government agencies. This project is expected to be completed in the first quarter of 2019.

The government also foresees the growth of 'prosumers' – electricity customers who are able to sell the electricity back to the grid – and has taken proactive steps, including streamlining payment procedures for prosumers, establishing a central intermediary who handles administrative necessities in the solar market, and enhancing market and regulatory frameworks by providing innovative business models such as solar leasing.

- Challenges in meeting future target

Because of the limited land area, Singapore is confined to rooftop solar panel installations and cannot implement wide-scale solar PV projects. Hence, the country may explore other options such as floating solar PV.

Singapore is also developing solutions in response to the intermittent nature of solar PV. A back-up system is required to recover the generation and maintain the system's stability when weather conditions change. Reserves mostly come from conventional power sources in Singapore.

- Plan for absorbing fluctuating power output from solar

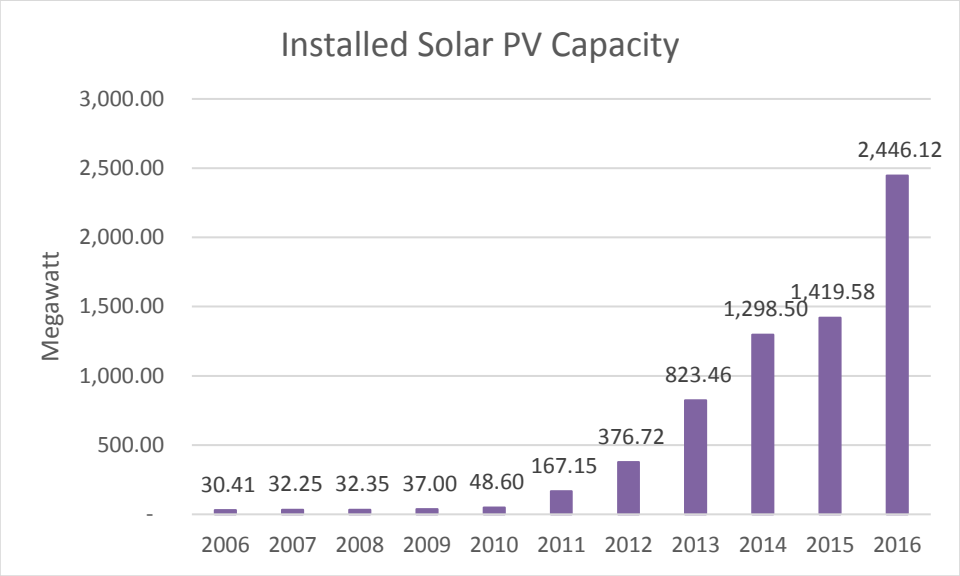
There is no need yet to incorporate storage systems into the grid given that utility-scale solar power development in Singapore is limited by its space. However, since solar PV is mostly deployed as solar PV rooftop installations, the country must prepare for the time when it would need to install storage system to mitigate future intermittency issues.

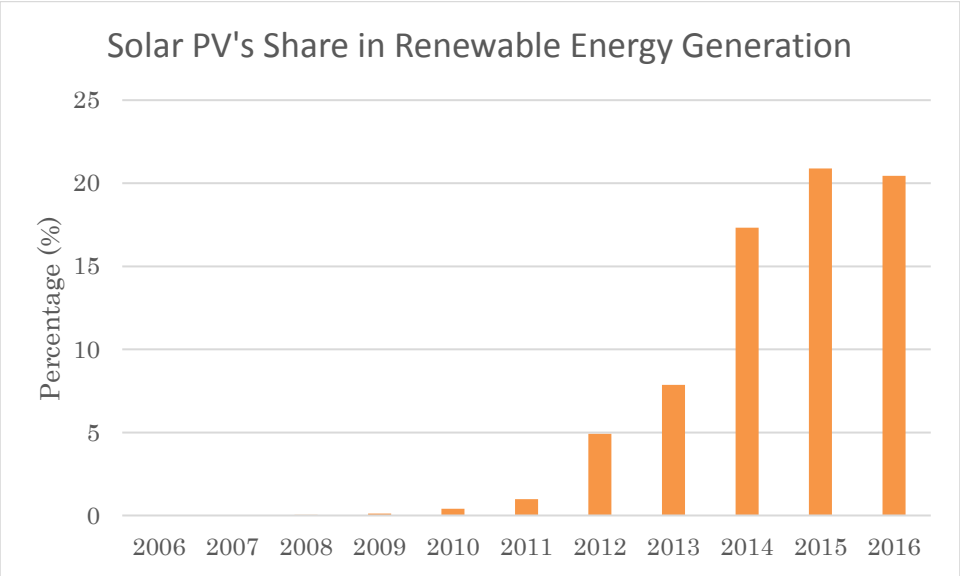
2-10 Thailand

- Installed capacity and power generation of solar PV

Thailand has several RE facilities on biomass, hydropower, waste-to-energy, and solar power. Its number of solar PV installations has grown since the Adder scheme was implemented in 2007. Much higher growth was seen since 2011, after various supporting policies were enacted. By 2016, solar PV capacity reached 2,446.12 MW while power generation from solar PV was 3,430 GW. During the period, the share of solar PV in the renewable power generation mix was about 20%.

Figure 2-6. Solar PV Capacity and Its Share In Renewable Power Generation: Thailand





Source: ASEAN Centre for Energy database (2017).

- Promotion policy of solar PV

According to the Alternative Energy Development Plan, Thailand aspires to have RE account for 30% of the total energy consumption; 15% to 20% of electricity generation; 30% to 35% of the total heat generation; and 20% to 25% of biofuel production by 2036. This target of 30% RE share is further broken down by source type such as biogas, biofuel, hydropower, and wind power. In the power sector, the respective targets for installed capacity of solar and heat application by 2036 are 6,000 MW and 1,200 ktoe, respectively.

To support the development of RE (especially solar PV), Thailand was the first country in ASEAN to introduced the precursor of the FiT scheme in 2007: the Adder scheme. During that time, RE generation could be purchased by paying a fixed amount on top of the wholesale electricity tariff. For solar energy, under the Adder scheme, the amount purchases from the electricity producer are for the period of 10 years. In 2014–2015 the Adder scheme was replaced by a comprehensive FiT policy for hydro, wind, solar, municipal solid waste, biomass, and biogas. Thailand also provided a premium FiT for projects with special conditions, such as those located in four southern provinces of Thailand. Under this new FiT scheme, the PPA duration is 20 years.

Table 2-5. Solar Feed-in-Tariff (FiT) in Thailand 2018

RE Technology	FiT (US cent/kWh)	FiT Premium– Southern provinces (US cent/kWh)
Rooftop (0 – 10 kWp)	21.81	1.59
Rooftop (>10 – 250 kWp)	20.38	1.59
Rooftop (>250–1000 kWp)	19.13	1.59
Ground mounted (<= 90 MWp)	18.02	1.59
Ground mounted (government site and agriculture cooperative <= 5 MW)	18.02	1.59
PV ground mounted (agriculture cooperative <= 5 MW for 2016–2017)	13.12	1.59

RE = renewable energy.

Note: Exchange rate 31.61 THB /US$ (6 March 2018).

Source: DEDE Thailand (2017).

Net metering in solar PV, first introduced in Thailand in 2002, gives customers 80% of the retail rate for the electricity that they inject into the grid. However, this scheme was not well received and did not significantly drive distributed solar PV investment due to the high upfront cost of solar PV systems before 2008. Later, in 2013, the government introduced a national rooftop FiT programme with a limited quota of 200 MW. By the end of the programme in 2015, the large-scale distributed solar PV system (i.e. large commercial and industrial rooftop installations) was mature for self-consumption.

In 2017, the Energy Regulatory Commission introduced the SPP Hybrid Firm scheme, which is a FiT-scheme PPA bidding process for small power producers (SPPs). The scheme aims to enable multi-source RE projects as well as to move from a non-firm PPA to a firm PPA.

Under this hybrid PPA, a combined power generating capacity of 300 MW will be allocated nationally, with the greatest allocation going to southern, northern, and northeastern Thailand. The Energy Regulatory Commission will review applications from SPPs for the sale of capacities between 10 MW and 50 MW through a competitive bidding process.

Before this regulation was enacted, RE PPAs were 'non-firm' and accommodated the delivery of electricity below the installed capacity of a power plant. Hence, the SPP Hybrid is intended to reduce the variations in intermittent RE and will require a continuous baseline-level production not seen in previous stand-alone solar or wind power farms.

The FiT for SPP Hybrid firm is set at ฿3.66/kWh or about US$0.1156/kWh (exchange rate of ฿31.61/US$ on 6 March 2018). Table 2.6 presents the details of the FiT for SPP Hybrid Firm scheme.

Table 2-6. FiT for SPP Hybrid Firm in Thailand

Installed capacity (MW)	FiT (US cent/kWh)			Period (years)
	Fixed FiT	Variable FiT	Total FiT	
Installed capacity >10–50 MW	5.76	5.89	11.65	20

FiT = feed-in-tariff; SPP = small power producers.

Note: Exchange rate ฿31.61/US$ (6 March 2018).

Source: DEDE Thailand (2017).

The SPP Hybrid scheme requires the RE generator to deliver between 98% to 102% of the PPA capacity during the 'peak' periods (between 9:00 a.m. and 10:00 p.m., Mondays to Fridays) and limits power output outside the peak period to 66.3% of the PPA capacity. In this new scheme, applicants are required to specify the types of RE which will be used as a power plant, but there are no minimum types of RE to be used, and nor restrictions of RE to be applied. In other words, all combination of RE types and integration with energy storage are allowed (Williams, 2017).

The Energy Regulatory Commission also launched the Self-consumption PV Pilot Programme in August 2016. During the initial stage, there was no required compensation for electricity to be

injected into the grid. However, in the next phase of the programme, which was expected to start in 2017, there was a plan to set a buyback rate for the excess electricity, after monitoring and evaluation was to be completed.

Thailand's Board of Investment promulgated multiple tax incentives for RE developers. Several investment promotions were introduced for sustainable development industry activities such as income tax holiday, exemption from import duties for RE equipment, and corporate income tax reduction.

A number of programmes also provided financing support for the promotion of RE. Under Industry Act 2007, the Energy Regulatory Commission established the Power Development Plan, which included RE promotion. Additionally, the Department of Alternative Energy Development and Efficiency set up the Energy Service Company Revolving Fund (which was created under the Energy Conservation Promotion Fund) in 2008, to invest, along with private operators, in RE and energy efficiency initiatives. Investment services covered by the Energy Service Company Revolving Fund includes equity investment, equipment leasing with low interest, venture capital, greenhouse gas reduction project facility, and credit guarantee facility.

Finally, the government also provides capital subsidies for RE power projects that are operated and owned by government agencies.

- Challenges in meeting future target

Thailand is ahead of the rest in the ASEAN in terms of solar energy development. The market for solar energy has been nurtured by various incentives, starting with the introduction of the Adder scheme in 2007, which was replaced by the FiT scheme in 2014. Thailand's comprehensive FiT scheme for solar energy consists of a fixed FiT and a premium rate for specific regions. On the other hand, the SPP Hybrid Firm, which was introduced to encourage integration of storage systems in RE, was not well received by project developers, since the FiT offered was deemed too low, given the size of the required investment in the storage battery appropriate for the hybrid power plant.

- Plan for absorbing fluctuating power output from solar

According to state enterprise Electricity Generating Authority Thailand, the country is currently using battery banks to mitigate the fluctuating power output from renewables, especially solar

power. For energy storage, the pumped storage hydropower is an option. At present, the battery bank's capacity is 10 MW while the pump storage hydropower capacity is around 200 MW. The country is expected to continue to top up this capacity, considering the growing renewable energy generated (EGAT, 2018).

2-11 Viet Nam

- Installed capacity and power generation of solar PV

Until 2015, there was no utility-scale solar PV installed in Viet Nam. Solar panel installation in the country was limited to small-scale application for off-grid electricity supply, specifically for building and households. However, ever since FiT was introduced in 2017, construction projects on utility-scale solar PV plants increased in number.

- Promotion policy of solar PV

The RE target in Viet Nam, as stipulated in the current Power Development Plan, consists of 11% RE share of 60 GW installed capacity in 2020; 13% RE of 96 GW in 2025; and 21% RE of 130 GW in 2030. Renewable energy consists of 2.1% wind, 15.5% hydro, 2.1% biomass, and 3.3% solar out of the total installed capacity in Vietnam. In particular, solar PV installation is expected to be 850 MW in 2020, 4000 MW in 2025, and 12000 MW in 2030.

To hit the targets, the government introduced the FiT scheme for solar farms and rooftop generation (net metering) in June 2017, as set out by the Prime Minister's Decision No. 11/2017/QD-TTg. The FiT for solar PV is D2,086/kWh – or equivalent to US$0.0935/kWh (exclusive of value-added tax) – and intended for any projects that can achieve a commercial operation date before the end of June 2019.

Following the issuance of Decision No. 11 on solar power, the Ministry of Industry and Trade of Viet Nam also released the first draft of a circular that provides detailed guidelines on the development of solar power projects in Viet Nam. The circular includes the draft of the solar PPA template as well as details of national and provincial solar power development plans. Under the draft solar PPA, Vietnam Electricity Corporation shall purchase the generation facility in a 20-year contract.

Under Decision No. 11, the government provides similar investment incentives as those for wind power projects. It has duty exemption for imports of solar components, corporate income tax

deductions, and land use incentives. The government also offers state investment credit to eligible solar power projects under Decree No. 32/2017/-ND-CP dated 31 March 2017. According to this decree, investors in solar projects could apply a loan with the Viet Nam Development Bank of up to 70% of the total investment capital (exclusive of working capital with a maximum tenor of 12 years) (Asian Power, 2017).

- Challenges in meeting future target

The issuance of Decision No. 11 and the draft circular, including the draft on the PPA for solar energy generation, are encouraging steps that can draw in more investment in solar installations (Baker McKenzie, 2017). However, there are some key issues that the draft circular has not resolved but may impact the bankability of solar projects and leave 'grey areas' for project developers. Rising concerns over the unclear sections of the draft circular include:

1) There is no provision to address the inflation risk nor are there rules on adjustment in the FiT if the exchange rate changes;
2) In the draft PPA, there is no stated compensation or payment to the project developer if Vietnam Electricity Corporation, as the purchaser, is given the rights to stop purchasing electricity under certain circumstances;
3) No provision for government guarantee or assurance to enhance creditworthiness of Vietnam Electricity Corporation as the off-taker;
4) No provision to address the risk of changes in law or tax and the payment protection in political *force majeure*.

- Plan for absorbing fluctuating power output from solar

Viet Nam has just established the FiT for solar energy generation in 2017. In the next years, investment in solar energy is predicted to take off, accompanied by additional solar capacity. At this point, the need to set up storage systems to address the intermittency is not urgent given that Viet Nam's solar capacity in the grid is not big enough. However, considering the attractive FiT scheme, the addition in solar capacity is predicted to increase rapidly in the future.