Executive Summary

The Association of Southeast Asian Nations (ASEAN) Member States are at different stages of development in their solar energy potential. Each has established a national target on renewable energy as well as a target for solar photovoltaic (PV) in particular. To achieve their targets, each ASEAN nation has initiated numerous policies and supporting schemes.

Table 1. Solar PV Policies and Incentives of 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 Types of Incentives for Solar PV
Brunei Darussalam	✔					
Cambodia					✔	✔
Indonesia	✔	✔	✔	✔	✔	
Lao PDR	✔				✔	
Malaysia	✔	✔	✔	✔	✔	
Myanmar					✔	
Philippines	✔	✔	✔		✔	
Singapore	✔		✔	✔		✔
Thailand	✔	✔	✔	✔	✔	
Viet Nam	✔	✔			✔	

Source: ASEAN Centre for Energy database (2017).

The challenges these ASEAN countries encounter as they try to meet their targets on solar energy differ from each other due to specific circumstance in their respective energy landscapes. To enhance the solar power capacity in the region, the ASEAN Member States need to overcome regulatory, technical, and financial challenges.

Table 1. ASEAN Challenges in Developing Solar PV

Regulatory	Financial	Technical
• For ASEAN nations that are in the early phase of developing their solar power market, the absence of dedicated policy or financing support (i.e. FiT, solar PPA) for solar energy is a hindrance • For ASEAN nations that have a mature solar market, the challenge is in how to transition to more efficient scheme to further reduce the cost (i.e from FiT to auction) • Inconsistent and unclear supporting policies for solar • Still lack of policy reinforcement for solar implementation as rural electrification method	• No clear investment guideline for investor to invest in solar energy • Lack of support from financial institution to finance RE projects, especially solar power	• Complicated permitting process and land acquisition issues for developing solar power plant • Land constraint for developing utility-scale solar power plant • Lack of technical expertise and experience in solar power in some ASEAN members states • No clear guidelines established for grid interconnection for solar project

PV = photovoltaics; FiT = feed-in-tariff; PPA = power project agreement.
Source: ASEAN Centre for Energy.

According to the study, at the current price level of solar PV and battery in ASEAN countries, both utility-scale solar PV + battery system; and residential solar PV + battery cannot compete with incumbent power supply options (i.e. conventional large-scale thermal power or residential electricity tariff). However, if the price of solar PV and battery decreases to the international best-price level in the future, the solar PV + battery system could compete with major conventional thermal power plants and bring benefits to residential customers as well. With ASEAN countries' domestic markets becoming more and more mature, cost reduction through economies of scale and efficiency in the supply chain can be expected.

Utility-scale Solar PV + Battery

- In the near term, with only a few utility-scale solar PV in the grid of most ASEAN countries, existing grid flexibility measures that have low costs, such as ramping capability of the gas-fired power plants, interconnection of transmission lines, and curtailment, should be preferentially used;
- Utility-scale solar PV + battery system can become a cost-effective and clean substitute for diesel as a power supply for small and isolated systems;
    - Simulation results suggest that although power generation costs of solar PV + battery at present price levels (solar PV: US$1,500/kW; battery: US$600/kWh) are still expensive (around US$0.24–US$0.30/kWh) compared with diesel, the power generation cost of solar PV + battery will be lower than that of diesel generators should there be slight cost reductions (for example, solar PV to drop to US$1,000/kW, and battery to US$300/kWh). Nowadays, prices for solar PV that are lower than US$1,000/kW and batteries lower

than US$300/kWh are already observed in global best cases (IRENA, 2017, 2018);

  - However, since batteries are not suitable for inter-seasonal or seasonal energy storage, solar PV+ battery alone is not sufficient to provide 7/24 stable power supply.

- **In the larger system,** supporting policies are needed to further bring down solar PV + battery power generation cost and make it competitive vis-à-vis conventional thermal power technologies.

  - The simulation result shows that if solar PV and battery cost could be further reduced to, for example, US$500/kW and US$100/kWh, respectively, the solar PV + battery system could compete with conventional thermal power generation technologies. According to the International Renewable Energy Agency (IRENA) and Fraunhofer Institute for Solar Energy System, the system cost of solar PV can be reduced to as low as US$630/kW until 2025 (IRENA 2016) and US$320/kW[1] until 2050 (Fraunhofer ISE, 2015). In addition, IRENA estimates that the installation cost of lithium-ion battery can be reduced to US$77–US$215/kWh until 2030 (IRENA, 2017). Given that most of the components for solar PV systems and batteries are already international circulated commodities, a cost reduction to US$500/kW for solar PV and US$100/kWh for battery is a possibility in ASEAN countries in the medium to long term.

  - Initiatives such as technical trainings for solar PV and battery project managers and installation contractors, low interest loan or loan guarantee, permits to use public land at low cost, and supports on land-use negotiations can help bring down the solar PV + battery system's generation cost.

Rooftop Solar PV + Battery

- The case study on residential solar PV in Lao PDR suggests that for typical households in a suburban area close to Vientiane, the power supply cost of a 4 kW solar PV with 5 kWh battery system can proximate the grid electricity tariff's level when the costs of solar PV and battery are reduced to US$1,000/kW and US$300/kWh, respectively.

- The economics of residential solar PV + battery is highly dependent on whether net metering is allowed or not; and on the compensation policy for the solar power fed back to the grid.

  - When the penetration of residential solar PV is still low, allowing net metering and giving certain compensation for the fed-back power can help encourage the installation of solar PV.

  - When the penetration rate goes higher, measures such as limiting the fed-back power to the grid, lowering compensation to the residential solar power sold to the grid, applying flexible electricity tariff mechanisms, and rolling out smart metering can help harmonise residential solar PV, battery, and grid operations.

[1] Converted from euro to US dollar based on exchange rate of €1 = US$1.14.