Chapter 5

Policy Recommendations

This study shows that at the current price level of solar PV and battery in ASEAN countries, both the utility-scale solar PV (or large-scale solar PV plant) + battery system as well as residential solar PV + battery cannot compete with existing power supply options (such as 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.

Utility-scale solar PV + Battery

The solar PV's impact on the grid depends on the penetration rate of solar PV and the flexibility of the grid. When the penetration rate of solar PV is still low, its intermittency can be absorbed by the existing grid flexibility resources, such as ramping capability of the gas-fired power plants, interconnected transmission lines, and curtailment. Since these measures usually do not require additional investment, the cost is low. Therefore, in the short term, since the presence of solar PV in the grid is expected to remain low in most ASEAN countries, existing low-cost grid flexibility measures should be preferred.

However, **utility-scale solar PV + battery system can become a cost effective and clean substitute to diesel as a power supply to small and isolated systems** such as remote islands. In such places, the demand is small and the flexibility measure is few, which leaves energy storage as one of the limited options for balancing solar PV intermittency. In ASEAN countries, most of the remote islands rely on diesel for their power supply. Because of the high logistics cost of bringing diesel to the island, the cost of power supply is usually high and the system is constantly exposed to fuel price fluctuations.

Simulation results of this study indicate that, at their present prices (solar PV: US$1,500/kW, battery: US$600/kWh), power generation cost of solar PV + battery is still expensive (around

US$0.24–US$0.30/kWh) compare to diesel. However, the power generation cost of solar PV + battery will be lower than that of diesel generators when there are slight cost reductions (for example, solar PV to drop to US$1,000/kW and battery, to US$300/kWh). This is, in fact, already being achieved in nations outside of the ASEAN. In the short term, solar PV + battery can become a viable alternative to diesel as power source in isolated villages or remote islands once solar PV + battery costs reach the international best-practice level. However, it should also be made clear that since the battery is not suitable for inter-seasonal or seasonal energy storage, solar PV+ battery alone is not sufficient to provide 7/24 stable power supply.

Supporting policies are needed to further bring down solar PV + battery's power generation costs and make such system competitive when compared with conventional thermal power technologies. Simulation results show that if further solar PV and battery cost are reduced to US$500/kW (for solar PV) and US$100/kWh (for battery), the solar PV + battery system compete with conventional thermal power generation technologies (such as coal-fired or gas-fired thermal power) in ASEAN countries.

Although the cost reduction is contributed largely by the cost reduction and efficiency improvement in equipment (solar panel, inverter, Li-ion battery, etc.), it is also influenced by many other factors such as construction cost, logistics cost, financing cost, and land use cost. Policies such as on technical training of 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

If residential solar PV + battery system can supply electricity at cost lower than the grid's electricity tariff, the former's penetration rate is expected to grow rapidly. At the same time, regulations and mechanisms that encourage self-consumption of the residential solar PV power generation are important in maintaining the grid's stability and in ensuring fairness amongst customers.

Table 5–1. Essentials of Policy Design for Utility-Scale Solar PV + Battery

	Application	Flexibility measures
Short term	Remote/isolated area application to partly replace diesel generator.	Explore existing low-cost measures -– e.g., ramping capability of gas-fired power plants, interconnection of transmission lines, and curtailment.
Long term	Larger application to replace conventional thermal power.	Support solar PV + battery system’s cost reduction

Note: The table is indicative. Policy designs generally differ by country.

Source: Authors.

In places such as Australia and Hawaii, where residential solar PV is starting to become competitive vis-à-vis the grid’s electricity, the issue of how to handle the excess solar power feeding back into the grid is looming large. In such places, policy priority is shifting from encouraging installation of solar PV to encouraging self-consumption of solar PV. In this case, battery is the most effective option for improving the self-consumption rate of residential solar PV.

Although the penetration rate of residential solar PV in ASEAN countries is still low, the continuing cost reduction in residential solar PV systems (even if equipped with batteries) could become increasingly competitive with the electricity supplied from the grid. The case study on residential solar PV in Lao PDR shows that, for the typical household in a suburban area close to Vientiane, the power supply cost of a 4 kW solar PV with 5 kWh battery system could proximate the grid electricity tariff if the costs of solar PV and battery are reduced to US$1,000/kW and US$300/kWh, respectively.

On the other hand, the economics of residential solar PV + battery is highly dependent on whether net metering is allowed and how the excess power fed back to the grid is compensated. From the end-user’s perspective, if net metering is not allowed, all the cost of solar PV is borne by the installer; hence, the customers will have little incentive to install solar PV system when the cost is high. If net metering is allowed and the fed-back power to the grid is compensated at a high price, part of the cost of solar PV system can be recovered by selling electricity to the grid, and the incentive for solar PV installation will be higher. In this case, when the excess power can be sold to the grid at a higher price, the need for an energy storage system, i.e. batteries, is low.

However, from the perspective of the whole grid, net metering is supposed to bring two negative effects. First, an increase in fed-back power from residential solar PV systems will increase the fluctuations in the distribution network. Second, compensating the excess residential solar PV at higher price means that it increases the amount shouldered by all the customers, including households that do not have solar PV installed in their homes.

Therefore, it is when residential solar PV is still scarce that both net metering and compensation for the fed-back power can help encourage the installation of more solar PV system. When the penetration rate starts to rise, policies such as limiting the fed-back power to the grid or lowering compensation to the residential solar power sold to the grid, imposing flexible electricity tariff mechanisms, and rolling out smart meters, can help harmonise residential solar PV, battery, and grid operations. Detailed policy designs could vary from country to country, or even from service area to service area, depending on their social-economic conditions and electricity market structure.

Table 5–2. Essentials of Policy Design for Rooftop Solar PV

		Policy instrument	
	Priority of policy	Net metering of excess solar power	Compensation for solar power fed back to the grid
Pre-mature market	Increase solar PV capacity	Allow	High
	↓	↓	↓
Mature market	Increase self-consumption of solar power (storage capacity)	Restrict	Low

PV = photovoltaics.

Note: The table is indicative. Detail design of policy will differ by country.

Source: Authors.

Long-term Comprehensive Strategy

In the long term, an energy storage deployment strategy should be an integral part of a country's long-term power generation development plan. The need for energy storage is determined by the penetration level of variable renewable energy as well as the potential and cost of other grid flexibility measures.

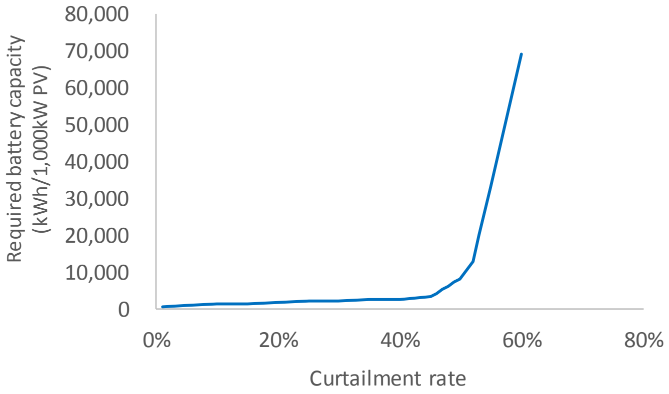
In a larger system, there is higher grid flexibility to accommodate variable renewables, but when all the low-cost grid flexibility potential is exhausted, energy storage is a natural choice to maintain the grid's stability. Amongst the major energy storage options, pumped storage hydropower and battery systems are promising technologies. Although the pumped storage hydropower, as a matured technology, is less expensive in terms of cost per unit capacity, it requires huge land acquisition and longer construction time. On the other hand, batteries, although currently still expensive, is more flexible and can be a practical solution for variable renewable technologies' grid integration. Since there are a wide variety of batteries, each exhibiting distinctive characteristics and trends in terms of cost reduction, construction lead time, etc., a comprehensive energy storage strategy that considers a country's long-term energy plan can help policymakers develop well targeted and effective supporting policies.

Annex 1. Results by Country

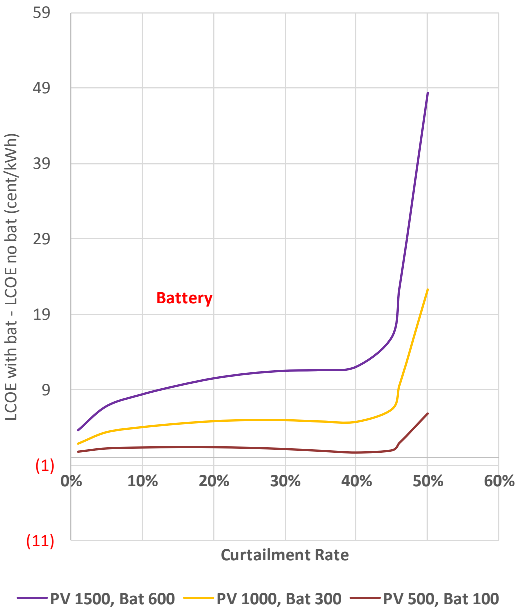
Cambodia

Observed electricity load curve data of January (2018) was provided by the participant of the first workshop meeting. Load curve data from February to December were filled per week by using the weekly average value calculated from the observed data.

(1) Required battery capacity per 1,000 kW of PV



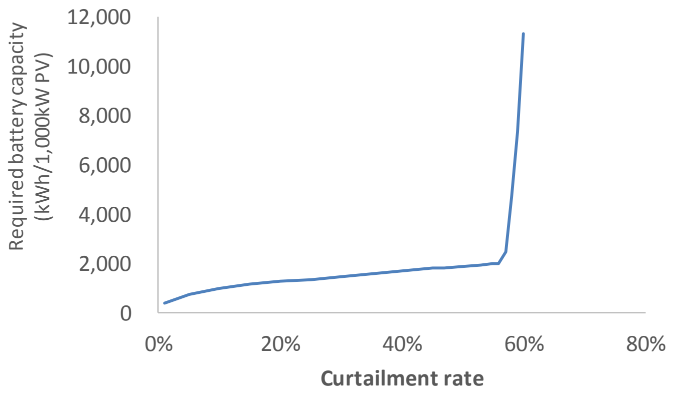
(2) Economics of energy storage for curtailment avoidance



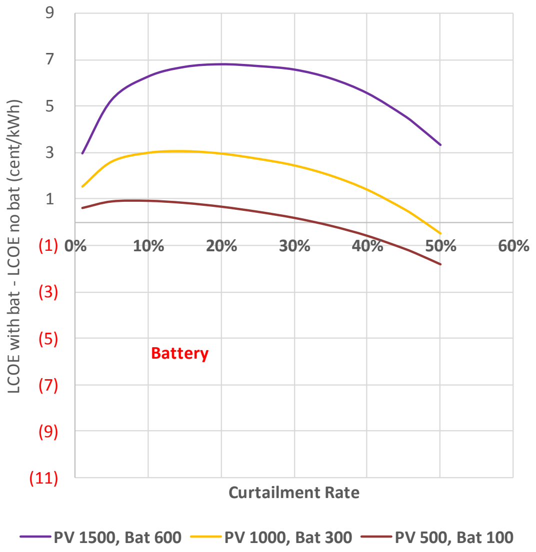
Indonesia Java–Bali

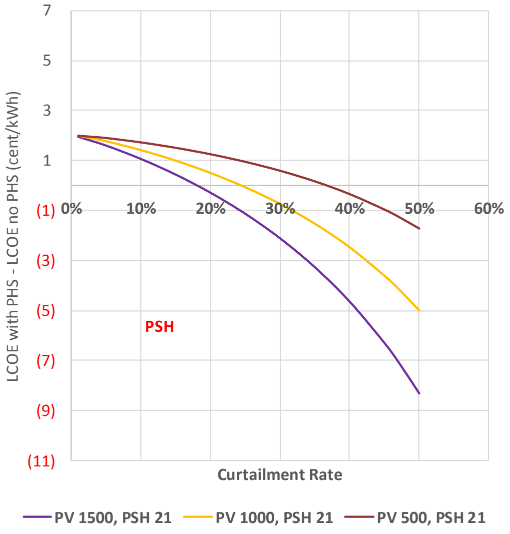
Two patterns of daily load curve, differentiated by season (dry/rainy), were applied to the whole year. The data is derived from previous ERIA studies.

(1) Required battery capacity per 1,000 kW of PV



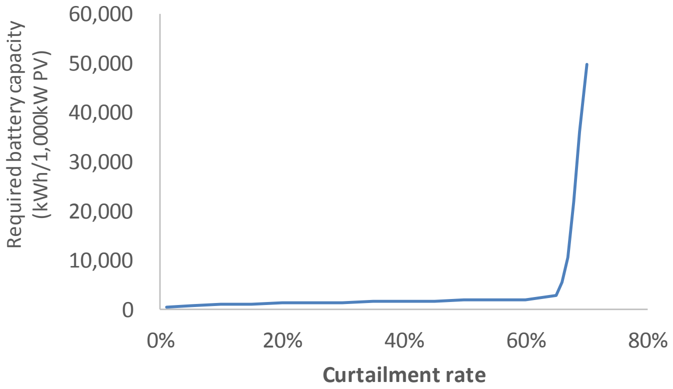
(2) Economics of energy storage for curtailment avoidance



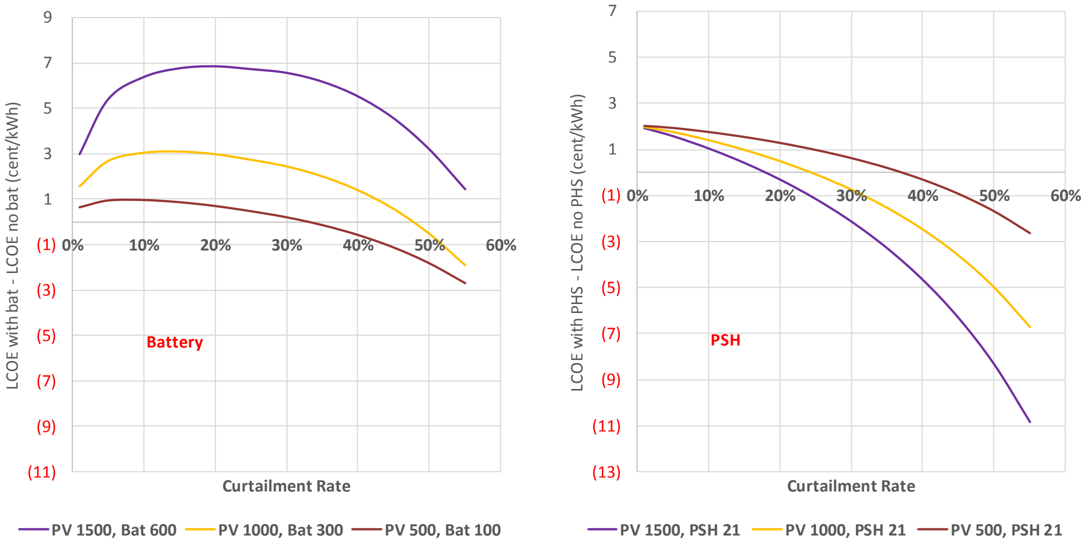


Indonesia Sumba Island

(1) Required battery capacity per 1,000 kW of PV

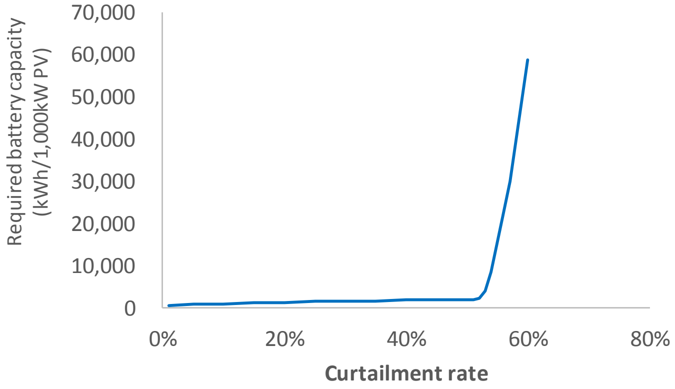


(2) Economics of energy storage for curtailment avoidance

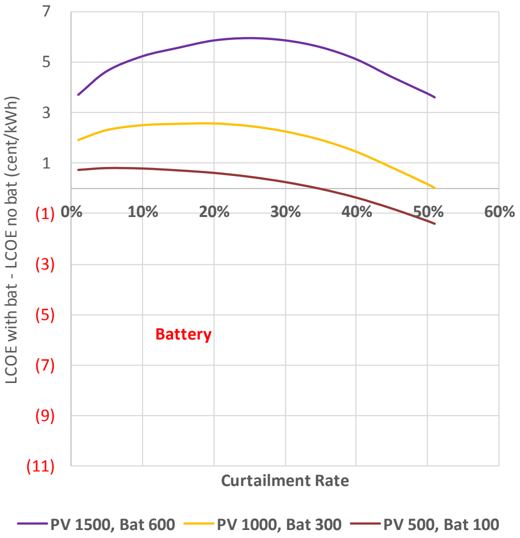


Lao PDR

(1) Required battery capacity per 1,000 kW of PV

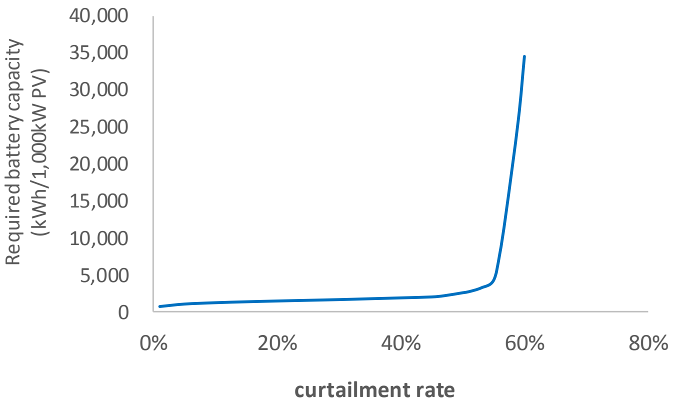


(2) Economics of energy storage for curtailment avoidance

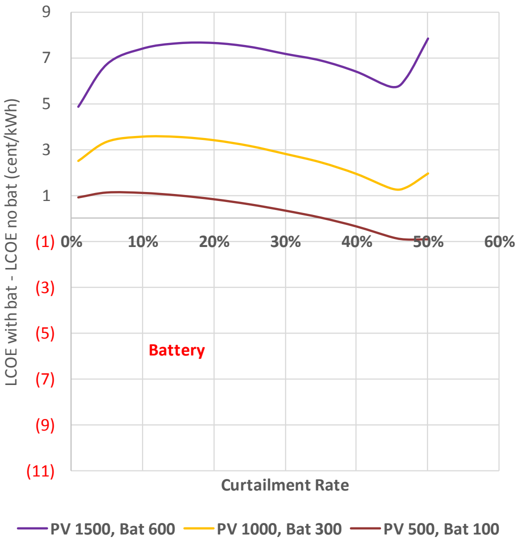


Malaysia

(1) Required battery capacity per 1,000 kW of PV

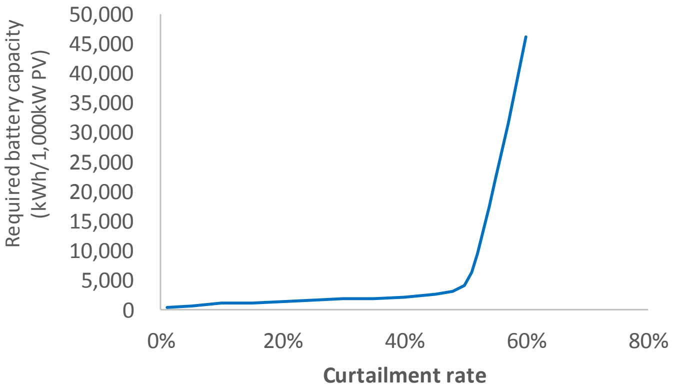


(2) Economics of energy storage for curtailment avoidance

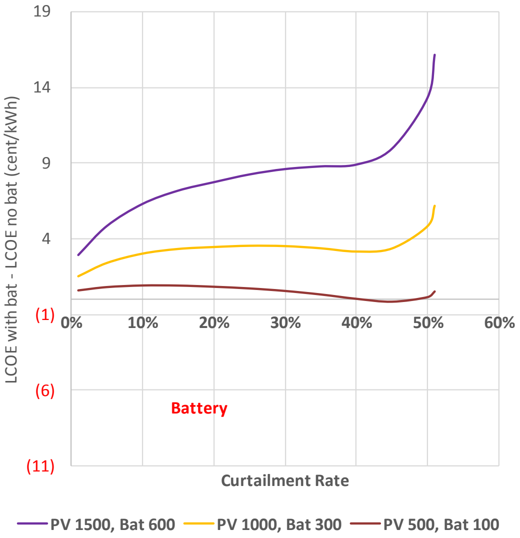


Myanmar

(1) Required battery capacity per 1,000 kW of PV

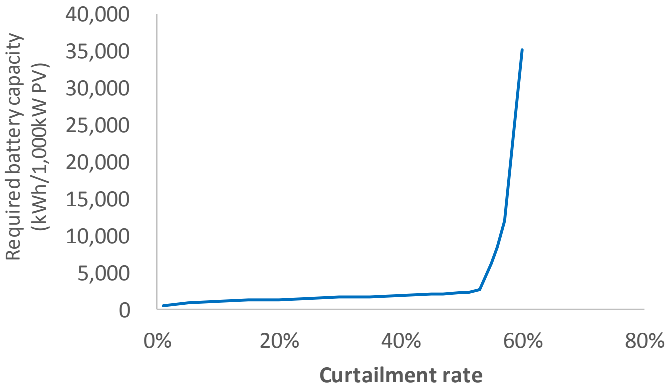


(2) Economics of energy storage for curtailment avoidance

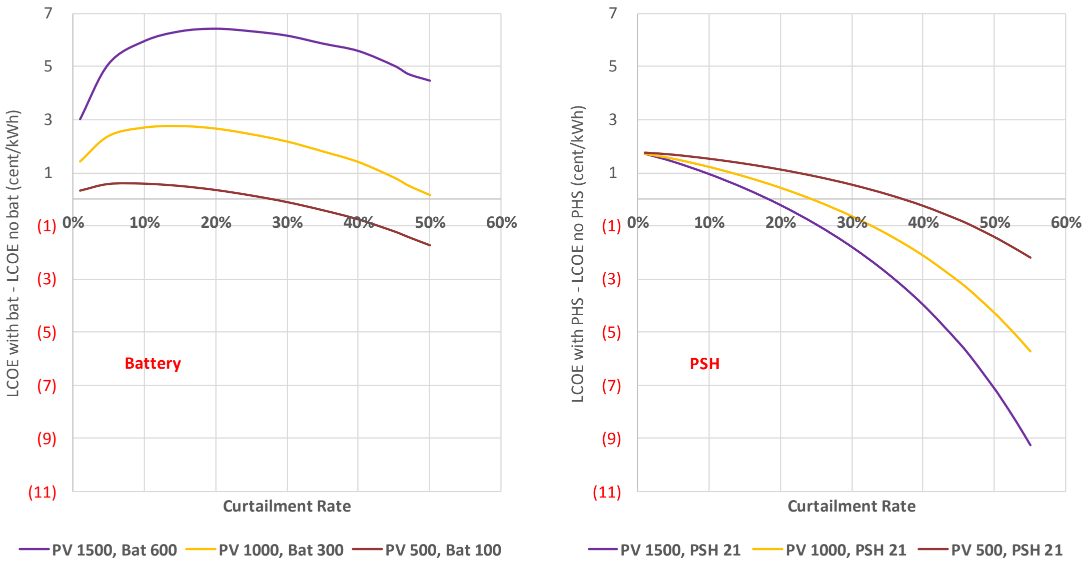


Thailand

(1) Required battery capacity per 1,000 kW of PV

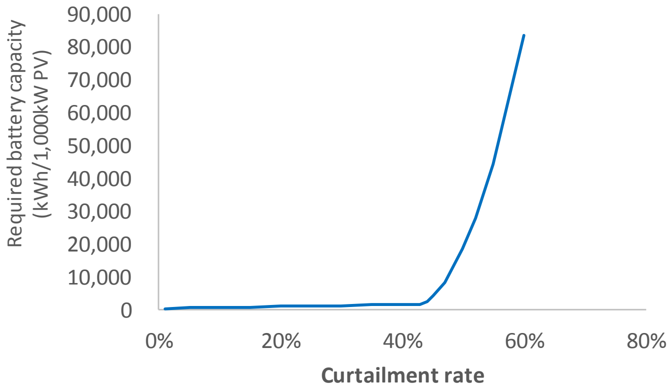


(2) Economics of energy storage for curtailment avoidance

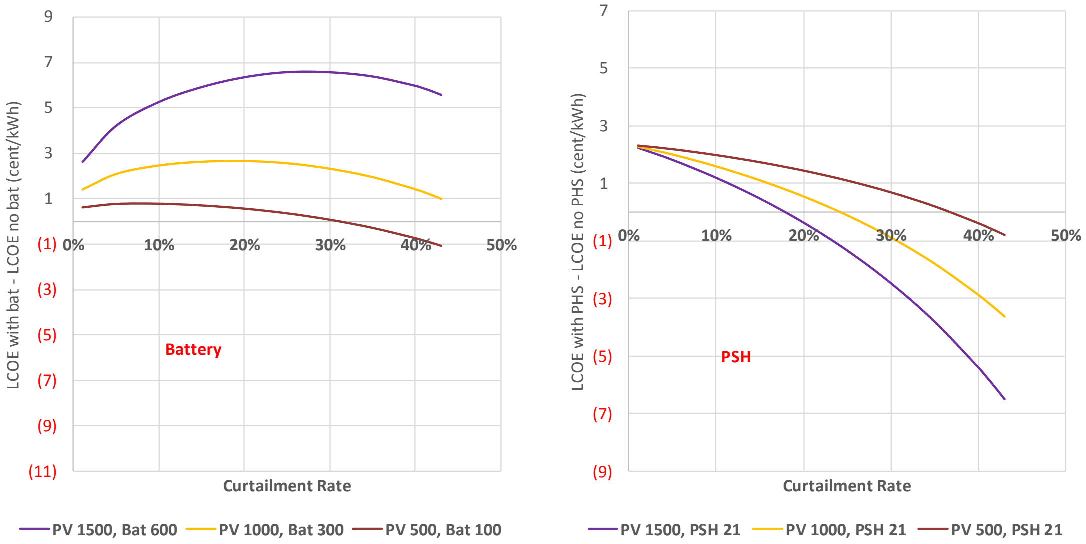


Viet Nam

(1) Required battery capacity per 1,000 kW of PV



(2) Economics of energy storage for curtailment avoidance



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