

List of Figures

Figure 2-1	Solar PV Capacity and Its Share in Renewable Power Generation: Brunei Darussalam	6
Figure 2-2	Solar PV Capacity and Its Share in Renewable Power Generation: Indonesia	10
Figure 2-3	Solar PV Capacity and Its Share in Renewable Power Generation: Malaysia	15
Figure 2-4	Solar PV Capacity and Its Share in Renewable Power Generation: Philippines	21
Figure 2-5	Solar PV Capacity and Its Share in Renewable Power Generation: Singapore	24
Figure 2-6	Solar PV Capacity and Its Share in Renewable Power Generation:: Thailand	27
Figure 3-1	Operation Mechanism of CAES	35
Figure 3-2	Flywheel Energy Storage System	36
Figure 3-3	Example of Solar PV and Heat Pump System for Home Energy Supply	37
Figure 3-4	Basic Structure of Batteries	38
Figure 3-5	Mechanism of Flow Battery	39
Figure 3-6	Image of Power-To-Gas System	40
Figure 3-7	Unit Installation Cost of Various Storage Technologies as of 2016	41
Figure 3-8	Price Reduction of Li-ion Battery from 2010 to 2016	42
Figure 3-6	Cost Reduction and Cycle Life Improvement of Various Battery Technologies through 2030	42
Figure 3-10	Mapping of Energy Storage Applications and Technologies by Power Capacity and Discharge Duration	43
Figure 4-1	Example of Hourly Solar Radiation in ASEAN Countries	45
Figure 4-2	Example of One Day Load Curve (Normalized) in ASEAN Countries	46
Figure 4-3	Curtailment of Solar PV	48
Figure 4-4	Image of Using Energy Storage to Absorb The Excessive Solar PV	48
Figure 4-5	Output of Solar PV After Firming by Energy Storage	50
Figure 4-6	Output of Solar PV After Shaping to Follow Load Change	50
Figure 4-7	Residential Solar PV Without Energy Storage	51
Figure 4-8	Residential Solar PV and Energy Storage	52

Figure 4-9	Required Battery Capacity per 1000 kW Solar PV by Curtailment Rate Assumption (example of Malaysia)	58
Figure 4-10	Image of Battery Charging and discharging in Cases of 10% and 54% Curtailment Rate Assumptions (example of Malaysia)	58
Figure 4-11	LCOEs With and Without Energy Storage (PV = US\$1,500/kW, battery = US\$600/kWh, PSH = US\$21/kWh)	59
Figure 4-12	LCOEs With and Without Energy Storage (PV = US\$1,000/kW, battery = US\$300/kWh, PSH = US\$21/kWh)	60
Figure 4-13	LCOEs With and Without Energy Storage (PV = US\$500/kW, battery = US\$100/kWh, PSH = US\$21/kWh)	60
Figure 4-14	Evolution of Economic Viability of Energy Storage for Curtailment Avoidance (example of Thailand)	62
Figure 4-15	LCOE of Solar PV + Energy Storage for Daily Capacity Firming	64
Figure 4-16	LCOE of Solar PV + Energy Storage with Load Following Output	64
Figure 4-17	Self Consumption Rate of Various Solar PV and Battery Combinations	65
Figure 4-18	Share of Electricity Demand Met by Solar + Battery System	66
Figure 4-19	Power Generation Cost of Solar PV and Solar PV + Battery Under Various Cost Assumptions (solar PV 4kW, battery 5 kWh)	67
Figure 4-20	Power Generation Cost of Solar PV + Battery When Net Metering is Not Allowed (Solar PV 4kW)	68