

PV Grid-Connected System with BESS

Baan Prueksathorn Demonstration Site | Operational record 2018-2025

55.32 kWp
SOLAR PV
CAPACITY

67.2 kWh
BATTERY
CAPACITY

Grid-connected
SYSTEM
CONFIGURATION

Strategy
Self-Consumption
First

Tariff

On-peak 5.798 THB/kWh
Off-peak 2.637 THB/kWh

SYSTEM DEVELOPMENT

2017 Initial installation

PV 23.1 kWp
Battery 17.4 kWh

2020 PV expansion

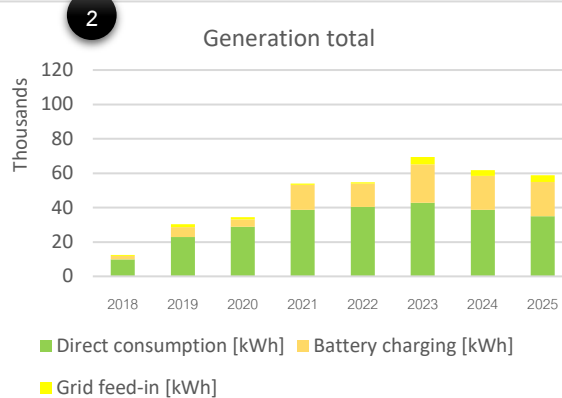
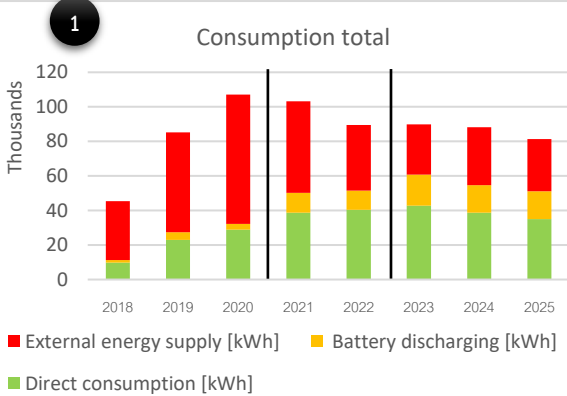
PV 28.06 kWp
(4.96kWp)

2021 Major expansion

PV 55.32 kWp (27.26kWp)
Battery 67.2 kWh (Changing)

2022-Now Energy Management

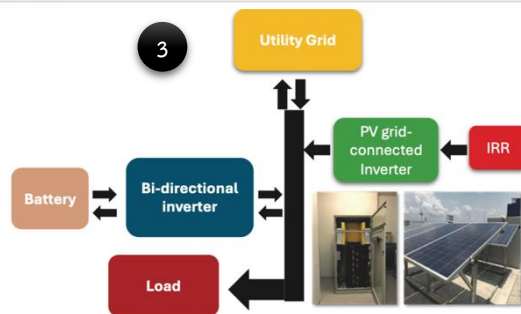
Monitoring, equipment
And operating strategy



Annual Energy Balance

The energy trend follows the system expansion timeline. The original 23.1 kWp PV and 17.4 kWh battery supported the site during 2018–2019. PV capacity increased to 28.06 kWp in 2020, followed by a major expansion to 55.32 kWp PV and 67.2 kWh battery in 2021. From 2022 onward, energy management and operating strategies have been improved to maximize the use of the expanded PV and battery capacity.

3



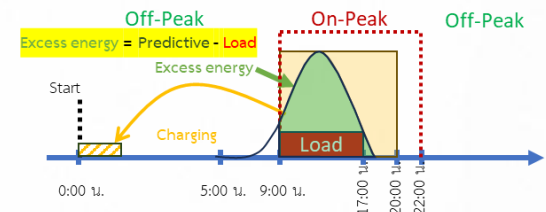
Energy Flow Priority

1. PV → Load first
2. Excess PV → Battery
3. Remaining surplus → Grid
4. When PV is insufficient:
Battery → Load, then Grid

5

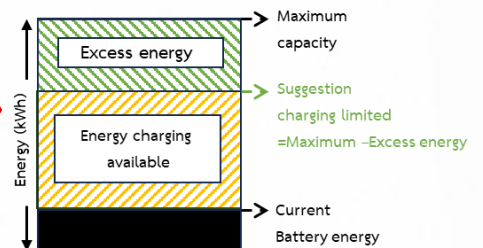
Predictive control concept

Predict-NL (PV-Noon & Load charge mode)

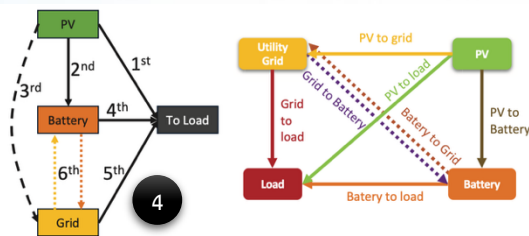


Predictive Control Concept

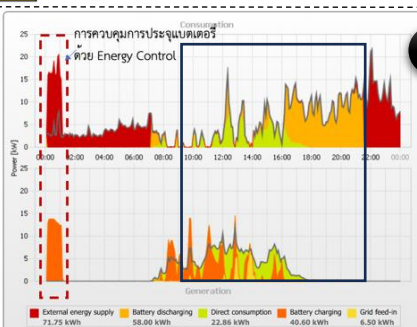
Predict-NL forecasts daytime PV and load, estimates the expected excess solar energy, and reserves battery capacity for the next On-peak period. Charging is limited at the calculated level so the battery is not filled too early.



4

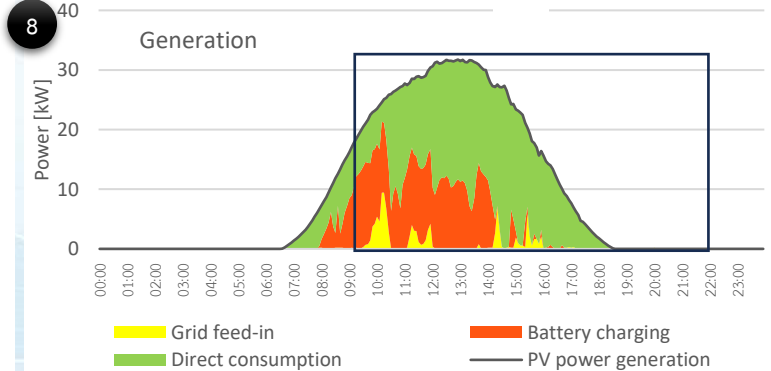
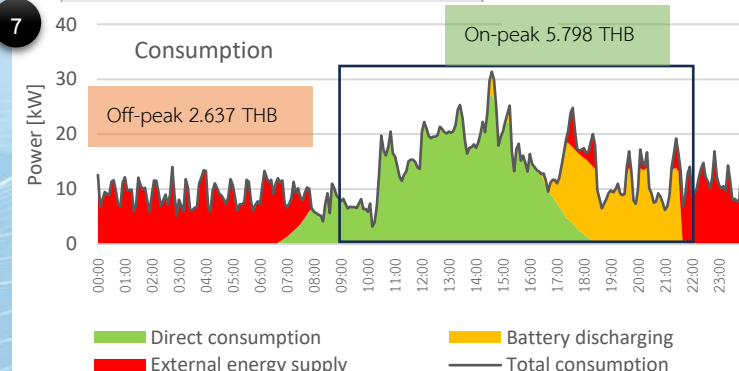


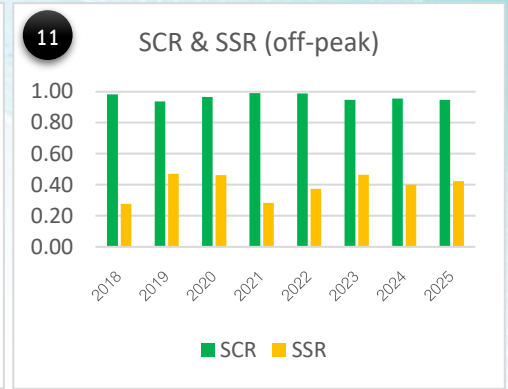
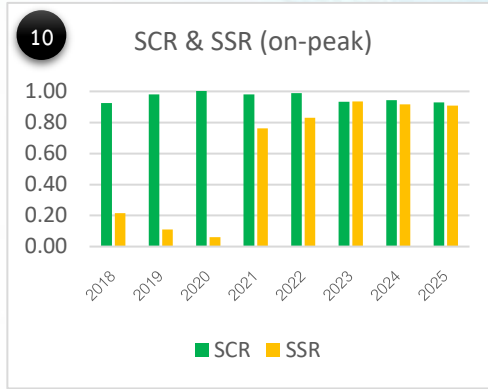
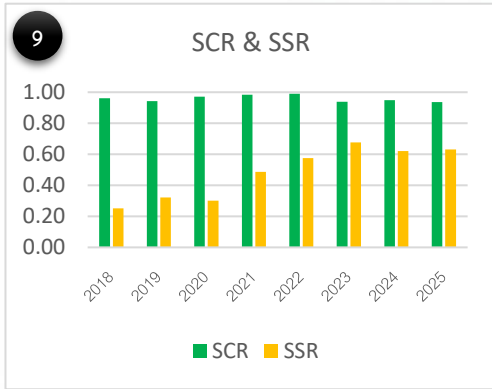
6



Predictive TOU Operation

During Off-peak, low-tariff grid energy is used only as needed to prepare the battery. During On-peak, PV supplies the load first; excess PV charges the battery, while the battery supports the load when PV falls. The forecast-based charging limit preserves space for expected solar energy and reduces unnecessary grid purchases.



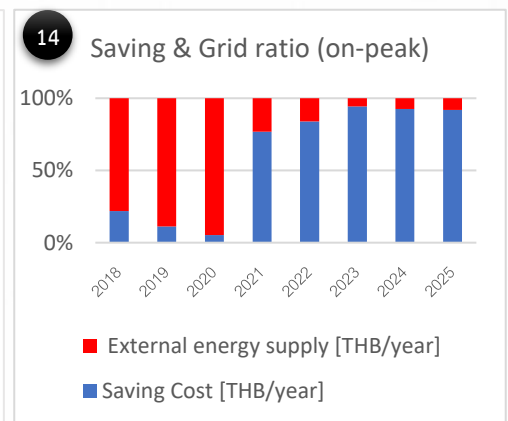
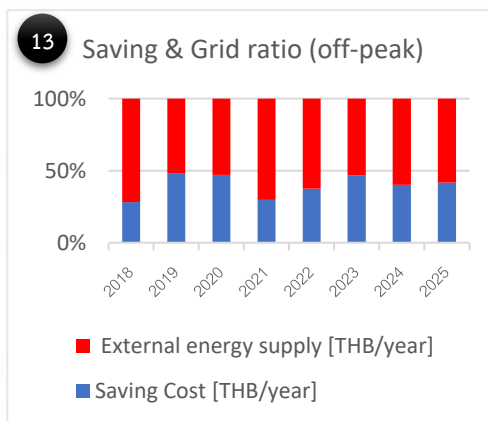
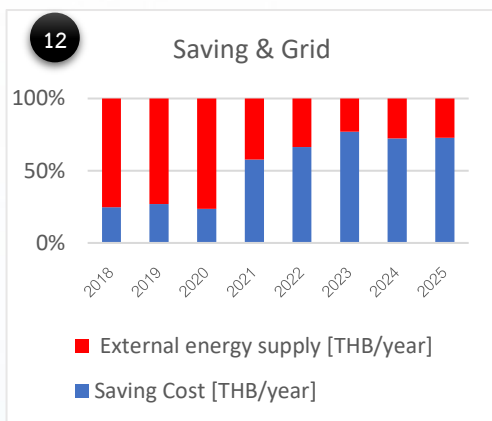


SCR & SSR Interpretation

- **SCR (Self-Consumption Ratio)** shows the proportion of PV energy used on-site rather than exported to the grid.

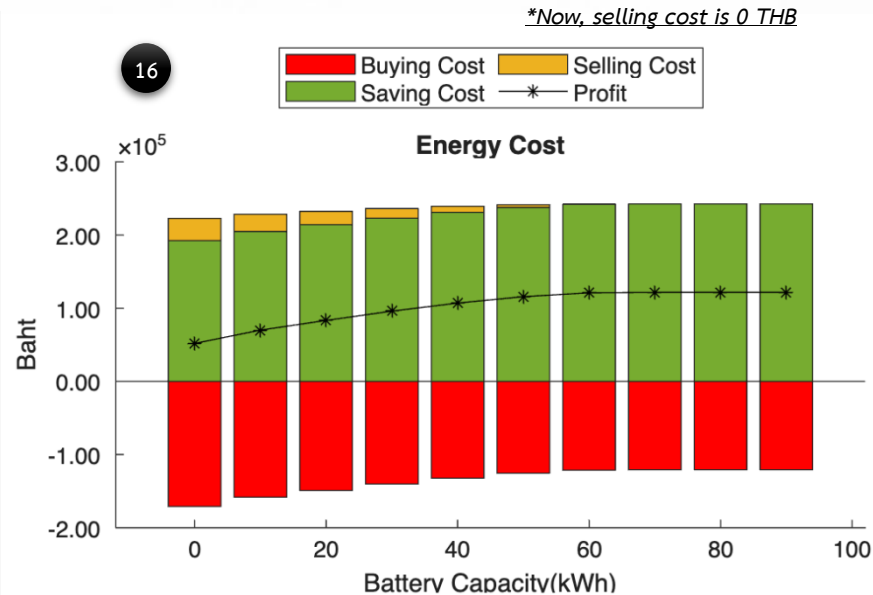
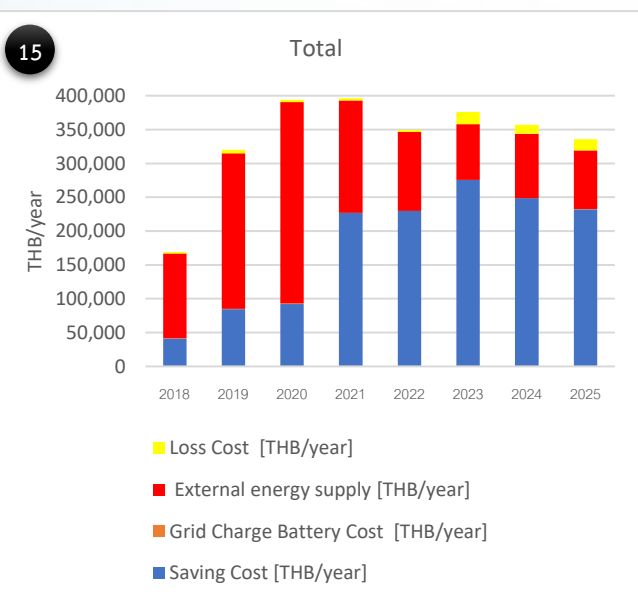
- **SSR (Self-Sufficiency Ratio)** shows how much of the site's electricity demand is supplied by PV and the battery instead of the grid.

SCR remains consistently high across 2018–2025, indicating that most PV energy is utilized on-site. SSR increases significantly after the 2021 PV/BESS expansion, especially during On-peak, showing that a larger share of the load can be supplied by PV and the battery. Off-peak SSR remains lower because solar generation is limited.



Cost Saving by TOU Period

The larger PV/BESS system shifts a greater share of annual electricity cost from grid purchase to on-site savings. The effect is strongest during On-peak, where the tariff is 5.798 THB/kWh; after 2021 the saving share becomes dominant. Off-peak savings are smaller because the tariff is only 2.637 THB/kWh. The battery-capacity trend also shows diminishing additional benefit as capacity becomes large.



Overall Financial Performance

The 2021 major expansion is the main turning point: annual saving value increases substantially while the external-grid cost share decreases. Savings remain high through 2025, with only small contributions from loss and grid-charging costs. Overall, the PV/BESS system creates its greatest economic value by increasing on-site solar utilization and reducing expensive grid purchases, particularly during On-peak periods.

