CASE STUDY

2 MWp SOLAR PV + 3 MWh X-BESS

Green Power 21, Gorna Oryahovitsa, Bulgaria

Integrated utility-connected solar generation and battery energy storage system | Bulgaria



THE CHALLENGE – INTEGRATING SOLAR GENERATION WITH FLEXIBLE ENERGY STORAGE

A 2 MWp photovoltaic plant can generate substantial renewable electricity, but solar output fluctuates with irradiation, weather and time of day. Coupling the PV installation with a 3 MWh X-BESS rated at 1.5 MW AC creates a controllable energy asset that can absorb surplus production, shift delivery to higher-value periods and manage power at the grid interface. The actual dispatch strategy depends on the point-of-connection agreement, applicable market rules and site operating profile.

❖ **Challenge 1 — Variable PV production**

PV generation changes rapidly and does not necessarily coincide with local demand or high-value export periods. Without storage, surplus production may be exported at unfavorable prices or curtailed when grid limits apply.

❖ **Challenge 2 — Grid connection and export constraints**

The medium-voltage connection, transformers, protections and utility agreement must accommodate PV generation and bidirectional BESS flows. A 2 MWp DC array is not equivalent to a guaranteed 2 MW AC export capability.

❖ **Challenge 3 — Energy** value **optimization**

Day-ahead/intraday price variability creates opportunities to shift solar energy, but battery cycles, conversion losses, tariffs and degradation must be accounted for.

❖ **Challenge 4 — Safe and reliable integration**

BESS operation requires coordinated electrical protection, battery management, cooling, emergency response provisions, fire-risk assessment, commissioning and secure remote supervision.

❖ **Challenge 5 — Operational coordination**

PV inverters, PCS, BMS, revenue-grade metering and plant EMS must share reliable telemetry and comply with grid-code requirements, power limits and control priorities.

THE SOLUTION

An integrated AC-coupled solar-plus-storage system combines the following assets under a plant-wide Energy Management System (EMS):

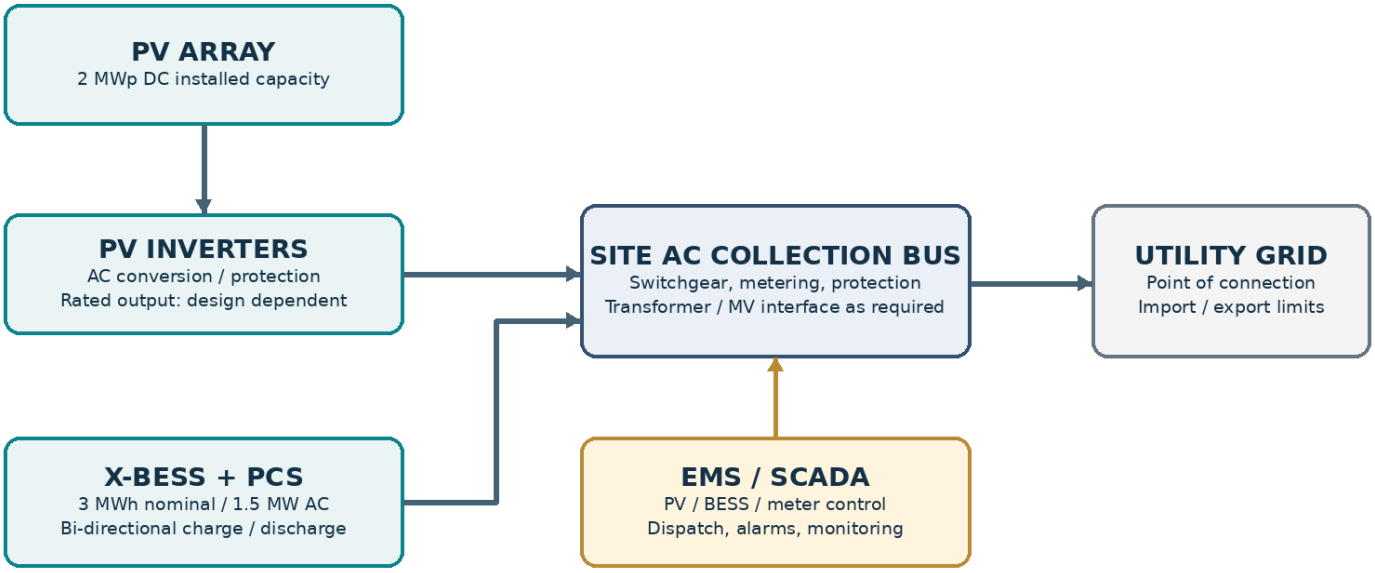
- 2 MWp photovoltaic plant — installed DC peak capacity.
- **3 MWh IPS EXERON X-BESS** — nominal battery energy capacity.
- **1.5 MW AC battery power conversion capability** — bidirectional charge/discharge power rating.
- PV inverter system, AC collection and grid-interconnection equipment — ratings established in detailed design.
- **EMS / SCADA** — coordinates PV generation, battery dispatch, export limits, metering and plant monitoring.

At nameplate ratings, the battery energy-to-power ratio is 3 MWh ÷ 1.5 MW = 2 hours. This is a nominal full-power duration before usable-energy limits, conversion losses, auxiliary loads and operating reserves; it is not a guaranteed continuous discharge duration.

X-BESS 3000 · KEY SPECIFICATIONS

Parameter	New PV + BESS use case
Solar PV installed capacity	2 MWp (DC)
Battery system	IPS EXERON X-BESS
Nominal energy capacity	3,000 kWh / 3 MWh
BESS AC rated power	1,500 kW / 1.5 MW
Nominal energy-to-power ratio	2.0 h at 1.5 MW
Integration concept	AC coupled, grid connected
Voltage DC	1500 VDC
Voltage AC	800 VAC
Battery cell chemistry	LFP
Thermal Management System:	Liquid cooling
Fire prevention/suppression system:	YES
Operating temperature(ambient):	-40 °C up +60 °C
Cycle Design Life Rating:	12 000

INTEGRATED SYSTEM ARCHITECTURE



Conceptual AC-coupled arrangement; final SLD, voltage levels and ratings require project-specific engineering.

Architecture logic: PV strings feed PV inverters; their AC output and the bidirectional X-BESS PCS connect to a common AC bus. Site switchgear, protection, metering and any required transformer connect the plant to the distribution network. The EMS receives measurements and dispatches setpoints to the BESS and PV inverters.

EMS / SCADA — CORE CONTROL FUNCTIONS

- Forecast PV generation and monitor state of charge (SoC), battery availability and site/grid measurements.
- Prioritize direct PV delivery, then charge X-BESS with available solar energy when technically and commercially appropriate.
- Discharge X-BESS to shift renewable energy to later periods or support contracted power schedules.
- Enforce utility import/export constraints, inverter and PCS limits, SoC boundaries and charge/discharge interlocks.
- Support power smoothing, curtailment reduction and active/reactive power control where permitted by grid requirements.
- Log alarms, operating KPIs and energy flows; support remote monitoring, diagnostics and performance optimization.

KEY BENEFITS

✓ **Higher PV energy utilization**

Capture otherwise curtailed or low-value solar energy, subject to export and dispatch conditions.

✓ **Energy time-shifting**

Transfer selected PV production to evening or more valuable market periods.

✓ **Grid flexibility**

Control net injection and respond to agreed grid-interface limits.

✓ **Operational resilience**

Provide controlled plant operation and diagnostics; backup or islanded supply requires dedicated design and approvals.

✓ **Integrated delivery**

Single engineering, commissioning and O&M framework for PV, X-BESS, EMS and grid interface.

COMMERCIAL PROJECT RESULTS

2 MWp PV + 3 MWh / 1.5 MW X-BESS | Bulgaria

The integrated PV and battery energy storage system is designed to maximize renewable energy generation value, improve electricity trading flexibility and optimize grid interaction.

Based on regional solar irradiation and indicative Bulgarian electricity market conditions, the proposed project offers the following potential financial performance:

- ✓ **2,600–2,800 MWh** annual solar electricity production;
- ✓ **€169,000–€266,000 annual PV electricity revenue** or avoided purchasing costs, depending on the realized electricity price and consumption structure.
- ✓ **€25,000–€95,000 additional annual BESS operating** contribution through energy arbitrage and solar generation shifting, subject to market volatility and dispatch strategy.
- ✓ **€194,000–€361,000 combined annual gross** energy value, before fixed operating expenses.
- ✓ **€149,000–€321,000 indicative annual operating cash flow** after estimated operating expenses.

The integrated EMS optimizes energy flows between the photovoltaic system, X-BESS and electrical grid, enabling higher-value energy dispatch, reduced exposure to unfavorable daytime electricity prices and potential participation in flexibility markets.

Additional revenue opportunities may arise from balancing services, peak-demand reduction and contracted electricity supply arrangements.

TELELINK INFRA SCOPE

- ➢ **Engineering & Design:** Site and connection assessment; PV + BESS sizing validation; yield and dispatch modelling; protection, safety and grid studies.
- ➢ **EPC Delivery:** Design & Procurement · Construction · Commissioning
- ➢ **Digital Energy Management:** EMS / SCADA · Real-time monitoring · Performance optimization
- ➢ **Operations & Maintenance:** 24/7 Monitoring Center · Predictive maintenance · SLA-backed support