


KSTAR Case Study

NORTH MACEDONIA



Capturing Every Peak Hour:
KSTAR Delivers 12.5MW/40MWh
Turnkey Storage in North Macedonia



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01 Executive Summary

EVN, the designated distribution network operator for North Macedonia, sought to enhance the operational performance of its existing PV generation asset. The primary objectives were to increase self-consumption of the conventional PV plant, secure revenue predictability, and adapt to a market governed by dynamic electricity pricing.

KSTAR delivered a 12.5MW/40MWh turnkey energy storage system, comprising five GSE2500C-MV integrated units and five 4MWh battery cabinets. The solution features a skid-mounted, fully integrated station architecture that unifies the PCS, step-up transformer, and ring main unit. This design facilitates rapid deployment and commissioning while substantially curtailing the project construction timeline. The system also integrates seamlessly with the customer's self-developed EMS, enabling real-time response to dynamic price signals and thereby maximizing plant revenue.

02 Customer Profile

EVN operates as the primary distribution network company in North Macedonia, responsible for grid management and stability. Beyond its core distribution mandate, EVN also manages renewable generation facilities. Facing a transitional energy market characterized by time-of-use pricing mechanisms rather than fixed feed-in tariffs, EVN recognized the necessity of retrofitting its solar asset with energy storage to preserve and enhance project economics.

Location :	North Macedonia
Capacity:	12.5MW / 40MWh
System Configuration:	5 units of KSTAR GSE2500C-MV turnkey solution with 5 units of 4MWh battery cabinets
Customer:	EVN (Distribution network company for North Macedonia)

03 The Challenge

The existing PV plant faced several limitations:

- Without storage, excess solar generation during peak hours could not be fully self-consumed or sold at favorable prices.
- The plant needed to respond to dynamic electricity prices to increase the selling price of power.
- A fast, low-disruption deployment was required to minimize downtime.
- The storage hardware had to work with third-party EMS, which controls charge/discharge based on live price signals.



04 Solution: KSTAR Turnkey Skid-Mounted Integrated System

KSTAR engineered and supplied a fully pre-integrated storage solution tailored to EVN's technical and commercial requirements.

System Configuration

Component	Specification
PCS + Transformer + RMU	5 x GSE2500C-MV (2.5MW each), skid-mounted integrated enclosure
Battery Cabinets	5 x 4MWh LFP battery cabinets
Total System Capacity	12.5MW / 40MWh

Key Technical Attributes

1. Skid-Mounted Integrated Station Structure

The GSE2500C-MV unit consolidates the PCS, step-up transformer, and ring main unit into a single, factory-assembled, weatherproof skid. This architecture eliminates the need for separate substation buildings, extensive on-site cabling, and complex civil works. The consequent benefit is rapid deployment, expedited commissioning, and a meaningful reduction in the overall construction period relative to conventional, non-integrated approaches.



2. Dynamic Control / Time-of-Use Operational Logic

The system is architected to temporally shift PV generation from low-value periods (e.g., midday oversupply) to high-value periods (e.g., morning and evening peak demand). This operational strategy directly improves the self-consumption ratio of the traditional PV plant and provides a mechanism for revenue assurance.

3. Seamless Integration with Customer Self-Developed EMS

The EMS ingests live dynamic electricity price signals from the North Macedonian power exchange. Via an open and standard communication interface (Modbus TCP/IP & IEC 104), the EMS issues direct charge and discharge commands to the KSTAR GSE2500C-MV units. This enables the system to adapt instantaneously to price variations, thereby optimizing the realized selling price of electricity.

05 Project Outcomes

- **Enhanced PV self-consumption** through temporal energy shifting, reducing reliance on grid export during low-price periods.
- **Increased average electricity selling price** by enabling dynamic response to real-time market price signals via the EMS.
- **Shortened construction and commissioning timeline** attributable to the skid-mounted integrated station design, which minimized on-site work.
- **Full interoperability** with customer's self-developed EMS, preserving the customer's autonomy over dispatch logic and trading strategy.



06 Conclusion

By deploying 5 KSTAR GSE2500C-MV integrated skid-mounted units alongside 40MWh of battery storage, KSTAR enabled EVN to transform a conventional PV plant in North Macedonia into a dynamic, revenue-optimized hybrid asset. The project fulfilled all stated objectives: improving self-consumption, guaranteeing revenue under dynamic pricing, enabling time-of-use arbitrage, and achieving rapid deployment via an integrated turnkey design.

This case study exemplifies KSTAR's capability to deliver sophisticated, EMS-ready, rapid-deployment energy storage solutions for distribution network operators and PV asset owners navigating the transition toward dynamic energy markets.