Optimizing Energy Sales and Peaks Shaving

1. Context and Objective

The 400 kW photovoltaic park, equipped with SMA Sunny inverters, operates in full grid injection mode. Pentru a optimiza randamentul economic și a reduce pierderile cauzate de limitări de rețea și de variațiile tarifare, a fost instalat un sistem de stocare a energiei electrice de 1 MWh.

Main objectives of storage system integration:

- Smoothing production peaks (peak shaving on PV injection)

- Storing energy during off-peak price periods

- Selling stored energy during peak/high-price periods (peak / day-ahead market)

- Stabilizing grid injection and maximizing revenues

2. Technical Configuration

Photovoltaic Component:

- Installed power: 400 kW

- Inverters: SMA Sunny Tripower

- Operating mode: Full grid injection

Storage System:

- Total capacity: 1 MWh

- Bidirectional inverter power: 500 kW

- Battery technology: Li-Fe-PO_4

- Fully integrated with: EMS, BMS, STS, HVAC, fire suppression system, lighting, protections

3. Operating Strategy

The system is controlled via the EMS, which correlates in real-time the estimated production, energy market prices, battery status, and injection thresholds. The

TSM Synergy Solutions SRL
Strada Marcus Aurelius 18, Constanța 900744
0730 665 410
office@tsm-synergy.com

charging/discharging management is performed through a measurement loop that aligns the photovoltaic production with the export limit to the grid imposed by the operator or with time intervals defined by the operator.

Operating modes:

1. Peak shaving on solar production

2. Charging during off-peak intervals (night)

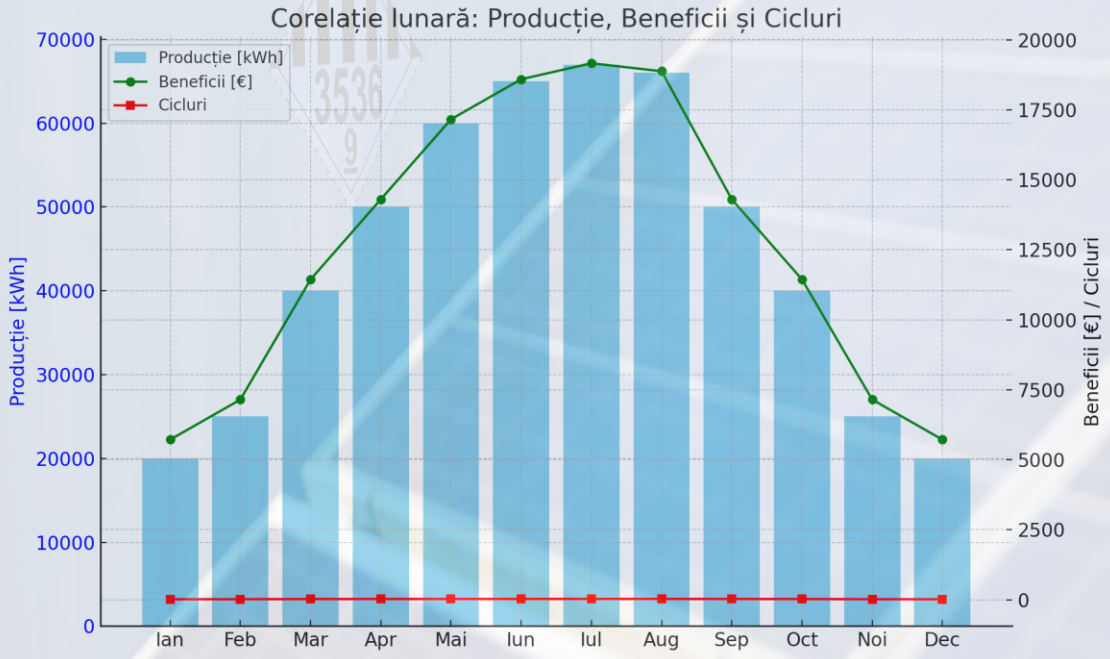
3. Discharging during on-peak intervals

4. Results and Economic Benefits

Financial Benefits (Monthly Estimates):
- Savings from avoided PV losses: €6,300 (range: €2,000 – €7,000)
- Additional revenues from peak sales: €8,000 (range: €3,000 – €9,000)
- Estimated total monthly revenue: €14,300

Operational Performance:
- Cycles per day: 0.8 – 1.2
- Usable daily energy: 800 – 1,000 kWh
- Estimated ROI: 4 – 6 years

The chart below illustrates the seasonality of production and the correlation with benefits and monthly cycles.:



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5. Challenges and Lessons Learned

- EMS integration with energy markets
- Synchronization of PV inverter and battery
- Medium-voltage grid limitations
- Active battery cooling
- Safety and fire fighting system

6. Conclusion

The integration of the 1 MWh storage system with the 400 kW photovoltaic park has proven to be a technically and economically viable solution. The direct benefits from loss avoidance and revenue maximization demonstrate the system's profitability.

7. Future Directions

- Automated trading
- Participation in balancing markets (FCR, aFRR)
- Scaling with additional 1 MWh or 2 MWh units
- EMS upgrade with AI-based forecasting

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