

# Maximizing wind asset value through hybridization, EMS control, and VPP coordination

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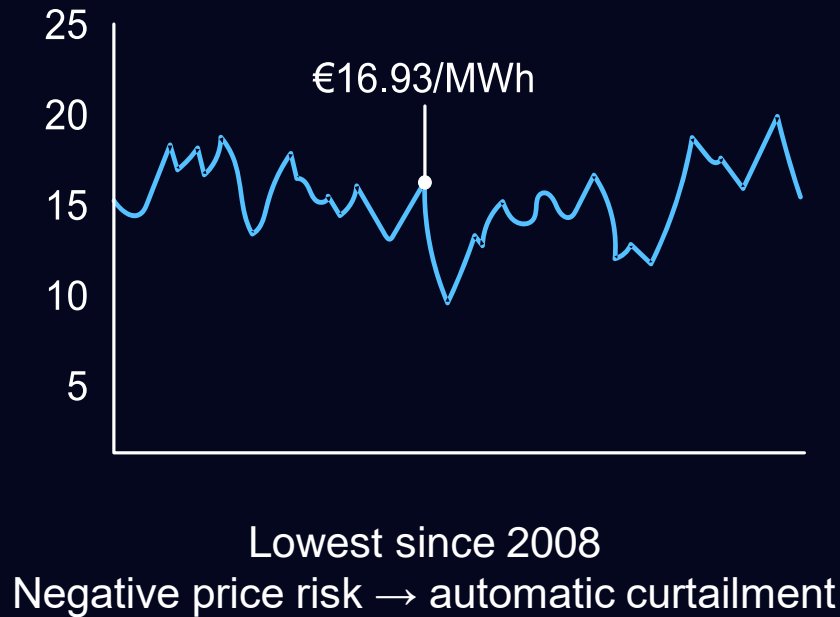
# Wind curtailment & market pressure in Spain

## Spain's wind fleet challenges:

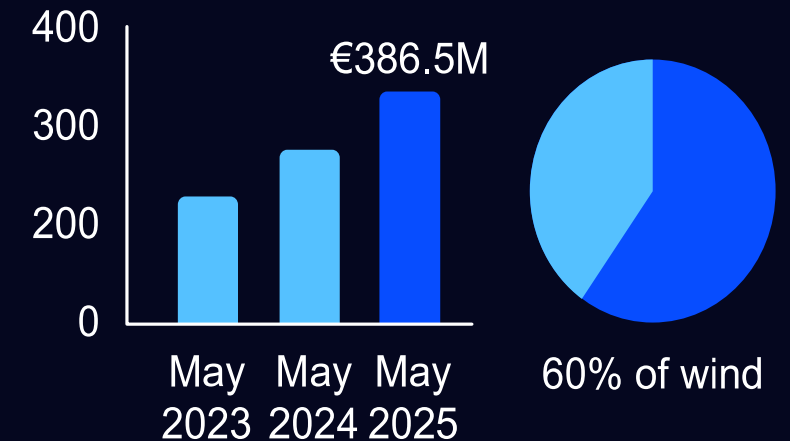
- Record low market prices
- Rising curtailment
- Persistent grid congestion

## Impact:

- Revenue loss
- Reliability risks



## Technical curtailment costs

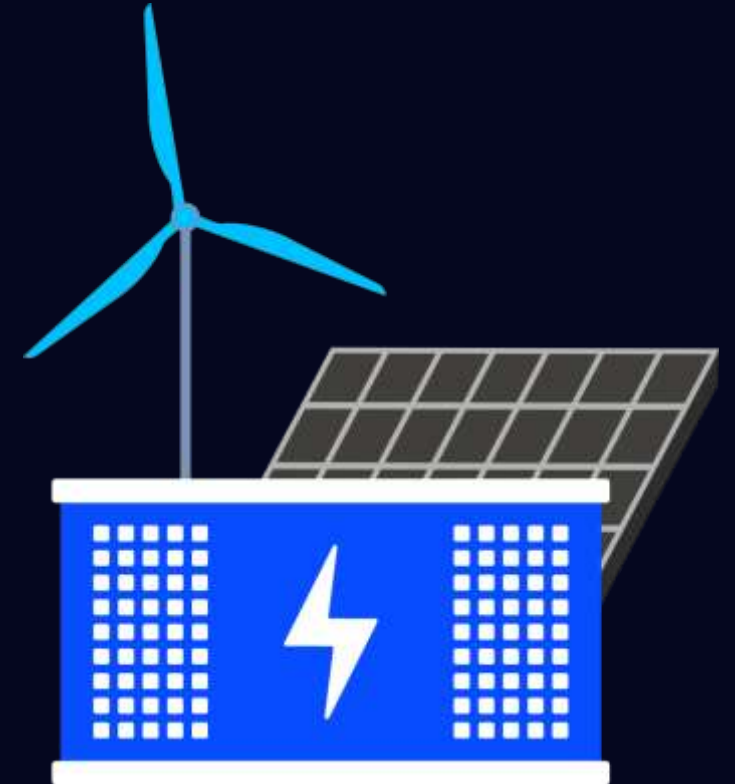


Projected curtailment: rising to ~5% by 2027 before new infrastructure reduces congestion

# Hybridization – the successful way

## Questions that define hybrid success:

- A. What are the market opportunities you're building on?
- B. How does the TSO / grid want to operate hybrid assets?
- C. What are the requirements for grid compliance?
- D. What technology you need?

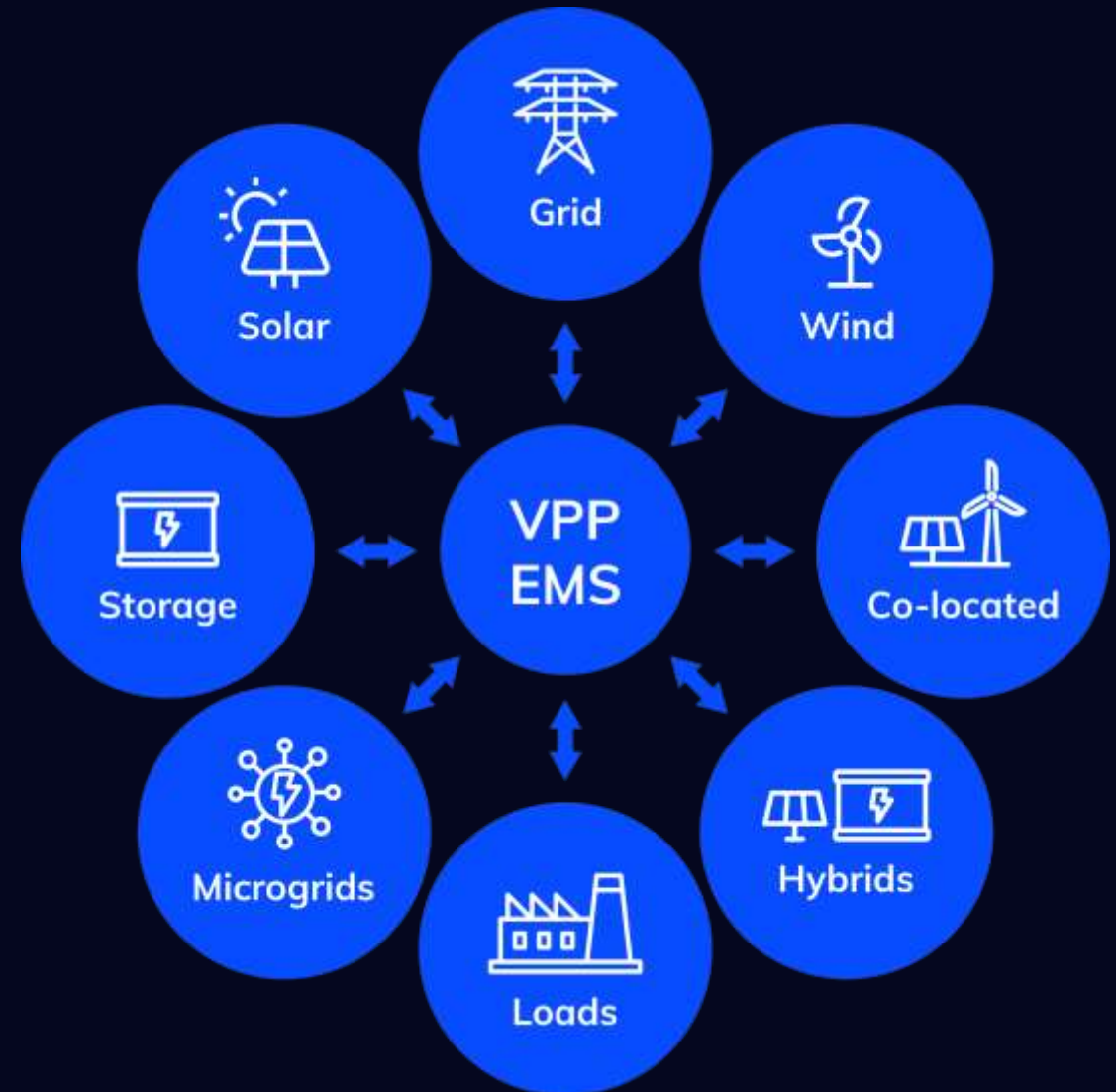


## Why are VPPs important?

- Market access
- Risk mitigation
- Grid stability

## Key applications of VPPs in EMS

- Grid balancing
- Energy trading / PPAs
- Peak shaving
- Renewable integration
- Microgrid management



# Project Spotlight - VPP with dynamic dispatch for grid and market services in EMEA



## The challenge:

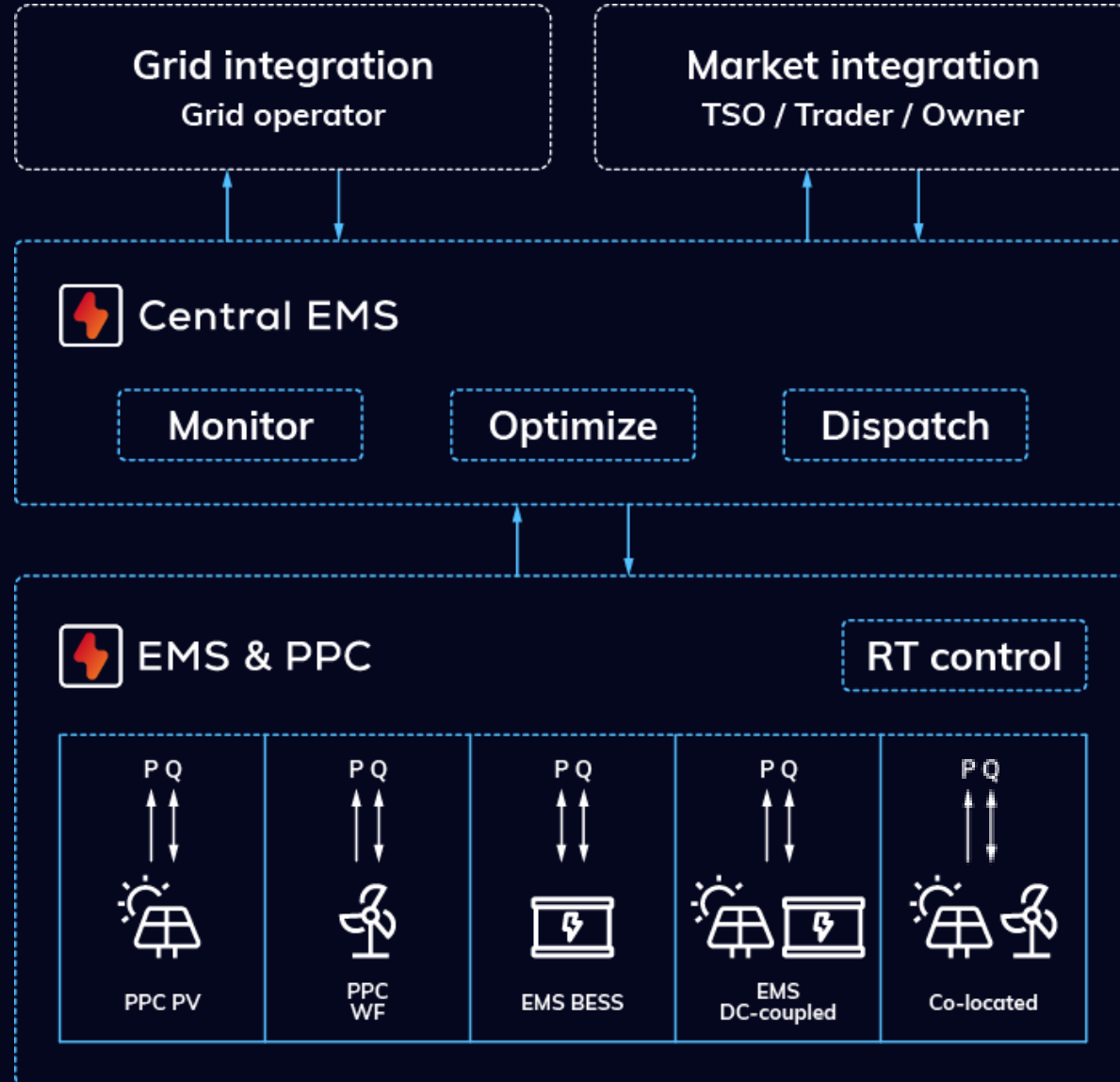
Integrate solar, wind, and storage into one reliable, single dispatchable virtual power plant, across two sites **hundreds of km apart, each with its own POI.**

## The goal:

Meet PPA commitments, avoid TSO penalties, and optimize constraints in real-time to maximize revenue.

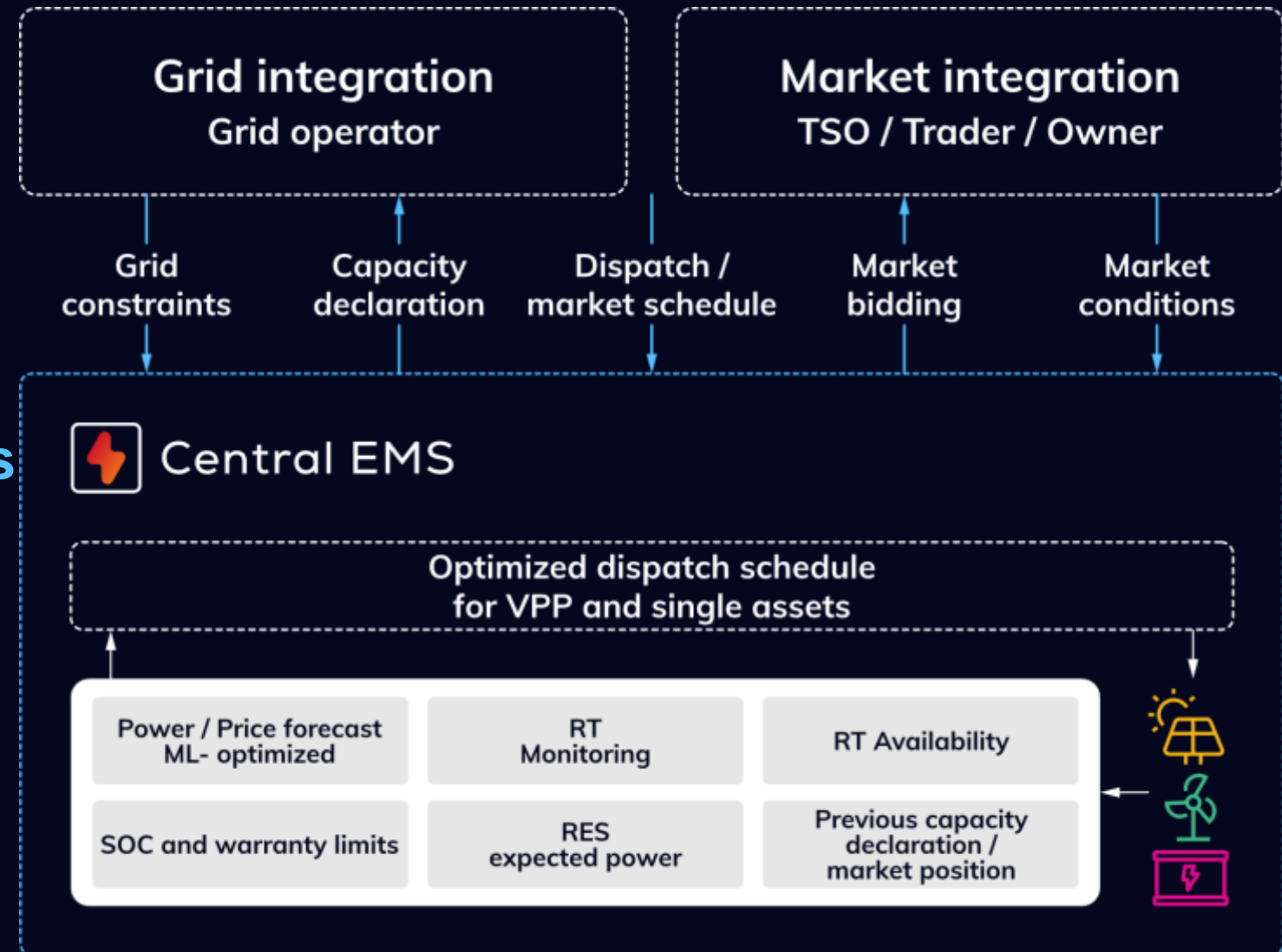


# Unlocking the Power of VPPs with EMS



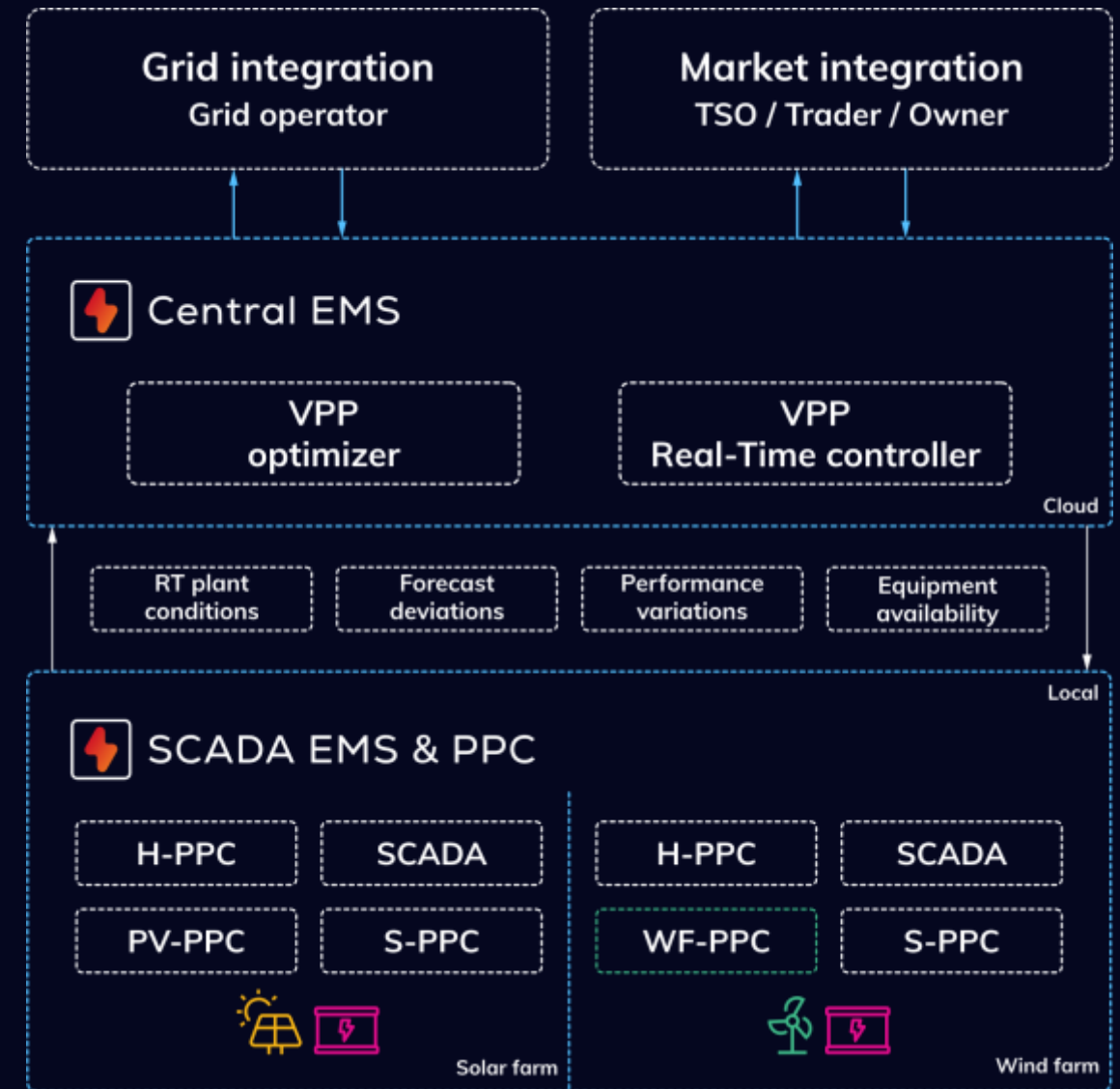
# Dispatch Optimization

## Maximize revenues while respecting system constraints

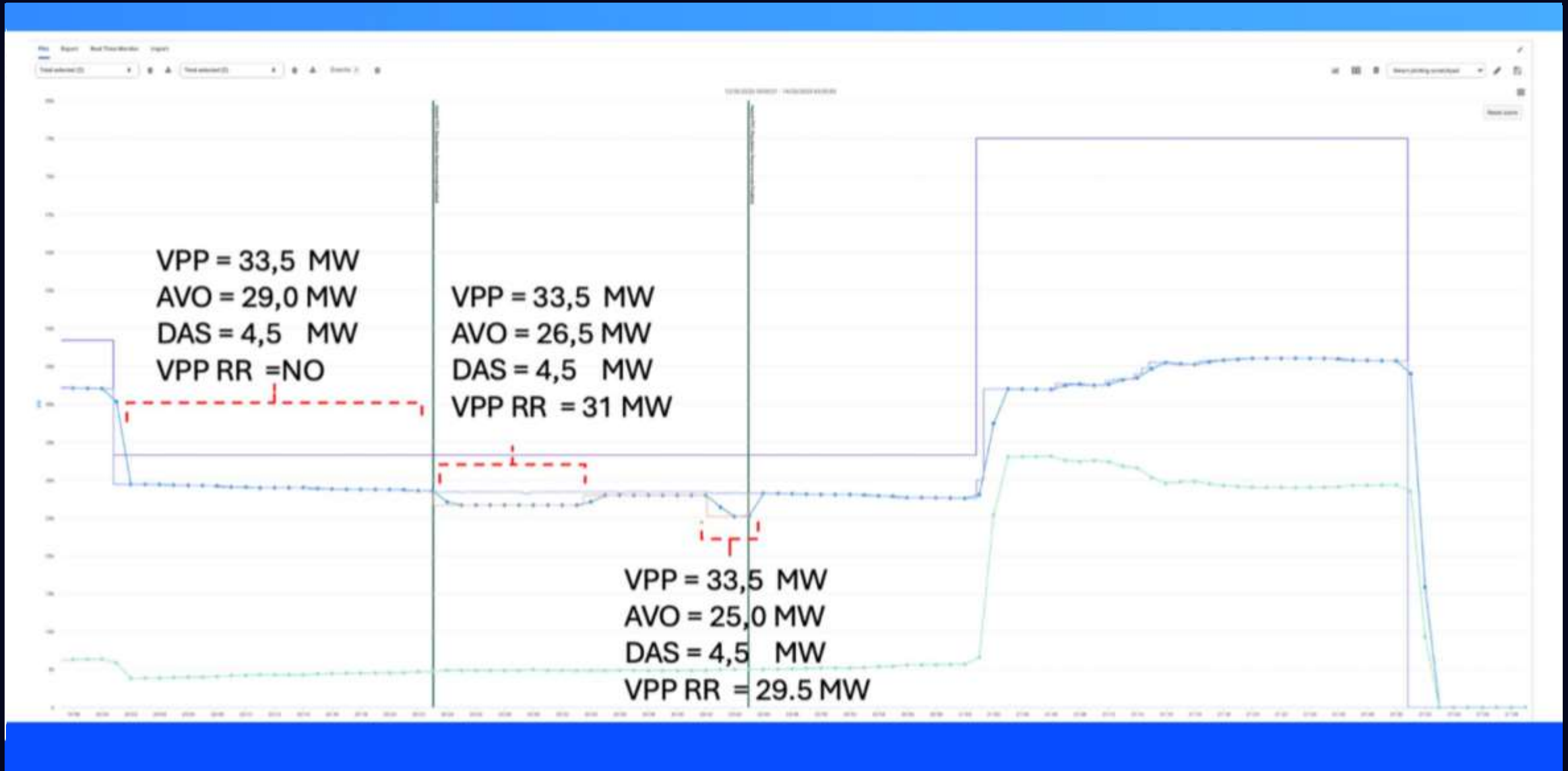


# VPP control and Real Time dispatcher

## Critical role in ensuring real-time optimization of dispatch schedules



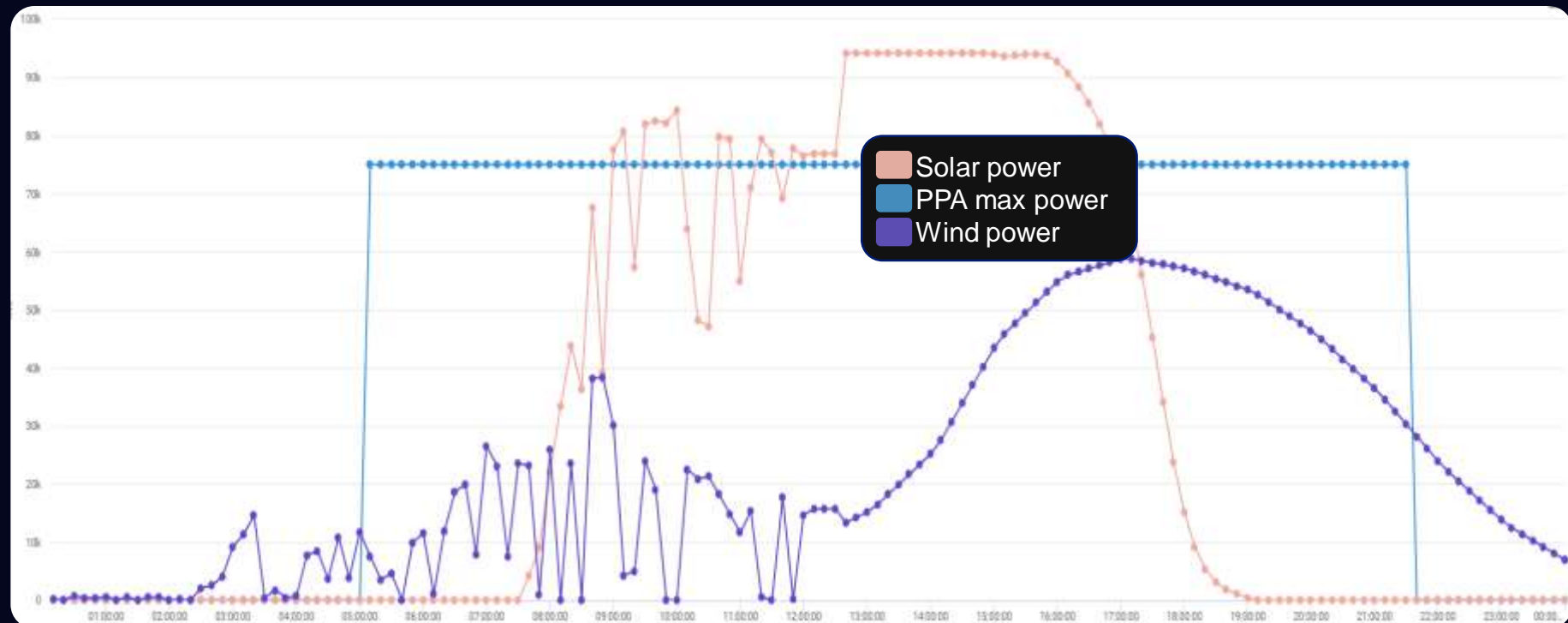




# Projected results

## More stable generation

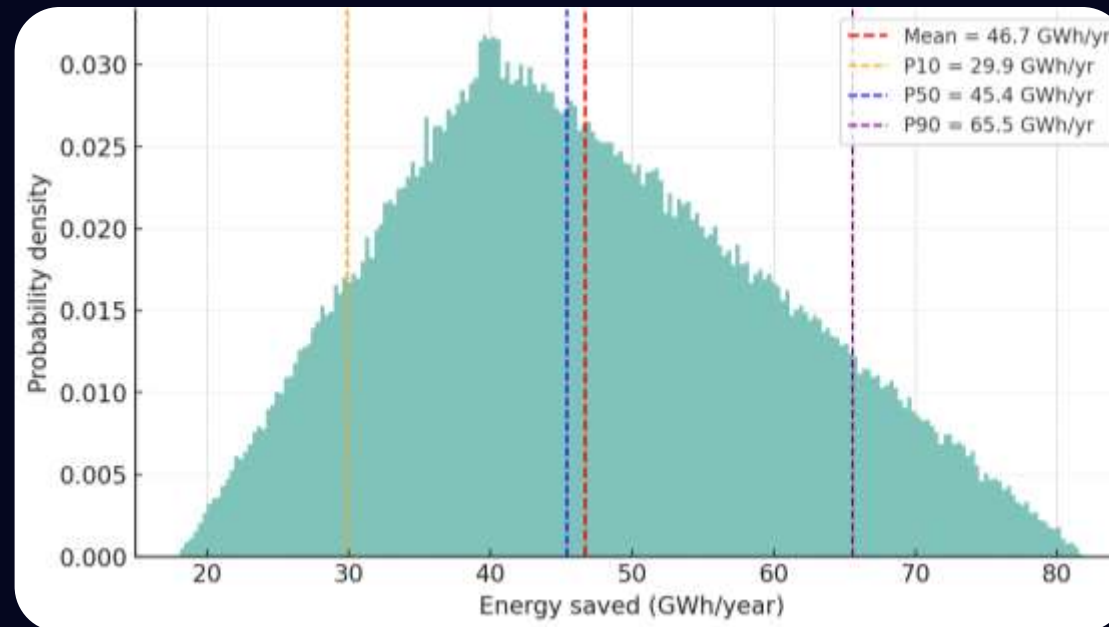
Hourly diversification—less volatile



# Projected results

## More energy, less curtailment

The hybrid architecture saves an average of **40 GWh/year** of renewable energy that would otherwise be lost\*

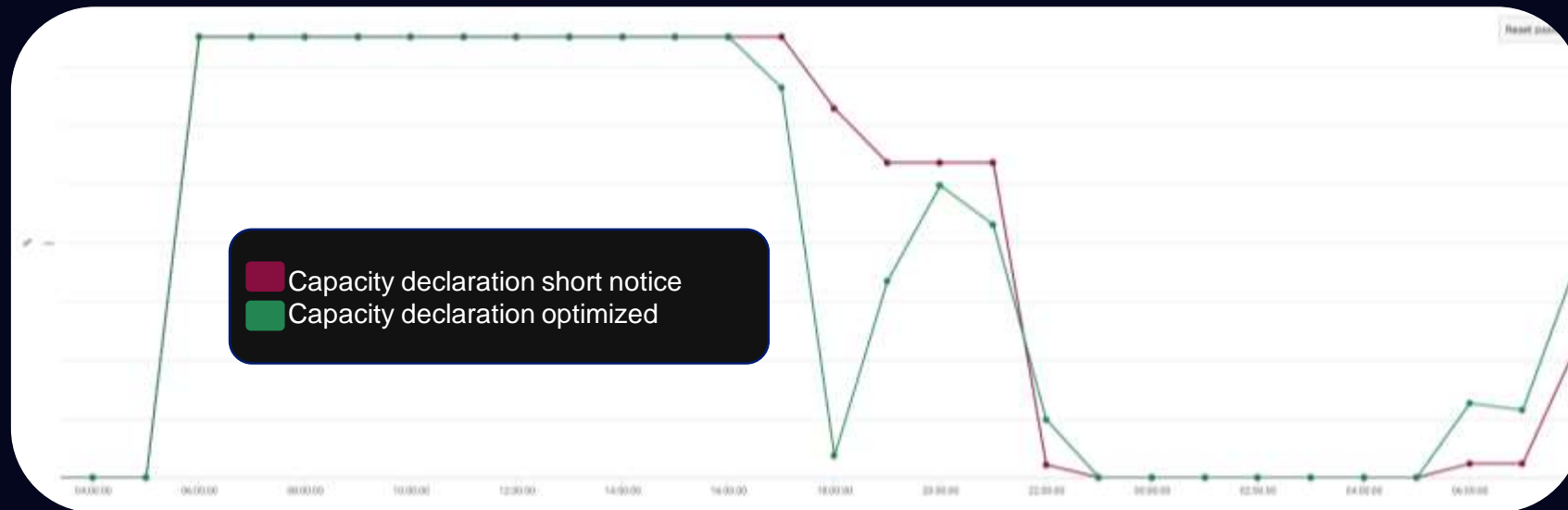


\*Calculated based real site data, real weather data, PPA constraints and capacity factor of the sites.

# Projected results

## Revenue saved on TSO penalties

~750K euros/year saved on penalties



\*Projected based on lab simulation, given two identical VPPs, simulating the same data and only one variable: optimizer on/off.

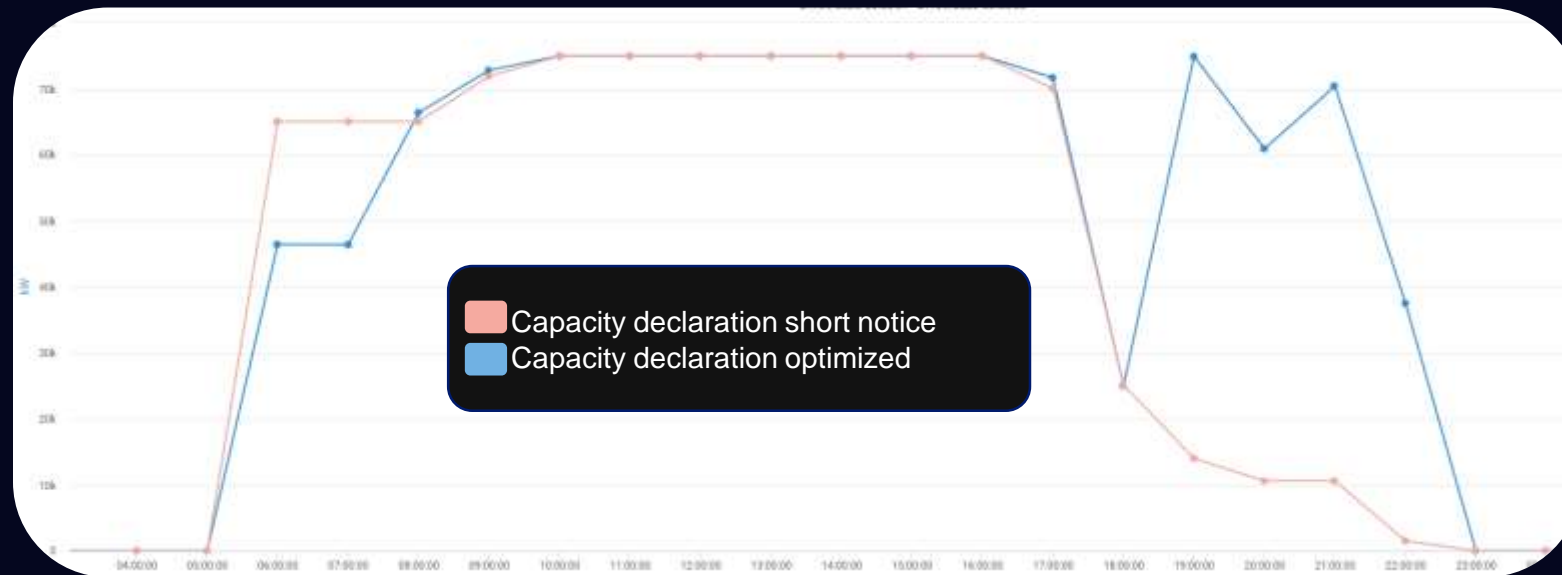
\*\*Penalties in the region go from 15€/MWh up to 140 €/MWh or higher, 40 €/MWh took as average.

\*\*\*Benchmark in the country: TSO penalties around 5–10% of annual earnings

# Projected results

## Increased revenue though optimization

~230K euros/year generated by the optimizer



\*Projected based on lab simulation, given two identical VPPs, simulating the same data and only one variable: optimizer on/off

\*\*Higher revenue due to accurate capacity redeclaration, prioritizing specific asset types based on configuration.

Optimizer: considering grid constraints, RT availability, RT power, ML forecast, battery SOC and capability.



# Thank you!

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**Questions?**

Contact our sales department:

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