Smart4RES

Decision-aid tools for power system management & electricity markets

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Research challenges

WP5 aims to develop **prescriptive strategies** integrating information about forecast uncertainty in different power system and electricity market use cases driven by decarbonization and resilience needs. The goal is to **create a human-in-the-loop approaches** leveraging from **explainable** and **interpretable** data-driven methods.

Main outcomes

Various algorithms have been developed and validated in simulated environment.

Power system management with RES

Integrate forecasts in TSO/DSO control rooms

- Development of a methodology guiding the human operator along 1) the different flexibility options available in each hour, ranking them according to their effectiveness under uncertainty, and 2) decision-support with multiple forecasts updates

- Uncertainty forecasts can lead to cost savings in grid technical constraints management

- Choosing the best moment to "reserve" flexibility leads to cost savings, in comparison to a strategy that always reserves flexibility when it is cheaper
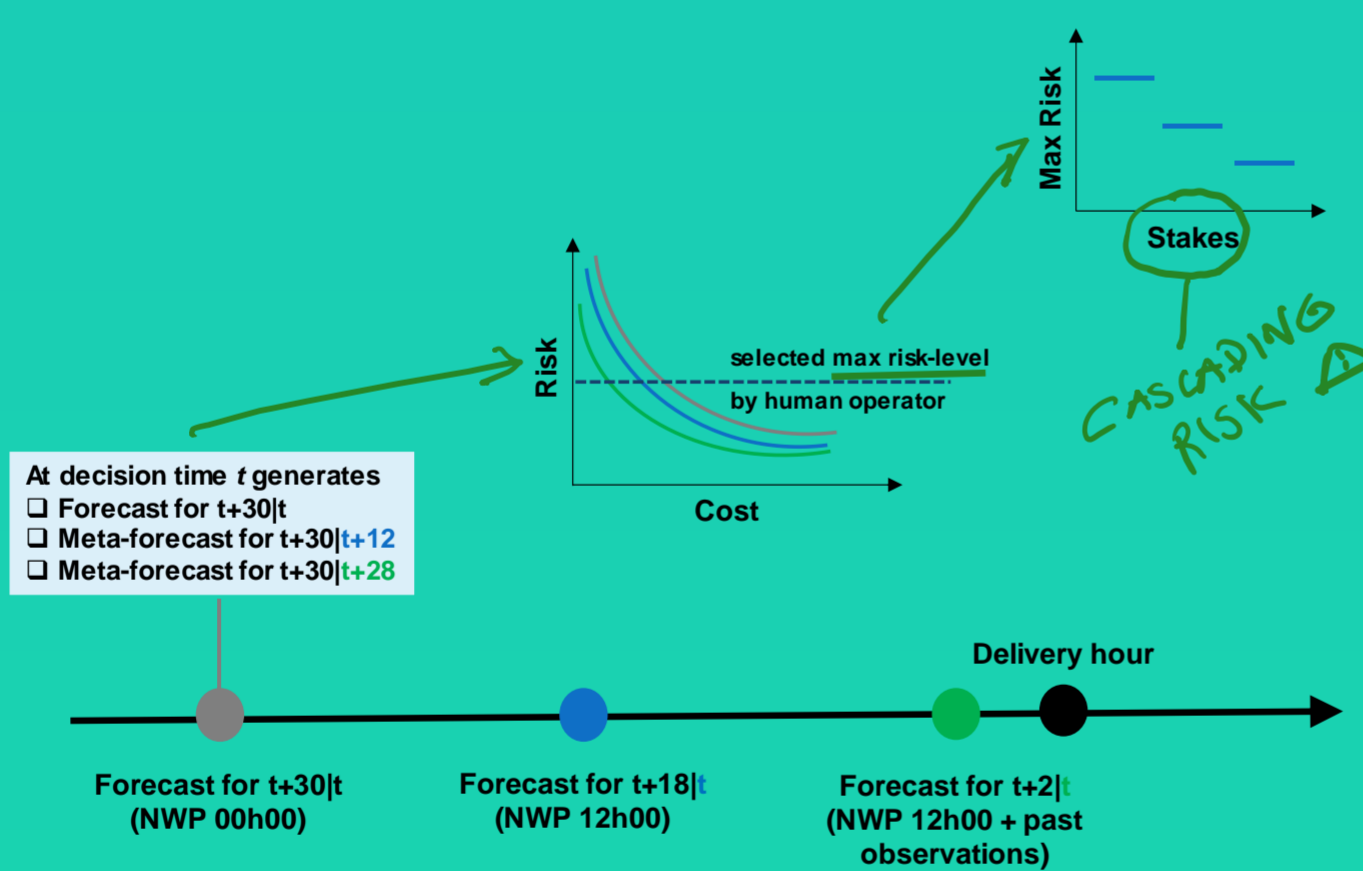
Towards near-100% renewable energy in isolated power systems

- Dynamic security constrained unit commitment/economic dispatch with RES uncertainty have been combined with data-driven approach for dynamic security assessment

- Optimal dispatch of synchronous inertia compensator reduces: 1) in 86% load shedding events and 2) in 17.2% the dispatch of additional diesel generators

Cost-effective integration and operation of storage

- Multi-objective optimization have been applied to 1) decide the volumes of energy and ancillary services traded; 2) short-term model predictive control.

- BESS degradation cost are reduced by 23%
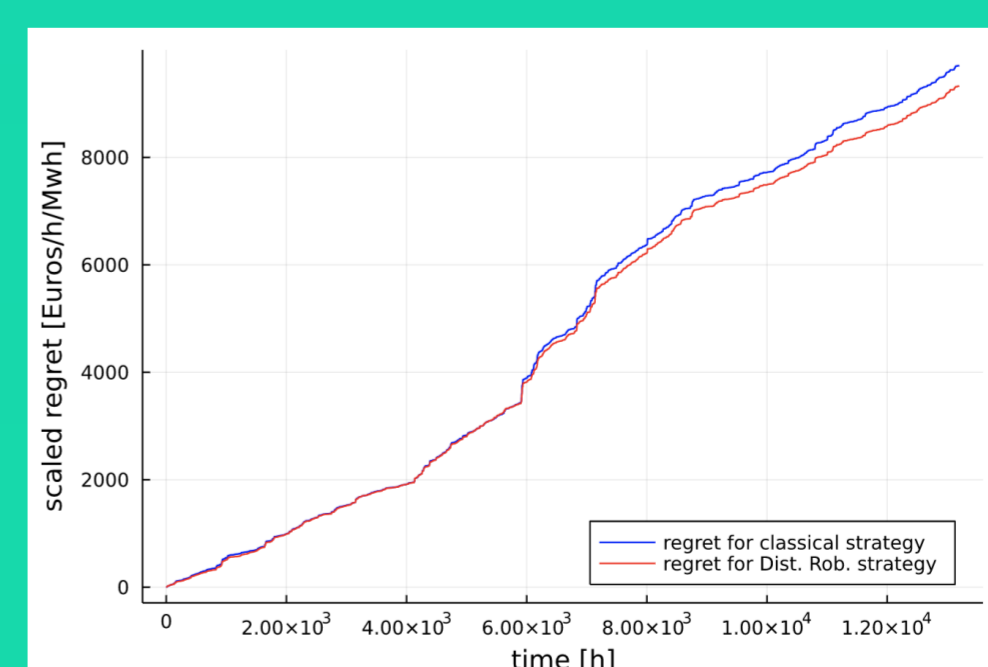
- Increase of 15-20% in market revenue

Cost-effective integration of RES in electricity markets

Development of prescriptive trees analytics and distributionally robust optimization approaches

- Prescriptive analytics approach reduces complexity in the bidding model chain
- Increase market revenue in 3-8%

- Distributionally robust trading strategies allow 5% decrease in imbalance costs
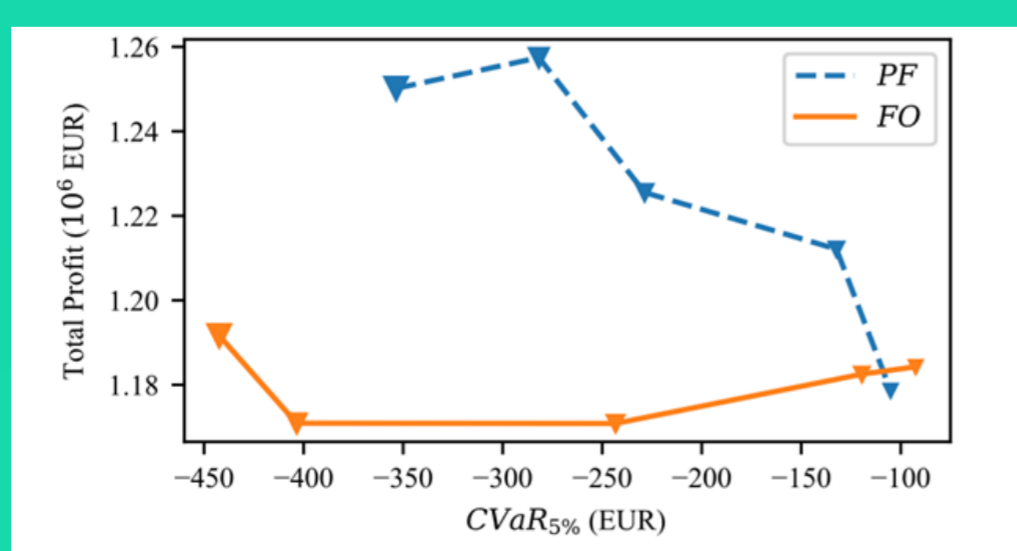
Risk-reward trade-off against the standard Forecast-then-Optimize (FO) modeling approach

Download WP5 deliverables

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