Battery Energy Storage Systems Operation Optimization

Energy Storage Systems (ESS) are becoming essential for energy sufficiency and grid stability due to the increasing penetration of Renewable Energy Sources (RES) in the electric energy mix and their stochastic behavior. Utility-scale battery arrays is the most promising technology for ESS in terms of efficiency and maturity.

Due to the variety of installation options and a multitude of key parameters, it can be a challenge to plan the operational scheme of a grid-connected Battery ESS:

- Battery ESS Systems can be installed as stand-alone power plants or as Hybrid RES/BESS plants.
- In the case of hybrid plants, the Battery ESS can be operated as Behind-the-Meter (BTM) or Front-of-the-Meter (FTM), depending on the storage unit's license to charge only from the RES unit or both from RES and the grid.

Revenue of Battery ESS can come from:

- Power Purchase Agreements (PPAs)
- Participation in the free market (day-ahead and intra-day market)
- Auxiliary services to the grid (balancing market)
- RES capacity firming
- Other ancillary services to the system/grid
- Stacking of the above

To provide insight to the management of Battery ESS targeting to maximize its revenues, iWind has developed an optimization tool that addresses the planning of a Battery ESS operation. Its features include:

- Simulation of variety of grid-connected installations FTM or BTM
- Optimization of Battery ESS power and energy sizing
- Charge/Discharge throughput on hourly basis
- Charge/discharge cycles limit
- Battery roundtrip efficiency and degradation
- Implementation of actual price time-series of the capacity and energy markets
- Revenue maximization for given time-series of capacity and energy markets prices, based on historical prices or scenarios prices provided by a companion Electricity Prices Forecasting Tool, also developed by iWind.
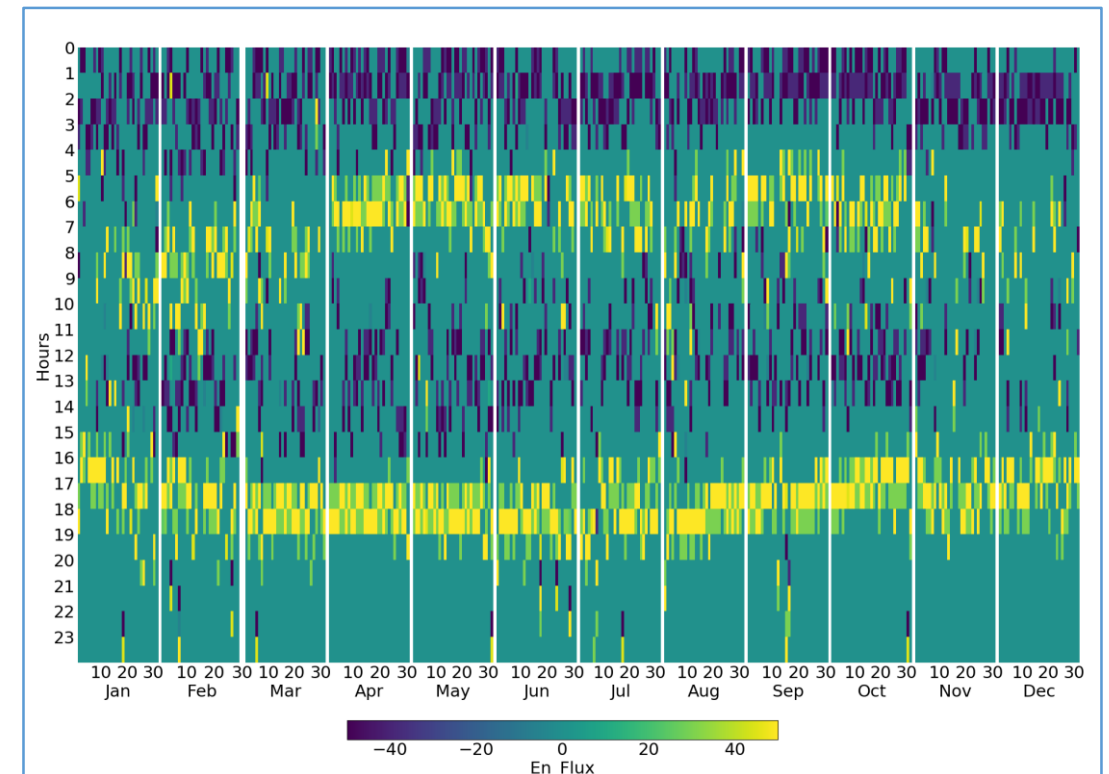
Full year energy flux heatmap in (MWh).
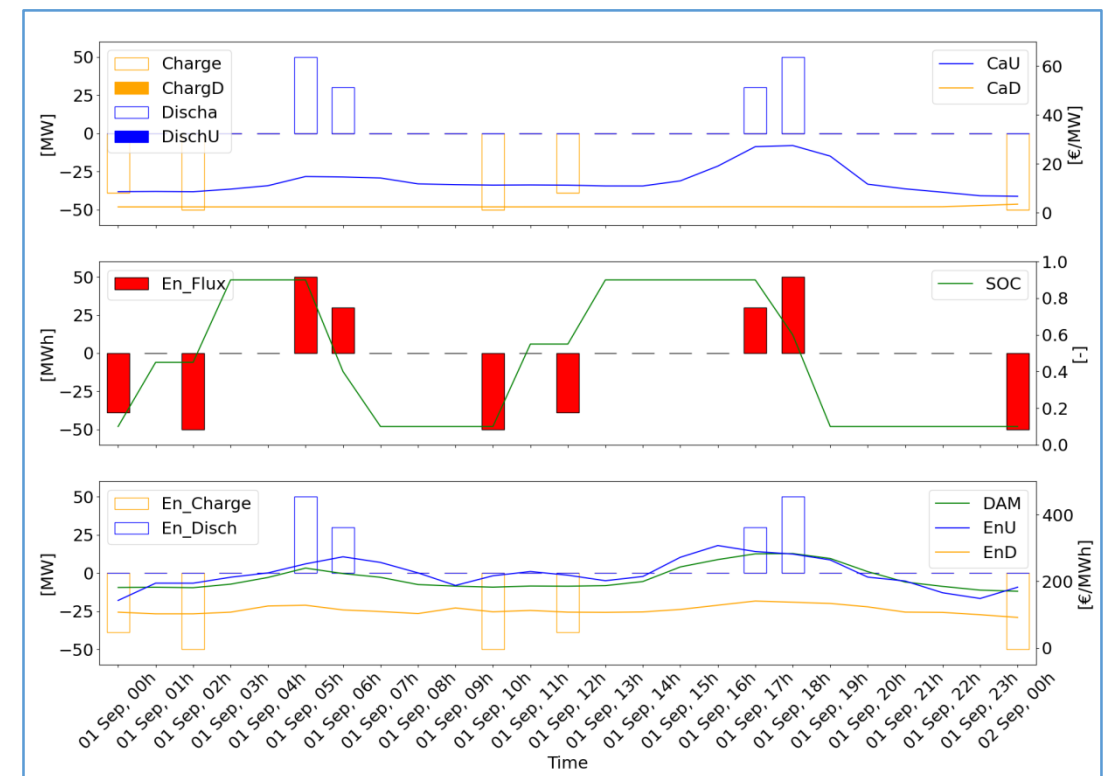
Optimised daily power/energy throughput and market prices.