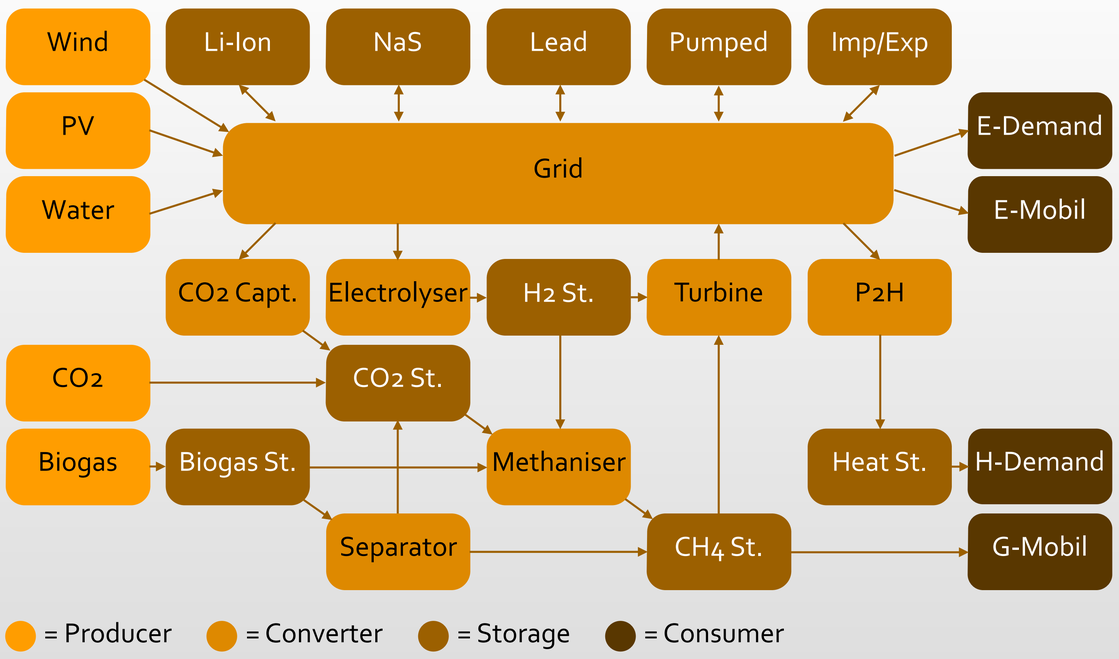
// Virtual and Hybrid Power Plant Simulation

Solutions for 100% Renewable Energy Supply

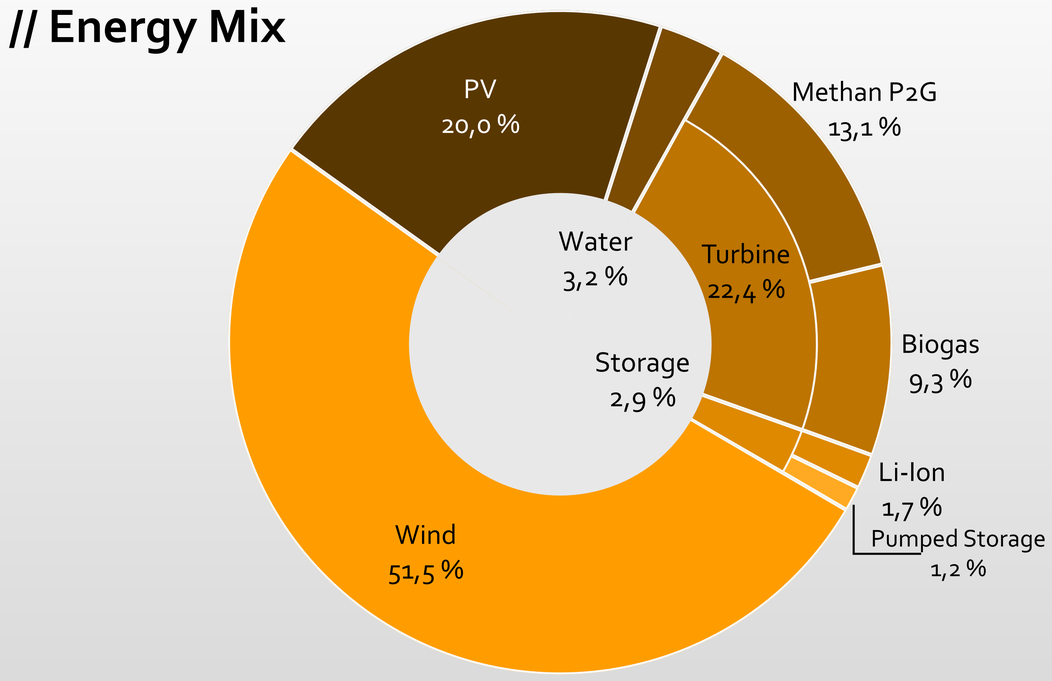
// Energy Flow in P²IONEER



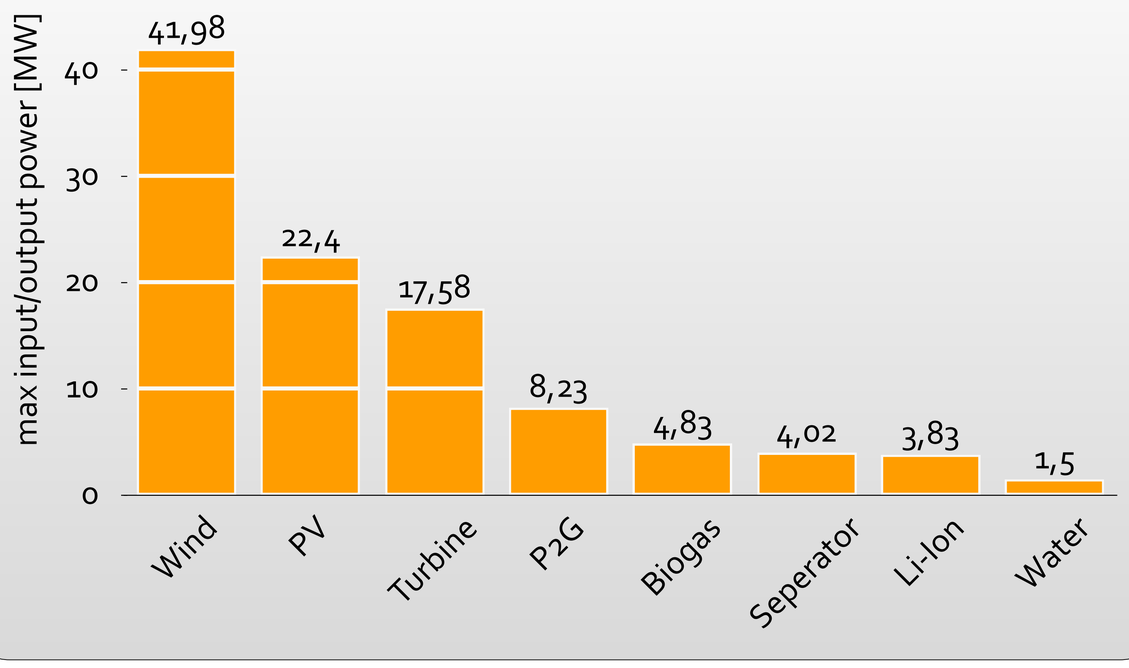
P²IONEER

Virtual Power Plant Optimization

// Energy Mix



// Example – Optimal Installed Capacities



// Simulation and Optimization of Virtual and Hybrid Power Plants

Concern for self-sufficient electricity and thermal power supply is soaring in communities, companies or even with building owners. With the new simulation and optimization tool P²IONEER, finding the cost optimal setup for hybrid power plants with freely configurable renewable energy penetration rate is a breeze.

P²IONEER works on time series of electrical and (optionally) thermal demand, together with corresponding meteorological data. The user can also choose from a large number of available power generator, energy converter and storage technologies using an intuitive graphical user interface.
In the case of distributed hybrid power plants, P²IONEER can take existing electricity and gas grid infrastructure into account, which makes it ideal for optimizing distributed hybrid power systems for regions and entire countries.

// PGPE – Optimisation technique

The P²IONEER tool simulates power flow with arbitrary time resolution for up to multi-year wind, PV, and water power time series as well as demand profiles. The cost optimal combination of renewable energy, storage and fossil power generator capacities will be determined from multiple, iteratively improved simulation runs.

Usually, genetic algorithms are applied to such optimization problems. P²IONEER instead relies on Policy Gradients with Parameter-based exploration (PGPE), a state-of-the-art reinforcement learning technique which needs significantly fewer simulation runs to find the optimal solution.

Center for Solar Energy and Hydrogen Research Baden Württemberg
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// Virtual and Hybrid Power Plant Simulation

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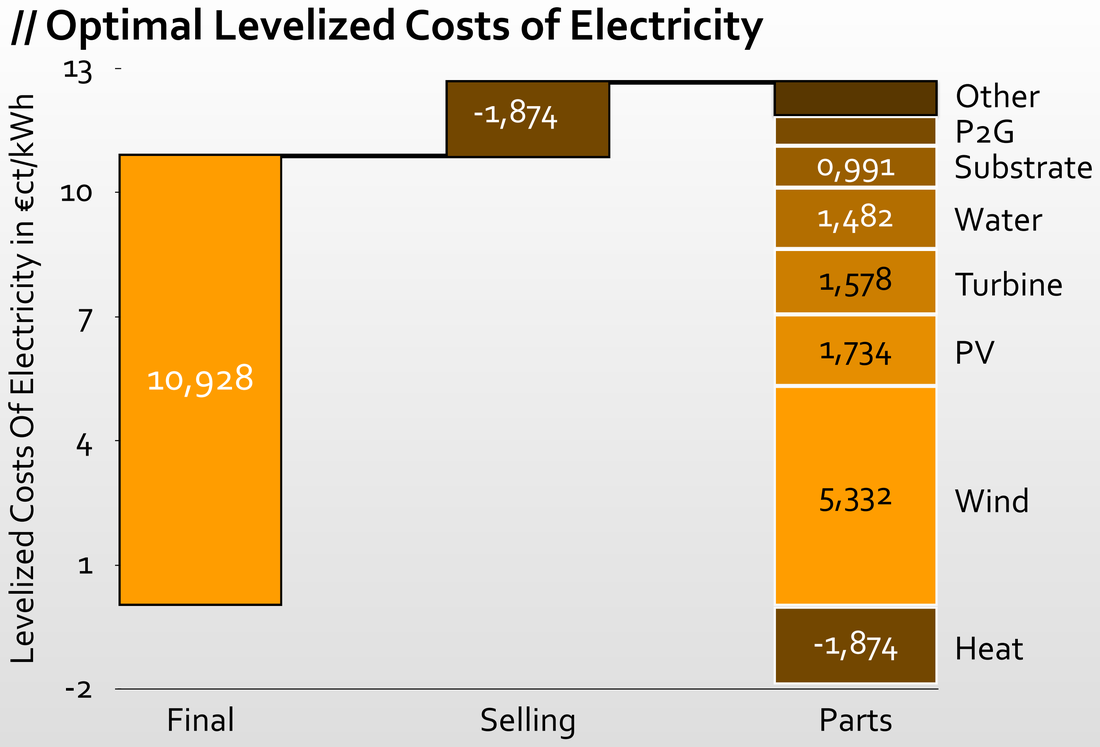
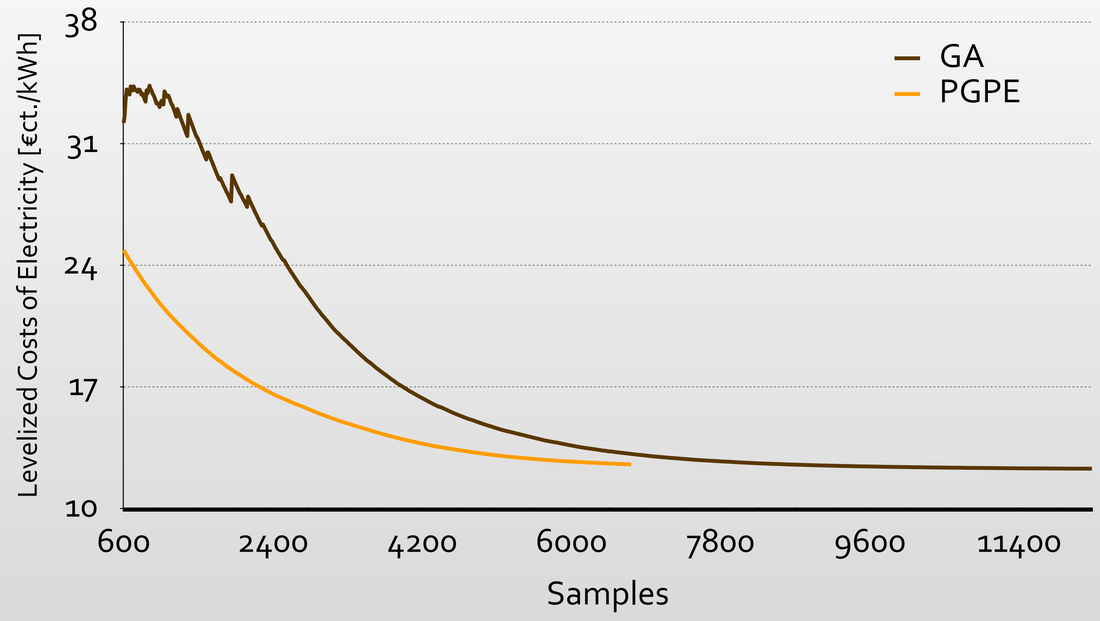
// Optimal Levelized Costs of Electricity



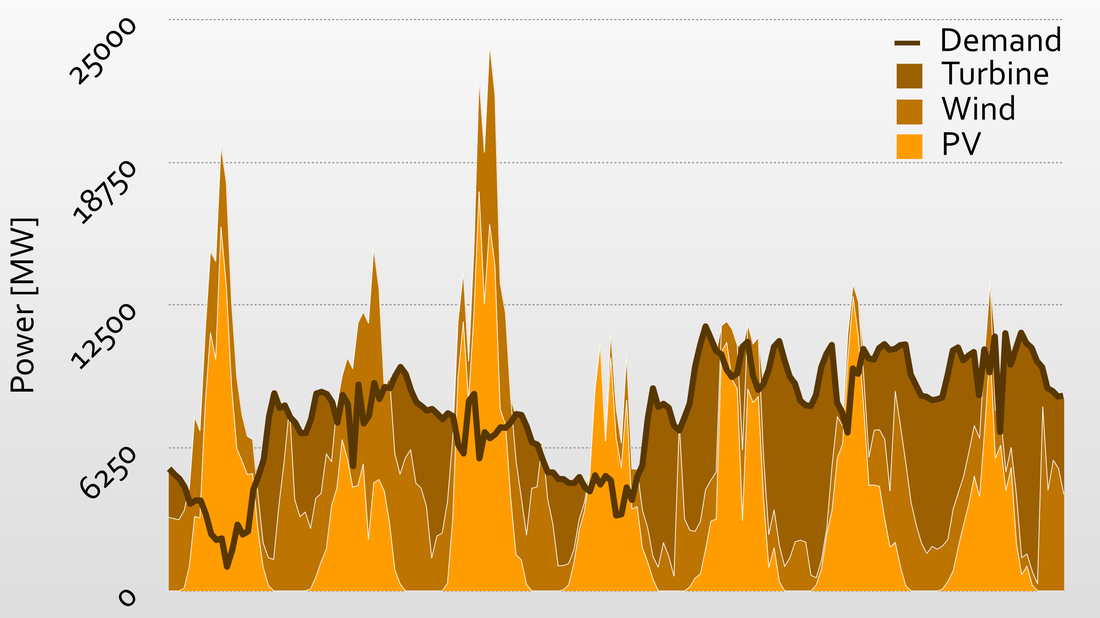
P²IONEER

Virtual Power Plant Optimization

// Model-Based Super Symmetric PGPE



// Example Energy Mix - One Week End of August



// Analytics

P²IONEER result output consists of a full simulation of the optimized energy system, which can be visualized and analyzed in great detail. Charging times of storage, power gradients for each component as well as the impact of technology dependent efficiency levels can be evaluated, changed and reanalyzed. For each configuration of the system the levelized costs of electricity can be recalculated.

During runtime of the optimization process P²IONEER shows the most relevant data of the current best solution found in the form of real time graphs. Among other data, the graphs show optimal energy mix, overview of installed capacities, system specific cost distribution and various input and output time series.

// Applications

P²IONEER has been used for various studies of energy scenarios, ranging from PV-battery systems of households, communities and towns with tens of thousands inhabitants up to simulated regions featuring distributed hybrid power plants with more than half a million inhabitants and about 3 TWh annual electricity demand.

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