Power-to-Gas in a Virtual Power Plant

Felix Jedamzik, Next Kraftwerke GmbH
“In 2009, we started with our vision of a Virtual Power Plant. Today, we operate one of the largest Virtual Power Plants in the world.”

Fair – sustainable – direct
Jochen Schwill & Hendrik Sämisc (Founders & CEOs)

Aggregated Power: 7,000 MW
Aggregated Assets: 8,000
Providing services to: 8 system operators
But it does moves

<table>
<thead>
<tr>
<th>Number of power plants in Germany</th>
<th>800</th>
<th>1.500.000</th>
<th>Decentralization</th>
</tr>
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<tbody>
<tr>
<td>Number of spot exchanges in Europe</td>
<td>0</td>
<td>12</td>
<td>Liberalization</td>
</tr>
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<td>Number of LTE connections (global)</td>
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<td>Energy sources</td>
<td>Fossil &amp; nuclear energy sources</td>
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<td>Nuclear phase-out / start of decarbonization</td>
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The Virtual Power Plant – for an energy system based on renewable energy

- Flexibility thanks to decentralized and decarbonized units
- Liberalized power gives small-scale operators access to markets
The platform for the digital energy world

Assets types in a Virtual Power Plant
- Biogas
- Solar
- Wind
- Hydro power
- CHP
- Renewable power plants
- Power-to-X
- Power consumers
- Utilities / aggregators
- Batteries
- Emergency power generators

Interfaces / technologies
- Next Box
- Protocol interfaces
- APIs
Case Study: Power to Gas

How VPP contribute local flexibility
The city of Haßfurt
The distribution grid’s components
The gas grid
Excess calculation

\[ \text{Excess} = \frac{\text{Generation Wind} + \text{Generation PV} - \text{Consumption Haßfurt}}{\text{Excess/Deficite}} \]
Forecasting the power generation (PV)

- Installed capacity: 12 MW with ca 500 PV units
- Individual PV forecast for the largest three parks
- Third party provider
- Internal forecast improvement using live data
Forecasting the power generation (Wind)

- Installed capacity: 36 MW with 4 parks
- Highly volatile
- Dark blue line: forecast by third party service provider
- Orange line: internal forecast improvement using live data
Forecasting the power consumption

- Energy consumption in local grid: ranging from 2 MW to 13 MW
Forecasting the power excess

- Combine individual forecasts
- Determine signal for P2G unit
- Why forecast?? Trading!!!
Forecast the gas grid

- Mainly temperature driven consumption
- Private consumers and one big industrial site
- Gas grid has limited absorption capacity for H2 (5%)
Forecast the gas storage

- Limited gas storage capacity of 1750m³
- Indicates potential for flexible operation of electrolyser (wholesale market price dispatch)
P2G operation
P2G operation

Call by TSO

Excess scenario
Optimization parameters

- Renewable power generation
- Power consumption (households & industrial sites)
- Hydrogen storage
- Gas consumption
- Gas grid capacity
- Technical restriction of P2G (ramp speed, installed capacity etc.)
- Short term wholesale market prices
- Grid frequency
- ...

The complexity of a VPP
VPP Control System as heart of operation

VPP as a service for worldwide approach
Contact

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What does a VPP offer?

- M2M-communication between the control system, individual assets, the TSO and the power exchange
- Algorithmic calculation of each individual asset’s schedule of operation
- Automatic steering of assets
- Redundant server structure for maximum security
But it does moves

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