Project grid-control
Future Grid-Management of a DSO 2.0

European Utility Week 2016 Barcelona
Katharina Volk
Netze BW GmbH (Germany)
16th November 2016
<table>
<thead>
<tr>
<th>Electricity</th>
<th>Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply points</td>
<td>Supply points</td>
</tr>
<tr>
<td>≈ 3,0 Mil.</td>
<td>≈ 143400</td>
</tr>
<tr>
<td>Overall grid length</td>
<td>Overall grid length</td>
</tr>
<tr>
<td>≈ 102100km</td>
<td>≈ 4900 km</td>
</tr>
<tr>
<td>Power distributed</td>
<td></td>
</tr>
<tr>
<td>≈ 48 TWh</td>
<td></td>
</tr>
<tr>
<td>Operated voltage levels</td>
<td></td>
</tr>
<tr>
<td>LV / MV / HV</td>
<td></td>
</tr>
<tr>
<td>Renewable generation units</td>
<td></td>
</tr>
<tr>
<td>≈ 150000 units</td>
<td></td>
</tr>
<tr>
<td>Installed capacity</td>
<td></td>
</tr>
<tr>
<td>≈ 8.7 GW</td>
<td></td>
</tr>
</tbody>
</table>

approx. 3200 employees

<table>
<thead>
<tr>
<th>Water</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh Water Supplies</td>
<td>Lighting</td>
</tr>
<tr>
<td>Infrastructure and planning</td>
<td>Infrastructure</td>
</tr>
<tr>
<td></td>
<td>Telecommunications</td>
</tr>
<tr>
<td></td>
<td>District heating</td>
</tr>
</tbody>
</table>
Project grid-control
Funding initiative and partners

Funding Initiative
“Sustainable Power Grids”

Objective: Application of modern technology and innovative concepts in order to develop a power grid infrastructure enabling the integration large amounts of renewables

€ 157 mil. sponsoring 67 projects

Research Project
grid-control

△ July 2015 – June 2018
△ Project volume: app. € 9 mil.
△ 9 partners
△ Development and evaluation of concepts and system solutions
Future Challenges Of Distribution Grids
Renewable energy expansion and new flexible consumers

**Yesterday**
Distribution grids link between power plants and customers

**Today**
Decentralized production in distribution grids

**Tomorrow**
New prosumers and flexible loads in distribution grids

**Challenges**
1. Taking over the tasks of conventional power plants
2. Coordination of flexible loads
3. Acting within the physical limits of distribution grids

→ Distribution grids need to be active
Supply reliability
Sustainability
Affordability

Our Goal
A technical-economical system approach

Installation renewable generation in Baden-Württemberg (GW)

Demand
1.7 4.6 8.7 14

2005 2010 2015 2020

Acceptance
Supply reliability

Development and evaluation of new approaches and role specific solutions in an overall concept for sustainable grids
Approaches and Scope of Work

Resources efficiency and supply reliability

- Dimensioning the network’s capacity
  - Δ Probabilistic network planning

- Ancillary services
  - Δ Voltage management
  - Δ Spinning reserve & short circuit power

- Prediction & avoidance of grid congestion
  - Δ Power-flow prognosis
  - Δ Congestion management

- Network reliability
  - Δ State estimation & capacity management
  - Δ Power balancing

→ Added value by using synergy effects in an overall concept
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Resources efficiency and supply reliability

Dimensioning the network’s capacity
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Ancillary services
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Network reliability
- State estimation & capacity management
- Power balancing

→ Added value by using synergy effects in an overall concept
Market oriented load management based on the “Traffic-Light Concept”

**Congestion in real time**
Emergency measures by the distribution system operator

**Grid congestion predicted**
Interaction between Smart Grid & Smart Market
→ DSO sets constraints for sales by providing non-discriminatory quota

**No congestion predicted**
Market participants are free to manage the flexibilities within constraints set by the DSO

REMS: Regional Energy Management System,
FMS: Flexibility Management System,
GEMS: Building Energy Management System
grid-control Traffic Light Concept
Interaction of Smart Grid, Smart Market and Smart Home

Prosumer
- Initial schedule and flexibilities for the following day
- Building Energy Management System (GEMS)
- Operate the system

Market Participant
- Gather and broadcast schedules for the following day
- Flexibility Management System (FMS)
- Market oriented schedule optimization considering grid constraints
- predicting congestions

Distribution System Operator
- Grid Load Management System (GLMS)
- Power-flow prognosis
- Calculate capacity constraints
- Regional Energy Management System (REMS)
- Generate control signal
- state estimation
- Grid state

avoiding congestions
Implementation of the Traffic Light Concept

Regional grid clusters:

- **Level 1**
  - HV/MV Transf.
- **Level 2**
  - MV-output
- **Level 3**
  - MV/LV Transf.
- **Level 4**
  - LV-output

**FMS**
Flexibility Management System

**GLMS**
Grid Load Management System

**REMS**
Regional Energy Management System

**GEMS**
Building Energy Management System

**Congestion Management**

**Future grid management of a DSO 2.0**

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- State estimation & Capacity management
- Power balancing
Power Balancing
Further development of the feed-in management

Automatization of distribution networks

- Merging decentralized generation units to a Wide Area Power Plant
- Taking over the tasks of conventional power plants
Power Balancing
Further development of the feed-in management

Automatization of distribution networks

- Merging decentralized generation units to a Wide Area Power Plant
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Power Balancing
Advanced system operation methods

Power-flow control with a fixed set point

Power-flow reduction with a fixed kW-delta
Field Test
Demonstration and evaluation

Testing the grid of the future in Freiamt

Field test in NETlab Freiamt
- REMS, FMS, GLMS, GEMS and State Estimation
- Up to 30 secondary substations with information- and communication technology
- Up to 60 renewable energy generation units
- 5 battery storage units
- Charging point for EV
- Controllable MV/LV transformer

Expectation
- Demonstration and evaluation of the developed concepts and solutions
Summary

Our vision of a future distribution system operator

Market facilitator:
Non-discriminatory grid access for all customers

Flexibilities:
Enable an efficient grid operation and avoid an expansion of the grid by using the flexibilities on the customers side

Ancillary services:
Responsible for the system stability and supply guarantee together with the TSO

Data:
Economical use of data for efficient network planning and operation, secure data transport
The Future?

Optimized Swabian feed-in compensation
Thank you for your attention!

For more Information: www.projekt-grid-control.de

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Intelligent ideas for tomorrow’s distribution grids

Energy storage technologies
- System solutions to integrate Solar PV into the LV-Grid (Sonderbuch)
- Operating the distribution network as an area power plant (Freiamt)
- Integrating wind energy on the medium voltage level, supply guarantee (Niederstetten)
- Load management on the customers side: Wind energy heating (Boxberg, Stockach)
- Integrating electric cars using an intelligent charging infrastructure (Stuttgart)

Measuring technology
- Adaptable Distribution Transformer
- Load management
- Communication technology
- E-Mobility

Overall concept for the distribution grid of the future
- Funding initiative „Zukunftsfähige Stromnetze“
- Project duration: July 2015 – June 2018
- Project volume: € 9 mil.