Energy Storage in Germany – demand, market environment and regulatory framework

HydroBalance Kick-off meeting
Trondheim, 23rd of October 2013
Michaela Harasta, E.ON Global Unit Generation
E.ON is an experienced operator of a European hydropower portfolio totaling nearly 6,000 MW.

<table>
<thead>
<tr>
<th>E.ON Generation</th>
<th>E.ON Intl. Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam</td>
<td>CCGT</td>
</tr>
<tr>
<td>No. of operated hydropower plants</td>
<td>209</td>
</tr>
<tr>
<td>Efficient capacity (net installed capacity)¹</td>
<td>5,409 MW</td>
</tr>
<tr>
<td>Annual net generation¹,²</td>
<td>15.5 TWh</td>
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1) Incl. power-procurement rights
2) Annual generation excluding pumped storage power plants
3) Status January 2013; 0.8 GW under construction, 0.8 GW under development

**Map showing locations:**
- Dingolfing - Germany
- Ramsele - Sweden
- Cotilia - Italy
- Silvón - Spain
- Sundsvall
- Malmö
- Landshut
- Terni
- Istanbul
- Turkey
- Germany
- Spain
- Italy

**Country capacities:**
- **Sweden:** 1,775 MW (7.9 TWh)
- **Germany:** 2,411 MW (5.7 TWh)
- **Spain:** 692 MW (0.6 TWh)
- **Italy:** 531 MW (1.3 TWh)

**Other locations:**
- Dingolfing - Germany
- Ramsele - Sweden
- Cotilia - Italy
- Silvón - Spain
Innovation topics at E.ON are managed by Innovation Centers in co-operation with experts in operative units.

### Main topics of E.ON Innovation Center Storage

Assessment and development of storage technologies:
- Battery storage
- Power to gas
- Compressed air energy storage
- Thermal energy storage

- **Pumped-storage plant innovations**, where the EIC co-operates closely with the Hydro Fleet, such as:

### E.ON Innovation Centers

<table>
<thead>
<tr>
<th>Category</th>
<th>Subcategories</th>
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<tbody>
<tr>
<td>Renewables</td>
<td>Gas-CCGT, Storage, Customer Solutions</td>
</tr>
<tr>
<td>Hydro</td>
<td>CCS, Distribution, Technology to Business</td>
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<td>Nuclear</td>
<td>Exploration &amp; Production</td>
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<tr>
<td>Steam</td>
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<td>Energy System</td>
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<td>Energy Intelligence</td>
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</table>
Demand for energy storage in Germany in 2050
Conclusion from existing energy demand studies

Drivers for energy storage demand

- **Share of RES** in generation mix
- **Total energy consumption**
- **Amount of import and export**
- **Number of E-vehicles** with “smart” charging
- **Degree of demand side management**
- **Distribution grid** improvements
- **Transmission grid** extensions

Comparing various studies

- **Significant variation** of study results
- **Comparability** of results is **rather low** due to differences in:
  - **Study purpose** (determining storage demand, optimal RES generation etc.)
  - **Methodology and optimization algorithm** (system cost minimization, residual load minimization etc.)
  - **Input parameters** (transmission constraints, technology costs etc.)

There is no clear view on how much storage capacity will be needed exactly, but there will be a large demand in the long term future. Hence, we have to develop efficient energy storage solutions for the system already today.
Market design is to be revised to set investment signals for Energy Storage

**Facts**

- **“Peak shaving”** through PV → main remuneration component for PSPs shrinking
- **Alternative “products” not remunerated** by current market mechanism
- Thus, **reduced profitability** with missing investment signals

**Conclusions**

a. Current remuneration concept (peak-offpeak spread) does not generate enough income

b. New remuneration concepts for demanded system services is required → new market design and/or products to be introduced

c. Operational profitability and investment risks currently not acceptable → reliable framework to be developed shortly
“Peak shaving” by feed-in of RES generation reduces profitability of pumped-storage plants in Germany

Especially subsidized PV-feed-in “shaves” price spikes and decreases achievable peak/offpeak-spread for pumped-storage plants → the original wholesale arbitrage business model does not generate sufficient profit anymore.
The achievable wholesale arbitrage profits decreased by approx. 50% since 2008

Wholesale market optimization of a generic pumped-storage plant:

The market conditions are currently very challenging for operation of pumped-storage plants and energy storage in general.
Introduction of new products could facilitate investments in energy storage and help the “energy transition”

- Controversial discussion in Germany as to which extend a market for flexibility is needed
- Some markets for flexibility are established already, e.g. reserve, intraday, balance energy
- But demand for flexibility and system services that facilitate the challenges of the energy transition will increase in future
- Respective products and remuneration concepts do not exist
  - Storage
  - Congestion management
  - Forecast error mitigation
  - …

New products and remuneration concepts would have to be initiated by politics, but once introduced, these products should be traded based on market principles.
**Regulation:** The existing regulatory framework leads to disadvantages for Energy Storage

### Facts

- Energy storages are regarded as final consumers and hence subject to **grid fees**
- **EEG**\(^1\) **regulations** focus solely on RES generation but do not cover storage/balancing requirements for the system
- **TSOs as storage operators** discussed

### Conclusions

- **Grid fees** impose a massive economical burden to PSPs today and deteriorate profitability even more
- **EEG subsidies** in Germany avoid investments into required storage technology for RES integration \(\rightarrow\) macro-economically inefficient
- Operation of storages by the TSOs would eliminate market principles e.g. for reserve capacity
- Energy storage needs an own regulatory framework

\(^1\) German renewable energy act
Grid fees for final consumption reduce the profitability of a pumped-storage plant by approx. 50%.

- **Generic pumped-storage plant** optimized in wholesale market
- Two effects impact profitability:
  - **Lower number of operating hours** (energy fee reduces spread and leads to different optimization)
  - **Capacity and energy fee** in its absolute height

### Operating hours: -25%

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<tr>
<th></th>
<th>w/o grid fee</th>
<th>with grid fee</th>
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<tbody>
<tr>
<td>Turbining hours</td>
<td>1.647</td>
<td>1.242</td>
</tr>
<tr>
<td>Pumping hours</td>
<td>2.611</td>
<td>1.968</td>
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### Achievable Contribution Margin (m€): -45%

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<tr>
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<th>w/o grid fee</th>
<th>with grid fee</th>
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<tbody>
<tr>
<td>CM w/o grid fee</td>
<td>4.80</td>
<td>4.5</td>
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<tr>
<td>Effect lower op. Hours</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>CM with lower op. Hours</td>
<td>1.8</td>
<td>2.7</td>
</tr>
<tr>
<td>Grid fee</td>
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In the current demanding market environment with low spreads the grid fee burden can hardly be born anymore → profitable operation is in danger and investment signals are not given (neither new build nor refurbishments of existing assets).
Current regulations in Germany do not give any incentives to RES generators to use energy storage

- Subsidies for selected technologies (mainly Wind, PV), but no view on total system requirements
- Granted remuneration to RES operators, irrespective whether there is a demand of electricity or not
- Re-dispatch more favorable for RES generators then use of storage
- No balancing obligations for RES generators

Requirement for amendments of current subsidy system to avoid further uncontrolled expansion of RES capacities is recognized and currently discussed:

- Financing of RES will also in future be necessary, but lower returns intended
- More coordination between RES installations and extension of necessary infrastructure
- More market-integration of RES generation into established mechanisms
Summary and conclusion

- **Storages will play a key role** in the future energy system, but there is no clear view on the exact demand of energy storage yet.

- Storages represent a “fourth element” in the system. They are different from the other system participants generation, grid and end consumers. Hence, storages need their own and technology neutral regulatory framework.

- Today the economic preconditions for investments into energy storages are not given, remuneration concepts need to be adjusted.

- Moreover, energy storages should be relieved from any fees associated with end consumption as they only defer and convert energy for future use.

- Storage should be part of a competitive market, but current legislation and RES subsidies in Germany do not give any incentive to use storage.
Thank you for your attention!

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