Younicos
Let the fossils rest in peace.
How can battery storage contribute to system stability in Europe?

Lars Stephan - Senior Manager for Regulatory and Government Affairs, Younicos AG
Younicos at a Glance

- Founding of the Company: 2005
- Younicos Inc.: Kyle and Austin, Texas, USA
- Younicos AG: Berlin, Germany
- Experience from battery storage: 97
- Total number of employees: 130
- More than 2 terabytes of field performance data collected
- 23 storage projects worldwide
- >60 gigawatt-hours charged and discharged
- 850,000 hours of operating run time on integrated power control & battery systems

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Who we are – We tailor battery solutions according to your needs

<table>
<thead>
<tr>
<th>Battery Parks</th>
<th>Island Systems</th>
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</thead>
<tbody>
<tr>
<td>• Increase grid stability</td>
<td>• Reduce energy cost</td>
</tr>
<tr>
<td>• Avoid grid expansion costs</td>
<td>• Reduce dependency on diesel</td>
</tr>
<tr>
<td>• Increase renewable share</td>
<td>• Reduce energy price volatility</td>
</tr>
<tr>
<td>• Optimize portfolios</td>
<td>• Increase renewable share</td>
</tr>
<tr>
<td>• Reduce carbon footprint</td>
<td>• Improve power quality</td>
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</table>
From south pole to Alaska: Experience from over 97 MW in the field
Battery storage - safeguard to grid stability
Storage is the key to higher efficiency and grid stability today

Services provided by Younicos storage solutions

**System services**
- Frequency containment reserve
- Frequency restoration reserve
- Voltage support
- Islanding capability
- Black start capability
- Short-circuit power
- Oscillation damping

**Other services**
- Grid investment deferral
- Ramp rate control
- Renewables integration
- Gen-Set optimization
- Fuel reduction
- Peak load management
- Self consumption optimization
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load
Storage roadmap for the Energiewende

System requirements define application, time and usage of storage technologies in the energy sector
Problem: Must-run limitation restrict the integration of Renewables

Must-run losses over a 24 h-period

Must-run losses over a year

In Germany, ~ 600 MW primary frequency control, equivalent to ~ 20 GW must run, creating damage of ~€5.25 bn. in 2017*

Europe requires 3,000 MW of primary frequency control

* SRU, Systemkonflikt in der Transformation der Stromerzeugung. 2010 Deutsch Übertragungsnetzbetreiber, Auswirkungen reduzierter Schwungmasse auf einen stabilen Netzbetrieb, 2014
Batteries offer higher efficiency in the provision of frequency containment

Control bands of different power plants in % of overall power (Frequency Containment Reserve and Frequency Restoration Reserve)

<table>
<thead>
<tr>
<th>Power Plant</th>
<th>Total Power (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lignite</td>
<td>20%</td>
</tr>
<tr>
<td>Hard coal</td>
<td>30%</td>
</tr>
<tr>
<td>Gas fired</td>
<td>40%</td>
</tr>
<tr>
<td>Hydro power</td>
<td>60% -35%</td>
</tr>
<tr>
<td>Battery</td>
<td>100% -100%</td>
</tr>
</tbody>
</table>

- Blue: must-run limitation
- Yellow: frequency band

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Microeconomic balance: Batteries are the cheapest option to provide grid stability

Comparing costs for 2MW control band of frequency regulation

External costs outside the regulated framework*

Batteries are cheaper for the system, because they operate without external costs

*(dena, Systemdienstleistungen 2030, 2014)
Batteries are more flexible and accurate than conventional power plants

Faster and more accurate response of batteries make balancing more efficient and lowers the need for frequency regulation

*Battery power plant's response time < 5 ms
Ecological balance of battery storage: Battery vs. coal plant

Comparison for the provision of frequency containment reserve

Batteries help to reduce emissions and pollution from the energy sector

*FZ Jülich (2015): Life Cycle assessment of primary control provision by battery storage systems and fossil power plants
From R&D to innovation to market design: Battery storage is a proven technology today
Battery Storage is ready to penetrate the market

Schwerin Battery Park

- 5 MW/5 MWh
- Lithium-Ion
- Primary frequency response
- Younicos delivered turnkey battery power plant
- Option to extend to 10 MW/10 MWh
- Commissioned: 06/2014
- Client:

WEMAG
From south pole to Alaska: Experience from over 97 MW in the field
Battery Energy Storage – a new enabler in the old regulatory framework

Across the unbundled energy sector

Across different grid-levels

Storage technology can be employed in different applications and on different grid levels, which constitutes a challenge in today’s regulatory framework
Regulatory Challenges: Is the market ready for battery storage?

No definition for storage in unbundled markets, whereas storage can provide services as production, load and grid source

→ Need to definition storage during legislative process to redesign electricity market

Technology specific barriers for storage prevent market penetration
NC LFCR Art. 45(6) – 30 min capacity requirement for storage

→ Markets have to be designed non-discriminatory towards different technologies

Value of storage to the grid is not yet reflected by market design, e.g. speed and precision of service delivery; most ancillary services not traded on markets

→ Adaptation of technology-friendly regulation and unfreezing of restricted markets to competition (see regulation in the US)
Thank you for your attention!

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