Geschäftsmodelle und Bedarf für Großspeicher in der Energiewende

Dr. Matthias Leuthold, Head of Storage, RES Deutschland GmbH

Speicher als Vektor für die Flexibilität der Energiewende

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2015-17 Business Development Manager Storage RES DE
2010-15 Team Leader Stationary Storage, ISEA, RWTH Aachen
2008-10 Research Engineer, Siemens Windpower, Aachen
Renewable Energy Systems (RES)

15 GW
PROJECT PORTFOLIO

37
YEARS OF EXPERIENCE

3 GW
OF OPERATIONAL ASSETS SUPPORTED

2,000
EMPLOYEES

ACTIVITIES

DEVELOP
CONSTRUCT
OPERATE

TECHNOLOGIES

WIND
SOLAR
STORAGE
TRANSMISSION & DISTRIBUTION
Utility Scale Battery Storage from 1MW/1MWh to 100 MW/130 MWh

2013

2014

2015

2016

2017

2018

2019

STEAG, Lessy, 1MW 1 MWh

2015 RES, Chicago, 19 MW 8 MWh

2018 Eneco, DE, 50 MW 50 MWh

2014 RES, Ohio, 4MW 2.6 MWh

2017 STEAG 6 x 15 MW, 130 MWh

2018 Tesla, Australia, 100 MW, 129 MWh
### Top Gun, USA 2020

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Power Rating:</td>
<td>30 MW</td>
</tr>
<tr>
<td>Energy Capacity:</td>
<td>120 MWh</td>
</tr>
<tr>
<td>Type:</td>
<td>Lithium-Ion (NMC)</td>
</tr>
<tr>
<td>Usage:</td>
<td>Peaking power, Grid stabilization</td>
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<tr>
<td>Enclosure:</td>
<td>Container</td>
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</table>
Carbon reduction + nuclear phase out + coal phase out + sector coupling (E-mobility, electrical heat)
Carbon reduction + nuclear phase out + coal phase out + sector coupling (E-mobility, electrical heat) = double fluctuating renewable generation by 2030

⇒ Generation exceeding consumption for significant hours per year
Typical Markets Utility Scale storage

- Markets driven by renewables
- Other markets (Grid)

Frequency Services

- 3-4 years

Market size
GW /GWh

10 years
Typical Markets Utility Scale storage

**US**
- Market size: GW /GWh
- Frequency: 4-6 years
- Renewable Storage
- Other

**UK**
- Market size: GW /GWh
- Frequency: 2 years
- Renewable Storage
- Other

**DE**
- Market size: GW /GWh
- Frequency: 4-5 years
- Renewable Storage
- Other
- Grid extension
- DSM, P2X
- Local Excess
- Grid Delay
Status Battery Storage Market Germany (2019)

Utility Storage market predominantly FCR

<table>
<thead>
<tr>
<th>year</th>
<th>MW FR</th>
<th>cumulated</th>
<th>% of Germany</th>
<th>% of Coupled Market</th>
<th>% of UCTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>26</td>
<td>26</td>
<td>4%</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>2015</td>
<td>0</td>
<td>26</td>
<td>4%</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>2016</td>
<td>128</td>
<td>154</td>
<td>26%</td>
<td>11%</td>
<td>5%</td>
</tr>
<tr>
<td>2017</td>
<td>94</td>
<td>247</td>
<td>41%</td>
<td>17%</td>
<td>8%</td>
</tr>
<tr>
<td>2018</td>
<td>171</td>
<td>418</td>
<td>70%</td>
<td>30%</td>
<td>14%</td>
</tr>
</tbody>
</table>

Cumulated installation Germany

- Utility scale (400 MW FCR*)
  ≈ 600 MW/ 600 MWh
- PV-Home-storage ≈ 400 MW/1.000 MWh

➔ 98% of utility scale storage are one time projects i.e. none but one owner invested a second time

*) FCR-Market in Germany saturated to 2/3, D-A-CH-F-NL-B-DK to 1/3, UCTE to 1/6
Grid Booster

Speicher können Netzausnutzung verbessern.
Prices for FCR service in Germany (weekly/daily auction)

- Monatlich: monthly
- Wöchentlich: weekly
- Täglich: daily

2008-2018:
- Eneco: 36 MW, 0.63 Mio €/MW
- STEAG: 90 MW, ca. 1.1 Mio €/MW
- WEMAG: 5 MW, 1.2 Mio €/MW
- PRL:
- WEMAG
- STEAG
- Eneco

“Cannibalisation“ - prices are falling below viable levels
➔ no sustainable market!
➔ Introduction of storage requires market design to achieve bankability.

LEAG: 50 MW, 0.5 Mio €/MW

2020?

12
Why Storage?

Replacing fossil generation!

Model for CO$_2$ avoidance cost using storage

- daily cycle of excess generation (already today regionally significant curtailment/export)
- using BESS to replace fossil generation (400-1.000 g CO$_2$/kWh)
- LCOE BESS: CAPEX 250 €/kWh, 5.000 cycles, 15 years,
  i.e. 7-8 ct/kWh system cost + 5-7 ct/kWh levies and taxes

Carbon replacement cost per metric ton CO$_2$ total 160 €/ton

➔ approx. 100 €/ton hardware cost, plus 60-70 €/ton regulatory costs (levies and taxes)

For comparison:

- Wind 6 ct/kWh i.e. 80 €/ton CO$_2$
- PV 5.5 ct/kWh i.e. 73 €/ton CO$_2$
- Biogas 12 ct/kWh i.e. 160 €/ton CO$_2$

*) carbon footprint for production and recycling, avoided grid cost due to grid upgrade deferral not yet included.
How to implement storage for energy transition?

What’s the problem? ... storage would solve?
- Redispatch / Curtailment: 2015-2018: 0.9 .. 1.4 Mrd €/Jahr
- Negative power prices / price volatility
- Carbon free system stability / resilience (25. June 2019)
- Reduction of Must Run Capacity (= reduction of excess conventional generation)

What does it take? ... to access the potential of storage?
- Bankability - as all technologies with high CAPEX and low marginal cost

How can it be achieved at minimal cost?
- Competition & Cost reduction due to learning (curve) effects, innovation
- Investment in cost reduction - requires stable conditions for pay back
  ➔ Repeat business required for implementation of cost reduction / learning cycle
    (remember: FCR >98% one time projects)

Possible Market Design for Phase-in period:
- Auction of limited capacity over several years to generate repeat business
- Contract for Difference with several run time combined with obligation to act system compliant
  (Owner/Operators have to earn income in market but also have a minimum security)
  ➔ minimizes societal cost by A) unfolding cost reduction mechanisms and B) automatically falling funding cost when price spread increases
Summary

- 2020-2030: nuclear + coal phase out & sector coupling
  ➔ 2-3 fold renewable generation, excess generation >1.500-2.000 hours per year

- Utility scale Battery Energy Storage Systems (BESS) can integrate excess generation

- Technology is available, further reduction of battery-system cost required
  ➔ technology development + repeat business required for learning curve

- Regulation currently prevents development of storage potential
  ➔ CO₂ avoidance cost: approx. 100 €/ton\textsubscript{CO₂} for technol. plus 60-70 €/ton\textsubscript{CO₂} regulatory costs

- Energy only market will not support storage investments due to
  - Cannibalisation - prevents stable revenue
  - Power price scenarios unstable - in part due to regulatory uncertainties (e.g. political readiness to accept high price spikes)

- Exploitation of full potential of storage requires
  A) further technology development  
  B) adequate market design

  ➔ proposal CFD, runtime 8-12 years, with obligation to integrate fluctuating RE
Thank you!

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