Integrating storages in energy regions and local communities – a range of storage capacities

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The model region Osnabrück-Steinfurt

Master plan regions with targets regarding:

- Reduction of green house gas emissions: - 95 %
- Reduction of electric energy demand: - 50 % until 2050 (compared to 1990)
- Significant increase of renewable energy supply

The project EOS evaluates electricity storage solutions with regard to:

- technical and economic aspects
- the legal framework
- consumer acceptance

(Dec 2013 bis Nov 2018)
The model region Osnabrück-Steinfurt

- Two rural regions and one city
- Electric energy demand: approx. 6,000 GWh
- Master plan targets for the electricity sector are related to:
  - Reduction of electric energy demand
  - Increase of renewable energies (mainly wind power and photovoltaic)

Master plan targets:

- Wind power in MW
- Photovoltaic in MW
- Biogas potential in GWh/a

Diagram showing installed capacity in MW and biogas potential in GWh/a for different regions.
Research questions

• How do rural and urban regions complement regarding excess and deficit energy?

• What is the storage demand in future energy systems from the perspective of an energy region?
  • Influence of weather data from different years
  • Influence of various renewable energy potential
  • Influence of various combinations of cross-linking regions
Methods

- Open energy modeling framework „oemof“ → open source and community modeling project
- Simulation of one year in hourly time steps
- Linear invest and dispatch optimization

<table>
<thead>
<tr>
<th></th>
<th>Generic Battery Storage</th>
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<tbody>
<tr>
<td>Cycle efficiency</td>
<td>0.80</td>
</tr>
<tr>
<td>C-rate</td>
<td>1</td>
</tr>
<tr>
<td>Usable range</td>
<td>0 to 100 %</td>
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</tbody>
</table>

Assumption of various self-sufficiency degrees
Results

• Cross-linking of the city with the rural surroundings, without storage
• Residual load = demand – production from renewable energies (master plan 2030)

LKOS: Landkreis Osnabrück
KRST: Kreis Steinfurt
Results

Storage capacity for reaching different self-sufficiency degrees in the master plan region, assuming the master plan targets for 2030 and 2050, weather year range 1998 - 2014

- Broad range of storage capacities depending on self-sufficiency degree and weather year
- Partly immense and not reasonable storage capacities
- But also: self-sufficiency degrees of up to 85 % are achieved without any storage
Results

Municipalities of Kreis Steinfurt → storage capacity calculated
- individually
- 2 regions each cross-linked
Results

Self-sufficiency degree assuming wind and PV potential (targets 2050)

Storage capacity for self-sufficiency degree of 80 %

Self-sufficiency degree in %
- 19 - 43
- 43 - 67
- 67 - 74
- 74 - 85
- 85 - 91

Storage capacity in MWh
- infeasible
- 0
- 0 - 50
- 50 - 100
- 100 - 200
- > 200
Results

Storage capacity for self-sufficiency degree of 80 % and the self-sufficiency without storage

Regions where 80 % self-sufficiency is impossible
Results

Storage capacity for self-sufficiency degree of 80 % and the annual demand
Results

Storage capacity for self-sufficiency degree of 80 % and the installed wind power and PV capacity

Regions where 80 % self-sufficiency is impossible
**Results**

Storage capacity in the municipality regions assuming a self-sufficiency degree of 80% (153 combinations of 2 regions)

- In 43 region combinations, storage capacity decreases to 0
- In 16 region combinations, storage capacity decreases less than 5%
Summary and Outlook

• Analysis of storage capacity for the electricity sector from the perspective of energy regions

• Wide range in storage capacities depending on assumed parameters

• Especially the weather data have a great influence on calculated storage capacities.

• Outlook: what kind of regions are suitable for an urban-rural cross-linking in energy supply?
Thank you for your attention!
Methods

Electric energy generation

Storage state of charge

Demand and excess