Decentralization of the Electric Sector
Experience from the German energy transition

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Electricity generation in Brazil

Source: OECD / IEA (2017)
Newly installed wind capacity in 2016

MW

Source: Global wind energy council
Wind installations not necessarily decentral

Source: fotolia (niklove)
Big solar „plants“
Growth of renewable installations

More small, decentral suppliers and big consumers

<table>
<thead>
<tr>
<th>Electricity supply</th>
<th>Electricity demand</th>
</tr>
</thead>
</table>

[Diagram showing renewable energy sources and energy demand]
Locations of supply and demand in Brazil
The prospect of a (more) decentralized energy system

<table>
<thead>
<tr>
<th>Possible advantages</th>
<th>Challenges</th>
</tr>
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<tbody>
<tr>
<td>• Supply closer to demand</td>
<td>• Grid connection</td>
</tr>
<tr>
<td>• More flexibility</td>
<td>• Congestion management</td>
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<tr>
<td>• Less market concentration</td>
<td>• Security of supply</td>
</tr>
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<td></td>
<td>• Pricing</td>
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</tbody>
</table>
Renewable sources in Brazil

Advantage: complementary rather than alternative
Locations of supply and demand in Germany

Images: fotolia
Renewable energy in Germany

Share of electricity generation from renewable sources in percent

Source: German Federal Ministry for Economic Affairs and Energy
Installed net-power for the production of electricity

Capacity in GW in Germany (2016)

Quelle: Agora Energiewende (2017)
Highest to lowest proportion of renewable energy

Production and consumption of electricity - Wind/Solar/Conventional in GW 2016

- Conventional power stations
- Solar
- Wind onshore
- Wind offshore
- Hydroelectric power
- Biomass

Quelle: Agora Energiewende (2017)
Development of the components of electricity costs

Data in cents per kWh

<table>
<thead>
<tr>
<th>Year</th>
<th>Beschaffung, Netzentgelt, Vertrieb</th>
<th>Konzessionsabgabe</th>
<th>EEG-Umlage</th>
<th>Offshore-Haftungsumlage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>10,7</td>
<td>1,16</td>
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</tr>
<tr>
<td>2009</td>
<td>8,7</td>
<td>1,31</td>
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<td>2010</td>
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<td>2011</td>
<td>8,83</td>
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<td>2012</td>
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<td>2013</td>
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<td>5,277</td>
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<td>2014</td>
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<td>6,24</td>
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<td>2015</td>
<td>7,19</td>
<td>6,17</td>
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<tr>
<td>2016</td>
<td>6,89</td>
<td>6,354</td>
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</tbody>
</table>

Quelle: BDEW
Cost of congestion management in Germany
in million Euro

Quelle: Bundesnetzagentur
New Risks: Security of Supply?

- Electricity from guaranteed capacities is needed in a system that highly relies on fluctuant energy sources.
- Decreasing revenues of conventional power plants (less production hours, lower prices)
- Investment restraints within the conventional power plant sector

But: This is not necessarily a signal for market failure = Ongoing Debate
Security of supply as a product?

Demand side management increases flexibility

Price vs. Security of supply

1st to be turned off

Last to be turned off
Decentralization is a possible market result
– not a sensible policy target

- Depending on the market design smaller decentral installations of wind and solar power are encouraged by the promotion of renewable energy
- Still, there are advantages of bigger (renewable energy) plants:
  - Scale effects of bigger installations
  - More efficient land use in windy / sunny areas
  - Distance to residential buildings
  - Transportation
- Net infrastructure needs to fit installation structure
- Prices should incentivize most efficient locations for installations
Trends in global CO$_2$ emissions

in millions of tonnes of CO$_2$

Source: EU Commission / EDGAR, 2017
Comparison of CO$_2$ emissions in Germany and Brazil
in millions of tonnes of CO$_2$

Source: EU Commission / EDGAR, 2017
Political implications

Inconsistencies will persist without internationally comparable CO₂ prices.

1st best solution

- **Global** emissions trading system resulting in consistent prices for greenhouse gas emissions

2nd best solution

- **Regional** emissions trading for all sectors with perfect carbon leakage protection for highly competitive sectors

Current situation

- Inconsistent regulation of different sectors
- Overlapping inconsistent instruments
- Higher costs due to additional national regulations
Criteria for an efficient policy mix

► International agreements and/or instruments in place?
  • Additional national targets or measures have no extra effect

► Which target(s) does a policy instrument address?
  • Are other instruments addressing the same target(s)?
  • Is there a priority / hierarchy of targets?

► Simple rule (Tinbergen):
  one instrument ↔ one target