Digitisation of the energy transition in Germany

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IEA workshop on Digitalisation and Energy
5 April 2017, Paris, France
Germany’s electricity system in 2022: exemplary summer week

![Electricity Generation and Demand Graph]

- **Generation/Demand**: GW
- **Energy Sources**:
  - Photovoltaic
  - Residual Load (fossil plants)
  - Hydro
  - Onshore/Offshore Wind
  - Biomass

Source: Agora Energiewende 2012
Energy system of the future:
flexible demand-orientated generation
+ flexible generation-orientated demand, ancillary services also by distribution networks

- Storage
- RES-E
- Fossil generation

220/380 kV
110 kV
20/10 kV
0.4 kV

VPP
sector coupling
prosumers
demand-side management

Bidirectional power flows
Act on the Digitisation of the Energy Transition

• gradual phase in of smart meters in DE:
  • large-scale consumers and generating installations (start 2017)
  • smaller consumers later (start 2020)

• Smart meter: **intelligent metering systems** = digital meter + communications unit (smart meter gateway - SMG)

• Aim: development of a digital infrastructure
  → provide a secure **communication platform = data hub**
    • → Connect all players of the energy system:
      • consumers, generators, smart home, ...
      • system operators, utility, aggregators,...

• heavy focus on data protection and data security (e.g. “privacy by design”)

• Act is **start** → now development of specific use cases and products necessary
The SINTEG programme: “Smart Energy Showcases – Digital Agenda for the Energy Transition”

- Overall aim: develop solutions for a secure and efficient energy system relying on **temporarily up to 100% of RES**
- **focus**: connect generation, demand side, storage, grids and market using ICT → **smart grids/ market**
- Solutions are to be implemented in **five large pilot regions (showcases)** → **scalability/ preparing mass market** → **pilot solutions** for our future energy system (e.g. market platforms, sector coupling, ancillary services, TSO-DSO cooperation,...)
- **more than 300 firms + other players** involved; Start: 12/2016 + 01/2017
- Volume of funding: more than € 200 million; firms provide more than € 300 million → **some € 500 millions to be spent on smart grids**
- Solutions are to serve as a **blueprint for wider use**
- “**regulatory sand box**: gain experience → information on necessary adjustments to the regulatory framework → upcoming amendments
- **part of the German government’s “digital agenda”**
Thank you for your attention!

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back up
Electricity prices have declined and volatility sank over the past years.

Source: Ecofys 2015, EEX 2015
### Germany’s “Energiewende” targets until 2050

<table>
<thead>
<tr>
<th>Climate</th>
<th>Achieved 2014</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>% greenhouse gas reduction (vs. 1990)</td>
<td>-27%</td>
<td>-40</td>
<td>-55</td>
<td>-70</td>
<td>-80</td>
<td>-80 to -95</td>
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<tr>
<td>Renewable Energies</td>
<td></td>
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<tr>
<td>% gross electricity consumption (2015)</td>
<td>32.6%</td>
<td>35</td>
<td>40 to 45</td>
<td>50</td>
<td>55 to 60</td>
<td>65</td>
<td>80</td>
</tr>
<tr>
<td>% gross final energy consumption</td>
<td>13.7%</td>
<td>18</td>
<td>30</td>
<td>45</td>
<td>60</td>
<td></td>
<td></td>
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<tr>
<td>Energy Efficiency</td>
<td></td>
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</tr>
<tr>
<td>% primary energy consumption (vs. 2008)</td>
<td>-7.3% (2015)</td>
<td>-20</td>
<td></td>
<td></td>
<td></td>
<td>-50</td>
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<tr>
<td>final energy productivity (vs. 2008)</td>
<td>1.7% p.a.</td>
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<tr>
<td>building renovation</td>
<td>~1% p.a.</td>
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<td>doubling of renovation rate: 1% → 2% p.a.</td>
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<tr>
<td>% transport energy consumption (vs. 2008)</td>
<td>1.7%</td>
<td>-10</td>
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<td></td>
<td></td>
<td>-40</td>
<td></td>
</tr>
</tbody>
</table>

Development of installed capacity of RES-E in Germany

- Maximum RES-E share: 23.08.2015, 1 p.m.: 83.2%

- Referenz 2012
- Szenario B2024
- Szenario B2034

(maximum RES-E share: 23.08.2015, 1 p.m.: 83.2%)

(data source: NEP 2014, Szenariorahmen)
SINTEG Showcase regions
Showcase regions

• In common: show cases cover the entire smart energy system of the future
  o Efficient and secure grid operation with high shares of renewables
  o tapping efficiency and flexibility potentials (in terms of markets and grids)
  o Ensuring efficient and secure cooperation of all players in the smart energy system → data explosion
  o New business models in the energy sector

• Each of the project has different points of focus
Showcase regions

- Examples
  - Feeding regional information into the electricity market/stock exchange → ‘regional order books’
  - several hundred MW of demand-side management across different sectors (PtH, PtC, PtG), e.g. to use excess electricity within the region
  - Use/roll-out of > 300,000 iMSys
  - ICT platforms for networking/coordination
  - 800 supermarkets to act as flexible consumers
  - Energy transition AppStore for players involved (across different sectors, e.g. to help increase the energy performance of buildings)
### Selected showcase regions

<table>
<thead>
<tr>
<th>No.</th>
<th>Title</th>
<th>Partners involved in project (associated partners/contractors)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>C/sells</strong>: large-scale showcase in the ‘solar arch’ region in southern Germany</td>
<td>53 (15)</td>
</tr>
<tr>
<td>2</td>
<td><strong>Designetz</strong>: a modular concept – from isolated solutions to an efficient energy system</td>
<td>35 (14)</td>
</tr>
<tr>
<td>3</td>
<td><strong>enera</strong>: The next big step in the energy transition</td>
<td>32 (19)</td>
</tr>
<tr>
<td>4</td>
<td><strong>NEW 4.0</strong>: The energy transition in northern Germany</td>
<td>37 (11)</td>
</tr>
<tr>
<td>5</td>
<td><strong>WindNODE</strong>: showcase for smart energy from the north-east of Germany</td>
<td>49 (16)</td>
</tr>
</tbody>
</table>
C/sells – the solar arch in the south

- 1,200 MW of load, 1m consumers, 15,000 distributed PV installations (500 MW); 200 electric vehicles, 1,000 controllable electric heating systems, 600 controllable loads

- Looks at flexibility across different sectors using an energy system organised in cellular form (subsidiary within and across cells)
- Autonomous regional cells that interact at supra-regional level
- Cloud-based infrastructure information system (IIS) serving as an ICT platform
- Expanding regional markets for ancillary services
- Flexibility between electric power, heat and transport
Designetz – a modular concept

- Rural renewables vs. industrial centres of demand → typical situation in DE
- Distributed energy (mix of solar and wind) to be used to supply industrial centres of demand

- **Responsibility for the system across grid levels**
- **Cascading, bidirectional procedure:**
  - Requests for greater flexibility to be made by higher grid levels to lower grid levels
  - Lower grid levels provide projections of grid condition and of scope for flexibility
- Use of iMSys, sensors and actuators to assess the state of distribution networks and to control (including data from some 100,000 metering systems)
- includes gas and heat (PtG, PtH etc.)
Enera – the next big step

• Share of renewables > 170% (wind, PV, biogas)
• 390,000 inhabitants, approx. 200,000 households, 1.75 GW RES-E (onshore wind: 1.5 GW, offshore wind: 175 MW; another 1,000 MW envisaged)

• Transition to a dynamic, distributed energy system
• Increasing flexibility of distributed generators, loads, storage
• Regional ancillary services to be treated as tradable, regional goods (e.g. voltage stability)
• Feeding in regional information into the electricity exchange to support distribution networks
• Rollout and management of 40,000 iMsys
• ‘Smart Data and Services’ platform
• 30–60 start-ups to develop new business models for a smart energy system for the future
• ‘Energy transition AppStore’
NEW 4.0 – energy transition in the north

- large centre of energy demand (Hamburg) with rural region as centre of supply of wind energy (Schleswig-Holstein)
- Project is to demonstrate that 70%-share of renewables in region’s supply providing full energy security will be possible by 2025

- Main objective: finding efficient ways of dealing with local surplus electricity
  Two-way strategy:
  - better export to other regions;
  - greater flexibility to use energy locally
- Greater flexibility mainly by means of demand-side (load management, storage, sector coupling) (100s of MW)
- Minimising ‘must-run capacity’ of conventional power plants with the help of innovative ancillary services, DSM and flexible CHP
WindNODE – smart energy from the north-east of Germany

• Balancing zone of 50 Hertz (excluding Hamburg)
• Thousands of controllable loads, > 150 MW
• Installed renewables capacity (in 2014): 25 GW (59% wind, 33% PV),
• 42%-share of renewables in electricity consumption
  • **Optimisation of overall system**: electricity, heat, mobility
  • ICT platform connects generators, loads, grids, markets and provides for flexibility (e.g. flexible industrial loads, PtX, electric mobility, distributed small-scale generators)
  • **More than 800 supermarkets involved, which will act as flexible loads**
  • **New system operation TSO-DSO**
  • “Regional power plants”/VPP
  • Urban-rural energy cooperation (Berlin and Brandenburg)
  • Greater **system responsibility** assigned to balance responsible parties (BRP) and aggregators