How flexibilities support sector coupling – the integration of more renewable energies

- The de-carbonation of Germany
- The customer role
- The link between electricity and gas

EnBW Energie Baden-Württemberg AG
Dr. Holger Wiechmann
EEM 2018
Dresden, 27th April, 2018
The starting point: The German energy transition is a paradigm shift for all Energy market segments

From the old energy market... ... to the power supply of the future

- Generation has to be de-carbonized
  - Phase out of nuclear energy by 2022
  - Discussion about the phase out of lignite and hard coal (government commission)
- Decentralized structure
  - RE-generation based on PV and wind
  - Battery storage, EV and electric heating
- Smart distribution grids
- Necessity of using the flexibility on the demand site
From the energy transition ... to the de-carbonization of all sectors

› More or less complete de-carbonization
  – electricity
  – heating
  – transportation
Final energy consumption in Germany

2.542 TWh

- Households: 665 TWh
- Business, Commerce, Services: 411 TWh
- Traffic: 749 TWh
- Industry: 717 TWh

Has to be CO₂-free! But how?
The deep impact:
Sector coupling significantly increases demand for electricity

100 %-proportion of electricity in Germany means:

› Without efficiency measures up to 3.000 TWh/a
› With efficiency measures up to 1.300 TWh/a

Source: Quaschning, Volker; Sektorkopplung durch die Energiewende; htw Hochschule für Technik und Wirtschaft Berlin, 20. Juni 2016
Substantial need for additional RE-capacity due to the sector coupling!
Need for additional RE-capacity due to the sector coupling

Development of renewable electricity generation and electricity consumption to achieve climate-neutral energy supply, taking efficiency measures into account

This means:
› about 50 % of efficiency measures

This means:
› about 400 GW of PV
› about 200 GW of onshore wind
› about 75 GW of offshore wind
› (about 20 GW of biomass)
› (about 7 GW of hydro)

Source: Quaschning, Volker; Sektorkopplung durch die Energiewende; htw Hochschule für Technik und Wirtschaft Berlin, 20. Juni 2016
We have to speed up, if we want to reach the CO$_2$-emission targets
The customer role: initial position in households

**Initial behaviour:**
- Household without PV-system or battery
- 100 % electricity from grid
The customer role: step one in households

**Initial behaviour:**
- Household with PV-system
- 100% electricity from grid
- 100% feed in due to feed in law
- feed in tariff > tariff for electricity
Adapted behaviour:
› Household with PV-system and self-consumption
› 60 – 80 % electricity from grid
› 20 – 40 % self-consumption
› X % feed in into grid
› feed in tariff < tariff for electricity

The customer role: step two in households

load profile with daily and seasonal variety

PV-system
Adapted behaviour:

- Household with PV-system, self-consumption and battery
- ~30% electricity from grid
- ~70% self-consumption
- Y% feed in due to feed in law
- feed in tariff < tariff for electricity
Adapted behaviour:

› Household with PV-system, self-consumption, battery, e-heating and e-mobility
› ~40 % electricity from grid
› ~60 % self-consumption
› Z % feed in due to feed in law
› feed in tariff < tariff for electricity
Three examples of local flexibility and load management potentials:

- (Small scale) stationary battery systems
  - Assumption: 50 % of the residential buildings (10 m) with battery system (aver. capacity of 10 kW)
  - **Additional capacity of 100 GW**

- (Small scale) moveable battery storage (e-mobility)
  - Assumption: 50 % as e-vehicles (25 m) with aver. charge capacity of 20 kW
  - **Additional capacity of 500 GW**

- Heat storage (hybrid heating)
  - Heating rod with a backup heating system based on gas, oil, heat pumps, etc.
  - Assumption: 50 % of the residential buildings (10 m) with a heating rod (average capacity of 10 kW)
  - **Additional capacity of 100 GW**
The customer - the big unknown with a lot of shift load potentials!
The four roles of storage and flexibility technologies

Storage and flexibility technologies in an essential role:

1. daily-based solution
   - batteries
   - heat storage
   - flexible use
   - pump storage
   - etc.

2. solution for control energy
   - batteries
   - pump storage
   - flying wheels
   - heat storage
   - flexible use
   - power-to-X
   - etc.

3. seasonal-based solution
   - power-to-gas-to-power
   - power-to-liquids-to-power
   - etc. ?????? → big question

4. grid expansion
   - a solution to avoid the need for flexibility?
The EnBW-solution!

The VIRTUAL POWER PLANT

The energy infrastructure of the future
The link between electricity and gas

**The transport of energy over long distances**
- already bottlenecks in the electricity grid
  - north-south challenge in Germany
  - increasing demand for electricity
- significant time delay in network expansion in the electricity grid

**But**
- existing gas transportation grid
- decreasing demand for heating gas, this means less need for grid capacity
- gas grid expansion less controversial than electricity grid expansion
Let us use the gas grid for the long distance transport of green energy / green gas
The German “Energiewende” is the first step to the sector coupling...

... and storage technologies – especially power-to-gas – will get an essential role for the interaction between generation and consumption
EnBW Energie Baden-Württemberg AG
Senior Manager

Dr. Holger Wiechmann
Durlacher Allee 93
D-76131 Karlsruhe
h.wiechmann@enbw.com
+49 711 289 81689