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

but sector coupling means more than electricity!

- 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

The deep impact:
The Paris Climate Change Conference November 2015

From the energy transition **... to the de-carbonization of all sectors**

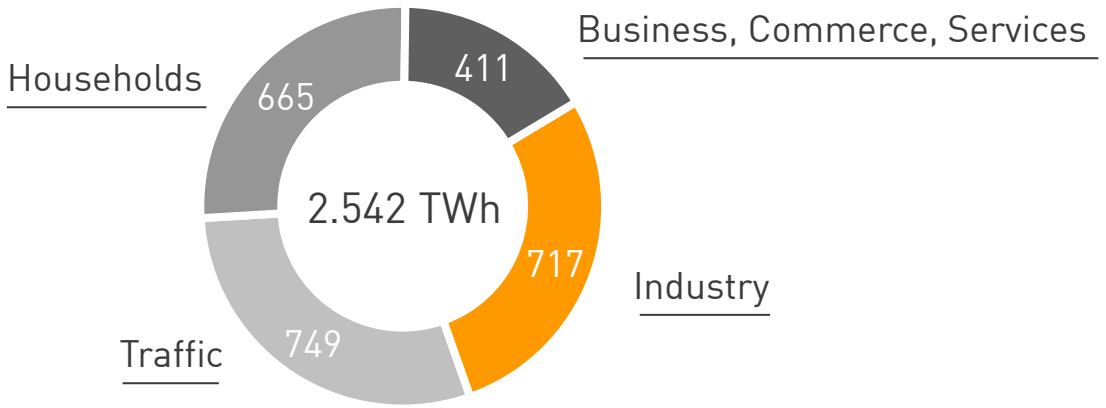
PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

MARRAKECH 2016
COP22 | CMP12 | CMA1
UN CLIMATE CHANGE CONFERENCE
مؤتمر الأمم المتحدة لتغير المناخ

- More or less complete de-carbonization
  - electricity
  - heating
  - transportation

Initial Position:
The final energy consumption in Germany

final energy consumption 2016 [TWh/a]



› **Has to be CO_2-free! But how?**

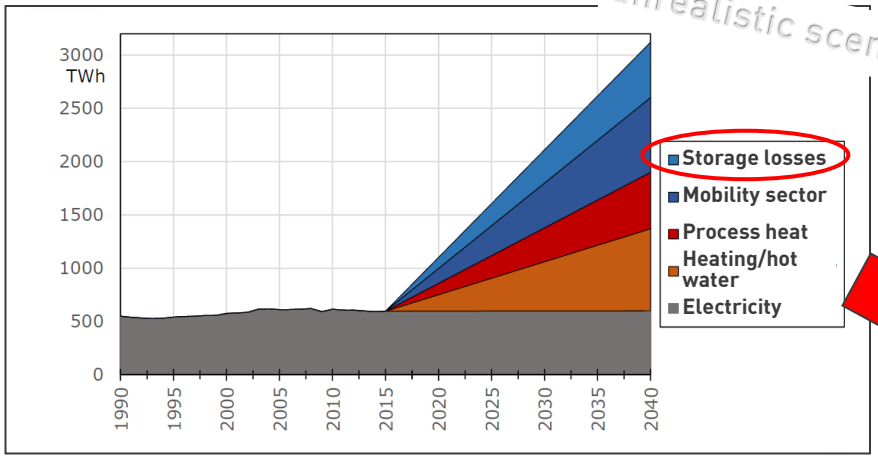
Source: AG Energiebilanzen, own representation

The deep impact:
Sector coupling significantly increases demand for electricity

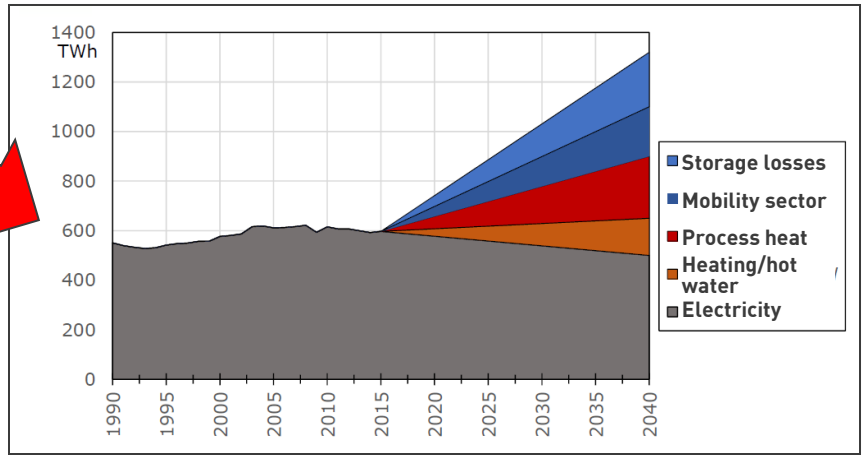
100 %-proportion of electricity in Germany means:

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

unrealistic scenario



plausible scenario



Source: Quaschning, Volker; Sektorkopplung durch die Energiewende; htw Hochschule für Technik und Wirtschaft Berlin, 20. Juni 2016

First thesis

- **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

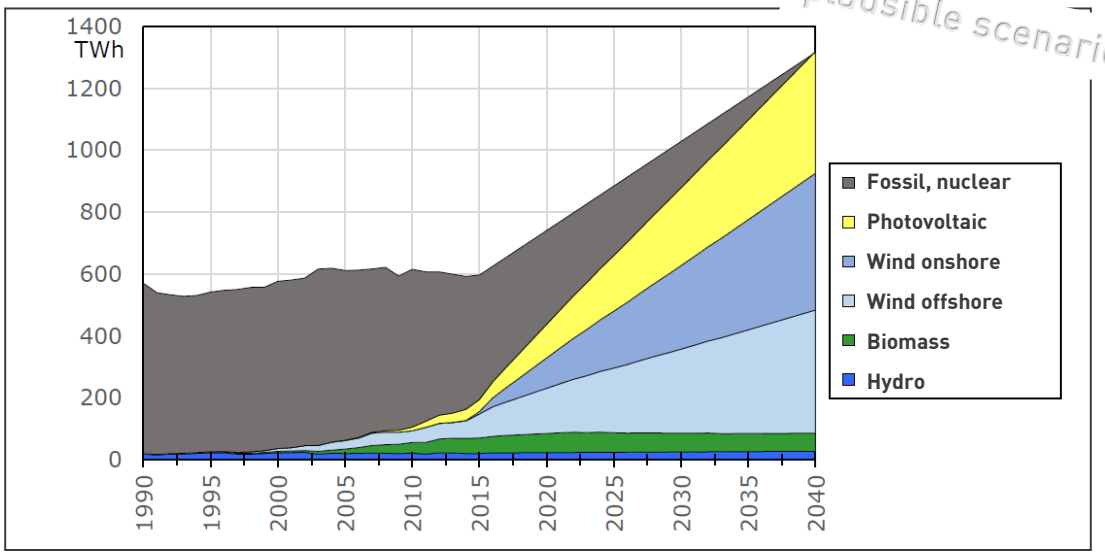
This means:

› 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

Second thesis

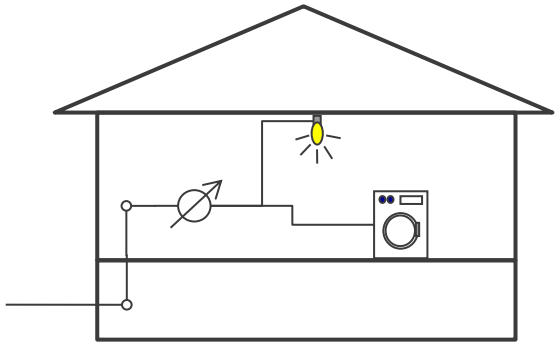
> **We have to speed up, if we want to reach the CO_2-emission targets**

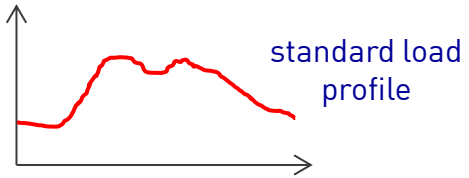
The customer role: initial position in households

Initial behaviour:

- Household without PV-system or battery
- 100 % electricity from grid

No flexibility



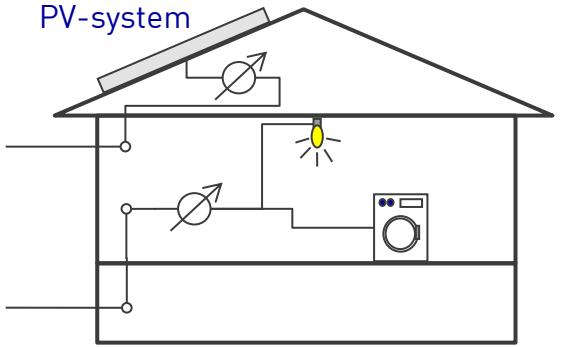


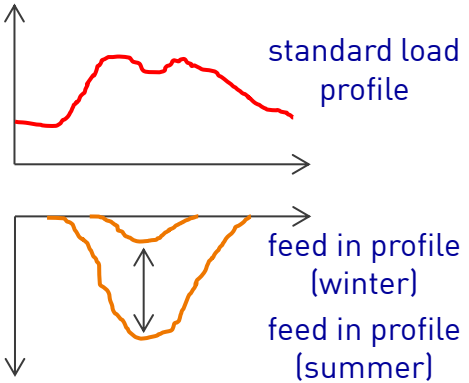
The customer role: step one in households

Initial behaviour:

- Household with PV-system
- 100 % electricity from grid
- 100 % feed in due to feed in law
- feed in tariff > tariff for electricity

no flexibility



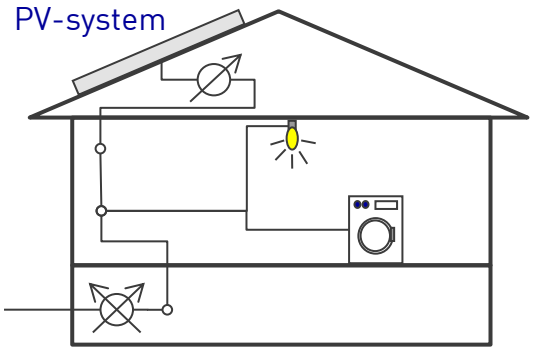


The customer role: step two in households

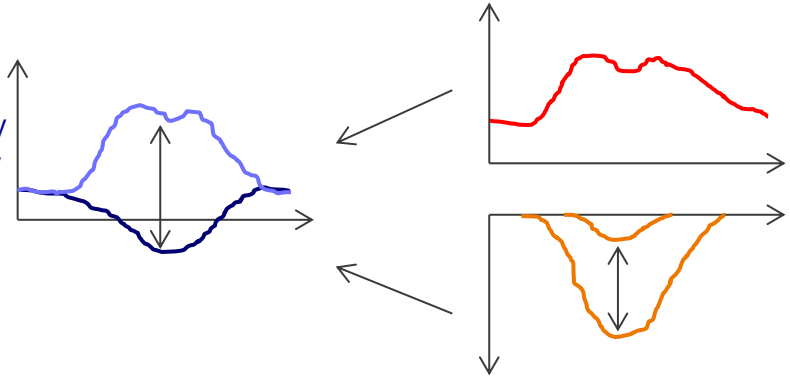
Adapted behaviour:

- 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

no flexibility



load profile with daily and seasonal variety

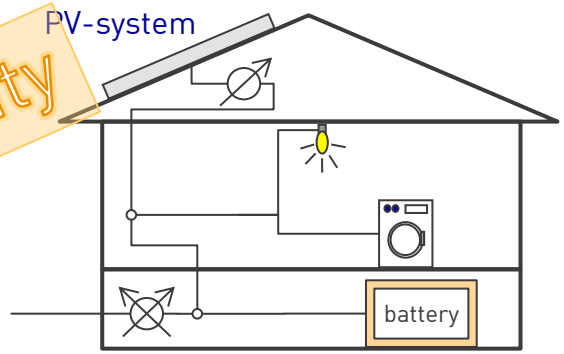


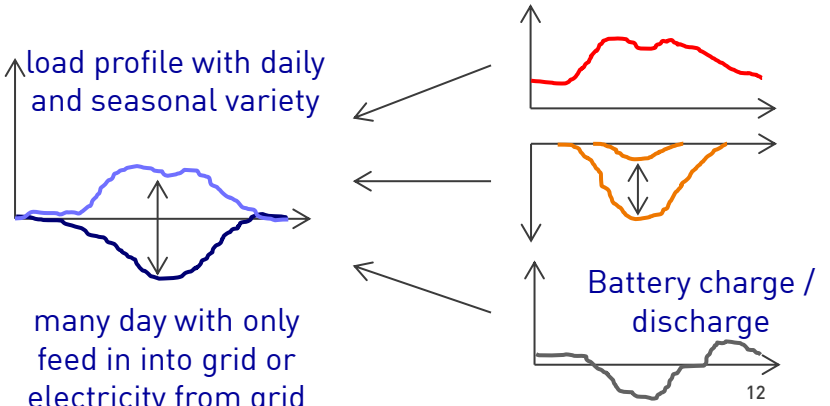
The customer role: step three in households

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

potential of flexibility



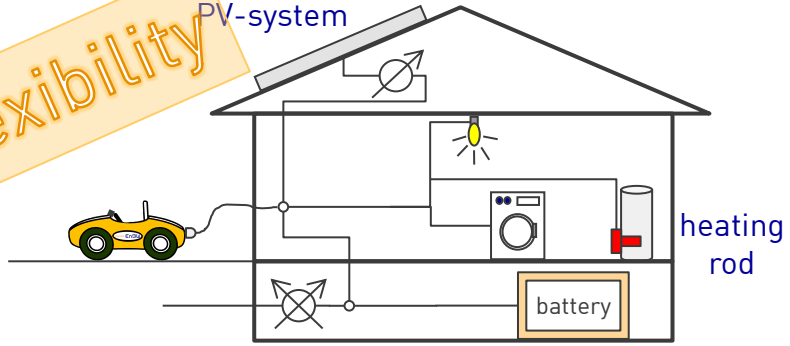


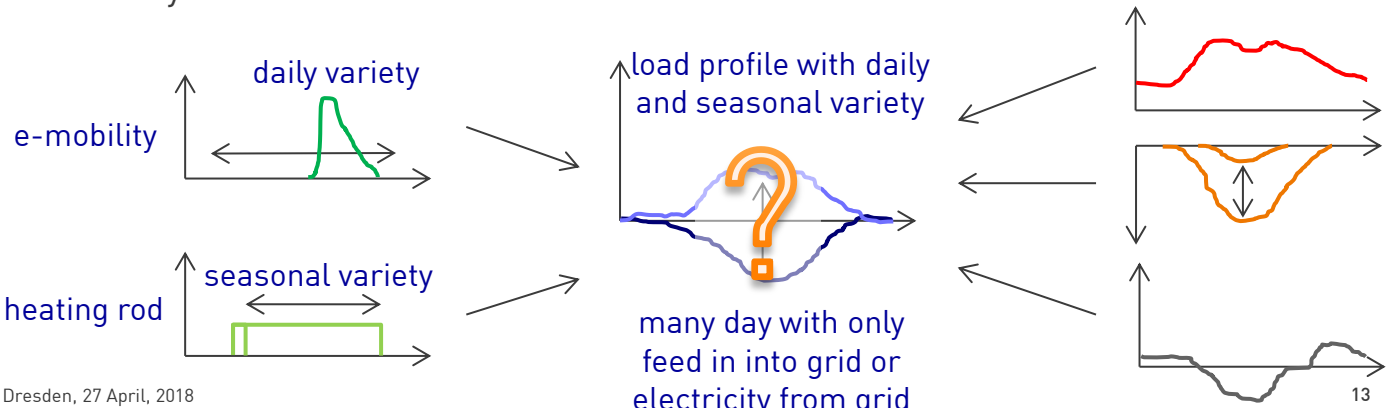
The customer role: step four in households

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

potential of flexibility

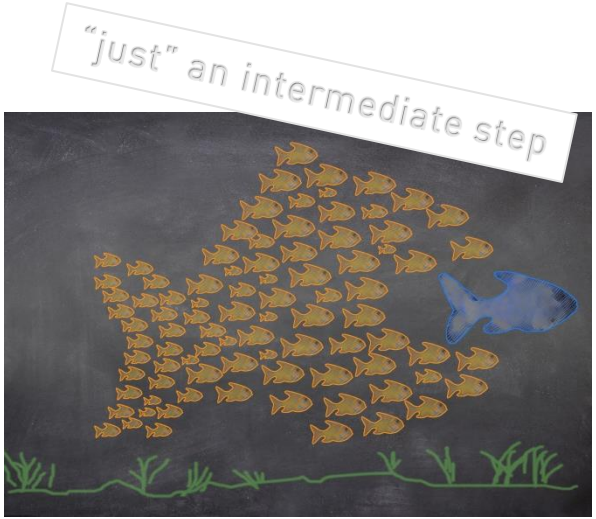




The customers role: The local shift load potentials

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**



Third thesis

- **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 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

Fifth thesis

- **Let us use the gas grid for the long distance transport of green energy / green gas**

Conclusion

- **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

Contact

EnBW Energie Baden-Württemberg AG
Senior Manager

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