Proposals for a new market design to support sector coupling ›

- The de-carbonation of Germany
- The link between electricity and gas
- Five Approaches to a new market design

EnBW Energie Baden-Württemberg AG
Dr. Holger Wiechmann
EnergyDays 2018 – Energy landscapes of today and tomorrow
Leipzig, 24-25 September, 2018

EnBW

Once upon a time (part 1)...

... a summer in Germany 2018

› And many are calling for state help (e. g. farmers, foresters, fishermen, boatmen, ...)

Source: http://www.spiegel.de/fotostrecke/cartoon-des-tages-fotostrecke-142907-6.html

The deep impact:
The Paris Climate Change Conference November 2015

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

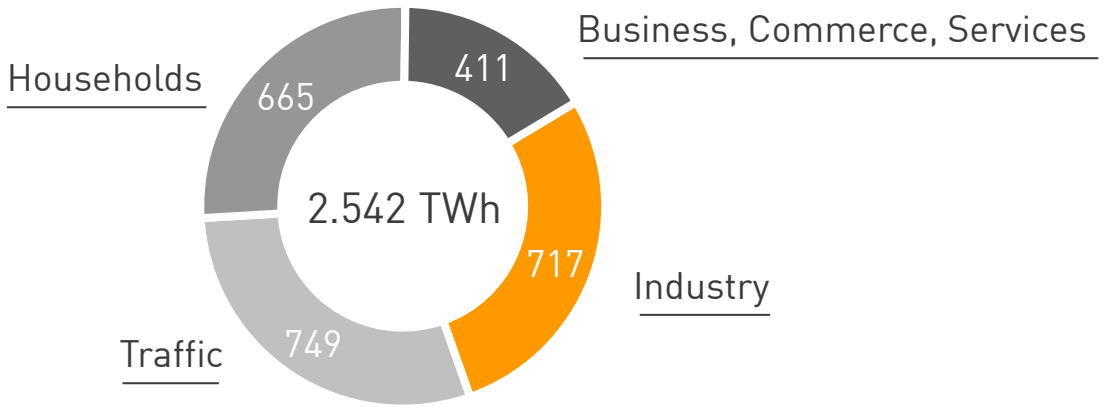
PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

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

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

The initial position:
The final energy consumption in Germany

final energy consumption 2016 [TWh/a]



› **Has to be CO_2-free! But how?**

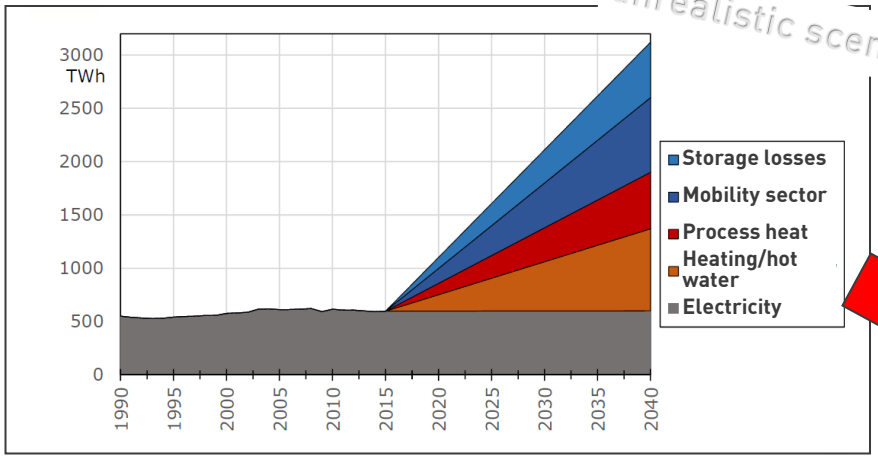
Source: AG Energiebilanzen, own representation

The deep impact:
Sector coupling significantly increases demand for electricity

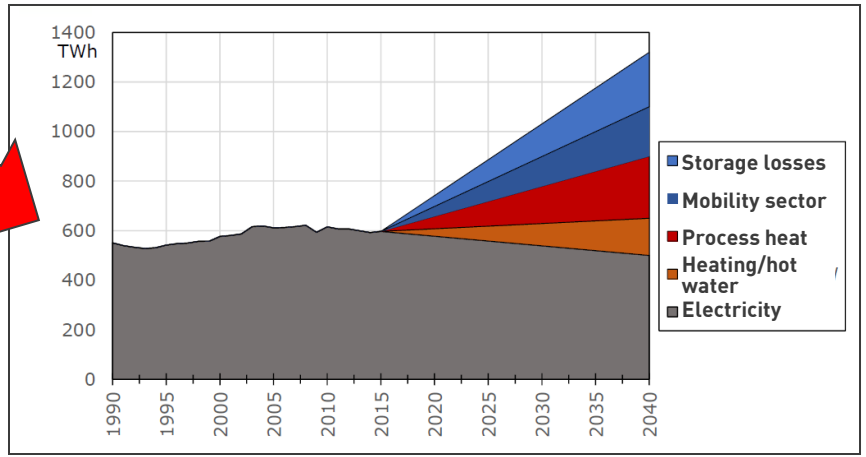
100 %-proportion of electricity in Germany means:

- 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

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

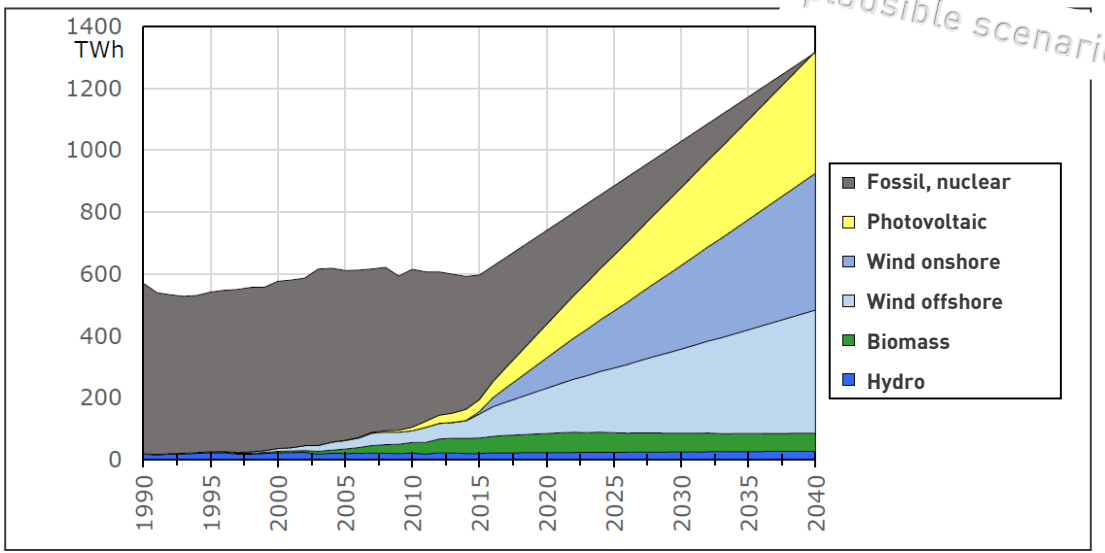
This means:

- 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

First thesis

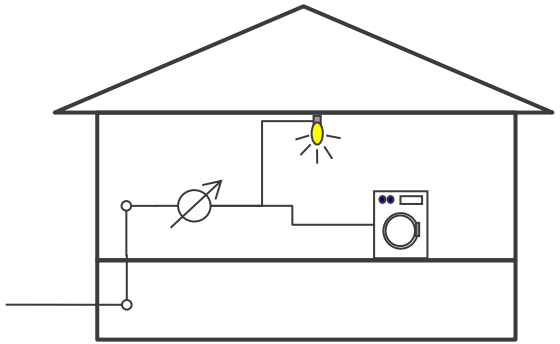
› The current market framework does not match new capacities

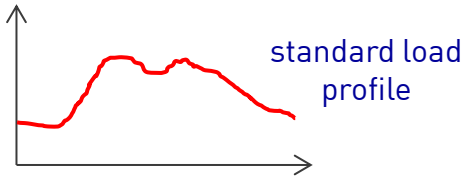
The customer role: initial position in households

Initial behaviour:

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

No flexibility



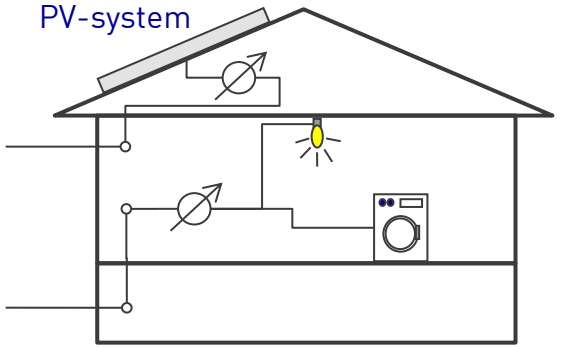


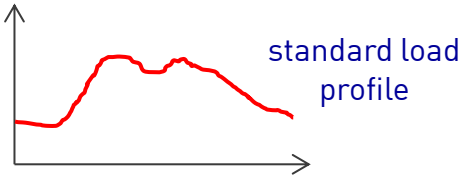
The customer role: step one in households

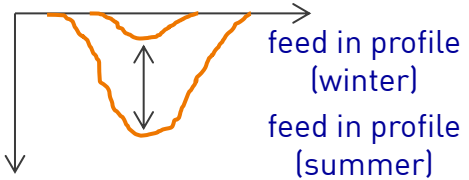
Initial behaviour:

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

no flexibility







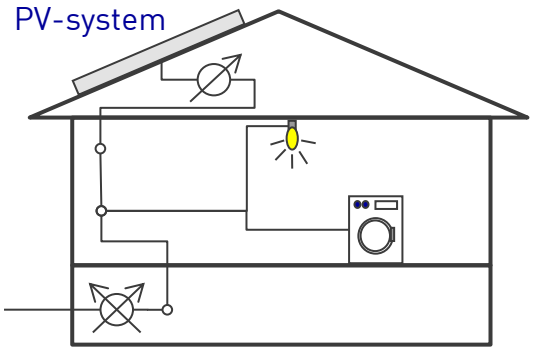
feed in load profile with daily and seasonal variety

The customer role: step two in households

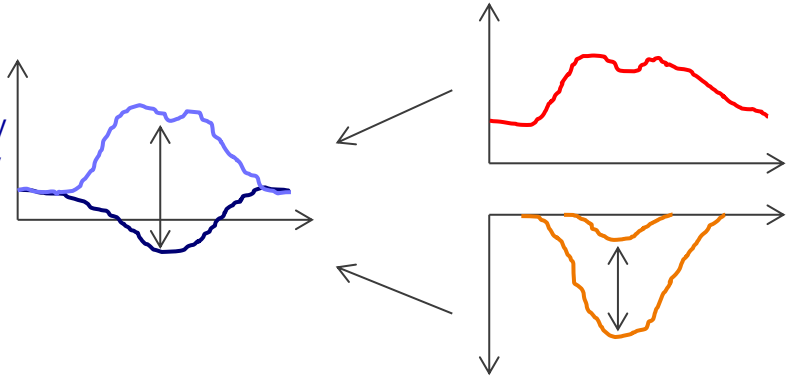
Adapted behaviour:

- 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

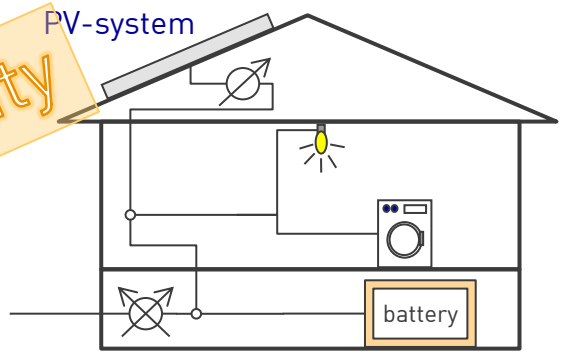


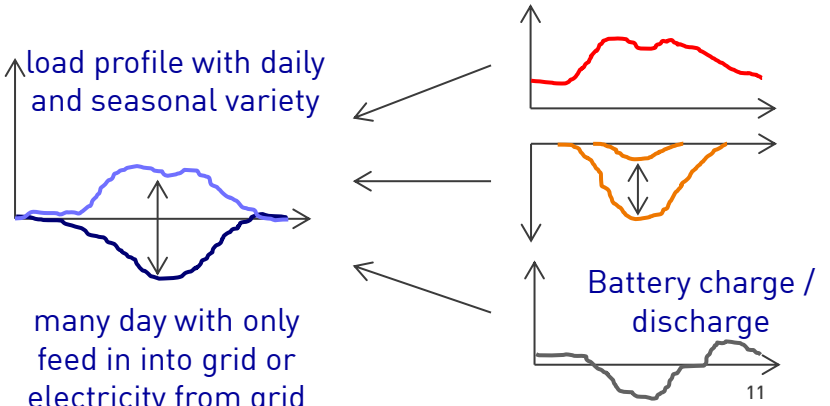
The customer role: step three in households

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



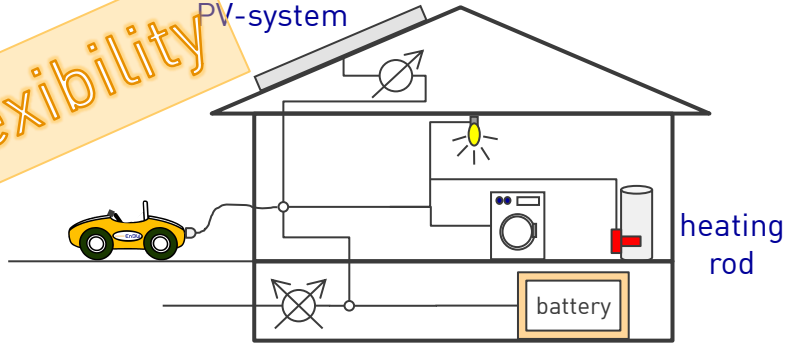


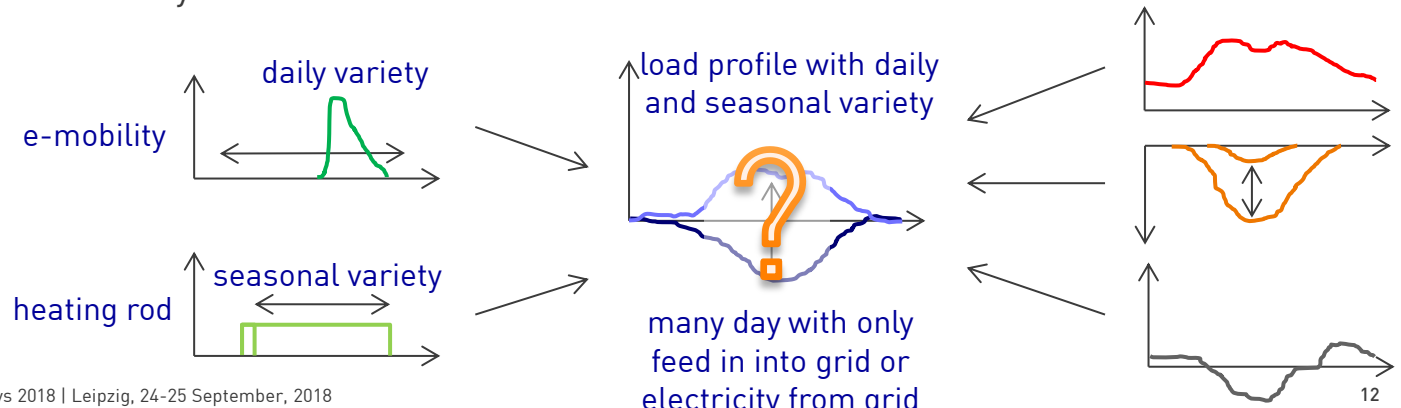
The customer role: step four in households

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

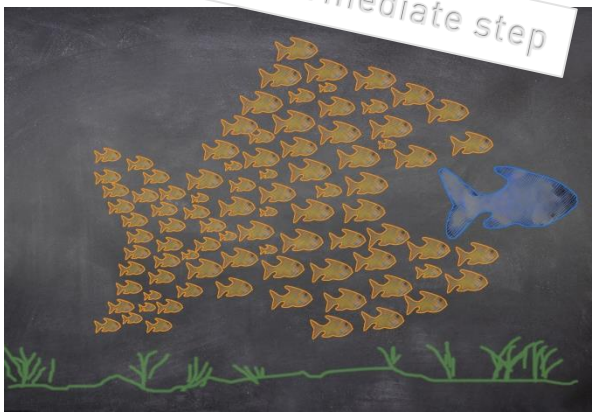
potential of flexibility





The customers role: The local shift load potentials

Three examples of local flexibility and load management potentials:

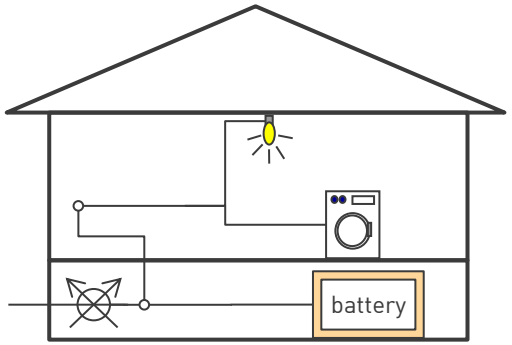


- (Small scale) stationary battery systems
  - Assumption: 50 % of the residential buildings (10 m) with battery system (aver. capacity of 10 kW)
  - **Additional capacity of 100 GW**
- (Small scale) moveable battery storage (e-mobility)
  - Assumption: 50 % as e-vehicles (25 m) with aver. charge capacity 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**

The new customer – a visionary outlook (1/2)

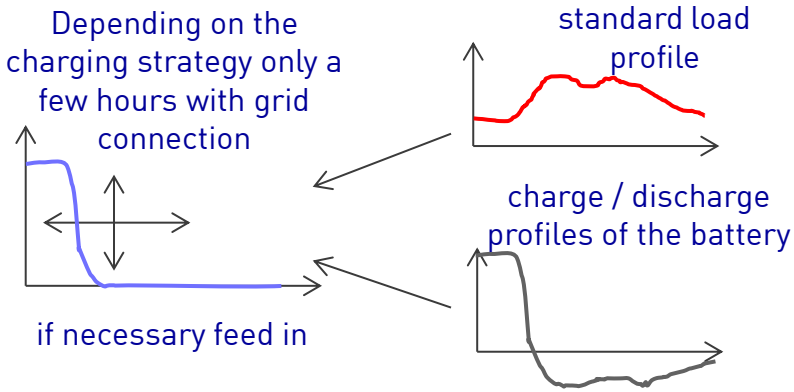
Description of a customer with battery storage:

- Average energy demand of 10 kWh/a (3,650 kWh/a)
- Stand-alone battery storage with 40 kWh storage capacity and at least 20 kW power
- 10 % rolling losses (365 kWh/a)



In the extreme case, this means at the grid transfer point:

- Only every three days a grid connection of 2 h with a power of about 20 kW necessary to provide the customer with energy or recharge the battery storage
- Customer has a flexibility potential of up to 72 h
- This customer still requires a maximum of 245 h/a of grid connection - that would be just 2.8 % of the hours of a year



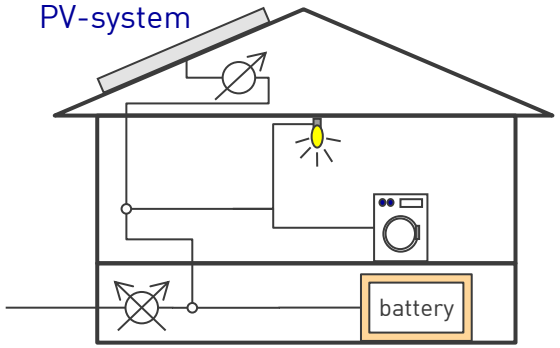
The new customer – a visionary outlook (2/2)

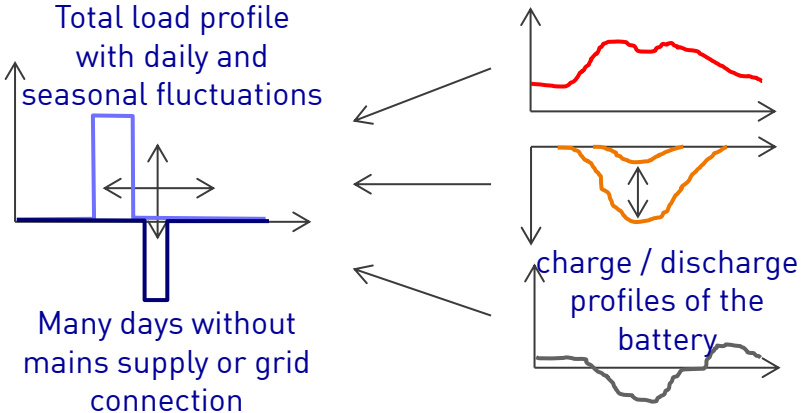
A customer with battery storage and a PV-system:

- Average energy demand of 10 kWh/a (3,650 kWh/a)
- 10 kW_{peak} PV-system with 10,000 kWh/a generation and a maximum daily generation of 65 kWh
- Stand-alone battery storage with 40 kWh storage capacity and at least 20 kW power

In the extreme case, this means at the grid transfer point:

- Only a maximum daily power supply of about 2.5 h with about 20 kW is necessary for power purchase and feed in
  - when generating >40 kWh/d, a (partial) grid feed-in at PV production times is necessary
- This customer still requires a maximum of 915 h/a of grid connection - that would be just 10.5 % of the yearly hours
  - probably only half the time, assuming that there are less than 180 sunny days per year





Second thesis

- **The customer - the big unknown and above all, the current market framework does not fit with this new behavior of customers**

Another aspect of sector coupling – The P2G 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

- improved P2G technologies available
- 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

Third thesis

Let us use the gas grid for the long distance transport of green gas, but the current market framework does not fit with P2G

Initial position: The current market design

Description of the current market design:

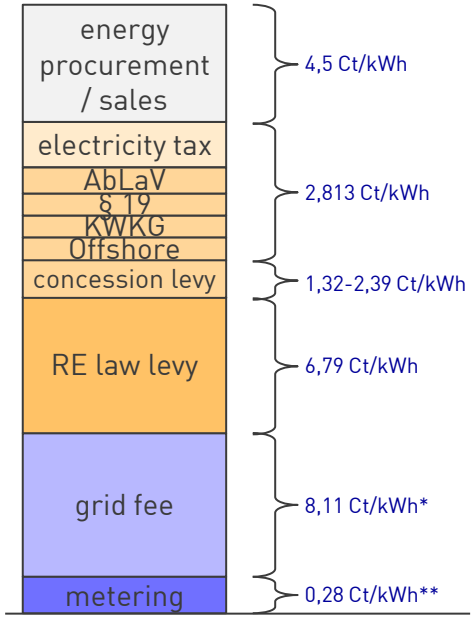
- Stocked market prices only based on kWh
- Levies only based on kWh
- Grid fee mainly based on kWh or kW
- Tariffs mainly based on kWh
- Tariffs only based on static pricing models

But

- generation of wind and PV nearly without marginal costs
- grid costs nearly without marginal costs

Conclusion

- the current market design is not future proof



Example consideration for a basic supply tariff:

- Customer with 3,500 kWh/a
- Acceptance for energy procurement and sales 45 € / MWh
- Values 2018
- Total (net)
  - 833,48 – 870,93 €/a
  - 23,81 – 24,88 Ct/kWh
  - flat rate share: 37,80 €/a or 4,3- 4,5 % proportion of total costs

State-induced levies

- 10,923 – 11,993 Ct/kWh (plus VAT)
- About twice the price compared to the gas price!!

* Netze BW, basic fee 28 €/a; energy price 7,31 Ct/kWh
** tariff meter without converter version; 9,80 €/a Netze BW

Analysis of the state levy issue problem

The state levy issue problem

- About 50 % share of the total costs
  → way too much
- Static pricing model regarding the state levies from the customer's point of view
  → no "real" incentives for RE or CO_2-free electricity use even with a stock market price of zero
- Electricity too heavily burdened with levy charges compared to gas and fuel oil
  → no level playing field between electricity, natural gas and fuel oil, and so no sector coupling

Additional basic aspects

- Static kWh-based tariff structures in contrast to the "marginal cost-free" generation from wind and PV
  → no incentives for load management regarding the fluctuated generation of Wind and PV
  → problem with the state levies no longer up to date
- The grid fee structure with kWh- and kW-based rates
  → no incentives for a grid friendly behaviour

Five Approaches to a new market design

If we really want the sector coupling we need a level playing field electricity, gas and fuel oil:

1. Less state levies for electricity and more for heating and the transportation sector
   → e. g. a staggered CO_2 tax that charges electricity, natural gas and oil differently
2. Conversion of the EEG- and KWKG-surcharges and other levies into a CO_2-based energy transition fee for all energy sources and the transportation sector
   → this creates a level playing field
3. New grid fees with less kWh- and kW-based rates
   → Connection capacity based grid fees at the grid transfer point
   → Consideration of a grid friendly behaviour (§ 14a regulation)
4. Enable new tariff structures regarding the "marginal cost-free" generation from wind and PV
   → e. g. with flat rates as in the telecommunications sector in combination with load management
5. Avoid hardship cases through intelligent market design
   → e. g. apartment building with a capacity based grid fee at the grid transfer point

Conclusion

- **The German “Energiewende” is the first step to the sector coupling…**

  … but now, we do really need a new market design to reach the decarbonisation

Once upon a time (part 2)...

... a summer in Germany 2018

› **Let's finally do something against the climate change!**

Source: http://www.spiegel.de/fotostrecke/cartoon-des-tages-fotostrecke-142907.html

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