SMART ENERGY SYSTEMS 2019

System friendly operation of sector coupling devices:

between welfare requirements and business reality

Max Fette
Copenhagen, 10/09/2019

Outline

- **background**
  - research project Multi-Sector-Coupling, MuSeKo
  - energy system model MuGriFlex
- **model coupling**
- **exemplary preliminary results**

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background: research project MuSeKo

Multi Sector Coupling

(MuSeKo 2013- 19)

- In cooperation with:

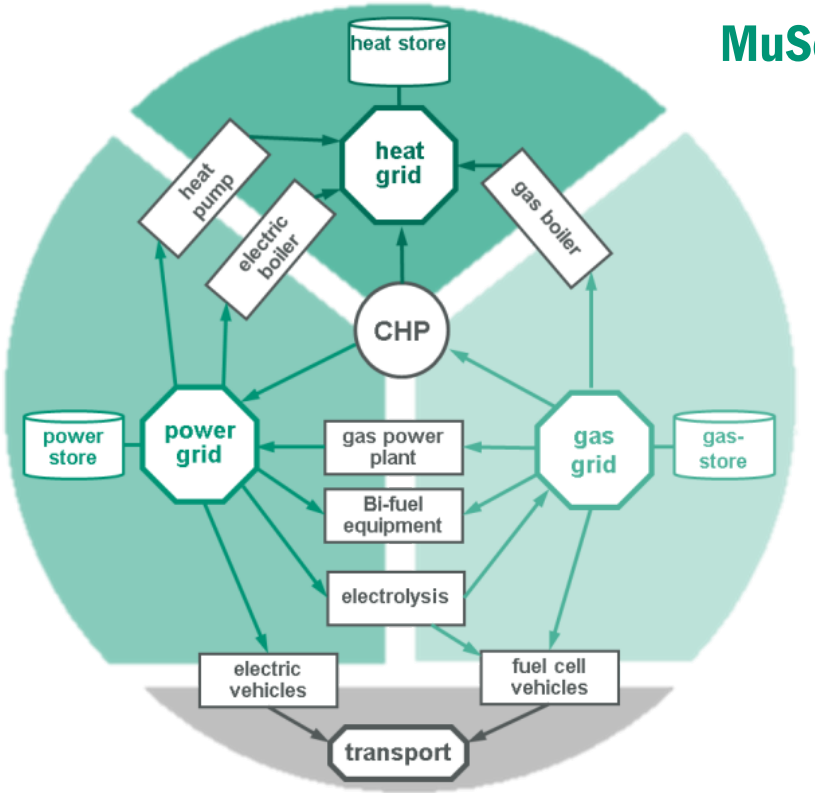
DLR

gwi Gas- und Wärme-Institut Essen e.V.

Funded by

Federal Ministry for Economic Affairs and Energy

pursuant to a resolution of the German Bundestag



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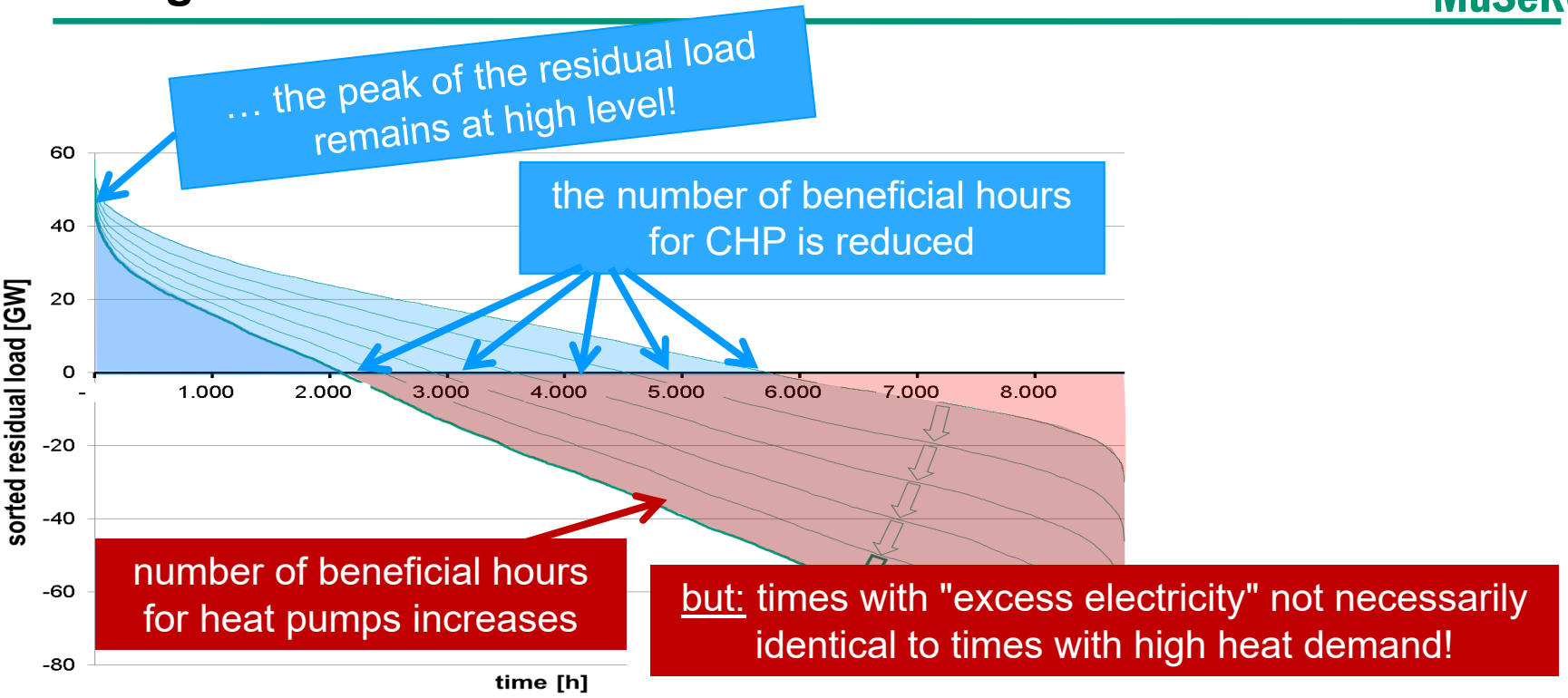
background: residual load



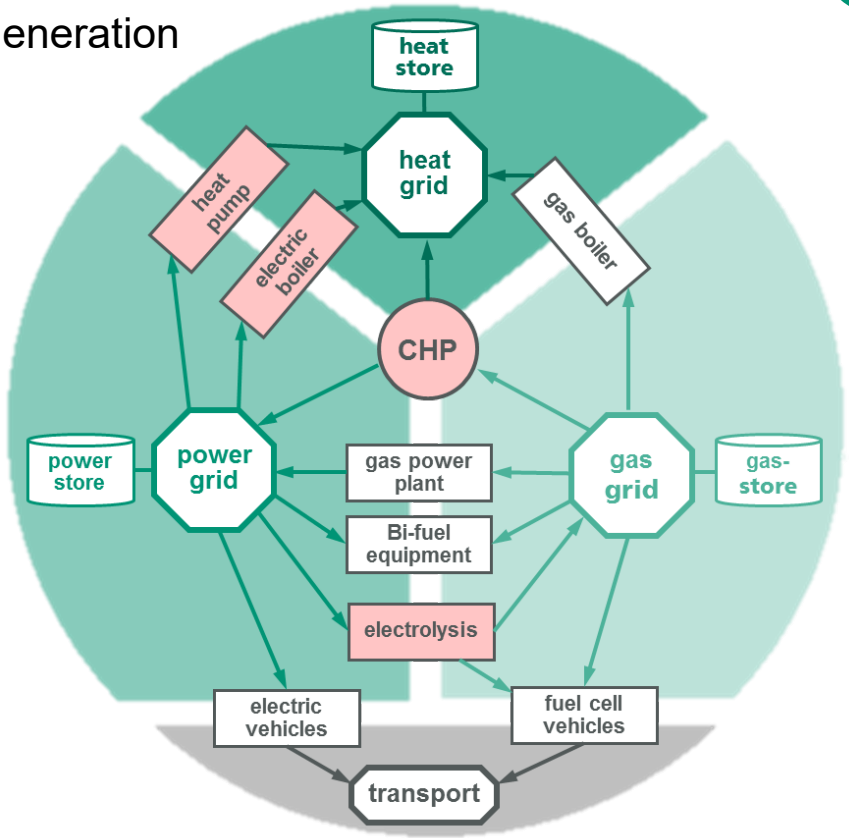
source: b.kwk short study Fraunhofer IFAM "The role of CHP in the energy system transformation"

background: flexibility

Flexibility is the **ability to adapt** electricity generation and consumption to maintain system stability.

- technical ability given by several elements such as CHP, P2H and P2G
- institutional ability in a decentralized and liberalized system achieved via regulation and market rules

➢ do elements that can adapt have incentives to do so?



modeling in MuGriFlex - example: heat supply

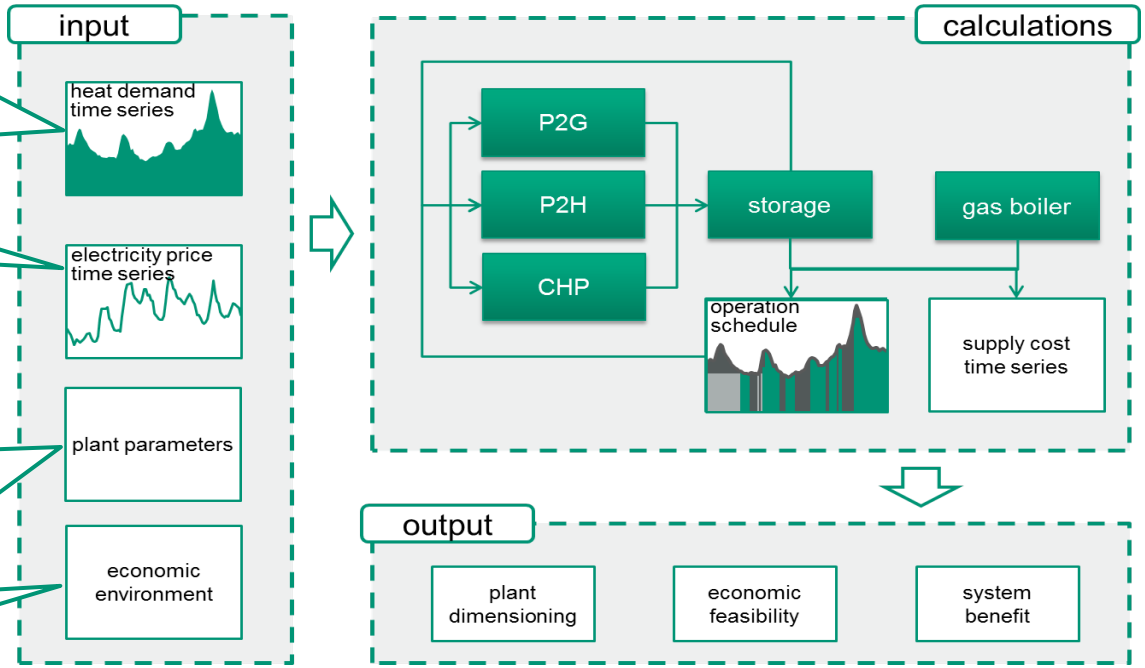
hourly simulation of the heat generators over one year on the basis of varying electricity prices and heat demand profile

Outdoor temperature
→ temperature dependency of HP and solar collectors)
Solar radiation

spot market
energy balancing markets

technical (performance, efficiencies, etc.)
economical (investment, operating costs)

charges, levies, surcharges, taxes etc.



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model coupling: procedure

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REMix (DLR):

- Modeling of plant dimensioning and plant deployment.
  Aim: macro economic optimum
- Europe-wide, aggregated in regions
- Determination of marginal costs (electricity)

MuGriFlex (Fraunhofer IFAM):

- Dispatch planning using these marginal costs and the system parameters determined in REMix:
  - Use of REMix gas and CO_2 costs
    ➔ marginal electricity costs in many hours of the year lower than gas costs
  - additional consideration (of current framework conditions such as levies on electricity procurement and CHP-feed-in-tariff)

model coupling: procedure

- Comparison: Plant design under commercial conditions
- Comparison: Plant operation under commercial conditions

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model coupling: first results

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REMix:

- Sizing of sector coupling technology (preliminary data)
  - REMix technology “small district heating with CHP".
  - one typical region in Germany, projection 2050
  - total heat demand of all these "systems“ in that region: 12.1 TWh/a, year

factor $\frac{\text{capacity}}{\text{peak load}}$

CHP	HP	E-boiler	gas boiler	heat store
1.24	0.49	0.26	0.004	6.1h Peak Demand

MuGriFlex:

- scaled down to a typical heat network with this technology
- total heat demand: 70 GWh/a, peak load: 22 MWth

27.2 MW_{th}	10.7 MW_{th}	5.7 MW_{th}	0.1 MW_{th}	134 MWh

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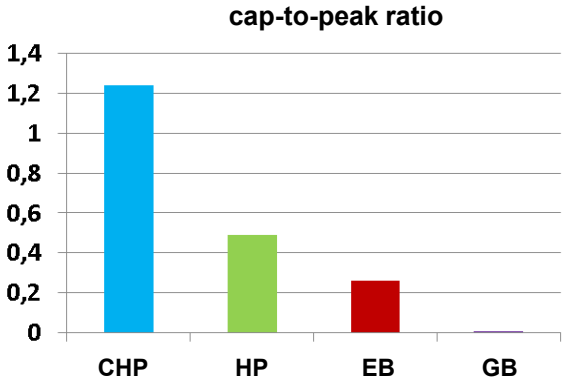
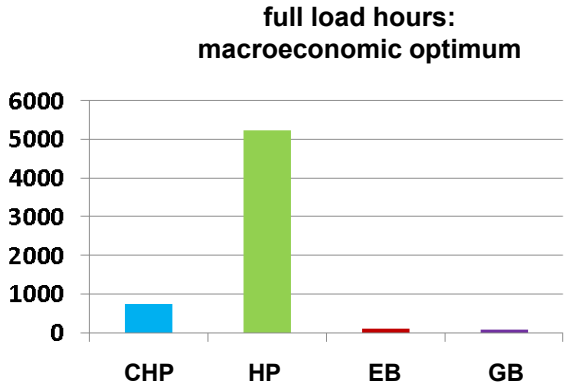
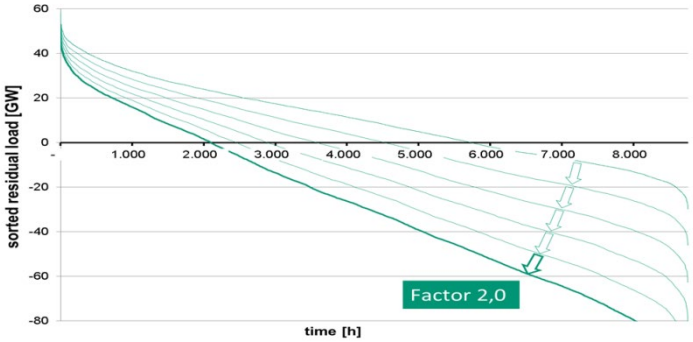
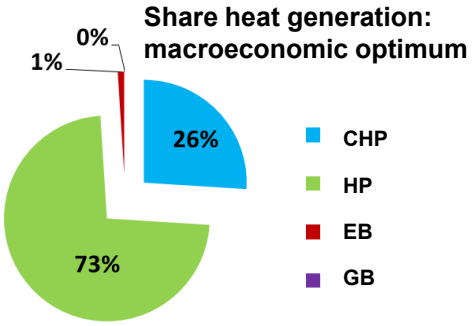
macro economic optimisation

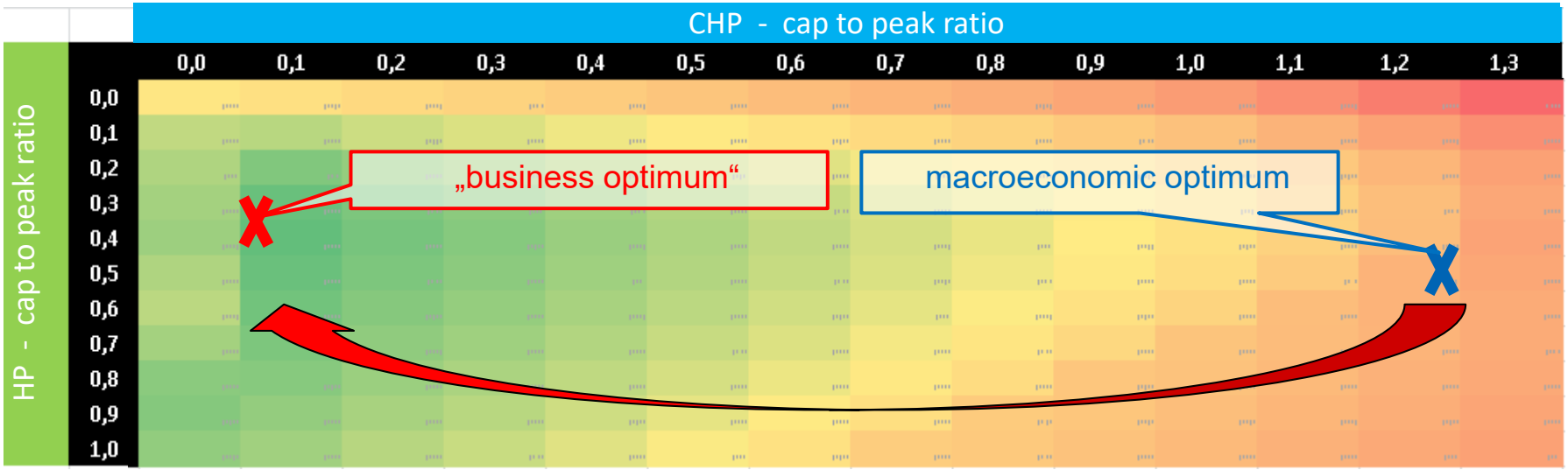








plant sizing macro economic vs. business optimum



- C2P-ratio of **heat pump** „drops“ from 0.49 to 0.35
- C2P-ratio of **CHP** „drops“ from 1.24 to 0.06!

can the business case be brought in line with macro-economic 0ptimum?
1: variation of CHP feed-in-tariff

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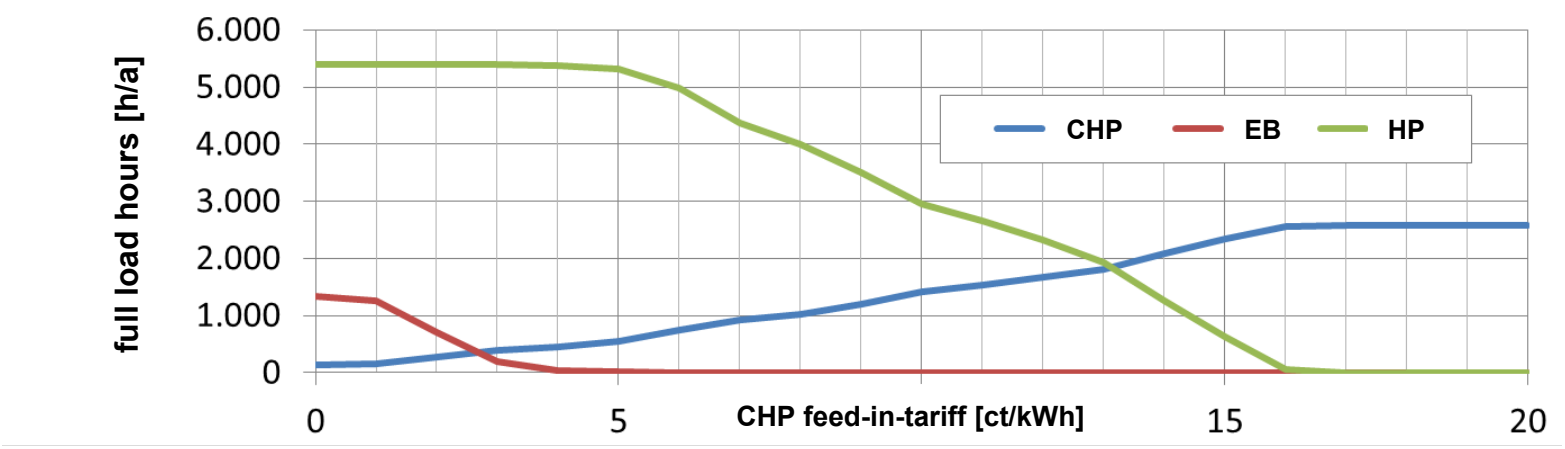

can the business case be brought in line with macro-economic optimum? 2: variation of surcharges on electricity (HP and EB)

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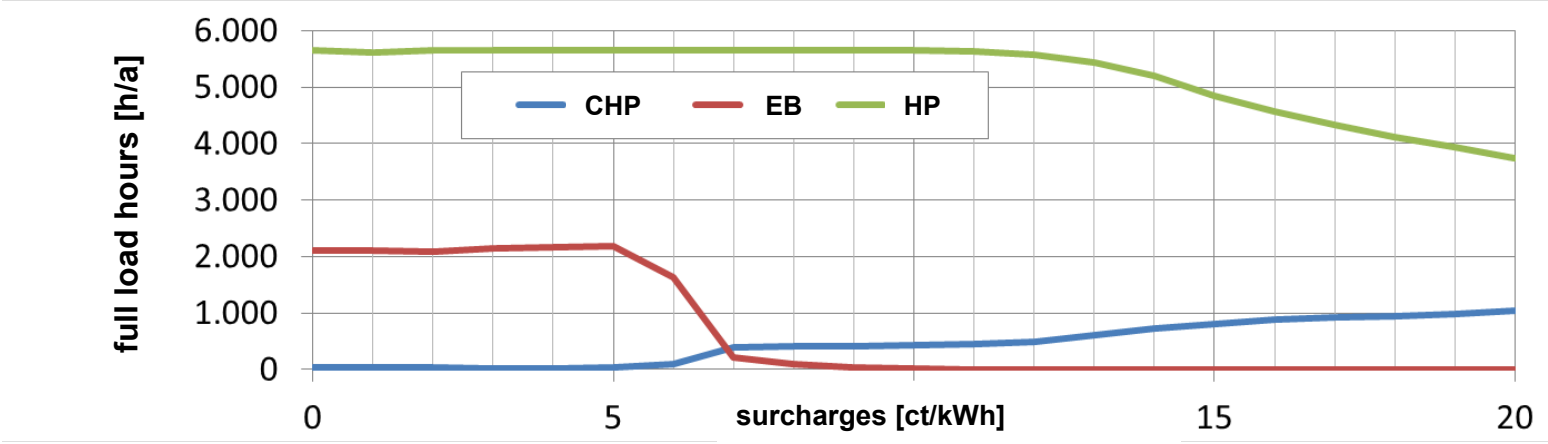

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can the business case be brought in line with macro-economic optimum?
3: variable surcharges on electricity (HP and EB) (1/2)

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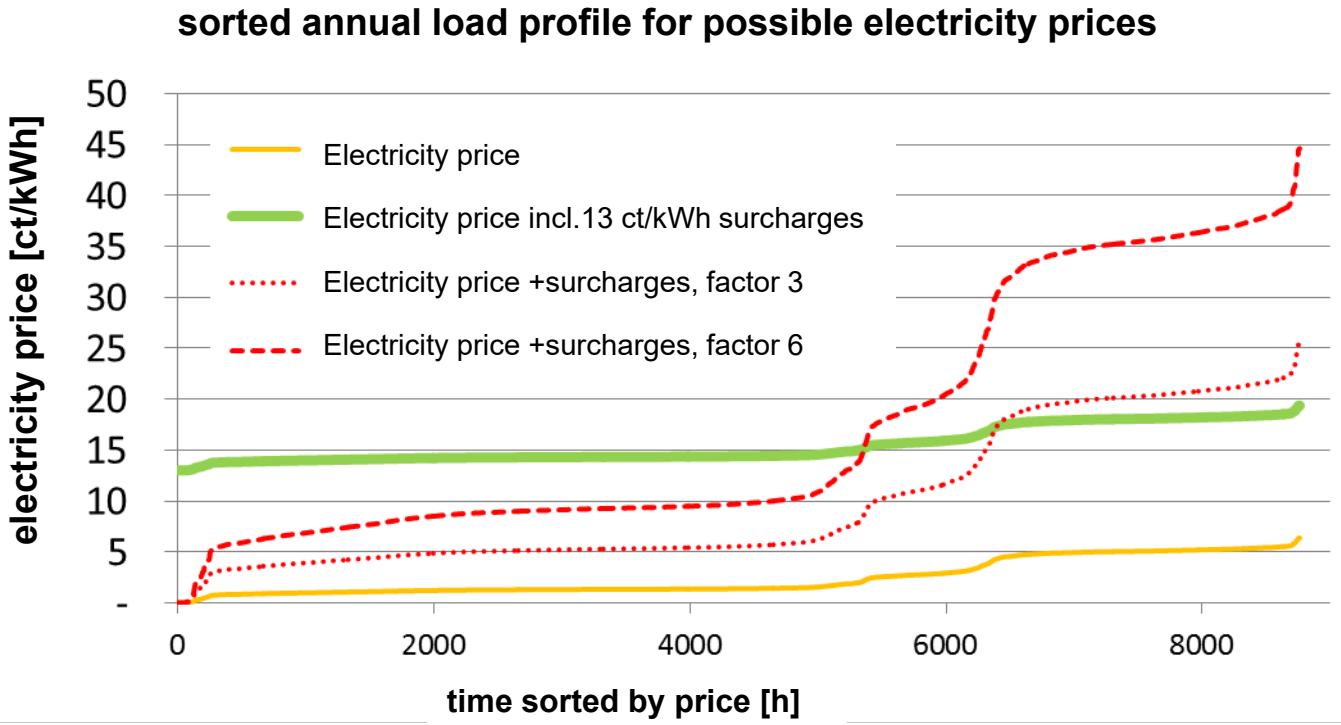

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can the business case be brought in line with macro-economic optimum?
3: variable surcharges on current (HP and EB) (2/2)

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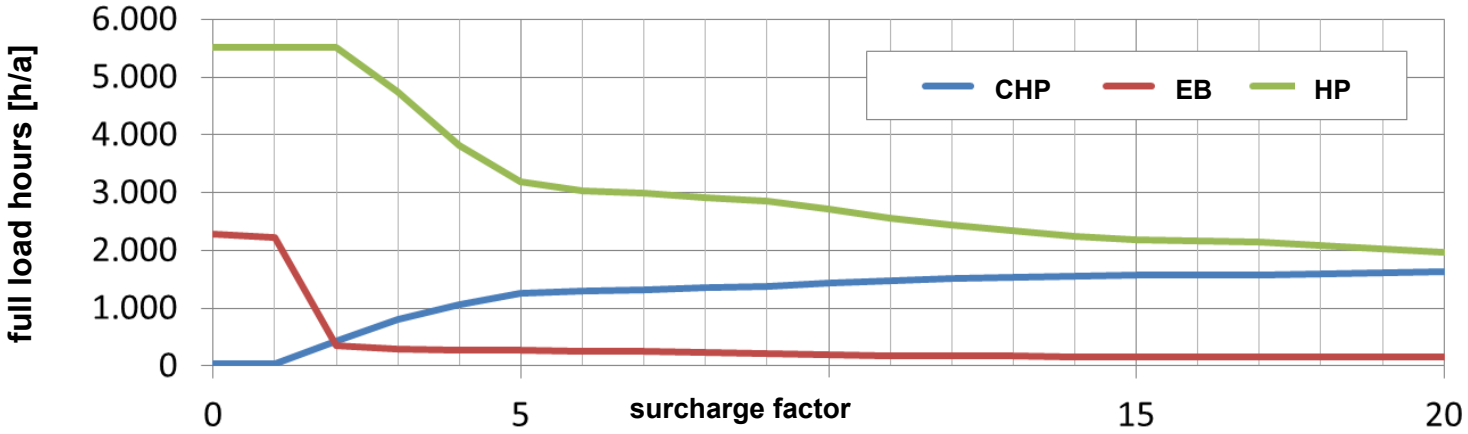

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Summary

- the optimum configuration and operating mode of
  - CHP plants
  - heat pumps and electric boilers

  strongly depends on whether the optimisation is based on macroeconomic or business aspects

- the future framework conditions have a decisive influence on achieving targets

- without adjustments to the framework conditions, operation and investment will not be possible in the future according to economically reasonable criteria

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Tak for din opmærksomhed!

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