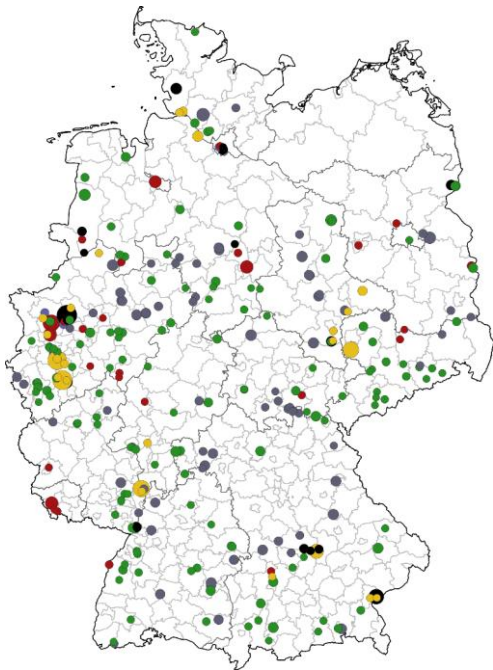

FUTURE SYNERGIES OF INDUSTRIAL EXCESS HEAT POTENTIALS AND BUILDINGS' ENERGY DEMAND IN GERMANY



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Pia Manz
Fraunhofer Institute for Systems and Innovation Research (ISI)
Energy Technology and Energy Systems

Email: pia.manz@isi.fraunhofer.de

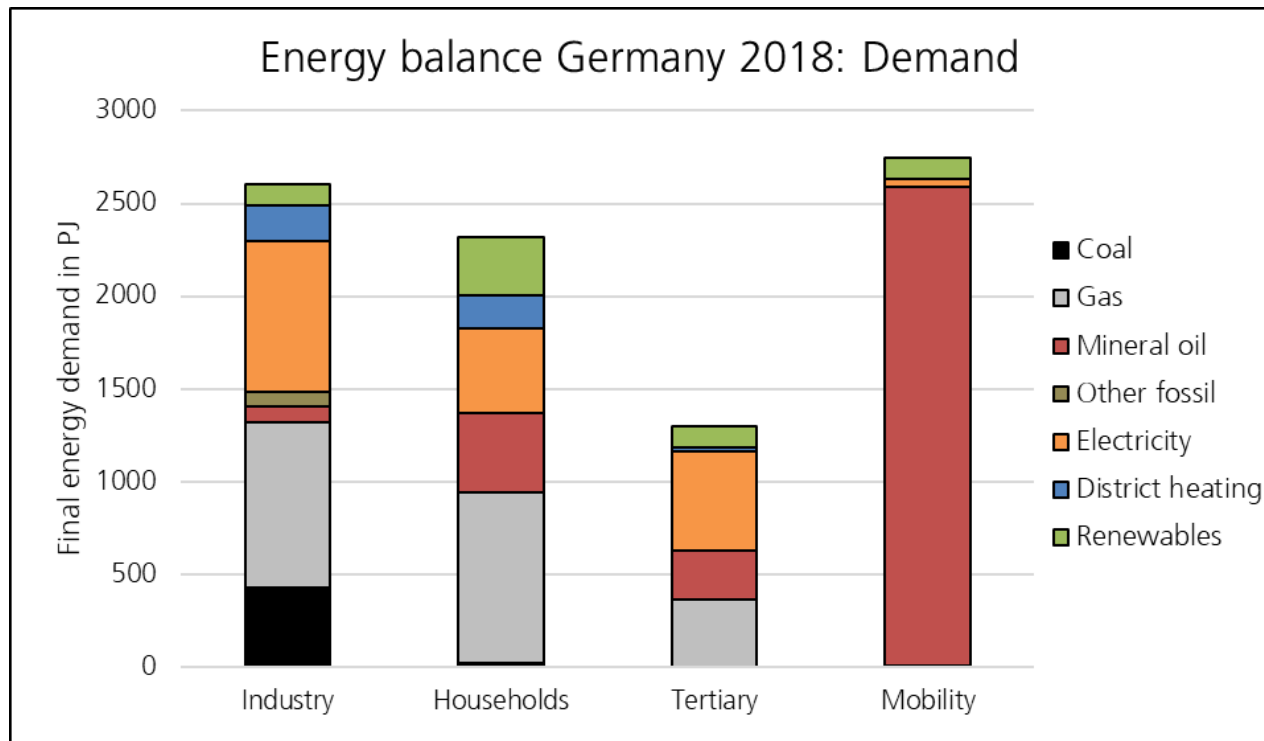


Outline

1. Motivation
2. Methodology
3. Results
4. Conclusions

Transformation of energy system: towards net-neutrality

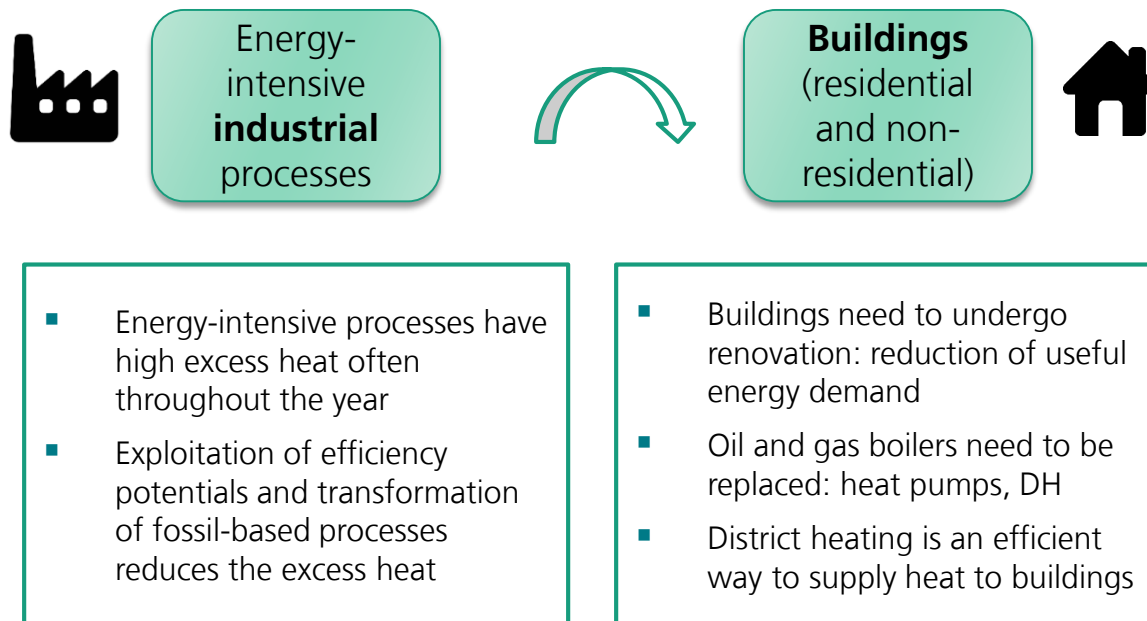
- Fossil energy carriers like **coal**, **gas** and **oil** dominate final energy demand (67%)
- **Electricity** and **district heating** need to be based on renewables
- Massive **increase** of electricity demand and synthetic gases to be expected in 2050



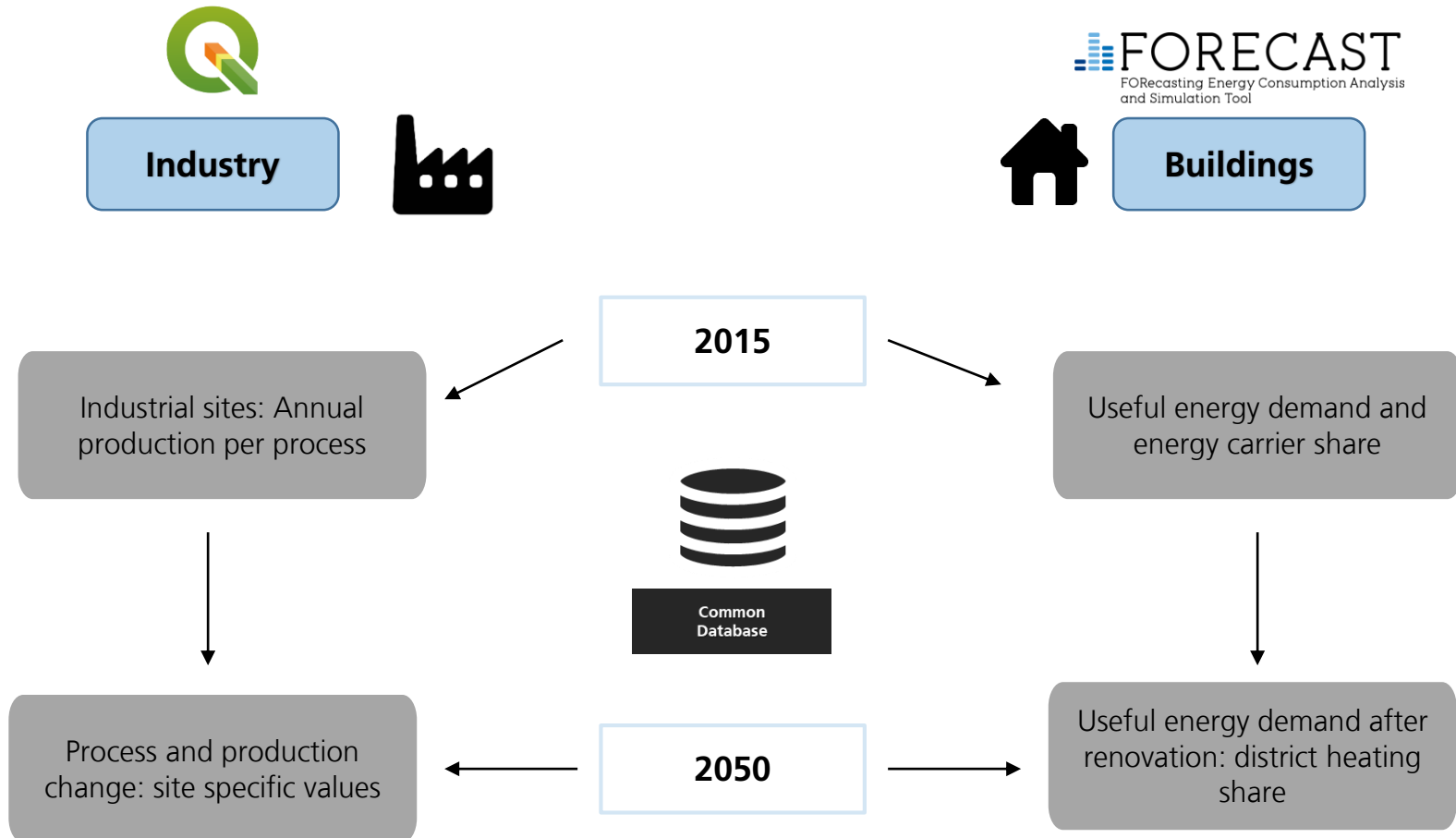
Motivation

Transformation will change final energy demand structurally

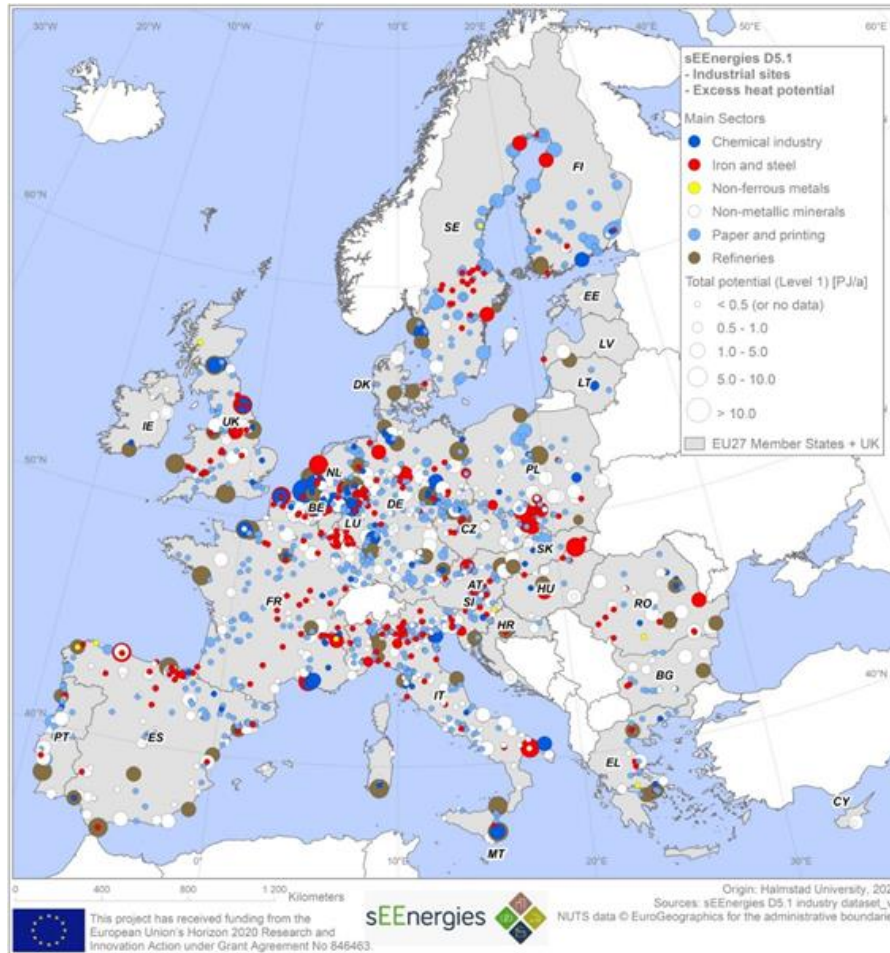
What are the future synergies of industry and buildings energy demand?



Energy demand for Industry and Buildings is modeled in scenarios



Allocation of industrial sites enables excess heat analysis

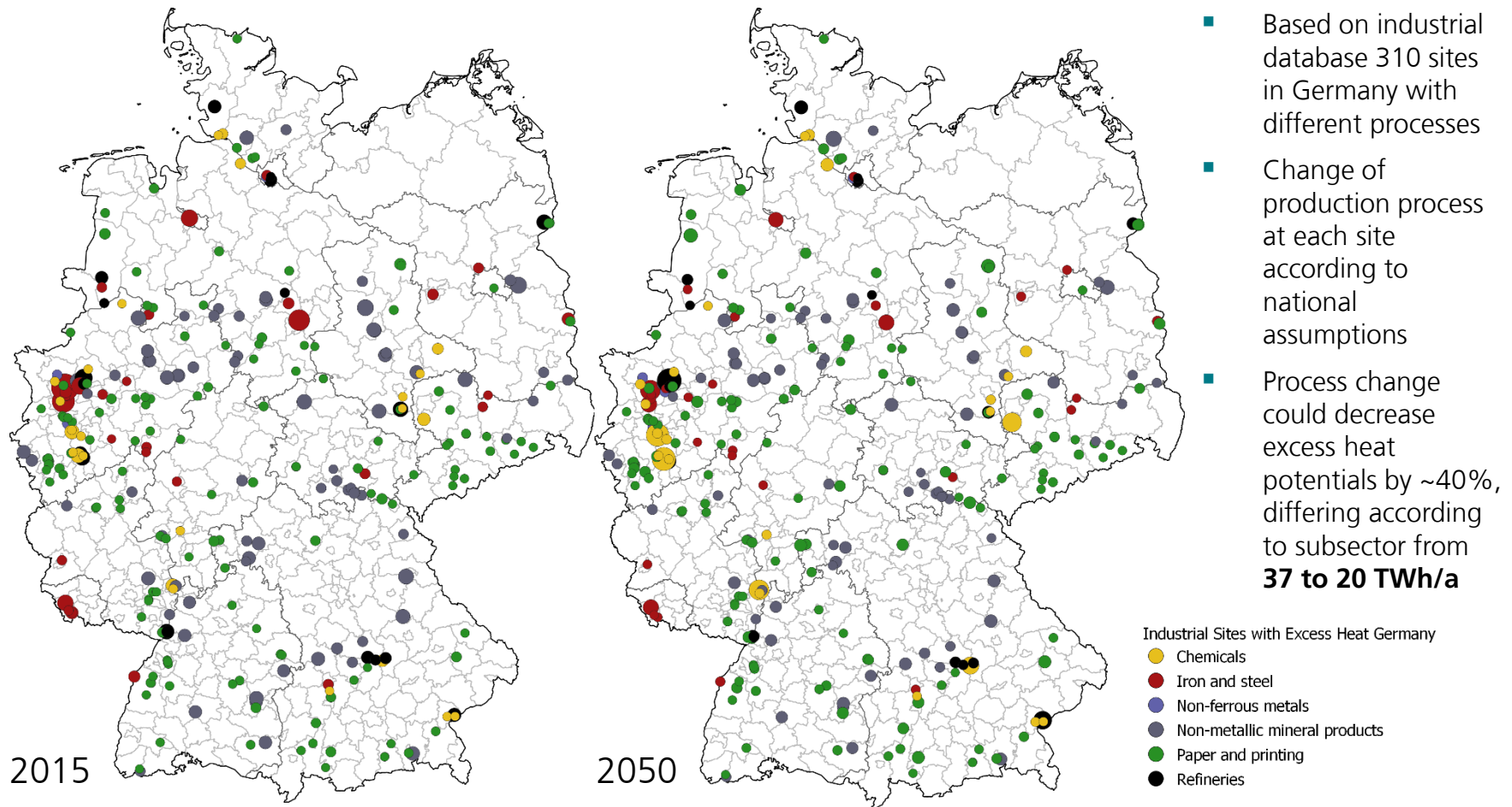


- Process-based estimation of excess heat based on today's processes
- Matched with current and future district heating systems (available as open-data)
- In total, 42 TWh are available in EU 28 currently for district heating
- In future, 189 TWh could be available: 4th generation district heating systems and extension of grids

Situation in 2050: Decarbonisation of industry

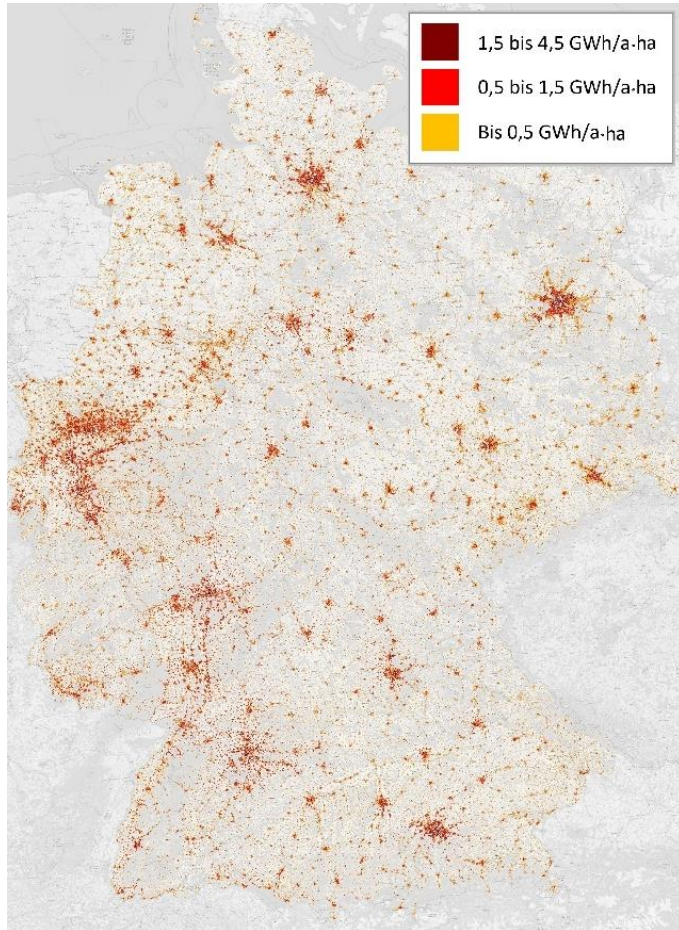
- Future processes: Electricity- and hydrogen based steel production with lower temperature
- Chemicals (ammonia, ethylene) and refineries: no steam cracking of natural gas
- Furnaces in cement and glass production based on electricity or hydrogen

Excess heat potentials for Germany will change until 2050



Results

Regional useful energy demand of buildings for heating will decrease until 2050



- Building structure on hectare level for different age classes¹
- Coupling with national results on useful energy demand possible
- Results show that city centers have a high share of old buildings with refurbishment needs
- Data about refurbishment not available locally, national: up to 1.8%
- Useful energy demand 2015: 567 TWh/a
- Useful energy demand 2050: 375 TWh/a
- DH market share ~40%: Industrial excess heat could contribute about **12%** of final energy demand for DH (potential today: 7% in Germany)

¹ Available as open data from <https://gitlab.com/hotmaps>

Modelling of excess heat utilisation necessitates scenario-based approach

- In Germany, almost all industrial sites are located nearby district heating infrastructure
- Future transformation:
 - decreases both excess heat (esp. for steel) and useful energy demand of buildings
 - low-temperature DH can increase excess heat utilization (e.g. for paper industry)
- Innovative processes: yet very unclear, hydrogen production sites (excess heat) not clear
- Potential synergies need to be assessed based on regional availability and cost structure