Heat Transformation Munich – Development of a systemic cost optimal heat supply transformation

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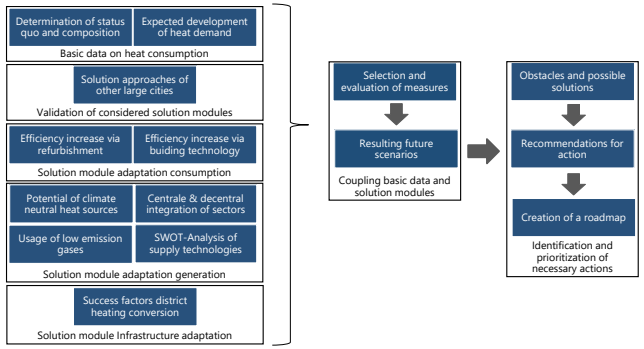
Thema

Project target of „Heat Transformation Munich“

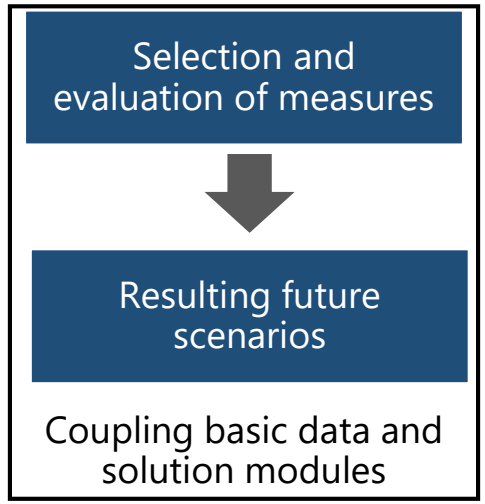
Aim of the study

- Development of a **long-term concept** to achieve climate neutrality by 2035
  - Only selection and investment in long-term **target-conform measures**
- Development of **ambitious and feasible transformation pathways** with effective CO_2 saving measures using transparent cost estimation
- Use of a **holistic view** on the topic of heat supply incl. analysis of obstacles
- Consideration of possible **instruments to overcome the barriers**

Overall research approach (see Paper & presentation Backup)



Focus of this presentation



Prioritization of measures according to CO_2 abatement costs – Methodology and Viewpoint

Aim of prioritization

- Select long-term most cost efficient measures for emission abatement

Formula for CO_2 abatement costs

$$k_{CO_2} = \frac{K_{Subst} - K_{Ref}}{E_{Ref} - E_{Subst}}$$

k_{CO_2}	= *CO_2-abatement cost in €/t CO_2*
K	= *Costs in €/a*
E	= *Emissions in €/a*
$Subst$	= *Substitution technology*
Ref	= *Reference technology -> Gas boiler*

Comparison of measures from viewpoint of municipal heating strategy development:

- Included: Energy price and taxes, CO_2 price, long-term expected subsidies by federal government
- Interest rate 2%
- Usage of technical lifetime
- Exclusion of VAT on investments and energy sources

Details available in paper: Sources for investment cost functions, maintenance costs; expected development of financial support by technology

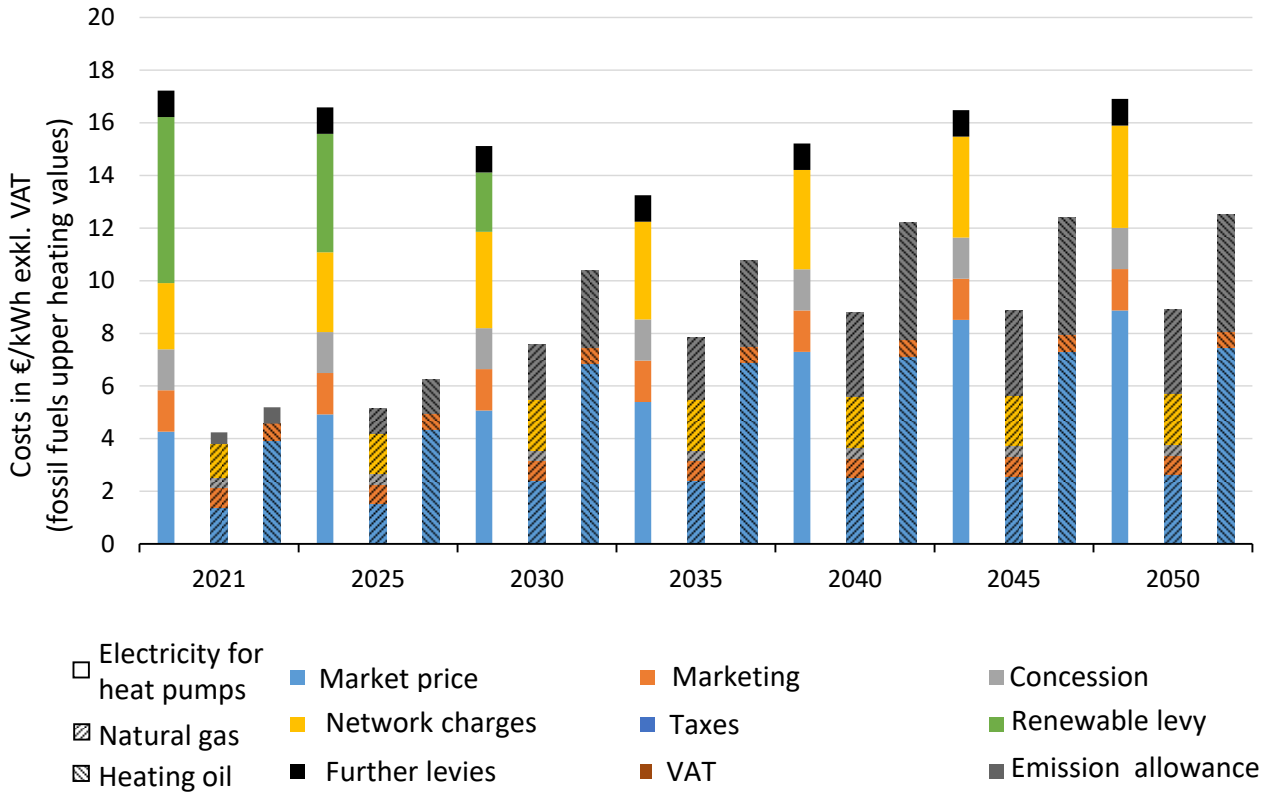
Regarded technologies and boundary conditions

Selected technologies

- Air heat pump
- Ground water heat pump
- District Heating
  a. Basic scenario – DH increase in connection rate area

+ Extended geothermal scenarios
  b. DH increase in connection rate area
  c. DH extension area

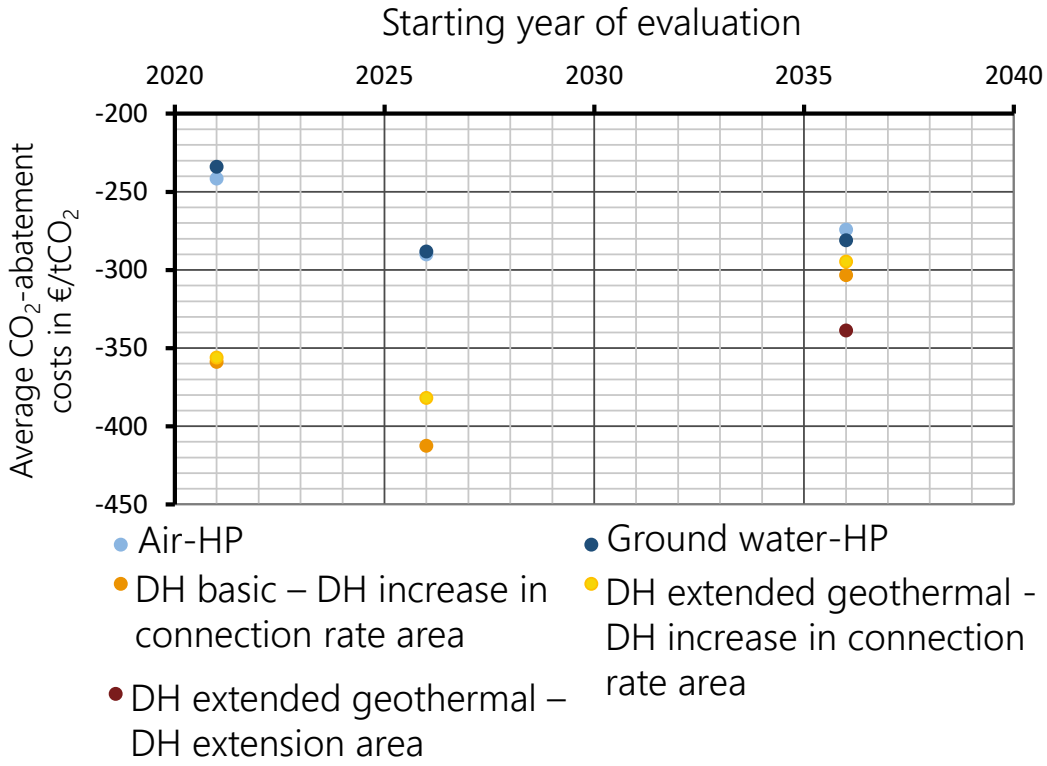
Development of fuel prices



Core results of CO_2-abatement costs

Results for medium sized **refurbished** buildings

➢ Average of abatement cost over 25 years



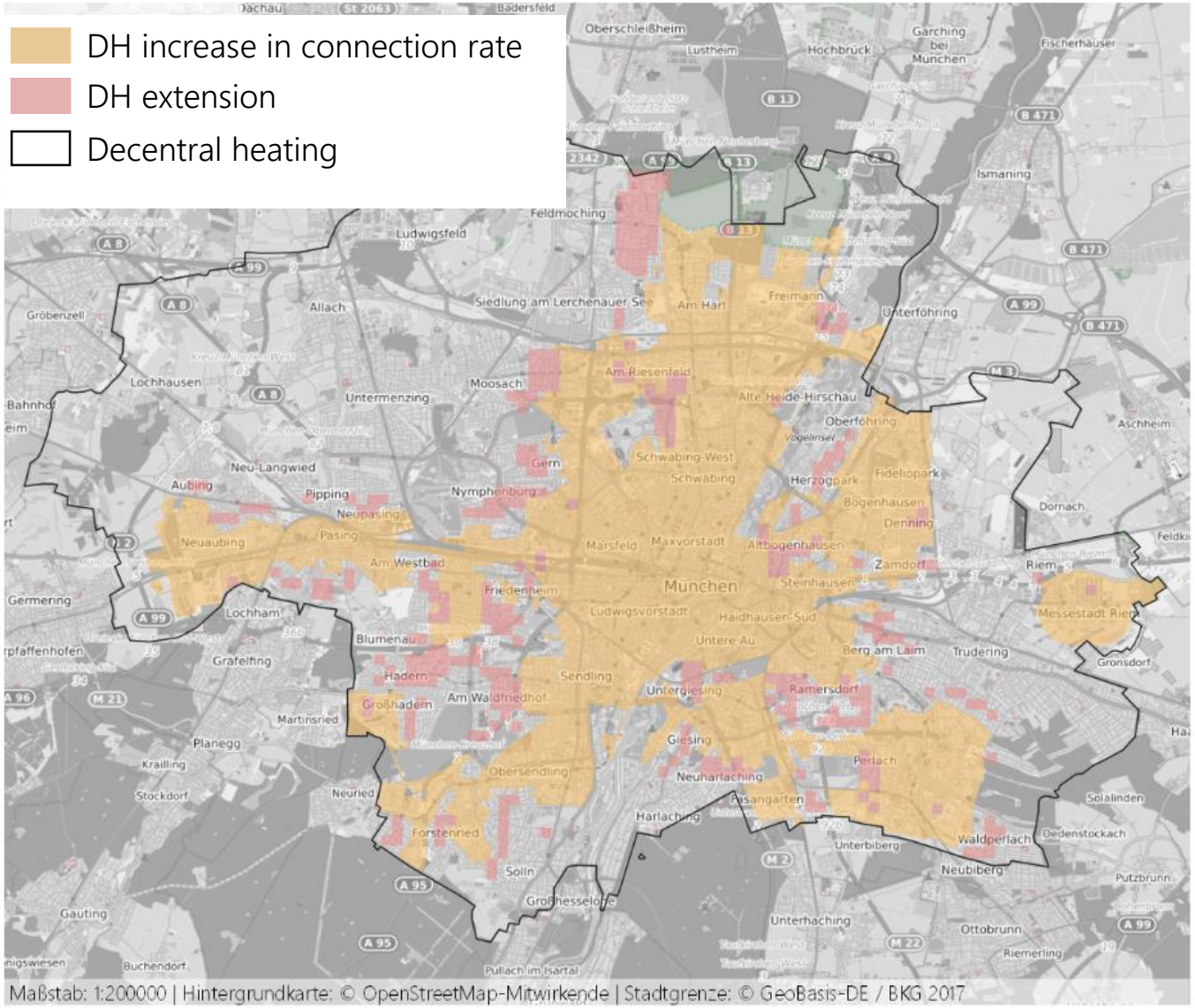
- All CO_2 **abatement costs** have **negative values**
  - CO_2-emissionen mitigation leads to cost reduction compared to r**eference technology (natural gas boiler**)
    - ➢ Favourable development of framework parameters (e.g. energy prices, interest rate, promotions)
- Prioritization varies depending on heat demand of individual consumers and their localization
  - ➢ For smaller buildings HP are favourable

Overview on simulation tool composition – regionalized simulation

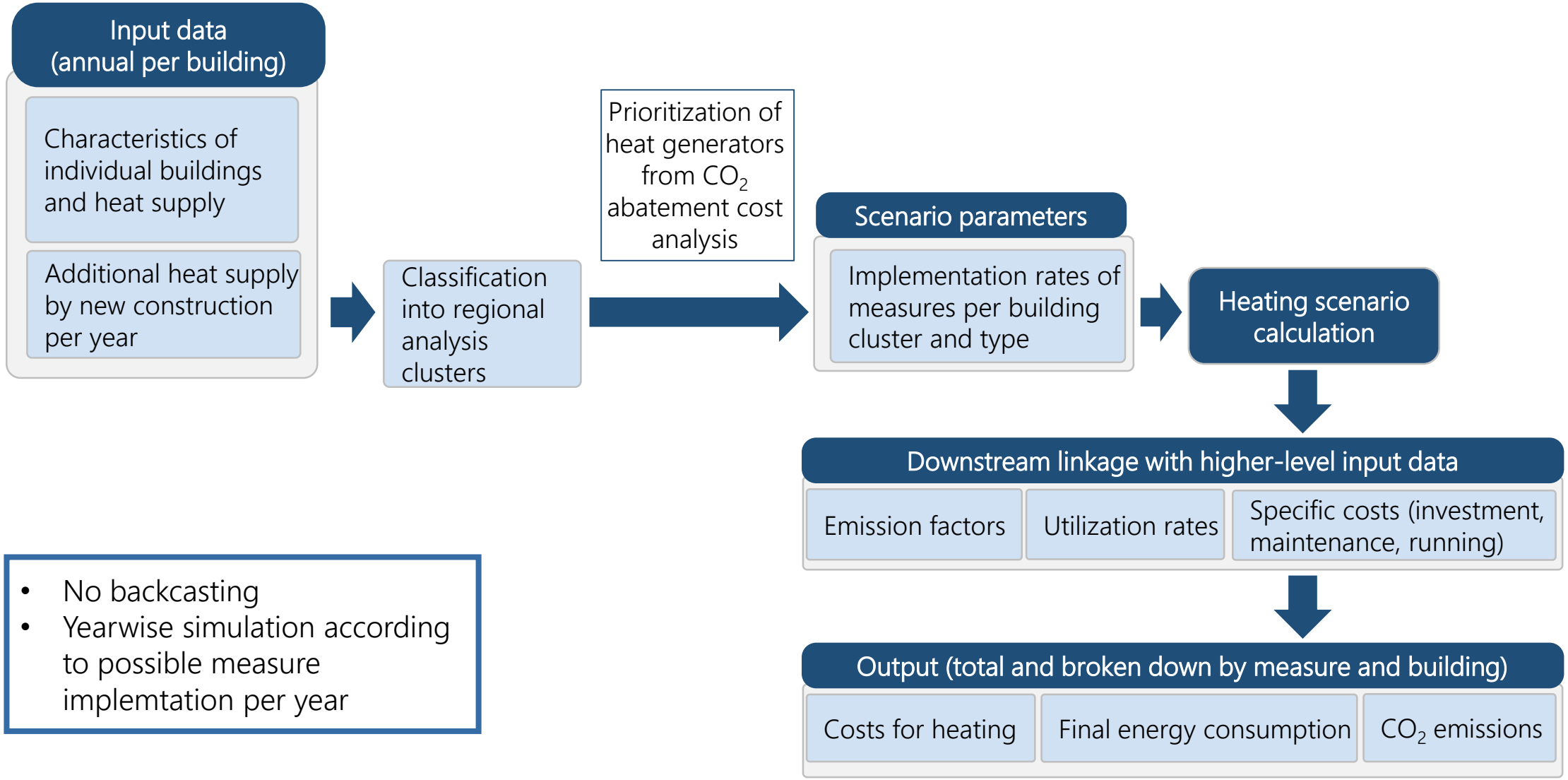
Input data (annual per building)

- Characteristics of individual buildings and heat supply
- Additional heat supply by new construction per year

→ Classification into regional analysis clusters →



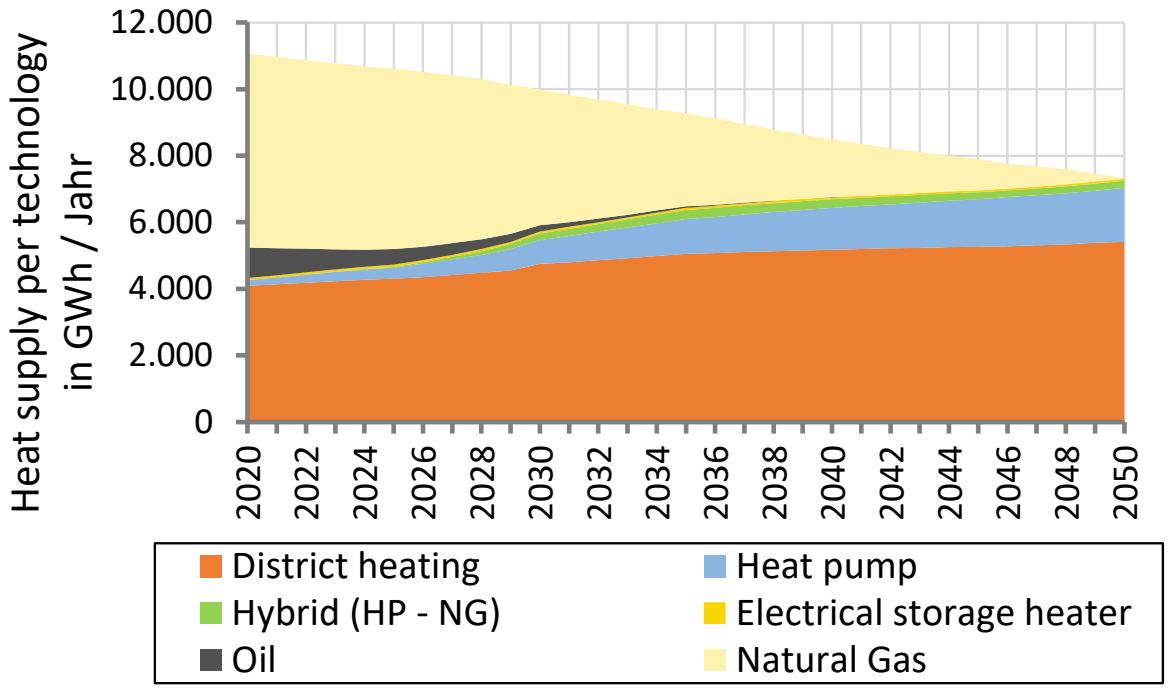
Overview on stepwise simulation approach



- No backcasting
- Yearwise simulation according to possible measure implemtation per year

Overview on munich-related results regarding heat supply composition

Results available per regional cluster



Simulation done for

- Two different scenarios
- One reference scenario

Additional individual simulation of

- District heating composition

Further analyses

- Effect on electric supply system
- Resulting costs
- Changes in costs per household

Most relevant results and outlook for Munich and research approach

Key findings

- **Economic challenges, limited potentials** for low emission heat sources and **capacities for implementation** restrict speed of heat transition
- A **heating transformation strategy** must be **transparently coordinated** between utility and city
- **Securing land** is of high importance here
- Most important technical solutions are **refurbishment, heat pumps and climate-neutral district heating**

Outlook for strategy implementation

- Improvement of data basis on potentials for low emission
- Analysis should be increased in **regional detailedness**
- Cost reductions due to application of **regionalized concentrated measure implementation** should be integrated (esp. for district heating, refurbishment)

- Limiting factors are key parameters, but realistic **estimation is complicated**
- **CO_2 abatement costs** are suitable for technology prioritization, however, analysis must be conducted carefully and **including sensitivities**

- Limiting factor analysis and prioritization could be conducted in **higher detailedness** (e.g. regionalization

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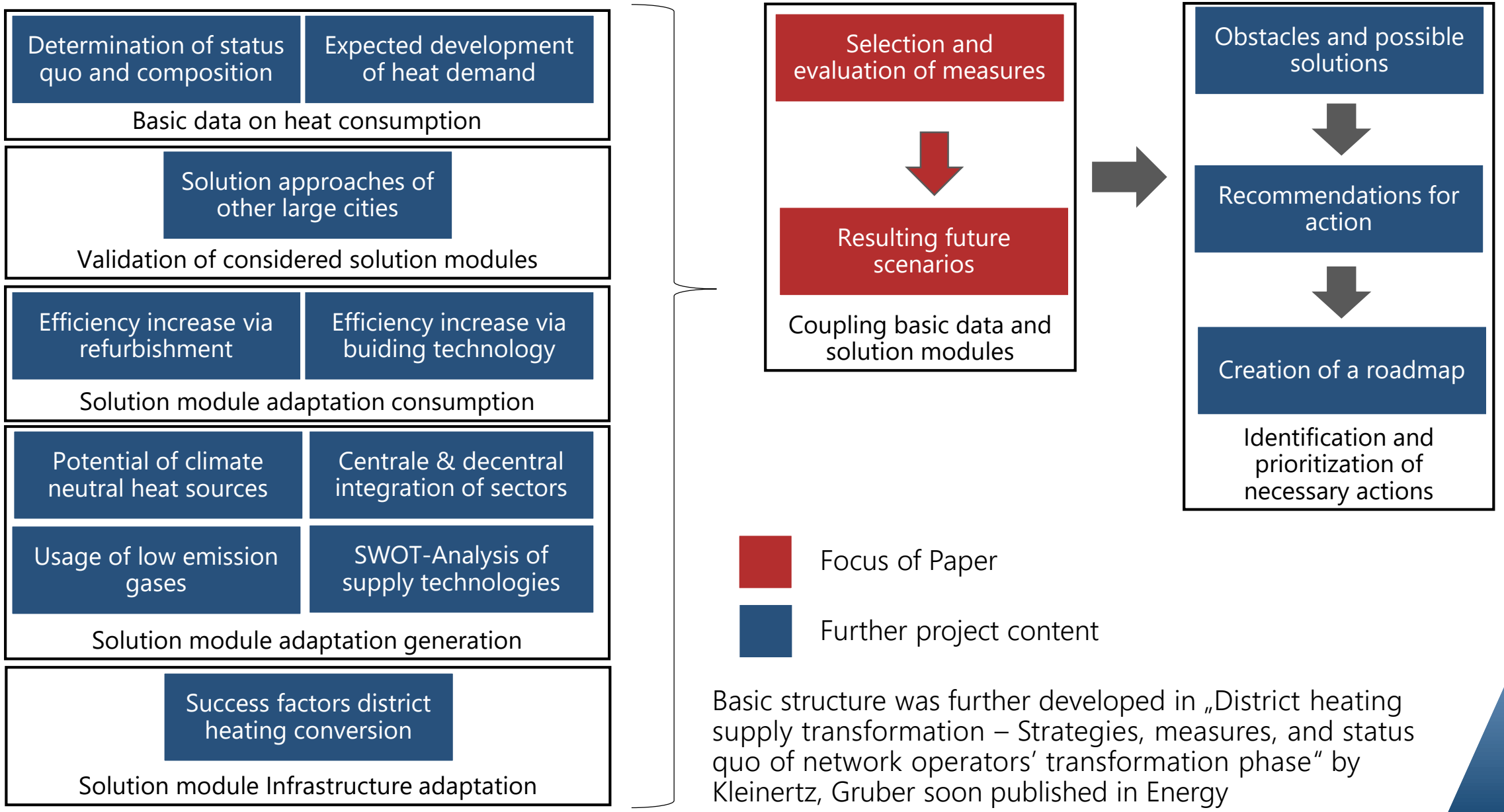
Workflow of research project



Basic structure was further developed in „District heating supply transformation – Strategies, measures, and status quo of network operators' transformation phase" by Kleinertz, Gruber soon published in Energy