TECHNISCHE UNIVERSITÄT WIEN

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e think ENERGY RESEARCH

What is the impact of European climate goals on the future of gas distribution networks?

Estimation of Gas Network Length and associated Costs for EU-27 at NUTS 3 Level based on Open Data

Bernhard Mayr, e-think energy research

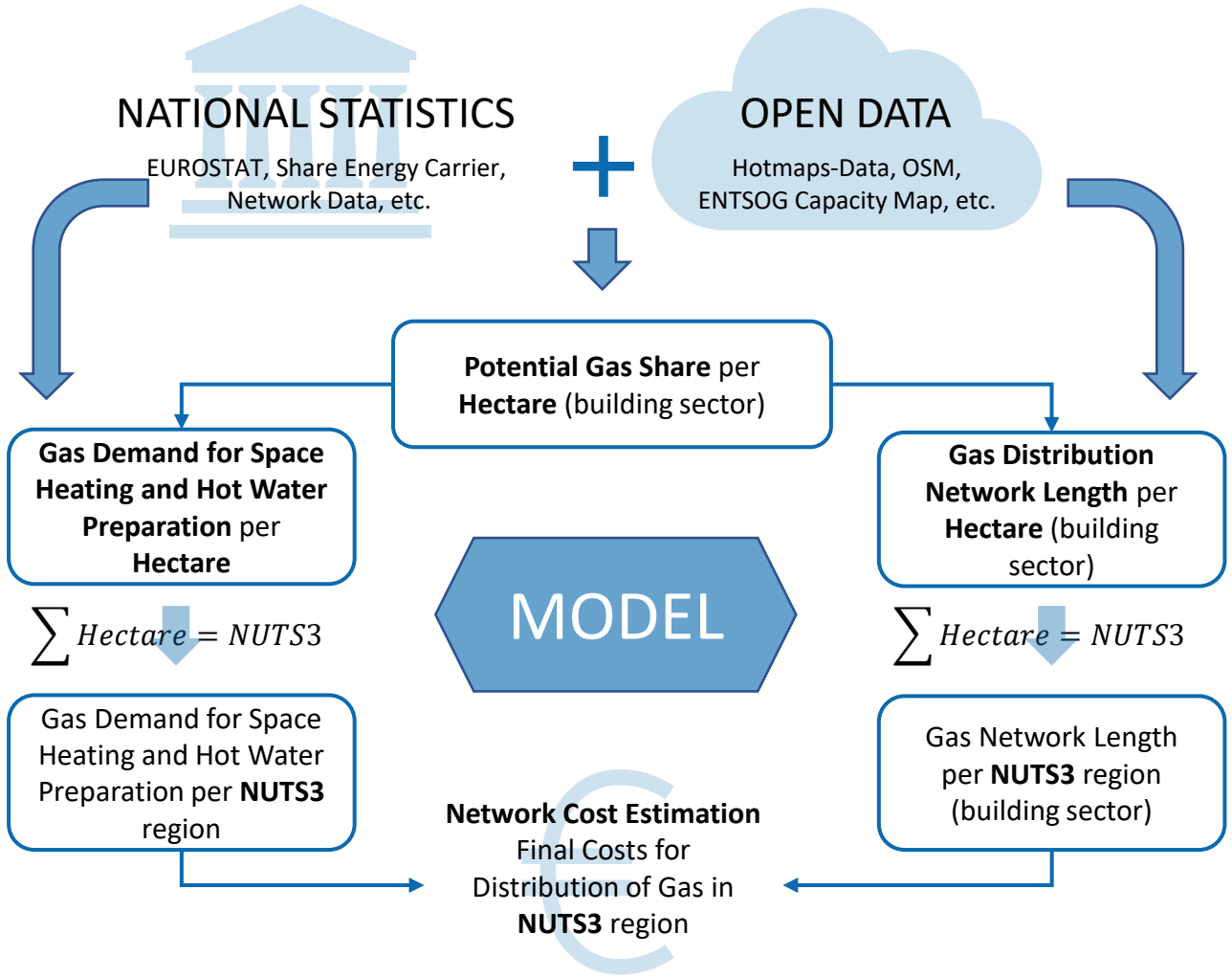
Motivation

- The European Union follows the objective of becoming carbon neutral before 2050.
- Many carbon-neutral scenarios have been developed
- Change of gas demand compared to the current situation on gas transport costs is not well evaluated so far. (Then et al. – Feb.2020)

Methodology – General Approach

Main Approach:

1. Distribution of data from the national level (gas demand in the building sector) to the hectare level
2. Distribution key is based on the location and data of buildings (OSM), the national building stock characteristics (European Settlement Map, Hotmaps-data) and the location of European gas transmission lines (ENTSOG Capacity Map)

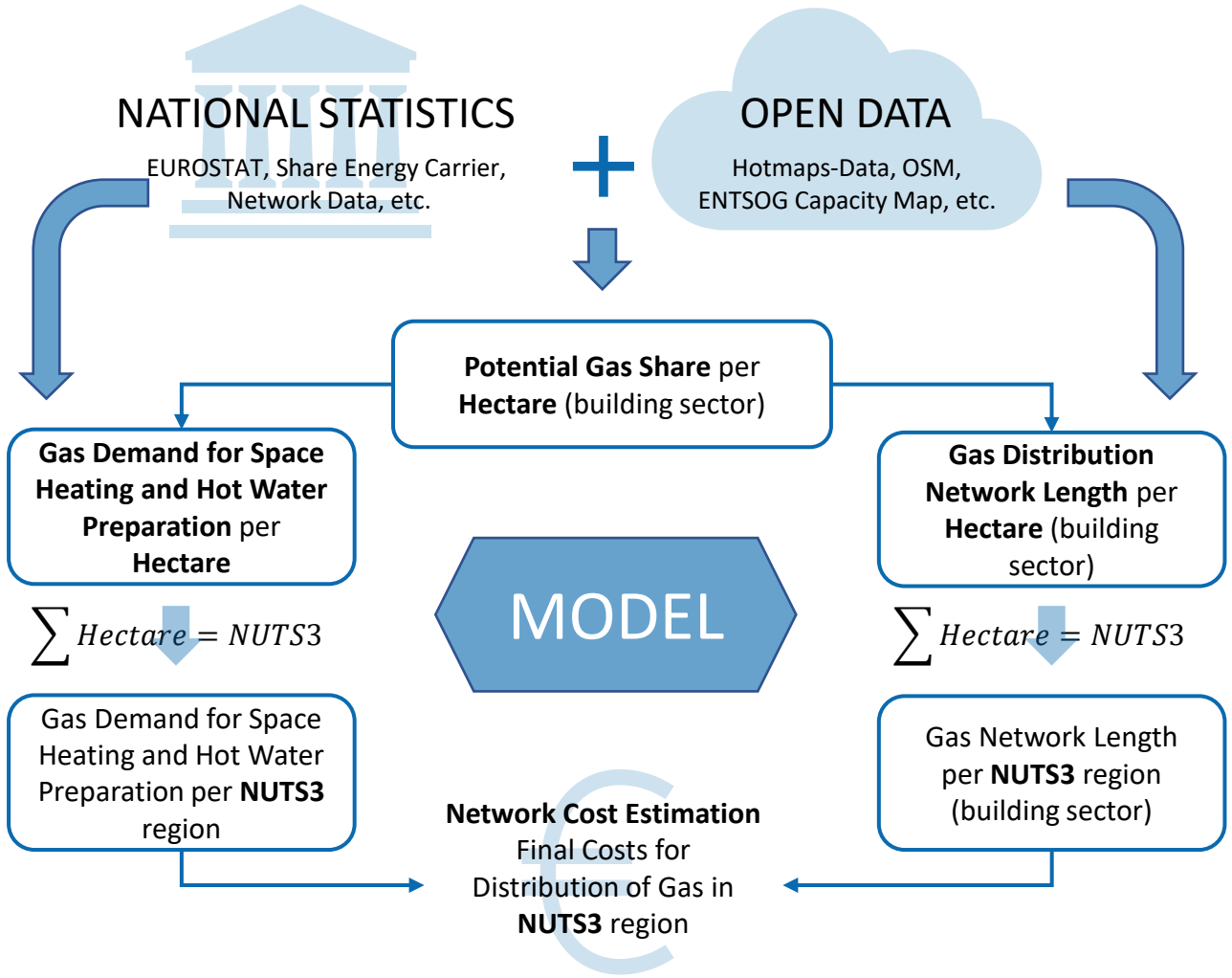


Methodology – General Approach

Main Assumptions:

Two main assumptions to distribute national gas demand over hectares:

1. The most densely built-up areas are supplied with district heating - less densely with gas, weighted according to the national share for district heating and gas.
2. The closer an area is to the European transmission line, the higher the probability of local gas supply.



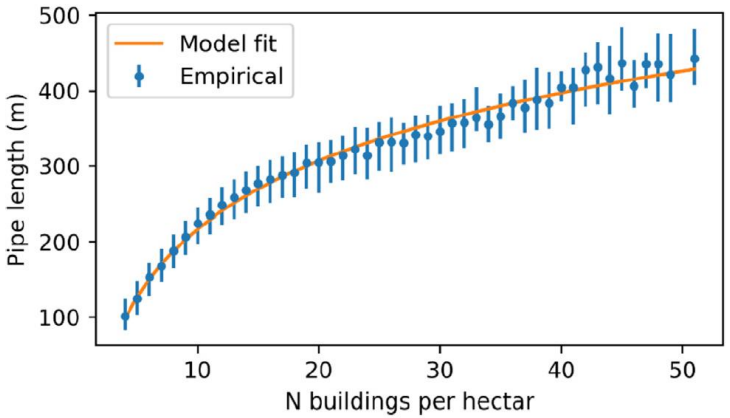
Methodology – General Approach

Gas Demand:

Derived from the national final energy demand for space heating and hot water

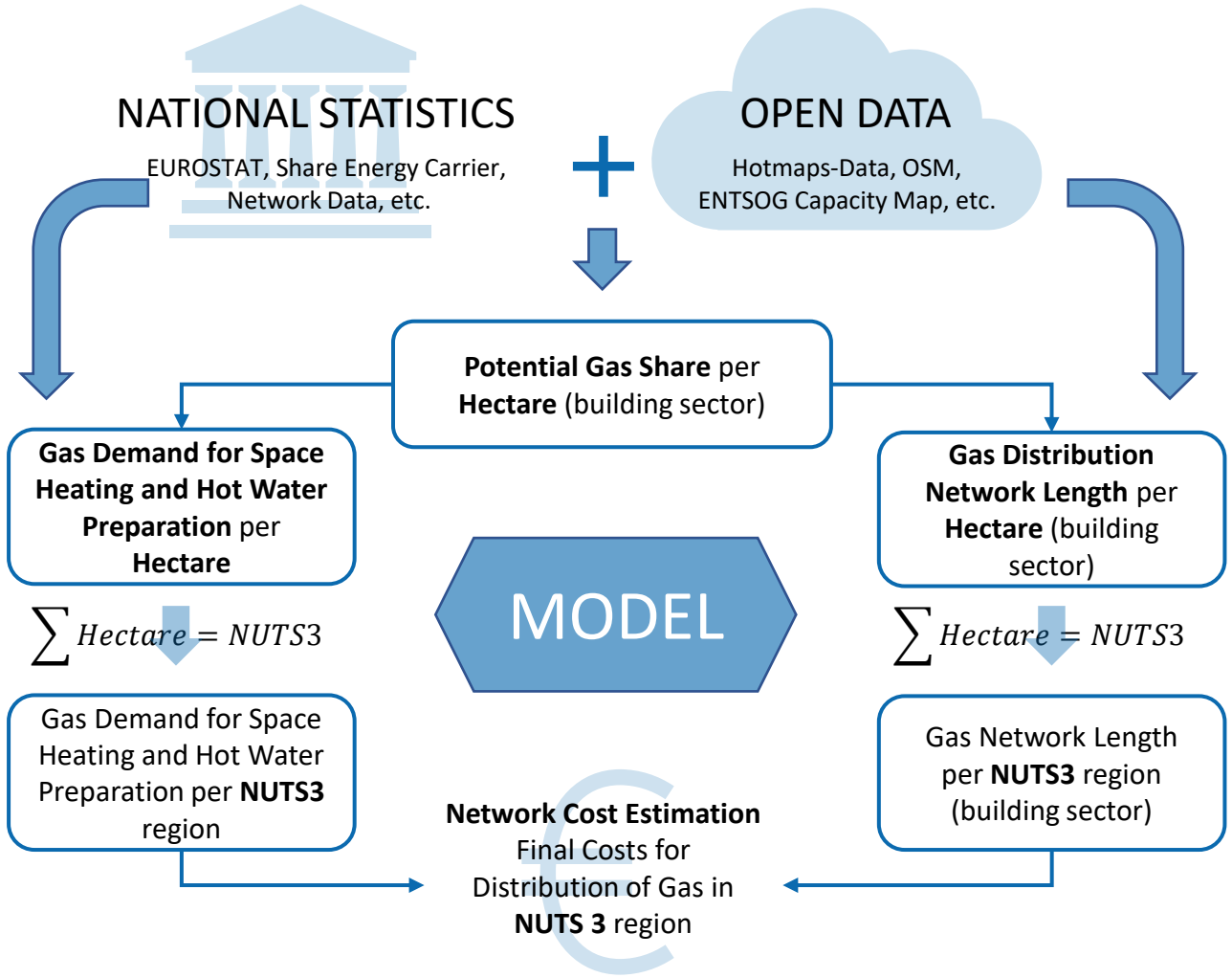
Gas Distribution Length:

(Chambers et al.,2019)



Network Costs Estimation:

Net Present Value of Gas Networks in NUTS 3 region based on gas demand and gas network length



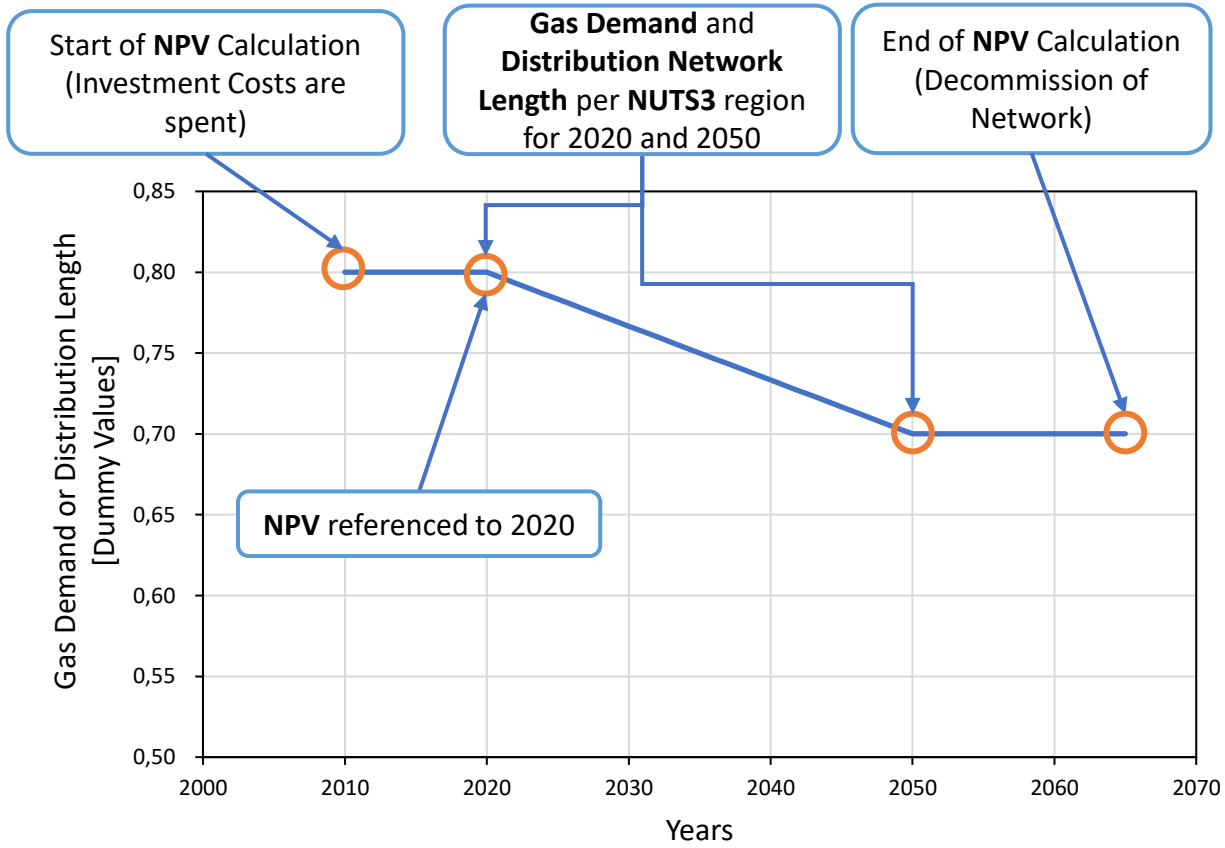
Scenario Assumptions

Two scenarios, both consider the European target of a climate-neutral energy system:

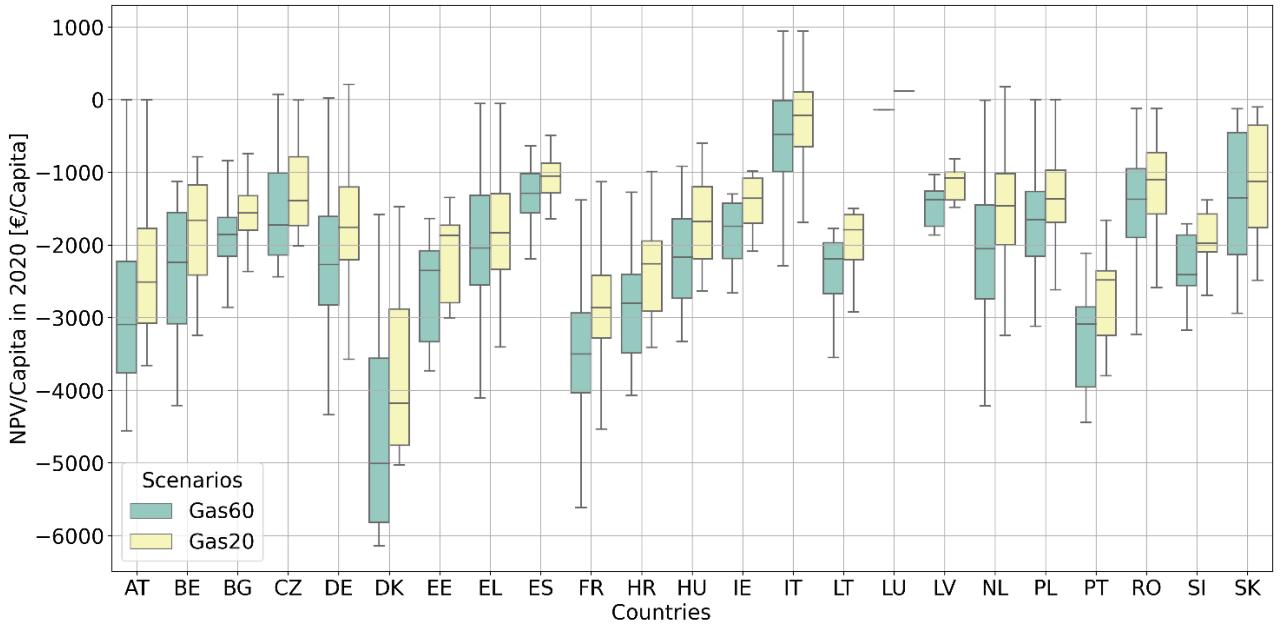
Gas60: Continuation of space heating and hot water preparation via gas-based technologies in the building sector after 2050.

Gas20: Phase-out of gas-based technologies in the building sector after 2050.

* Scenario details are derived from an ongoing research project (Tersteegen et al., 2022)



Results – Net Present Value per Capita of Gas Networks



Main Insight

- Barely any NUTS 3 region's gas distribution network has an NPV greater than 0 (some in IT, LU, DE, NL)
- NPV is lower in Gas60 than in Gas20:
  - Network lengths decrease less until 2050 in Gas60 => higher maintenance costs
  - Gas60 networks are operated longer after 2050 (without covering running costs) => negative residual value

Conclusion & Outlook

- Even under the continuation of gas heating in buildings after 2050, gas distribution networks will experience a sharp decline in gas demand due to renovation and efficiency measures in the building stock
- Counter measures:
  - Increasing grid charges (can lead to a spiral of customers leaving the network and higher costs for remaining customers)
  - Planned decommission of single network lines, to increase gas demand/network length
- Further evaluation of strategies that create a gas phase-out that results in the least amount of loss for stakeholders or stabilises profitability of the district gas networks in the long term
- Model will be improved in the future:
  - i.) Current results are based partly on rough estimations of model input parameters (e.g. specific costs for network o&m, investment, etc.). Parameters will be improved and model will be published under an open-source licence.
  - ii.) Improvement of model mechanisms.

Thanks for the interest!

Any questions?

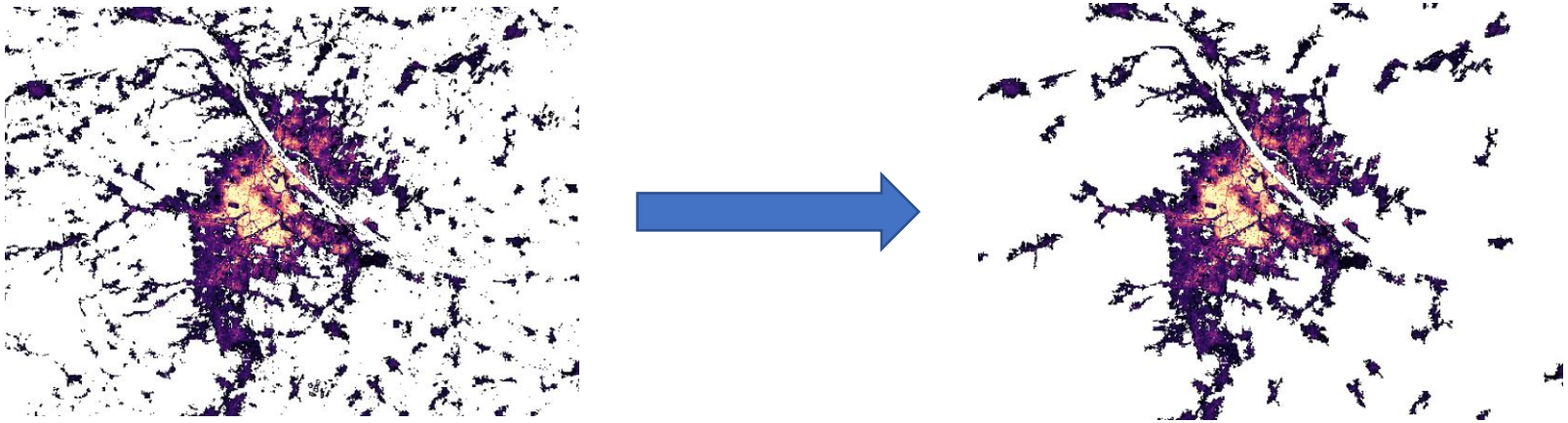
mayr@e-think.ac.at

Orig. Photo: Patrick Stargardt

Methodology – Potential Gas Share

Clustering of Areas with high FED with DBSCAN (Scikit-Library)

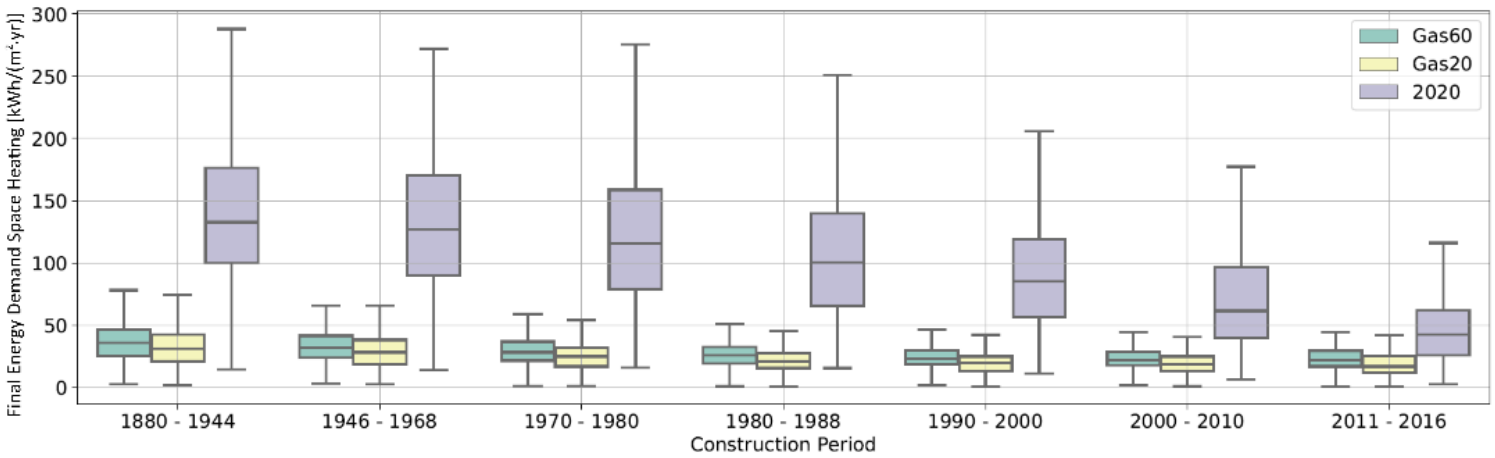
1. Identification of clusters and outliers
2. Outliers set to 0
3. Calculation of the cluster's total FED
4. Only if calculated value exceeds user-defined value, cluster remains, else set to 0

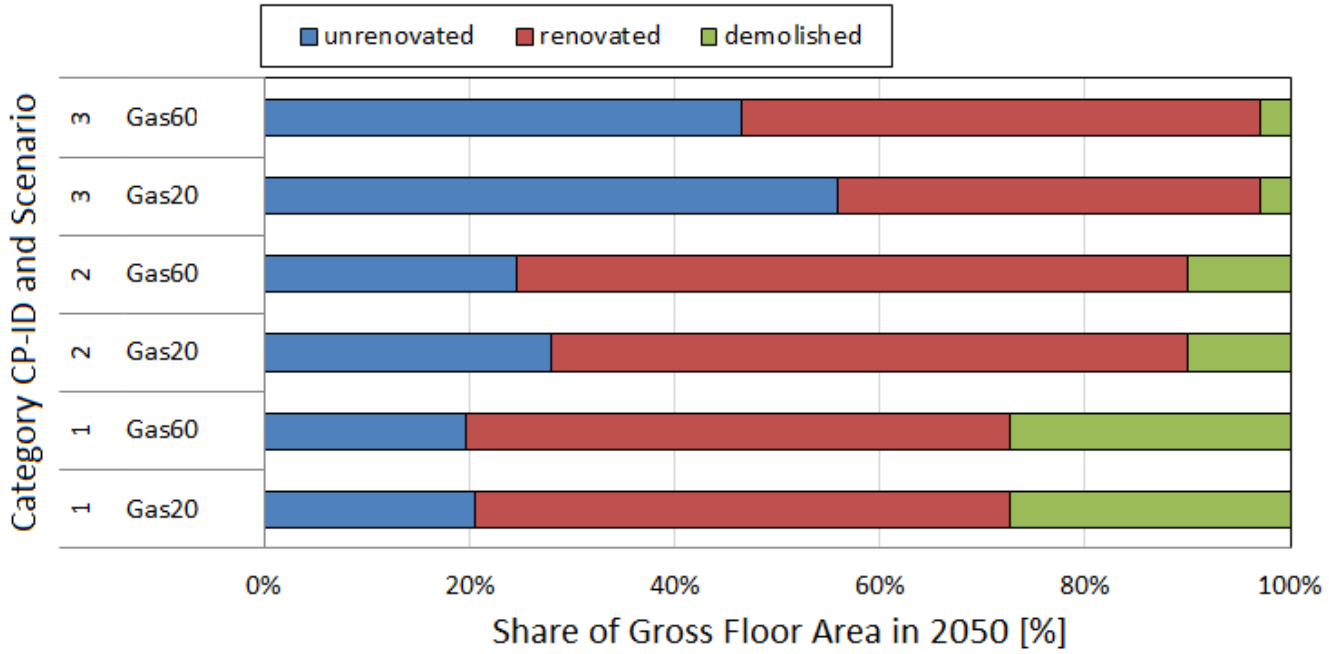


FED, rest

clustered FED

Methodology – Scenario Assumptions





Results – Gas Demand and Distribution Network Length