Potential of air-source heat pumps complying with sound immission limits in the German building stock

Simon Greif, Timo Limmer, Florian Mayer

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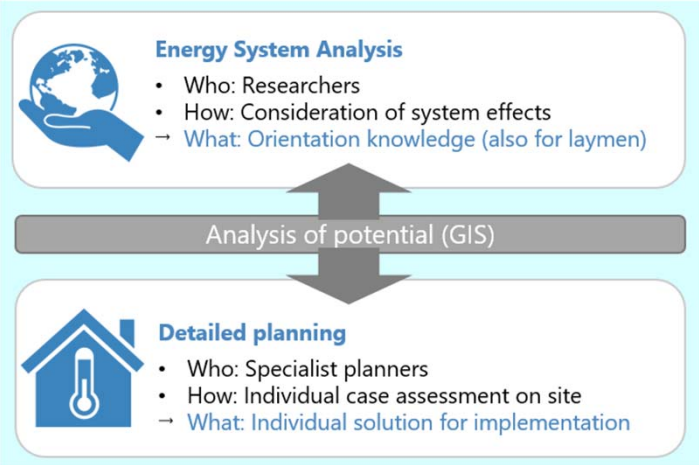
Goal – Project „Heat Pump Atlas“

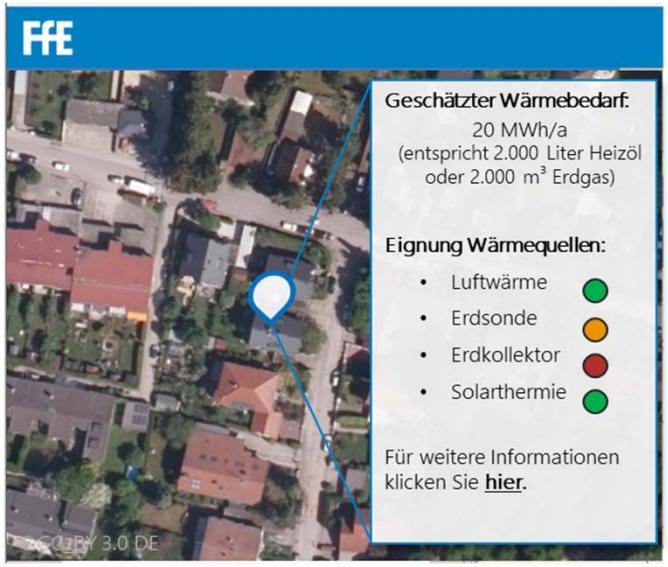
Primary Goal

- Quantitative evaluation of how many buildings in Germany can be equipped with different heat pump technologies, including sensitivity of the results
- Target group: System researchers

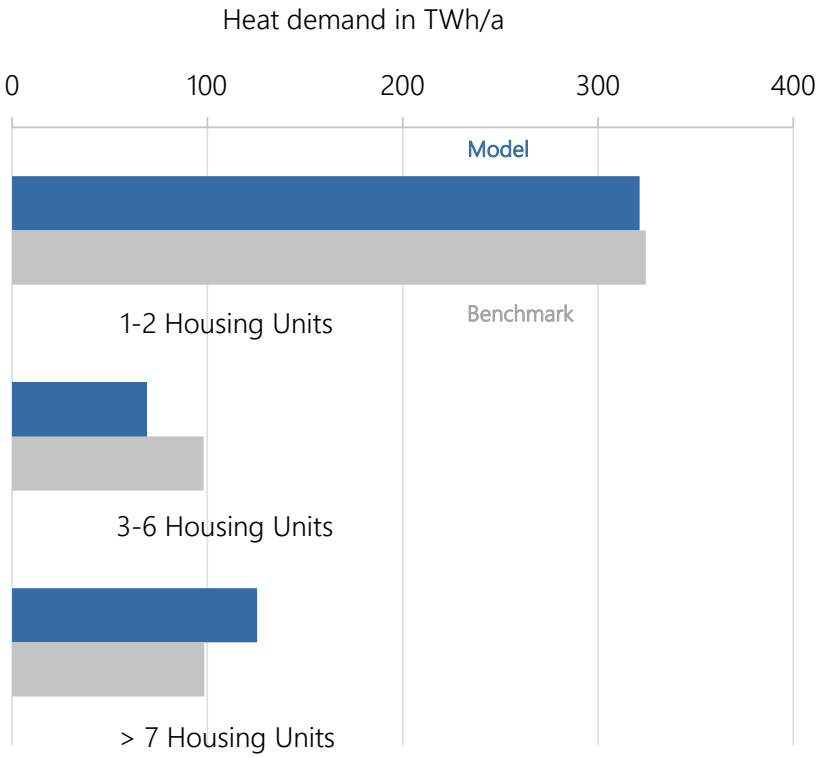


Secondary goal

- Selected results are to be made publicly available in the form of a website to inform building owners about possibilities for their property. This information cannot replace detailed planning!
- Target group: Building owners / laymen



Methodology – Building Model and quantification of the thermal demand



Key parameters captured through geospatial data

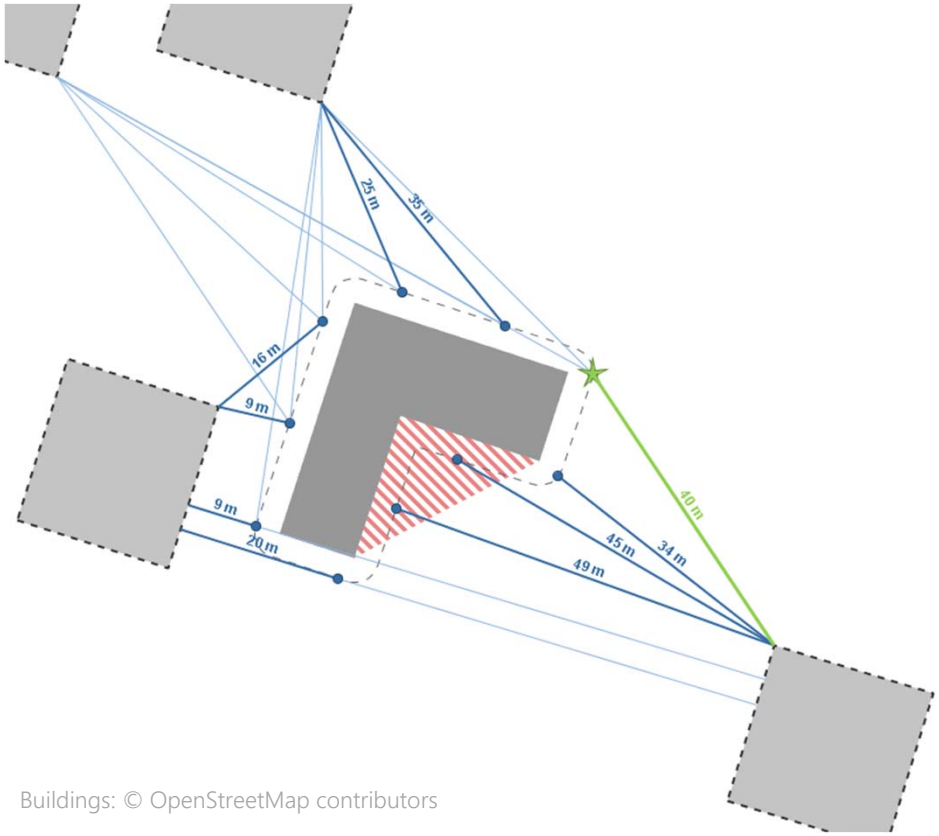
- Time of construction with data of census
- Building type, based on attributes such as: length, width, floor area, number of house numbers and land use
- Floor area

Calculate Heat demand

- Determine specific heat demand depending on the construction time and the building type
- Assume the number of floors based on the building type
- Calculate absolute heat demand by multiplying total floor area and specific heat demand

The validation for the 14 million residential buildings is carried out based on the heat demand.

Methodology – Potential of air-source heat pumps complying with noise immission limits



Buildings: © OpenStreetMap contributors

Establish the ideal installation location

- Shorten the calculation time with a filter to the surrounding neighbors
- Place potential installation points at intervals around the building (o)
- Draw lines between all installation locations and all neighbors
- Delete lines, which pass through buildings (shielding)
- Assign Malus for installation sites in the convex hull (reflection)
- Identify the best installation site with the greatest distance to the nearest neighbor (*)

Calculate the thermal power of the air source heat pump from the distance

- Maximum sound emission as a function of distance and sound immission limit (35 dB(A) at night)
- Research manufacturer data on sound emissions and power

Results – Applicability of air-source heat pumps

Applicability of air-source heat pumps

- Arrows mark the distance from the optimal installation location to its nearest neighbour
- If the potential thermal power of the air-source-heat pump is higher than the heat source demand an air-source heat pump is applicable (green); Otherwise, this is not possible (red)
- If the potential thermal power of the air-source-heat pump is lower than the heat demand, the share that can be provided is indicated

The potential varies greatly depending on the building type

- For single-family and duplex the potential is usually sufficient
- Terraced houses have a limited potential due to the small distance to their neighbours; Only end-terrace houses differ
- The heat demand of small multi-family houses can partly not be met
- In large multi-family buildings, mostly located in a densely built environment, the potential is usually insufficient to meet the high heat demand