Assessment of the influence of demographics, refurbishment and climate on the heat demand in district heating planning

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Background

- In many cases, district heating networks are modeled using heat demand calculations

  - at a certain building energy efficiency standard

  - and for a certain climate.

- Energy-efficient refurbishments already carried out are mostly neglected due to the lack of information.

- Incorrect estimates lead to incorrect dimensioning of the district heating system.

Objectives

- Development of approaches to take into account factors influencing the accuracy of heat demand calculations.

- Investigate the possible impact of incorrect estimation of building heat demand on the profitability of district heating systems.

Changes in the energy reference areas [1]

- Energy reference area projections take into account declining population, increasing housing space per person, and upgrading to energy efficient buildings.

- Increase in the residential building stock in Germany by 2030 and 2050 by 4% and 7%, respectively.

Development of energy reference areas in residential buildings
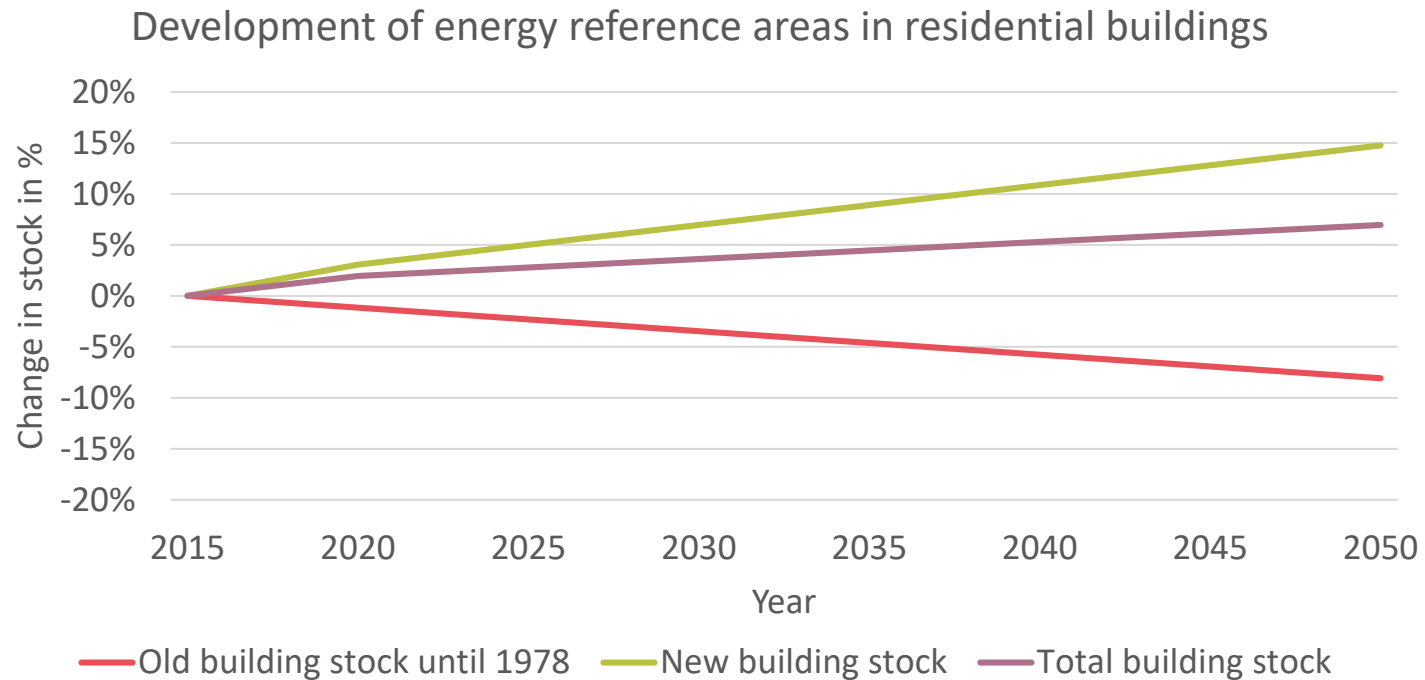
Influence of energy refurbishment progress [2; 3]

- Assessment based on a survey of refurbishment rates in the German residential building stock.

  - Refurbishment progress of buildings components (walls, roof/upper floor ceiling, floor/basement ceiling, window)

$$F = (f_{Wall} \cdot 0{,}5) + (f_{Roof} \cdot 0{,}25) + (f_{Floor} \cdot 0{,}12) + (f_{Window} \cdot 0{,}13)$$

Total building area

- Distribution of the component proportions in the total building area takes into account their influence on the heat demand.

- New, modified area-specific heat demand values can be assigned to each building.
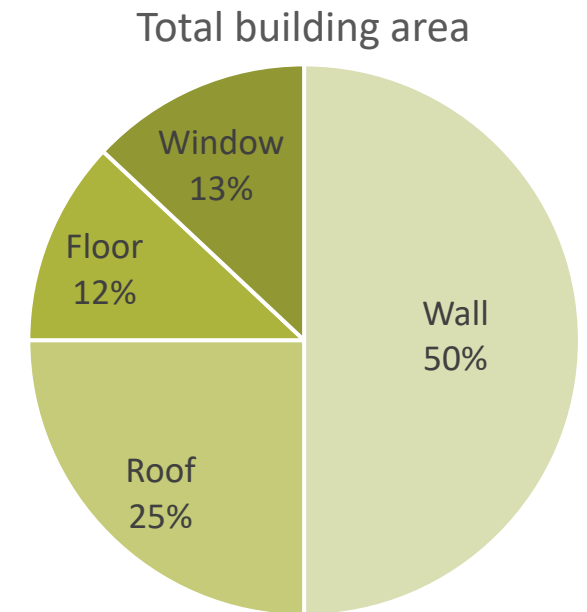
Influence of climate [4]

- Area-specific heat demand values refer to the "Reference Climate Germany".

- Colder or warmer sites can be considered using appropriate climate factors (8233 different sites).

- The heating demand can increase by up to 28 % or decrease by up to 26 %, depending on location.

Averaged climate factors 2009 – 2019
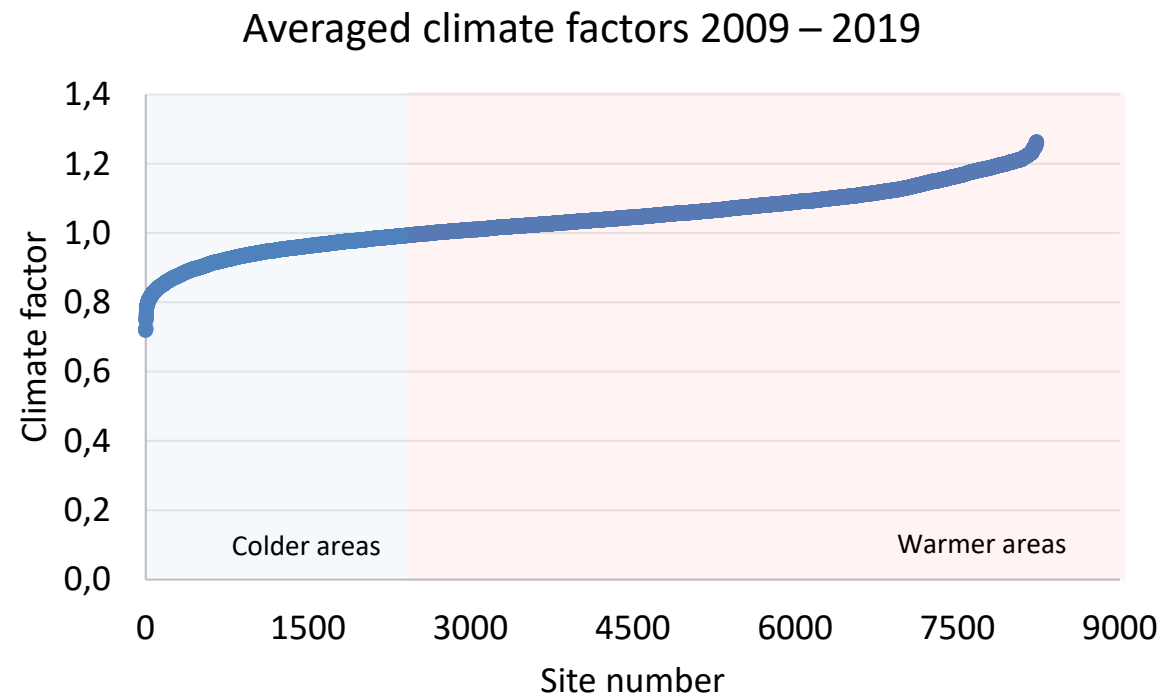
Change in profitability – district heating network model

- Due to the decreasing heat demand as a result of building efficiency and climate, the heat generation costs (including distribution and losses) increase significantly.

- At heat demands smaller -20 % than expected, the modeled network becomes unprofitable.

Profitability of the DHS

Heat sales prices —— Heat generation costs
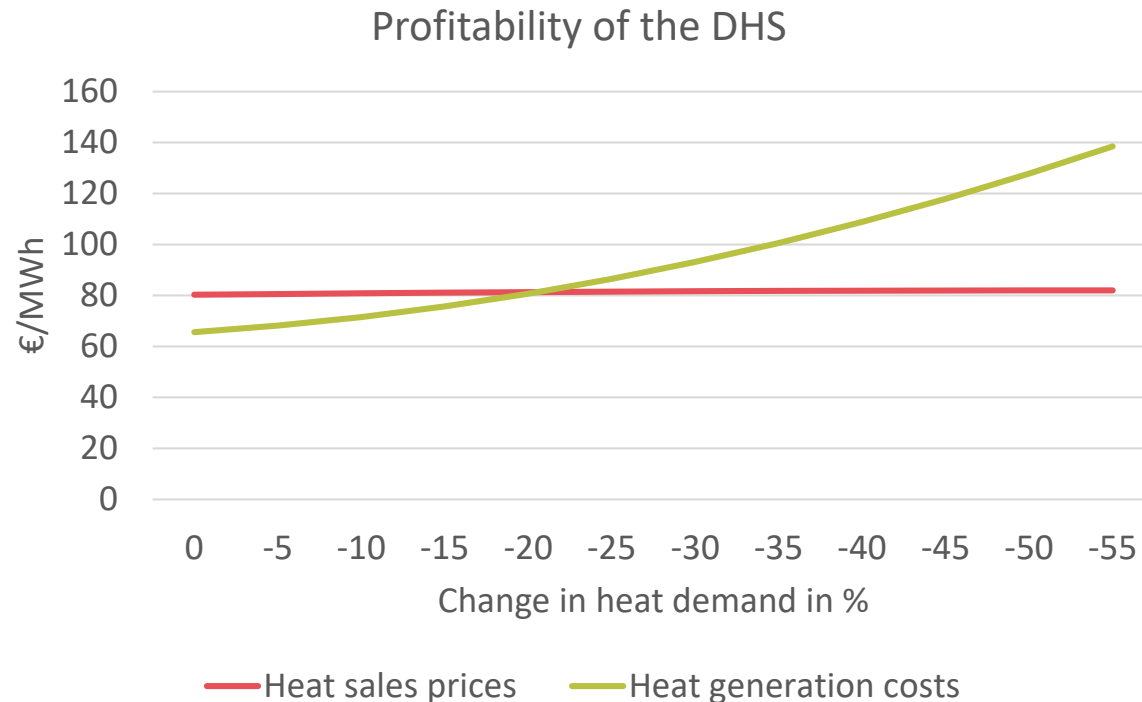
Discussion

- The investigated parameters of the energy efficiency in buildings as well as the climate can reduce the calculated heat demand by more than the half.

- The approaches used are generally valid and can be used in further projects. However, the results presented refer to a specific district heating system model.

References

[1] Diefenbach, N.; Loga, T.; Stein, B. (2015) Szenarienanalysen und Monitoringkonzepte im Hinblick auf die langfristigen Klimaschutzziele im deutschen Wohngebäudebestand – Bericht im Rahmen des europäischen Projekts EPISCOPE. Darmstadt: Institut Wohnen und Umwelt.

[2] Cischinsky, H.; Diefenbach, N. (2018) Datenerhebung Wohngebäudebestand 2016 – Datenerhebung zu den energetischen Merkmalen und Modernisierungsraten im deutschen und hessischen Wohngebäudebestand.

[3] Diefenbach, N. et al. (2010) Datenbasis Gebäudebestand – Datenerhebung zur energetischen Qualität und zu den Modernisierungstrends im deutschen Wohngebäudebestand. Darmstadt, Bremen: Institut Wohnen und Umwelt; Bremer Energie-Institut.

[4] DWD (2020) Klimafaktoren (KF) für Energieverbrauchsausweise.

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