

## Master's Thesis

# Heat demand assessment of Bavaria with a synthesized database for non-residential buildings

## Background

Within an upcoming research project, a long-term planning tool for power and heat supply in Bavaria will be developed using a multi-scale energy system model approach. Hereby, obtaining accurate data for the residential energy demand and flexibilities is crucial to obtain a meaningful solution. Especially for determining the **heat demand**, the type, the construction year and the heat characteristics of buildings are important parameters.

Preliminary work for this has already been made in our chair, mainly through the development of an open-source heat demand software *UrbanHeatPro*<sup>a</sup>, which considers the space heating for all kind of buildings and hot water demand for residential buildings, on individual building level. However, because of computational and data availability challenges, large-scale characterization was made using aggregated regional statistics so far.

## Goals

Within this Master's thesis:

- A comprehensive database for the non-residential (commercial and industry) buildings in **Bavaria**, along with forecasts for their renovation, will be synthesized on the **individual building level**.
- The methodology will bring together
  - the real data that is only available for select quarters or cities and
  - various synthesis methods using GIS data for especially commercial buildings
- Characteristic heat demand curves will be generated on a high regional resolution by a) extending *UrbanHeatPro* for heat uses besides space heating and domestic hot water and b) applying the extended *UrbanHeatPro* methodology with the database developed in the previous step

## Learning outcomes

By completing this thesis, you will

- obtain knowledge regarding the heat demand in Bavaria
- put your programming skills into application

As this thesis is related to a work package of an upcoming research cluster, you will also get familiar with the workflow of a research project within TUM and across various research institutes.

## Requirements

- Basic understanding of heat demand, data processing and analysis
- Knowledge of *Python* and *pandas* (optional: knowledge of using *Jupyter notebooks*)
- Please attach your CV and grade report to your application

## Contact

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<sup>a</sup> <https://github.com/tum-ens/urban-heat-pro>

[1] C. Nägeli, C. Camarasa, M. Jakob, G. Catenazzi and Y. Ostermeyer, "Synthetic building stocks as a way to assess the energy demand and greenhouse gas emissions of national building stocks," *Energy and Buildings*, vol. 173, pp. 443-460, 2018.

[2] IWU, "TABULA Web Tool," 2016. [Online]. Available: <http://webtool.building-typology.eu/#bd>.