

IDP

# Software development for an automated communal energy planning tool

## Background

The climate goals and recent political developments demonstrate the grand need of rapid transition towards locally sourced, decarbonized heat supply, not the least in the building level. In the electricity system planning the decisions are generally made in a top-down manner, namely by the rollout of large-scale power system components. In the heating sector however, the heterogeneity of the building stock, their current heating systems and the local availability of renewable resources necessitate an individualized, bottom-up decision-making at the building level. This lead to **communal heat planning** guidelines to be conceptualized by various regulatory bodies (example from Baden Württemberg<sup>1</sup>).

In this vein, in the STROM project<sup>2</sup>, a digital, automatized energy supply planning tool is to be developed (see Figure 1). For an arbitrary district, this tool shall use local data such as renewable resource potentials, energy demand and distribution grid topology. By definition of the district through these data, a multi-sector, system-scale cost optimization takes place by use of the optimization framework urbs<sup>3</sup>. The optimization derives then the optimal transition pathways for covering the emerging energy demands in the district and assists decision making, e.g. **Should heat be provided centrally through a heating grid or by using decentral heating units? what portion of the district shall switch to electrical heating? Should the distribution grid be reinforced or could that be avoided by using flexibilities?**

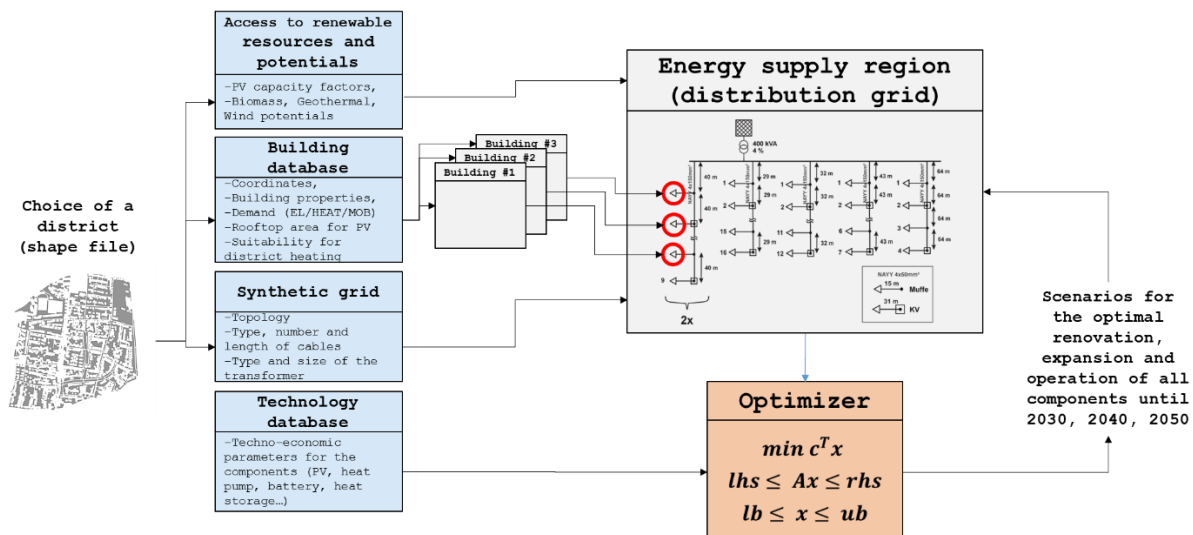


Figure 1. Envisioned workflow of the automated communal energy planning tool.

<sup>1</sup> <https://um.baden-wuerttemberg.de/de/service/publikation/did/handlungsleitfaden-kommunale-waermeplanung/>

<sup>2</sup> <https://www.epe.ed.tum.de/en/ens/research/projects/current-projects/strom-subproject-2-potential-assessment-und-model-integration/>

<sup>3</sup> <https://github.com/tum-ens/urbs>

## Goals

Most of the individual modules of the aforementioned planning tool have been developed, however an automated operation with a concrete workflow implementation is yet to be made. Therefore, in this interdisciplinary project, you will be

- developing a software architecture in Python by combining the existing modules for i) renewable potentials, ii) synthetic grid, iii) building demand data, and iv) the optimization module with each other, and
- showing a proof of concept by applying the tool in an example district in Bavaria.

## Requirements

- Good command of Python and object-oriented programming
- Experience with data structures (such as pandas)
- Experience (academic or practical) on software architecture is a big plus

## Learning outcomes

By completing this thesis, you will

- gain understanding of energy systems
- employ your programming experience to an energy-related application
- make a big contribution to one of the most relevant questions of our current time

## Contact

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