



# Master's Thesis

(Theoretical)

## Open-Source Development of a Stochastic Programming District Heating Network Design Model in Python

### Description:

The residential heating sector represents over a fourth of the final energy consumption in the EU, of which only a small fraction (27 %) is sourced from renewable energy sources. A speed-up in the transformation of the heating sector is critical to reaching ambitious climate targets. District heating can be an efficient technology to supply dense urban areas with renewable heating. However, these complex networks need an accurate, fast, and scalable design process to deploy them at scale. The open-source package `topotherm` (<https://github.com/jylambert/topotherm/>), developed and maintained by the Chair of Energy Systems, performs particularly well in comparison to existing open-source models.

This master's thesis focuses on further developing and evaluating the `topotherm` package, by improving collaboratively and openly the model. In particular, the model's potential for a stochastic optimization with decomposition methods such as Bender's, will be developed and tested.

### Requirements:

- Interest in and fundamental understanding of energy systems.
- Experience programming with Python.
- Interest in district heating networks.
- Knowledge of mixed-integer linear programming is a plus.

### Work Packages:

1. Testing, profiling of the current `topotherm` implementation
2. Literature research on stochastic programming and Bender's decomposition with Python and district heating networks
3. Model development
4. Thesis writing

**Start Date:** Flexible

**Contact:** M. Sc. Amedeo Ceruti, M. Sc. Jerry Lambert

**Office:** MW 3703

**Tel.:** 089 289 16279

**Email:** amedeo.ceruti@tum.de