



Institute of New Energy Systems (InES)

The Institute of New Energy Systems is one out of three institutes for applied research at Technische Hochschule Ingolstadt (THI). The research activities of InES are focusing on the following fields of research: Bio-Energy Technology, Energy Systems Technology, Geothermal Energy, Networking & International Projects and Solar Energy Technology. Five professors and about 20 researchers and Ph.D. students carry out applied research projects in the field of renewable energy technologies. Bachelor and master students will find excellent career opportunities at the InES.

Student job / Bachelor / Master thesis:

Development of a Simulation Environment for Annual Performance Evaluation of a Two-Compressor Dual-Source Heat Pump

Research project and background:

Utilizing two separate evaporator branches in a dual-source heat pump (DSHP) allows smaller heat source dimensioning (especially for the ground source) and covering peak load with parallel operation. The increased efficiency and reduced collector investment costs are contrasted by a more complex heat pump refrigerant cycle. At the *Institute for new Energy Systems*, a prototype has been experimentally investigated and modelled. For a holistic economic investigation, annual simulations have to be performed to compare the developed DSHP with other technologies. Parameter studies have to be performed and then the optimum compared to other technologies.

Objective of the thesis:

The key selling point of this DSHP is the option to use several operation modes – single source or parallel operation – to cover the heating load. This can improve efficiencies compared to pure air-source operation and reduce the geological requirements compared to ground-source heat pumps. Based on an existing system simulation, a structured approach needs to be designed and implemented accordingly. Parameter studies of the hardware (like ground-source dimensions) and software (control parameters) are to be conducted and the annual performance compared to conventional heat generators.

Depending on the scope of the thesis, this can include:

- **Adaptation of an existing annual simulation for comparative and repeatable performance** using MATLAB/Simulink
- **Development of a parameter study for different parameter sets and evaluation of the annual performance** for the DSHP
- **Comparison of the DSHP performance** with conventional heating systems
- Optional: **Economic evaluation and comparison**

Target Group:

Students of the subject areas/study courses:

- Energy Systems and Renewable Energy Systems, Engineering, or similar
- Knowledge about thermodynamic behaviour of heat pumps and simulation within MATLAB/Simulink is advantageous
- Fluent in either English or German

Period of time: Starting winter term, 3-6 months

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University, region and research group

Our institute is part of the Technische Hochschule Ingolstadt, which is located near the historic centre of Ingolstadt and the former Bavarian State Fortress. Ingolstadt is the fifth largest city in Bavaria and part of the Munich Metropolitan Area, which has a total population of more than 5 million. It combines tradition and modernity in many ways and is due to living experience and the atmosphere one of the fastest growing and youngest cities in Germany.

During your thesis, you will be integrated in our young and aspiring research group *Building Energy Systems* with around ten researchers, Ph.D. students as well as national and international trainees.

