

The value of flexible power-to-heat systems in residential buildings and related CO₂ emission in the EU Member States

(Master or Bachelor Thesis)

Background

The Institute for Resource Efficiency and Energy Strategies – IREES – in Karlsruhe, Germany, is active in the field of the sustainable use of natural resources, with emphasis on technological and service-related options of energy, material efficiency and low-emission production processes. The team operates on an interdisciplinary research unit (energy efficiency networks, energy projections and technologies, and socio-economic research) that scales technological, economic and political fields in addition to a social-scientific agenda all geared towards a more efficient use of resources.

Accounting for about 50% of final energy consumption, heating and cooling represents the biggest energy use sector in the EU, which is still dominated by fossil fuel use and responsible for a major share of EU GHG emissions. Power-to-heat solutions can play an important role in decarbonizing this sector and at the same time integrate large shares of electricity generated by variable renewable energy sources such as wind and photovoltaics. Heat pumps are considered a major technology to provide flexibility to the power system, meanwhile providing efficient heating and cooling solutions to residential buildings.

Research questions:

- Which building types can be supplied with efficient heat pumps (COP > 2.5) in EU-27 Member States (MS) and what are the related specific CO₂ emissions?
- What are the cost saving potentials of optimizing the dispatch of a heat pump for the electricity system and for a building occupant in single- and multi-family houses in several EU MS?

Methodology:

Simulation of electricity demand for heat pumps based on simplified building physics models and link to the electricity generation mix o. Linear Optimization model to simulate the optimal dispatch of heat pumps based on hourly electricity prices.

Case study objectives/ tasks:

Calculation for individual houses within 3-5 building categories for more than 5 EU MS in different electricity market areas. Estimations for the total building stock of EU 27 classified by building classes.

Requirements:

- Fields of study: Engineering sciences, Mathematics, or similar.
- Knowledge in Building Energy Modelling (e.g. EnergyPlus or comparable software)
- Experience with linear programming and optimization

Our offer:

- Opportunity to apply your knowledge and skills in a scientific environment
- Open and communicative working atmosphere and intensive support
- Working on future-oriented topics such as sector coupling (PtH) and digitisation

If you are interested, then please send us your short cover letter with a tabular curriculum vitae as well as certificates (intermediate certificates/bachelor's degree, and others if applicable) by e-mail to:

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