



# Master's Thesis

(Theoretical)

## Sustainable Energy Systems Design: Integration of Life Cycle Assessment in Energy Systems Optimization

### 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. Accurately planning energy supply with a highly spatial and temporal resolution is essential to achieve this acceleration. Linear programming optimization methods are a valuable tool for achieving that. However, these models generally only include economic indicators, producing an environmentally sub-optimal result.

This master's thesis focuses on integrating the sustainability assessment method of life cycle assessment (LCA) into a linear programming (LP) optimization. The selected tools are all Python-based, open-source: Brightway2 for the LCA formulation, PyPSA for the energy system model and linopy for the custom equations within PyPSA. The new equation system will be implemented for a representative industrial supply case study where several technologies have already been modeled with LCA. A particular focus will be placed on fully reproducible Python code to ensure transparency and replicability of the research process.

### Requirements:

- Fundamental understanding of energy systems.
- Experience programming with Python or MATLAB.
- Interest in linear programming methods and optimization methods
- Knowledge of life cycle assessment is a plus.

### Work Packages:

1. Literature review
2. Model Formulation
3. Software Implementation with Python
4. Optimization of a case-study

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