TU Clausthal

Project Work/Master's Thesis

Integrated Heat Pump and Thermal Storage System Analysis in an Expanded Neighborhood Model

This project focuses on expanding an existing neighborhood model by adding a module that includes a primary large-scale heat pump (> 500 kW electrical) and implements seasonal-controlled aquifer storage and above-ground heat buffer storage. The project aims to analyze the operational parameters, performance, and efficiency of these storage systems, including cascading secondary heat pumps for serial storage and retrieval, as well as dynamic switching for bidirectional heat storage. A comparison of the two storage solutions will be conducted for negative regulation power and thermal peak load balancing, along with an evaluation of the economic viability of the implemented energy system, considering aquifer storage and revenue generation in energy markets.

Highlighted Points to Work On:

1. Develop an additional module integrating a large-scale heat pump and seasonal-controlled aquifer storage into the existing neighborhood model.
2. Compare storage solutions for negative regulation power and thermal peak load balancing.
3. Optimize the system using mixed-integer linear programming to minimize energy demand while considering network requirements and system economics.
4. Evaluate the efficiency of large-scale heat pumps and minimize losses while maximizing performance.
5. Assess the economic viability of the implemented energy system, considering revenue generation in energy markets and the utilization of renewable energy sources.

Requirements:

- Studying in Energy Systems Engineering, Mechanical Engineering, Industrial Engineering, Process Engineering, or related fields.
- Prior knowledge of Matlab, Python, or similar programming languages.

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