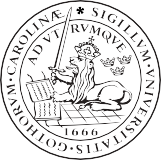
Development of an integrated hybrid energy system model for cloud deployment

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## Abstract

## Acknowledgements

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## Introduction

* 1. **Purpose and scope of the project**

In recent years, the use of cloud-based simulation platforms for the design and analysis of industrial systems has become increasingly popular. One such platform is Modelon's Impact, which provides a wide range of models for simulating different energy systems such as heat pumps, district heating systems, and thermal energy storage. However, there is currently no model available that contains all of these components in a single system. This presents an opportunity for research to develop such a model, which could potentially be used to analyze systems where an industrial heat pump is utilized to satisfy heat consumption.

The purpose of this Master’s Thesis project is to create a coupled system model based on available Modelica components within the Modelon Impact cloud-based simulation platform. The model will include a high-fidelity industrial heat pump model, district heating network model, thermal energy storage, and other needed equipment such as a backup boiler, electric heater, and solar thermal. The simulation study using the developed model will focus on addressing the economic control strategy, the safety of supply temperature with varying weather conditions, and live-coupling of the cloud-based system model with online available weather data and electrical grid frequency.

In addition to the development and simulation of the model, the project also includes optional deliverables such as the optimization of the model's operation and the creation of a Web-Application to demonstrate the model.

The results of this study will provide insights into the potential benefits of using a coupled system model containing an industrial heat pump, district heating network, thermal energy storage, and other necessary equipment to analyze and optimize the performance of real-world energy systems.

The thesis will be divided into several phases, starting with a literature review, familiarization with the platform, and definition of a representative reference system aligned to a real-world hybrid energy system. The second phase will be concentrated on the development of the model, the next one will be focused on the simulation study of the developed model and the development process of optional deliverables. Finally, in the last phase, the results are going to be summarized in the report and orally presented.

* 1. **Research questions**

This Master’s Thesis project aims to address several key questions related to the use of an industrial heat pump in a district heating system. The first research question is whether a district heating system with a heat pump can be modelled in the Modelon Impact platform. This question is important as it addresses the technical feasibility of using the platform to simulate such a system.

The second research question focuses on identifying the other necessary components that are needed in such a system. This question is important as it addresses the broader system requirements for implementing an industrial heat pump in a district heating system.

The third research question addresses the safety of the heat supply in such a system, specifically whether it can provide a safe heat supply regardless of varying weather conditions. This question is important as it addresses the operational and performance characteristics of the system under different weather conditions.

Finally, the fourth research question addresses how to optimize the operation of the system. This question is important as it addresses the potential for cost savings and improved performance through the optimization of the system's operation.

Overall, these research questions aim to provide a comprehensive understanding of the technical feasibility, system requirements, performance characteristics and potential for optimization of an industrial heat pump in a district heating system, using the Modelon Impact platform.

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## Literature review

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## Background of the topic

* 1. **District heating systems**
  2. **Industrial heat pumps**
  3. **Thermal energy storage**
  4. **Other relevant topics**
  5. **Energy systems modelling**

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## Development of a model

* 1. **High-fidelity industrial heat pump model**
  2. **District heating network model**
  3. **Thermal energy storage model**
  4. **Other needed equipment models**
  5. **Complete model**

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## Simulation study

* 1. **Economic control strategy**
  2. **Safety of supply temperature with varying weather conditions**
  3. **Live-coupling of the cloud-based system model with online available weather data and electrical grid frequency**
  4. **Optimization of the developed model**
  5. **Creating a web-application to demo the model**

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## Results and discussion

* 1. **Results**
  2. **Discussion**
  3. **Future work**

## Bibliography

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