

# Data-driven methods for modelling the energy use in non-residential buildings for benchmarking, optimization and control

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## Summary

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*Increasing use of building automation and sub-metering of energy use provides the opportunity for advanced energy use analysis and application of new business models. The PhD project focuses on developing data-driven methods for modelling the energy use in existing non-residential buildings that will lead to more efficient technical systems. The developed methods will be applied to (1) identify abnormal energy use patterns in buildings for quality control during operation, (2) optimize the operation of heating, ventilation and air-conditioning (HVAC) systems, (3) quantify the impact of energy saving measures after implementation.*

Research field:	Building and civil engineering and architecture
Supervisors:	Martin Thalfeldt Prof. Dr. Eduard Petlenkov
Availability:	This position is available.
Offered by:	School of Engineering Department of Civil Engineering and Architecture
Application deadline:	Applications are accepted between June 01, 2022 00:00 and June 30, 2022 23:59 (Europe/Zurich)

## Description

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The largest share of primary energy in the EU and Estonia is consumed in buildings. Therefore, it is essential to improve the energy-efficiency of the entire building stock to reach the climate neutrality goals by 2050. The Energy Performance of Buildings Directive requires installation of building automation systems (BMS) in a large share of non-residential buildings to improve energy-efficiency through optimal control of building service systems. Additionally, the share of intermittent renewable energy production is increasing, which makes it increasingly important to improve the energy demand side management in buildings. The Estonian energy certification scheme and best practice guidelines motivate installing separate energy meters for building service systems and monitoring the indoor climate. This gradually increases the potential of practical application of data-driven methods for modelling the energy use in non-residential buildings.

The goal of this PhD project is to develop such methods applicable for benchmarking, optimization and control. Specifically, the project should examine the long- and short-term energy use patterns of heat and electricity to benchmark the energy use against other similar buildings and identify the need and provide input for further energy auditing and potential optimization of HVAC control and quantify the impact of implemented energy saving measures. The research is conducted based on case study buildings from the campus of Tallinn University of Technology, and cities of Tallinn and Tartu.

The thesis should address the following questions: 1) How to identify abnormal energy use in non-residential buildings with data-driven models? 2) How to utilize the models for optimization of HVAC systems' control? 3) How to quantify the impact of implemented energy saving measures? 4) How to utilize the models for price-based control and demand side response?

## Responsibilities and (foreseen) tasks

- Identify potential data-driven models for modelling the energy use in non-residential buildings based on existing literature
- Compile an overview of potential application of the data-driven methods
- Conduct a survey of the collected energy data and building service systems in 25 case study buildings.
- Apply and validate the data-driven models based on the collected data
- Identify abnormal energy use patterns and provide suggestions for optimizing the control of HVAC systems in the case study buildings



- Quantify the impact of optimizing the control of HVAC systems and if possible other energy saving measured implemented during the project



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