Université de Liège

# Master Thesis Proposal: Analysis of aggregate battery models to characterize the flexibility of electric water heaters in the Belgian energy system

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## Context

Due to the fast deployment of renewable energy sources in the power system, an increasing amount of flexibility is required. Residential thermostatically controlled loads, such as electric water heaters, are good candidates to provide this flexibility at the demand side. However, the provision of flexibility with such appliances involves a large-scale control problem which poses computational challenges.

To address these issues, a recent line of research has been dedicated to the development of aggregate models, which allow to represent a large group of thermal appliances as one entity. Within these aggregate representations, virtual battery models are particularly useful, as they provide a clear view of the available flexibility and can easily be embedded in model predictive control frameworks.

## Objectives

In this master thesis, it is proposed to use such aggregate models to evaluate the potential flexibility that could be provided by a large number of electrical water heaters in the Belgian energy system. To that aim, the data and experience gathered by ThermoVault will be used and coupled to Dispa-SET, a power system model developed at the University of Liège. The final goal is to evaluate the beneficial impact of such systems for the further integration of renewable energy sources in the Belgian power system.

## Requirements

The candidate should have a Bachelor in engineering and a background in Electrical/Electromechanical/Energy engineering. Knowledge or experience in, Python, linear programming and in energy markets is a plus.

## Location

This final thesis will be performed within the premises of ThermoVault, in close collaboration with the Integrated and Sustainable Energy Systems (ISES) research team of the University of Liège. The selection of the candidate will be done based on a CV and a short interview.

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## Further informations

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