Title	Modelling of an Electrical Energy Storage Device at Saxion Flexlab
Company	Saxion, Sustainable Energy Systems (Project BatteryNL)
Assignment Type	Internship/Graduation EEE
Version	20240425

Introduction

In order to combat climate change, our modern world is currently undertaking an energy transition. This transition aims to reduce carbon emissions int the atmosphere and to end our dependency on fossil fuels. However, the energy transition comes with a number of challenges that need to be tackled. There is an increasing penetration of renewable energy sources such as solar PV and wind turbines as well as the electrification of traditionally non electrical processes such as mobility and heating. In order to provide the required electricity network flexibility needed to match energy demand and production, so called smart microgrids can be used. These are power networks which can actively control certain types of connected loads such as heat pumps and Electric Vehicles (EVs), as well as use energy buffering in the form of energy storage devices such as batteries, to balance energy production and generation locally. Furthermore, the effects of implementing smart grids are not always certain, and should be evaluated on a case by case basis.

In this context, the research line of System Integration and Smart Energy (SISE), from the department of Sustainable Energy Systems (SES), is developing a laboratory called the 'Flexibility Lab'. Its objective is to offer a testing environment to help both students and researchers learn more about electricity network flexibility and hence the energy transition. Two types setups will be available to use in September 2024, including a Nanogrid setup for system level simulations as a Hardware in Loop (HIL) setup for component level simulations. The setups will be useful within projects such as BatteryNL (see batterynl.nl), and eight year project with multiple partners in the Netherlands, tasked with developing the next generation of lithium-ion batteries, as well investigating the usages of such batteries in the electricity grid.

Problem definition

Within BatteryNL, SES is tasked with developing a system integration model. Consequently, it is useful to have an accurate model of a lithium-ion battery, specifically the battery type which is currently used in the flexibility lab. Often times models of batteries are simplistic, and only consider storage capacity and charge/discharge rates. It is necessary to have a model which considers other storage characteristics and dynamics. The model could then be integrated with the environment used in the Flexlab (python based tool DEMKit, developed by the University of Twente).

Objective

The objective of the assignment is to create and validate a model of a lithium ion battery in python. This model should also integrated into the DEMKit simulation environment. In a first step, the behaviour of the battery should be analysed by applying various (dis)charge profiles using the Nanogrid setup. Next, the behaviour of the battery should be modelled. Lastly, the model should be validated using a real world relevant use case, to be agreed upon at the beginning of the project period.

Assignment

The assignment activities are as follows:

- Literature research; you familiarize yourself with the Nanogrid setup, battery characteristics and DEMKit.
- A model must be implemented in python, and integrated into DEMKit.
- The scope of the model must be discussed beforehand.
- To investigate the characteristics of the battery, various (dis)charge test should be done using the Nanogrid setup. A testing procedure must be created to ensure that this is carried out correctly.
- The model should be validated to evaluate its accuracy. In addition, a microgrid use case should be investigated.
- You document your approach, the results and your conclusions sufficiently so that another student can continue with your research when you have completed the project.

What we offer
At the research group of Sustainable Energy systems, you will be able to:

- Work on problems that are relevant to the energy transition.
- Work on projects with regional partner companies and institutes.
- Have the independence to make the research your own, and have your curiosity lead the way within the bounds of the assignment.
- Make significant and relevant contribution to the projects we have. This includes the potential for scientific publications as well as presentations for partners.
- Work with researchers within the group allowing you to get up to date knowledge of energy transition challenges and solutions.

Requirement of Student
The student should be:

- Comfortable with modelling and simulations, as well as energy networks.
- Comfortable with dealing with applied research oriented projects.
- Preferable comfortable with programming, including Python (or willing to learn)
- Proactive approach.
- Able to work independently.
- Able to manage client expectations.
- Be able to work toward strict deadlines.
- Have an acceptable level of communication (English or Dutch).

If you are interested please contact e.w.schaefer@saxion.nl or b.homan@saxion.nl for more information and to set up an interview.