LABORATOIRE D'ELECTROTECHNIQUE ET D'ELECTRONIQUE DE PUISSANCE DE LILLE

Master project, 2021-2022

— MODELLING AND INTEGRATION OF ELECTRIC FLEXIBILITY OF TERTIARY BUILDING EQUIPMENT FOR ENERGY MANAGEMENT OPTIMISATION —

Supervisor: Benoit Durillon benoit.durillon@junia.com, Khaled Almaksour Khaled.almaksour@junia.com

L2EP – Univ. Lille1

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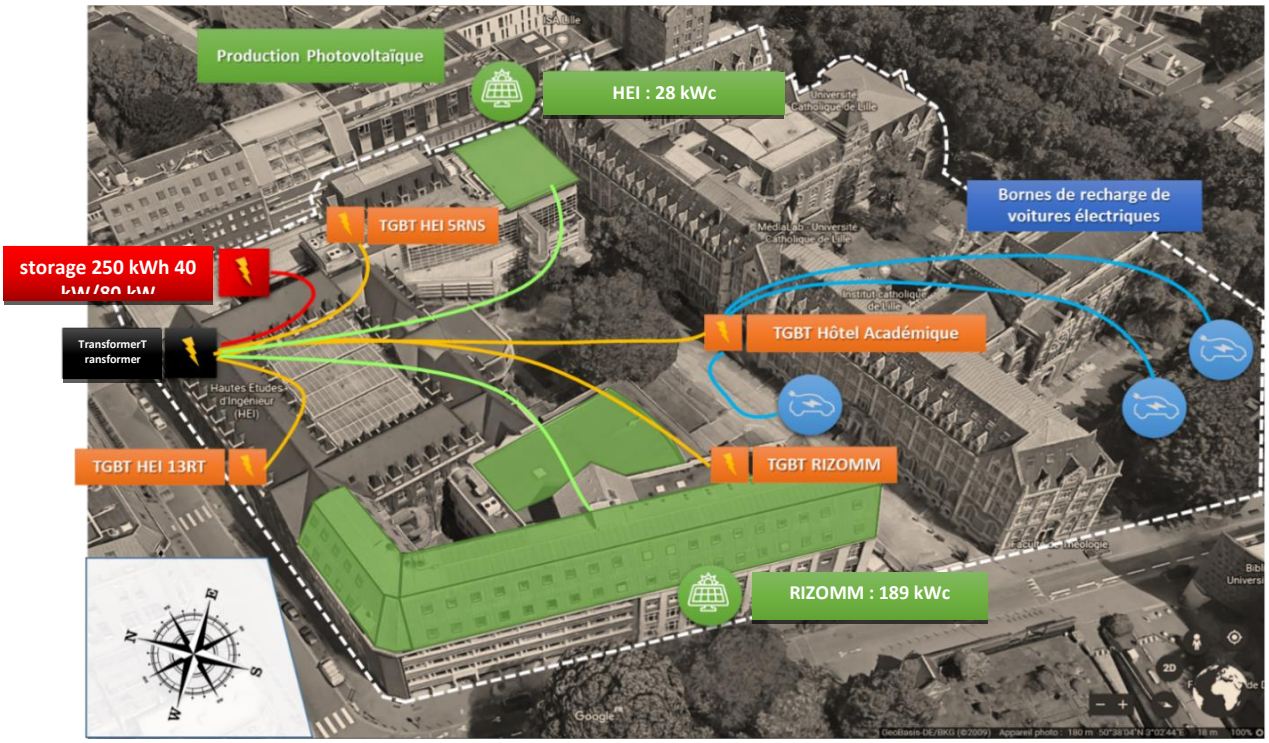
Context

The ebalance-plus project aims to increase the energy flexibility of distribution grids, predict the available flexibility, increase the distribution electricity grid resilience and design and test new ancillary models to promote new markets based on energy flexibility. These objectives allow unlocking the energy flexibility market in distribution grids to support energy end-users (prosumers), exploitation managers of Distributed Energy Resources (DER) and energy operators (e.g. energy aggregators and DSOs) with tailored end-user's interfaces.

In this context, Four building of the Catholic University of Lille are used as a smart grid demonstrator, and are monitored and controlled by Building management systems (BMS). Additionally, two Solar PV stations (218 kW_p), a set of battery (around 250 kWh, Li-Ion) and six VE charger are installed.



Catholic University / JUNIA Smart grid demonstrator

The goal of this project is to model the electric flexibility at the building scale, by studying all appliances and equipment able to participate in this flexibility, and to integrate it into new energy management algorithms.

Objective

The inventory of existing equipment has been carried out, together with their available and monitored data in order to construct the model of their operation. Based on this first work, this master project aims to model the possible flexibility of these equipment and its integration in optimization algorithms. This flexibility will be used to answer to the grid operator demands (see Figure 1), such as: lowering the consumption, reducing GHG emissions, reducing the cost, …

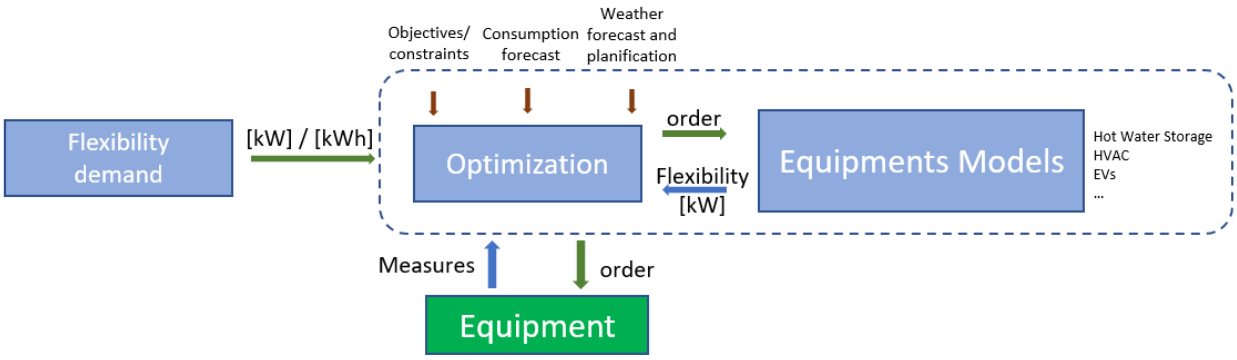


Figure 1: Flexibility in building energy management

After a bibliographic study on load side management, the first step is to analyse the electric consumption of each building to retrieve the contribution of each equipment to the total building load. Then, based on the existing literature, investigate the possible flexibilities (Shifting, lowering, increasing of the consumption) and define KPIs (Key Performance Indicators) for their estimation (keeping in mind that it will later be used for energy management optimization), given the building's objectives and constraints. Different definitions may be used, investigating various scenarios: with/without forecast and/or with/without global objectives.

The second step is then to integrate the modelled flexibility in the energy management algorithm and to test the feasibility regarding different objectives. AnalyzingAnalyzing KPIs will therefore be crucial to evaluate the obtained flexibility and the real gains on the reached objectives.

Work steps

Open to discussion, the work to be done could be organized as follows:

- Literature review on load side management, electric flexibility and its model and indicatorsindicators.
- Analysis of the daily load curve of each building of the demonstrator.
- Investigation of suitable KPIs and flexibility types with respect to the local buildings.
- Modelling of load flexibility based on appliances model and operating modes. .
- Investigating the ways of integration of the modelled flexibility in the energy management systemsystem
- Final report writing.

Key word

SmartSmart-grid, energy management, flexibility, appliances model