1 Python tool for the assessment of photovoltaic system performance, availability and fault

This MT will be organized in collaboration with LuciSun, which has developed an internal suite of software solutions to estimate plant performance and reliability and to automatically detect and diagnose the presence of possible faults in photovoltaic systems. The protocol of standardizing the configuration of input data received and data quality check is the main part that increases the time spent on analysis and the objective of this work is to validate and help on productizing the different algorithm present in the suite of tools. The master thesis will focus on the application of data analytics to several case studies of photovoltaic installations. One of the applications cases will be the PV installations present on the roofs of the ULB buildings and the procedures will be integrated into the automatic performance analyses and fault detection routines of the university. This work will be fully integrated in a large-scale European research project (SERENDI-PV).

LuciSun has developed an internal suite of software solutions to estimate plant performance and reliability and to automatically detect and diagnose the presence of possible faults in photovoltaic systems. The protocol of standardizing the configuration of input data received and data quality check is the main part that increases the time spent on analysis and the objective of this work is to validate and help on productizing the different algorithm present in the suite of tools. The collaboration will begin with an internship, the aim of which will be to familiarize the student with solar photovoltaic simulation in Python language. This internship will therefore focus on input data quality checks protocol and standardization of solar plants systems and portfolios. The work will be done in collaboration with the engineering team of LuciSun. The internship will then be followed by the master thesis which will focus on the application of these data analytics to several case studies of photovoltaic installations. One of the applications cases will be the PV installations present on the roofs of the buildings ULB and the procedures will be integrated into the automatic performance analyses and fault detection routines of the university. This work will be fully integrated in a large-scale European research project (SERENDI-PV).

2 Simulation tool in Python for the collective self-consumption of solar photovoltaic energy

PV production is an intermittent source of energy, and there is a need to assess mechanisms that mitigate and alleviate the associated problems so that more PV energy can be integrated into the grid at a lower cost. The company LuciSun has developed a simulation tool for the individual and collective self-consumption of buildings equipped with solar photovoltaic systems in the Brussels-Capital Region. This simulator is currently being developed to include the possibility of integrating the presence of charging stations for electric vehicles in the local network (V2G) and their influence on the self-consumption parameters. The purpose of this MT will be the development and integration of these new simulation options into the already existing tool. The master thesis will focus on the self-consumption of photovoltaic energy. This work will contribute to the development of a calculation model that simulates the self-consumption ratios, individual and collective, and self-production, for a set of neighboring PV installations in Brussels.
Validation methods for satellite-based solar irradiation and meteorological data and forecasting

The MT will be organized in collaboration with LuciSun that has developed an internal API that makes possible to provide satellite-based meteorological data for any coordinates in Europe and Africa. Prior to productizing its satellite data service, LuciSun would like to develop an internal benchmark validation protocol to compare its data with meteo station data and also with data provided by competitors. LuciSun has tested heuristical and statistical models forecast (ARIMA, SARIMA, OLS) and would like to test Machine learning models such as light gradient boosting machine. A proof of concept currently exists and Lucisun now aims to release an operational solar power forecast system that efficiently uses power production data from operational solar. The student will be required to:

- become familiar with the present forecast systems methodology (State of the art),
- get insights and understanding of LuciSun’s models (currently only ARIMA, SARIMA, and OLS already implemented),
- develop new models for intraday and day-ahead solar power forecasting integrating time-series models. This work will solely focus on non-physical models.

Development and validation of a simulation tool in Python of photovoltaic system energy yield

ULB-ATM and LuciSun have developed an online Python-based simulation software for the simulation of the energy yield of solar photovoltaic (PV) systems under complex situations. In particular, this simulation is currently among the most advanced software solutions in the world for the simulation of complex shading, bifacial energy gain, and the long-term energy yield assessment of PV energy yield and associated uncertainty. The simulation tool makes use of advanced 3D functionalities that were implemented in the last decade for the video game industry into the graphic processing units (GPUs) of the computers, which makes it possible to obtain advanced evaluations of the solar irradiance received on the front and back side of the PV modules. The master thesis will focus on the familiarization of the student with solar photovoltaic simulation in Python language, and he will contribute to the development and validation of this simulation tool. This work will be fully integrated in a large-scale European project (SERENDI-PV).