Authors: M.Foti and E. Petrianou, UBITECH

The active participation of the consumers in energy micro-generation through the installation of PV and battery equipment creates a new stream of beneficiaries, named **prosumers** and novel business models (prosumer-oriented business models). The role of the prosumers in the Phoenix project is to **promote the energy efficiency** by using as much as possible of the power generated on the building (maximizing the self-consumption) and minimize the excess of energy given back to the grid. The formal definition of self-consumption is the share of the PV energy production consumed in the dwelling that the PV is installed compared to the total PV production. Managing and optimizing self-consumption of on-site or off-site PV electricity, can be achieved either through local storage (battery use) or by load shifting of certain flexible assets to limit the grid feed at peak times where the price of electricity also increases. More importantly, the predicted day-ahead self-consumption optimization can guide the prosumer into making decisions based on the road of maximizing his/her energy cost saving.

Phoenix project mainly focuses on the following scenarios:

- **Optimal PV Generation Usage**: This scenario considers the maximization of self-consumption in demonstration sites where PV generation is available and consumption from EVs is simulated.
- **Optimal Battery Usage**: This scenario considers the maximization of self-consumption in demonstration sites where PV generation is available along with storage capabilities.
- **Optimal Battery Usage with Electrical Vehicles**: This scenario considers the maximization of self-consumption in demonstration sites where PV generation is available along with storage capabilities and simulated consumption from EVs.

All the above-described scenarios are formulated as a linear optimization problem under constraints, and only one optimal sub-case is selected amongst all others available.

The input variables of the Linear Programming problem to be solved include:

- Day-ahead generation forecast.
- Day-ahead demand forecast.
- EV characteristics, like the minimum and maximum accepted capacity of the battery, the charging/discharging rate, the battery capacity at the beginning of the optimization procedure and EV usage details for the simulation of a daily trip.
- Battery characteristics, like nominal capacity, minimum and maximum State of Charge, the charging/discharging rate and the initial capacity of the battery at the beginning of the calculations.

For the problem-solving procedure, Python's Pyomo library was used.

The optimization procedure of the scenarios is scheduled every day at the end of the day (11PM UTC) and is referring to the next day. The output of the formulated problem is the 24-value series of variables, indicating a suggested EV and/or battery hourly usage so as to achieve the maximum power to be self-consumed throughout the day. Based on the output variables, two metrics for self-consumption are calculated: The **self-consumption rate**, which refers to the percentage of total PV power consumed in respect to total energy produced and the **self-consumption factor**, which refers to the percentage of PV and battery power consumed in respect to total energy demand.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 893079