ABSTRACT

The growing popularity of photovoltaic (PV) micro-installations installed by individual consumers contributes to periodic adverse phenomena in the power system, the main reason being that the generation of these sources is too high in relation to the actual energy consumption in individual residential buildings, which means that the excess energy produced is fed back into the power grid. Remedial measures taken by distribution system operators, consisting in grid modernization and expansion, only improve the situation for a short time, usually until further micro-installations are connected in a given area. Moreover, these measures are very costly and take years to implement. Therefore, it is desirable to find an alternative solution that would increase the level of self-consumption of energy generated by PV micro-installations and thus reduce the amount of energy fed into the power grid by prosumers. To make this possible, a system for managing the energy generated at the point of production needs to be developed, which will perform the following functions:

- measuring - monitoring the current parameters characterizing the operation of the power supply system in the building under consideration, including the generation in the PV source,
- forecasting - consisting in the preparation of forecast profiles of the base demand of the building and the energy generation of the PV micro-installation integrated with it,
- optimizing - to plan the operation of the energy storage and the appliances with flexible switching times in a way that fulfils the set objective function,
- controlling - controlling the operation of energy storage and selected appliances in accordance with the operation plan developed for these devices.

The design and implementation of a system that performs the aforementioned functions will be a step towards efficient electricity management within a single building equipped with a PV micro-installation, energy storage and appliances with flexible switching times. This dissertation presents a proposal for a Home Energy Management System (HEMS) that is feasible for practical implementation in both newly constructed and existing buildings of this type.