SIMULATION OF DAILY PROSUMER LOAD PROFILES

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Nowadays, power systems around the world are being transformed by integrating renewable energy sources and new types of energy consumers. Prosumer are becoming a central figure in grid through the fusion of production and consumption. These processes tend to increase the discrepancies between the energy demand and supply in the household sector and might become a threat to the power system stability. To overcome these problems, it is necessary to create automatic control systems for the prosumer’s energy equipment [1], which in turn requires models of their energy generation and consumption. This report is dedicated to the problem of simulation of prosumer load profiles.

There are two main approaches to simulation of the household consumers load profiles – “top-down” and “bottom-up”. The “top-down” approach considers the household sector as a single energy consumer and does not take into account individual end-users. It uses aggregate historical power data of region and regresses individual household energy consumption depending on top-level variables such as macroeconomic indicators, energy price, and overall climate. The “bottom-up” approach extrapolates the estimated energy consumption of a representative set of individual households to regional and national levels. It consists of two different methods: the statistical method and the engineering one. Bottom-up statistical models describe basic devices usage and take into account a consumer behavior, leading to a deviation from typical energy consumption. Bottom-up engineering models estimate the device consumption based on their technical characteristics trying to cope the wide variety of energy devices in households.

Earlier in [1], a top-down model was used to simulate the operation modes of prosumer integrated into a smart grid. In this study, this model was changed to bottom-up models described in [2] and [3] and available as load profile generating applications. Model [2] is based on detailed behavioral models of the residential electricity consumers, while model [3] is more focused on the HVAC systems consumption. A comparison of the prosumer’s energy equipment operating modes showed an increased amount of battery charge/discharge switching, a shift in peak load moments, and a change of energy sale periods. This indicates a significant impact of the load model accuracy on the resulting control and working modes of prosumer power equipment.

A comparison of the models [2] and [3] and corresponding load profile generating applications showed that the model [2] makes it easier to take into account the local consumers and prosumers features, e.g. in Ukraine. In general, the use of bottom-up engineering models allows researching of the Smart grid control system at the initial stages of implementation while lacking detailed statistical information.

Reference:

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