Case study

St. Jean: how to implement Demand-Response campaigns based on the consumer's comfort and flexibility potential

The challenge

In the recent years, SOREA, among other DSOs, has observed a number of significant changes in its electrical grid; such as increased electricity consumption, increasing number of producers connected to the network due to liberalization of the electricity market, and integration of intermittent renewable energy sources due to the new objectives in the greenhouse gases emissions. Despite these changes, it is essential that the electricity network meets the consumer requirements and at the same time maintain a high quality of service, balance of supply and demand, and safety of the system.

In this context, three levels of the electricity distribution system architecture need to be addressed in order to update the network services and meet the requirements of safety, quality and stability: the transmission and distribution network, the communication and data collection, and the level of applications and services. The application of smart grid technologies is expected to promote the network modernization on these three levels in order to keep up with the ongoing changes.

The solution

To address the aforementioned points, TREK in co-operation with SOREA has designed and developed the St.Jean Pilot Scheme in regards to three of the InteGRIDy project pillars: Demand response, Smartening the distribution grid, and Energy storage. The purpose of this pilot scheme is to implement and test an innovative portfolio management system that allows ESCOs/ Aggregators to optimize and implement DR campaigns taking into account the consumer comfort and flexibility potential. To achieve this, a user profile framework has been developed based on real-time energy demand data and ambient information from the consumers' premises in order to define continuously calibrated, personalized visual and thermal comfort profiles, dynamic consumer flexibility profiles and assess the assets' capabilities to virtual energy storage. Both commercial and residential buildings have been selected as pilots.

As the proposed system relies on the continuous flow of monitoring and metering data streams from the participating buildings, the establishment of a non-intrusive and flexible IoT system is necessary to allow the DSOs/Aggregators to have real-time access to their consumers' data. Additionally, an intuitive and easy-to-use tool that provides visual analytics for the comparison of the received data is necessary to facilitate the portfolio management, the evaluation of the proposed DR strategies and the actualization of the available dispatch control actions.

For these purposes, TREK has designed a complete solution including the design of a sensor network based on off-the-shelf meters and sensors to be installed at the consumers' premises, a reliable and robust data management system, and two tools: the Demand Side Energy Profiling (DSEP) tool and the Visual Analytics Engine (VAE) tool.

The designed sensor network allows the collection of information at the consumer premises in a non-intrusive way as it is based on wireless protocols, eliminating the use of cables. The data management system collects real time data from the installed devices, additionally offering a back-up mechanism to avoid the loss of information in cases of connectivity disruptions. The data streams are uploaded to TREK's cloud server where they were processed and stored in a dedicated data base.

The DSEP tool deployed in the cloud server uses the collected data streams in order to derive personalized visual and thermal profiles of the consumers and DER profiles of the available devices. By correlating these profiles, the available flexibility is assessed in order to allow the generation of optimized DR scenarios that also preserve the indoor conditions within the acceptable comfort conditions of the users. Last but not least, the VAE tool provides a visualization and interaction mechanism that provides the DSOs/Aggregators with different metrics and KPIs which facilitate the analysis and management of their asset portfolio through a web application. Functionalities such as "what-if" scenarios to allow the optimization of the DR campaigns and dispatch control signals to implement them are also included in the web application.

The benefits

The installations of the non-intrusive wireless sensor network have been successfully carried out at the pilot buildings at the St. Jean area, and a continuous data flow of indoor conditions and energy consumption information has been established. The bilateral communication of the developed system with the actuators installed at the pilot buildings allows not only the collection of information regarding the operational status of the electrical equipment at the consumer premises but also their remote control within the scope of the proposed context aware DR strategies. In this way, the conventional energy transmission grid becomes smart and enables the optimization of the DR campaigns in a human-centric way, using accurate and personalized flexibility profiles of the consumers.

The developed tools offer a number of innovative functionalities to the involved business stakeholders, who can adjust their business strategies based on a human-oriented philosophy to improve the effectiveness of their offered services and increase user acceptance. In this way, the competitiveness of the DSO in the electricity market is increased as the quality of services provided is improved. Finally, the visualization tool developed within the scope of InteGRIDy provides to the DSO a user friendly and intuitive way of monitoring and managing the assets composing their portfolio through a wide list of metrics and KPIs.

Contact details:

TREK Consulting SA

A 32 Perikleous St, 15232 Athens, Greece

Angelina Katsifaraki - a.katsifaraki@trek.gr

SOREA Energies & Communications

6 Rue Porte Martel - ZA Pré de Pâques

73870 Saint-Julien-Montdenis, France

Romain Chomaz - Romain.Chomaz@sorea-maurienne.fr

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731268.