Improved Modelling of Electric Loads for Enabling Demand Response by Applying Physical and Data-Driven Models - RESPONSE

The aim of the project is to develop enhanced models for load and control response forecasting required by dynamic on-line optimization of demand response (DR) actions and network operation in a future sustainable energy system. DR is one of the key issues in adaptation of energy production and consumption and in creating flexibility to integrated energy systems. In addition to DR also other novel forthcoming Smart Grid related functions like price elasticity, customer level micro generation and electric vehicles affects distribution network loads and these effects should be taken into account in the load models.
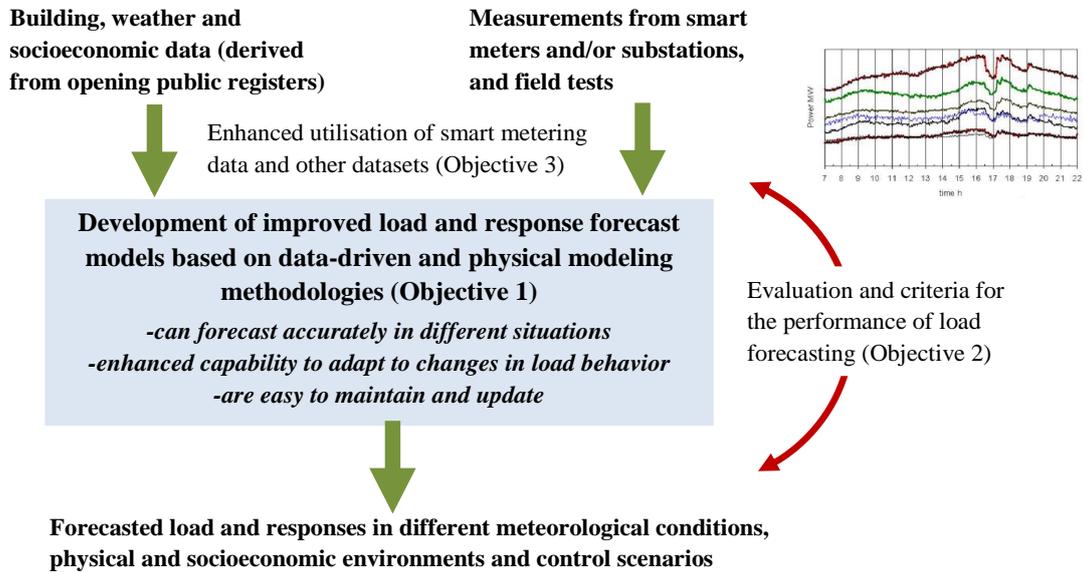
The project is carried out in the multi-disciplinary research consortium with wide scientific expertise including units from Tampere University of Technology, University of Eastern Finland and VTT.

Research project focuses on the following objectives:
1) Developing improved models for short term load forecasting and optimization of electric load dynamic responses to load control actions and weather variations.
2) Analyzing and developing criteria for comparing the performance of the short term load forecasting.
3) Enhancing utilization of smart metering data and other spatial information in updating and verification of load response models.
4) Proving that the developed load modelling methods improve the state estimation and network analysis accuracy.

The research methods include various mathematical and statistical methods, including artificial neural networks, support vector machines, Bayesian methods, Kalman filtering, modern control and optimization methods, and simulation environments.

The research project utilizes industrial co-operation in terms of data and knowledge exchange and practical piloting. Large smart metering data sets and field tests from several network companies are used together with open data (i.e. weather, building and socioeconomic grid data) in modelling.

Building, weather and socioeconomic data (derived from opening public registers)

Measurements from smart meters and/or substations, and field tests

Enhanced utilisation of smart metering data and other datasets (Objective 3)

Development of improved load and response forecast models based on data-driven and physical modeling methodologies (Objective 1)

-can forecast accurately in different situations
-enhanced capability to adapt to changes in load behavior
-are easy to maintain and update

Evaluation and criteria for the performance of load forecasting (Objective 2)

Forecasted load and responses in different meteorological conditions, physical and socioeconomic environments and control scenarios

Research group (titles and tasks, and contact information)

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