Project Outline – short and long description

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Project – short description	Helen Electricity Network Ltd. has participated to Finnish research program Smart Grids and Energy Markets (SGEM). During the first period on one specific work package with Aalto University and Tekla Ltd. AMR data is used in spatial long-term scenarios of electrical energy consumption in Helsinki area. In the tool, background data from various sources was linked to the measured load curves. During the second research period to simulated scenarios will enable possibility to make modifications due to expected demand response, energy efficiency improvements and heating type changes. Especially effects of demand response to spatial load curves are challenging to model. Otherwise demand response is also most important modification, because it can cause big changes to electricity load. There are both technical and economical limitations to the large scale implementation of demand response. Output of research task will be mathematical model how demand response can be taken into account in electricity load curves mainly on the economical point of view. Finally modifications due to demand response can be included to existing load scenarios.

Project – long description (max. 5 pages):

Ville Rimali

Model of demand response to spatial load curves

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1. Introduction

At the moment, AMR meter deployment is going on in Finland. By the end of 2013 practically all the customers will have new meters. In the future, a considerable amount of hourly metered load data will be available and new applications based on this data is being developed.

Helen Electricity Network Ltd. has participated to Finnish research program Smart Grids and Energy Markets (SGEM). During the first period on one specific work package with Aalto University and Tekla Ltd. AMR data is used in spatial long-term scenarios of electrical energy consumption in Helsinki area. Electricity utilities need long-term scenarios when responding to the development of the society. While the planning and building of the transmission system and substations may take several years to over a decade the time scales of the scenarios should accordingly cover these needs.

In the developed scenario tool, the measured load data acted as a starting point of the scenario. In the tool, background data from various sources, like the network information system, the customer data base, municipality registers, interviews, the temperature data, was linked to the measured load curves (Figure 1.). Manifold analyses were made possible and e.g. load curves can be updated and specific consumption determined. In the project, the measured load curves were analysed in respect of the temperature and the day light. In addition, the customer type can be recognized from the measurements without using any background data.

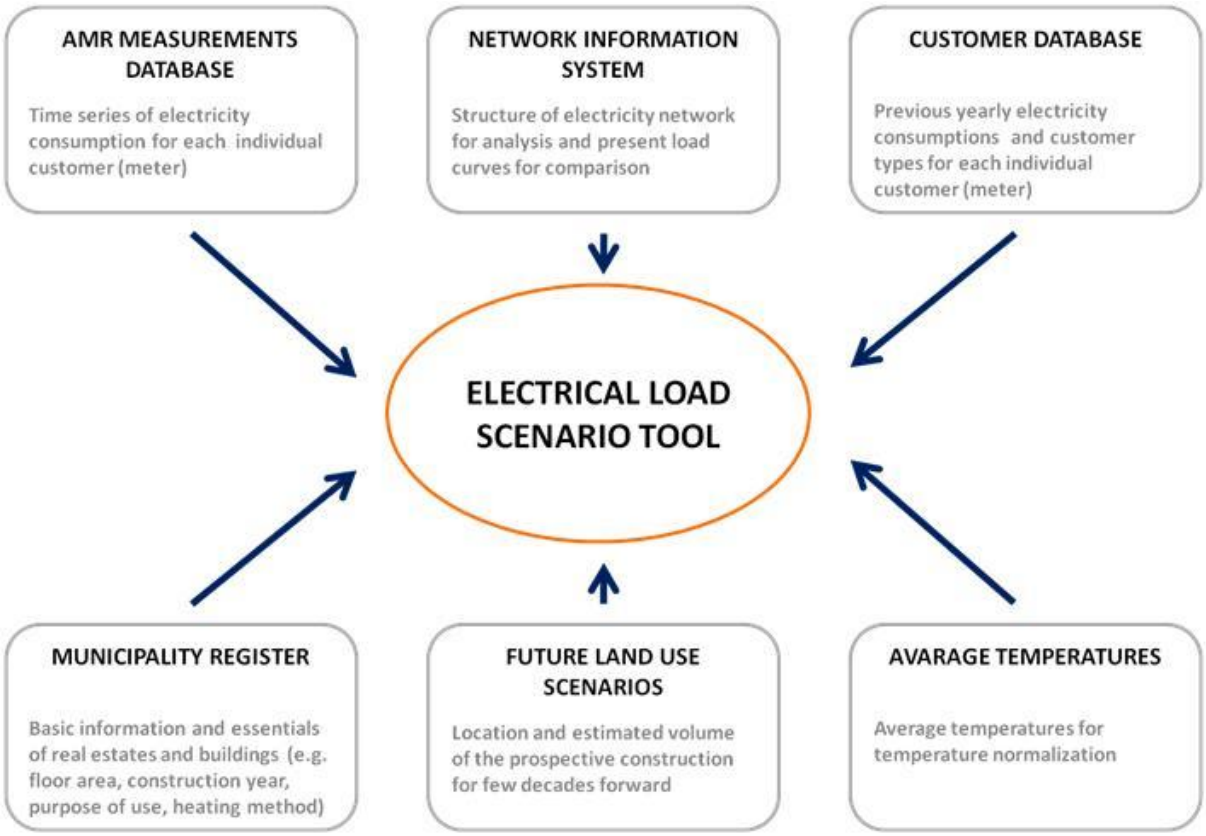

Figure 1. Modern Scenario tool includes several data sources

A spatial simulation method was applied to create the load forecasts. In this part, the spatial future construction of the area was a critical input data. In addition, the future changes of the use of electricity and totally new loads can be added by to the present, temperature normalized load curve.

During the second research period that began on March 2011, to simulated scenarios will enable possibility to make modifications due to expected demand response, energy efficiency improvements and heating type changes. Especially effects of demand response to spatial load curves are challenging to model. There are both technical and economical limitations to the large scale implementation of demand response. My personal task is concentrate to economical possibilities and limitations of demand response on modern smart grids.

2. Aims/Objects

The main goal on this task of the project is model the comprehensive and as accurate as possible modifications to spatial load curves resulting from increasing demand response. To achieve this goal both technical and economical characteristic of whole Nordic electricity network and its electricity market have to take into account.

3. Methodology

Implementation of this task will carry out with following steps:

1. Determine the correlation between electricity load and electricity price

Study correlation between electricity load and electricity price on the Nordic electricity market utilizing a regression model where electricity price is dependent variable and electricity price is explanatory variable. Determine what is the coefficient of determination. Modeling can be done utilizing historical electricity prices and loads on Nordic Electricity Markets.

2. Surplus potential of the load balancing to electricity providers

Determine the possible surplus potential of the absolute balanced load. This settles the upper limit for electricity price discounts to customers utilizing demand response. Are the possible incentives sufficient to encourage customers to be flexible with electricity consumption? How elastic electricity demand really is? What is the difference on demand elasticity if you avoid consumption or move it to other hour? If everybody uses electricity during lowest price, it won't be cheapest price any more.

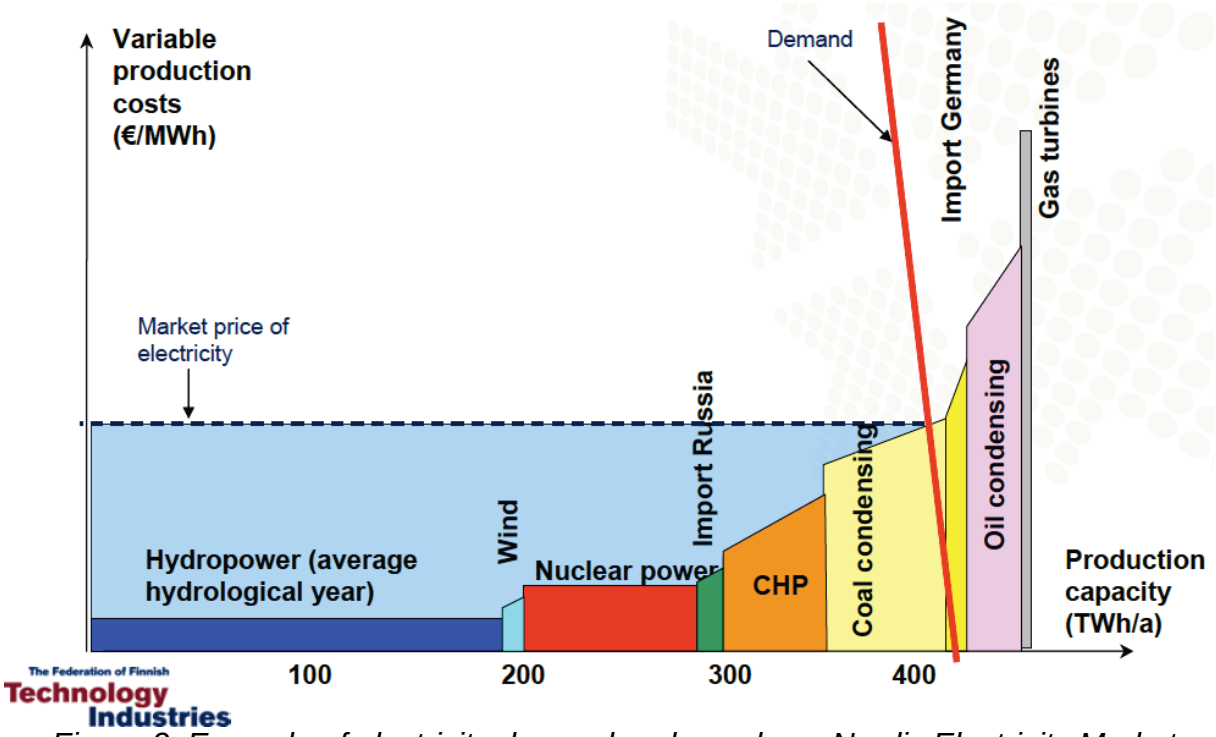

Figure 2. Example of electricity demand and supply on Nordic Electricity Market

3. Technical limitations to demand response

Figure out the technical limitations to demand response on the Nordic Electricity Markets. How much individual customers have electricity load that can response to demand. Settle network further limitations to demand response: spatial production capacity, network's transmission capacity, electricity price areas or legislations.

4. Modelling effects of demand response to load curves

Based on previous steps we can model the demand response's effects to spatial load curves as a modification to existing load curves.

4. Output

Mathematical model how demand response can be taken into account in electricity load curves mainly on the economical point of view. Make scenarios to load curves on many implementation levels of demand response. Finally include effects to existing load scenarios.

5. Summary

During the earlier research period has been noticed that possibility to make modifications to existing electricity consumption scenarios is needed. Most demanding modification to future's load curves is effects of demand response. In the model have to take into account both technical and economical limitations of extensive demand response. Although, studying previous steps in this research task, modelling the demand response to load curves should be possible.