



CITIES

Centre for IT Intelligent Energy Systems

Smart Meter Data Analytics

Objective

This CITIES demonstration project is aimed at investigating data mining of smart meter electricity consumption data. WP1 is focused on end user behavior and data management, this demo case will investigate different approaches to analysis of smart meter data. Initially only the data from smart meters will be used to develop statistical classification framework to identify different consumption patterns. The classification will help give a more detailed picture of consumption patterns which then can be used for estimation and dimensioning of the energy grid. It is the hope of this project to gather socio-economic, demographic and weather data to develop the classifications even further.



Partners

- Dansk Energi
- DTU Compute
- DTU Management Engineering, Systems Analysis
- Syd Energi

Background

Traditionally classification of electricity customers has primarily been based on statistical data known about the customers, and their known energy consumption reported biannually. By the end of 2020 all electricity customers in Denmark will be equipped with digital meters (Smart meters) that automatically reports energy consumption at least every 15 minutes. This is a huge change from the biannual reporting done by the consumer. Going from 2 observations to 35040 observations per year for each household makes it possible to profile

consumption on much more detailed level. Some DSO's have already installed smart meters, and been collecting data for some years.

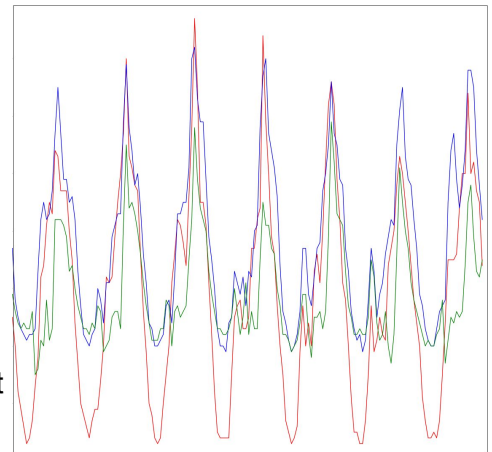
Connection with CITIES WP's

WP1: End user analysis

WP5: Forecast and control

Data description and methodology

This demo project will utilize data from Syd Energi and will include data from about 270.000 smart meters, with 15 minutes to 1 hour resolution and recorded for approximately one year. There is neither physical information about the building types nor information about demographics or socio-economic relationship provided with the smart meter data – it only contains the consumption data (current, total and segment). The data includes a wide variety of consumers, e.g. private houses, apartments and businesses. The current classification label has more than 130 different profiles. Some of these segments contain only a couple of meters. Using statistical classification techniques on the smart meter data will improve the current profiles and reduce the number of classes.



Methodology

Data from the demo project will be used to show how smart meter data can be utilized for classification and characterization of electricity consumption.

On a 15 minutes level the meters are not failsafe, and there can be large series of missing data in each meter's total data stream. This very seldom affects the billing information over the consumption period, but the exact meter reading at an exact timestamp can be missing as well as there can be series of missing values. In order to ensure the raw meter data is fit for analysis a thorough data refinement of the data is needed. It will be required to investigate techniques for imputing missing data in time series, on single values and missing chunks of data.

Modern techniques from machine learning and time series analysis will be used to develop classes that the consumers can be segmented into and afterwards to characterize the consumption in each profile. It is the intend to develop a method that will be able to calculate an average consumption for each profile and indicate if a specific consumption realization is above or below the average profile. This can help identify consumers who have a high

consumption and quantify the consumption in a monetary setting directly to the consumer, or for energy optimization consultancy.

Expecting that customer profiles can develop over time, both within classes and move between classes, techniques from statistical process control will be applied to see if they can detect changes in consumption or switch between profiles.

To further develop insights of the profiles and characterizations, we will investigate if there are physical, climatic, demographic or socio-economic data that can be utilized for better classification of the data.

Deliverables

Development of methods for segmenting time series consumption profiles from electricity smart meters.

Framework, of algorithms and software for segmenting and analyzing electricity consumers using only smart meter data, and potentially find external data for improved knowledge of the identified segments.

Time Schedule

2016-2017