Distributing costs in the electricity sector using a bottom-up Big-Data approach

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Overview

The amount of available consumption data is rapidly increasing in the electricity sector, partly because of recommendations made by the EU. In Sweden, this has led to regulatory demands which stimulates an expansion of smart electricity meters with an ability to deliver hourly meter readings. But there already exists consumer technology (meters) which are able to perform metering with intervals down to 6 minutes. But this data doesn't hold a value just by itself, so how do we utilize this information to achive a more efficient electricity market?

We believe that one area of usage is for complementing the traditional top-down approach which dominates in the electricity sector, where patterns and changes are analysed based on aggregated data. While this method of analysis should not be diminished, it can benefit greatly from being complemented by a detailed bottom-up analysis, leading to more trustworthy results.

Today, electriciy retailers and DSO:s have limitied information regarding their customers. But as available data becomes of a higher resolution, the easier it gets to identify individual loads based on the composite load profile (e.i. the load profile that passes through the meter). This way it is possible to gain increased knowledge regarding how the load will look like under certain conditions, for instance leading to more accurate prognosis of future demand. And on top of the fact that this will lead to lowered risk for market actors, it will also allow a more accurate and cost reflective pricing on individual customer level.

For the DSO, the ability to determine how individual consumption patterns directly relates to costs gives the opportunity of putting together tariffs which facilitate demand response based on the individual customer's idiosyncratic composite consumtion profile. While a unique tariff for each and every customer might not be efficient, clustering together customers based on what kind of tariff-construction they get most incentivized by could be. All customer-types have different prerequisites and ability to adapt, compare for instance street lighting with an apartment. For the apartment, a power-tariff (EUR/kW) could provide a clear incentive while a energy-tariff would present a much more obvious incentive for the street lighting (since the street lights have to be lit all the dark hours of the day, which means energy efficiency is a much clearer incentive).

Another effect from being able to determine the costs each customer is creating, is that it will get clear which customers that are subsidizing others. In Sweden a tariff based on fuse-size is commonplace, in large part because of the fair accuracy it provides even with access only to monthly metering. But with hourly metering it becomes possible to determine costs to a greater extent based on the consumption profile.

Methods

By gathering consumption data from a vast number of customers and using specially adapted software, it is possible to achive a quite flexible and cost effective management of large quantities of data. And by also collecting parallel datasets (eg. weather-data, market-price data and costs for the DSO) various analytics is possible.

Furthermore, with statistical methods one can cluster together groups of customers which share similar traits by using for instance the method *k-means*.

Results

By using the *k-means* method, individual consumption patterns are clustered together and trends become visible. With this information, the DSO can for instance create more cost reflective tariffs which allocates costs more fairly. Also, creation of tailor-made tariffs taking into account the individual customer's DR-resources and/or energy-efficiency potential can facilitate increased effectiveness due to givning the customer a more tangible way for cost reductions.

Conclusions

Given the current market setup, the DSO:s tariffs is a powerful tool for initiating change. And tariffs which are more cost-reflective and presents tailor-made incentives can facilitate a change to a more efficient electricity sector.

The method of performing analytics on lagre amounts of disaggregated consumption-data will lead to increased knowledge in the sector regarding what drives the demand. If used correctly, it will also result in an improved cost-reflectiveness which makes sure that actions are taken where they are needed the most.

References

Synthesis of electricity tariffs, REPORT 2015:170, Energiforsk

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