RP1023

RESIDENTIAL & SMALL COMMERCIAL ELECTRICITY LOAD FORECASTING

Research Question

What is the most effective method for forecasting residential & small commercial electricity loads? Accurate short & midterm forecasts are fundamental components of energy management solutions. These forecasts can not only benefit individual home owners but also give crucial information to the electricity industry and policy makers.

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Figure 1: Forecasting and home energy analysis in residential energy management solutions (lowcarbonlivingcrc)

Methodology

The following models have been used in the research so far: Regression, Polynomial Fit, Neural Networks, Regression Trees. Other common methods are Time Series (AR, ARMA, ARIMA), Conditional Demand Analysis (CDA) and Physical Engineering Models. Top down approach focuses on aggregate forecasts whereas bottom up approach focuses on individual household or appliance level forecasts. The model selection should be based on the available data set, desired accuracy and ease of implementation.

Results

Detailed data and information for the desired building may not always be available for use. Statistical models are known for their ease of use and can give accurate forecasts with using historical time series load & weather data. CDA and physical models on the other hand, require more detailed data on the household demographics and building envelope. One of the aim of the project is to produce accurate forecasts without relying on detailed and difficult to obtain datasets which makes statistical models a favourable point to start with. Some other machine learning models are also used as an initial analysis. Below table summarises the model verification results for hourly forecasts by use of different methods on a sample household.

	Rsquared	RMSE
Regression	0.341	391.47
Polynomial	0.246	434.7
Neural Networks	0.587	369.27
Regression Trees	0.664	516.99

Figure 2: A table of comparison for the results obtained by using different models on a sample house electricity load.

The research is at its initial stages, the next steps include but not limited to; using other machine learning methods, time series models, implementing CDA, building hybrid models and focusing on peak load forecasting. The desired forecast resolutions can be half hourly, hourly, time of use, daily or weekly forecasts.

Conclusions

The initial efforts has shown that statistical regression models may not give the most accurate results for residential load forecasting since occupancy behaviour has a major impact on the loads. Predictions become a more difficult task for the regression methods as it is not easy to capture the underlying relationship between the load and other parameters. The initial analysis showed that the Regression Trees (machine learning) gave the most accurate forecasts.

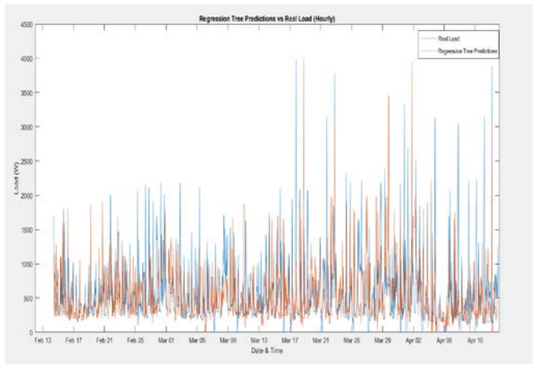

Figure 3: Forecasts made by using regression trees vs real electricity load (Feb13-Apr13 2015).

Anticipated impacts

Accurate electricity load forecasts will assist energy management solutions and benefit residential & small commercial owners by giving them an opportunity to have effective control on their electricity consumption. Having a better understanding and analysis of residential energy consumption can further benefit policy makers and electricity industry.

Key statement about the research project to go into this space (what is the key message?).

Accurate residential & small commercial building electricity forecasts are fundamental components in energy analysis and energy management solutions. These forecasts can bring significant economic and environmental benefits to individual owners and society.

Further information

The project is a collaboration between CRC, UNSW and Solar Analytics. Below, are the names of the academic supervisors involved in the project.

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