Smart Battery for Smart Energy Usage

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Data Science for Smart Grid

The Smart Grid is the system that always tries to satisfy the equilibrium between energy supply and demand. How does it do it?

- By utilizing electronic devises (smart meters) which collect data about energy consumption
- Analysis of obtained data and use of machine learning techniques to derive predictions on energy demand
- Introduction of energy storage devices (batteries) in households brings new opportunities for a more efficient and reliable energy demand and generation.

London Household Smart Meter Readings

I used large collection of smart meter data obtained by UK Power Networks a sample of 5,567 London households between November 2011 and February 2014.

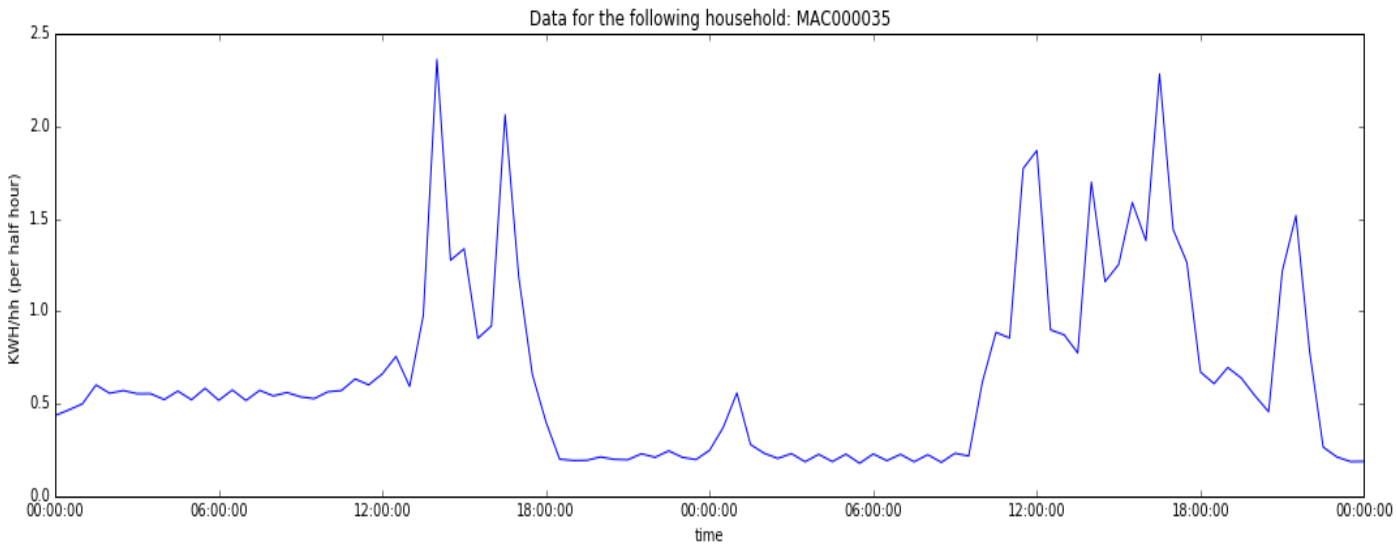

Figure: Two days energy demand for a typical household.

Modeling Technique

I have developed complex model which consists of a number of ARMA sub-models. Below is outline of its architecture:

- I split day into a several time intervals and train a separate sub-model for each time interval over a number of days of previous data.
- Each sub-model produces a single prediction for one day ahead of training data such that all sub-models together produce forecast for entire day.
- Smart meter data present 48 records for a single day with half hour interval. Thus, the entire model is a combination of 48 sub-models trained separately for each time interval.

Performance of the Model

Each model can be trained on weekdays/weekends subsets of data only as well as on data with no split with respect to different parts of week.

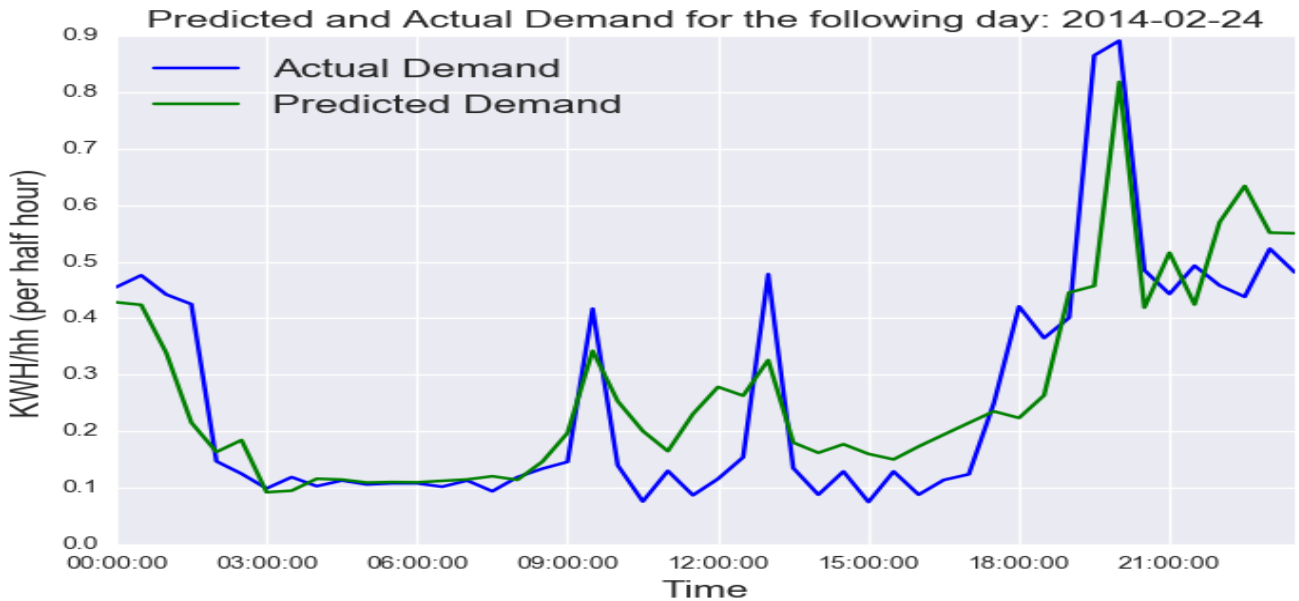

Figure: Weekdays 48 sub-models model forecast for one day. The model was trained on 350 days.

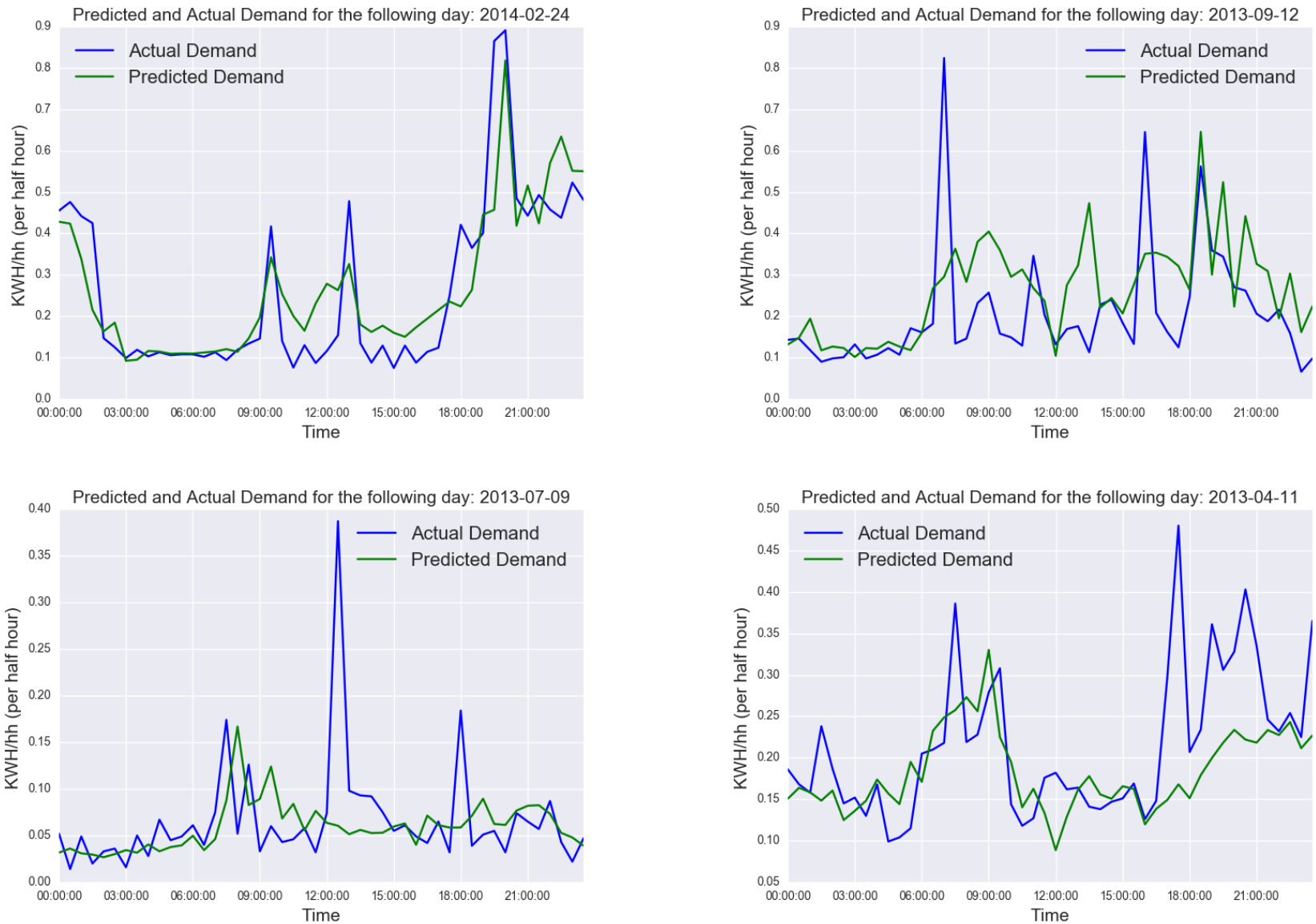

Figure: Weekdays model forecast for one day for 4 households.

Predictions of the Battery Charge-Standby-Discharge Cycles

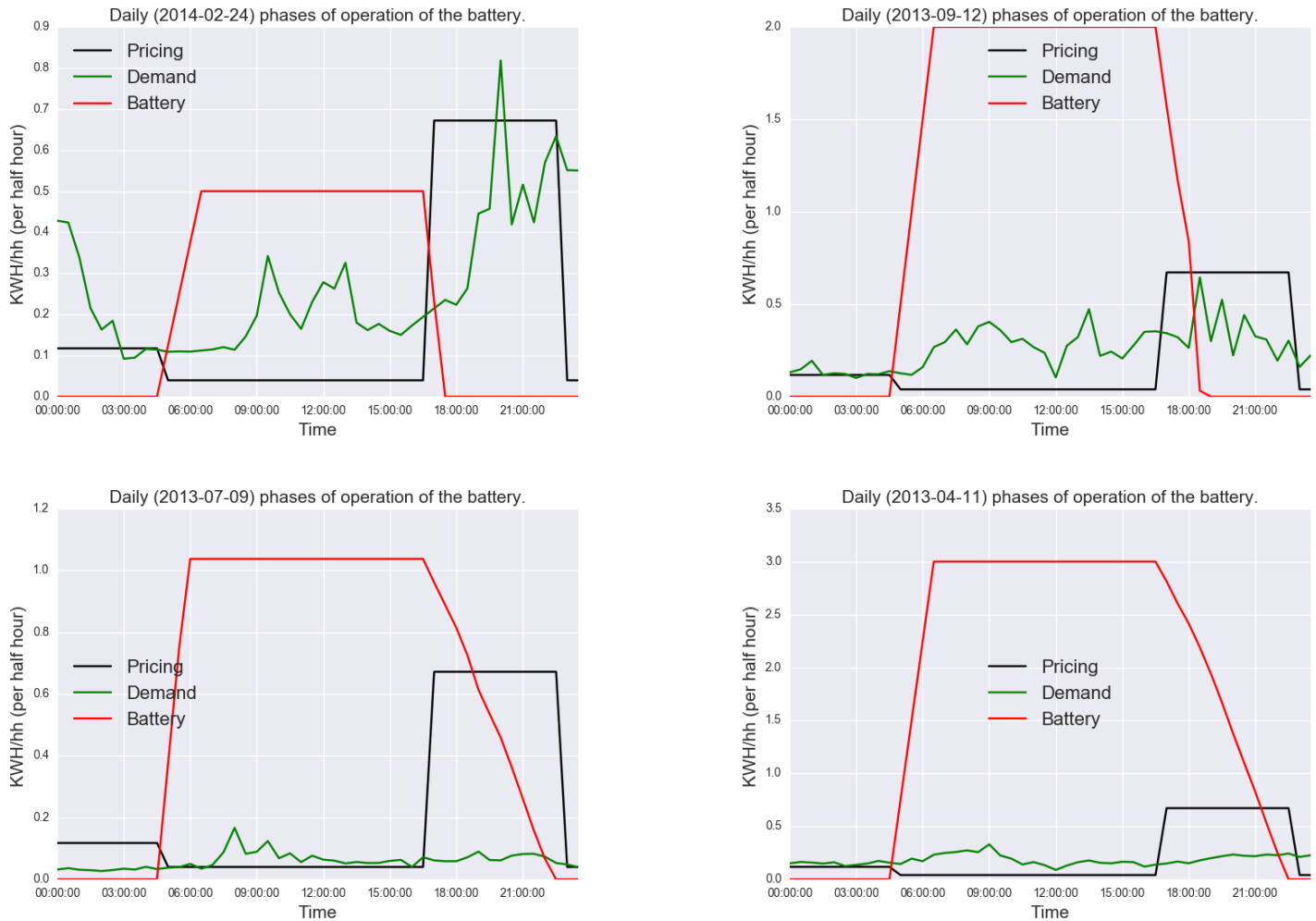

Figure: Weekdays forecast for the battery cycles for 4 households.

Ruler to Determine Optimal Size of Battery

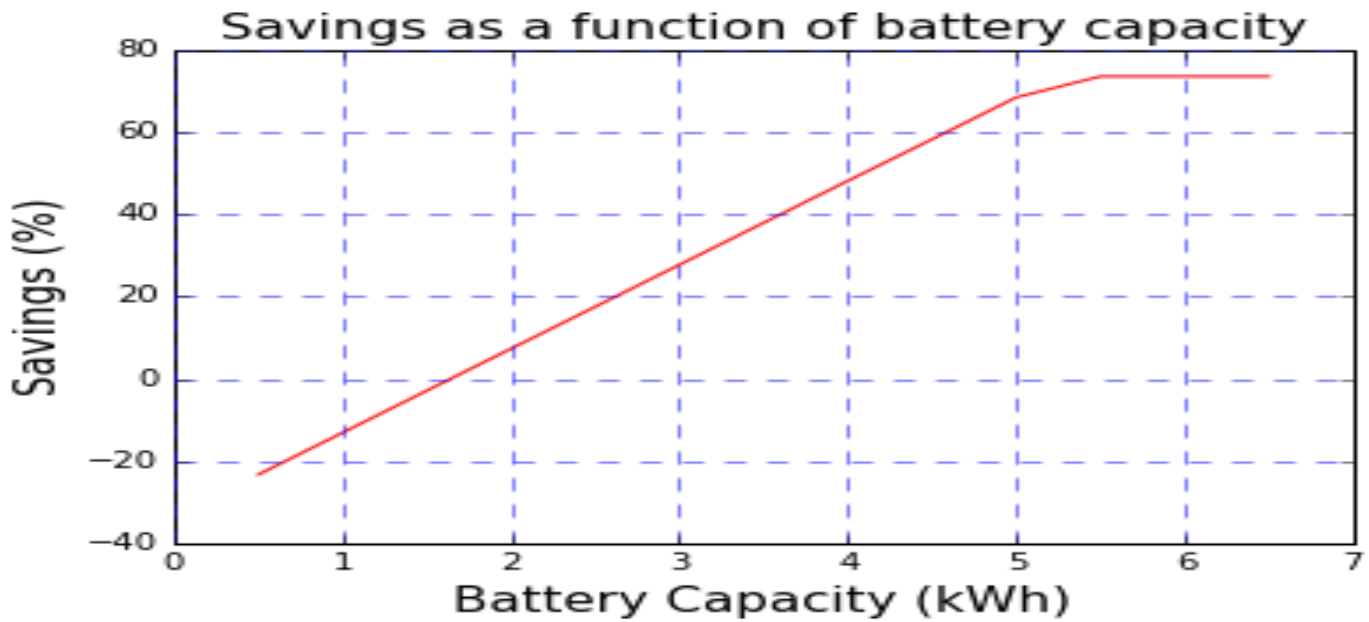

Figure: Forecast of potential savings for a particular household and various battery capacities.

Thank You!

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