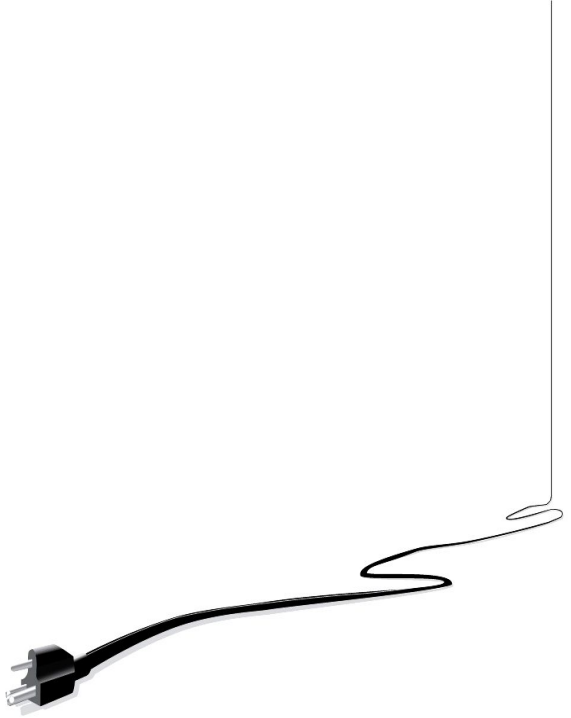
Day-Ahead Electricity Price Prediction



Carter Bouley

Project Goals

Wholesale Electricity prices change over the course of the day

This provides opportunity to optimize consumption according to prices

Price Prediction

- Electricity prices follow patterns over ***daily***, ***weekly*** and ***seasonal*** timeframes.
- Machine learning techniques can be utilized to ***predict*** these patterns effectively

Few electricity providers give their customers access to wholesale prices.

Octopus energy has designed an 'Agile Tariff' which does exactly that.

Data Collection

Electricity

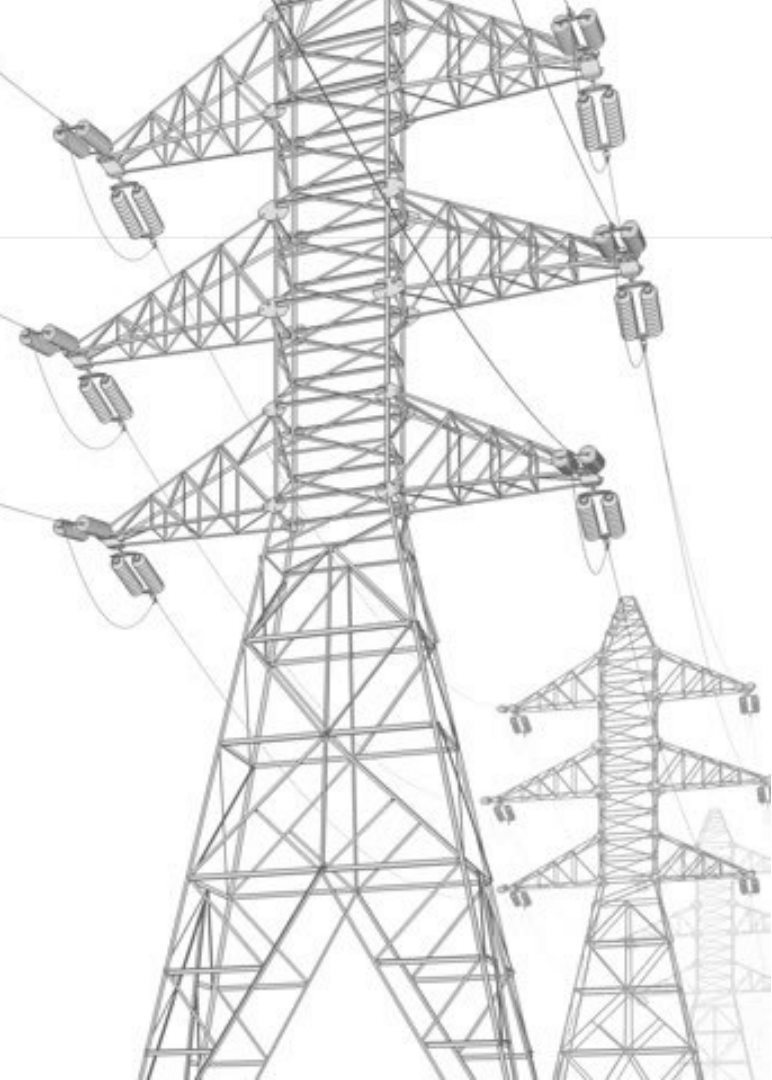
- Hourly electricity price data

Commodity

- Daily commodity prices

Temperature

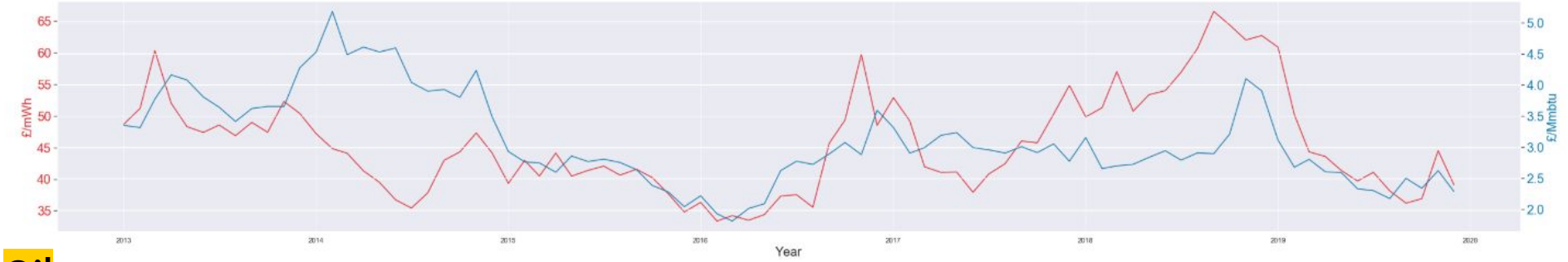
- Hourly temperature data



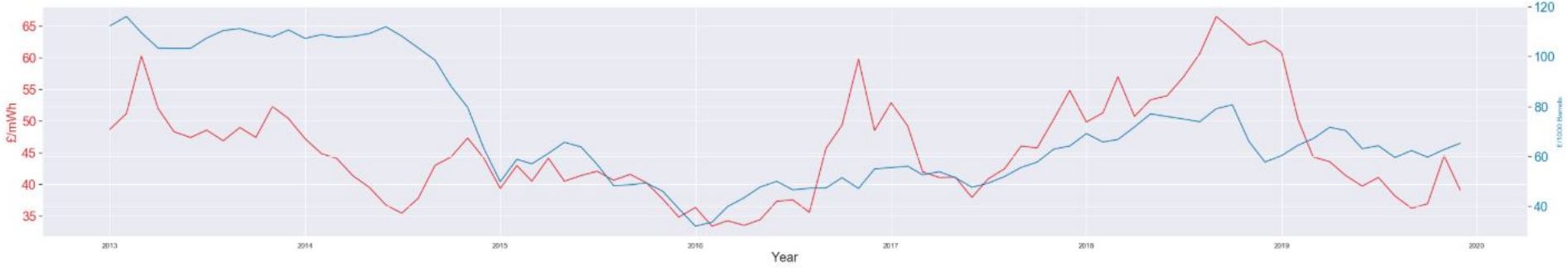
Daily Patterns

Adding Multiple Variables

Natural Gas

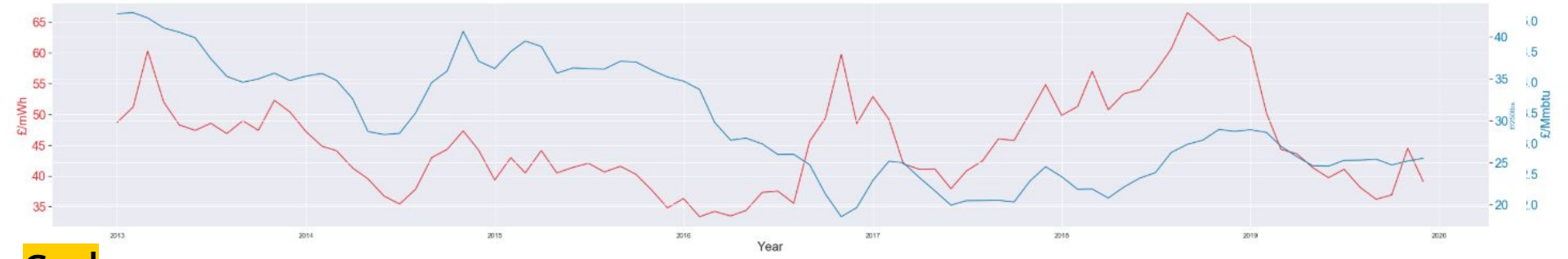


Oil

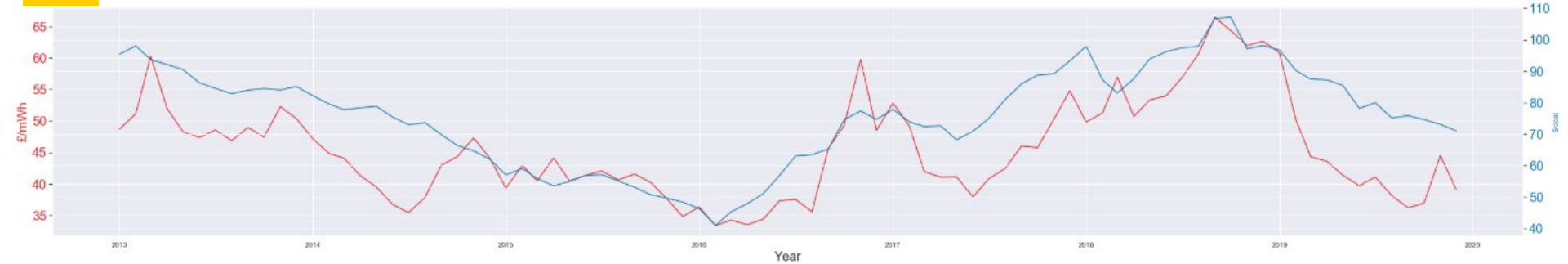


Adding Multiple Variables

Uranium



Coal

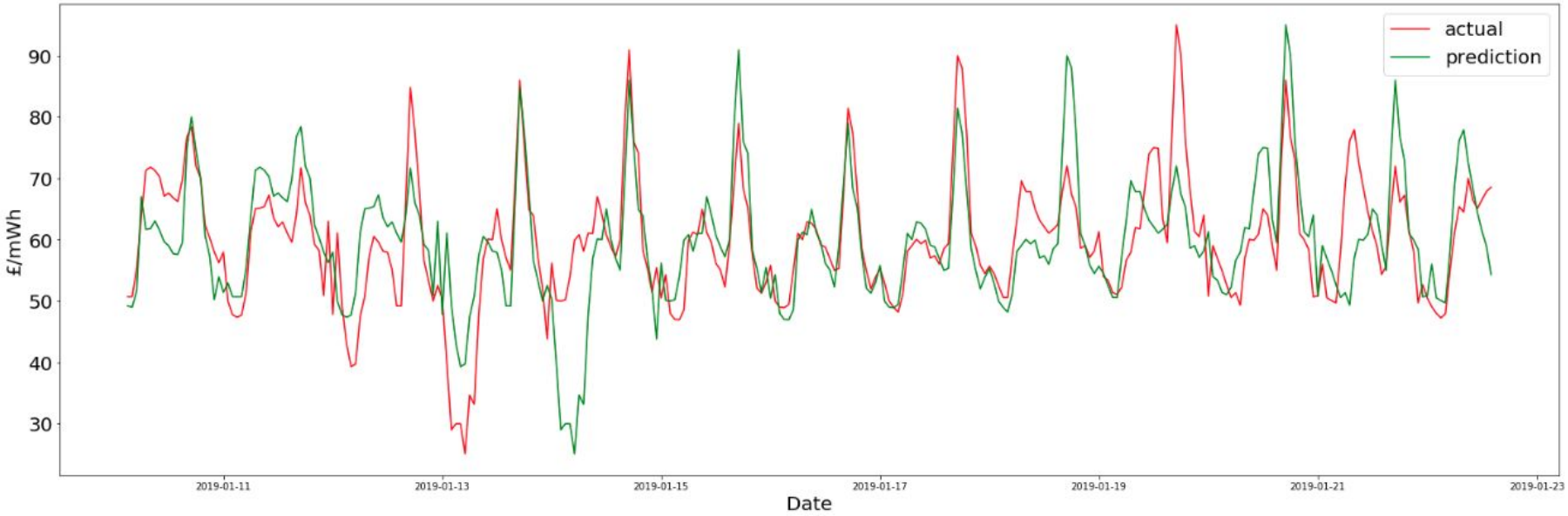


Selecting a Baseline Model

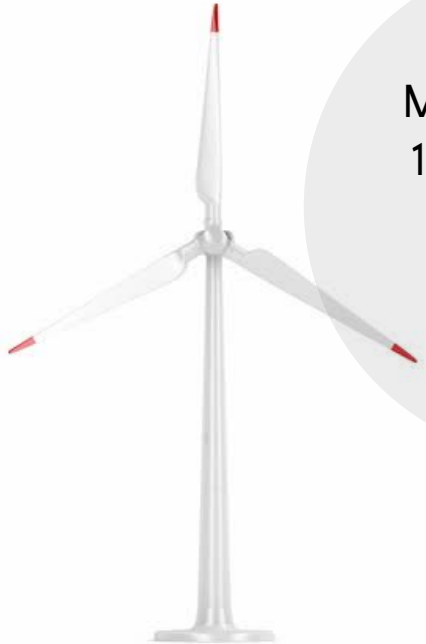
- Target is to predict price in **24** hours
- Baseline model uses the price ***now*** as the prediction for the price at ***this time tomorrow***
- This provides a ***target*** to beat

The Mean Absolute Percentage Error of this method is **17.33%**

Selecting a Baseline Model



Data Shape



Input

Model can ‘see’ 168 hours into the past # of each of the variables

Process

Predicts hourly electricity price for 24 hours into the future

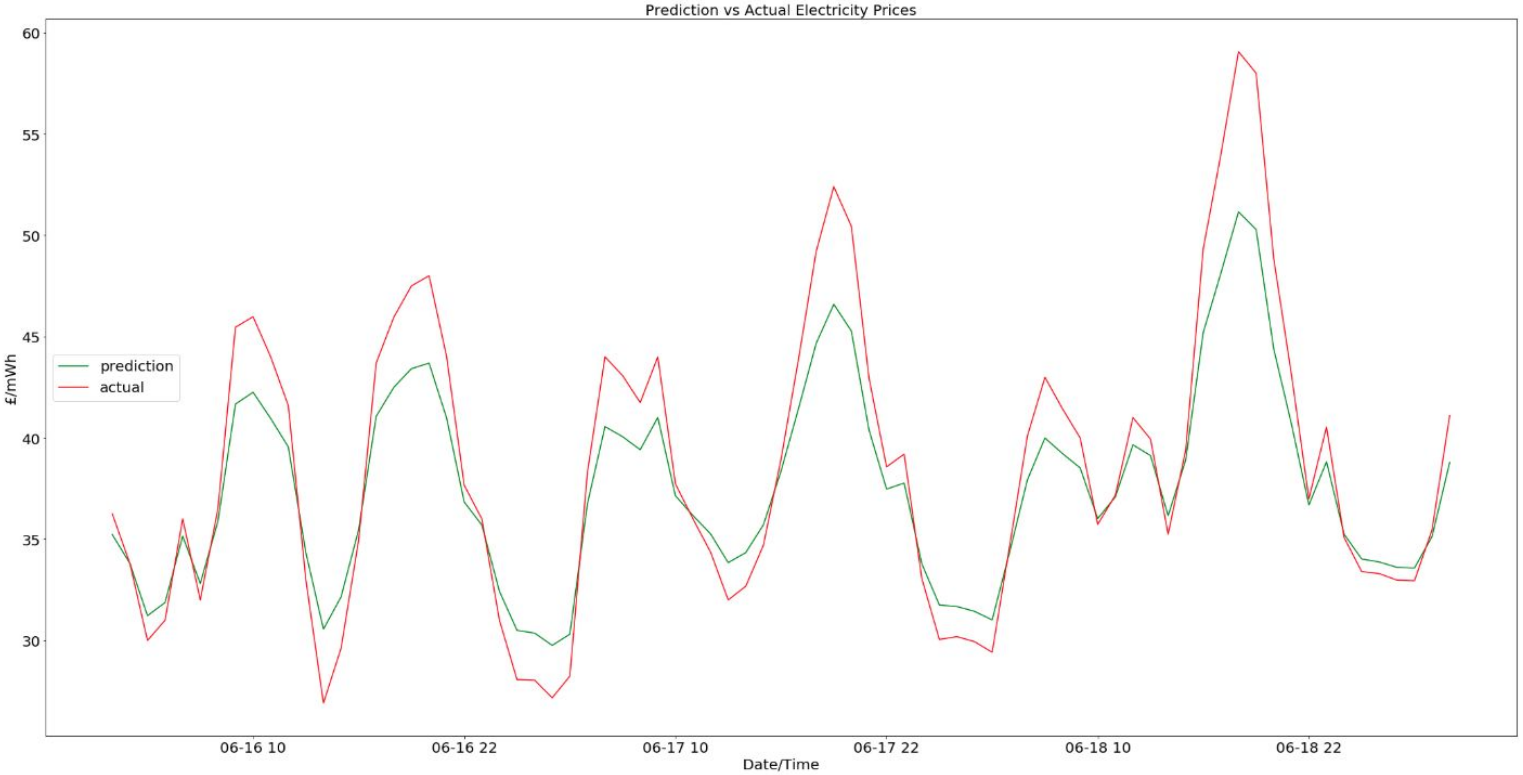
Output

Hour 24

Machine Learning Methods

	MAPE	Comparison Vs 'Dumb'
Arima	14.43%	+20.09%
Pure Time Series Simple Neural Network	18.85%	-8.77%
Multivariate Recurrent Neural Network	8.13%	+46.91%

Results


Prediction vs Actual Electricity Prices
£/mWh
60
55
50
45
40
35
30
prediction
actual
06-16 10
06-16 22
06-17 10
06-17 22
06-18 10
06-18 22
Date/Time

Why is this useful?

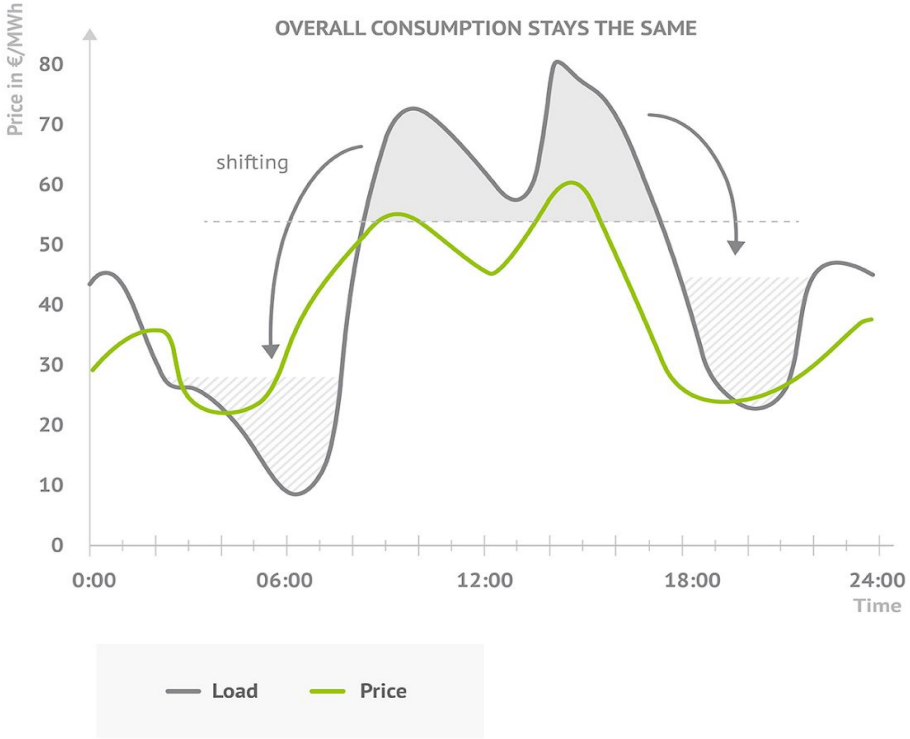
Load Shifting

Optimizing building electricity ***demand*** can lead to both monetary and carbon emission savings without sacrificing overall consumption.

Battery Simulation

A similar result can be achieved through storage. I have chosen to model this through a battery simulation.

Using the a popular home battery's parameters *(Tesla Powerwall 2)* I can attribute a value to the price prediction.



Battery Modelling

Battery Capacity

The Tesla Powerwall 2 has a Capacity of 14 kWh

Battery Power

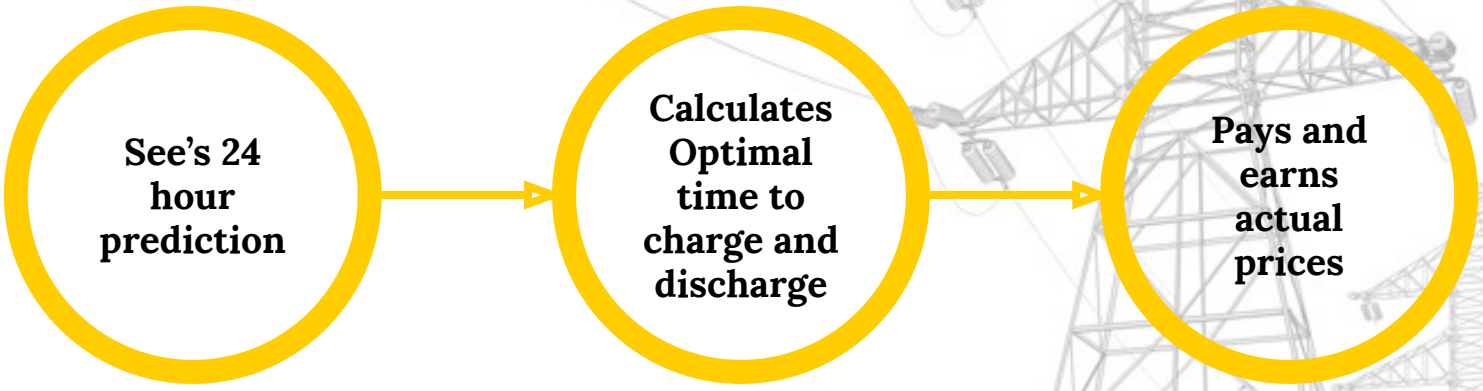
The battery has power of 5kW.

This leads to the full Capacity in just under 3 hours.

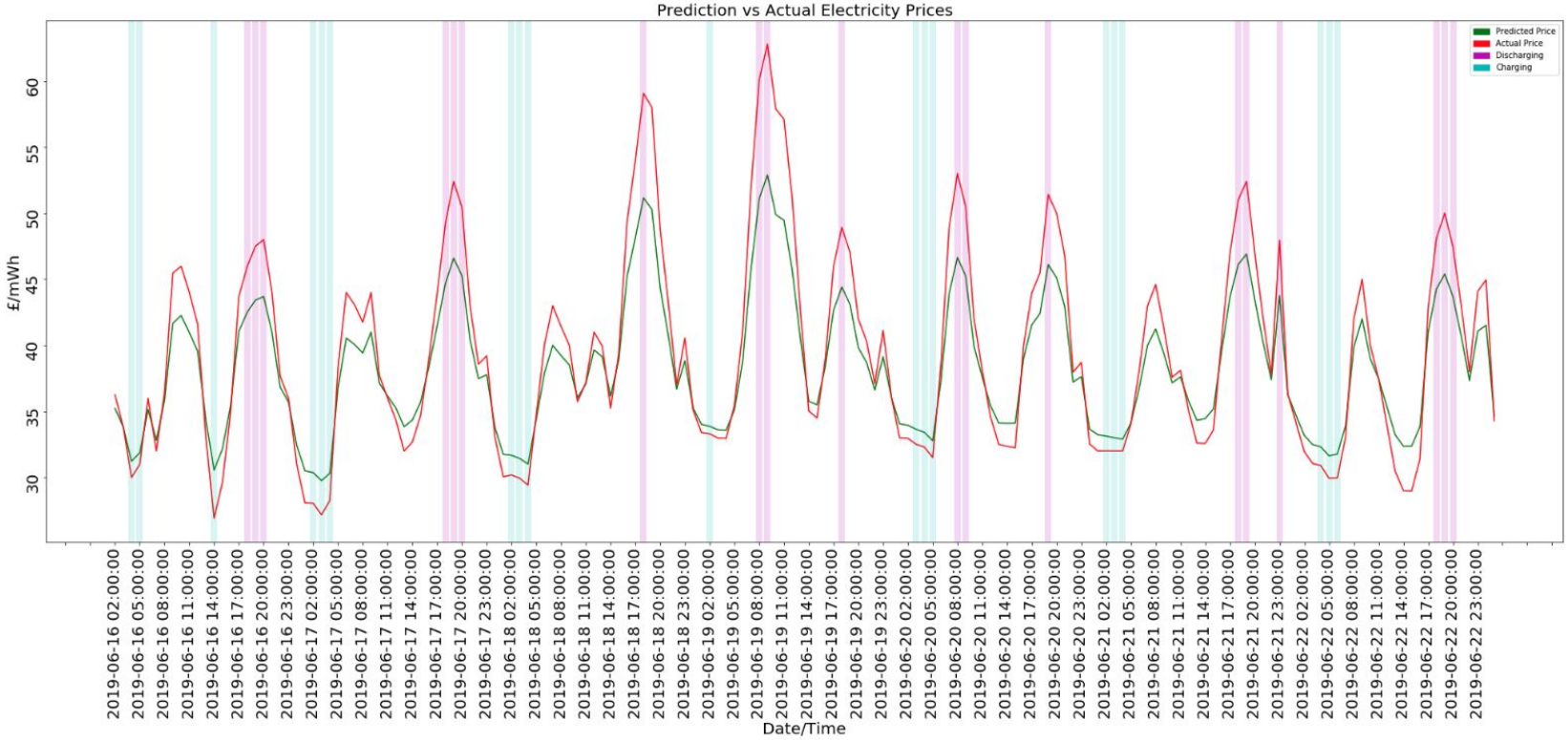
Target

The battery target is to charge at the cheapest times, and discharge at the most expensive times, maximizing profit.

Battery Decision Process



Charging Cycle



One-Year Returns

£151.02

Spend on Charging

£280.23

Earned from ‘selling’ to the Grid

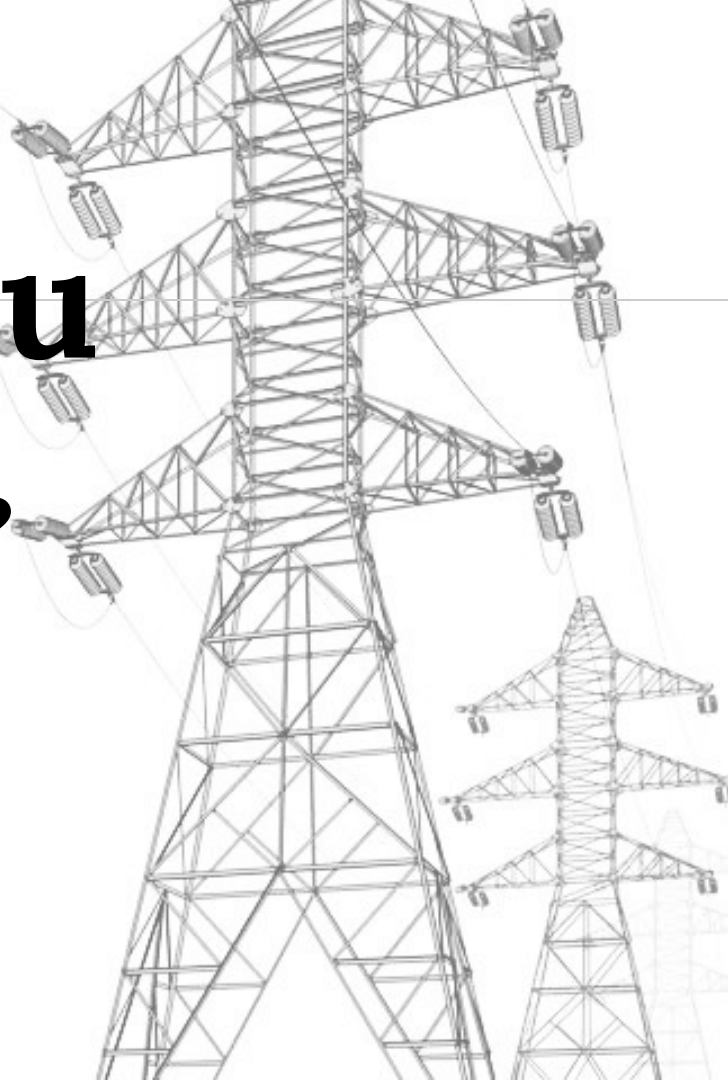
85.55%*

ROI

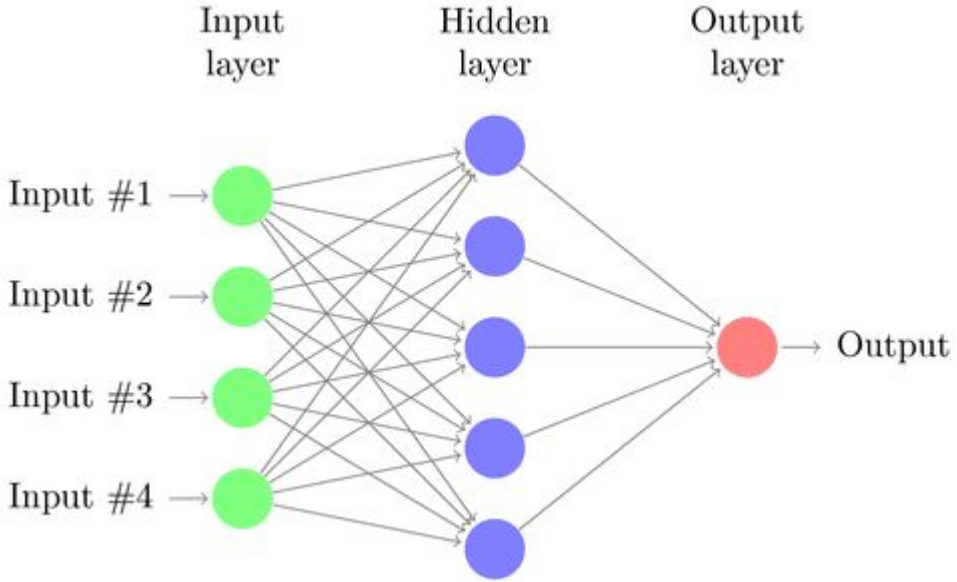
***4.4% including cost of battery**

Thank You

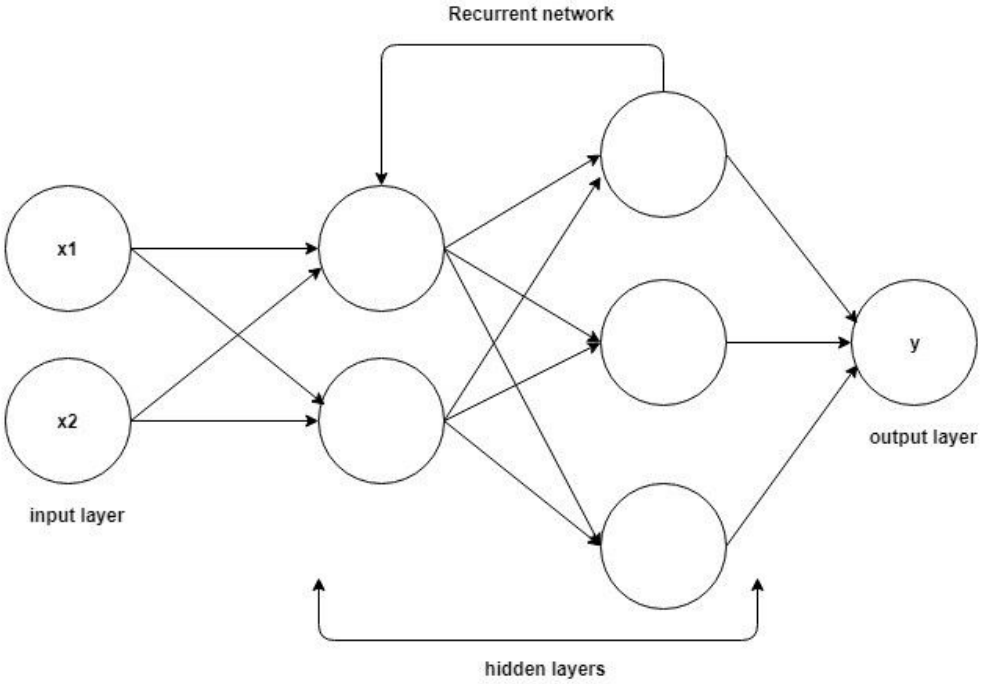
Any questions ?



Simple Neural Network



Recurrent Neural Network



Backpropagation