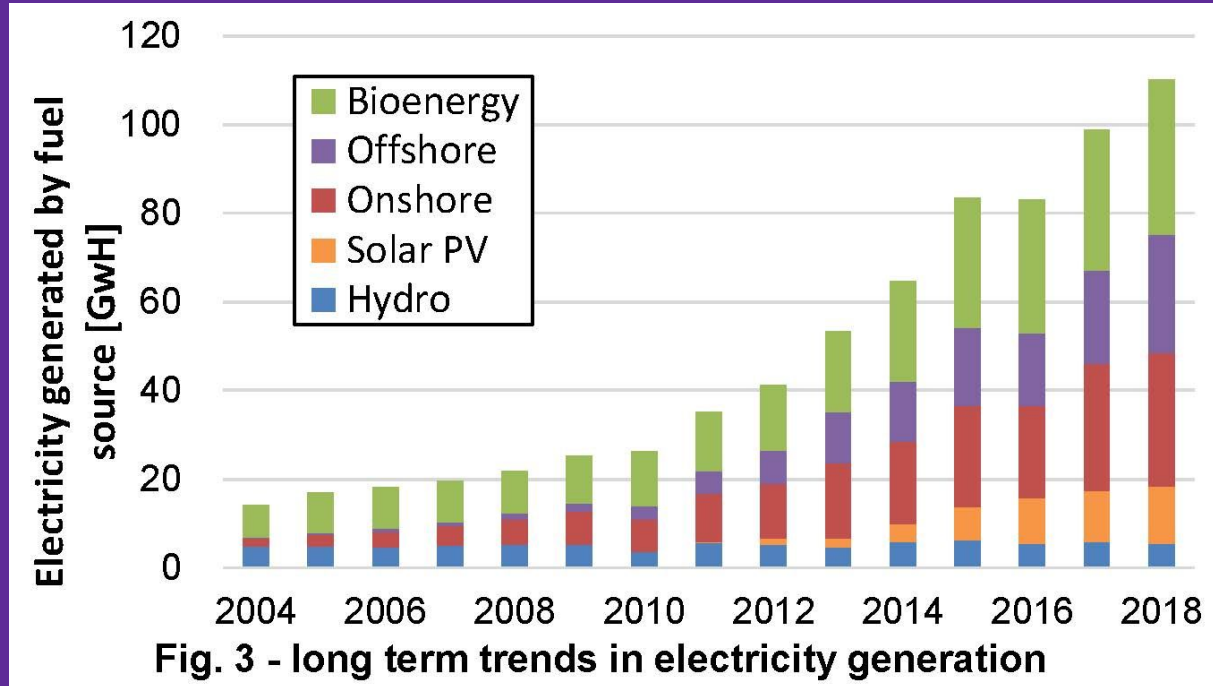


# Profiting from Battery Energy Trading - AI Hack 2022

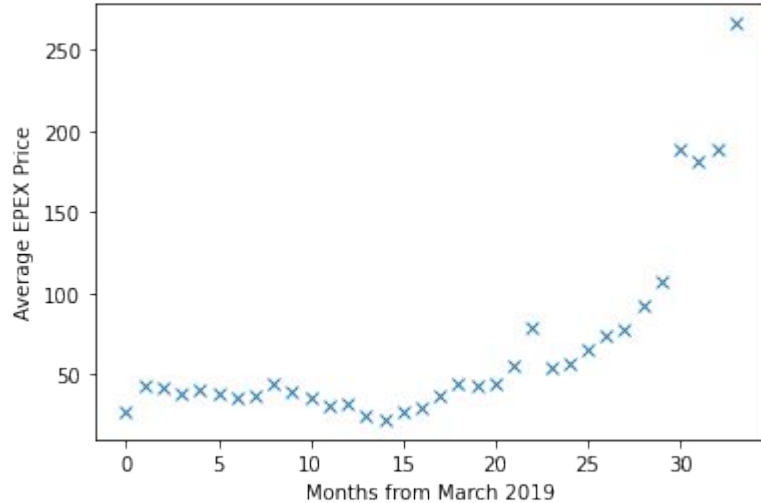
Hanzhi Bao, Myungchan Kim, Timothy Chung, Yuji Go



# Increasing reliance on volatile renewables + better battery tech = ??



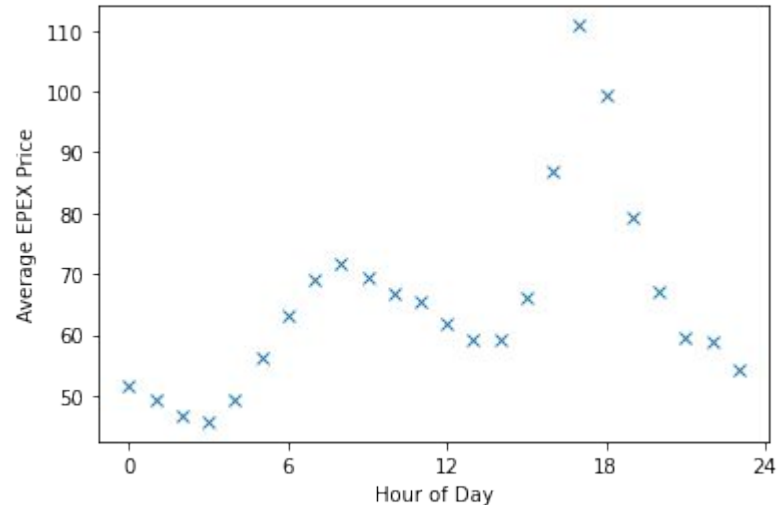
# What is the Market Like?



Strong Increase in price with time.

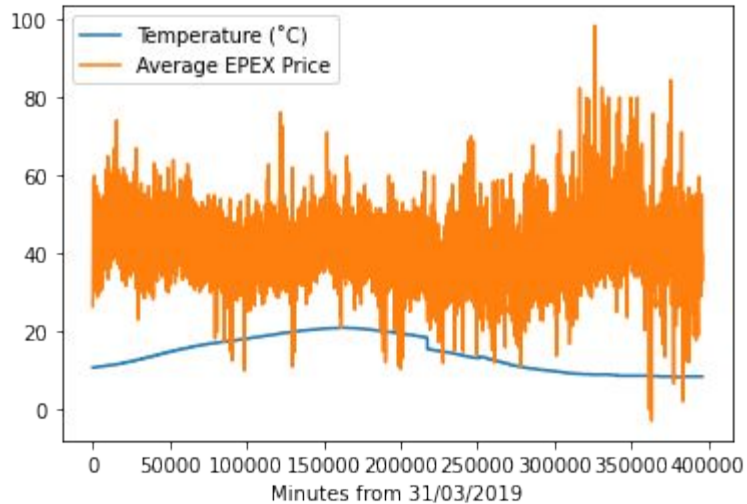
Seasonality seems to be drowned out?

Distinct Peaks and Minima throughout the day.

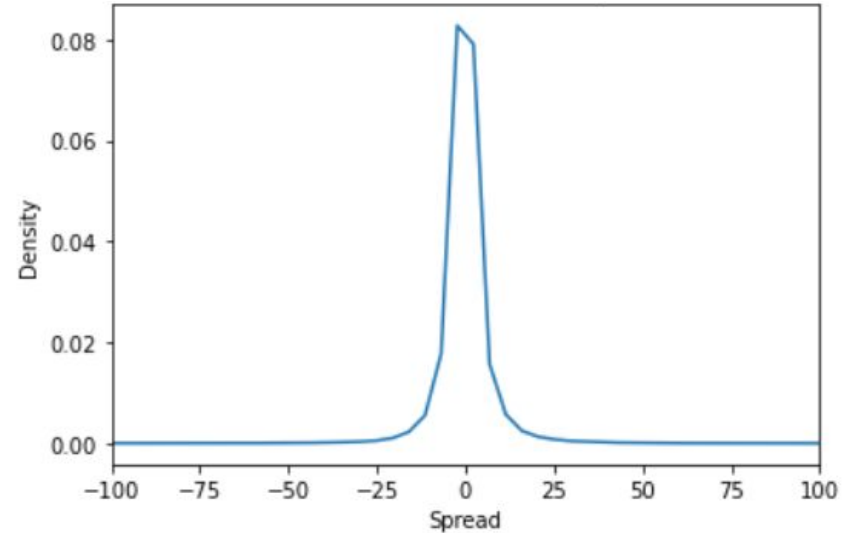


# What is the Market Like?

## Temperature and EPEX Price

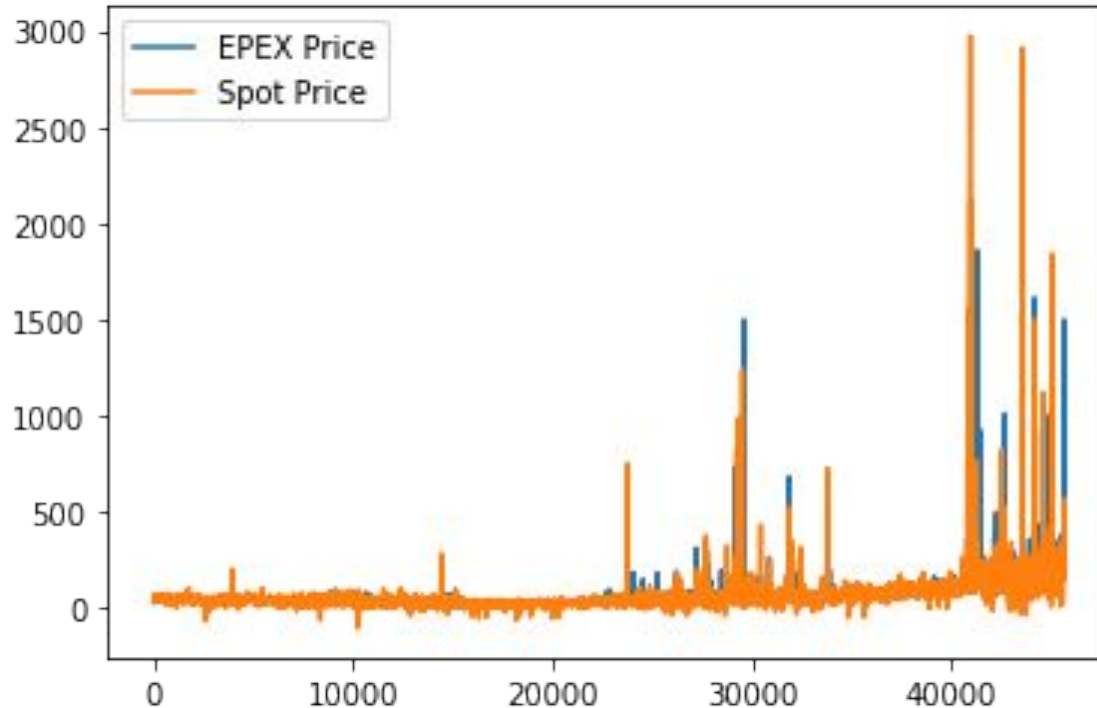


## Distribution of EPEX price Spreads



# What is the Market Like?

Temperature and EPEX vs Spot Price



# Training the Model

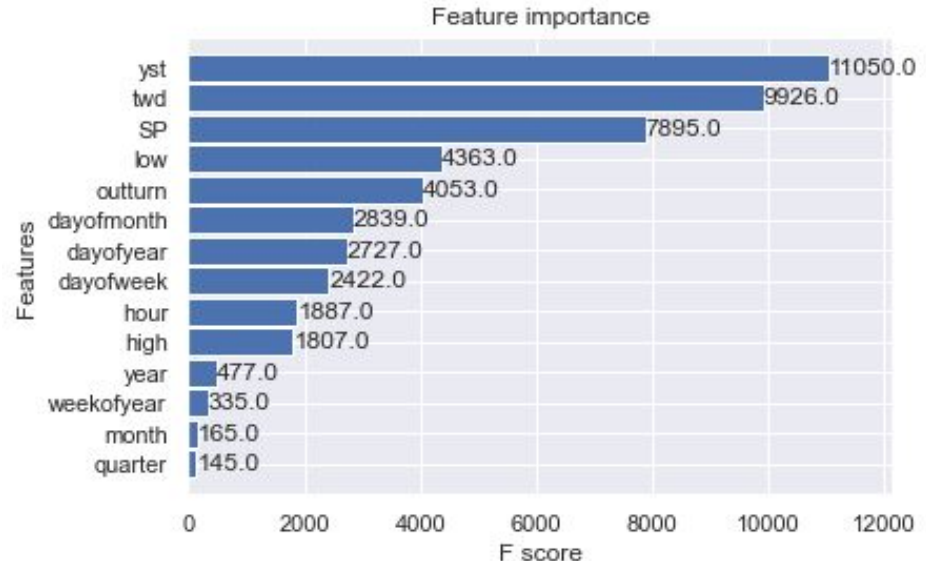
Predict the prices using **historical data** as inputs to predict EPEX price

Multivariable time series forecasting

Dataset split into Training Dataset, Validation Dataset and Unseen Dataset (September 2019)

Features Used:

EPEX price 24 hours back (yst), EPEX price 48 hours back (twd), Time of day, Temperature Stats of Day (high, low, outturn)

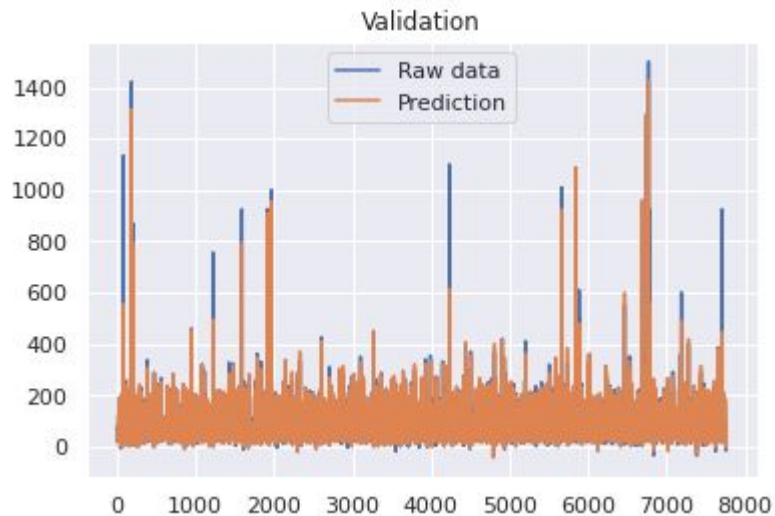


# Parameter tuning in XGBoost and Validation

Functions used for tuning the parameters:  
GridSearchCV (sklearn.model\_selection) +  
TuneGridSearchCV (tune\_sklearn)

Mostly controlled model complexity: e.g.  
max\_depth, min\_child\_weight and gamma

Squared error minimization



# Validation of Results

Accuracies (highest) = 1-MAPE :

**XGBoost : 67.45%**

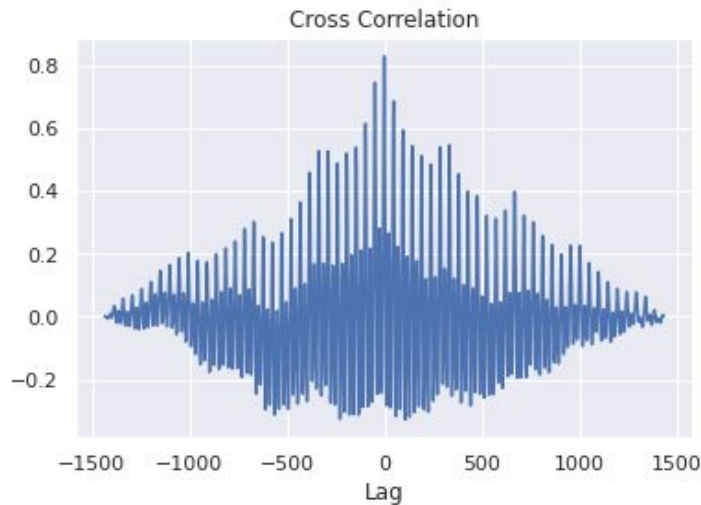
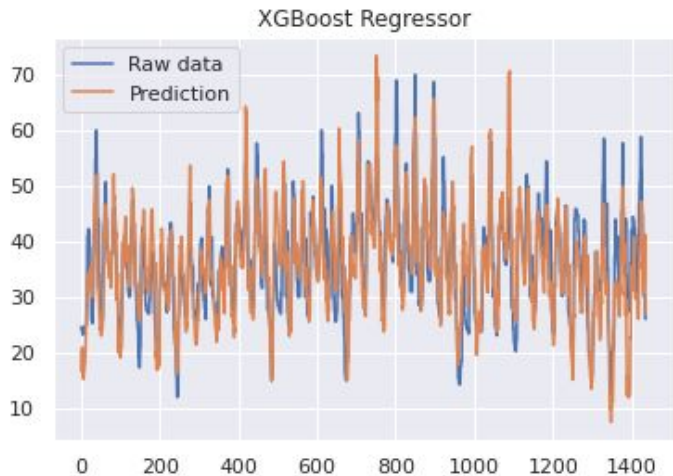
**Random Forest : 67.35%**

Mean Absolute Errors (lowest):

**XGBoost: 4.311**

**Random Forest: 4.354**

- Results are very close but XGBoost has many more parameters to be tuned, so it is potentially better if we can tune the parameters better.



Maximum cross-correlation at lag = 0 (~0.8)



# Trading for Electricity

Find Peaks and Troughs using **scipy.signal.find\_peak**

Simple algorithm built to buy at troughs and sell during peaks

Errors in the code, losses when accounting 85% efficiency

**Final Profit for September 2019: £1217.27**

**Updated Final Profit for September 2019: -£187**

Needs 88% efficiency to breakeven, and 100% efficiency will achieve £839.31 Profit

# Improvements in the Model

## Trading Algorithm

- Model **did not account for profit** when picking peak-trough pairs

## XGBoost

- **Fine tuning parameters**
- **Adding new parameters** (system price and net imbalance volume)
- **Construct a stacked model** by combining several finely tuned models, then train together with a part of the training data (meta training data) and predict a common answer in the end.

## Profitability

- Needs to be profitable as companies are profiting off volatile energy supplies
- One 1MWh battery costs around half a million USD and there is added maintenance cost<sup>[1]</sup>
- Energy trading companies should be making at least **10 times more** than our calculated monthly profit

# Thank you!

1. *<https://www.energy-storage.news/monetising-battery-storage-in-the-uk-and-europe-in-2021-new-opportunities-and-a-new-way-of-thinking/>*