Improving the efficiency of an energy management system with machine learning

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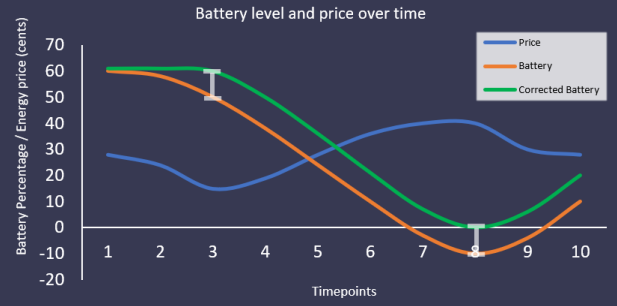
1. Introduction

Widely used energy management systems only take the current data into account for deciding when to buy or sell energy. However, with future knowledge of the energy prices, consumption and production, better choices can be made.

This project focusses on how machine learning can be used to make these choices for 'prosumer' households, which are able to generate and store energy.

2. Method

Instead of only using the current data, an algorithm is created that monitors the battery levels of the future. If the battery runs out of energy or overflows, the optimal time to buy or sell this energy will be calculated.



To predict the future data the following machine learning methods have been used: Neural network, k-neighbors, ARIMA and ETS.

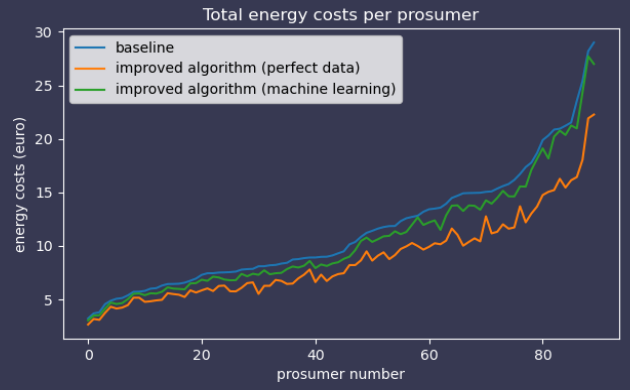
3. Results

The RMSE scores of the models are displayed below. Each score is an average over multiple timepoints and multiple prosumers. The models predict the upcoming 48 datapoints (24 hours).

Model	Prices (¢)	Demand (W)	Production (m/s)*
Neural network	1.70	196.3	0.49
K-neighbors	1.54	159.8	–
ETS	0.87	196.6	–
ARIMA	1.12	169.2	–

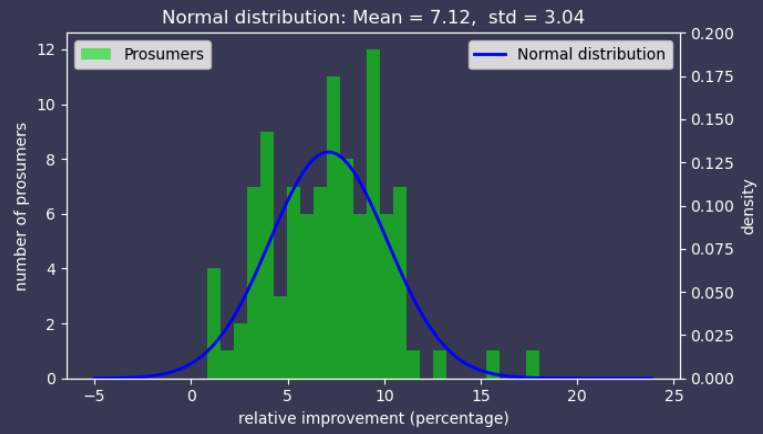
*With the wind speed the wind energy production can be calculated

The designed EMS has been run for 1000 datapoints (500 hours) on 100 prosumers with each a 10-kWh battery and a total energy production of 70% of its total demand. The average improvements with the machine learning data were 7% and with the perfect future data 23%.



4. Analysis

By plotting the relative improvements for all the prosumers, the following normal distribution can be created. Using this normal distribution, we can determine that there is only a 0.7% chance that there was no average improvement.



5. Conclusion

The results gathered show a significant improvement over the baseline algorithm but can still be increased with better predictions as seen by the theoretical improvements. To achieve these, many other machine learning models and further parameter tuning can be explored.