Plant Management

Projects and Data Description

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# **Project 1 – SPOT Price Prediction**

Provided historical data on grid, hedged and own energy costs, provide 7-day-forecast for grid energy prices. In other words, given the energy cost up to Fridays at noon, provide the future costs of energy in the upcoming Monday, Tuesday, …, Sunday.

## Extensive explanation.

Due to factory constrains the price prediction must be smarter and flexible. Indeed, despite having large fluctuations of cost, the factory production cannot be shut down completely even if this would be the theoretical best scenario and, vice versa, there are production capping due to actual factory limitations, working hours, labor constraints.

For this reason, **one possible approach would be to first preprocess the data weekly in terms of relatively[[1]](#footnote-1) low price, relatively mid-price and relatively high price.** Here relatively means ´with respect to the cost of energy in that specific week´. We might get insights like ´Saturday mornings we have low energy prices´.

The harder task is mostly understanding the right granularity (Business suggest at least 4h), moving from hourly prediction to prediction at different granularity. Larger slots, easier and more accurate the prediction would be, but of course also less applicable for business purposes, and vice versa.

Under this constrain the candidate **must find the right balance between prediction’s accuracy and prediction’s granularity.**

The solution must allow the business to change certain specific parameters in the forecast, such as:

* The day when the prediction is made, above is suggested Friday.
* The number of days predicted, above is suggested 7 days but business has already mentioned that in many plants 14 days forecast would be also crucial.
* The project description suggests to cluster historical price in three buckets: low, mid, high relative price with respect to hedge price. It could be nice to parametrize the number of buckets.
* As a first business requirement, we are asked to work with slots of at least 4 hours. Business would be happy to work with a range, with dynamic length. For instance, having slots of length between 2h and 6h.

# **Project 2 – Load Allocation**

Given next week Plant Total Energy Consumption (TPL) and assuming we know the exact hourly next week energy price, provide the best allocation for the TPL, under the following constrains:

* The factory cannot be completely shut down, it must always run at least at the 0.0001 of the total weekly TPL
* The factory cannot overload the 5% of the TPL per hour.
* Change of factory load can be made only at :00 and :30.
* Change of factory load can be only at least 5 hours apart (possibly this could be parametrized). In other words, if a change of the factory load is made at 10 AM, the next possible change must wait until 3 PM; of course, one can decide to keep the status and maybe adjust at 4:30 PM.
* When the SPOT price is higher than 150% of the HBB price (HBP), please adjust the NPL to the HBB volume.

## Extensive explanation.

This is an optimization problem under complex combinatorial constraints. There are many possible creative solutions, from the most easy simplex method to combinatorial optimization, from **sklearn.optimizer to advanced Genetic Optimization**. All solutions are good as long as they are presented clearly. Moreover, a solution should be provided as a csv with three columns: starting time, ending time, suggested load.

# Data

We share three CSV files containing the data of the production of three fake plants.

## Data Description

It follows the description of each column in the CSV.

**Timestamp, [CET]:**

Date and time of the measurement.

**Plant Name:**

Name of the plant.

**Country:**

Country where the plant is located.

**City:**

City where the plant is located.

**Plant Load (PL), [MWh]:**

It is the hourly consumption of energy providing from the grid, and from renewable source (solar here).

**Generation behind the Meter (GBM), [MWh]:**

It is the (own-produced) renewable energy consumption (planned).

**Net Plant Load (NPL), [MWh]:**

It is the hourly energy consumption (data provided, from grid).

**Hedged Base Band (HBB), [MWh]:**

**In practical terms, a Hedged Base Band would indicate the quantity of energy an organization has hedged against market price risks, ensuring a stable supply or cost for that specific amount of energy over a particular period. This is the static input (constant every hour within 1 month).**

**Hedged Base Band Cost (HBC), [EUR/MWh]:**

Energy price for the hedged Base Band.

**Power Market Price (SPOT), [EUR/MWh]:**

This is the price at which electricity is bought and sold in the wholesale electricity market. It reflects the supply and demand dynamics in the market and can fluctuate throughout the day. In another word, it is the forecasted hourly electrical price.

**Additional Power Price (Add.), [EUR/MWh]:**

This price represents the distribution costs or capacity fee for the electrical energy supplied plant and is applicable only to some selected sites. Price granularity can be in site or country level. This price is set to 0 EUR/MWh for this study.

**SPOT + Add.Price, [EUR/MWh]:**

The sum of SPOT price and Add.Price.

The business has also highlighted that the HBB price (HBP) is defined hourly by HBC/HBB.

1. What does relatively here mean? As suggested by the business, here we want to compare the energy price with respect to the Hedges base band price (HBP). [↑](#footnote-ref-1)