

Maltesers

## Analysis of Hourly Electricity Prices: Temporal Evolution and Influential Factors

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23/05/2024



## Abstract:

This project proposal consists of investigating how the shape of the hourly power price curve has evolved over time due to the influence of diverse factors. Thus, the goal is to find out the correlation between the hourly power price curve and diverse potential influencing factors to then apply this outcome to set of the curve accordingly. The research is planned to be conducted by a group of students as part of their master's thesis.

## Introduction:

Electricity hourly prices are settled daily based on producers' and consumers' exchanges. The first side offers their production at a certain price while the latest asks to cover their consumption at a certain cost. In addition to supply and demand auctions for each hour, the price is settled in a central exchange for Spain.

The price levels depend on several variables as underlying commodities and indexes (e.g., the cost of the gas used to produce electricity will impact the price at which those producers will offer their production) and weather (the colder it is, the more energy people will demand). Understanding the temporal patterns of these price changes is crucial for both consumers and energy market stakeholders. This project seeks to explore the factors contributing to these fluctuations and how their trends have followed and influenced over time the price of electricity.

## Objectives:

1. To analyze hourly electricity price data over a specified period.
2. To identify temporal patterns and trends in electricity prices.
3. To investigate the influence of various factors on hourly price variations.
4. To develop alternative models to predict future price movements based on the previous outcome applied in the shape of the curve used to calculate the prices.

## Methodology:

Together with HES experts, the team will be responsible for:

- **Data Collection:** obtain hourly electricity price data from relevant sources, such as energy market databases or utility companies.
- **Data Analysis:** to apply statistical and econometric methods to analyze the data. This includes time series analysis, regression analysis, and correlation analysis.
- **Factor Identification:** to identify potential factors influencing hourly price variations, such as demand, supply, weather conditions, renewable energy penetration, market regulations, and geopolitical events.
- **Temporal Evolution Analysis:** to examine how these factors interact with electricity prices over time and identify any temporal trends or cycles.
- **Model Development:** to develop predictive models to forecast future electricity prices based on the identified factors.

## Expected Outcomes:

- Insight into the temporal evolution of hourly electricity prices.
- Identification of key factors influencing price variations.
- Development of predictive models for forecasting future price movements.
- Recommendations for consumers and energy market stakeholders based on the findings.
- Deep learning of the energy market field and influent factors.

## Deliverables:

A Project folder containing the following material:

- First part: One Jupyter notebook containing the analysis of the factors and its influence as outcome.
- Second part: the development of a model implemented by AI that calculates the forecast electricity price curve based on the application of the previous outcomes on historical price values for period of time.

The content requires a manual containing a description of the variables, statistical methodology applied, equations, criteria, priorities, and requirements (and difficulties encountered). Conclusions and potential improvements to be carried out in the long term.



## Factors and drivers to analyze per topic:

Below, the list of topics to analyze how they will impact the electricity price curve in the medium/long-time:

- Demand (Red Eléctrica)
- Installed Capacity (Red Eléctrica)
  - Wind (up) / Solar (up) / Hydro (cycle) / Nuke (down)
- Production (ENTSOe) per type: renewable and non-renewable
- Interconnection with FRA (currently at c.2.7%, based on Spanish exports) (Red Eléctrica)
- Gas (OMIP)
- CO2

The goal is to evaluate with what weight and sense these topics will impact the curve. To do so, the following parameters will be assessed:

- Base
- Winter/Summer
- Peak/Base
- Hourly shape
- Volatility
- Spikiness / Accidents



## API's

- Red Electrica: <https://www.ree.es/es/apidatos>
- Entsoe: [https://transparency.entsoe.eu/content/static\\_content/Static%20content/web%20api/Guide.html](https://transparency.entsoe.eu/content/static_content/Static%20content/web%20api/Guide.html)
- OMIE: <https://github.com/acruzgarcia/OMIEData>

**A small challenge:** to work with API from red eléctrica

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## Factors and drivers to analyze per topic:

The objective is to analyze each of the topics and how they affected historically in the curve to then, be able to fill the grid (in light yellow) below with +2, +1.5, +1, +0.5, 0, -0.5, -1, -1.5, -2.

Topic		Base	Peak/Base	Winter/Summer	Hourly shape	Volatility	Spikiness / Accidents
Demand							
Installed Capacity	Wind						
	Solar						
	Hydro						
	Nukes						
	CCGT						
Production renewables vs non-renewables							
Interconnection w/ FRA							
Gas price							
CO2 price							

# IE master final thesis proposal



## IE requirements:

Deadline: 9<sup>th</sup> of July

Minimum: 1 check point mid of June

## HES requirements:

Deadline: 5<sup>th</sup> of July

Internal presentation: 9<sup>th</sup> July

At least 4 meetings before the deadline; 5<sup>th</sup>, 12<sup>th</sup>, 19<sup>th</sup>, 26<sup>th</sup> of June.

	Task Finish	Comments
5 <sup>th</sup> June	Analysis of the impact of demand	Very important and to have time to check data
12 <sup>th</sup> June	Installed Capacity	
19 <sup>th</sup> June	Production (renewable / non-renewable) and interconnection with France	
26 <sup>th</sup> June	If with time (include CO2 and GAS impacts) Otherwise launch the ML model	Naturally prices of gas and CO2 are implicit in power prices but it is still important to see its analysis



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