SustAInify '24: Problem Statement

Introduction :-

A Steel Manufacturing Company operates a plant in Europe, requiring an electricity supply of 1,200 MWh / Day to maintain its operations. This demand is met through a combination of sourcing from the State Electricity Grid, State Power Exchange, and the company's own captive solar power plant.

The company aims to balance its electricity procurement costs with its environmental impact, particularly focusing on carbon footprint while ensuring a minimum of 20% renewable energy utilisation in its energy mix.

Objective :-

1. Create an ML/ DL model for the prediction of **daily average electricity prices** at the Power Exchange using the Power Exchange Data for the year **2010 to 2017**.

2. Predict the daily average electricity prices for **all the days in the year 2018** and store it in a CSV file having two columns: 'Date' and 'Predicted Average Price (EUR/MWh)'.

3. Assume that the plant is operating on **1st January 2018**. From the **predicted price** and other parameters (given in Details section), optimise the **electricity procurement costs along with its environmental impact** (in terms of Carbon Footprint) while ensuring a minimum of 20% renewable electricity utilisation in its energy mix and report the following optimised quantities for the plant:

   a) Optimised Percentage of the Total Renewable Electricity out of the Total Electricity

   b) Optimised Quantity of Electricity to be drawn from the State Electricity Grid

   c) Optimised Quantity of Electricity to be drawn from the Power Exchange

Note: Assume Coal to be the only source for generating Non-Renewable Electricity for the calculation of Carbon Footprint.

[1 MWh of Non-Renewable Energy generated using coal contributes to 0.95 MTCO2e]

Details :-

Demand: 1,200 MWh/ Day for the Steel Plant.

Supply Sources: State Electricity Grid, Energy Exchange, Company's Solar Plant.

Fixed Parameters:

- Proportion of Renewable Electricity out of the Total provided by Electricity Grid is **15%**
- Proportion of Renewable Electricity out of the Total provided by Power Exchange is **5%**
- Electricity provided by the company's captive solar power plant is **150 MWh/Day**
- Cost of Electricity drawn from the company's captive solar power plant is **0 EUR**
- Price of Electricity drawn from the State Electricity Grid is **57.62 EUR/MWh**

Variable Parameters:

Q_Grid: Total Quantity of electricity sourced from the Electricity Grid in MWh/Day

Q_Exchange : Total Quantity of electricity sourced from the Energy Exchange in MWh/Day

Constraints :

1. Total Demand of Electricity : Must be equal to **1,200 MWh/Day**
2. Renewable Energy Minimum: **At least 20%** of the Total Energy mix.

Deliverables :-

ZIP Folder containing the following:

1. Jupyter Notebook (**.ipynb File**) for the Electricity Average Price Prediction Model

2. **CSV File** containing the predicted average electricity prices for all the days in 2018

3. Solution Report (**PDF File)** constituting a brief summary and accuracy score (Adjusted R2) of the Prediction Model and the details and calculations of the optimization done.

   The report **must have** the value of the following quantities for 1st January 2018:

a) Optimised Percentage of Total Renewable Electricity of Total Electricity

b) Optimised Quantity of Electricity drawn from State Electricity Grid (Q_Grid)

c) Optimised Quantity of Electricity drawn from the Power Exchange (Q_Exchange)