

# ENERGY CONSUMPTION FORECASTING USING MACHINE LEARNING FOR SMART GRID TECHNOLOGY

## Data Catalogue:

1. **settlement date** - date for which the data corresponds.
2. **Settlement period.** Time periods within an hour is 2 so that  $2 * 30$  mins
  - $24 \text{ hrs} * 2 = 48$  periods a day
3. **nd - National demand** - Mega Watts for specific period
  - This represents the overall electricity consumption across the national grid. (30 mins - settlement period)
  - not-includes - residential, commercial, industrial
  - It varies from 2000 MW to 5000 Mw depending upon the need of a country.
4. **tsd - Transmission System Demand** –
  - This demand includes electricity supply by a main grid to homes, business and industries.
  - Excludes → local generation embedded generation - wind, solar self consumption, roof top panels, this focuses more on demand that must be met by large generators
5. **england wale-demand:**  
Region-Specific Demand:
  - This value reflects the combined electricity demand for both **England** and **Wales**, as they share a connected grid system.
  - Like the **National Demand (ND)**, the **england\_wales\_demand** represents the electricity drawn from the national transmission grid for the region. It includes residential, commercial, and industrial usage.
  - Demand levels will fluctuate throughout the day, peaking during times of high activity (morning and evening) and reducing during off-peak hours (late night and early morning).
6. **embedded wind generation:**
  - Embedded generation refers to smaller, decentralized power sources (in this case, wind turbines) that are directly connected to local distribution networks, not the main high-voltage transmission system.
  - These wind power sources generate electricity locally, often to meet local demand without the need to transmit it over long distances via the main grid.

- The number in this column represents the total amount of electricity generated by embedded wind turbines during that specific settlement period (a 30-minute window).

#### **7. embedded\_wind\_capacity:**

- Embedded wind capacity refers to the total potential power output of all the wind turbines connected to local distribution networks (as opposed to large-scale wind farms connected to the national transmission grid).
- This capacity is the theoretical upper limit of how much power these embedded wind turbines can generate if they were running at full capacity under perfect wind conditions.

#### **8. embedded -solar generation and embedded solar -capacity:**

#### **9. non\_bm\_stor**

- Non-Balancing Mechanism (Non-BM) storage refers to energy storage systems that store electricity but are not actively managed by the national grid to balance supply and demand in real time.
- These systems may charge (store electricity) during periods of low demand and discharge (supply electricity) during periods of high demand, but they operate independently from the grid's main balancing operations. (BM)
- **Charging:** When there is excess electricity on the grid (for example, during times of low demand or high renewable generation), the storage systems may charge by absorbing electricity from the grid, but this might not happen constantly.
- **Discharging:** When electricity demand increases and supply is tight, these systems may discharge stored electricity to help meet the demand, but again, this depends on the grid's needs

#### **10. pump\_storage\_pumping:**

- Pumped storage hydroelectricity is a form of energy storage used by the grid to balance supply and demand.
- It works by using electricity (often during times of low demand or excess generation) to pump water from a lower reservoir to a higher one.
- When electricity demand is high, the stored water is released back down through turbines to generate electricity, providing power when it's needed most.

#### **11. ifa\_flow:**

- The ifa\_flow column likely represents the flow of electricity through the Interconnexion France-Angleterre (IFA), which is an electricity interconnector between the UK and France.
- A **positive value** indicates that the UK is **importing electricity** from France (i.e., power is flowing from France to the UK).
- A **negative value** means that the UK is **exporting electricity** to France (i.e., power is flowing from the UK to France).

#### 12. ifa2\_flow:

- **IFA2** is the second electrical interconnector between the UK and France, launched in **2021**.
- It has a transmission capacity of **1,000 MW**, which is half of the capacity of the original IFA (which has 2,000 MW).
- **Positive values** indicate that the UK is **importing electricity** from France via IFA2.
- **Negative values** indicate that the UK is **exporting electricity** to France via IFA2.

#### 13. britned\_flow:

- The britned\_flow column refers to the electricity flow through the BritNed interconnector between the UK and the Netherlands, commissioned in 2011. It has a capacity of 1,000 MW, allowing up to 1,000 megawatts of electricity to be transferred between the two countries.
- **Positive values** indicate that the UK is **importing electricity** from the Netherlands.
- **Negative values** indicate that the UK is **exporting electricity** to the Netherlands.

#### 14. moyle\_flow:

- The moyle\_flow column refers to the electricity flow through the Moyle Interconnector which is a high-voltage direct current (HVDC) subsea interconnector that links the electricity grid of Northern Ireland to Scotland.
- The interconnector has a capacity of 500 MW, allowing for the transfer of electricity between Northern Ireland and Great Britain (through Scotland).
- A **positive value** indicates that **Northern Ireland is importing electricity** from Scotland (and the rest of the UK).
- A **negative value** indicates that **Northern Ireland is exporting electricity** to Scotland.

#### 15. east\_west\_flow:

- The east\_west\_flow column refers to the **electricity flow through the East-West Interconnector**, which is a subsea high-voltage direct current (HVDC) cable linking the electricity grids of **Ireland** and **Great Britain** (via Wales).

- The interconnector, commissioned in **2012**, has a **capacity of 500 MW**, allowing up to 500 megawatts of electricity to be transferred between Ireland and the UK.
- **Positive values** indicate that **Ireland is importing electricity** from the UK (i.e., power is flowing from Great Britain to Ireland).
- **Negative values** indicate that **Ireland is exporting electricity** to the UK (i.e., power is flowing from Ireland to Great Britain).

#### 16. **nemo\_flow:**

- The **nemo\_flow** column refers to the electricity flow through the **NEMO Link**, which is an **interconnector** between the electricity grids of the **UK** and **Belgium**.
- Commissioned in **2019**, the NEMO Link has a capacity of **1,000 MW**, allowing the transfer of up to 1,000 megawatts of electricity between the two countries.
- **Positive values** indicate that the UK is **importing electricity** from Belgium (i.e., electricity flows from Belgium to the UK).
- **Negative values** indicate that the UK is **exporting electricity** to Belgium (i.e., electricity flows from the UK to Belgium).

#### 17. **nsi\_flow:**

- The **North Sea Link (NSL)** is a **high-voltage direct current (HVDC) subsea interconnector** connecting the electricity grids of **Norway** and the **United Kingdom**.
- Commissioned in **October 2021**, the NSL has a capacity of **1,400 MW**, making it the longest subsea interconnector in the world, stretching about 720 km under the North Sea.
- **Positive values** indicate that the UK is **importing electricity** from Norway (i.e., power flows from Norway to the UK).
- **Negative values** indicate that the UK is **exporting electricity** to Norway (i.e., power flows from the UK to Norway).

#### 18. **elecLink\_flow**

- The **ElecLink Interconnector** is an **HVDC cable** that runs through the **Channel Tunnel** (the tunnel under the English Channel) between **Great Britain** and **France**.
- Commissioned in **2022**, ElecLink has a capacity of **1,000 MW**, enabling the exchange of up to 1,000 megawatts of electricity between the two countries.

- **Positive values** indicate that the UK is **importing electricity** from France (i.e., power flows from France to the UK).
- **Negative values** indicate that the UK is **exporting electricity** to France (i.e., power flows from the UK to France).

#### 19. **scottish\_transfer:**

- The **Scottish Transfer** represents the amount of electricity flowing from Scotland to England and Wales (or vice versa) across the **interconnected electricity grid** that links the Scottish and English transmission systems.
- **Positive values** indicate that Scotland is **exporting electricity** to England and Wales.
- **Negative values** indicate that Scotland is **importing electricity** from England and Wales.

#### 20. **viking\_flow:**

- The **viking\_flow** column refers to the electricity flow through the **Viking Link Interconnector**, which is a high-voltage direct current (HVDC) subsea cable connecting the **United Kingdom** and **Denmark**.
- **Positive values** indicate that the UK is **importing electricity** from Denmark (i.e., power flows from Denmark to the UK).
- **Negative values** indicate that the UK is **exporting electricity** to Denmark (i.e., power flows from the UK to Denmark).

#### 21. **is\_holiday**

- 0 means not a holiday
- 1 means it's a holiday