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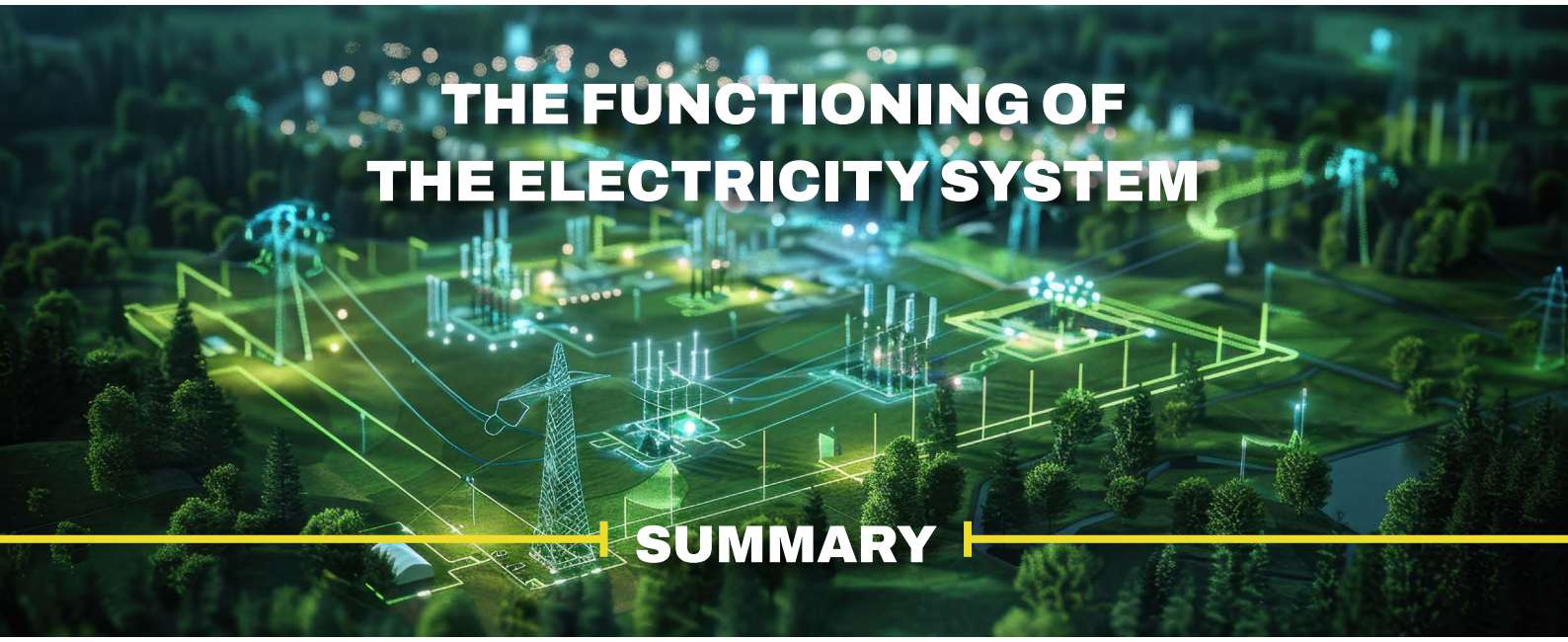
Notes from
the Observatory of the
French Electricity Industry

Uses of Electricity | **Electricity System** | Energy Policy

March 2025



THE FUNCTIONING OF THE ELECTRICITY SYSTEM

SUMMARY

1 WHAT ARE THE LARGE INFRASTRUCTURES THAT MAKE UP THE ELECTRICITY SYSTEM?

The electricity system is composed of various types of power generation units, each with different characteristics, the main ones of which are listed below:

- **Carbon-intensive or low-carbon power generation units:** power plants generating power through the combustion of fossil fuels (coal, fuel oil and gas) emit greenhouse gases with the electricity production, whereas renewable power plants (mainly hydro, wind and photovoltaic) and nuclear do not emit any when in use[1].

- **Dispatchable or variable power generation units:** nuclear, fossil and hydro power plants with storage capacity are dispatchable power generation units, in that their activation and power variations can be controlled. On the opposite side of the spectrum, wind turbine, photovoltaic and run-of-river hydro power plants are considered variable, as their maximum instantaneous generation relies on weather conditions (amount of wind, sunshine or water flow). If equipped with control systems, these power generation units can nevertheless adjust the level of electricity that is injected into the grids.

France stands out as having a very large share of nuclear in its electricity mix (67% of its production in 2024). Due to predominant reliance on low-carbon sources of energy generation (nuclear, hydro and more recently the fast-developing wind and photovoltaic energies) and the progressive closure of the largest carbon-emitting plants (coal and fuel oil), the **France's electricity mix**, with a carbon intensity of 21gCO2eq/KWh in 2024, **is one of the lowest emitters in Europe.**

DISCOVER THE COMPLETE NOTE ABOUT ELECTRICITY SYSTEM INFRASTRUCTURES

[1] All power plants also emit greenhouse gases during the other phases of their lifecycle (construction and dismantling). This is why it is preferable to use the term "low-carbon" rather than "decarbonised" when referring to renewable and nuclear energies.

Once generated, the electricity is then injected into the electricity network:

The transmission network, which is composed of high and ultra-high voltage lines, is used to transport the electricity generated by the largest power plants over long distances, to the large consumers and the distribution network. In France, the electricity transmission system operator (TSO) is RTE.

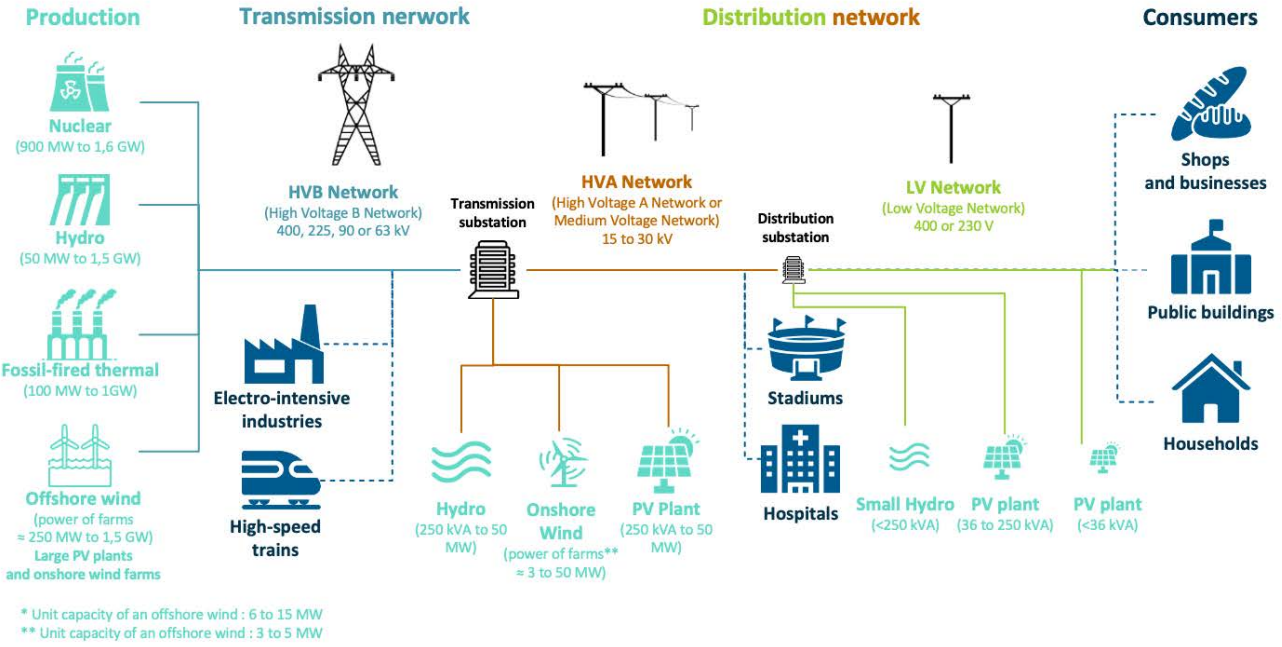
The distriubtion network is composed of medium and low voltage lines. The former distributes electricity on the scale of regions and departments, whereas the latter provides households, public buildings and businesses with electricity. In France, Enedis (covering 95% of the country), and around a hundred local distribution operators are the electricity distribution system operators (DSOs).

The volume of electricity consumed varies constantly due to multiple factors such as temperature, hours of sunshine and the level of economic activity. Furthermore, electricity is currently difficult to store in large amounts and over a long period of time. **Generation and consumption must therefore be continuously adjusted in order to maintain a balance in the electricity system. This is the role of the TSO.**

In the past, the high share of dispatchable power generation units has enabled the electricity supply to adjust to fluctuations in demand and thus to maintain the balance of the electricity system. Although they play an essential role in decarbonising the European economy, the development of variable renewable energies and the progressive shift away from fossil fuels has made reaching this balance increasingly challenging. From now on, flexibility solutions, such as demand-side management, dispatchable low-carbon power generation units, storage and interconnections, **are playing an increasingly significant role by allowing to adapt to the variability of the different modes of power generation and consumption.**

Electricity can be exchanged between countries through interconnections: they both have a physical dimension (optimising the balance of the electricity system and improving the security of supply by fostering mutual support between States) and an economic one (mobilise in priority the most competitive means of power generation available in Europe).

Simplified representation of the electricity network



2 WHAT IS THE LINK BETWEEN THE CONSUMER'S BILL AND THE EUROPEAN ELECTRICITY MARKET?

The consumer's electricity bill can be broken down into three parts, the size of which varies depending on the year, the country and the type of consumer:

1 **The part related to the cost of electricity supply** concerns the procurement of electricity. This cost is borne by the supplier, a legal entity holding an authorisation. The supplier advises, contracts with and provides one or more final consumers (retail market) with electricity that was either generated by them or purchased on the European wholesale market. This part covers the cost of the power generation units (energy and capacity), in addition to costs related to the commercialisation of electricity (including the cost of white certificates).

2 **The part related to the electricity transmission cost** enables the different grid operators to cover the costs for operating, developing and maintaining the networks. In France, the cost of managing the infrastructures is covered by the "TURPE" (Tariff for the use of public electricity networks)[2].

3 **The part related to taxes on electricity** in France is composed of two specific taxes:

- **Excise duty on electricity**[3] which rose sharply between 2003 and 2016, initially to support the development of renewable electric energies. Since 2017, revenues from this tax have been directly funding the budget of the State. After an initial increase in 2024, the unit price of the excise duty on electricity was raised once more in 2025. It had been reduced to its minimum between 1 February 2022 and 31 January 2024 in compliance with the Energy Taxation Directive (ETD) and in the framework of the French energy tariff shield. In line with the finances bill for 2025, the French government applied a mark-up on the excise duty to fund territorial tariffs equalisation in non-interconnected zones (NIZ)[4].
- **The contribution to transmission tariff** is used to fund part of the pension schemes for the Gas and Electricity industries workers.

Lastly, **the usual VAT rate of 20 % is applied to the supply and network parts of the bill, but also to the specific taxes on electricity.**

DISCOVER THE COMPLETE NOTE TO BETTER UNDERSTAND YOUR ELECTRICITY BILL

TO BE NOTED

Electricity bills for consumers are composed of three blocks related to supply, networks and taxes. **The parts corresponding to the networks and taxes are the same for market prices and regulated electricity sale tariffs[5]. Only a part of the supply block directly reflects the procurement strategy of each supplier and is partially linked to how the European electricity market is operated.**

[2] The TURPE is based on multi-annual pricing periods. The next one is scheduled to start on 1 August 2025.

[3] Formerly called the "CSPE" (Contribution to the Public Electricity Service) and then the "TICEE" (internal tax on final energy consumption).

[4] The standard level of excise duty that is currently applicable until 31 January 2026 is €25.09/MWh for households and similar, with a markup of €4.89/MWh. The standard amount of the excise duty was €21/MWh between 1 February 2024 and 31 January 2025, compared to €1/MWh between 1 February 2022 and 31 January 2024 and €22.5/MWh previously.

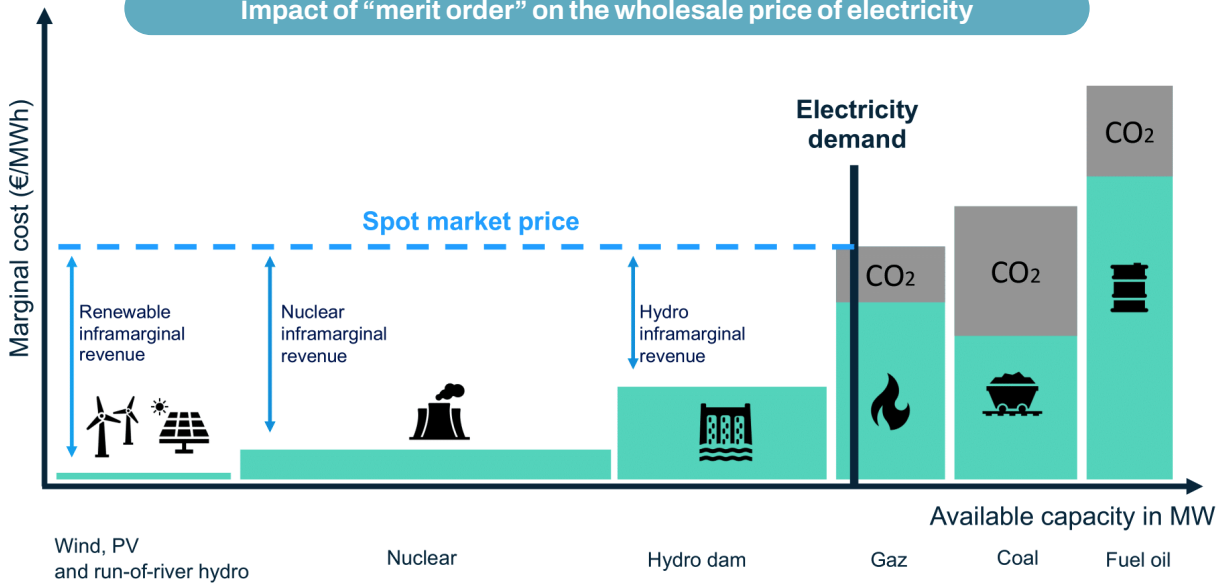
[5] In France, longstanding suppliers (EDF and local distribution operators) must offer regulated tariffs for the sale of electricity to households and micro-enterprises and similar (art. L. 337-7 of the Energy Code). These tariffs are reviewed once a year, in February, and can be updated in August to take into account changes in the "TURPE" (tariff for the use of public electricity networks).

3 HOW DOES THE ELECTRICITY WHOLESALE MARKET WORK?

To secure their financial trajectory, **electricity suppliers cover most of their procurement on futures markets** (from a few years to a few days before the electricity is delivered). In France, since 2011 and up to the end of 2025, and alongside futures markets, suppliers can benefit from the longstanding ARENH mechanism (Regulated Access to Historical Nuclear Electricity) which entitles them to purchase up to 100 TWh per year at a regulated tariff.

As delivery deadlines come closer, **suppliers** get a clearer idea of their customers' consumption and can balance their portfolio on the spot market (for day-ahead and even same-day delivery). This market is extremely volatile and reflects the short-term, supply-demand balance (temperature variations, cloudiness, available capacity of power stations or interconnections, etc.). The price is set according to the principle of **economic dispatch**, known as the **merit order**: the European power plants are ranked, for each hour, **from lowest to highest marginal costs (cost of producing an additional kilowatthour). Transactions are settled at the marginal cost of the last production unit[6] needed to cover the aggregated European demand.**

Impact of "merit order" on the wholesale price of electricity



[6] The margins made by the producers compared with the marginal cost of their plant (also known as "inframarginal revenue") means that they can, in theory, amortise their fixed costs.

The wholesale electricity market, by making optimal use of interconnections, **can therefore benefit from the most competitive and least carbon-intensive power plants that are available for a given hour.** However, due to its limited horizon (3 years for France and up to 5 years for Germany) and the high price volatility[7], **the wholesale electricity market is not designed to ensure investments in new low-carbon generation assets, ensure their sustainability, and to allow consumers to benefit from stable and predictable prices.** Publicly subsidised support schemes to develop the generation of renewable energies have been gradually set up, in addition to capacity mechanisms, aimed at safeguarding the security of supply.

The European Union was forced to adapt, in the aftermath of an unprecedented crisis on energy prices in 2021-2022 - notably due to soaring gas prices which were exacerbated by the conflict in Ukraine - by reforming the **European electricity market design** in 2024. This reform aimed at reducing the volatility of electricity prices for consumers and to offer greater visibility for investors in low-carbon sources of electricity, notably by encouraging the development of long-term contracts[8].

DISCOVER THE COMPLETE NOTE ABOUT THE FUNCTIONING OF THE ELECTRICITY WHOLESALE MARKET

DISCOVER THE COMPLETE NOTE ABOUT THE EUROPEAN ELECTRICTY MARKET DEVELOP

[7] Electricity prices are referred to as “volatile” because they can fluctuate significantly depending on a number of factors such as the amount of electricity generated and the consumption of electricity, as well as the cost of the fuel and the price of CO2 for thermal fossil-fuelled power stations.

[8] Long-term contracts that are either private (such as Power Purchase Agreements) or contracted with the State (such as Contracts for Difference) guarantee a price over a larger timescale (several decades) than wholesale futures markets.

4 WHAT POLICIES HAVE BEEN IMPLEMENTED AND WHAT CHALLENGES TO ACHIEVE CARBON NEUTRALITY?

To achieve carbon neutrality in 2050, the European Union set in 2020 the goal to reduce greenhouse gas emissions by 55% in 2030 compared to 1990. This goal led to the "**Fit for 55**" package which has a major impact on the European electricity system.

DISCOVER THE COMPLETE NOTE ABOUT EUROPEAN POLITICAL FRAMEWORK

Reaching these goals requires a massive and rapid reduction of fossil energies consumption. This means strengthening the importance of **sobriety and energy efficiency actions on a European level**, so that energy is consumed in lesser proportions and in a better way, and that efforts to decarbonise energy consumption continue. The European electricity system also has an essential role to play by:

- **Accelerating domestic and industrial electrification** to replace fossil fuel consumption (electric vehicles, heat pumps, electric industrial furnaces, etc.)[10] ;
- **Stepping up generation of low-carbon electricity (renewable and nuclear)**, which should progressively replace fossil energies within the European energy mix to generate enough electricity to meet the needs for electrification. This change requires **a large-scale development of new flexibilities** (demand-side management, storage, dispatchable low-carbon power generation units, etc.).

Ensuring the electrification of uses and making sure that all the newly-build renewable power plants are included in this drive, means **developing and modernising electricity networks.**

DISCOVER THE COMPLETE NOTE ABOUT THE CHALLENGES FOR EUROPE'S ELECTRICITY SYSTEM

In France, the goal to achieve carbon neutrality led to the "**SFEC**" (French Strategy for Energy and the Climate), built on four pillars: the planning law[9], the National Low-Carbon Strategy (SNBC in French) the National Climate Change Impact Adaptation Plan (PNACC in French) et the Multi-Annual Energy Plan (PPE in French).

CONTENT OF THE DRAFT PPE OF MARCH 2025

The draft PPE that was issued for consultation in March 2025 predicts **a sharp increase in renewable energies, the lengthening of the lifecycle of existing nuclear power plants** - as long as they are deemed secure - and the **revival of the French nuclear sector** (EPR2 and small modular reactors). To reach these goals, the acceleration laws, aimed at stepping up the generation of renewable and nuclear energies that were adopted in 2023, simplified administrative procedures by providing greater scope for investments and encouraging innovation.

DISCOVER THE COMPLETE NOTE ABOUT THE FRENCH POLITICAL FRAMEWORK

[9] Created by the 2019 law relative to energy and the climate, and added to in 2021 by the climate and resilience law, article L100-1 A of the Energy Code stipulated that this law be published before 1 July 2023, which was not the case on the date at which this note was published.

[10] In 2050, electricity could account for 60% of the final energy consumption of the European Union, compared with 23% today (source: Eurelectric).