14 April 2026

How do France's neighbours benefit from its nuclear fleet?

An Aurora Energy Research study commissioned by Sfen

France recorded a new export record in 2025, with 92.3 TWh exported, equivalent to 17% of its generation. Wholesale prices are on average lower in France than in neighbouring countries. The country benefits from a central geographic position and a high level of interconnection, with 23 GW of export capacity and 18 GW of import capacity. At a time when new discussions are under way at European level to strengthen security of supply and make electricity prices more competitive, **Sfen sought to assess the value provided by the French nuclear fleet within the European electricity market**.

Sfen commissioned **Aurora Energy Research to carry out a forward-looking modelling exercise of the European short-term power system for 2026**[1], with a particular focus on six countries: France, the United Kingdom, Belgium, Germany, Italy and Spain. The study provides insight into how markets operate and into the economic benefits of cross-border exchanges for each country.

The study highlights how French nuclear power:

- Provides value that extends beyond France itself. On a daily basis, together with renewables, it also helps reduce wholesale prices and CO_2 emissions in neighbouring countries.

- Is fully called upon during seasonal periods of stress on the European power system such as temperature drops and wind/solar shortages, in order to contain increases in wholesale prices and CO_2 emissions. A voluntary or involuntary reduction in nuclear capacity in France has a significant impact on neighbouring countries.

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[1] 2026 assumptions compared with 2025: 5 GW of additional solar capacity and 2 GW of additional wind capacity, the Flamanville EPR fully operational, and a slight increase in demand.

- Makes a major contribution to European security of supply during extreme weather events.

- Helps mitigate the impact of potential gas price increases on electricity markets during external crises.

Through these different analyses, the study shows France's role in the regional balance. The **Western European power system is now the right scale** at which to understand the strategic value provided by nuclear power in containing wholesale prices and emissions across the European power system.

Recently, the President of the European Commission acknowledged that the decision to reduce the share of nuclear energy in Europe had been a "strategic mistake". The Commission appears committed to pursuing an approach of **strict technological neutrality** in both the objectives and the full set of implementation tools of energy policy. Beyond this, SFEN recommends :

- **Recognising the insurance value of French nuclear power**, that is, the economic value of its availability in situations of supply-demand stress and external crises affecting the European power system. In the longer term, a well-functioning market requires that all the positive externalities of nuclear power be remunerated by those who benefit from them.

- **Taking decisions in favour of nuclear energy, and launching concrete actions to support its development**, just as has been done for other technologies such as renewables and hydrogen. As a reminder, the PINC (*Nuclear Illustrative Programme*) published in March 2026 echoes the conclusions of the IEA (*International Energy Agency*), according to which nuclear energy helps reduce total power system costs by lowering investment needs in transmission, distribution, storage and flexibility infrastructure.

Methodology: the model developed by Aurora makes it possible to simulate and observe, on an hourly basis and depending on weather conditions and external factors such as gas prices, wholesale price formation in the day-ahead market, generation dispatch, and the dynamics of cross-border exchanges. It makes it possible to isolate the factors that shape economic equilibria in the operation of the European power system, beyond the simple correlations that can be observed in historical data.

Key findings from the Aurora study

1. The value provided by the French nuclear fleet extends beyond France itself

French nuclear power, alongside renewable energy sources, helps reduce wholesale prices and CO2 emissions in neighbouring countries on a daily basis.

France benefits from a low average day-ahead wholesale price thanks to its abundant low-carbon electricity generation. Cross-border flows follow price differentials: countries with the highest prices import electricity from countries where prices are lower. Northern Italy has higher prices than France more than three quarters of the time, with an average difference of €27/MWh**.** Germany's prices are on average €9/MWh higher than France's, and are lower only 25% of the time. Spain is broadly at parity with France on average: between the two countries, prices in France are higher 40% of the time, lower 40% of the time, and converge within a ±€5/MWh range 20% of the time.

French **wholesale prices** are simultaneously lower than those of all its neighbours for nearly one third of the hours in the year. Conversely, **during the remaining two thirds of the time, at least one neighbouring country has a marginal price that is at least €5/MWh lower.** By importing electricity from that country while at the same time likely exporting to another, France economically optimises the operation of its power system, given installed capacity.

Hours per year by price position relative to France
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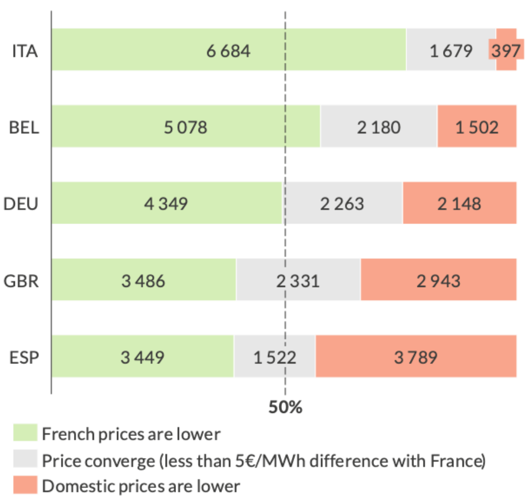
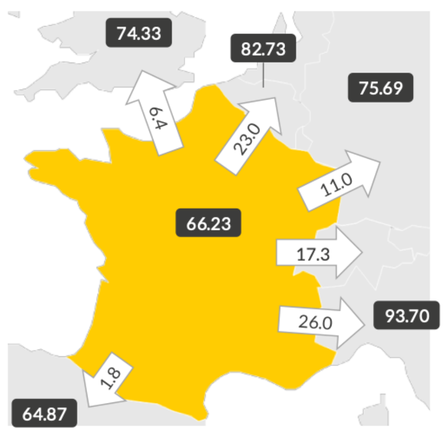


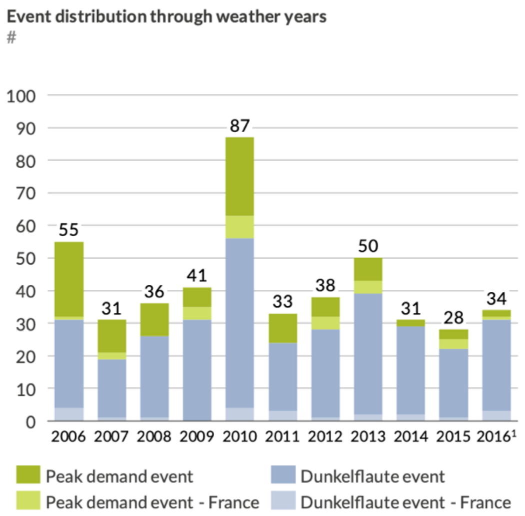
Source: Aurora Energy Research (2026)

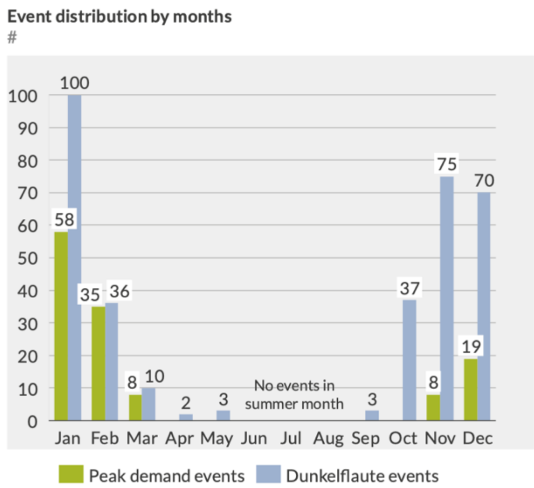
Cross-border flows resulting from market integration
Net position (arrows) – TWh, average price (boxes) - €/MWh



2. French nuclear power is fully called upon during seasonal periods of stress on the European power system, such as temperature drops and wind/solar shortages

While public debate often focuses, rightly so, on the growing number of situations involving overgeneration and negative prices, the full-year simulation shows highly contrasted situations in terms of supply-demand stress at any given time, both in France and in neighbouring countries. Across the six countries studied, **a total of 454 stress events were identified**[2]: 118 demand peak events[3], including 26 in France, and 336 wind/solar shortage events[4], including 22 in France.





Source: Aurora Energy Research (2026)

During these events, which occur mainly in winter, France must rely on all available nuclear capacity, as well as on fossil-fuel-based generation, in order to meet so-called residual demand, that is, demand after subtracting solar and wind generation. Average day-ahead prices then range between €100/MWh and €125/MWh (shown in red in the figure below), and CO_2 emissions are higher than during other periods. These weather-driven episodes are frequent and significant enough to have a substantial impact on average annual prices.

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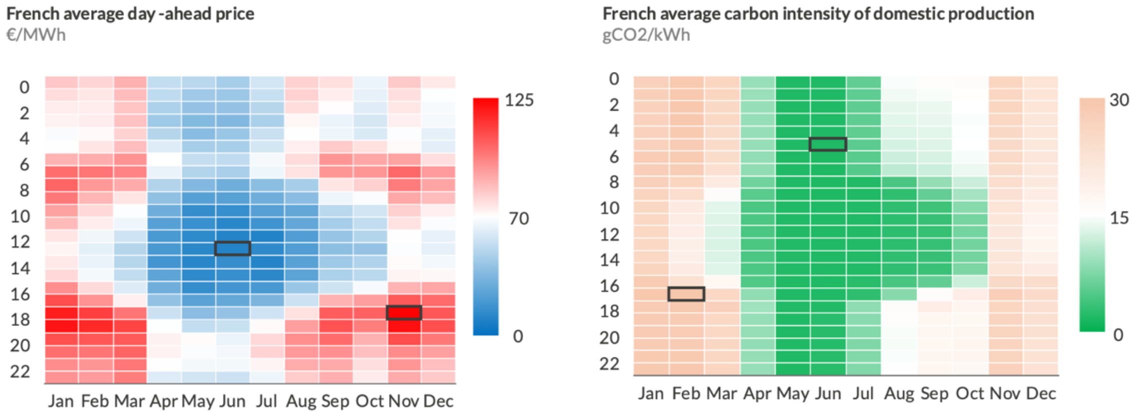
[2] The reference year for weather conditions is 2013, adjusted using observations from the 2006-2016 period.

[3] Definition: a period of at least 48 consecutive hours during which demand exceeds 70% of the maximum demand observed across all weather sensitivities for the price zone under consideration.

[4] Definition: a period of at least 48 consecutive hours during which the combined wind and solar load factor is below 15%.



Source: Aurora Energy Research (2026)

To isolate the contribution of French nuclear power to wholesale price containment and emissions reduction across the six countries studied, Aurora Energy Research simulated the European power system under a scenario in which French nuclear capacity **is reduced, whether as a result of political decisions or involuntarily**, as was the case during the stress corrosion crisis in 2022[5].

The analysis shows that **a 15%[6] reduction in French nuclear capacity leads to an increase in average electricity prices of €17/MWh[7] in France over the year as a whole, and of between €1/MWh and €6/MWh in neighbouring countries**. Cumulative CO2 emissions across the six countries covered by the study increase by 8% over the year, highlighting the key role played by French nuclear power in the decarbonisation of the wider region. This sensitivity analysis also shows how a voluntary or involuntary reduction in nuclear capacity in France has a significant negative impact on neighbouring countries.

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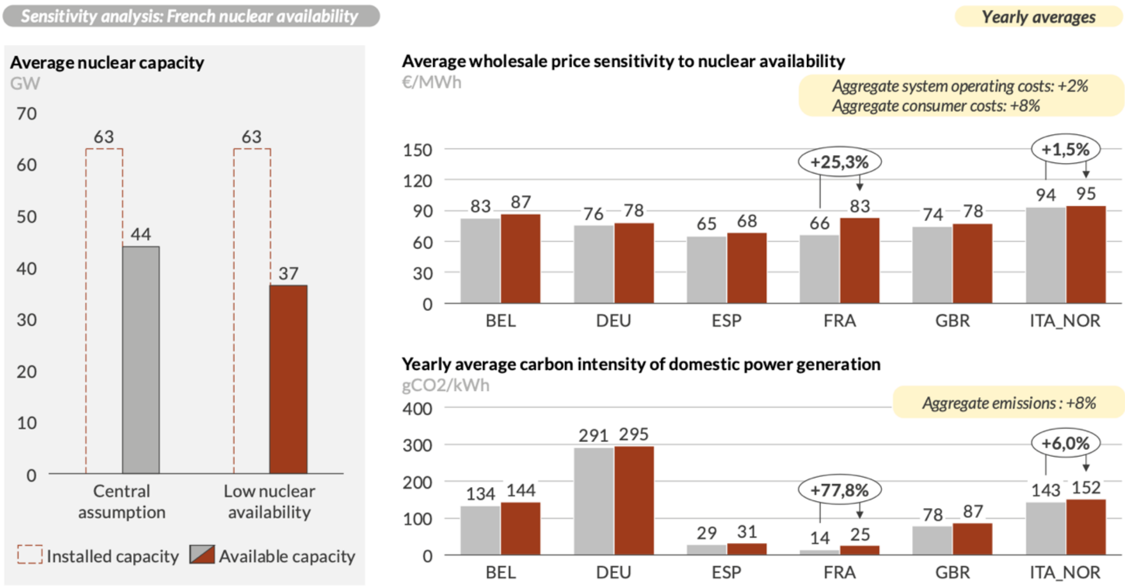
[5] Generic stress corrosion issue affecting the French nuclear fleet.

[6] Capacity range of 32-45 GW (average: 37 GW), instead of 38-54 GW (average: 44 GW), corresponding to the 2022 situation.

[7] From an annual average of €66/MWh to €83/MWh.

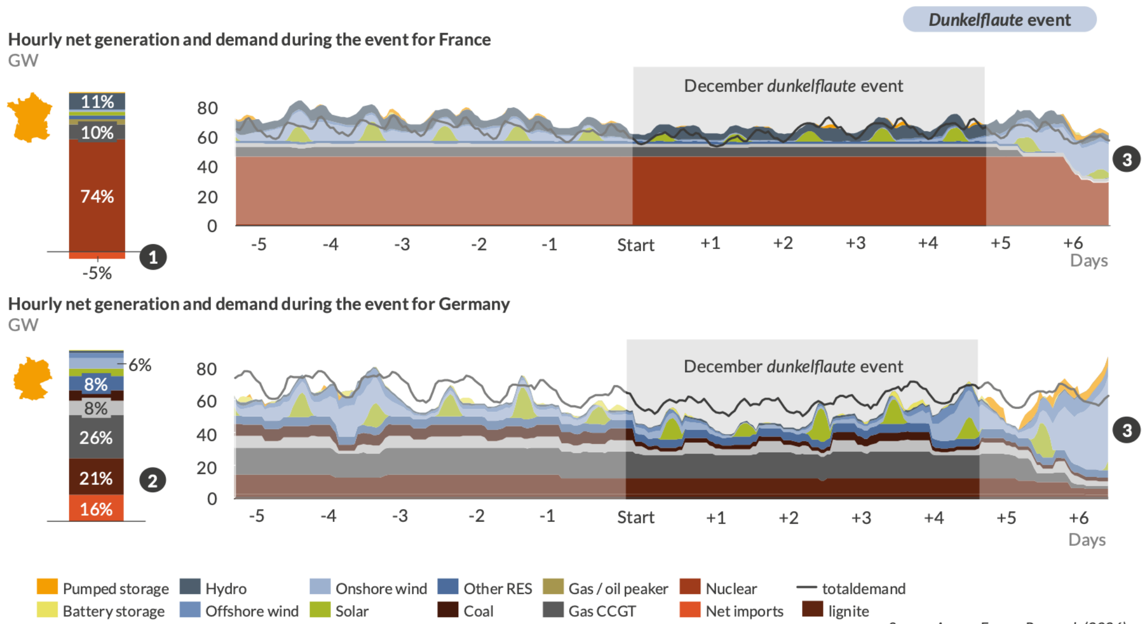


Source: Aurora Energy Research (2026)

3. French nuclear power makes a major contribution to security of supply during extreme weather events

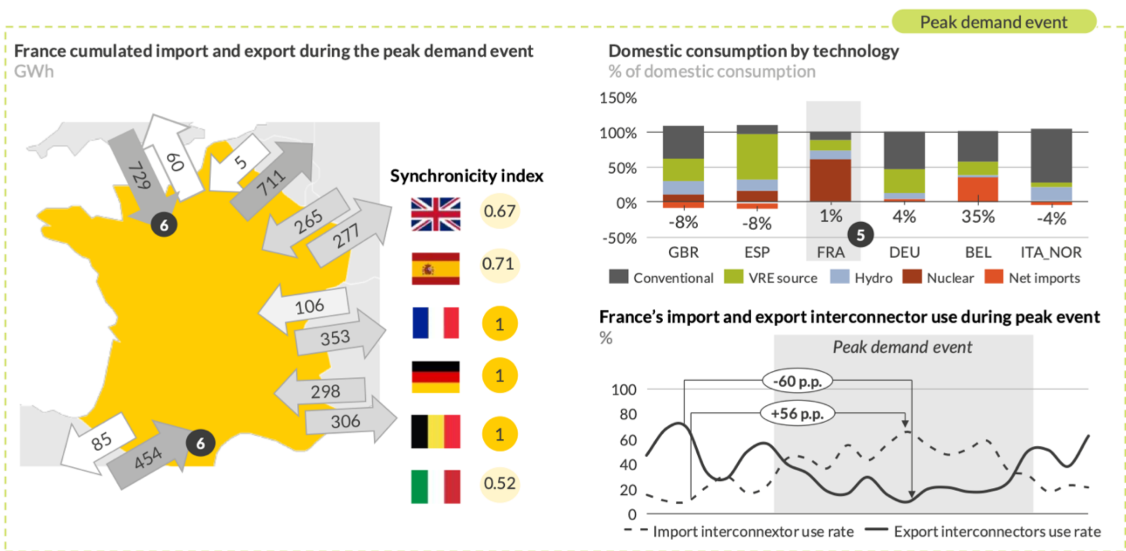
The contribution of nuclear power is particularly important **during an extreme European wind/solar shortage event**. Aurora therefore modelled two extreme weather events in the 2026 European power system, i.e. using current power system capacities.

The first is the ***Dunkelflaute* weather event observed in 2006 (*Dunkelflaute* meaning "dark calm" in German)** during which the availability of wind and solar generation capacity, as measured by load factors, remained at an average of 4% for more than four consecutive days. Very different dynamics can be observed in France and Germany. France, with 70% nuclear power and its combined-cycle gas plants, **continues to export 5% of its generation during this stress event**, even though it is subject to the same weather conditions. Germany, which in this situation brings all its gas- and coal-fired baseload plants online, meets 16% of its needs through imports, while Belgium covers 19% of its needs through imports.



Source: Aurora Energy Research (2026)

The second extreme event analysed is **a 14-day demand peak** corresponding to the February 2012 cold spell that affected the whole of Europe. France, Germany and Belgium are the three countries most affected by this event. France then mobilises all its generation resources, including its entire nuclear capacity, and almost manages to cover demand, even though it is the most temperature-sensitive country in Europe. France is a net importer for only 1% of its needs during this event, a low figure compared with Belgium, which imports 35% of its needs, although it remains significant given France's usual profile as a net exporter. France imports electricity from Great Britain and Spain, which are less exposed to the cold spell, while continuing to export, in particular to Belgium. In doing so, it economically optimises the operation of its power system, given installed capacity.



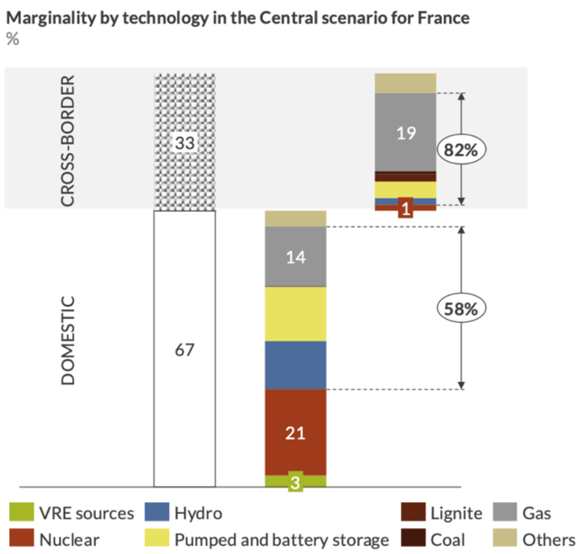
Source: Aurora Energy Research (2026)

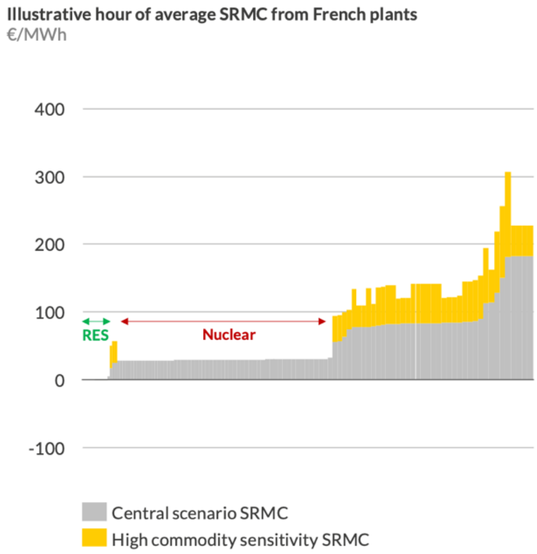
4. During external crises, French nuclear power helps mitigate the impact of potential gas price increases on electricity markets

As a generation source with a very low marginal cost, nuclear power ranks high in the merit order, just after solar and wind, whose marginal cost is zero. Although nuclear and renewable energy together account for more than 95% of the French electricity mix, the study shows that, over the year as a whole, nuclear is price-setting only 21% of the time, and variable renewables only 3% of the time. Over the year, it is nuclear and renewables that enable France to maintain lower prices than its neighbours. It should be noted that the marginal cost of nuclear power is only just sufficient to cover its variable fuel and maintenance costs. Fixed costs therefore need to be recovered elsewhere, through generation assets with higher marginal costs lower in the merit order. Persistently low price levels would not allow generation assets, whether renewable or nuclear, to recover their full costs on the market.

The technologies that come after nuclear in the merit order, such as gas-fired generation or hydro reservoirs, whose use value is closely linked to gas prices, are the ones that most frequently set prices. In the modelling, when account is taken of the hours during which gas-fired plants are marginal, whether domestic or foreign via interconnections, as well as the hours during which hydropower with reservoirs or storage are marginal, with their valuation being driven by gas prices, **French wholesale prices are found to be set by gas nearly two thirds of the time**. This is not a matter of indexation, but the result of prices being set by the last unit needed to balance supply and demand.

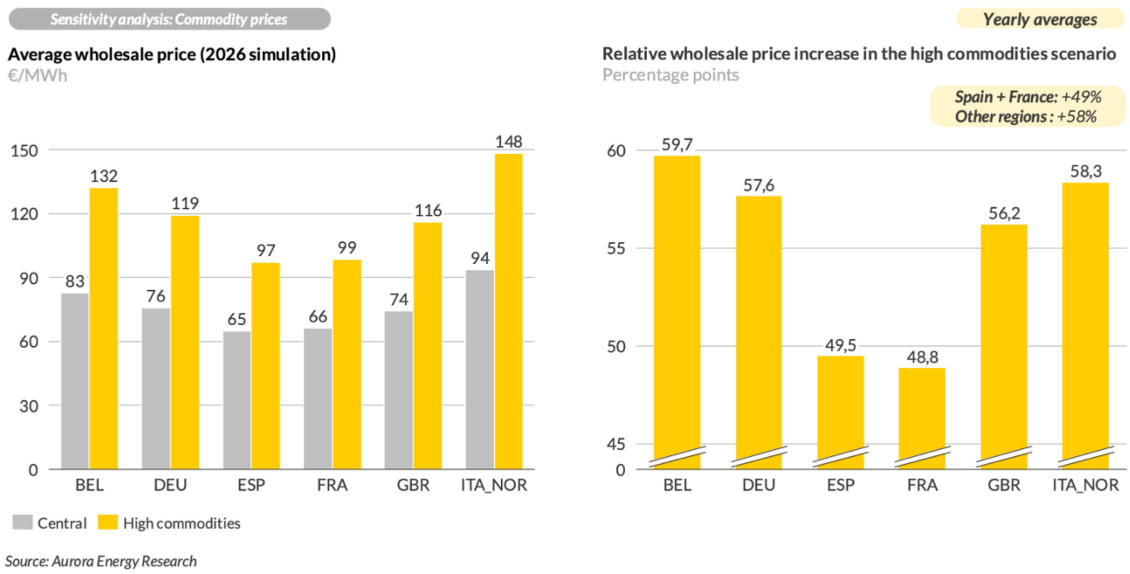
It is important to clearly distinguish this mechanism, which is intended to ensure the optimal allocation of short-term generation assets in the power system, from other regulatory arrangements aimed at encouraging the construction of new generation capacity, and from the regulations intended, as will be discussed below, to protect final consumers.





Source: Aurora Energy Research (2026)

A simulation nevertheless shows that France is less sensitive than its neighbours to a gas shock: a 70% increase in gas prices would lead to a 50% increase in wholesale prices in France over the year, compared with 60% in neighbouring countries.



More importantly, the real benefit of installed nuclear capacity for both France and Europe in the event of a gas shock becomes clear when looking at total system costs. In France, these are only marginally affected by a gas price shock, given that gas-fired generation accounts for less than 5% of the electricity mix. The situation is very different in neighbouring countries, where gas-fired power plants make up a significant share of the electricity mix: 16% in Germany, 21% in Spain, and more than 56% in Italy. This advantage in terms of total power system costs benefits consumers, beyond the remuneration of generation assets, notably through various mechanisms such as the new universal nuclear payment (*versement nucléaire universel*, VNU). This mechanism provides for the taxation of EDF's nuclear revenues when the average revenue of the nuclear fleet exceeds certain thresholds: 50% of revenues above the first threshold, indicated at around €78/MWh, and 90% above the second threshold, indicated at around €110/MWh. Each year, CRE calculates EDF's nuclear revenues in order to determine the share to be redistributed. Any amounts collected are then redistributed to all final electricity consumers, both households and businesses, in the form of a reduction in the electricity price, shown on the bill under a dedicated line item.