

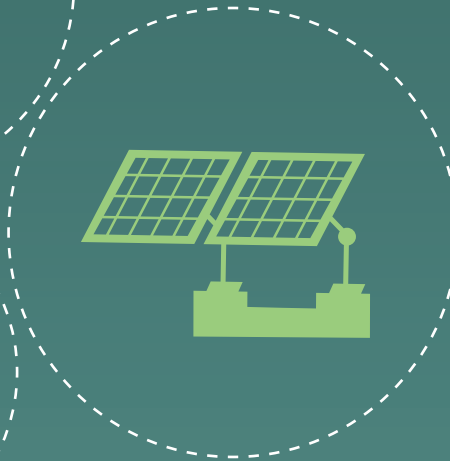


European  
Commission

# Quarterly report

## On European electricity markets

with focus on annual overview  
for 2023



Market Observatory for Energy  
DG Energy

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Energy

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Directorate-General for Energy, unit A4, Market Observatory for Energy, 2024

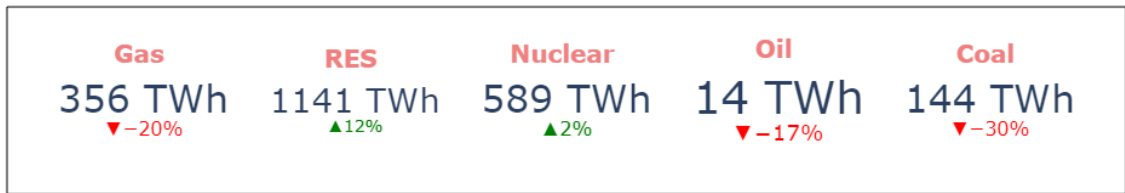
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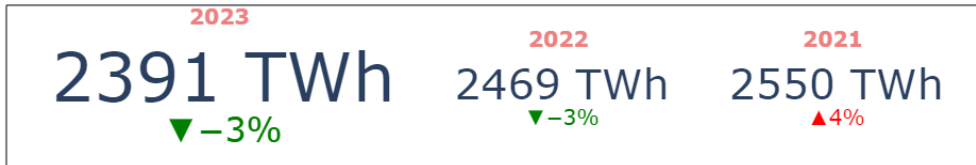
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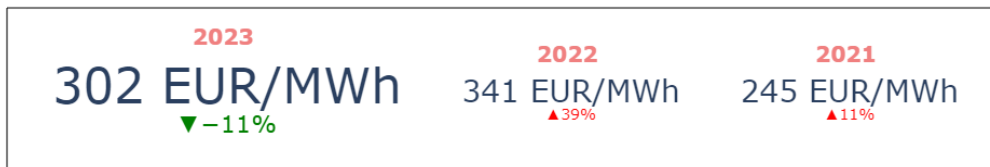
Electricity consumption in 2023, 2022 and 2021



Electricity wholesale prices in 2023, 2022 and 2021

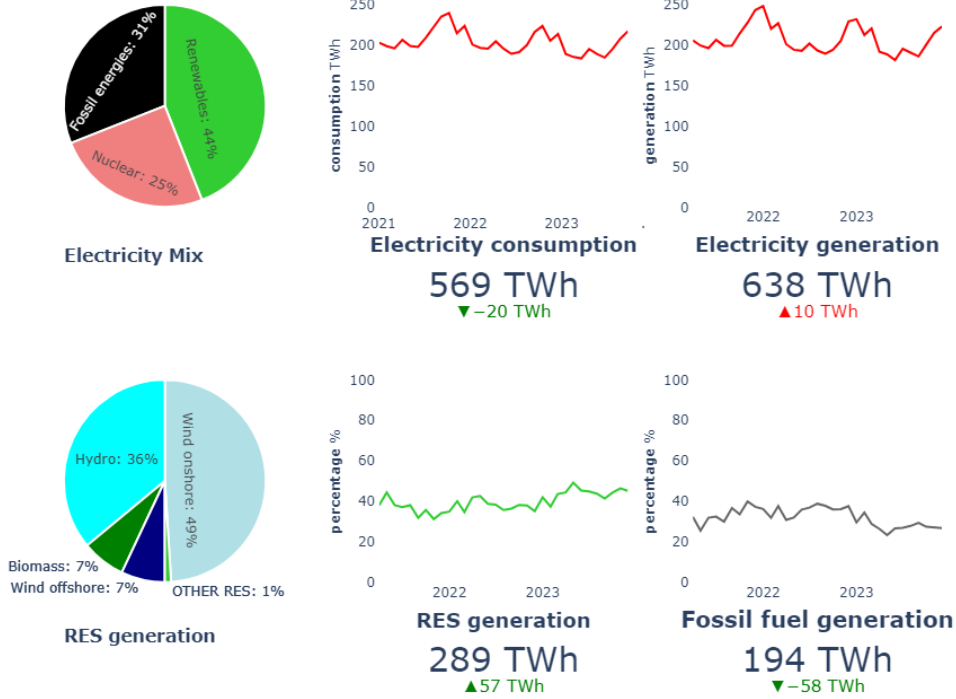


Electricity retail prices in 2023, 2022 and 2021



## Key figures of the quarter

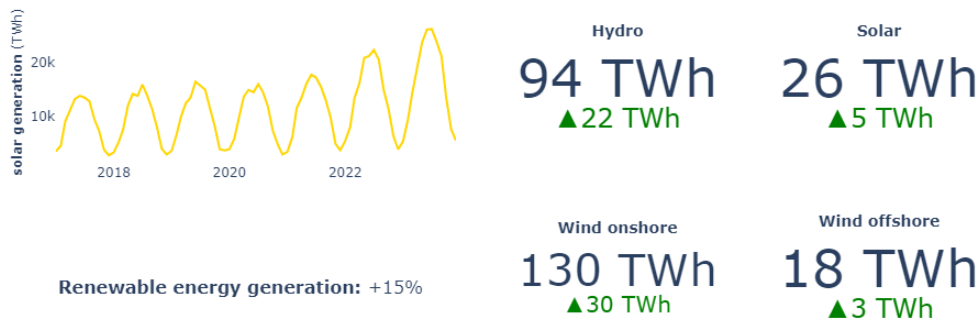
Electricity generation and consumption in Q4 2023 and year-on-year comparison



Prices in Q4 2023 and year-on-year comparison



Focus of the Quarter: Renewable energy generation and year-on-year comparison



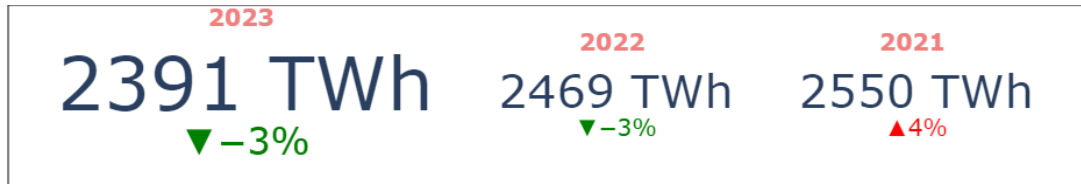
## HIGHLIGHTS OF THE REPORT

- **The year 2023 was marked by a continuation of positive market fundamentals that supported lower wholesale electricity prices, mainly mirroring the developments in gas prices.** Lower levels of gas prices, combined with subdued demand, higher renewables and nuclear generation, helped to alleviate wholesale electricity prices across EU markets.
- **The improvements in market fundamentals supported a fall in wholesale electricity prices in European markets in 2023, compared with the historical highs in 2022. The European Power Benchmark averaged 95 €/MWh in 2023, 57% lower than in 2022.** The largest year-on-year price declines in Member States were registered in France (-65%), and Finland (-63%). Yearly average prices ranged from 51 €/MWh in Sweden to 128 €/MWh in Italy. In Q4 2023, markets experienced a decline in wholesale electricity prices (ranging from -67% to -34%). In Q4 2023, the European Power Benchmark averaged 83 €/MWh, 55% lower on yearly basis.
- **Electricity consumption in the EU fell (-3%) compared with last year's levels in 2023,** mainly due to the industrial demand reduction and changes in consumption as a result of the high prices during the energy crisis. Despite the decline observed in electricity consumption throughout the year, Q4 2023 consumption registered a small year-on-year (+2%) increase.
- **The share of renewables increased to 44% in 2023** (from 38% in 2022), while **the share of fossil fuels fell significantly to 32%** (from 39% in 2022), supported by strong renewable deployment and reduced electricity demand.
- **Solar and wind registered +15% in generation in 2023 (+87 TWh).** Onshore wind generation rose by 14% (+51 TWh) and solar generation surged by 19% (+31 TWh). Hydropower improved its output by 17% (+49 TWh) while offshore wind generation rose by 10% (+5 TWh).
- **Fossil fuel generation dropped by 24% in 2023,** supported by lower demand and sustained renewables generation. In total, coal-fired generation fell by 28% (-118 TWh), whereas less CO<sub>2</sub>-intensive gas generation dropped by 20% (-88 TWh). Nuclear output rose by 2% (+9 TWh) in 2023.
- **A new record of installed renewable capacity was reached in the EU in 2023, with additional solar and wind capacity by 14% on a yearly basis** (from 320 TW in 2022, to 365 TW in 2023). Solar installed capacity rose by 22%, while onshore and offshore wind grew by 8% and 11%, respectively. Additional installed capacity supported higher levels of renewables generation in 2023.
- **Carbon prices reached a record high in 2023, at 83 €/tCO<sub>2</sub>, marking a 3% increase from 2022.** Prices fluctuated mainly between 75 and 95 €/tCO<sub>2</sub>. In 2023, high carbon prices, combined with lower gas prices supported favourable conditions for a shift from coal to gas generation, after the uneconomical conditions for gas vis-à-vis coal power plants during the energy crisis.
- **The decrease in wholesale prices registered in 2023 alleviated the pressure on household electricity retail prices across the EU.** Retail electricity prices for households in EU capital cities were down by 11% in 2023, compared with 2022. **Electricity prices for industrial users in the EU registered a year-on-year decrease of 7% in the second half of 2023** (compared to the second half of 2022). These are the first signs of falling electricity prices at industrial level since the energy crisis.
- **2.3 million new electric vehicles (EVs) were sold in the EU during 2023, a yearly increase of 16%.** Close to 643,000 new EVs were registered in the EU in Q4 2023, 7% less than in Q4 2022. Demand for electrical vehicles (EVs) positioned Q4 2023 as the second highest quarterly figure on record. Q4 2023 numbers translated into an impressive 25% of market share, lower than China, but two and a half times the market share registered in the United States.
- **The record number of hours with negative wholesale prices in 2023 (6870) was 1107% higher than in 2022.** Most of hours with negative prices occurred in October (1685), mainly in Northern European markets.

*Methodological Note: The rapid changes in gas and electricity markets happening through the energy transition as well as the significant restructuring of the EU's energy supply following the energy crisis, call for reviewing the Quarterly Reports of the European Electricity and Gas Markets so as to make them best fit for purpose. The aim is to ensure a more timely publication, modernise presentation, increase data transparency and an easier access to the data used to produce the reports. All this should increase usability for readers. The process of the review is planned to be carried out gradually attending the feedback we receive on it. As the Commission advances with its review, the quarterly reports will progressively reflect the methodological, technical, and editing changes as well as the comments received from stakeholders.*

## Electricity market fundamentals

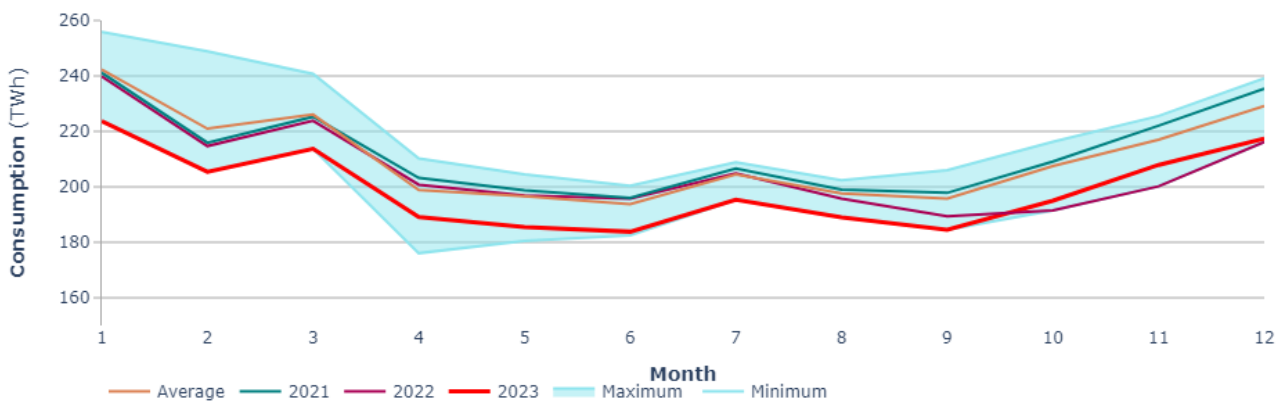
### 1.1 Demand side factors



*Electricity consumption in 2023, 2022 and 2021*

- In 2023, the total electricity consumption in the EU dropped 3% compared with last year's levels, following the impact of reduced industrial demand due to high prices in 2022 and changes in consumer behaviour, combined with weather related factors. Despite the decline observed in electricity consumption throughout the year, Q4 2023 registered a small (+2%) increase. Demand levels for the fourth quarter of 2023 were still below the 2019-2022 range, lower than in the equivalent quarter in 2020, which was a particular year with low levels of demand due to the COVID-19 impact.

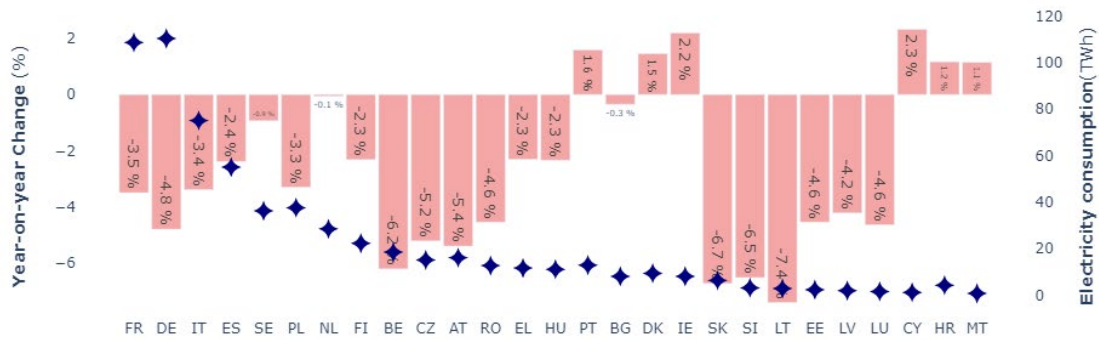
**Figure 1 – Monthly EU consumption of electricity**



Source: Eurostat

- Figure 2** sums up changes in electricity consumption over 2023, compared to 2022. EU electricity consumption decreased of 3% in 2023 compared to 2022, in nineteen Member States. The biggest decreases had been registered in Slovenia, Slovakia and Lithuania (-7%) while slight increases had been registered in Cyprus (+2%) and Denmark (+1%).
- In Q4 2023, the EU electricity consumption was 2% higher than in Q4 2022 (see Figure 52 in Annex). The largest declines took place in Czech (-3%) and Belgium (-2%). Conversely, Denmark (13%), Malta (+9%), Cyprus (8%) reported significant increases in consumption during 2023.

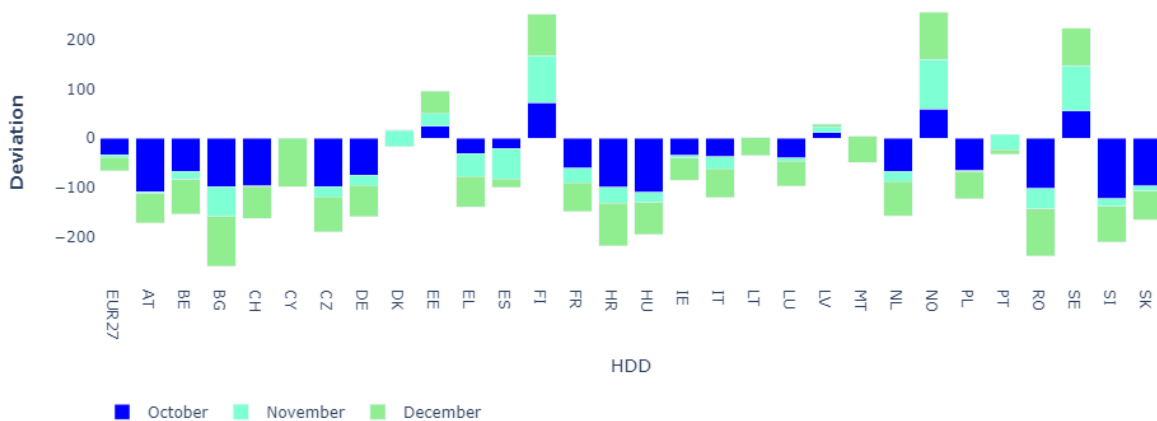
**Figure 2 – Yearly changes in electricity consumption by Member State in 2023 compared with 2022**



Source: Eurostat

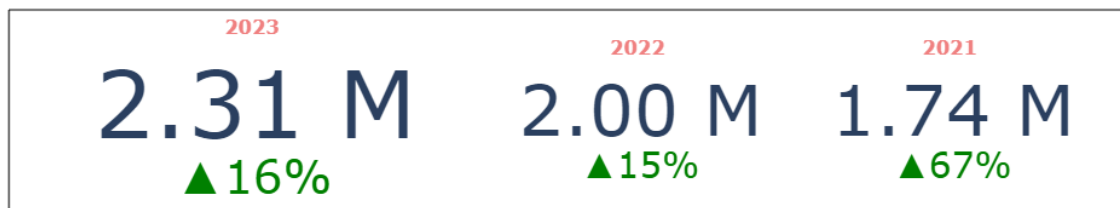
- Figure 3** illustrates the monthly deviation of actual Heating Degree Days (HDDs) from the long-term average (a period between 1979 and the last calendar year completed) in Q4 2023. EU-wide, the reference quarter was warmer than the historical range. October and December were particularly warmer than the historical average, while November was closer to the average, albeit also registered warmer-than-usual temperatures. Overall, Q4 2023 registered -177 HDDs below the long-term average. Most of the European countries registered warmer-than-average temperatures, with the exception of Nordic and Baltic countries (e.g. Norway, Finland, Sweden and Estonia).

**Figure 3 - Deviation of actual heating days from the long-term average in October-December 2023**



Source: JRC. The colder the weather, the higher the number of HDDs. The hotter the weather, the higher the number of CDDs

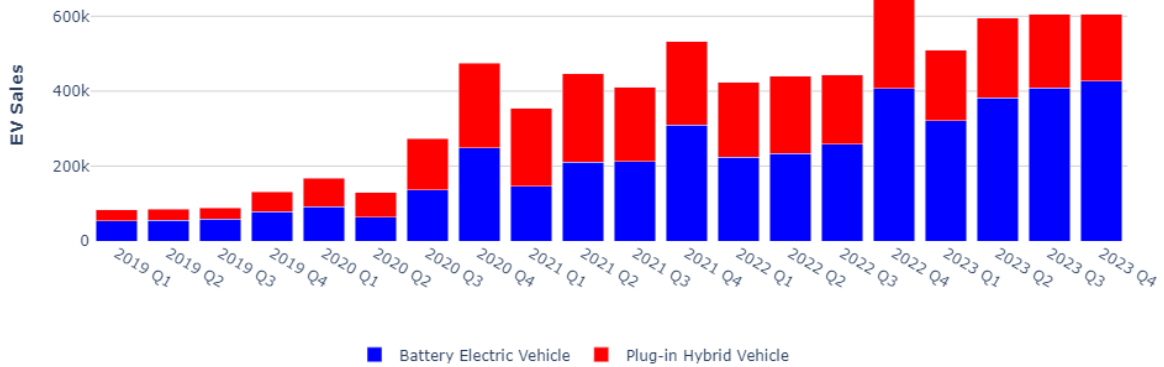
- Figure 5** shows that close to 643,000 new EVs were registered in the EU in Q4 2023 (-7% compared with Q4 2022). This is still the second highest quarterly figure on record and translates into a 25% market share; lower than China (44%), but two and half times the market share registered in the United States (10%). The battery electric vehicles segment continued to grow (+5% year-on-year more than 426,000). However, the demand for plug-in hybrid vehicles registered a decrease (-25% year-on-year to more than 215,000). Hybrid electric vehicles (not chargeable) sales amounted to more than 716,000, registering an increase of 31% compared with Q4 2022.
- Overall, 2.3 million new EVs were sold in the EU during 2023, an increase of 16% compared with 2022 figures.



EVs sold in 2023, 2022 and 2021



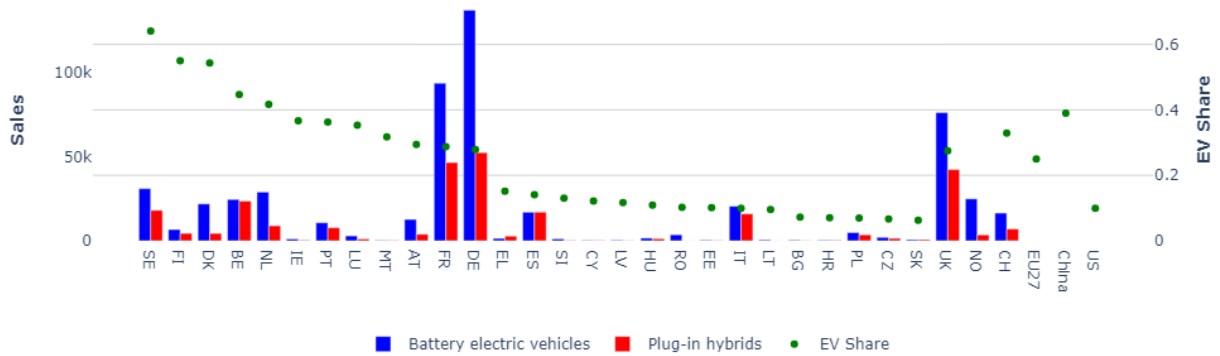
**Figure 4 – Quarterly EV sales in the EU**



Source: ACEA

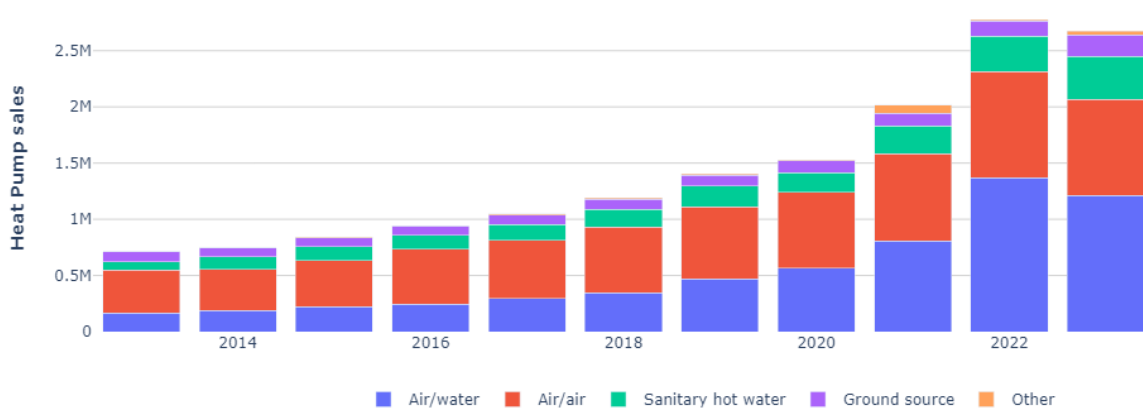
- The largest share of sales of new EVs was observed in another quarter in Sweden, where 64% of all cars sold in Q4 2023 were EVs. Moreover, in Finland, more than half of all passenger cars sold could be plugged (55%), followed by Denmark (54%), Belgium (44%) and the Netherlands (42%). Germany retained the position of the largest individual market (more than 189,000 EV sales in Q4 2023) followed by France, where sales amounted to more than 140,000 new EVs in the reference quarter.

**Figure 5 – Electrically chargeable passenger vehicle (EV) sales in selected countries in Q4 2023**



Source: ACEA, CPCA, BloombergNEF

**Figure 6 – Yearly Heat Pump sales in Europe**



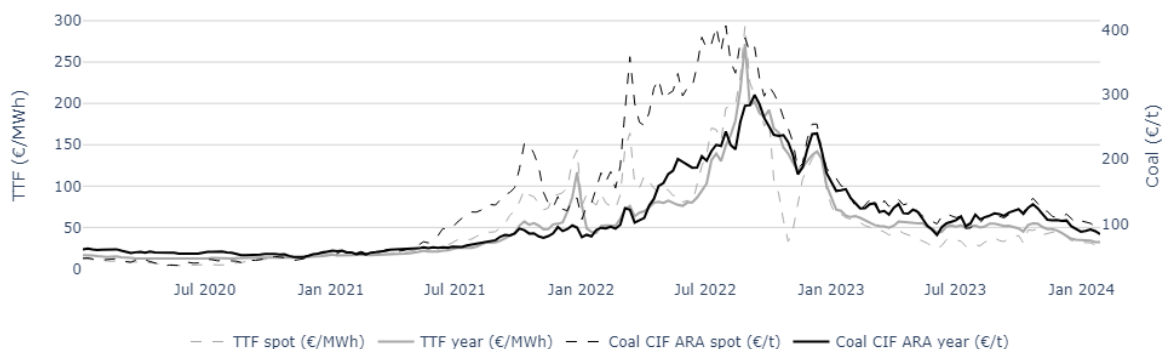
Source: EHPA, 14 European countries (BE, CH, DE, DK, ES, FI, FR, IT, NL, NO, AT, PL, PT, SE, SK)

- In 2023, the number of sales of Heat Pumps decreased slightly of 4% to 2.68 million (from 2.78 million in 2022). The biggest markets for heat pumps were in France, Italy, Sweden and Germany.

## 1.2 Supply side factors

- **Figure 7** reports on developments in European coal and gas prices. Despite factors such as the Australian strikes and the intensification of the conflicts in the Middle East, spot and forward gas and coal prices decreased for most of 2023. Prices remain at lower levels than in 2022, supported by improved market fundamentals (i.e. high storage levels, reduced demand and additional LNG regasification capacities in Europe). In 2023, spot gas prices were at 41 €/MWh, 67% lower than in 2022 (and 13% lower than in 2021). Spot coal prices declined to 120 €/ton, which is 57% lower than in 2022, but 13% higher than in 2021. After peaking in summer 2022 (above 400 €/ton), coal prices were in a downward trend that ended in 2023, before rising again during the autumn supported by higher gas prices and electricity demand.
- Moreover, spot gas prices averaged 40 €/MWh in Q4 2023, 57% lower than prices in Q4 2022. TTF day-ahead prices remained at a discount to TTF forward contracts (month and year ahead) during Q4 2023. Year-ahead prices averaged 46 €/MWh in Q4 2023, 66% lower than in Q4 2022. Thermal coal spot prices, represented by the CIF ARA contract, fell to 117 €/t in Q4 2023 (from 108 €/t recorded in the previous quarter).

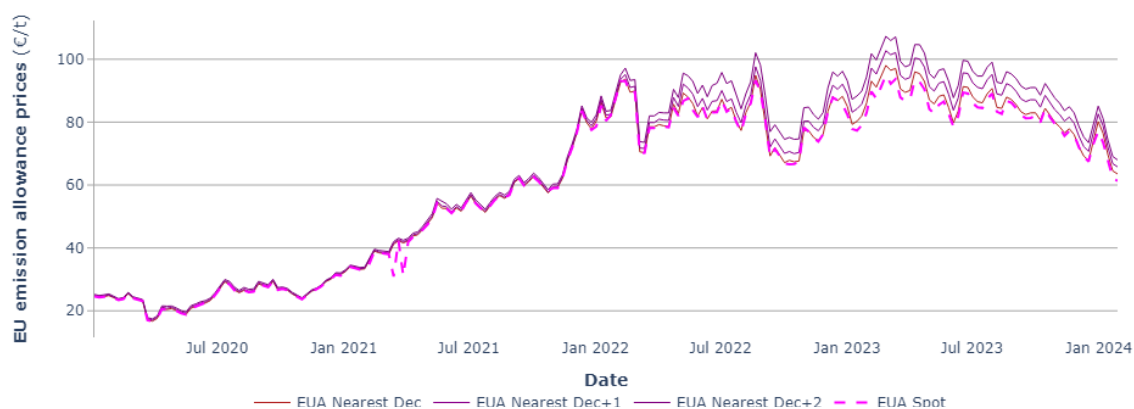
**Figure 7 – Weekly evolution of spot and year-ahead coal and gas prices**



Source: S&P Global Platts

- The European market for emission allowances, shown in **Figure 8**, has been relatively stable, but prices have been decreasing more markedly since summer. Spot prices fluctuated between 75 and 95 €/tCO<sub>2</sub> during 2023. The average spot price of CO<sub>2</sub> in 2023 (83 €/tCO<sub>2</sub>) was 3% higher than in 2022. The average spot price in Q4 2023 (76 €/tCO<sub>2</sub>) was only 1% lower than in Q4 2022. However, emissions have been in a falling trend, reaching a low of around 50 €/tCO<sub>2</sub> in February 2024. Lower gas prices have supported coal-to-gas fuel switch, thanks to high carbon prices which put coal and lignite power plants at a greater disadvantage against their less polluting gas-fired competitors (see **Figure 20**).

**Figure 8 – Evolution of EU emission allowance spot and future prices from 2020**



Source: S&P Global Platts

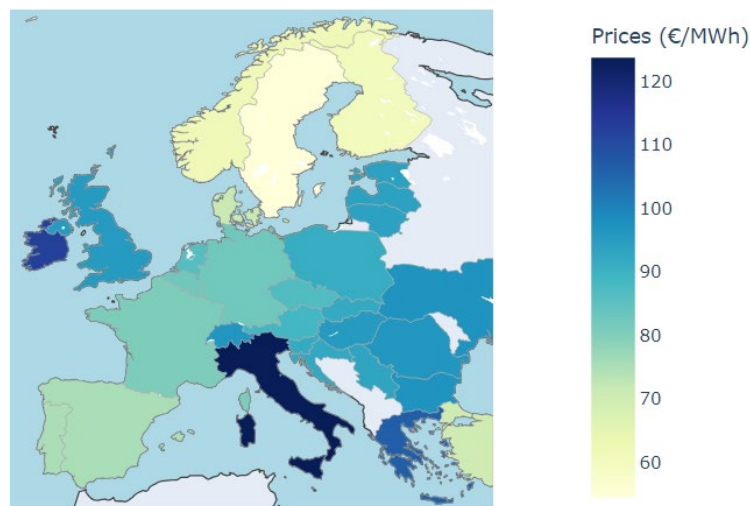
## European wholesale markets

### 1.3 European wholesale electricity markets and their international comparison



- The map below (**Figure 9**) shows the average day-ahead wholesale electricity prices in Europe in 2023. Average day-ahead wholesale electricity prices in Europe were 59% lower than in 2022. Low gas prices, increased renewable energy generation and moderate demand from industries and households, contributed to the fall in prices. The higher level of renewable energy generation (in particular, solar and wind, but also improved hydropower output) had been accompanied with the enhanced nuclear fleet availability. Average prices ranged from 77 to 89 €/MWh during the fourth quarter of 2023, following the developments of the gas market, while remaining well below the levels seen in Q4 2022.
- On yearly basis, the European Power Benchmark averaged 95 €/MWh in 2023, 57% lower than in 2022. On a yearly basis, European markets experienced a decline in wholesale electricity prices, ranging from a yearly average of 51 €/MWh in Sweden to 128 €/MWh in Italy. The largest year-on-year price falls in Member States were registered in France (-65%), and Finland (-63%). The lowest decreases were seen in Poland (-34%) in 2023, compared with 2022 prices.
- As for quarterly prices, European Union Member States markets experienced a decline in wholesale electricity prices (ranging from -67% to -34%) in Q4 2023. The European Power Benchmark averaged 83 €/MWh in Q4 2023, 55% lower on yearly basis. Compared to Q3 2023, the quarterly average price rose slightly by 2%.

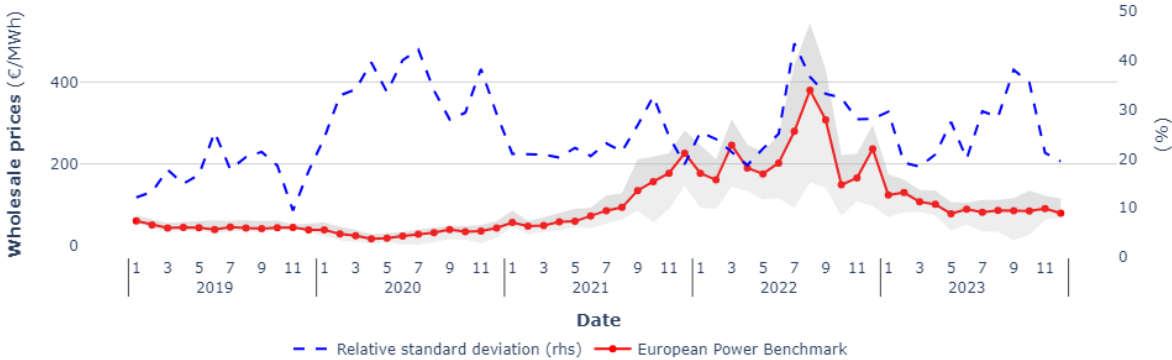
**Figure 9 – Comparison of average wholesale baseload electricity prices, 2023**



Source: European wholesale power exchanges, government agencies and intermediaries

- **Figure 10** shows the lowest and highest regional prices in Europe represented by the two boundary lines of the shaded area, the weighted EU average of these regional markets (European Power Benchmark), as well as the relative standard deviation of regional prices. The relative standard deviation metric shows a peak in October 2023 after decreasing to more normal levels in November and December. The **Annex** provides graphics of the monthly and daily evolution of regional prices in Europe.

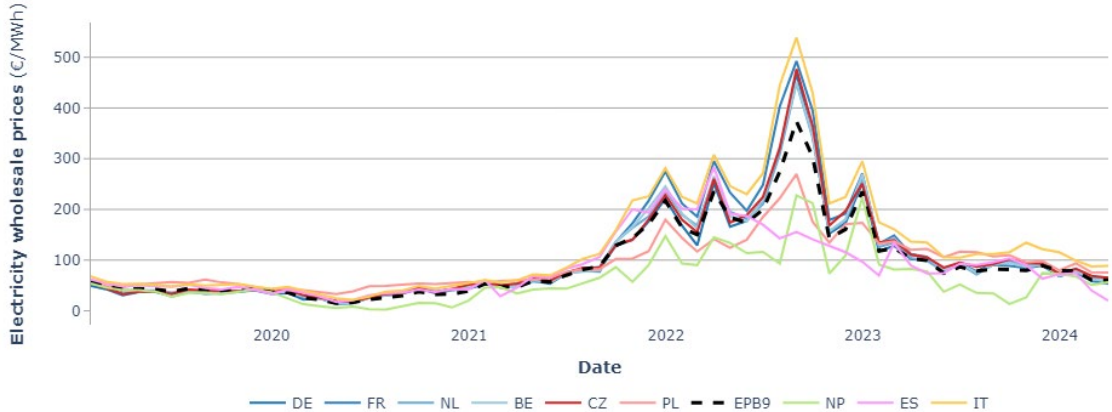
**Figure 10 - The evolution of the lowest and the highest regional wholesale electricity prices in the European day-ahead markets and the relative standard deviation of the regional prices**



Source: S&P Global Platts, European power exchanges. The shaded area delineates the spectrum of prices across European regions.

- Figure 11** presents the evolution of weekly average electricity wholesale prices in nine selected European markets. Thanks to demand reduction, higher wind and solar, combined with recovering hydro and enhanced nuclear generation; Germany, France and the Netherlands were able to decrease their fossil fuel output, registering a fall in prices. The French nuclear fleet improved its availability in 2023, which helped to decrease pressure on prices and consolidating back power flows into the historical net exporting position of France.
- Germany, France and the Netherlands average prices in 2023 were 95, 97 and 96 €/MWh, respectively from 235, 275 and 241 €/MWh in 2022. Italy registered an average yearly price in 2023 of 128 €/MWh, the highest of the nine selected markets. However, Italian prices decreased by 58% compared to 2022.
- Strong solar generation supported lower prices in Spain, averaging 87 €/MWh during 2023 (-48% compared to 2022, average of 168 €/MWh). At 57 €/MWh, prices in Northern Europe remained significantly lower than in the continent, from 136 €/MWh in 2022.
- Central Eastern Europe markets followed prices at a higher level than in Central Western Europe, with prices at 112 and 101 €/MWh in average in 2023 in Poland and Czechia, respectively. However, Poland and Czechia also registered yearly prices decrease compared to 2022 (-33% and -59% respectively).

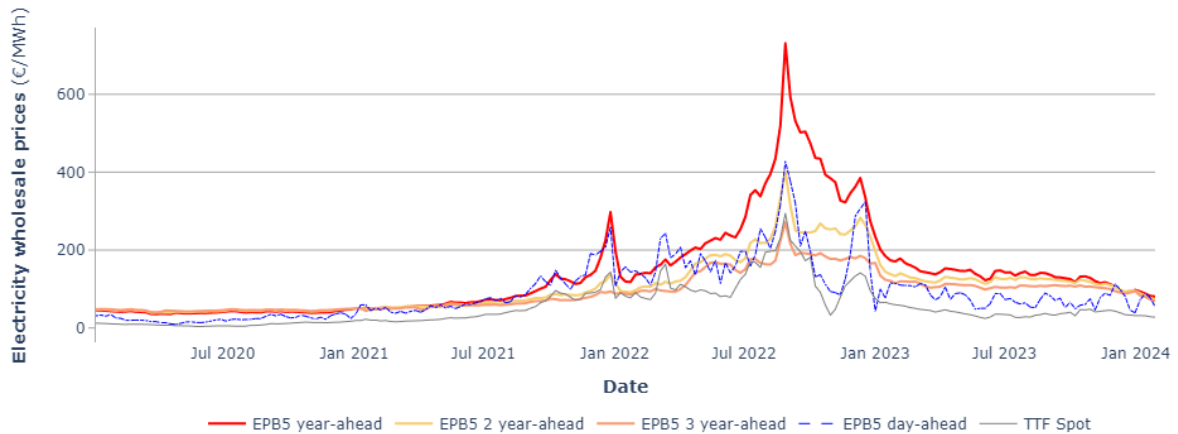
**Figure 11 – Weekly average electricity wholesale prices in nine selected European markets**



Source: S&P Global Platts, European power exchanges, ENER

- Figure 12**, shows how gas prices (TTF spot prices) were a relevant factor driving future electricity prices. During the energy crisis, we roughly observed a high correlation between gas and electricity prices, with a two-fold leverage effect (proportionality factor induced by gas power plants efficiency and gas being the marginal power plant in electricity price setting). This correlation is fading away since last summer 2023.
- In 2023, the average electricity year-ahead, two-year ahead and three-year ahead contracts were respectively 138 €/MWh, 123 €/MWh and 107 €/MWh. The premium of the weekly average between the year-ahead contract and the spot price averaged at 53 €/MWh during 2023.

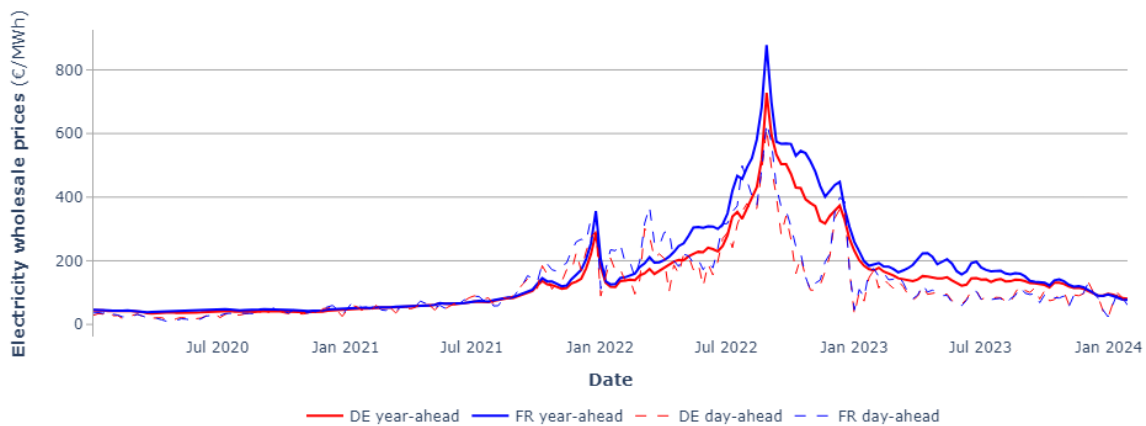
**Figure 12 – Weekly futures baseload prices – weighted average of selected European markets**



Source: S&P Global Platts.

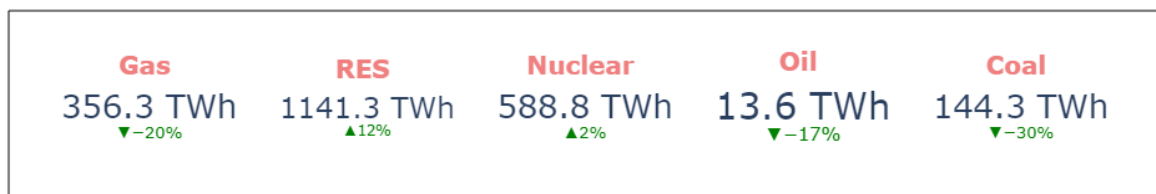
- Figure 13** shows the evolution of year-ahead contracts of Germany and France, together with their equivalent spot (day-ahead) prices. The divergence between the two forward contracts decreased in 2023. In 2023, the divergences reflected some structural differences between the two markets (i.e. the high proportion of French nuclear power plants under maintenance in and the relevance of wind generation when can cover a significant part of the demand at times in Germany). The average premium of the French contract over their German equivalent contract averaged 25 €/MWh during 2023 (96% lower than in 2022).

**Figure 13 – Weekly German and French year-ahead contracts**



Source: S&P Global Platts.

#### 1.4 Electricity mix in the EU

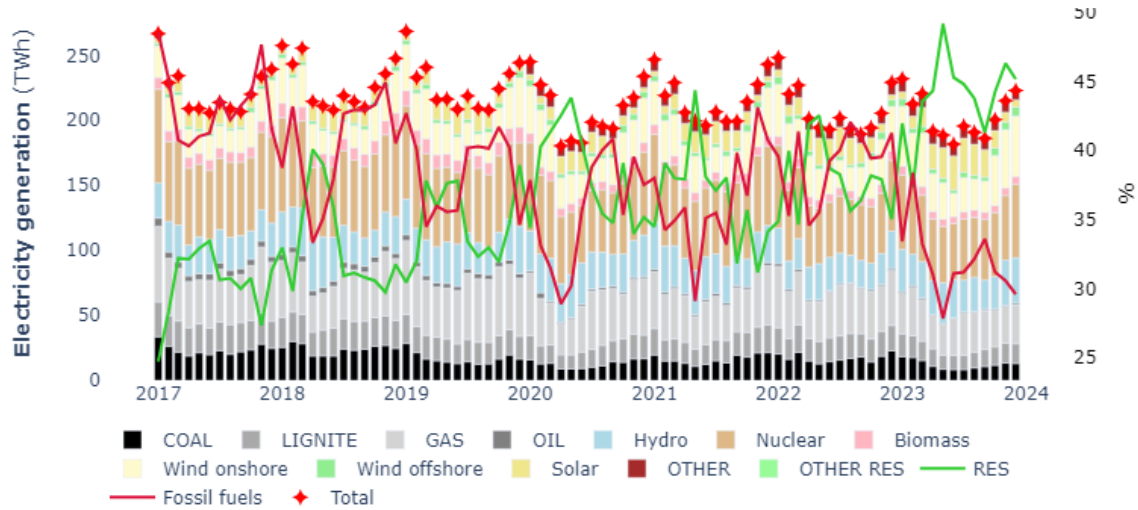


Electricity generation in 2023 compared to 2022. Source: ENTSO-E

- Figure 14** shows the monthly evolution of the electricity mix in the EU. In 2023, the RES generation reached a record of 1 141 TWh (+12% compared with 2022) constituting 44% of the electricity mix (from 38% in 2022). This share of renewable generation was also supported by a yearly decrease of the EU electricity generation in the EU (-2% in 2023). In May 2023, the share of the electricity generated through RES reached a high-record level of 49%.

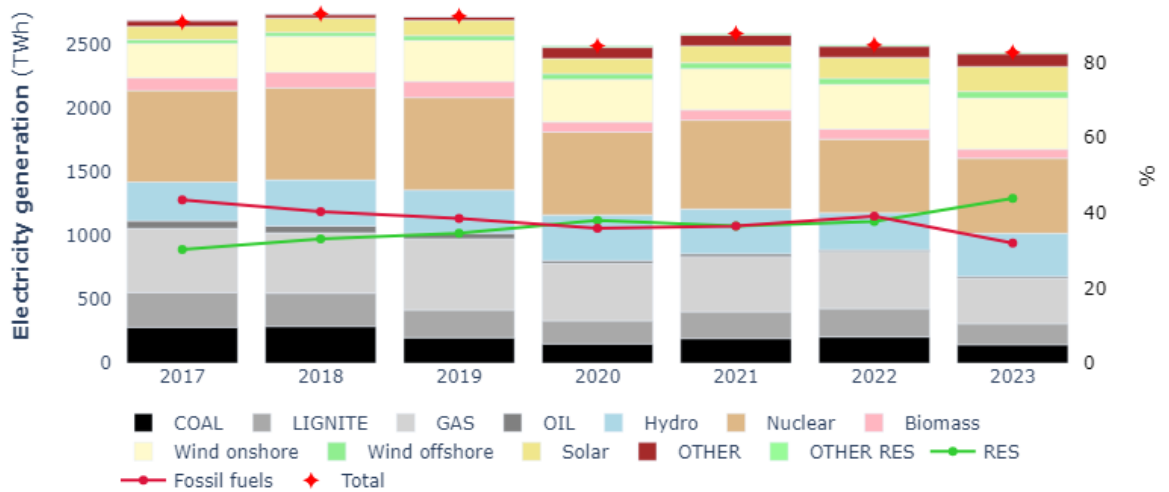
- In 2023 compared with 2022, the share of the electricity produced from fossil fuels declined to 32% from 39%, due to a decrease of the electricity generated through coal (-30%), gas (-20%) and oil (-17%). The share of electricity produced through nuclear remained stable, increasing marginally from 23% to 24%.

**Figure 14 – Monthly electricity generation mix in the EU**



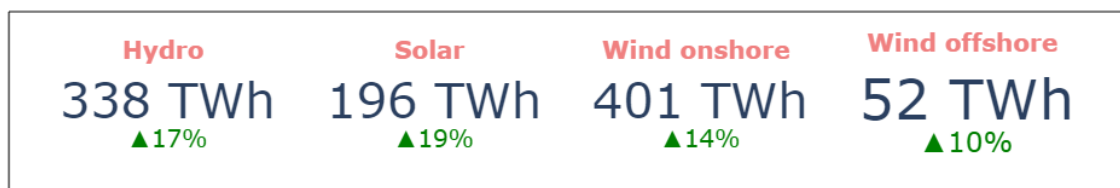
Source: ENTSO-E. Fossil fuel share calculation covers power generation from coal, lignite, gas, oil and others.

**Figure 15 – Yearly electricity generation mix in the EU**

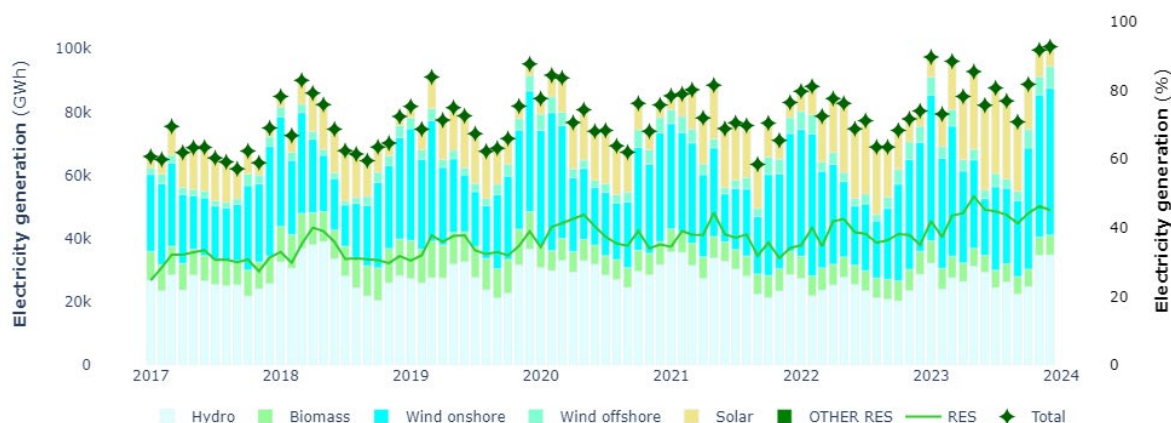


Source: ENTSO-E

- **Figure 16** depicts the evolution of monthly renewable energy generation in the EU, alongside its share in the electricity generation mix. The growth of the share of renewable energy generation in 2023 compared to 2022 (4% and 39%, respectively) was supported mainly by a remarkable increase of +19% in solar generation (+31 TWh) and 14% in onshore wind (+51 TWh). The increase was also supported by a +17% in improved hydropower (+49 TWh) and +10% in offshore wind (+5 TWh) generation. The notorious rise in solar and wind onshore generation was supported by record levels of new solar and wind onshore capacity installed in the EU in recent years. Wind and solar generation together (650 TWh) registered an increase of +15% (+87 TWh).



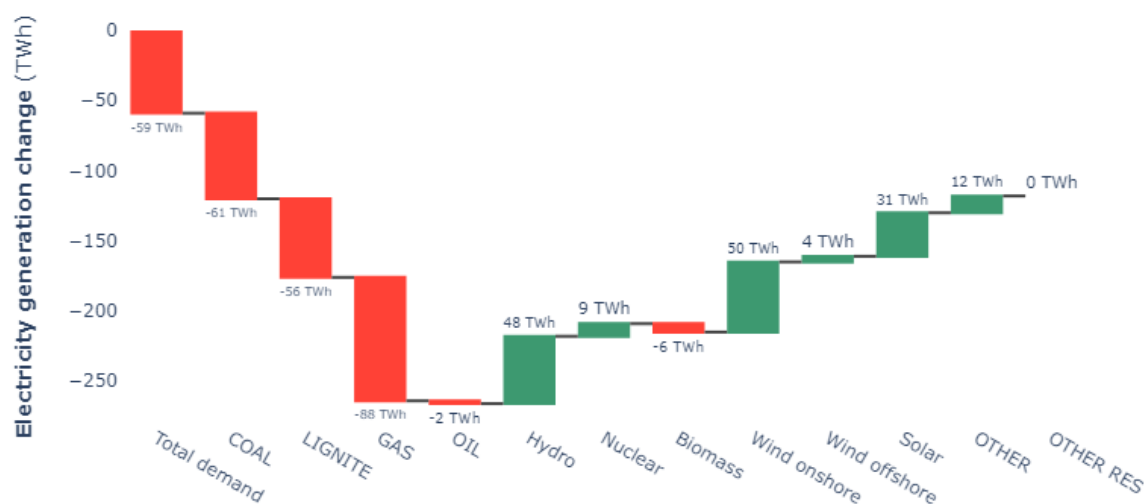
**Figure 16 – Monthly renewable generation in the EU and the share of renewables in the power mix**



Source: ENTSO-E. Data represent net generation.

- **Figure 17** visualises changes in the EU27 electricity generation, imports and consumption in 2023 compared to 2022. Between 2022 and 2023, fossil fuel generation dropped by 24% (-205 TWh), supported by coal, lignite, gas, and oil generation falling by 61 TWh (-30%), 56 TWh (-25%), 88 TWh (-20%), and 2 TWh (-17%) respectively. Wind onshore and hydro generation registered the biggest absolute increase (respectively +50 and +49 TWh) compared to 2022. Solar generation registered the biggest relative increase between 2023 and 2022 (+19%, equivalent to +31 TWh).

**Figure 17 – Changes in power generation in the EU between 2022 and 2023**



Source: ENTSO-E.

- **Figure 18** maps renewable installed power capacity in the EU in 2023, 2022 and 2021. Rising carbon-free generation in the EU was greatly helped by a 22% of increased annual solar capacity in 2023. Moreover, wind onshore and offshore grew by +8% and +11% of installed capacity, respectively (+8% combined). Overall, wind and solar combined installed capacity grew by +14% in 2023, from 320 TW in 2022, to 365 TW in 2023.

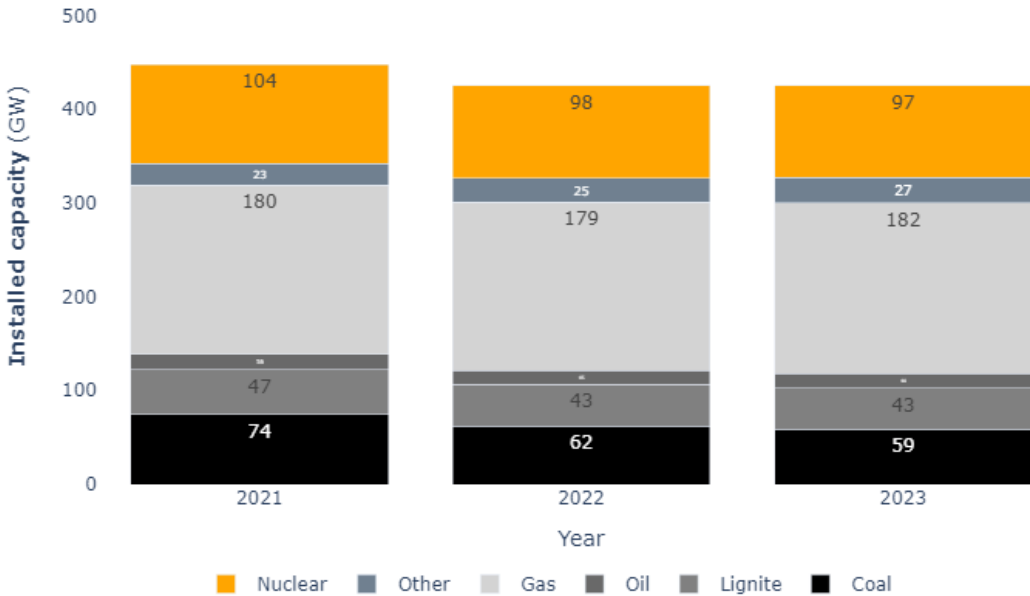
**Figure 18 – Installed capacity - renewables**



Source: ENTSO-E Net Generating Capacity Statistical Reports

- **Figure 25** maps conventional (fossil fuel and nuclear) installed power capacity in the EU in 2023, 2022 and 2021. Nuclear generation fell slightly by -1% in 2023, while coal and lignite installed capacity fell by -5% and -1%, respectively. Gas-fired installed capacity rose only slightly by +1.6% in 2023.

**Figure 19 – Installed capacity – fossil fuel and nuclear**

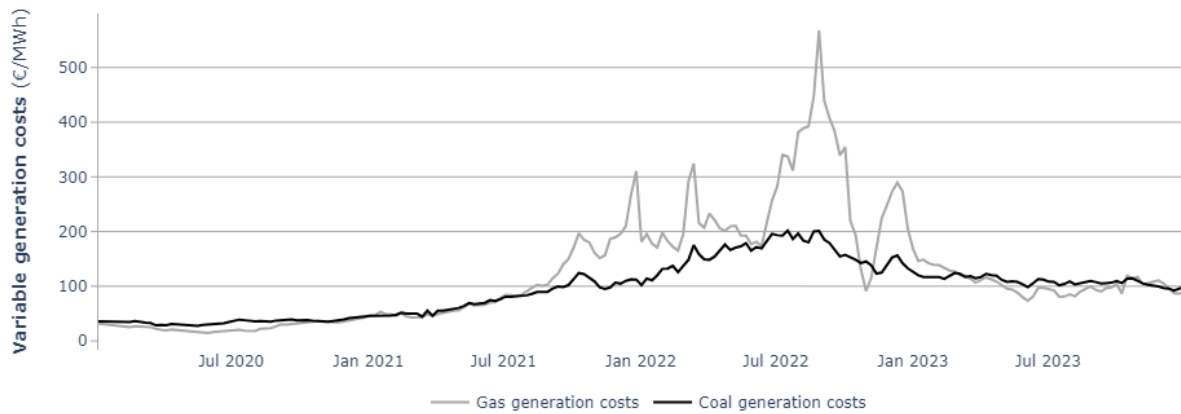


Source: ENTSO-E Net Generating Capacity Statistical Reports

- **Figure 20** shows the impact of gas prices on estimated gas and coal-fired generation variable costs for estimated average power plants (fuel and emission allowances costs). Lower gas prices and relative high level of carbon prices (despite falling prices towards the end of the year) supported coal-to-gas fuel switching in most part of 2023, after the energy crisis mid-2021-2022. Despite some rebound in gas prices towards the fourth quarter of 2023, the overall trend continued into Q1 2024.



**Figure 20 – Estimated variable generation costs of coal- and gas-fired power plants.**

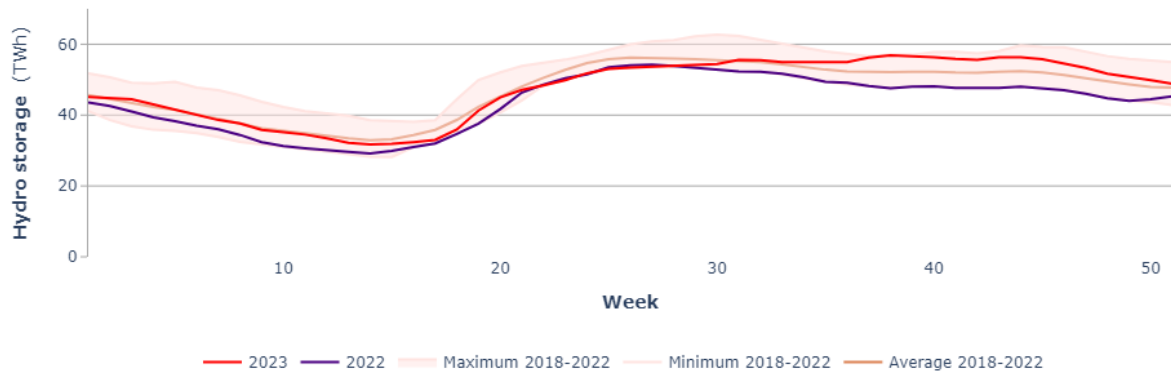


Source: S&P Platts, ENER.

Note: Thermal efficiency values used for coal- and gas-fired plants were 41% and 55% respectively. Emissions intensity values used were 0.85 and 0.37 tCO<sub>2</sub>e/MWh respectively for coal- and gas-fired generation.

- **Figure 21** shows the sum of 2023 levels of hydro reservoirs in the reported markets. In 2023, the overall sum of hydropower reservoirs recorded a recovery from the low levels registered in 2022 (+9% compared with 2022 levels). This trend was especially noticeable during the last quarter of 2023, because of intense floods the as hydropower reservoirs were in average 16% higher than in Q4 2022.

**Figure 21 – Aggregated EU hydropower reservoirs – weekly**

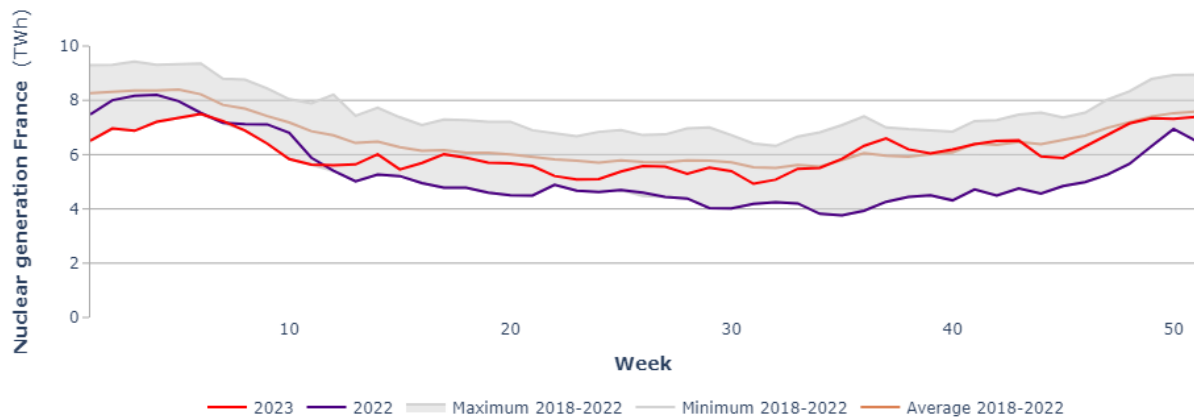


Source: ENTSO-E. Aggregated hydropower reservoirs for Austria, Bulgaria, Spain, Finland, France, Greece, Hungary, Italy, Lithuania, Latvia, Portugal, Romania and Sweden.

- As shown in **Figure 22**, French nuclear output amounted to 382 TWh in 2023 and was up by 37% compared to 2022 which was a year with an especially low output. Indeed, the French nuclear output in 2022 (279 TWh) was the lowest since 1998. Compared to the 5-years average of 2018-2022, the French nuclear generation was 14% higher.



**Figure 22 – Weekly nuclear electricity generation in France**

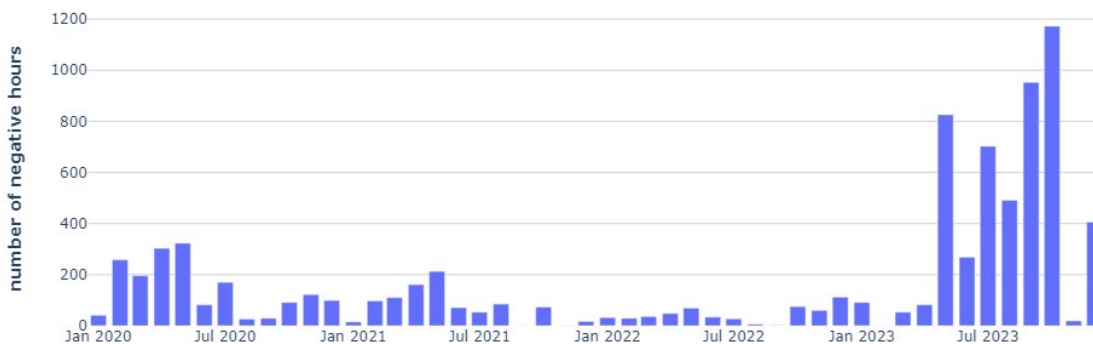


Source: ENTSO-E



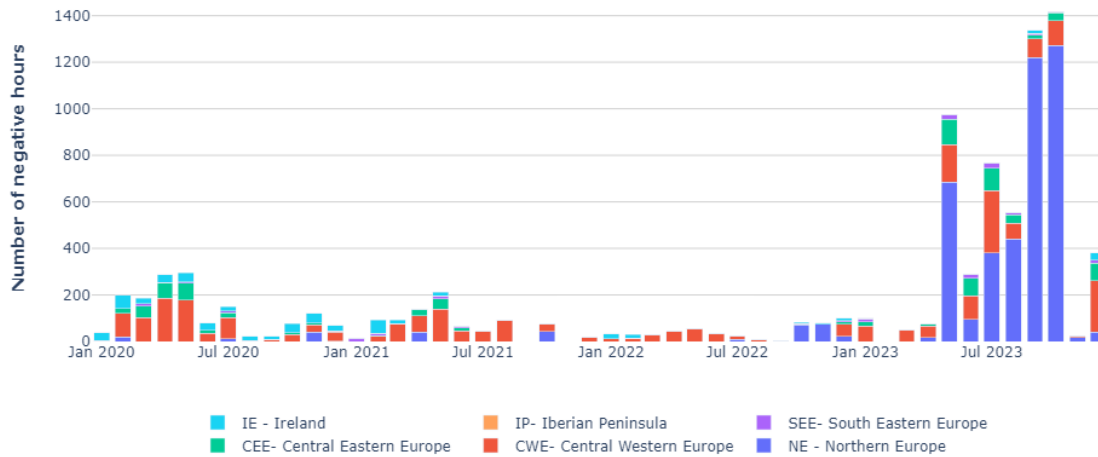
- **Figure 23** and **Figure 24** show the monthly frequency of the occurrence of negative hourly wholesale electricity prices in selected European markets. Negative hourly prices generally occur when electricity demand is lower than expected and when variable renewable energy generation is abundant, combined with large and relatively inflexible baseload electricity generation (e.g. nuclear or lignite). In such cases, conventional power plants offer their output for a negative price to avoid switching the unit off and having to go through the costly and high-maintenance operation of restarting the facility when they want to enter the market again.
- In 2023, the number of negative hours reached a record of 6870 in European markets, compared to 569 in 2022 (+1107%). At 3064, the number of hours with negative wholesale prices reached a record number in Q3 2023. In Q4 2024, the occurrence of negative hours amounted to 2120, a +641% increase from Q4 2022. October registered a record number of 1685 hours with negative prices in the selected European markets.
- A record number of negative hours occurred mainly in Northern Europe in September and October. The Nordics are benefiting by the development of wind and solar power, oversupply of hydroelectric power, especially in Sweden and Norway, and the changes in market dynamics in Finland, as the Olkiluoto 3 nuclear reactor came online in mid-April 2023. The lack of flexible supply, demand reduction and higher levels of renewable generation registered in 2023, may also have influenced the occurrence of negative prices in other markets.

**Figure 23 – Number of negative hourly wholesale prices on selected day-ahead trading platforms on the EU**



Source: ENTSO-E

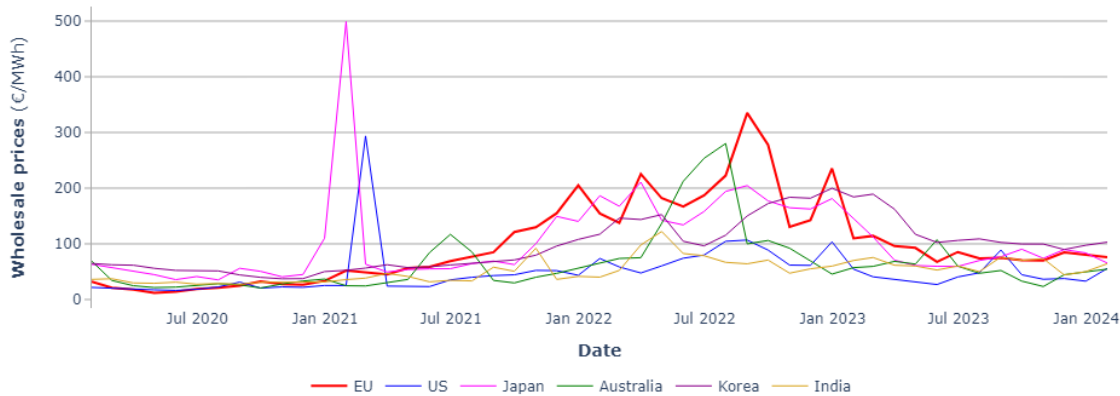
**Figure 24 – Number of negative hourly wholesale prices on selected day-ahead trading platforms in Europe.**



Source: ENTSO-E.

- **Figure 25** compares price developments in wholesale electricity markets of selected major economies. Most markets saw power prices easing due to year-on-year improved fundamentals in global energy markets.
- In the U.S., wholesale electricity prices in selected regional markets fell between 5% (ERCOT) and 60% (NYISO) year-on-year in 2023, supported by lower gas prices. In 2023, the US average price of selected markets was 44% lower than in 2022.
- In Japan, year-on-year prices fell by 52% in 2023, to 83 €/MWh, supported by lower international LNG prices. Japan relies heavily on fossil-fuel power generation, and it is one of the three most important LNG buyers in the global market. Prices in Korea also fell by 17% during the year.
- In Australia, wholesale electricity prices fell by 56% year-on-year in 2023, to 56 €/MWh. Prices in India registered a year-on-year fall of 11% in 2023.

**Figure 25 – Monthly average wholesale electricity prices in international markets (D-A markets)**



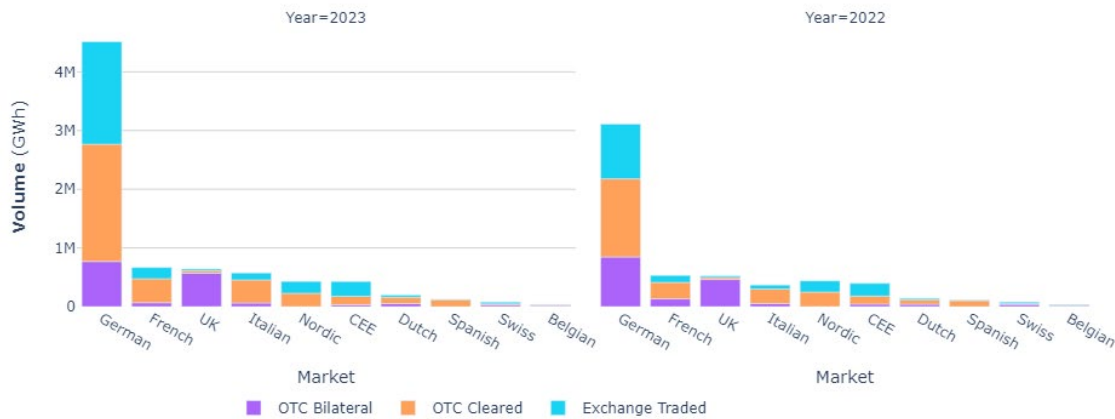
Source: European Power Benchmark based on S&P Global Platts and ENTSO-E Transparency Platform, JPEX (Japan), AEMO (Australia), and the arithmetic average of selected PJM West, ERCOT, MISO Illinois, CAISO, NYISO Hudson Valley and ISONE Internal regional wholesale hubs in the United States.

### 1.5 Traded volumes and cross border flows

- **Figure 26** shows annual changes of traded volumes of electricity in the main European markets in 2023, including exchange-executed trade and over-the-counter (OTC) trade. Selected markets and regions witnessed a year-on-year improvement in trading activity. The increase in total traded volumes between 2022 and 2023 (+34%) reflects the level of recovery in trading activity in the electricity sector. Activity also grew in OTC cleared contracts in 2023 (+40%) but decreased slightly in OTC bilateral (-3%).

- In 2023, Germany was by far the largest and most liquid European market, as total volume was equivalent to 59% of the total traded volumes under observation (77 TWh).
- The total activity in selected markets rose by 34% in 2023. The biggest year-on-year increases were seen in Italy (+55%), Germany (+45%) and the Netherlands (+40%). Nordic countries registered a decrease of 2% in activity during 2023.

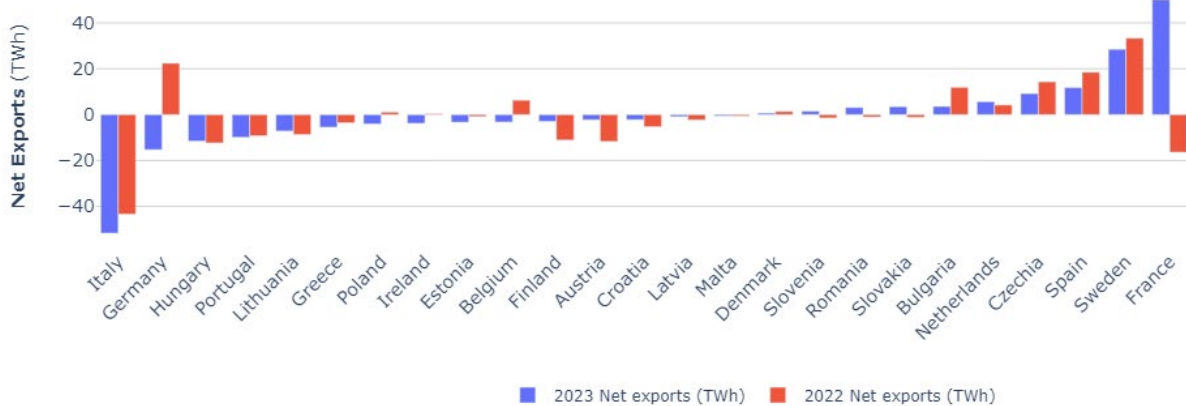
**Figure 26– Annual change in traded volume of electricity on the most liquid European markets**



Source: Trayport, London Energy Brokers Association (LEBA) and DG ENER computations

- **Figure 27** compares net balances of physical electricity flows among EU Member States in 2023 and 2022. The net trading position in 2023 was more balanced and closer to historical behaviour than in 2022, where normal flows reversed in some key markets.
- France managed to reverse the 2022 trend and go back to its position as a net exporter in 2023 (50 TWh), +66 TWh. The improved situation of the French nuclear fleet supported a rise in export flows, allowing France to regain its position as the main EU net exporter in 2023.
- Sweden was the second largest net exporter (28 TWh), thanks to a significant discount in wholesale electricity prices vis-à-vis the neighbouring and other continental European markets. In 2023, the other important EU exporters were Spain (12 TWh) and Czechia (9 TWh).
- The biggest EU importers were Italy (-52 TWh), Germany (-16 TWh), Hungary (-12 TWh) and Portugal (-10 TWh). Germany was a net exporter in 2022, but became a net importer in 2023.

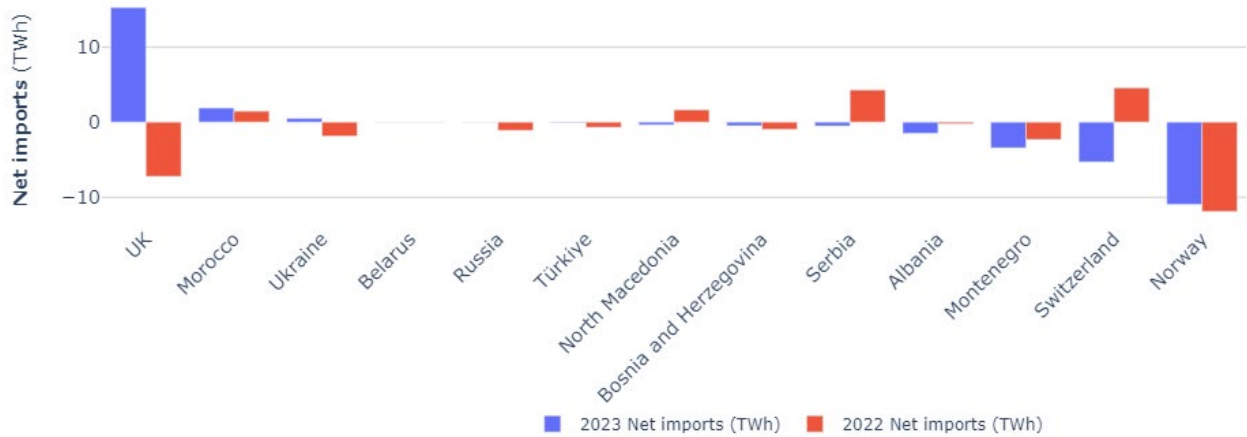
**Figure 27 – Member States’ net scheduled commercial export/import positions within the EU in 2023 and 2022**



Source: Scheduled Commercial flows ENTSO-E, TSOs

- **Figure 28** shows netted electricity exchanges with EU neighbours in 2023. Great Britain registered a fall in its export balance, becoming a net importer from the EU in 2023 (15 TWh). Norway improved its position as the largest net exporter to the EU (-11 TWh).
- Net exports from the EU to Ukraine amounted to 504 GWh in 2023. Commercial exchanges of electricity between Continental Europe and Ukraine/Moldova started in June 2022, after the successful synchronisation of the power systems. Ukraine halted exports to Continental Europe after the massive Russian attacks of their energy infrastructure in October 2022. Since then, the TSOs of Continental Europe have regularly increased the capacity available for trading.

**Figure 28 – Extra-EU electricity commercial scheduled exchanges in 2023 and 2022 – netted**



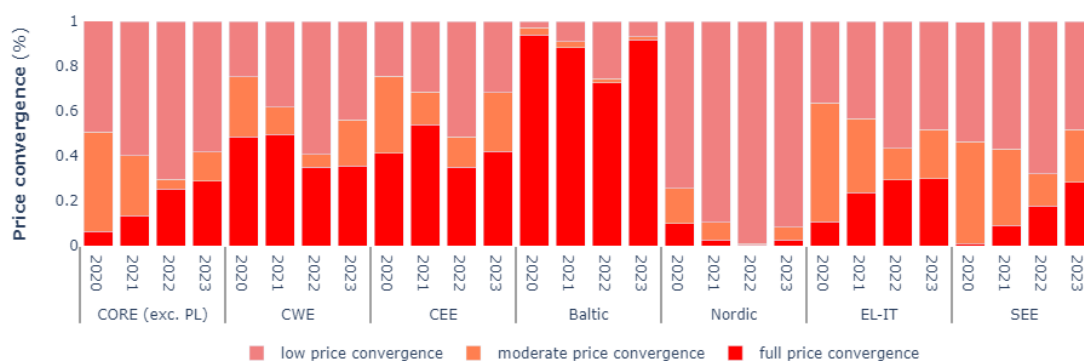
Source: Scheduled Commercial Flows ENTSO-E, TSOs. Negative values indicate net flows into the EU.

## 2 Focus on developments in annual wholesale prices

### 2.1 Day-ahead price convergence

- **Figure 29** illustrates the degree of price convergence in day-ahead markets within selected European regions, expressed in percentages of hours in a given year. Price convergence provides an indication of the level of market integration. It is important to note that achieving complete price convergence is not a goal in itself because it would demand investing excessively in network infrastructure.
- Longer-term drivers of price convergence are market coupling initiatives or the expansion of interconnection capacities. In the short term, fluctuations in convergence may also be caused by factors not necessarily related to the level of market integration, such as changes in the amount of cross-zonal capacity designated by TSOs for commercial purposes, outages of transmission lines, significant shifts in the power mix or in consumption patterns.
- Overall, market coupling supported day-ahead prices convergence throughout European markets. Whereas in 2022, the energy crisis emphasised certain structural disparities between markets, in 2023, lower prices supported an increase in full price convergence.
- In June 2022, the Core Flow-Based Market Coupling (Core FB MC) project announced its successful go-live. The aim of the Core FB MC is to facilitate the development and implementation of a flow-based day-ahead market coupling across the entire Core capacity calculation region (Core CCR) within the Single Day-Ahead Coupling (SDAC) framework. The Flow-Based Market Coupling Mechanism is a significant development in the transition to sustainable energy. It improves the European power grid's capacity to handle fluctuations in variable renewable energy sources. Core comprises BE, CZ, DE, FR, HR, HU, LU, NL, RO, AT, PL, SK, SI. In the CORE region (excluding PL), the number of occurrences of full price convergence increased from 25% to 29% of hours in 2023.
- In the CWE region the number of occurrences of full price convergence rose slightly (from 35% to 36% of hours). In Central Eastern Europe (CEE), full price convergence rose to 42% of hours (from 35% in 2022). The three Member States in the Baltic region remained highly convergent (full convergence from 88% in 2022 to 92% in 2023). Italy and Greece have been coupled only since the middle of December 2020. Since then, convergence levels have been increasing year-on-year, with hourly prices nearly identical 30% of the time in 2023. The Nordic registered only a slight increase in convergence levels in 2023. In the SEE region full price convergence rose in 2023 (from 18% to 28% of hours).

**Figure 29 – Price convergence on day-ahead markets in selected regions as percentage of hours in a given year**



Source: ENTSO-E, ENER calculations. The CORE region includes BE, CZ, DE, FR, HR, HU, LU, NL, RO, AT, SK and SI. (PL is not included). CWE region comprises of BE, FR, NL and DE-LU zones. The CEE region includes CZ, SK, HU, RO bidding zones. The Baltic region includes EE, LV, LT bidding zones. The Nordic region includes 13 bidding zones of Norway, Sweden, Finland and Denmark. The SEE regions includes EL, BG, HR.

### 2.2 Average annual price levels and volatility

- **Figure 30** maps annual changes in average day-ahead baseload prices and in hourly price dispersion across European day-ahead markets. After the turmoil in energy commodity markets in 2022, in 2023 average day-ahead baseload prices were generally decreasing.
- Most markets experienced comparable lower levels of price volatility in 2023 than in 2022 (measured as relative standard deviation of hourly prices and plotted on the right-hand scale of the chart). This could be linked to the energy crisis post-shock scenario following the main 2022 disruption events in energy markets.

**Figure 30 – Changes in average baseload prices and hourly price volatility in European day-ahead markets between 2023 and 2022**



Source: ENTSO-E, ENER calculations. Italy is represented by the national average (PUN), the rest of the markets under observation correspond to bidding zones. Ireland has a common bidding zone with Northern Ireland (ISEM). Prices in Great Britain are represented by the N2EX power market.

## Retail markets

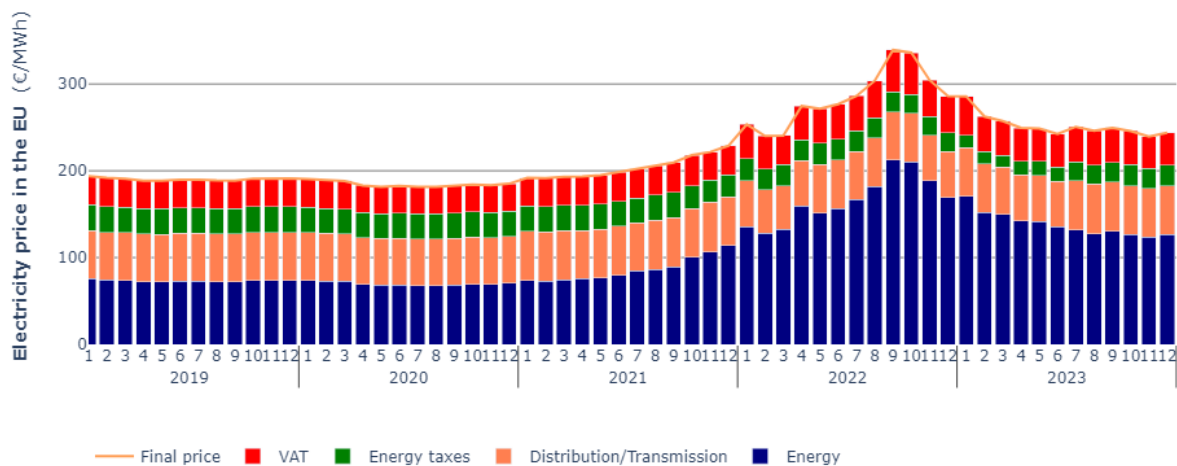
### 2.3 Retail electricity markets in the EU



Retail electricity prices in 2023, 2022 and 2021.

- Increasing wholesale prices in 2022 put upward pressure on retail prices, as high wholesale prices were passed through into consumer contracts. Government interventions in some Member States alleviated the bill for consumers. However, 2023 saw a decrease of 11% in wholesale prices compared to 2022.
- Figure 31** shows the monthly evolution of the EU average residential retail electricity prices over the last few years. The average retail electricity prices for household costumers in EU capital cities felt slightly from October to December 2023, from 259 €/MWh to 250 €/MWh (- 2%). Prices in Q4 2023 remained only marginally below the previous quarter (Q3 2023). However, in Q4 2023 prices registered a fall of 19% compared with the last quarter of 2022, but were still 15% higher than in the last quarter of 2021.

**Figure 31 - Monthly average electricity price in the EU, paid by typical household customers**

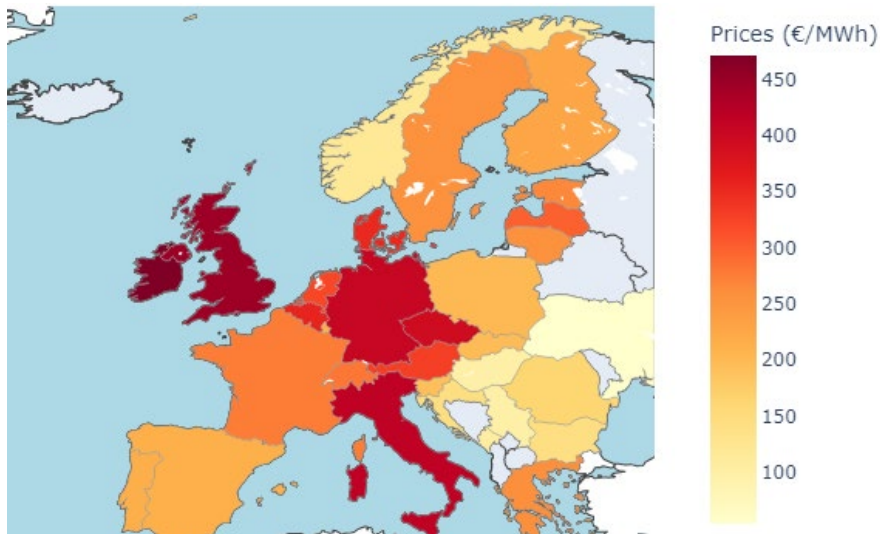


Source: Vaasaett

- Figure 32** shows the average yearly electricity prices paid by households in capital cities in EU Member States and other European countries with typical annual consumption.

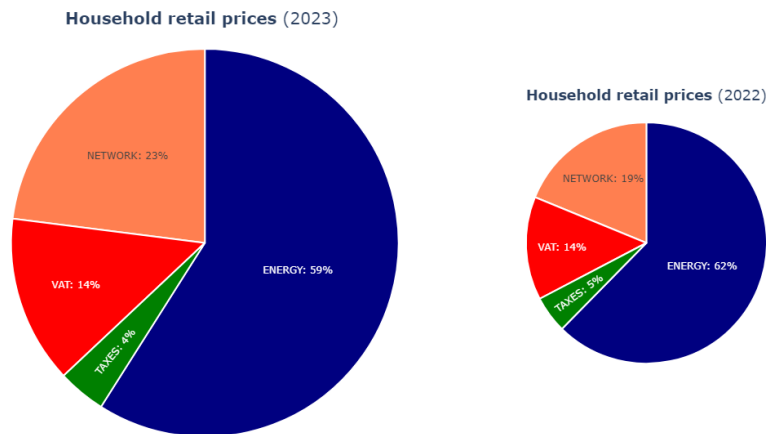


**Figure 32 –Average household retail electricity prices in European capitals, 2023**

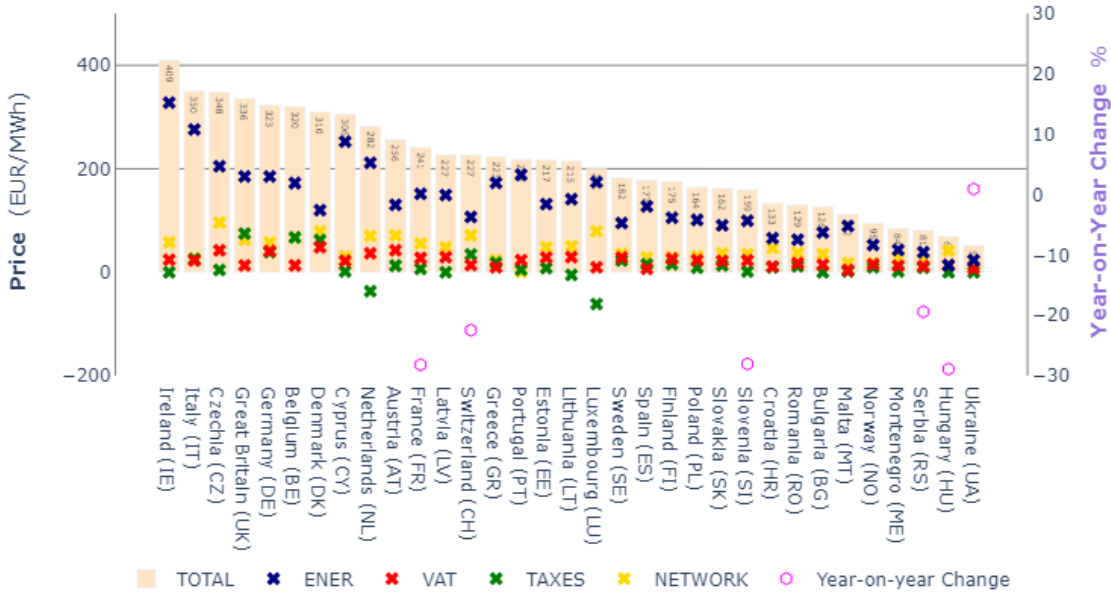


Source: Vaasaett

- **Figure 33** shows retail electricity prices for representative household consumers in European capital cities, and their composition divided into four categories (energy, network charges, energy taxes and the value added tax). In 2023, the highest average yearly prices were observed in Ireland, Italy and Germany (471, 415 and 405 €/MWh, respectively). The lowest ones had been observed in Hungary, Malta and Bulgaria (97, 123 and 142 €/MWh).
- In 2023, the energy component share was, in average, of 59% which is a decrease of 3 percentage points compared to 2022.
- EU-wide, retail prices started a steep climb since September 2021. Moreover, pushed by high wholesale prices, retail prices kept increasing throughout the year, intensifying the pressure on inflation throughout 2022. A peak in retail prices for electricity consumers was registered in October 2022. Since then, retail electricity prices have followed a falling trend, stabilising since May 2023.



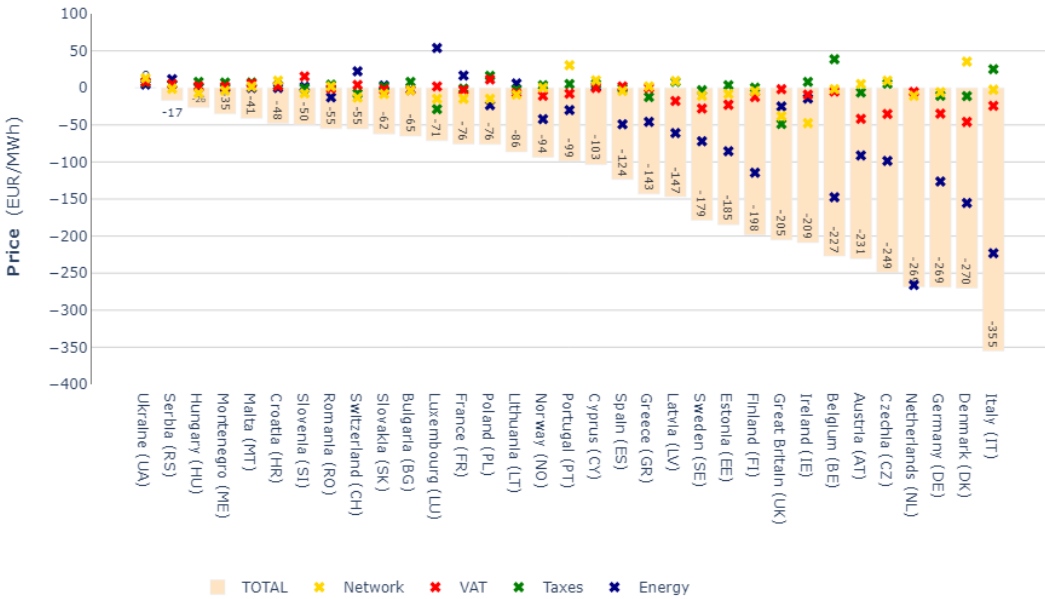
**Figure 33 – The Household Energy Price Index (HEPI) in European capital cities, Q4 2023**



Source: Vaasaett

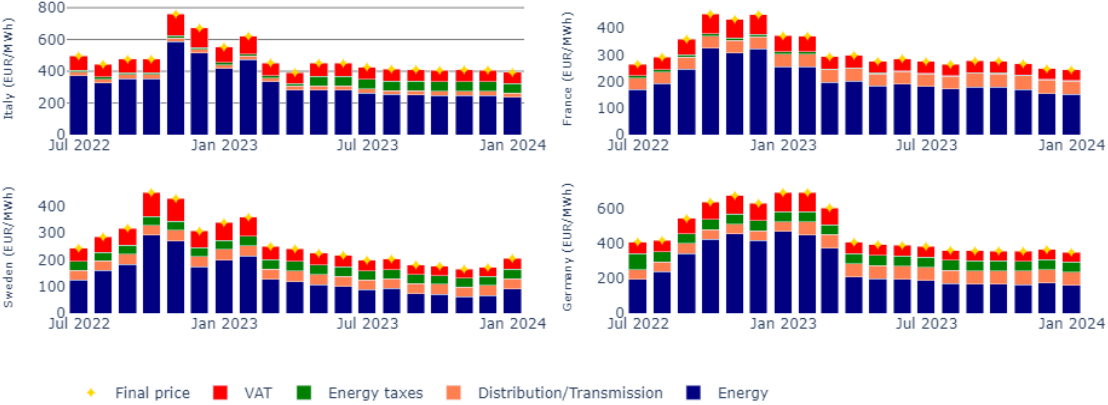
- Compared to the same quarter of the previous year, the largest price decrease in relative terms in the EU in Q4 2023 was observed in Rome (-355 €/MWh), Copenhagen (-270 €/MWh) and Berlin (-269 €/MWh). Malta, Croatia and Slovenia had been the country registering the smallest decreases, respectively 41, 48 and 50 €/MWh.
- As shown in **Figure 34**, decreasing prices in some EU capitals were driven by not only by lower wholesale prices, but also by government interventions in some Member States aimed at helping to alleviate the bill for consumers.

**Figure 34 – Year-on-year change in electricity prices by cost components in the European capital cities comparing Q4 2023 with Q4 2022**



Source: Vaasaett

**Figure 355 –Industrial retail prices for SMEs in selected EU countries**

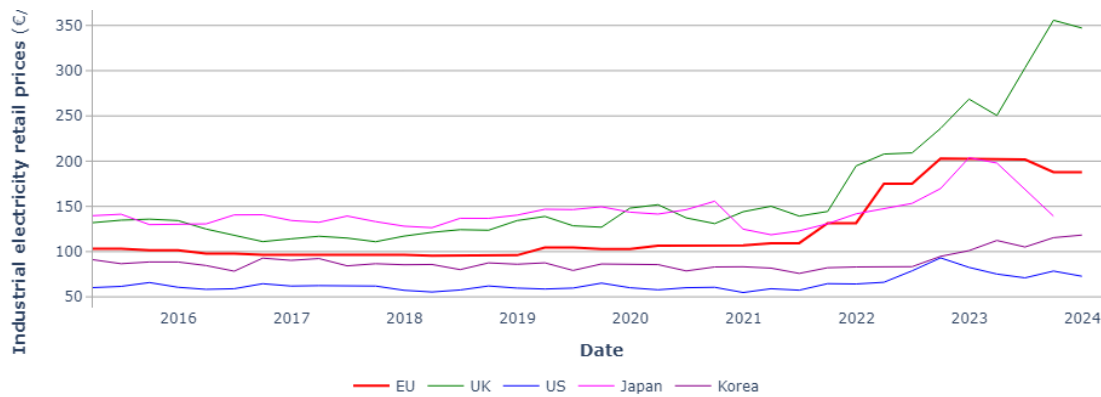


- **Figure 35** shows industrial SMEs (IB Band) electricity prices for selected Member States in Q4 2023. End user prices in Italy were at 403 €/MWh , which is more than in Germany (360 €/MWh), France (250 €/MWh) and Sweden (180 €/MWh).
- Interestingly, France and Sweden, have the Value Added Tax (VAT) contributing significantly to the final industrial electricity price. In Sweden, the VAT constitutes 20% of the final price (16% in France). However, when it comes to energy taxes, the scenario is quite different. In France, energy taxes for the selected consumption band of prices are close to zero. Contrastingly, in Sweden and Italy, these taxes contribute significantly, reaching 15% of the final price. Moreover, both France and Sweden experience higher distribution costs, reaching 21%, in Sweden.
- These variations highlight the complex interplay of factors shaping industrial electricity prices for small and medium consumption in different regions of the EU. The almost negligible taxes in France, contrasting with Italy’s substantial contribution, and the divergent distribution cost structures among the selected Member States, underscore the nuanced nature of pricing dynamics. These disparities are influenced by a combination of market dynamics, regulatory policies, and the energy mix.

2.4 International comparison of retail electricity prices

- **Figure 35** displays industrial retail prices paid by consumers in the EU<sup>1</sup> and in its major trading partners. Prices include VAT (with the exception of US prices) and other recoverable taxes for the purpose of comparability.
- Electricity prices for industrial users in the EU registered a year-on-year decrease in the second half of 2023 compared to the second half of 2022 (-7%). These are the first signs of falling electricity prices at industrial level since the energy crisis. We also observe the first signs of decreasing prices in Q4 2023 in the UK (+29% y-o-y). The US (-11%) registered year-on-year lower prices, while remaining lower than in the EU.

**Figure 36 – Retail electricity prices paid by industrial customers in the EU and its main trading partners**



Source: Eurostat, EIA, DESNZ, IEA, DG ENER computations. Industrial prices in the EU are represented by the ID consumption band for the purposes of international comparison.

<sup>1</sup> The EU average is reported biennially in the [Eurostat database](#). The prices in the quarter reflect electricity non-household retail prices from 2H 2023 for the ID band.

## Annex

### Regional wholesale markets

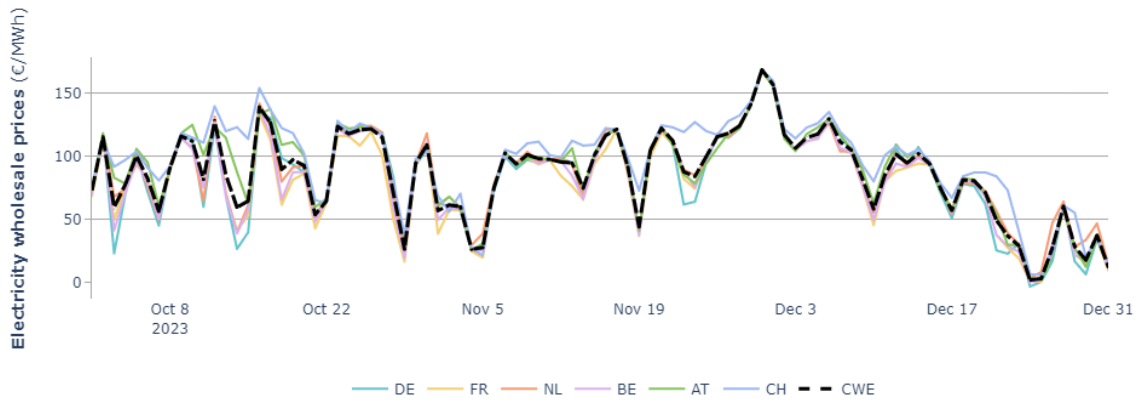
#### 2.5 Central Western Europe (Austria, Belgium, France, Germany, Luxembourg, the Netherlands, Switzerland)

**Figure 37 – Monthly exchange traded volumes of day-ahead contracts and monthly average prices in Central Western Europe**



Source: S&P Global Platts, ENTSO-E, EPEX.

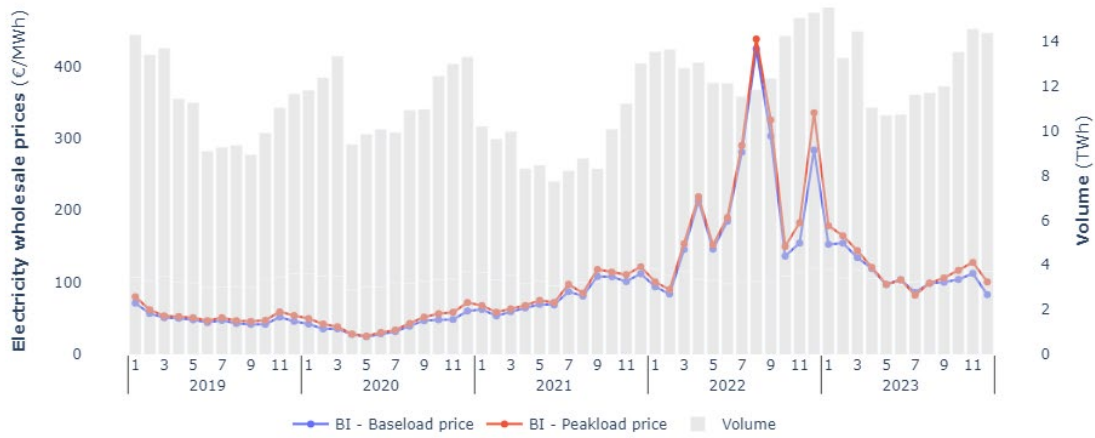
**Figure 38 – Daily average power prices on the day-ahead market in the CWE region**



Source: S&P Platts, ENTSO-E, EPEX

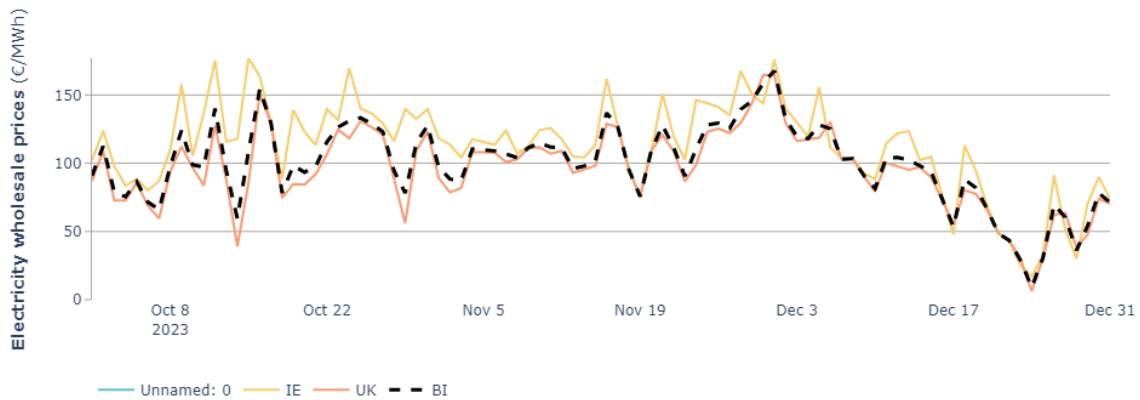
## 2.6 British Isles (GB, Ireland)

**Figure 39 – Monthly exchange traded volumes of day-ahead contracts and monthly average prices in Great Britain and Ireland**



Source: Nord Pool N2EX, SEMO, Utility Regulator

**Figure 40 – Daily average electricity prices on the day-ahead market in Great Britain and Ireland**



Source: Nord Pool N2EX, SEMO

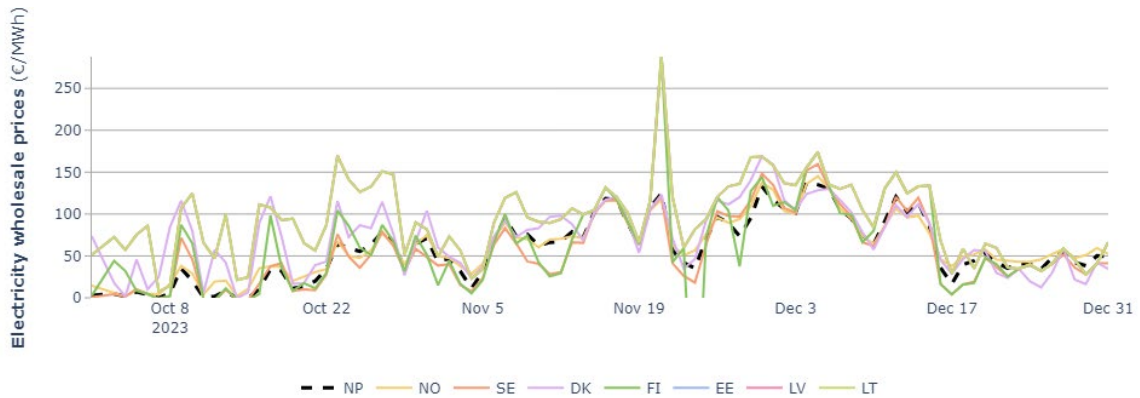
## 2.7 Northern Europe (Denmark, Estonia, Finland, Latvia, Lithuania, Sweden, Norway)

**Figure 41 – Monthly electricity exchange traded volumes and the average day-ahead wholesale prices in Northern Europe**



Source: S&P Global Platts, Nord Pool spot market

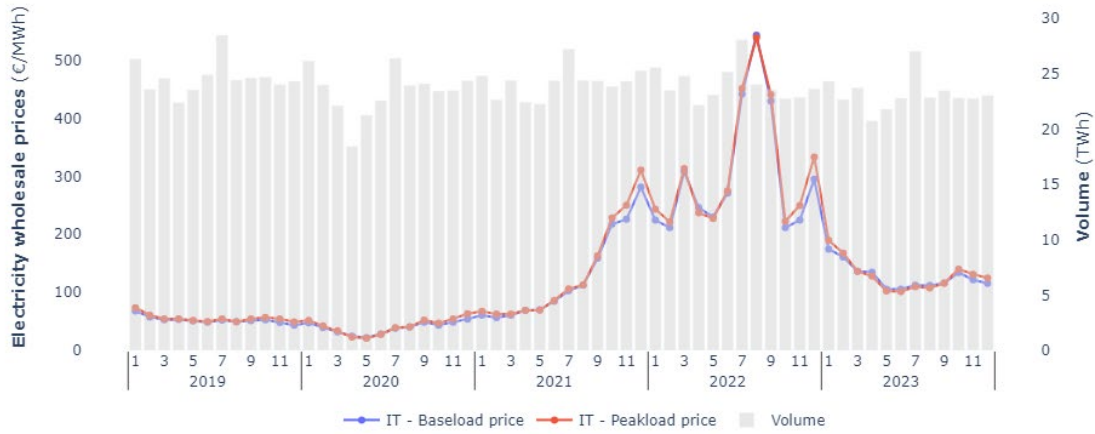
**Figure 42 – Daily average regional prices and the system price on the day-ahead market in the Nordic region**



Source: S&P Global Platts, Nord Pool spot market

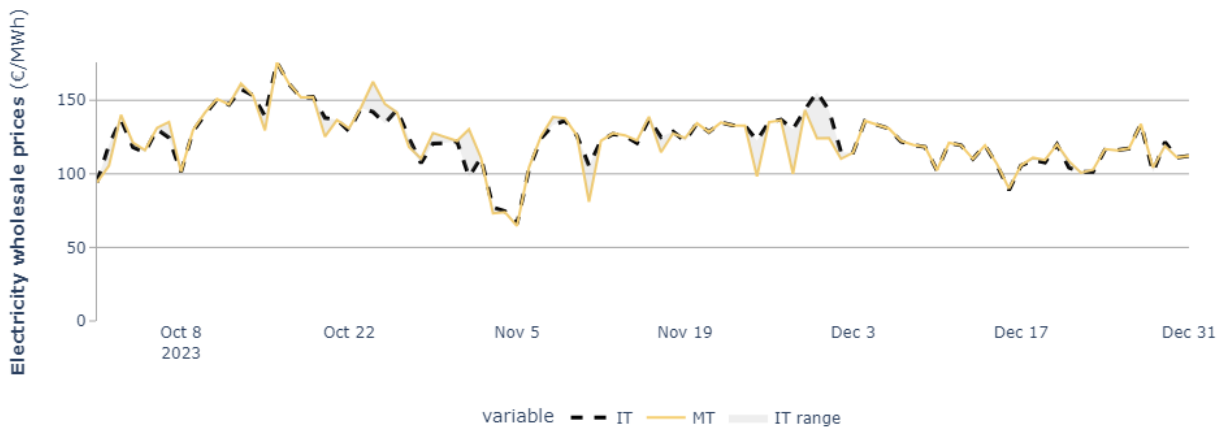
## 2.8 Apennine Peninsula (Italy, Malta)

**Figure 43 – Monthly electricity exchange traded volumes and average day-ahead wholesale prices in Italy**



Source: GME (IPEX)

**Figure 44 – Daily average electricity prices in the Italian day-ahead market, within the range of different area prices**

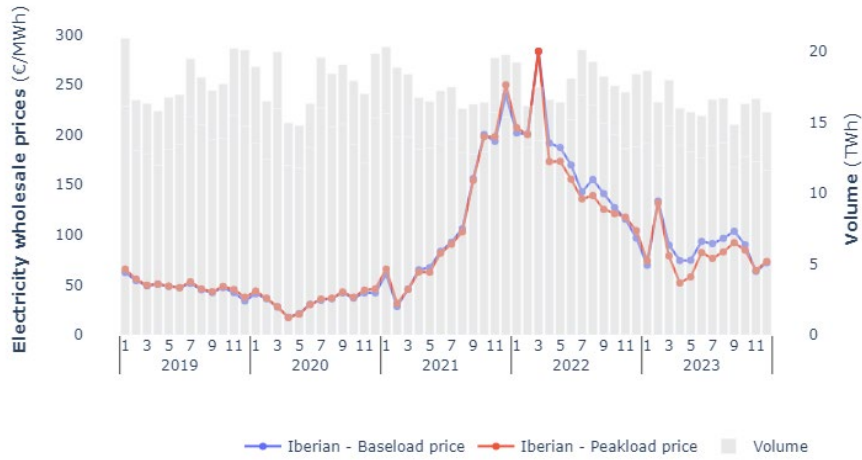


Source: GME (IPEX)



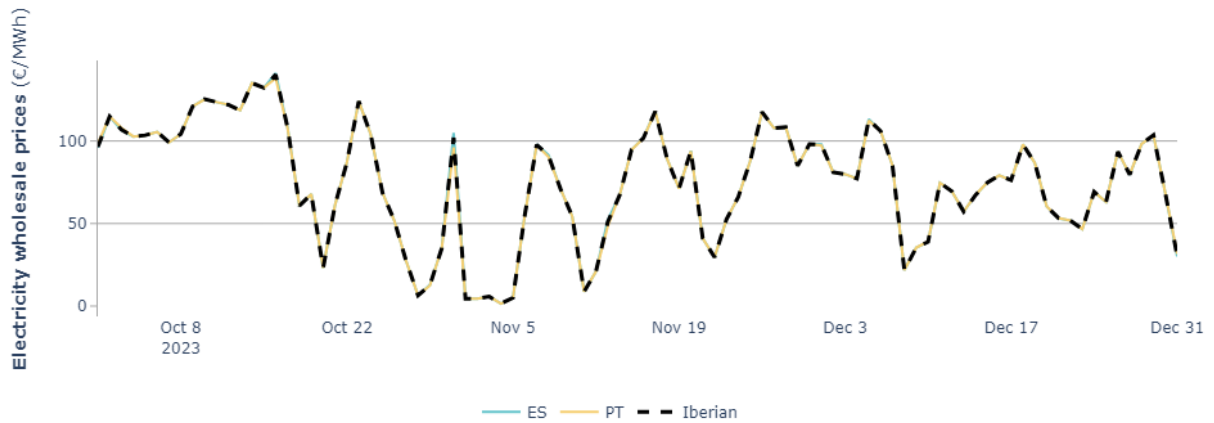
## 2.9 Iberian Peninsula (Spain and Portugal)

**Figure 45 – Monthly electricity exchange traded volumes and average day-ahead prices in the Iberian Peninsula**



Source: S&P Global Platts, OMEL, DGEG

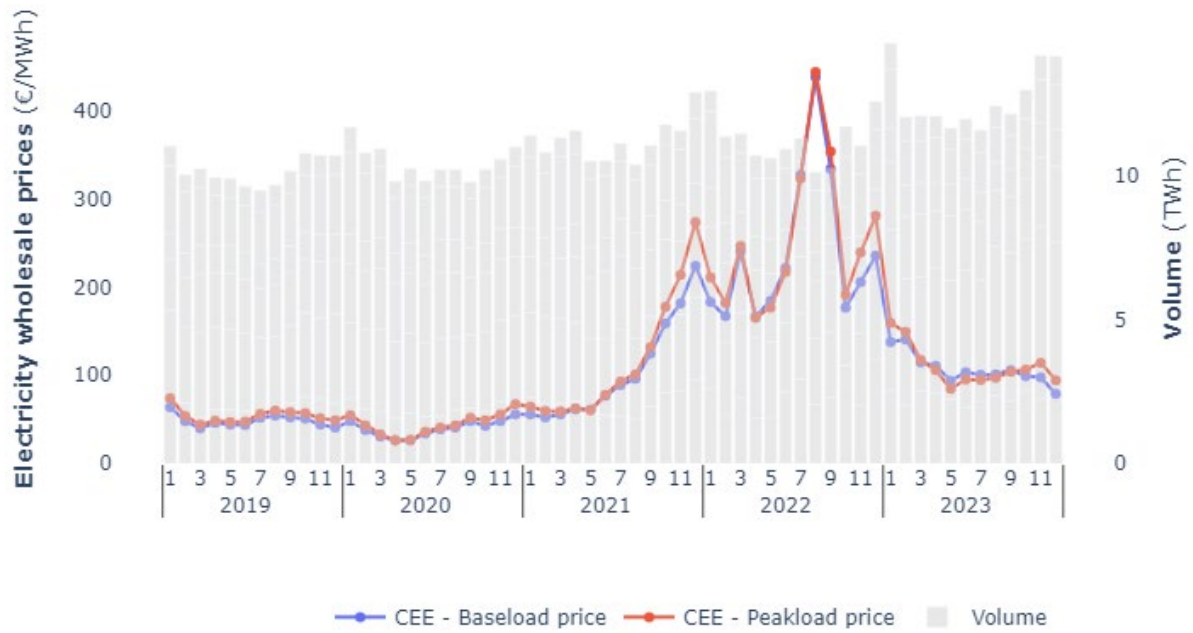
**Figure 46 – Daily average electricity prices on the day-ahead market in the Iberian Peninsula**



Source: S&P Global Platts, OMEL, DGEG

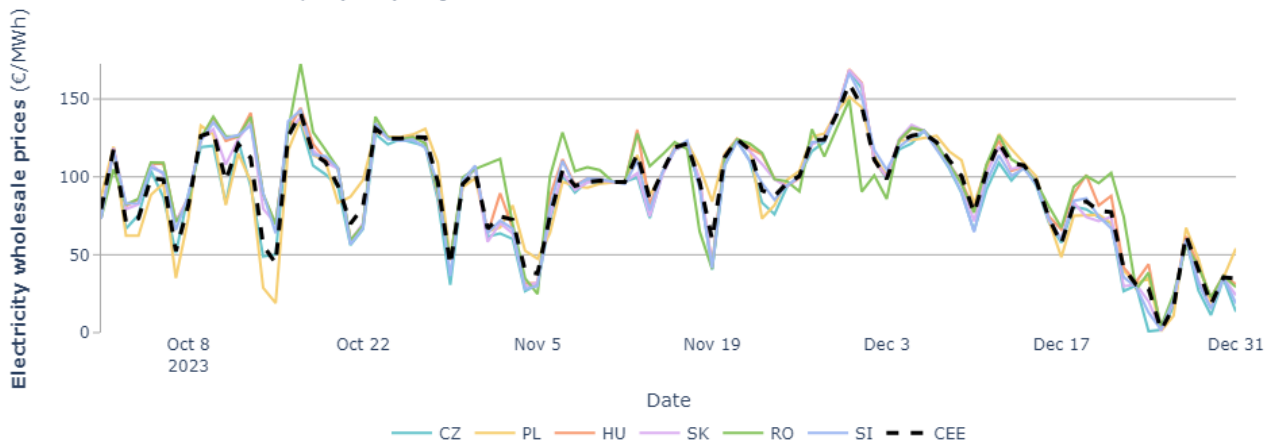
2.10 Central Eastern Europe (Czechia, Hungary, Poland, Romania, Slovakia, Slovenia)

**Figure 47 – Monthly electricity exchange traded volumes and average day-ahead prices in Central Eastern Europe (CEE)**



Source: Regional power exchanges, Central and Eastern Europe (CEE), CEE: CZ, HU, RO, PL, SK, SI

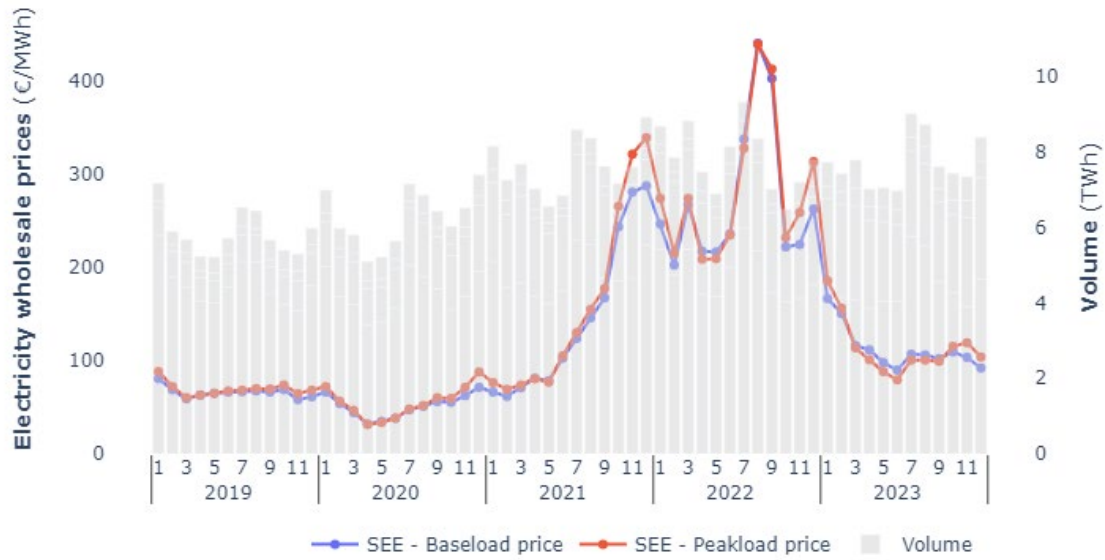
**Figure 48 – Daily average power prices on the day-ahead market in the CEE region**



Source: Regional power exchanges

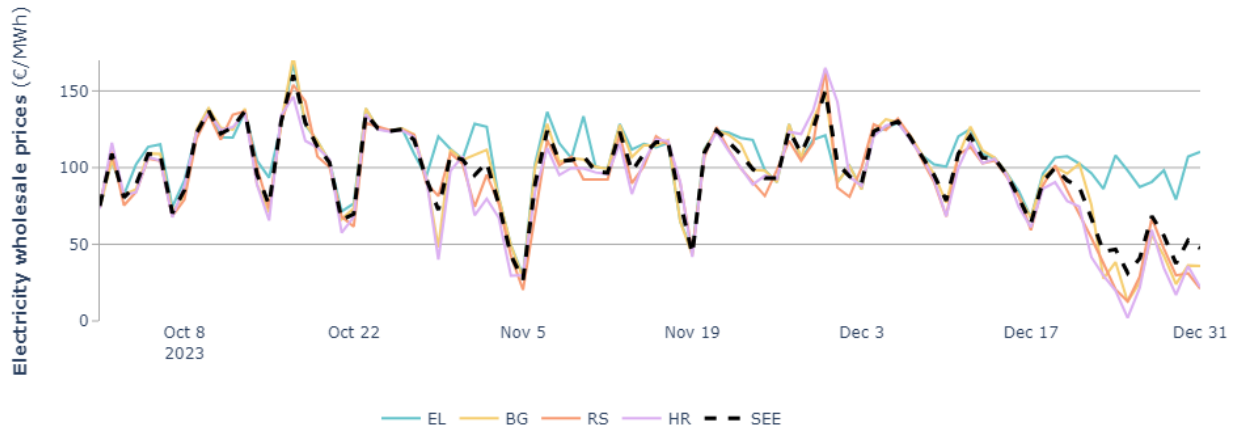
## 2.11 South-Eastern Europe (Bulgaria, Croatia, Greece and Serbia)

**Figure 49 – Monthly traded volumes and baseload prices in South-Eastern Europe (SEE)**



Source: ENTSO-E, IBEX, LAGIE, CROPEX, SEEPEX

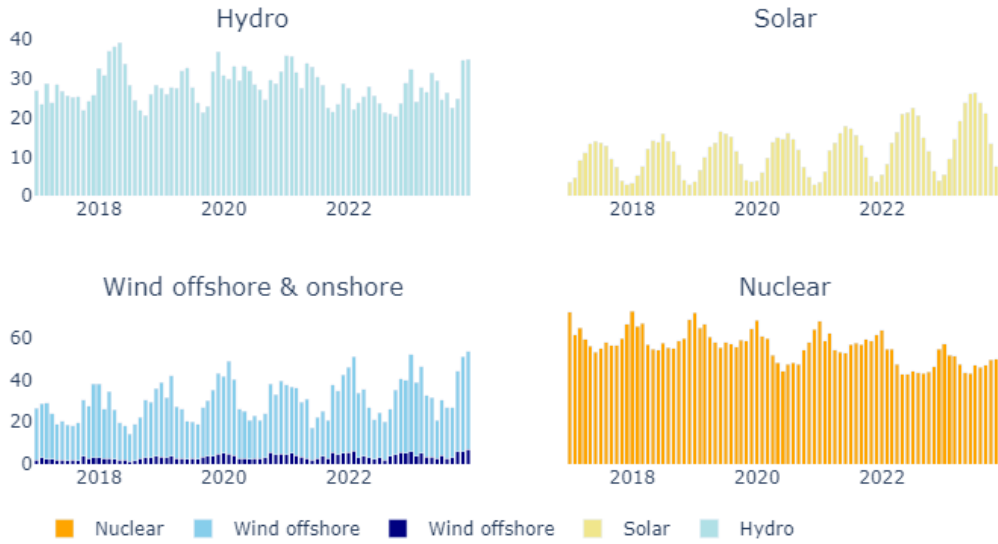
**Figure 50 – Daily average power prices on the day-ahead market in Bulgaria, Croatia, Greece and Serbia**



Source: ENTSO-E, IBEX, LAGIE, SEEPEX, CROPEX

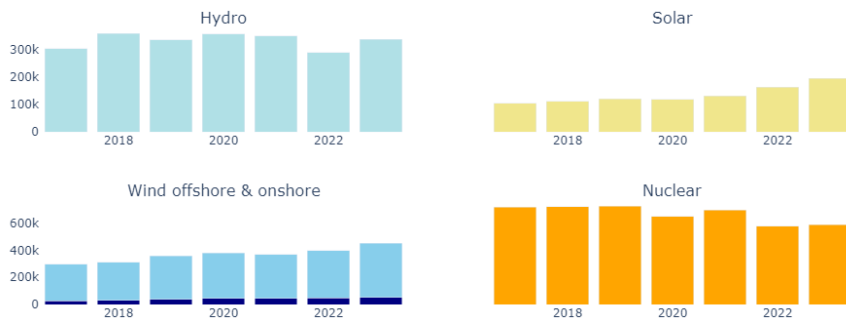
## 2.12 Electricity generation

**Figure 51 - Monthly renewable generation in the EU (TWh)**



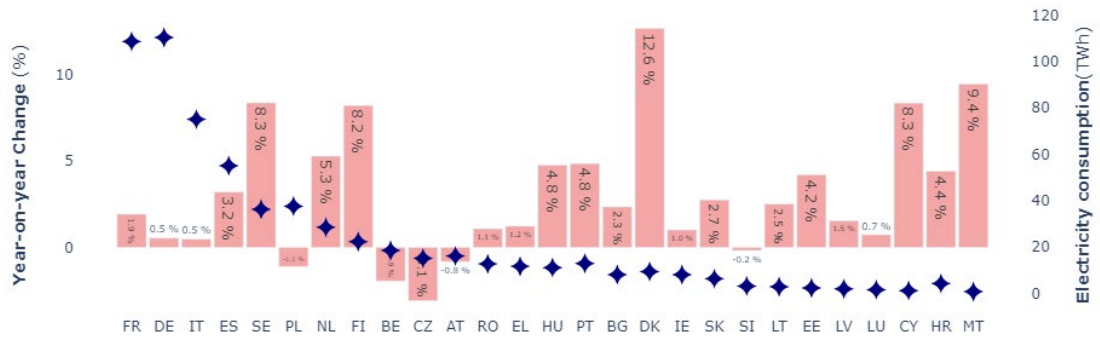
Source: ENTSO-E. Data represent net generation

**Figure 52 - Yearly renewable generation in the EU (TWh)**



Source: ENTSO-E. Data represent net generation

**Figure 553 – Yearly changes in electricity consumption by Member State in Q4 2023 compared with Q4 2022**



## Glossary

**Backwardation** occurs when the closer-to-maturity contract is priced higher than the contract which matures at a later stage.

**Contango:** A situation of contango arises when the closer to maturity contract has a lower price than the contract which is longer to maturity on the forward curve.

**Emission allowances' spot prices** are defined as prices for an allowance traded on the secondary market and with a date of delivery in the nearest December.

**European Power Benchmark (EPB9)** is a replacement of the former Platt's PEP index discontinued at the end of 2016, computed as weighted average of nine representative European markets' (Belgium, Czechia, France, Italy, Germany, Netherlands, Spain, the United Kingdom and the Nord Pool system price) day-ahead contracts.

**EPS** is a consumption-weighted baseload benchmark of five most advanced markets offering a 3-year visibility into the future. Markets included in the benchmark are France, Germany, the Netherlands, Spain and Nord Pool. Prices are weighted according to the consumption levels in individual markets. Forward prices are rolled over towards the end of each year, meaning that the year-ahead benchmark in 2021 shows the price for 2022; and the year-ahead curve in 2022, in turn, shows baseload prices for delivery in 2023.

**Flow against price differentials (FAPDs):** By combining hourly price and flow data, FAPDs are designed to give a measure of the consistency of economic decisions of market participants in the context of close to real time operation of electrical systems.

With the closure of the day-ahead markets (D-1), the prices for each hourly slot of day D are known by market participants. Based on the information from the power exchanges of two neighbouring areas, market participants can establish hourly price differentials. Later in D-1, market participants also nominate commercial schedules for day D. An event named 'flow against price differentials' (FAPD) occurs when commercial nominations for cross border capacities are such that power is set to flow from a higher price area to a lower price area. The FAPD chart in this quarterly report provides detailed information on adverse flows, presenting the ratio of the number of hours with adverse flows to the number of total trading hours in a quarter.

**Relative standard deviation** is the ratio of standard deviation (measuring the dispersion within a statistical set of values from the mean) and the mean (statistical average) of the given set of values. It measures in percentage how the data points of the dataset are close to the mean (the higher is the standard deviation, the higher is the dispersion). Relative standard deviation enables to compare the dispersion of values of different magnitudes, as by dividing the standard deviation by the average the impact of absolute values is eliminated, making possible the comparison of different time series on a single chart.

**Retail prices** paid by households include all taxes, levies, fees and charges. Prices paid by industrial customers exclude VAT and recoverable taxes. Monthly retail electricity prices are estimated by using Harmonised Consumer Price Indices (HICP) based on bi-annual retail energy price data from Eurostat.

**Tariff deficit** expresses the difference between the price (called a tariff) that a *regulated utility*, such as an electricity producer is allowed to charge and its generation cost per unit.