

# European Electricity Market Summary

Full Year 2022

## Generation and Contribution by Fuel Type

Renewables: 1,179TWh (-1%)

Fossil Fuels: 1,017TWh (+1%)

Nuclear: 646TWh (-15%)

Percentage changes are from the previous year

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## Executive Summary

During 2022, Europe saw very high levels of wholesale power prices driven by gas prices that have repeatedly broken all-time high records since the start of the Ukraine war. TTF prices reached the unprecedented high of €308.18/MWh in August. In addition to the war in Ukraine, European gas markets were tightened by widespread reductions in availability of the French nuclear fleet as well as reduced hydropower output across multiple regions. The reduced hydropower generation was a result of drought. The low river levels also contributed to the nuclear output reduction as cooling water restrictions were imposed. The issues with the French nuclear fleet resulted in France becoming a primary importer of power during various periods of 2022, which constituted unprecedented behaviour since France has historically been one of the largest exporters of power in Europe. Prices started dropping toward the end of the year once large volumes of gas were stored in preparation for winter. A warm autumn contributed to the drop in prices and for a short period there was an oversupply of gas, with LNG tankers waiting offshore to be offloaded, while storage was filled to its limits.

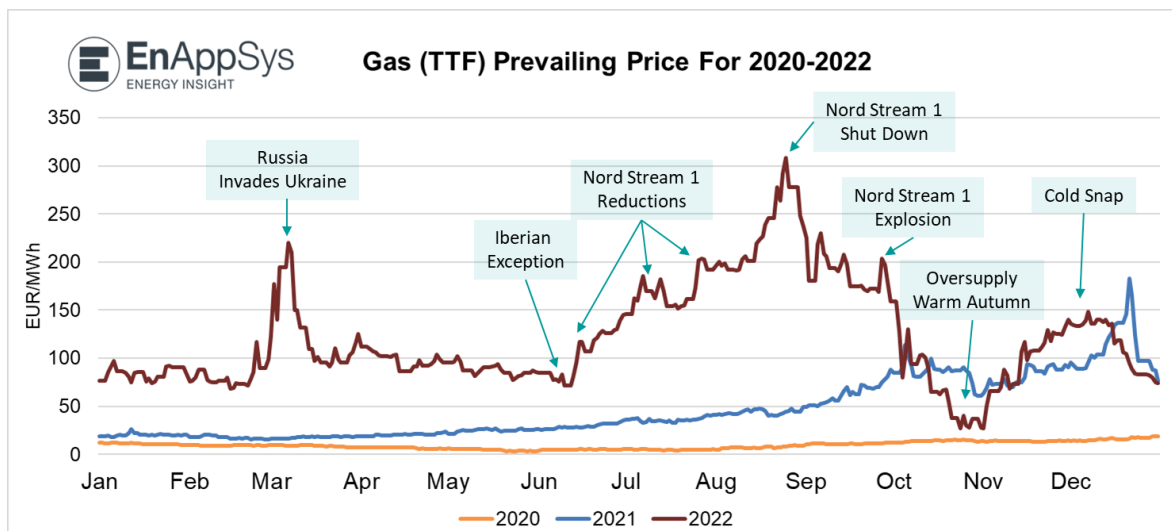
The key points from the year are:

- The war in Ukraine created concerns over gas supply and impacted gas prices across the continent throughout the year. Policy changes were made to reduce dependency on Russian gas imports, which will impact developments in markets in the coming years.
- Yearlong issues in the French nuclear fleet added pressure to the European energy supply. France was a net importer of energy during many periods this year as a result.
- Drought across the continent reduced hydro generation and caused further tightness in power markets. This, combined with high temperatures and low river levels, led to cooling water restrictions. The drought even caused Norway, historically one of the biggest exporters of power to, at times, reverse the flow of its interconnectors from a net export to a net import position for multiple periods during the year.
- Due to high gas prices, coal and lignite generation were higher than in previous years as high gas prices pushed gas units out of merit in many markets. Poland, normally a net importer of power, was able to export for extended periods as its coal and lignite power plants had a lower marginal cost than the gas assets in surrounding countries.

- Concerns over gas supply, combined with high prices, caused demand destruction on both consumer and industrial levels. Coupled with mild weather this winter, demand in 2022 was lower than in the previous year. Demand in Q4 2022 was lower than in in Q4 2021 by a substantial margin.
- Spain and Portugal implemented a cap on gas prices for power generation, resulting in higher gas consumption since its implementation, lower power prices and more export to France.

## Prices

This year, the headlines surrounding the Ukraine war had the greatest impact on European gas prices. Q1 2022 in particular was dominated by the impact of the conflict in Ukraine on a market already experiencing very high wholesale fuel prices. At their peak, TTF prevailing price reached €220/MWh on 7<sup>th</sup> March, pushing up electricity prices to record highs. On the last day of the quarter, a second wave of soaring prices was driven by Presidential Decree No. 172 by Russian President Vladimir Putin, which imposed severe limitations on gas imports to Europe from Russia by requiring all transactions to be paid in roubles. The TTF gas prices on this day reached €125/MWh.



**Figure 1:** TTF gas prices from 2020 to 2022 (EUR/MWh). Notable events are labelled.

However, there were other factors that further contributed to the rise in prices besides the war in Ukraine. Q2 2022 faced more scarcity of power with a decline from French nuclear generation and a drought in Norway. France saw nuclear generation dip as low as ~20GW at times due to stress corrosion cracking in the aging reactors that substantially reduced availability. Meanwhile, the drought in Norway caused a steep rise in wholesale electricity prices in Q2 2022 that resulted in an average of €168/MWh for NO1-2-5. The hydro fleet comprises the majority of the Norwegian generation mix, and so prices are highly sensitive to variations in hydro generation.

At the beginning of Q3 2022, gas flows to Germany through the Nord Stream 1 pipeline completely stopped due to maintenance that lasted for 10 days. As a result, TTF gas prices on 7<sup>th</sup> July reached as high as ~€186/MWh. Following the conclusion of the maintenance, gas flows through the pipeline were reduced to just 20% of capacity in August and by September flows were halted indefinitely. Towards the end of September, gas leaks were observed at both Nord Stream 1 and the as-yet unused Nord Stream 2, meaning that the pipelines are to remain out of use for an extended period. These events resulted in a lot of uncertainty in the gas markets and gas prices in this quarter climbed from the ~€145/MWh seen at the close of Q2 to reach a peak of €308.18/MWh around the end of August. By the end of the quarter, however, gas prices declined to €159.40/MWh as gas storages were filled.

Q4 2022 saw lower prices as a result of mild weather and high levels of gas storage. In the first half of Q4 2022, TTF gas prices were lower than in Q4 2021. However, by the end of November, temperatures dropped and prices rose as a result. TTF gas prices in Q4 2022 reached a peak of €148.23/MWh on 7<sup>th</sup> December.

## Demand

As a result of higher prices, Europe saw lower demand this year in general when compared to previous years, though demand did not dip beneath 2020 levels during Q2, as the beginning of the COVID-19 pandemic in 2020 brought demand to unprecedentedly low levels. The total European demand this year was ~3050TWh which is a drop of 2% from 2021. There are two main reasons behind the drop: milder weather conditions in Q1 and Q4 and the impact of high wholesale prices on demand. Demand destruction was widespread in Europe and impacted both industry and consumers. This became most prominent during Q4 in which demand was substantially below that of previous years. In October 2022, European demand was ~25GW (~7%) below that seen in October 2021.

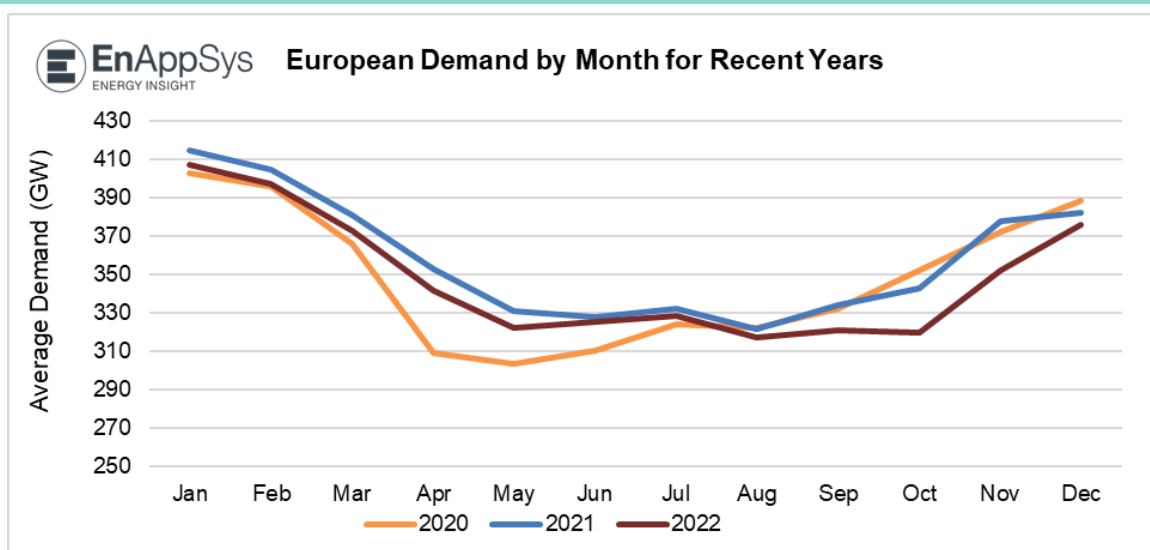


Figure 2: European demand by month for 2020-2022

### French nuclear outage and interconnector flows

French nuclear availability declined rapidly in 2022 to reach a low of just 22GW in Q3, a level that was even lower than the 28GW seen during Q2 2020 when the COVID-19 pandemic was in its early days. The continuous decline of French nuclear power put added pressure on the European wholesale market since France has historically been a primary exporter in Europe. Most of the French units were laid over based on scheduled outages, but a few were shut down due to safety protocols, following high river temperatures and further discoveries of stress corrosion cracking problems. In Q4 2022, nuclear availability and generation did increase with cooler water temperatures, but generation was still not as high as in the previous Q4. The schedule by which the nuclear fleet was expected to increase its availability to normal levels was subject to frequent changes and delays which contributed to some uncertainty in the market.

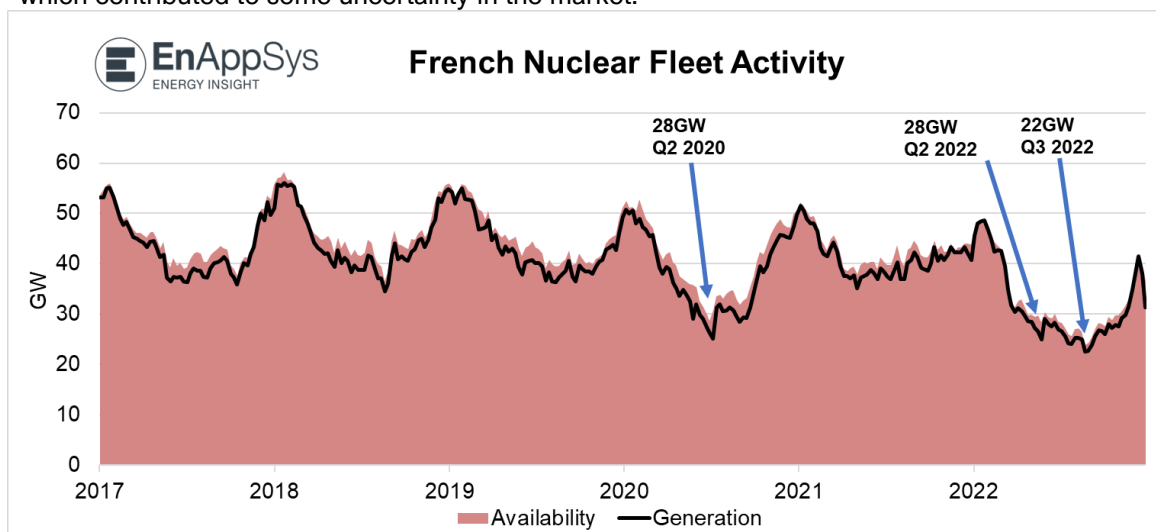
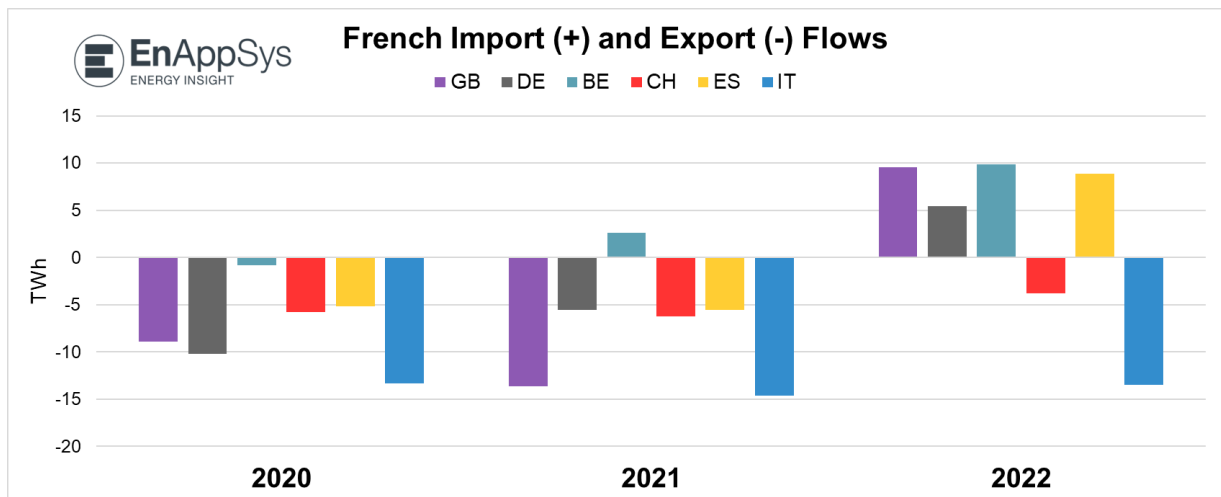


Figure 3: French nuclear generation from 2017 to 2022. Notable low points in availability have been highlighted.

France’s nuclear issues caused the nation’s day-ahead prices to rise to record highs this year, resulting in a switch in the position of the French market from being one of the largest exporters of power in Europe to being a net importer. Figure 4, demonstrates that France saw net imports of power from all countries except Italy and Switzerland in 2022. In total, 16.4TWh of power was imported by France in 2022, compared to 43TWh of export in the previous year. Sweden became the new largest exporter in Europe, with ~33TWh being exported from Sweden across the year. Denmark and Finland received the largest share of these exports.



**Figure 4:** Interconnector flows between neighboring countries and France in 2020-2022. High levels of imports to France can be seen in 2022 (positive value indicates import to France).

To illustrate the impact of French nuclear outages on power flows, below table shows a comparison of 2022 versus the previous 3 years. French imports were nearly 4 times higher than in 2021, over 10 times higher than in 2019. Due to high price levels, the net cost of imports exceeds the sum of net revenues of the previous 3 years by 2.9 Billion euros.

Year	Import TWh	Export TWh	Value of Export (Billion €)	Value of Import (Billion €)	NET (Billion €)
2019	2.21	60.49	€ 2.15	€ 0.14	€ 2.01
2020	3.40	49.10	€ 1.34	€ 0.18	€ 1.16
2021	6.95	53.07	€ 4.33	€ 1.69	€ 2.64
2022	26.84	7.99	€ 1.31	€ 9.97	€ - 8.65

\*) All imports and exports valued at French EPEX DA Price

**Figure 5:** Volume and value of French imported and exported volumes in billions of Euros.

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## Interconnector switch in Norway

In addition to France, southern Norway also saw significant changes in its interconnector flows this year. Historically a net exporter due to its high levels of renewable hydro generation, this quarter saw a drought in Norway that reduced its water reservoir levels and thereby limited its renewable generation. In the south-west of Norway, where all the interconnectors as well as the majority of the population are located, water reservoir levels were lower than in the previous years. Although the north of the country saw much higher water reservoir levels than in the south, the lack of connection capacity between the two zones meant that the lower prices were localised to the north. Since the hydro fleet typically comprises a large element of the Norwegian generation mix, the drought has caused steep increases in wholesale electricity prices this year with peaks around €800/MWh for price areas NO1, NO2 and NO5 (southern Norway). With the high prices, Norway imported much larger volumes from its neighbours, including Sweden, Denmark and particularly GB.

## Iberian Exception

On 14<sup>th</sup> June, Spain and Portugal implemented the “Iberian Exception”. This exception concerns the gas price used for power generation, the introduction of a cap on the gas price, resulted in lower prices on Iberian power markets, which reversed the flow across the border into France. To limit the flow to France, a cap of 2GW was set by Spain.



## Supporting Statistics

	2015	2016	2017	2018	2019	2020	2021	2022
<b>TOTAL GENERATION BY FUEL (TWh)</b>								
Biomass	64.5	70.9	78.2	91.5	93.8	96.8	98.1	91.4
Coal/Lignite	660.3	601.1	624.6	605.5	463.2	384.7	449.4	455.1
Gas	285.5	427.8	466.9	463.5	573.3	546.5	539.8	547.7
Hydro	402.3	471.5	435.6	484.3	454.6	496.6	495.5	417.5
Nuclear	818.0	816.1	808.7	808.0	804.0	718.9	759.6	646.2
Oil	10.1	12.9	14.0	12.6	13.3	12.8	13.9	10.0
Peat	6.3	6.4	6.0	6.5	5.8	3.9	4.2	4.0
Solar	79.9	96.9	103.3	108.2	113.1	133.0	145.8	180.0
Waste	12.9	14.2	15.0	15.2	15.0	14.8	16.5	15.6
Wind	268.7	282.8	336.2	348.7	396.2	440.9	431.6	474.1
<b>FOSSIL FUELS</b>	<b>962.3</b>	<b>1048.1</b>	<b>1111.5</b>	<b>1088.2</b>	<b>1055.6</b>	<b>947.9</b>	<b>1007.4</b>	<b>1016.8</b>
<b>RENEWABLE (INCLUDES WASTE)</b>	<b>828.2</b>	<b>936.2</b>	<b>968.2</b>	<b>1047.8</b>	<b>1072.7</b>	<b>1182.2</b>	<b>1187.6</b>	<b>1178.7</b>
<b>TOTAL</b>	<b>2608.5</b>	<b>2800.4</b>	<b>2888.5</b>	<b>2944.0</b>	<b>2932.4</b>	<b>2849.1</b>	<b>2954.6</b>	<b>2841.6</b>
Fossil Fuel Percentage	37%	37%	38%	37%	36%	33%	34%	36%
Clean Percentage	63%	63%	62%	63%	64%	67%	66%	64%
Renewable Share of Clean Power	50%	53%	54%	56%	57%	62%	61%	65%

	2015	2016	2017	2018	2019	2020	2021	2022
<b>SHARE OF GENERATION (%)</b>								
Biomass	2.5%	2.5%	2.7%	3.1%	3.2%	3.4%	3.3%	3.2%
Coal/Lignite	25.3%	21.5%	21.6%	20.6%	15.8%	13.5%	15.2%	16.0%
Gas	10.9%	15.3%	16.2%	15.7%	19.6%	19.2%	18.3%	19.3%
Hydro	15.4%	16.8%	15.1%	16.4%	15.5%	17.4%	16.8%	14.7%
Nuclear	31.4%	29.1%	28.0%	27.4%	27.4%	25.2%	25.7%	22.7%
Oil	0.4%	0.5%	0.5%	0.4%	0.5%	0.5%	0.5%	0.4%
Peat	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%
Solar	3.1%	3.5%	3.6%	3.7%	3.9%	4.7%	4.9%	6.3%
Waste	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.6%	0.5%
Wind	10.3%	10.1%	11.6%	11.8%	13.5%	15.5%	14.6%	16.7%
<b>FOSSIL FUELS</b>	<b>36.6%</b>	<b>37.2%</b>	<b>38.3%</b>	<b>36.7%</b>	<b>35.8%</b>	<b>33.1%</b>	<b>34.0%</b>	<b>35.6%</b>
<b>RENEWABLE (INCLUDES WASTE)</b>	<b>31.8%</b>	<b>33.4%</b>	<b>33.5%</b>	<b>35.6%</b>	<b>36.6%</b>	<b>41.5%</b>	<b>40.2%</b>	<b>41.5%</b>

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Renewable Share of Clean Power	50%	53%	54%	56%	57%	62%	61%	65%

	2015	2016	2017	2018	2019	2020	2021	2022
<b>CHANGE SINCE 2015 (%)</b>								
Biomass		10%	21%	42%	45%	50%	52%	42%
Coal/Lignite		-9%	-5%	-8%	-30%	-42%	-32%	-31%
Gas		50%	64%	62%	101%	91%	89%	92%
Hydro		17%	8%	20%	13%	23%	23%	4%
Nuclear		0%	-1%	-1%	-2%	-12%	-7%	-21%
Oil		27%	39%	25%	32%	27%	38%	-1%
Peat		1%	-5%	3%	-8%	-38%	-34%	-37%
Solar		21%	29%	35%	42%	67%	83%	125%
Waste		10%	16%	18%	16%	15%	28%	21%
Wind		5%	25%	30%	47%	64%	61%	76%
<b>FOSSIL FUELS</b>		9%	16%	13%	10%	-1%	5%	6%
<b>RENEWABLE (INCLUDES WASTE)</b>		13%	17%	27%	30%	43%	43%	42%

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## Notes on the Report

The figures used in the report refer to data provided through ENTSO-E which have been aggregated by EnAppSys into a European total. This data does sometimes suffer from outages or gaps in reporting but is considered to be generally complete. This report is based on the most recently available data as at quarter and year ends.

### Included Countries

Albania	Germany	North Macedonia
Austria	Great Britain	Norway
Belgium	Greece	Poland
Bosnia & Herzegovina	Hungary	Portugal
Bulgaria	I-SEM	Romania
Croatia	Italy	Serbia
Czech Republic	Kosovo	Slovakia
Denmark	Latvia	Slovenia
Estonia	Lithuania	Spain
Finland	Montenegro	Sweden
France	Netherlands	Switzerland

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