

European Electricity Market Summary

Q3-2022

July to September

Generation and Contribution by Fuel Type

Renewables: 246.6TWh (-9%)

Fossil Fuels: 260.1 TWh (17%)

Nuclear: 145.7TWh (-2%)

Percentage changes are from the previous quarter

Contents

1	Quarterly Review of European Electricity Market Q3 2022.....	1
	Gas Prices	2
	Nuclear availability in the French system	3
	Interconnector switch between Norway and other countries	5
2	Day-ahead Price Trends	6
3	Generation Activity Overview	7
4	Notes on the Report	9

1 Quarterly Review of European Electricity Market Q3 2022

As with the previous two quarters, Q3 2022 was impacted by the war in Ukraine and by the unfavourable climate conditions that affected hydro and nuclear energy. Since Russia began the invasion of Ukraine in March, gas supplies to Europe have been reduced significantly, and as of early September, supplies to Nord Stream 1 pipeline have completely stopped. With the explosions at both Nord Stream 1 and 2 later in the month, it is clear that there will be no flows through the pipelines for an extended period. The pressure from all of these factors has resulted in increased gas prices across the continent.

This quarter's average wholesale gas prices were 115% higher than last quarter's and 18% higher than the record-breaking average gas prices of Q1 2022. They were more than double those seen in Q3 2021. Due to the soaring gas prices in the EU as well as a multitude of other factors such as the EU's higher dependency on Russian oil, the wholesale electricity prices relative to the prices in the GB market have become even higher for many EU nations.

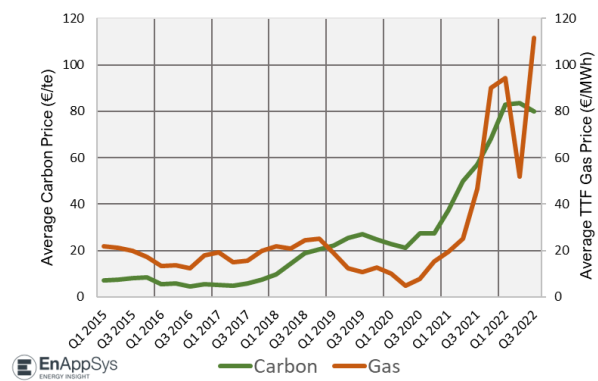
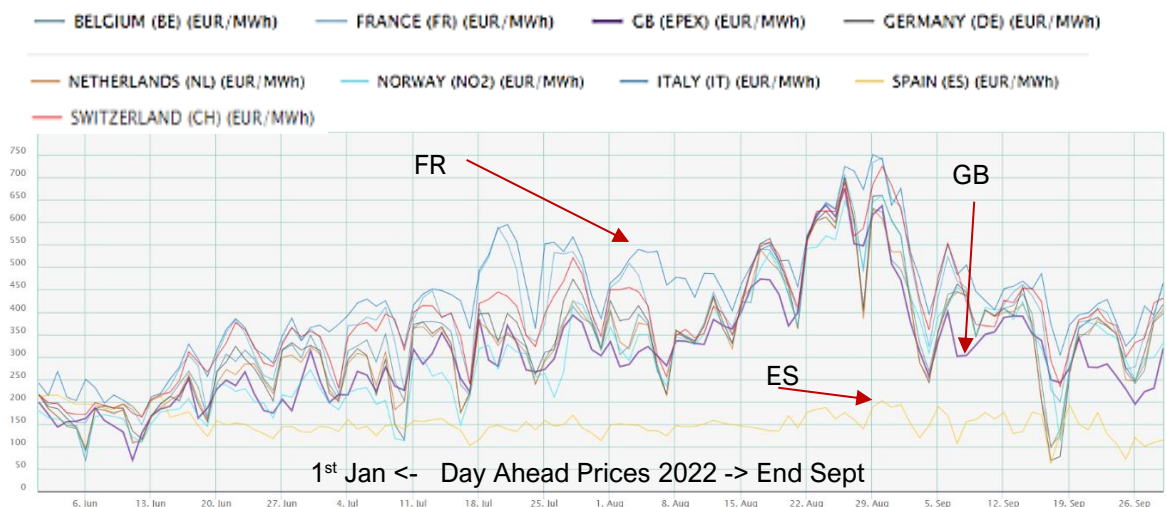


Figure 1: Gas (TTF) and carbon prices from Q1 2015 to Q2

The below chart clearly shows the more moderate price evolution of GB versus other European countries. Spain is the exception, due to the "Iberian Exception" capped gas price for power generation.



For more details, see [Table 1 : EPEX Day-ahead quarterly average prices](#) to see the difference by country.

High levels of thermal generation continued from the last quarter as hydro generation was still materially lower than generally expected levels and France’s nuclear output fell further than the levels seen in Q2.

The key points from the quarter are:

- The war in Ukraine creating concerns over gas supply and further increasing gas prices across the continent.
- Several European countries like Germany, Spain and the Netherlands saw the prominence of coal over gas this quarter.
- High temperatures in the first half of this quarter caused further issues in the French nuclear fleet, adding pressure to the European energy supply. France continues to be a net importer of energy as a result.
- A drought in Norway reduced Norwegian hydro generation and reversed the flow of its interconnectors from a net export to a net import position for extended periods.
- Spain and Portugal implemented a cap of 2GW in power exports to France.

Gas Prices



Figure 2: TTF gas prices from January 2021 to September 2022 (EUR/MWh)

The third quarter of 2022 saw a record high for gas prices, beating the old all-time high record price seen in Q1 2022. This was primarily driven by the changes in the gas flows through Nord Stream 1. Firstly, Russia shut down the pipeline’s gas flows to Germany for maintenance in July for ten days. 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 likely to remain out of use for an extended period. These events saw gas prices in this quarter climb from the €145.48/MWh seen at the close of last quarter 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.

Nuclear availability in the French system

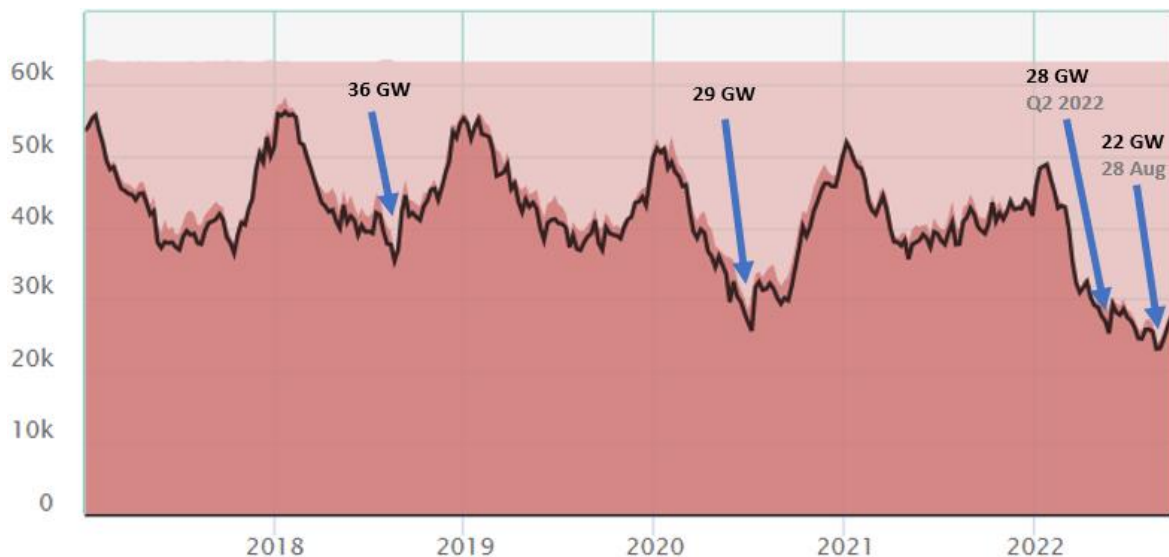


Figure 3: French nuclear generation from 2017 to 2022. Notable low points have been highlighted

In Q3 2022, the French nuclear availability repeatedly broke its previous all-time low of 28 GW in Q2 2022 and reached a new all-time low of 22 GW on 28 August. The continuous decline of French nuclear power has put added pressure on the European wholesale market since France has consistently 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. Under French regulations, EDF must reduce or halt nuclear output when river temperatures reach certain thresholds to ensure the water used to cool the plants won't harm the environment when put back into waterways. In early August, the French utility said that nuclear plants on the Rhone and Garonne rivers would be producing less but will generate a minimum level of output to keep the grid stable. However, by the end of the same month, EDF announced extended shutdowns of four nuclear reactors due to corrosion problems.

French Interconnectors

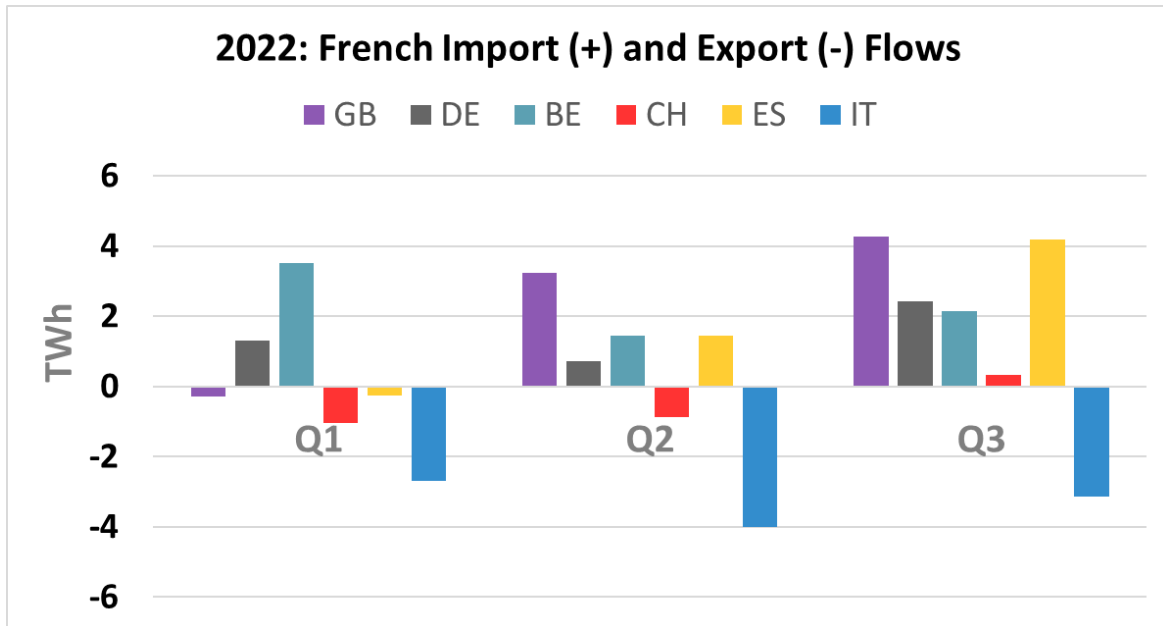


Figure 4: Interconnector flows between neighboring countries and France in 2022. High levels of imports to France can be seen in Q3 (positive value indicates import to France).

France's nuclear issues caused the nation's day-ahead prices to be record high this quarter, which resulted in a materially stronger net-import position for the French market when compared to Q2 2022. From figure 4, we see France importing power from all countries except Italy, including Switzerland which had typically imported power from France. In Q3, France saw net imports of 10.2TWh compared to the net imports of 1.9TWh, which were seen in Q2 2022. The difference between Q3 and Q2 is highlighted by the increased power exports from Great Britain, Germany and Spain to France.

Interconnector switch between Norway and other countries

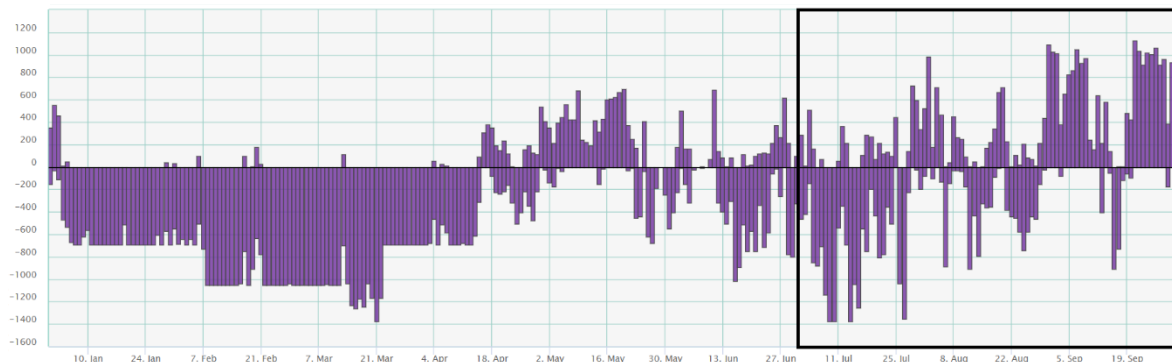


Figure 5: Interconnector flows between Norway (NO2) and GB in 2022. Higher levels of import can be seen in Q2 (positive value indicates import to Norway and the black box highlights Q3)

In addition to France, southern Norway also saw significant changes in its interconnector flows this quarter, particularly in September. 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 are located, as well as the majority of its population, water levels have been so low that residents of Oslo have been asked to economise on the water by taking shorter showers and turning their tap off whilst brushing their teeth. The north of Norway has no shortage of energy, however, as there are no cables connecting the north to the south of the country, apart from a cable through Sweden. 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 quarter at €310/MWh for price areas NO1, NO2 and NO5 (southern Norway), which is 85% higher than the previous quarter (which was also record-breaking).

Typically, Norway's high levels of hydro generation result in low wholesale prices and high levels of exports to its interconnected markets, but this year's drought has caused this spike in prices and thereby frequent reversals in the interconnector flows, as can be seen in figure 5 which shows the flows of the North Sea Link interconnector between southern Norway and GB in 2022.

2 Day-ahead Price Trends

This quarter, wholesale markets were under the heavy influence of the elevated gas prices which sustained the high levels seen in the last quarter. For many EU countries, day-ahead prices in Q3 2022 were between twice and four and a half times as high as Q3 2021, which was itself seen as an expensive quarter compared to the previous third quarters. Italy, with large dependence on gas generation for meeting its demand, was exposed to the highest average day-ahead price this quarter as well as the last at €461.6/MWh, which is more than triple the levels of Q3 2021. For GB, despite low gas prices bringing wholesale prices down considerably from the extreme highs seen in the previous two quarters, prices this quarter were still very high within a wider historical context, being almost double the prices from Q3 2021. As a result of low nuclear fleet availability, France also saw extremely high wholesale price levels this quarter with average day-ahead prices at €429.7/MWh, which was more than quadruple the levels seen in Q3 2021.

Table 1: EPEX Day-ahead quarterly average prices (EUR/MWh)

	BE	DE	DK (Ave)	ES	FR	GB	IT (Ave)	NL	NO 1-2-5	NO 3-4	SE 3-4	SE 1-2
Q1 2015	47.0	33.0	28.1	45.9	45.2	39.6	51.9	43.2	27.3	28.0	28.9	27.7
Q2 2015	41.4	28.3	23.0	48.4	32.6	42.0	47.6	39.1	20.0	20.9	22.1	20.8
Q3 2015	45.8	32.8	19.9	55.7	35.8	41.4	56.6	40.2	11.0	13.8	15.7	14.7
Q4 2015	44.8	33.2	23.8	51.2	40.6	37.6	52.5	37.9	21.2	20.8	23.2	21.6
Q1 2016	28.4	25.2	22.9	30.7	28.8	34.7	39.3	27.7	22.7	22.9	24.3	23.1
Q2 2016	27.1	24.8	25.7	29.5	25.9	35.1	36.3	28.4	22.8	24.1	26.5	26.4
Q3 2016	32.6	28.3	28.9	41.7	32.3	39.6	42.1	31.4	22.4	27.3	29.6	29.5
Q4 2016	58.1	37.6	34.6	56.5	59.8	52.4	53.1	41.4	33.7	33.1	37.0	36.7
Q1 2017	51.7	41.3	31.0	55.6	55.0	48.0	55.3	42.8	31.0	28.7	32.3	31.7
Q2 2017	35.7	29.8	28.7	47.0	33.9	40.0	46.4	34.6	27.1	26.2	28.8	28.5
Q3 2017	34.2	32.7	33.8	48.4	34.5	43.0	52.1	35.4	27.6	25.6	33.7	33.0
Q4 2017	56.8	33.0	30.6	58.0	56.5	50.2	61.0	44.5	29.9	30.0	32.0	30.2
Q1 2018	44.9	35.5	36.8	48.1	43.8	52.7	54.2	45.1	37.8	38.3	39.2	38.9
Q2 2018	44.1	36.0	39.7	52.0	36.8	52.7	55.0	46.1	38.7	39.7	39.5	38.5
Q3 2018	60.7	53.5	53.2	65.8	57.2	61.3	70.3	58.1	49.7	50.2	52.6	51.8
Q4 2018	71.1	52.6	50.4	63.0	62.7	63.0	68.3	60.6	46.8	47.1	50.2	47.4
Q1 2019	48.6	40.9	43.0	55.0	47.2	51.8	59.3	48.6	48.0	46.1	46.7	46.0
Q2 2019	34.5	35.8	36.9	48.7	34.9	41.3	52.3	39.1	37.0	35.3	33.8	33.0
Q3 2019	35.0	37.4	38.0	46.2	35.5	38.5	52.9	37.9	33.2	34.7	36.6	35.3
Q4 2019	39.4	36.6	38.9	41.0	40.3	40.1	48.5	39.3	39.0	37.7	39.4	37.5
Q1 2020	30.1	26.6	21.2	34.9	29.4	32.7	40.4	30.5	15.1	15.4	19.5	15.6
Q2 2020	18.5	20.3	20.5	23.2	18.0	24.3	25.2	20.9	4.5	5.6	16.2	8.2
Q3 2020	36.5	36.1	33.9	37.5	39.0	36.4	43.9	35.3	4.8	5.7	29.1	18.6
Q4 2020	42.3	38.8	31.0	40.1	42.2	47.5	49.5	42.1	12.6	10.0	29.2	15.1
Q1 2021	51.0	49.6	49.1	45.2	53.0	76.3	58.8	50.6	46.8	35.5	47.6	37.5
Q2 2021	62.3	60.3	58.7	71.8	63.9	86.6	77.2	62.1	47.2	30.0	46.5	33.1
Q3 2021	97.3	97.1	96.0	117.8	96.6	154.3	126.2	101.5	77.8	45.1	80.8	54.8
Q4 2021	204.3	178.9	147.1	211.0	221.4	246.3	237.4	196.0	126.4	41.5	117.3	44.5
Q1 2022	208.0	185.4	152.6	229.4	232.2	241.0	246.0	207.5	151.4	20.1	105.6	24.8
Q2 2022	193.9	188.5	179.6	182.8	226.0	155.3	247.0	195.5	167.1	18.6	119.4	51.7
Q3 2022	372.3	381.6	347.9	146.3	429.7	294.8	461.6	365.4	309.7	22.4	188.8	49.0

3 Generation Activity Overview

This quarter saw the lowest hydro and the lowest nuclear of any Q3 of the last five years with 89.9TWh

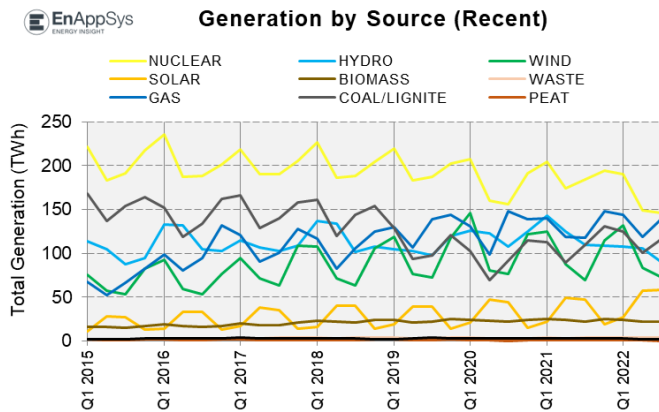


Figure 6: Generation by source in Europe from 2015 to 2022

of hydro and 145.7TWh of nuclear across the continent. Hydro and nuclear generation in Q3 2021 were 109.5TWh and 184TWh respectively. Renewables saw an 11% increase compared to Q3 2021 which is in line with the growth trend of each year. Notably, solar saw a 64% increase compared to the previous year. Fossil fuels saw a 6% increase compared to Q3 2021 whereas, in the past years, fossil fuels had been experiencing a decline.

Table 2: Quarterly generation summary Q2 2020 – Q3 2022

	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022	Q2 2022	Q3 2022
TOTAL GENERATION BY FUEL (TWh)									
Biomass	21.9	24.4	25.6	24.6	22.3	25.7	23.9	21.7	22.6
Coal/Lignite	91.2	114.9	113.0	89.4	110.1	131.3	124.5	100.4	117.1
Gas	147.8	138.9	139.9	118.4	117.9	148.3	144.5	118.6	140.4
Hydro	108.2	124.8	143.3	125.2	109.5	109.3	108.1	105.3	89.9
Nuclear	156.0	191.4	204.6	174.4	184.0	194.4	189.8	148.7	145.7
Oil	3.3	2.8	3.4	3.4	3.3	3.2	3.2	1.9	2.2
Peat	0.4	1.1	1.4	0.8	0.6	1.3	1.5	1.1	0.5
Solar	43.9	15.5	21.8	49.6	47.5	18.8	26.9	57.9	58.4
Waste	3.2	3.5	3.7	3.6	4.1	4.2	4.2	3.8	3.7
Wind	76.9	121.6	124.5	87.5	69.1	114.6	132.3	83.4	72.1
FOSSIL FUELS	242.7	257.7	257.7	211.9	231.9	284.1	273.7	221.8	260.1
NUCLEAR	156.0	191.4	204.6	174.4	184.0	194.4	189.8	148.7	145.7
RENEWABLE (INCLUDES WASTE)	254.1	289.8	318.9	290.5	252.6	272.6	295.4	272.1	246.6
TOTAL	652.8	738.8	781.1	676.9	668.5	751.0	758.9	642.7	652.4
Fossil Fuel Percentage									
Fossil Fuel Percentage	37%	35%	33%	31%	35%	38%	36%	35%	40%
Clean Percentage									
Clean Percentage	63%	65%	67%	69%	65%	62%	64%	65%	60%
Renewable Share of Clean Power									
Renewable Share of Clean Power	62%	60%	61%	62%	58%	58%	61%	65%	63%
SHARE OF GENERATION (%)									
Biomass	3.3%	3.3%	3.3%	3.6%	3.3%	3.4%	3.2%	3.4%	3.5%
Coal/Lignite	14.0%	15.5%	14.5%	13.2%	16.5%	17.5%	16.4%	15.6%	17.9%
Gas	22.6%	18.8%	17.9%	17.5%	17.6%	19.8%	19.0%	18.5%	21.5%
Hydro	16.6%	16.9%	18.3%	18.5%	16.4%	14.6%	14.2%	16.4%	13.8%
Nuclear	23.9%	25.9%	26.2%	25.8%	27.5%	25.9%	25.0%	23.1%	22.3%
Oil	0.5%	0.4%	0.4%	0.5%	0.5%	0.4%	0.4%	0.3%	0.3%
Peat	0.1%	0.1%	0.2%	0.1%	0.1%	0.2%	0.2%	0.2%	0.1%
Solar	6.7%	2.1%	2.8%	7.3%	7.1%	2.5%	3.5%	9.0%	8.9%
Waste	0.5%	0.5%	0.5%	0.5%	0.6%	0.6%	0.5%	0.6%	0.6%
Wind	11.8%	16.5%	15.9%	12.9%	10.3%	15.3%	17.4%	13.0%	11.0%
FOSSIL FUELS	37.1%	34.7%	32.8%	31.2%	34.6%	37.7%	35.9%	34.4%	39.8%
NUCLEAR	23.9%	25.9%	26.2%	25.8%	27.5%	25.9%	25.0%	23.1%	22.3%
RENEWABLE (INCLUDES WASTE)	38.9%	39.2%	40.8%	42.9%	37.8%	36.3%	38.9%	42.3%	37.8%

Table 3: Year-on-year comparison of Q2 generation (TWh and %)

	Q3 2017	Q3 2018	Q3 2019	Q3 2020	Q3 2021	Q3 2022
TOTAL GENERATION BY FUEL (TWh)						
Biomass	17.8	21.7	22.0	21.9	22.3	22.6
Coal/Lignite	140.3	144.4	97.9	91.2	110.1	117.1
Gas	100.7	106.0	139.0	147.8	117.9	140.4
Hydro	102.3	101.8	98.0	108.2	109.5	89.9
Nuclear	190.4	188.7	187.4	156.0	184.0	145.7
Oil	3.3	3.2	3.6	3.3	3.3	2.2
Peat	0.6	1.3	1.0	0.4	0.6	0.5
Solar	35.5	40.6	39.8	43.9	47.5	58.4
Waste	3.6	3.8	3.6	3.2	4.1	3.7
Wind	63.0	63.9	72.6	76.9	69.1	72.1
FOSSIL FUELS	245.0	254.9	241.5	242.7	231.9	260.1
NUCLEAR	190.4	188.7	187.4	156.0	184.0	145.7
RENEWABLE (INCLUDES WASTE)	222.3	231.7	236.1	254.1	252.6	246.6
TOTAL	657.7	675.3	664.9	652.8	668.5	652.4
Fossil Fuel Percentage	37%	38%	36%	37%	35%	40%
Clean Percentage	63%	62%	64%	63%	65%	60%
Renewable Share of Clean Power	54%	55%	56%	62%	58%	63%
CHANGE SINCE Q1 2017 (%)						
Biomass		22%	24%	23%	25%	27%
Coal/Lignite		3%	-30%	-35%	-22%	-17%
Gas		5%	38%	47%	17%	39%
Hydro		-1%	-4%	6%	7%	-12%
Nuclear		-1%	-2%	-18%	-3%	-23%
Oil		-4%	9%	0%	-1%	-35%
Peat		113%	66%	-27%	4%	-21%
Solar		14%	12%	24%	34%	64%
Waste		4%	-1%	-11%	13%	2%
Wind		1%	15%	22%	10%	14%
FOSSIL FUELS		4%	-1%	-1%	-5%	6%
NUCLEAR		-1%	-2%	-18%	-3%	-23%
RENEWABLE (INCLUDES WASTE)		4%	6%	14%	14%	11%

4 Notes on the Report

The figures used in the report refer to data provided through ENTSO-E for the period from 2015 which have been aggregated by EnAppSys into a European total. This data does sometimes suffer from outages or gaps in reporting, but it is considered generally complete. This report is based on the most recently available data as at quarter and year ends. National Grid data is used for GB demand.

Included Countries

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

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