

European Electricity Generation Summary

Q1-2022

January to March

Generation and Contribution by Fuel Type

Renewables: 312.7TWh (+8%)

Fossil Fuels: 270.5TWh(-3%)

Nuclear: 189.8TWh (-2%)

Percentage changes are from the previous quarter

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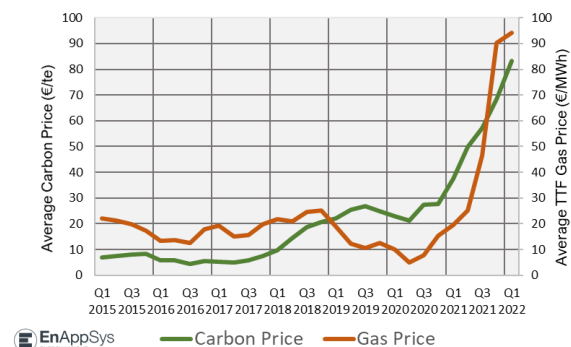
1 Executive Summary

Q1 2022 was dominated by the impact of the conflict in Ukraine on a market already experiencing very high wholesale fuel prices. At their peak, wholesale gas prices quadrupled the previous record, pushing up electricity prices to record highs.

Despite high fuel prices, high levels of gas and coal/lignite generation were seen as hydro generation was materially lower than levels generally expected for Q1 periods following a dry spell and nuclear output also fell, with France in particular seeing an unprecedented level of unplanned outages in the nuclear fleet.

High levels of wind and solar offset some of the reduction in hydro output, resulting in renewables contributed 40% of the generation mix, with fossil fuels contributing 35% and nuclear 25%.

The first quarter of 2022 delivered various new records, nevertheless electricity markets were primarily driven by the extreme pressure of the gas prices. Q1 2022 saw a new gas price record of 246.8€/MWh on 4th of March driven by the impact of the Russia-Ukraine conflict, which dwarfed the all-time price record of the last quarter that was driven by the post-Covid global economic growth and supply issues. The average day-ahead prices across Europe quadrupled the levels of previous first quarter. There were more drastic and more frequent price decoupling periods and considerable increase in the volatility in certain markets, such as France, Belgium and Netherlands.



In response to the increasing gas prices, coal/lignite generation increased to 124.5TWh, levels last seen during the 'Beast from the East' period, a sharp cold spell in 2018. Germany (+6.7TWh) saw the largest increase of any individual country in hard coal generation.

European demand (773.0TWh) noticeably fell below the seasonal averages for Q1 periods (-2.5%) driven by the effect of the milder weather conditions and the economic impact of the war, demand destruction hit sectors as fertilizers and steel industry.

Despite the spike in the fossil fuel generation, aggregate renewable generation (including biomass and waste) continued its dominance over conventional sources by ~42TWh (312.7TWh versus 270.5TWh). Compared to Q1 of 2021, hydro generation decreased by a massive 25% which led to 2% decrease in total renewable generation despite a 23% increase in solar and 21% increase in wind generation. There were several countries with significant drops in hydro generation specifically in Southern Europe, suffering from severe droughts with the quarter seeing much lower than usual precipitation.

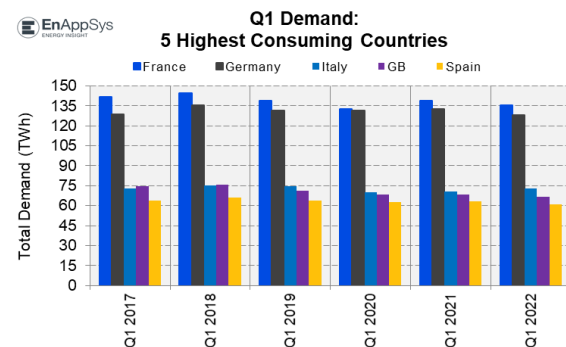
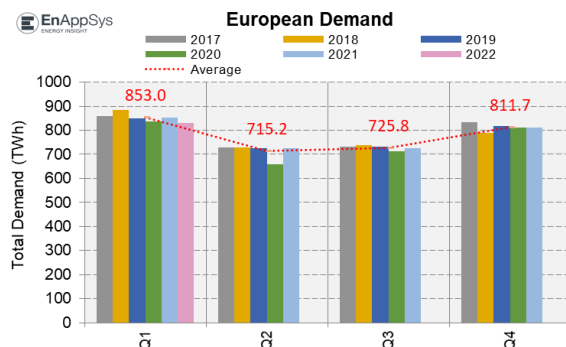
In addition to the new installed capacities, the first quarters usually see the highest wind availability which led to record high wind generation in this quarter in Europe with 150.2TWh. In terms of the contribution of individual countries, Germany (44.8TWh) maintains the lead in wind generation with an increase of 10.6TWh from the previous first quarter, whereas Sweden (11TWh) replaced France (10.6TWh) as a fourth largest wind generator with 60% increase in output compared to the previous Q1.

Nuclear generation had the highest outturn of a single fuel type in the quarter, with 189.8TWh and contributed 24.6% to total generation, though it saw a decrease of 7% in comparison to the previous Q4.

2 Demand trends

The European Demand chart shows that the Q1 2022 total demand level was lower than the usual. There is a drop of 2.3% in the demand compared to 2021 Q1, whereas in consideration of the Q1 averages since 2017 (853TWh) the drop is 2.5%.

There are two main reasons behind the drop: milder weather conditions and the impact of high prices on the demand. Except Italy which saw an increase of demand by 2.47TWh in comparison to Q1 of 2021, all of the 5 countries with the highest demand levels of Europe saw drops in demand by 2-5%. Only a few other countries did see an increase this quarter.



The 20TWh decrease in European demand compared to 2021 Q1 is driven by the significant drop of the demand of multiple countries, yet most noticeably Germany (-4.56TWh) and France (-3.34TWh). France has not seen such low demand level in a Q1 in more than 6 years, whereas last time Germany had levels below 128TWh was Q1 of 2016. The drop of Norwegian demand in Q1 of 2022 corresponds to 7.6% of their total demand.

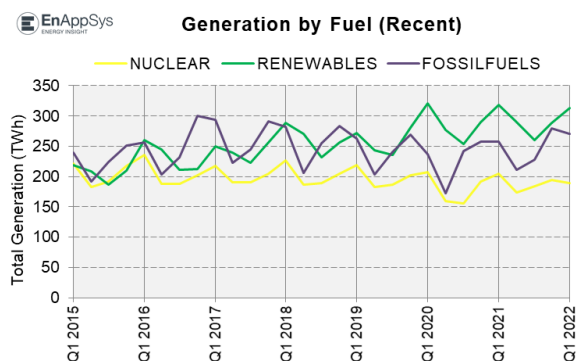
The demand trajectory had been extraordinarily high in the Q1 2021, as a consequence of the cold weather prevailing throughout Europe during that period and this year Q1 demand seems to be more aligned with the average trajectory. **The temperature profile of the first quarter of 2022 resembles that of the mild winter of 2019.**

Together with Italy, Greece and Bulgaria had increase in demand by 6.8% and 5.3%, respectively. This was due to the cold spell in the South-East Europe which brought temperatures 8°C down in comparison to the seasonal averages between the last week of February to the mid-March.

3 Generation Activity Overview

Europe Totals

Total generation levels were 773.0TWh this quarter corresponding to a 1% increase from Q4 and 1% decrease from previous Q1, driven by the drop in the demand levels. **Despite the spike in the fossil fuel generation, aggregate renewable generation (including biomass and waste) continued its dominance over the conventional sources by ~42TWh (312.7TWh versus 270.5TWh). This trend started in the 4th quarter of 2019 and this Q1 the renewable share of total generation was 40.5%.** This can be seen in the Generation by Fuel chart, which presents total generation by the grouped categories of renewables, fossil fuels, and nuclear.



In total, 312.7TWh was generated by renewables, down 2% from the 318.9TWh in Q1 of 2021, but up 8% from the 289.2TWh in Q4 of 2021. Fossil fuel-fired generation (270.5TWh) has followed renewables with 34.8% of total generation, whereas nuclear generation was 189.8TWh (24.6% contribution). Renewable share of the clean generation was 62% (61% in Q1 of 2021).

Nuclear generation

Nuclear has consistently seen the highest generation of any single fuel type and this continued in this quarter as expected. **Nuclear generation showed a decrease of 7% in comparison to the last Q1, with some long-running nuclear units going under maintenance, in addition to German units retiring from service (~4GW) at the start of the year.**

The available assets in the European nuclear fleet have been running at higher loads for longer time periods, to relieve the stress of high gas and carbon allowance prices on markets. The unusual levels of generation which have been ongoing since Q3 of 2021, have put a strain on the aging nuclear fleet of Europe, which led to unexpected and longer durations of maintenance mainly in France.

French nuclear output has been in a continuous decline since the end of January with 7.5GW going offline over February and 12.9GW going offline over March, for maintenance. Most of these units were laid over based on scheduled outage, whereas a few were shut-down due to the safety protocols, following the discovery of stress corrosion cracking problems.

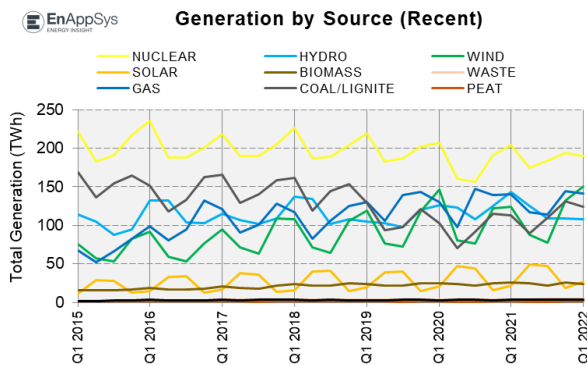
Meanwhile, the much delayed Finnish unit **Olkiluoto 3 reactor (1.6GW) is currently undergoing commissioning and has been generating since mid-March.** The generator is expected to meet 14% of the demand of the country by itself, drastically reducing Finnish import dependence.

Nuclear generation in Europe was 189.8TWh, 48.5TWh higher than gas which was the second highest generation type in this quarter. Please note that, nuclear generation has never been this low in a first quarter in the previous 7 years, as far as Entso-e records go.

Belgium stepped back from its plan to retire the entire nuclear fleet by 2025, as the deadline approaches and the security of supply issues are present. 2 of the units Doel 4 and Tihange 3, in total ~2.1GW are now likely to be kept in operation until the end of 2035. These units will need prolonged maintenance in the coming years, to prepare for this extension.

Fossil fuel generation

This Q1 saw unusually high fossil fuel generation (unprecedented since the Beast from the East of 2018) to cover for the drop in the nuclear generation and low levels of hydro. **This increase is despite the extremely high prices of gas, coal and carbon in Q1 this year compared to previous Q1s.**



The average decrease in fossil fuel generation from fourth to first quarter has been 12.7TWh since 2016. (Note that this decrease was as much as 31.9TWh in the 2019-2020 transition). This year, fossil fuel generation decreased only 9.6TWh from Q4 to Q1, which corresponds to a 3% decrease.

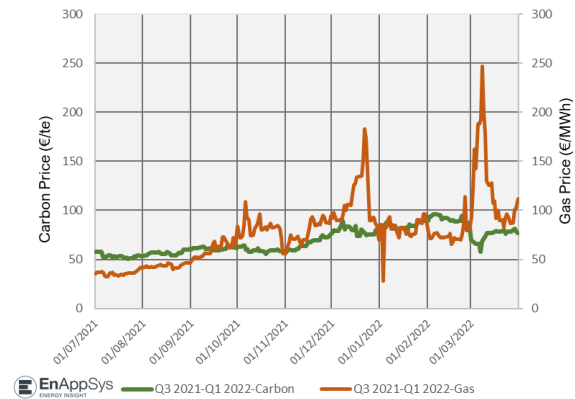
Despite high generation levels, coal/lignite generation is in fourth place this quarter (16.1% share), with the record high wind generation (19.4% share) taking the second place after nuclear (24.6%) and with gas (18.3%) at the third place. Coal/lignite generation (124.5TWh) saw a 5% decrease from Q4 (131.3TWh) and a 10% increase from the previous Q1 (113.0TWh). This is the second consecutive Q1 that coal generation has shown an increasing trend, this time driven by the extremely high gas prices, which led to gas-to-coal and gas-to-lignite switches in some countries, similar to Q4 2021.

Germany (+6.7TWh) saw the largest increase, which corresponds to 90% of the total European increase in hard coal generation versus the previous Q1. This development brought Germany (18.7TWh) into a close second place after Poland (19.6TWh) for hard coal generation, as Poland saw an unprecedented decrease of 1.5TWh in comparison to the previous Q1.

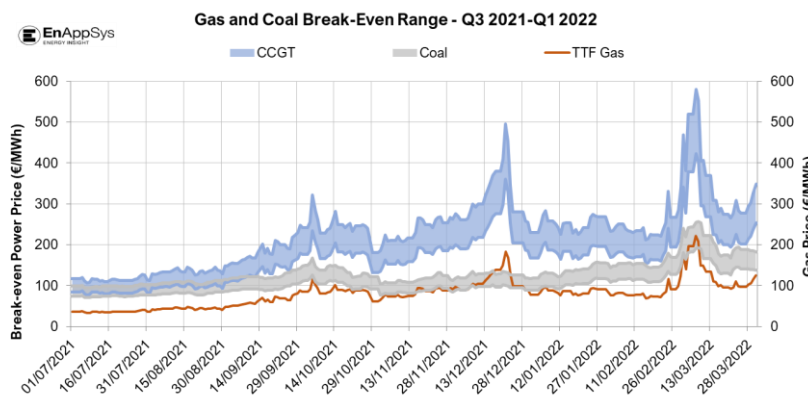
Lignite generation increased significantly by 4TWh in comparison to the previous Q1, despite the 1.3TWh decrease in the output of Germany with the phase-out scheme in place. Bulgarian lignite generation increased by 3TWh which corresponds to a 43% increase for the country. Nevertheless, Germany remains to be the largest lignite generator of Europe and produced 38% of the total lignite generation. Poland takes the second place, moreover with an increase 14% from the previous Q1.

The new government of Germany, the largest generator of coal/lignite in Europe, has keeps its pledge to bring the country to 100% renewables-based electricity by 2035 and commit to the coal phase-out by 2030. On the other hand, the security-of-supply concerns due to the Russian-Ukrainian conflict made the new government reconsider the phase-out plan. Allegedly, a new strategic coal reserve will be curated, in addition to the existing reserves which already keep few of the retiring assets to reduce import-dependence from Russia. This reserve is planned to allow the coal fleet run for 30 days in the winter months. Whereas the Rotterdam 1 (Onyx) coal power plant of Netherlands is now expected to continue operation against the original plan of retiring by the end of this year.

Gas-fired generation saw an increase of 1% in comparison to last year's Q1, despite the immense increase in the gas prices and took third place being the largest generation type after wind. Gas prices have been in a steeply increasing trend since March 2021 with the scarcity of supply in the global gas market. However, after the December peak (182.5€/MWh on 21st), the markets had been



withdrawing back to levels below 80€/MWh gradually until the Russian-Ukrainian conflict arose. At the peak of the market, TTF gas prevailing price saw 246.8€/MWh on 4th of March, significantly greater than the previous peak which was the record of last 10 years. EU ETS Allowance prices also saw a record high on the same day as well, reaching 96€/te. However, at such high levels of gas price for an average CCGT unit, the carbon allowance price remained to be a relatively small expense constituting ~6% of the break-even marginal cost of generation.



The increasing gas prices and unavailability of the nuclear fleet led to more coal and lignite-based generation, which had a ripple effect on the EU ETS Allowance prices. Gas and Coal Break-Even Range chart shows the range of

marginal cost of generation for different units based on the efficiency scale including fuel and carbon costs versus the TTF gas price.

The country with the largest gas generation level was Italy (33.8TWh) as it had been in the last two quarters and each quarter of 2020, with a significant difference to the second largest generator GB (21.4TWh). GB (-6.5TWh), Netherlands (-3.8TWh) and Germany (-3.3TWh) were the countries which showed the largest volumes of switch from gas.

Due to the ongoing conflict, Nord Stream 2 project, which was expected to commission by the end of 2021, is still on halt. On the other hand, Europe is on search for diversifying the gas supply and acquiring more energy security. In response to the on-going issues, Dutch government brought back the option of keeping the Groningen gas field operational.

Statistics

The following tables set out key statistics relating to generation in the quarter:

Table 1 Quarterly generation summary Q1-2020 to Q1-2022

	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022
TOTAL GENERATION BY FUEL (TWh)									
Biomass	24.5	23.5	21.9	24.4	25.6	24.6	22.1	25.5	23.7
Coal/Lignite	102.9	70.0	91.2	114.9	113.0	89.4	110.1	131.3	124.5
Gas	130.5	98.2	147.8	138.9	139.9	117.4	113.7	144.3	141.3
Hydro	125.9	122.9	108.2	124.8	143.3	125.2	109.4	109.0	107.8
Nuclear	207.2	160.1	156.0	191.4	204.6	174.4	184.0	194.4	189.8
Oil	3.0	3.1	3.3	2.8	3.4	3.4	3.3	3.2	3.2
Peat	1.2	0.7	0.4	1.1	1.4	0.8	0.6	1.3	1.5
Solar	21.3	47.3	43.9	15.5	21.8	49.6	47.5	18.8	26.9
Waste	3.8	3.0	3.2	3.5	3.7	3.6	4.1	4.2	4.2
Wind	146.1	80.2	76.9	121.6	124.5	87.6	77.1	131.8	150.2
FOSSIL FUELS	237.7	172.0	242.7	257.7	257.7	211.0	227.7	280.1	270.5
NUCLEAR	207.2	160.1	156.0	191.4	204.6	174.4	184.0	194.4	189.8
RENEWABLE (INCLUDES WASTE)	321.5	276.9	254.1	289.8	318.9	290.5	260.3	289.2	312.7
TOTAL	766.4	609.0	652.8	738.8	781.1	675.9	672.0	763.7	773.0
Fossil Fuel Percentage									
Fossil Fuel Percentage	31%	28%	37%	35%	33%	31%	34%	37%	35%
Clean Percentage									
Clean Percentage	69%	72%	63%	65%	67%	69%	66%	63%	65%
Renewable Share of Clean Power									
Renewable Share of Clean Power	61%	63%	62%	60%	61%	62%	59%	60%	62%
SHARE OF GENERATION (%)									
Biomass	3.2%	3.9%	3.3%	3.3%	3.3%	3.6%	3.3%	3.3%	3.1%
Coal/Lignite	13.4%	11.5%	14.0%	15.5%	14.5%	13.2%	16.4%	17.2%	16.1%
Gas	17.0%	16.1%	22.6%	18.8%	17.9%	17.4%	16.9%	18.9%	18.3%
Hydro	16.4%	20.2%	16.6%	16.9%	18.3%	18.5%	16.3%	14.3%	13.9%
Nuclear	27.0%	26.3%	23.9%	25.9%	26.2%	25.8%	27.4%	25.5%	24.6%
Oil	0.4%	0.5%	0.5%	0.4%	0.4%	0.5%	0.5%	0.4%	0.4%
Peat	0.2%	0.1%	0.1%	0.1%	0.2%	0.1%	0.1%	0.2%	0.2%
Solar	2.8%	7.8%	6.7%	2.1%	2.8%	7.3%	7.1%	2.5%	3.5%
Waste	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.6%	0.5%	0.5%
Wind	19.1%	13.2%	11.8%	16.5%	15.9%	13.0%	11.5%	17.3%	19.4%
FOSSIL FUELS	30.9%	28.1%	37.1%	34.7%	32.8%	31.1%	33.8%	36.5%	34.8%
NUCLEAR	27.0%	26.3%	23.9%	25.9%	26.2%	25.8%	27.4%	25.5%	24.6%
RENEWABLE (INCLUDES WASTE)	42.0%	45.5%	38.9%	39.2%	40.8%	43.0%	38.7%	37.9%	40.5%

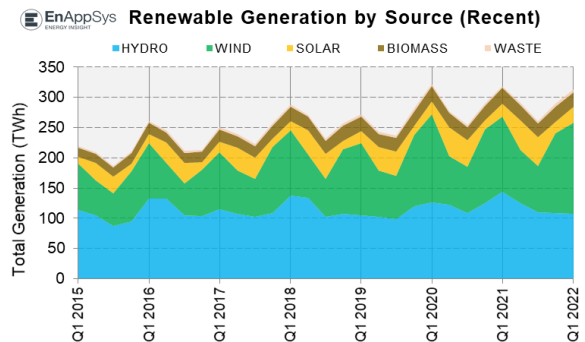
The following table sets out key statistics comparing the quarter with the same quarter in the previous six years:

Table 2 Year-on-year comparison of Q4 generation (TWh and %)

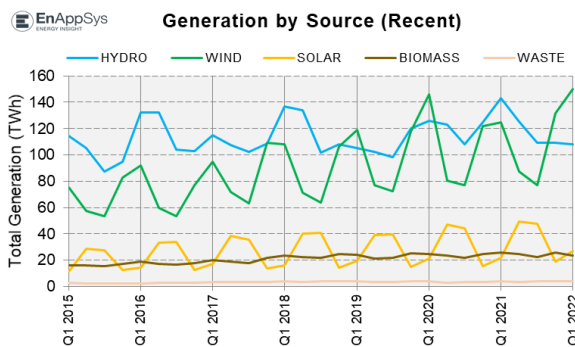
	Q1 2017	Q1 2018	Q1 2019	Q1 2020	Q1 2021	Q1 2022
TOTAL GENERATION BY FUEL (TWh)						
Biomass	20.3	23.6	24.2	24.5	25.6	23.7
Coal/Lignite	166.2	161.2	128.7	102.9	113.0	124.5
Gas	121.3	116.6	130.2	130.5	139.9	141.3
Hydro	114.9	137.0	105.2	125.9	143.3	107.8
Nuclear	218.2	226.1	219.2	207.2	204.6	189.8
Oil	3.8	3.4	2.5	3.0	3.4	3.2
Peat	1.9	1.5	1.9	1.2	1.4	1.5
Solar	17.1	16.0	19.7	21.3	21.8	26.9
Waste	3.2	3.7	3.8	3.8	3.7	4.2
Wind	94.6	108.0	118.8	146.1	124.5	150.2
FOSSIL FUELS	293.2	282.7	263.3	237.7	257.7	270.5
NUCLEAR	218.2	226.1	219.2	207.2	204.6	189.8
RENEWABLE (INCLUDES WASTE)	250.1	288.4	271.7	321.5	318.9	312.7
TOTAL	761.6	797.3	754.2	766.4	781.1	773.0
Fossil Fuel Percentage	39%	35%	35%	31%	33%	35%
Clean Percentage	61%	65%	65%	69%	67%	65%
Renewable Share of Clean Power	53%	56%	55%	61%	61%	62%
CHANGE SINCE Q1 2017 (%)						
Biomass		16%	19%	21%	26%	17%
Coal/Lignite		-3%	-23%	-38%	-32%	-25%
Gas		-4%	7%	8%	15%	17%
Hydro		19%	-8%	10%	25%	-6%
Nuclear		4%	0%	-5%	-6%	-13%
Oil		-11%	-34%	-20%	-12%	-17%
Peat		-20%	-2%	-36%	-28%	-23%
Solar		-6%	15%	24%	28%	57%
Waste		16%	19%	19%	15%	31%
Wind		14%	26%	54%	32%	59%
FOSSIL FUELS		-4%	-10%	-19%	-12%	-8%
NUCLEAR		4%	0%	-5%	-6%	-13%
RENEWABLE (INCLUDES WASTE)		15%	9%	29%	27%	25%

4 Renewables

Across Europe as a whole, Q1 2022 saw 312.7TWh of power production from renewable sources (including biomass and waste), amounting to 40.5% of total European electricity generation. This is an increase of 8% from the 736.7TWh in Q4 2021, powered by the significant increases in both solar and wind generation. First quarter periods generally see the highest renewable generation in a year, except 2019 when the fourth quarter saw record levels of wind availability.



Compared to Q1 of 2021, hydro generation decreased by 25% which led to 2% decrease in *total* renewable generation, despite the 23% increase in solar and 21% increase in wind generation. There were several countries with significant drops in hydro generation, specifically in Southern Europe, suffering from severe droughts with the quarter seeing much lower than usual precipitation.

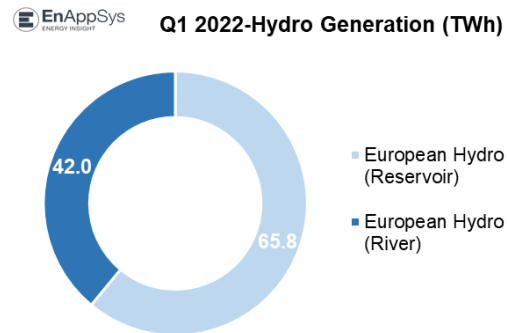


Wind generation remained the largest renewable generation type second time in a row. Wind generation corresponded to 48% of the total renewable generation which broke the previous record of 45.6% in Q4 2021. The second largest component of renewable generation was hydro at 107.8TWh generation, dropping to the levels recorded in 2019. Solar generation broke a new record of generation and renewable contribution levels of 8.6% in a first quarter (26.9TWh), up from 6.9% (21.8TWh) in Q1 2021.

4.1 Hydro

Hydro generation was very low this quarter, similar to the levels of 2019 Q1 which was followed by even drier periods until winter. The average increase from fourth to first quarter, historically is 14.1TWh, whereas from Q4 2021 to Q1 of 2022 hydro generation dropped by 1.2TWh.

Hydro (reservoir + river) generation was limited to 107.8TWh which corresponds to a 25% drop compared to Q1 of 2021 and a 17% drop compared to Q1 of 2020. This quarter Norway remained the largest hydro generator of Europe with a 34% average contribution to total European hydro generation.

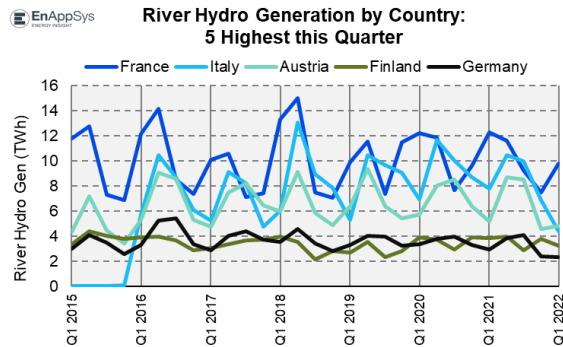


Norway kept its recently changed reporting scheme of reservoir and river generation data, which was adjusted after the go-live of North-Sea-Link. Certain volumes previously classed as reservoir generation (~4GW) are now reported under the category of run-of-river generation. The change has on-going impact on the statistics, as not only Norwegian trends seem distorted, but also the European totals due to the sheer volume of hydro generation in Norway.

Reservoir hydro

Despite the drop in the generation levels due to reporting reasons, Norway remains the largest reservoir generator with 31.5TWh generation, yet with a 6.1TWh decrease in comparison to Q1 of 2021. This also corresponds to 37.2% of the European reservoir generation drop from Q1 of 2021 to Q1 of 2022. Whereas Sweden remained in second place with 18.4TWh generation, with 3TWh drop from the previous Q1. In consideration of such a large drop in the Swedish reservoir generation, the drop in the Norwegian generation is high-likely not only related with the re-categorisation, but also with the dry season. Nevertheless, the largest drop in the reservoir generation was recorded for Spain in comparison to Q1 2021. Spain kept its third place among the reservoir generators, however saw a material drop of 6.2TWh, which corresponds to a 60% drop. Spain has seen a similarly dry season 2019, yet has never recorded such a low level of 4.1TWh in a first quarter before.

River hydro

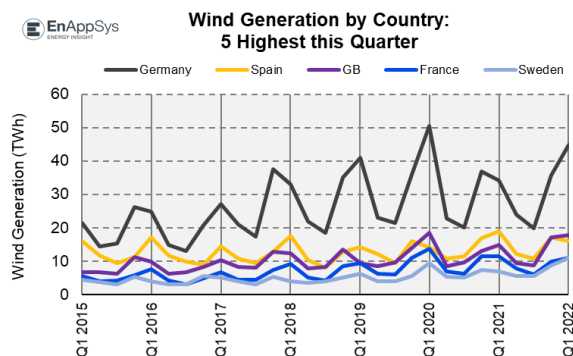


No country saw an increase in the river generation (except Norway due to above mentioned technical reasons) and European generation fell by 11TWh in comparison to the Q1 of 2021.

France keeps the first place in river generation this quarter as well, as usual for the first quarters. France generated 9.8TWh in Q1 with a major drop of 2.5TWh compared to the previous Q1. With the new categorisation Norway has the second place among the largest river generators with 5.1TWh generation which corresponds to 145% increase from the previous Q1.

Overall, the southern European countries saw large drops in the river generation due to the severe droughts. Italy saw 80% less rain and 60% less snow in the first quarter and suffered from the largest drop among all the European countries with 3.4TWh. Italy has historically been the second largest river generator in first quarter periods, however this year it dropped to the 4th place with 4.4TWh generation. Portugal was another noticeable country with a drop in generation of over 71% from Q1 2021 to Q1 2022.

4.2 Wind



The rapid development of new wind capacity across Europe continues to deliver new records each quarter. In addition to the new installed capacities, the first quarters usually see the highest wind availability which led to record high wind generation in this quarter in Europe with 150.2TWh. Wind generation increased drastically from the last quarter by 18.4TWh

(+21%) – considering the average increase of 12.7TWh. On the other hand, Q1 2021 had relatively low wind generation.

Germany (44.8TWh) maintains the lead in wind generation with an increase of 10.6TWh from the previous first quarter. Nevertheless, this is not the highest wind generation in a quarter recorded in

Germany, as Q1 2020 levels were as high as 50.4TWh. In second place, with a large difference from German generation levels, is GB at 17.9TWh, which is followed by Spain at 16TWh.

The development of wind energy in Sweden contributes a noticeable increase each quarter, as Sweden moves from the fifth to fourth place this quarter with an increase of 60% from the previous Q1. This quarter wind generation (11TWh) met the 28% of the demand in Sweden. France (10.9TWh) first time fell behind Sweden in wind generation.

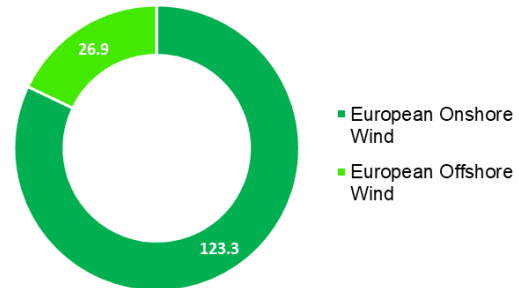
Onshore wind

European onshore generation increased by 18% (+18.4TWh) from 2021 Q1. Germany is the largest contributor with 37.3TWh and 10.4TWh increase from the previous Q1. Spain remained as the second largest generator, despite being one of the very few countries which saw a decrease in output this quarter. This quarter onshore fleet of Netherlands recorded 101% increase from the previous Q1 and reached 3.5TWh. Although this only means 12th place in the onshore generation ranking by country, the generation met 13% of the quarterly demand. Another country which made a significant jump in generation was Poland, bringing the first quarter output from 4TWh to 6.4TWh in the last year.

Offshore wind

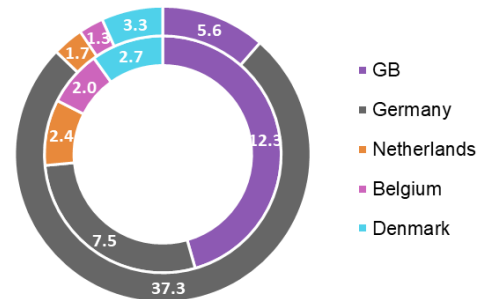
Although there are several countries that are soon to commission offshore farms, such as Portugal, Spain and France, this quarter GB, Germany, Netherlands, Belgium and Denmark remain the only commercial offshore generators. European offshore generation increased by 7.2TWh this quarter in comparison to Q1 2020 and reached 26.9TWh constituting 18% of the total wind generation.

EnAppSys **Q1 2022-Wind Generation (TWh)**



Offshore generation in GB is not only an integral part of British wind generation, but also European offshore generation in aggregate. GB offshore generation in this quarter was 12.3TWh, corresponding to 46% of the total offshore generation. Denmark recorded a noticeable increase of 1TWh (+61%) from the previous first quarter and reached all-time high of 2.7TWh thanks to new units.

EnAppSys **Q1 2022 - Onshore (Outer Circle) & Offshore (Inner Circle) Generations (TWh)**



Netherlands officially announced its intention to expand their offshore fleet aggressively and reach to 21GW by 2030, which exceeds the peak demand level (~16GW) of the country.

4.3 Solar

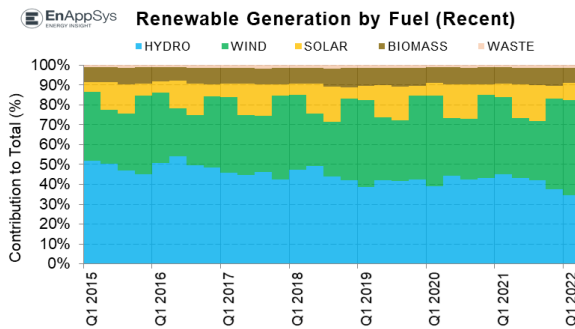
Solar generation reached a new record level of Q1 output in this Q1 with 26.9TWh. This means an increase of 43% from the last quarter and an increase of 23% from the previous Q1. Please note that, such an increase in from fourth the first quarters is expected, as the average increase since 2019 is 42%. Nevertheless an increase of 8.1TWh was never recorded before, this thanks to the development in the solar capacity across Europe. It is clear that the spring is likely to bring further new records. This quarter solar generation met 3.2% of the European demand.

Germany remained the largest solar generator with 8.7TWh total generation and showed a 29% increase from the previous Q1. Spain (5.0TWh) followed Germany and ranked second. The Spanish fleet boosted its output by 25% this quarter. Italy remained in third place with 4.3TWh generation.

Portugal saw a significant increase of 69% in solar generation from the previous first quarter, nevertheless the output remained only at 0.5TWh.

Moreover, solar generation was under the heavy influence of the Sahara dust and unusual cloud formation due to increased aerosol levels in CWE in the beginning of March, which decreased the generation levels for a week.

4.4 Biomass and Waste



Biomass output (23.7TWh) decreased by 7% from the last quarter, and still was in the historic 20-25TWh range. Waste generation significantly increased by 14% compared to Q1 last year and broke a generation record again with 4.2TWh this quarter as well.

Statistics

The following table sets out key statistics by quarter:

Table 3 Quarterly renewable generation statistics Q1 2020 to Q1 2022 (TWh and %)

	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022
TOTAL GENERATION BY FUEL (TWh)									
Biomass	24.5	23.5	21.9	24.4	25.6	24.6	22.1	25.5	23.7
Hydro	125.9	122.9	108.2	124.8	143.3	125.2	109.4	109.0	107.8
Solar	21.3	47.3	43.9	15.5	21.8	49.6	47.5	18.8	26.9
Waste	3.8	3.0	3.2	3.5	3.7	3.6	4.1	4.2	4.2
Wind	146.1	80.2	76.9	121.6	124.5	87.6	77.1	131.8	150.2
TOTAL	321.5	276.9	254.1	289.8	318.9	290.5	260.3	289.2	312.7
Primary Renewable Source	WIND	HYDRO	HYDRO	HYDRO	HYDRO	HYDRO	HYDRO	WIND	WIND
SHARE OF RENEWABLES (%)									
Biomass	7.6%	8.5%	8.6%	8.4%	8.0%	8.5%	8.5%	8.8%	7.6%
Hydro	39.1%	44.4%	42.6%	43.1%	44.9%	43.1%	42.0%	37.7%	34.5%
Solar	6.6%	17.1%	17.3%	5.3%	6.9%	17.1%	18.3%	6.5%	8.6%
Waste	1.2%	1.1%	1.3%	1.2%	1.1%	1.2%	1.6%	1.5%	1.3%
Wind	45.4%	29.0%	30.3%	42.0%	39.1%	30.1%	29.6%	45.6%	48.0%

The following table contains the key statistics comparing the quarter with the same quarter in previous years:

Table 4 Year-on-year comparison of Q1 renewable generation TWh

	Q1 2017	Q1 2018	Q1 2019	Q1 2020	Q1 2021	Q1 2022
TOTAL GENERATION BY FUEL (TWh)						
Biomass	20.3	23.6	24.2	24.5	25.6	23.7
Hydro	114.9	137.0	105.2	125.9	143.3	107.8
Solar	17.1	16.0	19.7	21.3	21.8	26.9
Waste	3.2	3.7	3.8	3.8	3.7	4.2
Wind	94.6	108.0	118.8	146.1	124.5	150.2
TOTAL	250.1	288.4	271.7	321.5	318.9	312.7
Primary Renewable Source	HYDRO	HYDRO	WIND	WIND	HYDRO	WIND
CHANGE SINCE Q2 2016 (%)						
Biomass		16%	19%	21%	26%	17%
Hydro		19%	-8%	10%	25%	-6%
Solar		-6%	15%	24%	28%	57%
Waste		16%	19%	19%	15%	31%
Wind		14%	26%	54%	32%	59%

5 Day-ahead Price Trends

This quarter wholesale markets were under the heavy influence of the elevated gas prices, which further built on the record levels seen in the last quarter. Italy with large dependence on gas generation for meeting its baseload was exposed to the highest average day-ahead price this quarter at 245.7€/MWh which is more than the quadruple the average price of Q1 2021. On the other hand, almost all of the countries saw extreme prices above 650€/MWh at least once in Q1 2022.

Table 5 EPEX Day-ahead quarterly average prices (€/MWh)

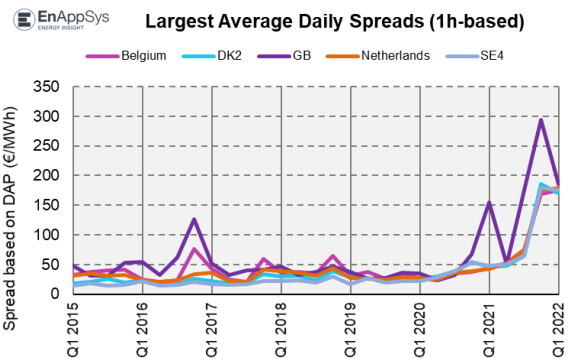
	BE	DE	DK (Ave)	ES	FR	GB	IT (Ave)	NL	NO 1-2-5	NO 3-4	SE 3-4	SE 1-2
Q1 2015	47.0	33.0	28.1	45.9	45.2	39.6	51.9	43.2	27.3	28.0	28.9	27.7
Q2 2015	41.4	28.4	23.0	48.4	32.6	42.0	47.6	39.1	20.0	20.9	22.1	20.8
Q3 2015	45.8	32.8	19.9	55.7	35.8	41.4	56.6	40.2	11.0	13.8	15.7	14.7
Q4 2015	44.8	33.2	23.8	51.2	40.6	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	29.6	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	39.5	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	47.9	55.3	42.8	31.0	28.7	32.3	31.7
Q2 2017	35.8	29.8	28.7	47.0	33.9	40.0	46.4	34.6	27.1	26.2	28.8	28.5
Q3 2017	34.1	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	57.9	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	52.1	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	61.2	70.3	58.2	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	34.0	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	42.2	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	126.3	101.5	77.8	45.1	80.7	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	208.1	184.6	152.6	229.4	232.3	241.0	245.7	207.5	151.4	20.1	105.7	24.8

Furthermore, divergence in the price decoupling was more apparent this quarter, as interconnectors were fully utilized and capacities were not sufficient to converge to similar price levels. The northern zones of Norway and Sweden were distinctively decoupled at much lower prices across the year powered by the hydro generation, whereas the other countries saw a large variance in their price profiles driven by renewable availability and coal/gas switch capability.

France was heavily relying on the nuclear fleet for a long period of time and providing large volumes of export due to relatively lower prices for the last 3 quarters. However, after the start of the drop in the nuclear availability with the planned and unplanned outages, France became exposed to very high prices toward the end of the quarter. The availability of the nuclear fleet influenced the price premium in markets.

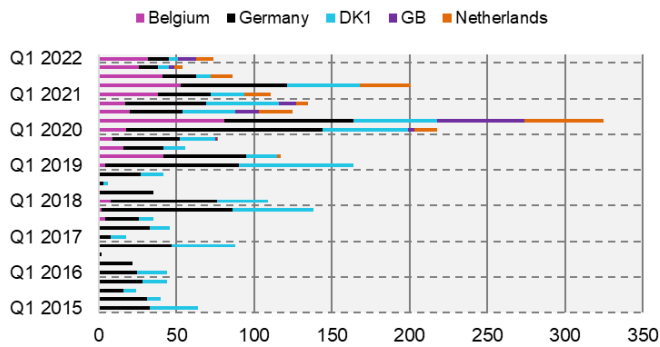
5.1 Spreads between daily minimum and maximum prices

As renewables take a larger share in the generation mix, volatility in the current market conditions is increasing as the necessary flexibility is scarce and very valuable. Due to GB being an more island system, it has generally seen more volatility and exposed to large spreads between maximum and minimum prices each day. On the other hand, this quarter Netherlands with average 178.9€/MWh day-ahead 1 hour-based spreads almost caught up with GB at 186.3€/MWh.



Netherlands with average 178.9€/MWh day-ahead 1 hour-based spreads almost caught up with GB at 186.3€/MWh.

Number of Negative Day-ahead Prices



As one of the most volatile markets, Belgium saw the highest number of negative price periods this quarter (32 occasions), despite the very high price levels in the market on average. The negative hours were driven by the very high wind generation which occasionally led to curtailments in Belgium in February.

6 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 to be 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	

EnAppSys offers incredibly detailed market insights and consultancy services for companies in the energy industry.

*This report has been created using our pan-European **market data platform**, which has flexible configurable screens and automated data feeds. If you would like to gain more detailed information and insight, please contact us to arrange trial access to the platform via: sales@enappsys.com*

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