

# European Electricity Generation Summary

Q4-2021

October to December

## Generation and Contribution by Fuel Type

Renewables: 293.2TWh (+13%)

Fossil Fuels: 289.4TWh(+24%)

Nuclear: 206.5TWh (+6%)

Percentage changes are from the previous quarter

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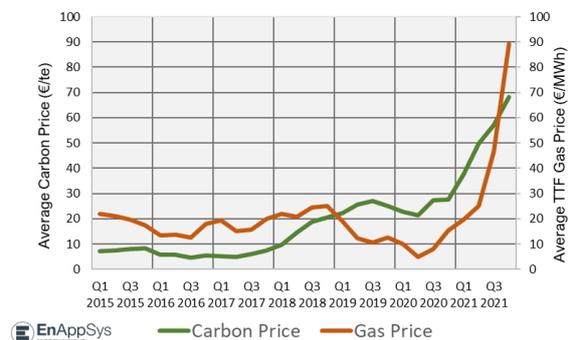
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## 1 Executive Summary

Europe saw very high levels of wholesale prices driven by the gas prices breaking new records day after day since the early days of the third quarter and reaching the unprecedented level of €182.5/MWh by the end of the quarter. This led to the bankruptcy of many suppliers of various sizes in Q4. European gas markets tightening with the increasing demand from Asia combined with the increased levels of willingness to pay and Nord-Stream 2 suspension, tipped down toward the end of the December with the large volumes of shale gas dispatched from USA.

In the meantime, there were significant volumes of gas-to-coal and gas-to-lignite switches in the countries with available installed capacity, such as Netherlands and Germany. Coal/Lignite generation (132.4TWh) this was a 20% increase versus the last quarter and a 15% increase from the previous year's Q4. This had a compounding impact on the ETS prices, as the spread between break-even ranges of gas and coal/lignite units reached over 200€/MWh at times. Just before the increasing wholesale prices, Spain removed the price cap of 100€/MWh (and the price floor as well), a decision unrelated to market circumstances, but with unprecedented price consequences.



European demand (823.1TWh) has noticeably increased, with Scandinavia seeing the coldest months of the last 50 years, in addition to the cold December in France. In the fourth quarter, with the increase in heating demand, France became a major importer. In parallel, the quarterly statistics show that France suffered from low wind (-1.6TWh) and hydro (-3.5TWh) generation, followed by a series of nuclear maintenance outages toward the end of the year, seeing the lowest nuclear availability levels in recent history.

Hydro generation was particularly low in comparison to the previous fourth quarters in the last 2 years, at 109.4TWh. The dry season brought the record lowest increase in hydro generation from third to fourth quarter in Europe, at just 1%. Nevertheless, wind generation showed an immense increase of 74% from the past quarter (versus a 61% increase from Q3 to Q4 last year) to 135.0TWh and contributed to 17.1% of the total generation. This meant that wind overtook hydro as the most productive renewable generator after 3 quarters. Thanks mainly to the increase in wind generation, renewables continued to have the largest share (37.2%) in the fuel mix, in terms of fuel type groupings, with a total of 293.2TWh versus 289.4TWh for fossil fuels.

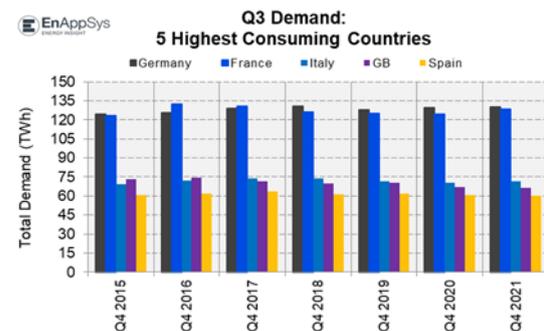
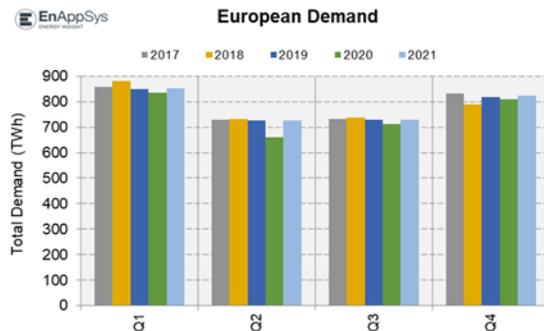
Nuclear generation had the highest outturn of a single fuel type in the quarter, with 206.5TWh. It saw an increase of 8% in comparison to the previous Q4 and contributed 26.2% to total generation. Germany phased-out ~4GW of nuclear capacity, whereas Finland commissioned a new reactor (~1.6GW) at the end of the quarter. These effects will become visible in Q1 of 2022.

## 2 Demand trends

The European Demand chart shows that the Q4 2021 total demand level was in the expected range. There is an increase of 1.6% in the demand compared to 2020 Q4, whereas the increase is limited to 1.2% in consideration of the Q4 average since 2015 (813.5TWh).

The 12.6TWh increase in European demand compared to 2020 Q4 is mainly driven by France (+3.94TWh), Finland (+2.14TWh), Sweden (+1.78TWh) and Norway (+1.13TWh), which counteract decreases seen mainly in the Balkan countries. There are two different reasons for the increase, which overlap in the case of Sweden (38.0TWh) and Norway (37.7TWh).

France (128.6TWh), one is temperature sensitivity in the electricity demand due to electricity-based heating and the other is an increase in EV charging. Electrical heating demand increased in France as the country met with ~1.2C colder than the average temperatures in December (based on 2015-2020 temperature data). Whereas **Scandinavia was hit by the coldest seasonal temperatures in 50 years from November to December, the effect of which was further amplified by the heavy electrification of heating systems in Norway.** Furthermore, EV mobility continuous to increase rapidly in Norway and Sweden, which not only has an impact on the total demand levels, but also the daily demand trends. Nevertheless, these changes were not enough to change the rank of the top 5 highest consuming countries in Europe, which were again Germany, France, Italy, GB and Spain.

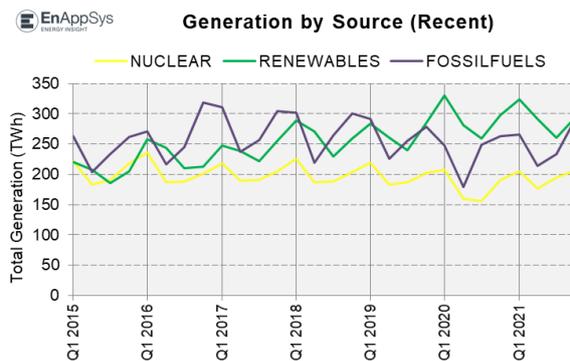


### 3 Generation Activity Overview

#### Europe Totals

Total generation levels were at a record high for a fourth quarter with 789.0TWh corresponding to 15% increase from Q3 and 5% increase from previous Q4, this is partially due to the increase in the demand levels reaching Q4 levels seen before 2018. **Despite the spike in the fossil fuel generation, aggregate renewable generation (including biomass and waste)**

**continued its dominance over the conventional sources by ~4TWh (293.2TWh versus 289.4TWh). This trend started in the 4<sup>th</sup> quarter of 2019 and this Q4 the renewable share of total generation was 37.2%.** 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, 293.2TWh was generated by renewables, down 2% from the 297.1TWh in Q4 of 2020, but up 13% from the 259.9TWh in Q3 of 2021.** Fossil fuel-fired generation (289.4TWh) has closely followed renewables with 36.5% of total generation, whereas nuclear generation was 206.5TWh (26.2% contribution). Renewable share of the clean generation was 59% (61% in Q4 of 2021).

#### Nuclear generation

**Nuclear has consistently seen the highest generation of any single fuel type and this continues in this quarter.** Nuclear generation showed an increase of 8% in comparison to the last Q4, which indicates a shift in the power mix. This shift is associated with the continuing high gas and carbon allowance prices, which drives the nuclear fleets to run at higher loads for longer time periods. These 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 occasionally in France and Belgium.

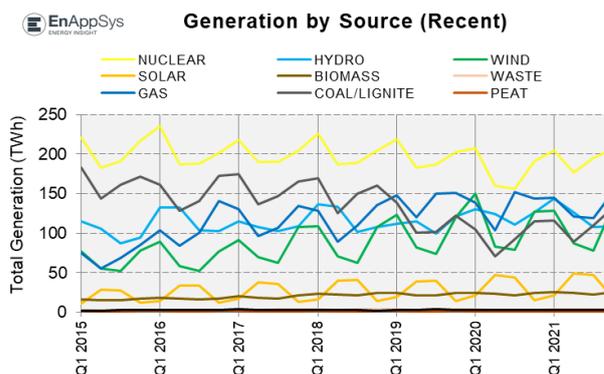
Germany shut down 3 (~4GW) of the last 6 (~8GW) nuclear power plant in the country by the end of 2021, which decreased the nuclear availability of the country to 4GW. The rest is to be retired at the end of 2022. On the other hand, **Finland finally commissioned the Olkiluoto 3 reactor (1.6GW)**

**after 12 years of delay at the end of December.** The generator is expected to meet 14% of the demand of the country by itself.

Nuclear generation in Europe was 206.5TWh, 54.0TWh higher than gas which was the second highest generation type in this quarter. Last time nuclear generation levels in Q4 saw these levels was the winter of 2017.

### Fossil fuel generation

Fossil fuel generation increased from the third quarter to fourth quarter, following the normal seasonal patterns with the arrival of the winter. **The decreasing trend of fossil fuel generation compared with previous Q4s since 2016 was broken this year for the first time. This increase is despite the high prices of gas, coal and carbon in Q4 this year compared to previous Q4s.**



The average increase in fossil fuel generation from third to fourth quarter is 43.7TWh since 2015. This year, with the impact of the extremely cold winter in Scandinavia and cold December in France, fossil fuel generation increased 55.7TWh from Q3 to Q4, which corresponds to a 24% increase.

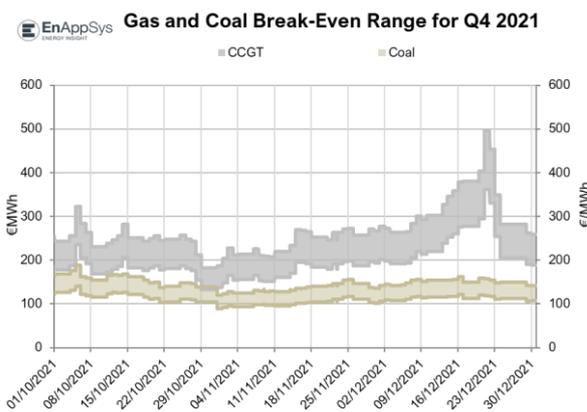
**Despite the high generation levels, coal/lignite generation is in fourth place this quarter (16.8% share), with the unprecedented levels of high wind generation (17.1% share) taking the third place after nuclear (26.2%) and gas (19.3%).** Coal/lignite generation (132.4TWh) saw a 20% increase from the Q3 (110.1TWh) and 15% increase from the previous Q4 (115.3TWh). This is driven by the extremely high gas prices, which eventually lead to gas-to-coal and gas-to-lignite switches in some countries.

Germany (+4.9TWh) and Netherlands (+3.0TWh) saw the largest increases in hard coal generation. This development brought Germany (18TWh) into a close second place after Poland (21.7TWh) for hard coal generation. In comparison to the hard coal, lignite generation did not have a material increase in the sum. Poland (+2.4TWh) and Bulgaria (+2.7TWh) had the largest absolute increases in the lignite generation. On the other hand, Germany (27.9TWh) alone generated more than 40% of lignite fuelled generation in Europe.

Scotland and Portugal were the two countries officially phased-out coal/lignite generators in 2022. The contribution of coal/lignite generation to meeting the national demand was limited to less than 1% in Portugal in Q4 of 2021, and Scotland's last active coal power plant Longannet stopped operation already in 2016.

**The largest generator of coal/lignite in Europe, Germany, has a new government in power since December 2021. The new government, which has a Green party in coalition, pledged to bring the coal/lignite phase-out earlier than previously planned, from 2038 to 2030.**

**Gas-fired generation had an increase of 6% in comparison to last year's Q4 and took the second place as the largest generation type after nuclear. Gas prices were in a steeply increasing trend since March 2021 with the scarcity of supply in the global gas market. In Q4 of 2021, the prevailing gas prices in TTF saw the peak of the last 10 years on December 21<sup>st</sup> with 182.5€/MWh. The increasing trend of gas prices had a ripple effect on the EU ETS Allowance (EUA) prices, as the gas-to-coal/lignite switch became more profitable, which can be seen in the chart below showing the Gas and Coal Break-Even Range based on prevailing fuel and EUA costs.**



The country with the largest gas generation level was Italy (34.4TWh) as it had been in Q1 and Q3 this year and each quarter of 2020, with a significant difference to the second largest generator GB (27TWh). Netherlands (-1.6TWh) and Germany (-3.2TWh) were the countries which showed the largest volumes of switch from gas to coal/lignite generation.

A drop in gas prices that started at the end of December brought the gas prices to around 70€/MWh as the new shale gas supply exported from USA reduced the tightness in the market. Meanwhile, Nord Stream 2 commissioning is suspended for the time being due to political and bureaucratic reasons, despite the technical readiness of the project.

## Statistics

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

*Table 1 Quarterly generation summary Q4-2019 to Q4-2021*

	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021
<b>TOTAL GENERATION BY FUEL (TWh)</b>									
Biomass	25.0	24.5	23.5	21.9	24.4	25.6	24.6	22.4	25.8
Coal/Lignite	122.1	105.2	71.3	92.6	115.3	116.1	89.6	110.1	132.4
Gas	151.5	138.3	103.9	152.2	143.7	144.5	120.8	119.6	152.5
Hydro	120.8	130.1	124.6	111.0	126.8	144.4	125.9	108.3	109.4
Nuclear	202.5	207.2	160.1	156.0	191.4	204.6	176.8	194.9	206.5
Oil	3.4	3.0	3.1	3.3	2.8	3.4	3.4	3.3	3.2
Peat	1.7	1.2	0.7	0.4	1.1	1.4	0.8	0.6	1.3
Solar	14.6	21.3	47.3	43.9	15.5	21.8	49.7	47.5	18.8
Waste	4.0	3.8	3.0	3.2	3.5	3.7	3.6	4.1	4.2
Wind	120.3	150.2	83.0	79.5	127.6	128.1	87.7	77.7	135.0
FOSSIL FUELS	278.6	247.8	179.0	248.5	263.0	265.3	214.7	233.6	289.4
NUCLEAR	202.5	207.2	160.1	156.0	191.4	204.6	176.8	194.9	206.5
RENEWABLE (INCLUDES WASTE)	284.7	329.8	281.5	259.5	297.8	323.5	291.4	260.0	293.2
<b>TOTAL</b>	<b>765.8</b>	<b>784.7</b>	<b>620.6</b>	<b>664.1</b>	<b>752.2</b>	<b>793.5</b>	<b>682.9</b>	<b>688.5</b>	<b>789.0</b>
<b>PERCENTAGE</b>									
Fossil Fuel Percentage	36%	32%	29%	37%	35%	33%	31%	34%	37%
Clean Percentage	64%	68%	71%	63%	65%	67%	69%	66%	63%
Renewable Share of Clean Power	58%	61%	64%	62%	61%	61%	62%	57%	59%
<b>SHARE OF GENERATION (%)</b>									
Biomass	3.3%	3.1%	3.8%	3.3%	3.2%	3.2%	3.6%	3.3%	3.3%
Coal/Lignite	15.9%	13.4%	11.5%	13.9%	15.3%	14.6%	13.1%	16.0%	16.8%
Gas	19.8%	17.6%	16.7%	22.9%	19.1%	18.2%	17.7%	17.4%	19.3%
Hydro	15.8%	16.6%	20.1%	16.7%	16.9%	18.2%	18.4%	15.7%	13.9%
Nuclear	26.4%	26.4%	25.8%	23.5%	25.4%	25.8%	25.9%	28.3%	26.2%
Oil	0.4%	0.4%	0.5%	0.5%	0.4%	0.4%	0.5%	0.5%	0.4%
Peat	0.2%	0.2%	0.1%	0.1%	0.1%	0.2%	0.1%	0.1%	0.2%
Solar	1.9%	2.7%	7.6%	6.6%	2.1%	2.8%	7.3%	6.9%	2.4%
Waste	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.6%	0.5%
Wind	15.7%	19.1%	13.4%	12.0%	17.0%	16.1%	12.8%	11.3%	17.1%
FOSSIL FUELS	36.2%	31.4%	28.7%	37.4%	34.8%	33.3%	31.3%	33.8%	36.5%
NUCLEAR	26.4%	26.4%	25.8%	23.5%	25.4%	25.8%	25.9%	28.3%	26.2%
RENEWABLE (INCLUDES WASTE)	37.2%	42.0%	45.4%	39.1%	39.6%	40.8%	42.7%	37.8%	37.2%

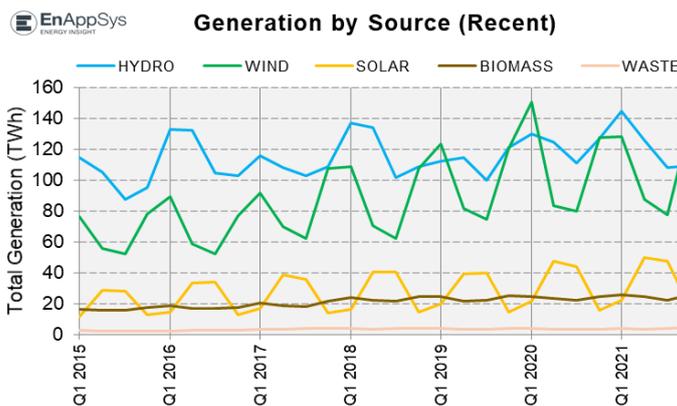
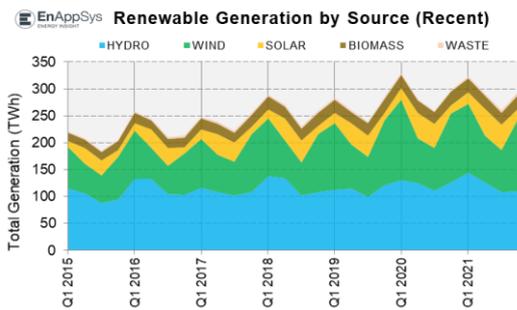
The following table sets out key statistics comparing the quarter with the same quarter in the previous six years:

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

	Q4 2016	Q4 2017	Q4 2018	Q4 2019	Q4 2020	Q4 2021
<b>TOTAL GENERATION BY FUEL (TWh)</b>						
Biomass	17.6	21.7	24.5	25.0	24.4	25.8
Coal/Lignite	173.0	165.9	160.8	122.1	115.3	132.4
Gas	140.7	134.3	135.3	151.5	143.7	152.5
Hydro	102.8	108.8	108.4	120.8	126.8	109.4
Nuclear	201.6	205.0	204.2	202.5	191.4	206.5
Oil	3.1	3.3	2.3	3.4	2.8	3.2
Peat	2.0	1.4	1.9	1.7	1.1	1.3
Solar	12.7	13.7	14.4	14.6	15.5	18.8
Waste	3.0	3.6	4.1	4.0	3.5	4.2
Wind	76.6	107.4	107.7	120.3	127.6	135.0
<b>FOSSIL FUELS</b>	<b>318.8</b>	<b>304.9</b>	<b>300.3</b>	<b>278.6</b>	<b>263.0</b>	<b>289.4</b>
<b>NUCLEAR</b>	<b>201.6</b>	<b>205.0</b>	<b>204.2</b>	<b>202.5</b>	<b>191.4</b>	<b>206.5</b>
<b>RENEWABLE (INCLUDES WASTE)</b>	<b>212.6</b>	<b>255.2</b>	<b>259.1</b>	<b>284.7</b>	<b>297.8</b>	<b>293.2</b>
<b>TOTAL</b>	<b>733.0</b>	<b>765.1</b>	<b>763.6</b>	<b>765.8</b>	<b>752.2</b>	<b>789.0</b>
Fossil Fuel Percentage	43%	40%	39%	36%	35%	37%
Clean Percentage	57%	60%	61%	64%	65%	63%
Renewable Share of Clean Power	51%	55%	56%	58%	61%	59%
<b>CHANGE SINCE Q3 2016 (%)</b>						
Biomass		23%	39%	42%	39%	47%
Coal/Lignite		-4%	-7%	-29%	-33%	-23%
Gas		-5%	-4%	8%	2%	8%
Hydro		6%	5%	18%	23%	6%
Nuclear		2%	1%	0%	-5%	2%
Oil		8%	-24%	12%	-8%	6%
Peat		-32%	-8%	-19%	-46%	-38%
Solar		8%	14%	15%	22%	48%
Waste		21%	36%	33%	16%	41%
Wind		40%	41%	57%	67%	76%
<b>FOSSIL FUELS</b>		<b>-4%</b>	<b>-6%</b>	<b>-13%</b>	<b>-18%</b>	<b>-9%</b>
<b>NUCLEAR</b>		<b>2%</b>	<b>1%</b>	<b>0%</b>	<b>-5%</b>	<b>2%</b>
<b>RENEWABLE (INCLUDES WASTE)</b>		<b>20%</b>	<b>22%</b>	<b>34%</b>	<b>40%</b>	<b>38%</b>

## 4 Renewables

Across Europe as a whole, Q4 2021 saw 293.2TWh of power production from renewable sources (including biomass and waste), amounting to 37.2% of total European electricity generation. This is a decrease of 13% from the 260.0TWh in Q3 2021, despite the significant decrease of 60% in solar generation with the arrival of the winter. On the other hand, **compared to Q4 of 2020, all the renewable generation types, except hydro (-14%) had an increase in generation in this quarter.** There were several countries with a significant drop in hydro generation with the dry autumn and start of the winter.



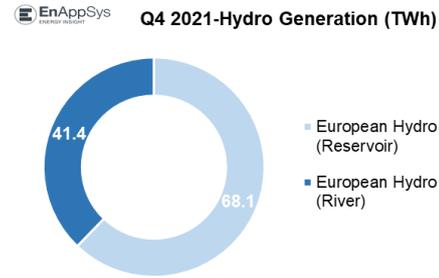
generation saw renewable contribution levels of 6.4% in a fourth quarter (18.8TWh), up from 5.2% (15.5TWh) in Q4 2020.

Wind generation became not only the largest renewable generation type this quarter, but also the third largest generation type overall with the increase of 74% from Q3 of 2021, which had particularly low yield in terms of wind availability. Wind generation constituted 46% of the renewable generation, which was followed by hydro generation with 37.3%. Thanks to large capacity development across Europe, solar

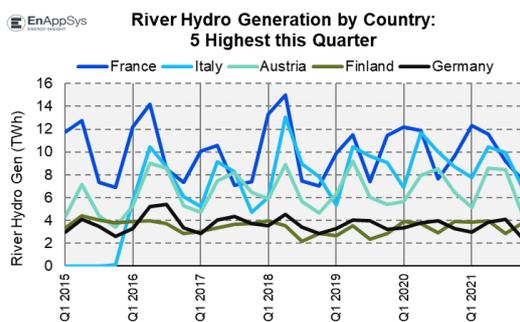
### 4.1 Hydro

Although Europe started the year with very high hydro generation levels, they fell below 2020 levels in Q3 and Q4. The relatively dry weather in Q4 this year across the continent brought the lowest generation increase from third the fourth quarter (+1%) this year, whereas this value was +14.3% in 2020 and +21.3% in 2019.

Hydro (reservoir + river) generation was limited to 109.4TWh which corresponds to a 14% drop compared to Q4 of 2020 and a 9% drop compared to Q4 of 2019. This quarter Norway (the largest hydro generator of Europe with a 34% average contribution to total European hydro generation) changed its reporting of the reservoir and river generation categories after the go-live of North-Sea-Link. This change in reporting led to extremely high levels reported for river generation, meanwhile dropping the reservoir generation levels. Although the sum of these categories is aligned with historical regional trends, the change in the individual categories introduced a bias not only at country level, but also on European level statistics.



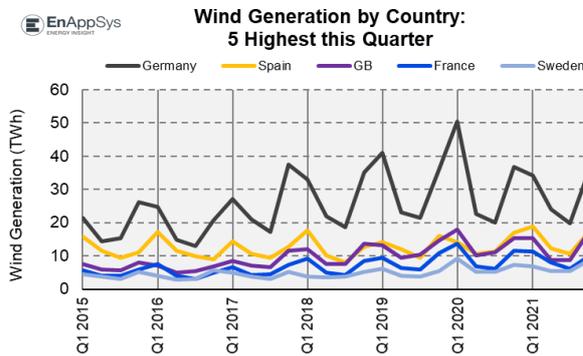
Despite the drop in the generation levels due to reporting reasons, Norway remains the largest reservoir generator with 31.0TWh generation, yet with a 3.9TWh decrease in comparison to Q4 of 2020. This also corresponds to 43.5% of the European reservoir generation drop from Q4 of 2021 to Q4 of 2020. Whereas Sweden remained in second place with 20.7TWh generation, with a large difference to the third largest generator Spain at 4.0TWh. Across Europe, there was a drop in reservoir generation, with France (-1.3TWh) and Spain (-2.2TWh) suffering from the largest drops compared to the previous fourth quarter.



France has taken the first place in river generation from Italy in the fourth quarter as usual. France generated 7.5TWh in Q4 with a major drop of 2.1TWh compared to the previous Q4, whereas Italy saw 1.8TWh drop in river generation. Portugal was another noticeable country with a drop in generation of over 55% from Q4 2020 to Q4 2021.

Norway (5.9TWh) appears in the top 5 of river generators taking the place of Austria with the new statistics this quarter, nevertheless these are subject to confirmation still, following the recent reclassification of some river and reservoir hydro sites.

## 4.2 Wind



This quarter wind generation reached unprecedented levels of 135.0TWh in a fourth quarter, maintaining the increasing trend started in Q4 of 2016. Wind generation increased drastically from the last quarter (+74%% in total) - given the underlying seasonal trend an increase would be expected between Q3 and Q4 yet in

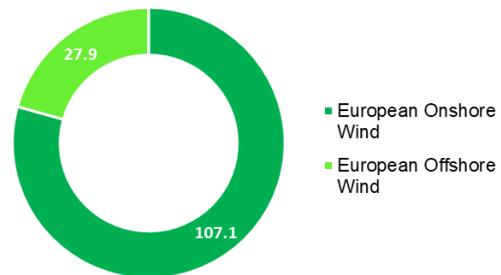
comparison to the previous Q3, the increase is 12% . The greater increase from Q3 and Q4 this year reflects low levels of wind during Q3 and also the rapid development of wind generation capacity across Europe.

Germany (35.6TWh) maintains the lead in wind generation, despite the drop of 1.1TWh in comparison to the Q4 of 2020. Second place is shared this quarter between GB (17.2TWh) and Spain (17.2TWh) with a considerable increase both from the onshore (+1TWh) and offshore (+0.9TWh) fleets of GB from the previous Q4. Swedish wind generation continues to increase with record levels of capacity development taking place since the beginning of 2021. This quarter wind generation (8.8TWh) met the 23.2% of the demand in Sweden.

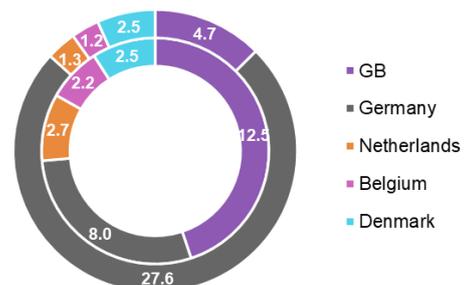
Germany and GB are the only countries with offshore fleets in the top 5 of wind (onshore + offshore) generators. This is to change with the commissioning of a series of offshore farms in France with the target of reaching over 12.4GW installed capacity by 2028 with ~1GW already in the connection phase.

Italy (6.2TWh) has seen a noticeable increase in wind generation as well, with 1.6TWh increase from Q4 of 2020. Nevertheless, it was still not enough to reach the record generation level of 7.1TWh reached in Q1 of 2019. France suffered the most from the drop (-1.6TWh) in the onshore generation this quarter, seeing ~14% drop in

**EnAppSys Q4 2021-Wind Generation (TWh)**



**EnAppSys Q4 2021 - Onshore (Outer Circle) & Offshore (Inner Circle) Generations (TWh)**



comparison to the Q4 of 2020. This brought Sweden closer to the fourth place in the largest wind generators in Europe.

This quarter brought several records for offshore generation as it increased by 12.3TWh from the last quarter and reached all time high of 27.9TWh. High levels of wind returned in Germany (+3.5TWh vs Q3 of 2021), whereas GB started benefitting from the generation of the newly commissioned farms. GB offshore generation saw the record level of 12.5TWh this quarter and constituted 44.8% of the European offshore generation. Netherlands saw an increase of 0.7TWh in offshore generation in comparison to Q4 of 2020, as a continuing impact of the Borssele wind farms. This also corresponds to 37% increase in Dutch offshore generation and brings the record total generation of 2.7TWh. Denmark has increased its offshore generation by 41% compared to Q4 of 2020 and for the first time reached levels above 2.5TWh.

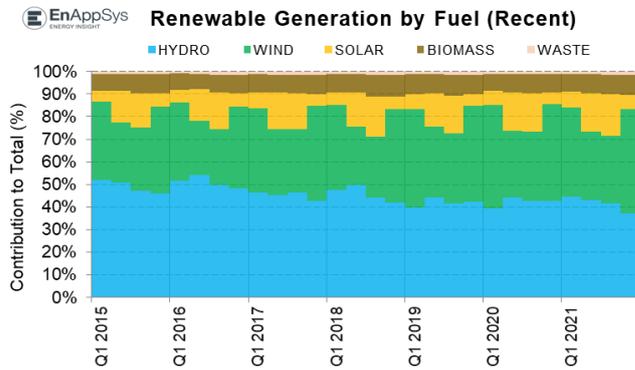
### 4.3 Solar

Solar generation reached a new record level of Q4 output in this Q4 with 18.8TWh. On the other hand, this also means a 60% drop from the abundant Q3 of 2021 given the underlying seasonal pattern in output. With the onset of winter, solar generation dropped below biomass-fired generation (25.8TWh) as usual in Q4s.

Germany remained the largest solar generator with 5.1TWh total generation and showed a 15.9% increase from the previous Q4. With a small difference, Spain (4.6TWh) came in second, despite the large difference between the installed capacities. The expansion of the Spanish fleet by 2.9GW brought a 22% increase in generation.

Italy remained in third place with 2.8TWh generation and was one of the very few countries whose solar generation levels lowered in comparison to the same quarter last year. Netherlands saw the largest relative improvement with 92% higher generation levels in comparison to the Q4 of 2020. Nevertheless, the contribution of the Netherlands to total solar generation remained only at 0.03TWh, with the shorter day-time durations and unfavourable weather conditions.

## 4.4 Biomass and Waste



subsidies.

Biomass output slightly exceeded the historic 20-25TWh range and recorded a 6% increase from previous Q3. Waste generation significantly increased by 21% compared to Q4 last year and broke a generation record again with 4.2TWh this quarter as well. Biomass and waste generators saw more utilisation this quarter with high market prices and

## Statistics

The following table sets out key statistics by quarter:

*Table 3 Quarterly renewable generation statistics Q4 2019 to Q4 2021 (TWh and %)*

	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021
<b>TOTAL GENERATION BY FUEL (TWh)</b>									
Biomass	25.0	24.5	23.5	21.9	24.4	25.6	24.6	22.4	25.8
Hydro	120.8	130.1	124.6	111.0	126.8	144.4	125.9	108.3	109.4
Solar	14.6	21.3	47.3	43.9	15.5	21.8	49.7	47.5	18.8
Waste	4.0	3.8	3.0	3.2	3.5	3.7	3.6	4.1	4.2
Wind	120.3	150.2	83.0	79.5	127.6	128.1	87.7	77.7	135.0
<b>TOTAL</b>	<b>284.7</b>	<b>329.8</b>	<b>281.5</b>	<b>259.5</b>	<b>297.8</b>	<b>323.5</b>	<b>291.4</b>	<b>260.0</b>	<b>293.2</b>
Primary Renewable Source	HYDRO	WIND	HYDRO	HYDRO	WIND	HYDRO	HYDRO	HYDRO	WIND
<b>SHARE OF RENEWABLES (%)</b>									
Biomass	8.8%	7.4%	8.4%	8.4%	8.2%	7.9%	8.4%	8.6%	8.8%
Hydro	42.4%	39.4%	44.3%	42.8%	42.6%	44.6%	43.2%	41.6%	37.3%
Solar	5.1%	6.5%	16.8%	16.9%	5.2%	6.8%	17.0%	18.3%	6.4%
Waste	1.4%	1.1%	1.1%	1.2%	1.2%	1.1%	1.2%	1.6%	1.4%
Wind	42.3%	45.5%	29.5%	30.6%	42.9%	39.6%	30.1%	29.9%	46.0%

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

*Table 4 Year-on-year comparison of Q4 renewable generation TWh*

	Q4 2016	Q4 2017	Q4 2018	Q4 2019	Q4 2020	Q4 2021
<b>TOTAL GENERATION BY FUEL (TWh)</b>						
Biomass	17.6	21.7	24.5	25.0	24.4	25.8
Hydro	102.8	108.8	108.4	120.8	126.8	109.4
Solar	12.7	13.7	14.4	14.6	15.5	18.8
Waste	3.0	3.6	4.1	4.0	3.5	4.2
Wind	76.6	107.4	107.7	120.3	127.6	135.0
<b>TOTAL</b>	<b>212.6</b>	<b>255.2</b>	<b>259.1</b>	<b>284.7</b>	<b>297.8</b>	<b>293.2</b>
Primary Renewable Source	HYDRO	HYDRO	HYDRO	HYDRO	WIND	WIND
<b>CHANGE SINCE Q4 2016 (%)</b>						
Biomass		23%	39%	42%	39%	47%
Hydro		6%	5%	18%	23%	6%
Solar		8%	14%	15%	22%	48%
Waste		21%	36%	33%	16%	41%
Wind		40%	41%	57%	67%	76%

## 5 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 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	

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