RYSTAD ENERGY

POWER MARKET TRENDS REPORT

CONDENSED VERSION

February 2022

CAN EUROPEAN POWER COPE WITH A DISRUPTION IN RUSSIAN GAS SUPPLY?

Could coal and wind save the day in Europe?

Market review – Europe

- January 2022 was the month when power prices finally fell across Europe, from all-time highs in December 2021. Nonetheless, prices continued to stay at a very high level, driven by elevated coal, gas and carbon prices. Increased wind power, warmer-than-normal weather and higher nuclear generation availability eased the pressure slightly.
- Coal remained the cheaper source of generation compared to gas in January, despite carbon prices approaching €90 (US$103) per tonne. The gas market continued to be extremely nervous in January, with tensions between Russia and Ukraine and the potential impact on Russian gas supply to Europe the main focus.

Market review – US

- High power demand met with increased fossil fuel generation. Generation from natural gas in January was 138 terawatt-hour (TWh), an all-time high for the month.
- The Northeast US was hit by a particularly cold January, paired with natural gas delivery constraints. With limited natural gas supply, the region was forced to use fuel oil or dormant coal plants to meet domestic demand.
- Regions across the US are experiencing significantly different power spreads. In Texas, coal was substantially more competitive with the dark spread earning an average $11.64 per megawatt-hour (MWh) in January compared to $7.38 per MWh in December while gas (spark spread) earned an average $3.60 and $3.49 per MWh in January and December respectively.
- The US has continued to increase emissions from the power sector over the last two years.

Market review – Japan

- Japan’s electricity demand in January was in line with the trend seen in last three months, rising more than 8% compared to December to average almost 117 gigawatts (GW).
- Unplanned outages across Japan's thermal generation units and weaker solar output sent power prices higher in January.
- Tighter power fundamentals and continued high LNG prices lifted the Japan Electric Power Exchange’s (JEPX) average system price to $245/MWh between 15-21 January, up 33.9% from a week earlier.

Market review – India

- January's increase in demand was limited by a third Covid-19 wave. Electricity demand in January 2021 totaled 110.32 TWh, some 4.5% higher than the 105.55 TWh seen in January 2020
- Restrictions due to rising cases of Covid-19 caused the market clearing price (MCP) to lose around 4.5% in January 2022, falling to $45.42/MWh from $47.55/MWh in December 2021.

In focus: Russia-Ukraine tensions

- Russian natural gas supplies to Europe are at their lowest level in seven years and this has caused gas prices to reach historic highs, severely impacting the power market.
- A potential gas supply disruption from Russia could impact more than 50 billion cubic meters (Bcm) of pipeline supplies. The power sector is the most flexible source of gas demand, meaning that if supplies drop gas-fired generation will need to decline.
- Looking at the region’s total installed capacity in 2022 and the maximum capacity factors for each generation source, the electric system has the potential to add around 152 TWh of additional supply in 2022.
- Higher coal generation would be required while new wind capacity will add new supplies. Issues with nuclear and hydro power across the region limit the flexibility of the system. Bio and liquid power generation could also help replace gas power supply.

Policy update

- Gas and nuclear have been labeled as green energy sources under the EU taxonomy.

Pressure eases in European power markets, but not by much

January 2022 was the month when power prices finally fell across Europe, from all-time highs in December 2021. Nonetheless, prices continued to stay at a very high level, driven by elevated coal, gas and carbon prices. Increased wind power, warmer-than-normal weather and higher nuclear generation availability eased the pressure slightly.

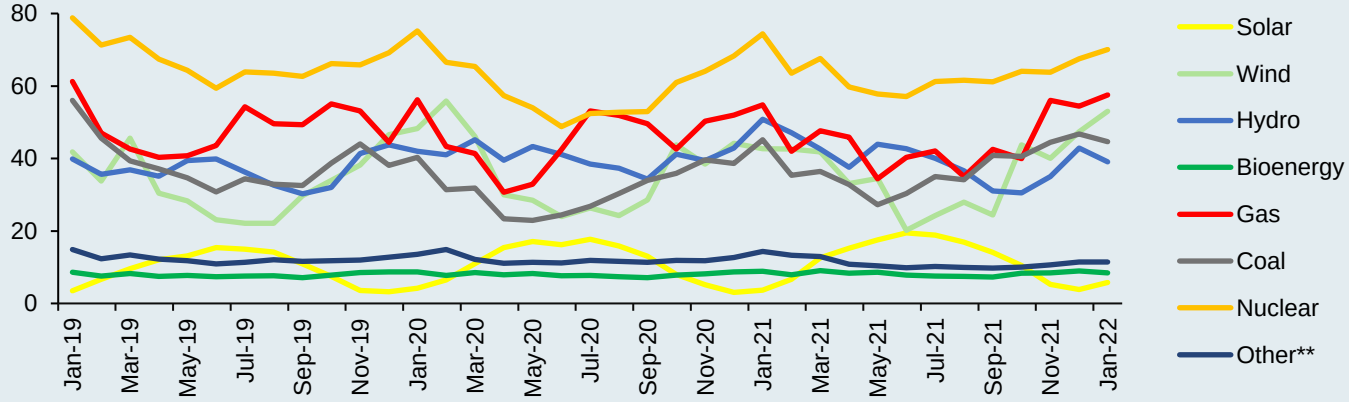
The greatest change in generation balance from last month was in wind power, with the beginning and end of January experiencing very high wind output across Europe. The balance between gas and coal was also altered, with gas increasing and coal decreasing, despite coal still being cheaper on average as a power generation source. However, the gap was reduced with coal prices rising over the month but gas prices remaining largely stable. Nuclear output also rose, which also helped reduce power prices. However, compared to previous years, nuclear generation has not been this low in Europe for many years. The major contributor to this is Germany's nuclear phaseout, where only three reactors are now in operation. Hydropower saw a strong reduction in output compared to last month, one reason being the fact that Europe's largest hydro generator Norway produced less output than normal, due to less demand on warmer weather and low reservoirs levels. The last major factor was reduced power demand compared to January last year, with a 1.6% year-on-year reduction.

Looking ahead, the market expects electricity prices to stay high for the rest of the European winter, although at slightly lower levels than seen in January. The contracts for full year 2022 are now priced evenly and are expected to stay high, including in the summer months on lower demand. The main reason for this is that the gas market is expected to stay tight for the duration of 2022, as reflected in the European gas forward curves, as well as new records in carbon prices and continued high coal prices well above $100 per tonne.

Uncertainties and price drivers for the rest of the winter will be weather, wind power output and the Russian gas supply situation.

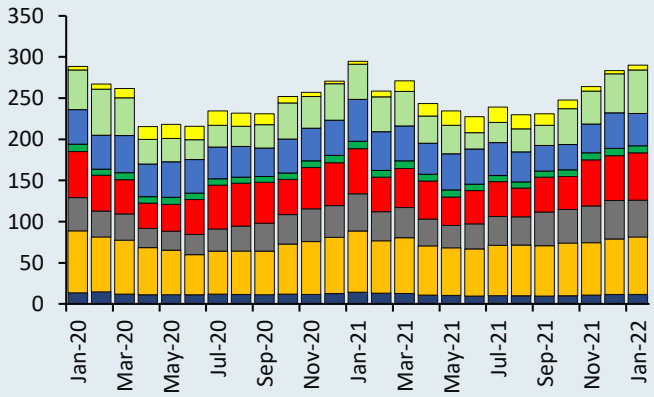
Europe monthly power generation*

Terawatt-hours (TWh)



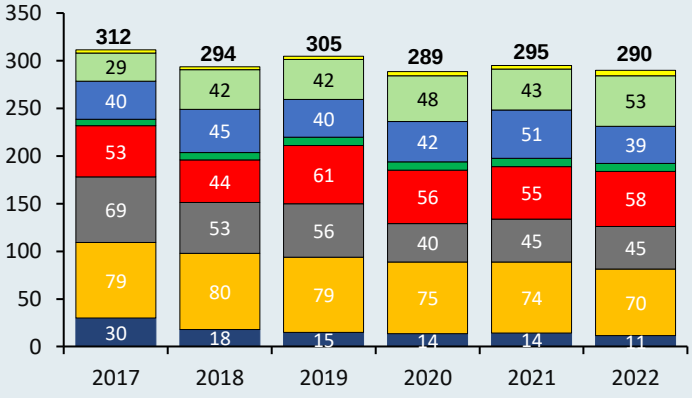
Europe monthly power generation*

Terawatt-hours (TWh)



Europe January power generation*

Terawatt-hours (TWh)



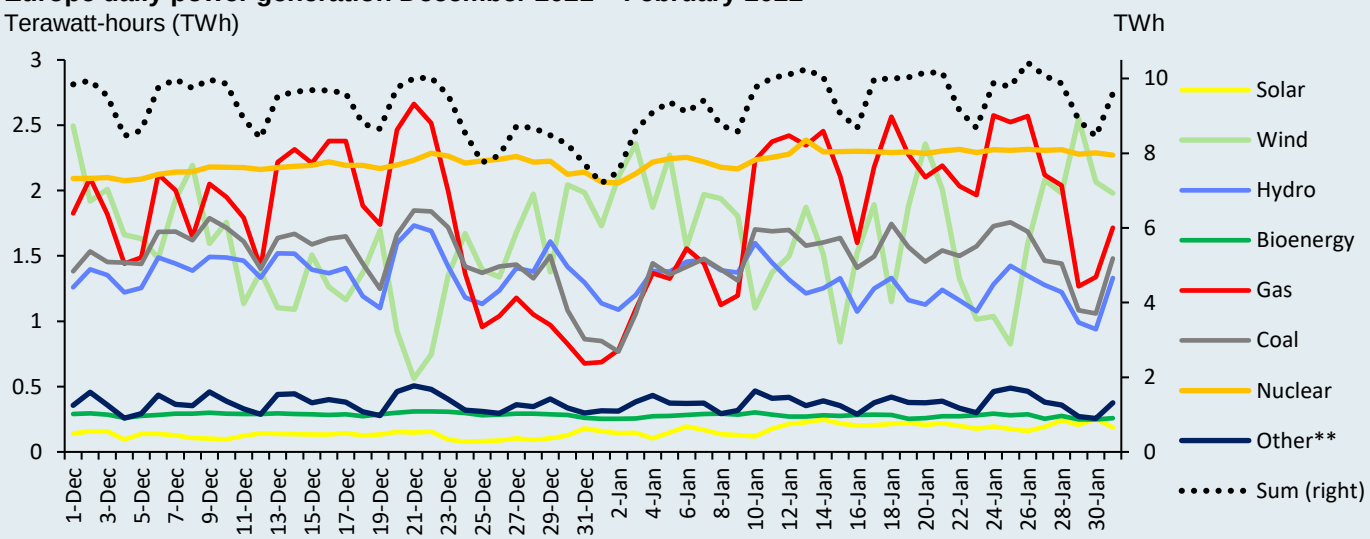
*Europe includes EU-27 plus the United Kingdom, Norway, Serbia and Switzerland. **Includes geothermal, liquids, marine/tidal, other renewable and other non-renewables. Sources: Rystad Energy research and analysis, ENTSO-E

Large wind variations remains one of the main drivers for prices

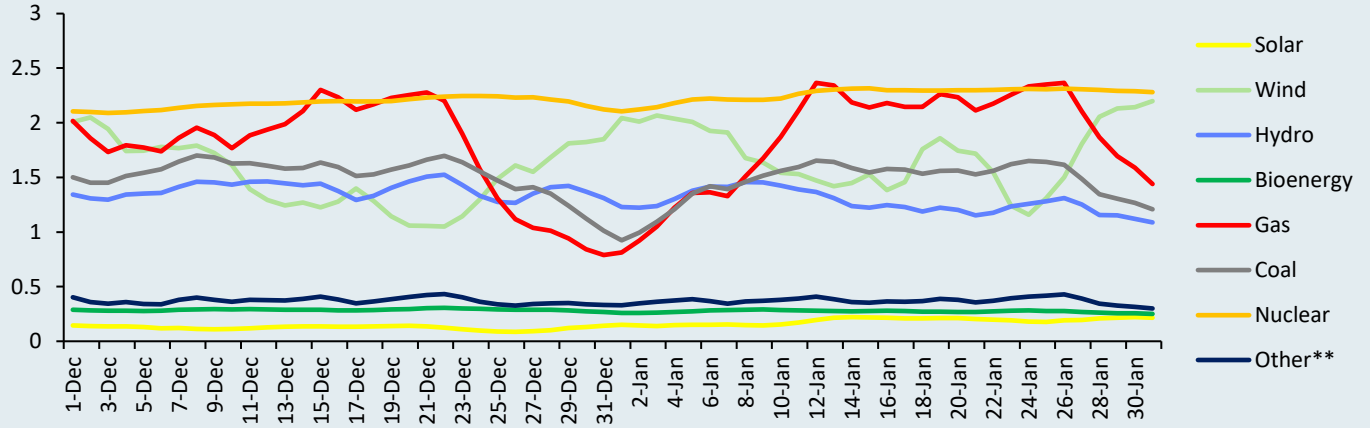
The last week of December 2021 typically has a noticeable dip in power demand, mainly due to lower industrial and commercial activity as seen in the daily generation chart below. Mostly gas and coal generation was reduced in this period. Going into January 2022, strong wind speeds across Europe resulted in high wind power production, leading to continued low gas and coal generation output for the first week.

When wind output fell later in January, gas again served the main flexible source, surpassing nuclear as the largest source for several days in the month. The final days of January saw wind output again reach very high levels, resulting in lower power prices in most major markets, as it pushes the cost of generation down. Periods of January also had warmer-than-normal weather, easing pressure in the power market. Compared to December 2020, solar power also increased noticeably, but stayed low compared to other sources.

Europe daily power generation December 2021 – February 2022*



Europe power generation, five days floating average*



*Europe includes EU-27 plus the United Kingdom, Norway, Serbia and Switzerland. **Includes geothermal, liquids, marine/tidal, other renewable and other non-renewables. Sources: Rystad Energy research and analysis, ENTSO-E, Refinitiv Eikon, Bloomberg

Power prices finally slide in all major markets

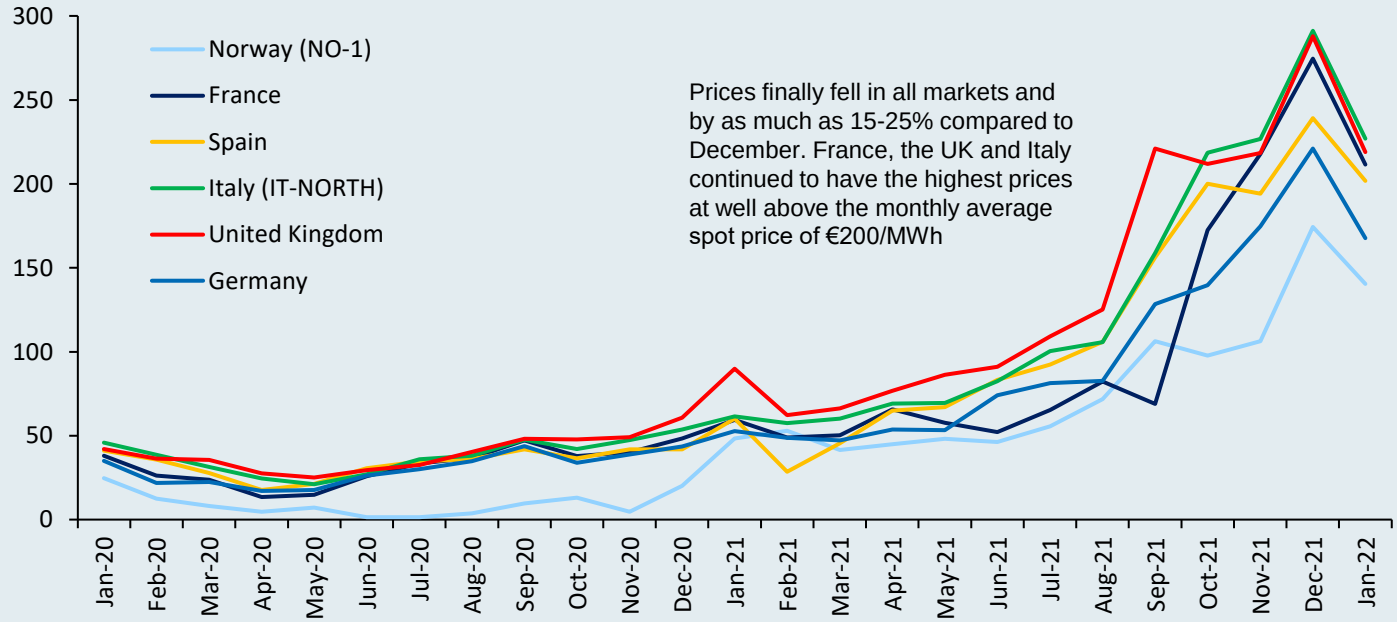
Most European power prices have been on a rising trend every month since early 2021. The trend was finally broken in January due to a combination of factors, the first one being a reduction in gas prices compared to December. However, as discussed in more detail in this report, both coal and gas prices stayed high. The two other major factors for power price reductions were milder-than-normal temperatures at times in January, and a comeback in wind power as described earlier. Nuclear generation also increased slightly compared to December, mainly due to the higher availability of French reactors.

As in December, Italy, the UK and France were the priciest power markets, with very little difference in price. Italy had the highest monthly average price at €226 (US$258) per megawatt-hour (MWh), a similar level to November 2021.The UK had the largest overall reduction in prices compared to December, with a drop of €69/MWh or 32%. This is more than double the percentage-wise reduction seen in the Spanish market, which only fell by €37/MWh or 16%. One reason for this is increased wind power output in the UK compared to Spain.

The spread between French and German prices remained relatively unchanged, mainly due to a continued tight power situation in France. The Nordic region remained the lowest-priced power market, illustrated by the south-east Norwegian price zone NO-1 in the chart below, which still has substantially lower prices than the rest of the continent. The reasons are the same as before in that the Nordic power market is less exposed to gas and coal prices, which continue to stay at very high levels and are the main price driver in most European countries.

Significant variability in wind power continued to be the main driver for high day-to-day variation in power prices in many markets. Low prices were seen in north-west Europe very early and very late in the month, coinciding with high wind power output. For several days in the beginning of December, continental power prices were lower than Nordic prices, which does not happen often.

Monthly average spot price in selected European markets
Euros per megawatt-hour (MWh)



Sources: Rystad Energy research and analysis, EPEX, Nord Pool

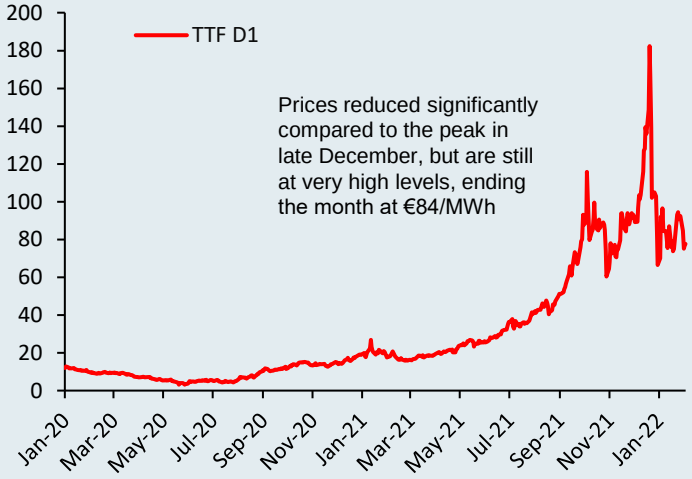
Gas still uncompetitive as fuel, but gap is closing

The gas market continued to be extremely nervous in January, with tensions between Russia and Ukraine and the potential impact on Russian gas supply to Europe the main focus. Volatility remained high but overall, prices stayed similar at the beginning and end of the month. Russian supply had improved slightly by the end of the month, easing the pressure. Prices are still at record highs with the forward curve now suggesting high prices for all of 2022 above €70 per MWh. Longer term, there is still a strong contango in the gas curve as the market expects the supply situation to improve in 2023 and 2024.

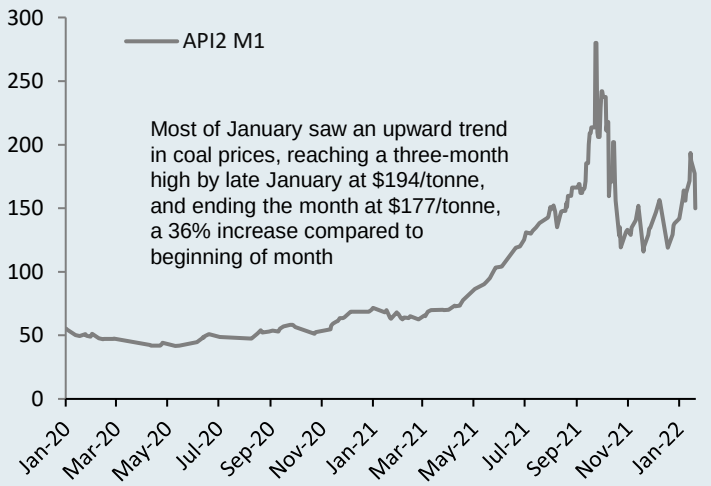
In the coal market, we saw a large price increase with the API2 front-month contract ending the month at $177 per tonne, a 36% increase compared to the beginning of January. One reason for this was strong demand for coal in Asia which pushed European coal prices upwards. This naturally affected the futures markets, where prices for contracts with delivery for the coming month are much higher than before. A strong contango is seen in the European coal market in 2022, before long-term contracts stabilize around $100 per tonne.

Considering current pricing for 2024 contracts and a carbon price of $100 per tonne, natural gas is likely to be a much cheaper power generation source than coal with average power plant efficiencies. Also, as illustrated in the chart, it is clear that the contango in gas prices is much steeper than for coal.

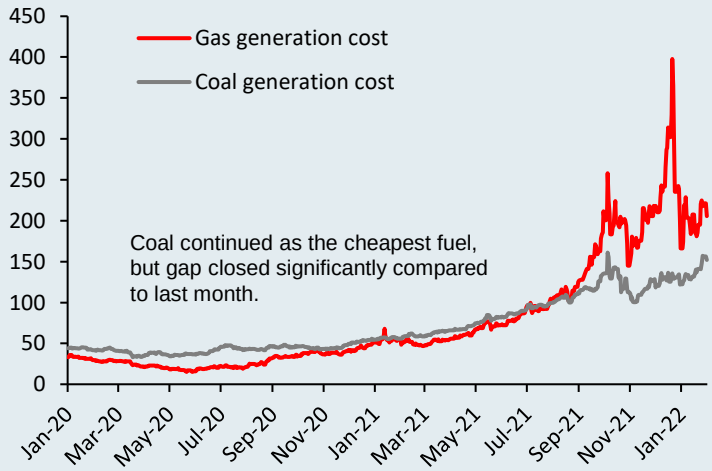
European gas price (TTF day ahead)*
Euros per megawatt-hour (MWh)



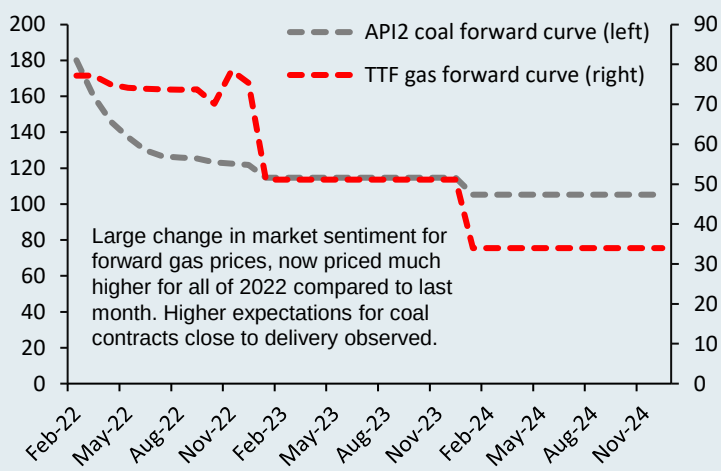
European coal price (API2 front month)
USD per tonne



European power generation costs gas and coal
Euro per megawatt-hour (MWh)



Coal (left) and gas (right) forward curves
USD per tonne Euro/MWh



*TTF: Title Transfer Facility
Source: Rystad Energy research and analysis; Bloomberg; Refinitiv Eikon

Carbon prices are again approaching €90, with new records being set in the futures market

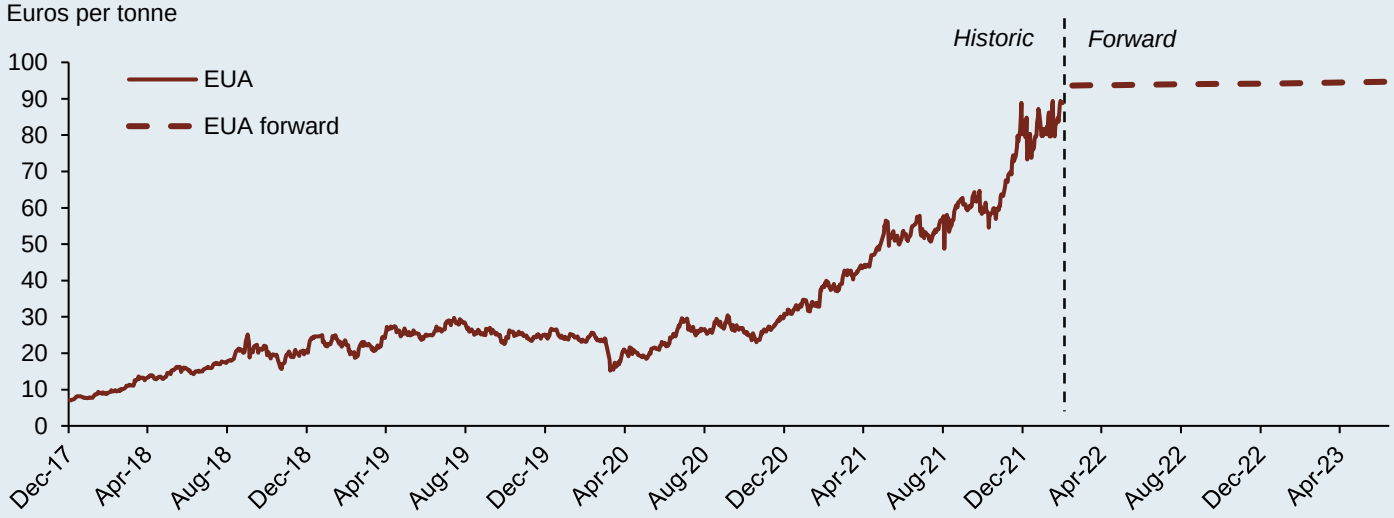
2021 was a remarkable year in the European carbon market with prices continuing to stay at record levels and approaching new all-time highs by month-end. The driver was continued high demand for European Union Allowances (EUAs) as gas generation increased and coal generation only fell moderately. In addition, the futures markets is also now priced at record high levels above €90 for all contracts, both short and long term.

Power sector emissions fell slightly in January compared to December, even though total non-renewable thermal generation increased as reduced coal generation outweighed the increase in gas generation in terms of emissions. However, emissions are still at a very high level with three-month averages at a two-year high.

Looking ahead, emissions will depend on weather, nuclear availability and the balance between coal and gas market prices.

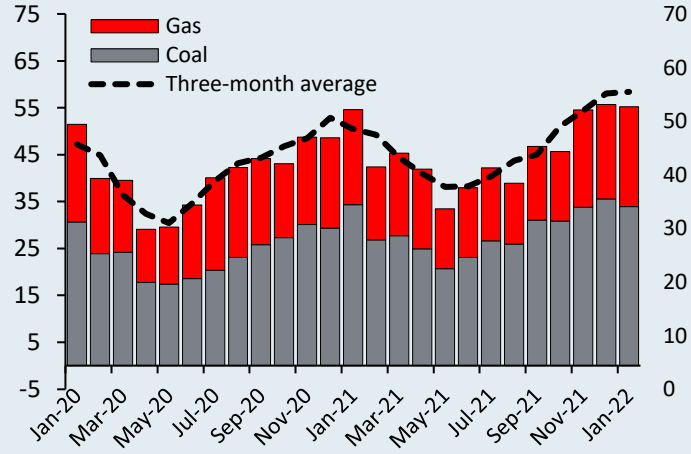
European Union Allowance (EUA) price – EU Emission Trading System

Euros per tonne



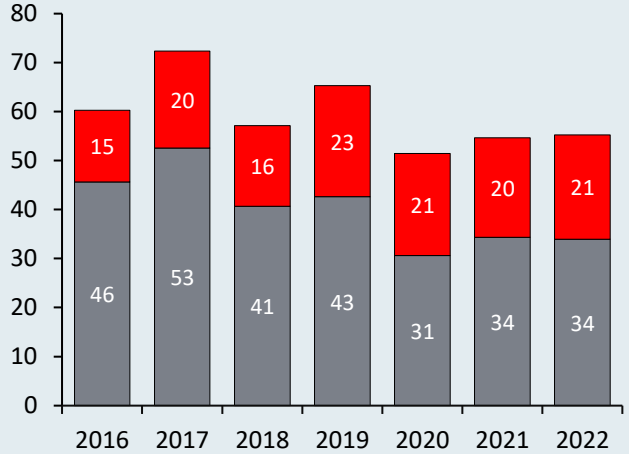
Europe monthly power sector emissions*

Million tonnes of CO_2 equivalent (Mt CO_2e)



Europe January power sector emissions*

Million tonnes of CO_2 equivalent (Mt CO_2e)



*Europe includes EU-27 plus UK, Norway, Serbia and Switzerland. Average emission factors are used. Only direct emissions from coal and gas are included. Sources: Rystad Energy research and analysis, Bloomberg, European Commission

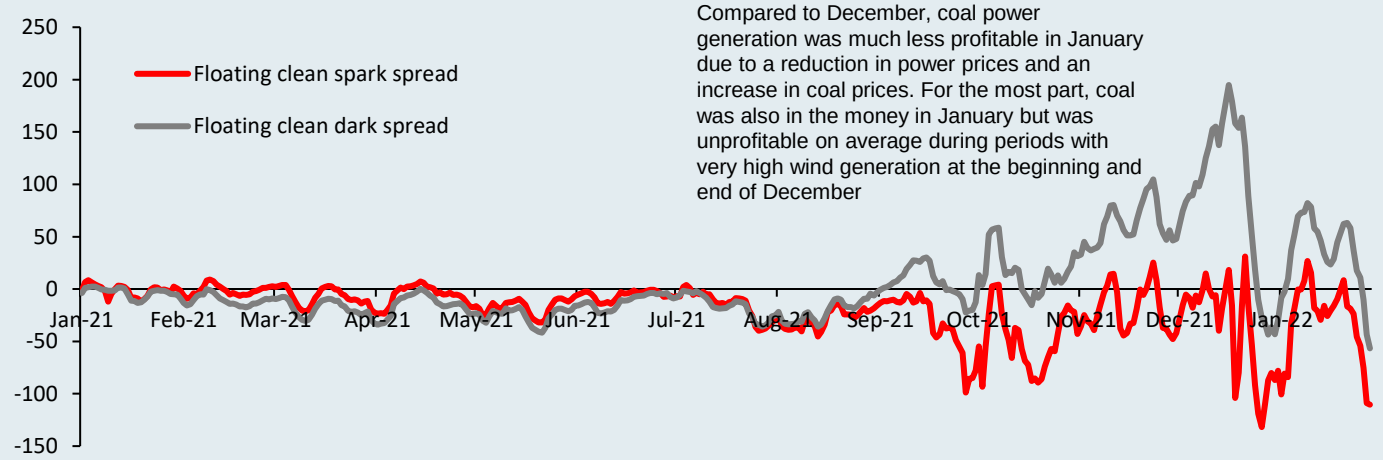
Coal stays in the money, but advantage reduced

As shown earlier, coal remained the cheaper source of generation compared to gas in January, even with the very high carbon prices. The period with low demand and high wind power generation in the last week of December can clearly be seen in the chart, as well as the period at the end of the month which was again due to very high wind power levels.

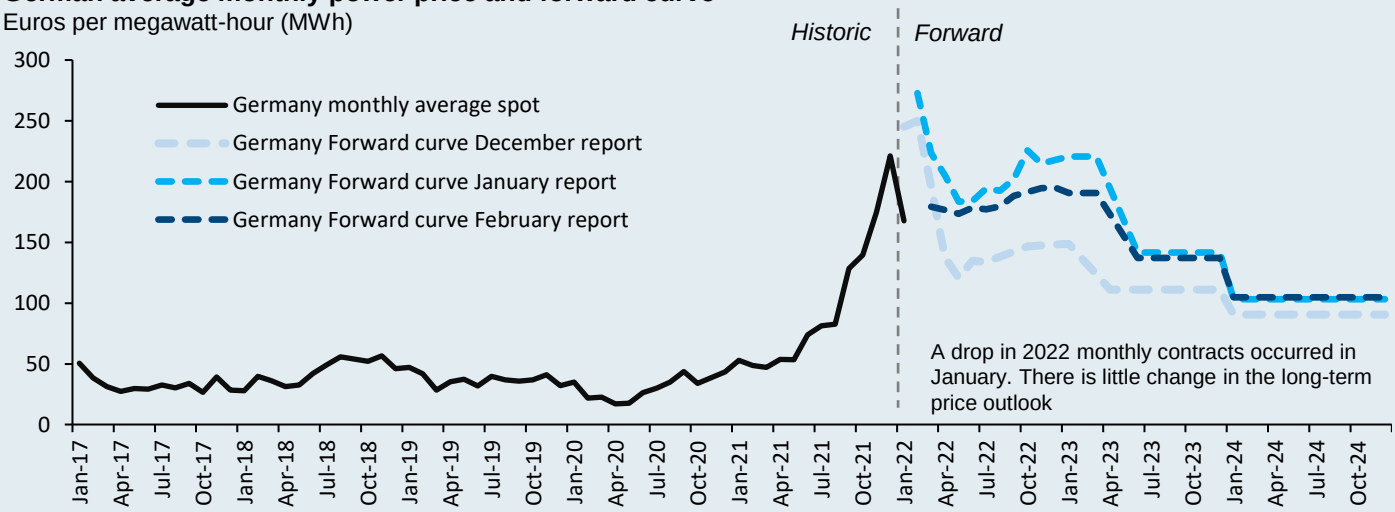
When it comes to the futures market, the trend of increasing prices for 2022 contracts was broken, with contracts now trading at lower levels than in the beginning of January. However, prices are still at very high levels with monthly contracts now trading in the range of €170- €190 for all months of the year. This is very much connected to gas market pricing, which is also now at a high level for the whole year. Ongoing high prices for the whole year will continue to impact consumers and extend Europe's energy crisis.

Long term contracts show little volatility and are priced much lower than short-term contracts, a factor that is connected to the expectation that gas will ultimately be cheaper in the future.

European power spreads*
Euro per megawatt-hour (MWh)



German average monthly power price and forward curve
Euros per megawatt-hour (MWh)



*Spark and dark spreads are calculated with Title Transfer Facility (TTF) day-ahead (D1) and API2 month-ahead (M1) fuel prices, EUA spot prices for carbon and seven-day floating average for German spot prices. This way of calculating dark and spark spread is for illustrative purposes only and does not represent actual profitability of coal and gas power generation. Sources: Rystad Energy research and analysis, Refinitiv Eikon, Bloomberg

Tensions between Russia and Ukraine disrupt gas and power markets

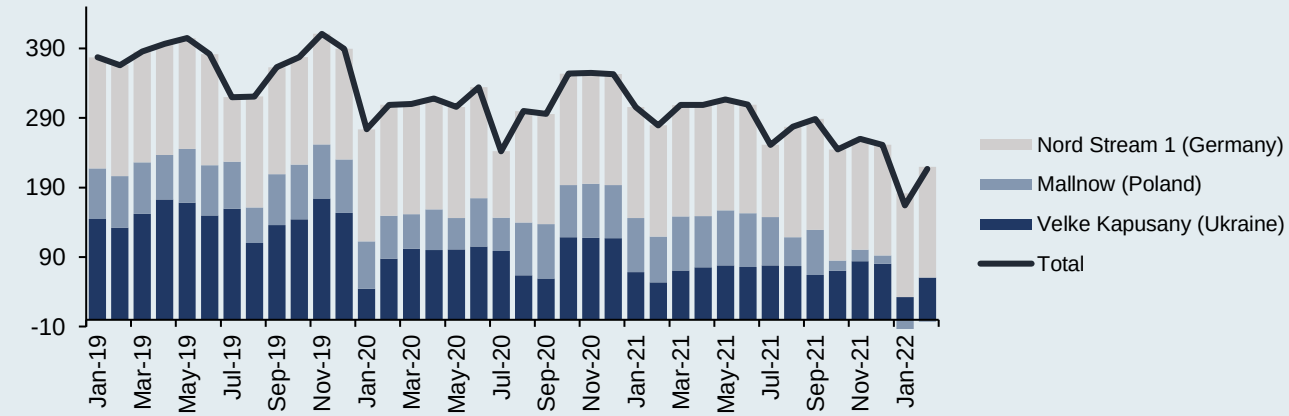
Russian natural gas supplies to Europe are at their lowest level in seven years and this has caused gas prices to reach historic highs, severely impacting the power market. As seen in the chart, flows from Russia to Western Europe have been on a declining trend since the start of 2020 with exports falling from a daily average flow rate of 410 million cubic meters per day (MMcmd) in November 2019 to under 200 MMcmd in January 2022. The decline has been driven mostly by lower exports to Western Europe through Ukraine and a sharp drop in deliveries to Poland. Gazprom has continued to honor long-term contracts with European buyers meaning the decline could be the result of lower nominations from buyers, Gazprom delivering lower spot volumes to the market or a combination of both.

Rising tensions at the Russia-Ukraine border has kept the market in suspense with players speculating the risk of a complete halt to gas flows through Ukraine in the event of military conflict. This would reduce total gas flows further to closer to 160 MMcmd, assuming direct deliveries to Germany through Nord Stream 1 and other export routes to South Europe remain untouched, putting at risk a total of 52 Bcm of gas supplies in 2022.

Such an event represents a large upside risk to gas prices and would have severe implications for the power market. Even though Rystad Energy does not see this as the base case scenario, it is important to understand if there are any alternatives for the European power sector to adapt to a potential shortfall in gas supplies this year to avoid power outages.

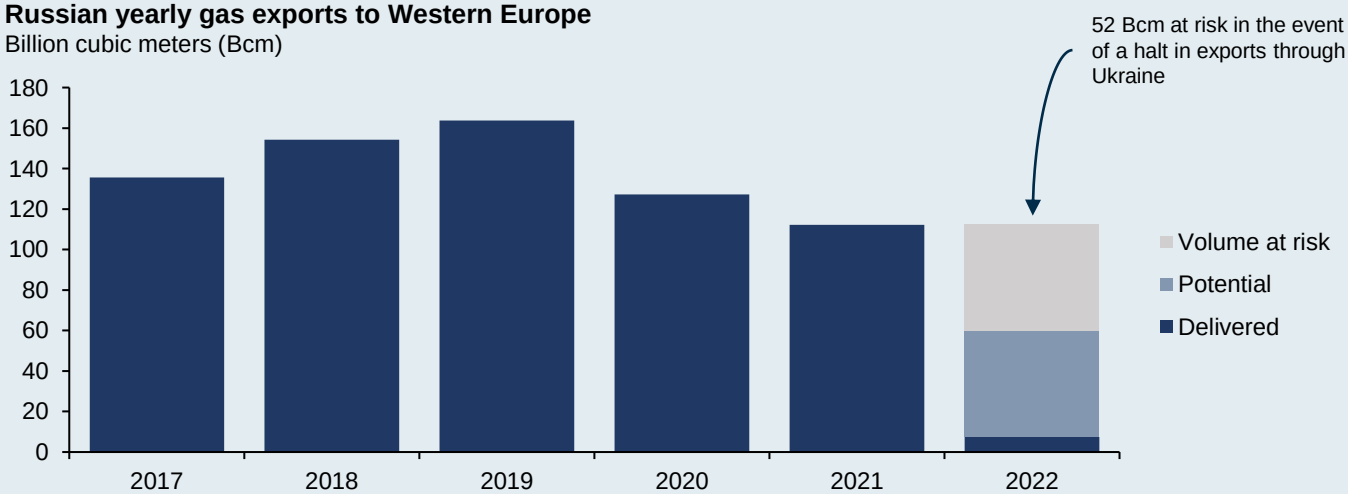
Russian monthly average gas exports to Western Europe

Million cubic meters per day (MMcmd)



Russian yearly gas exports to Western Europe

Billion cubic meters (Bcm)



Source: Rystad Energy research and analysis, Eikon

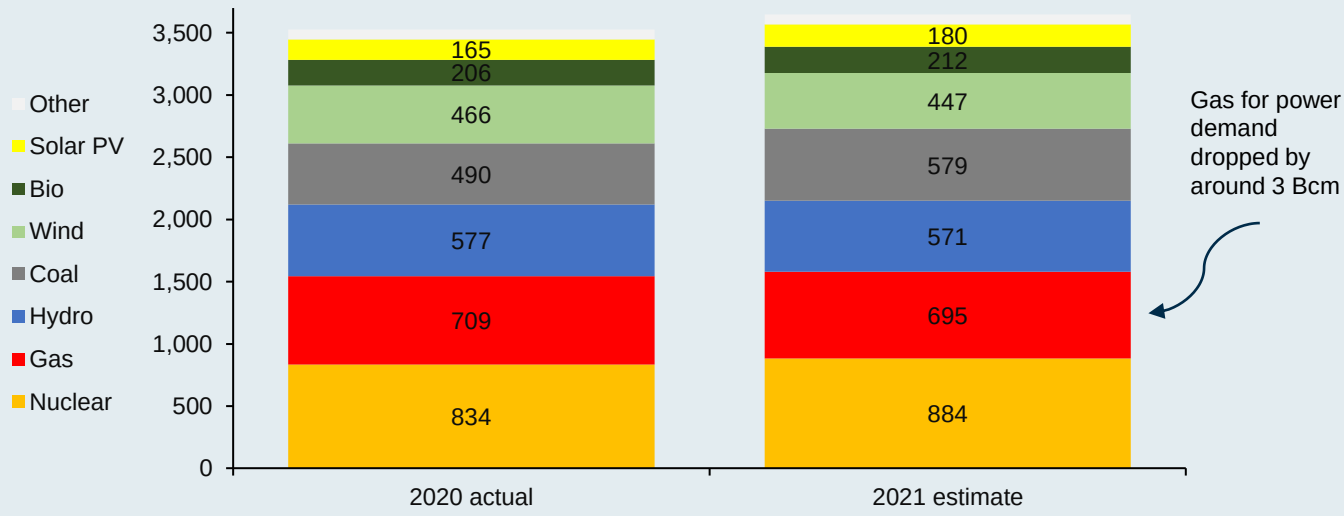
Coal generation had the largest increase in 2021 but gas remained resilient

Despite the power sector being one of the largest sources of gas demand in Europe, consumption fell slightly in 2021 due to very high prices. Preliminary numbers show that power generation in the region totaled around 3,650 TWh in 2021, an increase of 3.4% on 2020 as the region gradually emerged from the worst period of the pandemic. Despite higher electricity demand, gas-fired generation fell from 709 TWh in 2020 to 695 TWh in 2021 (-2%) as historically high gas prices made the fuel uncompetitive in power generation, leading to substantial gas-to-coal switching. By contrast, coal-fired generation increased by 18% making it the fourth-largest source of supply.

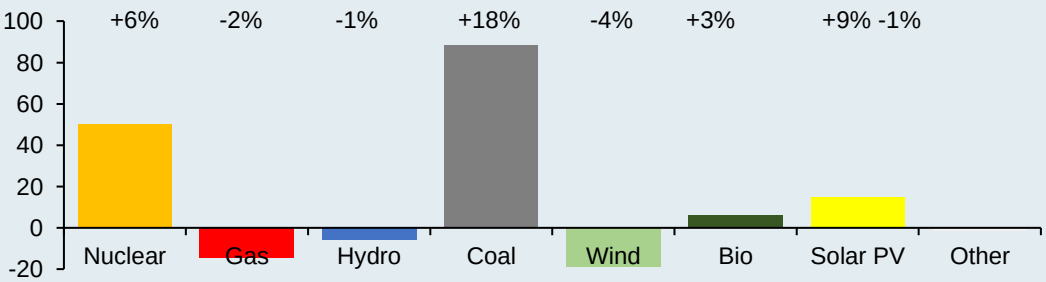
As a result of lower gas-fired power generation, gas demand from this sector is estimated to have dropped from 147 Bcm in 2020 to 144 Bcm in 2021, a modest decline considering that gas prices reached €182/MWh in December, a year-on-year increase of 900%. Gas' resilience was partly driven by low hydro dam levels and lower wind speeds throughout the year which led to a decline in generation from these sources. As a result, gas power was required to fill the gap that was not able to be met by coal as European coal generation capacity has declined substantially in recent years.

The power sector is the most flexible source of gas demand meaning that if supplies drop by around 50 Bcm it is likely to result in a further reduction in gas-fired generation. But does the power sector have the capacity for such a shock in supplies?

European power generation by source 2020, 2021
Terawatt-hours (TWh)



Change in power generation 2020 vs 2021
Terawatt-hours (TWh)



Source: Rystad Energy Power Solutions, Entsoe

Alternative sources to gas power could add up to 152 TWh of additional supply

As explained in our recent commentary, Europe has few alternatives to replace Russian supplies as LNG regasification terminals are already being used at close to capacity and domestic production is maxed out. This means that if a supply disruption materializes, demand will need to adjust downwards with the power sector having the most flexibility to adapt. In 2021, coal generation provided most of the flexibility by adding 88 TWh of supply across Europe, while nuclear power added 50 TWh.

Looking at the region's total installed capacity in 2022 and the maximum capacity factors (or load factors) for each generation source, the electric system has the potential to add around 152 TWh of additional supply in 2022. Last year, coal plants were used at an average load factor of 44% compared to the historical maximum of 55%. If utilities were to increase the use of coal plants to their maximum, this source alone could add 63 TWh of electricity supply even though installed capacity is expected to drop due to the continued shutdown of capacity as a result of environmental policies.

During 2021, wind power generation was relatively low due to low wind speeds in north-western Europe. If wind speeds normalize this year and with installed capacity expected to reach 243 GW (+20 GW), generation from this source could add up to 22 TWh of new supply. Similarly, a growth in installed solar PV capacity of 19 GW has the potential to add 11 TWh of new supply. Liquids and bioenergy plants could add an additional 77 TWh. With European gas prices currently trading above $27/MMBtu (€80/MWh) and Brent at $90 per barrel (bbl), more gas-to-liquids switching is economically viable. While these sources have the potential to add more supply, nuclear and hydro have a limited upside in generation.

European power generation by source 2021 and maximum potential for 2022

	2021			2022			
	Capacity (GW)	Capacity factor	Generation (TWh)	Capacity (GW)	Max capacity factor	Max generation (TWh)	Change in generation 2021 vs 2022
Nuclear	130	78%	884	124	80%	868	-16
Gas	231	34%	695	233	52%		
Hydro	174	37%	571	175	37%	566	-5
Coal	150	44%	579	133	55%	641	63
Wind	223	23%	447	233	23%	469	22
Bio	47	52%	212	48	60%	253	41
Solar PV	173	12%	180	182	12%	191	11
Liquids	34	16%	48	32	30%	84	36
Other	15	23%	30	15	23%	30	1
Total	**1,176**		**3,646**	**1,175**		**3,104**	**152**
				Call for gas power (TWh)		**543**	**-152**
				Gas for power demand (Bcm)		**112**	**-31**

Source: Rystad Energy Power Solutions

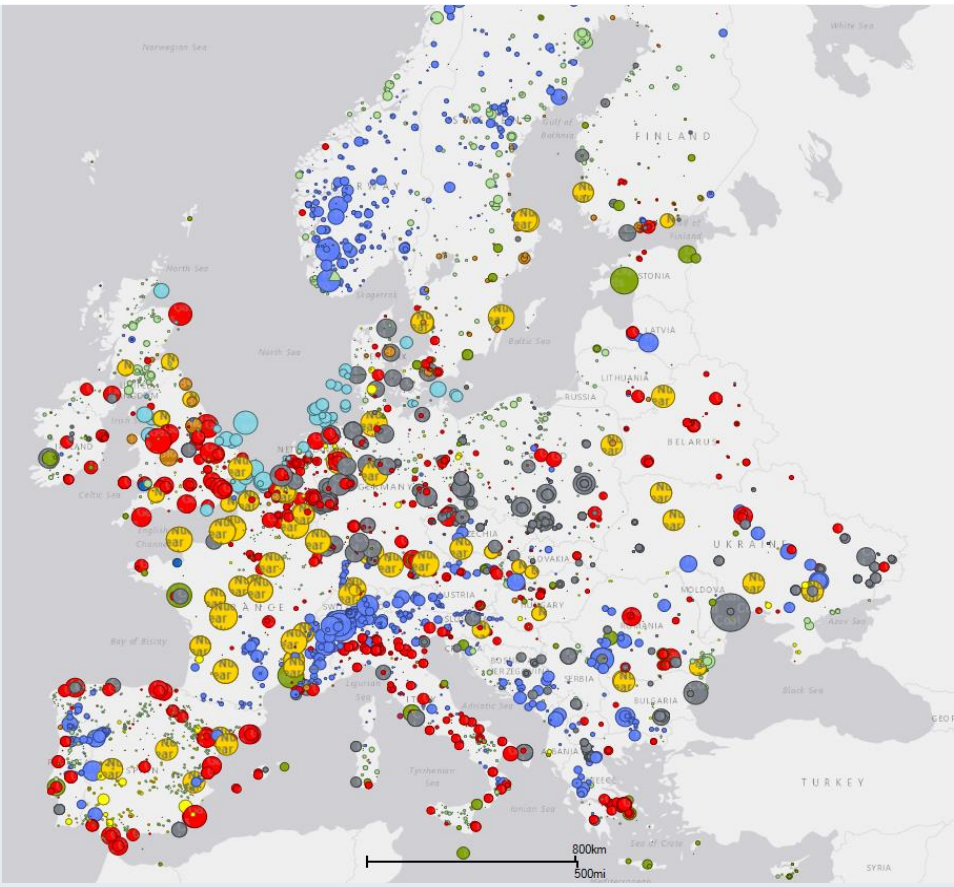
Limited availability of nuclear and hydro power drive continued need for gas

Hydropower plants across Europe produced some 570 TWh in 2021, around 1% less than in 2020 with the decline being driven by low reservoir levels. In comparison, output from this source has reached a maximum of more than 610 TWh in 2014, meaning that this source could theoretically add 41 TWh of supply. Unfortunately, reservoir levels in Norway and the Alps (the two main producing regions) are still below average so there is a risk that output will remain unchanged from last year or drop further.

The outlook for nuclear power generation is not bright either as plants are still being decommissioned and unplanned outages are curtailing capacity. Installed capacity is expected to drop from 130 GW in 2021 to 124 GW in 2022, meaning the maximum output from this source could be around 870 TWh, a decline of 16 GWh from last year. Additionally, Electricité de France has continued to struggle with unplanned outages which could remove an additional 13 GW of operational capacity from the market for at least six months.

In summary, if electricity demand this year remains in line with 2021's level of 3,646 TWh and meteorological conditions are adequate, alternative sources could supply a total of 3,104 TWh, with gas power required to supply the remaining 543 TWh. This level of gas power generation represents a drop of 152 TWh from 2021's output and would result in a decline in gas demand of 31 Bcm. As seen in the map, countries such as Italy, the Netherlands, the UK and Spain have the largest number of gas generation assets making them more vulnerable to supply disruptions. But the European system is well interconnected making the distribution of electricity from alternative sources across the continent feasible and should help ease the concerns of potential outages. However, with current high gas prices (and the risk of them increasing further in the event of supply disruptions) gas-fired power generation will remain the marginal source of supply and the price setter in Europe during 2022. The tensions affecting the gas market will continue to have a direct impact on power prices.

European power generation assets by source



Source: Rystad Energy PowerCube

Gas and nuclear labeled as green energy sources under EU taxonomy

On 2 February 2022, the European Commission approved in principle a Complementary Climate Delegated Act (CDA) to include nuclear and gas-related energy activities in the EU taxonomy. The taxonomy is a classification system the defines a list of environmentally sustainable activities with the main objective of reaching emission reduction targets set out in the European Green Deal. The purpose of including specific gas and nuclear activities is to facilitate a faster move away from more polluting liquid and solid fossil fuels (coal, fuel oil and diesel) and to help meet EU carbon neutrality targets by 2050. Gas activities are labeled as transitional, meaning they will eventually be phased out. The labeling of nuclear energy is more ambiguous with the Act specifying that there is evidence for the potential contribution from this energy source to reach climate objectives.

Summary of EU taxonomy for gas and nuclear energy activities

Implications for natural gas	The CDA includes technical screening criteria for gas-related activities such as electricity generation, cogeneration and district heating/cooling. Facilities need to comply with all of the following: • For facilities for which the construction permit is granted before the end of 2030, the total greenhouse gas emissions (GHG) need to be lower than 270 grams of CO_2 equivalent per kilowatt-hours of electricity generated (gCO_2e/kWh) which is a very low level compared to the average GHG emission level for existing plants of close to 400 gCO_2e/kWh. If the plant is granted a construction permit after 2030, a lifetime GHG emissions limit of 100 gCO_2e/kWh applies. • GHG emissions cannot exceed an average of 550 kilograms of CO_2 equivalent per kilowatts of electricity generated ($kgCO_2/kW$) of the facility's capacity over 20 years (which helps define a guideline for reserve capacity). • The development of this capacity is conditional on the fact that the power to be replaced cannot be generated from renewable energy sources, is based on cost competitiveness and is technical feasible. • The facility it is replacing is an existing high-emitting electricity generation source. • Facilities should be designed and start using renewable and/or low-carbon gaseous fuels by the end of 2035.
Implications for nuclear power	The CDA includes criteria for the construction and safe operation of new and existing nuclear plants for the generation of electricity or heat, including for hydrogen production. Facilities should comply with all of the following: • The construction permit has been issued by 2045 with the construction of the plant being done with the best available technology. • Complies with the Euratom Treaty as well as applicable EU environmental law. Special measures must be in place to protect against external hazards (such as extreme weather). • Has in place a radioactive waste management fund and a nuclear decommissioning fund which can be combined. • Needs to demonstrate that it will have resources available at the end of the useful life corresponding to the estimated cost of the radioactive waste management and decommissioning. • Has operational final disposal facilities for all very low, low and intermediate level radioactive waste. Has a plan with detailed steps to have in operation by 2050 a disposal facility for high-level radioactive waste.

Source: Rystad Energy Power Solutions, European Commission

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