

Energy outlook 2023: From power to utilities to renewables

Rarely has the energy market been such an important driver of global economic conditions. So what can we expect from oil and gas, European utilities and renewables in 2023? Read the individual articles and download the full Energy Outlook report below.

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European gas prices have collapsed over the Northern Hemisphere winter. Mild weather and weak industrial demand have ensured that gas storage has remained...

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2023 Energy Outlook: From power to utilities to renewables

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By Gerben Hieminga, Warren Patterson and 2 others

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European storage to finish heating season well above average

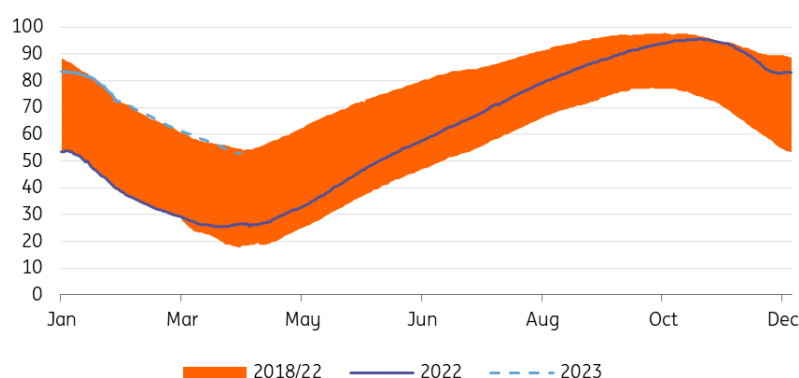
A late start to the 2022/23 heating season saw Europe building gas storage almost until mid-November. At a little over 95% full, storage was essentially maxed out. This was far above the target of 80% by 1 November 2022 set by the European Commission. While there have been some cold spells in the current heating season, it has been largely mild, which has meant storage levels have held up well. In fact, there have been days this winter when storage has seen net increases. Storage at the moment is 72% full, well above the five-year average of 54% for this time of year.

Assuming Europe does not experience a prolonged cold spell in the current heating season, the region should exit the 2022/23 winter with storage above 50% full. This is significantly higher than the 26% seen at the end of the last heating season and above the five-year average of 34%.

Ending this winter with very comfortable inventories makes the job of refilling storage over the injection season and hitting EU inventory targets of 90% by 1 November 2023 easier. Between 1 April and the end of October last year, the EU added in the region of 67bcm to storage. If we were to see similar storage levels at the start of the next heating season, the EU would only need to add

around 43bcm of gas this year.

EU storage to exit this winter comfortably (% full)



Source: GIE, ENTSOG, Eurostat, ING Research

Aggressive demand cuts

The level of demand destruction seen in recent months has been considerable. The latest numbers from Eurostat show that EU demand was 25% below the five-year average for October 2022 while Germany's weekly data shows declines in the first two weeks of 2023 in excess of 30% from the 2018-21 average. However, it is important to note that demand in the third week of January was only around 9% below the 2018-21 average. Splitting it out, household demand was down 8.8% while industrial demand was almost 10% lower than the 2018-21 average. We will need to keep an eye on this, but it could suggest that demand is starting to respond to the lower price environment.

The reduction in demand in recent months has far exceeded the Commission's target of 15% below the five-year average between August 2022 and the end of March 2023. As a result, the level of demand destruction that will be needed from April through until March 2024 is more modest than initially expected. Our numbers suggest that a 10% decline from the five-year average is needed between April 2023 and March 2024 to meet the European Commission's 90% storage target by 1 November 2023. The requirement for lower levels of demand destruction suggests that prices do not need to go as high as initially expected.

However, two key assumptions behind this are that remaining Russian daily gas flows stay unchanged and that LNG import volumes into the EU grow marginally year-on-year in 2023. The big uncertainty over LNG flows into Europe is how strong a demand recovery we see from China this year.

LNG market still tight in 2023

A well-supplied European market has meant that we have seen some shifts in regional spreads. Most noticeable is the spread between TTF and Asian spot LNG. For the bulk of last year, TTF was trading at a premium to Asian LNG in order to pull in cargoes and make up for Russian supply losses. However, since mid-December, TTF is trading at a discount to Asia. This should support the redirecting of LNG cargoes towards Asia.

Admittedly looking at the forward curves, TTF's discount to Asia is only in the prompt market, and

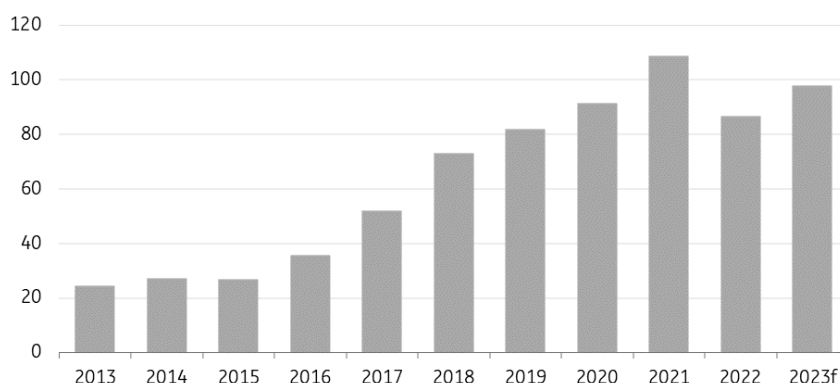
further along the curve there is little between the two markets. Clearly, there is little aggressive competition between the two regions for cargo at the moment, but this could change as China returns from its Lunar New Year holidays.

Weaker Chinese demand through 2022 offered relief to Europe. Last year, China imported 87bcm of LNG, down 20% year-on-year and the weakest annual import volume since 2019. However, the relaxation of Covid measures and several support measures to help the domestic property sector could drive a recovery in demand this year. China also has a larger volume of contracts with fixed destination clauses this year (100bcm vs 88bcm last year according to the IEA).

Ultimately though, Chinese demand is a big uncertainty for the global LNG market. While we are likely to see an increase in demand, it is difficult to gauge exactly how much stronger it could be this year. We are assuming for now that Chinese demand will not return to 2021 levels. Instead, we are expecting more modest growth of a little over 10% YoY.

The restart of the Freeport LNG plant (20bcm per year) could provide some relief to a tight LNG market, particularly if we see stronger-than-expected Chinese demand. There appears to be some progress on the regulatory front for the restart of the plant, but the market may have to wait a while longer for exports to resume.

Chinese LNG imports to see partial recovery in 2023 (bcm)



Source: China Customs, ING Research

The highs are behind us

The more comfortable storage situation does put Europe in a better position to handle the 2023/24 winter. It certainly isn't looking as dire as it did just several months ago. Therefore, prices do not need to go as high as originally expected going into the next heating season. We expect TTF to average in the region of EUR60-65/MWh over the first half of 2023, increasing to EUR75-80/MWh over the second half of the year. The assumptions around this are that there are no further declines in remaining Russian gas flows, that we see a small increase in EU LNG imports over 2023 and that Europe experiences a normal winter in 2023/24. This should allow the EU to start the next heating season with storage exceeding the European Commission target of 90% by 1 November, and the region should get through the winter months in a fairly comfortable manner. However, Europe will rely more on storage in the 23/24 winter than it has in the current winter.

ING natural gas price forecasts

	1Q23	2Q23	3Q23	4Q23	1Q24	2Q24	3Q24	4Q24	FY23	FY24
TTF (EUR/MWh)	65	60	75	80	80	65	50	60	70	64

Source: ING Research

What are the upside risks to our forecasts?

There are two key upside risks to our new forecasts. Firstly, the bulk of Russian gas flows to the EU have already been halted. However, there is still the risk that flows via Ukraine and possibly even through TurkStream are stopped. If this was to occur, Europe could lose 15-20bcm of gas on an annual basis, which is still a sizeable volume. This would need to be made up either by further LNG imports or through higher levels of demand destruction. Both would likely require prices to move higher from current levels.

The second key risk is related to Chinese LNG demand. We are assuming only a marginal recovery in Chinese import demand this year (a little over 10%), rather than returning to 2021 levels. If Chinese demand surprised to the upside, this would mean a tighter-than-expected LNG market, increasing the need for Europe to compete more aggressively with Asia for supply. This would also mean higher-than-expected prices.

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Energy Outlook 2023: European utilities are resilient but not immune to crises

European utilities will continue to be driven by opposing forces in 2023. The recent financial distress of a few strongly dependent on Russian gas supply...



European utility sector operating profits set to rise again

2021 was marked by a number of bankruptcies among European electricity and gas providers, all of whom had different [business and earnings models](#). The victims were primarily pure energy resellers with low capitalisation and they didn't have the necessary cash to acquire power and gas volumes at high prices on the wholesale markets. 2022 saw far fewer bankruptcies in the sector. Despite a complex operating environment, the European utilities sector recorded strong revenues and operating profit growth.

For the full year 2023, the sector is expected to record an average operating profit (EBITDA) growth of 6%, a performance relatively in line with 2022.

6% Average EBITDA growth expected for the European utility sector in 2023

Supported by past investments, higher power prices and inflation-linked remuneration on grids, the European utility sector is set to post another EBITDA growth in 2023. At a sector level, we forecast a 6% EBITDA increase in 2023.

• *Integrated utilities*

At a sub-segment level, for integrated utilities (operating grids and power plants) the growth should approach 7%. While price caps and taxes on windfall profits could mildly impact the results of some European utilities, integrated utilities should again benefit from their geographically diverse exposure to regions such as Latin America and the United States where the current energy crisis has been less severe.

Large investment programmes will also continue to spur future cash flow generation due to asset expansion. And the data published by utilities communicating their power price hedging strategies show that the electricity volumes they will deliver in 2023 have been sold at higher prices than those locked in 2021 by an average of 25%.

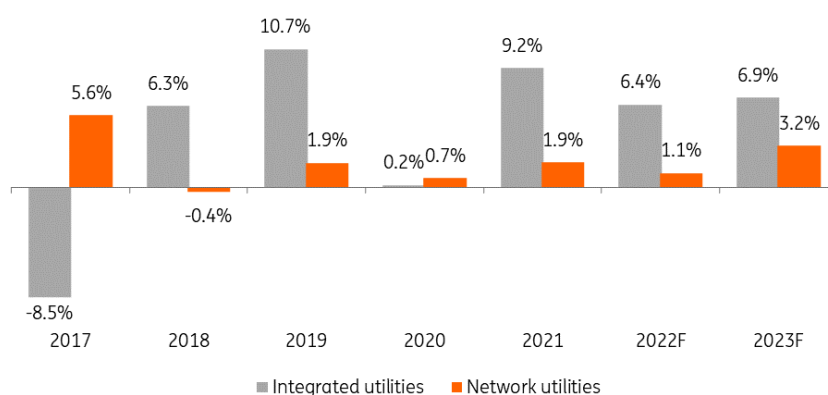
• *Network utilities*

For pure network utilities, the growth will be more limited due to their regulated revenue caps. We expect the sub-sector's EBITDA to increase by around 3% on higher tariff correction for inflation as well as growing regulated asset bases. In a few countries, the regulator will also allow for a shorter timing concerning the recouping of certain costs. As distributing or transmitting energy along networks requires power usage, higher power prices have had a negative impact on the operating results of grid companies.

On top of this, certain players have suffered from higher power leakages due to increased flows coming from renewables. While utilities have been very active in upgrading their networks, they continue to face limitations.

European utility sector: average EBITDA

YoY change (%)



Source: Company info and guidance, ING

Liquidity issues still in the background

The volatility of commodity prices, [namely natural gas](#) and power requires European utilities to have extra liquidity available to meet margin call requirements. The needed additional cash collaterals have created a difficult environment where most utilities need to extend and increase credit lines or loans all at the same time.

With banks having limited room to increase their available capital, finding liquidity on the market has become a challenge. While natural gas prices appear to be coming down from their highs, volatility might be difficult to keep under control, especially once stored LNG stocks are depleted and will need to be replaced from February onwards. We would expect the EU proposal for a [new TTF gas wholesale market mechanism](#) as well as governments' liquidity support plans to increase stability.

As of today, [Germany has earmarked a budget of €68bn available to utilities](#) needing extra liquidity to meet margin call requirements. The United Kingdom is willing to dedicate €46bn and Sweden €23bn. Finland and France have thus far both evaluated liquidity needs at €10bn.

EU proposals to tackle the energy crisis should not be disruptive

From September 2022 onwards, the European Commission has worked on different actions that could be adopted to mitigate the impact of high energy prices.

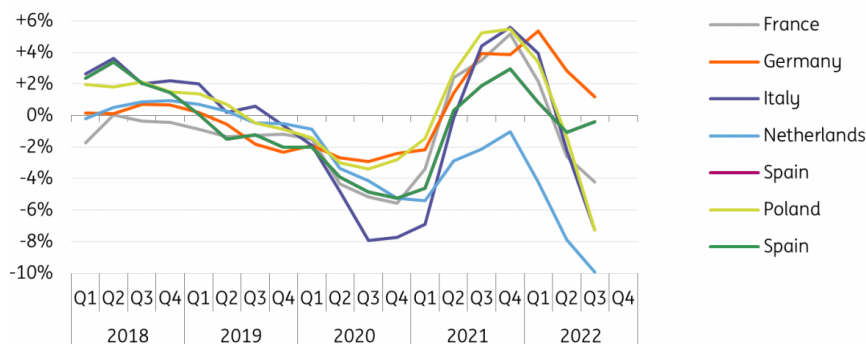
• *Energy savings*

Member states are being asked to reduce gas demand by 15% and electricity consumption by 10% with an additional 5% during peak hours compared to long-term averages. According to ENTSO-E statistics, a decline in power demand started at the end of 2021. The Netherlands led the way in reducing electricity consumption the most by the end of the third quarter of 2022, seeing a -10%

drop. Poland was not far behind with -7.5%, and France at 4%. The Netherlands has also reduced gas consumption by 30% as households lower their thermostats and industries substitute energy sources or even curtail production where high gas usage makes production unprofitable.

Year on year growth in electricity demand

4-quarters moving average



Source: ENTSO-E, ING

Power proposals

- **Price cap on electricity:** The EU proposes a €180/MWh day-ahead [wholesale price cap](#) for low-cost technologies. The scheme is expected to bring some €140bn in excess revenues that would be redistributed to the final energy consumers. The biggest European power producers will not be much impacted by the measure. As seen above, European integrated utilities do sell forward large amounts of future production at fixed prices. Despite being higher than those sold forward a year ago, pre-sold prices for 2023 remain below €100/MWh.
- **Joint gas storage:** as of today, [about 85%](#) of gas storage capacity across Europe is filled. In the future, the EU Commission would like to establish a joint LNG capacity purchasing system and targets for gas storage levels.
- **Taxes on fossil fuel companies:** EU members will apply additional taxes to fossil fuel suppliers given that the current crisis partly fuels higher profits from surging oil and gas prices. A number of countries have already announced their taxation plans with Italy, for instance, applying a 50% tax on windfall profits on some 7,000 energy providers from 2023 onwards.
- **Hydrogen:** €3bn funds to facilitate hydrogen development in order to switch from a niche market to a mass market product.
- **A price cap on wholesale natural gas** has been debated for a long time, with EU members voicing concerns about a mechanism and price level that could threaten the security of supply.

Government support schemes for consumers are rather positive

Government support and subsidy schemes help utilities too. They allow companies to keep bad

debt under control. Parts of the announced support schemes are expected to be financed by caps and tax systems that will bring financial proceeds to governments.

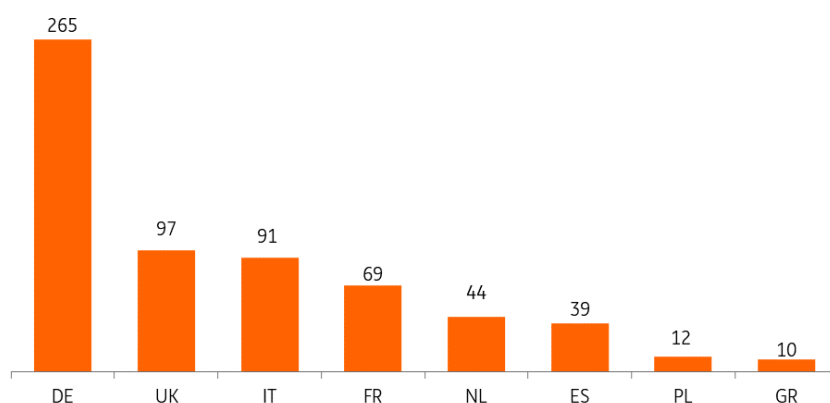
In its latest roadmap for measures concerning energy inflation, the European Union is proposing a [€40bn programme](#) to which EU country members can apply in order to support their national consumers.

Government support and subsidy schemes help utilities too

A significant number of EU members have announced their own support schemes to help consumers - both households and companies - to pay their energy bills. Risking criticism from other European countries, Germany announced it would make as much as €265bn in subsidies available. Between September 2021 and the end of November 2022, the United Kingdom communicated a total cumulative budget of €97bn and France €69bn. As far as Italy is concerned, the country will dedicate as much as €91bn on a cumulative basis as the government recently announced an additional package worth €35bn, partially financed by taxes on energy firms' windfall profits.

The size of support varies greatly between countries

Cumulative budgets announced by EU governments to shield consumers and enterprises from rising energy prices (€bn)



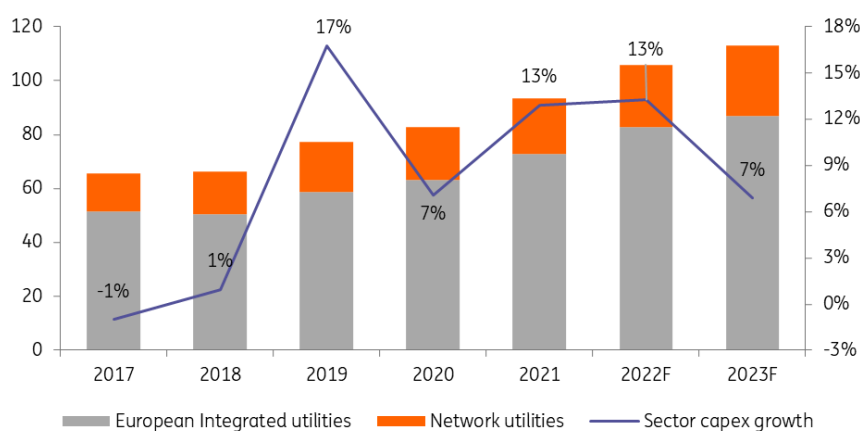
Source: EU governments, ING

Capital expenditure continues to boost growth prospects

Utilities are at the heart of the energy transition theme, and the path from fossil fuel power generation to clean electricity production requires large investment plans. This applies to both power generation assets and grids that need upgrades and extensions to support the growing power flows from renewables.

Capital expenditure programmes

2017-2023F (€bn) and YoY change (%)

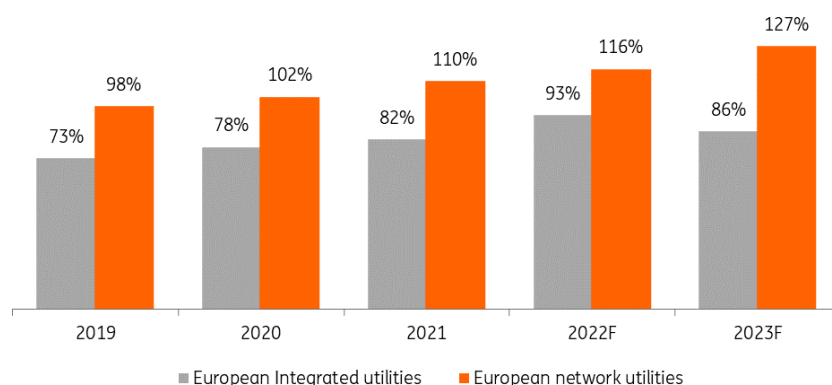


Source: Company data, ING

While these large investments are an important growth driver for the sector, they are also a concern for utilities' financial health. This is particularly true for pure network players whose funds generated by operations do not cover capital expenditure needs. The 15 main European grid utilities will see investments surpassing forecasted funds from operation by more than 20% in 2023. This situation, which we've seen since 2020, pushes transmission and distribution utilities to recourse to additional debt, adding pressure on leverage metrics.

Expenditure to Funds from Operations

European integrated and network utilities



Source: Company data, ING

Rising funding costs should stabilise

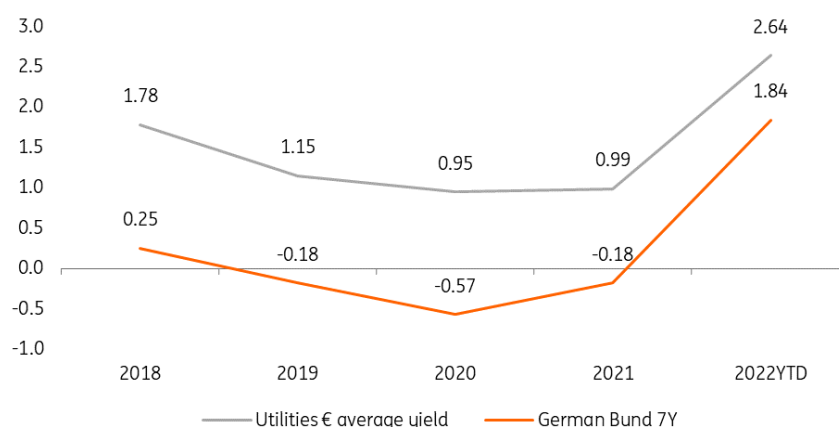
With substantial capital expenditure programmes, and we'll look at that shortly, the European utilities' sector is an important debt issuer industry. We forecast European utilities to issue €50bn in new bonds in 2023 corresponding to €30bn of bond refinancing and €20bn of new bonds to partly finance capital expenditure needs.

Favourable market conditions

Market conditions have been very favourable for utilities and corporates in general, with average bond yields between 0.5% and 1.1% in the period 2019-2021. Utilities took advantage during this time to approach the credit market more often. High inflation along with the actions of the European Central Bank to deal with the new economic environment resulted in a sharp increase in yields. Year-to-date, the average € bond yield paid by utility issuers in 2022 is 2.64% with average yields towards 1.2% in the first few months of the year and 3.5% in the last three months of 2022.

The European Central Bank announced another rate hike on 15 December with a deposit rate going from 1.5% to 2%. This should lead to higher yields paid by corporates to issue new debt. However, our ING rates strategists believe a recession over the winter still looks very likely. The challenged European global economic outlook should result in rates tightening again, allowing corporates and utilities to print new bonds at lower yields in 2023.

Average € 7Y German Bund and € Utilities bond issuance yields (%)



Source: Refinitiv, ING

80% of bonds issued by utilities will be sustainable bonds in 2023

Issuers and investors alike are embracing Environmental, Social and Governance (ESG) notions into core financing or investment philosophies. As the pressure from societies, governments, activists and regulators accelerate, there is a bigger push for ESG bond issuance.

80% of € bonds issued by utilities in 2023 will be sustainable bonds

We forecast €100bn of the expected total corporate €270bn bond issuance in 2023 to be ESG issuance. The percentage of ESG bond supply relative to overall € corporate supply is growing year on year. We expect this to jump to 40% in 2023, up from 35% in 2022. For utilities, out of the €50bn of new bond issuance in 2023, we forecast €40bn will be made in sustainable bonds, representing 80% of utilities' bond issuance. This ratio was 75% in 2022. Green bonds will remain the preferred format for the sector.

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Energy outlook 2023: The growth in renewables, batteries, CCS and hydrogen infrastructure

In 2023, we expect key technologies, including wind, solar, batteries, CCS and hydrogen infrastructure, to continue growing. Headwinds from supply chain...



The share of fossil fuels in the global energy mix has been stubbornly high, at around 80%, for decades. According to the International Energy Agency (IEA), this share needs to come down to 22% by 2050 in a net-zero economy. This requires an energy system based on new energy technologies, and here's what we can expect next year.

Flat growth potential for solar and wind

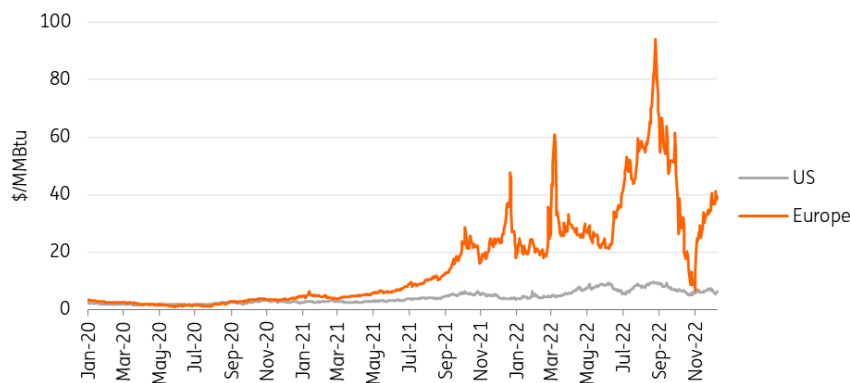
Predicting the future is never exactly easy, and the 2023 forecast for renewables is no exception as there are opposing factors at play.

On a positive note, solar and wind benefit from high energy prices, in particular in Europe. Increased demand by governments, businesses and households in their efforts to become less dependent on high gas and power prices from a fossil-driven energy system all help too. The US is less affected by the energy crisis, but a more volatile energy market will indeed trigger more

renewable buildout. The [Inflation Reduction Act \(IRA\)](#) gives a huge boost to renewable project development, but the effect will likely kick in after 2023.

High energy prices are a push for renewables, particularly in Europe

Natural gas price in \$/MMBtu



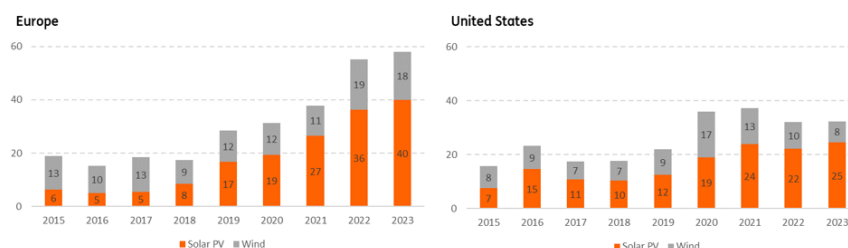
Source: ING Research based on Macrobond

However, both wind and solar continue to struggle with supply chain disruptions and high input costs for steel, rare earth elements and in some markets, labour. Financing costs have increased on the back of higher interest rates. So have shipping costs and while they have come down a lot recently, they could easily go up again given the highly-charged geopolitical situation right now.

The economic environment is also uncertain, and policy risks have increased as governments impose price caps with or without windfall profits.

Growth in solar outpaces growth in wind

Yearly installed capacity additions for solar and wind energy in Europe and the US in gigawatt (GW)



Source: ING Research based on BNEF and IEA

In this environment, we don't expect strong growth in solar and wind capacity, which has been a feature of the renewable energy market in the past few years, particularly in Europe.

Overall, we see about the same capacity additions as in 2022, both for Europe and the US. Solar additions should increase, notably due to a strong uptake in rooftop solar panels. Growth in wind capacity is somewhat lower as governments fail to speed up permitting procedures significantly,

despite good intentions. It also takes time for market participants to adjust to the new normal of high and volatile power markets and price caps, particularly in Europe. The disappointing outcome of a [Spanish renewables auction](#) is a case in point, where the €47/MWh cap was too low for market participants to cover higher costs and increased risks. As a result, only 46 MW of the 3.3 GW tender was awarded.

Finally, grid congestion is increasingly becoming a barrier to strong renewables build-out, and grid enforcements don't happen overnight. In fact, in many regions, grid limitations are the big elephant in the room for future growth in renewables.

All in all, we expect to see 58 GW growth in the combined wind and solar market in Europe and 32 GW in the US in 2023. This equates to roughly €70bn of investment in Europe and €37bn (\$35bn) in the US.

CCS is growing but a fast scale-up will take time

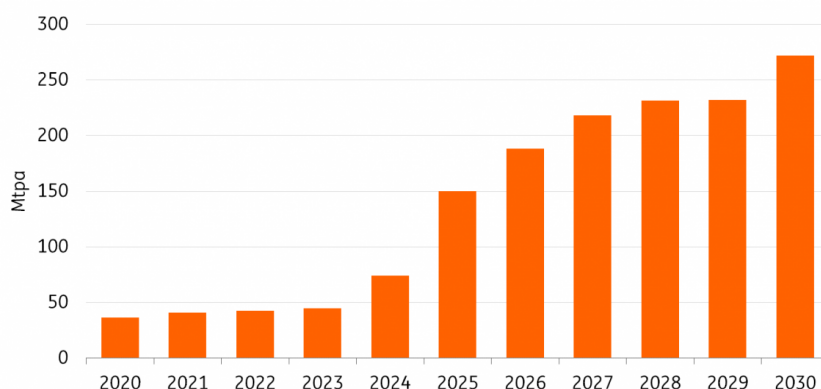
With more companies in hard-to-abate sectors committed to decarbonisation, as well as governments showing increasing [policy support](#), Carbon Capture and Storage (CCS) technologies will continue to gain momentum in 2023.

Moreover, the UN's Intergovernmental Panel on Climate Change (IPCC) emphasised in a report that realising the Paris Agreement requires substantially more use of carbon removal technologies. Against this backdrop, 61 new CCS projects were announced worldwide from January to mid-September 2022. Global commercial CCS capacity that is operational or under development is set to grow by 44% this year to 244 million tonnes per annum (Mtpa).

Yet of the projects under development, only three—two in China and one in Australia—are expected to commence operation in 2023, bringing the total operational capacity up by 2.3 Mtpa to 44.9 Mtpa. The fast growth period will arrive in 2025 when the completion of more projects is forecast to triple the current capacity.

CCS is expected to scale up significantly after 2023

Global CCS capacity in Mtpa, forecast based on current announcements



Source: ING Research based on IEA, BNEF, and Global CCS Institute

- *Policy support*

Several trends stand out behind this projected growth. The first is enhanced policy support. In the US, the IRA is raising Section 45Q tax credits from \$50/tonne to \$85/tonne of CO₂ captured and stored, and the value has increased to \$180/tonne for direct air capture, a more costly technology which directly removes CO₂ from the atmosphere and is gaining higher popularity.

- *Infrastructure investment*

Additionally, the Infrastructure Investment and Jobs Act invests \$11bn in CCS demonstration and networks. These policies will together boost project revenue streams, incentivise technological advancement, enhance related infrastructure, and cement the US's leading position in the technology.

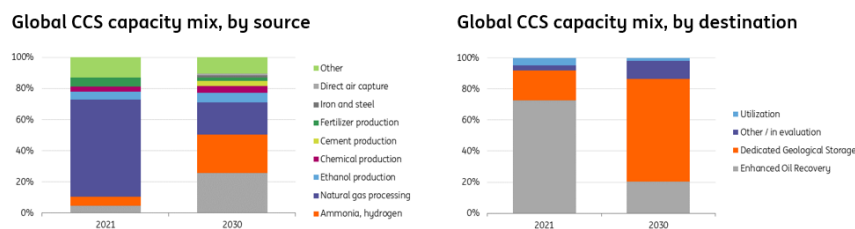
In Europe, funding has been made available to facilitate the development of CCS. The EU Innovation Fund, which was created in 2020 to help realise the bloc's climate targets, has supported more CCS projects this year. The Netherlands' Sustainable Energy Transition Subsidy Scheme (SDE++), part of which is dedicated to funding CCS projects, has been increased from €5bn to €13bn. In the UK, the government has established the CCUS Innovation Programme to advance related research and the CCS Infrastructure Fund to develop CCS networks.

- *A more diverse mix*

We are going to see CCS technologies being applied to more sectors. Traditionally, CCS is predominantly used in natural gas processing, where the CO₂ separated from purified natural gas is captured. But under the urgency of decarbonisation, CCS is being extended to other sectors such as hydrogen, power, cement, iron, and steel. This trend is set to continue among projects that are going to be announced in 2023—which will eventually lead to a more diverse mix of CCS applications by 2030.

In parallel, there will be more projects that can permanently store and capture CO₂, as opposed to only using CO₂ for processes such as enhanced oil recovery. This will lead to more emissions reduction from CCS.

CCS is being applied in more sectors and with different CCS technologies



Source: ING Research based on BNEF

2023 will also see the further materialisation of CCS hubs globally. Over 40 Mtpa of capturing capacity have been proposed under hubs in the EU and UK, mostly near the North Sea. In the US, 90 Mtpa of hubs are planned, the majority of which is concentrated in Texas and the Midwest. More CCS hubs will enhance the spillover effect of technology know-how, increase the sharing of pipeline and storage infrastructure (and thereby cutting costs), and raise the chances of projects collectively receiving government funding.

Hydrogen policies trigger investment in hydrogen infrastructure

A growing number of corporate leaders are now fundamentally rethinking their climate strategies and are aiming to become net-zero emitters by 2050, according to the [Science Based Target Initiative](#). Hydrogen provides them with a tool to radically green their business and reduce future emissions, particularly in manufacturing, shipping and aviation. This trend will continue in 2023.

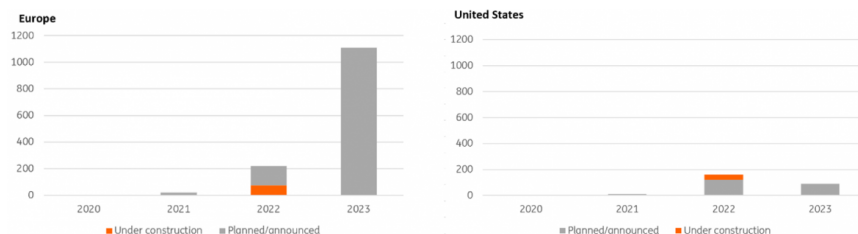
The energy crisis puts hydrogen on the short-term agenda too, as it provides politicians and corporate leaders glimpses of what a future may look like in which they are less dependent on fossil fuels. That's true particularly in Europe as the continent is committed to weaning itself off Russian gas. But, the energy crisis has worsened the business case for hydrogen, so the [economics](#) of this transition are far from easy.

Hydrogen is still in its infancy, with most projects being in the development stage rather than the construction phase. Europe has more electrolyser projects in development to kickstart the production of green hydrogen. The project size is also bigger with several projects of +100 MWe in development. In both Europe and the US, electrolysers are powered by large solar fields, on and offshore wind farms, and with power from the grid. The US is also developing projects that run on nuclear power.

Both continents also have schemes for blue hydrogen in development. However, the Netherlands faces an important setback now that the permitting process for its Porthos CCS project has been [delayed](#) due to legislation on nitrogen emissions during the construction phase.

Green hydrogen: Europe has more electrolyser projects in development compared to the US

Electrolyser project pipeline in Megawatt electricity (MWe)



Source: ING Research based on BNEF

Actual investment volumes are expected to be higher for hydrogen infrastructure, which is a prerequisite for a hydrogen economy. For example, the US and the Netherlands aim to build hydrogen hubs that can facilitate hydrogen trade flows. That would be a major difference from the current situation where hydrogen is often produced and consumed within the same industrial site.

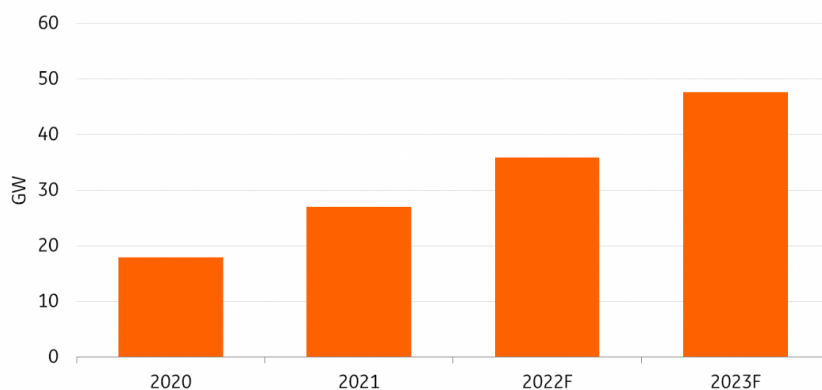
Batteries: Rapid increase in demand calls for more supply

A sustained energy transition requires [more batteries to be built](#). In 2023, the demand for batteries will grow strongly.

In the power sector, batteries are essential to enhance grid flexibility, as they can store renewable electricity and serve at peak demand hours, especially in markets with high renewable penetration. Global installed battery capacity is projected by the IEA to grow between tenfold and sixteenfold by 2030. If that does become the case, we expect battery storage to grow to 48GW in 2023.

In the EU, the bloc aims to raise renewable energy generation capacity to 1,236GW by 2030 in order to reduce reliance on Russian gas. Although this does not include storage the target will bring tremendous growth potential to battery storage in the region. In the US, the IRA has made investment tax credits available for grid-connected stand-alone batteries – previously batteries needed to be coupled with renewable energy to qualify for federal tax credits.

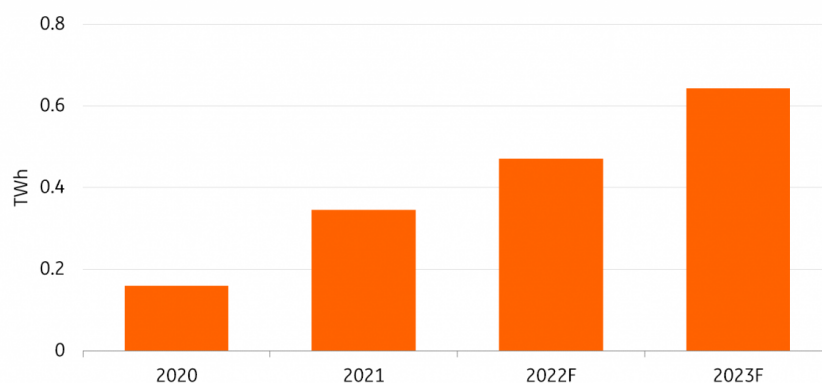
Global stationary battery storage forecast



Source: ING Research based on IEA

In the transport sector, renewed policy support in major jurisdictions and automaker climate ambitions point to higher demand for electric vehicles and hence for batteries to power EVs. Global battery demand for EVs doubled between 2020 and 2021 to roughly 0.3 TWh/year, and we expect that this number will grow to 0.6 TWh/year in 2023.

Global EV battery demand forecast



Source: ING Research based on IEA

However, metal prices, especially those of lithium, are adding headwinds to faster EV battery production to meet surging demand. One factor driving metal price rises is supply chain risks. Just as rare earth metal production started to pick up pace again after the pandemic, the Russian invasion of Ukraine has led to supply limitations of Class 1 (high-purity) nickel, where Russia accounts for a little less than 20% of the global production. Another factor is structural underinvestment in metals in the several years pre-pandemic as a result of low metal prices back then. In 2023, we expect metal prices to stay elevated, despite some relief from their highest levels, due to the ongoing war and an uncertain economic environment in China, which dominates the world's EV battery production.

Consistently high metal prices could prompt battery makers and automakers to switch to fewer batteries which use fewer metal materials, such as lithium iron phosphate cathode chemistry (LFP) batteries, as they do not need nickel or cobalt as an input. Global LFP EV battery production has more than doubled since 2020, largely driven by technological advancement in China, and this trend is expected to keep growing in 2023. Some companies are also looking into developing sodium-ion (Na-ion) batteries, but the production of these kinds of batteries will not become largely commercially available in the short term. Companies outside of China are also working to form new supply chains to reduce dependence on the country, but we will not see any substantial change in 2023.

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