

2023 Energy Outlook

December 2022

From power

to utilities

to renewables



Oil, gas and power markets to remain tight

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Both oil and European gas prices may be off those highs we saw earlier in the year. Immediate gas supply worries have eased in recent months, although demand concerns are weighing on sentiment for oil. We do expect both markets to tighten again in 2023 and that, of course, suggests higher prices



Oil outlook: Russian oil supply set to fall

The key supply uncertainty for the oil market this year has been how well Russian supply would hold up following a number of countries banning Russian exports, along with an increased amount of self-sanctioning. Russian supply has held up better than many were expecting, with India, China and a handful of other smaller buyers increasing their purchases of Russian crude oil, given the steep discounts available. As a result, exports in October were 7.7 million barrels a day (MMbbls/d), down just one hundred thousand barrels per day (Mbbls/d) Year-on-Year (YoY).

However, the impact of the EU ban on Russian crude oil is still playing out, and we will have to wait until early February for the ban on Russian refined products. The ability of India and China to absorb a still more significant amount of Russian oil is likely limited. As a result, we expect Russian supply to fall in the region of 1.6-1.8MMbbls/d Year-on-Year in the first quarter of 2023. As for the G-7 price cap, we expect it to have little direct impact on Russian oil supply for now, given that at US\$60/bbl, it is above where Russian Urals are trading.

How the Russia/Ukraine war evolves will be important for oil markets in 2023. While a de-escalation might not lead to the return of pre-war oil trade flows, it would remove a lot of supply risk from the market.

OPEC+ sticks to its guns

OPEC+ has largely ignored calls from the US and other key consumers to increase oil supply more aggressively this year amid higher prices and supply concerns. And the group's decision to reduce output targets by 2MMbbls/d from November 2022 until the end of 2023 has been criticised, particularly by the Americans. Although, with hindsight, the decision by OPEC+ might appear to be the right one, at least in the near term, as it offers stability to the market. Given that most of its members are producing

well below their production targets, OPEC+ supply cuts work out to an effective cut of around 1.1MMbbls/d. In aggregate, OPEC+ production was 3.22MMbbls/d below target levels in October.

However, the cuts may prove to be more destabilising in the medium term, given the expectation of a tighter market through 2023.

US oil producers are not there to fill the gap

The response from US producers to the higher price environment this year has been anything but impressive. And this appears to have also given OPEC+ confidence to cut supply without the risk of losing market share. US crude oil supply is forecast to grow by less than 600MMbbls/d to average around 11.8MMbbls/d in 2022. While for 2023 supply is forecast to grow by less than 500MMbbls/d to around 12.3MMbbls/d. This growth is much more modest than the supply growth seen in previous upcycles.

The mentality of US producers has changed significantly from producing as much as possible to focusing on shareholder returns and as a result, continuing to show discipline when it comes to capital spending. Supply chain issues, labour shortages and rising costs have also played a role in the more modest supply growth expected over the next year.

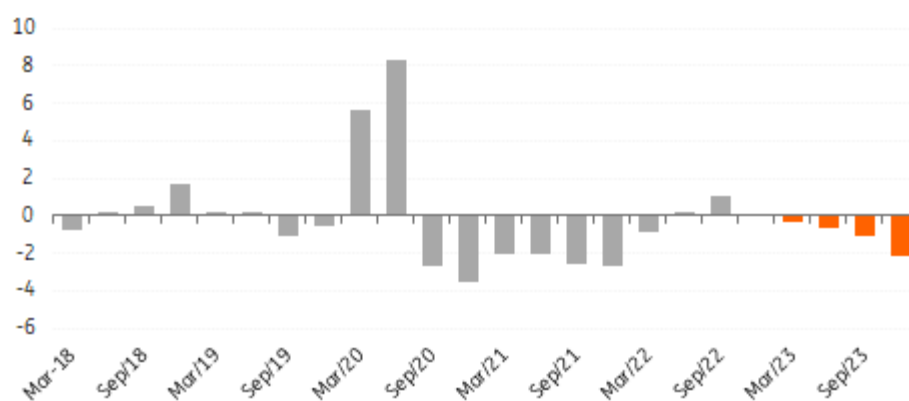
Oil demand is weaker than expected

High energy prices, a gloomier macro outlook and China's zero-Covid policy have all weighed on oil demand this year. At the beginning of 2022, global oil demand was expected to grow by more than 3MMbbls/d YoY and hit pre-Covid levels. However, demand is estimated to grow at a more modest 2MMbbls/d this year, leaving it below pre-Covid levels. While for 2023, demand is expected to grow in the region of 1.7MMbbls/d.

Almost 50% of this growth is expected to come from China with the expectation of an economic recovery.

Oil market remains tight in 2023

Quarterly global oil balance (MMbbls/d)



Source: ING Research based on IEA, EIA and OPEC

Tighter oil market in 2023

A combination of lower Russian oil supply and OPEC+ supply cuts means that the global oil market is expected to tighten over 2023. We expect a growing deficit over the course of the year, which suggests that oil prices should trade higher from current levels. We currently forecast ICE Brent to average US\$104/bbl over 2023, but the uncertainty around our forecast is high given the geopolitical situation and the direction of the global economy. You can find our oil scenarios here.

ING oil price forecasts

	1Q23	2Q23	3Q23	4Q23	FY23
ICE Brent (US\$/bbl)	100	100	105	110	104
NYMEX WTI (US\$/bbl)	96	97	102	107	101

Source: ING research

Gas outlook: Topping gas reserves likely to be more difficult in 2023

Given the circumstances, Europe could not have hoped for a better situation heading into this winter. Demand destruction and milder-than-usual weather in the early part of the heating season have ensured that the region has continued to build storage deeper into winter. EU storage continued to grow until mid-November, with it reaching nearly 96% full. This is above the five-year average of almost 88% for mid-November. This leaves Europe in a better-than-expected position for this winter and the next few months should be more manageable. However, it is still vital that the region remains cautious as Europe needs to try to end the current heating season with storage as high as possible given the expectation of a further reduction in gas flows next year.

European demand has responded to higher prices

Higher prices through much of this year have ensured demand destruction, and as a result, the European Commission has been able to stick to its voluntary demand cut of 15% between August and the end of March, rather than imposing a mandatory 15% reduction. Eurostat data shows that in September, EU natural gas demand was 15% below the five-year average, while numbers from third-party consultants suggest that in the months since, demand reductions have exceeded the 15% target.

Europe will need to see continued demand destruction through 2023 to ensure adequate supply for the 2023/24 winter. This is particularly the case given the risk that we see further declines in Russian gas supply to the EU.

Russian natural gas flows remain a risk

Russian pipeline gas flows have fallen significantly this year. The latest data shows that Year-to-Date pipeline flows from Russia to Europe have fallen by around 50% YoY to roughly 58bcm. And, obviously, these flows have declined progressively as we have moved through the year with reduced output via Ukraine and Nord Stream. Daily Russian gas flows to the EU are down around 80% YoY at the moment. Therefore, if we assume that Russian gas flows remain at current levels through 2023, annual Russian pipeline gas to the EU could fall by a further 60% to around 23bcm in 2023. And clearly, there is a very real risk that the remaining flows will be halted.

Limited LNG supply growth

The liquefied natural gas (LNG) market has helped Europe significantly this year. LNG imports into the EU over October grew by almost 70% YoY, with volumes exceeding 9bcm.

However, there are constraints to how much more LNG Europe can import due to limited LNG regasification capacity. However, we have seen the start-up of a fair amount of regasification capacity in the form of floating storage regasification units (FSRUs) over the second half of this year. The Netherlands, Germany, Finland & Estonia have - or are in the process of - starting up operations at these FSRUs with a combined capacity in the region of 23-27bcm. Germany is expected to bring a further 15bcm of regas capacity online early next year. This will help with some of the infrastructure constraints Europe is facing, but the issue is also around global LNG supply and the limited capacity which is expected to start next year.

Global LNG export capacity was set to grow by around 19bcm in 2023, driven by the US, Russia and Mauritania. However, following Russia's invasion of Ukraine and the sanctions which followed, it is likely that any ramping up of Russian capacity is surely on hold. Russian capacity makes up for 46% of the total new capacity expected next year. Therefore, we could see just 10.5bcm of new supply capacity.

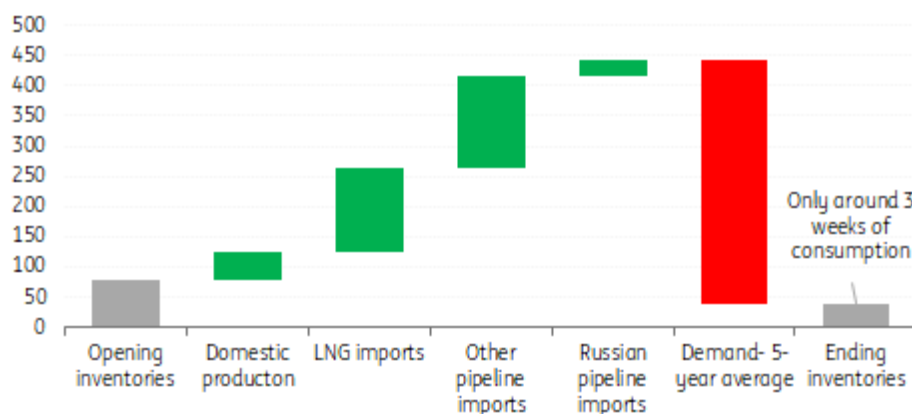
2023 will be tight for European gas

The pace of inventory builds during the 2023 injection season will be much more modest compared to what we have seen this year, given the reductions in Russian supply. The ability of the EU to completely turn to other sources is just not possible. Therefore, Europe is likely to go into the 2023/24 winter with tight storage, which could leave the region vulnerable.

In order to get through the 2023/24 winter comfortably, we will have to see continued demand destruction once again. This will have to be either as a result of market forces or EU-mandated demand cuts. While Europe should be able to scrape through the 2023/24 winter if current Russian gas flows continue, it is much more challenging if remaining Russian gas flows come to a full stop.

Therefore, we believe that there is upside to European gas prices in 2023. However, much will depend on how much storage the EU manages to draw down this winter.

Europe is likely to start the filling season with lower gas reserves



Source: ING Research based on ENTSOG, GIE and Eurostat

The US natural gas market is more comfortable

The US natural gas market this year has also seen significant strength, trading to multi-year highs. Strong global LNG prices, stronger demand from the power sector and below-average inventories have all proved bullish for Henry Hub. However, the outlook for US gas prices is more bearish. US dry gas production is expected to hit record levels next year, growing by a little more than 1.6bcf/d to average almost 99.7bcf/day over 2023, whilst finishing 2023 with output in excess of 100bcf/day.

In addition, this year saw stronger demand from the power sector over the summer, which pushed overall gas demand higher this year. Expectations are that domestic demand will fall back towards more normal levels. Meanwhile, on the export side, while there is more LNG capacity set to start up over the course of the year, this is fairly limited. LNG exports are expected to average a little over 12.3bcf/day in 2023, up from an estimated 10.8bcf/day in 2022.

As a result, over the course of 2023, we should see US natural gas inventories moving from below their five-year average to above it ahead of the next heating season. In fact, the US could go into the 2023/24 winter with storage at its highest levels since 2020. Therefore, we expect Henry Hub to trade lower in 2023 relative to 2022.

ING natural gas price forecasts

	1Q23	2Q23	3Q23	4Q23	FY23
TTF (EUR/MWh)	150	140	190	220	175
NBP (GBP/therm)	265	245	330	380	305
Henry Hub (US\$/MMBtu)	6.5	5.0	4.3	4.7	5.1

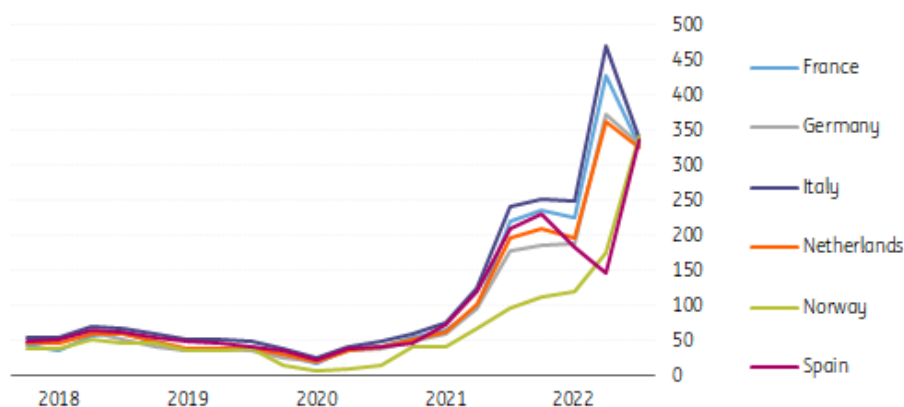
Source: ING Research

The uncertainty around our gas price forecast is high given the geopolitical situation and the direction of the global economy. You can find our gas price scenarios here.

Power outlook: 2023 could be another perfect storm for European power markets

In 2022 Europe not only faced a major gas crisis, it also had to cope with a broader power crisis. Yes, this was partly a result of what was going on in the gas market, but there are a number of other factors which have helped to see power prices skyrocket.

High power prices across Europe



Source: ING Research based on Refinitiv

Lower nuclear capacity

First, France experienced prolonged periods of nuclear capacity outages. This is partly due to regular maintenance and refuelling, but reactors are also taken offline due to more serious weld issues and signs of corrosion. Nuclear summer output in 2022 stood at around 25 GW, well below the levels above 40 GW seen in the summer of 2021. Nuclear output was also down because of heatwaves which limited the amount of cooling water for nuclear power plants. As a result, France experienced the highest power prices in Europe, while it used to have the lowest when nuclear power operated at full capacity. The distress in the French power had knock-on effects on Germany due to lower exports of electricity to the industry-rich southern part of the country.

Unusually hot weather

Second, Europe's hydropower market was also negatively impacted by severe droughts. Reservoirs started drying up. Hydro stocks in France, Spain, Italy and Portugal were all below the 5-year average.

Finally, Rhine water levels recorded record lows in 2022. As a result, some river-based coal plants are facing supply issues and cannot generate as they would like.

We expect power markets to remain very tight in 2023, with benchmark APX prices averaging €375/MWh. The height of the summer price peak will depend on whether Europe will experience another drought and whether it can keep existing nuclear

capacity running while maximising output from coal-fired power stations. And as always, power markets remain local markets with large variations in the level of power prices across European [bidding zones](#).

ING power price forecast

	1Q23	2Q23	3Q23	4Q23	FY23
APX (EUR/MWh)	350	320	450	390	375

Source: ING Research

European utilities are resilient but not immune to crises

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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 is concerning. Nevertheless, the reality is that most fared very well this year and will continue to do so in the next



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

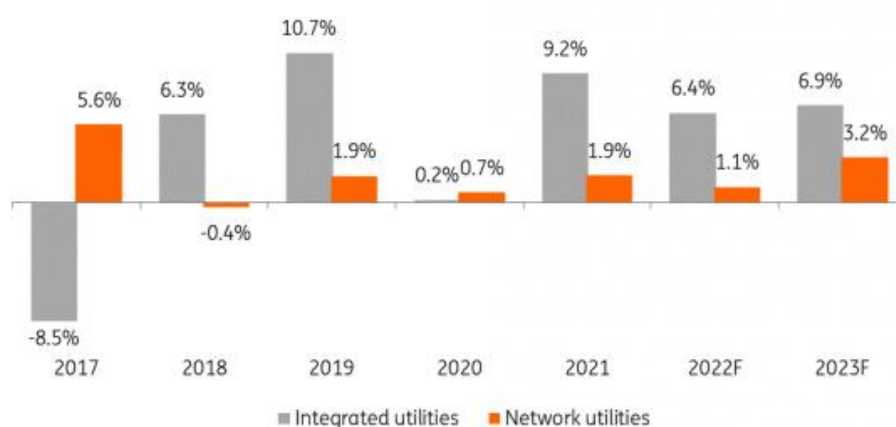
price hedging strategies show that the electricity volumes they will deliver in 2023 have been sold at higher prices than those locked in 2021 by an average of 25%.

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 %ch)



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

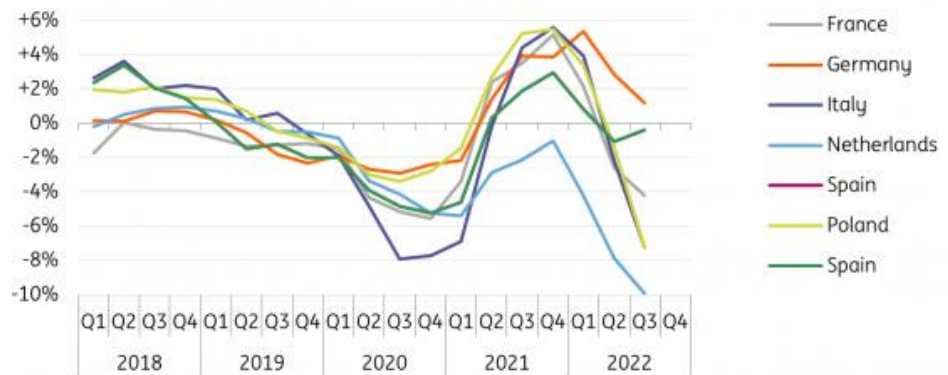
From September 2022 onwards, the European Commission has worked on different actions that could be adopted to mitigate the impact of high energy prices.

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

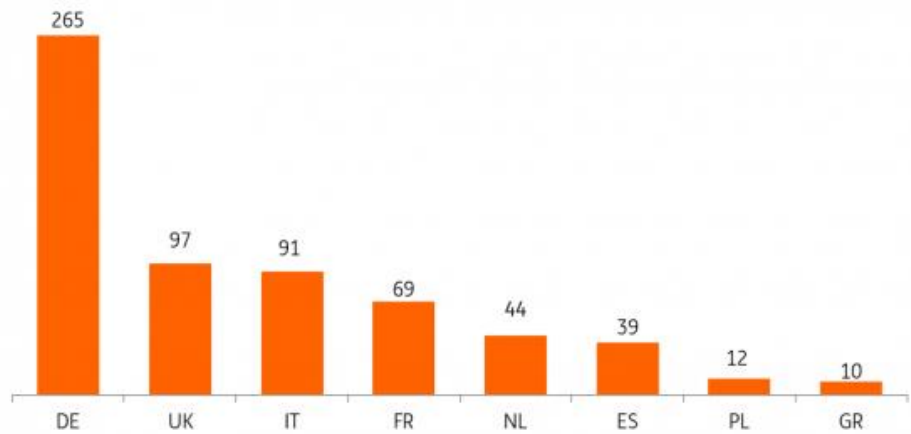
Government support and subsidy schemes help utilities too. They allow companies to keep bad debt under control. Parts of the announced support schemes are expected to be financed by caps and tax systems that will bring financial proceeds to governments.

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



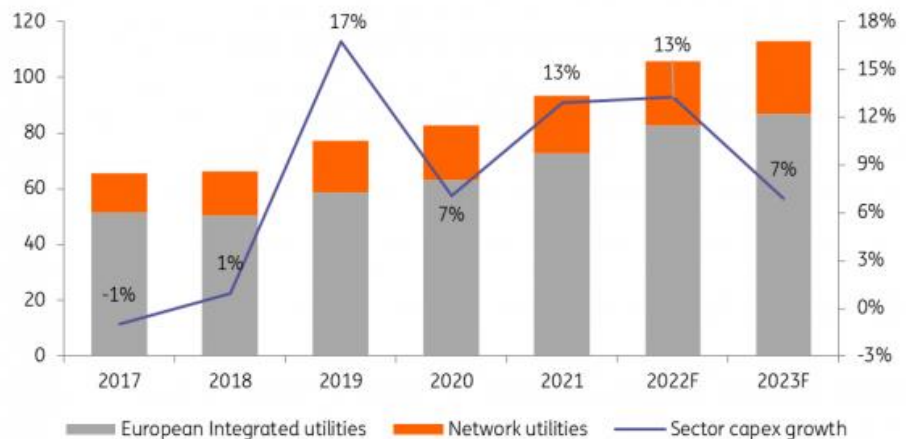
Source: EU governments, ING

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

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 (%)

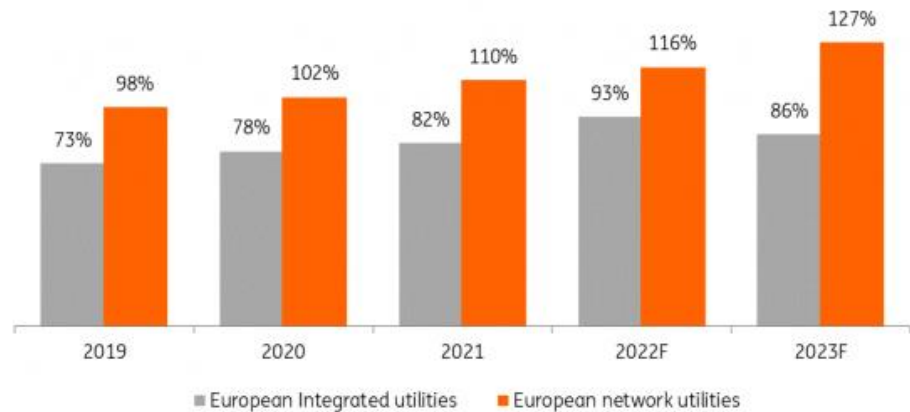


Source: Company data, ING

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



Source: Company data, ING

Rising funding costs should stabilise

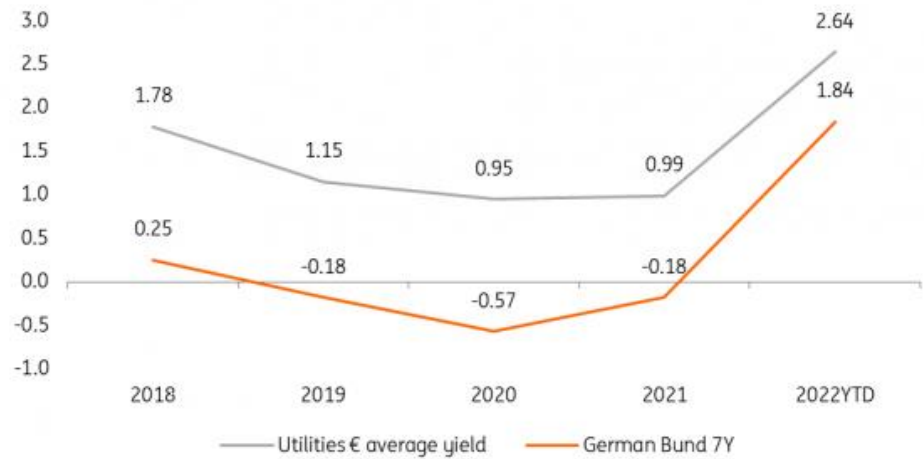
With substantial capital expenditure programmes, and we'll look at that shortly, the European utilities' sector is an important debt issuer industry. We forecast European utilities to issue €50bn in new bonds in 2023 corresponding to €30bn of bond refinancing and €20bn of new bonds to partly finance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

The growth in renewables, batteries, CCS and hydrogen infrastructure

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In 2023, we expect key technologies, including wind, solar, batteries, CCS and hydrogen infrastructure, to continue growing. Headwinds from supply chain disruptions and higher interest rates will likely persist, but policy support and company climate commitments will keep the capacity growth aspects positive



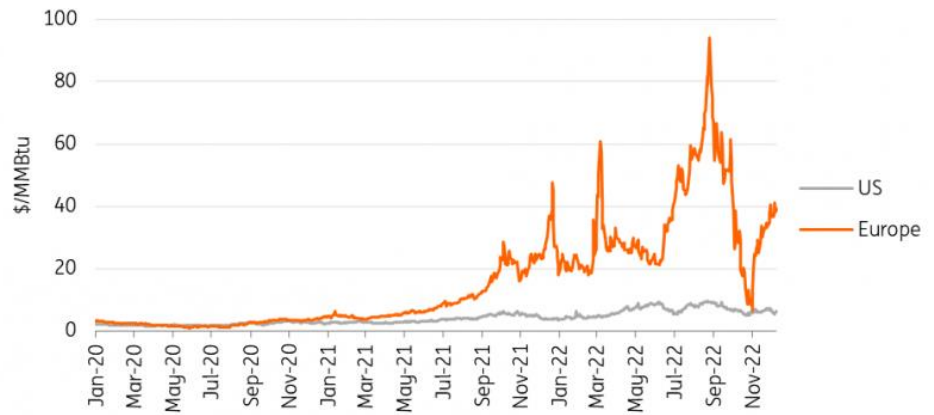
The share of fossil fuels in the global energy mix has been stubbornly high, at around 80%, for decades. According to the International Energy Agency (IEA), this share needs to come down to 22% by 2050 in a net-zero economy. This requires an energy system based on new energy technologies, and here's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



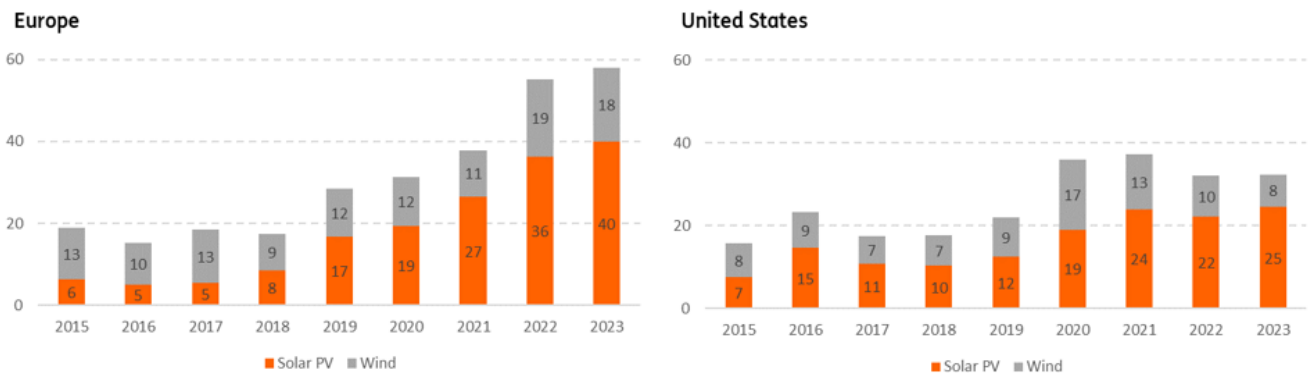
Natural gas price in \$/MMBtu
Source: ING Research based on Macrobond

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

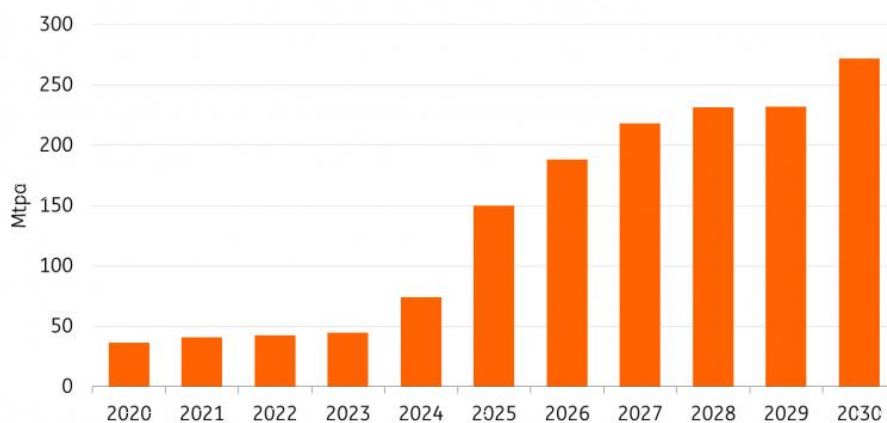
With more companies in hard-to-abate sectors committed to decarbonisation, as well as governments showing increasing [policy support](#), Carbon Capture and Storage (CCS) technologies will continue to gain momentum in 2023.

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.

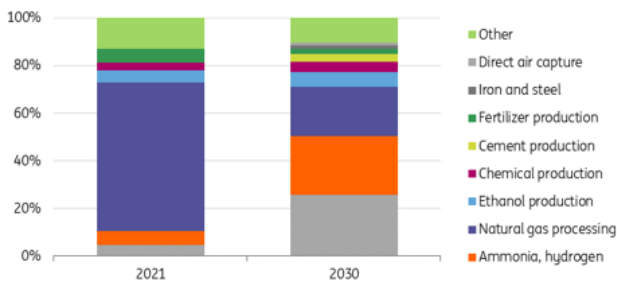
A more diverse mix

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.

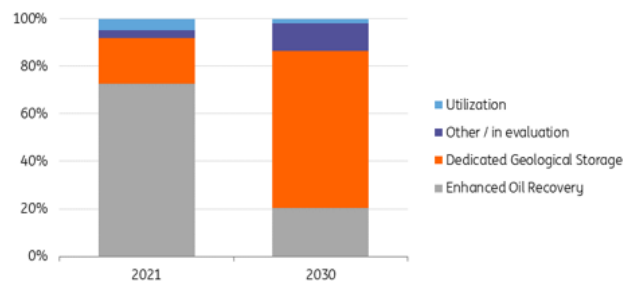
In parallel, there will be more projects that can permanently store and capture CO2, as opposed to only using CO2 for processes such as enhanced oil recovery. This will lead to more emissions reduction from CCS.

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

Global CCS capacity mix, by source



Global CCS capacity mix, by destination



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.

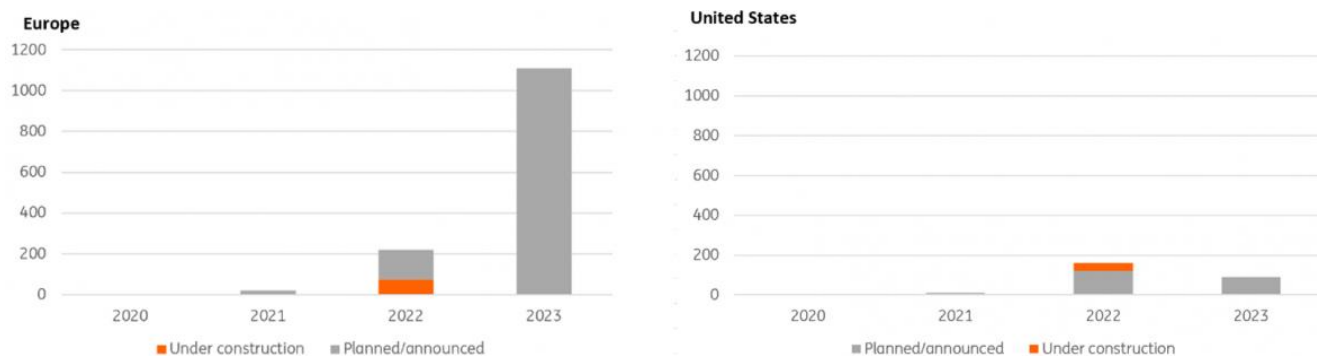
Hydrogen is still in its infancy, with most projects being in the development stage rather than the construction phase. Europe has more electrolyser projects in development to

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, electrolyzers 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: SIX

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.

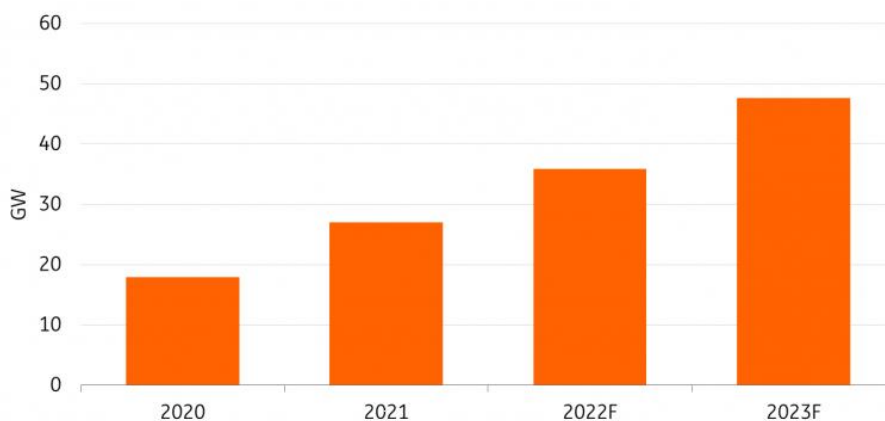
Batteries: Rapid increase in demand calls for more supply

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.

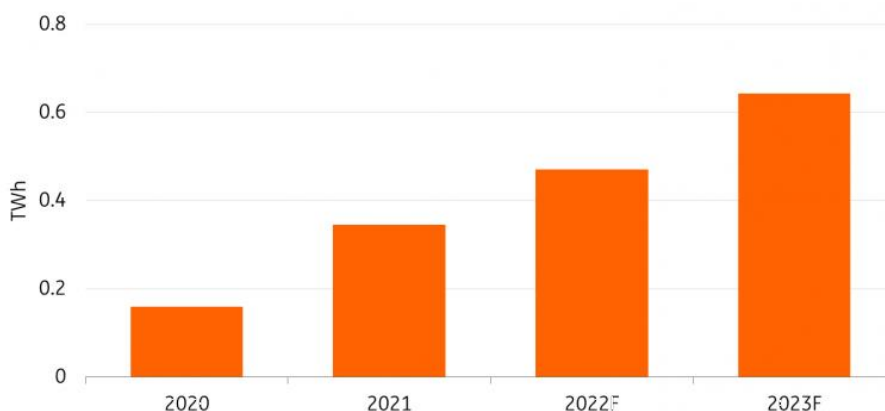
Global stationary battery storage forecast



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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