



RystadEnergy

Rebalancing Europe's Natural Gas Supply

2nd Edition Summary

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Report prepared for



American
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Institute

Technical input from



Introduction

The first edition of this study, published in 2022, was triggered by Russia's invasion of Ukraine and the subsequent reduction of natural gas supplies from Russia. The study results received significant interest from European Union (EU) policymakers as well as from various national governments and industry stakeholders.

The study showed how Europe can rebalance its natural gas supplies by maximizing existing domestic production and pipeline imports, and by significantly increasing liquefied natural gas (LNG) supplies. It showed how the gas infrastructure was able to handle new west-east flows following debottlenecking measures and LNG regasification terminals mainly in Northwest Europe, and how the internal market ensured that gas was transported where it was needed most. The 2022 edition of the study can be found [here](#).

This second edition of the study builds on the first instalment but addresses questions raised by policymakers, discusses lessons learned

about gas market functioning since the beginning of the war, and looks more closely at the need for future natural gas supplies to Europe and related policy implications.

As with the first edition, this latest edition benefits from an integrated value chain approach, with data input from the European Network of Transmission System Operators for Gas (ENTSO-G) and Gas Infrastructure Europe (GIE), to reflect infrastructure developments, and from the American Petroleum Institute (API), reflecting global LNG market dynamics. The study is co-funded by the International Association of Oil & Gas Producers (IOGP) Europe and API.

The scope of the study once again is wider Europe – the EU, the European Economic Area (EEA), the UK, Switzerland, Ukraine, and the Balkan states. The time horizon used in the report is 2040.

Gas market review, 2022/2023

- Market signals helped balance market through lower demand and higher LNG imports

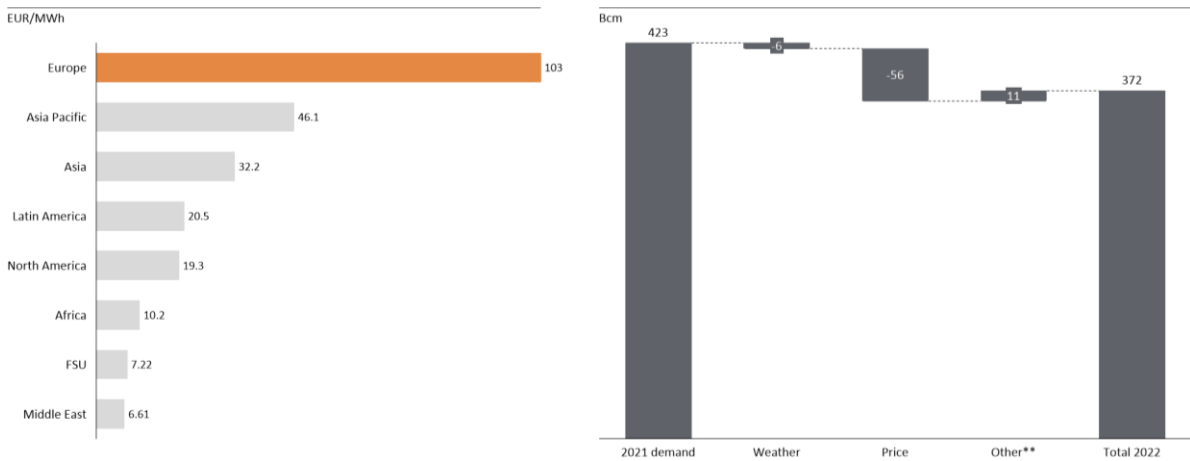
Gas market functioning was at the core of mitigating an energy supply crisis in Europe largely as a result of the Russia-Ukraine conflict. High gas prices redirected global LNG streams and triggered industrial demand reduction or destruction, fuel switching, and consumer behavior changes.

Both, the increased cost for natural gas supplies between February 2022 and September this year and the lost gross domestic product (GDP) triggered by the supply shock, suggest that a resilient natural gas supply mix from diverse and reliable sources has significant value for Europe's

economy and citizens.

The study confirms that the sudden demand for supplies mostly from the global LNG market came at a cost: average wholesale prices in Europe in 2022 where €103 per megawatt-hour (MWh), compared with average prices in Asia (including mainland China) of €32 per MWh, and in North America of €19 per MWh. The surge in the average full year wholesale price from 2021 to 2022 meant that EU27 alone paid an estimated additional €250B for the 2022 gas demand compared to what would be paid with 2021 price levels. See Figure 1 below.

Figure 1: 2022 average gas wholesale prices by region* and EU27 gas demand changes



However, the high prices attracted 'flexible' LNG cargoes to Europe, increasing Europe's LNG supplies by 56 Bcm from 96 Bcm in 2021 to 152 Bcm in 2022. The strong demand for LNG increased Europe's share in the global 'flexible LNG market'*** to a record level of 70% (versus 35% before).

The high market prices not only attracted new supplies but also reduced market demand by 56 Bcm or 13% last year compared to 2021. Other demand impacts from mild weather, more renewable energy, and low nuclear availability nearly offset each other. See Figure 1 above.

*EUR/USD as of Oct 11th 2023 at 0.94; **Other is defined as net effect of less nuclear and more renewable power generation

***Flexible LNG market' described by Rystad as sum of all cargoes available for spot sales and those contracted based on US FOB/portfolio terms

Source: Rystad Energy research and analysis, Rystad Energy GasMarketCube; IGU; IEA

Gas market review, 2022/2023

- Market signals helped balance market through lower demand and higher LNG imports

The study estimates that the supply shock contributed to €2.8 trillion of lost GDP growth in the EU alone (European Central Bank data on expected GDP growth) between 2022 and 2028.

These data stress the significant value of a diversely and sufficiently supplied European gas system being resilient against supply shocks. Long-term (LNG) contracts can increase resilience because they can reduce exposure to short-term global price volatility and – depending on detailed contractual terms – can provide buyers with a first call on the right to be supplied.

Swift government and industry actions debottlenecked remaining cross-border infrastructure barriers in Europe, enabling west-to-east gas flows, and replacing Russia's pipeline capacity to Northern and Western Europe with LNG regasification capacity.

The study shows that the about 118 Bcm per annum (Bcma) of lost import capacity from Russia into Germany and the Baltics (Nord Stream I & II and Imatra) was partially compensated quickly through 36 Bcma of new LNG regas capacities and the new Baltic Pipe facility, as well as the full utilization of existing

LNG regas terminals in the region (31 Bcma).

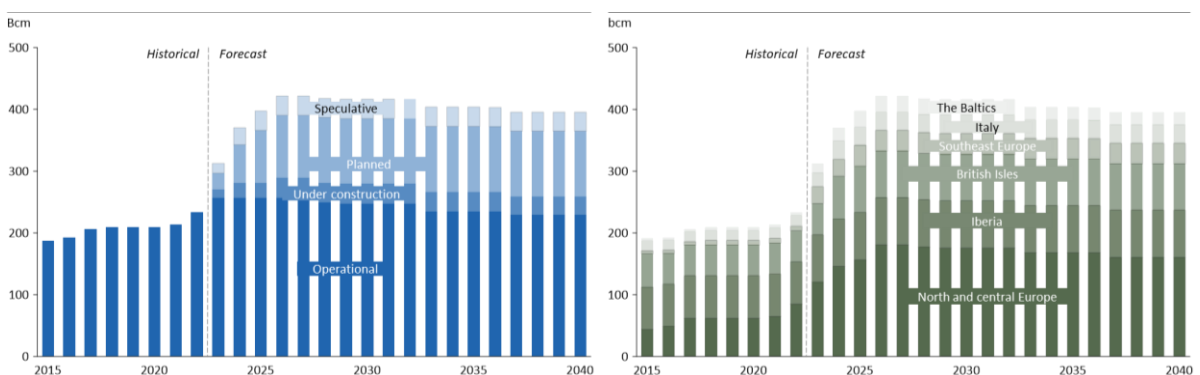
The additionally planned regas and floating storage and regasification unit (FSRU) capacities of 31 Bcma in that region will further increase the region's energy import capacity resilience. The recent flow interruptions of the Baltic Pipe gas pipeline are an example of how regas terminals ensure regional supply resilience.

The interconnectivity of Europe's gas system was further improved through various debottlenecking actions by Europe's gas infrastructure operators (details available on the websites of ENTSOG and GIE).

Imports through Europe's LNG regas terminals are now key to balancing Europe's natural gas demand.

Europe's total LNG import capacity from existing terminals and those under construction amounts to around 290 Bcma. Additional LNG regas capacity of about 100 Bcma is planned until 2026 and will further increase Europe's natural gas supply resilience. *See Figure 2 below.*

Figure 2: European regas capacity by status and region



Source: Rystad Energy research and analysis; Rystad Energy GasMarketCube; GIE

Gas market review, 2022/2023

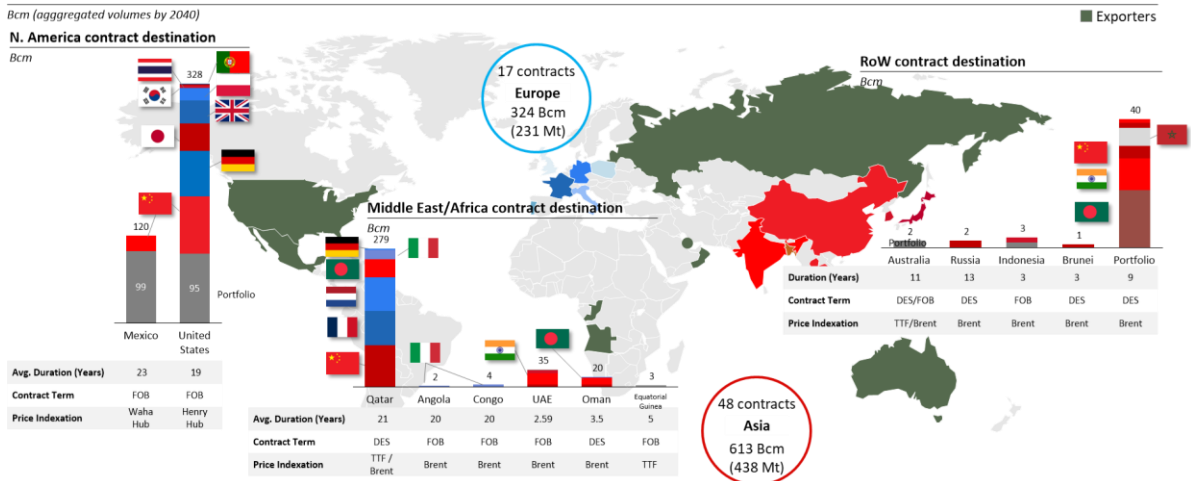
- Market signals helped balance market through lower demand and higher LNG imports

Europe's buyers secured only half of the LNG volumes secured by Asian buyers since February 2022.

The study shows that European buyers concluded 17 LNG contracts between 2022 and the end of October this year, securing an aggregate of 323 Bcm of supplies, whereas Asian buyers concluded 48 contracts, securing an aggregate of 613 Bcm of supplies over the same period. This demonstrates how Europe

and Asia are competing for long-term LNG contracts, with Asian buyers still in the driving seat. The inability or unwillingness to conclude longer-term contracts may stem from the significant uncertainty around future European natural gas demand and the potential resumption of Russian supplies. See *Figure 3 below*.

Figure 3: LNG contracts* concluded in 2022 and 2023



*Only includes SPA signed in 2022 and up to 31st October 2023, MoUs and HoAs are excluded

Source: Rystad Energy research and analysis, GasMarketCube

Gas market review, 2022/2023

- Market signals helped balance market through lower demand and higher LNG imports

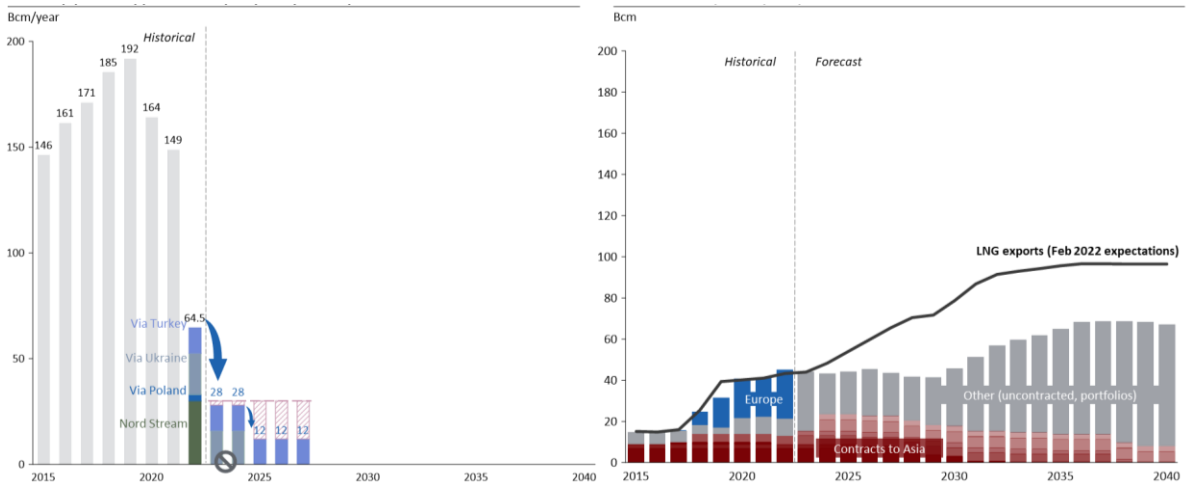
Gas sales from Russia to Europe until 2040 via pipelines and Russian LNG exports to the global market are expected to be about 3,200 Bcm and 450 Bcm lower, respectively, than expected prior to the invasion of Ukraine – in aggregate equivalent to about €750 billion in lost revenues.

Pipeline exports from Russia to Europe have reduced from levels of between 150 Bcm and 190 Bcm between 2015 and 2021 to 65 Bcm in 2022, while they are expected to fall to 28 Bcm in 2023 (via Ukraine and Turkey only), and to 12 Bcm as of 2025 (after the end of the Ukraine transport contract, via

Turkey only). This means Russia will forego about 3,200 Bcm of natural sales via pipelines to Europe through to 2040, corresponding to €660 billion of lost revenues at pre-war export price levels.

The study shows that Russia will be able to compensate for no more than 12% of these volumes through the increase of exports of natural gas-based products, such as fertilizers, and through the increase of sales to China, but only if the 2,800-kilometer Power of Siberia II pipeline can be built. See *Figure 4 below*.

Figure 4: Russian European pipelines supplies and Russian LNG exports



Source: Rystad Energy research and analysis; Rystad Energy GasMarketCube

Mid-term outlook

- *Fragile market equilibrium where Asia and Europe compete for limited LNG cargoes*

Mid-term outlook is expected to reflect a tight market where European buyers compete with Asian buyers for remaining supplies and where Europe is exposed to global market volatility. The market exists in a fragile equilibrium where price volatility is expected given the uncertainty around demand and supply as well as limited spare capacity.

With the aim of assessing the need for future natural gas supplies to Europe, the study determines a 'Median Demand Scenario': Rystad Energy assessed 18 demand forecasts from the EU, the International Energy Agency (IEA), ENTSOG as well as oil and gas companies.

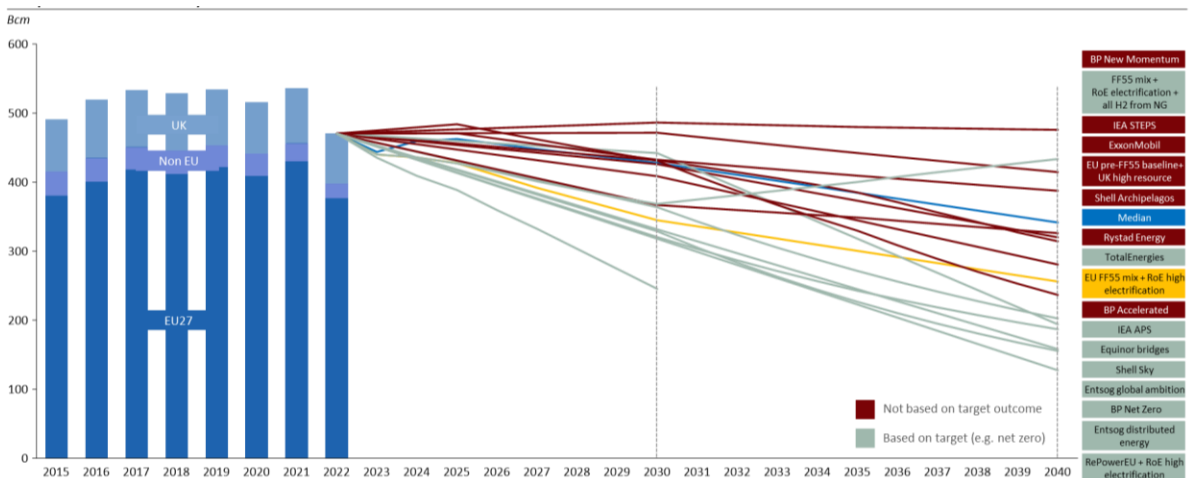
Forecasts show natural gas demand of 180 Bcm to 480 Bcm by 2040, a huge variation depending on assumptions on the transition speed and whether a forecast is developed 'backward', starting at an envisaged future target, or developed 'bottom-up', beginning at today's consumption patterns and installed technologies. Additional uncertainty stems from the potential of Russia to once again

potentially supply certain volumes to Europe longer term. The demand variations and Russia's supply potential create significant uncertainties for investors along the value chain – uncertainty not only for those who invest into the supply of natural gas but also for industries that invest into the decarbonization of their activities, such as the capture and storage of carbon dioxide (CO₂) or the production of low-carbon hydrogen.

More certainty about Europe's future natural gas demand and supply options can increase certainty for investors, thus reducing risks of future supply shocks.

Rystad Energy defines a 'Median Demand Scenario' as the median of all non-outcome-based forecasts. That forecast shows 341 Bcm of natural gas demand by 2040 and is 85 Bcm higher than the EU Fit for 55 Mix Scenario (plus forecast demand in the rest of Europe). See Figure 5 below.

Figure 5: European gas demand outlook by scenario



Countries included: the EU, the EEA, the UK, Switzerland, Ukraine, and the Balkan states. Multiple scenarios use relevant growth rate for outlook – geographic coverage is not 1 to 1 with historical data points. EU FF55 mix + RoE high electrification refers to EU Fit For 55 Mix scenario and UK High Electrification net zero pathway scenario. EU FF55 demand decline also used for rest of Europe.

Source: Rystad Energy research and analysis; Rystad Energy GasMarketCube; European Commission; UK Department for Business, Energy & Industrial Strategy; IEA; Equinor; TotalEnergies

Mid-term outlook

- Fragile market equilibrium where Asia and Europe compete for limited LNG cargoes

The study shows that even with all competitive domestic production and pipeline imports, European buyers still need to contract about 600 Bcm of natural gas supplies in aggregate between 2023 and 2027. These volumes will need to be supplied from the global LNG market to balance forecast demand with supply – natural gas that otherwise would have been supplied by Russia. See Figure 6 below.

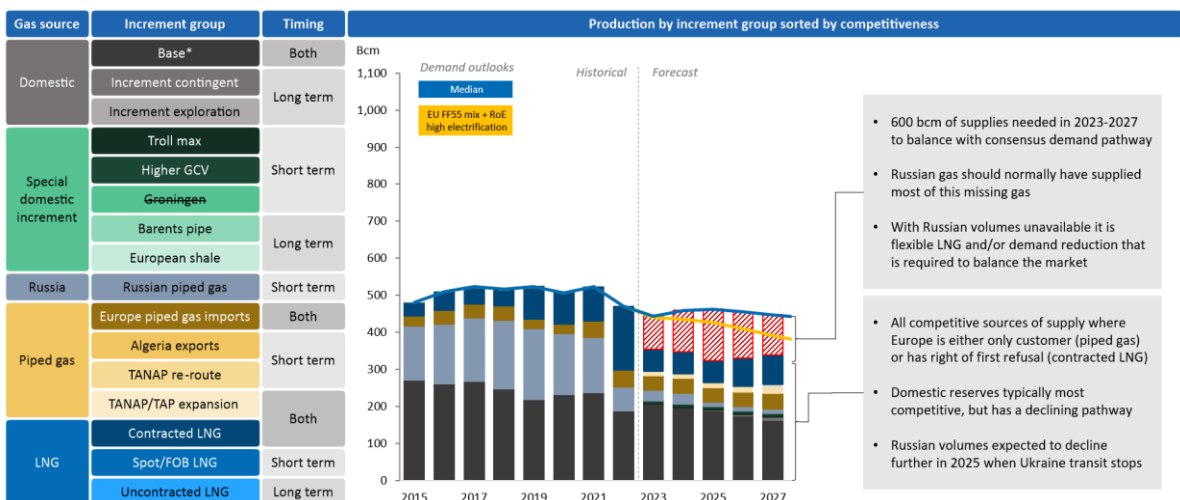
The global LNG market is expected to remain tight until about 2027. Assuming LNG supplies into Asia with delivered ex-ship (DES) terms are not directly available for supplying Europe, Europe's share in the global flexible LNG market – defined by Rystad Energy as all uncontracted volumes available for spot sales and US free on board (FOB)/portfolio contracts – would increase from 35% in 2021

to record high levels of about 60% to 80% between 2023 and 2027.

Europe has so far secured only 33% of the LNG supplies it needs for the period from 2023 to 2027. If market conditions result in high demand – for example, driven by weather, economic activity or supply outages – in both Europe and Asia, short-term available flexible LNG volumes may not be sufficient to supply both markets, thus likely triggering market reactions, including strong competition for the redirection of even long-term contracted LNG supplies.

Without resilient and longer-term LNG supplies, Europe remains exposed to the volatility of the global LNG market.

Figure 6: Gas supply by increment group sorted by competitiveness



Note: EU FF55 mix + RoE high electrification refers to EU Fit For 55 Mix scenario and UK High Electrification net zero pathway scenario. EU FF55 demand decline also used for rest of Europe. Contracted LNG volumes as of end of October 2023. *Base increment group includes storage

Source: Rystad Energy research and analysis; Rystad Energy GasMarketCube; European Commission; UK BEIS

Mid-term outlook

- *Fragile market equilibrium where Asia and Europe compete for limited LNG cargoes*

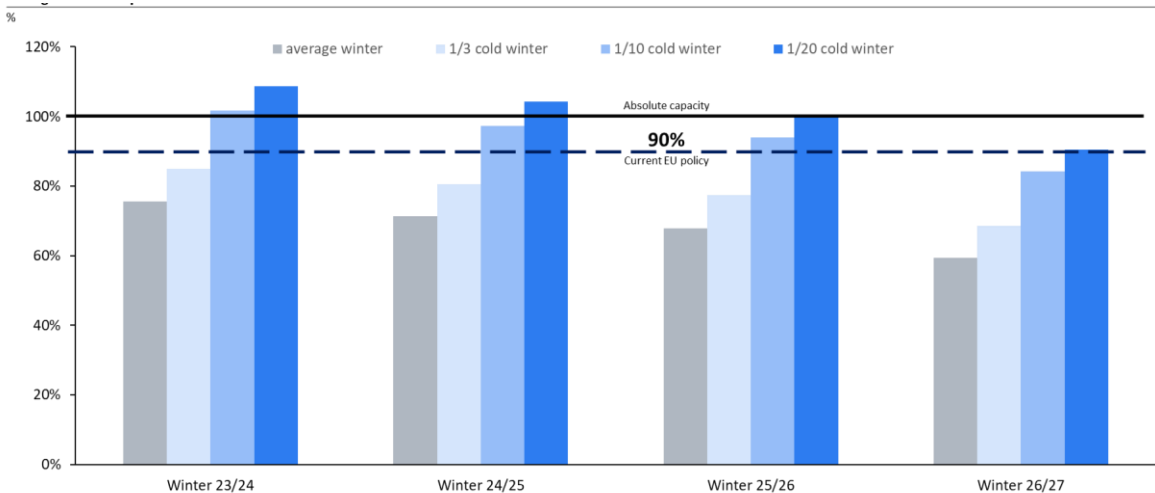
Europe needs to fully utilize its storage in the short term. Filling levels depend on risk appetite towards exposure of short-term LNG supplies in a tight market versus willingness to pay ‘insurance premia’.

The study describes how the reduction or end of flexible supplies from the Groningen field in the Netherlands, from Russia, and from the Troll field in Norway have created the need for flexible supplies from other sources.

Despite the recent LNG regas capacity additions, the global flexible LNG market will struggle to supply Europe if demand nears

levels equal to the coldest winter of the past 20 years. This increases the role of Europe’s storage facilities in supplying Europe’s winter demand peaks. The study suggests that storage filling levels between 75% and 105% are needed for 2023/2024 winter if a market share of 80% in the global flexible LNG market shall not be exceeded. Those shares reduce to a range from 60% to 90% until the winter of 2026/2027. See Figure 7 below.

Figure 7: Storage level required before winter withdrawal* season



*Assumes 108.8 Bcm storage capacity of European facilities. Assumes average modelled supply with maximum historically observed share of LNG imports
Source: GIE

Long-term outlook

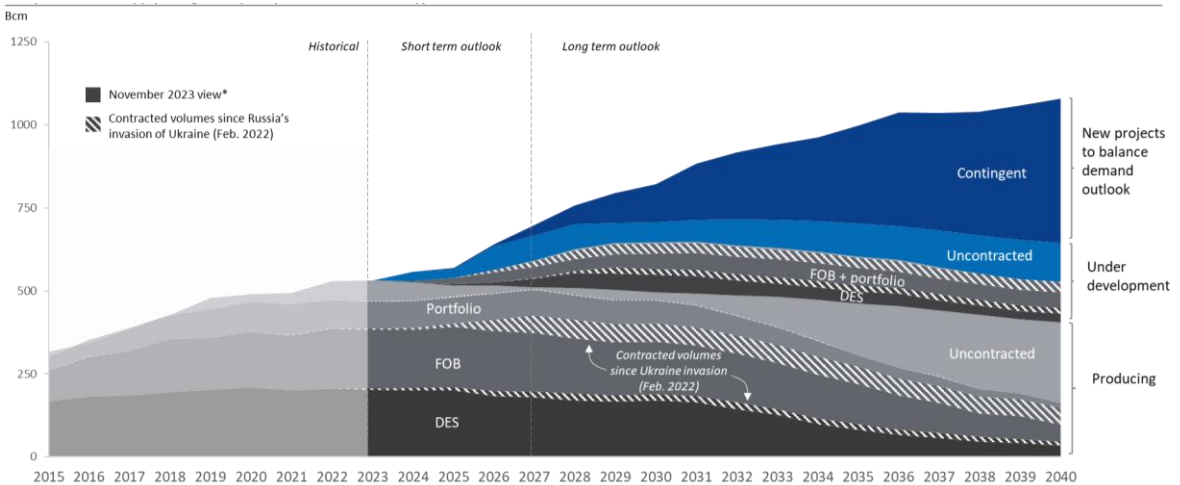
- Europe likely to be short gas with LNG as only possible supply choice

Europe has contracted only 32% of the LNG it needs for 2028 to 2040 but has the opportunity to do so in a market with an abundance of long-term LNG supply opportunities. However, significant new liquefaction capacity must likely be underpinned by new long-term contracts in order to secure sufficient global supply to meet demand projections.

As a function of government demand projections in Asia, the median demand case in Europe and stagnating to falling domestic supply in both regions, global LNG demand is expected to double towards 1,080 Bcma by

2040. The study shows that before Russia's invasion of Ukraine, 4,900 Bcm of global LNG supplies (from existing LNG liquefaction plants and those under development) was available in aggregate for contracting over the period 2023 to 2040. This available volume has, meanwhile, reduced by 35% to 3,170 Bcm following the rush for LNG contracts, mainly by Asian buyers in the past 1.5 years. See *Figure 8 below*.

Figure 8: Competitive LNG supply categories split by contracted volume type



Note: FOB – Free on Board; DES – To destination; * Contracts signed by end of October 2023

Source: Rystad Energy research and analysis

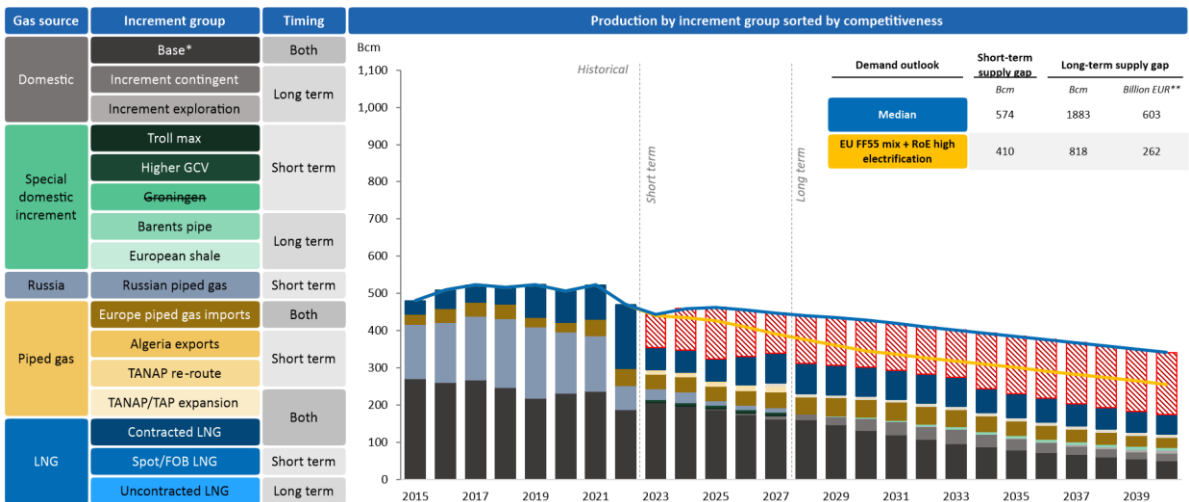
Long-term outlook

- Europe likely to be short gas with LNG as only possible supply choice

Assuming the Median Demand Scenario and no re-entry of supplies from Russia, European buyers have contracted only 890 Bcm of the LNG needed for between 2028 and 2040, while Europe will need about 1,900 Bcm of additional LNG supplies for that period. In other words, European buyers have only

contracted 32% of the LNG needed for that period. Europe will have to consider what type of approach it wants to take vis a vis the global LNG market – being either a follower or a proactive participant. See Figure 9 below.

Figure 9: Gas supply by increment group sorted by competitiveness



Note: EU FF55 mix + RoE high electrification refers to EU Fit For 55 Mix scenario and UK High Electrification net zero pathway scenario. EU FF55 demand decline also used for rest of Europe. Contracted LNG volumes as of end of October 2023; *Base increment group includes storage. **Based on 10 USD/Mmbtu, 0.9 EUR/USD and 35.7 trillion btu per bcm
Source: Rystad Energy research and analysis; Rystad Energy GasMarketCube; European Commission; UK BEIS

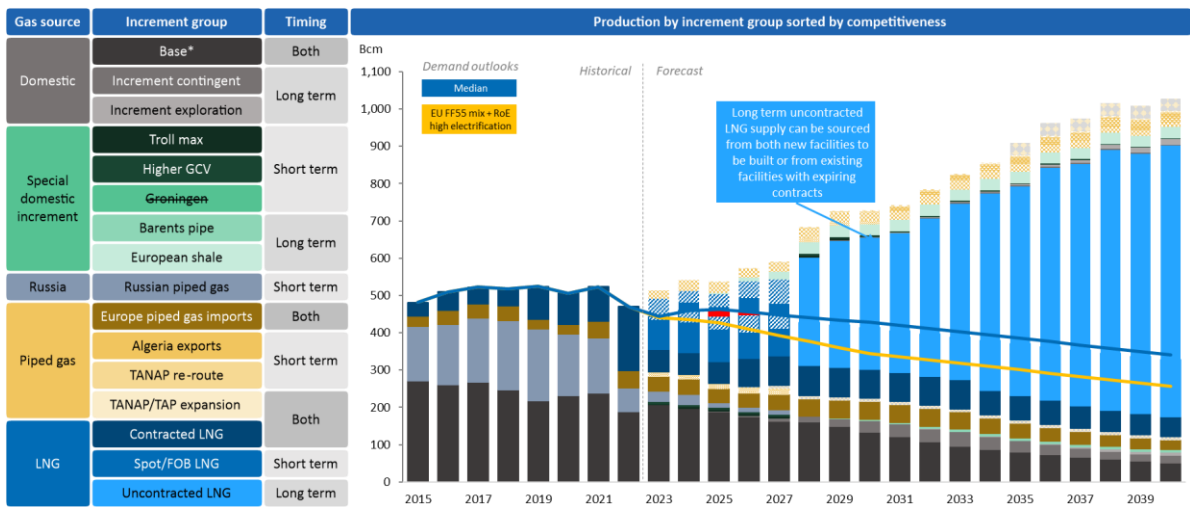
Long-term outlook

- Europe likely to be short gas with LNG as only possible supply choice

However, the study also shows that, longer term, there is an abundance of LNG supplies available if investment decisions are taken to develop LNG projects from the 'contingent' category, typically projects which need at least

partial underpinning by contracts before investment decisions are taken. See Figure 10 below.

Figure 10: Gas supply by increment group sorted by competitiveness



Note: EU FF55 mix + RoE high electrification refers to EU Fit For 55 Mix scenario and UK High Electrification net zero pathway scenario. EU FF55 demand decline also used for rest of Europe. Contracted LNG volumes as of end of October 2023. *Base increment group includes storage

Source: Rystad Energy research and analysis; Rystad Energy GasMarketCube; European Commission; UK BEIS

Long-term outlook

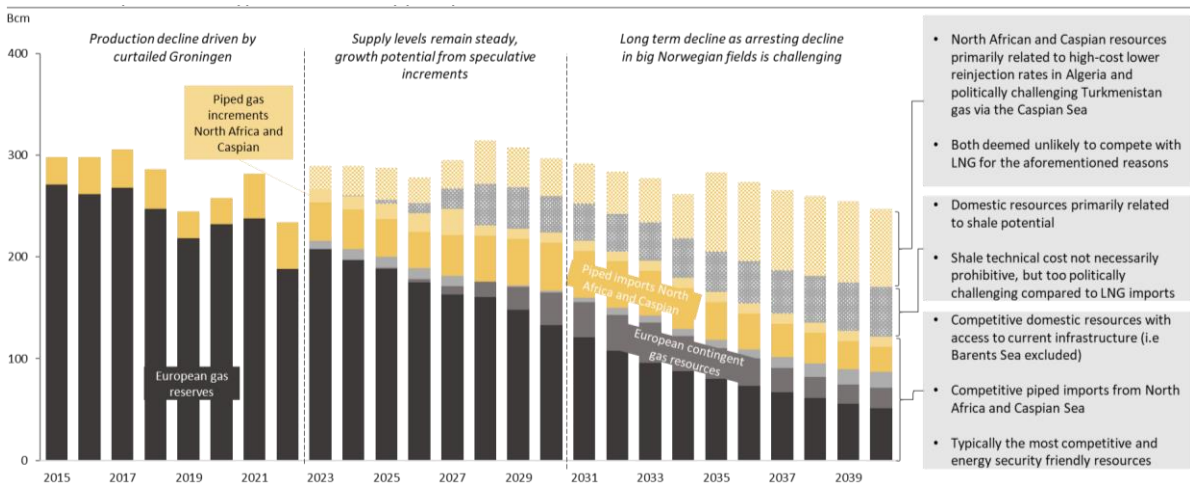
- Europe likely to be short gas with LNG as only possible supply choice

Europe can increase the resilience of its energy system by looking for supplies in its own backyard and from reliable neighbors – but there are limited options.

Europe's supplies from domestic sources are expected to gradually decline from 190 Bcma (corresponding to 40% of total supplies to Europe) in 2022 to about 90 Bcma by 2040, mainly due to the decline of Norwegian production. However, this decline of domestically produced gas could be somewhat halted if policymakers were to support the development of Europe's domestic resources, especially its shale gas potential. Shale gas

alone is estimated to have the potential to contribute around 10 Bcma within a decade but has permitting barriers to resolve before any production can be realized. The development of these domestic resources would directly reduce Europe's need to import LNG, thus increasing Europe's energy autonomy. Domestic production also likely has a lower greenhouse gas footprint as it does not need to be transported over long distances or be subject to the energy intensive liquefaction process. *See Figure 11 below.*

Figure 11: Overview of European domestic supplies and non-Russian piped imports*



*Does include net storage as in supply stack, hence relatively large movements

Source: Rystad Energy research and analysis; Rystad Energy GasMarketCube

Long-term outlook

- Europe likely to be short gas with LNG as only possible supply choice

Pipeline import potential from North Africa (Algeria and Libya) and the Caspian region (via the TANAP and TAP pipelines) has increased by approximately 12.5 Bcma versus the first edition of the study, mainly due to higher expected imports from Algeria (due to the discovery of the large LD2 Hassi R'mel formation).

The study continues to expect an expansion of the TANAP and TAP pipelines as of 2027 (now also backed by the EU's strategic partnership with Azerbaijan) and some marginal re-routing to Europe of volumes originally supplying Turkey. Any possible supply potential from resources in the Eastern Mediterranean region continues to be assessed as being supplied through the global LNG pool, having a small impact on the global LNG balance.

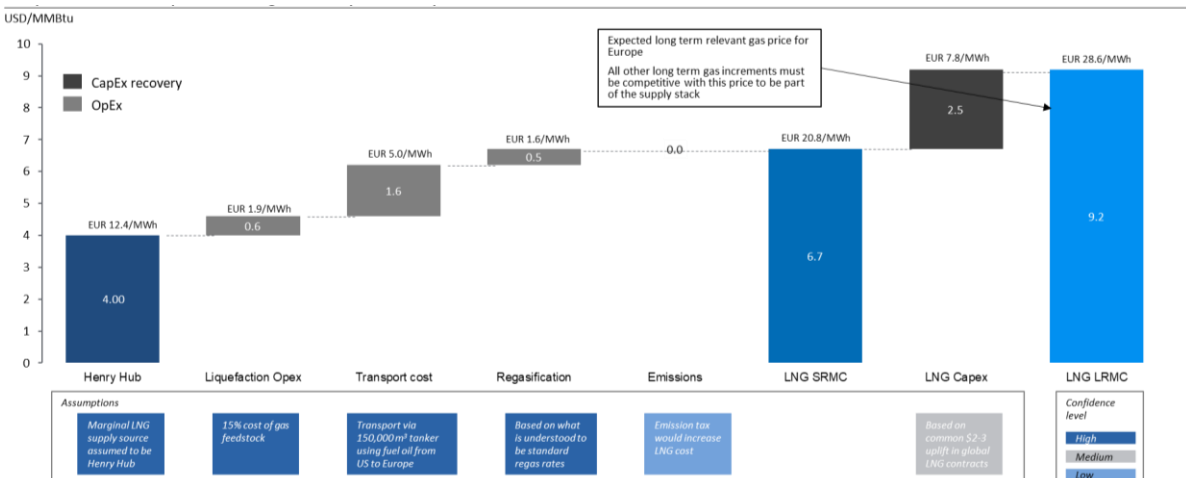
While North American LNG is expected to have a high global market share and act as a price setter, Europe can diversify its supplies

and increase its resilience by contracting with suppliers in Africa and the Middle East.

The study shows the relative competitiveness of North American LNG supplies to Europe with long run marginal cost (LRMC) of supplies into Europe at pre-crisis expectation levels. Rystad Energy assesses the LRMC of supply at the US Henry Hub at €12 per MWh. Adding cost for liquefaction, shipping, regasification, and return on capital employed, Rystad Energy assesses the LRMC of LNG supplies to Europe at about €30 per MWh. This is similar to levels expected prior to Russia's invasion of Ukraine. See Figure 12 below.

However, contracting LNG supplies from Africa (for example, Tanzania, Mozambique, Mauritania, Senegal, Nigeria, Angola, Egypt) and the Middle East (mainly Qatar and the UAE) can diversify Europe's supply mix.

Figure 12: LNG price forecast buildup based on long-term Henry Hub assumption



Hydrogen outlook

- Blue hydrogen can help ease pressure on green hydrogen expansion

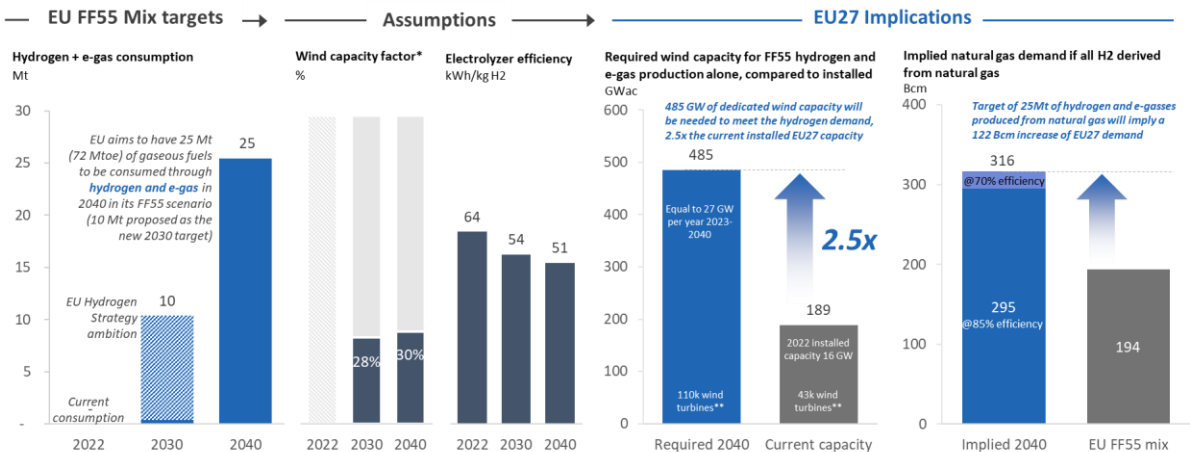
The non-backcasted demand outlooks indicate a skepticism that the wind capacity required to meet EU policy scenario clean power to produce green hydrogen by 2040 can be achieved. A commensurate path to help establish hydrogen as a pillar in Europe's future energy system can involve low-carbon hydrogen derived from natural gas with carbon capture and storage as the main abatement mechanism.

The study points out that the 25 million tonnes (72 million tonnes of oil equivalent) of hydrogen (including hydrogen demand to produce E-fuels) envisaged to be produced by 2040 under the Fit for 55 Mix Scenario would require about 1,275 TWh per annum of electricity if produced through electrolysis. Assuming that this amount of electricity would be produced exclusively with wind power, a

total wind power capacity of 485 gigawatts (GW) would be needed to produce these volumes of hydrogen alone. This wind power capacity corresponds to 257% of the total wind capacity in the EU in 2022 and would require annual wind power capacity additions of 27 GW annually through 2040 for the production of hydrogen alone.

These additions come on top of the new wind capacities needed to decarbonize the power sector and supply the electrification of Europe's energy system (EVs, heat pumps, etc.). This aggregate number compares with 2022 additions of about 16 GW. It is this rapid capacity expansion the non-backcasted outlooks deem too ambitious. *See Figure 13 below.*

Figure 13: Hydrogen assumptions



*Average wind capacity factor from EU FF55 Mix scenario. **Based on 2022 average MW capacity per turbine

Source: EU Commission; Rystad Energy research and analysis; Wind Europe; IEA

Hydrogen outlook

- Blue hydrogen can help ease pressure on green hydrogen expansion

If wind power capacity additions will not be realized as needed, yet the objective of the build-up of a hydrogen economy in Europe is maintained, the 25 million tonnes of hydrogen can be produced with natural gas using one of the lowest-cost carbon abatement technologies: carbon capture and storage (CCS). This would, however, increase natural gas demand by 2040 as forecast under the EU Fit for 55 Scenario (and for the Rest of Europe) from 256 Bcm to 433 Bcm (+177 Bcm). Natural gas can, therefore, be the fallback solution to

produce the low-carbon hydrogen the energy transition needs and thus reduce pressure on RES in supplying the energy Europe needs, although it will require additional CCS capacity to be added. Rystad Energy also assesses that producing the above-mentioned 25 million tonnes of hydrogen by 2040 through steam reformed natural gas with CO₂ capture, would create a need for 232 million tones of CO₂ annual storage injection capacity.

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Navigating the future of **energy**

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