

Gas Market Report, Q4-2022

including *Global Gas Security Review 2022*



INTERNATIONAL ENERGY AGENCY

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Abstract

This year's winter gas season opens with extreme natural gas price levels and volatility, caused by unprecedented uncertainty of supply as Russia steeply curtails its pipeline deliveries to Europe. The result is considerable market tension in alternative sources of supply. Security of supply has become a top priority in Europe and other importing regions as a total cut-off in Russian flows to Europe cannot be ruled out, creating further tensions and demand destruction for all competing LNG importers.

The gas crisis triggered by Russia's invasion of Ukraine in February 2022 has caused a series of market adjustments. European buyers have strongly increased their LNG procurement, resulting in market tightening and demand destruction in various importing regions. This has also had a visible impact on LNG contracting behaviours, with a return to more traditional features such as fixed-destination and longer-duration contracts. The European Union, whose member states are directly exposed to the threat of further supply cuts, has adopted a number of measures to enhance security of supply and market resilience ahead of the coming winter.

This quarterly report includes the IEA's annual *Global Gas Security Review* and an analysis of short-term gas market evolution to 2023.

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Cold comfort

As the summer ends in the northern hemisphere on new highs for natural gas prices and volatility, and markets brace themselves for a winter of unprecedented uncertainty of supply due to Russia's behaviour, security of energy supply has become a priority issue for consumers and policy makers across major consuming markets. A complete shutdown of Russian pipeline flows to the European Union cannot be ruled out.

The sharp decline in Russian gas flows to Europe and a tight power market drove European gas prices – and indirectly Asian spot LNG prices – to record highs in the third quarter of 2022. Meanwhile, prices in the United States reached their highest summer levels since 2008. This has come with extremely high price volatility, which further increases financial pressure on market participants and the risk of defaults, limiting the number of active market participants and resulting in further volatility.

The high price and tight supply environment has led to a decline in natural gas consumption across a majority of regions. In OECD Europe, gas demand declined by close to 10% y-o-y in the period January to August, falling by an estimated 15% in industry due to production curtailments. Major Asian gas markets experienced limited to negative growth – China and Japan were close to flat, and India and Korea contracted. South and Central America also recorded a decline in H1. North America was one of the few regions where demand increased, supported by demand from power

generation and comparatively lower prices – albeit at decade highs. This forecast expects global gas demand to decline by 0.8% this year, followed by meagre 0.4% growth in 2023.

Preparing for winter

Against the backdrop of growing uncertainty and systemic supply risk for the forthcoming winter, in the early days of the summer the IEA emphasised [the essential role of co-ordinated action across Europe to prevent a major gas crunch](#). The agency put forward concrete measures to further enhance the region's resilience against the risk of a full cut-off in gas supply from Russia. The European Union and its member states have taken a range of measures and actions over recent months to strengthen security of supply, including further diversifying supply sources, setting minimum underground storage inventory obligations, and co-ordinating seasonal demand reductions.

The IEA's seasonal resilience analysis shows that gas saving measures will be crucial in Europe to minimise the call on storage in the instance that Russia entirely cuts pipeline supply this winter, and thus to maintain supply flexibility for potential late cold spells. Interregional competition in LNG procurement may create further tension, as additional European needs would put more pressure on other buyers, especially in Asia, and conversely cold spells in Northeast Asia could limit Europe's access to LNG

Global Gas Security Review 2022

Securing natural gas supply in times of crisis

This seventh issue of the IEA's annual *Global Gas Security Review* comes at a time when the global energy crisis – triggered by Russia's invasion of Ukraine – has put security of supply back on the agenda. This is in sharp contrast with the loose energy supply situation experienced during the Covid-19 pandemic only two years ago.

The gas crisis has triggered a series of market adjustments and policy measures to increase resilience ahead of winter

High prices and a tight supply market environment have led to a decline in natural gas consumption across a majority of regions. In OECD Europe, which is directly exposed to the impact of Russian gas supply cuts, gas demand fell by close to 10% y-o-y in the period January to August 2022. The repercussions of the crisis have extended to all gas importing regions, as Europe's surging LNG demand has led to supply tensions and spiralling spot prices for competing buyers.

Gas consumption recorded limited to negative growth in most Asian markets: it increased by less than 1% y-o-y in the first eight months of 2022 in China, decreased by nearly 4% in India over the same period, and was flat in Japan during H1. South and Central America experienced an estimated 3% y-o-y decline in H1. North America was one of the few regions where demand increased (up by over

4% in the United States in the first eight months and 8% in Canada in H1), supported by demand from power generation and comparatively lower prices – nonetheless at decade highs.

The European Union and its member states adopted a number of measures to enhance security of supply and market resilience ahead of the coming winter. They include a new storage regulation that sets a minimum 80% filling level at the opening of winter 2022/23, and up to 90% for the following years. The bloc is also ramping up its LNG import capacity, either through the expansion of existing onshore regasification plants or the hiring of floating storage and regasification units (FSRUs). Several EU-based companies secured additional LNG supply via tenders and short-term LNG contracts. In addition to the record inflow of LNG, EU member states started to diversify their imports from non-Russian pipeline suppliers. The European Union adopted a 15% voluntary reduction target for its gas demand between 1 August 2022 and 31 March 2023, compared with its five-year average.

The IEA conducted a seasonal resilience analysis of the European market in the case of complete Russian pipeline gas supply cut-off, starting from 1 November 2022, including the risk of a potential late cold spell. The analysis shows that a demand reduction of 9% compared to the five-year average would be necessary to maintain storage levels above 25% in the case of lower LNG inflow, while a reduction of 13% compared to the five-year average would be

necessary through the winter period to sustain storage levels above 33% in the case of lower LNG supply. In this context, implementing gas saving measures will be crucial to minimise storage withdrawals and keep inventories at an adequate level until the end of the heating season.

LNG trade plays a critical role in providing flexibility and security of supply, but tight supply has affected contracting trends

Global LNG trade expanded by nearly 6% y-o-y in January through to August 2022. The market was driven by surging LNG demand in Europe, which rose by 65% y-o-y, triggering a wholesale realignment of LNG trade flows around the world. The Asia Pacific region, where LNG demand fell by 7% (or 18 bcm) y-o-y as a result of mild weather, high prices and Covid-related disruption in China, has provided most of the relief for the European market so far in 2022.

Amid high and volatile spot prices, LNG contracting activity rebounded strongly in 2021 (up 28% y-o-y) to about 80 bcm, second only to the 2018 record of 88 bcm. It has slowed in 2022 to date, with 27 bcm contracted with operational projects or projects under development – against 48 bcm in the same period of 2021. Two projects have taken final investment decision (FID) so far this year, both in the United States, for a total annual export capacity of 32 bcm.

The return to a sellers' market with growing LNG supply tension since 2021 has led to changes in contracting patterns, and especially a marked decline in destination flexibility. Flexible contracts accounted for almost 80% of the average contracted volumes in 2018-2019, and were driven by new FIDs in the United States. The share of destination-flexible volumes in new contracts dropped to 35% in 2020 and 11% in 2021. The trend has been more balanced in the first eight months of 2022, with destination-fixed contracts accounting for 47%. Contract duration has also been increasing, with long-term contracts (over 10 years) accounting for around 74% of newly signed LNG contract volumes in 2020 and 84% in 2021, up from an average of 60% in 2015-2019.

The gas crisis in Europe has drawn away from Asia not only flexible LNG volumes, but also the limited number of available FSRU vessels – which were initially expected to be deployed mainly in South and Southeast Asia as part of the region's energy transitions. As of August 2022 just over 20 FSRU vessels were available or under construction. Since the invasion of Ukraine, 12 FSRUs have been secured for recently approved import facilities in Europe, and another nine additional FSRU-based terminals are planned. This shift and resulting scarcity of FSRUs is challenging for emerging markets in Southeast Asia, where floating units were expected to account for a sizeable share of future regasification capacity.

Security of supply in the context of the current gas crisis

The European Union's gas supply security faces unprecedented risks amid the structural uncertainty created by Russia's behaviour

Russia's invasion of Ukraine triggered deep concern over gas supply security in the European market and ripple effects in the global LNG market. Russia's strategic behaviour of using natural gas as a political weapon has become increasingly obvious since September 2021. Despite available production and transport capacity, Russia has reduced its gas supplies to the European Union by close to 50% y-o-y since the start of 2022.

In the current context, the complete shutdown of Russian pipeline gas supplies to the European Union cannot be excluded ahead of the 2022/23 heating season – when the European gas market is at its most vulnerable. Almost half of natural gas is consumed in the residential and commercial sectors for space heating purposes during this period, with demand strongly linked to the variation in temperatures. The following section provides an overview of the European Union's preparedness for the 2022/23 winter and a resilience analysis in the case of a complete cut-off in Russian pipeline gas supply starting from 1 November 2022.

Russia's behaviour created structural uncertainty in the European market ahead of the 2022/23 heating season

Gazprom started to gradually reduce its gas supplies to the European Union ahead of the 2021/22 heating season. This

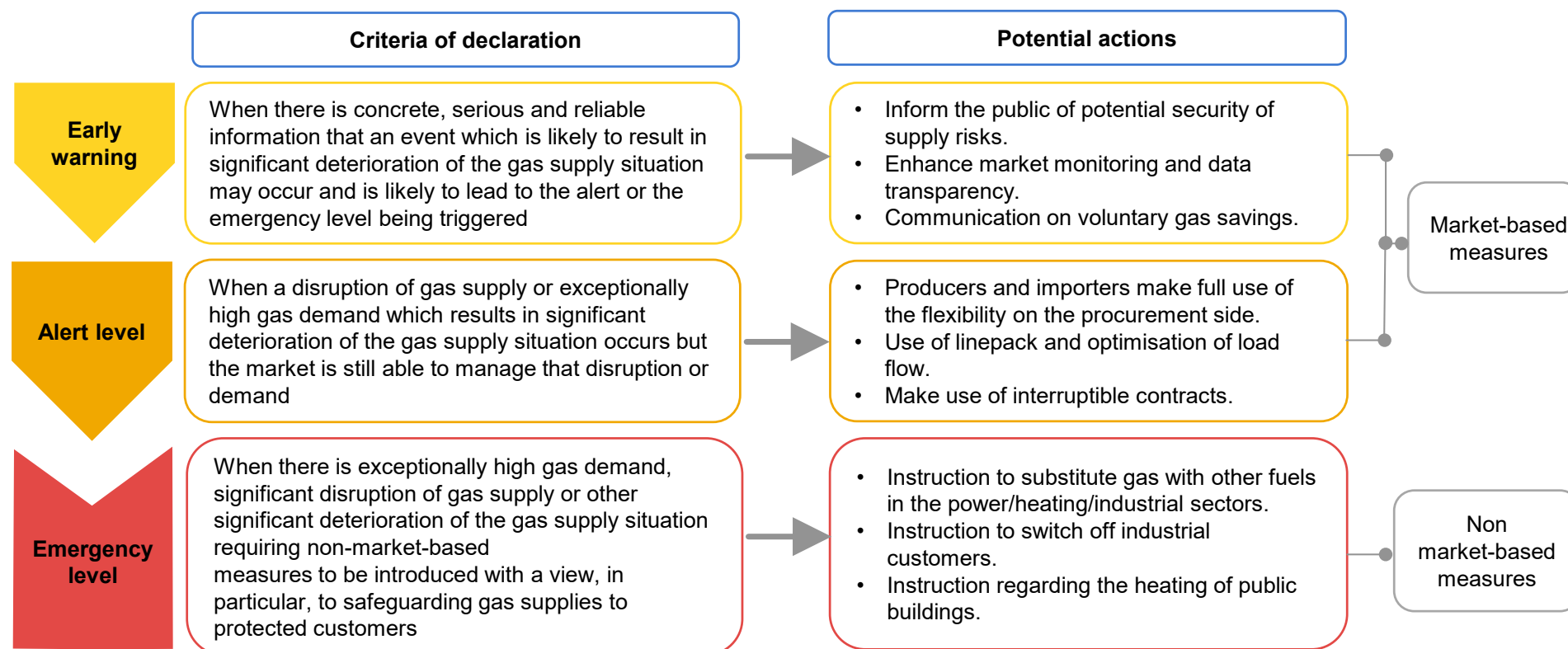
included lower direct sales to the European hubs, cessation of gas auctions on its electronic sales platform and failure to fill the company's gas storage sites in Europe. Reduced Russian gas flows and below-average storage fill levels created an environment of "artificial scarcity" on the European market, providing strong upward pressure on gas prices.

Russia has accelerated its gas supply cuts since the beginning of 2022. Gazprom unilaterally cut deliveries to several EU member states during Q2 2022 following their refusal to adhere to the new rouble-based payment system, which Russia introduced in late Q1. Gazprom also curtailed supplies to its former subsidiaries in Europe once they were placed under Russia's sanctions in May 2022. From mid-June, Gazprom gradually reduced gas deliveries via Nord Stream to just 20% of the pipeline's capacity and had completely stopped gas flowing via this route by the beginning of September.

Notably, Russian gas deliveries fell below the minimum contractual commitments with several European offtakers, creating structural uncertainty in the market. Amid the rapidly deteriorating gas supply picture, 11 EU member states issued early warning notices during Q1-3 under their gas emergency plans, while Germany issued an alert-level notice.

The European Union's security of supply regulation identifies three stages of gas crisis

Selected measures under the gas crisis levels of the European Union's regulation to safeguard the security of gas supply

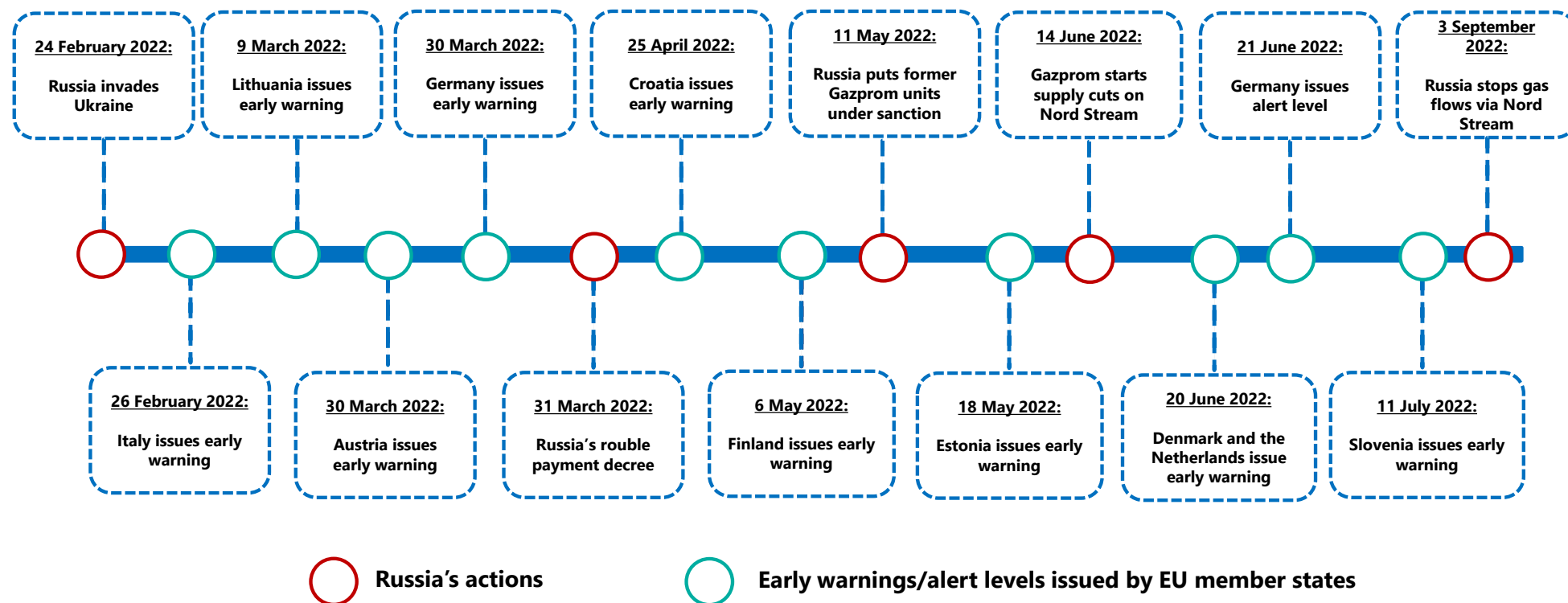


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Sources: IEA analysis based on [Regulation \(EU\) 2017/1938 of the European Parliament and the of the Council of 25 October 2017 concerning measures to safeguard the security of gas supply and repealing Regulation \(EU\) No 994/2010](#) and various [Emergency Plans](#) of EU member states.

By the end of Q3 2022, 11 EU member states had issued early warning notices, while Germany declared alert level under its gas emergency plan

Key gas supply security events, Q1-3 2022



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Winter is coming: Measures to enhance security of supply ahead of the 2022/23 heating season

The European Union and its member states have adopted a number of measures to enhance security of supply and market resilience ahead of the 2022/23 heating season. The IEA has provided thought leadership and expert guidance through a series of dedicated action plans and commentaries, and a [joint work programme with the European Commission](#).

Introduction of minimum gas storage obligations

The IEA's [10-Point Plan to Reduce the European Union's Reliance on Russian Natural Gas](#), published at the start of March 2022, suggested the introduction of minimum gas storage obligations. The agency noted that fill levels of at least 90% of working storage capacity by 1 October would be necessary to provide an adequate buffer for the European gas market through the heating season. The European Union [adopted a new storage regulation](#) at end of June 2022, according to which storage sites have to be filled to at least 80% of their capacity before the winter of 2022/23, and to 90% ahead of all following winter periods. Several EU member states (including Belgium, France, Germany and Italy) adopted more stringent storage regulations, aiming for fill targets above 90%. The European Union had reached its 80% fill target by the beginning of September and storage levels rose to over 88% of working capacity by the end of September 2022.

Build-up of additional LNG regasification capacity

LNG has played a key role in offsetting the shortfall in Russian gas supplies during 2022. EU LNG imports rose by almost 70% (or 35 bcm) y-o-y in the first eight months of 2022, driving up the utilisation rate of LNG terminals in northwest Europe to nameplate capacity. The expansion of existing regasification terminals and the leasing of FSRUs will allow the European Union to expand its regasification capacity by 15% (or 25 bcm/yr) during the 2022/23 heating season. This includes the expansion of the GATE terminal (4 bcm) and the start-up of the Eemshaven LNG terminal (8 bcm/yr) in the Netherlands, two FSRUs in Germany (with a combined capacity of about 8 bcm/yr) and the joint Estonia-Finland FSRU (~5 bcm/yr). While the European Union's expanding regasification capacity provides additional possibility to procure LNG, it does not necessarily guarantee an increase in LNG supply. Several EU-based companies secured additional LNG supply via tenders and short-term LNG contracts; however, the majority of incremental LNG supply this winter is expected to be sourced from the spot market.

Diversification of pipeline imports and enhanced midstream interconnectivity

In addition to the record inflow of LNG, EU member states started to diversify their imports from non-Russian pipeline suppliers. Italy's ENI reached agreement with Algeria's Sonatrach in April 2022 to gradually increase pipeline imports from 2022, by up to 9 bcm/yr in 2023-2024. EU gas imports from Azerbaijan rose by 50% y-o-y in

the first eight months of 2022. The European Commission signed a [Memorandum of Understanding on a Strategic Partnership in the Field of Energy](#) with Azerbaijan in July, noting that Azeri gas supplies could reach 12 bcm in 2022. The Baltic Pipe was inaugurated on 27 September 2022. The pipeline has a transmission capacity of 10 bcm/yr from Norway to Poland and 3 bcm from Poland to Denmark. Poland expects to receive 0.8 bcm of gas via the new pipeline system in Q4 2022.

In addition, several interconnectors were commissioned ahead of the 2022/23 heating season, further facilitating internal gas flows and enhancing market resilience:

- The gas interconnector between Poland and Lithuania was commissioned in May 2022. The technical capacity to Lithuania is 2 bcm/yr and interruptible capacity to Poland is 1.9 bcm/yr.
- The interconnector between Poland and Slovakia is set to start commercial operations at the beginning of October. The pipeline has a capacity of 4.7 bcm/yr in the direction of Slovakia and 5.7 bcm/yr to Poland.
- The Greece–Bulgaria interconnector is expected to start commercial operations at the beginning of October. The pipeline has a capacity of 3 bcm/yr and will facilitate Bulgaria's access to

Azeri pipeline gas and regasified LNG via Greece's LNG terminals.

- Gas transmission capacity from Romania to Hungary increased by almost 50% (or 0.75 bcm/yr) from 1 October.

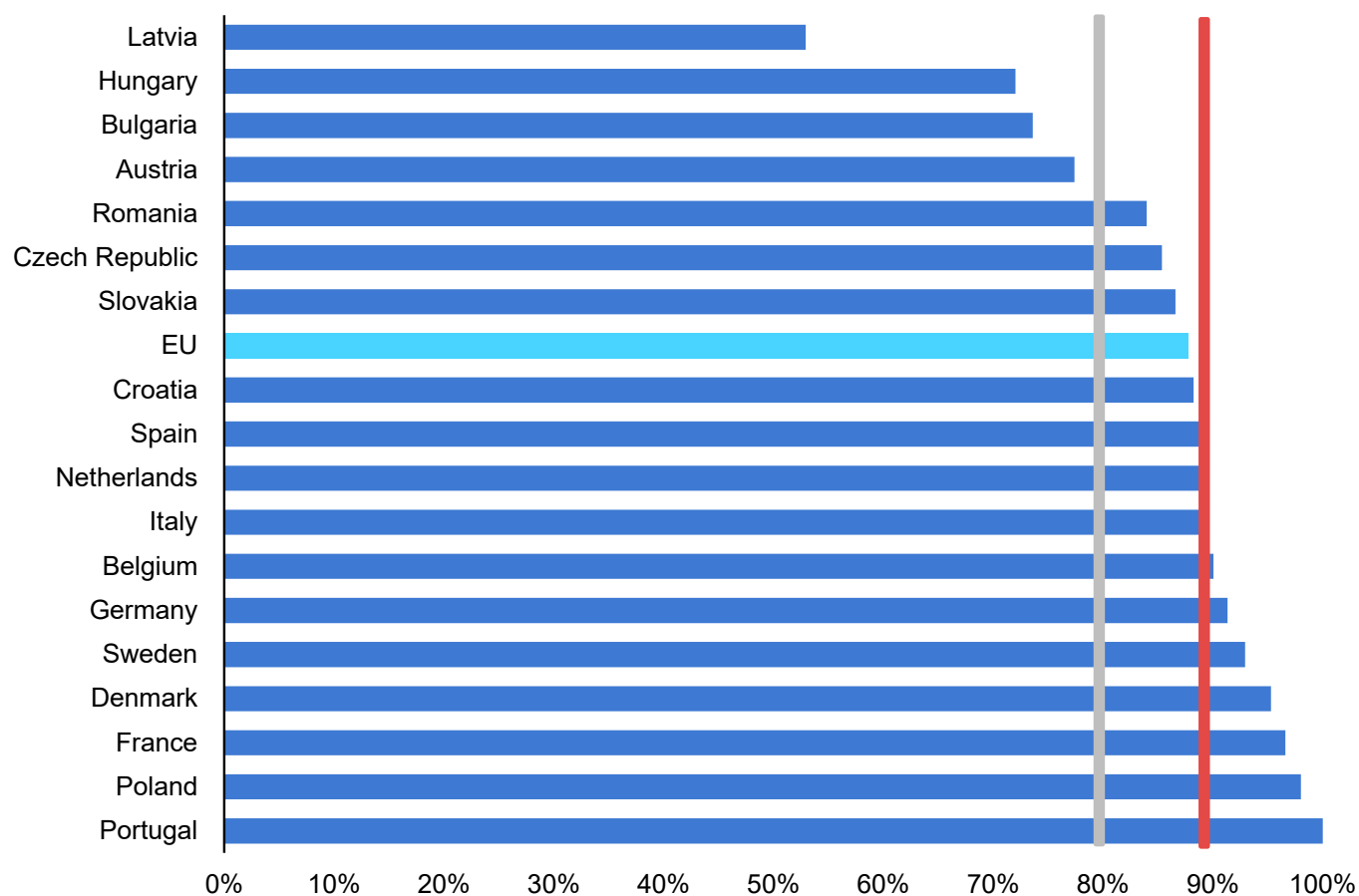
Gas saving measures

The European Union adopted the [regulation on co-ordinated demand reduction measures for gas](#) at the end of July 2022. The regulation targets a 15% voluntary reduction in the European Union's gas demand between 1 August 2022 and 31 March 2023, compared to its five-year average. Several member states received derogations from the regulation and are targeting lower gas demand reductions. Consequently, the effective reduction in gas demand is estimated to be 11% (or just over 30 bcm) compared with the same period in 2021–2022, if all the voluntary gas demand reduction targets are reached.

In the instance of substantial risk of a severe gas supply shortage and/or an exceptionally high gas demand, a “Union alert” could be declared by the European Council upon being proposed by the European Commission. The declaration of a Union alert would trigger mandatory gas reduction measures.

EU gas inventory levels stood at 87% of their working storage capacity on 26 September 2022

Natural gas inventory levels as a percentage of working storage capacity in EU member states,
26 September 2022



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Source: IEA analysis based on GIE (2022), [Aggregated Gas Storage Inventory](#).

Maintaining storage at adequate levels for the second half of the heating season will be a crucial factor in ensuring the security of gas supply

This section provides analysis of the European market's resilience in the case of Russia completely cutting pipeline gas supply to Europe from 1 November 2022. The focal point of the stress test is a cold spell occurring at the end of the heating season (March 2023).

Late cold spells are particularly challenging for the gas system. The deliverability of storage sites declines with the decreasing level of working gas in stock (due to the lower reservoir pressure). This means that storage sites become less reactive (both in time and volume) to variations in demand by the end of the heating season, making the gas system particularly vulnerable to late cold snaps.

Hence, storage fill levels at the end of the 2022/23 heating season will be a crucial factor in assessing security of gas supply.

Underground storage sites in the European Union are assumed to be filled up to 90% of their working capacity by 1 November. Their depletion rate will largely depend on the evolution of primary gas supply and demand-side factors. On the supply side, the following assumptions are made for the European Union and the United Kingdom during the heating season:

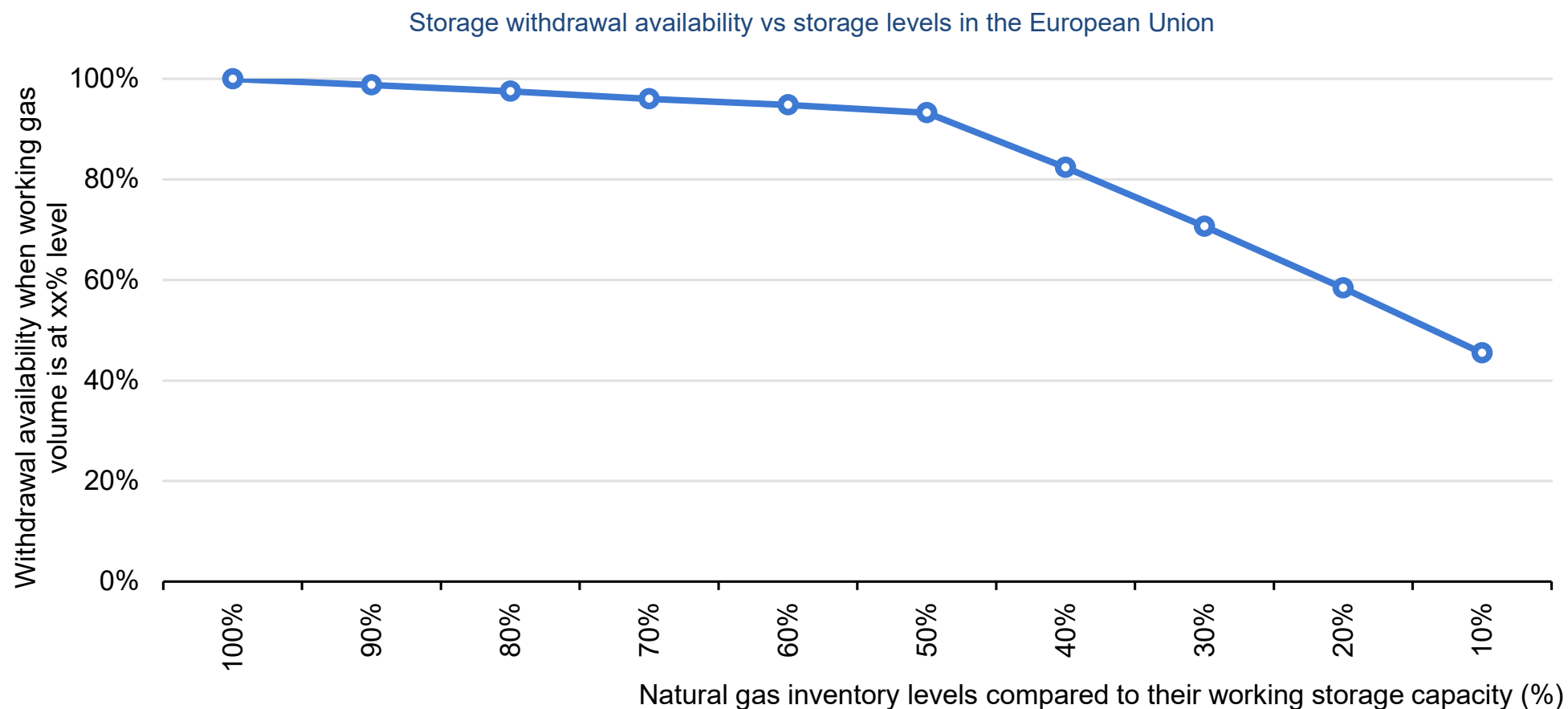
- Pipeline deliveries from Norway stand at 340 mcm/d (against a nameplate capacity of 350 mcm/d).
- Pipeline imports from North Africa increase by 10% y-o-y allowing for a total supply of 100 mcm/d.

- Pipeline supplies from Azerbaijan increase by 70% y-o-y and flow at nameplate capacity (33 mcm/d).
- Domestic production, including biomethane, declines by 5% y-o-y, in line with recent market trends.
- LNG imports are sustained at their highest historic level of 15 bcm/month, translating into 480 mcm/d. Higher seasonal demand in Northeast Asia remains a significant downside risk to this assumption. A second LNG supply scenario is considered, assuming 12 bcm/month of LNG inflow.

On the demand side, three scenarios are considered:

- Natural gas consumption stays close to its five-year average, assuming current market trends prevail and winter is 8% colder than average in terms of heating degree days.
- Demand reduction of 9% compared to its five-year average is achieved, assuming that current market trends prevail and no mandatory gas demand reduction measures are introduced.
- Demand reduction of 13% compared to its five-year average is achieved, assuming that the targets of the European Union are fulfilled.

The deliverability of underground storage sites starts to decline when storage levels fall below 50% of working capacity



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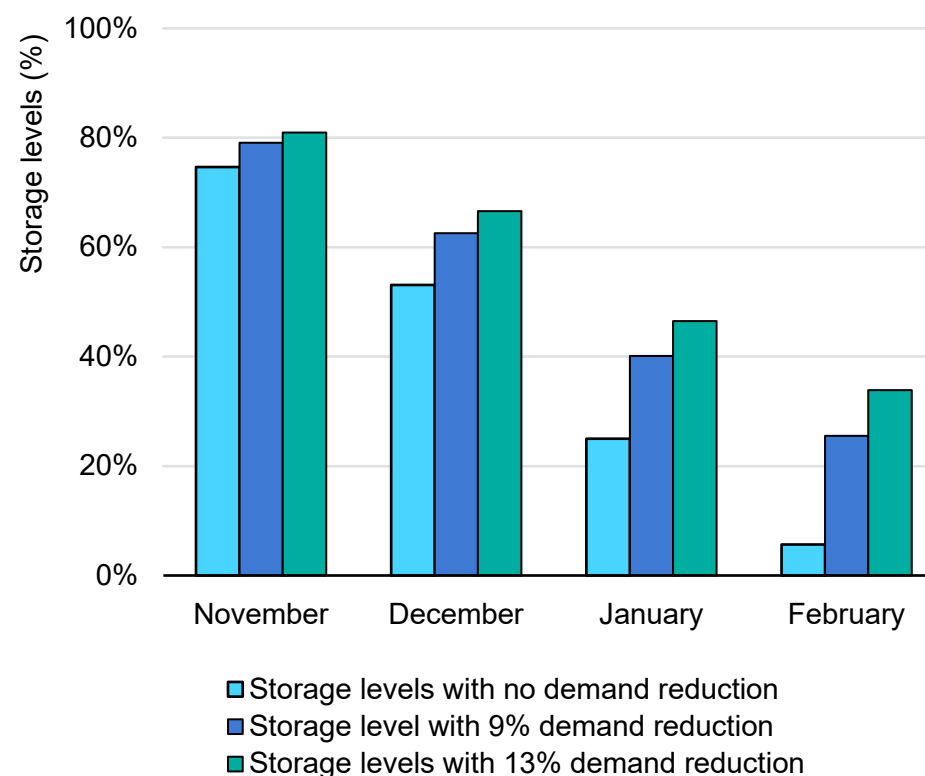
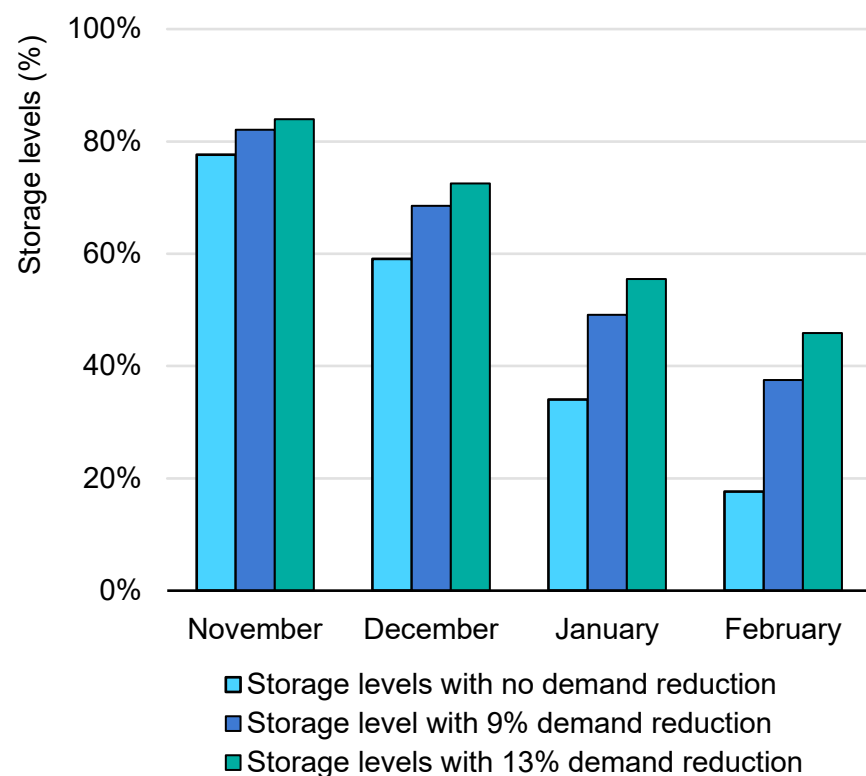
Sources: IEA analysis based on ENTSG (2022), [Winter Supply Outlook 2021/22](#).

Gas demand savings and LNG imports will be crucial to maintain gas storage at adequate levels until the end of the 2022/23 heating season

Potential evolution of gas storage levels in the European Union in the event of a complete cut-off in Russian gas supply from 1 November 2022

High LNG supply assumption

Low LNG supply assumption



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Simulating late cold spells: The Achilles heel of European gas supply security

The three demand scenarios described above result in different inventory levels by the beginning of March 2023: (1) in the case of no demand reduction, EU storage levels would fall to 18% of their working capacity (and to 5% assuming lower LNG supply); (2) a 9% demand reduction would result in storage levels standing at 38% of their capacity (and 25% if lower LNG inflow); and (3) 13% gas savings would allow storage levels to stand at 45% of their working capacity (and at 33% assuming lower LNG imports).

In our simulation, demand on the peak day was fixed at 2 400 mcm in view of peak days in 2018 and 2021 and assuming a 30% reduction in industrial gas demand. No primary supply outages were considered in terms of primary supply, which would perform as described in the previous section. The table below provides a summary of the results of the simulation assuming different storage fill levels. The risk of physical shortages increases when inventory levels decline below 30% of their working storage capacity

Risk of gas supply shortages in the case of a late cold spell occurring at the beginning of March 2023, under different storage fill levels and assuming no Russian piped gas supply

| Storage levels (% of working capacity) | Estimate of available withdrawal rate (mcm/d) | Demand to be curtailed on the peak day | | Description of the impacts |
|--|--|--|----------------------------------|---|
| | | Amount (mcm/d) | As a percentage of all demand | |
| 5% | 407 | 790 | 33% | Widespread gas supply shortages. Curtailment to industry, power plants, and public and commercial sectors, with risk of supply cuts to households |
| 15% | 930 | 267 | 11% | Widespread gas supply cuts to industry and heightened risk of power outages due to gas supply shortages at power plants |
| 25% | 1 155 | 42 | 2% | Interruption of gas supply to certain industrial gas consumers |
| 33% | 1 391 | 0 | 0% | Limited risk of supply shortages; low storage levels at the end of the heating season will further tighten the summer gas market |
| 38% | 1 401 | 0 | 0% | Adequate storage levels |
| 45% | 1 572 | 0 | 0% | Adequate storage levels |

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Solidarity, unity and responsible household behaviour will be crucial to ensure supply security

Europe's security of gas supply is facing unprecedented risk as Russia intensifies its use of natural gas supplies as a political weapon. The possibility of a complete cut-off in Russian gas deliveries cannot be dismissed ahead of the 2022/23 heating season – when the European gas system is at its most vulnerable due to the high temperature sensitivity of space heating demand.

Our analysis indicates that maintaining adequate storage levels until the end of the heating season – at 33% of their working storage capacity as a minimum – will be crucial for a safe and secure winter. Higher storage levels would also moderate injection needs during the 2023 summer, potentially reducing some of the market tensions. Storage levels below this threshold might not be sufficient to tackle a cold spell occurring at the end of the heating season, similar to the one Europe faced in March 2018. Storage fill levels will largely depend on the evolution of demand factors as well as primary gas supply, particularly LNG inflow into Europe. The rapid build-up of regasification capacity creates the possibility of additional imports, but does not guarantee an increase in LNG supply. Increased natural gas demand due to a colder winter, stronger recovery in economic activity in Northeast Asia and unplanned outages could, separately or collectively, weigh on Europe's winter LNG supply and lead to a more rapid depletion of underground gas storage.

Our analysis shows that a demand reduction of 9% compared to the five-year average would be necessary to maintain storage levels

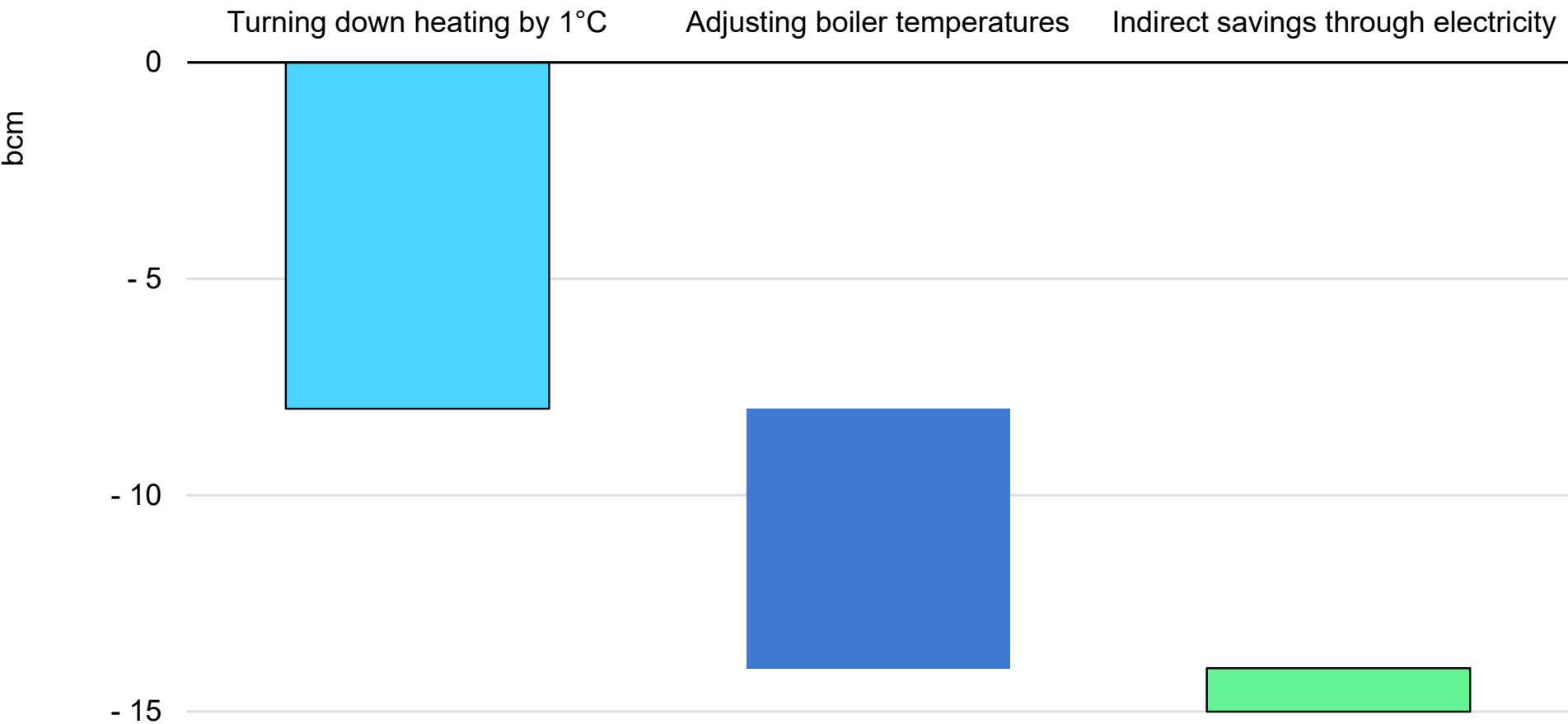
above 35% in the case of higher LNG inflow, while a reduction of 13% would be required to sustain storage levels above 33% in the case of lower LNG inflow. Hence, implementing gas saving measures will be a crucial to minimise storage withdrawals and keep inventories at an adequate level until the end of the heating season.

As highlighted by the IEA's Executive Director, [co-ordinated actions across Europe are essential to prevent a major gas crunch](#). This necessitates incentivising further reductions in industrial gas demand (via auctions), minimising gas burn in the power sector and lowering gas use in buildings (e.g. with lower heating standards). Enhanced co-ordination among gas and electricity operators across Europe would also be required to ensure both gas and electricity supply security. Solidarity agreements between EU member states and neighbouring countries should be strengthened to facilitate gas supplies in case of supply and/or demand shocks.

Notably, however, a 13% demand reduction would also necessitate gas savings from households and require responsible electricity and gas consumption behaviour. Our analysis indicates that behaviour change could reduce gas demand by 15 bcm during the 2022/23 heating season, equating to over 40% of the 13% demand reduction.

Behaviour change could reduce gas demand by 15 bcm through the 2022/23 heating season

Potential natural gas savings from behaviour change during the 2022/23 heating season



IEA. CC BY 4.0.

Sources: IEA based on the analysis developed for [Playing my part](#).

High prices erode gas demand across the main gas markets in Asia Pacific

The main LNG importing countries in Asia have not been uniformly impacted by sharply rising LNG prices in 2022. The extent of price-driven demand erosion – which varied from substantial to negligible – has depended on the degree of both spot market exposure and purchasing power, market structure, and the availability of fuel substitutes, among other factors.

In **China** the demand response to high prices has been most visible in the electricity sector. Power sector gas burn dropped by 9% y-o-y in the first eight months of 2022 despite an overall 4% increase in electricity demand over the same period. High prices for imported LNG prompted generators in southern China in particular to reduce operating hours or idle their plants to avoid losses. Operating hours at gas-fired power plants across China were down by 10% y-o-y during the first eight months of 2022. The price impact on demand in other sectors is more difficult to disaggregate from the negative effects of Covid-related lockdowns and slowing economic activity. Nevertheless, anecdotal evidence indicates ongoing demand destruction in the ceramics sector, for example, where a third of production lines were reportedly shut in March due to high fuel costs. LNG-fuelled truck sales in H1 2022 also fell to less than a third of their level in H1 2021, which could indicate fuel switching from gas to oil in the transport sector as well.

India's gas burn for power generation dropped by nearly 30% in the first eight months of 2022 amid rising spot LNG prices, with much of the gap filled by coal-fired power plants. Gas consumption in the refining and chemical sectors (down by 29% and 23% y-o-y, respectively, during the first eight months) also took a heavy hit as operators with flexible plants switched to oil. Overall gas demand in the first eight months of 2022 was down by 4% y-o-y, while oil consumption rose by 11% and coal-based power generation increased by 9% over the same period.

Japan and **Korea** saw limited demand response to high spot LNG prices in the short term (due to their higher purchasing power and traditional reliance on long-term LNG contracts, which – at around USD 15 per MMBtu – are currently much cheaper than spot LNG). However, both countries instituted policies to reduce reliance on imported LNG in the wake of the crisis. Japan announced a plan in August to accelerate the restart of up to seven additional nuclear reactors starting in mid-2023, bringing the total number of operational units to 17. Work is also underway on a contingency plan (which includes gas saving measures and enhanced co-ordination on LNG supply security) for the possible disruption of contracted LNG flows. Meanwhile, Korea suspended voluntary coal plant restrictions in July and August to reduce LNG use during the peak summer months and accelerated the scheduled start-up of new coal-fired and nuclear units.

Pakistan has been in the midst of a deep energy crisis as a consequence of surging LNG prices, facing rolling blackouts (in some cases lasting 12 hours a day), double-digit inflation, falling foreign exchange reserves and skyrocketing import bills for generation fuels. In the first eight months of 2022 Pakistan's LNG imports were down by 19% y-o-y as the country was all but priced out of the spot LNG market. Some of Pakistan's term suppliers even defaulted on more than a dozen contracted cargoes, which were scheduled for delivery during the Q4 2021-Q2 2022 period. Oil-fired generation has increased fivefold in 2022 to date, but this has not been enough to eliminate power shortages completely. In June 2022 Pakistan introduced a set of electricity conservation measures, such as limiting operating hours for shops and factories and introducing a five-day work week for public service employees.

Bangladesh also experienced widespread power cuts in Q3 2022 as it halted unaffordable spot LNG purchases completely in July and August to avoid a broader balance of payments crisis. At the height of the crisis in mid-July nearly 20% of the country's electricity load was shed due to generating fuel shortages. Mandatory conservation measures, such as reduced working hours, early store closures and bans on illuminating buildings, remain in place at the time of writing.

Thailand saw its total gas consumption drop by 12% and its power sector gas burn decrease by 6% y-o-y in the first seven months of

2022 as high prices put pressure on demand. Several buy tenders have been cancelled or left unawarded so far in 2022 due to astronomical bid prices, while diesel-based power generation surged 16-fold in the January-July period to fill the emerging fuel supply gap.

Demand response to high LNG prices varied widely among the main importers in Asia

Gas demand impacts of high spot LNG prices across Asia

Pakistan

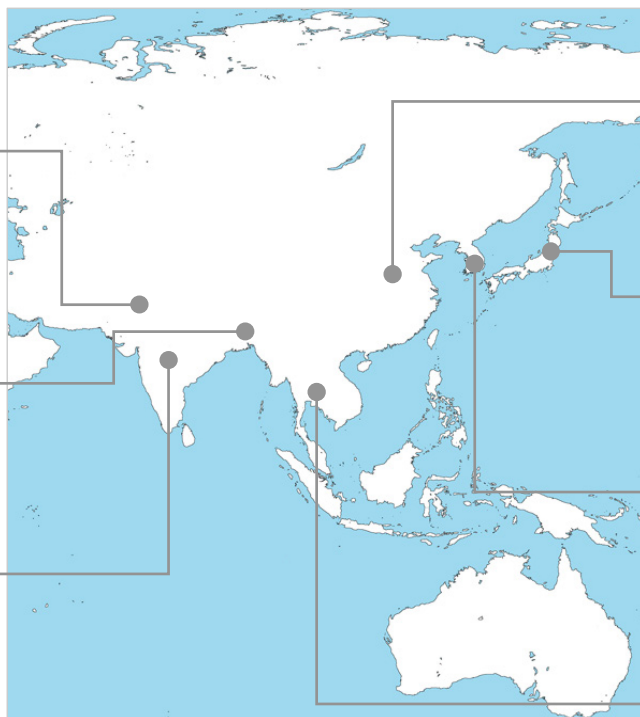
- Deep energy crisis with economy-wide implications
- Rolling blackouts of up to 12 hours
- LNG imports down 19% y-o-y in January-August 2022
- Spot LNG purchases down to a bare minimum
- Oil-fired generation up fivefold

Bangladesh

- No spot LNG purchases in July-August 2022
- Load shedding of up to 20% in mid-July
- Mandatory conservation measures

India

- Power sector gas burn down 28% y-o-y in January-August 2022 (partly replaced with coal)
- Reduced gas use in refining (down 29%) and chemicals (down 23%) mostly replaced with oil



China

- Power sector gas use down by 9% y-o-y in January-August 2022
- Evidence of demand destruction in industry and transport

Japan

- Accelerated restart of 7 nuclear reactors from mid-2023
- Contingency plan for LNG supply cut scenario

Korea

- Voluntary coal restrictions suspended for summer 2022
- Accelerated start-up of new coal-fired and nuclear units

Thailand

- Power sector gas burn down by 6% y-o-y in January-July 2022, diesel generation up 16-fold
- Buy tenders cancelled or unawarded due to high price

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Global LNG market tightness induces shifting LNG trade patterns in Asia

The rapid tightening of the global LNG market and Europe's emergence as the new premium market for LNG have prompted profound changes in LNG trade dynamics across Asia.

Spot LNG trade – unsurprisingly – has seen a disproportionate decline so far in 2022 as record high prices have driven price-sensitive Asian buyers away from spot purchases. Between January and July 2022 the monthly volume of spot LNG imports into Asia fell by more than 60% (before slightly recovering in August). During the first eight months of 2022 Asian spot LNG imports were down by 28% y-o-y, a much steeper decline than the 7% y-o-y drop in the region's total LNG imports over the same period. The biggest y-o-y decreases in volume terms occurred in China (down 59%), Japan (down 17%), Pakistan (down 73%) and India (down 22%). China alone was responsible for 80% of the net reduction in the Asia's spot LNG purchases in January-August 2022 as the country's appetite was tempered not only by high prices, but also by mild winter temperatures, weakening economic activity, Covid-related lockdowns and strong coal and renewable generation growth in the power sector.

The collapse of spot LNG sales into Asia by no means signifies a lack of interest in securing prompt LNG shipments. Asian importers issued buy tenders for a record number of spot cargoes in 2021 (close to 400), and the number of cargoes sought in short-term

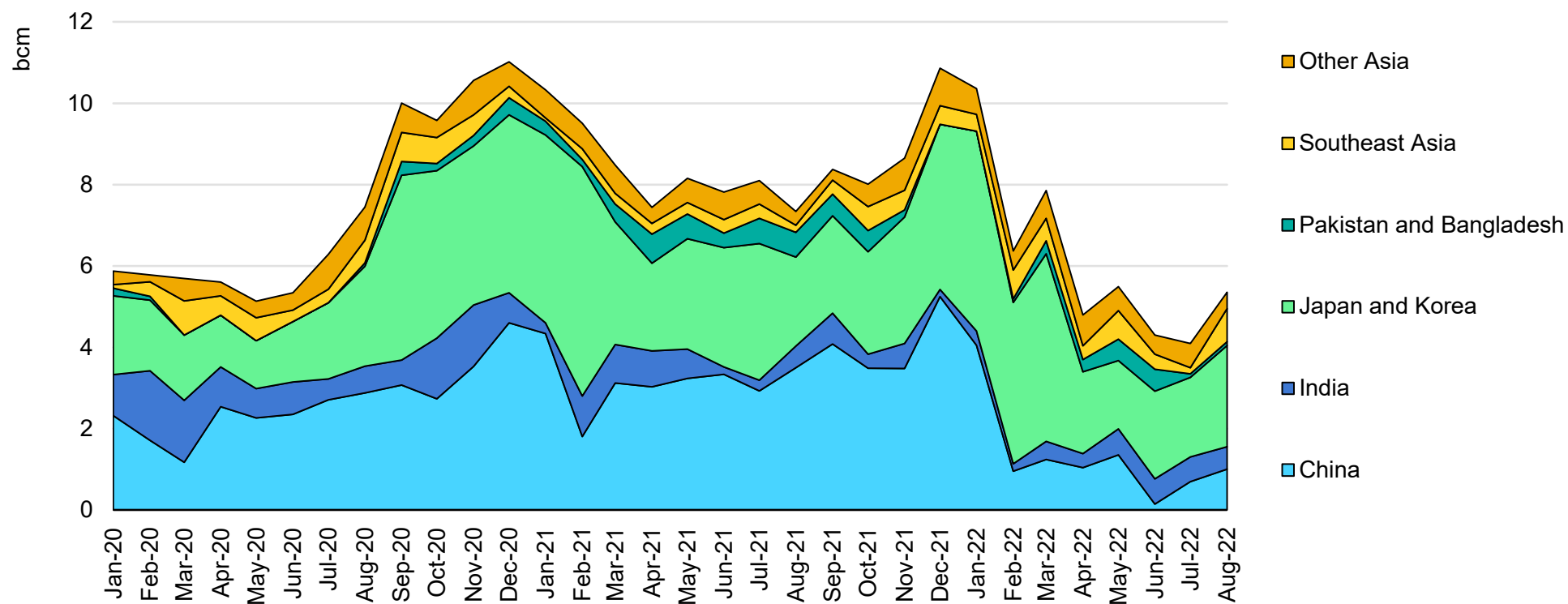
tenders (defined as having a delivery window of less than one year from tender close) remained at highly elevated levels (at well over 200) in the first eight months of 2022 also. However, in the same period nearly 40% of the tendered cargoes were not awarded due to excessively high bid prices (compared to a rejection rate of 35% in 2021 and an average of less than 20% in 2015-2020). Therefore, the collapse in spot imports in most cases meant that buyers without term contracts were simply priced out of the market and could not secure the LNG they needed at an acceptable price.

China was a notable exception. Due to the drop in LNG demand for reasons beyond high prices, some Chinese buyers had excess LNG, which they sought to resell on the spot market. As a result, Chinese entities offered about 30% more LNG on sell tenders during the January to August 2022 period than they sought to buy over the same timeframe. LNG reloads in Asia were also at an all-time high and jumped by 48% y-o-y in the same period, reflecting the incentive to redirect flexible LNG supplies to Europe.

These changes reflect the new reality that Asia – with its limited toolkit – has been the primary balancing market for flexible LNG flows in 2022 to date. In the near future China in particular could see its market balancing role further enhanced with the expected increase in flexible LNG volumes in its contract portfolio.

Asian spot LNG imports collapsed in January-August 2022

Evolution of spot LNG trade in Asia Pacific, 2020-2022



IEA. CC BY 4.0.

Source: IEA analysis based on ICIS (2022), [ICIS LNG Edge](#).

Sailing away: Outlook for new FSRU projects sharply deteriorates in South and Southeast Asia

Europe – with its rapidly rising LNG requirement to substitute for reduced pipeline gas supplies from Russia – has drawn away not only flexible LNG volumes from Asia, but also the limited number of FSRU vessels available for hire in the foreseeable future. These were previously expected to play a key role in unlocking additional LNG demand in South and Southeast Asia in particular.

As of August 2022 the available and under-construction FSRU fleet comprised just over 20 vessels. Since the start of the war in Ukraine, European companies have secured 12 FSRUs for recently approved import facilities and have announced plans for 9 additional FSRU-based terminal projects. These, together with a handful of vessels committed to projects outside South and Southeast Asia, already exceed the number of available vessels in the short term.

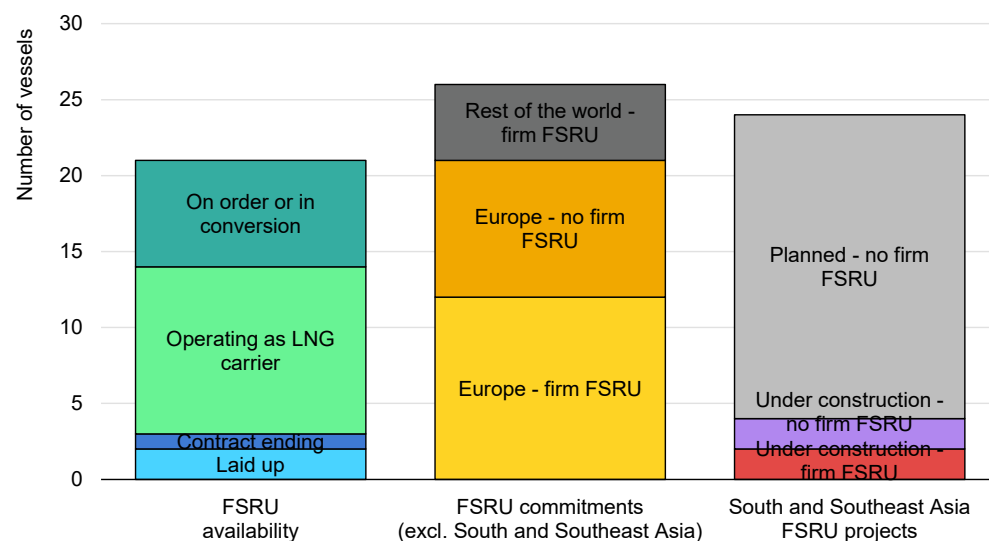
This newfound scarcity of FSRUs is particularly challenging for South and Southeast Asia, where a significant share of the under-construction and planned LNG import infrastructure is based on their availability. As of mid-2022 at least 24 FSRU terminals were actively being developed across South and Southeast Asia. Of these, only four were in the construction phase (and only two had secured FSRU vessels), while 20 were in various stages of pre-construction planning. The capacity of the region's FSRU-based projects that are actively being developed is in excess of 100 bcm/yr, which represents about half of the total regasification project pipeline in South and Southeast Asia.

With Europe and a handful of projects in other parts of the world absorbing the entire fleet of FSRUs until 2025, the outlook for South and Southeast Asia's floating terminal projects – which were already beset by a host of project- and country-specific challenges – has further deteriorated. The scarcity of FSRUs is already reflected in higher daily charter rates, which were reported to have more than doubled from 2021 levels to USD 200 000 by one assessment. Moreover, shipyards in South Korea face severe capacity constraints and one of the three major yards capable of constructing new FSRUs has put a halt on new orders due to the lack of available shipbuilding slots. Even projects with firm FSRUs can see their vessel commitments withdrawn. Hoegh LNG, for example, has recently terminated its 10-year FSRU charter with the much-delayed Jaigarh LNG project in India, and is now expected to redeploy the vessel to a new European FSRU terminal later this year.

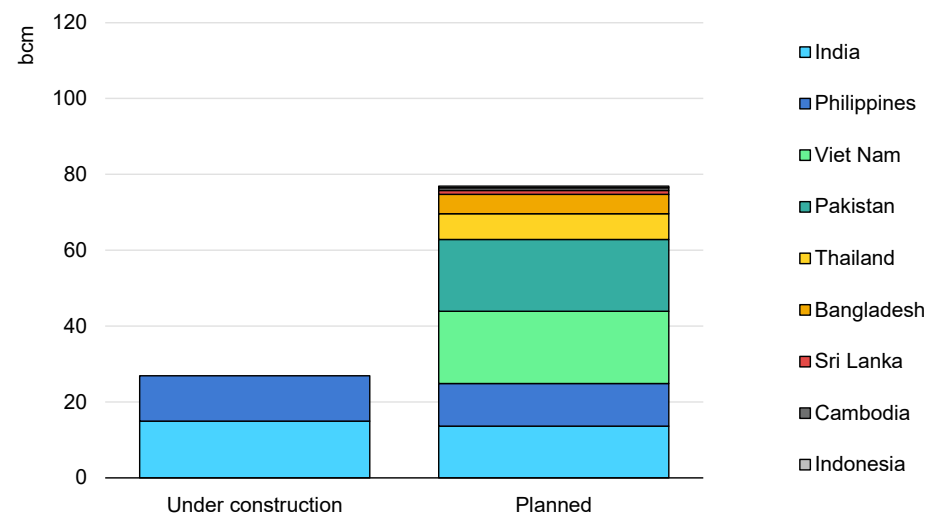
Thus the energy crisis following Russia's invasion of Ukraine has not only rendered incremental LNG supply unaffordable for developing markets in Asia, but has also undermined the a critical component of the infrastructure needed to unlock the region's future demand growth by pulling away flexible FSRUs from these markets for the foreseeable future.

Most of the FSRU project pipeline is at risk in South and Southeast Asia

FSRU availability and requirements as of August 2022



FSRU projects by status in South and Southeast Asia



IEA. CC BY 4.0.

Note: Status as of 31 August 2022.

Sources: IEA analysis based on ICIS (2022), [ICIS LNG Edge](#); GIIGNL (2022), [Annual Report](#).

Europe's diversification of supply triggers a flurry of developments in Africa and the Mediterranean

Europe's growing concern over security of gas supply following Russia's invasion of Ukraine has put alternative sources in the spotlight, especially in neighbouring North Africa, with its proximity and existing infrastructure connections to the continent. Other opportunities are under development in sub-Saharan Africa.

Algeria, a long-time supplier of natural gas to Europe, has seen a strong increase in contracting activity since the beginning of the supply crisis. In April state-owned oil and gas company Sonatrach signed a deal with Eni to progressively increase flows through the Transmed/Enrico Mattei pipeline to Italy by up to 9 bcm/yr by 2023-24. Sonatrach is expected to increase its production by 1.8 bcm/yr by early Q4 with the completion of the first phase of the Tinhert field development, in time for the beginning of the heating season. The company announced a major discovery in late June with the Lias carbonate deposit (LD2) find in the core Hassi R'Mel area, which could hold an estimated 100-340 bcm of gas condensate. It is potentially the country's largest discovery in the past two decades. Sonatrach stated in early August that LD2 production will be fast-tracked to start operating in November 2022 and deliver 10 mcm/d – or close to 1.5 bcm – during the coming winter months of November to March. The Ain Tsila development is also on track to start producing in the first quarter of 2023 and deliver 3.5 bcm/yr. These projects will provide additional export capacity, as well as

compensate for natural decline from ageing fields. The positive outlook for Algerian upstream development was further confirmed with a USD 4 billion contract signed in July with Oxy, Eni and TotalEnergies to extend production in the Berkine Basin's Blocks 404a and 208. Although current output solely comprises liquids, the project's partners expect to monetise significant volumes of associated gas that could be earmarked for export markets. Eni also signed a memorandum of understanding in May to develop up to 3 bcm/yr of gas from the Berkine Basin.

The eastern Mediterranean has also seen developments in gas supply contracting in recent months. In April **Egypt's** EGAS signed an agreement with Eni to develop short-term opportunities to increase natural gas exports to Europe; this agreement would contribute to raising Egypt's LNG exports by up to 3 bcm in 2022. Egypt's LNG exports increased by 10% y-o-y in the first eight months of 2022. Egyptian gas production has been constrained since early 2022 due to a cap put on the core Zohr field (20% below its capacity to limit the risk of reservoir collapse from water infiltration) and technical issues in the Raven field. To maintain LNG export levels, the country reduced its gas burn for power generation and switched to fuel oil, consumption of which increased fivefold in the first half of 2022 compared to average 2020 and 2021 volumes. In September 2022 the Egyptian government

announced an objective to accelerate the development of its wind and solar generation capacity in order to free up more natural gas for export markets.

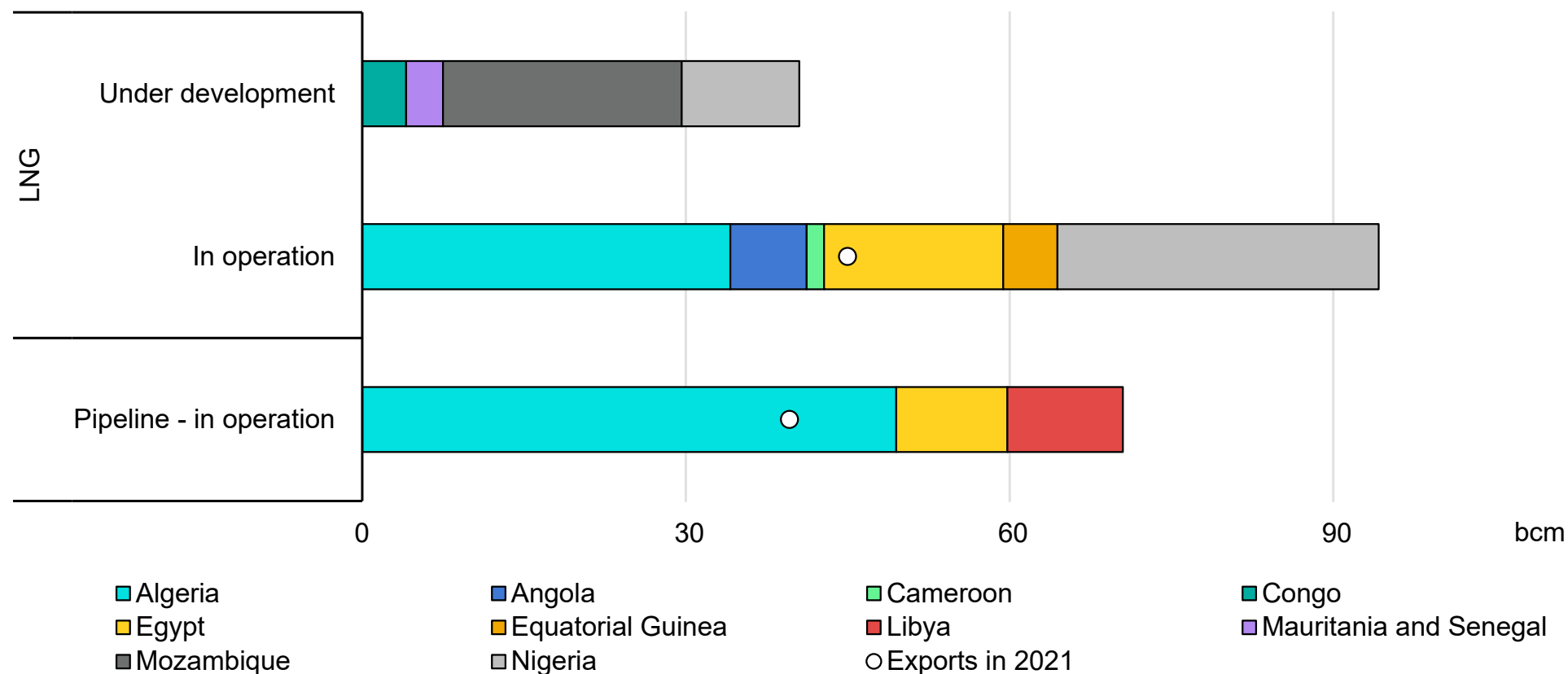
Egypt also further increased its pipeline imports from **Israel**, principally from the Leviathan gas field, which saw its exports to Egypt increase by 75% y-o-y in the second quarter of 2022 to reach 1.4 bcm with the commissioning of a new route through Jordan. Israel expects further production capacity additions with the ramp-up of the Karish field. It is expected to start operations before the end of 2022 from the 40 bcm Karish Main asset, followed by the commissioning of the 34 bcm Karish North asset scheduled for the second half of 2023. Operator Energean is also working on options regarding the development of the recently discovered 8 bcm Athena-1 well and the 26 bcm Tanin field. Chevron, who operates Leviathan and Tamar, mentioned in its Q2 earnings call that capacity development options could be envisaged to further increase LNG exports, either from new floating liquefaction or via Egypt's existing liquefaction plants. The European Union signed a trilateral memorandum of understanding with Egypt and Israel in June 2022, aimed at increasing LNG export deliveries to Europe.

This search for new export prospects also includes several recent developments in sub-Saharan Africa. First LNG is scheduled before the end of 2022 from **Mozambique** with the commissioning of the 3.4 Mtpa (about 4.6 bcm/yr) Coral Sul floating LNG (FLNG) in gas-

rich offshore Area 4. Operator Eni and its partners announced in late July the potential to develop a second FLNG in the same block, which could be fast-tracked and deliver 2.5-3 Mtpa (3.4-4 bcm/yr). In **Congo**, the fast-track development of the Marine XII offshore field and association with a floating liquefaction unit should help to start LNG exports by mid-2023, with an expected plateau capacity of 4.5 bcm/yr. Eni, the project's operator, secured another FLNG to monetise associated gas output from various offshore Congolese fields, also starting in mid-2023 and delivering up to 1.9 bcm/yr of additional LNG. In **Angola**, state-owned Sonangol partnered with BP, Eni, Chevron and TotalEnergies to take FID in July 2022 on the Quiluma and Maboqueiro offshore fields, the country's first non-associated gas development project. The project, which is to be connected to Angola's existing LNG export plant, is aiming for first gas in 2026 and a plateau capacity of 4 bcm/yr. In **Senegal and Mauritania**'s joint offshore developments, the first phase of Grand Tortue Ahmeyim was reported as 80% complete as of early Q3 2022, with an expected start-up in Q3 2023 and first LNG exports by the end of 2023. A development decision regarding the second phase of the project is expected before the end of 2022, in parallel with negotiations covering the Bir Allah and Orca discoveries in Mauritania and progress on a development concept for the Yakaar-Teranga find in Senegal.

New developments in Africa contribute to growing the continent's natural gas export capacity and deliverability from existing infrastructure over the short to medium term

Nameplate natural gas export capacity by country (in operation and under development) and exports, Africa, 2021



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LNG contracting and availability update

Turbulence in 2020-2022 highlights both the benefits and limitations of LNG market flexibility

Every year since 2016 the IEA's *Global Gas Security Review* assesses the flexibility of the global LNG market by analysing supply availability, seller and buyer behaviour, and the evolution of destination flexibility in LNG contracts. This analysis is based on the contractual positions and trading activity of buyers and sellers using the IEA's own LNG contract database.

Since the first issue of the *Global Gas Security Review*, the LNG market has expanded and evolved to become increasingly liquid and global. The number and diversity of buyers and sellers have grown substantially, LNG supply contracts provide greater flexibility and optionality, pricing has diversified with alternatives to traditional oil indexation, and total traded volumes have increased by close to 50%. Short-term flexibility has also increased thanks to the addition of about 100 bcm of flexible US LNG supply and the emergence of new procurement strategies, such as tendering.

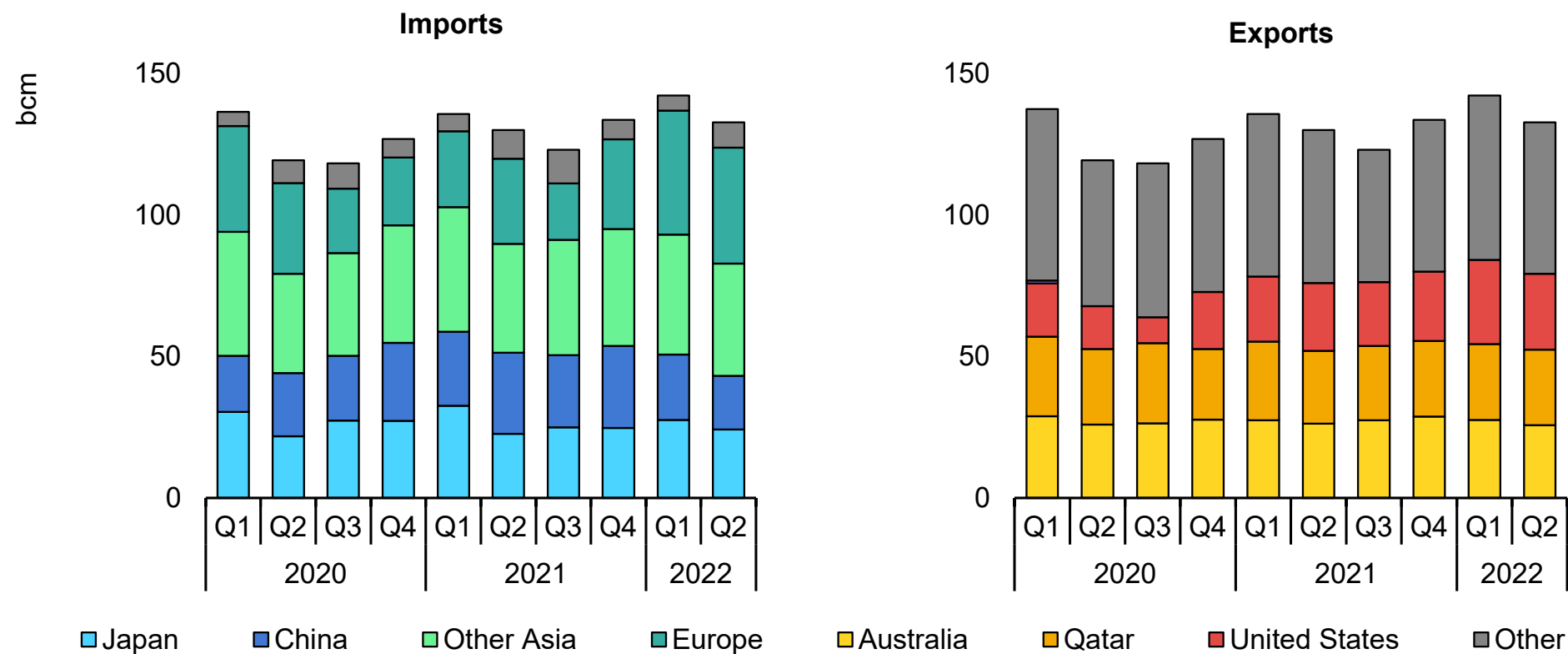
The past two years have been particularly challenging for market participants, highlighting both the benefits and limitations of LNG market flexibility. The development of a globalised LNG market contributed to gas supply flexibility under extreme market conditions, including during the unprecedented fall in demand due to the Covid-19 pandemic in the first half of 2020, as well as during the rapid rise in European demand from late 2021 to compensate for reduced pipeline gas imports from Russia.

LNG trade has faced several unprecedented market situations in the past two years, and has played a major role in solving them. LNG trade flows declined by almost 10% y-o-y in mid-2020 to adjust to the Covid-19-induced fall in demand. In January 2021 Northeast Asia faced a combination of sudden demand hikes due to a cold spell and LNG supply outages, but flexible LNG heading into the region contributed to the avoidance of major shortages. The global LNG market provides Europe with the greatest near-term potential to diversify its gas supplies in response to falling Russian gas imports. Europe's LNG imports surged by 65% y-o-y in the first eight months of 2022. This strong inflow of flexible LNG largely offset the steep drop in gas from Russia and helped refill the European gas storage inventory for the coming winter.

Without the contribution of flexible LNG supply, market adjustments would have been less orderly and could potentially have led to more serious disruption – noting that the current tight market situation leaves price-sensitive short-term buyers particularly vulnerable.

LNG trade plays a strong balancing role in global natural gas markets

Quarterly LNG imports and exports, 2020-2022



IEA. CC BY 4.0.

Source: IEA analysis based on ICIS (2022), [ICIS LNG Edge](#).

Investment decisions are recovering gradually from the low point in 2020

FIDs on LNG export projects moved dramatically from a landmark year in 2019, when over USD 65 billion was committed to almost 100 bcm of new capacity, to just one project in 2020, Energía Costa Azul in Mexico with 4 bcm/yr of capacity. Uncertainties relating to the impact of the Covid-19 pandemic and falling oil and gas prices put investment decisions on hold, while Covid-related disruptions led to construction delays and the rescheduling of project start-up dates. Although some of these impacts on project timelines continue to linger, FID activity has been recovering since 2021.

In 2021 two export projects were confirmed for a total of 52 bcm/yr of liquefaction capacity, namely Qatar Petroleum's 44 bcm/yr North Field East expansion project – the single largest LNG FID on record – and Pluto LNG train 2 in Australia.

Two projects have taken FID so far in 2022 at the time of writing, both in the United States: the first phase of the Plaquemines LNG with around 18 bcm/yr of capacity, and Corpus Christi LNG's stage 3 expansion with around 14 bcm/yr of capacity. Although Plaquemines LNG is a large-scale greenfield LNG project, its modular liquefaction train system with pre-assembled units is designed to enable faster installation and lower construction costs. The Calcasieu Pass LNG project, which uses the same modular

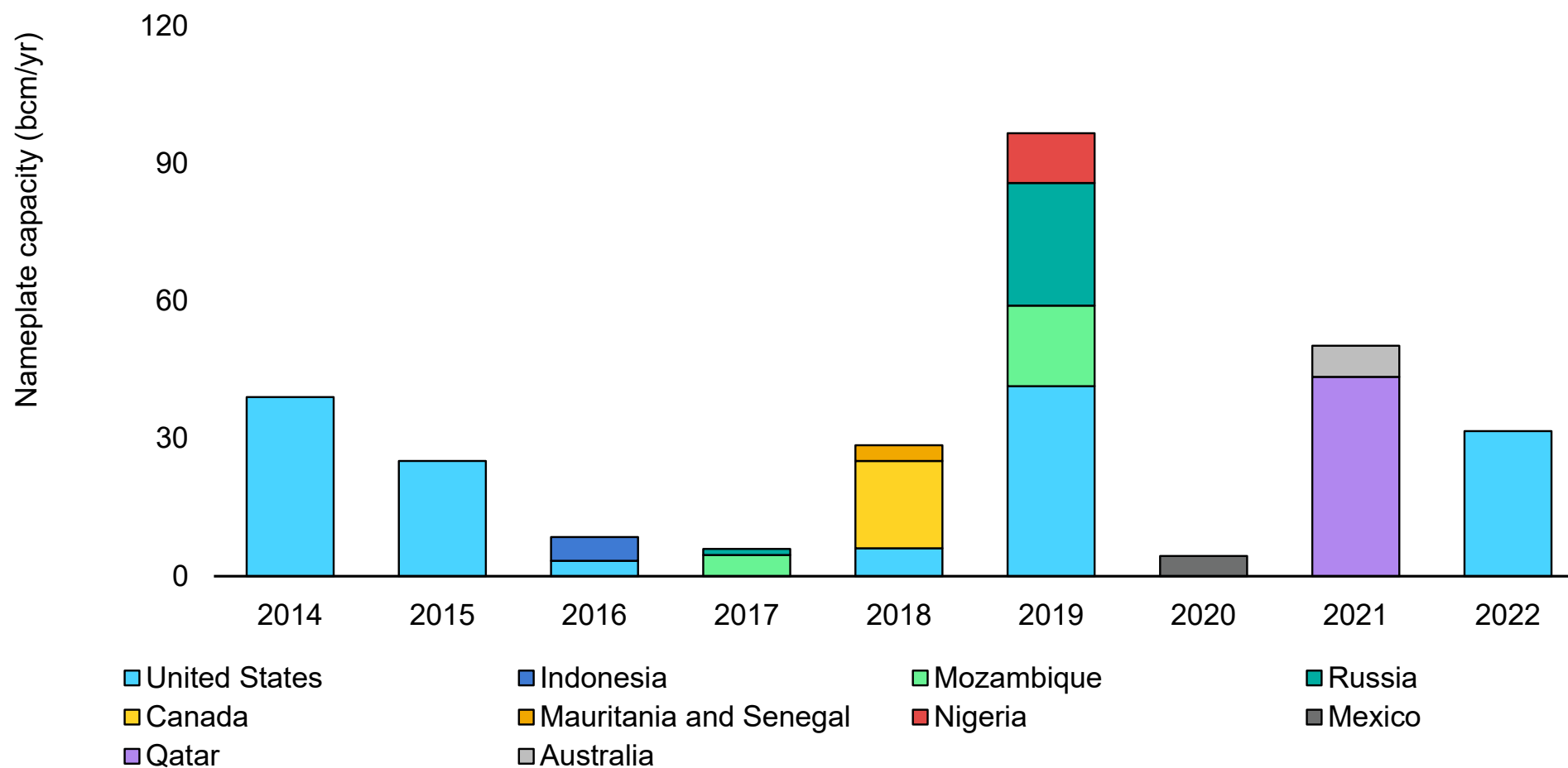
process, was completed in just 29 months (from FID to first LNG production), an industry record for a greenfield project of this scale. Plaquemines LNG is scheduled to start operations in 2024, in time to bring relief to today's tight LNG market. Several projects (mostly in North America) announced plans to take FID this year amid a major global energy security crisis triggered by Russia's invasion of Ukraine, the resulting high price environment and looming competition among LNG buyers.

The first eight months of 2022 saw contracts signed for 27 bcm/yr associated with confirmed export projects and 55 bcm/yr with projects that have not yet taken FID (all based in North America), which could underpin additional investment decisions. However, high levels of uncertainty about the longer-term market evolution and the role of gas in the energy transition still cast a shadow over investment decisions. This could lead to a mismatch between buyers reluctant to sign long-term LNG contracts and sellers continuing to require such contracts to underpin new investment decisions – with portfolio players¹ and trading houses potentially having to step in to intermediate.

¹ Portfolio players are market players who hold both purchase and sale contracts. They often hold an equity stake in LNG facilities or purchase LNG from other sellers in multiple regions, permitting them to independently market a share of the facility production capacity to end users.

A cautious return to investment in new liquefaction capacity

FIDs for new LNG liquefaction capacity, 2014-2022



IEA. CC BY 4.0.

Note: 2022 represents FIDs as of the end of August 2022.

Contracting activity has rebounded strongly since 2021 amid high and volatile spot prices

Contracting activity rebounded strongly in 2021 after the Covid-19-induced slowdown in 2020. The total volume of concluded contracts in 2021 was about 80 bcm, which was a 28% increase compared to 2020 and second only to 2018 (at 88 bcm), the highest on record.² This notable rise was driven by export projects in the Middle East, Eurasia and North America, which together accounted for over 80% of LNG contracts in 2021.

On the export side, North America was the largest source of newly signed contracts in 2021, accounting for almost 33% of the total volume (up from only 9% in 2020), creating favourable conditions for new investment in the region. The same trends have continued in 2022 to date, with North America accounting for 54% of the total contracted volume amid the global energy crisis after Russia's invasion of Ukraine. Portfolio players' share on the supply side was 13% in 2021, a sharp decrease from the 35% average over the previous five years.

On the import side, the Asia Pacific region continued to lead, accounting for more than 80% of the total volume contracted in 2021. China alone accounted for 61% of the total contract volume signed in 2021. Chinese buyers contracted over 48 bcm of LNG last year, a sharp increase on the five-year average of 12 bcm. The

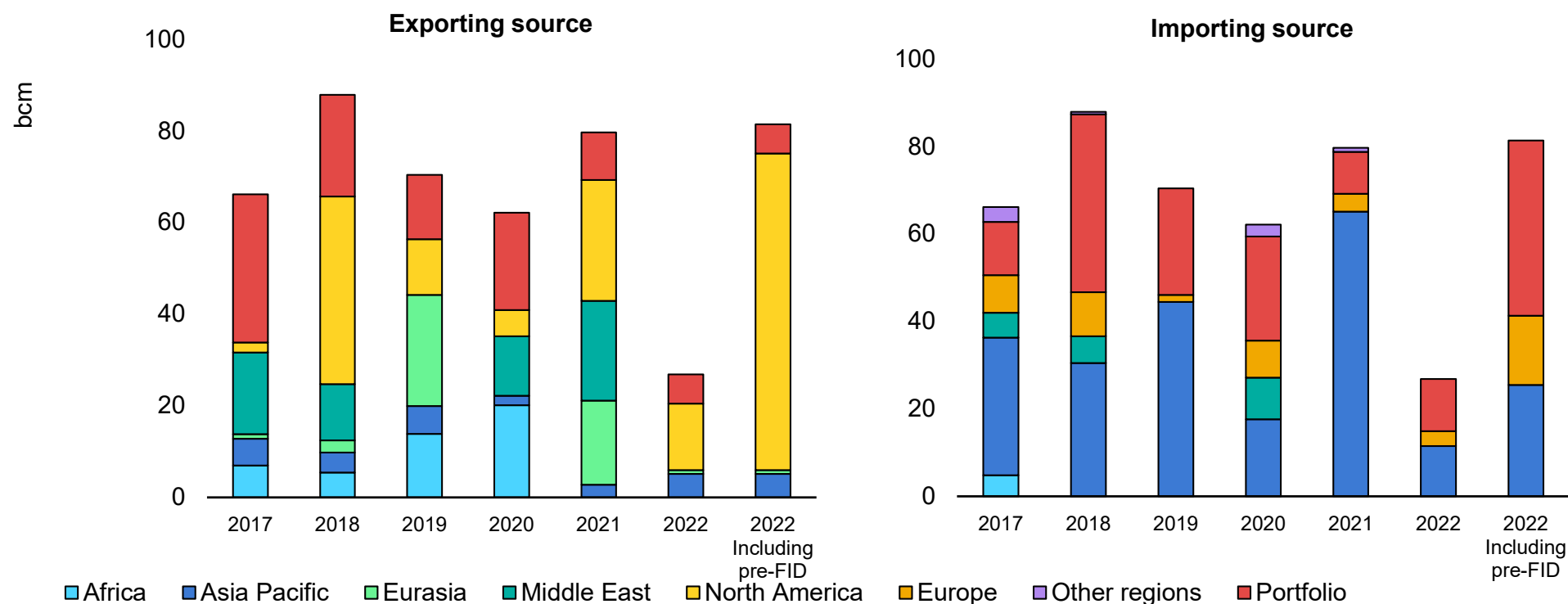
strong growth in China's LNG contracting activity reflects the country's desire to reduce its exposure to spot market volatility and secure stable supply to meet expected demand growth. European buyers signed only 5% of the total LNG import contracts in 2021.

In the first eight months of 2022, 27 bcm of LNG contracts were concluded with operational or under-development projects. This is a relatively small volume compared with the circa 48 bcm signed in the same period of 2021. Total contracting activity to date amounts to above 81 bcm, including 55 bcm of contracts signed with projects that have not taken FID at the time of writing, a 3.5 times increase y-o-y. Almost 90% of this total volume was contracted with US LNG project developers from the export side, while on the offtake side portfolio players accounted for almost half and Europe and China each accounted for one quarter. This further highlights the important role of portfolio players in bridging the gap between certain buyers' reluctance to sign long-term contracts and the sellers' imperative to secure long-term contracts before sanctioning new projects. Since Russia's invasion of Ukraine, European buyers have signed LNG contracts totalling 16 bcm (associated with both FID and pre-FID projects), which is almost twice the five-year average.

² Our methodology only includes firm sale and purchase agreements (SPAs) and does not account for memorandums of understanding, heads of agreement or other non-binding agreements.

The Asia Pacific region remains the dominant driver of LNG contracting globally

Volume of contracts concluded in each year split by exporting and importing source, 2017-2022



IEA. CC BY 4.0.

Notes: Contracted volumes used for the analysis are associated with confirmed export projects that have taken FID. 2022 represents volumes signed by the end of August 2022.

"Portfolio" volumes are contracted by a market player who may source product from one or multiple regions to fulfil contractual obligations.

Source: IEA analysis based on ICIS (2022), [ICIS LNG Edge](#).

Contracting has returned to more traditional terms since 2020

In 2021, 80 bcm of newly signed contracts were concluded with post-FID projects and portfolio players, the second highest level on record since 2018. Recent contracting activity has shown a return to traditional destination-fixed terms, while the duration and volume terms are more balanced.

The share of destination-fixed contracts has increased sharply since 2020. Flexible contracts accounted for almost 80% of the average contracted volumes in 2018-2019, driven by new FIDs in the United States. Most of these were on FOB (free on board) transport terms, which provides the greatest flexibility to portfolio players to leverage their trading capabilities. The share of destination-flexible contracts dropped to 35% in 2020 and 11% in 2021. This trend of returning to destination-fixed terms results from a declining share of flexible supply sources in contracting activity (mainly in the United States) and a corresponding rise in available supply from Eurasia and the Middle East, with a preference for fixed-destination sales contracts. The share of destination-flexible volumes among the portfolio players' newly signed contracts in 2020 was 11%, the lowest level since 2015. China was the single largest signatory of fixed-destination contracts in 2021 with a share of almost two-thirds of the total volume.

The trend has been more balanced in the first eight months of 2022, with destination-fixed contracts accounting for 47% of the total 27 bcm signed with post-FID projects during this period.

As older fixed-destination contracts expire, almost 60% of primary³ LNG export volumes will come from flexible-destination contracts by 2025, according to current contracts. Nevertheless, destination-fixed contracts may appeal to buyers who would otherwise need to import LNG from the volatile spot market, where they face not only competition between European and Asian buyers, but also the ups and downs of an often turbulent global LNG market.

Long-term contracts (> 10 years) accounted for around 74% of newly signed LNG contract volumes in 2020 and 84% in 2021, a significant increase from an average of 60% in 2015-2019. This high share in 2021 was driven by Asian buyers, which accounted for 84% of contracted long-term volumes. China alone was responsible for 63% of them, in conjunction with a flurry of new investments in LNG receiving terminals. Although the import of gas via pipeline is generally cheaper than importing LNG from external supply sources, China nonetheless bought the majority of its gas imports in the form of LNG in 2021.

³ Sourced directly from export project owners, as opposed to secondary volumes sold by portfolio players.

In terms of size, large contracts (exceeding 4 bcm/yr) accounted for 22% of contracted volumes in 2021, a sharp increase from only 13% in 2020 and their highest share since 2015. Medium-sized contracts (2-4 bcm/yr) and small contracts (< 2 bcm/yr) made up 38% and 40% of the total volume in 2021, respectively. During the first eight months of 2022, 40% of newly signed contracts had contracted volumes below 4 bcm/yr. Only two contracts were concluded with large volumes, by portfolio players. This reflected some risk aversion on the part of the buyers, which prompted them to sign smaller contracts in the face of the current market tightness and longer-term uncertainties.

On the export side, the United States accounts for the bulk of additional contracted volumes, with a tenfold increase between 2017 and 2025 based on contracts concluded with post-FID projects. On the import side, the share of the Asia Pacific region remains broadly stable to 2025, with a significant increase going to China, which reaches almost 160 bcm by 2025, two and a half times higher than in 2017. Contracted volumes going to traditional Asian buyers, including Japan and Korea, by contrast are decreasing gradually. Europe's contractual position (based on current volumes) is also on course for a nearly 40% decline by 2025 compared to 2021 levels.

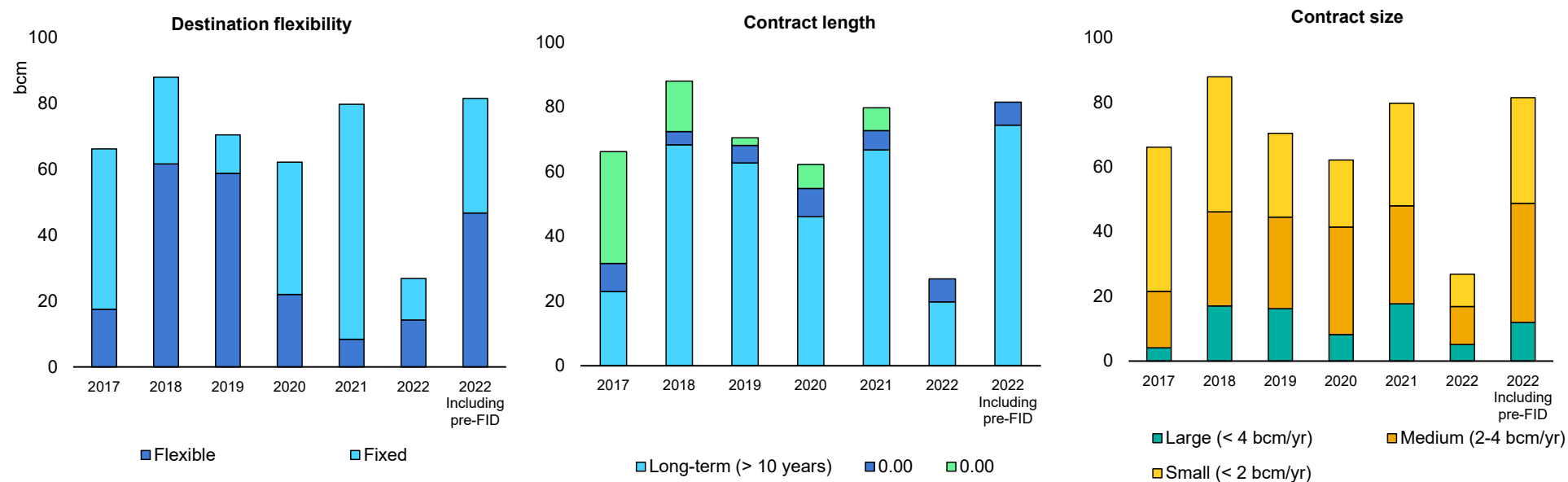
The observed tightening of the LNG market since late 2020, further exacerbated by a sharp demand recovery and supply outages in 2021, and by extreme market tensions caused by Russia's invasion

of Ukraine, has put sellers in a stronger position to demand more traditional features in newly signed LNG contracts, such as longer durations, fixed destination and larger quantities. Meanwhile, the opposing trends of short-term scarcity and longer-term uncertainty of natural gas demand have prompted certain buyers to opt for shorter and smaller contracts. In the past, similar gaps between seller preferences and buyer requirements were bridged by portfolio players who contracted primary supplies on a flexible long-term basis, and resold these volumes with shorter durations and in smaller volumes to end users at a premium. However, this model requires primary export volumes to remain destination flexible and portfolio players to retain their appetite for such open positions in the future.

LNG liquefaction capacity additions are set to slow significantly until 2025 due to a combination of budget cuts during the period of lower oil and gas prices throughout the mid-2010s, and construction delays stemming from Covid-19 lockdowns. Additions are set to average just over 20 bcm/yr between 2021 and 2025, around half of the 40 bcm/yr average seen between 2017 and 2020. However, with the expiry of approximately 180 bcm/yr of legacy contracts, the primary source of contracting activity is shifting from new primary supply to the re-contracting of legacy volumes over time.

Recent contracting trends present a shift back to destination-fixed LNG supply

Volume of contracts concluded in each year split by contractual element, 2017-2022



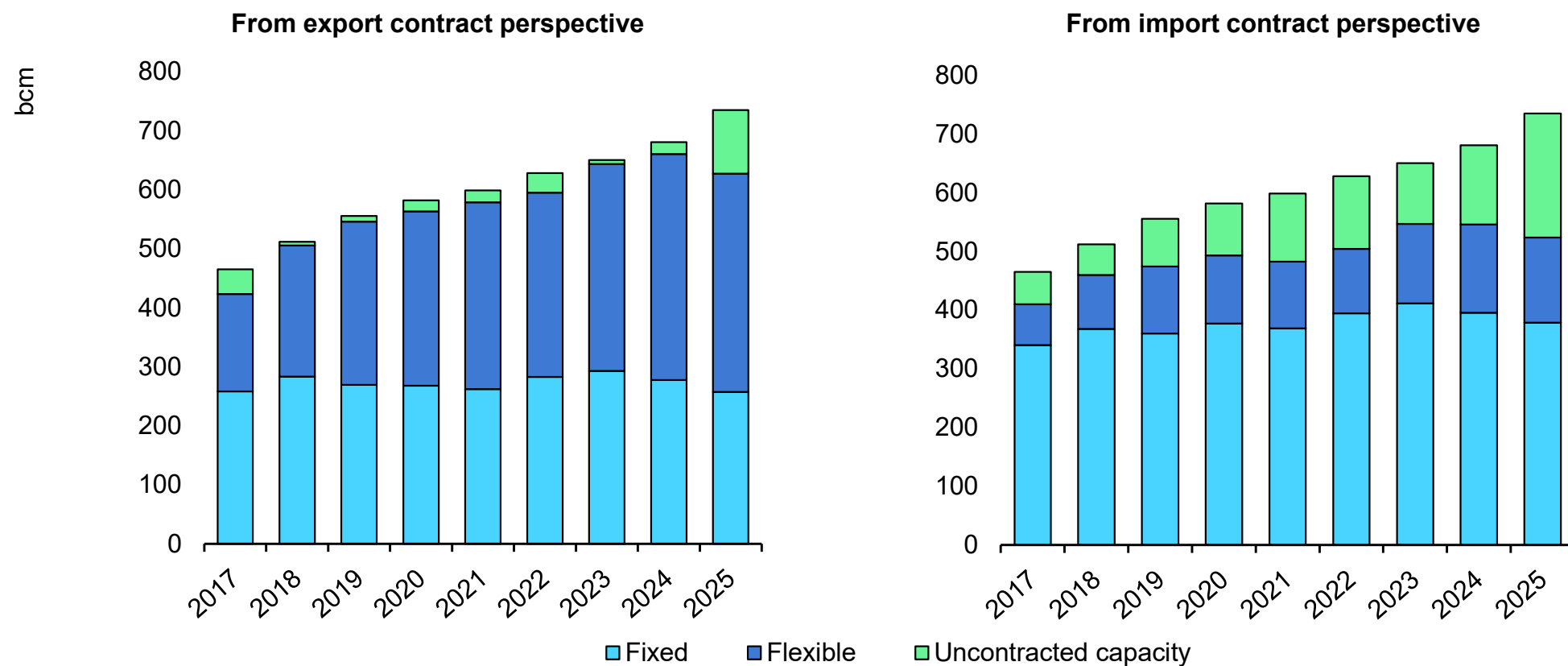
IEA. CC BY 4.0.

Note: 2022 represents volumes signed by the end of August 2022.

Source: IEA analysis based on ICIS (2022), [ICIS LNG Edge](#).

Destination-flexible contracts and uncontracted capacity account for the bulk of additional export volumes to 2025

LNG supply capacity by destination flexibility (excluding portfolio contracts), 2017-2025

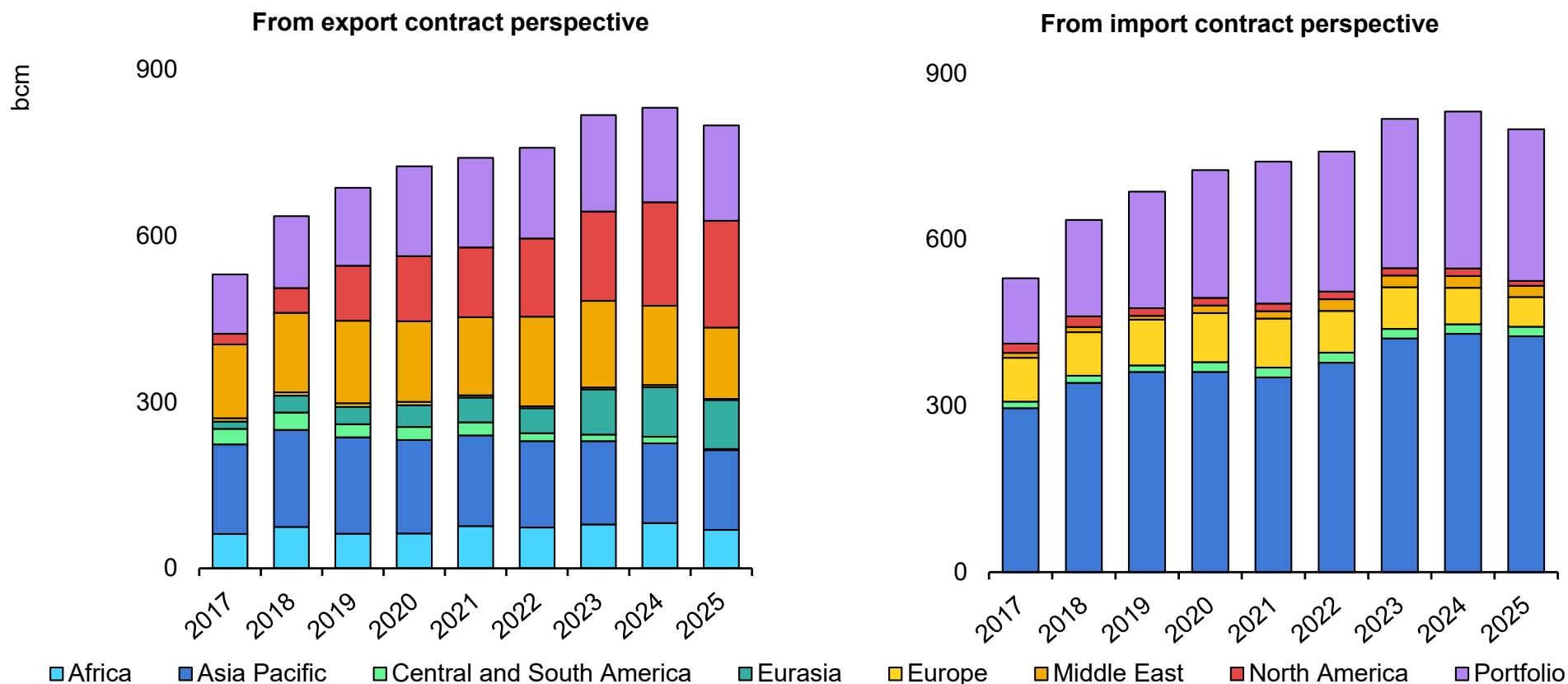


IEA. CC BY 4.0.

Source: IEA analysis based on ICIS (2022), [ICIS LNG Edge](#).

North America is the main source of additional contracted exports to 2025, while Asia Pacific retains its leading role in contracted LNG imports

Total active LNG contracts, 2017-2025



IEA. CC BY 4.0.

Source: IEA analysis based on ICIS (2022), [ICIS LNG Edge](#).

Portfolio players' role in the global LNG market and their trading volumes are important

Portfolio players procure a mix of LNG supplies from multiple sources and resell to customers according to their requirements via term contracts and spot market sales. They are an important source of flexibility in a global market and for this reason have been playing a major role in providing volumes to Europe in the recent tight and uncertain market context.

The share of portfolio players in newly signed LNG contracts as sellers was 23% in 2021, a sharp decline from both the 2017 peak of 50% and the 2016-2020 average of 35%. The average duration of contracted volumes sold by portfolio players increased over time. Long-term contracts (> 10 years) accounted for over 70% of the volumes sold by portfolio players in 2021, up from 55% in 2020, and 25% in 2016.

The contracted ratio⁴ of portfolio players dropped from 66% in 2017 to 52% by 2021. Consequently, their net open position (the portfolio volumes not covered by back-to-back sales contracts) increased from 34% to 48% between 2017 and 2021. This has been instrumental in providing liquidity to the short-term and spot LNG markets and bridging any short-term gaps between supply and demand. Based on existing contracts, this open position is expected to slightly increase in the coming years, and stabilise at an average rate of around 53% between 2022 and 2025.

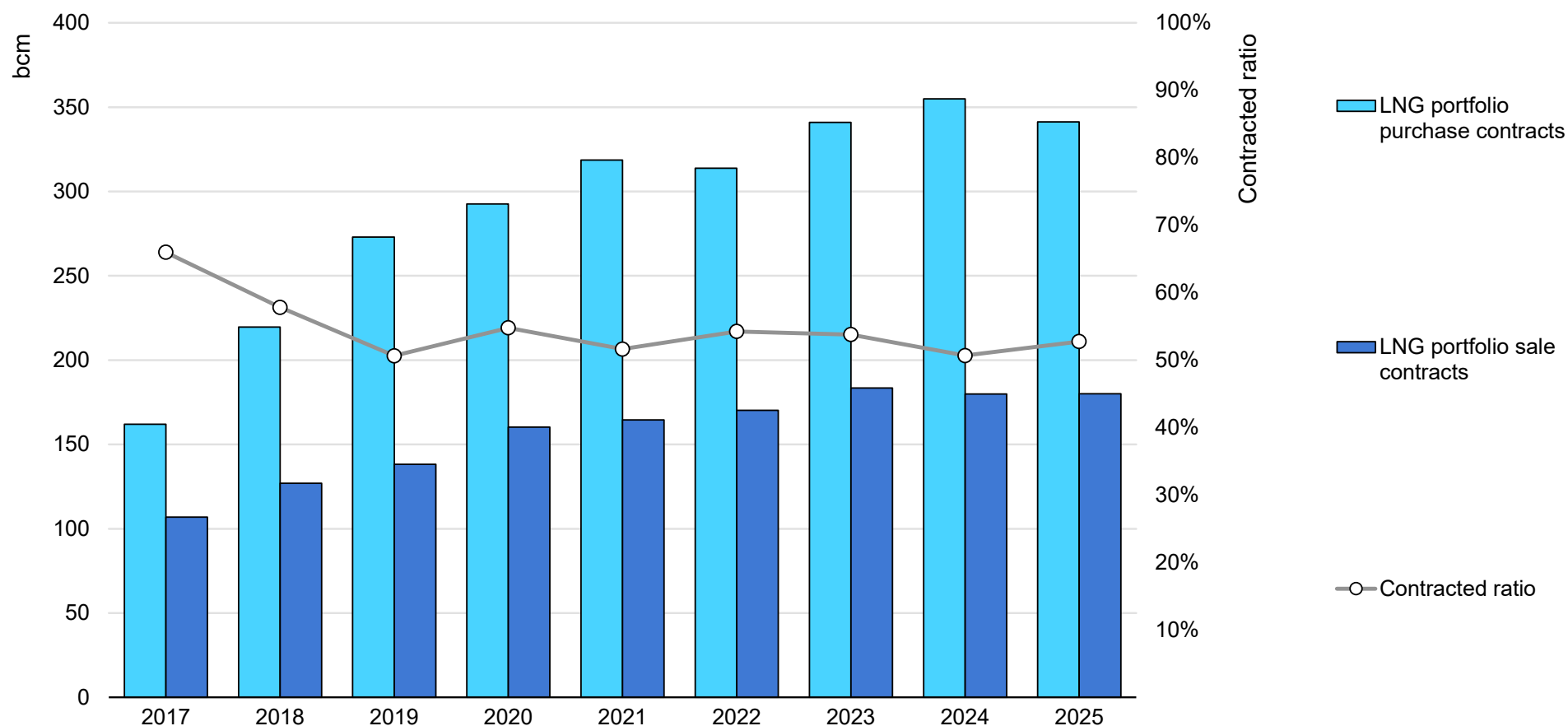
Several factors may be contributing to the downward trend in the contracted ratio of portfolio players, implying a pause in new term contracts. With the extreme rise in gas prices since late 2021, sellers are likely to want to sell their LNG volumes on the spot market to make an additional profit. In addition, buyers (especially in Europe) are confronting greater uncertainty of supply, prompting them to think about making long-term commitments and possibly show a preference for an open position as opposed to having a binding contract.

Portfolio players are thus expected to continue to play an important role in supplying flexible LNG to the market, unless they decide to increase their contracting activity with end users to materially reduce their net open position in the future. The current situation is financially attractive for short-term sellers. Yet, they may opt to secure demand outlets against the backdrop of higher long-term market uncertainty. Equally, security of supply concerns could prompt some buyers to conclude medium- to long-term contracts rather than sourcing LNG on the spot market, which brings the risk of a squeeze in case of strong competition from other buyers for the same cargoes.

⁴ Sales offtake as a percentage of purchase obligations, a metric of relative exposure to certain types of market risk.

Portfolio players' net open position is expected to remain a key source of market flexibility

LNG portfolio players' contractual position and contracted ratio, 2017-2025



IEA. CC BY 4.0.

Note: 2022 represents volumes signed by the end of August 2022.

Source: IEA analysis based on ICIS (2022), [ICIS LNG Edge](#).

Expiring legacy contracts and uncontracted LNG could further boost market flexibility

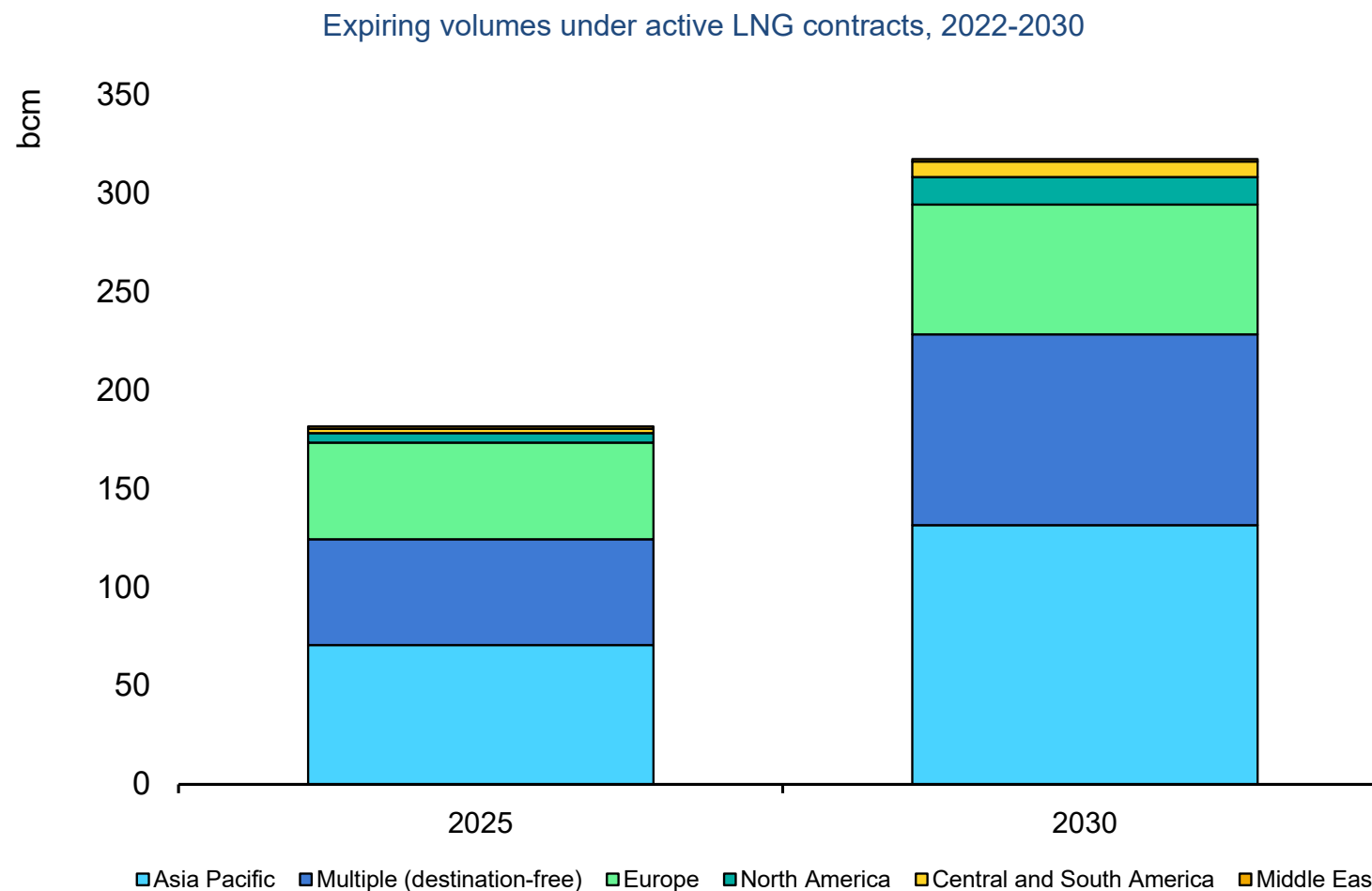
About 180 bcm of active LNG contracts are set to expire between 2022 and 2025, followed by an additional 135 bcm between 2026 and 2030. The Asia Pacific region, which is the largest current holder of contracted purchase volumes, is expected to account for almost 40% of the expired contracts by 2025, followed by Europe with a 27% share in the same period. As a result of expiring contracts (and in the absence of new SPAs), Europe's contracted LNG supply would decline by almost 40% by 2025 compared to 2021 levels, leaving the region at a greater exposure to spot market volatility. On the seller side, the Middle East is expected to see the largest turnover, with almost 50 bcm of its sale contracts expiring by 2025. Only about 22 bcm of new contracts were signed in 2021 with several buyers who have specific destination requirements, and no additional contracts have been signed yet in 2022. Following the Middle East, the Africa and Asia Pacific regions stand out as having notable contract expiries, totalling over 30 bcm each. Contracts with multiple sources also fall by 27 bcm between 2022 and 2025, but new contracts with portfolio sources are exceeding the expired contract volumes to result in a net increase of 10 bcm over the 2021 level.

LNG contracting has historically been dominated by oil indexation. Based on the IEA's internal LNG contract database, the share of oil-indexed LNG export contracts decreased by 15 percentage points between 2016 and 2021, from a share of around 61% to 45%. This

has coincided with a corresponding increase in gas indexation. The latter is linked to the expansion of LNG exports from the United States, which are mostly indexed to Henry Hub gas prices. According to current contractual data, the share of gas hub-linked LNG contracts is set to increase from 41% in 2021 to close to 44% by 2025. At the same time, oil-linked pricing also keeps evolving; it offers greater diversity today than in previous decades thanks to hybrid pricing with multiple indices.

The share of uncontracted LNG volumes on the export side is expected to account for almost 15% of projected liquefaction capacity (or over 95 bcm) by 2025. This substantial volume of uncontracted LNG could further accelerate the adoption of more flexible contractual approaches and the continuing diversification of LNG contracts. However, today's tight market conditions and volatile price environment could equally lead to a retreat to more traditional index pricing mechanisms, such as oil indexation.

About 180 bcm of active LNG contracts are due to expire between 2022 and 2025, and almost 320 bcm will have expired by 2030

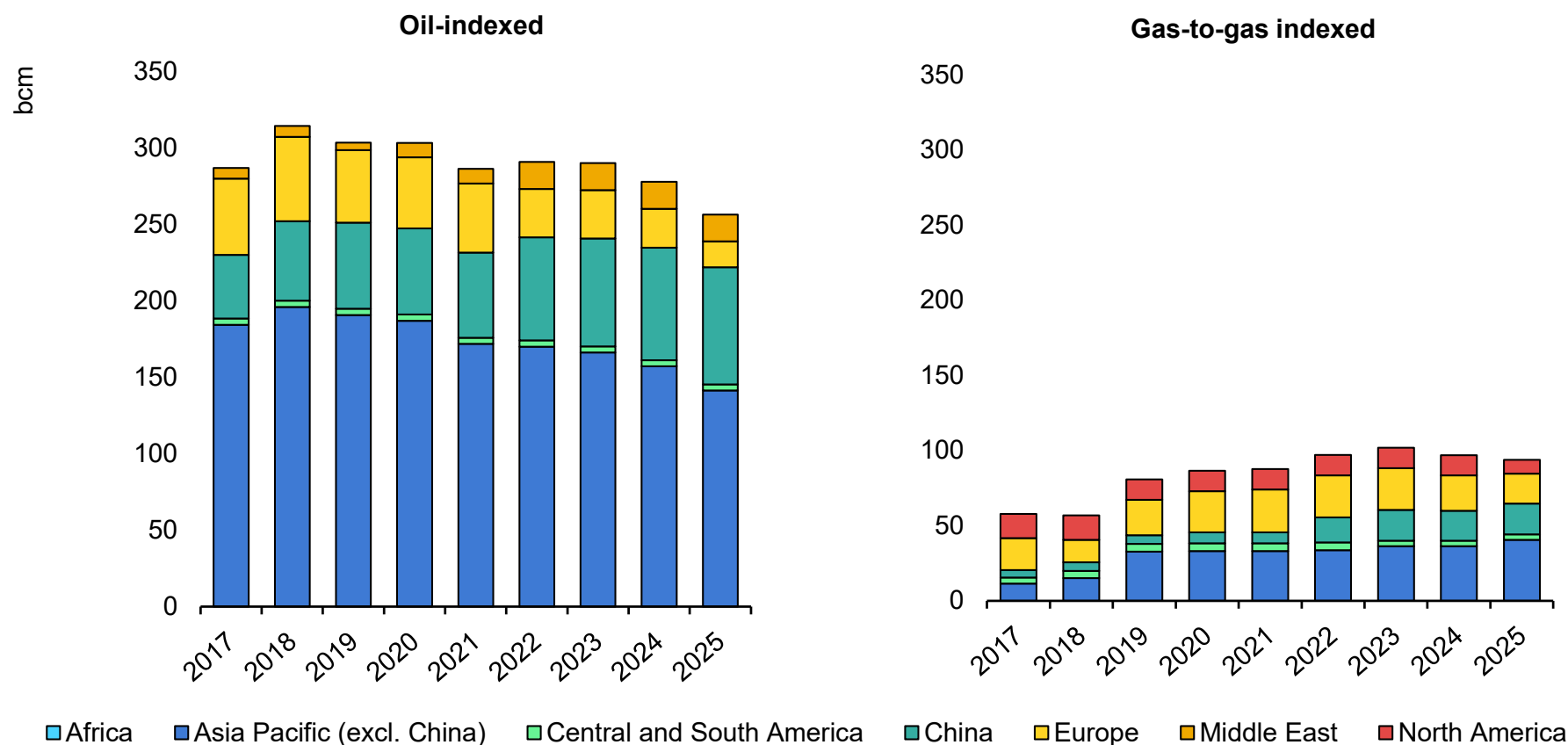


Source: IEA analysis based on ICIS (2022), [ICIS LNG Edge](#).

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Oil-linked pricing remains dominant in import contracts, though gas indexation is gaining ground

LNG import contract volumes with oil-indexed and gas-to-gas pricing, by region and country, 2017-2025



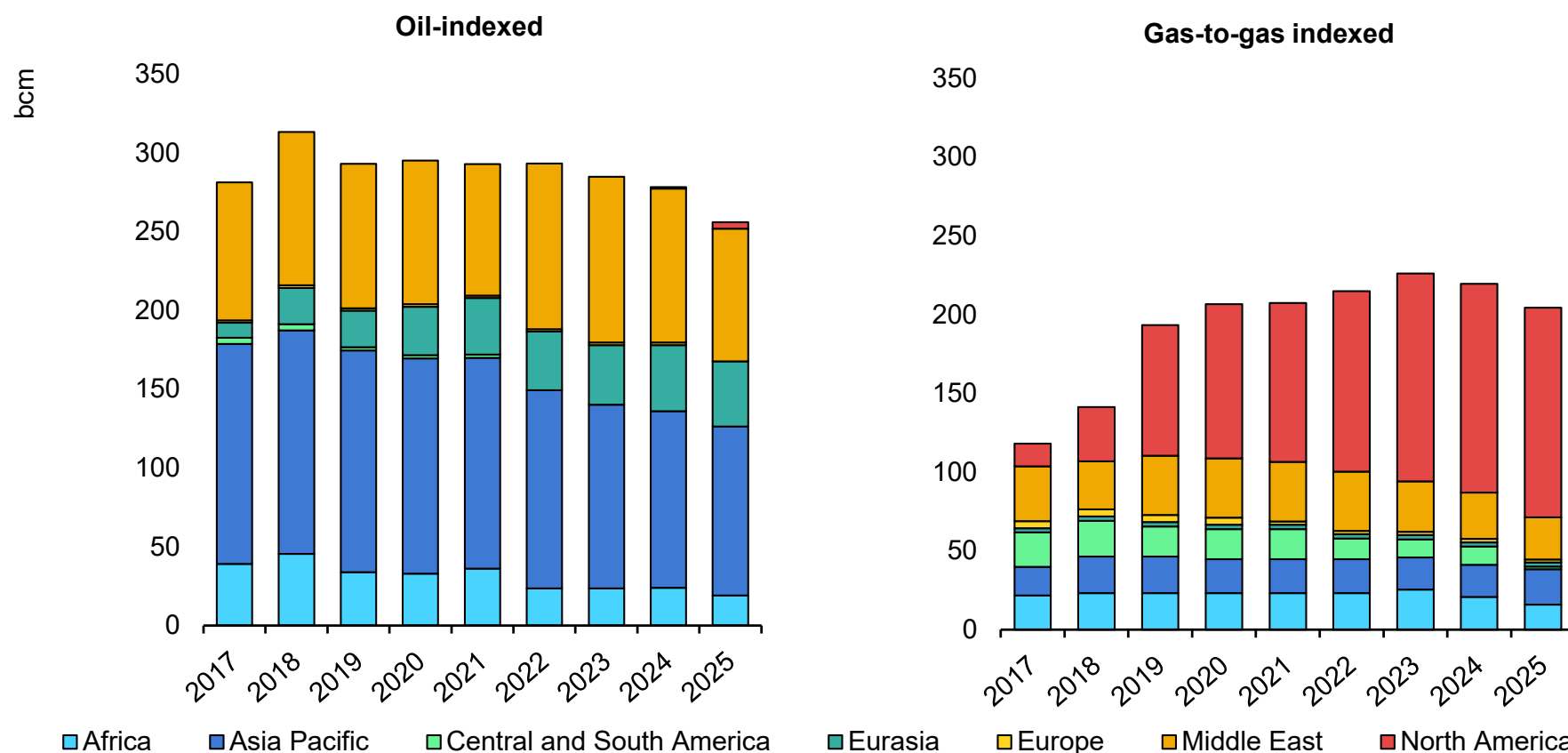
IEA. CC BY 4.0.

Note: Contracts not linked to a specific origin or destination have been excluded from the analysis.

Source: IEA analysis based on ICIS (2022), [ICIS LNG Edge](#).

Among export contracts, gas-indexed volumes show an increasing share, driven by the United States

LNG export contract volumes with oil-indexed and gas-to-gas pricing, by region and country, 2017-2025



IEA. CC BY 4.0.

Note: Contracts not linked to a specific origin or destination have been excluded from the analysis.

Source: IEA analysis based on ICIS (2022), [ICIS LNG Edge](#).

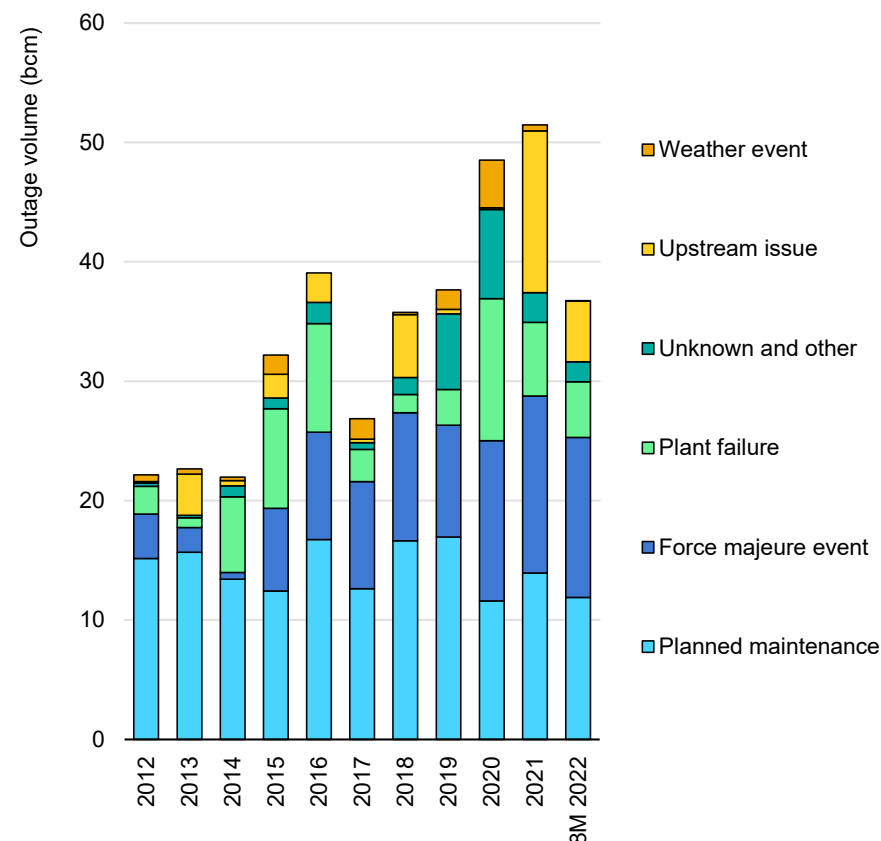
LNG capacity outages continue to tighten the global gas market

LNG supply outages reached all-time highs in 2020 and 2021, and remained at elevated levels in the first eight months of 2022 as well, exacerbating the tightness in the global LNG market and adding to concerns about supply security.

In the first eight months of 2022 close to 37 bcm of LNG production was lost due to planned or unplanned events, a 7% increase on the same period in 2021. Unplanned outages accounted for more than two-thirds of the total outage volume. The biggest unplanned losses during the first eight months occurred in the United States (due to a fire at Freeport), Algeria (due to turbine damage at Arzew), Norway (due to protracted repairs at Hammerfest LNG following a fire in 2020) and Australia (due to mechanical issues and worker strikes at Prelude).

The extended shutdown of the 20 bcm Freeport LNG terminal due to a fire in June has been the most significant outage event so far in 2022. Freeport is the second largest liquefaction terminal in the United States, accounting for a fifth of total US LNG exports prior to the incident. According to the latest guidance from the operator, the plant will only resume partial operations from mid-November and return to full service in March 2023. This represents a total supply loss of nearly 10 bcm during the entire duration of the outage (including 9 bcm to the end of 2022 and 4.4 bcm in June-August 2022 alone).

Planned and unplanned LNG capacity outages, 2012-2022



IEA. CC BY 4.0.

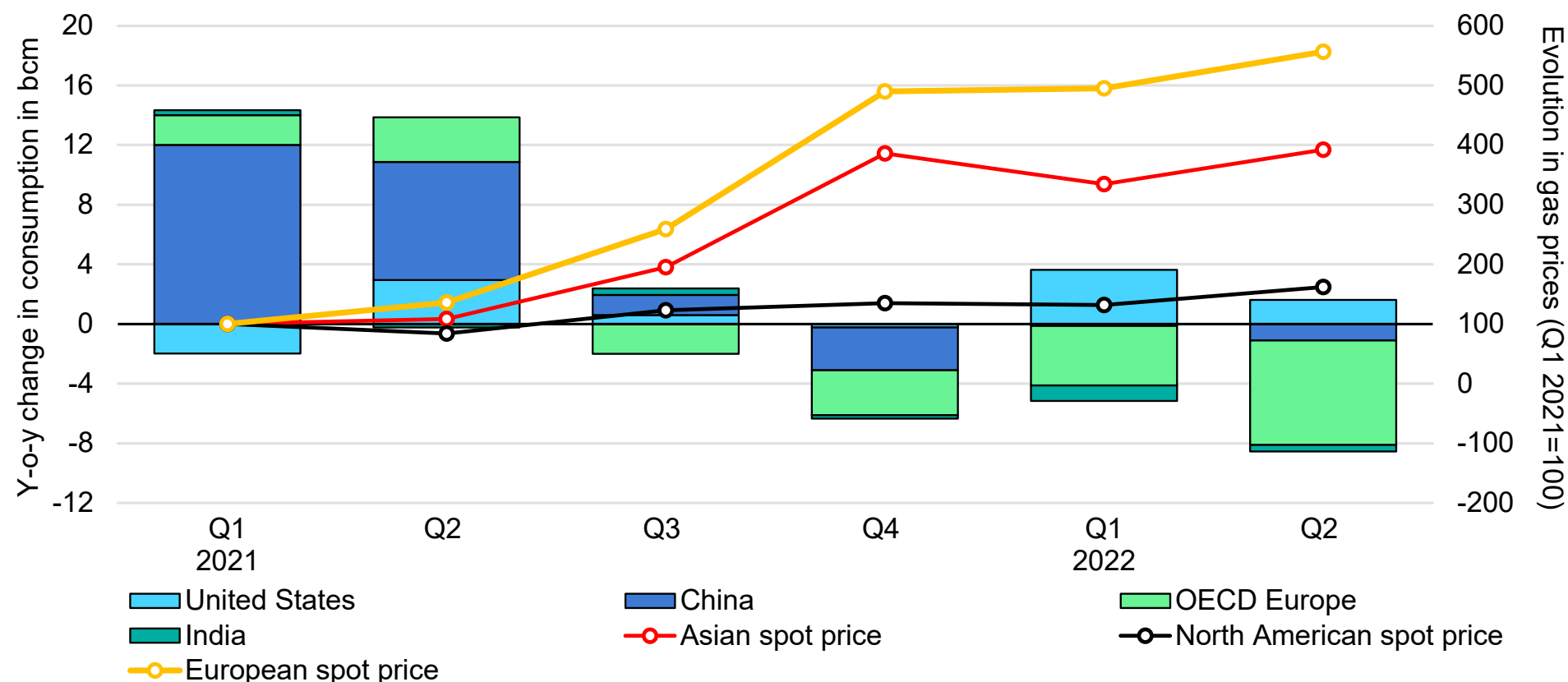
Note: 8M = 1 January-31 August.

Source: IEA analysis based on ICIS (2022), [ICIS LNG Edge](#).

Gas market update and short-term forecast

Gas demand growth from the industrial sector, which strongly recovered in early 2021, is being severely affected by tight supply and spiralling spot prices

Quarterly evolution of natural gas consumption in the industrial sector and spot prices in major markets, 2021-2022



IEA. CC BY 4.0.

Note: For India, consumption comprises only the fertiliser, refining and petrochemical sub-sectors.

Sources: IEA analysis based on CQPGX (2022), [Nanbin Observation](#); EIA (2022), [Natural Gas Consumption](#); Enagas (2022), [Natural Gas Demand](#); ENTSOG (2022), [Transparency Platform](#); EPIAS (2022), [Transparency Platform](#); PPAC (2022), [Gas Consumption](#).

North American gas demand still sees some growth in 2022 in spite of higher prices, although a slowdown is expected for 2023

Natural gas consumption in the **United States** increased by over 4% y-o-y in January to August 2022, supported principally by the power generation and residential and commercial sectors. This increase was principally driven by weather conditions, with colder than average temperatures in the first half of the year, followed in the summer by successive heatwaves resulting in an increase in gas-fired power generation for cooling.

Despite an environment of increasing domestic prices, the share of natural gas in the power generation mix managed to gain ground during Q3, in particular in the Midwest and the North East. Since May 2022 the contribution of natural gas to the electricity mix has gradually increased, breaking the 40% share threshold in both July and August 2022. This represents an increase of more than one percentage point y-o-y to the detriment of coal. Natural gas consumption for power generation grew by close to 5% in the first eight months of 2022.

Natural gas consumption in the residential and commercial sector grew by close to 4% over the same period, while demand from the industrial sector weakened during the third quarter on high prices, albeit still showing positive growth of over 3% y-o-y in January through to August 2022.

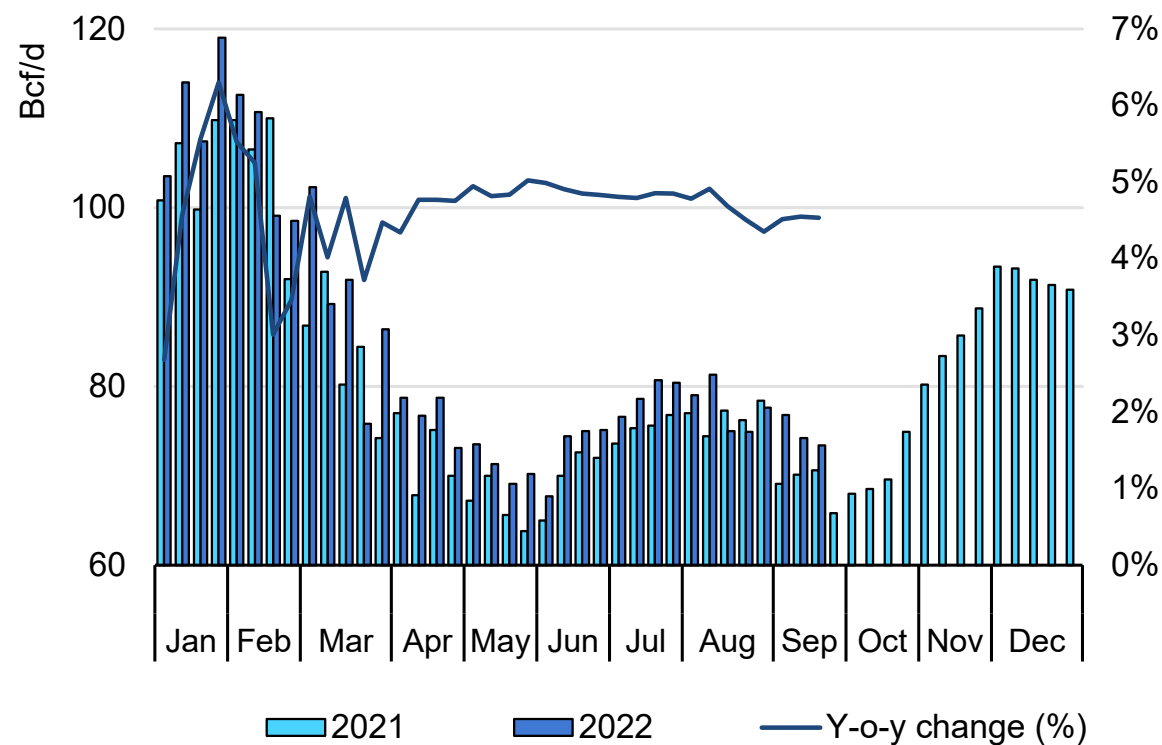
Natural gas consumption in **Canada** increased by an estimated 8% in the first half of 2022, led by a marked upturn in wholesale demand for power generation and industrial uses (together up 7%). This increase was set in motion by coal-to-gas switching in the power sector due to the accelerated coal phase-out in the province of Alberta. Higher retail demand from residential and commercial customers further contributed to the trend, while pipeline exports to the US market increased by close to 9% in the first half of the year.

Observed natural gas consumption in **Mexico** continued its decline in July 2022, leading to a 2.1% y-o-y contraction in the first seven months of 2022. There was no sign of recovery in its pipeline imports from the United States, which endorses the downtrend in Mexican natural gas demand in 2022.

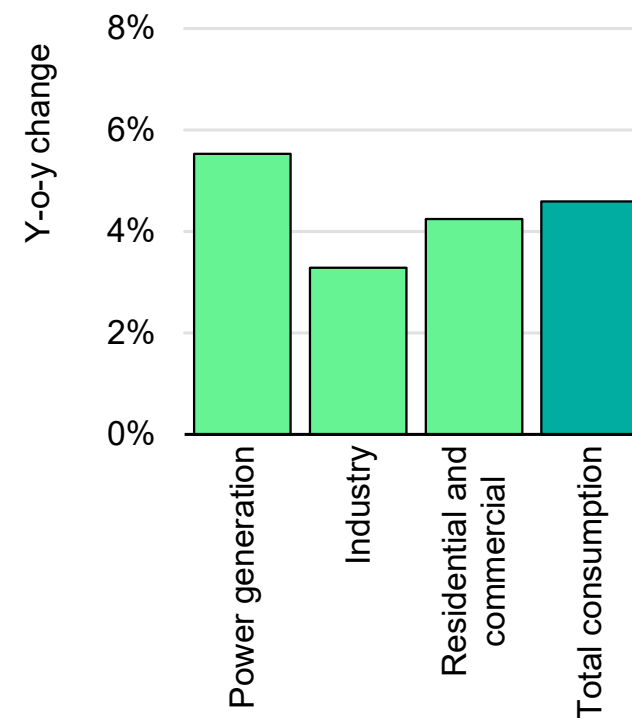
In this forecast North American growth in natural gas demand is expected to experience a slowdown by the end of the year as high prices negatively affect gas use in power generation and industry, resulting in a close to 3% increase for 2022. Demand is expected to flatten and then slightly contract in 2023 with a close to 1% decline, led by lower gas use for power generation and under the assumption of average weather conditions, which would reduce demand for space heating compared with 2022.

US gas consumption was up by over 4% y-o-y in the first eight months of 2022

Weekly natural gas consumption, United States,
2021-2022



Gas consumption by sector, United States,
January-August, 2022 relative to 2021



IEA. CC BY 4.0.

Sources: IEA analysis based on EIA (2022), [Natural Gas Consumption](#); [Natural Gas Weekly Update](#).

South America is expected to see negative gas consumption growth in 2022

Brazil's natural gas demand declined by an estimated 12% y-o-y during the first half of 2022, driven by improved hydro conditions for power generation. According to operational data from the Electricity Sector Monitoring Committee (ONS), hydroelectricity was up by 23 TWh (11% y-o-y) whereas total generation grew by only about 6 TWh (2% increase). This led to a 20 TWh drop in thermal generation (down 40%), principally affecting gas-fired generation, which declined by 51% y-o-y or about 14 TWh. Gas consumption in the industrial sector was stable y-o-y in the first five months of 2022, while gas use in refineries was down by 6%. Gross domestic production of gas increased by 1% in the first half of the year, led by associated production from oil-driven fields. Net available production declined by close to 10% due to higher gas reinjection and flaring (up 11% and 13% respectively).

Natural gas consumption in **Argentina** was close to flat in January through to May 2022; according to operational data, demand from power generation was down by 13%, while gas use increased in the energy and residential and commercial sectors (up 11% and 15% respectively) and was stable in the industrial sector. LNG imports increased by 11% y-o-y in the first seven months of the year, and jumped 50% in July to over 1 bcm to cover seasonal demand increases. Work on the new Néstor Kirchner gas pipeline project was launched in August, with start-up expected in mid-2023. Once operational, the pipeline will connect the Vaca Muerta shale basin

with the Buenos Aires area, enabling the distribution of domestic production to expand and reducing reliance on LNG and pipeline imports, especially during the winter when domestic production currently accounts for about three-quarters of supply.

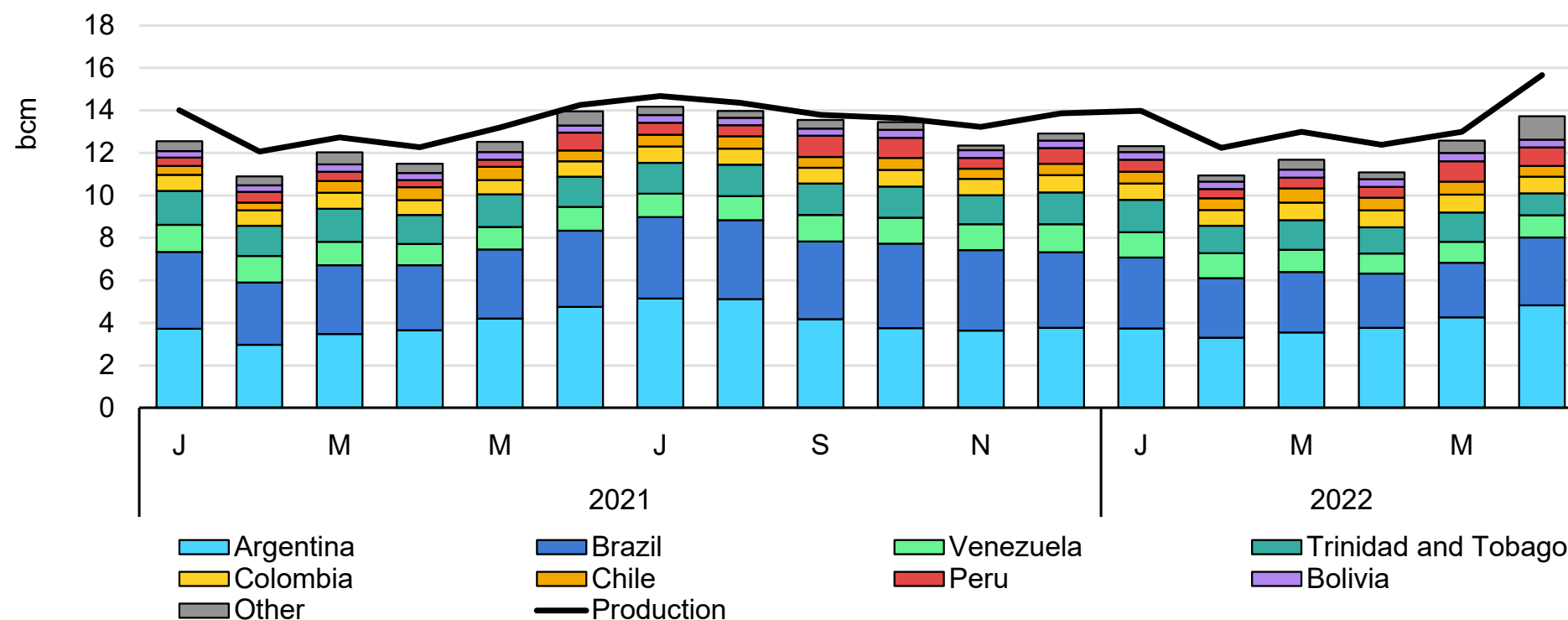
Gas use increased in **Columbia** by an estimated 9% y-o-y during the first seven months of 2022, supported by a strong 19% increase in consumption in the power sector and a 12% increase among industrial customers, while retail use grew by 4% and energy sector own use declined by 4%. Apparent consumption in **Peru** reportedly grew by 20% over the same period, due to increasing domestic production deliveries.

In **Central America and the Caribbean**, apparent natural gas consumption grew by over 9% y-o-y in January through to July 2022, supported by a close to 20% increase in LNG imports in Jamaica and a near doubling in Panama, while LNG flows experienced a slight decline in both the Dominican Republic and Puerto Rico.

This forecast expects gas consumption to decline by over 4% y-o-y in Central and South America in 2022, principally due to improving hydro conditions for power generation and lower industrial demand due to high natural gas prices, and then to broadly stabilise in 2023.

South American gas demand picked up at the end of Q2, but remained below 2021 in H1

Monthly natural gas demand and production, Central and South America, 2021-2022



IEA. CC BY 4.0.

Sources: IEA analysis based on ANP (2022), [Boletim Mensal da Produção de Petróleo e Gás Natural](#); BMC (2022), [Informes Mensuales](#); Central Bank of Trinidad and Tobago (2022), [Statistics](#); CNE (2022), [Generación bruta SEN](#); ENARGAS (2022), [Datos Abiertos](#); ICIS (2022), [ICIS LNG Edge](#); IEA (2022), [Monthly Gas Data Service](#); JODI (2022), [Gas Database](#); MME (2022), [Boletim Mensal de Acompanhamento da Indústria de Gás Natural](#); OSINERG (2022), [Reporte diario de la operación de los sistemas de transporte de gas natural](#).

European gas demand is set for its steepest drop in history amid record high prices

Natural gas demand in OECD Europe fell by close to 10% y-o-y in the first eight months of 2022 and by an estimated 9% y-o-y in Q3. This was driven by milder temperatures in Q1-2 and record high gas prices weighing on gas use in both the industrial and power sectors.

Distribution network-related demand, most of which is associated with the residential and commercial sectors, fell by over 12% y-o-y in the first eight months of 2022. Milder winter and spring temperatures reduced space heating requirements and depressed gas demand. The decline was particularly steep in Q2, when residential and commercial demand fell by over 20%. Distribution network-related demand decreased by an estimated 15% in Q3, suggesting that record high gas prices have prompted energy saving measures across the residential and commercial sectors and in small-scale industries.

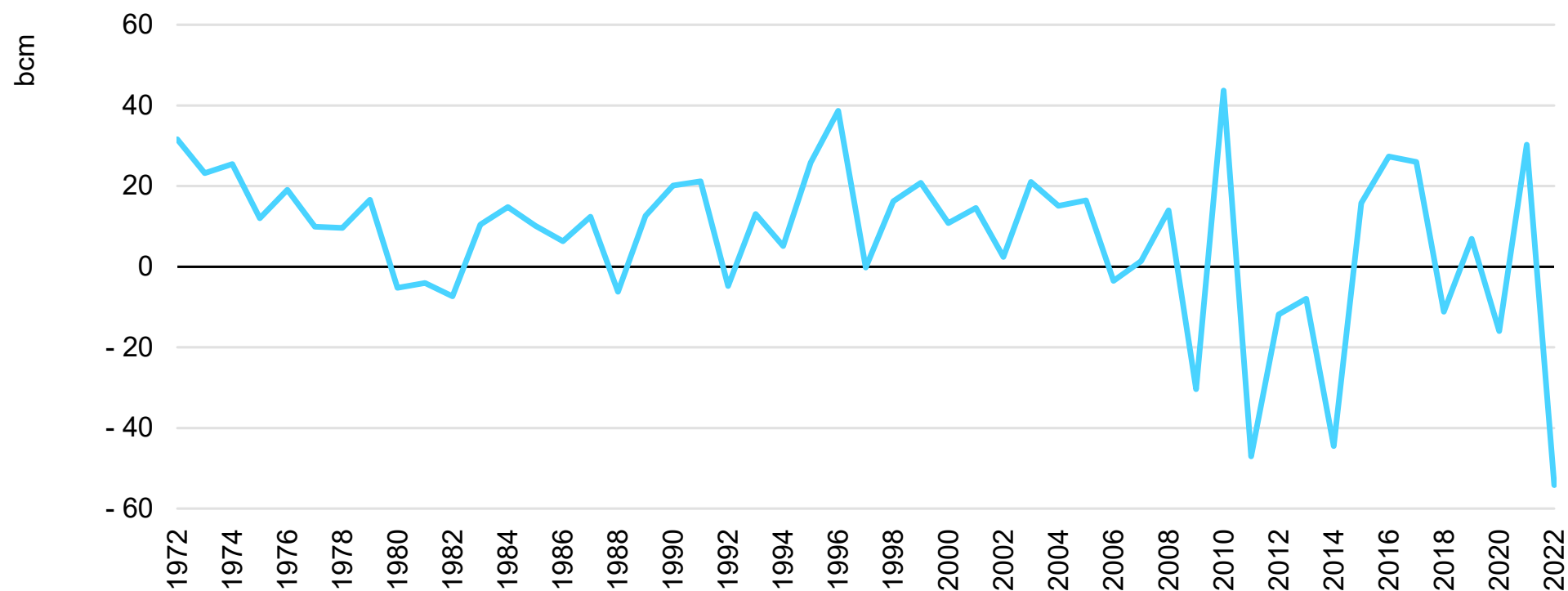
Gas demand in industry fell by an estimated 15% y-o-y in the first eight months of 2022, as record high gas prices led to production curtailments in the most energy- and gas-intensive industries. Latest data suggest that industrial gas demand plummeted by over 25% y-o-y in Q3. [According to Fertilizers Europe](#), 70% of European fertiliser production capacity had been curtailed by the end of August. The steep reduction in fertiliser output puts additional pressure on food supply chains.

In contrast with the industrial sector, gas burn in the power sector remained resilient and stayed close to last year's levels in the first eight months of 2022. Latest data indicate that despite the record high gas prices, gas-fired generation rose by an estimated 10% y-o-y in Q3. The steep drop in hydropower output in southern European markets, together with record low nuclear output in France, provided additional market space for gas-fired power plants. In Northwest, Central and Eastern Europe – with considerable gas-to-coal potential – coal-fired generation rose by 13%, while output from gas-fired power plants fell by 5% y-o-y in 8M 2022.

OECD Europe's natural gas demand is forecast to decline by 10% (or 54 bcm) in 2022, its steepest decline in history. This represents a further downward revision compared to our previous forecast in Q3 2022. It reflects the expectation of higher gas prices and the European Union's ambition to reduce the bloc's gas consumption by 15% between August 2022 and March 2023 compared to its five-year average. Gas burn in the power sector is expected to decline by close to 3% in 2022, while industrial gas demand is foreseen to drop by 20%. Assuming average weather conditions, gas demand in the residential and commercial sectors is expected to remain below 2021 levels. In 2023 OECD Europe's demand is forecast to decline by 4% amid high prices. Further potential disruption to the supply of Russian gas provides additional downside risk to this outlook.

European gas demand is expected to drop by over 50 bcm in 2022...

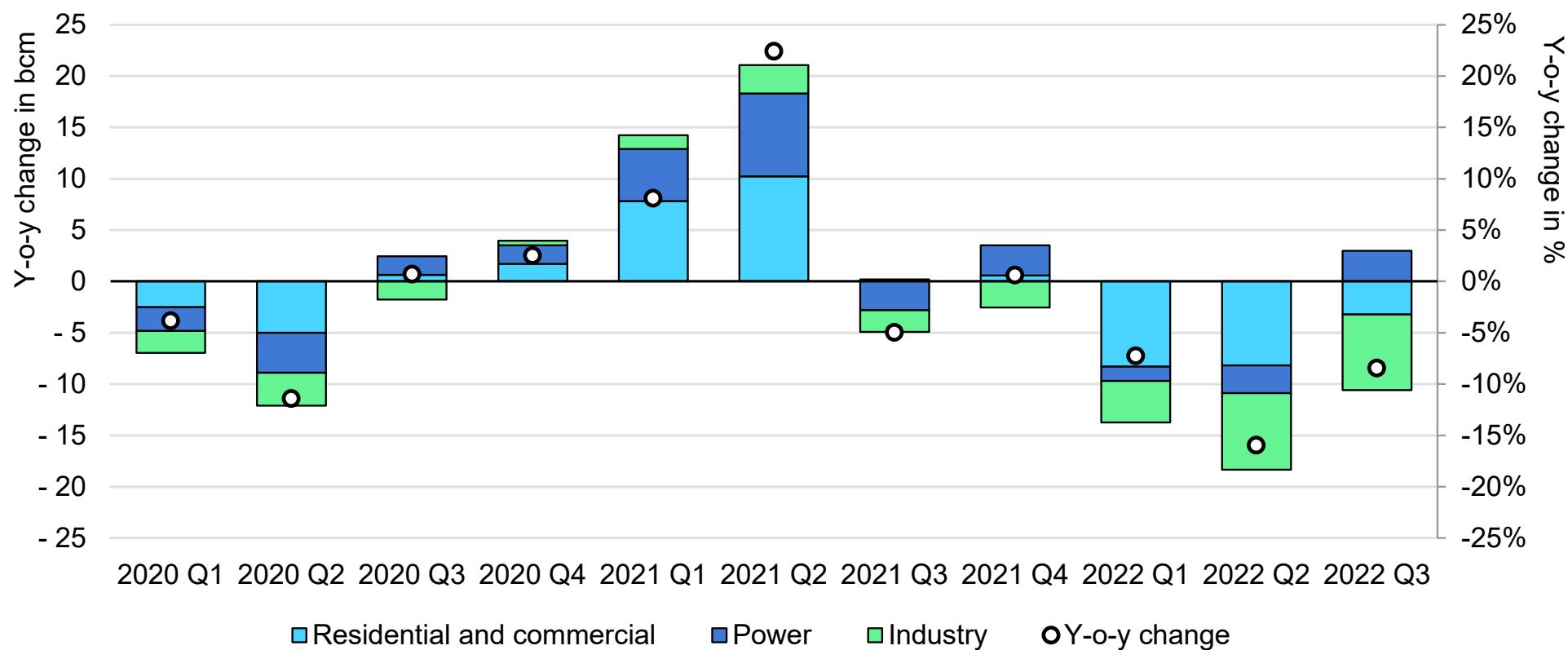
Annual change in gas demand, OECD Europe, 1972-2022



IEA. CC BY 4.0.

...largely driven by demand destruction in the industrial sector

Estimated quarterly change in gas demand, OECD Europe, 2020-2022



IEA. CC BY 4.0.

Sources: IEA analysis based on Enagas (2022), [Natural Gas Demand](#); ENTSG (2022), [Transparency Platform](#); EPIAS (2022), [Transparency Platform](#); Trading Hub Europe (2022), [Aggregated consumption data](#).

Asia's gas demand growth grinds to a halt in 2022, followed by a modest 3% recovery in 2023

Asia's gas consumption growth has slowed markedly so far in 2022, a combined result of high LNG prices, Covid-related disruptions in China in H1 and mild winter temperatures across Northeast Asia earlier in the year. For 2022 as a whole, Asia's gas demand is projected to remain flat, a steep deceleration from the bumper growth of 7% in 2021 as high prices continue to weigh on gas consumption in the remainder of the year. Demand could see a modest recovery to 3% growth in 2023 on the assumption of a normalising Covid situation and rebounding economic activity in China, and a return to modest expansion in India and emerging Asia (after declines in both in 2022).

China's gas consumption increased by less than 1% y-o-y in the first eight months of 2022. Mild winter temperatures, slowing economic growth, price-driven demand destruction and widespread lockdowns under China's "zero Covid policy" have all contributed to anaemic growth so far this year. Total gas consumption in 2022 is expected to increase by less than 2% (vs 12% in 2021), which would be the lowest annual growth rate since the early 1990s. This very modest growth is mostly driven by the industrial sector, where activity is anticipated to recover in H2 following the Covid-related disruption in the first half of 2022. Meanwhile, gas use for power generation is on course to record a double-digit decline in 2022 (despite a brief drought-driven spike in August) due to strong coal-fired and renewable generation, which is keeping a lid on overall gas demand growth this year. Further lockdowns in China or an economic downturn – either in China or its export markets – present

downside risks to this forecast. In 2023 total consumption is set to expand by 5% on the back of recovering economic activity and China's growing resilience to high spot LNG prices thanks to the country's newly signed LNG contracts.

India's gas consumption dropped by nearly 4% y-o-y in the first eight months of 2022 as high prices for both imported LNG and domestic gas squeezed demand in the more price-sensitive sectors of the economy. Gas use for power generation (down 28% y-o-y), refining (down 29% y-o-y) and chemicals production (down 23% y-o-y) suffered the steepest declines in the first eight months of 2022. These were only partially offset by modest increases in the fertiliser, city gas and other end-use segments (which include agriculture, upstream operations and other industries). India's LNG imports were down by 14% y-o-y in the January to August 2022 period, as rising domestic production (up by 5% y-o-y in the first eight months of 2022) and widespread fuel switching away from gas conspired to decimate LNG demand. Total gas consumption in 2022 is now projected to drop by 1.5% y-o-y. Total consumption in 2023 is expected to increase by 2% thanks to growing demand in the industrial and city gas segments.

Japan's gas consumption was flat in the first six months of 2022, with declines in power generation largely offset by increases in other sectors. Despite overall electricity demand growing in H1 2022 due to high summer temperatures, power sector gas demand dropped in Q1 due to an increase in renewable and nuclear

generation, and was only partially reversed in Q2 by growing power sector gas burn due to a reduction in nuclear output. Gas use in the industrial and commercial sectors increased by more than 5% y-o-y during the January to June period thanks to Japan's ongoing economic recovery. Total consumption in 2022 is projected to remain flat as the H1 trend of growing industrial and commercial demand and shrinking power sector demand continues into the second half of the year. In 2023 Japan's gas consumption is expected to decrease by 5% as nuclear restarts (which could be accelerated even further by government support) and growing solar generation cut demand in the power sector more sharply.⁵

Korea's gas imports decreased by 1.6% y-o-y during the first six months of 2022 due to the near-doubling of aggregate import prices. In the same period, gas demand rose by 0.1% y-o-y as healthy growth in the industrial, district heating and city gas segments more than offset a nearly 5% y-o-y decrease in gas use for power generation (which was due to higher nuclear and coal-fired output in H1). The gap between imports and demand was met by heavy withdrawals from LNG stocks, especially in February and June. Overall gas consumption in 2022 is expected to decrease by 4% (assuming average temperatures during the coming winter). In 2023 gas consumption is projected to remain unchanged from 2022, as growing gas use in the industrial sector is more or less

offset by reduced power sector burn as a result of additional nuclear and coal-fired plant start-ups.

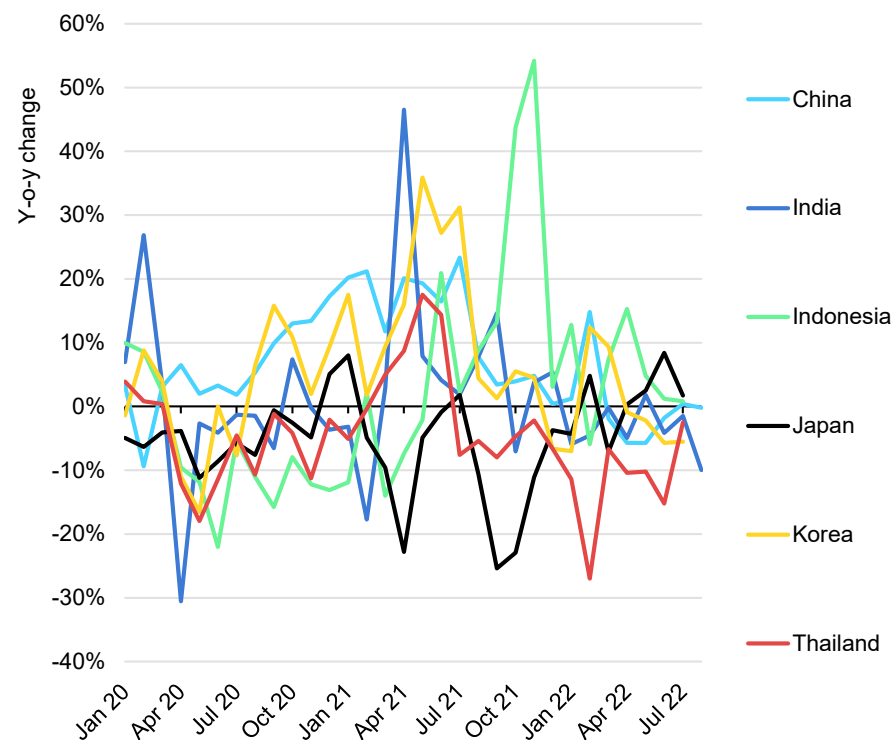
Emerging Asia's gas demand growth slowed markedly in the first seven months of 2022 as high energy prices and falling indigenous supply took their toll on consumption. Thailand, the region's largest gas user, accounting for one-fifth of consumption, saw a massive 12% y-o-y drop in demand in the first seven months of 2022 as high prices squeezed power sector use and falling domestic production reduced the energy sector's own consumption simultaneously. Indonesia, the second largest gas market in the region, was a relative outlier with a 5% y-o-y increase in January-July 2022 on the back of recovering economic activity and low coal availability earlier in the year. Gas demand in South Asian economies was particularly hard hit by high LNG prices. LNG imports into Pakistan (down 19% y-o-y) and Bangladesh (down 10% y-o-y) dropped sharply in the first eight months of 2022 and both countries face acute fuel shortages and power cuts in today's very tight global LNG market. Total gas consumption in emerging Asia is expected to shrink by 1% in 2022 (vs 3% growth in 2021) as high prices and tight LNG supply put the brakes on demand. In 2023 the region is projected to register a 4% increase in total consumption as economies continue to recover and power demand expands. However, total demand in emerging Asia is only expected to exceed the previous 2019 peak by about 1% in 2023.

⁵ The current projection is based on the assumption of 13 nuclear reactors being in operation during 2023. Japan's Prime Minister announced a plan in August 2022 to accelerate nuclear restarts and bring the number of operational reactors to 17 after mid-2023. However, the timing and execution

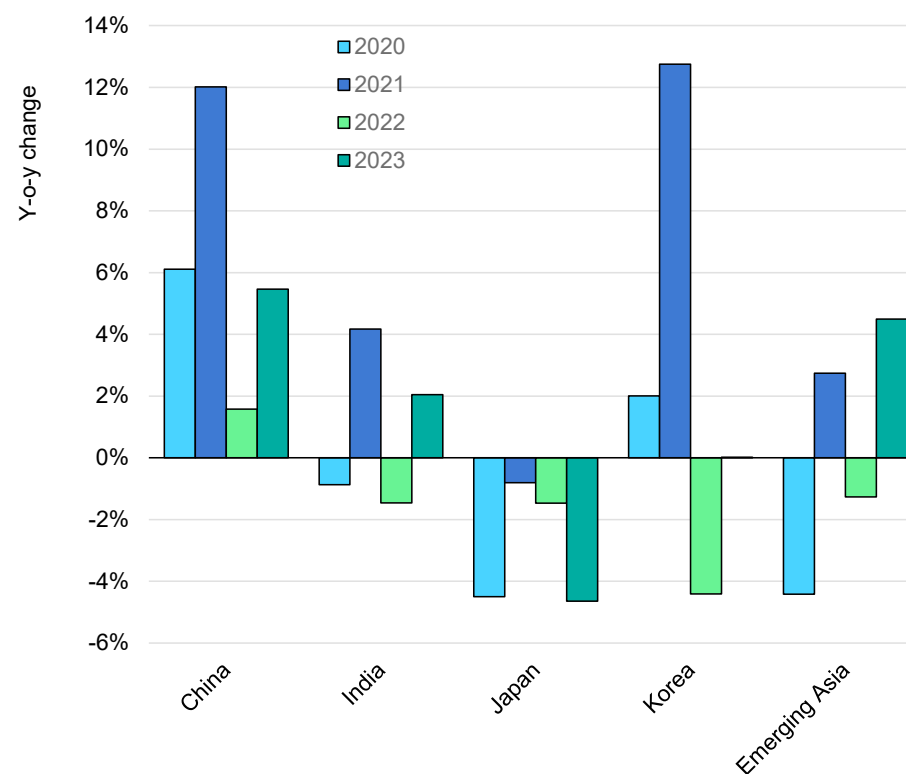
of the plan remains uncertain, partly due to factors outside the central government's control, such as the need to secure approval for reactor restarts at the municipal level.

Asia's uneven gas demand recovery continues in 2022 and 2023

Monthly gas demand, selected Asian countries, 2020-2022



Annual gas demand, selected Asian countries, 2020-2023



IEA. CC BY 4.0.

Sources: IEA analysis based on ICIS (2022), [ICIS LNG Edge](#); CQPGX (2022), [Nanbin Observation](#); JODI (2022), [Gas World Database](#); PPAC (2022), [Gas Consumption](#); EPPO (2022), [Energy Statistics](#).

US gas output kept growing over the summer, principally supported by associated production

Dry gas production in the United States is estimated to have increased by close to 4% y-o-y in the first eight months of 2022 to reach a record average of 98 bcf/d in July-August and above 99 bcf/d in the first half of September. This growth was principally driven by higher associated gas production in the oil-driven Permian Basin and higher output from the gas-driven Haynesville play. Production growth from the major Appalachian Basin appeared more limited. Natural gas output in Pennsylvania, the country's second largest gas-producing state after Texas, posted y-o-y declines in both Q1 and Q2 2022 (down 0.6% and 0.9% respectively). These results, published by the state's Independent Fiscal Office, were interpreted as resulting from lower drilling activity in 2020 and 2021, and from the impact of transport infrastructure bottlenecks.

Financial reporting on H1 2022 from large natural gas-focused producers confirmed strong earnings and showed some increase in capital expenditure, which was mainly driven by cost inflation. In spite of the continued high price environment, the spending strategy remains constrained while financial guidance continues to be geared towards maximising short-term shareholder returns with a combination of accelerated debt repayment, share buyback and higher dividend distribution. Some consolidation is also under way with a series of mergers and acquisitions, including the

USD 4.8 billion takeover of THQ Appalachia by EQT announced in early September 2022.

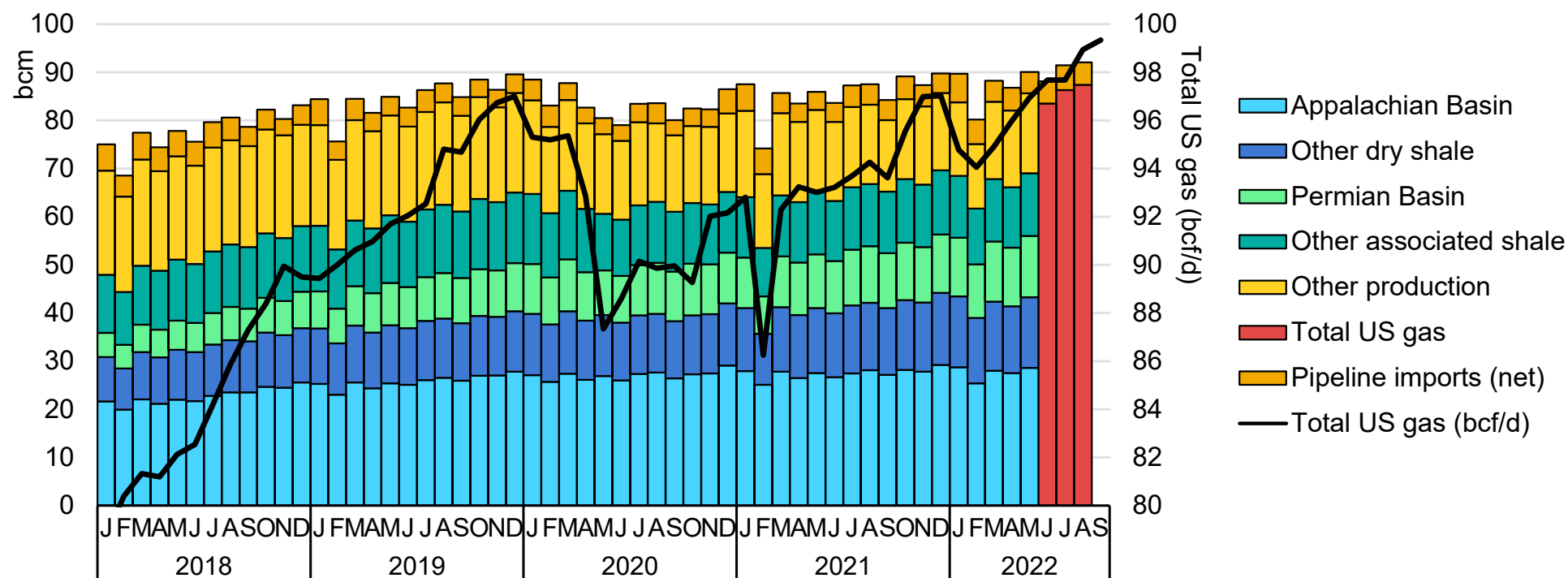
US drilling activity kept growing throughout the summer, reaching 166 active natural gas rigs by mid-September. This is a marked 57% increase compared with the beginning of the year, and its highest value since August 2019. The number of active rigs in the Appalachian Basin returned to its pre-Covid levels with around 50 active natural gas units, or about one-third of total US natural gas drilling activity. Dry gas production from the Permian Basin is associated with light tight oil and therefore fluctuates according to oil drilling activity; an average of 350 oil rigs were active in the Permian in July to mid-September, a 20% increase compared with early January, yet still about 15% below its pre-Covid level in early 2020.

Takeaway capacity from the Permian Basin is expected to keep growing in the coming two years, with a close to 4.2 bcf/d cumulative capacity increase resulting from a series of new investment decisions taken since the beginning of Q2. In the Appalachian Basin, growth potential is more limited as several pipeline projects have been cancelled or put on hold.

This forecast expects a continuation of the observed trend for the rest of the year, with a close to 4% increase in US dry gas production in 2022, slightly slowing to 3% in 2023

US dry gas production at record daily levels since June 2022

Gas production by type, United States, 2018-2022



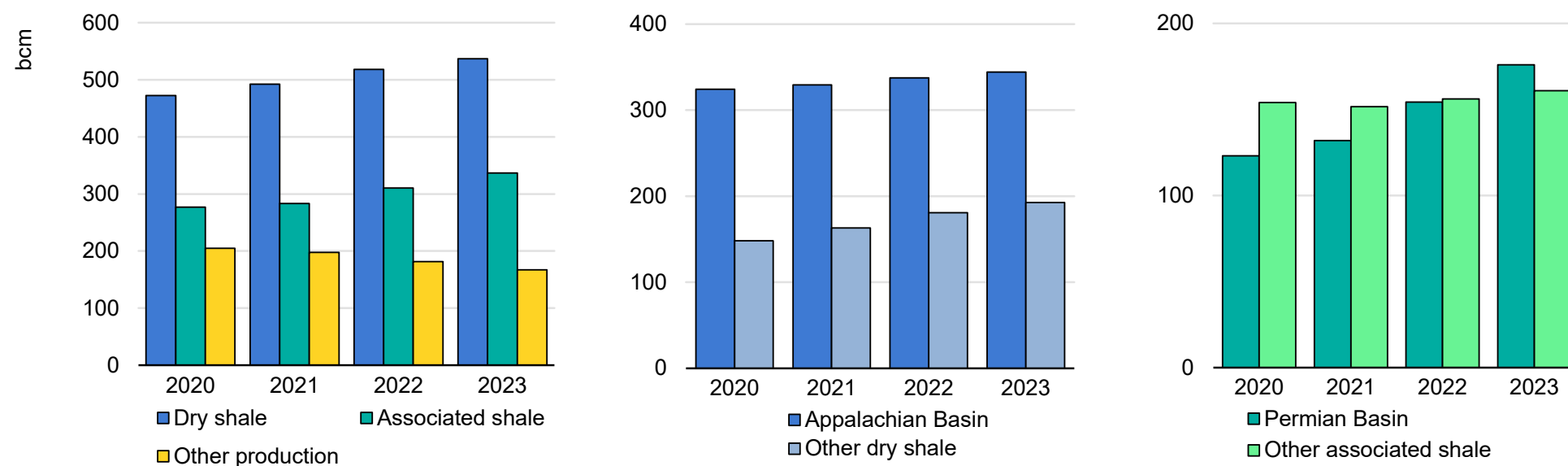
IEA. CC BY 4.0.

Note: September daily production estimate is based on data available as of 23 September.

Sources: IEA analysis based on EIA (2022), [Natural Gas Data](#); [Natural Gas Weekly Update](#).

Associated gas production, led by the Permian Basin, is expected to drive most of the growth in 2023

Dry gas production by main source, United States, 2020-2023



IEA. CC BY 4.0.

Sources: IEA analysis based on EIA (2022), [Natural Gas Data](#); [Natural Gas Weekly Update](#).

Russia's piped supplies to Europe fell to decade lows in Q3 2022

Russia's Gazprom accelerated its cuts to gas supplies to OECD Europe in Q3, further exacerbating tensions in both the European and global LNG markets. Europe's LNG imports rose to seasonal highs, partially offsetting lower Russian flows and enabling Europe to fill its storage sites to above 88% capacity by the end of September 2022.

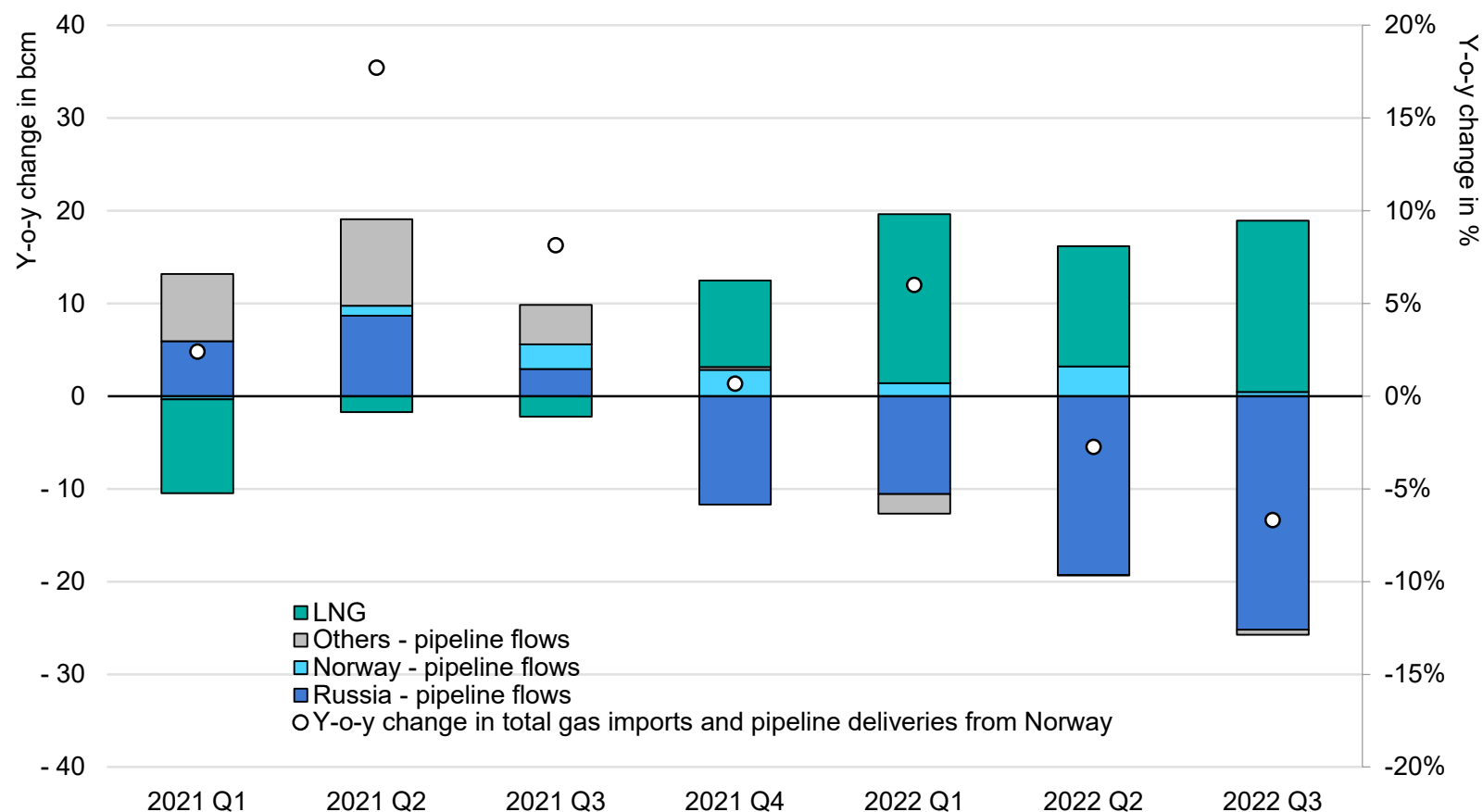
Russia's piped exports to OECD Europe declined by an estimated 40% (or over 45 bcm) y-o-y in the first eight months of 2022. While deliveries to the Republic of Türkiye dropped by 13% y-o-y in the first seven months of 2022, gas supplies to the European Union plummeted by 45% y-o-y in the first eight months of 2022. Gazprom unilaterally cut gas supplies to several EU member states during Q2, following their refusal to adhere to a new payment system imposed by Russia. In addition, Russia introduced a range of sanctions on European companies in May, following which Gazprom announced that it would cease to use the Yamal–Europe pipeline. Gazprom started to gradually reduce gas flows via Nord Stream in mid-June on reduced compressor power. According to Gazprom, the gas turbines undergoing maintenance in Canada were not returned to Russia due to the sanction regime in place. Despite the Canadian government granting a sanctions waiver and returning the gas turbines to Germany, Russia continued to raise administrative barriers and rejected receiving the gas turbines during Q3. Gas flows via Nord Stream had fallen to just 20% of the pipeline's capacity by the end of July and were halted completely at

the beginning of September. Russia's pipeline exports to the European Union fell by 70% y-o-y in Q3 to below 10 bcm, their lowest level in at least two decades. Lower flows from Russia and flat non-Norwegian domestic production were compensated by higher pipeline deliveries from alternative sources and record volumes of LNG inflow. Pipeline supplies from Norway rose by 8% (6 bcm) and flows from Azerbaijan via the Trans Adriatic Pipeline surged by 50% (2.5 bcm) y-o-y in the first eight months of 2022. In the same period North African gas supplies declined by 14% due to the non-availability of the Maghreb–Europe pipeline and lower Libyan flows. LNG imports rose by close to 65% y-o-y to reach over 110 bcm, their highest ever total for the first eight months of the year. LNG supplies from the United States to the European Union stood at 12 bcm in Q3, surpassing Russia's piped exports for the first time in history.

OECD Europe's domestic gas production is expected to increase by 5% in 2022 and by 1% in 2023, driven by higher output in Norway and the United Kingdom. Assuming that current flow rates continue, Russian piped supplies are expected to fall by 50% y-o-y in 2022, partly compensated by higher LNG inflows, up by over 55%. Again, assuming the current flow rate, Russian pipeline deliveries are expected to be 50-55 bcm in 2023, while LNG imports are foreseen to increase by close to 10%. Potential supply disruptions from Russia provide further upside potential for European LNG import growth.

Record high LNG imports partially offset the shortfall in Russian piped gas supplies in Q3 2022

Y-o-y change in quarterly European natural gas imports and deliveries from Norway, 2021-2022



IEA. CC BY 4.0.

Sources: IEA analysis based on ENTSOG (2022), [Transparency Platform](#); Eurostat (2022), [Energy Statistics](#); Gas Transmission System Operator of Ukraine (2022), [Transparency Platform](#); [ICIS LNG Edge](#); JODI (2022), [Gas World Database](#).

Global LNG trade growth is fuelled by European demand and US supply

In the first eight months of 2022 global LNG trade expanded by nearly 6% y-o-y, a slight increase on the 2021 growth rate of 5.5%, but less than the 2016-2021 average of 8%.

LNG import flows were dominated by surging LNG demand in Europe in response to sharp cuts in pipeline gas supply from Russia. In January-August 2022 net LNG imports to Europe rose by a stunning 65% (or 43 bcm) y-o-y, triggering a wholesale realignment of LNG trade flows around the world. Most of the relief for the European market so far in 2022 has been provided by the Asia Pacific region, where LNG demand fell by 7% (or 18 bcm) y-o-y as a result of a mild winter, high prices and Covid-related disruption in China. Central and South America also registered a sharp 29% (5 bcm) y-o-y drop in LNG imports due to recovering hydro generation levels across the region following last year's droughts, which freed up further spot volumes for the tight European market. The balance of small changes in LNG inflows to all other regions was close to zero.

LNG export growth in January-August 2022 was once again dominated by the United States (up 14% y-o-y), which accounted for more than half of the net increase in global LNG output thanks to the ramp-up of Sabine Pass train 6 and the Calcasieu Pass terminal (and notwithstanding the prolonged outage at the Freeport facility

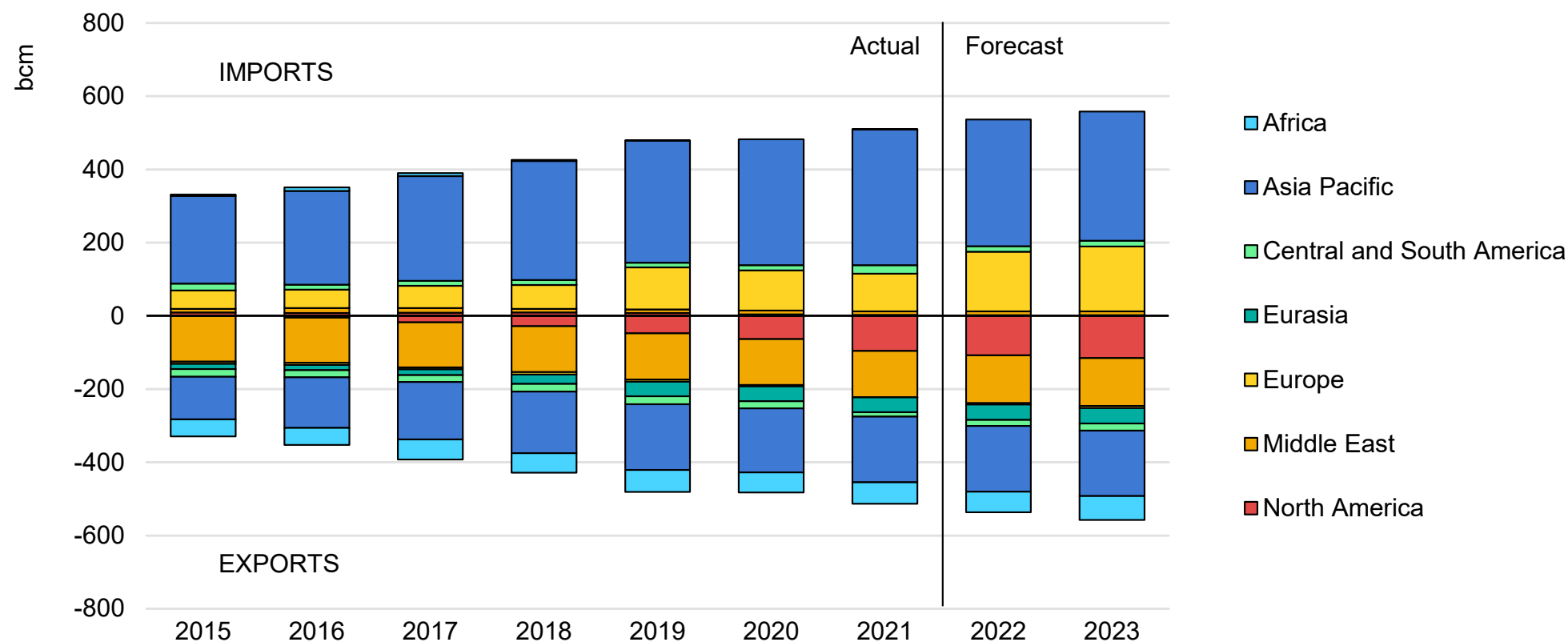
since June). The second biggest contribution came from Russia, where LNG outflows jumped also by 14% y-o-y due to record production at the Yamal LNG facility. The restart of Norway's Hammerfest terminal following a nearly two-year outage has also contributed to global LNG export growth since June. The leading legacy producers in the Middle East (Qatar and Oman) and South America (Trinidad and Tobago and Peru) reported sizeable gains, while those in Africa (Nigeria and Algeria) posted y-o-y declines.

In 2022 global LNG trade is projected to expand by 5%, supported by surging LNG inflows into Europe on the demand side and, on the supply side, rising production in the top three LNG exporters (United States, Qatar and Russia), coupled with the recovery of some previously disrupted volumes in Trinidad and Tobago, Norway and Peru.

In 2023 the volume of global LNG trade is set to increase by 4%. The expansion of LNG demand is fuelled by a continuing rise in European imports to an all-time high of 177 bcm (thanks in part to new infrastructure) and by a modest recovery in Asia following the region's demand decline in 2022. LNG export growth continues at around 4% thanks to the anticipated return to full production of the 20 bcm Freeport LNG terminal in Texas, despite a marked slowdown in new liquefaction capacity additions in 2023.

Global LNG trade growth set to continue at 5% in 2022, slowing to 4% in 2023

LNG imports and exports by region, 2015-2023



IEA. CC BY 4.0.

Source: IEA analysis based on ICIS (2022), [ICIS LNG Edge](#).

Asian and European spot prices surged to new record highs in Q3 2022

The steep decline in Russian piped gas supply to Europe and tight power supply drove European hub prices to new record highs in Q3, and indirectly had the same effect on Asian spot LNG. In the United States tight supply–demand fundamentals, together with low storage levels, drove Q3 prices to their highest level since 2008.

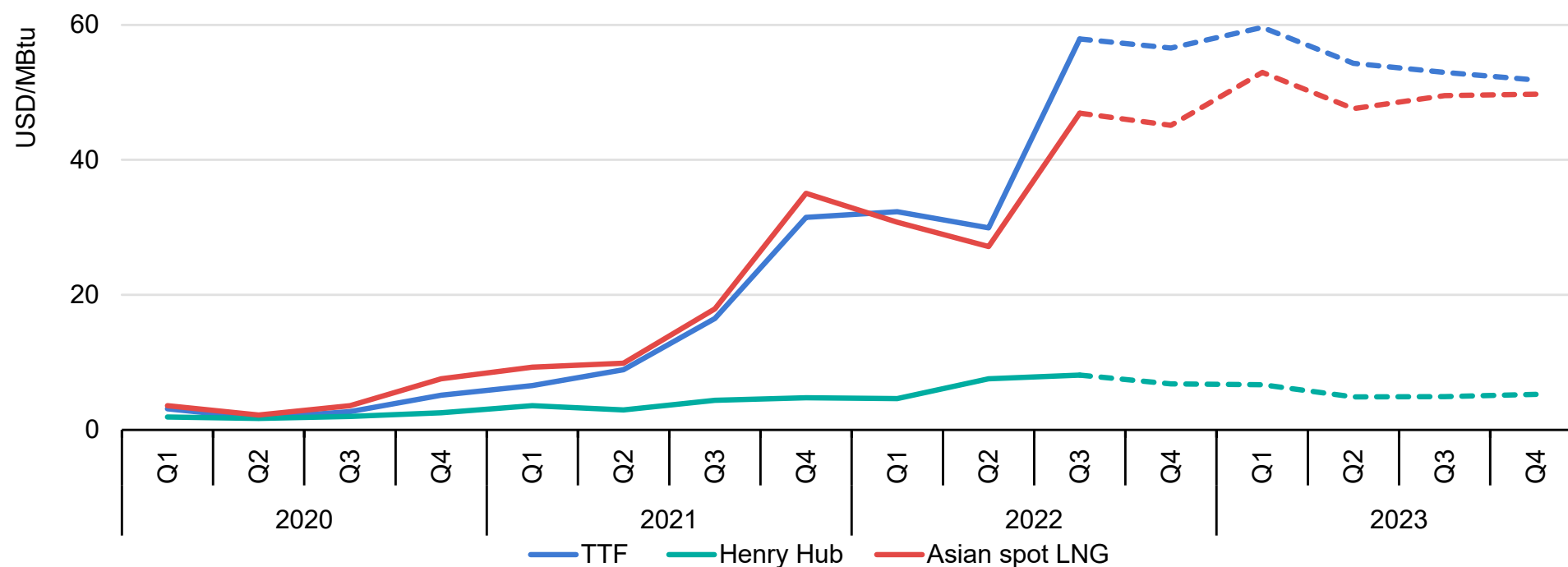
In **Europe**, TTF prices almost doubled compared to their Q2 levels and averaged at over 55 MBtu in Q3, more than eight times their five-year average for this period of the year. A combination of the steep reduction in Russian piped supplies to the European Union, higher gas burn in the power sector amid lower nuclear and hydro electricity output, and strong storage injections, provided upward pressure on European hub prices. Gas prices spiked at an all-time high of EUR 340/MWh (USD 99/MBtu) on 26 August, following Gazprom's announcement on unplanned maintenance on the Nord Stream pipeline system. Price decorrelation across key European gas hubs continued during Q3, as the record high LNG imports resulted in pipeline bottlenecks. Markets with remaining spare regasification capacity displayed significant discounts compared to TTF. For example, during Q3 the United Kingdom's NBP averaged EUR 60/MWh below TTF and Spain's PVB averaged EUR 55/MWh below. In contrast, certain Central and Eastern Europe markets – which have limited access to LNG supply – continue to display a premium compared to TTF.

Asian spot LNG prices rose by 70% compared to their Q2 levels to an average of over USD 45/MBtu in Q3 2022, their highest quarterly level on record. The increasingly fierce competition with Europe for LNG cargoes, together with lower LNG supply from Australia and the United States, provided strong upward pressure on Asian LNG spot prices. The wide TTF–Asian spot LNG premium continued to favour Europe as the key destination for flexible LNG in Q3. In the **United States**, Henry Hub prices averaged at USD 8/MBtu in Q3, their highest level since 2008. Strong cooling-induced gas demand and higher gas burn in the power sector (amid a sharp increase in coal prices) coincided with strong y-o-y growth in LNG exports and weak supply response from US producers.

Forward curves as of the end of September 2022 indicate that TTF is set to average close to USD 60/MBtu, Asian spot LNG near USD 50/MBtu and Henry Hub at USD 7/MBtu between October 2022 and March 2023. Uncertain Russian gas supply and high seasonal gas demand are set to provide strong support to gas prices during the 2022/23 heating season. Again according to forward curves, TTF is expected to trade at a premium of USD 13/MBtu above Asian spot LNG during the 2022/23 gas winter, enabling strong LNG inflow into Europe. Forward curves suggest Asian and European spot prices averaging at all-time highs of USD 50/MBtu and USD 55/MBtu, respectively, in 2023.

TTF is expected to retain its premium over Asian spot LNG prices during the 2022/23 heating season

Main spot and forward natural gas prices, 2020-2023



IEA. CC BY 4.0.

Sources: IEA analysis based on CME (2022), [Henry Hub Natural Gas Futures Quotes](#), [Dutch TTF Natural Gas Month Futures Settlements](#); CME Group (2022), [LNG Japan/Korea Marker \(Platts\) Futures Settlements](#); EIA (2022), [Henry Hub Natural Gas Spot Price](#); ICIS (2021), [ICIS LNG Edge](#); Powernext (2022), [Spot Market Data](#).

Race against time: EU storage injections surge amid winter supply uncertainty

Storage dynamics displayed a varied pattern across major gas markets during Q2-3 2022. Injections in the European Union stood well above their five-year average and enabled the bloc to surpass its 80% fill target by early September. In contrast, slow injections in the United States resulted in storage levels well below their five-year average at the end of Q3 2022.

In the European Union gas storage sites stood 25% (or 8.5 bcm) below their five-year average at the beginning of April, which marks the end of the European heating season. The strong inflow of LNG together with lower consumption enabled a strong storage build-up in Q2 and Q3. Storage injections were 18% above their five-year average and totalled over 60 bcm during the gas summer. Despite lower Russian flows, storage injections were 15% above their five-year average in Q3. Consequently, the European Union completely eradicated its storage deficit, inventory levels standing 2.5% (or 2.5 bcm) above their five-year average at the end of Q3. Inventory levels reached close to 90% of their working storage capacity at the end of September, surpassing the EU target of storage sites reaching at least 80% capacity by 1 November and in line with the recommendations of the [IEA's 10-Point Plan to Reduce the European Union's Reliance on Russian Natural Gas](#). In Ukraine gas storage levels remain low, standing at just 30% of their working storage capacity as at the end of Q3 according to data from Gas

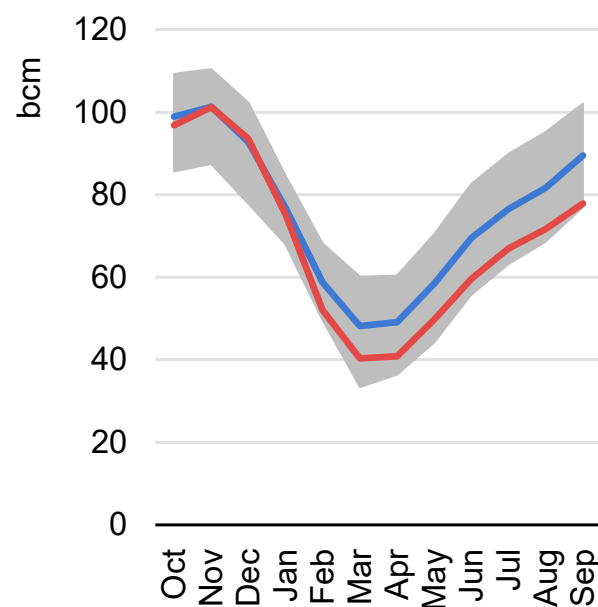
Infrastructure Europe. In Russia storage sites were over 90% full at the end of August and may have reached full capacity by the end of Q3.

In the United States storage sites closed the 2021/22 heating season 17% (or 8 bcm) below their five-year average. Tight supply-demand fundamentals limited the build-up of storage during Q2-mid-September, when injections fell 3% (or 1.5 bcm) below their five-year average. Consequently, storage levels stood 10% (or 9 bcm) below their five-year average as of mid-September. Inventory levels had reached 67% of their working storage capacity by mid-September. If injections return to their five-year average, storage should be 75% full by the beginning of November, which typically marks the start of the heating season in the United States.

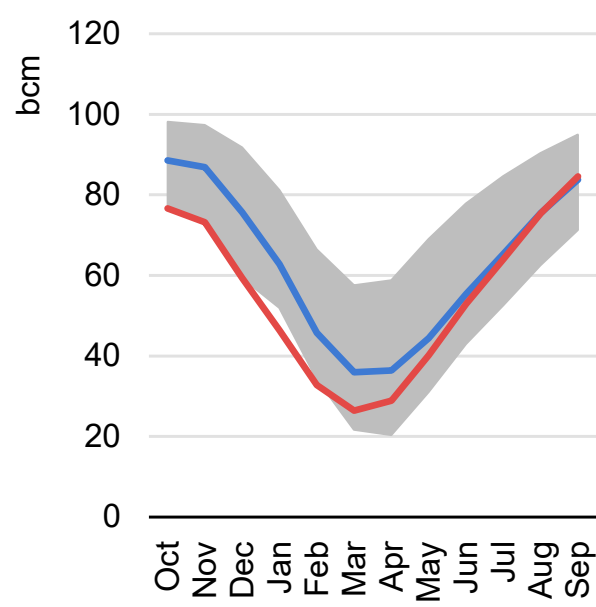
In Japan and Korea, LNG closing stocks stood 8% above their five-year average in June 2022. The LNG stocks of Japan's largest power generation companies stood at 2.6 Mt (3.6 bcm) as of mid-September, well-above their five-year average.

The European Union has surpassed its 80% storage target, while fill levels in the United States remained well below their five-year average at the end of Q3 2022

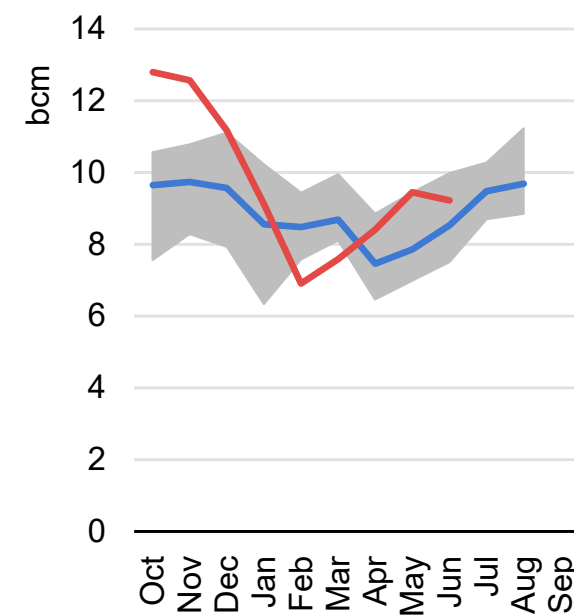
US underground storage inventory



EU underground storage inventory



Japan and Korea LNG stock inventory



■ Five-year range

— Five-year average

— 2021/22

IEA. CC BY 4.0.

Sources: IEA analysis based on EIA (2022), [Weekly Working Gas In Underground Storage](#); GIE (2022), [AGSI+ Database](#); IEA (2022), [Monthly Gas Data Service](#).

Annex

Summary table

World natural gas demand and production by region and key country (bcm)

| | Demand | | | | | Production | | | | |
|-------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| | 2019 | 2020 | 2021 | 2022 | 2023 | 2019 | 2020 | 2021 | 2022 | 2023 |
| Africa | 164 | 161 | 169 | 166 | 171 | 252 | 241 | 262 | 270 | 278 |
| Asia Pacific | 835 | 841 | 895 | 895 | 923 | 637 | 630 | 650 | 669 | 681 |
| <i>of which China</i> | 306 | 325 | 364 | 370 | 390 | 174 | 189 | 205 | 220 | 230 |
| Central and South America | 155 | 142 | 153 | 147 | 147 | 167 | 150 | 147 | 149 | 151 |
| Eurasia | 608 | 584 | 634 | 619 | 614 | 921 | 866 | 955 | 841 | 817 |
| <i>of which Russia</i> | 482 | 460 | 501 | 484 | 479 | 738 | 692 | 762 | 651 | 623 |
| Europe | 586 | 573 | 604 | 548 | 531 | 249 | 230 | 223 | 232 | 235 |
| Middle East | 545 | 548 | 564 | 582 | 596 | 671 | 674 | 694 | 715 | 732 |
| North America | 1 106 | 1 080 | 1 084 | 1 114 | 1 102 | 1 174 | 1 154 | 1 178 | 1 212 | 1 235 |
| <i>of which United States</i> | 888 | 869 | 867 | 890 | 876 | 968 | 954 | 973 | 1 010 | 1 041 |
| World | 3 999 | 3 930 | 4 103 | 4 071 | 4 085 | 4 071 | 3 945 | 4 109 | 4 089 | 4 129 |

Regional and country groupings

Africa – Algeria, Angola, Benin, Botswana, Cameroon, Congo, Democratic Republic of Congo, Côte d'Ivoire, Egypt, Eritrea, Ethiopia, Gabon, Ghana, Kenya, Libya, Morocco, Mozambique, Namibia, Nigeria, Senegal, South Africa, Sudan, United Republic of Tanzania, Togo, Tunisia, Zambia, Zimbabwe and other countries and territories.¹

Asia Pacific – Australia, Bangladesh, Brunei Darussalam, Cambodia, Chinese Taipei, India, Indonesia, Japan, Korea, the Democratic People's Republic of Korea, Malaysia, Mongolia, Myanmar, Nepal, New Zealand, Pakistan, the People's Republic of China,² the Philippines, Singapore, Sri Lanka, Thailand, Viet Nam and other countries and territories.³

Central and South America – Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, the Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, Trinidad and Tobago, Uruguay, Venezuela and other countries and territories.⁴

Eurasia – Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Russian Federation, Tajikistan, Turkmenistan and Uzbekistan.

Europe – Albania, Austria, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus,^{5,6} Czech Republic, Denmark, Estonia, Finland, the Former Yugoslav Republic of North Macedonia, France, Germany, Gibraltar, Greece, Hungary, Iceland, Ireland, Italy, Kosovo,⁷ Latvia, Lithuania, Luxembourg, Malta, the Republic of Moldova, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Republic of Türkiye, Ukraine and United Kingdom.

European Union – Austria, Belgium, Bulgaria, Croatia, Cyprus,^{5,6} Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, the Slovak Republic, Slovenia, Spain and Sweden.

Middle East – Bahrain, the Islamic Republic of Iran, Iraq, Israel,⁸ Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, the Syrian Arab Republic, the United Arab Emirates and Yemen.

North Africa – Algeria, Egypt, Libya, Morocco and Tunisia.

North America – Canada, Mexico and the United States.

¹ Individual data are not available and are estimated in aggregate for: Burkina Faso, Burundi, Cape Verde, Central African Republic, Chad, Comoros, Djibouti, Equatorial Guinea, Gambia, Guinea, Guinea-Bissau, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Niger, Reunion, Rwanda, Sao Tome and Principe, Seychelles, Sierra Leone, Somalia, Swaziland and Uganda.

² Including Hong Kong.

³ Individual data are not available and are estimated in aggregate for: Afghanistan, Bhutan, Cook Islands, Fiji, French Polynesia, Kiribati, the Lao People's Democratic Republic, Macau (China), Maldives, New Caledonia, Palau, Papua New Guinea, Samoa, Solomon Islands, Timor-Leste, Tonga and Vanuatu.

⁴ Individual data are not available and are estimated in aggregate for: Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, British Virgin Islands, Cayman Islands, Dominica, Falkland Islands (Malvinas), French Guyana, Grenada, Guadeloupe, Guyana, Martinique, Montserrat, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname and Turks and Caicos Islands.

⁵ Note by the Republic of Türkiye

The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. The Republic of Türkiye recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, The Republic of Türkiye shall preserve its position concerning the "Cyprus issue".

⁶ Note by all the European Union Member States of the OECD and the European Union

The Republic of Cyprus is recognised by all members of the United Nations with the exception of Türkiye. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

⁷ The designation is without prejudice to positions on status, and is in line with the United Nations Security Council Resolution 1244/99 and the Advisory Opinion of the International Court of Justice on Kosovo's declaration of Independence.

⁸ The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD and/or the IEA is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Abbreviations and acronyms

| | |
|---------|---|
| ANP | National Petroleum Agency (Brazil) |
| CAPEX | capital expenditure |
| CME | Chicago Mercantile Exchange (United States) |
| CNE | National Energy Commission (Chile) |
| CNG | compressed natural gas |
| CNY | Chinese yuan |
| CQPGX | Chongqing Petroleum Exchange (China) |
| EIA | Energy Information Administration (United States) |
| ENARGAS | National Gas Regulatory Entity (Argentina) |
| ENTSOE | European Network of Transmission System Operators for Electricity |
| ENTSOG | European Network of Transmission System Operators for Gas |
| EPIAS | Enerji Piyasaları İşletme A.Ş. (the Republic of Türkiye) |
| EPPO | Energy Policy and Planning Office (Thailand) |
| FID | final investment decision |
| GIE | Gas Infrastructure Europe |
| HH | Henry Hub |
| IEA | International Energy Agency |
| ICIS | Independent Chemical Information Services |
| JODI | Joint Oil Data Initiative |
| LNG | liquefied natural gas |
| MME | Ministry of Mines and Energy (Brazil) |
| m-o-m | month-on-month |
| NBP | National Balancing Point (United Kingdom) |

| | |
|---------|---|
| OPEC | Organisation of the Petroleum Exporting Countries |
| OSINERG | Energy Regulatory Commission (Peru) |
| PPAC | Petroleum Planning and Analysis Cell (India) |
| SENER | Secretariat of Energy (Mexico) |
| TAP | Trans Adriatic Pipeline |
| TTF | Title Transfer Facility (the Netherlands) |
| USD | United States dollar |
| w-o-w | week-on-week |
| y-o-y | year-on-year |

Units of measure

| | |
|--------|-------------------------------|
| bcf | billion cubic feet |
| bcf/d | billion cubic feet per day |
| bcm | billion cubic metres |
| bcm/y | billion cubic metres per year |
| mb/d | million barrels per day |
| MBtu | million British thermal units |
| mcm/d | million cubic metres per day |
| MMcf/d | million cubic feet per day |
| tcm | trillion cubic metres |
| TWh | terawatt hour |

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