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2024 WORLD LNG REPORT

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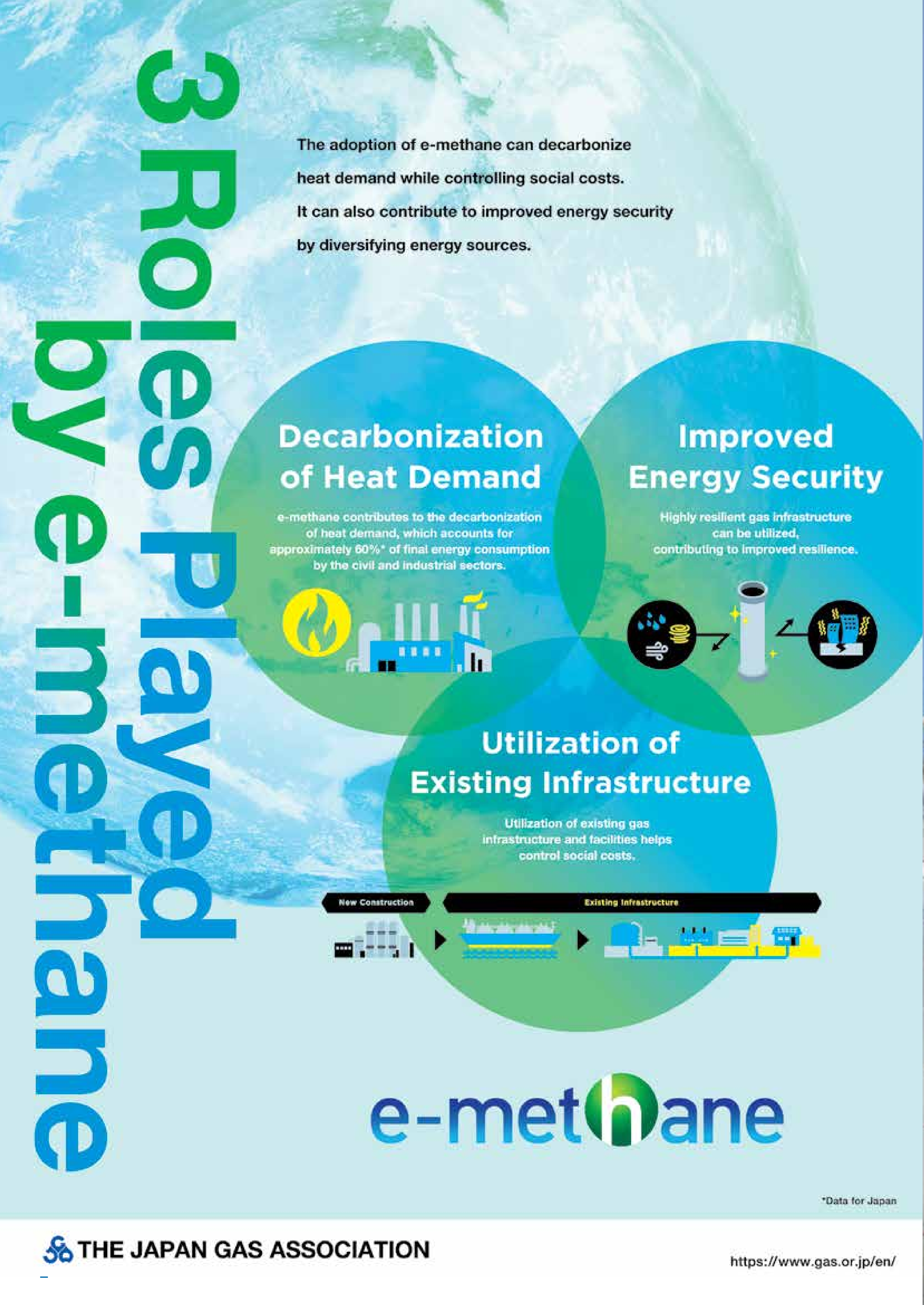
3 Roles Played by e-methane
The adoption of e-methane can decarbonize heat demand while controlling social costs. It can also contribute to improved energy security by diversifying energy sources.
Decarbonization of Heat Demand
e-methane contributes to the decarbonization of heat demand, which accounts for approximately 60%* of final energy consumption by the civil and industrial sectors.
Improved Energy Security
Highly resilient gas infrastructure can be utilized, contributing to improved resilience.
Utilization of Existing Infrastructure
Utilization of existing gas infrastructure and facilities helps control social costs.
New Construction
Existing Infrastructure
e-methane
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MESSAGE FROM THE PRESIDENT OF THE INTERNATIONAL GAS UNION

Dear Colleagues,

It is my pleasure to present to you the 15th annual edition of the IGU World LNG report.

The 2024 report traditionally provides a comprehensive review of the global LNG industry and markets, reflecting on another dynamic year for this rapidly evolving sector of the gas industry.

Global LNG trade continued on a growth trajectory from 2022, with a further 2.1% increase in 2023, connecting 20 exporting with 51 importing markets. After the most turbulent year on record, global LNG Prices saw a welcome cooling in 2023, and consumers in Asia where gas remains a clean, premium fuel, have more LNG available to enhance security of supply and upgrade energy mix. However, despite the materially lower price environment, driven in large part by lower seasonal demand thanks to a warm northern hemisphere winter of 2022, the growth in LNG trade was limited by the available supply, with only one new facility in Indonesia to start production last year (Tangguh LNG 3.8 MTPA). The market rebalancing was driven mostly by consumption changes, including demand reductions from the industrial sector in Europe and OECD Asia.

This is a crucial signal that underscores the fact that the LNG market conditions remain tight, despite lower price. The global market's newfound equilibrium is still fragile and sensitive to uncertainties from supply and demand sides.

In this year's edition, we outline some of the key transforming opportunities, uncertainties, and innovations, which will continue to shape the future of the global LNG market. The market continues to rapidly develop and experience exciting evolution to meet market players' needs and respond to constant change in global energy dynamics. Growing gas demand in emerging markets, increasing diversification of market participants, expansion of LNG infrastructure, and acceleration of technology development and innovation are the shaping dynamics of the LNG space today.

I am proud to emphasise that the LNG industry has demonstrated incredible agility and innovation through some of the toughest tests of the recent years, and this is an industry that continues to play a pivotal role to navigate through an energy crisis that has not yet been fully resolved and an energy transition that has been challenged.

As the world moves toward a lower emissions future, nations are seeking ways to achieve their climate commitments while keeping energy affordable, available, and secure. LNG is a tool that will be critical to providing greater resiliency for rapidly changing energy systems around the world, and it will have an essential role mitigating the inherent risk of uncertainty through that process.

Sincerely,

Li Yalan
President of the
International Gas Union

1. State of the LNG Industry

The IGU is grateful to its Members, the report Sponsoring Members, the IGU LNG Committee, and the World LNG Report Study Group, including partners from S&P Global Commodity Insights and GIIGNL, as well as our Knowledge Partner Rystad Energy, for making this report possible.

Courtesy QatarEnergy

LNG Trade

401.42 MT
Global LNG Trade in 2023

Global LNG trade grew by 2.1% between 2022 and 2023 to about 401.42 million tonnes (MT), connecting 20 exporting markets with 51 importing markets. Despite the materially lower price environment driven by the warm northern hemisphere winter of 2022, resulting in significantly lower energy consumption, and slow demand recovery, LNG trade growth was limited by the lack of LNG supply growth, with Tangguh LNG Train 3 in Indonesia the only new facility to start production last year.

Asia Pacific remained the largest exporting region with 134.80 MT in 2023, a 0.32 MT decrease compared to 134.49 MT in 2022. The Middle East continued as the second-largest exporting region with 94.69 MT in 2023, a 1.84 MT decrease compared to 96.53 MT in 2022. The third-largest exporting region was North America, with 84.53 MT, an 8.90 MT increase compared to 75.63 MT in 2022, driven by the return of Freeport LNG in the US to full production and Calcasieu Pass, also in the US, ramping up production. In February 2024, the Marine XII FLNG facility in Congo began LNG exports.

The largest change in imports in 2023 came from Asia with an increase of 10.50 MT YOY, as lower prices by the end of the year incentivised spot imports by several markets, including new importers Vietnam and the Philippines. India imported 21.96 MT in 2023 versus 20.02 MT in 2022, which is a 1.94 MT (9.7%) increase. China imported 71.19 MT in 2023 versus 63.61 MT in 2022 (+11.9%), while also increasing domestic production and pipeline imports. European imports remained steady (with a 0.02 MT decline). European underground storage remained relatively full in the winter, limiting import demand. Japan imports fell to 66.12 MT in 2023, from 73.06 MT in 2022, while South Korea's imports fell to 45.17 MT in 2023, from 46.81 MT in 2022.

Price Trends

Platts JKM benchmark averaged
$13.86/ mmBtu
in 2023

2023 saw LNG markets eventually regain equilibrium. Platts JKM, Asia's price reference for LNG, averaged $13.86/million British thermal units (mmBtu) during the year, close to its 10-year average of $12.01/mmBtu. Ahead of many analysts' expectations, in Q1 2024 JKM was below long-term oil-linked contract prices.

The rebalancing was aided mostly by consumption changes, including significantly lower seasonal demand, due to weather, as well as higher nuclear power generation, renewables deployment, energy saving measures, energy efficiency improvements, and demand reductions from the industrial sector in Europe and OECD Asia, with LNG supplies only marginally improving versus the previous year. Traditional North Asian importers pared back on LNG purchases, with Japan, South Korea and Chinese Taipei reducing intake YOY, while Europe's LNG imports remained largely stable. As markets returned closer to long-term average prices, South Asian markets showed demand growth, and several markets imported their first LNG cargoes. The recent LNG demand growth engine, China, saw imports rebound, albeit to a lower total level when compared with its 2021 peak.

Liquefaction Plants

483.1 MTPA[1]
Global liquefaction capacity, end-February 2024

In 2023, a total of 3.8 MTPA of liquefaction capacity was brought online globally with the addition of Tangguh LNG T3 (3.8 MTPA) in Indonesia, which increased the plant's total capacity to 11.4 MTPA. This was the only new facility to begin production in 2023, limiting LNG supply growth to 0.8% YOY. Tango FLNG, a floating LNG project in Congo, commenced production in February 2024, promoting global liquefaction capacity to around 483.1 MTPA as of end-February 2024.

In 2023, the volume of approved liquefaction capacity reached 58.8 MTPA, a significant increase compared to 22.4 MTPA in 2022. This was primarily contributed by Rio Grande LNG T1-T3 (17.6 MTPA), Port Arthur LNG T1-T2 (13.5 MTPA), Plaquemines LNG T19-T36 (10 MTPA), all three of which are in the US, and QatarEnergy LNG T12-T13 (15.6 MTPA) in Qatar. In addition, Gabon LNG (0.7 MTPA) and Altamira LNG T2 (1.4 MTPA) were also approved.

Decarbonising the global energy sector remains a key priority in global efforts to deliver on an energy transition and the climate goals of the Paris Agreement. LNG has become a critical component of the global energy mix, with its role as a flexible and highly efficient and reliable resource continuing to grow, and as such, decarbonising along the LNG value chain is a priority for many stakeholders in the industry. The liquefaction sector has seen a notable increase in efforts to minimise emissions. Several proposed projects – such as Cedar LNG in British Columbia, Canada – are looking to use hydropower to run their operations, with a carbon capture and storage (CCS) integration study planned for Egypt's Idku LNG plant. The progress towards low-carbon LNG is also under way, with initiatives such as the use of renewable energy sources and the development of CCS technology at liquefaction facilities. CP2 LNG in the US, Abadi LNG in Indonesia and some other plants are also developing CCS facilities. Inpex, operator of Ichthys LNG in Australia, plans to pursue more aggressive energy efficiency measures, and is investigating a CCS injection project at the plant in an effort to offset greenhouse gas (GHG) emissions, as is Rio Grande LNG in the US. Tokyo Gas, Osaka Gas, Toho Gas, Mitsubishi Corporation and Sempra Infrastructure Partners signed a letter of intent to jointly study the establishment of a supply chain for the production, liquefaction and international transportation of e-methane, the decarbonised synthetic gas captured through a chemical reaction between hydrogen and carbon dioxide (CO_2) in Cameron LNG in the US for contributing to the realisation of a smooth energy transition. Osaka Gas signed a memorandum of understanding with Tallgrass MLP Operations, which owns and operates natural gas pipelines and other energy infrastructure, and Green Plains, which owns and operates bioethanol plants, to study the feasibility of an e-methane production project. The project aims to begin production of up to 200,000 tonnes of e-methane per year by 2030, with a view to liquefying it at Freeport LNG terminal in the US and exporting it to Japan. As demand for low-carbon LNG grows, it is expected that more stakeholders in the industry will prioritise the decarbonisation of their operations.

In March 2024, Tokyo Gas and Mitsui delivered a bio-LNG cargo from the Cameron LNG project in the US to Japan, with around 40,000 cubic metres (cm) of biomethane, derived from landfill biogas liquefied as part of the LNG.

Proposed New Liquefaction Plants

1,046 MTPA
Proposed aspirational liquefaction capacity in pre-FID stage, end-February 2024

As of the end of February 2024, 1,046 MTPA of aspirational liquefaction capacity was in the pre-final investment decision (FID) stage. Most proposed capacity is in North America (643 MTPA), with 363.9 MTPA situated in the US, 230.3 MTPA in Canada, and 48.8 MTPA in Mexico. This is followed by Russia (157.4 MTPA), Africa (101.3 MTPA), Asia Pacific (66.5 MTPA) and the Middle East (71.5 MTPA). About 6.45 MTPA of liquefaction capacity is proposed in the rest of the world. Global liquefaction capacity is likely to climb from 483 MTPA in 2023 to over 700 MTPA by 2030, driven by new FIDs and the start-up of projects currently under construction to support growing demand.

Overall, the market upheaval caused by the Russia-Ukraine conflict is likely to stimulate investment in additional liquefaction facilities as governments put more emphasis on increasing energy security, while at the same time balancing decarbonisation goals in this fast-changing landscape. If all projects materialise, global liquefaction capacity would increase three-fold. However, a fair portion of pre-FID projects are not likely to progress to sanction. Projects also face delays from regulatory impacts such as the US Department of Energy's (DoE) decision to pause LNG export approvals.

[1] Includes Yemen and Libya, although Yemen LNG and Marsa El Brega LNG have suspended operations

Regasification Terminals

1,029.9 MTPA

Global nominal regasification capacity, end-February 2024

As of end-February 2024, global regasification capacity registered 1,029.9 MTPA across 47 markets. In 2023, 69.9 MTPA of regasification capacity addition was seen, with commissioning of 16 new LNG import terminals and one expansion project of an existing terminal, and with the largest new capacity of the year from Hong Kong FSRU (Bauhinia Spirit), a floating, storage and regasification unit project in China, at 6.1 MTPA.

Global regasification capacity additions speeded up in 2023, with 17 (one expansion and 16 new) projects online across 10 markets, compared with 11 projects commissioning across 8 markets in 2022. The highest capacity addition occurred in Europe at 30 MTPA, followed by 26.9 MTPA from Asia region, and 13 MTPA from Asia Pacific. Out of the 69.9 MTPA regasification capacity additions in 2023, 65.1 MTPA were from 16 new terminals and 4.8 MTPA from an expansion project at an existing terminal.

Global regasification utilisation saw a downward trend in 2023, dropping from 43% on average in 2022 to 41%. Tepid demand in the main regional markets, including Europe and Asia Pacific, and sizable new start-ups of regasification terminals in 2023 dragged down global average utilisation.

The 6.1 MTPA Hong Kong FSRU facility in China contributed the largest capacity addition by project, followed by the 5.9 MTPA El Musel onshore LNG in Spain, and the 5.6 MTPA Gulf of Saros FSRU project in Turkey. Regasification projects also started up in new markets, including in the Philippines and Vietnam. The 5 MTPA Batangas Bay LNG became the first LNG terminal in Philippines, with its commissioning cargo arriving in April 2023. The market's second LNG terminal, the 5 MTPA First Gen LNG terminal, started commercial operation in October. In another Asia Pacific market, Vietnam's first LNG terminal, the 3 MTPA Thi Vai LNG, was brought online in July 2023.

Projects in Europe, including new plans, expansions and reactivated terminals, have seen rapid progress following the outbreak of the Russia-Ukraine crisis, to enhance LNG import channels. Europe had 14.5 MTPA and 30 MTPA of new capacity online in 2022 and 2023, respectively, while capacity additions in early years were very limited. Seven European projects were commissioned in 2023, with two in Germany and another five in Finland, Turkey, Italy, Spain and France. New start-ups are also expected throughout 2024, while the construction of three new terminals and four expansion projects is under way with the aim of commissioning this year. As floating terminals offer greater flexibility and require lower fixed investment, Europe has kept its preference for floating-based projects over onshore terminals – out of its seven new projects online in 2023, six are FSRU-based with a total capacity of 24 MTPA.

By contrast, Asia and Asia Pacific have shown a preference for onshore terminals, which are set to meet increasing LNG demand in the short to long term and allow for further capacity expansions. Currently, the two regions hold the largest share of global regasification capacity, with major plans and projects under construction. It is worth noting that projects in South Asia and Southeast Asia have faced notable delays in recent years due to a lack of incentives for investors given the risks to LNG demand in the price-sensitive region, and generally slow pace of infrastructure development.

Long-term factors in the two regions point to LNG demand growth – for example, Southeast Asia is expected to turn into a net gas importer from the 2030s. In the short term, retreating LNG prices in 2023 have led to some LNG demand recovery. The Philippines and Vietnam became new LNG importers, with their first LNG terminals commissioning in the year, while India's Dhamra LNG was also brought online in 2023 after being delayed by two years from its original start-up schedule. However, it is worth noting that competition from alternative fuels and price sensitivity could weigh on their LNG demand growth. Regasification terminals in Southeast Asia and South Asia may find it difficult to achieve expected utilisations, with concerns on price levels of LNG supply.

Floating and Offshore Regasification

200.9 MTPA

Global floating and offshore regasification capacity, end-February 2024

There are 49 floating and offshore terminals around the world, with a total regasification capacity of 200.9 MTPA as of end-February 2024. They make up around 20% of global regasification capacity. Nine new floating-based projects were commissioned in 2023, with a capacity addition of 40.3 MTPA.

17 floating and offshore terminals are under construction as of end-February 2024, with a combined capacity of 52.1 MTPA. This includes 28 MTPA from Asia and Asia Pacific, 9.8 MTPA from Europe, 10.2 MTPA from Latin America and 4.2 MTPA from Africa. India is leading in terms of newbuild of floating-based projects, with three projects or 16 MTPA to be online in 2025-2026. Since 2022, the surge in FSRU demand in Europe implies many projects in emerging Asia may be delayed given the limited number of FSRUs.

LNG Shipping

701 Vessels

LNG fleet, end-February 2024

Thanks to the mild northern hemisphere winter in 2022, market fundamentals in 2023 were better balanced, which eased freight rates. In September 2023, Europe prepared in advance for winter and pushed the LNG shipping market into the peak season. West of Suez rates reached $117,000/day for steam turbine vessels, $200,000/day for TFDE/DFDE vessels and $250,000 /day for two-stroke vessels by the end of September 2023, which like the previous year saw a buildup of floating storage. Then, with high gas inventories in Europe and Asia, prices declined again, much lower than at the end of 2022. Due to the post-pandemic re-opening of most economies and the substitution of LNG shipping for pipeline gas in Europe, a total of 7,004 LNG trade voyages departed in 2023, up 1.7% from 2022.

2023 was also characterised by disruptions to the international shipping market. From 3Q 2023, a drought in Panama reduced water levels at Gatun Lake, the water source of the Panama Canal, reducing the number of daily transits and causing US LNG cargoes to take the longer route around the Cape of Good Hope to reach Asia. By early 2024, the situation eased with a recovery in rainfall. However, by then transits through the Red Sea began to be impacted by attacks on vessels by Houthi rebels in Yemen. By February, LNG vessels began avoiding the Red Sea and, by extension, the Suez Canal for transits to Asia and Europe. The market has partially managed these constraints through the use of trading swaps and other optimisations.

With the delivery of 32 vessels in 2023 and 11 vessels across January – February 2024, the global LNG carrier fleet consisted of 701 active vessels as of the end of February 2024, including 47 operational FSRUs and 10 FSUs. This also represents a 5% growth in the fleet size from 2022 to 2023, comparable to a 1.7% growth in the number of LNG voyages, representing a healthy supply of LNG carriers relative to the growth in LNG trade.

Capitalising on better fuel efficiencies and lower emissions, both generations of XDF are currently the main propulsion systems of choice, with at least 141 currently on order. The competing ME-GI system has 16 orders, while the new generation of MEGA system has at least 112. There are still 68 ships equipped with MEGA or XDF systems, and the specific system remains to be confirmed.

LNG Bunkering Vessels and Terminals

48 Units

Global operational LNG bunkering vessel fleet, end-February 2024

Global LNG price experienced severe fluctuations in 2022 and 2023. After skyrocketing to high prices in 2022, global LNG prices have significantly declined 60% y-o-y, providing higher economic viability of LNG as a bunker fuel. It is expected that, with a looser global LNG market in 2024 compared to 2023, the global LNG price will increase the prospects of LNG as a bunker fuel, especially considering the current high oil price environment as of February. These developments are supportive of LNG as a bunker fuel in addition to structural factors such as environmental advantages over fuel oil and chemical compatibility with bio and e-LNG.

There are an additional 9 vessels on the global order book to be delivered. The typical size of vessels ordered is increasing over time, with the average capacity of the active fleet rising to 8,745 cm by the end of 2023, up from 7,700 cm in 2022. The order book averages 8,478 cm.

Courtesy Hanwha Ocean

2. Opportunities, Uncertainties and Innovations in the LNG Industry

The rapid evolution and development of the global LNG market is ongoing to meet market players' needs and respond to changing dynamics. Growing gas demand in emerging markets, increasing diversification of market participants, and expansion of LNG infrastructure and acceleration in technology development as well as innovation are the dynamics of today's LNG market. At the same time, regulatory, geopolitical, infrastructural, and environmental concerns could challenge the steady growth of the LNG industry and introduce uncertainty. Navigating these opportunities and uncertainties requires innovations in project planning to make LNG sustainable in the long-term.

Courtesy Samsung Heavy Industries

2.1 OPPORTUNITIES IN THE LNG MARKET

Rise of portfolio players: LNG is no longer a game only for big markets or big companies. In 2023, 401.42 MT of LNG was shipped from 20 exporting markets to 51 importing markets. About 180 companies were involved in deliveries under term contracts[1]. Out of the total traded volume, 35% of the transactions were concluded on spot[2] basis. Portfolio players are entities (often integrated energy companies or traders) that manage a diverse portfolio of LNG supply sources, contracts, and destinations. They have the financial capacity to commit to long-term contracts and have underwritten project FIDs in recent years. On the other hand, they have risk management capabilities and with their diversified portfolios can also balance shorter-term and spot purchases. The rise of LNG portfolio players offers smaller markets and companies access to LNG on a shorter-term basis by providing flexibility in infrastructure, delivery volume, and time.

Joint purchasing: A joint purchase scheme helps to bolster supply security for smaller entities that pool demand, share infrastructure, risks, and optimise purchasing costs collectively. This scheme is traditionally used by Japanese buyers which procure LNG via the establishment of consortiums. AggregateEU, launched by the European Commission in 2023, was also designed to enhance joint purchasing power and diversified gas supplies for the winter 2023/2024 in EU markets and Energy Community Contracting Parties[3]. The initiative strengthens the ability of the European markets to attract needed new gas supply to replace Russian pipeline volumes, promote transparency and reduce price volatility. In December 2023, it was extended to the end of 2024. Mid-term tenders were introduced in early 2024 to allow buyers to submit seasonal demand for periods from April 2024 to October 2029. A tender closed on 21 February 2024 with a total of 34 bcm of demand was aggregated by 19 companies, asking for 15.3 bcm of LNG and 18.3 bcm of pipeline gas. The tender attracted 97.4 bcm of supply offers internationally. In 2023, KOGAS and JERA, major LNG importers into South Korea and Japan, respectively, agreed to expand cooperation in joint LNG purchasing and trading, including emergency swap agreements to bolster energy security in both markets.

FSRU and FSU conversions: Floating Storage and Regasification Units or FSRUs are a regasification solution characterised by high flexibility, speedy deployment to market, and flexible scope for redeployment in different locations. They have been Europe's go-to stop gap measure to import additional LNG in the wake of the Russia-Ukraine war and the subsequent decline in Russian pipeline gas supplies. In ports with enough supporting infrastructure, FSRUs can be deployed in a matter of months. FSRUs also have less upfront investment than onshore terminals (as they can be leased) and could potentially facilitate additional LNG imports into Asia in coming years. For similar reasons, Floating Storage Units or FSUs may be an alternative to onshore LNG storage for import and export terminals, especially in emerging markets. Further, with the onset of the IMO's EEXI (a measure of energy efficiency of the vessel design) and CII rules (a measure of operational efficiency and CO2 emissions), more than 200 LNG carriers with out-dated propulsion systems or at the end of life could be taken off the market but can be repurposed into FSRUs or FSUs as a means of adding value to a depreciated asset. 18 converted FSRUs and FSUs are currently operational.

Small-scale LNG: This is the supply chain configuration used to deliver LNG to small, usually remote, demand centres with less than 1 MTPA of demand. Small-scale LNG is used to enhance energy access through cleaner burning LNG, especially in regions dependent on more polluting and expensive diesel, which often leads to energy access challenges and high power prices. The addressable market could work out to be material, considering the growth of LNG demand for truck fuels, bunkering, and off grid power generation such as in remote mines. Multiple such supply chains are operational today across Europe, Asia, Latin America, and Australia. Compared to liquid fuels, small scale LNG offers both economic advantages from the gravimetric energy density of LNG and environmental advantages from lower CO2 emissions, up to an 80% reduction in NOx and negligible SOx emissions. As an added advantage, LNG offers a structural decarbonisation pathway as it is chemically identical to E-LNG and Bio-LNG, all of which can be gradually blended or substituted.

2.2 UNCERTAINTIES IN THE LNG MARKET

Biden Administration non-FTA license pause: The decision by the United States Department of Energy (DOE) under the Biden Administration to pause the issuance of LNG export permits to non-Free Trade Agreement (FTA) markets, to update economic and environmental analyses to determine if such applications are in the public interest, has caused concern in the global LNG market over the role of US LNG to support the energy transition and energy security of customers in Europe and Asia. This could delay over 70 MTPA of new US LNG capacity until approval criteria is clarified but given there are many projects with non-FTA approvals in place, and pre-FID stage projects outside of the US, near term global LNG balances remain unaffected.

Sanctions impact on Russian LNG: The US Office of Foreign Assets Control (OFAC) has ramped up sanctions on the 19.6 MTPA Arctic LNG 2 project by complicating the delivery of icebreaker class vessels, without which the project is unable to export. The project counts Japanese and Chinese companies among its foundation customers, as well as portfolio volumes to TotalEnergies and operator Novatek. All foreign shareholders have suspended participation in the project, and TotalEnergies and Novatek have issued Force Majeure notices. Even currently operational projects may have issues procuring spare parts for maintenance.

Red Sea vessel attacks: Following the onset of the Middle East conflict, Houthi rebels in Yemen have been firing drone and missile attacks at vessels transiting the Bab-El-Mandeb Strait in the Red Sea since December 2023. As of early 2024, LNG vessels are now avoiding the Red Sea, and by extension the Suez Canal, largely used for Middle East–Europe, and Atlantic basin–Asia voyages, choosing to take the much longer route through the Cape of Good Hope. This will delay the arrival of LNG volumes to both regions, and the market remains open to the possibility of a closure of the much more crucial Strait of Hormuz in the event of a material escalation of hostilities in the Middle East. The Strait of Hormuz is the only outlet for LNG production out of Qatar and the UAE, which made up around 21% of global LNG supply in 2023.

Shipyard bottlenecks: As of February 2024, the LNG orderbook comprised a whopping 359 vessels, over 51% of the operational fleet as new liquefaction capacity and fleet renewal with the onset of tighter emissions regulations have led to a surge in LNG vessel demand. There are few shipyards with the technical capability to manufacture highly specialised LNG carriers, limited until recent history to Hyundai Ulsan, Hyundai Samho, Samsung Geoje, Hanwha Ocean, and Hudong Zhonghua. The recent surge in vessel demand and shipyard constraints to balance LNG carrier construction along with other high value-added carrier types have brought more shipyards from China, namely Jiangnan, Yangzijiang, China Merchants Heavy Industry, and Dalian Shipbuilding into the lucrative conventional LNG carrier sector. Even so, the market faces risk of vessel delivery delays considering shipyards have typically delivered under 60 LNG carriers per year but will need to deliver over 80 LNG carriers on average across 2024 – 2026. The high cost of newbuild deliveries has also resulted in burgeoning LNG shipping costs which impacts the price at the end market.

Declining legacy upstream production: Over 120 MTPA of currently operational liquefaction capacity is over 20 years old. Some of these facilities have been mothballed, such as Atlantic LNG Train 1 which was mothballed in 2020 due to insufficient upstream gas production from their offshore gas fields. Multiple other facilities are operating at low utilisation rates, and more could be headed for shut-ins, such as North-West Shelf's Train 2, due to legacy field decline and very slow development of backfill production. Younger facilities also face this risk if upstream production declines faster than expected, such as in Egypt.

2.3 INNOVATIONS IN LNG GREENHOUSE GAS EMISSION REDUCTION MEASURES

As LNG demand is projected to continue its long-term growth trajectory, driven mainly by needs of emerging Asia for lower emissions energy to support their economic development, it is worth discussing some of the innovative emissions reduction measures being undertaken by LNG projects worldwide.

Electrification of LNG compression is one such measure under consideration. If the electricity is drawn from a firmed renewable (which includes backup supply to cover for intermittency) or nuclear power source, it can bring down the emissions intensity of the compression process compared to a standard industrial gas turbine. This concept is being implemented in Canada in Woodfibre LNG (2.1 MTPA) and will also be the development concept for Cedar FLNG (3 MTPA) and Ksi Lisims FLNG (12 MTPA). The concept is also being considered for retrofitting Snohvit LNG (Norway, 4.3 MTPA) as part of the Snohvit Future Project. Ruwais LNG (9.6 MTPA) in the UAE will also use a combination of renewables and nuclear power.

In the US, Freeport Train 4 (5.1 MTPA) and Cameron Train 4 (6.75 MTPA) will also feature electric drives (like Freeport LNG's operational trains), while Papua LNG was recently reconfigured to a modular concept of four 1 MTPA trains featuring electric drives. Using electric drives also has the advantage of significantly reducing feedgas intake (with lower demand for fuel gas), reducing fugitive methane emissions, and increasing operational uptime with higher Mean Time Between Failure (MTBF) performance.

LNG-linked CCUS, with a carbon capture facility sourcing CO2 from the upstream or liquefaction components of LNG projects are another emissions mitigation measure. Already implemented at Gorgon LNG (4 MTPA of CCUS), Qatar's Ras Laffan Complex (2 MTPA of CCUS), and Snohvit LNG (1 MTPA of CCUS), the LNG-linked CCUS project pipeline indicates a staggering CCUS capacity of over 40 MTPA of CO2 by 2030 including Moomba (1.7 MTPA of CCUS), Bonaparte CCUS at Ichthys (2 MTPA), and Bayu-Undan (10 MTPA of CCUS) in Australia, 7 MTPA of upcoming CCUS by QatarEnergy, around 2.7 MTPA at Tangguh in Indonesia, 3.7 MTPA for the Kasawari gas field in Malaysia, and 1 MTPA at the Elk-Antelope gas field at Papua LNG. In the US, Venture Global has announced CCUS projects of 0.5 MTPA each at Calcasieu Pass, Plaquemines and Calcasieu Pass 2, while NextDecade is pursuing a 5 MTPA CCUS project for Rio Grande. This list is by no means exhaustive: many projects at earlier stages of development are likely to pursue this emission reduction option to secure financing and ensure longevity of the project through the energy transition. Several operating projects could also pursue CCUS, as is being considered by Shell and Energean for Egypt LNG, as well as by US operators Cheniere and Sempra. Per Table 2.1 many operators are pursuing both options.

[1] Term contracts include contracts of a duration of 1 year or more, as per Rystad Energy
[2] Spot indicates delivery within 3 months from the transaction date, as per GIIGNL
[3] https://energy.ec.europa.eu/topics/energy-security/eu-energy-platform_en#aggregateeu

The measures discussed above are in addition to many initiatives already being implemented by the industry in certain locations including zero routine flaring, electrification of upstream operations, sourcing feedstock from Renewable Natural Gas (RNG), enhanced emissions Monitoring, Reporting, and Verification (MRV), and multiple methane reduction initiatives such as the Global Methane Pledge and the Coalition for LNG Emission Abatement toward Net-zero (CLEAN).

Bio-LNG, a technology using renewable natural gas, is gaining momentum, since it is entirely interoperable with existing infrastructure as it is chemically identical to fossil-origin gas. It offers an opportunity to close the carbon loop and support the decarbonisation of hard to abate sectors. Tokyo Gas and Mitsui have recently delivered 40,000 cm of bio-LNG from landfill gas in the US through the Cameron LNG terminal to Japan.

The challenge for project developers will be to ensure price competitiveness to cater to demand growth while channelling investment into emissions reduction technology, which will require active policy support and emissions pricing schemes.

Table 2.1: Upcoming emissions reduction measures (electrification and CCUS) in LNG projects

Market	Emissions Reduction Technology	Project	Project Capacity (MTPA)	CCUS Capacity (MTPA of CO_2)
Canada	Renewables-sourced electric drive	Woodfibre LNG	2.1	
Canada		Cedar FLNG	3.0	
Canada		Ksi Lisims FLNG	12.0	
Norway		Snohvit LNG	4.3	
UAE	Renewables/nuclear sourced electric drive	Ruwais LNG	9.6	
US	Electric drive	Freeport LNG Train 4	5.1	
US		Cameron Train 4	6.75	
Papua New Guinea		Papua LNG	4.0	
Australia	CCUS	Moomba	NA	1.7
Australia		Bonaparte (Ichthys)	8.9	2.0
Australia		Bayu Undan (Darwin)	3.7	10.0
Qatar		QatarEnergy LNG expansion	NA	7.0
Indonesia		Tangguh	11.4	2.7
Malaysia		Kasawari (MLNG)	29.3	3.7
Papua New Guinea		Elk-Antelope (Papua LNG)	4.0	1.0
US		Calcasieu Pass	10.0	0.5
US		Plaquemines	20.0	0.5
US		Calcasieu Pass 2	19.8	0.5
US		Rio Grande LNG	17.6	5.0
US		Cameron Train 4	6.75	2.0

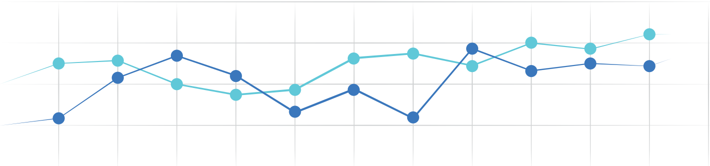
Source: Rystad Energy

Note: Project list is not exhaustive

CLEAN RESOLUTION - Courtesy DYNAGAS

3 LNG Trade

Global LNG trade increased to **401.4 MT**[1] in 2023, an increase of **8.4 MT**.



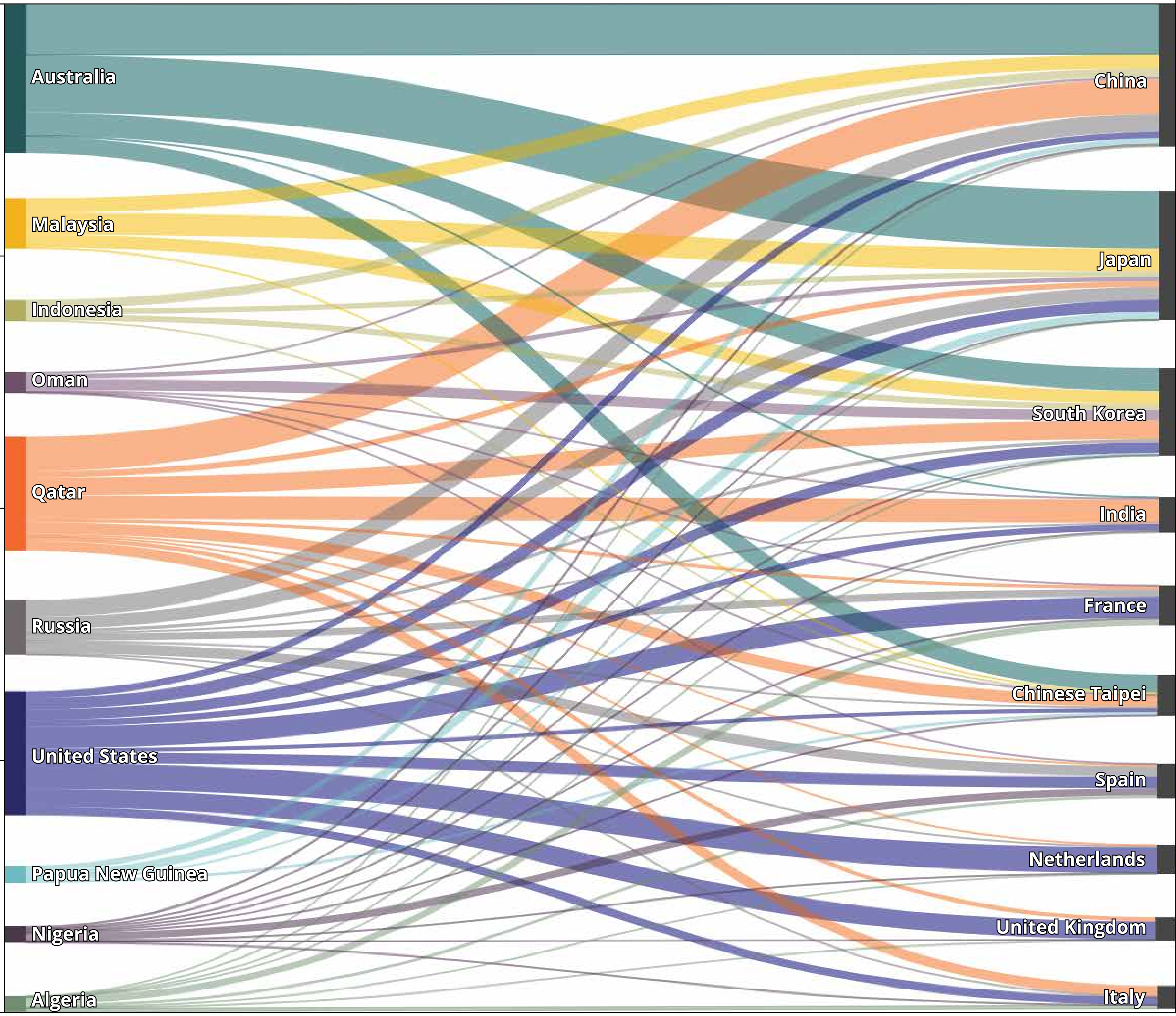
China regained its place as the largest importer with a total of **71.2 MT** of import (+7.6 MT vs. 2022)

1st The US became the largest exporter in 2023 with a total of **84.5 MT** of exports (+8.9 MT vs. 2022)

2nd Australia was the second largest exporter, exporting **79.6 MT**

3rd Qatar exported **78.2 MT**

4th Russia remained the world's fourth largest exporter at **31.4 MT**



Japan imported **66.1 MT** (-6.9 MT vs. 2022)

The largest global LNG trade flow route continues to be intra-Asia Pacific trade **95.0 MT**

India imported 1.9 MT more than in 2022 **22.0 MT**

European imports remained at **121.3 MT**

[1] Source: GIIGNL. Owing to data source and methodology change, some historical trade numbers have been restated.

The diagram only represents trade flows between the top 10 exporters and top 10 importers.

3. LNG Trade

Global LNG trade hit a new record of 401.42 MT in 2023, connecting 20 exporting markets with 51 importing markets. 21 markets performed re-export re-loading in 2023. The 8.4 MT increase was influenced by a gradual decline in LNG prices, which incentivised spot market purchases particularly in Asia. The price reduction was influenced by Gas and LNG inventories remaining high following a warmer than expected 2022-2023 Winter. The annual growth rate of 2.1% in LNG trade for 2023 was lower than the 5.6% seen in 2022.

Courtesy Hanwha Ocean

3.1 OVERVIEW

The growth in LNG exports in 2023 was influenced by United States (+8.90 MT), Algeria (+2.88 MT) and Mozambique (+2.62 MT).

It is likely that in the space of 5-6 years, the World's LNG export capacity will grow from circa 400 MTPA to 700 MTPA. This potential massive increase is an emphatic demonstration that the World still needs more LNG and is driven primary by demand in Asian developing economies and China. Peak LNG demand is not likely to be reached until the 2040s.

The US took the first spot as the world's largest LNG producer, exporting 84.53 MT in 2023 compared to 75.63 MT in 2022. Australia, the second-largest exporter held its position with 79.56 MT in exports compared to 79.27 MT in 2022. Qatar became the third-largest exporter, with 78.22 MT in 2023, slightly down from 79.63 MT in 2022.

Russia remained the fourth-largest exporter, with 31.36 MT in 2023 compared to 32.51 MT in 2022. Malaysia also retained its status as the fifth-largest exporter, exporting 26.75 MT in 2023 as compared to 27.57 MT in 2022.

Asia Pacific remained the largest exporting region with 134.80 MT in 2023, a 0.32 MT decrease compared to 134.49 MT in 2022. The Middle East continued as the second-largest exporting region with 94.69 MT in 2023, a 1.84 MT decrease compared to 96.53 MT in 2022. The third-largest exporting region was North America, with 84.53 MT, an 8.90 MT increased compared to 75.63 MT in 2022.

Asia Pacific was also the largest importing region with 155.32 MT in 2023, a 3.47 MT decrease compared to 158.78 MT in 2022. Europe was the second-largest importing region with 121.29 MT, a 0.02 MT decrease compared to 121.31 MT in 2022, while Asia was the third-largest importing region with 105.49, a 10.49 MT increase compared to 95 MT in 2022.

The largest change in imports came from Asia with an increase of 10.49 MT for the year, as lower prices by the end of 2022 incentivised spot imports by several markets. India imported 21.96 MT in 2023 versus 20.02 MT in 2022, which is a 1.94 MT increase. China imported 71.19 MT in 2023 versus 63.61 MT in 2022. Europe's imports remained steady with a decrease of only 0.02 MT as European underground storages remained relatively full during the winter, limiting import demand. Asia Pacific's imports dropped by 3.47 MT, as LNG inventories remained relatively high on mild weather conditions, and the availability of substitute fuels such as nuclear and renewables dampened imports. Japan imports fell to 66.12 MT in 2023, from 73.06 MT in 2022. Mild weather generally reduced the demand for LNG for most of 2023, with LNG inventory reported by power utilities to be higher than average throughout most of the year, resulting in less prompt demand for restocking. South Korea imports also fell to 45.17 MT in 2023, from 46.81 MT in 2022.

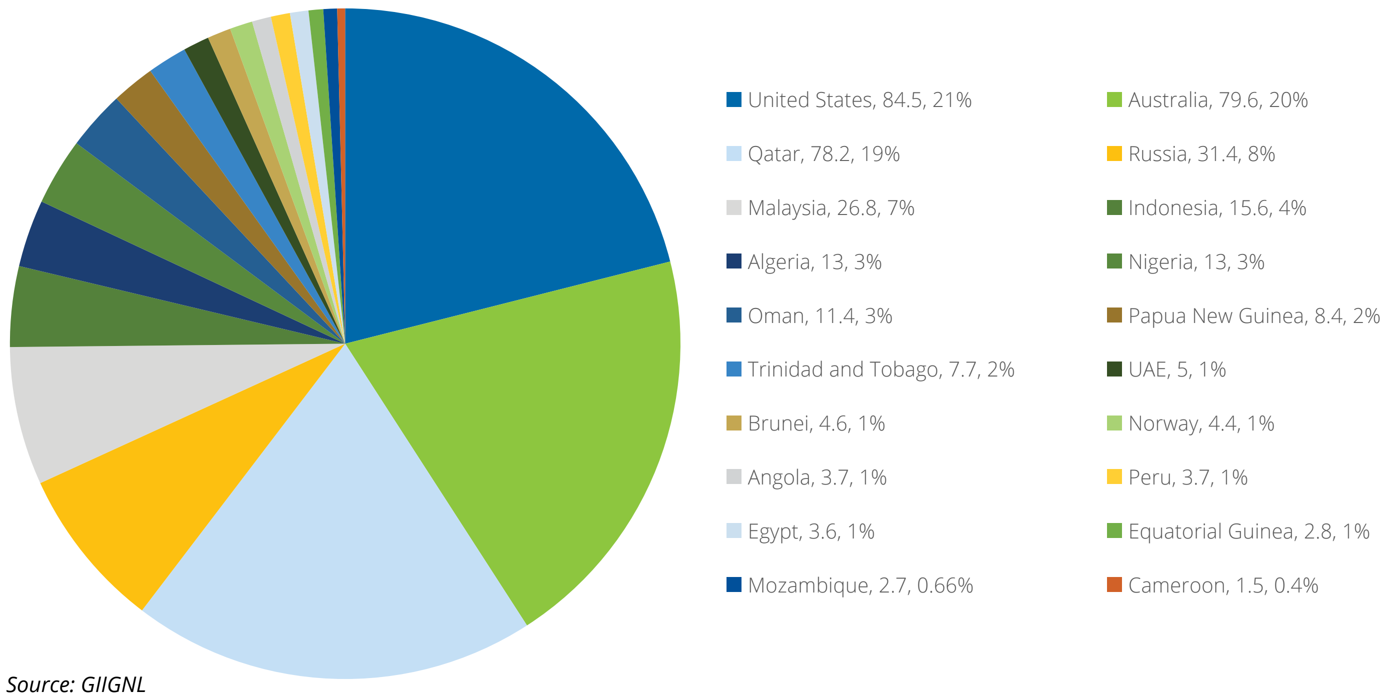
Global LNG trade	LNG exporters and importers	LNG re-exports
+8.40 MT Growth in global LNG trade	Growth in exports came from the US (+8.90 MT), Algeria (+2.88 MT) and Mozambique (+2.62 MT)	+0.71 MT Re-exported volumes increased by 10% year-on-year in 2023
Global LNG trade reached a new record of 401.42 MT in 2023, up 2.1% compared to 2022	There were 4 additional importing markets in 2023: Philippines, Vietnam, Iceland, and Cuba	Re-export activity increased to 7.97 MT in 2023 compared to 7.25 MT in 2022
Asia experienced the biggest change in net imports, increasing by 10.49 MT Europe net imports decreased by 0.02 MT	Europe decreased net imports by 0.02 MT. Utilisation rate of receiving terminals decreased to 54% due to addition of new terminals	Asia Pacific received the largest volume of re-exports (2.92 MT) while Europe loaded the largest volume of re-exports (-3.12 MT)
Asia Pacific remained the highest importing region, although there was a decrease in net imports of 3.47 MT		

Source: GIIGNL

Dapeng LNG Receiving Terminal_Courtesy CNOOC

3.2
LNG EXPORTS BY MARKET

Figure 3.1: 2023 LNG exports and market share by export market (MT)

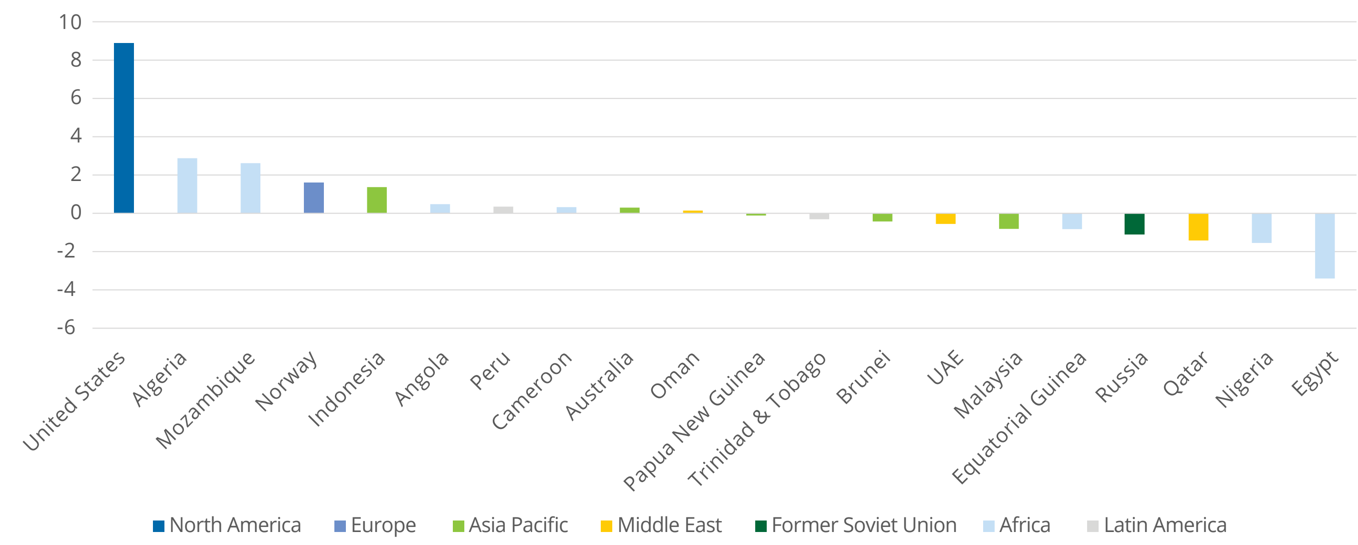


Source: GIIGNL

A total of 3.8 MTPA of liquefaction capacity was added globally in 2023, coming from the singular addition of Tangguh LNG T3 (3.8 MTPA) in Indonesia, which increased Tangguh LNG's capacity to 11.4 MTPA.

The US became the largest LNG exporter in 2023, exporting 84.53 MT. This is an annual increase of 8.90 MT, supplemented by Freeport LNG returning to service from an unplanned maintenance in 2022, which has allowed the US to export close to its nameplate capacity. New exports from Calcasieu Pass LNG had previously allowed the US to maintain its export figures in 2022 despite the outage. With both sites now contributing to export capacity, the US has overtaken both Australia and Qatar in 2023. Australia exports decreased slightly to 79.56 MT in 2023, as compared to 79.27 MT in 2022. Industrial action had threatened to bring Western Australia export figures down in the fourth quarter of 2023, but ultimately there were only minor disruptions which allowed most sites to maintain their exports. Qatar exports fell slightly with exports of 78.22 MT in 2023 versus 79.63 MT in 2022, although this remains above its yearly nameplate capacity of 77.1 MT. Together, the top 3 LNG exporters accounted for 60.4% of global LNG output in 2023. Russia exports decreased only slightly to 31.36 MT in 2023, against 32.51 MT in 2022. Sakhalin 2 LNG and Yamal LNG underwent annual maintenance in the summer, with exports still holding above nameplate capacity for both locations. Malaysia exports decreased slightly to 26.75 MT in 2023, versus 27.57 MT in 2022.

Figure 3.2: 2023 incremental LNG exports by market relative to 2022 (MT)



Source: GIIGNL

Of the 20 exporting markets, 10 increased exports in 2023, while the other 10 reduced exports. The biggest decline came from Egypt (-3.41 MT) as higher domestic demand due to warm weather, declining domestic gas production, and a temporary loss of Israeli pipeline imports meant that less gas and LNG could be diverted for exports. Nigeria (-1.55 MT) continued its force majeure, plagued by low volumes of feedstock gas due to upstream disruptions.

Of the exporting regions, Asia Pacific produced the most in 2023 with a total of 134.80 MT, as compared to 134.49 MT in 2022. This was balanced with decreases from Equatorial Guinea (-0.83 MT), Malaysia (-0.81 MT), Brunei (-0.42 MT), and increases from Indonesia (+1.37 MT) and Australia (+0.29 MT).

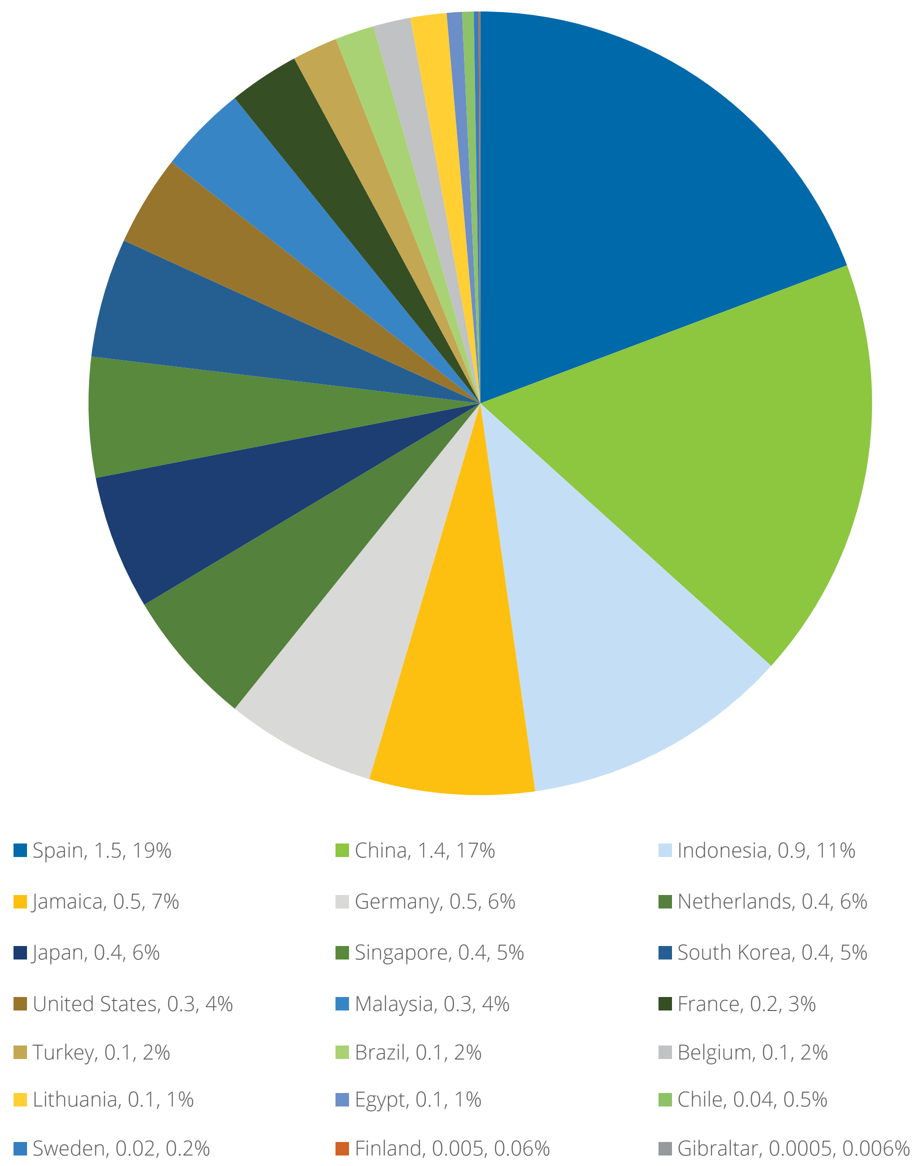
The largest increase for exporting regions came from North America (+8.90 MT) consisting of only the US, and Europe (+1.60 MT) consisting of only Norway. The biggest decreases in exports were down to the Middle East (-1.84 MT) and the Former Soviet Union (-1.14 MT), both of which were marginal decreases due to planned maintenance during the year.

Re-exported trade increased by 10%, from 7.25 MT in 2022 to 7.97 MT in 2023, which is equivalent to 1.99% of total LNG trade. Re-exports were loaded in 21 markets, with Spain (1.54 MT), China (1.39 MT) and Indonesia (0.88 MT) taking the top three positions. Europe loaded 39.2% of all re-exported volumes, followed by Asia Pacific with 30.1%.

The following markets performed re-export loadings in 2023, but did not do so in 2022: Germany, United States, Brazil, Egypt, and Gibraltar.

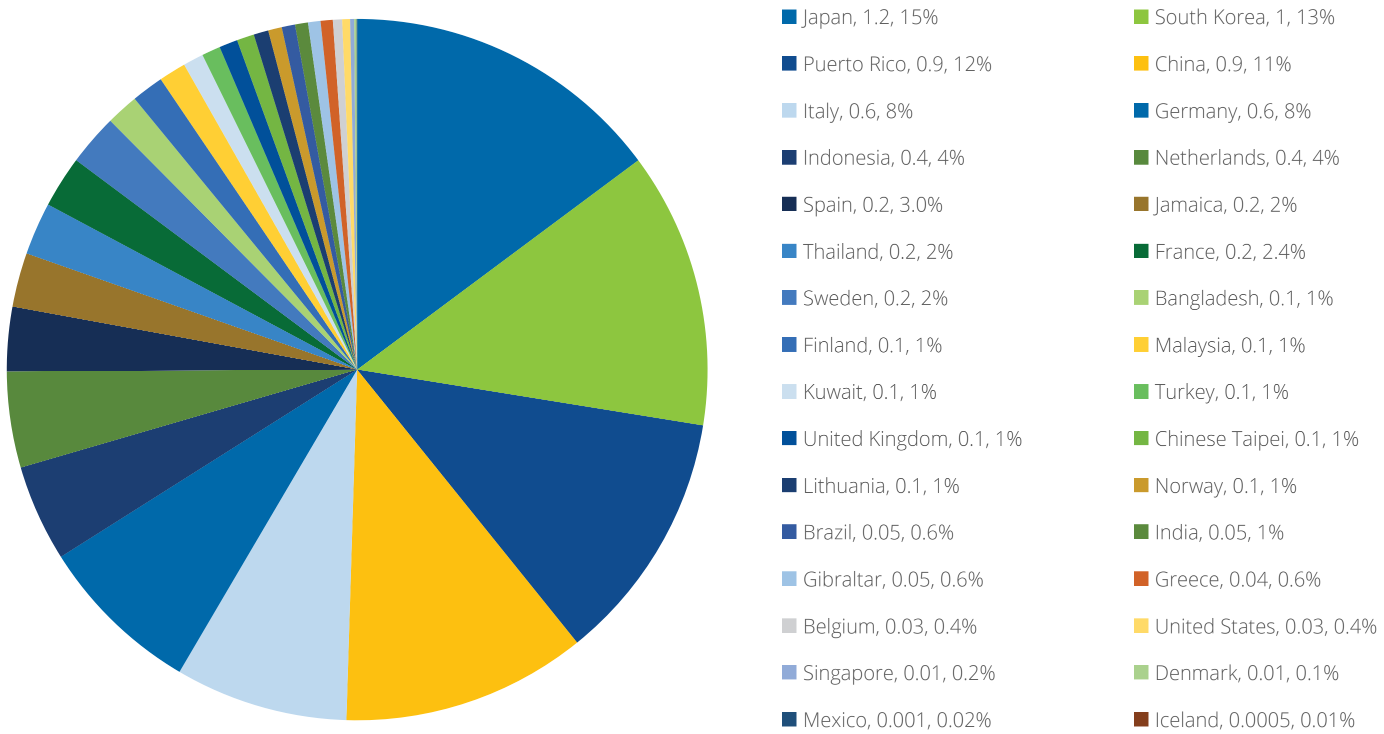
The Dominican Republic and Puerto Rico performed re-export loadings in 2022 but did not conduct any re-exports in 2023.

Figure 3.3: Re-exports loaded by re-loading market in 2023 (MT)



Source: GIIGNL

Figure 3.4: Re-exports received in 2023 by receiving market (MT)



Source: GIIGNL

Unloading arm_Courtesy Osaka Gas

3.3 NET LNG IMPORTS BY MARKET

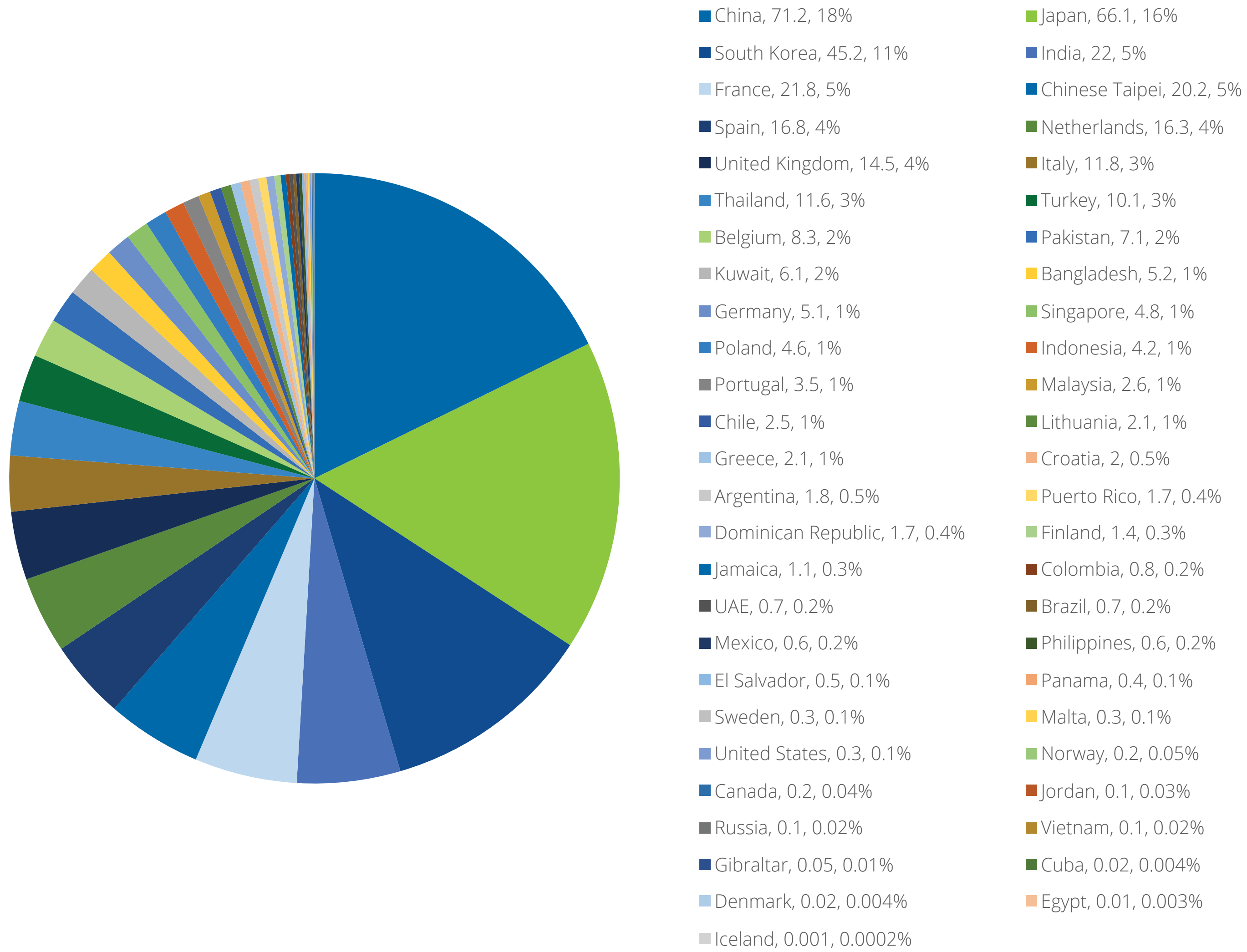
In 2023, there were 20 exporting markets and 51 importing markets. In Asia Pacific, Hong Kong in China, the Philippines, and Vietnam received their first cargoes. Hong Kong received its first cargo in May 2023 onto the 263,000m3 Bauhinia Spirit FSRU at the Hong Kong FSRU. Philippines received its first cargo on April 2023, onto the 138,000m3 Ish FSU at 5 MTPA Batangas Bay LNG Terminal owned by AG&P. Vietnam completed its first unloading at the 3 MTPA Thi Vai LNG in July 2023.

2023 was a year of reversal in terms of prices, with spot LNG prices declining to levels palatable for activity in Asia. China regained top spot as the largest LNG importer with 71.19 MT despite LNG import growth not being as high as originally anticipated upon the ceasing of the zero-covid policy. Lower prices have helped to increase imports by 7.58 MT instead of the 63.61 MT experienced in 2022.

Japan lost the top spot but remained as the second-largest importer, with 66.12 MT imported in 2023 versus 73.06 MT imported in 2022. South Korea stayed put as the third-largest importer, with 45.17 MT in 2023 versus 46.81 MT in 2022. The dynamics for both markets were very similar in 2023, with higher availability for coal and nuclear generation capacities compared to 2022, which are alternatives to LNG. Higher than normal LNG inventories and relatively mild weather through the year has also dampened demand for LNG.

India climbed to becoming the fourth-largest importer, with 21.96 MT imported in 2023 versus 20.02 MT in 2022. Prices falling below the $10 per MMBtu mark attracted the interest of many Indian importers that have returned to the spot market. France fell by one place to the fifth-largest importer, with 21.80 MT imported in 2023 versus 24.88 MT in 2022. Higher availability of competing power sources such as nuclear and renewables reduced the requirements for LNG in France. Underground gas storage levels throughout Europe were also maintained at higher-than-normal levels throughout most of 2023. This reduced the need for urgent LNG purchases to be injected into storage during the summer or imported during the winter.

Figure 3.5: 2023 LNG imports and market share by market (MT)



Source: GIIGNL

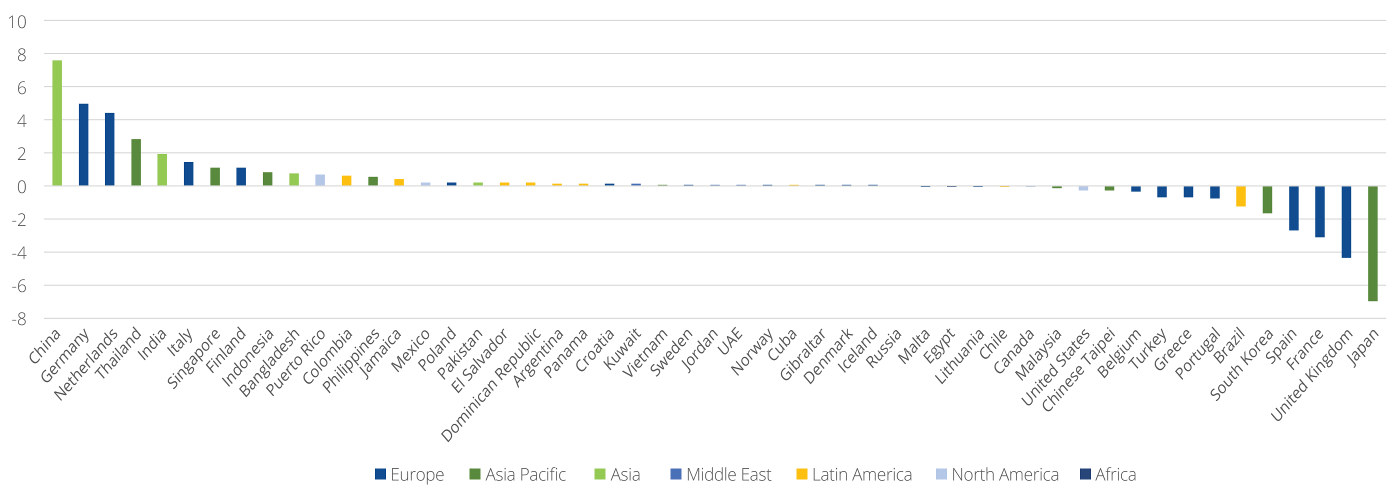
Asia Pacific remained the largest importing region in 2023 with 155.32 MT of total imports, which remained close to the 158.78 MT in 2022. Asia Pacific comprises of large LNG importers Japan, South Korea, and Chinese Taipei, as well as the medium sized LNG markets of Thailand, Indonesia, Singapore, and Malaysia. Although there were new importing markets such as Vietnam and the Philippines, the volumes imported by these new entrants were only marginal.

Europe maintained its position as the second-largest importing region with 121.29 MT of total imports in 2023, as compared to 121.31 MT in 2022. Due to a warmer than usual 2022-2023 winter, Europe began the year with higher-than-expected underground gas storage levels, and continued to maintain those levels, hitting the 90% winter storage target two full months ahead of winter 2023-2024. Although there was some pickup in industrial gas demand nearer to the last quarter of 2023, overall demand for gas and LNG was weaker due to the availability of alternate power sources and generally warmer weather conditions. The average utilisation rate at European regasification terminals was at 54% in 2023, as compared to 62% in 2022, due to new regasification capacity added in 2023. Stable pipeline supplies from Norway and imported LNG will continue to play a big part in replacing the lost pipeline gas from Russia. Given the ongoing discussions about restricting Russian LNG, these supplies could become even more important.

Asia was the third-largest importing region and comprises large-population centres such as China and India which saw an increase of 10.5 MT in imports, from 95.0 MT in 2022 to 105.5 MT in 2023. The lower prices of LNG in the second half of 2023, was highly conducive for gas users to capitalise on spot purchases.

Latin America saw LNG imports marginally decrease to 9.42 MT in 2023, against 8.85 MT in 2022. Latin America imports from US totaled 5.60 MT, while imports from Trinidad and Tobago totaled 2.32 MT. North America LNG imports increased to 2.79 in 2023, from 2.19 MT in 2022.

Figure 3.6: 2023 incremental LNG imports by market relative to 2022 (MT)



Source: GIIGNL

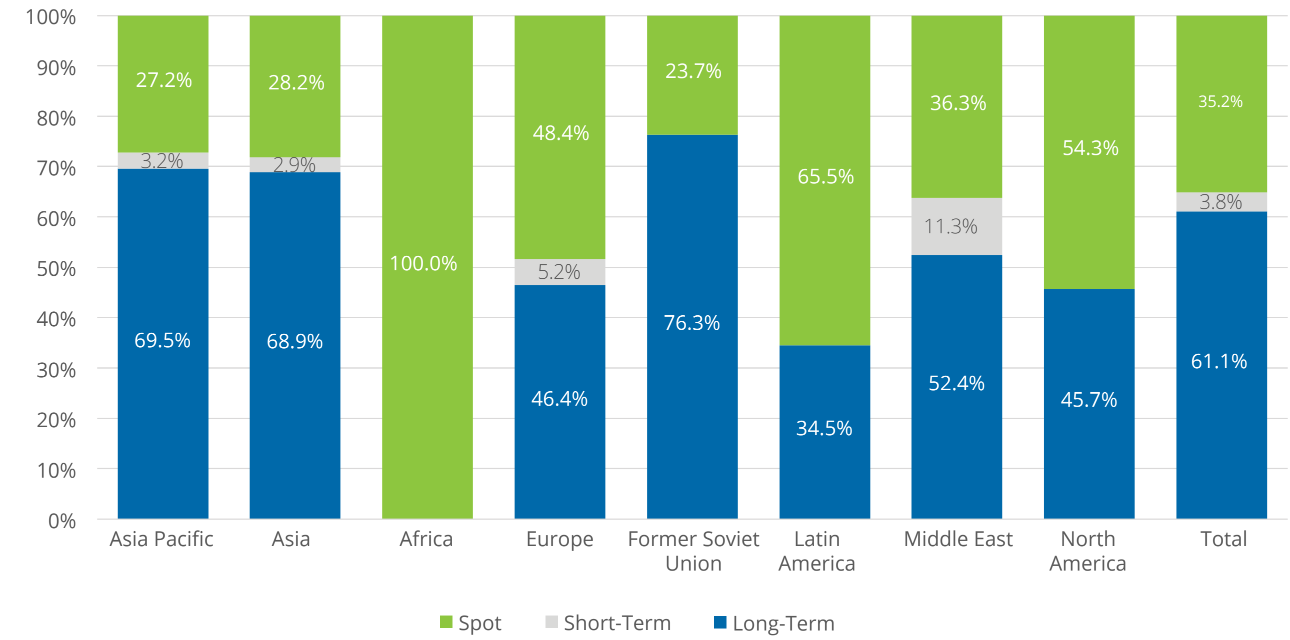
3.4 LNG INTERREGIONAL TRADE

In 2023, interregional trade continued to be dominated by long-term imports, with 61.1% of net imports on the long-term[2], 3.8% on the short-term[3] and 35.2% on spot.[4]

Asia and Asia Pacific remained heavy on long-term imports, with 68.9% and 69.5% of net imports on the long-term, whereas net imports on spot were only 28.2% and 27.2%, respectively. This is consistent with purchase patterns of major players in Asia and Asia Pacific that have historically preferred long-term contracts, with spot purchases being more opportunistic depending on prevalent prices and short-term demand.

Europe has mostly purchased on the spot market, corresponding to about 48.4% of net imports, with only 46.4% on long-term. This is consistent with European purchase patterns as spot cargoes were required to make up for an abrupt loss in Russian pipeline flow. Latin America purchases most of its cargoes in preparation for winter in the Southern Hemisphere, of which 65.5% of net imports are on the spot market, while long-term purchases are at 34.5%.

Figure 3.7: Net imports by Spot, Short-Term and Long-Term proportion across regions, 2023



Source: GIIGNL

Courtesy CNOOC

[2] Long-term by GIIGNL definition refers to quantities delivered under contracts of a duration above four years
[3] Short-term by GIIGNL definition refers to quantities delivered under contracts of a duration of four years or less
[4] Spot by GIIGNL definition refers to quantities delivered within three months from the transaction date

In 2023, global LNG trade flows remained concentrated within Asia Pacific, with Asia Pacific-to-Asia Pacific trade flows having the highest absolute value (95.0 MT). Intra-Asia Pacific flows were made up primarily of flows coming from Australia, which contributed to 54.75 MT. The most dominant intra-Asia Pacific trade flow was Australia-to-Japan (27.61 MT), then followed by Australia-to-South Korea (10.74 MT), and Malaysia-to-Japan (10.43 MT). Intra-Asia Pacific trade flows declined by 2.1 MT from 2022 to 2023. There were several notable increases from Australia to Thailand (+1.32 MT), intra-Indonesia flows (+0.88 MT), Malaysia to South Korea (+0.69 MT). However, contributing to a slight net decrease was Australia to Japan (-3.11 MT), Malaysia to Japan (-1.58 MT) and Australia to South Korea (-1.08 MT).

The second largest trade flow between two regions was from North America to Europe at 56.63 MT. The biggest drivers of this trade flow were from the US to United Kingdom (8.81 MT), US to Spain (5.32 MT), and US to Germany (4.14 MT). This trade flow remained almost constant year on year, mainly driven by US to Netherlands (+4.95 MT), US to Germany (+4.14 MT), and US to Italy (+1.62 MT). There were also decreases along this trade route, particularly US to Spain (-3.12 MT), US to France (-1.14 MT), and US to Turkey (-1.13 MT).

The third largest trade flow was from the Middle East to Asia at 43.29 MT in 2023, as compared to 41.25 MT in 2022, which was a 4.93% or 2.03 MT increase. Major contributors to this trade flow include Qatar to China (16.75 MT), Qatar to India (10.92 MT), and Qatar to Pakistan (6.32 MT). The biggest contributors to the net increase were Qatar to China (+0.70 MT), UAE to China (+0.56 MT), and Qatar to India (+0.37 MT).

Asia Pacific to Asia trade flow were also significant at 39.27 MT in 2023, mainly driven by Australia exports to China (24.34 MT), Malaysia exports to China (6.79 MT) and Indonesia exports to China (4.06 MT). This trade flow experienced a 7.8% or 2.84 MT increase, mainly driven by an increase in flows from Australia to China (+1.75 MT), and Brunei to China (+0.46 MT), although there was a decrease from Malaysia to China (-0.62 MT).

Another significant trade flow is Africa to Europe at 25.67 MT in 2023, with Algeria to Turkey (4.29 MT), Nigeria to Spain (3.59 MT) and Algeria to France (3.20 MT) taking up the lion's share. This trade flow experienced a decrease of 1.67 MT, falling from 27.35 MT in 2022 to 25.67 MT in 2023. Performance for flows between markets on this route varied from 2022 to 2023, with Egypt exports decreasing by 2.75 MT, and Nigeria exports decreasing by 1.81 MT. On the other hand, exports from Algeria increased by 2.42 MT.

Overall Russian trade flows decreased from 32.50 MT in 2022 to 31.36 MT in 2023. There were increases for Russia exports to Asia (+2.47 MT). On the other hand, Russia to Asia Pacific trade flows (-2.00 MT) and Russia to Europe trade flows (-1.62 MT) decreased.

Table 3.1: LNG trade between regions, 2023 vs 2022 (MT)

Exporting region / *Importing Region*		Asia Pacific	Middle East	North America	Africa	Russia	Latin America	Europe	**Total**
Asia Pacific	2022	97.1	31.4	13.2	4.6	10.2	2.0	-	**158.5**
	2023	95.0	31.1	14.4	4.5	8.2	1.6	-	**154.8**
Europe	2022	0.3	19.9	51.7	27.3	15.9	4.9	2.6	**122.6**
	2023	0.1	15.6	56.6	25.7	14.3	5.1	4.3	**121.7**
Asia	2022	36.4	41.3	4.7	4.7	6.2	0.7	0.1	**94.0**
	2023	39.3	43.3	6.7	7.0	8.6	1.0	-	**105.8**
Latin America	2022	0.2	0.1	4.7	1.7		2.4	0.1	**9.3**
	2023	0.04	0.1	5.6	1.5	0.1	2.5	0.04	**9.9**
Middle East	2022	0.1	3.8	1.1	1.3	0.1	0.3	-	**6.7**
	2023	0.2	4.6	0.7	1.2	0.1	0.1	-	**6.9**
North America	2022	0.3	0.1	0.1	0.1	-	1.1	-	**1.7**
	2023	0.2	-	0.5	0.3	-	1.1	0.04	**2.1**
Africa	2022	-	-	-	0.04	-	-	-	**0.04**
	2023	-	-	-	0.1	-	-	-	**0.1**
Russia	2022	-	-	-	0.02	0.1	-	-	**0.1**
	2023	-	-	-	-	0.1	-	-	**0.1**
Total	**2022**	**134.5**	**96.5**	**75.6**	**39.8**	**32.5**	**11.3**	**2.8**	**393.0**
	2023	**134.8**	**94.7**	**84.5**	**40.3**	**31.4**	**11.4**	**4.4**	**401.4**

Source: GIIGNL

Figure 3.8: LNG trade between regions, 2023

Source: Rystad Energy and GIIGNL

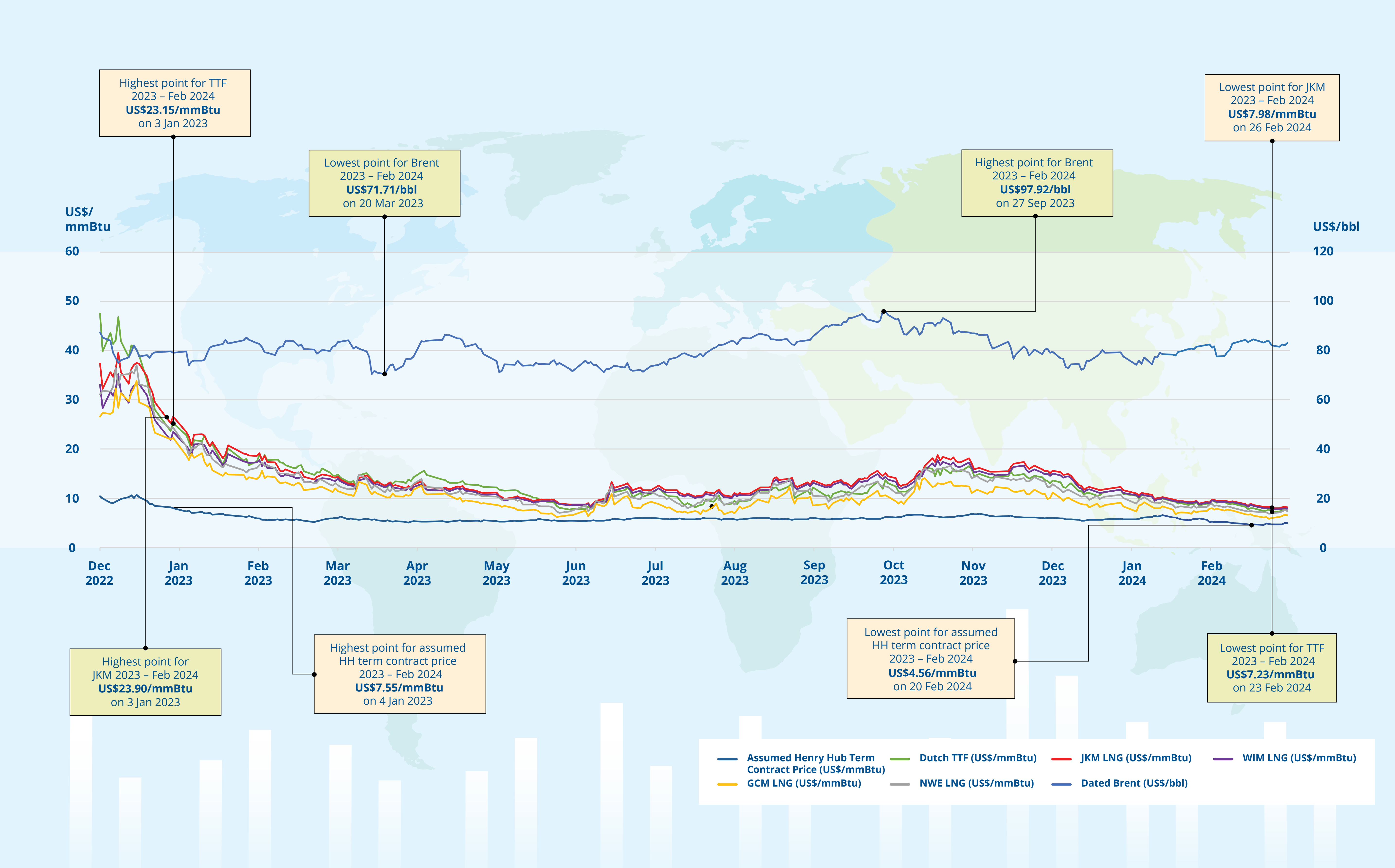
Courtesy Hyundai Heavy Industries

Table 3.2: LNG trade volumes between markets, 2023 (MT)

Markets	Algeria	Angola	Australia	Brunei	Cameroon	Egypt	Equatorial Guinea	Indonesia	Malaysia	Mozam-bique	Nigeria	Norway	Oman	Papua New Guinea	Peru	Qatar	Russia	Trinidad & Tobago	UAE	United States	Re-exports Received	Re-exports Loaded	2023 Net Imports	2022 Net Imports
China	0.35	-	24.34	0.79	0.07	0.27	0.20	4.06	6.79	0.66	1.21	-	1.08	2.54	0.15	16.75	8.15	0.40	0.67	3.17	0.90	-1.39	71.19	63.61
India	0.34	0.73	0.36	-	0.39	0.18	0.31	-	-	0.37	0.73	-	0.88	-	-	10.92	0.49	0.28	2.85	3.09	0.05	-	21.96	20.02
Pakistan	-	-	-	-	-	0.07	-	0.25	-	-	0.38	-	0.07	-	-	6.32	-	0.07	-	-	-	-	7.15	6.93
Bangladesh	0.13	0.20	-	-	-	0.14	0.07	0.06	0.07	-	0.21	-	-	-	-	3.75	-	0.06	-	0.40	0.12	-	5.20	4.43
Asia	0.83	0.93	24.70	0.79	0.46	0.66	0.58	4.36	6.87	1.03	2.53	-	2.03	2.54	0.15	37.74	8.64	0.81	3.52	6.66	1.07	-1.39	105.50	95.00
Japan	0.06	-	27.61	2.43	-	0.14	0.13	2.69	10.43	0.14	0.26	-	2.19	3.80	0.25	2.83	5.95	0.06	0.78	5.63	1.18	-0.44	66.12	73.06
South Korea	0.13	-	10.74	0.54	-	0.28	0.34	2.96	6.19	0.37	0.63	-	5.08	0.60	0.83	8.67	1.65	-	0.37	5.15	1.01	-0.39	45.17	46.81
Chinese Taipei	-	-	8.14	0.26	0.07	0.07	-	0.44	0.65	-	0.33	-	0.41	1.40	0.14	5.55	0.56	-	0.12	1.96	0.06	-	20.16	20.42
Thailand	0.08	-	2.81	0.33	-	-	0.27	0.45	1.83	0.65	0.27	-	0.63	-	-	2.82	-	0.21	-	1.05	0.19	-	11.58	8.74
Singapore	-	-	2.71	-	-	0.002	0.21	0.23	0.06	-	-	-	-	-	-	1.41	0.07	0.11	-	0.38	0.01	-0.39	4.81	3.70
Indonesia	-	-	0.53	-	-	-	-	4.04	-	-	0.01	-	-	-	-	-	-	-	-	0.13	0.35	-0.88	4.19	3.34
Malaysia	-	-	2.15	0.20	-	-	-	-	0.44	-	-	-	-	-	-	-	-	-	-	-	0.10	-0.29	2.60	2.71
Philippines	0.07	-	0.06	-	-	-	-	-	0.14	-	-	-	0.14	-	-	-	-	-	0.06	0.14	-	-	0.60	-
Vietnam	-	-	-	-	-	-	-	0.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.08	-
Asia Pacific	0.33	-	54.75	3.76	0.07	0.49	0.94	10.91	19.74	1.16	1.51	-	8.45	5.81	1.22	21.28	8.23	0.39	1.33	14.44	2.92	-2.40	155.32	158.78
France	3.20	0.67	-	-	0.64	0.21	-	-	-	-	0.45	0.89	0.07	-	0.28	1.65	3.47	0.25	-	10.06	0.19	-0.23	21.80	24.88
Spain	1.43	0.20	0.005	-	0.28	0.20	0.14	-	-	-	3.59	0.25	0.19	-	0.33	0.96	4.83	0.38	-	5.32	0.24	-1.54	16.81	19.47
Netherlands	0.19	0.74	-	-	-	0.13	0.28	-	-	-	0.20	0.87	-	-	0.07	0.57	0.72	0.69	-	11.97	0.35	-0.45	16.33	11.86
United Kingdom	0.34	0.61	-	-	-	0.21	-	-	-	-	0.34	0.31	-	-	1.38	2.04	-	0.40	-	8.81	0.07	-	14.51	18.84
Italy	1.71	-	-	-	-	0.22	0.13	-	-	0.12	0.22	-	-	-	-	4.82	0.12	-	-	3.86	0.64	-	11.85	10.39
Turkey	4.29	-	-	-	0.08	0.93	-	-	-	0.07	0.36	0.19	0.06	-	-	-	1.16	0.17	-	2.84	0.07	-0.15	10.09	10.73
Belgium	0.14	0.20	-	-	-	0.08	0.07	-	-	-	0.06	0.07	-	-	-	3.20	2.82	-	-	1.71	0.03	-0.12	8.26	8.57
Germany	-	0.34	-	-	-	0.05	-	-	-	-	-	0.20	-	-	-	-	-	0.20	0.06	4.14	0.60	-0.49	5.10	0.08
Poland	-	-	-	-	-	-	0.07	-	-	-	-	0.07	-	-	-	1.74	-	0.07	-	2.69	-	-	4.63	4.41
Portugal	-	-	-	-	-	-	-	-	-	-	1.51	-	-	-	-	-	0.29	0.19	-	1.48	-	-	3.46	4.23
Lithuania	0.06	-	-	-	-	-	-	-	-	-	0.07	0.91	-	-	-	-	-	0.09	-	1.08	0.05	-0.12	2.14	2.18
Greece	0.29	-	-	-	-	0.23	-	-	-	-	0.06	0.07	-	-	-	-	0.59	-	-	0.78	0.04	-	2.06	2.75
Croatia	-	-	-	-	-	-	-	0.07	-	0.12	0.06	-	0.23	-	-	-	-	0.39	-	1.10	-	-	1.96	1.81
Finland	0.07	-	-	-	-	-	-	-	-	-	-	0.29	-	-	-	-	0.15	-	-	0.74	0.12	-0.005	1.36	0.27
Sweden	-	-	-	-	-	-	-	-	-	-	-	0.10	-	-	-	-	0.07	-	-	-	0.19	-0.02	0.34	0.27
Malta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.27	-	0.05	-	-	0.32	0.34
Norway	-	-	-	-	-	-	-	-	-	-	-	0.10	-	-	-	-	0.06	-	-	-	0.05	-	0.21	0.19
Gibraltar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.001	0.05	-0.0005	0.05	0.04
Denmark	-	-	-	-	-	-	-	-	-	-	-	0.01	-	-	-	-	-	-	-	-	0.01	-	0.02	0.01
Iceland	-	-	-	-	-	-	-	-	-	-	-	0.0005	-	-	-	-	-	-	-	-	0.0005	-	0.0009	-
Europe	11.72	2.77	0.005	-	1.00	2.26	0.68	0.07	-	0.32	6.93	4.32	0.55	-	2.06	14.98	14.27	3.09	0.06	56.63	2.70	-3.12	121.29	121.31
Chile	-	-	0.001	-	-	0.03	0.42	-	-	-	-	-	-	-	-	-	-	1.41	-	0.62	-	-0.04	2.45	2.51
Argentina	0.04	-	-	-	-	0.04	0.07	-	-	-	0.06	-	-	-	-	0.14	-	0.10	-	1.40	-	-	1.85	1.66
Dominican Republic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.14	-	1.51	-	-	1.66	1.46
Jamaica	-	-	-	-	-	0.04	-	-	-	-	0.76	0.04	-	-	-	-	-	0.34	-	0.27	0.20	-0.54	1.09	0.64
Colombia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.07	-	0.70	-	-	0.77	0.10
Brazil	0.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.06	0.02	-	0.62	0.05	-0.13	0.66	1.91
El Salvador	-	-	0.04	-	-	-	0.06	-	-	-	-	-	-	-	0.13	-	-	0.24	-	0.03	-	-	0.50	0.29
Panama	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.43	-	-	0.43	0.27
Cuba	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02	-	-	0.02	-
Latin America	0.07	-	0.04	-	-	0.11	0.56	-	-	-	0.81	0.04	-	-	0.13	0.14	0.06	2.32	-	5.60	0.25	-0.71	9.42	8.85
Puerto Rico	-	-	-	-	-	-	-	-	-	-	0.30	-	-	-	-	-	-	0.49	-	-	0.93	-	1.72	1.02
Mexico	-	-	-	-	-	-	-	0.25	-	-	-	-	-	-	0.06	-	-	-	-	0.32	0.001	-	0.63	0.40
United States	-	-	-	-	-	-	-	-	-	-	0.03	0.04	-	-	-	-	-	0.33	-	0.14	0.03	-0.30	0.27	0.52
Canada	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.07	-	-	0.10	-	-	-	-	0.18	0.25
North America	-	-	-	-	-	-	-	0.25	-	-	0.33	0.04	-	-	0.13	-	-	0.92	-	0.46	0.96	-0.30	2.79	2.19
Kuwait	0.08	-	0.07	-	-	-	0.07	-	0.14	0.15	0.87	-	0.34	-	-	3.41	0.07	0.13	0.06	0.68	0.08	-	6.14	6.00
UAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.66	-	-	0.07	-	-	-	0.73	0.68
Jordan	-	-	-	-	-	-	-	-	-	-	-	-	0.06	-	-	-	-	-	-	0.07	-	-	0.13	0.07
Middle East	0.08	-	0.07	-	-	-	0.07	-	0.14	0.15	0.87	-	0.40	-	-	4.07	0.07	0.13	0.13	0.75	0.08	-	7.00	6.74
Egypt	-	-	-	-	-	0.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.05	0.01	0.04
Africa	-	-	-	-	-	0.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.05	0.01	0.04
Russia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.09	-	-	-	-	-	0.09	0.10
Former Soviet Union	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.09	0.10
2023 Exports	13.03	3.70	79.56	4.55	1.53	3.57	2.83	15.59	26.75	2.66	12.97	4.39	11.43	8.35	3.69	78.22	31.36	7.66	5.04	84.53	7.97	-7.97	401.42	-
2022 Exports	10.15	3.22	79.27	4.97	1.20	6.98	3.66	14.22	27.57	0.04	14.52	2.79	11.29	8.46	3.34	79.63	32.51	7.97	5.60	75.63	7.25	-7.25	-	393.02

Source: GIIGNL

4 Price Trends



Source: S&P Global Commodity Insights

4. Price Trends

Courtesy CNOOC

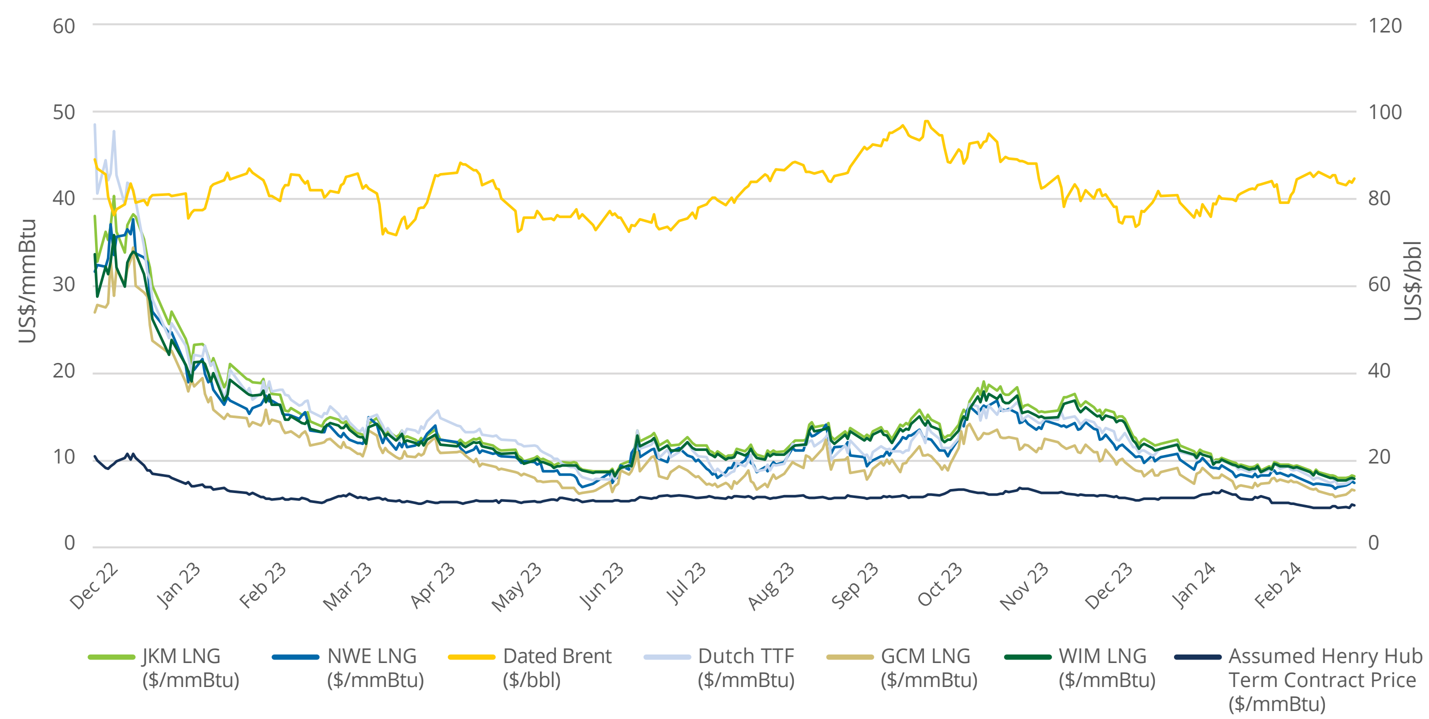
2023 saw LNG markets regain equilibrium. Platts JKM, Asia's price reference for LNG, averaged $13.86/million British thermal units (mmBtu) during the year, closer to its 10-year average of $12.01/mmBtu. Ahead of many analysts' expectations, in Q1 2024, JKM is trading below long-term oil-linked contract prices.

The rebalancing was aided mostly by consumption changes in OECD[1] Asia and Europe, with LNG supplies only marginally increasing versus the previous year. Traditional North Asian importers pared back on LNG purchases, with Japan, South Korea and Chinese Taipei reducing intake. As markets began returning to long-term average prices, South Asian markets showed demand growth, while several markets even imported their first LNG cargoes. The recent LNG demand growth engine, China, saw imports rebound, albeit to a lower total level compared with its 2021 peak. Europe's imports remained steady with a decrease of only 0.02 MT compared to 2022.

4.1 APAC LNG PRICE TRENDS

JKM's annual average dropped 60% from the 2022 level. The 2023 low was $8.40/mmBtu on June 7, while the high was $23.90/mmBtu on January 3. After January 2023, JKM did not breach the $20/mmBtu mark again. 2023 also saw price volatility drop significantly, which helped market activity return, the number of participants increase, and hedging activity start to recover.

Figure 4.1: Comparison of major LNG, pipeline gas and oil benchmarks, December 2022 to end-February 2024



Note: Assumed Henry Hub (HH) Term Contract Price = HH*115% + $2.75/mmBtu
Source: S&P Global Commodity Insights

Asian markets heavily exposed to LNG prices, with few domestic alternatives, including Japan and South Korea, managed to reduce imports in 2023, due to lower power consumption (which dropped 1-2%), higher nuclear power generation, and greater renewables deployment. With Europe's need for LNG being less urgent than in 2022, given mild weather, lower demand and high storage levels, the price differences between Asia and Europe became less predictable. While in 2022, Europe's largest gas hubs priced nearly $8/mmBtu higher on average than JKM, in 2023 the price difference was close to zero, with some periods of premium and others of discount.

Major price-impacting incidents within Asia included the on-off stories in August and September around strikes affecting up to three major LNG plants in Western Australia, and shipping restrictions firstly through the Panama Canal and, from December, through the Suez Canal.

A larger import volume was witnessed in China and Thailand, while Philippines and Vietnam imported their first LNG cargoes in 2023. India, Pakistan, and Bangladesh all saw a recovery in demand from 2022 thanks to lower outright LNG prices, and relative to some competing fuels.

[1] OECD: The Organisation for Economic Co-operation and Development

Market participants in Northeast Asia were observed procuring cargoes in strip transactions well in advance of the peak winter demand season, which also dampened appetite for prompter spot Southeast Asia LNG. The prices trend was very close to JKM, with Platts SEAM (Southeast Asia Marker) – launched in Q4 2023 – moving in a range of minus $0.10/mmBtu to minus $0.30/mmBtu against JKM since the launch. 60% of these emerging Southeast Asian LNG purchases are priced at a differential to JKM.

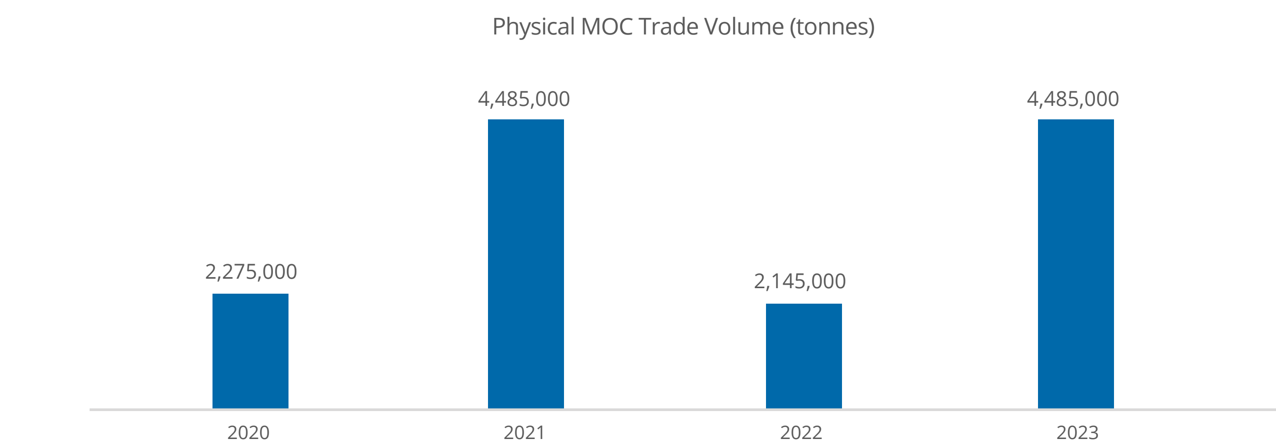
India saw a rebound in import volumes, aided by lower prices, growth in city gas distribution, fertiliser and industrial usage, as well as some early signs of increased use of natural gas in power generation. India's LNG imports increased 9.7% to approximately 22 MT in 2023, from 20.02 MT the year prior.

Market activity in Asia picked up after the effects of war in Europe on the global gas market became part of a new reality in the second half of 2023, with the number of spot trades and length of trading chains strengthening to levels not seen since 2021. Using Platts Market on Close (MOC)[2] price assessment process as an indicator of this trend, physical trade volume reported in the process was just under 4.5 MT, against 2.15 MT in 2022.

Matching trends in the wider market, which saw the number of participants transacting spot LNG cargoes increase, the MOC spiked 45% for the number of companies reporting trade in 2023.

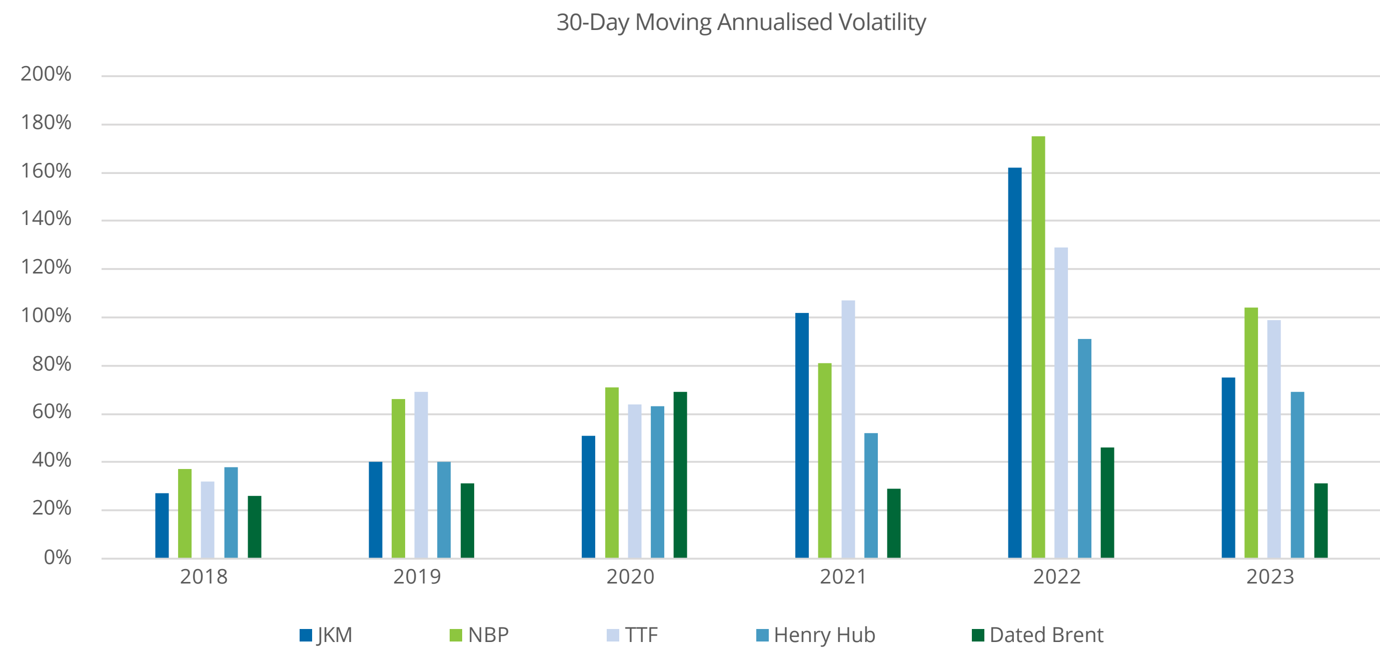
Similarly, LNG derivatives trading activity on exchanges increased 35% year-on-year to reach just under 70 MT for the last six months of 2023. This was partly aided by JKM volatility halving from the level seen in 2022. In 2023, 30-day rolling volatility averaged 75% vs 160% in 2022. While 2023 volatility was still higher than other annual averages, the reduced volatility meant that commodity clearing houses reduced margin requirements for LNG derivative contracts in 2023. One of the reasons for reduced LNG derivative activity in 2022 on exchanges was the high level of margin requirements, which reached over 50% of the value of the contract, when in less volatile times initial margins are around 10-15%.

Figure 4.2: Physical Market-on-Close Trade volume, 2020-2023



Source: S&P Global Commodity Insights

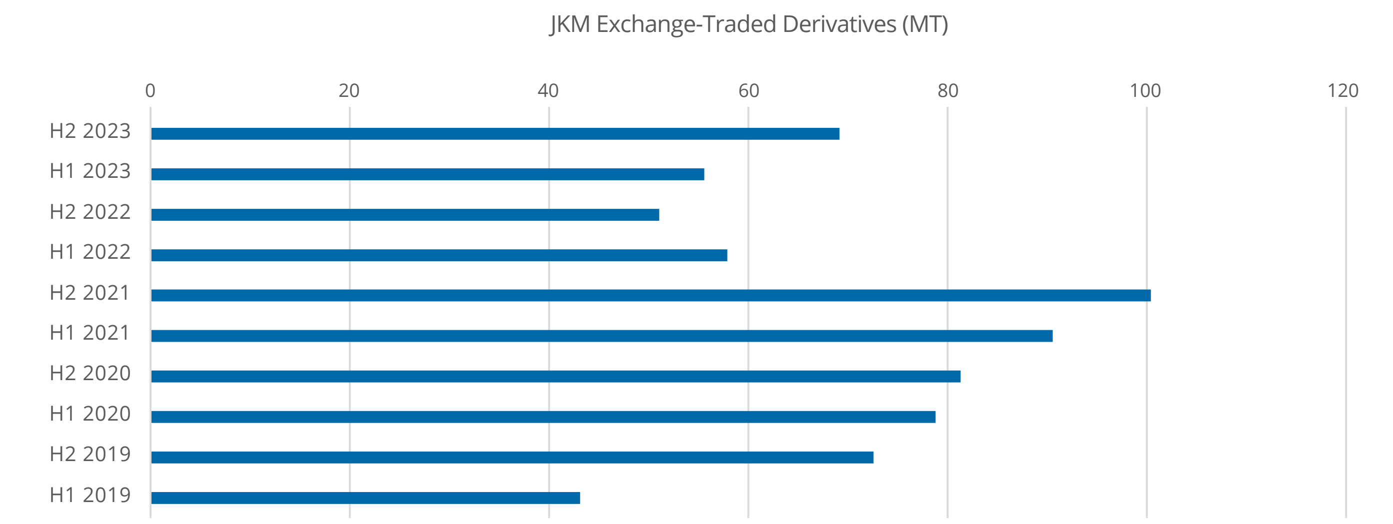
Figure 4.3: Comparison of major gas, LNG and crude price volatility, 2018-2023



Source: S&P Global Commodity Insights

[2] Platts LNG MOC is the price assessment process used to determine Platts JKM and other LNG benchmark prices published by S&P Global Commodity Insights, where market participants report bids, offers and trades on a real-time basis.

Figure 4.4: Traded volume of JKM derivatives on exchanges, 2019-2023



Source: S&P Global Commodity Insights

Interestingly, as LNG prices started to dip and get closer to formulas regularly used in 10+ year long-term contracts, Sales and Purchase Agreement (SPA) activity from some points of origin started to retreat. Project developers are now having to compete for end-user demand with intermediaries with significant long-term contract volumes to deploy. The influence of market prices on contract negotiations continued to strengthen in 2023, with more contracts reportedly signed using spot LNG prices as their basis, and others using different crude slopes in different years to account for expectations of different market dynamics in different time periods – expectations informed by a transparent LNG derivatives forward curve.

As the market could be entering a period of marginal fluctuating balances, where LNG prices rise above and fall below long-term contract formula prices, it remains to be seen if market participants will make a decisive move towards market-based LNG pricing for longer term contracts, or repeat the trend seen in 2019-2021, when companies turned to over-reliance on spot volumes when LNG prices became cheaper than long-term formulas, with some major importing markets relying on spot cargoes for approximately 40% of their demand.

A move to the former could temper long-term price volatility; a return to the latter could create exacerbate price movements during periods of boom and bust.

4.2 ATLANTIC LNG PRICE TRENDS

In 2023, Europe cemented its role as a major competing basin for LNG volumes. It remained the largest importing region from the world's largest LNG supplier, the US.

Europe needed somewhat less gas versus the year prior, thanks to a recovery in hydro, nuclear and growth in renewables, as well as sustained sluggish industrial gas demand and reduced seasonal demand due to mild weather conditions. Europe imported 121.29 MT in 2023, only 0.02 MT lower than in 2022.

Despite a marginal change in volume, there have been significant changes in the destinations and direction of LNG in Europe with additional receiving infrastructure. Germany imported substantial volumes of LNG for the first time in 2023, importing just over 5 MT, compared to around 80,000 tonnes the year prior.

Beyond Germany's entry to the LNG market, the return of Freeport LNG by 2Q 2023, after having been largely offline for nearly a year, helped ease supply concerns. Norway's pipeline flows have a direct impact on price direction, as they account for a significant proportion of Europe's gas supply. In 2023, for example, Norway shipped 7% less gas than in 2022, with particularly acute drops in September due to planned maintenance and concurrent unplanned outages, when monthly volumes dropped 37% year on year, leading to price increases.

The regasification infrastructure investment in 2022, which came after LNG became over 40% of the continent's gas supply, bore fruit in 2023, with regasification capacity rising by 30 MT in Europe. With higher installed regasification capacity, but marginally lower imports, the utilisation at Europe's regasification terminals reduced: in 2023 it stood at 54%, having been more than 60% in the 12-months prior period. Having this flexibility in receiving capacity can significantly aid security of supply by adding optionality, provided sufficient supply is available to meet demand.

This has also helped to lessen the vast differentials that opened between Northern continental European pipeline gas hub prices and other LNG prices. In 2023, Platts NWE averaged $0.85/mmBtu below the Dutch Title Transfer Facility (TTF) gas hub price, compared to an average discount of $8.5/mmBtu in 2022. It is notable that 2023's average differential was both the largest in any year bar 2022, and a highly variable differential. At some points during summer months, Platts NWE was at a premium to TTF, for example.

While the risk of returning to the double-digit discounts to TTF seen in 2022 is significantly reduced, the awareness of risk when pricing LNG into Europe against gas hub prices alone, has increased. The need to manage that risk began to be met during 2023, with Chicago Mercantile Exchange (CME)'s NWM (Northwest Marker) contract, which settles against Platts NWE, seeing 780 lots traded in the first 12 months since the launch.

The LNG-to-LNG relationship remained relatively stable, reflecting the changing competition between the basins for Atlantic LNG volumes. Despite drastically lower outright prices, the JKM – Platts Northwest Europe (NWE) price difference in 2023 was $1.59/mmBtu, versus $1.24/mmBtu the year prior. Consequently, US LNG exports continued overwhelmingly to go to Europe: around two-thirds of US LNG was delivered to Europe in 2023, proportionally unchanged versus the previous year.

2023 also saw the launch of the Agency for the Cooperation of Energy Regulators (ACER)'s LNG index. This was a novel approach put forward by the European Commission late-2022 and resulted in EU-based entities being mandated to provide trade activity to ACER for consideration in the agency's index.

Regarding other important consumption regions in the Atlantic Basin, Latin America remained quiet in 2023 overall, except when Colombia issued tenders seeking at least five cargoes due to drought affecting hydro levels, which doubled its imports in the third quarter of 2023 compared to the second quarter of 2023.

CONCLUSION

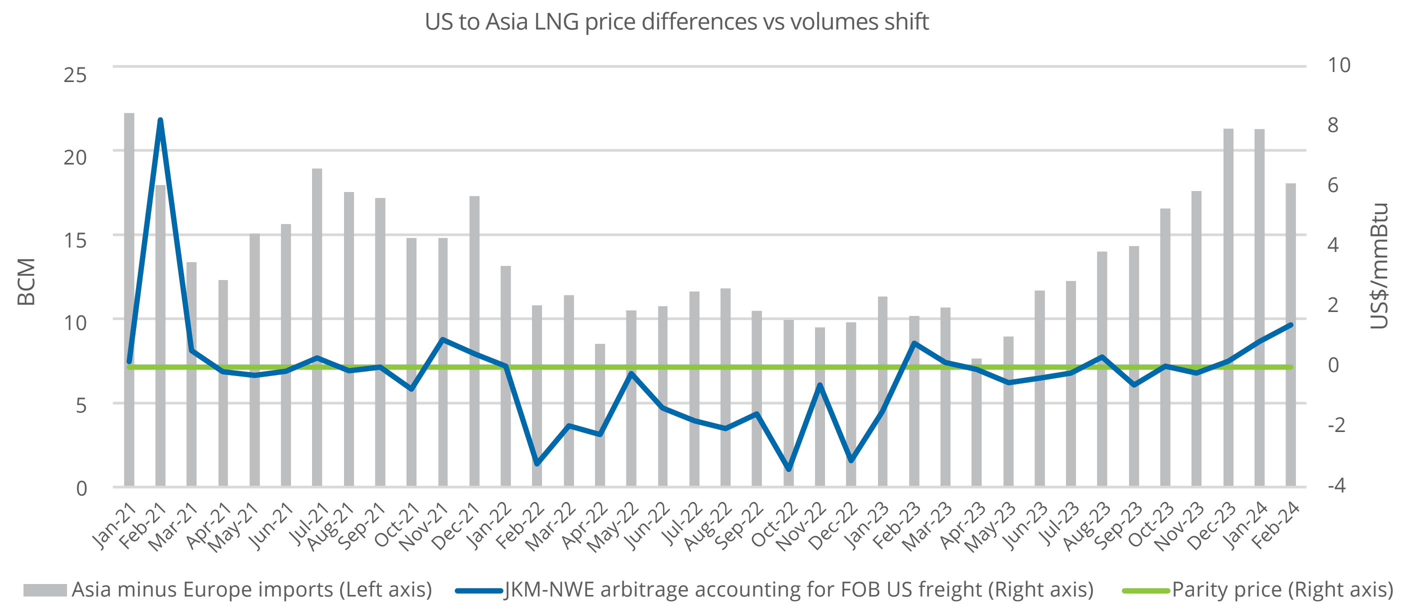
Overall, LNG markets settled into greater equilibrium by 2024, with volatility reduced, market participation up, greater risk management opportunities and higher levels of spot trade churn. Furthermore, the market is increasingly flexible and demonstrated its resilience even when faced with major route disruptions like those witnessed in the Suez and Panama Canals.

Based on the above, market conditions are favorable for levels of activity in 2024 to surpass the record levels seen in 2021.

Competition between Europe and Asia for LNG volume will continue as the former's dependency on LNG for its gas supply will remain. This marks a more sustained market change after the Ukraine war.

Seasonality, changes in fundamentals within individual markets and the interaction between long-term pricing formulas and spot LNG prices will continue to inform the price difference between JKM and Platts NWE.

Figure 4.5: Comparison of LNG price and import volume between Asia and Europe, January 2021 to end-February 2024



Source: S&P Global Commodity Insights

LNG LEVANTE_Courtesy PENINSULA

5 LNG Liquefaction Plants

Global liquefaction capacity reached **482.5 MTPA** in 2023.

Capacity Additions for 2023

3.8 MTPA of liquefaction capacity brought online

0.8% year-on-year growth vs 2022

United States
91.4 MTPA
Market with the highest liquefaction capacity

Australia
87.6 MTPA

Qatar
77.1 MTPA

Pre-FID

1,046 MTPA of liquefaction capacity currently in pre-FID stage

363.9 MTPA from USA

157.4 MTPA from Russia

230.3 MTPA from Canada

48.8 MTPA from Mexico

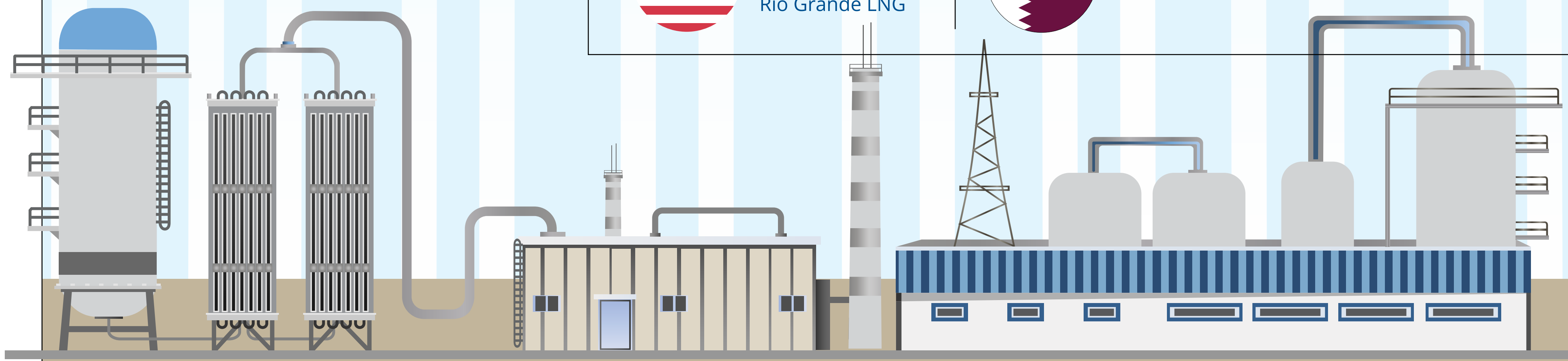
FIDs and Under Construction

FID in 2023
58.8 MTPA

216.9 MTPA of liquefaction capacity under construction or approved for development as of end-February 2024

Plaquemines LNG, Port Arthur LNG, Rio Grande LNG

QatarEnergy LNG Train 8-13



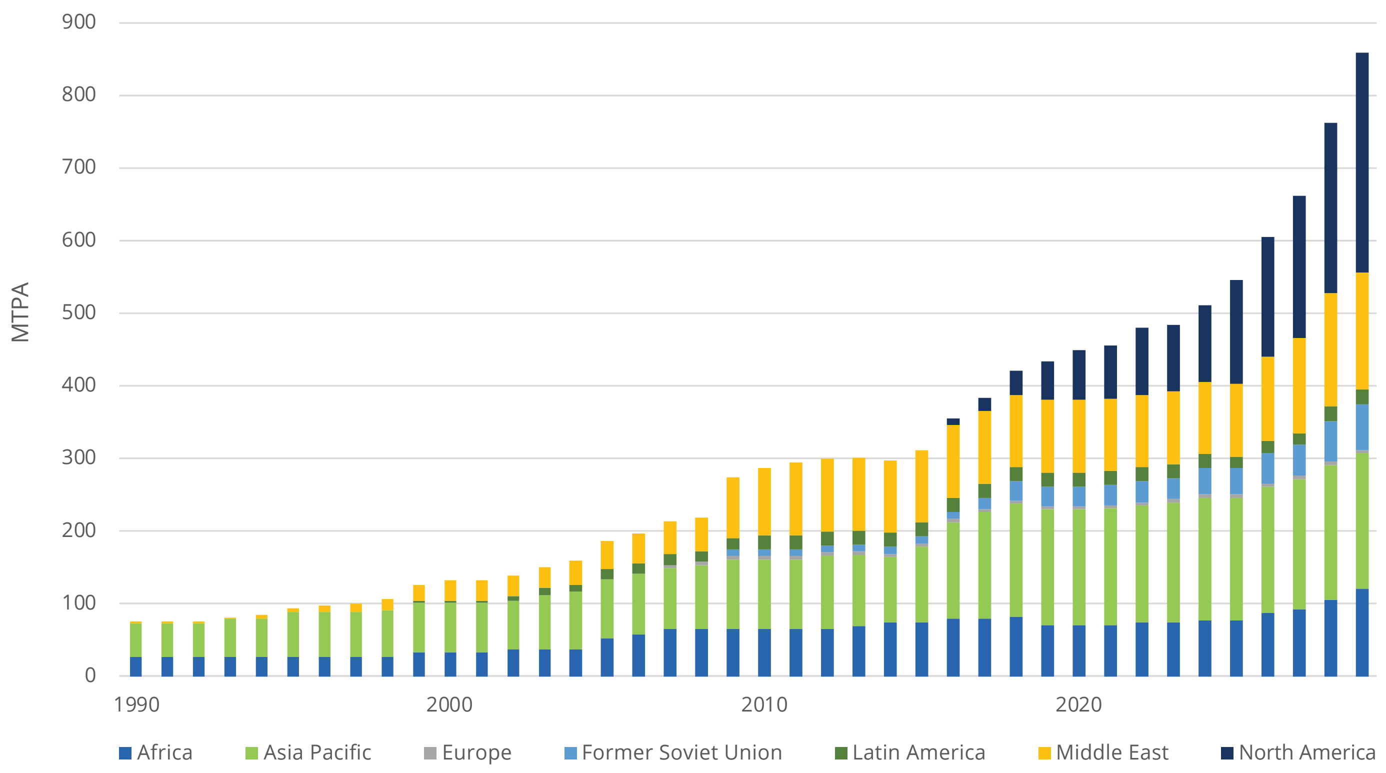
5. Liquefaction Plants

A total of 3.8 MTPA of liquefaction capacity was added in 2023, while an additional 0.6 MTPA was added with Tango FLNG in Congo-Brazzaville commencing in February in 2024, pushing global liquefaction capacity to around 483 MTPA as of the end of February. The average global utilisation rate in 2023 was 88.7%, similar to 89% in 2022. As of the end of February this year, total approved capacity of liquefaction projects is 216.9 MTPA.

Courtesy QatarEnergy

5.1 OVERVIEW

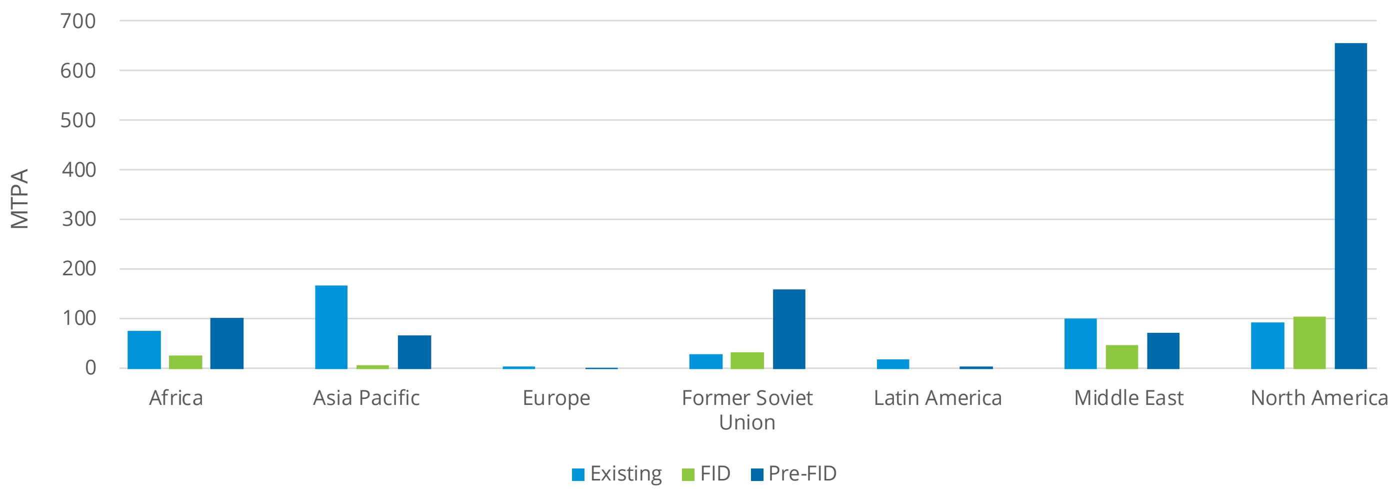
Figure 5.1: Global liquefaction capacity growth by region, 1990-2029



Source: Rystad Energy

A total of 3.8 MTPA of liquefaction capacity was brought online globally in 2023 with the addition of Tangguh LNG T3 (3.8 MTPA) in Indonesia, which increased the plant's total capacity to 11.4 MTPA. As the plant's operator, BP announced that shipment of the first cargo in October 2023 marked the start of full commercial operations at Tangguh LNG T3.

Figure 5.2: Global liquefaction capacity by region and status, end-February 2024



Source: Rystad Energy

Between 2023 to end-February 2024, the volume of approved liquefaction capacity reached 58.8 MTPA, a significant increase compared to 22.4 MTPA in 2022. This was primarily contributed by Rio Grande LNG T1-T3 (17.6 MTPA), Port Arthur LNG T1-T2 (13.5 MTPA), Plaquemines LNG T19-T36 (10 MTPA) in the US, Gabon LNG (0.7 MTPA), Altamira LNG T2 (1.4 MTPA) and QatarEnergy LNG T12-T13 (15.6 MTPA). In July 2023, NextDecade's Rio Grande LNG Phase I reached FID, with estimated capex of $18.4 billion. The project in South Texas aims to access primarily low-cost Permian Basin and Eagle Ford associated gas. Port Arthur LNG is a four-train greenfield liquefaction project that will be situated in Jefferson County, Texas. The project is being developed in two phases by Sempra Infrastructure. Phase 1 was approved in March 2023 and is expected to be put into operation in 2027. Phase 2, which would double the plant's capacity, remains under review by the Federal Energy Regulatory Commission (FERC). Plaquemines LNG, located in Louisiana, has a nameplate capacity of 20 MTPA and is being developed in two phases. Plaquemines Phase 1 T1-T18 (10 MTPA) was approved in May 2022 with first LNG production anticipated in 2024. In March 2023, Venture Global progressed to FID on Phase 2 of the Plaquemines LNG project T19-T36 (10 MTPA) with $7.8 billion of financing, lifting total financing for this project to $21 billion. In February 2023, Perenco Oil & Gas Gabon reached FID on the Gabon LNG project with over $1 billion of financing. New Fortress Energy reached FID for the second unit at Altamira LNG in August 2023 with approximately $1 billion of financing.

The focus on decarbonising the global energy sector has gained momentum in recent years. LNG is a major component of the global energy mix and decarbonising along the LNG value chain is a priority for many stakeholders in the industry. Driving down liquefaction sector emissions provides a significant opportunity to reduce GHG emissions in the value chain, and there has been a notable increase in efforts in this area. Several proposed projects – such as Cedar LNG 1 and Kitimat LNG in Canada – are looking to use hydropower to run their operations, with a CCS study planned for Egypt's Idku LNG plant. The progress towards low-carbon LNG is also under way, with initiatives such as the use of renewable energy sources and the development of CCS technology at liquefaction facilities. Inpex, operator of Ichthys LNG in Australia, plans to pursue energy efficiency measures and is investigating a CCS injection project at the plant in an effort to offset GHG emissions. CP2 LNG, Abadi LNG and Rio Grande LNG, as well as some other plants, are also developing CCS facilities, which could become among the largest in terms of capacity. On the other hand, regarding CCUS, Tokyo Gas, Osaka Gas, Toho Gas, Mitsubishi Corporation and Sempra Infrastructure Partners signed a letter of intent to jointly study the establishment of a supply chain for the production, liquefaction and international transportation of e-methane, the decarbonised synthetic gas captured through a chemical reaction between hydrogen and CO2, in Cameron LNG to contribute to the realisation of a smooth energy transition. Osaka Gas signed a memorandum of understanding with Tallgrass MLP Operations, which owns and operates natural gas pipelines and other energy infrastructure, and Green Plains, which owns and operates bioethanol plants, to study the feasibility of an e-methane production project. The project aims to begin production of up to 200,000 tonnes of e-methane per year by 2030, with a view to liquefying it at Freeport LNG terminal and exporting it to Japan. As demand for low-carbon LNG grows, it is expected that more stakeholders in the industry will prioritise the decarbonisation of their operations.

As of the end of February 2024, 1,046 MTPA of aspirational liquefaction capacity is in the pre-FID stage. Most proposed capacity is in North America (643 MTPA), with 363.9 MTPA situated in the US, 230.3 MTPA in Canada, and 48.8 MTPA in Mexico. This is followed by Russia (157.4 MTPA), Africa (101.3 MTPA), the Middle East (71.5 MTPA), and Asia Pacific (66.53 MTPA). About 6.45 MTPA of liquefaction capacity is proposed in the rest of the world. Overall, the market upheaval caused by the Russia-Ukraine conflict is likely to stimulate investment in additional liquefaction facilities as governments put more emphasis on increasing energy security while, at the same time, balancing decarbonisation goals in this fast-changing landscape. If all projects materialise, global liquefaction capacity would increase three-fold. However, a fair portion of pre-FID projects are not likely to progress due to the weak economic outlook and increasingly stringent environmental restrictions on fossil fuel projects.

5.2 GLOBAL LIQUEFACTION CAPACITY AND UTILISATION

Global operational liquefaction capacity totaled 483.1 MTPA as of the end of February 2024, with the weighted average utilisation rate in 2023 averaging 88.7% of pro-rated capacity[1], similar to 89% in 2022. It is notable that no major unplanned LNG outages occurred in 2023. However, maintenance, feedstock challenges and other factors impacted production at some plants. Some export facilities have been running below average – for example, Equatorial Guinea LNG operated at below 80% of capacity due to a major triennial maintenance project in April and natural decline at its original feedstock field. Feedstock challenges notably reduced LNG production at SEGAS LNG in Egypt, NLNG in Nigeria, Darwin LNG in Australia, as well as others. Despite outages and upstream supply disruptions, nine out of 20 LNG exporting markets achieved higher than global average utilisation rates in 2023.

Liquefaction plants in the US operated at almost full capacity in 2023, with a utilisation rate of 99.1%. This strong performance was largely attributed to the return of Freeport LNG and the ramp-up of Calcasieu Pass LNG, driven by growing global demand. Freeport LNG resumed operation in spring 2023 after being offline since June 2022 following a fire at the plant, and its capacity utilisation rose from less than 50% in 2022 to 83% in 2023. Calcasieu Pass LNG started up in 2022, and its production in 2023 increased by more than 3 MT compared to 2022. Favorable Henry Hub price differentials to downstream markets in Asia and Europe supported continued high utilisation at US LNG export plants in 2023. Similarly, liquefaction plants in the Middle East ran at high utilisation rates over the year, with Oman, Qatar and the UAE performing at 110%, 102% and 96%, respectively.

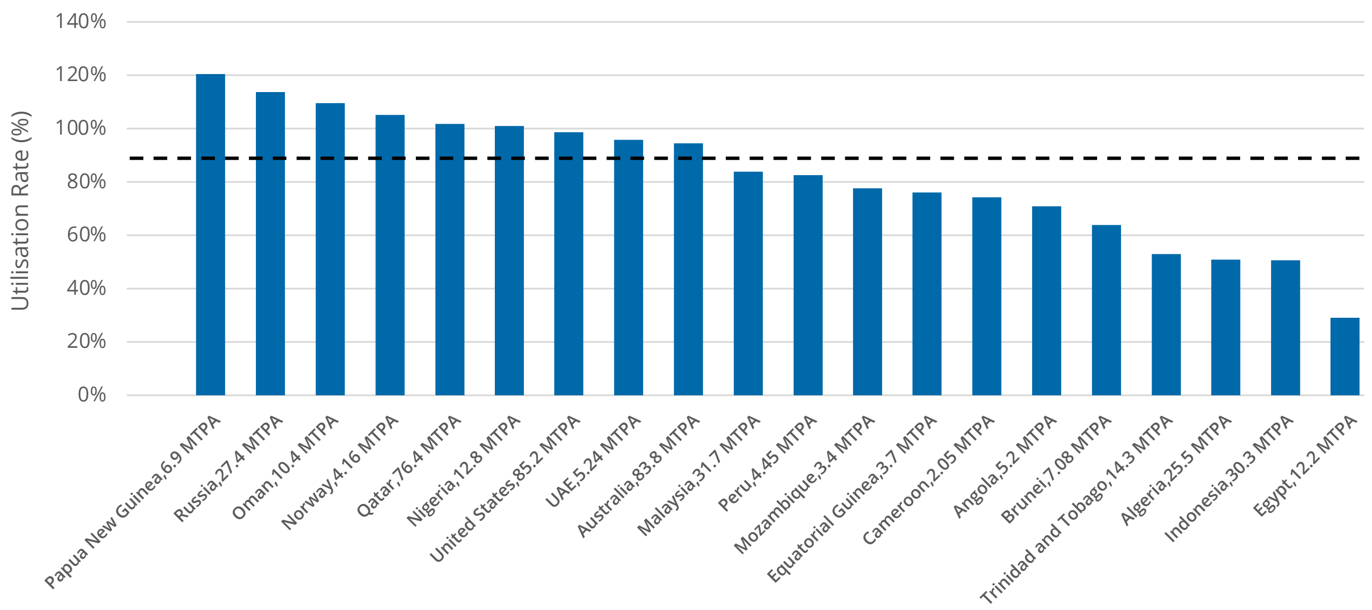
[1] Utilisation is calculated on a pro-rated basis, depending on when the plants are commissioned or when the plants went offline due to outages, upstream supplies disruption or other factors. Only operational facilities are considered.

In Africa, the nameplate utilisation rate at the NLNG liquefaction plant averaged 58% in 2023, with a further decrease compared to 2022, while the pro-rated utilisation rate (excluding outages) was at 101%. NLNG declared force majeure on some cargo loadings in October 2022, initially because of significant flooding across its upstream gas supply production regions, which required several gas production wells to be shut. While flooding conditions have been resolved, feedstock deliveries have still not recovered for pipeline vandalism. Exports from Egypt have declined with reduction in upstream feedgas production.

In Australia, the 3.7 MTPA Darwin LNG (DLNG) operated by Santos, had ceased production in the Bayu-Undan gas field, which is its primary source of feedstock. Santos has decided to proceed with its Darwin pipeline duplication project to enable gas from its offshore Barossa field to flow to Darwin LNG, with a target date set for 2025.

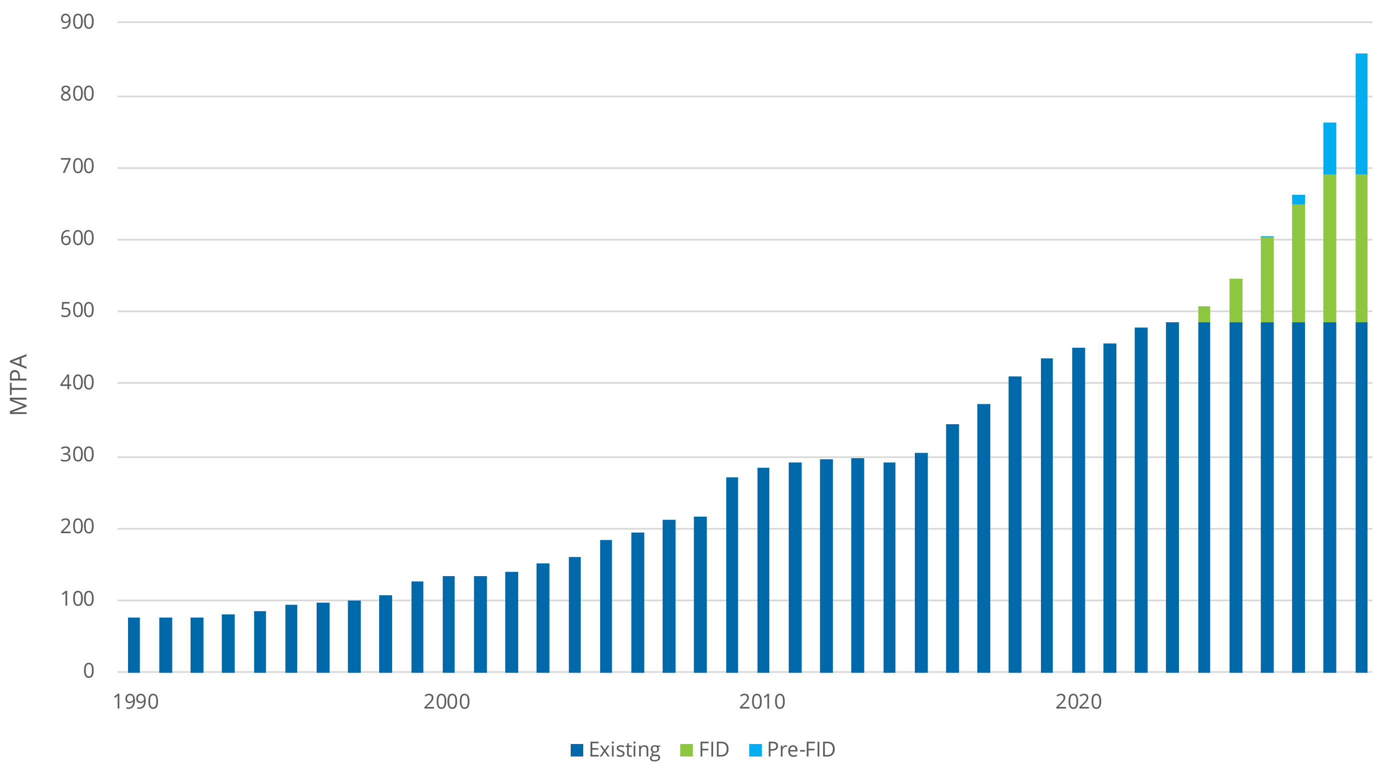
Offshore Australia, Prelude FLNG (3.6 MTPA) performed far below capacity in 2023, with its utilisation rate averaging just 41%. It followed a 46-day maintenance period from December 2022 to January 2023 after a fire in a turbine enclosure. Production was halted again due to planned maintenance from late August to December 2023. Operator Shell indicated that it expects further maintenance periods in the short-to-medium term.

Figure 5.3: Global liquefaction capacity utilisation, 2023 (capacity is pro-rated)



Source: Rystad Energy

Figure 5.4: Global liquefaction capacity development, 1990-2029



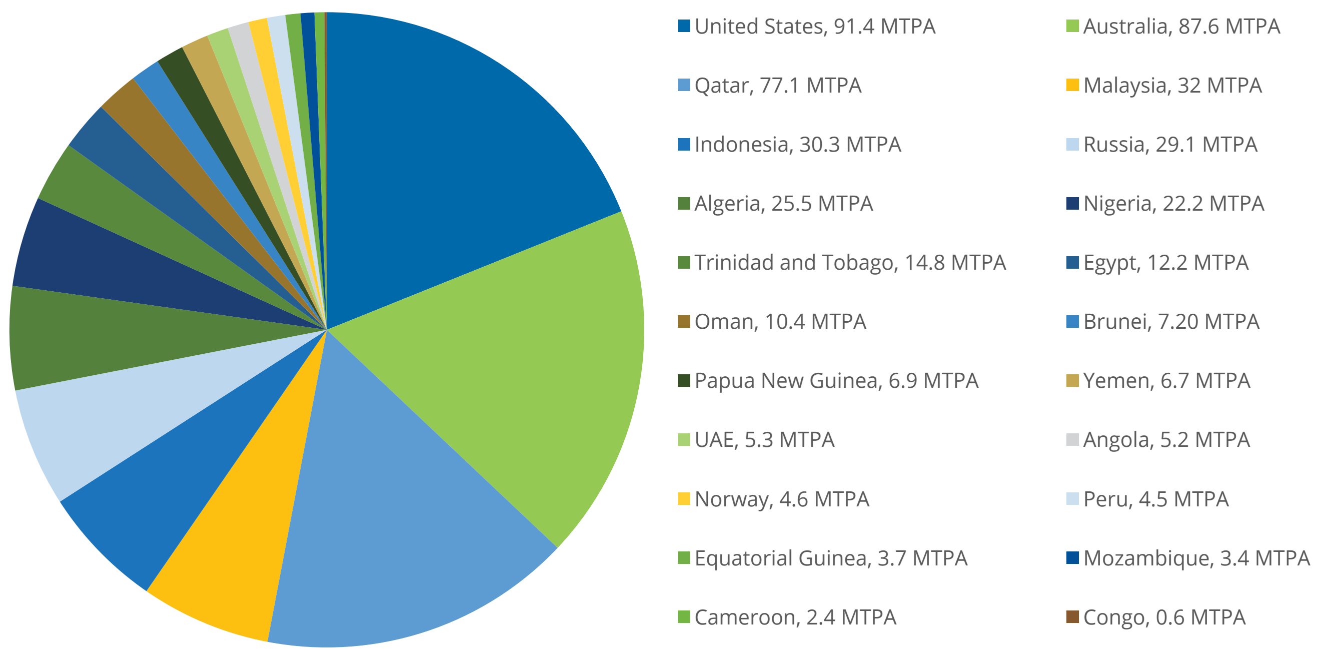
Source: Rystad Energy

5.3 LIQUEFACTION CAPACITY BY MARKET

Operational

As of the end of February 2024, there were 21 markets operating LNG export facilities. The US remained the market with the largest operational liquefaction capacity at around 91.4 MTPA, followed by Australia with liquefaction capacity of 87.6 MTPA, and Qatar with 77.1 MTPA. The top three LNG export markets currently represent more than half of global liquefaction capacity.

Figure 5.5: Global operational liquefaction capacity by market, end-February 2024



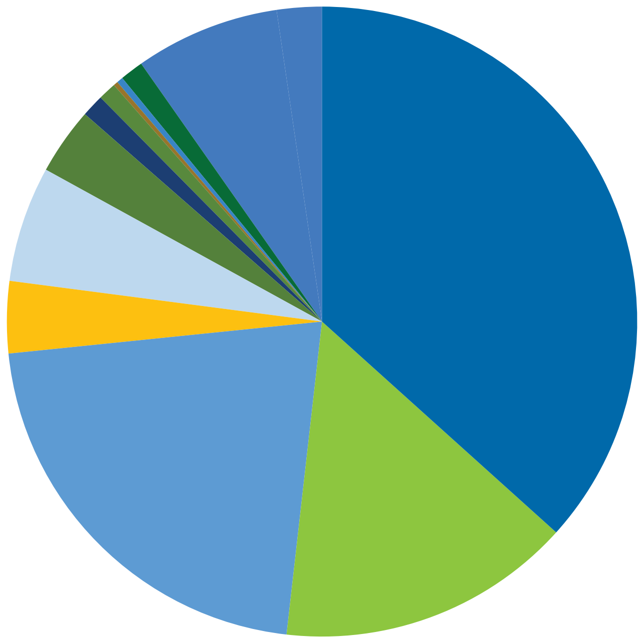
Source: Rystad Energy

Under-construction/FID

As of the end of February this year, 216.85 MTPA of liquefaction capacity is either under construction or approved for development, of which approximately 48% is in North America. In 2023 a total of 58.8 MTPA of liquefaction capacity was approved, mostly contributed by the Plaquemines LNG (T19-T36, 10 MTPA), Port Arthur LNG (13.5 MTPA), Rio Grande LNG (17.6 MTPA) in the US, and QatarEnergy LNG (15.6 MTPA) in Qatar.

Several liquefaction facilities are currently under construction and progressing towards completion. In the US, Plaquemines LNG (T1-T18, 10 MTPA) is currently under construction and is forecast to start operation this year. In Russia, Arctic LNG 2 T1 (6.6 MTPA) has been significantly delayed by sanctions, while the other two trains have been significantly delayed and are expected to start up only after 2026.

Figure 5.6: Global approved liquefaction capacity by market, end-February 2024



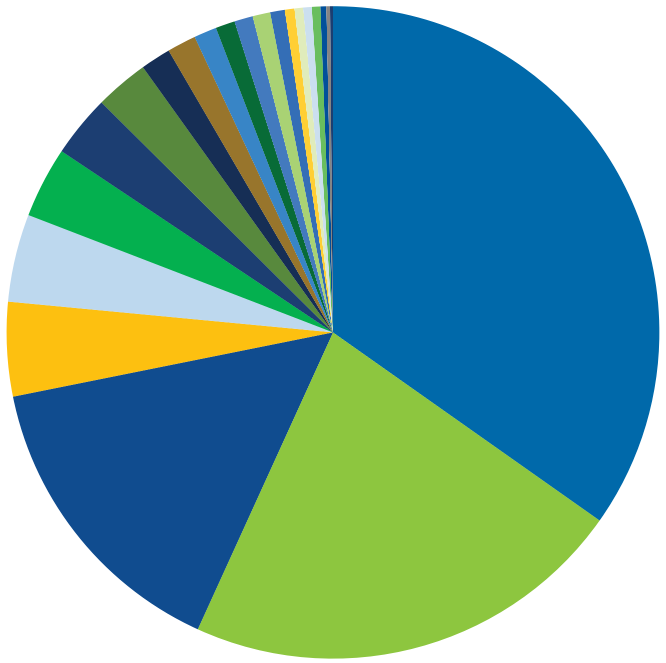
Source: Rystad Energy

Courtesy Samsung Heavy Industries

Proposed

As of the end of February 2024, there was 1,046 MTPA of potential liquefaction capacity in the pre-FID stage. With the Russia-Ukraine conflict still ongoing and a huge decline in Russian piped gas volumes in the market, a wave of proposed liquefaction projects has emerged to offset the loss of Russian supply. Some projects have also been fast-tracked to help meet demand. However, only a portion of pre-FID projects are going to proceed.

Figure 5.7: Global proposed liquefaction capacity by market, end-February 2024



Source: Rystad Energy

A large portion of US planned liquefaction plants is supported by gas production growth in the Permian and Hayesville basins in recent years, which are close to the Gulf of Mexico LNG exporting region. While most operational US LNG projects are brownfield conversion schemes, currently proposed US LNG projects are mainly greenfield schemes that consist of multiple small to mid-scale LNG trains delivered in a phased manner. This provides flexibility in securing long-term offtakers and increases competitiveness in project economics through modular construction. For example, CP2 LNG (19.8 MTPA) in Louisiana plans to accommodate up to 36 liquefaction trains configured in 18 blocks. Additionally, Driftwood LNG (27.6 MTPA) in Louisiana consists of 20 liquefaction trains and is designed to be built in multiple phases.

Out of the 230.3 MTPA of liquefaction capacity proposed in Canada, facilities on the west coast have the advantage of lower shipping costs to Asian markets when competing with other planned projects on the US Gulf Coast. Due to strict environmental standards, those LNG export projects in western Canada have adopted various strategies to reduce carbon emissions to comply with environmental regulations. Cedar LNG 1 (3.0 MTPA) and Kitimat LNG (18.0 MTPA) are planned to be powered by clean and renewable hydropower. Similarly, LNG Canada T3-T4 (14.0 MTPA) has selected high-efficiency aero-derivative gas turbines to minimise fuel use and will also power a portion of the liquefaction plant with renewable energy. Another three proposed projects on Canada's east coast will add 38.5 MTPA of liquefaction capacity by 2040: Bear Head LNG (12.0 MTPA), Saguenay LNG (11.0 MTPA) and AC LNG (15.5 MTPA). However, the timeline for and prospects for completion for many projects in Canada is unclear due to hurdles such as long distances from upstream fields and regulatory challenges.

With the significant reduction in gas flows to Europe, Russia is looking to increase LNG production and exports via a series of liquefaction projects. Russia currently has 157.4 MTPA of proposed liquefaction capacity, with Ob LNG T1-2 (5 MTPA) planned to be approved in 2024. Far East LNG, often referred to as Sakhalin-1 LNG (6.2 MTPA) is a major project in the pre-FID stage that is aiming to commercialise produced gas from the Sakhalin-1 gas fields. Sakhalin-2 LNG T3 (5.4 MTPA), another project in the pre-FID stage, may face difficulties with sourcing feed gas since it plans to purchase this from the abandoned Sakhalin-1 gas fields with developed gas reserves in the Sakhalin-2 region not yet sufficient. Meanwhile, Yakutsk LNG (17.7 MTPA) situated in Russia's Far East is estimated to start exports to Asian and Asia Pacific markets from 2031. This project involves a gas pipeline from Yakutia to the Sea of Okhotsk, and a condensate pipeline with capacity of 1.5 MTPA. Russia has set an ambitious goal of reaching at least 100 MTPA of LNG production by 2030. Hitting this target will require both a significant resource base as well as the relevant technologies and equipment. Following the large-scale exit of Western contractors from Russia's energy sector due to sanctions and a technology ban, the market has been developing its own liquefaction technologies to develop its vast resources. In April 2023, Novatek received a patent for its Arctic Cascade Modified (ACM) technology. ACM is suitable for small to medium-sized LNG plants with capacities up to 3 MTPA per train, and it allows the use of equipment from Russian manufacturers. In the long run, Russia still has major export potential for its vast resource base.

Africa's proposed liquefaction capacity has increased to 101.3 MTPA. Mozambique has the largest pipeline of proposed projects, with a combined capacity of 32.2 MTPA. In March 2023, ExxonMobil looked for FEED contractors for redesigned Rovuma LNG, which has been put on hold due to security issues in Cabo Delgado province and economic effects from the Covid-19 pandemic since 2020.

In the new design, the project may use a modular approach instead of a stick-built approach, with capacity expanded to 18 MTPA from 15.2 MTPA. Tanzania is also planning its first long-delayed LNG plant, Tanzania LNG T1-T2 (15 MTPA) with the latest FID target scheduled for 2027. In Nigeria, Brass LNG (10.0 MTPA) was proposed in 2003 and has been subject to numerous attempts to reach FID amid ownership changes and project alterations. In 2022, the Nigerian government announced plans to revive the project in the Niger Delta, citing increasing demand for gas as a transitional fuel. Plans for an eighth train at NLNG are under way. NLNG T8 (4.0 MTPA) is said to be different from the existing ones, with a focus on reducing carbon emissions. In Mauritania-Senegal, further evaluation for Phase 2 of the Greater Tortue Ahmeyim (GTA) project, operated by BP and partners, has been confirmed with the Phase 2 expansion project expected to add another 2.5 MTPA, for a total of 5 MTPA. The project's latest FID target was scheduled for 2024. However, actual progresses may largely depend on cooperation between governments and competition between new liquefaction projects. While good progress has been made, Africa must still overcome a series of challenges to drive timely execution of these proposed projects and to increase its attractiveness for capital by providing a stable investment climate to realise its vast resource potential.

In Asia Pacific, Australia remained the market with the largest planned capacity of 45.5 MTPA in the region in 2023. Proposed projects such as Abbot Point LNG T1-T4 (2.0 MTPA), Darwin LNG T2 (3.5 MTPA), Gorgon LNG T4 (5.2 MTPA) and Wheatstone LNG T3-T5 (15.9 MTPA) have yet to progress, with most still in the feasibility stage. In Papua New Guinea, after Oil Search announced in March 2021 that PNG LNG T3 was no longer part of its future development plans, Kumul Petroleum announced in 2023 that it would build a separate 1 MTPA third train at the facility to utilise its own fields, but plans are still in the preliminary stages. In addition, TotalEnergies has been progressing the Papua LNG project (4.0 MTPA), which is expected to be approved in 2024 and to start production in 2027.

In Southeast Asia, Indonesia has proposed 11.83 MTPA of liquefaction capacity, mainly from Abadi LNG (9.5 MTPA), which will be supplied by the Abadi gas and condensate field in the Masela PSC. A revised plan of development (PoD) with a CCS component was approved in December 2023.

Decommissioned and idle

There were no announcements of LNG plants that had been decommissioned or were scheduled to be decommissioned in 2023. Bontang LNG, Indonesia's first LNG project, possesses 8 trains. Since 2006, the plant's production has gradually decreased due to the depletion of feedstock supply. Two trains are already decommissioned and the remaining 4 trains are on standby although only two have been operational. The Marsa El Brega LNG plant in Libya halted production in 2011, and there are currently no plans to bring it back online. Yemen LNG has been offline since April 2015 under force majeure due to the civil war in Yemen.

There is currently 39.8 MTPA[2] of capacity at operational LNG liquefaction trains that are more than 35 years old, mainly including trains at Brunei LNG, ADGAS LNG in the UAE, Arzew LNG in Algeria, and MLNG in Malaysia. No major upgrading plans were announced for these plants in 2023.

5.4 LIQUEFACTION TECHNOLOGIES

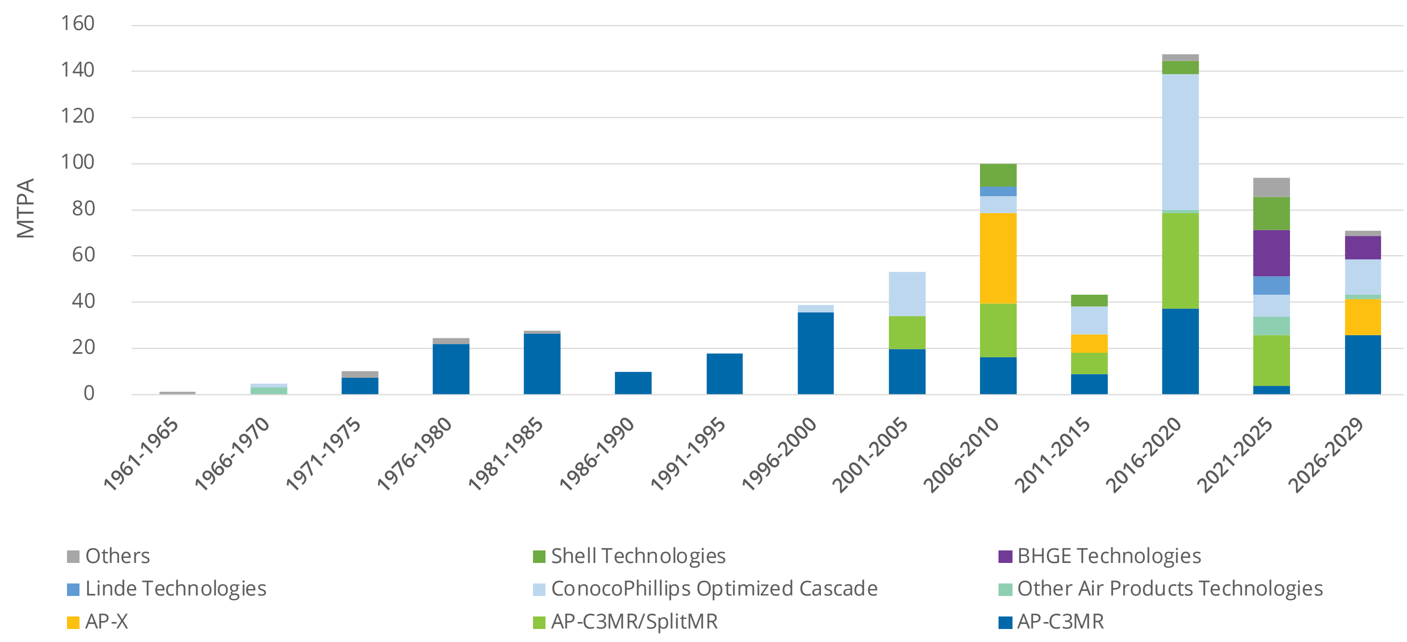
> Air products technologies account for
> **67% of Global operational capacity**

Among the liquefaction trains that became operational in 2023, Tangguh LNG T3 in Bintuni Bay adopted Air Products' Technology AP-C3MR/SplitMR technology. Currently, Air Products' liquefaction technologies dominate the market in liquefaction methodology, representing about 67% of total operational capacity in 2023. By contrast, AP-C3MR and AP-C3MR/SplitMR together hold about 57% share. BHGE Technologies is estimated to grow its use to 51 MTPA once Plaquemines LNG, CP2 LNG and Delta LNG's expansion have been deployed. Linde Technologies is estimated to grow its use to 28 MTPA once Arctic LNG 2 and Woodfibre LNG's expansion have been deployed. ConocoPhillips Optimized Cascade technology is estimated to grow its use to 132 MTPA once Corpus Christi Stage 3, Pluto LNG and Corpus Christi Midscale's expansion have been deployed. Once QatarEnergy LNG projects are deployed, AP-X technology is expected to increase to 94 MTPA. When Golden Pass LNG, Peru LNG and Cameron LNG projects are completed, AP-C3MR/SplitMR technology is expected to increase to 129 MTPA. If NLNG, Rio Grande LNG, Texas LNG, Mozambique LNG (Area 1), Freeport LNG and Monkey Island LNG projects are put into use, AP-C3MR technology will increase to 129 MTPA.

The development of liquefaction technologies can be traced back to the early 1960s. In the earliest LNG export facilities, Arzew GL4Z T1-T3 adopted the Classic Cascade process of ConocoPhillips, while Kenai LNG adopted the early version of ConocoPhillips' Optimized Cascade process. Air Products entered the liquefied technology market in 1970s with its Single Mixed Refrigerant technology (AP-SMR), which was implemented at Marsa El Brega LNG. At that time, the nameplate capacity of liquefied trains was limited to 1.5 MTPA per train. The early facilities were used as testing grounds for liquefaction technologies, which was continuously improved in cooling methane to about -162 degrees Celsius.

[2] This does not include Kenai LNG as plans to convert it to an import facility were approved in December 2020.

Figure 5.8: Installed and approved liquefaction capacity by technology and start-up year, 1961-2029



Source: Rystad Energy

Since the first launch of AP-C3MR in Brunei LNG in 1972, it has occupied a dominant position in liquefaction technology, accounting for nearly 57% of the global operating capacity (including the SplitMR variation) by 2023. The growth of AP-C3MR technology share was mainly driven by QatarGas (now QatarEnergy). Since the launch of QatarGas 1 T1 in 1996, about 30 MTPA sets have been obtained. Damietta LNG was the first LNG plant to adopt C3MR/SplitMR technology, which further improves the AP-C3MR technology by optimising the mechanical configuration and achieves higher turbine utilisation.

The AP-X technology of Air Products was first used in QatarGas 2 project in 2009, supporting the liquefaction capacity of 7.8 MTPA per train, which is the highest liquefaction capacity per train in the history of LNG development. AP-X technology will also be used in the North Field East (NFE) project in Qatar, approved three years ago and which consists of four giant trains, each with a liquefaction capacity of 8.0 MTPA. The high liquefaction capacity is mainly realised by the additional nitrogen refrigeration loop to C3MR technology, which is used for sub-cooling function and effectively provides additional refrigeration power. This technology has also been used in existing and under-construction floating liquefaction.

AP-N, a small-scale derivative of AP-X supercooling technology, is installed on Petronas' PFLNG Satu and PFLNG Dua in Malaysia, while Coral South FLNG in Mozambique has installed an AP DMR process. AP-N is the only EXP (expander-based) technology used in offshore development. Compared with the MR process, the EXP process has the advantages of simplicity and less equipment. Golar Gimi FLNG is a modified moss-type LNG carrier, which will adopt Black & Veatch PRICO technology.

Facing more competition in the 2000s, the market share of Air Products' liquefaction technology has dropped from over 90% in the 1980s and 1990s to 67.3% in 2023, which is mainly due to the increased use of ConocoPhillips' Optimized Cascade technology, such as at Corpus Christi, Sabine Pass and Atlantic LNG. The widespread uptake of ConocoPhillips' Optimized Cascade Process means it is now used in 113.9 MTPA of operational capacity, making it the second leading liquefaction technology on the market. The optimised cascade process of ConocoPhillips was first used in Kenai LNG in the late 1960s and reappeared in the market with the commissioning of Atlantic LNG T1 in 1999. From 2024 and 2029, it is expected that new liquefaction projects will increasingly enter the liquefaction technology market, mainly driven by the increasing demand for small to medium-sized LNG trains.

With the increasing interest in exploring a small amount of stranded natural gas, and the increasingly fierce competition among financing and offtakers of LNG projects, small and medium-sized LNG trains may become a low-risk alternative product. These trains are smaller in size, simpler in configuration and easy to standardise and modularise, thus saving cost and execution time. In 2023, Tangguh LNG T3, using AP-C3MR/SplitMR technology, has started operation with a capacity of 3.8 MTPA. Although the liquefaction technology market of large-scale LNG is dominated by a few companies, some new technologies have recently entered the market. One such technology is Novatek's Arctic Cascade process, which will be used in the Ob LNG T1 and T2 project, each train having capacity of 2.5 MTPA.

Operator-driven liquefaction technology is attracting more and more attention. The dual mixed refrigerant (DMR) process provided by Shell and APCI has been successfully applied to Sakhalin 2 LNG and Prelude FLNG processes. Shell DMR technology will be used at CLNG Canada. The configuration process of this technology is similar to AP-C3MR method, but DMR uses mixed refrigerant mainly composed of ethane and propane for precooling instead of pure propane in the exchanger. In a colder environment, the advantages of using the DMR process are more obvious, because precooling MR can avoid the pressure limitation of propane at low temperature. The Arctic Cascade process designed by Novatek for the Arctic climate is being used by Yamal LNG T4 (0.9 MTPA). The Arctic Cascade technology will be used at Ob LNG (scheduled for start-up in 2028, 5 MTPA).

For safety reasons (minimising highly flammable refrigerants) and space constraints due to its small deck footprint, small FLNGs mostly use relatively simple liquefaction technology. The first FLNG in operation, PFLNG Satu, used AP-N technology of Air Products in a simple nitrogen cooling cycle. Black & Veatch's PRICO process has been successfully applied to Cameroon FLNG. Compared with larger trains, the smaller modules of about 0.6 MTPA can achieve better configuration and make better use of limited deck space. More and more complex technologies appear on FLNGs with larger capacity. For example, Coral South FLNG (3.4 MTPA) adopts AP-DMR technology, Prelude FLNG (3.6 MTPA) adopts Shell DMR technology.

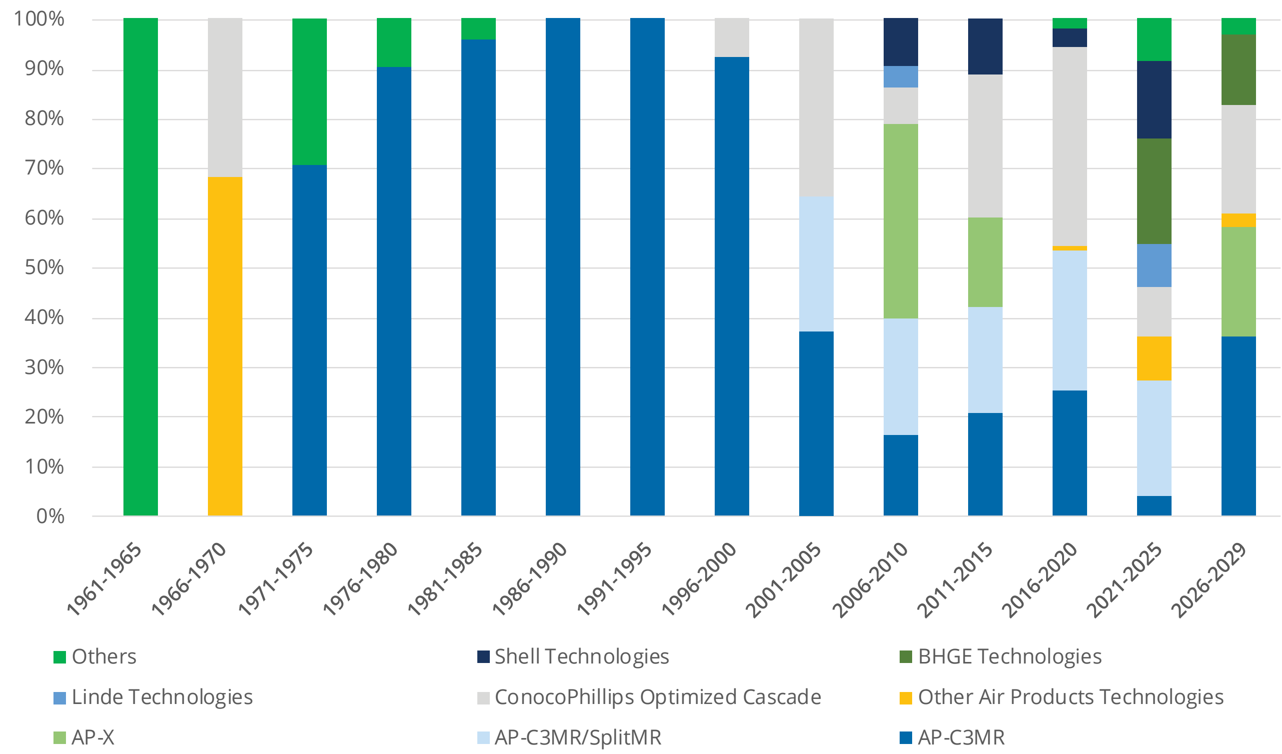
Emission-reduction measures

In the process of natural gas liquefaction, many measures have been taken to reduce carbon emissions. Carbon emissions of LNG facilities mainly come from three aspects: first, CO_2 emitted during the upstream pretreatment of acid gas; second, CO_2 released by gas turbines that provide power for the liquefaction process; and third, CO_2 released when generating electricity for the rest of the facilities.

Another way to reduce carbon emissions is to capture and sequester the CO_2 during the liquefaction process. Some LNG liquefaction plants are already exploring innovative solutions. For example, Hammerfest LNG in Norway introduced the all-electric concept, which has also been applied in Freeport LNG, using an electric motor to drive the liquefied compressor. The facility is also connected to the local power grid, which uses renewable energy as part of the power mix. This can significantly reduce emissions, depending on the power combination that fuels the motor. Other solutions include installing an acid gas removal unit (AGRU), which absorbs CO_2 and several sulfur-containing gases from the feed and finally releases CO_2 into the atmosphere.

CCS is another widely discussed solution in LNG industry. CCS deployment is mainly aimed at two areas: capturing CO_2 from reservoirs (as demonstrated by Hammerfest LNG project) and capturing CO_2 after combustion. The cost of capturing the CO_2 after combustion is higher, although it may be cost-effective for newly built liquefaction facility due to the synergy of design and location. Venture Global is currently developing CCS at its LNG facilities (Plaquemines LNG and Calcasieu Pass LNG), with the goal of capturing and storing about 500,000 tonnes of carbon each year. With the increase and expansion of global investment in liquefaction assets, it becomes more important to optimise the selection of liquefaction process. As governments and enterprises are committed to decarbonisation, choosing a more general and cost-effective liquefaction technology that meets strict emission standards will be a key concern of new projects.

Figure 5.9: Share of installed and future approved liquefaction capacity by technology and start-up year, 1961-2029



Source: Rystad Energy

Offshore supply ship at Ras Laffan Port - Courtesy QatarEnergy

5.5
FLOATING LIQUEFACTION (LNG-FPSOS)

12.7 MTPA
Operational Floating Liquefaction Capacity Worldwide as of end-February 2024

There are currently six operational FLNG units globally as of the end of February 2024. Tango FLNG in Congo is the latest FLNG to begin operations, starting up in February 2024 with a capacity of 0.6 MTPA. Petronas FLNG Satu is the world's first FLNG, built by South Korea's Daewoo Shipbuilding & Marine Engineering (now called Hanwha Ocean), with a design capacity of 1.2 MTPA. The terminal is located at the Kebabangan gas field off Sabah, East Malaysia. Petronas FLNG Dua is the second FLNG undertaken by South Korea's Samsung Heavy Industries for Petronas, with a design capacity of 1.5 MTPA. After moving from the Kanovit gas field offshore Sarawak, East Malaysia in 2019, PFLNG Satu is currently moored at the Kebabangan gas field off Sabah.

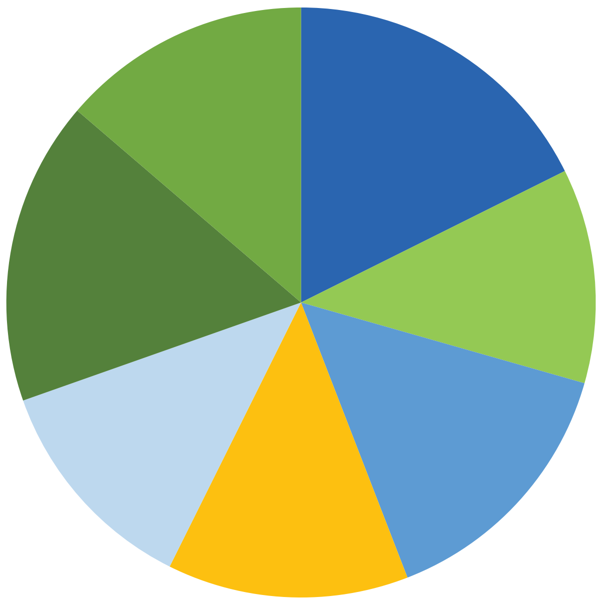
Prelude FLNG was built by Samsung Heavy Industries with a design capacity of 3.6 MTPA. The performance of the facility in 2022 was far below production capacity, initially due to the four-month maintenance period from December 2021 to early April 2022 after a fire. In May 2023, the Shell-operated facility temporarily stopped production due to technical issues with its processes.

The GTA LNG project, also known as the Golar Gimi FLNG project, was originally awarded FID in 2018 and it is expected to supply up to 10 MTPA of LNG through subsequent project stages. The cargo hold of the unit, with capacity of 126,000 cm, was built in 1976, with an annual production capacity of 2.5 million tonnes after being transformed into an FLNG unit. It will be deployed at the Greater Tortue Ahmeyim LNG project, with a design and operational life of 20 years, during which no drydocking will be needed, and it is stipulated in the contract to operate in a water depth of 30 metres. GTA FLNG was originally planned to be completed in 2022, but due to the Covid-19 pandemic, BP informed Golar LNG in October 2020 to postpone delivery of the FLNG for 11 months. By August 2023, 97% of the FLNG modification project was completed, and it was delivered after a final inspection and sea trial in Singapore. In November 2023, Golar LNG announced that the unit had left Seatrium's shipyard in Singapore and was then self-propelled with the support of an escort tugboat, heading for the cross-border natural gas project off Senegal and Mauritania.

Tango FLNG was built in 2017 with a nameplate capacity of 0.6 MTPA. Following the onset of the pandemic in early 2020, the unit remained idle until August 2022, when operator Eni announced it had reached an agreement with vessel owner Exmar to acquire Export LNG Ltd, which owns Tango FLNG Company. Eni has signed a contract with China's Wison Heavy Industries to build the second FLNG deployed in Congo, together with FLNG Tango. On 28 December 2023, Tango FLNG received its first batch of natural gas.

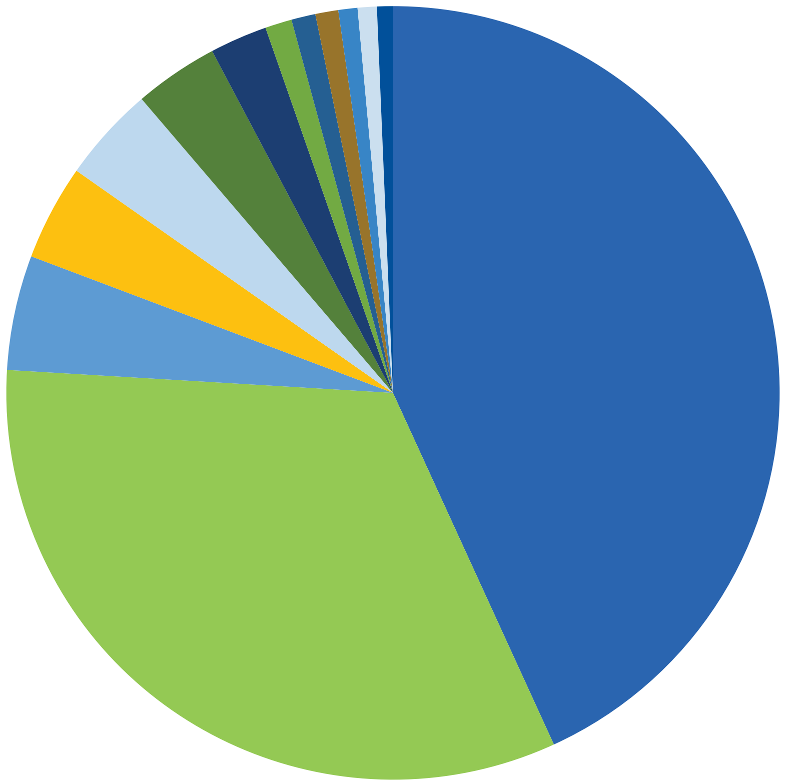
In Mozambique, the first batch of LNG cargo departed from Coral South FLNG in November 2022. The Coral South FLNG project is connected with the main coral reservoir located in the offshore Rovuma Basin, and it is the first floating LNG facility put into operation in an offshore deepwater area of the African continent.

Figure 5.10: Global operational and approved FLNG liquefaction capacity, end-February 2024



Source: Rystad Energy

Figure 5.11: Global proposed FLNG liquefaction capacity, end-February 2024



Source: Rystad Energy

There is currently 125.1 MTPA of aspirational liquefaction capacity proposed as FLNG developments as of the end of February 2024, of which 96.4 MTPA is in North America.

In the US, the Delfin FLNG project will consist of four floating liquefaction vessels, with the first vessel expected to be approved in 2024. The project was the first US FLNG project to receive regulatory approval but requested several extensions to its construction completion deadline. In July 2022, FERC in the US granted Delfin another year-long extension to put its project into service by September 2023. Delfin FLNG has signed multiple offtake agreements, which would be sufficient to meet the contractual threshold to reach FID on the first vessel . The remaining FLNG projects in the US – such as Point Comfort FLNG, Main Pass Energy Hub FLNG and Cambridge Energy FLNG – have been progressing at a slow pace for years.

In Africa, the proposed capacity currently for FLNG projects in the region is 13.6 MTPA. This includes Coral North FLNG (5 MTPA) in Mozambique, Djibouti FLNG (3 MTPA), Fortuna FLNG T1-T2 (4.4 MTPA) in Equatorial Guinea, and UTM Offshore FLNG (1.2 MTPA) in Nigeria.

There have been significant developments in floating liquefaction technology in recent years, primarily in the design of FLNG units. Rapid innovation has meant the cost of expensive, first-generation, highly bespoke FLNG units built by Shell, Petronas and Eni has been greatly reduced in second-generation FLNGs, commonly referred to as standardised FLNG units. Keppel Shipyard and Black & Veatch (B&V) first introduced the concept by converting the Moss-design LNG carrier Hilli into an FLNG retrofitted with B&V's PRICO liquefaction technology. Over the years, SBM Offshore has also patented its FLNG conversion solution, the TwinHull FLNG concept, which maximises efficiency and cost savings to optimise offshore gas fields. This design comprises two LNG tankers converted into a single integrated hull, allowing for greater storage capacity and optimisation of deck space. While these newer vessels are typically not as 'customised' with regards to the targeted field, they have greater flexibility in deployment and reduced lead times combined with significant cost savings. As well as their suitability for smaller, remote offshore gas fields, FLNG units can offer advantages over onshore projects, which can face land constraints and environmental challenges. They can even serve as a stopgap solution for larger fields until onshore liquefaction trains come online.

5.6 RISKS TO PROJECT DEVELOPMENT

Market balances

Global LNG supply and demand balances are some of the key indicators for assessing the need for new investments in LNG projects. Comparing the supply of LNG through the pipeline of upcoming and proposed liquefaction projects versus demand outlooks is key to determining the market balances. New liquefaction projects typically have a lead time of around 3-6 years between FID and commercial operation, which makes it relatively easy to see what is coming on the supply side. However, forecasting demand is far more challenging due large fluctuations in demand and LNG's common role as a marginal energy source in main importing markets. While there can be shocks to both LNG supply and demand, the market has experienced unexpected supply reduction in the past three years and a spike in LNG demand. This includes demand plunging during the start of the global Covid-19 pandemic in 2020, followed up by two years of spiking demand during the energy crunch in 2021, and the crisis caused by the Russia-Ukraine war in early 2022. Following these events, major demand hubs in Europe and Asia prepared in advance by piling up storage ahead of winter in 2023 only to face lackluster demand due to mild temperatures in the peak season.

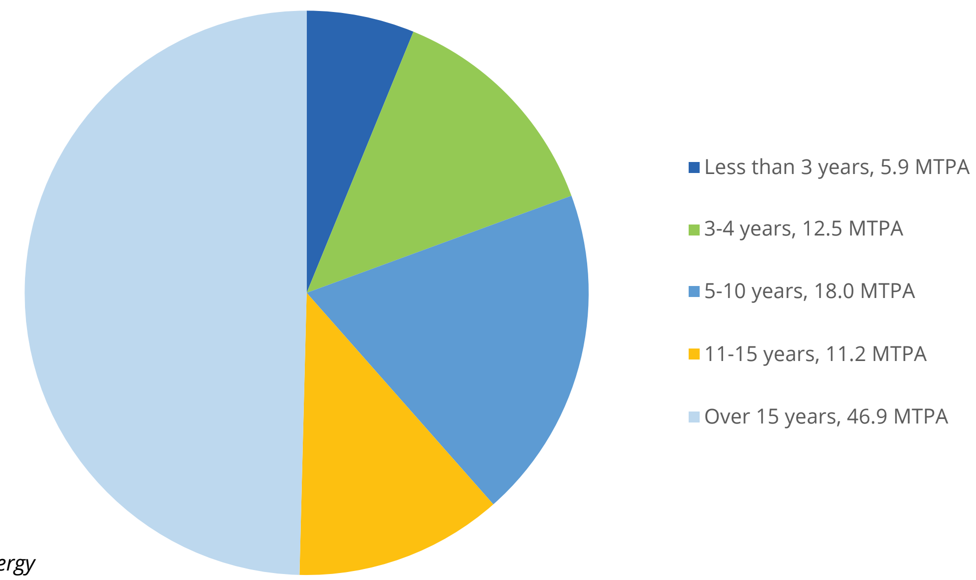
Supply and demand risks

More than two years have passed since the war broke out in Ukraine, with Europe continuing to depend significantly on LNG imports to replace reduced Russian pipeline gas flow. Ukraine may not extend the Russian gas transit deal at the end of 2024, which could put Europe at increased supply risk, although the region is likely going to hit its underground storage target ahead of schedule, as with 2023. The need for new LNG supplies persists as the war has also triggered a risk for future Russian LNG developments, as well as existing supplies, as Western companies providing equipment, technology and services have pulled out of Russian projects due to sanctions. However, due to mild winter and muted demand, global gas prices gradually fell. Europe has strategically kept underground storage levels higher ahead of winter, limiting the need to seek additional volumes for winter. Lower LNG prices globally have also incentivised price-sensitive buyers in Asia, such as Chinese and Indian companies, while other Asian importing markets such as Japan and South Korea kept facing high inventory levels. A sustained low-price environment could be bullish for LNG demand, although there is upside risk if new supply and expansion projects are delayed.

Contracting trend

Monitoring LNG contracting activity is key to assessing upcoming LNG project approvals. Project financing is highly dependent on firm offtake deals for future supplies due to the multi-billion-dollar investments needed for progress projects. The energy crisis has put security of supply back on the agenda, driving increased appetite for long-term LNG contracts in contrast to relying on spot market supply. Over 62 MTPA of LNG contracts were concluded in 2023, lower than the volumes concluded in 2021 and 2022, but higher than the average in the last five years. As of the end of February 2024, around 50% of contracts concluded had a duration over 15 years, with 18% over 20 years in length, signaling a long-term commitment to LNG from buyers.

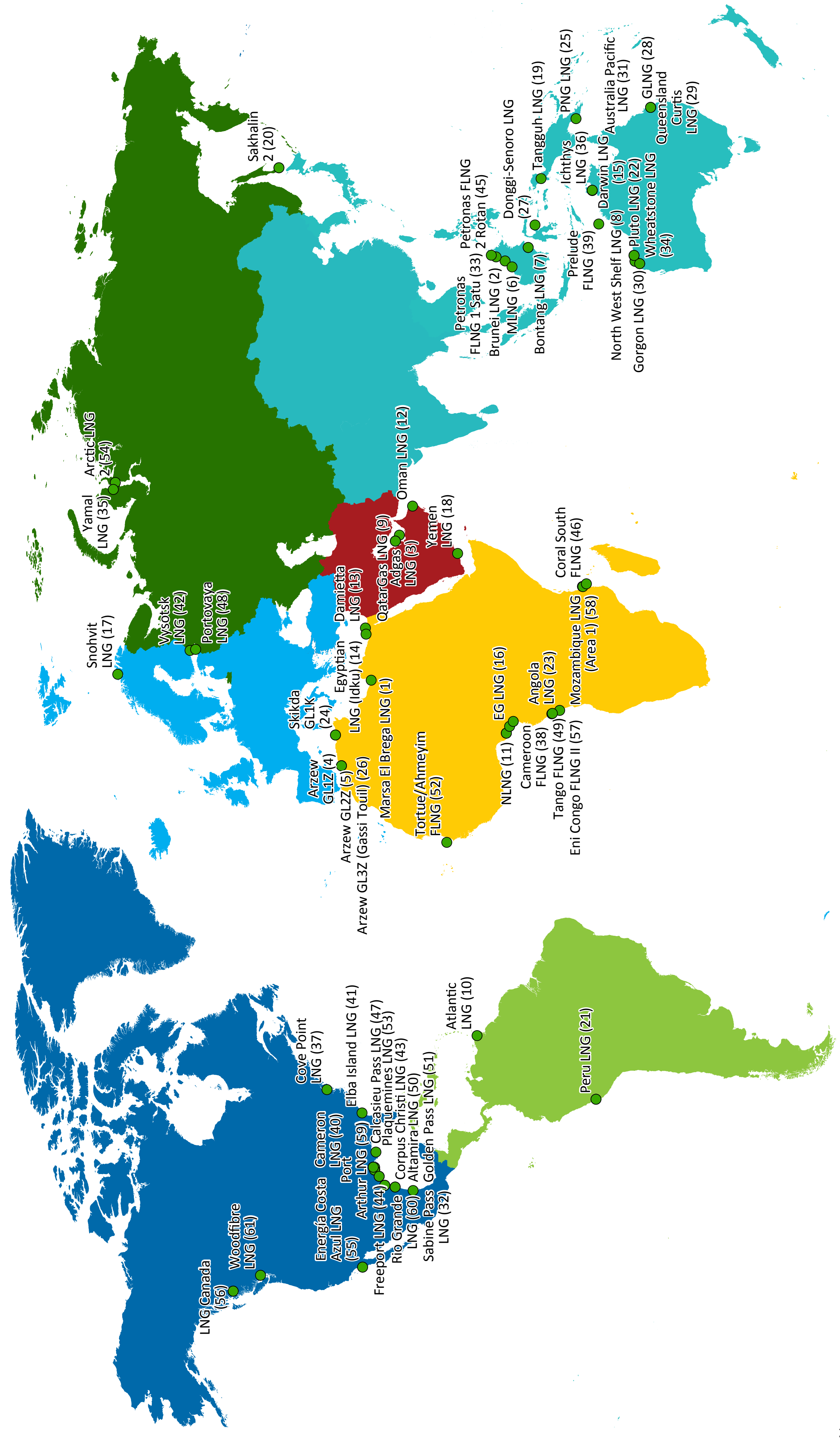
Figure 5.12: Global SPA duration signed between 1 January 2023 and 29 February 2024



Source: Rystad Energy

This will support project financing and development. Of the deals signed in 2023, Asian markets driven by China, some western European markets and LNG aggregators dominate as offtakers, with US exporters dominating as sellers, closely followed by Qatar. Aggregators play an important role as they support LNG project development by building up global LNG portfolios, which in turn generate future LNG demand through increased availability of supplies. This is particularly important when building new markets for LNG imports, which may not yet be ready to commit to gas and LNG through long-term contracts. Several proposed LNG projects are close to signing over 80% of their capacity through long-term deals, a significant step towards FID.

Figure 5.13: Global Operational Liquefaction Plants and FID Liquefaction Plants Expected to Commission by 2028, end-February 2024



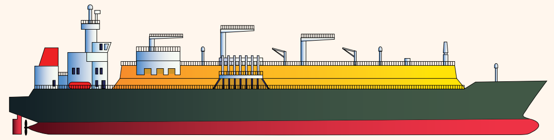
Note:
1. Numbers in parentheses behind project names refer to Appendix 1: Table of Global Liquefaction Plants and Appendix 2: Table of Global Liquefaction Plants Approved or Under Construction
Source: Rystad Energy

6 LNG Shipping

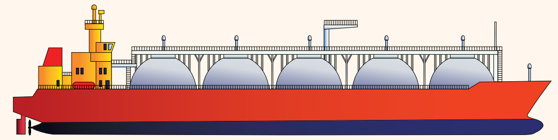
The global LNG fleet grew by **5% year-on-year** in 2023.

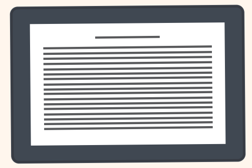
7,004
trade voyages, an increase of
1.7% year-on-year

701 active vessels / **43** new vessels[1]

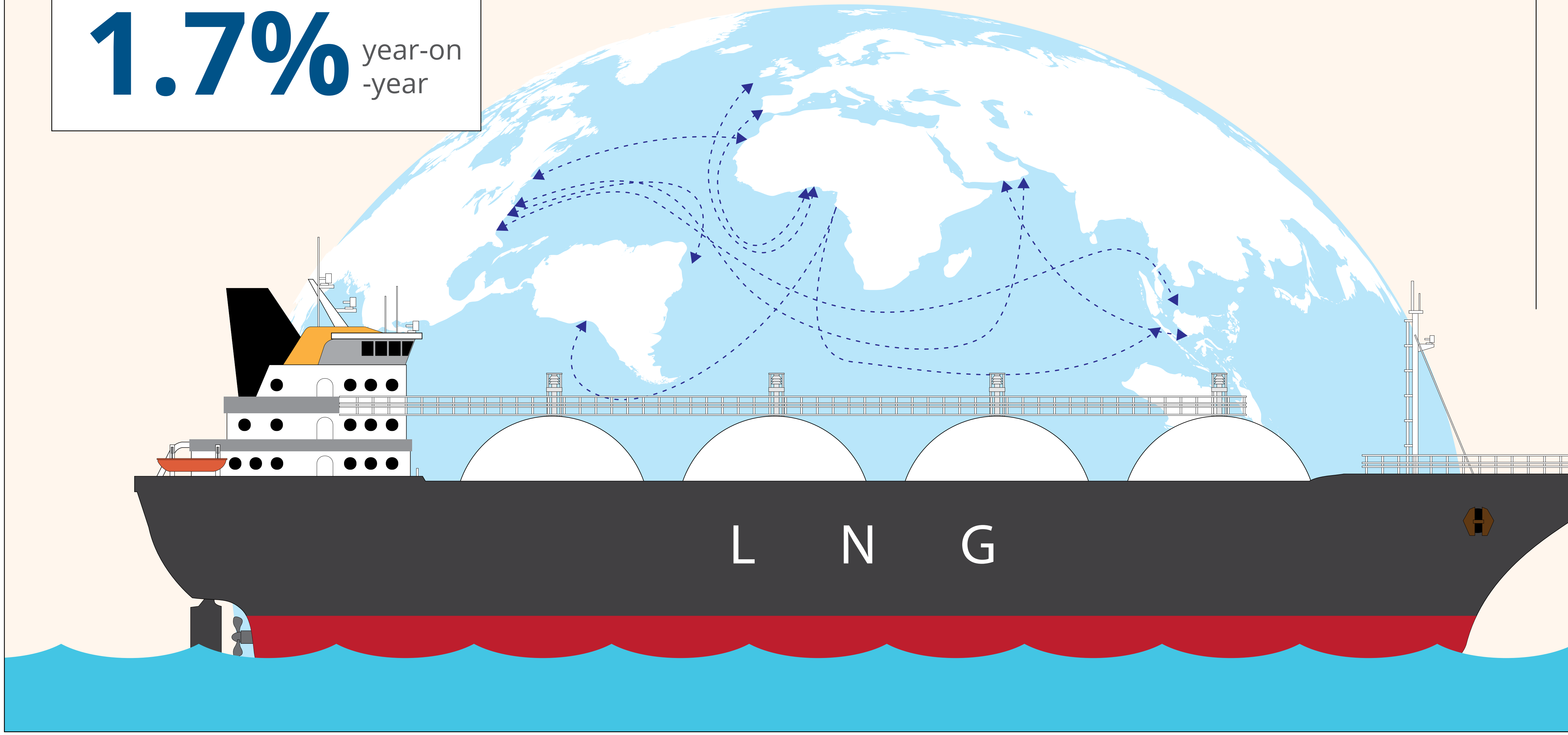


Including
47 FSRUs / **10** FSUs





Global LNG vessel orderbook[2]:
359 vessels



[1] During 2023 and the first two months of 2024
[2] Under construction vessels

6. LNG Shipping

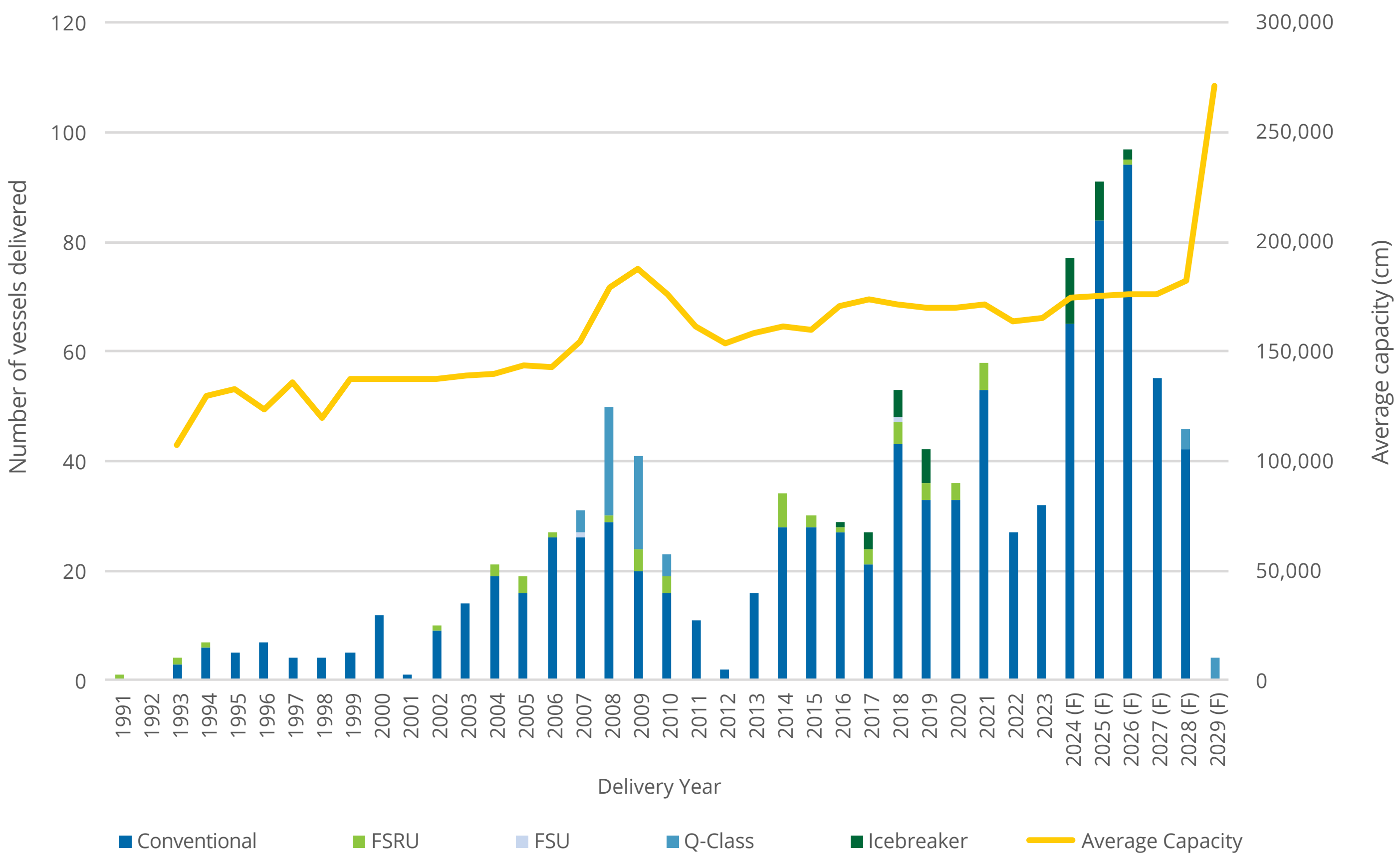
With the delivery of 32 vessels in 2023 and 11 vessels across January – February 2024, the global LNG carrier fleet consisted of 701 active vessels[3] as of end-February 2024, including 47 operational FSRUs and 10 FSUs. This also represents a 5.0% growth in the fleet size from 2022 to 2023, comparable to a 1.7% growth in the number of LNG voyages, representing a healthy supply of LNG carriers relative to the growth in LNG trade.

Courtesy QatarEnergy

[3] This section of the report only considers vessels with capacity of 30,000 cubic meters or more.

6.1 OVERVIEW

Figure 6.1: Global active LNG fleet and orderbook by delivery year and average capacity, 1991-2029



Source: Rystad Energy

359 LNG Vessels

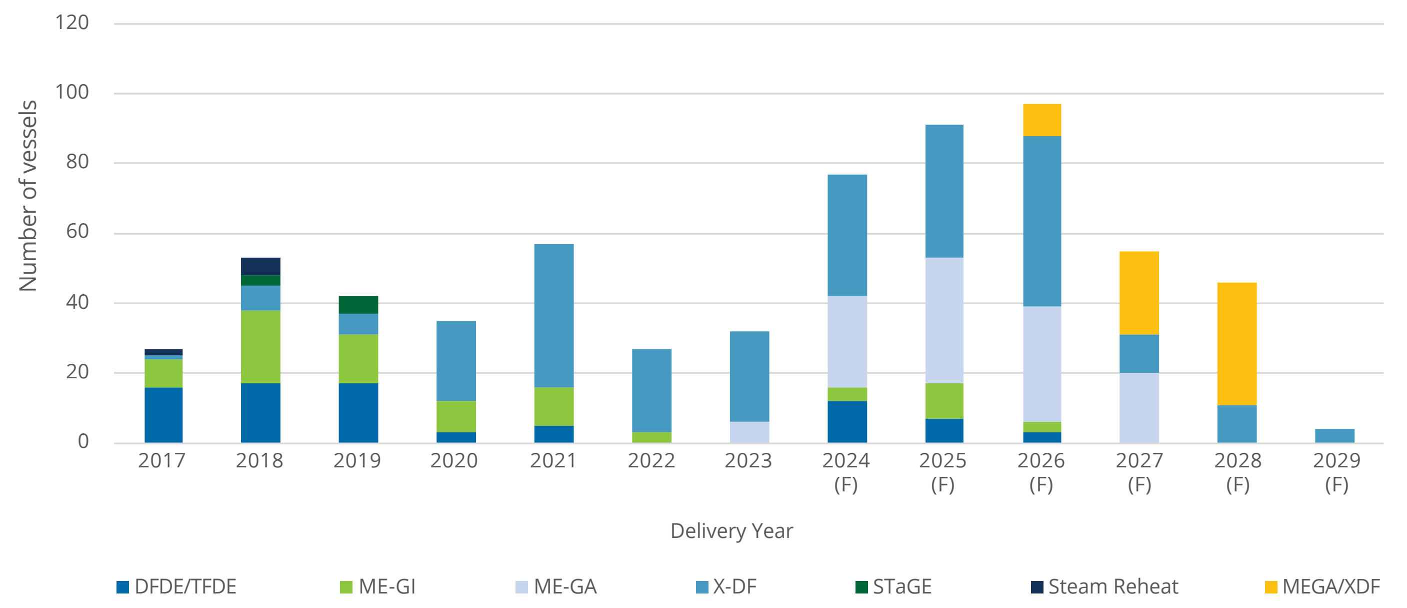
Under construction as of end-February 2024

Of the 32 newbuilds delivered in 2023, all except three have a capacity of between 170,000 and 200,000 cm. Vessels of this size remain within the upper limit of the Panama Canal's capacity following its expansion in 2016, while still benefiting from economies of scale, particularly as additional LNG capacity is developed in the US Gulf Coast (USGC) for long-haul delivery to Asia. QatarEnergy is once again at the forefront of the rising vessel capacities, ordering eight 271,000 cm vessels at Hudong-Zhonghua for delivery across 2028-29, slightly larger than the 45 Qatari Q-Class newbuilds of over 200,000 cm that were delivered during the 2007-2010 period. However, moving forward, 200,000 cm vessels or larger could find favour due to their economies of scale for long-haul voyages. The current orderbook comprises 22 vessels, each with capacity of either 200,000 cm or 271,000 cm for delivery during the period 2024-2029.

The global LNG fleet is relatively young due to the rapid increase in LNG trade over the past two decades. Vessels under 20 years of age make up 85.3% of the active fleet. Newer vessels are larger, more efficient, and have superior project economics over their operational lifetime. Only 21 active vessels are 30 years or older, including 8 that were converted into FSRUs or FSUs.

The global LNG orderbook had a staggering 359 newbuild vessels under construction at end of February-2024, equivalent to over 51% of the current active fleet. This illustrates shipowners' expectations that LNG trade will continue to grow in line with scheduled increases in liquefaction capacity, particularly from the US. An expected 77 carriers will be delivered in 2024, including the 11 already delivered. The orderbook includes 21 Icebreaker-class vessels for the Arctic LNG 2 project. These are highly innovative and CAPEX-intensive ships with the capabilities required to traverse the Arctic region. Due to the Russia-Ukraine conflict, these vessels have faced a risk of delayed deliveries or cancellations due to international sanctions on Russia that have complicated equipment delivery and payments. In November 2022, Hanwha Ocean (formerly DSME) cancelled three icebreaker orders for Russian owner Sovcomflot. However, it is understood that Hanwha Ocean has continued construction on these carriers. In November 2023, the US Office of Foreign Assets Control (OFAC) sanctioned Arctic LNG 2 directly, followed by sanctions on the first three Arc-7 carriers to be delivered to the project in February 2024.

Figure 6.2: Historical and future vessel deliveries by propulsion type, 2017-2029



Source: Rystad Energy

In 2020, more low-pressure slow-speed dual-fuel Winterthur Gas & Diesel engine (X-DF) systems were delivered than any other type, while 2023 was the first year in which a vessel with the Man B&W (M-type electronically controlled Gas Admission) ME-GA engine be delivered. Capitalizing on improved fuel efficiencies and lower emissions, X-DF systems will still be one of the main choices, with at least 141 systems on order as of end-February 2024. The efficient new generation M-type, electronically controlled gas admission (ME-GA) system is set to become one propulsion of choice in competition with the X-DF technology for newbuilds, with at least 112 orders to be delivered through 2027. There are still 68 vessels for which the propulsion type is yet to be confirmed but is likely to be either MEGA or X-DF. There are 16 competing M-type, electronically controlled (ME-GI) high pressure injection system vessels under construction. The ME-GI, ME-GA, and X-DF systems represent a major shift in favour of efficiency, economies of scale, and environmental performance from the popular propulsion systems of the previous generation – steam turbine, dual-fuel diesel-electric (DFDE) and tri-fuel diesel electric (TFDE).

South Korean shipbuilders HHI Shipbuilding Group, Samsung Heavy Industries and Hanwha Ocean remain the top three LNG carrier builders in the market, although Hudong Zhonghua has gained prominence in recent years. Chinese yards Jiangnan, Dalian Shipbuilding, Yangzijiang, and China Merchants Heavy Industries have also forayed into the lucrative market for conventional LNG carrier construction, with their business case bolstered by exorbitant newbuild prices and capacity constraints at South Korean yards. The latter four have a combined orderbook of 29 vessels to be delivered before end-2028.

Spot charter rates are affected by balances between shipping demand and supply, in turn driven by liquefaction capacity and LNG vessel deliveries. Charter costs in 2023 returned to pre-Russia-Ukraine conflict levels at approximately $54,000/day for steam turbine vessels, $90,000/day for TFDE vessels, and $121,000/day for two-stroke X-DF/ME-GI/MEGA vessels.

In total, 7004 LNG trade voyages were undertaken in 2023, a 1.7% increase from the 6,888 seen in 2022. This is in line with limited growth in global LNG production. While Asia remains the dominant demand centre with 4376 trade voyages, European trade voyages declined slightly by 3.6% to 2059 in 2023 because Europe imported slightly lower volumes of LNG on account of a mild winter 2022.

EXEMPLAR FSRU - Courtesy Excelerate Energy

6.2 LNG CARRIERS

Vessel Age and Capacity

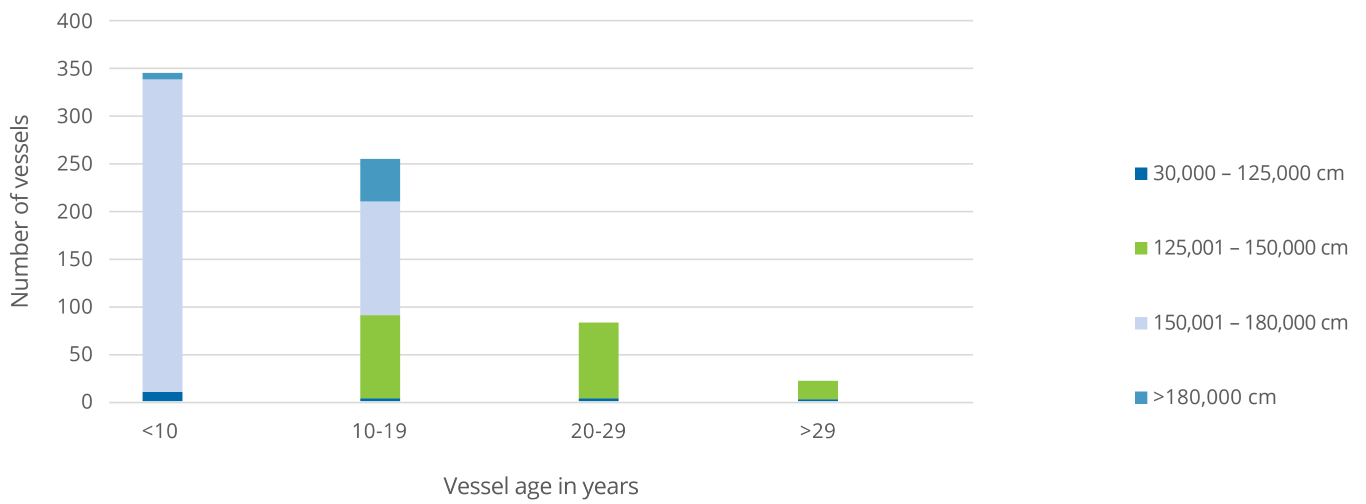
The current global LNG fleet is relatively young, considering the oldest LNG carrier operating was constructed in 1977. Some 85.3% of the fleet is under 20 years of age, consistent with the rapid growth of liquefaction capacity since the turn of the century. In addition, newer vessels are larger and more efficient, with superior project economics over their operational lifetime.

With financial and safety concerns in mind, shipowners used to operate a vessel for 35-40 years before it is laid-up, although challenges from upcoming emissions reduction regulations (notably, the IMO's EEXI and CII) could reduce this or incentivise retrofits or conversions. Due to the rapid development of technology and emissions regulations, the life duration may become shorter.

At the end of its operating life, a decision can be made on whether to scrap a carrier, convert it to an FSU/FSRU, or return it to operation should market conditions improve materially.

When commissioning a newbuild, a shipowner determines vessel capacity based on individual needs, ongoing market trends, technologies available at the time, and increasingly, with a view to future environmental regulations and demand for LNG. Flexibility of the LNG carrier designs to implement new technologies or solutions is also key since the shipowners demand future proof ideas easy to be retrofitted when required. Liquefaction and regasification plants also have berthing capacity limits, while certain trade-lanes may limit vessel dimensions, all of which are important considerations regarding ship dimensions and compatibility. The needs of individual shipowners are also largely affected by market demand, which means newbuild vessel capacities have stayed primarily within a small range around period averages, as illustrated in Figure 6.3.

Figure 6.3: Fleet capacity by vessel age, end-February 2024



Source: Rystad Energy

Due to the early dominance of steam turbine propulsion, vessels delivered before the mid-2000s were exclusively smaller than 150,000 cm as this was the range best suited for steam turbine propulsion systems, many of them equipped with Moss-type cargo tanks. The LNG carrier landscape changed dramatically when Qatari shipping line Nakilat introduced the Q-Flex (210,000 to 217,000 cm) and Q-Max (263,000 to 266,000 cm) vessels, specifically targeting large shipments of LNG to Asia and Europe. These vessels achieved greater economies of scale with their SSDR propulsion systems, representing the 45 largest LNG carriers ever built, but will be surpassed by QatarEnergy's next-generation 271,000 cm orders for its North Field Expansion projects.

Most newbuilds have settled at a size between 150,000 and 180,000 cm. This capacity range now makes up 63.6% of the current fleet. The technological developments that steered adoption of this size are two-stroke propulsion systems, such as the ME-GI, X-DF, and more recently ME-GA types, that maximise fuel efficiency between 170,000 and 180,000 cm. Another crucial factor is the new Panama Canal size limit – only vessels smaller than this size were initially authorised to pass through the new locks, imperative for any ship engaged in trade involving US LNG supply. The Q-Flex LNG carrier Al Safliya, which is larger than 200,000 cm, became the first Q-Flex type LNG vessel and the largest LNG carrier by cargo capacity to transit the Panama Canal in May 2019.

While 174,000 cm remains the most common newbuild size, larger ships have once again gathered interest from shipowners. There are fourteen 200,000 cm vessels currently on order. With further improved two-stroke propulsion solutions, the second-generation X-DF and ME-GA systems, 200,000 cm carriers might become a popular choice from an efficiency standpoint, although other aspects such as flexibility and terminal compatibility must also be considered. As of February 2024, there are also eight 271,000 cm carriers on order at Hudong-Zhonghua, meant to service QatarEnergy's North Field Expansion projects.

Containment Systems

LNG containment systems store LNG at a cryogenic temperature of approximately -162°C (-260°F), a key design element. LNG containment systems can be mainly split into two categories: membrane systems and self-supporting systems. Membrane systems are mostly designed by Gaztransport & Technigaz (GTT), while self-supporting systems mainly comprise spherical 'Moss' type vessels and IHI Corporation's Type B vessels. Due to the advantages highlighted below, modern newbuilds have almost entirely adopted the membrane type.

Table 6.1: Overview of containment systems

	Membrane	Self-supporting
Current fleet count	577	124
Current fleet proportion (%)	82.3%	17.7%
Systems	GTT-designed: Mark III, Mark III Flex, Mark III Flex+, NO96 series, NO96 Super+, CS1, NEXT1 (under development) KC LNG TECH Designed: KC-1, KC-2	Moss Maritime-designed: Moss Rosenberg IHI-designed: SPB LNT Marine-designed: LNT A-BOX
Advantages	• Space-efficient • Thin and lighter containment system • Higher fuel-efficiency • Lower wheelhouse height	• More robust in harsh conditions • Partial loading possible • Faster construction
Disadvantages	• Partial loading restricted • Less robust in harsh conditions	• Spherical design uses space inefficiently • Slower cool-down rate • Thicker, heavier containment system

Source: Rystad Energy

In both systems, a small amount of LNG is naturally vaporised during a voyage. This boil-off gas is a direct result of heat transferred from the atmospheric environment, liquid motion or sloshing, the tank-cooling process, and the tank-depressurisation process. Boil-off rates in new membrane carriers at laden conditions are usually below 0.10% of tank capacity per day, with partial or full re-liquefaction systems reducing this even further. This contrasts with older self-supporting carriers, which average about 0.15% of tank capacity per day. Membrane and self-supporting systems can be further split into specific types, which are examined below.

The two dominant membrane type LNG containment systems are the Mark III designed by Technigaz and the NO96 by Gaztransport. The two companies subsequently merged to form Gaztransport & Technigaz (GTT). Membrane-type systems have primary and secondary thin membranes made of metallic or composite materials that shrink minimally upon cooling. The Mark III has two foam insulation layers, while the NO96 uses insulated plywood boxes purged with nitrogen gas and filled up originally with perlite, then glass wool and more recently foam insulation. GTT is developing the NEXT1 containment system, which includes two metallic membranes supported by a layer of insulating reinforced polyurethane foam.

GTT states a boil-off-rate of 0.07% for its Mark III Flex+ and is aiming for a similar rate for its NEXT1 system, while the new NO96 Super+ has a boil-off rate of 0.085%. Within a range of tank filling levels, the natural pitching and rolling movement of the ship at sea and the liquid free-surface effect can cause the liquid to move within the tank in membrane containment systems, which may place high-impact pressure on the tank surface. This effect is called 'sloshing' and can cause structural damage. The first precaution is to maintain the level of the tanks within the required limits given by the tank designer (GTT). This is typically lower than a level corresponding to 10% of the height of the tank or higher than a level corresponding to 70% of the height of the tank. The membrane-type system has become the popular choice due to space efficiency of the prismatic shape and its lower boil-off-rate, despite restrictions on part-filling due to the sloshing effect.

The new generation of 200,000 cm vessels have four-tank membrane vessels, contrasting with five-tank Q-flex ships. The new generation of 271,000 cm cargo capacity carriers will feature five tanks.

Celebrating 51 years in operation, the Moss Rosenberg system was first delivered in 1973. LNG carriers of this design typically feature four or five self-supporting aluminium spherical tanks, insulated by polyurethane foam flushed with nitrogen. The spherical shape allows for accurate stress and fatigue prediction of the tank, increasing durability and removing the need for a complete secondary barrier. A partial secondary barrier in the form of a tray covers the bottom of the tank to capture any LNG leakage. Unlike membrane tanks, independent self-supporting spherical tanks allow for partial loading during a voyage. However, due to its spherical shape, the Moss Rosenberg system uses space inefficiently compared to membrane storage and its design necessitates a heavier containment unit.

The Sayaendo-type vessel, produced by Mitsubishi, is a recent improvement on the traditional Moss Rosenberg system. The spherical tanks are elongated into an apple shape, increasing volumetric efficiency. They are then covered with a lightweight prismatic hull to reduce wind resistance. Sayaendo vessels are powered by ultra-steam turbine plants, a steam reheat engine, which is more efficient than a regular steam turbine engine.

The Sayaringo Steam Turbine and Gas Engine (STaGE) type vessel, also produced by Mitsubishi, was a further improvement on the Saeyendo type vessel. The STaGE vessel adopts the shape of the Sayaendo alongside a hybrid propulsion system, combining a steam turbine and gas engine to maximise efficiency. Eight STaGE newbuilds were delivered from 2018-19.

The IHI-designed Self-supporting Prismatic type B (SPB) system was first implemented in 1993 in two 89,900 cm LNG carriers, Polar Spirit and Arctic Spirit. Since then, it has been used in several LPG and small-scale LNG vessels before Tokyo Gas commissioned four 165,000 cm vessels with the design, primarily for transportation from Cove Point. The design involves four tanks subdivided internally, allowing for partial loading during the voyage. The tanks have one longitudinal and one transversal subdivision internally to reduce sloshing. The result mitigates the issue of sloshing and does not require a pressure differential, claiming a relatively low boil-off-rate of 0.08%. It is worth noting that the SPB system has higher space efficiency and is lighter than the Moss Rosenberg design.

Moss Rosenberg and IHI SPB tank types represent just under 20% of the fleet in service. Although membranes have become the tank of choice for LNG carriers, self-supporting technology is still available and fully approved in accordance with international regulations.

Lastly, the LNT A-BOX is a self-supporting design of type A aimed at providing a reasonably priced LNG containment system with a primary barrier made of stainless steel or 9% nickel steel, and a secondary barrier made of liquid-tight polyurethane panels installed in the ship bulkheads, deck and ceiling of the cargo holds. Similar in shape to the IHI-SPB design, the system mitigates sloshing by way of an independent tank, with the aim of minimising boil-off gas. The first 45,000 cm newbuild with this system in place, Jia Xing (ex-Saga Dawn), was delivered in December 2019. LNT Marine has jointly developed a new LNG carrier design of 175,000 cm featuring the LNG A-BOX system.

Propulsion Systems

Propulsion systems influence levels of capital expenditure, operational expense, emissions, vessel size range, vessel reliability, and compliance with regulations. Before the early 2000s, steam turbine systems running on boil-off gas and heavy fuel oil were the only available propulsion solution for LNG carriers. Increasing fuel oil costs and stricter emission regulations led to the development of more efficient alternatives such as the DFDE, TFDE and the slow-speed diesel with re-liquefaction plant (SSDR).

In recent years, modern containment systems that generate lower boil-off gas and the rise of short-term and spot trading of LNG have spawned demand for more flexible and efficient propulsion systems to adapt to varied sailing speeds, distances, and conditions. These factors have resulted in a new wave of dual-fuel propulsion systems that also burn boil-off gas with a small amount of pilot fuel or diesel. This includes the high-pressure MAN B&W M-type electronically controlled, gas injection (ME-GI) system, the newly popular M-type electronically controlled, gas admission system (ME-GA) of low-pressure injection, and two generations of low-pressure injection Winterthur Gas & Diesel (WinGD) X-DF.

Special mention should be made of ABB's Azipod units, which have been deployed in the 15 ARC7 icebreaker units in service for the Yamal LNG project in Russia. The electrical motors of this propulsion system are housed in a submerged pod outside the LNG carrier's hull, with 360-degree rotational capabilities. The resulting heightened maneuverability enables the highly powered units to navigate efficiently through the Arctic, including through ice up to 2.1 metres thick. This propulsion system will be deployed in the ARC7 icebreakers ordered for Novatek's Arctic LNG 2 project.

Additional systems in place to reduce fuel consumption on board include air lubrication systems and PTO-Shaft generators in the propulsion lines. These technologies are being implemented in many vessels currently on order. Other systems are currently being assessed such as wind-assisted propulsion or fuel cells to mention some. It is also worth noting that an onboard carbon capture has been installed in 2023 on board the LNG carrier Seapeak Arwa as demonstration project. Some builders are currently proposing designs with such new technologies.

Steam turbine

Steam turbines for ship propulsion are now mostly considered to be a superseded technology and hiring crew with steam experience has become difficult. In a steam turbine propulsion system, two boilers supply highly pressurised steam at over 500°C (932°F) to a high and then low-pressure turbine to power the main propulsion and auxiliary systems. The steam turbine's main fuel source is boil-off gas, with heavy fuel oil used as an alternative if the former proves insufficient. The fuels can be burned at any ratio and excess boil-off gas can be converted to steam, making the engine reliable and eliminating the need for a gas combustion unit. Maintenance costs are also relatively low.

The key disadvantage of steam turbines is their low efficiency, running at 35% efficiency when fully loaded (most efficient). The newer generations of propulsion systems, DFDE/TFDE and ME-GI/ME-GA/X-DF engines, are approximately 25% and 50% more efficient, respectively, than steam. There are currently 221 active steam-turbine propulsion vessels, making up 31.5% of the total active fleet.

An improvement of the steam turbine was introduced in 2015, involving reheating the steam in-cycle to improve efficiency by more than 30%. Aptly named the steam reheat system (or ultra-steam turbine), there are 12 such active vessels with the propulsion in place and zero newbuilds due.

Dual-fuel diesel electric/triple-fuel diesel electric (DFDE and TFDE)

DFDE propulsion was introduced in 2006 as the first alternative to steam turbine systems, able to run on both diesel and boil-off gas. It does so in two separate modes, diesel or gas, powering generators which produce electricity used to drive electric motors for propulsion. Auxiliary power is also delivered through these generators, and a gas combustion unit (GCU) is in place should there be excess boil-off gas. In 2008, the arrival of TFDE vessels improved the adaptability of this type of vessel with the option of burning heavy fuel oil as an additional fuel source. Being able to choose from different fuels during different sailing conditions and prevailing fuel prices increases overall efficiency by up to 30% over steam turbine propulsion. In addition, the response of these vessels under a dynamic load, such as during adverse weather conditions, is considered excellent.

However, the DFDE and TFDE propulsion systems also have certain disadvantages. Capital outlays as well as maintenance costs are relatively high, in part due to the necessity for a GCU and the number of engines and cylinders. In gas mode, knocking and misfiring can happen if the boil-off gas composition is out of the engine-specified range. Knocking refers to ignition in the engine prior to the optimal point, which can be detrimental to engine operation. There are 194 active TFDE/DFDE vessels as of end-February 2024, representing 28% of the current fleet. There are currently 22 newbuild vessels with TFDE systems to be delivered, 21 icebreakers to service the upcoming Arctic LNG 2 project, and one newbuild FSRU for Excelerate Energy. It is likely that that the delivery of the vessels for the Arctic LNG 2 project will be materially delayed due to US sanctions.

Slow-speed diesel with re-liquefaction plant (SSDR)

The SSDR was introduced together with the DFDE propulsion system, running two low-speed diesel engines and four auxiliary generators with a full re-liquefaction plant to return boil-off gas to LNG tanks in a liquid state. The immediate advantages are the negligible boil-off, which optimised cargo value during the high gas price environment of 2022, and the option to efficiently use heavy fuel oil or diesel as a fuel source. However, the heavy electricity use of the re-liquefaction plant can negate efficiency gains and restrict the SSDR only to very large carriers (to achieve economies of scale). There are currently 48 SSDR vessels in the active LNG fleet, 44 of which are Nakilat's Q-Class vessels. The Q-Max vessel (Rasheeda) previously ran an SSDR engine before being converted to a ME-GI-type vessel in 2015. Due to more stringent environmental regulations and the introduction of third-generation engines, there are currently no SSDR engines on order.

M-type, electronically controlled (MAN B&W ME-GI, ME-GA)

Introduced in 2015 by MAN B&W, the two-stroke M-type electronically controlled, gas injection system (commonly known as ME-GI), pressurises boil-off gas up to around 350 bar and burns it with a small amount of injected diesel fuel (pilot fuel). Efficiency is maximised as the slow speed engine is able to run off a high proportion of boil-off gas while minimising the risk of knocking. Similar efficiency and reliability levels are observed when switching fuel sources as the engine is always running on diesel thermodynamic cycle.

Fuel efficiency is maximised for large-sized LNG carriers, which make up the majority of newbuilds today. As such, the current modern LNG fleet in service reflects the apparent advantages of the ME-GI propulsion system. A total of 72 newbuild vessels fitted with ME-GI systems have been delivered since 2015, with 16 additional newbuilds with the system under construction. However, low-pressure injection engines have become more compelling.

MAN B&W has developed a new engine based on the low-pressure Otto cycle, the two-stroke M-type electronically controlled, gas admission system (ME-GA), which is specifically designed for the LNG carrier segment and runs on the Otto thermodynamic cycle. This system allows for a low gas supply pressure and is better suited for use of boil-off gas as a fuel. The ME-GA is also touted to have lower capital expenditure, operational expenditure, and NOx emissions than current-generation engines. Exhaust recycling systems in place improve methane-slip by up to 50%. The popularity of the ME-GA engine has surged: six of which were delivered in 2023 and three in 2024, with at least 112 ME-GA vessels currently on order. 23 of these will be delivered in 2024, 36 in 2025, 33 in 2026, and 20 in 2027. There are still 68 ships equipped with ME-GA or X-DF systems, and the specific system remains to be confirmed.

Low-pressure slow-speed dual-fuel (Winterthur Gas & Diesel X-DF)

Originally introduced by Wärtsilä, the Winterthur Gas & Diesel (WinGD) X-DF was premiered on the South Korean newbuild SK Audace in 2017. The X-DF burns fuel and air, mixed at a high air-to-fuel ratio, injected at a low pressure in the Otto thermodynamic cycle. When burning gas, a small amount of fuel oil is used as pilot fuel. As the maintained pressure is low, the system is easier to implement and integrate with a range of vendors.

In terms of overall ship fuel consumption and efficiency, LNG carriers equipped with ME-GI and first-generation X-DF are comparable. Safety and emissions are the areas where the first-generation X-DF stands out, winning over the ME-GI due to low levels of nitrogen emissions without needing an after-treatment system. The ME-GI compensates for this with slightly lower fuel/gas consumption and better dynamic response.

In 2020, WinGD introduced the second-generation X-DF systems, building on its earlier success. The second-generation X-DF reduces methane slip by half and improves fuel consumption by between 3% and 5% through exhaust recycling systems. Overall efficiency has improved to over 50% as operations and maintenance requirements have remained excellent. The second-generation X-DF will compete with ME-GA systems. There are currently 136 vessels with the X-DF system in service. The orderbook for LNG carriers contains a least 141 X-DF vessels across both generations, representing 39% of total newbuilds to be delivered. There are still 68 ships to be equipped with ME-GA or X-DF systems, and the specific system remains to be confirmed.

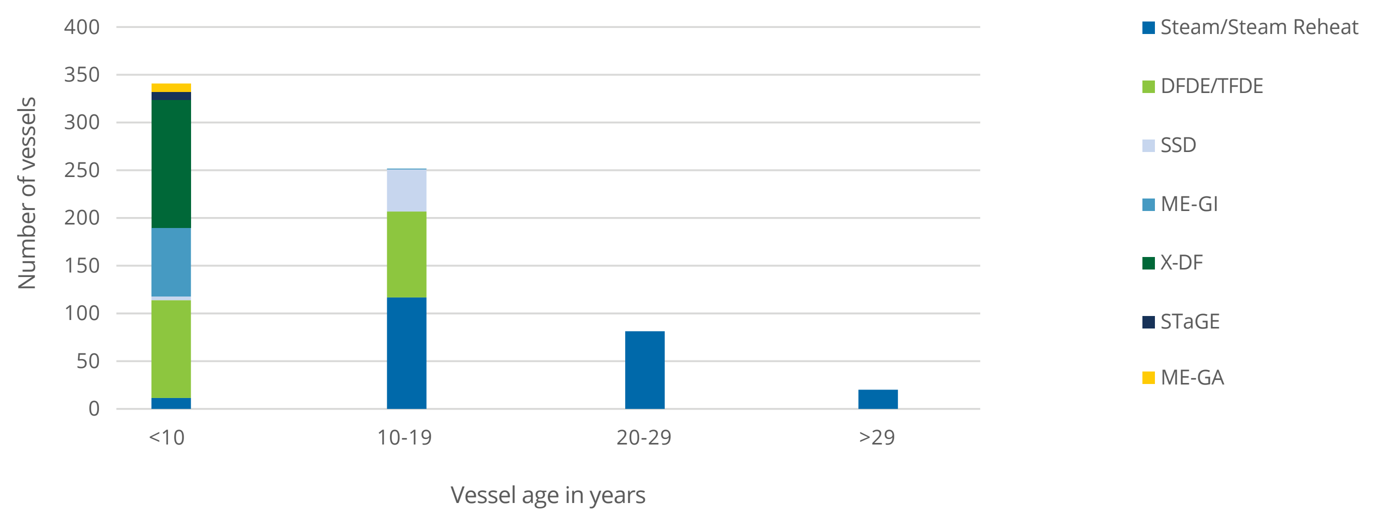
Steam turbine and gas engine (STaGE)

First introduced in a 2018 delivery, the Sayaringo STaGE propulsion system runs both a steam turbine and a dual-fuel engine. Waste heat from running the dual-fuel engine is recovered to heat feedwater and to generate steam for the steam turbine, significantly improving overall efficiency. The electric generators attached to the dual-fuel engine power both a propulsion system and the ship, eliminating the need for an additional turbine generator. In addition to efficiency, the combination of two propulsion systems improves the ship's adaptability while reducing overall emissions. A Japanese innovation, STaGE systems have been produced exclusively by Mitsubishi, with eight newbuilds delivered during 2018 and 2019. There are currently no STaGE vessels on order.

Fleet propulsion system breakdown by vessel age

Steam turbine systems make up the majority of older vessels, with DFDE/TFDE and SSDR representing a small proportion of vessels aged over 10 years. As almost all the SSDR vessels comprise Qatari Q-Class ships, the age range is in line with when they were delivered. The entirety of ME-GI, ME-GA, X-DF, and STaGE vessels are new due to the recent nature of these innovations. The global orderbook shows that moving forward, both generations of X-DF systems will make up a significant portion of delivered vessels until 2026, after which ME-GA and X-DF systems are expected to compete closely.

Figure 6.4: Fleet propulsion type by vessel age, end-February 2024

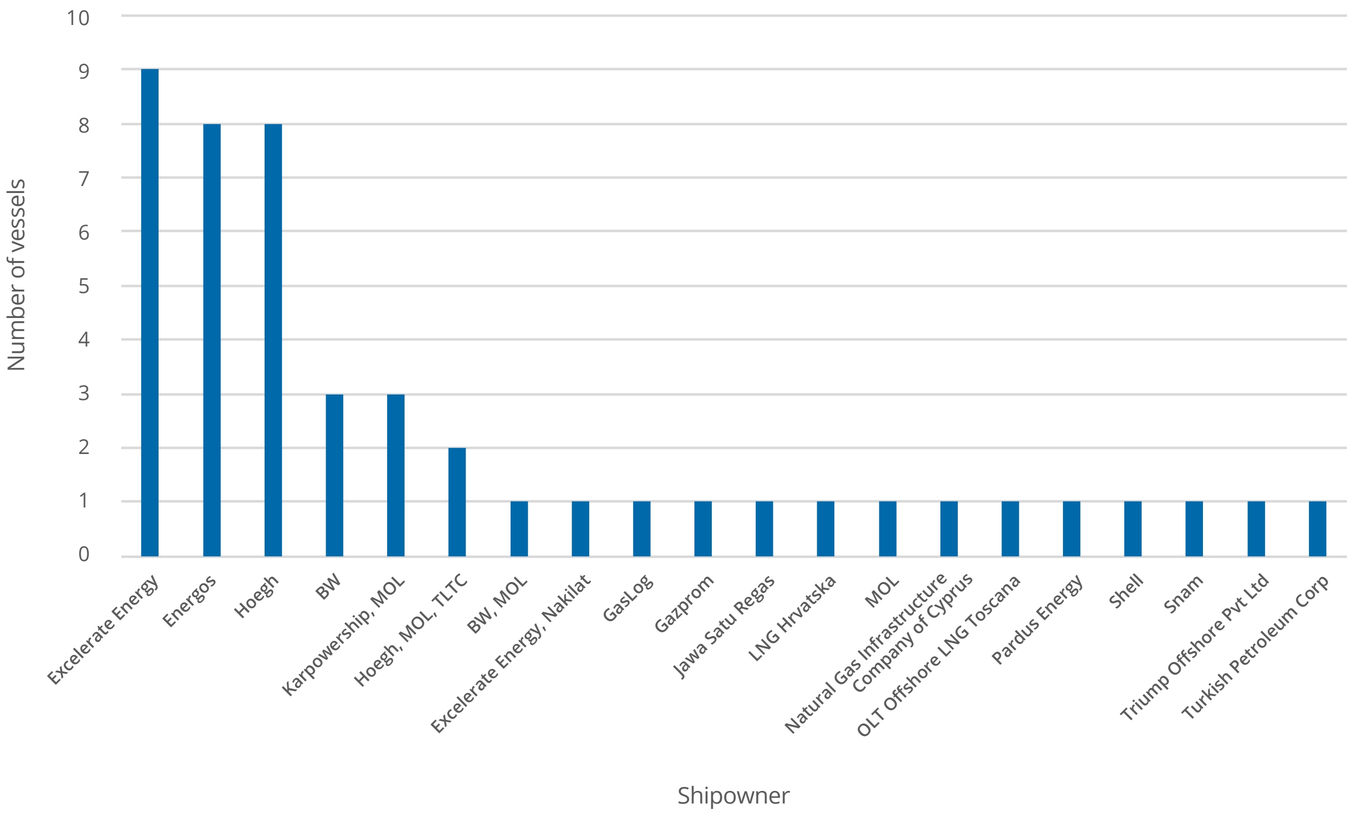


Source: Rystad Energy

MARAN GAS MARSEILLE - Courtesy MARAN GAS

6.3 FLOATING STORAGE AND REGASIFICATION UNIT (FSRU) OWNERSHIP

Figure 6.5: FSRU fleet by shipowner, end-February 2024



Source: Rystad Energy

FSRUs are used for LNG storage and regasification in addition to being regular LNG carriers, except for a few examples of non-propelled units. Compared to traditional onshore regasification plants, FSRUs offer better flexibility, lower capital outlay, and a faster means of importing LNG. 3 converted FSRUs were delivered in early 2024, with a total of 47 FSRUs making up 6.7% of the active global LNG fleet. Shipowners Excelerate Energy, Hoegh, Energos Infrastructure (a joint venture of Apollo Funds and New Fortress Energy), and BW continue to operate the largest fleets of active FSRUs, with Energos having taken over New Fortress Energy's fleet. Currently one newbuild FSRU is under construction for Excelerate, while multiple older LNGCs are being considered for conversion to FSRUs.

With the ability to import LNG via a 'plug-and-play' solution, FSRUs offer the flexibility of meeting demand as and where it is needed before being redeployed elsewhere. For example, in Brazil, Petrobras has swapped out FSRUs to optimise LNG send-out. Another important consideration is that FSRUs are deployed off the coast of the markets they serve instead of on land, offering an advantage in land-scarce regions or hard-to-reach areas.

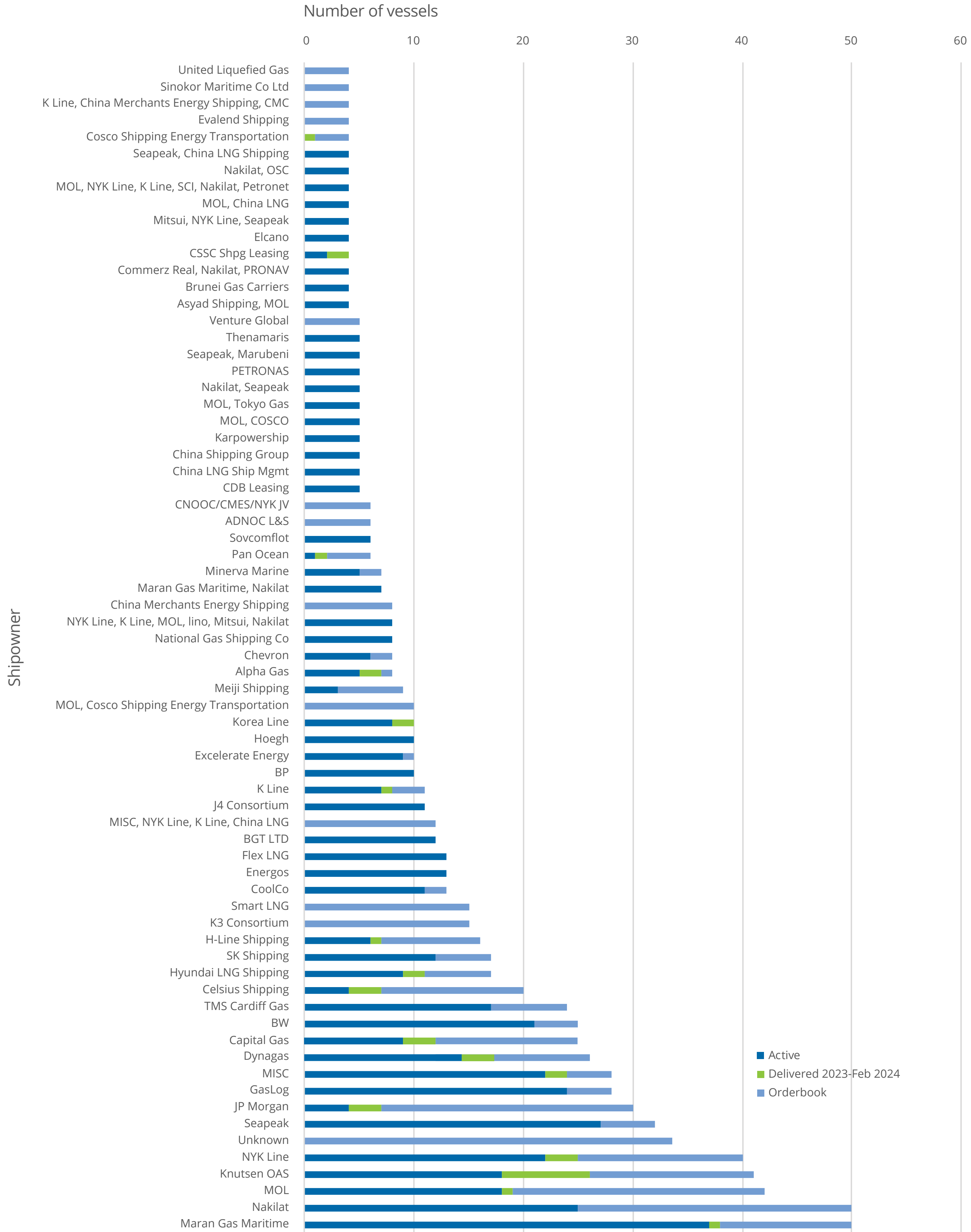
Capital expenditure of an FSRU can be as little as half that of an onshore terminal, while installation in regions with existing infrastructure can happen in months, though this is offset by higher operating expenditure. FSRUs can be newbuilds or conversions from existing LNG carriers. Newbuild FSRUs offer design flexibility and a wider range of outfitting options but are higher in cost and take longer to build.

FSRUs have not been free of issues. Delivery delays, power cuts and rising costs have affected certain projects in the past, slightly dampening demand for the vessel type. In addition, spikes in LNG transportation charter rates can motivate shipowners to use the ships as LNG carriers, reducing the number of FSRUs operating as regasification or storage units. The order book as of February 2024 had only one FSRU newbuild, set to be delivered in 2026, although in March MOL booked another newbuild for Poland's Gdansk project with HHI. The ability of firms to order FSRU newbuilds is challenged as most shipyards are currently constructing the fleet of standard LNG carriers required for a wave of project capacity additions from 2026-28.

The flexibility of FSRUs has proven useful for markets with changing natural gas needs. FSRUs are expected to remain a popular storage and regasification solution for years to come. The Russia-Ukraine conflict has further piqued FSRU interest across Europe, with their speed-to-market advantage helping alleviate the supply crunch and reduce dependence on Russian piped gas. FSRU charter rates which were languishing at sub-$100,000/day levels in 2021 quickly surged to around $200,000/day for vessels deployed to Germany in 2022.

6.4 LNG ORDERBOOK

Figure 6.6: Global fleet and orderbook by shipowner, end February-2024[4] *Source: Rystad Energy*

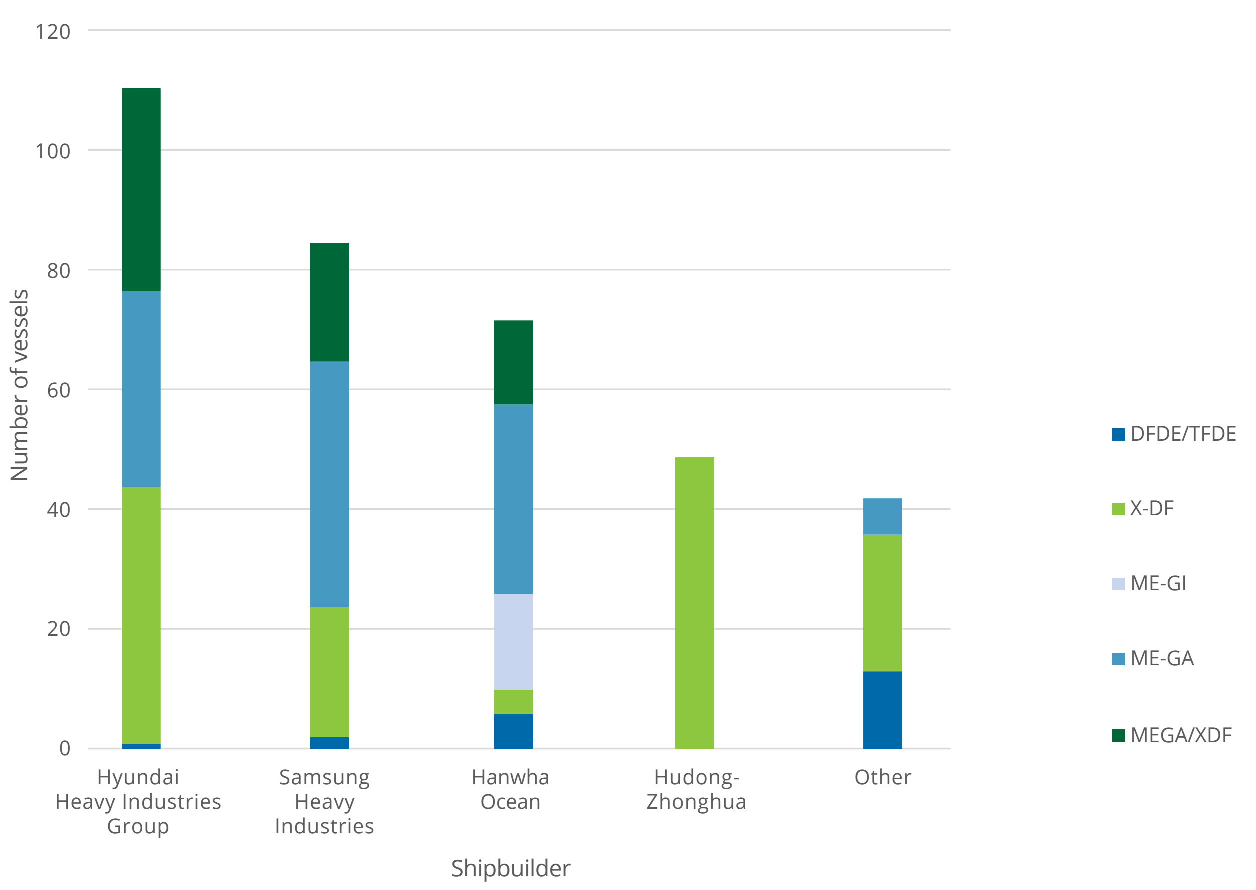


[4] Shipowners or consortiums with four or more total vessels included.

66 additional LNG vessels
scheduled for delivery in 2024

There were 359 LNG carriers under construction as of end-February 2024. Of the 359 vessels, 66 are scheduled for delivery later in 2024, 91 in 2025, 97 in 2026, 55 in 2027, 46 in 2028, and 4 in 2029. The newbuild demand is being driven by large projects under discussion, such as with QatarEnergy, and the ongoing wave of development in US LNG for which shipping is critical to maximise flexibility, as well as for fleet renewal as the IMO's EEXI and CII rules have begun taking effect from 2023. As of 2024, shipping is also now included in the EU Emissions Trading System.

Figure 6.7: Newbuild orderbook by propulsion type and shipbuilder, end-February 2024



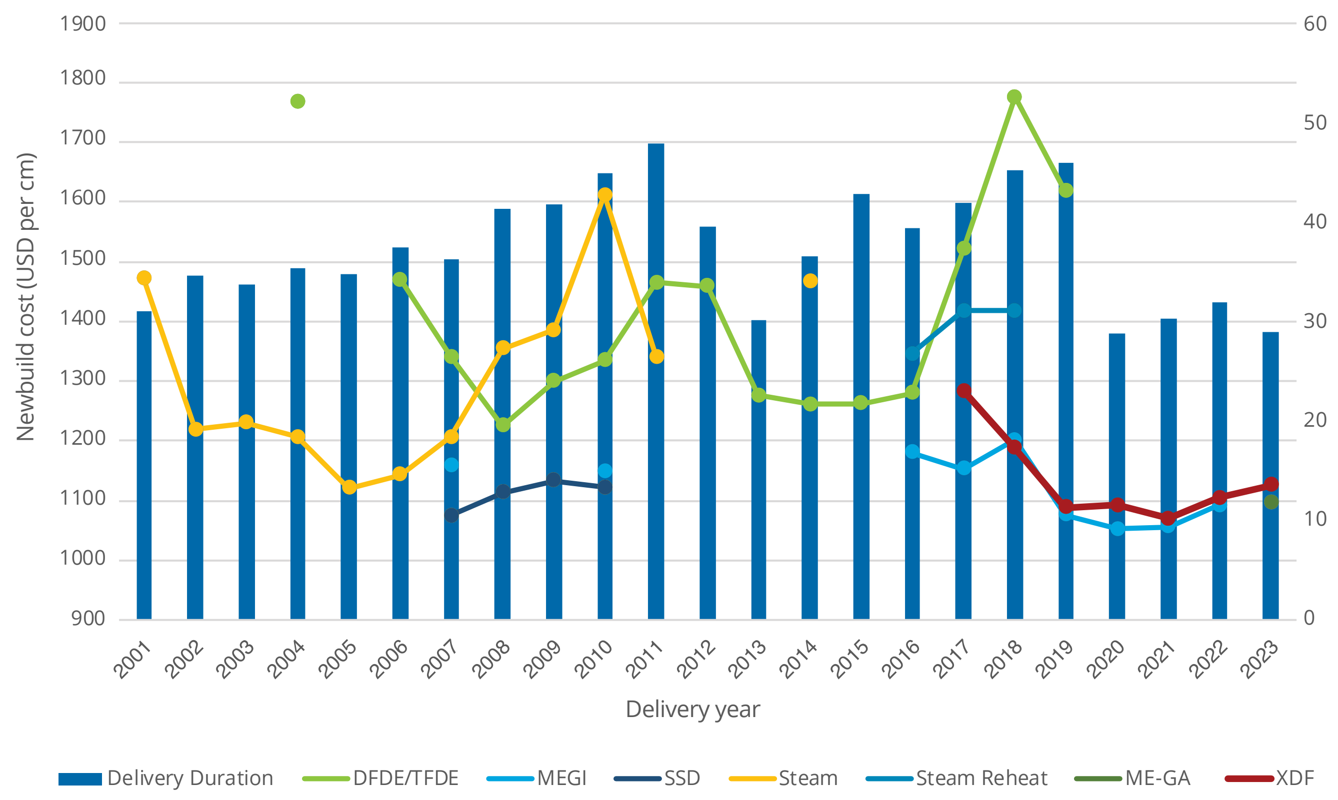
Source: Rystad Energy

Capitalising on better fuel efficiencies and lower emissions, both generations of X-DF are currently the main propulsion systems of choice, with at least 141 currently on order. The competing ME-GI system has 16 orders, while the new generation of ME-GA system has at least 112. There are still 68 ships equipped with ME-GA or X-DF systems, and the specific system remains to be confirmed. TFDE/DFDE systems account for 22 vessels. All vessels on order are at or above 170,000 cm in size, showing a clear trend towards larger vessels which can now be accommodated by new locks on the Panama Canal. With the new generation of two-stroke propulsion systems, vessel size might progressively trend towards 200,000 cm moving forward due to economies of scale for long-haul voyages. 14 such vessels are currently on order, 9 of which are for Dynagas. In 2022, two Dynagas-owned ships of 200,000 cm were delivered to charterer Cheniere Energy, namely Clean Cajun and Clean Copano. In 2023, an additional two Dynagas-owned ships of 200,000 cm were delivered to charterer Cheniere Energy, namely Clean Destiny and Clean Resolution, both of which were also equipped with MEGA propulsion. There are also eight 271,000 cm vessels on order for QatarEnergy, which will be the largest LNG carriers ever built.

South Korean shipbuilders Hyundai Heavy Industries Group, Samsung Heavy Industries and Hanwha Ocean are the top three shipbuilders for LNG vessels, with 111, 85, and 72 units on order, respectively. In addition, Samsung was previously assisting Zvezda shipyard in Russia in building 15 icebreakers for Arctic LNG 2, although this program has been stalled by the US sanctions. Hyundai and Samsung are working on a large proportion of newbuilds with both generations of X-DF systems and ME-GA, while Hanwha Ocean's orders cover X-DF, ME-GI, ME-GA, and a small number of DFDE/TFDE vessels. Chinese builder Hudong-Zhonghua is currently working on 49 vessels with an orderbook stretching into 2029, all of which are equipped with X-DF propulsion systems.

6.5 VESSEL COSTS AND DELIVERY SCHEDULE

Figure 6.8: Vessel delivery schedule and newbuild cost, 2001-2023



Source: Barry Rogliano Salles

47 Months
average delivery time for new LNG vessels contracted in 2023

The cost of constructing an LNG carrier is highly dependent on characteristics such as propulsion systems, capacity, and other specifications involving ship design. Historically, DFDE/TDFE vessels started out being pricier than steam turbine vessels, with the higher newbuild costs offset by efficiency gains from operating more modern ships. DFDE/TFDE newbuild costs have varied heavily over the years due to different specification standards – a prominent example being the 2018 peak of over $1,700 per cm for 15 ice-breaker class vessels ordered to service Yamal LNG. These vessels, contracted from 2017, were priced at about $320 million apiece, which drove up average prices.

While vessels equipped with X-DF systems started out marginally more expensive per cubic metre than vessels with ME-GI propulsion systems, they are now cost competitive. Figure 6.8 shows how the cost for X-DF, ME-GI, and MEGA vessels have trended, falling from an initial $1,200–$1,300/cm to around $1,100/cm for vessels delivered in 2023.

Despite changes in average vessel sizes over time, shipyards have been able to construct on a consistent delivery schedule, with variance within this band occurring during introduction of new propulsion systems. This can be attributed to shipyards having to adjust to novel designs with new engines, an example being delivery duration peaks in 2011, reaching almost 50 months in the years following the introduction of DFDE/TFDE systems. However, the delivery time for vessels ordered in 2023 has now stretched to 47 months (about 4 years) due to surging vessel demand and capacity limitations at South Korean shipyards.

Price levels last year for LNG carriers climbed steadily as shipbuilding demand for different ship types was strong. Prices for a standard 174,000 cm two-stroke vessel climbed from under $200 million to $250 million by year-end, and more recently to almost $265 million, with the orderbook remaining strong for subsequent years. Similarly, the lead time has increased substantially, with preferred newbuild slots at South Korean yards now having shifted to 2028, meaning the average delivery duration is likely to increase going forward, and at Hudong-Zhongua to 2029.

6.6
CHARTER MARKET

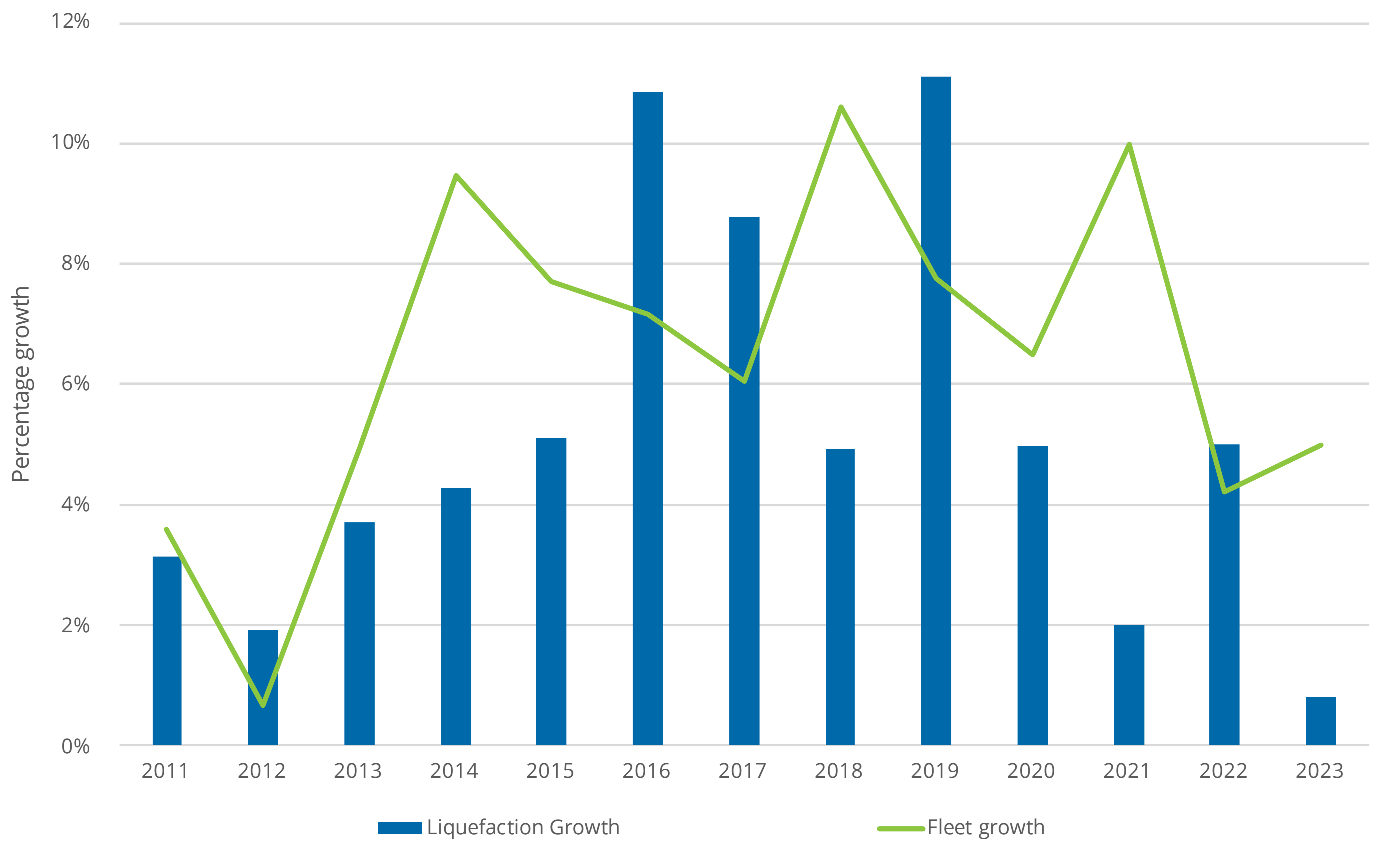
$250,000

for two-stroke, $200,000 for TFDE, and $117,000 for steam turbine vessels peak charter day rates in 2023

Shipping costs constitute an important proportion of netback calculations when delivering LNG. Therefore, charter rates are seriously considered when formulating market strategies. Historically, LNG was largely marketed through long-term contracts, encouraging shipowners to enter term charters with large players. As portfolio players have emerged, an increasing number of vessels have become available on the spot market, contributing to market depth of charter fixtures and pricing. However, lack of liquidity can still contribute to charter rate volatility due to a mismatch between supply and demand, and since the Russia-Ukraine conflict charterers have increasingly preferred longer duration charters to ensure supply security.

The price differentials between vessels with X-DF/ME-GI, TFDE/DFDE and steam turbine propulsion can be explained by efficiency gains from using newer propulsion systems. Steam turbine systems are significantly less efficient than TFDE/DFDE systems, which in turn are less efficient than X-DF, ME-GA, and ME-GI engines. In addition, vessels using steam turbines tend to be smaller in size, limiting usability as spot cargoes tend to be at least 150,000 cm. Finally, charterers, conscious about carrier emissions, are demanding newer technologies, further widening the price differential. As IMO regulations (EEXI and CII) enter into force, steam turbine and other less efficient propulsion types may be limited to certain trade lanes. Market participants must balance fuel efficiencies, boil-off gas savings and higher costs when choosing their carriers and associated propulsion system.

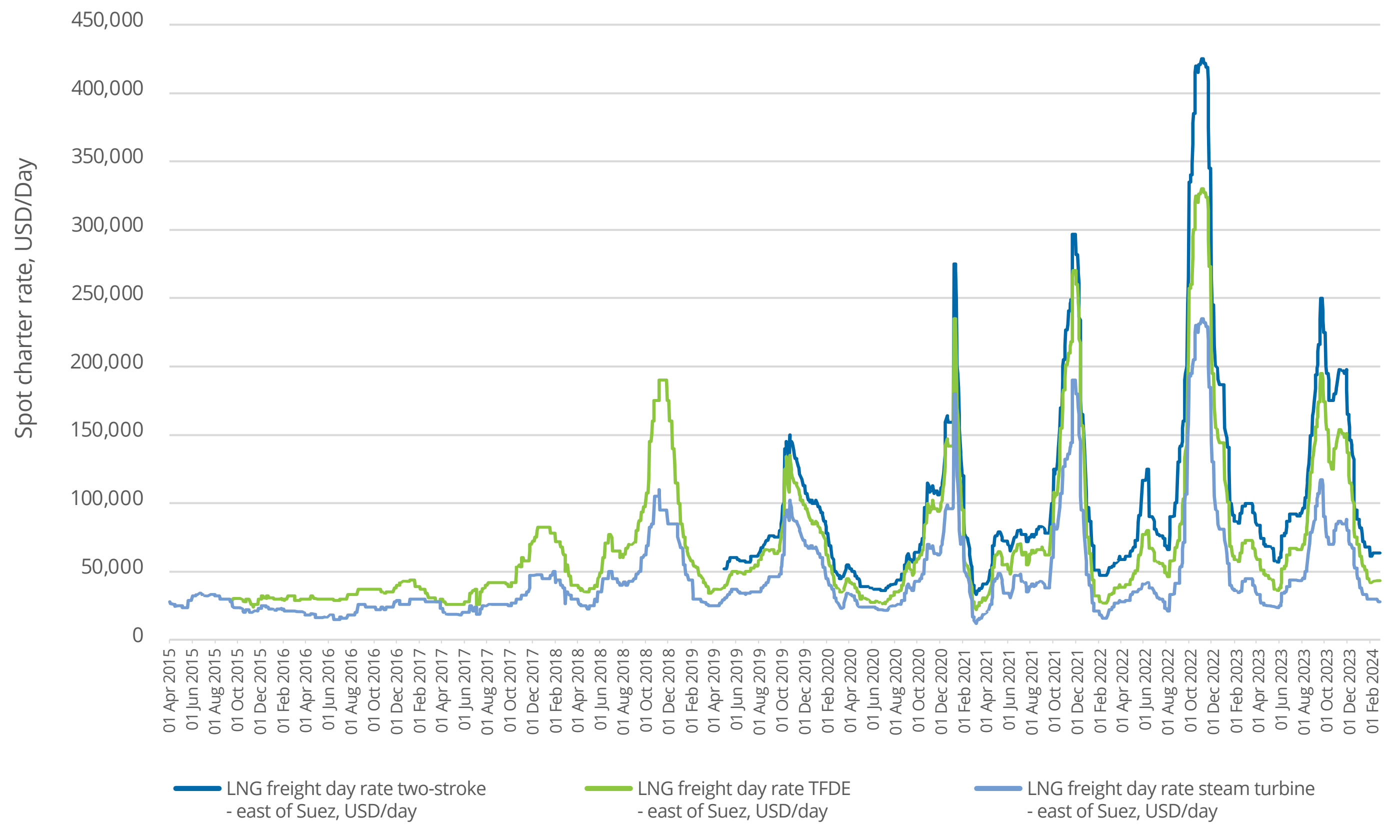
Figure 6.9: Liquefaction capacity growth vs LNG global fleet count growth, 2011-2023



Source: Rystad Energy

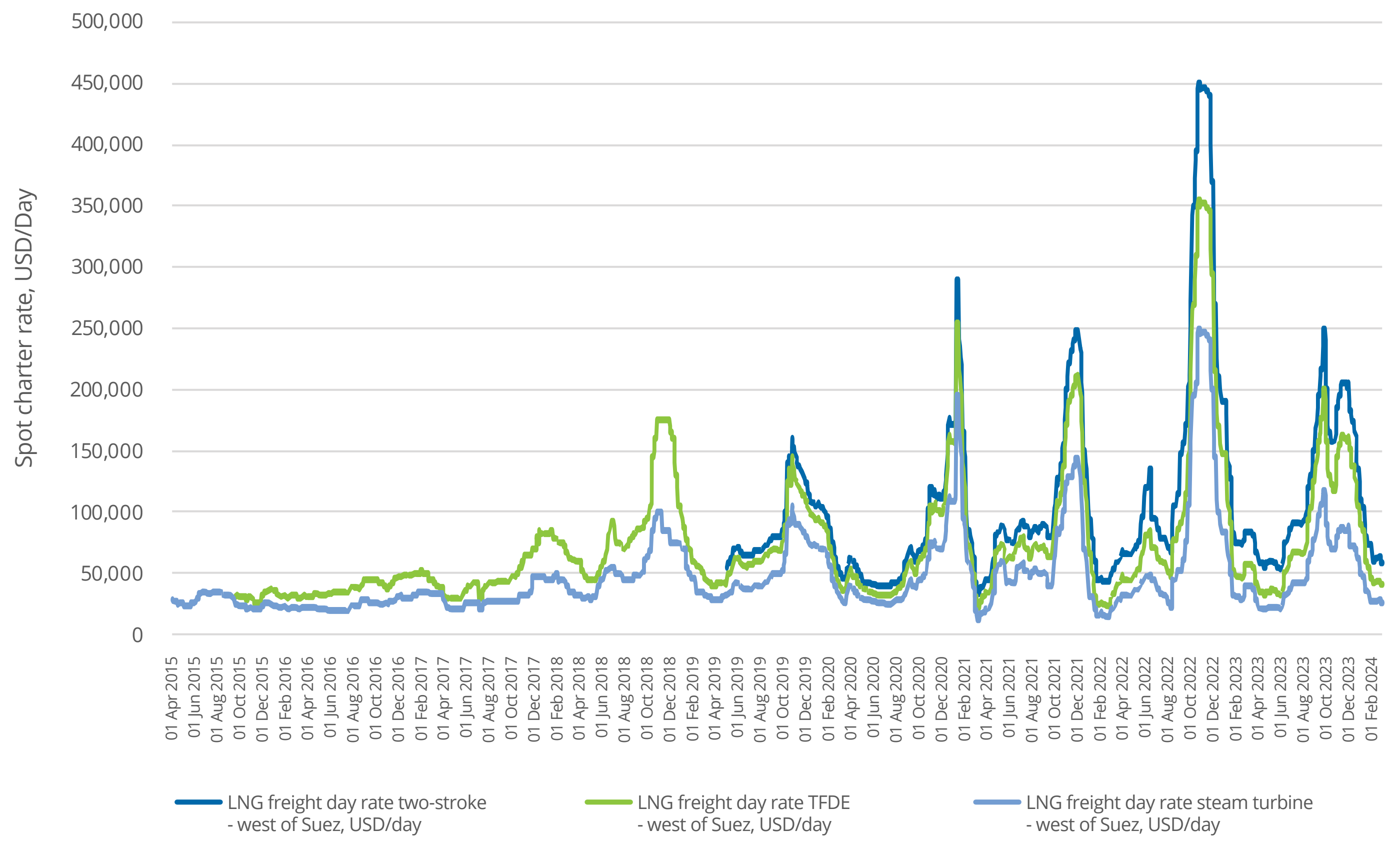
In the early 2010s, fleet growth was well balanced with additional liquefaction capacity coming online, resulting in a stable charter market. However, the rate of vessel deliveries far outweighed that of liquefaction capacity growth from 2013 onwards, resulting in a glut of LNG shipping capacity and a steady decline in charter rates. This continued until 2015, after which they remained between $15,000/day and $50,000/day (for steam turbine) until the fourth quarter of 2017 when a rapid increase in Asian LNG demand sparked an increase in charter rates. Rates were volatile throughout 2018, swinging between previous highs and corrections. Notably, end-2018 saw a spike in charter prices with TFDE day rates reaching $190,000/day for most of November. This was partially attributable to winter storage filling up rapidly, leaving vessels off the charter market while they waited to discharge cargo.

Figure 6.10: Spot charter rates east of Suez, April-2015 to end-February 2024



Source: Argus

Figure 6.11: Spot charter rates west of Suez, April-2015 to end-February 2024



Source: Argus

After peaking at end-2018, rates slowly returned to regular seasonal variations until October 2019 when US sanctions against Chinese state-owned shipping company COSCO removed many vessels available for charter in both the Atlantic and Pacific basins. Charter rates spiked, hitting a peak of $105,000/day for steam turbine vessels, $145,000/day for TFDE/DFDE vessels and $160,000/day for X-DF/ME-GI vessels, before ticking lower into 2020.

As the outbreak of the global COVID-19 pandemic started to impact demand through 2020, spot charter rates for all vessel types inched lower towards mid-March before a brief rally due to arbitrage opportunities between the Pacific and Atlantic basins. As the interbasin arbitrage closed, slower US exports weighed on freight demand, when depressed charter rates incentivised the use of LNG vessels as floating storage mid-year. It is worth noting that, at such charter rates, shipowners were likely operating at a short-term financial loss.

A tighter supply/demand balance from mid-August in 2020 led to rates climbing steadily towards the end of the year, as the Pacific and Atlantic basin price differential increased. This was attributable to strong mid-winter demand in Asia driven by temperature expectations and coal plant decommissioning in South Korea, alongside transit delays in the Panama Canal. With global LNG prices hitting record highs, charter rates soon followed, reaching an unprecedented peak of $190,000/day for steam turbine vessels, $255,000/day for TFDE/DFDE vessels and $290,000/day for X-DF/ME-GI vessels at the beginning of 2021.

2021 proved to be a turbulent year in the history of gas and LNG freight markets, with the charter spike quickly reversing as winter demand eased after February, with rates falling to historical lows in early March. A climb then commenced as the Ever-Given container ship blocked the Suez Canal, while it became clear that Europe and Asia would compete for LNG cargoes to increase filling in underground storage facilities. By October 2021, gas prices hit new record levels as demand growth from the industrial sector coincided with a coal shortage in China, which further strengthened its position as an LNG buyer. Once again, this caused a large spike in charter rates, reaching $140,000/day for steam turbine vessels, $210,000/day for TFDE/DFDE vessels and $250,000/day for X-DF/ME-GI vessels in mid-December.

2022 was a year of soaring LNG freight, driven by soaring LNG prices. At the beginning of 2022, as northern hemisphere winter volumes became accounted for, freight rates eased briefly before ticking upwards as the Ukraine crisis started in February, structurally increasing LNG demand in Europe. Nations previously relying on Russian pipeline gas imports are now looking to increase their LNG imports, while aiming to build out regasification capacity, placing material upward pressure on freight rates. Rates reached $45,000/day for steam turbine vessels, $80,000/ day for TFDE/DFDE vessels and $120,000/day for X-DF/ME-GI vessels in end-May 2022. Later, the freight rate decreased briefly with the seasonal trend. In August, Europe prepared in advance for winter and pushed the LNG shipping market into the peak season ahead of schedule. West of Suez rates reached $250,000/day for steam turbine vessels, $355,000/day for TFDE/DFDE vessels and $450,000/ day for X-DF/ME-GI vessels by the end of October 2022. Then, as the winter turned out to be milder than expected, with high inventory in European and Asian storage, prices softened considerably into early 2023, after which charter rates also declined.

2023 was a year of re-opening and recovery of the world, and the conflict in Ukraine still forced Europe – that built enough LNG infrastructure – and other LNG consumers to diversify from the Russian pipeline gas. The US has well played the role of filling the gap that Russia left and become the world's largest LNG exporter. Thanks to the mild winter of 2022, market fundamentals in 2023 were well balanced, which eased freight rates. In September 2023, Europe prepared in advance for winter and pushed the LNG shipping market into the peak season. West of Suez rates reached $117,000/day for steam turbine vessels, $200,000/day for TFDE/DFDE vessels and $250,000/day for X-DF/ME-GI vessels by the end of September 2023, which like the previous year saw a buildup of floating storage. Then, with high gas inventories in European and Asia, prices dropped again, much lower than the end of 2022.

However, 2023 was marked by a major disruption to the Panama Canal on account of drought conditions reducing water levels in the Gatun Lake, which forced US-Asia voyages through the Cape of Good Hope and the Suez Canal. However, since early 2024, the Suez Canal itself has been disrupted by geopolitical tensions in the Red Sea following the onset of the conflict in the region. Houthi-rebels began drone and missile attacks on vessels crossing the Bab El-Mandab strait, with LNG vessels suspending voyages through the Red Sea and Middle Eastern LNG cargoes taking the Cape of Good Hope route to Europe.

Courtesy Samsung Heavy Industries

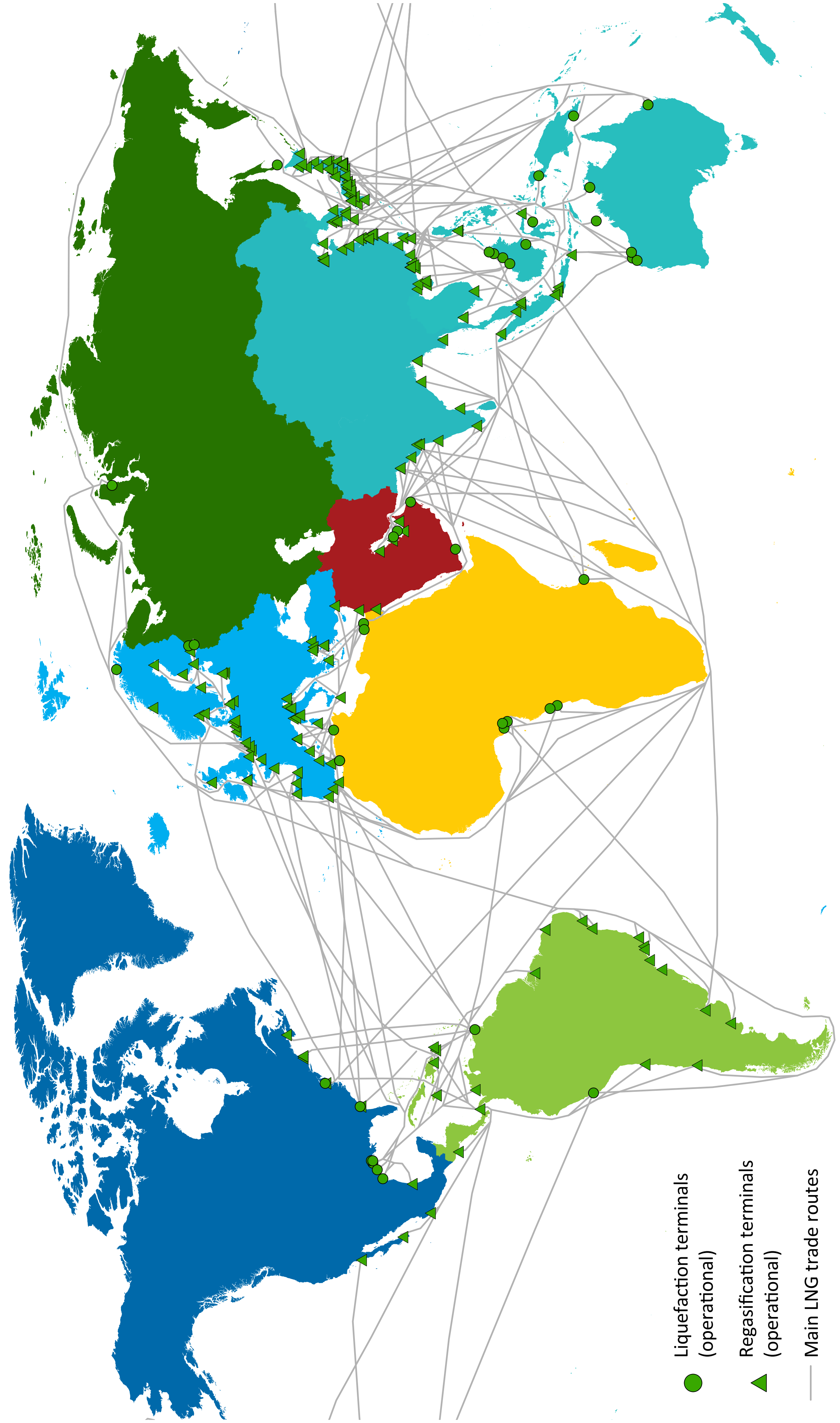


Figure 6.12: Major LNG shipping routes, 2023

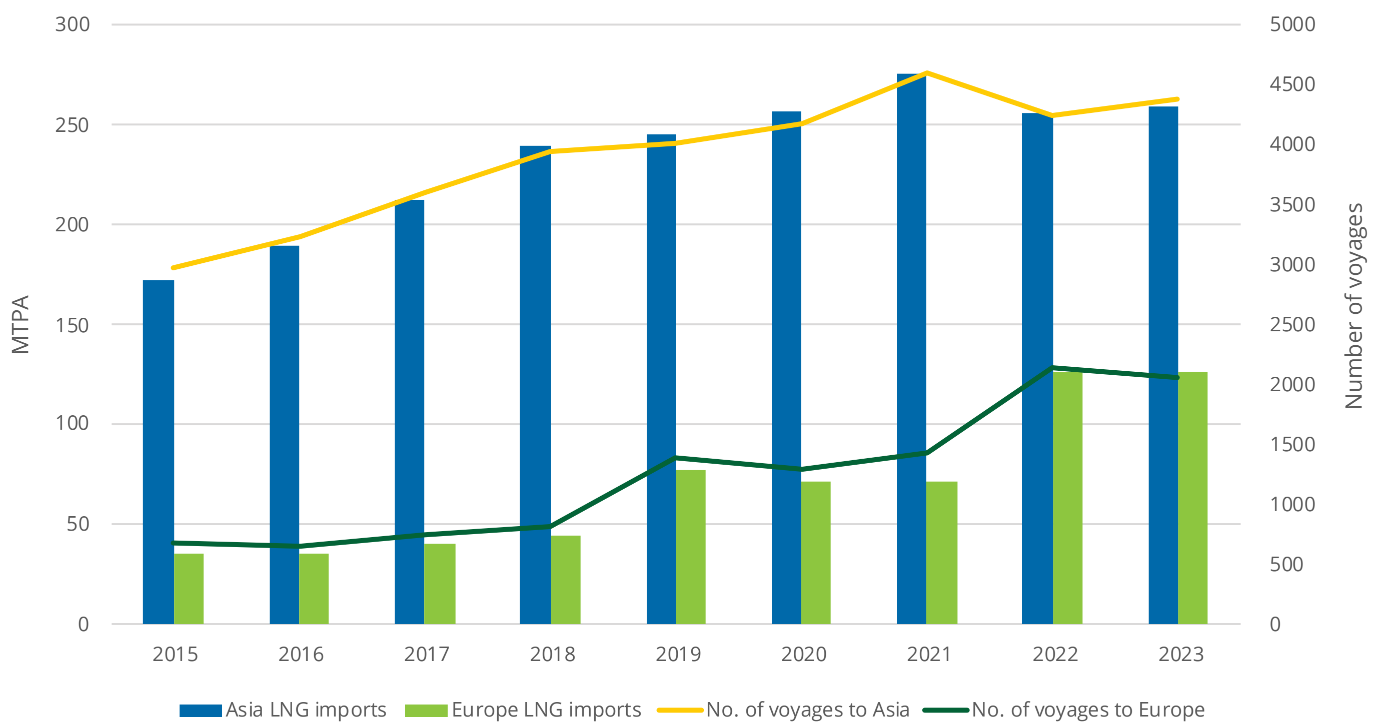
Source: Rystad Energy

6.7 FLEET VOYAGES AND VESSEL UTILISATION

7,004 LNG trade voyages
in 2023

As a result of the Russia-Ukraine conflict, 2022 saw a significant change in voyages and vessel utilisation. Due to the post-pandemic re-opening of most economies and the substitution of LNG shipping for pipeline gas in Europe, a total of 7004 LNG trade voyages departed in 2023, up 1.7% from 2022. Global growth in LNG trade voyages is similar to growth in liquefaction capacity at 0.8%. The number of LNG trade voyages both to Europe and Asia have trended upwards since 2015, with growing year-on-year liquefaction and vessel deliveries. The Panama Canal was widened and deepened in 2016, allowing for more transits and larger vessels The resulting voyage distance and time from the Sabine Pass terminal in the US to Japan's Kawasaki LNG facility was reduced to 9,400 nautical miles (nm) and 29 days through the Panama Canal, compared to 14,500 nm and 45 days through the Suez Canal and close to 16,000 nm and 49 days around the Cape of Good Hope. However, due to the popularity of the route, the Panama Canal has become a bottleneck for this voyage, with the situation exacerbated by draught conditions in Panama reducing water levels in the Gatun Lake in 2023, forcing re-routes through the Cape of Good Hope.

Figure 6.13: LNG imports and number of voyages to Asia and Europe, 2015-2023



Source: Rystad Energy, LSEG Data and Analytics

The number of LNG trade voyages from the US to Europe increased to 805 in 2023, up from 756 in 2022. After flows through the Nord Stream 1 pipeline from Russia to Germany ceased at end-September 2022 following alleged sabotage, the number of LNG trade voyages from the US to Europe grew 132% to 58 in October 2022, compared to 25 in October 2021.

The most common voyage globally in 2023 was from Australia to Japan, with 423 voyages. This was much higher than Australia-China journeys, which totaled 359. The most common voyage to Europe in 2023 was from the US to France at 147 shipments. Japan, China, and South Korea took the highest number of cargoes globally, receiving 3128 cargoes in total or 1367,1083, and 678 cargoes respectively. The average number of voyages completed per vessel was 10.25 in 2023, slightly higher than in 2022, as energy security concerns that previously dissuaded charterers from letting out idle tonnage to the market began to ease.

6.8 RECENT DEVELOPMENTS IN LNG SHIPPING

Sustainability matters for ship and cargo owners on the mid and long term and geopolitics are also playing an important role for shipping in the last years. The shipping industry is involved in a long decarbonisation process, a very relevant topic in the horizon to 2050. The different paths to follow are challenging, and different technical and operational measures are being considered as global and local regulations are becoming tougher and there have been few incentives for shipowners to implement costly solutions so far.

In addition to MARPOL IMO regulations limiting GHG emissions that entered into force last year, the European Union Fit for 55 package regulations (ETS and FuelEU) applicable to shipping add market-based measures to incentivise quicker implementation of solutions. In addition, the IMO requirements to use low sulphur fuels in North Sea, Baltic and the Mediterranean Sea in 2025 may also lead to the use of alternative fuels. Also on a regional level, the US is proposing another regulation to limit air emissions, in particular GHG, which would cover the impact of fuels used on board of ships, for different GHG emissions, and not only CO_2.

Among the IMO's measures, it is worth mentioning the life cycle assessment of marine fuels on a well to wake approach, that covers fuel production, distribution and utilisation modes. The environmental committees MEPC.81 and 82 in 2024 will discuss this matter further, after MEPC.80 issued Draft Guidelines on Life Cycle GHG Intensity of Marine Fuels last year, including 128 fuel pathways and just a few Default Emission Factors Per Fuel Pathways, more specifically 14 marine fuels, among them heavy and light fuel oils, marine diesel oils, LPG, LNG, FAME and renewable diesel, hydrogen, and ammonia.

Although shipping is an efficient transportation mode and considered a traditional industry, well before the implementation of air emission regulations and due to cost and competitiveness factors, many ship-owners have considered measures to reduce GHG emissions, including for instance slow steaming but not only. The next step that is progressively gaining momentum is the use of alternative fuels and technologies which help reducing emissions.

Among the preferred options so far for any type of ship, natural gas and more specifically LNG as fuel has been chosen by a significant number of companies. The main arguments for the use of the cleanest fossil fuel available are the well-established regulatory and technical framework, and an impressive deployment of LNG bunkering infrastructure. In addition, after a very short period of high gas prices in 2022, last year and Q1 2024 saw a very convincing price scenario relative to LNG bunker prices in various markets. Another advantage of using LNG as bunker fuel is an increasing portfolio of ship builders and equipment manufacturers, from fuel tanks to gas fuel supply system to internal combustion engines.

Courtesy Samsung Heavy Industries

As mentioned, regulations for the use of LNG as fuel exist for many years, including IMO IGF code for ships others than gas carriers and the IGC Code for gas carriers. Typically, all new LNG carrier fleets are equipped with dual fuel engines able to burn oil fuel and natural gas. It is also worth mentioning that LNG technology is suitable for the use of synthetic LNG and biogas which is being introduced for the time as a drop-in fuel.

We should also mention that the LNG bunkering infrastructure is growing to respond to the demand, while the old-fashioned "chicken and egg" dilemma is not mentioned anymore by industry stakeholders. Section 8 of this report will cover extensively the topic of LNG Bunkering Vessels and Terminals.

Due to a seasonal higher price of the LNG in 2022, methanol has become more popular in the past months. CAPEX related to methanol fuel installations would also help developments compared to installations needed for cryogenic fuels like LNG. However, there are some drawbacks to consider, such as availability of green methanol and the lower calorific value of this fuel leading to the need of additional bunker capacity on board of the ship to keep similar ship autonomy.

Another marine fuel that is already being used in gas carriers is LPG, mainly propane in internal combustion engines of dual fuel 2-stroke type is being use in many cases on board of new LPG carriers. In this case, most of the newbuild units on order are equipped with this technology and there have been a number of very large gas carriers (VLGC) retrofitted in the last few years as well.

To complete the list of bunker fuels under consideration, ammonia and hydrogen will need more time to be implemented. The main hurdles for the implementation are regulations and technology available. Obviously, it is expected that the price to produce blue or green fuels will be significantly higher than standard fuels which may also delay the adoption of decarbonised ammonia and hydrogen as bunker fuels.

Back to the segment of LNG carriers, still current modern designs are mainly equipped with dual fuel two-stroke engines and mechanical propulsion, typically twin screw, with a few examples of electric propulsion in units for ice-breaking LNG carriers, floating storage and regasification units or LNG bunkering vessels. Typically, LNG carriers are burning the boil-off gas for power production on board, to propel the ship and to mainly produce electricity. At the same time, boil-off gas management is key to controlling the pressure of the cargo tanks. Low boil off gas rate cargo tank technologies and reliquefaction or subcooling systems are preferred to give flexibility in fuel use, so the decision to use gas or oil fuel will also depend on the cargo owner's preferences to optimise the cargo delivered or reduce the fuel cost. Ship-owners will in any case have to comply with stringent regulations and limit the GHG emissions giving preference to the use of gas as fuel, but new concepts based on alternative fuels or technologies are proposed.

One such idea is pre-combustion carbon capture system to produce hydrogen that can be used as a fuel on board. Technologies such as fuel cells and internal combustion engines that will be able to burn hydrogen in the fuel mix or single hydrogen fuel are also under development. LNG carrier builders and ship-owners are also studying the feasibility of post-combustion solutions and one pilot installation has been carried out in 2023 on board of the LNG carrier "SEAPEAK ARWA" under the EverLoNG EU funded project. Among other technologies that are being proposed, wind propulsion systems are mature enough and will provide some advantages in term of fuel consumption reduction.

In addition, biofuels, including biogas (or even synthetic LNG) may be considered to reduce further the GHG footprint. In principle, biofuels may be used similarly to oil fuels in liquid form as main fuel or pilot fuel in gas mode. Then, biogas (or synthetic LNG) could be used as main fuel in gas mode. Obviously, a combination of biofuel and biogas (or synthetic LNG) could be used as pilot fuel and main fuel, respectively, when the engines are running in gas mode. This may the simpler way to reduce emissions since the engines plant onboard will not require any technical modification, although specific fuel tanks for bio or synthetic LNG may be required.

A relevant point still under scrutiny and considered for instance in the FuelEU regulation included in the "Fit for 55" EU package is the methane slip of the engines. Already, engine manufacturers are developing solutions to reduce this amount. Engine manufacturers will also follow any potential global international regulation, for instance IMO rules, to put in place additional solutions to further reduce the levels that are negligible for diesel cycle engines or only gas (spark ignited) technology.

In addition to alternative fuels and technologies to reduce emissions and transportation cost, when looking at unitary freight cost and transportation work, economies of scale may also be a way to improve the LNG carrier designs. Although standard 174,000 to 180,000 m3 ships have become common to keep a full compatibility with terminals worldwide, the designs of 200,000 m3 cargo capacity are getting traction connected to mid-to-long-term charter party contracts, mainly from the United States to the Asia Pacific. HHI and Hanwha Ocean shipyards are mainly involved with some units delivered in 2022, 2023, and earlier this year for Dynagas, while Venture Global has unit still on order. In addition, a new design of 271,000 m3 LNG carrier has been proposed by Hudong shipyard in China and another similar in size by Hanwha Ocean with 5 cargo tanks, similar to the large LNG carriers in service in the Qatar fleet but including the latest technologies for cargo containment and propulsion systems.

The IMO and EU regulations will impact the in-service fleet of LNG carriers similarly to other type of ships, in particular, the less efficient and older LNG carrier because of the higher fuel consumption. It is foreseen that scrap levels will be higher than previous years, but some old units may be converted or used as floating assets for instance, including FSRU or FSU conversions.

Other aspects under scrutiny in connection with emissions reduction and the rapid evolution of technologies are the design life of the ships and the service speed of the ships. Some new designs suggest reducing the speed since the average of LNG carriers is currently around 16 knots. By designing a ship optimised for the actual speed in operation, there may be some advantages in fuel savings, although the design may be able to reach standard service speed of around 19.5 knots which is still considered in many shipbuilding specifications. Regarding the design life, for instance for structural point of view, 40 years have been common. A reduced design life may be more in line with the market expectations nowadays, considering that a ship will possibly become obsolete compared to new designs with modern technologies earlier than originally expected. A flexible LNG carrier design to accommodate future technologies seems also be a realistic option.

In 2023, the appetite for new LNG carrier orders has been lower than in 2022 – a record period that will be difficult to see again in the future. The delay in the second batch of QatarEnergy units has also been a factor in the deceleration of orders. The expectations for 2024 are to maintain similar order levels or slightly above those of 2023, including the mentioned orders for the Qatar expansion projects. Picking up the trend initiated in 2022, Chinese yards gained new orders and as of today, 5 yards are active in the frame of standard 175,000 m3 cargo capacity. There is a record orderbook with approximately half of the fleet in terms of Gross Tonnage on order compared to the total fleet, and the market will have to absorb more than 300 LNG carriers to be delivered in the coming 4 years.

In relation to small scale LNG carriers, several ships on order will also be dedicated to bunkering activities, which are still a growing market specially in Europe, United States, and Asia and Asia Pacific. Middle East has not yet deployed any such units so far but there are projects under discussion. Most of the small-scale LNG carriers are designed with cargo containment and propulsion systems that are different than the equipment for large LNG carriers, and the bunkering ships in particular are equipped with suitable bunkering systems to transfer the LNG to the gas fuel ships. Because of the specific operational profile of the bunkering ships, it is expected that CII regulations will have a bigger impact than for pure small scale LNG carriers.

Further developments in FSRU have happened in 2023, specially, in Europe, and after the boom of fast-track projects mainly in Germany, Netherlands, and Finland, new projects will be deployed in other locations, regardless of geopoliticals, as energy security is a priority. As mentioned, some more conversions may be developed mainly for gas to power applications but not only. Other projects such as the Gaz System unit for Poland newbuilding or the Alexandroupolis and Vasilikos FSRU conversions will become new import terminals in the Baltic and Eastern Mediterranean Sea, respectively.

When talking about FLNG units, a new wave of projects is being discussed and one of the most representative is the ENI for Congo which was commissioned in December 2023. This export terminal is a combination of a processing and liquefaction barge and a converted LNG carrier which is a floating storage unit to increase the total capacity of the terminal. While this type of terminals are expensive, it is a feasible alternative to market stranded gas.

Other interesting segments of liquefied gas carriers which have potential to growth in connection to decarbonisation are ammonia carriers, LCO2 carriers and liquid hydrogen carriers. First, adapting an LPG carrier as ammonia-cargo-capable requires minimal work. Considering the potential for development of blue and green ammonia export/import terminals in the future, many owners are investing in large ammonia carriers, although it is expected that some will carry only LPG or grey ammonia to start with. Nevertheless, we still see some Very Large Ethane Carrier (VLEC) orders linked to shale gas produced in the US, as the main import companies in Asian markets.

In all these cases, the aspiration is to use the cargo as a fuel, as we have already seen in LPG and ethane carriers' cases. Finally, more and larger LCO2 carriers for Carbon Capture, Utilisation and Sequestration (CCUS) projects will be developed, in addition to the four units presently being built at DSIC yard for the Northern Lights project in Norway, one smaller Japanese-built unit delivered in 2023, and the 2+2 multipurpose 22,000 m3 carriers under construction in South Korea which may primarily be used to transport LPG initially.

Common denominators in the shipping industry are efficiency, reduced GHG footprint, and low unitary freight cost, and the challenges ahead are significant. Fortunately, gas carriers and in particular LNG carriers are well placed to respond to the increasing demand for clean energy in a sustainable manner. All industry stakeholders are working together to propose new solutions in line with client expectations and in compliance with a stringent regulatory framework.

Q-Flex Mesaimeer - Courtesy QatarEnergy

7 LNG Receiving Terminals[1]

69.9 MTPA of receiving capacity was added in 2023.

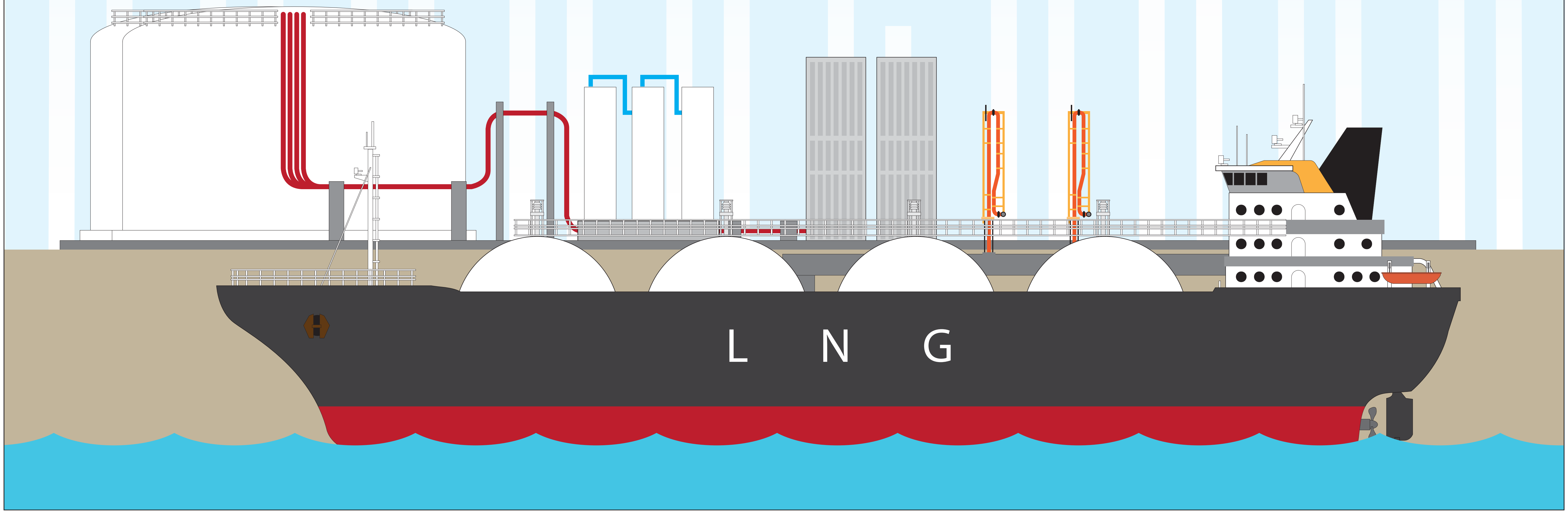
+16 new terminals in 2023

+1 expansion project at existing terminal

China expanded one existing LNG regasification plant

+9 new floating terminals: **Germany (2), Philippines (2), China (1), Turkey (1), France (1), Finland (1), Italy (1)**

271.2 MTPA of new regasification capacity under construction



[1] This report includes terminals with small-scale (<0.5 MTPA) regasification capacity adding large impact on import for the market.

7. LNG Receiving Terminals

As of end-February 2024, global regasification capacity registered 1,029.9 MTPA across 47 markets. In 2023, 69.9 MTPA of regasification capacity addition was seen, with commissioning of 16 new LNG import terminals and one expansion project of existing terminal, and with the largest new capacity of the year from Hong Kong FSRU (Bauhinia Spirit) in China at 6.1 MTPA.

Fujian LNG Receiving Terminal - Courtesy CNOOC

7.1 OVERVIEW

1,029.9 MTPA

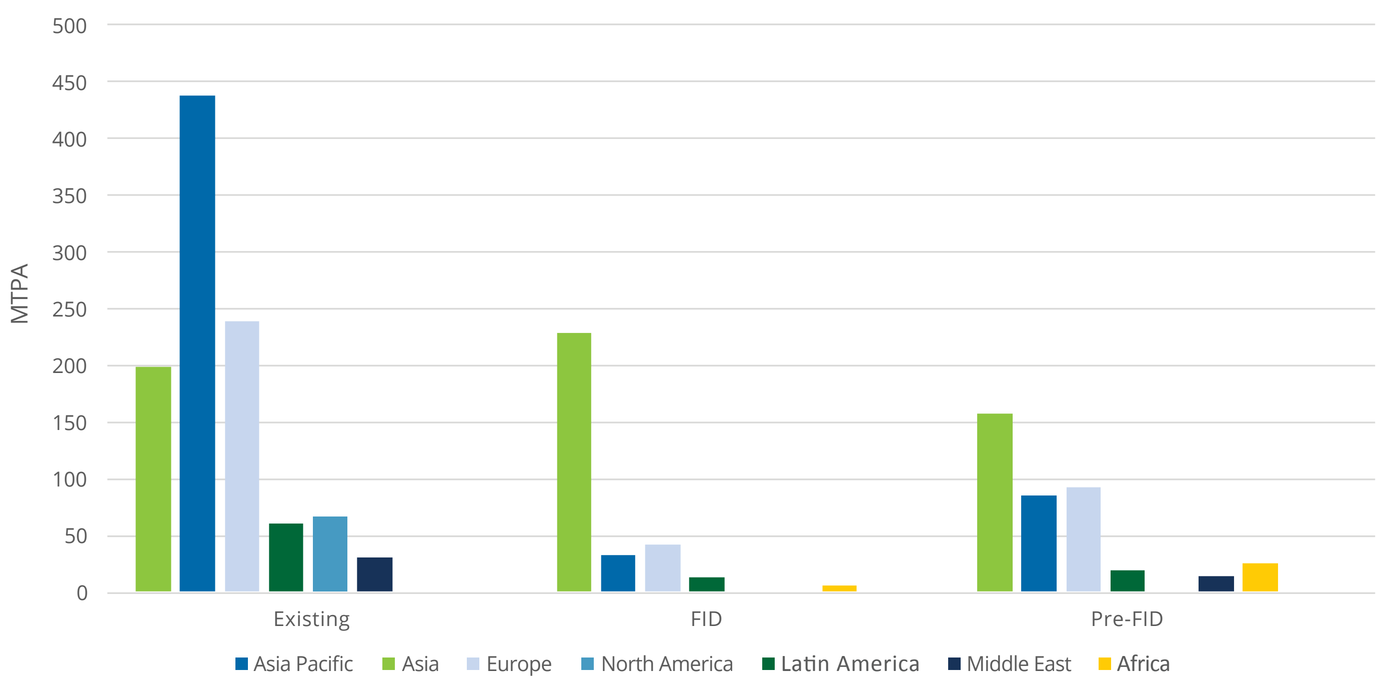
Global LNG regasification capacity as of February 2024

Global regasification capacity additions further spiked in 2023, with 17 projects online across 10 markets, compared with 11 projects commissioning across 8 markets in 2022. Highest capacity addition occurred in Europe at 30 MTPA, followed by 26.9 MTPA from Asia, and 13 MTPA from Asia Pacific. Out of the 69.9 MTPA regasification capacity additions in 2023, 65.1 MTPA were from 16 new terminals and 4.8 MTPA from an expansion project at an existing terminal.

The 6.1 MTPA Hong Kong FSRU (Bauhinia Spirit) in China contributed the largest capacity addition by project, followed by the 5.9 MTPA El Musel onshore LNG in Spain, and the 5.6 MTPA Gulf of Saros FSRU in Turkey. Regasification projects also started in new markets, including the Philippines and Vietnam. The 5 MTPA Batangas Bay LNG became the first LNG terminal in the Philippines, with its commissioning cargo arriving in April 2023. The market's second LNG terminal, the 5 MTPA First Gen LNG, started commercial operation in October 2023. In another Asia Pacific market, Vietnam's first LNG terminal, the 3 MTPA Thi Vai LNG, was brought online in July 2023.

Projects in Europe, including new plans, expansions, and reactivated terminals, have seen rapid progress following the outbreak of the Russia-Ukraine crisis, to enhance LNG import channels. Europe had 14.5 MTPA and 30 MTPA of capacities online in 2022 and 2023, respectively, while capacity additions in early years were very limited. Seven European projects commissioned in 2023, with two in Germany and another five in Finland, Turkey, Italy, Spain, and France. New startups are expected throughout 2024 as well. The 9.9 MTPA Mukran FSRU in Germany and the 4 MTPA Alexandroupolis FSRU in Greece commissioned in February. Construction of three new terminals and four expansion projects is underway and aims to commission in the rest of 2024. As floating terminals offer greater flexibility and require less fixed investment, Europe has kept its preference for floating-based projects over onshore terminals. Out of its seven new projects online in 2023, six are FSRU-based with a total capacity of 24 MTPA.

Figure 7.1: LNG regasification capacity by status and region, end-February 2024



Source: Rystad Energy

7.2 RECEIVING TERMINAL CAPACITY AND GLOBAL UTILISATION

2023 witnessed the highest regasification capacity addition since 2010, at 69.9 MTPA in nameplate capacity or 54.8 MTPA prorated by startup timing. This is supported by the completion of dozens of plans and constructions in Asia, Asia Pacific, and Europe regions. China and the Philippines are the top two drivers of capacity additions, with 21.9 MTPA and 10 MTPA, respectively. The Philippines together with Vietnam became two new LNG markets with their first regasification facilities online in April and July 2023, respectively. This will help lift the region's LNG demand and support the role of gas in the power mix, despite challenges from the cost perspective. Demand for floating-based terminals remain high, as it serves as a viable option to quickly strengthen LNG import capability to ensure energy security around the globe. Besides the two commissioning in the Philippines, 2023 had another seven floating-based terminals online in Asia and Europe, compared with startups of four FSRU-based terminals in 2022.

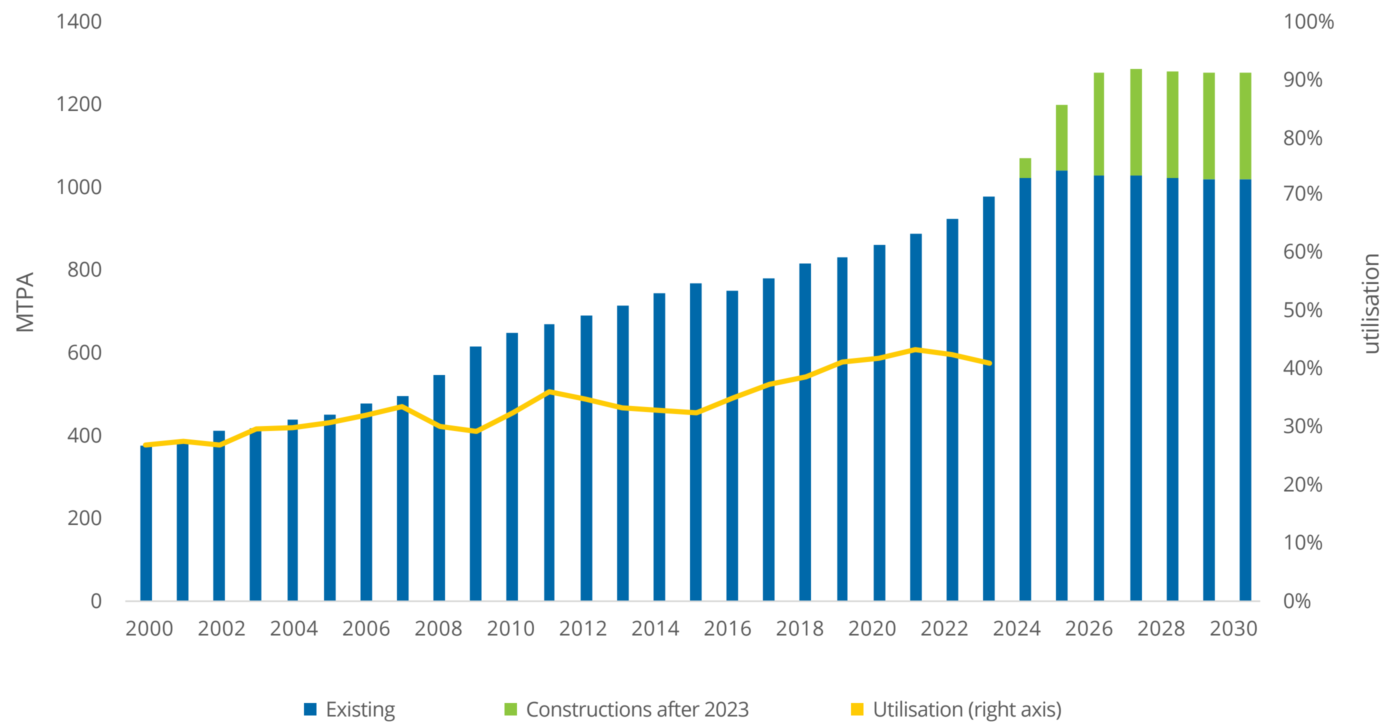
16 new regasification terminals started operations globally in 2023, with a total capacity addition of 65.1 MTPA. Seven were onshore terminals, located in China (Guangzhou Nansha, Tangshan, Tianjin Nangang and Wenzhou), India (Dhamra), Spain (El Musel) and Vietnam (Thi Vai). The 5.9 MTPA El Musel terminal in Spain was reactivated in 2023, after having been idled for nearly a decade due to a lack of demand. Its owner, Enagas, announced plans to restart the terminal's operation as part of its plan to strengthen energy security, following heightened geopolitical tensions in 2022. Besides its regasification function, the terminal will be primarily used for storage and re-exports, with two 150,000 cm LNG storage tanks.

China's Tianjin Nangang LNG phase 1, owned by Beijing Gas, started commercial operation in September 2023, with its first cargo from Australia. The facility currently has two 220,000 cm and two 200,000 cm LNG storage tanks, with another six 220,000 cm tanks planning to complete constructions by late 2024. The terminal will help enhance Beijing Gas's peaking shaving capacity and ensure gas supply for peak winter demand.

Also, Batangas Bay FSU and First Gen FSRU started operations in the Philippines, another seven FSRU-based terminals were brought online in China (Hong Kong FSRU (Bauhinia Spirit)), Finland (Inkoo FSRU), France (Le Havre FSRU), Italy (FSRU Italia), Turkey (Gulf of Saros FSRU), and Germany (Lubmin FSRU and Elbehafen FSRU) in 2023. They added a total capacity of 40.3 MTPA and LNG storage of 1.8 million cm. The 3.8 MTPA Lubmin FSRU became the second regasification facility in Germany, following the start-up of the 5.5 MTPA Wilhelmshaven FSRU in late 2022. In addition, Germany's third floating terminal – Elbehafen FSRU – was put into commercial operation in May 2023, with a regasification capacity of 3.7 MTPA and LNG storage of 170,000 cm. The FSRU vessel Hoegh Gannet arrived at Brunsbuettel's Elbehafen port in early 2023.

One expansion project at an existing terminal came online in 2023, with a regasification capacity of 4.8 MTPA. China's Tianjin Sinopec LNG completed its phase 2 construction in November and brought its total import capacity from 6 MTPA to 10.8 MTPA. It added three 220,000 cm LNG storage tanks.

Figure 7.2: Global receiving terminal capacity, 2000-2030



Source: Rystad Energy

This year, four regasification projects have started operation as of end-February 2024, with a total capacity of 23.9 MTPA. This includes 9.9 MTPA in Germany, 6 MTPA in Brazil, 4 MTPA in China, and 4 MTPA in Greece. 271.2 MTPA of new regasification capacity is under construction globally, as of end-February 2024. This includes 29 new onshore terminals, 17 new floating-based terminals, and 30 expansion projects at existing regasification facilities. Asia, Europe, and Asia Pacific are leading 76%, 10% and 9% of global under-construction regasification capacity, respectively. Market wise, China is leading new builds, followed by India, Pakistan, and Chinese Taipei. China has 153.3 MTPA of capacity under construction, including 20 new onshore terminals and 17 expansion projects at existing terminals. India has five new terminals and four expansion projects under construction with total capacity of 38 MTPA. Pakistan has two new terminals under construction with a total capacity of 14.1 MTPA. Out of the seven new terminals under construction in India and Pakistan, four are floating-based, reflecting the emerging markets' preference for floating terminals.

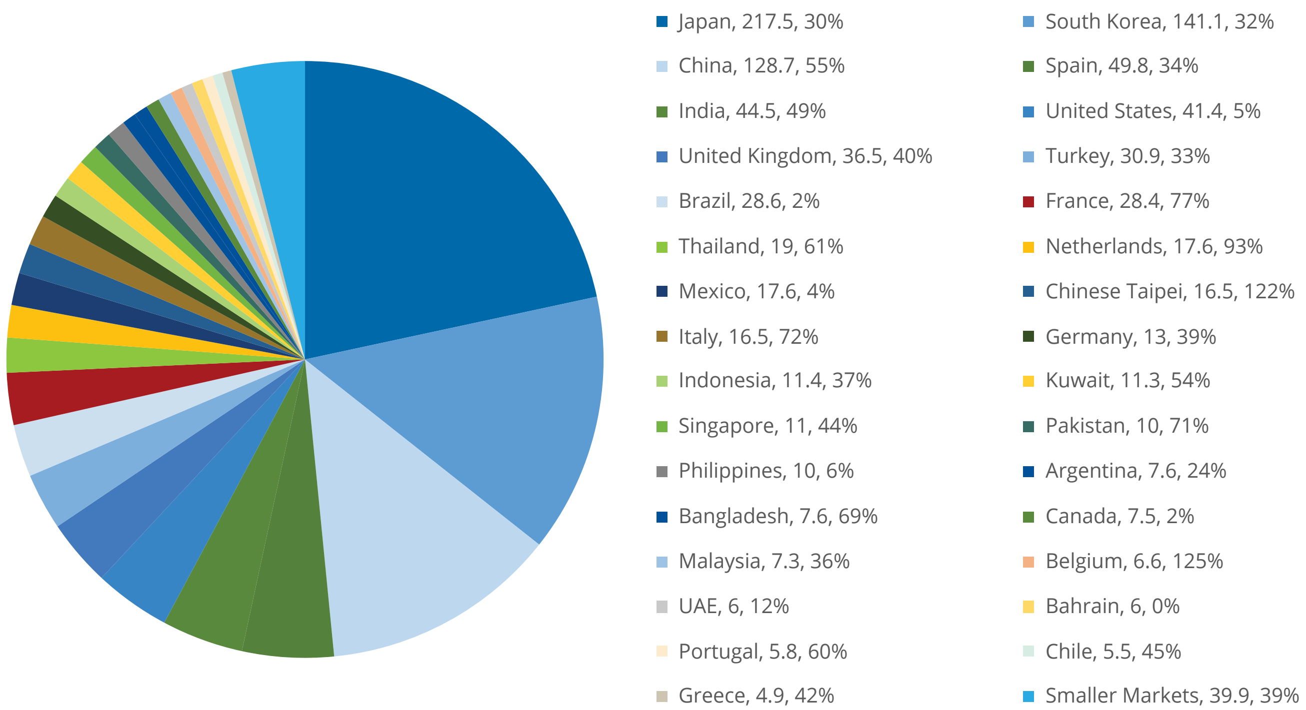
Seven new markets, including Senegal, Australia, Estonia, Ghana, Nicaragua, Cyprus, Antigua and Barbuda are currently building their first LNG import terminals and planning to start LNG imports in 2024-2025. The seven new markets are expected to add 9.9 MTPA of regasification capacity through the construction of one onshore terminal and six floating-based terminals. This also shows that floating-based solutions are generally more popular in emerging markets.

Constructions are also underway in 14 existing markets, including China, India, Pakistan, Chinese Taipei, the Philippines, Belgium, Germany, Vietnam, Poland, Italy, South Korea, France, Brazil, and Panama. Out of the 37 projects under construction in China, 13 were approved in 2022 but only one was approved in 2023. Although terminal approval has slowed in China, its LNG import capacity will continue to trend higher, with the expected massive completion of constructions in the coming years. The 6.5 MTPA Sinopec Longkou LNG terminal in China's Shandong province will be the largest new startup in 2024. The project will add four 220,000 cm LNG storage tanks. Another 13 new terminals currently under construction in China also plan to commission in 2024, adding 51.8 MTPA in total. Among them, top terminals by regasification capacity include Huizhou LNG (6.1 MTPA), Jiangsu Yancheng Binhai LNG 1 expansion (6 MTPA), Chaozhou Huaying LNG (6 MTPA), and Jiangsu Guoxin Rudong LNG (6 MTPA).

Global regasification utilisation has seen a downtrend in 2023, from 43% on average in 2022 to 41%. Tepid demand in the main regional markets, including Europe and Asia Pacific, and sizable new startups of regasification terminals in 2023 dragged down the world's average utilisation. Following a spike in 2022 to secure LNG supply, Europe's average utilisation in 2023 dropped to 54% from 62% in 2022, as European LNG demand is lower with gas storage remaining at high levels. Likewise, regasification utilisation edged lower in Asia and Asia Pacific from 43% on average in 2022 to 41% in 2023, as regasification capacity addition surpassed demand growth in these two regions.

7.3 RECEIVING TERMINAL CAPACITY AND UTILISATION BY MARKET

Figure 7.3: LNG regasification capacity by market (MTPA) and annual regasification utilisation, 2023



Source: Rystad Energy

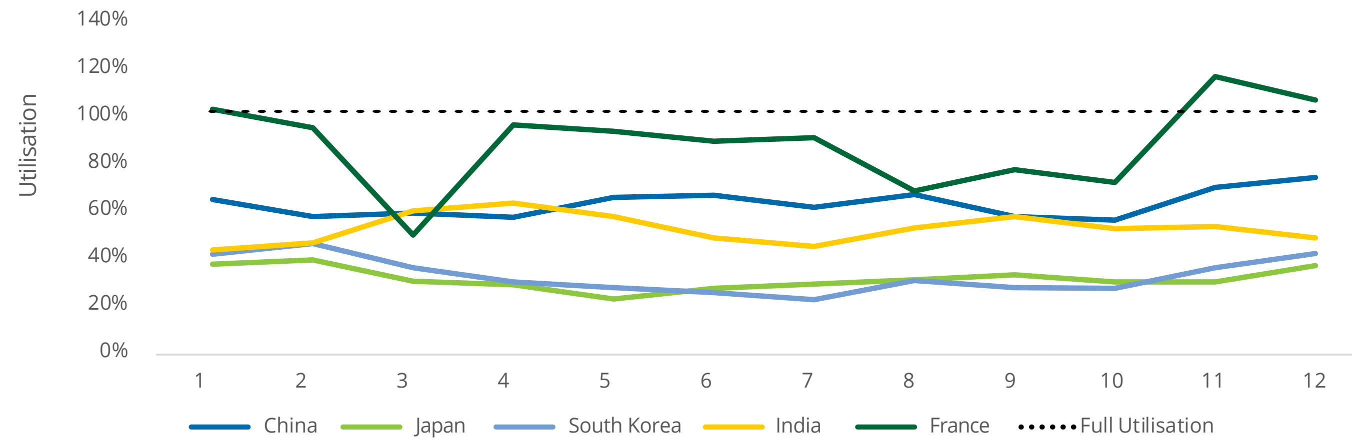
As one of the first markets to build regasification terminals, Japan has remained the largest owner of LNG import capacity, with 217.5 MTPA as of end-February 2024, making up nearly 22% of global capacity. No capacity was added in Japan in 2023, following startups of the 3.2 MTPA Hitachi LNG expansion project in 2021 and the 1 MTPA Niihama LNG in 2022. Japan's regasification utilisation continued to edge lower in 2023 – from 34% in 2022 and 37% in 2021 – to 30% as higher output of nuclear power has limited LNG demand for power, which is the main consumption sector of gas in Japan. Japan's LNG inventory remained at high levels in 2023, also curbing buying incentive of Japanese companies.

With eight existing terminals at 141.1 MTPA in total, South Korea has remained the second largest market for regasification capacity. Three of the world's five largest LNG import terminals are in South Korea, including Incheon LNG (54.9 MTPA), Pyeongtaek LNG (41.0 MTPA) and Tongyeong LNG (26.5 MTPA). South Korea's high regasification capacity has helped the market boost LNG flows and become one of the world's largest LNG importers, behind Japan and China. The latest new startup was seen in 2019, namely the 1 MTPA Jeju LNG. One project kicked off construction in early 2023 – South Korean company POSCO will expand its Gwangyang LNG terminal from the current 3.1 MTPA to 5.2 MTPA by 2025, with construction of two 200,000 cm LNG storage tanks. Similar to Japan, South Korea has increased its nuclear power output with higher capacity available. South Korea announced its 10th Basic Plan for Electricity Supply and Demand, and the energy policy reverses previous plans to phase out nuclear power generation. South Korea's regasification utilisation edged lower to 32% on average in 2023, from 33% in 2022 and 34% in 2021.

As the world's third largest market by regasification capacity, China experienced high-speed growth in gas demand before 2022, supported by strong economic growth, rapid urbanisation, and industrialisation. As China's gas demand growth has surpassed domestic gas production, LNG imports have become a crucial supply to meet growing demand across sectors. The share of LNG imports in China's total gas supplies reached 29% in 2021 when China overtook Japan to become the world's largest LNG importer. Significant regasification construction plans have been carried out in China to bring in more LNG flows. As of end-February 2024, China's regasification capacity has reached 132.7 MTPA, since its first LNG import terminal Guangdong Dapeng LNG started in 2006. Six regasification projects commissioned in 2023, including Tangshan LNG phase 1, Tianjin Nangang LNG phase 1, Hong Kong FSRU (Bauhinia Spirit), Wenzhou LNG, Guangzhou Nansha phase 1 and Tianjin Sinopec LNG phase 2. They added a total capacity of 21.9 MTPA. 2024 has seen the startup of the 4 MTPA Shandong (Qingdao) LNG phase 3 in January. With the construction of 20 new terminals and 17 expansion projects at existing terminals underway, another 153.3 MTPA of regasification capacity is expected to be added in China by 2030. Considering massive startups in the coming years, China will likely surpass South Korea in terms of regasification capacity and narrow the gap with Japan.

With the impact of the COVID-19 pandemic receding, China was able to restore gas demand growth in 2023, following an unprecedented slowdown in 2022. However, a modest year-on-year growth of 6.9% was below market expectations. Chinese LNG importers continued to stay away from spot market in 2023, and even retreated during the year could not incentivise more buying from China. Besides the lower-than-expected demand recovery, China's abundance of LNG term contracts also limited its spot buying. Contractual volumes remained price competitive against spot cargoes most of the time. China's regasification utilisation was about 55% in 2023, similar with the level in the prior year, but much lower than the over 80% in 2020 and 2021. Its utilisation was above 70% only last December, and the shoulder season saw rates around 60%. With contractual volumes as a solid base of LNG supply, spot LNG import mainly served as a peak shaving source in peak demand seasons, namely winter and summer. Going forward, with the rapid growth of China's regasification capacity and slowed growth in LNG demand, the market's regasification utilisation is expected to plateau at 40-50% and is unlikely to rebound to the record-high levels of 80-90% seen in 2020 and 2021. In the long run, China's LNG imports is likely to see rising competition from piped gas imports, especially with the ramp-up of Power of Siberia 1 from Russia, and with the planned Power of Siberia 2 also from Russia, as well as with Line D from Central Asia.

Figure 7.4: Monthly regasification utilisation by top five LNG importers, 2023



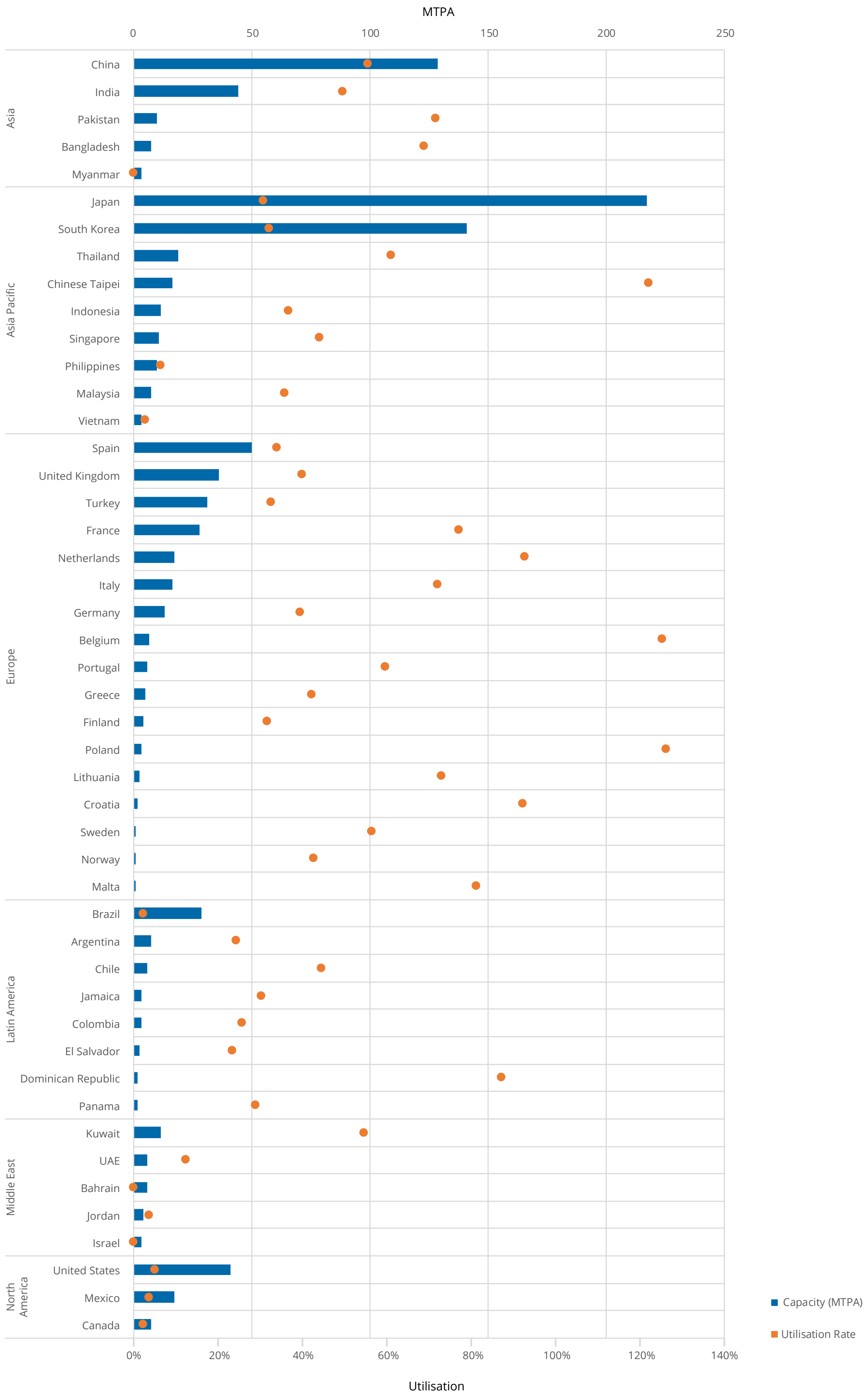
Source: Rystad Energy

India rose to become the be world's fourth largest LNG importer in 2023, with 22 MT LNG imports. India has seven LNG import terminals totaling 44.5 MTPA as of end-February 2024, overtaking the US to become the fifth largest market by regasification capacity. The latest startup was seen in April 2023, namely the 5 MTPA Dhamra LNG project. The 17.5 MTPA Dahej LNG ranks as the world's fifth-largest terminal by import capacity. On the back of its regasification capacity additions, India saw rapid growth in LNG imports in the period 2010-2020, making it one of the top importing markets. To further bring in more LNG, India has planned many import terminals. Five new terminals and four expansion projects at existing terminals are currently under construction, with a total regasification capacity of 38 MTPA. Three of them will be floating-based terminals, which could still face delays or cancellations amid the shortage of FSRU vessels around the world. India's sensitiveness to LNG prices also weighs on infrastructure investors' confidence level in terminal constructions. Dahej LNG maintains high utilisation at about 90%, while other terminals operated at less than 50% of nameplate capacities. Average regasification utilisation in India remained largely unchanged at 49% in 2023.

France comes after India and was the fifth-largest LNG importer in 2023, with a total volume of 21.8 MT, down from 24.9 MT in the prior year. With gradual easing of energy crisis and ample gas storage in 2023, Europe's LNG buying activity dropped. In France, average regasification utilisation fell from over 100% in 2022 to 77% in 2023. Utilisation in March 2023 was only 49%, but the rate reached 114% in November and 105% in December, due to peak winter demand. TotalEnergies has installed the FSRU vessel Cape Ann at the port of Le Havre in 2023, with a regasification capacity of 3.7 MTPA and LNG storage capacity of 145,130 cm. France is expanding Fos Cavaou LNG from the current 6 MTPA to 8 MTPA. The expansion project is expected to commission in 2026.

As the sixth largest LNG importer, Chinese Taipei imported 20.2 MT of LNG in 2023. It had strong performance in regasification utilisation which remained at noticeably high levels of over 120%. Chinese Taipei currently has two LNG import terminals, with a total regasification capacity of 16.5 MTPA. Its first terminal – the 10.5 MTPA Yung-An LNG – was commissioned in 1990. Another terminal – the 6 MTPA Taichung LNG – consists of two phases which started operations in 2009 and 2021, respectively. Backed by firm LNG demand particularly from the power sector and high regasification utilisation, Chinese Taipei is building another two regasification projects. The 3 MTPA Taoyuan LNG and the 4.5 MTPA Taichung LNG phase 3 are currently under construction and aim to commission in the coming years.

Figure 7.5: Receiving terminal import capacity and regasification utilisation by market, 2023



Source: Rystad Energy

Spain was the seventh-largest LNG importer in 2023, with LNG imports falling 20% year on year to 16.8 MT, in line with the overall tepid demand in Europe. The market's regasification utilisation dropped from 50% in 2022 to 34% in 2023. Spain owns the world's fourth largest regasification capacity at 49.8 MTPA with seven terminals, as of end-February 2024. As one of the massive regasification construction plans by Europe, Spain reactivated the idled 5.9 MTPA El Musel onshore terminal in August 2023 to strengthen its LNG import capacity. The terminal also offers storage and reloading services, with LNG storage capacity of 300,000 cm.

Heightened geopolitical tensions in 2022 spurred a regasification construction spree in European markets to reduce dependency on Russian gas and enhance energy security. Europe expedited its regasification startups in 2023, with a record-high of 30.0 MTPA commissioning, accounting for about 40% of global capacity additions last year. Except for the El Musel onshore terminal, the rest of 2023 startups are all FSRU-based. Germany had two terminals online last year, including the 3.8 MTPA Lubmin FSRU and 3.7 MTPA Elbehafen LNG FSRU, which commissioned in January and May 2023, respectively. Besides, Turkey, France, Finland, and Italy had FSRU-based terminals online as well, with a regasification of 5.6 MTPA, 3.7 MTPA, 3.7 MTPA and 3.7 MTPA, respectively. As of end-February 2024, two projects have been commissioned in Europe this year, including Germany's 9.9 MTPA Mukran FSRU and Greece's 4 MTPA Alexandroupolis FSRU. 12 projects across seven European markets are under construction, with a combined regasification capacity of 28 MTPA. 65% of the new capacity under construction will come from onshore terminals. Besides the significant startups of floating-based terminals that have been seen from 2022, European markets such as Belgium, France, Poland, and Germany have also planned and carried out onshore expansion projects on existing terminals to further strengthen LNG import capacity.

Germany is expected to add the largest amount of regasification capacity among European markets, projected at 46 MTPA. This involves building terminals at four sites, namely Wilhelmshaven, Elbehafen, Mukran and Stade, each with one or two phases of construction and with the startup timelines ranging from 2022 to 2027. Germany's regasification capacity is expected to meet over 60% of its gas demand once all terminals have started operation. This year witnessed the startup of the 9.9 MTPA Mukran FSRU in February. Germany's regasification utilisation registered 39% in 2023. Among German terminals, Wilhelmshaven had the highest utilisation at about 60% in 2023. Wilhelmshaven FSRU's utilisation dropped briefly last June, following extensive maintenances at several US LNG plants, as the US has been the largest LNG supplier to Germany.

Europe's regasification utilisation dropped to 54% on average in 2023 from its record high 62% in the prior year, with a notable increase in its regasification capacity, while LNG imports remained flat. Europe's gas balance has largely improved in 2023, despite the sustained Russia-Ukraine conflict and low gas transmissions from Russia to Europe. Regional gas demand trended lower with increased output of renewables and overall mild weathers in winter. Its gas storage levels remained at five-year highs, causing lower buying incentive of European importers. France ran its LNG import terminals at nearly 77% of utilisation, dropping from over 100% in 2022. Belgium's regasification utilisation fell from nearly 170% in the previous year to 125% in 2023, although the level is still much higher than most of other markets. With improving balance of European market, its gas price benchmark TTF has seen major retreat last year and averaged $13.2/mmBtu, with a 67% year-on-year decrease. Russia exported about 47.8 billion cubic meters of pipeline gas to Europe in 2023, down 43% year on year and down 71% from the pre-conflict levels. At the meantime, the US continued to send high volumes of LNG to Europe, with 56.6 MT in 2023 and accounting for 47% of the total European imports.

As of end-February 2024, the US is the sixth-largest market for regasification capacity, at 41.4 MTPA in total. Despite the relatively high regasification capacity, its demand for LNG imports has remained low. Average utilisation of regasification terminals was only around 5% in 2023. Over 80% of US market's LNG imports were received by terminals in Puerto Rico. LNG imports by Puerto Rico grew nearly 70% from a year earlier to 1.72 MT. Its regasification utilisation rose to 56% in 2023 from 28% in 2022. The 1.1 MTPA San Juan FSRU was brought online in 2020 and sends out LNG by truck to small industrial users and other consumers. The terminal planned to berth larger LNG carriers at San Juan from 2022, but the plan was delayed due to cons by environmental group. The project restarted in mid-2023 and plans to complete construction in 2024. Average regasification utilisation in the North America region, including the US, Mexico, and Canada, was only 4% in 2023. The region has tended to prioritise LNG exports in recent years and will drive the global liquefaction capacity addition.

Latin America's regasification capacity remained unchanged at 53.8 MTPA in 2023, compared to 2022. As of end-February 2024, the region has seen one new project commissioning this year, namely the 6 MTPA Para FSRU in Brazil. Brazil currently has seven FSRU-based terminals, with a total regasification capacity of 34.6 MTPA, accounting for 58% of Latin America's capacity as of end-February 2024. Brazil's LNG imports continued to fall from 1.9 MT in 2022 to 0.7 MT in 2023, as strong rainfalls and high reservoir levels lifted hydropower output and weighed on gas-for-power demand. This dragged down its regasification utilisation to only 2% in 2023 from about 7% in 2022. The instability of the domestic renewable output has resulted in uncertainty over Brazil's LNG import demand, and therefore, flexible FSRU-based terminals will likely remain a preferred option in Brazil, compared to onshore terminals. Four new floating-based terminals and one onshore terminal are currently under construction in Latin America, with a combined capacity of 10.2 MTPA. This includes the 4 MTPA Terminal Gas Sul LNG and the 3.8 MTPA Sao Paulo FSRU in Brazil, the 1.1 MTPA Sinolam LNG in Panama, the 1.3 MTPA Puerto Sandino FSRU in Nicaragua, and a small-scale onshore import terminal in Antigua and Barbuda. Last year, Chile approved its fourth terminal – the 3 MTPA GNL Penco-Lirquen – which plans to commission in 2027. The project will add an LNG storage capacity of 170,000 cm.

Dapeng LNG Receiving Terminal - Courtesy CNOOC

Table 7.1: LNG regasification terminals, January 2023 to February 2024

Receiving capacity	New LNG onshore import terminals	Number of regasification markets
+93.9 MTPA Net growth of global receiving capacity	**+7** Number of new onshore regasification terminals	**+2** New markets with regasification capacity as of end-February 2024
Net nameplate regasification capacity grew by 93.9 MTPA from end-2022 and reached 1,029.9 MTPA by February 2024.	New onshore regasification terminals were added in China (Tangshan, Wenzhou, Tianjin Nangang LNG, and Guangzhou), Spain (El Musel), India (Dhamra), and Vietnam (Thi Vai).	The number of markets with regasification capacity increased from 46 in 2022 to 47 by February 2024, with the addition of two new markets – the Philippines and Vietnam, and with a terminal in another market Egypt turning idled with FSRU leaving.
Capacity at new terminals was 85.1 MTPA while expansion projects amounted to 8.8 MTPA.	Two expansion projects at existing onshore terminal were completed in China (Tianjin Sinopec LNG, Shandong Qingdao).	No new market emerged in 2024 as of end-February 2024.

Source: Rystad Energy

7.4
RECEIVING TERMINAL LNG STORAGE CAPACITY

81.39 mmcm
of global storage capacity, as of end-2023

In line with the pace of global regasification terminal constructions, global LNG storage capacity witnessed strong growth in 2023 and reached 81.39 million cubic metres (mmcm). 16 new terminals and 2 expansion projects commissioning last year brought a total LNG storage capacity of 7.15 mmcm. Mainly driven by China, Asia added the highest storage capacity in 2023 at 5.14 mmcm across 8 regasification projects, making up 72% of global capacity addition. Europe followed, with 1.4 mmcm of storage capacity commissioning last year across six markets.

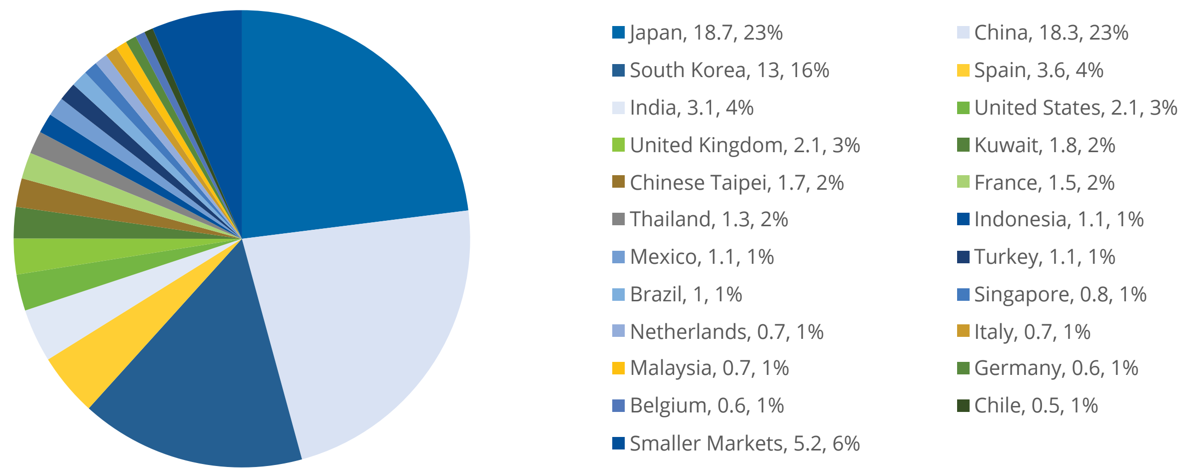
The three largest markets by regasification capacity, namely Japan, China, and South Korea, have the highest share of existing global LNG storage capacity at 62%. 74% of global LNG storage capacity comes from Asia and Asia Pacific, as LNG has become essential to ensure regional gas supplies and energy security for the two regions. Terminal-wise, South Korea's Pyeongtaek LNG has the largest storage capacity at 3.36 mmcm, compared to the world's average level per terminal at 0.44 mmcm. The terminal starting operation in 1986 and owned by KOGAS, has a regasification capacity of 40.6 MTPA, making it the world's second-largest regasification facility by import capacity.

Last year, 7.15 mmcm of LNG storage capacity was added, up from an addition of 2.68 mmcm in 2022. China brought online 4.78 mmcm of storage capacity in 2023, with the startups of Tianjin PipeChina LNG phase 2 (1.1 mmcm), Tianjin Nangang LNG phase 1 (0.84 mmcm), Tangshan LNG phase 1 (0.8 mmcm), Wenzhou LNG (0.8 mmcm), Tianjin Sinopec LNG phase 2 (0.66 mmcm), Guangzhou Nansha LNG phase 1 (0.32 mmcm), and Hong Kong FSRU (Bauhinia Spirit) (0.26 mmcm). They make up 67% of the world's LNG storage capacity addition in 2023. China has been expanding its LNG storage capacity rapidly with the startup of new terminals and expansion projects. The market currently has 29.1 mmcm of storage capacity under construction. Among the projects under construction, Jiangsu Yancheng Binhai LNG 1 expansion and Zhejiang Ningbo LNG phase 3 have the highest LNG storage capacity additions per regasification projects. Together, the projects will have six 270,000 cm LNG storage tanks, which is the world's largest capacity per tank.

Last year, 5.36 mmcm of capacity was added at nine onshore terminals across four markets, namely China, India, Vietnam, and Spain. China contributed over 80% of the total onshore LNG storage capacity additions. At the meantime, 1.79 mmcm of storage capacity was added at nine floating-based terminals. Six of these are in Europe, adding 1.1 mmcm.

Two new markets emerging in 2023, namely the Philippines and Vietnam, added 0.61 mmcm of storage capacity in total. The Philippines's Batangas Bay LNG terminal has 137,500 cm of storage via FSU vessel and 120,000 cm via two onshore LNG storage tanks. 173,000 cm was added in First Gen FSRU, also in the Philippines. Vietnam had a 180,000 cm storage capacity commissioning at Thi Vai LNG onshore terminal.

Figure 7.6: LNG storage tank capacity by market (mmcm) and percentage of total, 2023



Source: Rystad Energy

7.5
RECEIVING TERMINAL BERTHING CAPACITY

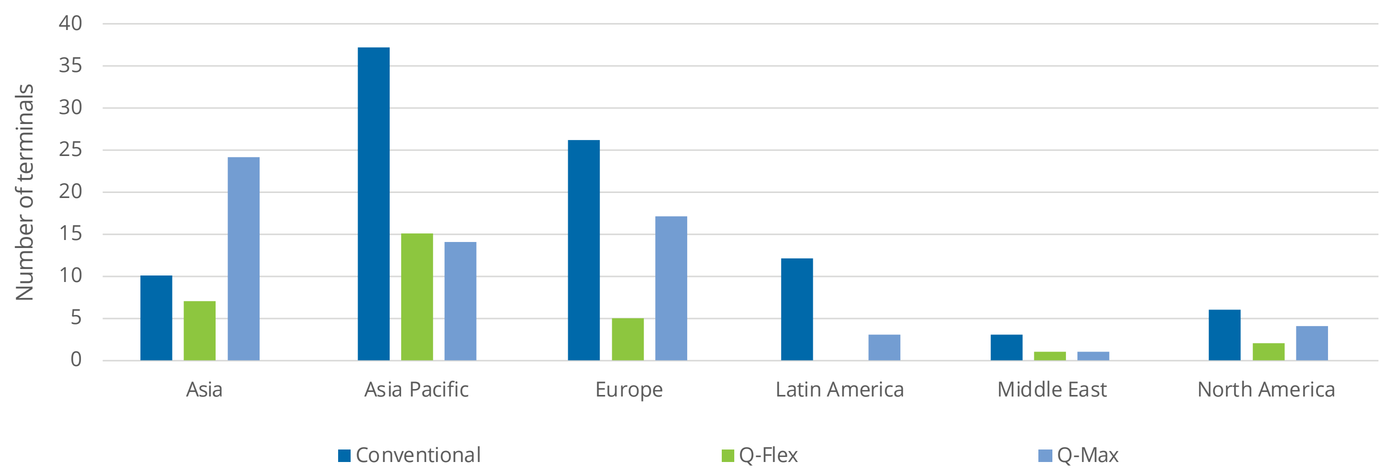
The berthing capacity of receiving terminals determines the size and type of LNG carriers that can offload at the terminal. There are generally three types of LNG carriers categorised by size, including conventional vessels typically with a capacity between 125,000 and 175,000 cm, Q-Flex carriers at about 210,000 cm, and Q-Max carriers at about 260,000 cm.

Among the world's 187 operational regasification terminals as of 2023, 94 terminals can handle conventional carriers. Out of the 16 new startups in 2023, eight can accommodate conventional vessels. With growing storage capacity and the rising use of Q-Class vessels, which currently have the largest capacity among LNG carriers, the berthing capacity of LNG import terminals has also increased to allow for flexibility on LNG shipping.

As of 2023, Q-Max carriers can berth at 63 terminals worldwide, with 24 in Asia, 14 in Asia Pacific, 17 in Europe, 3 in Latin America, 1 in Middle East, and 4 in North America. Q-Flex vessels can discharge at 30 terminals around the globe, with 22 located in Asia and Asia Pacific. Among the 2023 new startups, seven can accommodate Q-Max carriers and one has Q-Flex berthing capacity.

Among the 142 operational onshore terminals, 82 can berth Q-Max and Q-Flex carriers, accounting for 58% of the onshore facilities. Most of floating and offshore terminals are designed to accommodate conventional carriers, with only 24% of these terminals able to handle Q-Class vessels. Five new onshore terminals starting operation in 2023 have berthing capacity to handle Q-Max carriers. Three are located in China. Out of the nine floating and offshore terminals commissioning in 2023, only two can berth Q-Max vessels – the 3.7 MTPA Elbehafen FSRU 1 in Germany and the 6.1 MTPA Hongkong FSRU in China.

Figure 7.7: Number of LNG receiving terminals by maximum berthing capacity, and region, as of 2023



Source: Rystad Energy

7.6 FLOATING AND OFFSHORE REGASIFICATION

52.13 MTPA

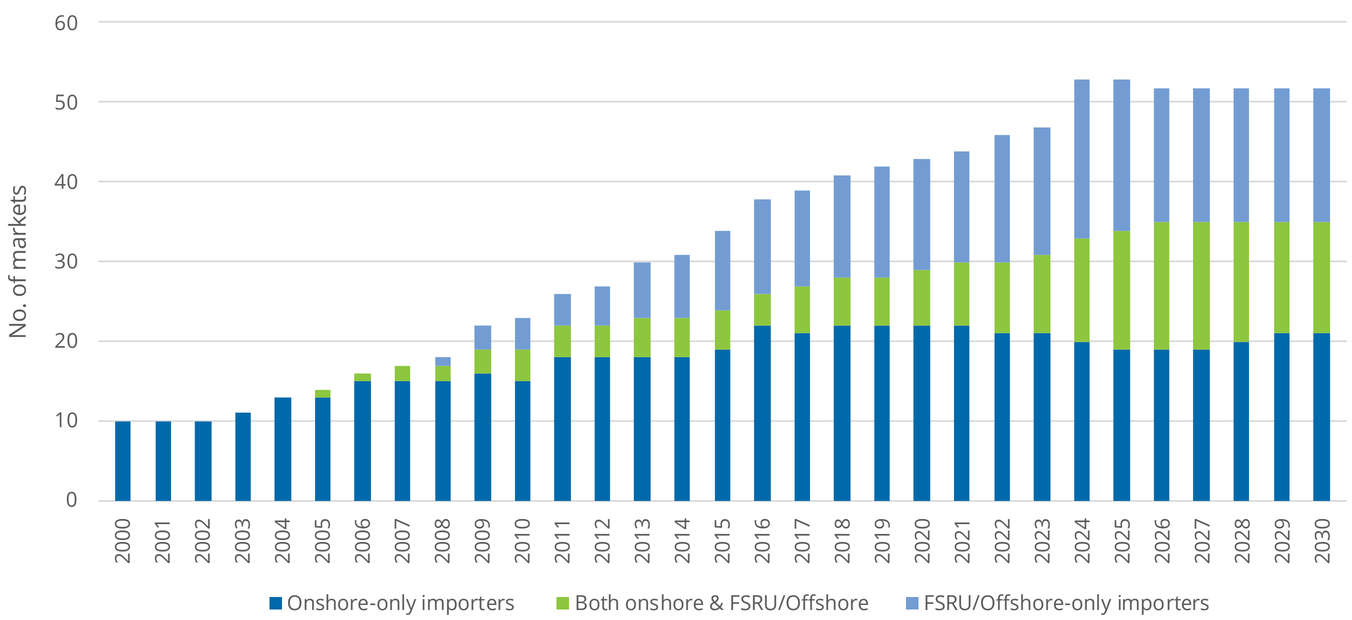
of floating and offshore terminals under construction, as of end-February 2024

Floating and offshore regasification developments have seen steady growth, with significant startups of FSRU-based terminals around the world, and with new markets beginning LNG imports. There are 49 floating and offshore terminals around the world, with a total regasification capacity of 200.9 MTPA, as of end-February 2024. They make up around 20% of global regasification capacity. FSRU-based terminals have become preferrable in new markets, although onshore terminals still dominate market share. As of end-February 2024, there are 17 floating and offshore regasification projects under construction, totaling 52.1 MTPA. Most are expected to start operation in 2024-2025. From 2021 to 2023, four new markets began LNG import following the startups of FSRU-based terminals, including Croatia in 2021, El Salvador and Germany in 2022, and the Philippines in 2023.

Nine new floating-based projects have been commissioned in 2023, with a capacity addition of 40.3 MTPA. As the massive regasification plans in Europe have been gradually completing constructions, the region witnessed six floating terminals commissioning last year, with a combined capacity of 24.1 MTPA, to further strengthen LNG import capacity. In Asia and Asia Pacific, 2023 had three new floating terminals commissioning, with two in the Philippines and one in China.

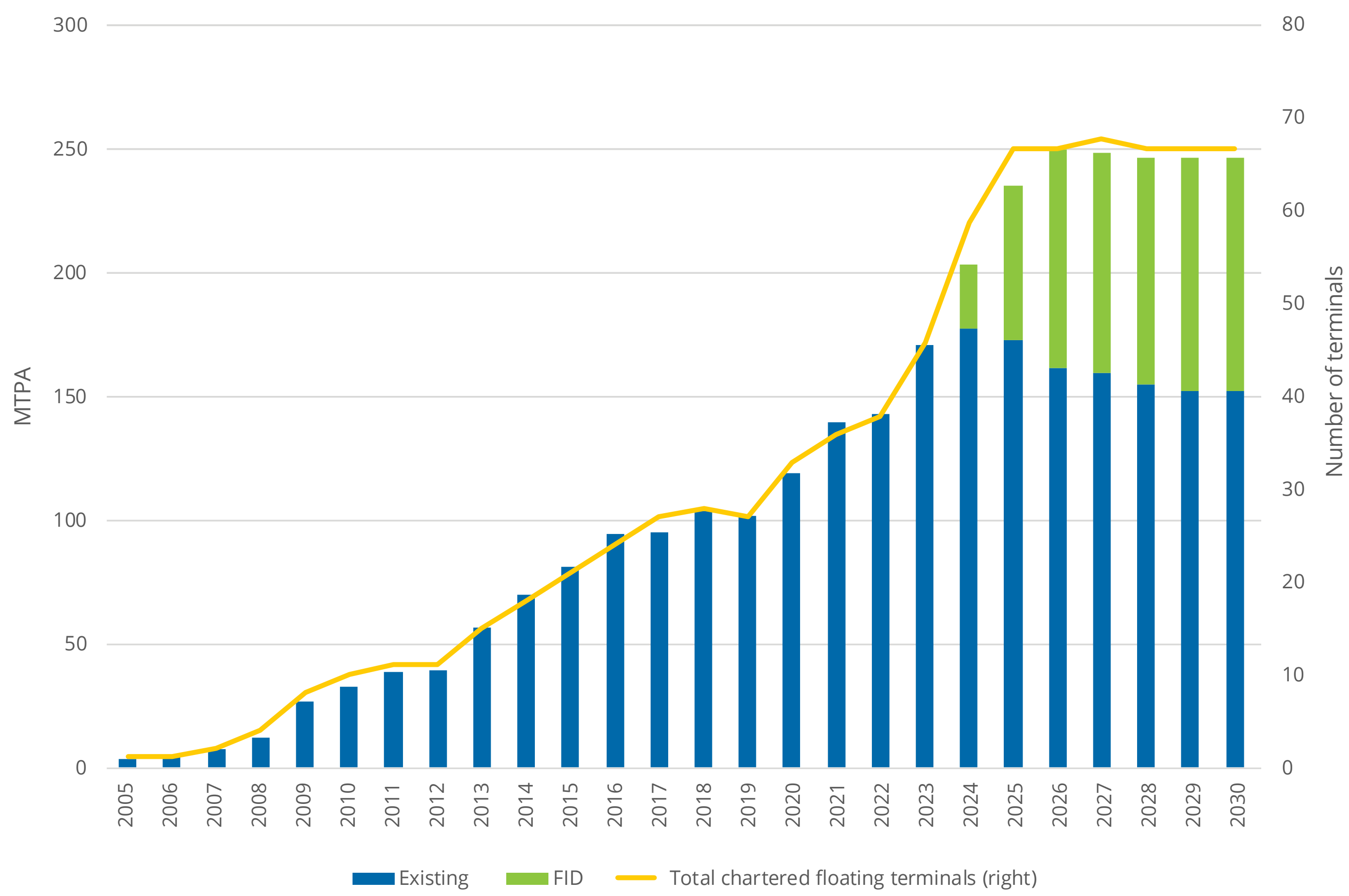
There are 17 floating and offshore terminals globally under construction as of end-February 2024, with a combined capacity of 52.1 MTPA. This includes 28 MTPA from Asia and Asia Pacific, 9.8 MTPA from Europe, 10.2 MTPA from Latin America and 4.2 MTPA from Africa. India is leading the new builds of floating-based projects, with three projects or 16 MTPA to be online in 2025-2026.

Figure 7.8: Number of regasification markets by type, 2000-2030



Source: Rystad Energy

Figure 7.9: Floating and offshore regasification capacity by status and number of terminals, 2005-2030



Source: Rystad Energy

Most new markets emerging in the past 10 years have entered the LNG import sector by installing FSRUs. Among the 47 existing LNG import markets as of end-ebruary 2024, 16 were floating and offshore-only importers, with another 10 importing LNG via both floating-based and onshore terminals, and 21 onshore-only importers. Only 7 markets purely relied on floating-based terminals back in 2013. FSRU's flexibility and convenience on construction, as well as lower fixed investment compared to onshore terminals can help new markets meet demand in the short term. The energy crisis in 2022 pushed European markets to deploy massive regasification terminals which are mainly floating-based, due to the urgency of expanding LNG import capacity and reducing dependency on Russian pipe gas.

Established gas markets still prefer onshore terminals, as they typically require larger regasification capacity and LNG storage tanks to meet demand. China, the third largest market by regasification capacity, currently has 29 terminals (46 projects) totaling 132.7 MTPA. 28 terminals (45 projects) of them are onshore terminals. China only has one FSRU-based terminal as of end-February 2024, namely the 6.1 MTPA Hong Kong FSRU (Bauhinia Spirit) which commissioned in 2023. Compared to floating-based terminals, onshore terminals have flexibility on capacity settings and expansions. They can also reduce exposure to risks from weather conditions, vessel performance and chartering renewal.

7.7 RECEIVING TERMINALS WITH RELOADING AND TRANS-SHIPMENT CAPABILITIES

Highest re-exports in 2023: Spain,

1.54 MT

LNG import terminals have tended to extend their service portfolio in recent years, from only traditional regasification service to other services, such as reloading, trans-shipment, small-scale LNG bunkering and truck-loading. An integrated LNG hub can help importers expand their trading business by leveraging cross-market arbitrage and their LNG portfolio by holding term contracts. A growing number of terminals have enhanced their facilities with reloading and trans-shipment capabilities aiming to better address the needs of the evolving market.

2023 global LNG re-exports grew 10% from the year-earlier level of 7.25 MTPA to 7.97 MTPA, with 21 markets re-exporting cargoes, up from 18 in 2022. The increase was mainly driven by Asia and Asia Pacific regions, where LNG re-exports combined rose from 2.96 MTPA in 2022 to 3.79 MTPA last year. Their combined share in global LNG re-exports increased from 41% to 48%. Tepid demand and high LNG inventories in the two regions have prompted them to lift LNG re-exports.

Spain remains the world's largest LNG re-export market in 2023, despite a drop in its volume from 1.67 MTPA a year earlier to 1.54 MTPA. This makes up 19% of global LNG re-exports. The fact that Spain has the highest regasification capacity in Europe has made it a main regional LNG hub and allowed it to further redistribute LNG cargoes to other markets in Europe, such as Italy, the Netherlands and France. The 5.9 MTPA El Musel terminal in Spain was reactivated in 2023, after having been idled for nearly a decade due to a lack of demand. Its owner, Enagas, announced plans to restart the terminal's operation as part of its plan to strengthen energy security, following heightened geopolitical tensions in 2022. The terminal has two 150,000 cm LNG storage tanks. The terminal will be primarily used for storage and re-exports. However, concerns about Europe's long-term gas demand and the significant startups of new terminals in Europe may weigh on the long-term perspective of El Musel.

China rose to be the second largest LNG re-export market in 2023, with the volume growing from 0.75 MTPA in 2022 to 1.39 MTPA in 2023. This accounts for 17% of global LNG re-exports and reached a record-high since China started its first LNG re-export in 2015. Increased volume was mainly driven by arbitrage opportunities. The main destinations included neighboring markets South Korea and Japan, as well as European markets. China's LNG re-exports were mainly from PipeChina's 3 MTPA Hainan Yangpu LNG terminal, one of China's terminals with reloading and trans-shipment capabilities. From late 2018, CNOOC began reloading service at Yangpu LNG terminal to other terminals, resulting in higher utilisation rates. In January-November 2023, Yangpu Port exported 19 cargoes to South Korea, Japan, Thailand, Bangladesh, Kuwait, and India.

Zhejiang Ningbo LNG terminal completed the conversion of an LNG storage tank into bonded warehouse for re-loading in 2023. It has become the largest LNG bonded warehouse in East China, with storage capacity of 320,000 cm. In September 2023, an LNG carrier carried out a four-day bonded LNG reloading operation at the terminal, to deliver 65,000 tonnes of bonded LNG to the Himeji port in Japan. This marks the start of bonded LNG re-export trading in East China, which is of great significance for China to expand its trading on the international market. Zhejiang Ningbo LNG aims to build a regional LNG storage, transportation, and trading centre, in line with the Belt and Road initiative.

BAUHINIA SPIRIT - Courtesy MITSUI OSK LINES

8 LNG Bunkering Vessels and Terminals

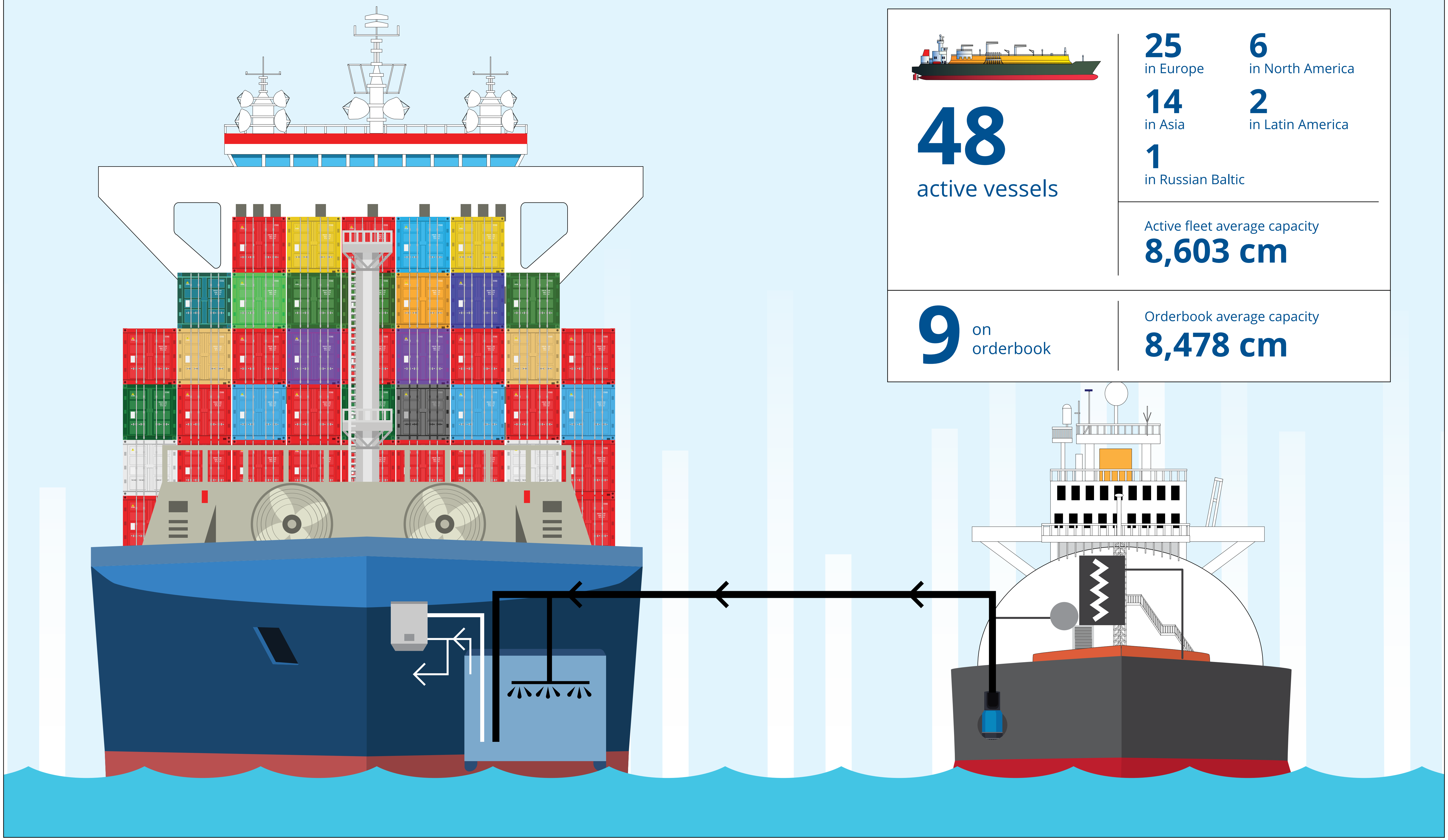
48 active vessels

- **25** in Europe
- **6** in North America
- **14** in Asia
- **2** in Latin America
- **1** in Russian Baltic

Active fleet average capacity
8,603 cm

9 on orderbook

Orderbook average capacity
8,478 cm



8. LNG Bunkering Vessels and Terminals[1]

In 2022 and 2023, the global LNG price experienced severe fluctuations. After skyrocketing to high prices in 2022, global LNG prices significantly declined 60% y-o-y, providing higher economic viability of LNG as a bunker fuel. It is expected that with a looser global LNG market in 2024 compared to 2023, the global LNG price will increase the prospects of LNG as a bunker fuel.

LNG BUNKER - Courtesy CNOOC

[1] This chapter does not account for the multiple inland bunkering barges in China and other markets

48 units

Global operational LNG bunkering vessel fleet, end-of-February 2024

Lower prices in gas and LNG markets from mid-2023 to early-2024 already had trickle-down effects on LNG bunkering. Due to the competitive price of LNG against conventional bunker fuels, several LNG bunkering hubs worldwide have experienced a large gain in LNG bunker demand. Barcelona LNG bunkered all-time high volumes of 143,000cm of LNG in 2023 alone, an increase from 26,000cm in 2022. Singapore bunkered 110,850 tonnes of LNG, as compared to 16,250 tonnes in 2022. Even the amount of bonded LNG bunkering volume in Shanghai doubled to 260,000cm in 2023.

Stricter environmental legislation is exerting pressure on marine vessel owners to consider the use of cleaner alternatives to bunker fuels. On 15 July 2011, the International Maritime Organization (IMO) adopted the first set of international mandatory measures to improve ship energy efficiency. Since then, the IMO has taken further regulatory measures, such as the adoption of the initial IMO Greenhouse Gas (GHG) Strategy in 2018 and the 2020 Global Sulphur Limit. The 2020 Limit stipulates that sulphur in fuel oil used on board ships will be reduced from 3.50% to 0.50% from 1 January 2020 globally. The introduction of stricter sulphur content limits on marine fuels has prompted a shift towards LNG fueled ships with near-zero sulphur oxide emissions.

In 2023, IMO revised Strategy on Reduction of GHG Emissions from Ships, incorporating enhanced targets to address detrimental emissions. The revised IMO GHG Strategy includes an enhanced common ambition to reach net-zero GHG emissions from international shipping by or around, i.e. close to, 2050, a commitment to ensure an uptake of alternative zero and near-zero GHG fuels by 2030, with indicative check-points on net-zero GHG emissions for international shipping to strive for by 2030 (reduction of at least 20%, striving for 30% against 2008 levels) and by 2040 (reduction of at least 70%, striving for 80% against 2008 levels). In particular, the 2023 IMO GHG Strategy aims to achieve a minimum of 40% reduction in carbon intensity of international shipping (i.e. CO2 emissions per transport work) by 2030, on average across the industry compared against 2008 levels. This ambitious target will be met through the adoption of zero or near-zero GHG emission technologies, fuels and/or energy sources, which are expected to account for at least 5%, with a goal of reaching up to 10%, of the total energy used by international shipping by 2030.

Multiple options exist for supplying LNG to vessels. The three most common methods have been terminal tank-to-ship, truck-to-ship, and ship-to-ship (STS) transfers. LNG-powered ships can be refuelled in a more timely and efficient manner through STS transfers from bunkering vessels than from jetty-side truck-to-ship LNG transfers.

In the early years of LNG bunkering, small-scale LNG carriers performed few ship-to-ship (STS) LNG bunkering services in addition to small-scale LNG deliveries. These carriers, ranging from 1,000 and 20,000 cm, were introduced in the early 1990s, but were not specifically designed and built for STS LNG bunkering operations. The Pioneer Knutsen, launched in 2004, is one of the smallest LNG carriers in the world with a capacity of 1,100 cm. It has a long track record of STS transfers, although not specifically for bunkering, as well as small-scale LNG deliveries along the Norwegian coast, averaging approximately 200 cargo deliveries per year.

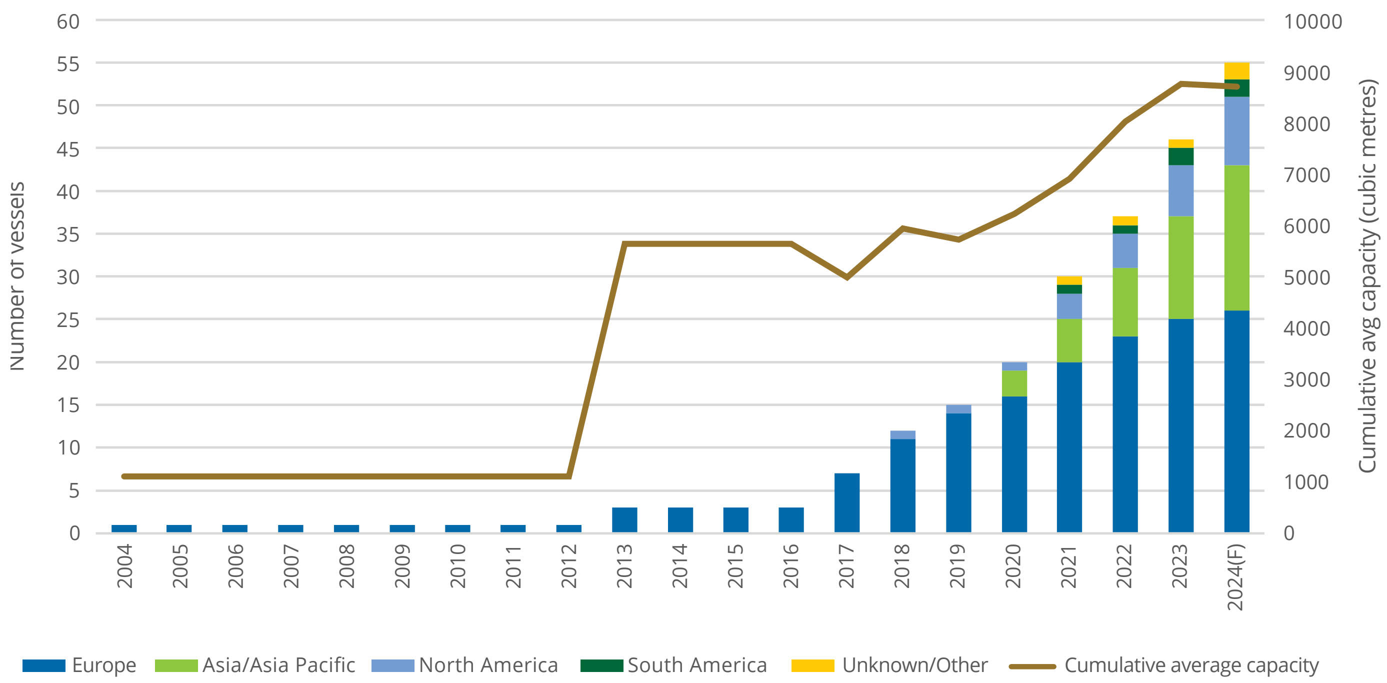
The Seagas, which commenced operations in 2013 at the Port of Stockholm, stands as the pioneering LNG bunkering barge. This 187 cm vessel, converted from a small Norwegian ferry, supplies approximately 70 tonnes of LNG to the large Viking Grace ferry almost every round trip. LNG is loaded onto the Seagas by trucks from the small-scale Nynashamn LNG terminal in Sweden, located almost 60 kilometres south of Stockholm.

The Seagas remained the sole dedicated STS bunkering barge for several years until some small inland LNG barges were developed in China between 2014 and 2016 for bunkering purposes. In 2017, three purpose-built LNG bunkering vessels with much larger capacities commenced operations: the Green Zeebrugge (5,000 cm, ex-Engie Zeebrugge), the Coralius (5,800 cm), and the New Frontier1 (6,500 cm, ex-Cardissa). Green Zeebrugge operates primarily near the Zeebrugge region, while Coralius and New Frontier1 serve the North Sea/Baltic Sea region, sailing from the Risavika and Rotterdam bases, respectively, to load and perform bunkering operations. These pioneering projects were supported by their proximity to LNG terminals as well as the ability to modify regasification facilities to accommodate small-scale ships at locations such as GATE terminal in Rotterdam. Within a year's time, Kairos, another LNG bunker vessel with a capacity of 7,500 cm, commenced operations at Klaipeda LNG terminal in Lithuania.

The expansion of marine LNG bunkering infrastructure has also been enabled by conversion and ship upgrading. The world's sixth LNG bunkering vessel, the Oizmendi, was converted from a heavy fuel oil/marine diesel oil bunkering tanker into a multifuel bunkering vessel with a capacity of 660 cm. It performed its first STS bunkering operation in the Port of Bilbao in early 2018 and serves the Iberian Peninsula. The Coral Methane (7,500 cm) is another vessel that was modified and upgraded with STS LNG bunkering capabilities in 2018. The highly mobile vessel performs bunkering operations across multiple ports, including Barcelona, Rotterdam, Marseille Fos, and Tenerife. Some other small scale LNG carriers have followed similar conversions.

The LNG bunkering fleet has experienced rapid growth since many regions received their first LNG bunkering vessel in 2020. The Gas Agility performed the first STS bunkering in the Port of Rotterdam in November 2020. It is equipped with membrane tanks with a total capacity of 18,600 cm. Russia's first vessel, the Dmitry Mendeleev (5,800 cm ice class), was delivered to Gazprom. Estonia received its first 6,000 cm vessel, the Optimus, while Italy and France both received their first LNG bunker vessels, the 7,500 cm Avenir Aspiration and the 18,600 cm Gas Vitality (sister ship of the Gas Agility), respectively. Korea Line took delivery of the 18,000 cm K. Lotus in 2022, which was charted by Shell to operate in the Port of Rotterdam. The 5,000 cm Haugesund Knutsen performed its first LNG bunkering operation in March 2023 at the Port of Barcelona. Titan LNG acquired two small-scale LNG vessels, the Titan Unikum (12,000 cm) and Titan Vision (12,000 cm) in 2023 from Seapeak. Titan LNG completed conversions for both vessels in 2023, to allow for the bunkering and transportation of LNG, biomethane and hydrogen derived e-methane and to add seagoing owned units to the fleet of non-propelled barges. The Levante LNG (12,500 cm) was delivered in July 2023 by HMD in Korea before moving to Algeciras and Gibraltar ports where she started bunkering operations in November 2023. The Avenir Ascension (7,500 cm), received in 2022 now acts as a shuttle carrier at the 4 MTPA Deutsche Ostsee regasification terminal, shuttling cargoes from larger conventional LNG vessels into the terminal. In France, Le Havre port completed its first STS LNG bunkering in September 2021, while La Rochelle Port achieved this in September 2022.

Figure 8.1: Cumulative number of operational LNG bunkering vessels by region and average vessel capacity, 2004 to 2024



Source: Rystad Energy

The maiden LNG bunker barge in the US, the Clean Jacksonville, has a capacity of 2,200 cm and is the first with a membrane cargo tank. It was stationed at the Port of Jacksonville in Florida and was built to supply LNG bunker to TOTE containerships from 2018 onwards until 2024, before being moved to Galveston, Texas. The Q-LNG 4000 was delivered in early 2021 as the market's first bunker and supply articulated tug barge (ATB) unit and was the second operational LNG bunker barge in the US after the Clean Jacksonville. In 2022, the Clean Canaveral became the third operational bunker barge, operating as an articulated tug barge (ATB) unit along the southeastern coast of the US, with a capacity of 5,000 cm. The Clean Everglades (5,500cm), owned by Seaside LNG and its bunkering arm Polaris New Energy was delivered in October 2023 and performed its first bunkering service in January 2024. Clean Everglades will now operate in Jacksonville in 2024, in place of the Clean Jacksonville (2,200 cm) which was moved to Galveston. South America's first LNG bunkering vessel, the Avenir Accolade (7,500 cm), was also delivered to Brazil in 2021.

The first LNG bunker vessel serving the Asia Pacific region started its operation in 2020, named SM JEJU LNG2 operated by Kogas, South Korea. Two other bunkering vessels were added in the Asia Pacific region in 2020 – the Kaguya in Japan, and the Avenir Advantage in Malaysia. In October 2020, Japan conducted its first STS LNG bunkering operation with the 3,500 cm Kaguya. This vessel is based at the Kawagoe Thermal Power Station and supplies LNG to other ships in the Chubu region. Similarly, Malaysia commenced STS LNG bunkering operations in October 2020 by chartering the 7,500 cm Avenir Advantage from Future Horizon, a joint venture between MISC Berhad and Avenir LNG. This vessel facilitates STS bunkering operations within the region while also serving as a means for transporting LNG to small-scale customers. The fourth operational LNG bunkering vessel in the Asia Pacific, which is also Singapore's first LNG bunkering vessel, the FueLNG Bellina, was successfully delivered in early 2021 to FueLNG and will provide STS LNG bunkering in Singapore. FueLNG is a joint venture between Keppel Offshore & Marine Ltd (Keppel O&M) and Shell Eastern Petroleum (Pte) Ltd.

The Avenir Allegiance (20,000 cm) was launched in 2021 before being sold to Shanghai SIPG Energy Service in early 2022 and became China's first active LNG bunker vessel, while being renamed as the Hai Gang Wei Lai. In 2022, STS bunkering of Asia Pacific region experienced rapid development with 4 vessels put into operation. The Hai Yang Shi You 301, which has a capacity of 30,000 cm, was converted from a small-scale LNG carrier in November 2022 and is the largest operational LNG bunkering vessel in the world. The Xin Ao Pu Tuo Hao (8,500 cm) was delivered to ENN in 2022 and will provide LNG bunkering services to the domestic market in the eastern China's coastal region. The K LNG Dream (500 cm) became the second LNG bunkering vessel in South Korea and was specifically built to bunker coastal ships.

2023 saw 3 newly built LNG bunkering vessels in Asia Pacific with the Blue Whale (7,500 cm) in South Korea, along with the FueLNG Venosa (18,000 cm) and Brassavola (12,000 cm) both serving the market of Singapore.

This year, two LNG bunkering vessels are already turned operational with their start year in 2024. Another seven are currently under construction and have their start year designated as 2024. Out of the seven, three are owned by energy companies in Japan and China, with a total added capacity of 29,500 cm from the two markets. Asia Pacific has indeed seen a large expansion in terms of STS bunkering capabilities.

South Korea currently offers STS bunkering at Tongyeong. The STS bunkering facility in Korea experienced progress in May 2023 when the Blue Whale (7,500 cm) entered service. It is equipped with the self-developed second-generation LNG cargo tank technology (KC-2B), built by Hyundai Heavy Industries, and was delivered to Kogas. Compared to the older KC-1 technology, the KC-2B system shows advantages of better thermal insulation, less LNG evaporation and higher economic efficiency. Although no new LNG bunkering vessels will be appearing in South Korea for 2024, South Korea is planning for increased LNG bunkering capabilities at its proposed 13.7 MTPA Dangjin LNG import facility.

The FueLNG Venosa (18,000 cm) and Brassavola (12,000 cm) became Singapore's second and third bunkering vessel, respectively, in 2023. The LNG Brassavola completed its first STS transfer in February 2024, and is owned by Mitsui O.S.K. Lines. It will be leased to Pavilion Energy to provide STS bunkering service in Singapore Port. It is the largest LNG bunkering vessel in Singapore and Pavilion Energy's first newly built LNG bunkering vessel as well.

In Japan, the Kaguya LNG bunkering vessel already provides STS bunkering in the Chubu region. A new LNG bunkering vessel, owned by KEYS Bunkering West Japan, named KEYS Azalea (3500cm) is being built by Mitsubishi and will be delivered and put into operation in 2024. It is responsible for providing LNG bunkering services for oceangoing ships docked at ports in the Kyushu and Seto Inland Sea region, engaging in LNG domestic transportation business. The Ecobunker Tokyo Bay (2500cm) is expected to serve the market of Japan in 2024.

Osaka Gas also has plans to commercialise a STS LNG bunkering business in the Osaka Bay and Setouchi area and the company aims to start the project in FY2026, when a bunkering vessel (3,500 cm) is scheduled to enter into service.

In China, STS bunkering services are provided at Shanghai, Shenzhen, Ningbo, and Guangzhou. The first STS transfer by CNPC was completed by the 8,500 cm Xin Ao Pu Tuo in Shenzhen Yantian in November 2022. Likewise, the first STS transfer completed by CNOOC was by the 30,000 cm Hai Yang Shi You 301 in January 2023. On November 5, 2023, a launching ceremony for CNOOC's 12,000 cm LNG bunkering vessel Hai Yang Shi You 302, took place in Jiangsu Province. The CCS (Chinese Classification Society) classed 132.9 meters long and 22 meters wide vessel has a draft of 11.8 meters and features two type C tanks each with a capacity of some 6,000 cm and is characterised by being energy saving, safe and environmental-friendly. The vessel will be put into operation in 2024. 2024 will see the launch of another Chinese-developed bunker vessel, the 14,000 cm Anhui Changjiang LNG vessel. It is specially designed for the Yangtze River and is owned by Anhui Changjiang LNG Co., Ltd.

As of end-February 2024, the global operational LNG bunkering and bunkering-capable small-scale vessel fleet has reached 48 units, 11 more than that in 2022, with a total added capacity of 116,400cm. Asia, Europe, North America, and South America have added 6, 2, 2 and 1 units, respectively. By the end of 2024, the number of LNG bunkering vessel fleet will reach 55 units with a total added capacity of 67,900 cm in 2024 alone, with 5 vessel additions from Asia Pacific, 2 from North America, and 1 more that is yet unknown. While the LNG bunkering fleet is growing in Asia and North America, about half of the vessels operated in Europe. The fleet is still young with most of the active bunkering vessels delivered over the past five years. While the bunkering needs of different ports and different types of vessels may vary widely, the typical size of LNG bunkering vessels has increased over time.

Ports and terminals have either expanded or modified their facilities to provide LNG bunkering services in response to the anticipated increase in LNG bunkering demand. These shore-based facilities are often situated in regions with stricter emissions control regulations and near LNG import terminals, facilitating efficient distribution. Truck-to-ship is currently the most used configuration at terminals and ports due to its low capital investment and limited infrastructure requirements. This approach has limitations such as restricted flow rates, which restricts bunkering operations to smaller LNG-fueled vessels. Alternative options such as STS and shore-to-ship (also known as terminal tank-to-ship) support larger storage capacities and higher flow rates. However, both STS and shore-to-ship require significantly higher capital investment in the form of bunker vessels, storage tanks and specialised loading arms. Avenir LNG has performed the first ship-to-truck transfer in Mukran, Germany. The cargo was unloaded from a small-scale LNG vessel onto trucks in February 2023, where it serviced the German market for trucked LNG.

The majority of LNG bunkering facilities in the North Sea and the Baltic Sea are integrated into a network of small-scale LNG terminals and ports that underwent significant expansion during the 2010s. The expansion was facilitated through the increase of small-scale LNG exports from Norway and the provision of reloading/trans-shipment services at large-scale LNG import terminals to small-scale LNG terminals and ports in the region. Several large-scale LNG terminals also offer truck-loading and bunkering services directly from the terminal, which supports the delivery of LNG to nearby ports to be loaded on vessels via truck-to-ship bunkering. Bunkering services are also available at small-scale export terminals. Shore-based LNG terminals, which have the capability to provide bunkering services, are more prevalent in Europe. However, progressive construction of such facilities is being witnessed in other regions of the world, including Asia and North America. The Risavika plant, one of Norway's liquefaction facilities, commissioned a dedicated bunkering facility in 2015 for Fjord Line ferries. The bunkering facility is linked to the plant's 30,000 cm LNG storage tank and supports direct shore-to-ship transfers through the region's first loading arm dedicated solely to bunkering purposes. Finland's Pori terminal, a small-scale import terminal, was equipped with direct LNG bunkering (terminal-to-ship) and truck-loading capabilities when it was commissioned in 2016. In 2019, another new small-scale receiving terminal in Finland, Tornio Manga, bunkered its first vessel, the Polaris. The terminal offers both tank-to-ship and truck-to-ship bunkering.

Iberian terminals have also embarked on diversification into LNG bunkering services. With support from the 'CORE LNGas hive' initiative aimed at building an Iberian LNG bunkering network, several Spanish ports have rapidly added truck-to-ship bunkering infrastructure and are implementing additional terminal enhancements to accommodate small-scale carriers and develop direct jetty-to-ship services for LNG-fueled vessels. The Cartagena LNG regasification terminal successfully conducted its first direct bunkering to an LNG-fueled tanker with 370 cm of LNG in 2017, using the facility's tank-to-jetty pipeline and a dedicated jetty. The Bilbao terminal adapted its marine jetty to accommodate small-scale vessels with capacities larger than 600 cm in 2017 and carried out its first LNG bunkering operation through a five-hour truck-to-ship transfer in the same year. In a bid to encourage the development of LNG bunkering at Spanish regasification terminals, a large reduction in reloading fees, especially for small ships destined for STS bunkering, was implemented in September 2020, and will be applied for the next six years. In 2022, energy company Repsol started up a bunkering facility at Bilbao providing truck-to-ship bunkering with a storage capacity of 1,000 cm and another one with the same storage capacity and truck-to-ship capability in Santander in 2023. Both terminals will fuel Brittany Ferries' LNG-powered ferries as part of deal signed in 2019.

Following the opening of first LNG bunkering terminal in Bilbao, the second one was successfully inaugurated in June 2023 at Santander. The new inaugurated terminal represents another step in Repsol's commitment of achieving zero emissions by 2050 and promotes Brittany Ferries' LNG bunkering operations in northern Spain.

Within the Asia Pacific region, a growing number of markets – such as Singapore, Japan, China, and South Korea – are building LNG bunkering infrastructure, signifying an increased demand for LNG as a marine fuel in the region. The development of infrastructure in the region appears to be more centred on STS bunkering, as described in the earlier paragraphs.

Despite that, Singapore's port has been modified and equipped with truck-to-ship bunkering capabilities since 2017. Likewise in Japan, the Port of Yokohama introduced truck-to-ship bunkering services in 2018.

The US is also expected to become a significant player in the LNG bunkering market. Currently, its bunkering operations occur primarily at the Jacksonville and Canaveral ports in Florida and Port Fourchon in Los Angeles. Jacksonville has conducted truck-to-ship operations since 2016 for two containerships and added STS bunkering services to the facility with the delivery of the Clean Jacksonville bunker barge in 2018. Port Fourchon completed the bunkering of its first LNG-fueled vessel in 2016 and plans to become a central LNG bunkering terminal in North America. With the arrival of the 4,000 cm Q-LNG 4000 ATB unit and its dedicated tug Q-Ocean Service in early 2021, Port Canaveral in Florida is on track to be the first LNG cruise port in the US. Q-LNG 4000 vessel will operate from Port Canaveral to provide LNG fuel to cruise ships after loading LNG from a fuel distribution facility on Elba Island, Georgia. Norwegian firm Kanfer is also exploring several LNG bunkering projects, namely in Brazil, the Suez Canal, and the Panama Canal, which are key waterways for the shipping industry.

North America and a yet unknown region will target to complete 2 bunkering vessels under construction in 2024 – the Seaspan-2 and Scale Gas BV – 1, respectively. In Asia, China-based shipbuilding firm Nantong CIMC Sinopacific Offshore & Engineering Co., Ltd (CIMC SOE) is constructing the first 7,600 cm LNG bunkering vessel named Seaspan Garibaldi in January 2024 for Canadian shipowner Seaspan ULC. This order series from Seaspan was for the delivery of three vessels, with the first two vessels to be delivered in 2024, and the third vessel Seaspan-3 arriving in 2025. A Canadian-flagged ship from the Seaspan order will be the first LNG bunkering ship in the Pacific Northwest region after its completion.

Table 8.1: Table of global LNG bunkering vessels

Market	Vessel Name	Start year	Capacity	Concept	Status
North Europe	Pioneer Knutsen	2004	1100	Small-scale/bunkerable	Operational
Sweden	Seagas	2013	187	Bunkering vessel	Operational
Europe	Coral Energy	2013	15600	Small-scale/bunkerable	Operational
Belgium	Green Zeebrugge (Ex-Engie Zeebrugge)	2017	5000	Bunkering vessel	Operational
North Europe	Coralius	2017	5800	Bunkering vessel	Operational
Netherlands	New Frontier 1 (ex-Cardissa)	2017	6500	Bunkering vessel	Operational
Spain	Oizmendi	2017	660	FO/DO/LNG Bunkering vessel	Operational
Spain	Bunker Breeze	2018	1200	FO/DO bunker vessel/LNG Bunker designed	Operational
US	Clean Jacksonville	2018	2200	Bunker barge (by tug)	Operational
Europe	Coral Methane	2018	7500	Small-scale/bunkerable	Operational
Finland	Coral Energice	2018	18000	Small-scale/bunkerable	Operational
Lithuania	Kairos	2018	7500	Bunkering vessel	Operational
North Europe	LNG London	2019	3000	Bunkering vessel	Operational
North Europe	Coral Fraseri	2019	10000	Small-scale/bunkerable	Operational
Netherlands	FlexFueler 001	2019	1480	Bunker barge (by tug)	Operational
Belgium	FlexFueler 002	2020	1480	Bunker barge (by tug)	Operational
Malaysia	Avenir Advantage	2020	7500	Bunkering vessel	Operational
South Korea	SM JEJU LNG2	2020	7500	Bunkering vessel	Operational
Netherlands	Gas Agility	2020	18600	Bunkering vessel	Operational
Japan	Kaguya	2020	3500	Bunkering vessel	Operational
US	Q-LNG ATB 4000	2021	4000	Bunker barge (by tug)	Operational
Norway	Bergen LNG	2021	850	Bunkering vessel	Operational
US	Clean Canaveral	2021	5000	Bunkering vessel	Operational
Russia	Dmitry Mendeleev	2021	5800	Bunkering vessel	Operational
North Europe	LNG Optimus	2021	6000	Bunkering vessel	Operational
Brazil	Avenir Accolade	2021	7500	Small-scale/bunkerable	Operational
North Europe	Avenir Aspiration	2021	7500	Bunkering vessel	Operational
Singapore	FueLNG Bellina	2021	7500	Bunkering vessel	Operational
Fos Cavou	Gas Vitality	2021	18600	Bunkering vessel	Operational
China	Hai Gang Wei Lai (ex-Avenir Allegiance)	2021	20000	Bunkering vessel	Operational
South Korea	K LNG Dream	2022	500	Bunkering vessel	Operational
China	Xin Ao Pu Tuo Hao	2022	8500	Bunkering vessel	Operational
Netherlands	K. Lotus	2022	18000	Bunkering vessel	Operational
Europe	Avenir Ascension	2022	7500	Bunkering vessel	Operational
North America	Avenir Achievement	2022	20000	Bunkering vessel	Operational
China	Hai Yang Shi You 301	2022	30000	Small-scale/bunkerable	Operational
Spain	Haugesund Knutsen	2022	5000	Bunkering vessel	Operational
South Korea	Blue Whale	2023	7500	Bunkering vessel	Operational
Singapore	FueLNG Venosa	2023	18000	Bunkering vessel	Operational
South America	New Frontier 2	2023	18000	Bunkering vessel	Operational
Europe	Alice Cosulich	2023	8200	Small-scale/bunkerable	Operational
North America	Titan Unikum	2023	12000	Bunkering vessel	Operational
Asia	Titan Vision	2023	12000	Bunkering vessel	Operational
Europe	Levante LNG	2023	12500	Bunkering vessel	Operational
North America	Clean Everglades	2023	5500	Bunkering vessel	Operational
Singapore	Brassavola	2023	12000	Bunkering vessel	Operational
Europe	Energy Stockholm	2024	8000	Bunker barge (by tug)	Under construction
Panama	Seaspan Garibaldi	2024	7600	Bunkering vessel	Under construction
Japan	Ecobunker Tokyo Bay	2024	2500	Bunkering vessel	Operational
Asia	Paolina Cosulich	2024	8200	Small-scale/bunkerable	Operational
North America	Seaspan-2	2024	7600	Bunkering vessel	Under construction
Japan	KEYS Azalea	2024	3500	Bunkering vessel	Under construction
China	Anhui Changjiang LNG	2024	14000	Bunkering vessel	Under construction
China	Hai Yang Shi You 302	2024	12000	Bunkering vessel	Under construction
Unknown	Scale Gas BV - 1	2024	12500	Bunkering vessel	Under construction
North America	Seaspan-3	2025	7600	Bunkering vessel	Under construction
Japan	Osaka Gas BV	2026	3500	Bunkering Vessel	Under construction

Source: Rystad Energy

LNG BUNKER - Courtesy CNOOC

9. References Used in the 2024 Edition

9.1 Data Collection

Data in Chapters 1, 2, 5, 6, 7, 8 and 9 of the 2024 IGU World LNG Report is sourced from a range of public and private domains, including Rystad Energy, the BP Statistical Review of World Energy, the International Energy Agency (IEA), the Oxford Institute for Energy Studies (OIES), the US Energy Information Administration (EIA), the US Department of Energy (DOE), Argus, the International Group of Liquefied Natural Gas Importers (GIIGNL), Refinitiv Eikon, DNV GL, Barry Rogliano Salles (BRS), company reports and announcements. Any private data obtained from third-party organisations is cited as a source at the point of reference (i.e. charts and tables). No representations or warranties, express or implied, are made by the sponsors concerning the accuracy or completeness of the data and forecasts supplied under the report.

9.2 Data Collection for Chapter 3

Data in Chapter 3 of the 2024 IGU World LNG Report is sourced from the International Group of Liquefied Natural Gas Importers (GIIGNL). No representations or warranties, express or implied, are made by the sponsors concerning the accuracy or completeness of the data and forecasts supplied under the report.

9.3 Data Collection for Chapter 4

Data in Chapter 4 of the 2024 IGU World LNG Report is sourced from S&P Global Commodities Insights. No representations or warranties, express or implied, are made by the sponsors concerning the accuracy or completeness of the data and forecasts supplied under the report.

9.4 Preparation and Publication of the 2024 IGU World LNG Report

The IGU wishes to thank the following organisations and Task Force members entrusted to oversee the preparation and publication of this report:

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9.5 Definitions

Brownfield Liquefaction Project: A land-based LNG project at a site with existing LNG infrastructure, such as: jetties, storage tanks, liquefaction facilities or regasification facilities.

Commercial Operations: For LNG liquefaction plants, commercial operations start when the plants deliver commercial cargos under the supply contracts with their customers.

East and West of Suez: The terms East and West of Suez refer to the location in which an LNG tanker fixture begins. For these purposes, marine locations to the west of the Suez Canal, Cape of Good Hope, or Novaya Zemlya, but to the east of Tierra del Fuego, the Panama Canal, or Lancaster Sound, are considered to lie west of Suez. Other points are considered to lie east of Suez.

Forecast Data: Forecast liquefaction and regasification capacity data only considers existing and approved capacity (criteria being FID taken) and is based on company announced start dates.

Greenfield Liquefaction Project: A land-based LNG project at a site where no previous LNG infrastructure has been developed.

Home Market: The market in which a company is based.

Laid-Up Vessel: A vessel is considered laid-up when it is inactive and temporarily out of commercial operation. This can be due to low freight demand or when running costs exceed ongoing freight rates. Laid-up LNG vessels can return to commercial operation, undergo FSU/FSRU conversion or proceed to be sold for scrap.

Liquefaction and Regasification Capacity: Unless otherwise noted, liquefaction and regasification capacity throughout the document refers to nominal capacity. It must be noted that re-loading and storage activity can significantly reduce the effective capacity available for regasification.

LNG Carriers: For the purposes of this report, only Q-Class and conventional LNG vessels with a capacity greater than 30,000 cm are considered part of the global fleet discussed in the 'LNG Carriers' chapter (Chapter 6). Vessels with a capacity of 30,000 cm or less are considered small-scale LNG carriers.

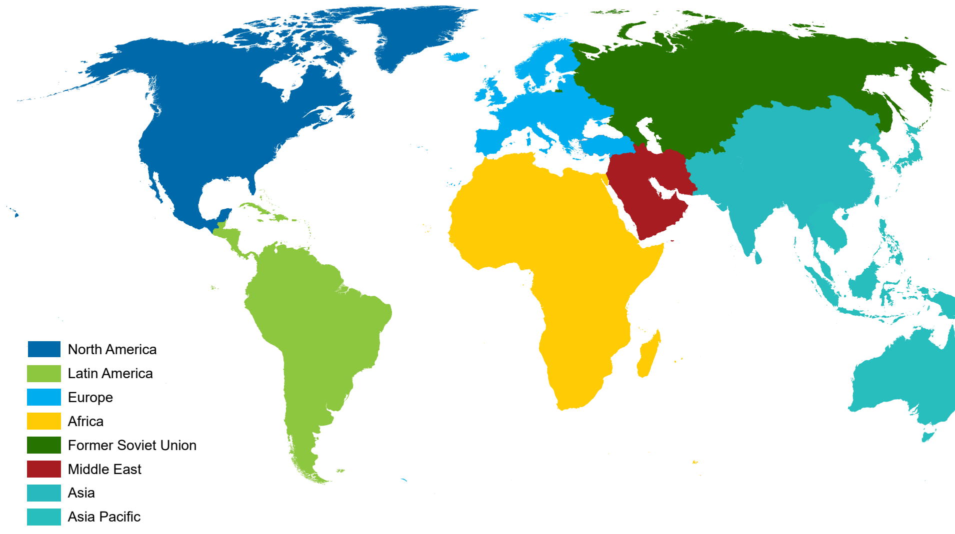
Scale of LNG Trains:
- **Small-scale:** 0-0.5 MTPA capacity per train
- **Mid-scale:** >0.5-1.5 MTPA capacity per train
- **Large-scale:** More than 1.5 MTPA capacity per train

Spot Charter Rates: Spot charter rates refer to fixtures beginning between five days after the date of assessment and the end of the following calendar month.

9.6 Regions and Basins

The IGU regions referred to throughout the report are defined as per the colour-coded areas in the map below. The report also refers to three basins: Atlantic, Pacific and Middle East. The Atlantic Basin encompasses all markets that border the Atlantic Ocean or Mediterranean Sea, while the Pacific Basin refers to all markets bordering the Pacific and Indian Oceans. However, these two categories do not include the following markets, which have been differentiated to compose the Middle East Basin: Bahrain, Iran, Iraq, Israel, Jordan, Kuwait, Oman, Qatar, UAE and Yemen. IGU has also considered markets with liquefaction or regasification activities in multiple basins and has adjusted the data accordingly.

Figure 9.1: Grouping of markets into regions



9.7 Acronyms

CAPEX = Capital Expenditure
CCS = Carbon Capture and Storage
CCUS = Carbon Capture, Utilisation and Storage
CII = Carbon Intensity Indicator
CO2 = Carbon Dioxide
CSG = Coal Seam Gas
CNG = Compressed Natural Gas
DES = Delivered Ex-Ship
DFDE = Dual-Fuel Diesel Electric
DMR = Dual Mixed Refrigerant
EEXI = Energy Efficiency Existing Ship Index
EPC = Engineering, Procurement and Construction
EU = European Union
FEED = Front-End Engineering and Design
FERC = Federal Energy Regulatory Commission
FID = Final Investment Decision
FLNG = Floating Liquefied Natural Gas
FOB = Free On-Board
FPSO = Floating Production, Storage and Offloading
FSRU = Floating Storage and Regasification Unit
FSU = Floating Storage Unit
FSU = Former Soviet Union
GCU = Gas Combustion Unit
GHG = Greenhouse Gas
GTT = Gaztransport & Technigaz
IHI = Ishikawajima-Harima Heavy Industries
IMO = International Maritime Organisation
ISO = International Organisation for Standardization
JKM = Platts Japan-Korea Marker
LPG = Liquefied Petroleum Gas
MARPOL = International Convention for the Prevention of Pollution from Ships
MEGA = M-type, Electronically Controlled, Gas Admission
MEGI = M-type, Electronically Controlled, Gas Injection
MEPC = Marine Environment Protection Committee
MMLS = Moveable Modular Liquefaction System
NGV = Natural Gas Vehicle
OPEX = Operating Expenditure
PSC = Production Sharing Contract
SOx = Sulfur Oxides
SPA = Sales and Purchase Agreement
STaGE = Steam Turbine and Gas Engine
SSDR = Slow Speed Diesel with Re-liquefaction Plant
STS = Ship-to-Ship
TFDE = Triple-Fuel Diesel Electric
TTF = Title Transfer Facility
UAE = United Arab Emirates
UK = United Kingdom
US = United States
XDF = Generation X dual-fuel engine
YOY = Year-on-Year

9.8 Units

bbl = barrel
bcfd = billion cubic feet per day
bcm = billion cubic metres
cm = cubic metres
GT = gigatonnes
KTPA = thousand tonnes per annum
mcm = thousand cubic metres
mmcfd = million cubic feet per day
mmcm = million cubic metres
mmBtu = million British thermal units
MT = million tonnes
MTPA = million tonnes per annum
nm = nautical miles
tcf = trillion cubic feet

9.9 Conversion Factors

Table 9.1: Overview of Conversion Factors

	Tonnes LNG	cm LNG	mmcm gas	mmcf gas	mmBtu	boe
Tonnes LNG	-	2.222	0.0013	0.0459	53.38	9.203
cm LNG	0.45	-	5.85 x 10-4	0.0207	24.02	4.141
mmcm gas	769.2	1,700	-	35.31	41,100	7,100
mmcf gas	21.78	48	0.0283	-	1,200	200.5
mmBtu	0.0187	0.0416	2.44 x 10-5	8.601 x 10-4	-	0.1724
boe	0.1087	0.2415	1.41 x 10-4	0.00499	5.8	-

LNG ships loading simultaneously at Ras Laffan Port - Courtesy QatarEnergy

Appendix 1: Table of Global liquefaction plants

Reference number	Market	Liquefaction Plant Train	Liquefaction technology	Infrastructure start year	Liquefaction capacity (MTPA)	Ownership
1	Libya	Marsa El Brega LNG	AP-SMR	1970	3.20	NOC (Libya)* (100%)
2	Brunei	Brunei LNG T1-T2	AP-C3MR	1972	2.88	Shell* (25%); Brunei Government (50%); Mitsubishi Corp (25%)
2	Brunei	Brunei LNG T3-T4	AP-C3MR	1973	2.88	Shell* (25%); Brunei Government (50%); Mitsubishi Corp (25%)
2	Brunei	Brunei LNG T5	AP-C3MR	1974	1.44	Shell* (25%); Brunei Government (50%); Mitsubishi Corp (25%)
3	UAE	Adgas LNG T1	AP-C3MR	1977	1.15	ADNOC LNG* (0%); Abu Dhabi NOC (70%); Mitsui (15%); BP (10%); TotalEnergies (5%)
3	UAE	Adgas LNG T2	AP-C3MR	1977	1.15	ADNOC LNG* (0%); Abu Dhabi NOC (70%); Mitsui (15%); BP (10%); TotalEnergies (5%)
4	Algeria	Arzew GL1Z T1-T6	AP-C3MR	1978	7.90	Sonatrach* (100%)
5	Algeria	Arzew GL2Z T1-T6	AP-C3MR	1981	8.40	Sonatrach* (100%)
6	Malaysia	MLNG Satu T1-T3	AP-C3MR	1982	8.40	Petronas* (90%); Mitsubishi Corp (5%); Sarawak State (5%)
7	Indonesia	Bontang LNG TC-TD	AP-C3MR	1983	5.60	Pertamina* (55%); Japan Indonesia LNG Co. (JILCO) (20%); PT VICO Indonesia (15%); TotalEnergies (10%)
7	Indonesia	Bontang LNG TE	AP-C3MR	1989	2.80	Pertamina* (55%); Japan Indonesia LNG Co. (JILCO) (20%); PT VICO Indonesia (15%); TotalEnergies (10%)
8	Australia	North West Shelf LNG T1	AP-C3MR	1989	2.50	Woodside* (16.67%); BHP (16.67%); BP (16.67%); Chevron (16.67%); Shell (16.67%); Mitsubishi Corp (8.33%); Mitsui (8.33%)
8	Australia	North West Shelf LNG T2	AP-C3MR	1989	2.50	Woodside* (16.67%); BHP (16.67%); BP (16.67%); Chevron (16.67%); Shell (16.67%); Mitsubishi Corp (8.33%); Mitsui (8.33%)
7	Indonesia	Bontang LNG TF	AP-C3MR	1993	2.80	Pertamina* (55%); Japan Indonesia LNG Co. (JILCO) (20%); PT VICO Indonesia (15%); TotalEnergies (10%)
8	Australia	North West Shelf LNG T3	AP-C3MR	1993	2.50	Woodside* (16.67%); BHP (16.67%); BP (16.67%); Chevron (16.67%); Shell (16.67%); Mitsubishi Corp (8.33%); Mitsui (8.33%)
3	UAE	Adgas LNG T3	AP-C3MR	1994	3.00	ADNOC LNG* (0%); Abu Dhabi NOC (70%); Mitsui (15%); BP (10%); TotalEnergies (5%)
6	Malaysia	MLNG Dua T4-T6	AP-C3MR	1995	9.60	Petronas* (80%); Mitsubishi Corp (10%); Sarawak State (10%)
9	Qatar	Qatargas 1 T1	AP-C3MR	1996	3.20	QatarEnergy* (100%)
9	Qatar	Qatargas 1 T2	AP-C3MR	1996	3.20	QatarEnergy* (100%)
9	Qatar	Qatargas 1 T3	AP-C3MR	1996	3.20	QatarEnergy* (100%)
7	Indonesia	Bontang LNG TG	AP-C3MR	1998	2.80	Pertamina* (55%); Japan Indonesia LNG Co. (JILCO) (20%); PT VICO Indonesia (15%); TotalEnergies (10%)
7	Indonesia	Bontang LNG TH	AP-C3MR	1999	2.95	Pertamina* (55%); Japan Indonesia LNG Co. (JILCO) (20%); PT VICO Indonesia (15%); TotalEnergies (10%)

Note:
1. Reference number is sorted by infrastructure start year and liquefaction plant project.

Appendix 1: Table of Global liquefaction plants (continued)

Reference number	Market	Liquefaction Plant Train	Liquefaction technology	Infrastructure start year	Liquefaction capacity (MTPA)	Ownership
9	Qatar		AP-C3MR	1999	3.30	QatarEnergy* (63%); ExxonMobil (25%); ITOCHU (4%); Korea Gas (3%); Sojitz (1.5%); Sumitomo (1.5%); Samsung (0.5%); Hyundai (0.4%); SK Innovation (0.4%); LG International (0.28%); Daesung (0.27%); Hanwha Energy (0.15%)
9	Qatar	Rasgas 1 T2	AP-C3MR	1999	3.30	QatarEnergy* (63%); ExxonMobil (25%); ITOCHU (4%); Korea Gas (3%); Sojitz (1.5%); Sumitomo (1.5%); Samsung (0.5%); Hyundai (0.4%); SK Innovation (0.4%); LG International (0.28%); Daesung (0.27%); Hanwha Energy (0.15%)
10	Trinidad and Tobago	Atlantic LNG T1	ConocoPhillips Optimized Cascade	1999	3.00	Atlantic LNG* (0%); Shell (46%); BP (34%); China Investment Corporation (10%); NGC (10%)
11	Nigeria	NLNG T1	AP-C3MR	1999	3.30	NNPC (Nigeria)* (49%); Shell (25.6%); TotalEnergies (15%); Eni (10.4%)
11	Nigeria	NLNG T2	AP-C3MR	1999	3.30	NNPC (Nigeria)* (49%); Shell (25.6%); TotalEnergies (15%); Eni (10.4%)
12	Oman	Oman LNG T1	AP-C3MR	2000	3.55	Oman LNG* (0%); Omani Government (51%); Shell (30%); TotalEnergies (5.54%); Korea LNG (5%); Mitsubishi Corp (2.77%); Mitsui (2.77%); PTTEP (Thailand) (2%); ITOCHU (0.92%)
12	Oman	Oman LNG T2	AP-C3MR	2000	3.55	Oman LNG* (0%); Omani Government (51%); Shell (30%); TotalEnergies (5.54%); Korea LNG (5%); Mitsubishi Corp (2.77%); Mitsui (2.77%); PTTEP (Thailand) (2%); ITOCHU (0.92%)
10	Trinidad and Tobago	Atlantic LNG T2	ConocoPhillips Optimized Cascade	2002	3.30	Atlantic LNG* (0%); Shell (57.5%); BP (42.5%)
11	Nigeria	NLNG T3	AP-C3MR	2002	3.30	NNPC (Nigeria)* (49%); Shell (25.6%); TotalEnergies (15%); Eni (10.4%)
6	Malaysia	MLNG Tiga T7-T8	AP-C3MR	2003	7.70	Petronas* (60%); Sarawak State (25%); JX Nippon Oil and Gas (10%); Mitsubishi Corp (5%)
10	Trinidad and Tobago	Atlantic LNG T3	ConocoPhillips Optimized Cascade	2003	3.30	
8	Australia	North West Shelf LNG T4	AP-C3MR	2004	4.60	Woodside* (16.67%); BHP (16.67%); BP (16.67%); Chevron (16.67%); Shell (16.67%); Mitsubishi Corp (8.33%); Mitsui (8.33%)
9	Qatar	Rasgas 2 T3	AP-C3MR/ SplitMR	2004	4.70	QatarEnergy* (70%); ExxonMobil (30%)
9	Qatar	Rasgas 2 T4	AP-C3MR/ SplitMR	2005	4.70	QatarEnergy* (70%); ExxonMobil (30%)
10	Trinidad and Tobago	Atlantic LNG T4	ConocoPhillips Optimized Cascade	2005	5.20	Atlantic LNG* (0%); Shell (51.1%); BP (37.8%); NGC (11.1%)

Appendix 1: Table of Global liquefaction plants (continued)

Reference number	Market	Liquefaction Plant Train	Liquefaction technology	Infrastructure start year	Liquefaction capacity (MTPA)	Ownership
11	Nigeria	NLNG T4	AP-C3MR	2005	4.10	NNPC (Nigeria)* (49%); Shell (25.6%); TotalEnergies (15%); Eni (10.4%)
13	Egypt	Damietta LNG T1	AP-C3MR/ SplitMR	2005	5.00	SEGAS* (0%); Eni (50%); EGAS (40%); EGPC (Egypt) (10%)
14	Egypt	Egyptian LNG (Idku) T1	ConocoPhillips Optimized Cascade	2005	3.60	Shell* (35.5%); Petronas (35.5%); EGPC (Egypt) (24%); TotalEnergies (5%)
14	Egypt	Egyptian LNG (Idku) T2	ConocoPhillips Optimized Cascade	2005	3.60	Shell* (38%); Petronas (38%); EGPC (Egypt) (24%)
11	Nigeria	NLNG T5	AP-C3MR	2006	4.10	NNPC (Nigeria)* (49%); Shell (25.6%); TotalEnergies (15%); Eni (10.4%)
12	Oman	Oman LNG T3 (Qalhat)	AP-C3MR	2006	3.30	Oman LNG* (0%); Omani Government (65.6%); Shell (11.04%); Mitsubishi Corp (4.02%); Eni (3.68%); Naturgy (3.68%); ITOCHU (3.34%); Osaka Gas (3%); TotalEnergies (2.04%); Korea LNG (1.84%); Mitsui (1.02%); PTTEP (Thailand) (0.74%)
15	Australia	Darwin LNG T1	ConocoPhillips Optimized Cascade	2006	3.70	Santos* (43.44%); SK E&S (25%); Inpex (11.38%); Eni (10.98%); JERA (6.13%); Tokyo Gas (3.07%)
9	Qatar	Rasgas 2 T5	AP-C3MR/ SplitMR	2007	4.70	QatarEnergy* (70%); ExxonMobil (30%)
11	Nigeria	NLNG T6	AP-C3MR	2007	4.10	NNPC (Nigeria)* (49%); Shell (25.6%); TotalEnergies (15%); Eni (10.4%)
16	Equatorial Guinea	EG LNG T1	ConocoPhillips Optimized Cascade	2007	3.70	Marathon Oil* (56%); Sonagas G.E. (25%); Mitsui (8.5%); Marubeni (6.5%); Equatorial Guinea Government (4%)
17	Norway	Snohvit LNG T1	Linde MFC	2007	4.30	Equinor* (36.79%); Petoro (30%); TotalEnergies (18.4%); Neptune Energy (12%); Wintershall Dea (2.81%)
8	Australia	North West Shelf LNG T5	AP-C3MR	2008	4.60	Woodside* (16.67%); BHP (16.67%); BP (16.67%); Chevron (16.67%); Shell (16.67%); Mitsubishi Corp (8.33%); Mitsui (8.33%)
9	Qatar	Qatargas 2 T4	AP-X	2009	7.80	QatarEnergy* (67.5%); ExxonMobil (24.15%); TotalEnergies (8.35%)
9	Qatar	Qatargas 2 T5	AP-X	2009	7.80	QatarEnergy* (67.5%); ExxonMobil (24.15%); TotalEnergies (8.35%)
9	Qatar	Rasgas 3 T6	AP-X	2009	7.80	QatarEnergy* (70%); ExxonMobil (30%)
9	Qatar	Rasgas 3 T7	AP-X	2009	7.80	QatarEnergy* (70%); ExxonMobil (30%)
18	Yemen	Yemen LNG (T1+T2)	AP-C3MR/ SplitMR	2009	6.70	TotalEnergies* (39.62%); Yemen General Oil and Gas (21.73%); Hunt Oil (17.22%); Korea Gas (8.88%); SK Innovation (8.49%); Hyundai (3%); KNOC (S.Korea) (1.06%)

Appendix 1: Table of Global liquefaction plants (continued)

Reference number	Market	Liquefaction Plant Train	Liquefaction technology	Infrastructure start year	Liquefaction capacity (MTPA)	Ownership
19	Indonesia	Tangguh LNG T1	AP-C3MR/ SplitMR	2009	3.80	BP* (40.22%); CNOOC (13.9%); JOGMEC (11.07%); Mitsubishi Corp (9.92%); Inpex (7.79%); JX Nippon Oil and Gas (7.46%); Sojitz (3.67%); Sumitomo (3.67%); Mitsui (2.3%)
19	Indonesia	Tangguh LNG T2	AP-C3MR/ SplitMR	2009	3.80	BP* (40.22%); CNOOC (13.9%); JOGMEC (11.07%); Mitsubishi Corp (9.92%); Inpex (7.79%); JX Nippon Oil and Gas (7.46%); Sojitz (3.67%); Sumitomo (3.67%); Mitsui (2.3%)
19	Indonesia	Tangguh LNG T3	AP-C3MR/ SplitMR	2023	3.80	BP* (40.22%); CNOOC (13.9%); JOGMEC (11.07%); Mitsubishi Corp (9.92%); Inpex (7.79%); JX Nippon Oil and Gas (7.46%); Sojitz (3.67%); Sumitomo (3.67%); Mitsui (2.3%)
20	Russia	Sakhalin 2 T1	Shell DMR	2009	4.80	Sakhalin Energy Investment Company* (0%); Gazprom (50%); Shell (27.5%); Mitsui (12.5%); Mitsubishi Corp (10%)
20	Russia	Sakhalin 2 T2	Shell DMR	2009	4.80	Sakhalin Energy Investment Company* (0%); Gazprom (50%); Shell (27.5%); Mitsui (12.5%); Mitsubishi Corp (10%)
9	Qatar	Qatargas 3 T6	AP-X	2010	7.80	QatarEnergy* (68.5%); ConocoPhillips (30%); Mitsui (1.5%)
21	Peru	Peru LNG T1	AP-C3MR/ SplitMR	2010	4.45	Hunt Oil* (50%); Shell (20%); SK Innovation (20%); Marubeni (10%)
9	Qatar	Qatargas 4 T7	AP-X	2011	7.80	QatarEnergy* (70%); Shell (30%)
22	Australia	Pluto LNG T1	Shell Propane Precooled Mixed Refrigerant	2012	4.90	Woodside* (90%); Kansai Electric (5%); Tokyo Gas (5%)
23	Angola	Angola LNG T1	ConocoPhillips Optimized Cascade	2013	5.20	Angola LNG* (0%); Chevron (36.4%); Sonangol (22.8%); BP (13.6%); Eni (13.6%); TotalEnergies (13.6%)
24	Algeria	Skikda GL1K T1 (rebuild)	AP-C3MR/ SplitMR	2013	4.50	Sonatrach* (100%)
25	Papua New Guinea	PNG LNG T1	AP-C3MR	2014	3.45	ExxonMobil* (33.2%); Santos (42.5%); Kumul Petroleum Holdings Limited (16.8%); JX Nippon Oil and Gas (3.72%); Mineral Resources Development (2.8%); Marubeni (0.98%)
25	Papua New Guinea	PNG LNG T2	AP-C3MR	2014	3.45	ExxonMobil* (33.2%); Santos (42.5%); Kumul Petroleum Holdings Limited (16.8%); JX Nippon Oil and Gas (3.72%); Mineral Resources Development (2.8%); Marubeni (0.98%)
26	Algeria	Arzew GL3Z (Gassi Touil) T1	AP-C3MR/ SplitMR	2014	4.70	Sonatrach* (100%)
27	Indonesia	Donggi-Senoro LNG T1	AP-C3MR	2015	2.00	Donggi-Senoro LNG (DSLNG)* (0%); Mitsubishi Corp (44.92%); Pertamina (29%); Korea Gas (14.98%); MedcoEnergi (11.1%)

Appendix 1: Table of Global liquefaction plants (continued)

Reference number	Market	Liquefaction Plant Train	Liquefaction technology	Infrastructure start year	Liquefaction capacity (MTPA)	Ownership
28	Australia	GLNG T1	ConocoPhillips Optimized Cascade	2015	3.90	Santos* (30%); Petronas (27.5%); TotalEnergies (27.5%); Korea Gas (15%)
29	Australia	Queensland Curtis LNG T2	ConocoPhillips Optimized Cascade	2015	4.25	Shell* (97.5%); Tokyo Gas (2.5%)
28	Australia	GLNG T2	ConocoPhillips Optimized Cascade	2016	3.90	Santos* (30%); Petronas (27.5%); TotalEnergies (27.5%); Korea Gas (15%)
30	Australia	Gorgon LNG T1	AP-C3MR/ SplitMR	2016	5.20	Chevron* (47.33%); ExxonMobil (25%); Shell (25%); Osaka Gas (1.25%); Tokyo Gas (1%); JERA (0.42%)
30	Australia	Gorgon LNG T2	AP-C3MR/ SplitMR	2016	5.20	Chevron* (47.33%); ExxonMobil (25%); Shell (25%); Osaka Gas (1.25%); Tokyo Gas (1%); JERA (0.42%)
30	Australia	Gorgon LNG T3	AP-C3MR/ SplitMR	2016	5.20	Chevron* (47.33%); ExxonMobil (25%); Shell (25%); Osaka Gas (1.25%); Tokyo Gas (1%); JERA (0.42%)
31	Australia	Australia Pacific LNG T1	ConocoPhillips Optimized Cascade	2016	4.50	Origin Energy* (27.5%); ConocoPhillips (47.5%); Sinopec Group (parent) (25%)
31	Australia	Australia Pacific LNG T2	ConocoPhillips Optimized Cascade	2016	4.50	Origin Energy* (27.5%); ConocoPhillips (47.5%); Sinopec Group (parent) (25%)
32	United States	Sabine Pass T1-T2	ConocoPhillips Optimized Cascade	2016	9.00	Cheniere Energy* (100%)
6	Malaysia	MLNG T9	AP-C3MR/ SplitMR	2017	3.60	Petronas* (80%); JX Nippon Oil and Gas (10%); Sarawak State (10%)
32	United States	Sabine Pass T3-T4	ConocoPhillips Optimized Cascade	2017	9.00	Cheniere Energy* (100%)
33	Malaysia	Petronas FLNG Satu (PFLNG1)	AP-N	2017	1.20	Petronas* (100%)
34	Australia	Wheatstone LNG T1	ConocoPhillips Optimized Cascade	2017	4.45	Chevron* (64.14%); Kuwait Petroleum Corp (KPC) (13.4%); Woodside (13%); JOGMEC (3.36%); Mitsubishi Corp (3.18%); Kyushu Electric (1.46%); Nippon Yusen Kabushiki Kaisha (NYK Line) (0.82%); JERA (0.64%)
34	Australia	Wheatstone LNG T2	ConocoPhillips Optimized Cascade	2017	4.45	Chevron* (64.14%); Kuwait Petroleum Corp (KPC) (13.4%); Woodside (13%); JOGMEC (3.36%); Mitsubishi Corp (3.18%); Kyushu Electric (1.46%); Nippon Yusen Kabushiki Kaisha (NYK Line) (0.82%); JERA (0.64%)
35	Russia	Yamal LNG T1	AP-C3MR	2017	5.50	OOO Yamal LNG* (0%); Novatek (50.1%); CNPC (parent) (20%); TotalEnergies (20%); Silk Road Fund (9.9%)
35	Russia	Yamal LNG T2	AP-C3MR	2018	5.50	OOO Yamal LNG* (0%); Novatek (50.1%); CNPC (parent) (20%); TotalEnergies (20%); Silk Road Fund (9.9%)

Appendix 1: Table of Global liquefaction plants (continued)

Reference number	Market	Liquefaction Plant Train	Liquefaction technology	Infrastructure start year	Liquefaction capacity (MTPA)	Ownership
35	Russia	Yamal LNG T1	AP-C3MR	2017	5.50	OOO Yamal LNG* (0%); Novatek (50.1%); CNPC (parent) (20%); TotalEnergies (20%); Silk Road Fund (9.9%)
35	Russia	Yamal LNG T2	AP-C3MR	2018	5.50	OOO Yamal LNG* (0%); Novatek (50.1%); CNPC (parent) (20%); TotalEnergies (20%); Silk Road Fund (9.9%)
35	Russia	Yamal LNG T3	AP-C3MR	2018	5.50	OOO Yamal LNG* (0%); Novatek (50.1%); CNPC (parent) (20%); TotalEnergies (20%); Silk Road Fund (9.9%)
36	Australia	Ichthys LNG T1	AP-C3MR/ SplitMR	2018	4.45	Inpex* (66.25%); TotalEnergies (26%); CPC Corporation (2.63%); Tokyo Gas (1.58%); Kansai Electric (1.2%); Osaka Gas (1.2%); JERA (0.73%); Toho Gas (0.41%)
36	Australia	Ichthys LNG T2	AP-C3MR/ SplitMR	2018	4.45	Inpex* (66.25%); TotalEnergies (26%); CPC Corporation (2.63%); Tokyo Gas (1.58%); Kansai Electric (1.2%); Osaka Gas (1.2%); JERA (0.73%); Toho Gas (0.41%)
37	United States	Cove Point LNG T1	AP-C3MR	2018	5.25	Berkshire Hathaway Energy* (25%); Dominion Cove Point LNG LP (50%); Brookfield Asset Management (25%)
38	Cameroon	Cameroon FLNG	Black and Veatch PRICO	2018	2.40	Perenco* (75%); SNH (Cameroon) (25%)
32	United States	Sabine Pass T5	ConocoPhillips Optimized Cascade	2019	5.00	Cheniere Energy* (100%)
39	Australia	Prelude FLNG	Shell DMR	2019	3.60	Shell* (67.5%); Inpex (17.5%); Korea Gas (10%); CPC Corporation (5%)
40	United States	Cameron LNG T1	AP-C3MR/ SplitMR	2019	4.50	Cameron LNG* (0%); Sempra (50.2%); Mitsui (16.6%); TotalEnergies (16.6%); Mitsubishi Corp (11.62%); Nippon Yusen Kabushiki Kaisha (NYK Line) (4.98%)
41	United States	Elba Island T1	Shell MMLS	2019	0.25	Southern LNG* (0%); Kinder Morgan (51%); EIG Partners (49%)
41	United States	Elba Island T2	Shell MMLS	2019	0.25	Southern LNG* (0%); Kinder Morgan (51%); EIG Partners (49%)
41	United States	Elba Island T3	Shell MMLS	2019	0.25	Southern LNG* (0%); Kinder Morgan (51%); EIG Partners (49%)
41	United States	Elba Island T4	Shell MMLS	2019	0.25	Southern LNG* (0%); Kinder Morgan (51%); EIG Partners (49%)
42	Russia	Vysotsk LNG T1	Air Liquide Smartfin	2019	0.66	Novatek* (51%); Gazprom (49%)
43	United States	Corpus Christi T1	ConocoPhillips Optimized Cascade	2019	4.52	Cheniere Energy* (100%)
43	United States	Corpus Christi T2	ConocoPhillips Optimized Cascade	2019	4.52	Cheniere Energy* (100%)

Appendix 1: Table of Global liquefaction plants (continued)

Reference number	Market	Liquefaction Plant Train	Liquefaction technology	Infrastructure start year	Liquefaction capacity (MTPA)	Ownership
44	United States	Freeport LNG T1	AP-C3MR	2019	5.10	Freeport LNG* (50%); JERA (25%); Osaka Gas (25%)
40	United States	Cameron LNG T2	AP-C3MR/ SplitMR	2020	4.50	Cameron LNG* (0%); Sempra (50.2%); Mitsui (16.6%); TotalEnergies (16.6%); Mitsubishi Corp (11.62%); Nippon Yusen Kabushiki Kaisha (NYK Line) (4.98%)
40	United States	Cameron LNG T3	AP-C3MR/ SplitMR	2020	4.50	Cameron LNG* (0%); Sempra (50.2%); Mitsui (16.6%); TotalEnergies (16.6%); Mitsubishi Corp (11.62%); Nippon Yusen Kabushiki Kaisha (NYK Line) (4.98%)
41	United States	Elba Island T10	Shell MMLS	2020	0.25	Southern LNG* (0%); Kinder Morgan (51%); EIG Partners (49%)
41	United States	Elba Island T5	Shell MMLS	2020	0.25	Southern LNG* (0%); Kinder Morgan (51%); EIG Partners (49%)
41	United States	Elba Island T6	Shell MMLS	2020	0.25	Southern LNG* (0%); Kinder Morgan (51%); EIG Partners (49%)
41	United States	Elba Island T7	Shell MMLS	2020	0.25	Southern LNG* (0%); Kinder Morgan (51%); EIG Partners (49%)
41	United States	Elba Island T8	Shell MMLS	2020	0.25	Southern LNG* (0%); Kinder Morgan (51%); EIG Partners (49%)
41	United States	Elba Island T9	Shell MMLS	2020	0.25	Southern LNG* (0%); Kinder Morgan (51%); EIG Partners (49%)
44	United States	Freeport LNG T2	AP-C3MR	2020	5.10	Freeport LNG* (57.5%); Global Infrastructure Partners (GIP) (25%); Osaka Gas (10%); Dow Chemical Company (7.5%)
44	United States	Freeport LNG T3	AP-C3MR	2020	5.10	Freeport LNG* (57.5%); Global Infrastructure Partners (GIP) (25%); Osaka Gas (10%); Dow Chemical Company (7.5%)
35	Russia	Yamal LNG T4	Novatek Arctic Cascade	2021	0.90	OOO Yamal LNG* (0%); Novatek (50.1%); CNPC (parent) (20%); TotalEnergies (20%); Silk Road Fund (9.9%)
43	United States	Corpus Christi T3	ConocoPhillips Optimized Cascade	2021	4.52	Cheniere Energy* (100%)
45	Malaysia	Petronas FLNG Rotan (PFLNG2)	AP-N	2021	1.50	Petronas* (100%)
32	United States	Sabine Pass T6	ConocoPhillips Optimized Cascade	2022	5.00	Cheniere Energy* (100%)
46	Mozambique	Coral South FLNG	AP-DMR	2022	3.40	Eni* (25%); ExxonMobil (25%); CNPC (parent) (20%); ENH (Mozambique) (10%); Galp Energia SA (10%); Korea Gas (10%)
47	United States	Calcasieu Pass LNG T1	BHGE SMR	2022	0.56	Venture Global LNG* (100%)
47	United States	Calcasieu Pass LNG T10	BHGE SMR	2022	0.56	Venture Global LNG* (100%)

Appendix 1: Table of Global liquefaction plants (continued)

Reference number	Market	Liquefaction Plant Train	Liquefaction technology	Infrastructure start year	Liquefaction capacity (MTPA)	Ownership
47	United States	Calcasieu Pass LNG T11	BHGE SMR	2022	0.56	Venture Global LNG* (100%)
47	United States	Calcasieu Pass LNG T12	BHGE SMR	2022	0.56	Venture Global LNG* (100%)
47	United States	Calcasieu Pass LNG T13	BHGE SMR	2022	0.56	Venture Global LNG* (100%)
47	United States	Calcasieu Pass LNG T14	BHGE SMR	2022	0.56	Venture Global LNG* (100%)
47	United States	Calcasieu Pass LNG T15	BHGE SMR	2022	0.56	Venture Global LNG* (100%)
47	United States	Calcasieu Pass LNG T16	BHGE SMR	2022	0.56	Venture Global LNG* (100%)
47	United States	Calcasieu Pass LNG T17	BHGE SMR	2022	0.56	Venture Global LNG* (100%)
47	United States	Calcasieu Pass LNG T18	BHGE SMR	2022	0.56	Venture Global LNG* (100%)
47	United States	Calcasieu Pass LNG T2	BHGE SMR	2022	0.56	Venture Global LNG* (100%)
47	United States	Calcasieu Pass LNG T3	BHGE SMR	2022	0.56	Venture Global LNG* (100%)
47	United States	Calcasieu Pass LNG T4	BHGE SMR	2022	0.56	Venture Global LNG* (100%)
47	United States	Calcasieu Pass LNG T5	BHGE SMR	2022	0.56	Venture Global LNG* (100%)
47	United States	Calcasieu Pass LNG T6	BHGE SMR	2022	0.56	Venture Global LNG* (100%)
47	United States	Calcasieu Pass LNG T7	BHGE SMR	2022	0.56	Venture Global LNG* (100%)
47	United States	Calcasieu Pass LNG T8	BHGE SMR	2022	0.56	Venture Global LNG* (100%)
47	United States	Calcasieu Pass LNG T9	BHGE SMR	2022	0.56	Venture Global LNG* (100%)
48	Russia	Portovaya LNG T1	Linde LIMUM	2022	1.50	Gazprom* (100%)
49	Congo	Tango FLNG	Black and Veatch PRICO	2024	0.60	Eni* (100%)

Note:
1. In the ownership column, companies with "*" refer to plant operators. If a company doesn't have any ownership stake in the LNG plant, it will be marked with "(0%)".
2. Marsa El Bregas LNG in Libya has not been operational since 2011. It is included for reference only.
3. Yemen LNG has not exported since 2015 due to an ongoing civil war.

Appendix 2: Table of liquefaction plants approved or under construction

Reference number	Market	Liquefaction Plant Train	Liquefaction technology	Infrastructure start year	Liquefaction capacity (MTPA)	Ownership
50	Mexico	Altamira FLNG 1	Fast LNG	2024	1.40	New Fortress Energy*(100%)
11	Nigeria	NLNG T7	AP-C3MR	2024	8.00	NNPC (Nigeria)* (49%); Shell (25.6%); TotalEnergies (15%); Eni (10.4%)
50	Mexico	Altamira FLNG 2	Fast LNG	2026	1.40	New Fortress Energy*(100%)
51	United States	Golden Pass LNG T1	AP-C3MR/ SplitMR	2024	5.20	Golden Pass Products* (0%); QatarEnergy (70%); ExxonMobil (30%)
51	United States	Golden Pass LNG T2	AP-C3MR/ SplitMR	2024	5.20	Golden Pass Products* (0%); QatarEnergy (70%); ExxonMobil (30%)
52	Mauritania	Tortue/Ahmeyim FLNG T1	Black and Veatch PRICO	2024	2.50	BP* (56.29%); Kosmos Energy (26.71%); Petrosen (10%); Societe Mauritanienne des Hydrocarbures (7%)
53	United States	Plaquemines LNG T1	BHGE SCMR	2024	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T10	BHGE SCMR	2024	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T11	BHGE SCMR	2024	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T12	BHGE SCMR	2024	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T13	BHGE SCMR	2024	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T14	BHGE SCMR	2024	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T15	BHGE SCMR	2024	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T16	BHGE SCMR	2024	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T17	BHGE SCMR	2024	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T18	BHGE SCMR	2024	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T2	BHGE SCMR	2024	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T3	BHGE SCMR	2024	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T4	BHGE SCMR	2024	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T5	BHGE SCMR	2024	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T6	BHGE SCMR	2024	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T7	BHGE SCMR	2024	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T8	BHGE SCMR	2024	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T9	BHGE SCMR	2024	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T8	BHGE SCMR	2024	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T9	BHGE SCMR	2024	0.56	Venture Global LNG* (100%)

Appendix 2: Table of liquefaction plants approved or under construction (continued)

Reference number	Market	Liquefaction Plant Train	Liquefaction technology	Infrastructure start year	Liquefaction capacity (MTPA)	Ownership
54	Russia	Arctic LNG 2 T1	Linde MFC	2024	6.60	OOO Arctic LNG-2* (0%); Novatek (60%); CNOOC (10%); CNPC (parent) (10%); TotalEnergies (10%); JOGMEC (7.5%); Mitsui (2.5%)
51	United States	Golden Pass LNG T3	AP-C3MR/ SplitMR	2025	5.20	Golden Pass Products* (0%); QatarEnergy (70%); ExxonMobil (30%)
55	Mexico	Energía Costa Azul LNG T1	AP-DMR	2025	3.25	Sempra* (83.4%); TotalEnergies (16.6%)
56	Canada	LNG Canada T1	Shell DMR	2025	7.00	Shell* (40%); Petronas (25%); Mitsubishi Corp (15%); PetroChina (15%); Korea Gas (5%)
56	Canada	LNG Canada T2	Shell DMR	2025	7.00	Shell* (40%); Petronas (25%); Mitsubishi Corp (15%); PetroChina (15%); Korea Gas (5%)
9	Qatar	QatarGas LNG T8	AP-X	2026	7.80	QatarEnergy* (100%)
9	Qatar	QatarGas LNG T9	AP-X	2026	7.80	QatarEnergy* (100%)
22	Australia	Pluto LNG T2 (expansion)	ConocoPhillips Optimized Cascade	2026	5.00	Woodside* (51%); Global Infrastructure Partners (GIP) (49%)
43	United States	Corpus Christi Stage 3 T1	ConocoPhillips Optimized Cascade	2026	1.42	Cheniere Energy* (100%)
43	United States	Corpus Christi Stage 3 T2	ConocoPhillips Optimized Cascade	2026	1.42	Cheniere Energy* (100%)
43	United States	Corpus Christi Stage 3 T3	ConocoPhillips Optimized Cascade	2026	1.42	Cheniere Energy* (100%)
43	United States	Corpus Christi Stage 3 T4	ConocoPhillips Optimized Cascade	2026	1.42	Cheniere Energy* (100%)
43	United States	Corpus Christi Stage 3 T5	ConocoPhillips Optimized Cascade	2026	1.42	Cheniere Energy* (100%)
43	United States	Corpus Christi Stage 3 T6	ConocoPhillips Optimized Cascade	2026	1.42	Cheniere Energy* (100%)
43	United States	Corpus Christi Stage 3 T7	ConocoPhillips Optimized Cascade	2026	1.42	Cheniere Energy* (100%)
53	United States	Plaquemines LNG T19	BHGE SCMR	2026	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T20	BHGE SCMR	2026	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T21	BHGE SCMR	2026	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T22	BHGE SCMR	2026	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T23	BHGE SCMR	2026	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T24	BHGE SCMR	2026	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T25	BHGE SCMR	2026	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T26	BHGE SCMR	2026	0.56	Venture Global LNG* (100%)

Appendix 2: Table of liquefaction plants approved or under construction (continued)

Reference number	Market	Liquefaction Plant Train	Liquefaction technology	Infrastructure start year	Liquefaction capacity (MTPA)	Ownership
53	United States	Plaquemines LNG T27	BHGE SCMR	2026	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T28	BHGE SCMR	2026	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T29	BHGE SCMR	2026	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T30	BHGE SCMR	2026	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T31	BHGE SCMR	2026	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T32	BHGE SCMR	2026	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T33	BHGE SCMR	2026	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T34	BHGE SCMR	2026	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T35	BHGE SCMR	2026	0.56	Venture Global LNG* (100%)
53	United States	Plaquemines LNG T36	BHGE SCMR	2026	0.56	Venture Global LNG* (100%)
9	Qatar	QatarGas LNG T10	AP-X	2027	7.80	QatarEnergy* (100%)
9	Qatar	QatarGas LNG T11	AP-X	2027	7.80	QatarEnergy* (100%)
57	Congo	Eni Congo FLNG II		2027	2.40	Eni* (100%)
58	Mozambique	Mozambique LNG (Area 1) T1	AP-C3MR	2028	6.44	TotalEnergies* (26.5%); Mitsui (20%); ONGC (India) (16%); ENH (Mozambique) (15%); Bharat Petroleum Corp (BPCL) (10%); PTTEP (Thailand) (8.5%); Oil India (4%)
58	Mozambique	Mozambique LNG (Area 1) T2	AP-C3MR	2028	6.44	TotalEnergies* (26.5%); Mitsui (20%); ONGC (India) (16%); ENH (Mozambique) (15%); Bharat Petroleum Corp (BPCL) (10%); PTTEP (Thailand) (8.5%); Oil India (4%)
59	United States	Port Arthur LNG T1	C3MR	2028	6.75	Sempra* (100%)
59	United States	Port Arthur LNG T2	C3MR	2028	6.75	Sempra* (100%)
60	United States	Rio Grande LNG T1	AP-C3MR	2027	5.87	NextDecade (100*)
60	United States	Rio Grande LNG T2	AP-C3MR	2027	5.87	NextDecade (100*)
60	United States	Rio Grande LNG T3	AP-C3MR	2027	5.87	NextDecade (100*)
61	Canada	Woodfibre LNG T1	Linde MFC	2027	1.05	Pacific Energy (70%); Enbridge (30%)
61	Canada	Woodfibre LNG T2	Linde MFC	2027	1.05	Pacific Energy (70%); Enbridge (30%)

Note:
1. In the ownership column, companies with "*" refer to plant operators. If a company doesn't have any ownership stake in the LNG plant, it will be marked with "(0%)".
2. Sengkang LNG T1 is not included in the table as construction progress has been stalled.

Appendix 3: Table of global active LNG fleet as of end-of-February 2024

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cm)	Cargo Type	Vessel Type	Propulsion Type	Delivery Year
9443401	Aamira	Nakilat	Samsung	266000	Membrane	Q-Max	SSD	2010
9501186	Adam LNG	Asyad Shipping	Hyundai	162000	Membrane	Conventional	DFDE	2014
9879698	Adamastos	Capital Gas	Hyundai	174000	Membrane	Conventional	X-DF	2021
9831220	Adriano Knutsen	Knutsen OAS	Hyundai	180000	Membrane	Conventional	ME-GI	2019
9338266	Al Aamriya	NYK Line, K Line, MOL, Iino, Mitsui, Nakilat	Hanwha Ocean	216200	Membrane	Q-Flex	SSD	2008
9325697	Al Areesh	Seapeak	Hanwha Ocean	151700	Membrane	Conventional	Steam	2007
9431147	Al Bahiya	Nakilat	Hanwha Ocean	210100	Membrane	Q-Flex	SSD	2010
9132741	Al Bidda	J4 Consortium	Kawasaki	137300	Spherical	Conventional	Steam	1999
9325702	Al Daayen	Seapeak	Hanwha Ocean	151700	Membrane	Conventional	Steam	2007
9443683	Al Dafna	Nakilat	Samsung	266400	Membrane	Q-Max	SSD	2009
9307176	Al Deebel	MOL, NYK Line, K Line	Samsung	145700	Membrane	Conventional	Steam	2005
9337705	Al Gattara	Nakilat, OSC	Hyundai	216200	Membrane	Q-Flex	SSD	2007
9337987	Al Ghariya	Commerz Real, Nakilat, PRONAV	Hanwha Ocean	210200	Membrane	Q-Flex	SSD	2008
9337717	Al Gharrafa	Nakilat, OSC	Hyundai	216200	Membrane	Q-Flex	SSD	2008
9397286	Al Ghashamiya	Nakilat	Samsung	217600	Membrane	Q-Flex	SSD	2009
9372743	Al Ghuwairiya	Nakilat	Hanwha Ocean	263300	Membrane	Q-Max	SSD	2008
9337743	Al Hamla	Nakilat, OSC	Samsung	216200	Membrane	Q-Flex	SSD	2008
9074640	Al Hamra	National Gas Shipping Co	Kvaerner Masa	135000	Spherical	Conventional	Steam	1997
9360879	Al Huwaila	Nakilat, Seapeak	Samsung	217000	Membrane	Q-Flex	SSD	2008
9132791	Al Jasra	J4 Consortium	Mitsubishi	137200	Spherical	Conventional	Steam	2000
9324435	Al Jassasiya	Maran Gas Maritime, Nakilat	Hanwha Ocean	145700	Membrane	Conventional	Steam	2007
9431123	Al Karaana	Nakilat	Hanwha Ocean	210100	Membrane	Q-Flex	SSD	2009
9397327	Al Kharaitiyat	Nakilat	Hyundai	216300	Membrane	Q-Flex	SSD	2009
9360881	Al Kharsaah	Nakilat, Seapeak	Samsung	217000	Membrane	Q-Flex	SSD	2008
9431111	Al Khattiya	Nakilat	Hanwha Ocean	210200	Membrane	Q-Flex	SSD	2009
9038440	Al Khaznah	National Gas Shipping Co	Mitsui	135000	Spherical	Conventional	Steam	1994
9085613	Al Khor	J4 Consortium	Mitsubishi	137400	Spherical	Conventional	Steam	1996
9360908	Al Khuwair	Nakilat, Seapeak	Samsung	217000	Membrane	Q-Flex	SSD	2008
9397315	Al Mafyar	Nakilat	Samsung	266400	Membrane	Q-Max	SSD	2009
9325685	Al Marrouna	Nakilat, Seapeak	Hanwha Ocean	152600	Membrane	Conventional	Steam	2006
9397298	Al Mayeda	Nakilat	Samsung	266000	Membrane	Q-Max	SSD	2009
9431135	Al Nuaman	Nakilat	Hanwha Ocean	210100	Membrane	Q-Flex	SSD	2009
9360790	Al Oraiq	NYK Line, K Line, MOL, Iino, Mitsui, Nakilat	Hanwha Ocean	210200	Membrane	Q-Flex	SSD	2008
9086734	Al Rayyan	J4 Consortium	Kawasaki	137400	Spherical	Conventional	Steam	1997
9397339	Al Rekayyat	Nakilat	Hyundai	216300	Membrane	Q-Flex	SSD	2009
9337951	Al Ruwais	Commerz Real, Nakilat, PRONAV	Hanwha Ocean	210200	Membrane	Q-Flex	SSD	2007
9397341	Al Sadd	Nakilat	Hanwha Ocean	210200	Membrane	Q-Flex	SSD	2009
9337963	Al Safliya	Commerz Real, Nakilat, PRONAV	Hanwha Ocean	210200	Membrane	Q-Flex	SSD	2007
9360855	Al Sahla	NYK Line, K Line, MOL, Iino, Mitsui, Nakilat	Hyundai	216200	Membrane	Q-Flex	SSD	2008

Appendix 3: Table of global active LNG fleet (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cm)	Cargo Type	Vessel Type	Propulsion Type	Delivery Year
9388821	Al Samriya	Nakilat	Hanwha Ocean	263300	Membrane	Q-Max	SSD	2009
9360893	Al Shamal	Nakilat, Seapeak	Samsung	217000	Membrane	Q-Flex	SSD	2008
9360831	Al Sheehaniya	Nakilat	Hanwha Ocean	210200	Membrane	Q-Flex	SSD	2009
9298399	Al Thakhira	K Line, Qatar Shpg.	Samsung	145700	Membrane	Conventional	Steam	2005
9360843	Al Thumama	NYK Line, K Line, MOL, Iino, Mitsui, Nakilat	Hyundai	216200	Membrane	Q-Flex	SSD	2008
9360867	Al Utouriya	NYK Line, K Line, MOL, Iino, Mitsui, Nakilat	Hyundai	215000	Membrane	Q-Flex	SSD	2008
9085625	Al Wajbah	J4 Consortium	Mitsubishi	137300	Spherical	Conventional	Steam	1997
9086746	Al Wakrah	J4 Consortium	Kawasaki	137600	Spherical	Conventional	Steam	1998
9085649	Al Zubarah	J4 Consortium	Mitsui	137600	Spherical	Conventional	Steam	1996
9390185	Alexandroupolis	GasLog	Hanjin H.I.	153000	Membrane	FSRU	TFDE	2010
9904194	Alicante Knutsen	Knutsen OAS	Hyundai	174000	Membrane	Conventional	X-DF	2022
9343106	Alto Acrux	TEPCO, NYK Line, Mitsubishi	Mitsubishi	147800	Spherical	Conventional	Steam	2008
9682552	Amadi	Brunei Gas Carriers	Hyundai	154800	Membrane	Conventional	TFDE	2015
9496317	Amali	Brunei Gas Carriers	Hanwha Ocean	147000	Membrane	Conventional	TFDE	2011
9661869	Amani	Brunei Gas Carriers	Hyundai	154800	Membrane	Conventional	TFDE	2014
9845776	Amberjack LNG	TMS Cardiff Gas	Hyundai	174000	Membrane	Conventional	X-DF	2020
9943841	Amore Mio I	Capital Gas	Hyundai	174000	Membrane	Conventional	MEGA	2023
9317999	Amur River	Dynagas	Hyundai	149700	Membrane	Conventional	Steam	2008
9645970	Arctic Aurora	Dynagas	Hyundai	155000	Membrane	Conventional	TFDE	2013
9276389	Arctic Discoverer	K Line, Equinor, Mitsui, Iino	Mitsui	142600	Spherical	Conventional	Steam	2006
9284192	Arctic Lady	Hoegh	Mitsubishi	148000	Spherical	Conventional	Steam	2006
9271248	Arctic Princess	Hoegh, MOL, Equinor	Mitsubishi	148000	Spherical	Conventional	Steam	2006
9275335	Arctic Voyager	K Line, Equinor, Mitsui, Iino	Kawasaki	142800	Spherical	Conventional	Steam	2006
9862918	Aristarchos	Capital Gas	Hyundai	174000	Membrane	Conventional	X-DF	2021
9862906	Aristidis I	Capital Gas	Hyundai	174000	Membrane	Conventional	X-DF	2021
9862891	Aristos I	Capital Gas	Hyundai	174000	Membrane	Conventional	X-DF	2020
9496305	Arkat	Brunei Gas Carriers	Hanwha Ocean	147000	Membrane	Conventional	TFDE	2011
8125868	Armada LNG Mediterrana	Bumi Armada Berhad	Mitsui	127209	Spherical	FSU	Steam	1985
9319404	Arrow Spirit	K Line	Imabari	155000	Membrane	Conventional	Steam	2008
9377547	Aseem	MOL, NYK Line, K Line, SCI, Nakilat, Petronet	Samsung	155000	Membrane	Conventional	DFDE	2009
9610779	Asia Endeavour	Chevron	Samsung	160000	Membrane	Conventional	DFDE	2015
9606950	Asia Energy	Chevron	Samsung	160000	Membrane	Conventional	DFDE	2014
9610767	Asia Excellence	Chevron	Samsung	160000	Membrane	Conventional	DFDE	2015
9680188	Asia Integrity	Chevron	Samsung	160000	Membrane	Conventional	DFDE	2017
9680190	Asia Venture	Chevron	Samsung	160000	Membrane	Conventional	TFDE	2017
9606948	Asia Vision	Chevron	Samsung	160000	Membrane	Conventional	TFDE	2014
9884021	Asklipios	Capital Gas	Hyundai	174000	Membrane	Conventional	X-DF	2021
9892298	Asterix I	Capital Gas	Hyundai	174000	Membrane	Conventional	X-DF	2023
9862920	Attalos	Capital Gas	Hyundai	174000	Membrane	Conventional	X-DF	2021
9943853	Axios II	Capital Gas	Hyundai	174000	Membrane	Conventional	MEGA	2024

Appendix 3: Table of global active LNG fleet (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cm)	Cargo Type	Vessel Type	Propulsion Type	Delivery Year
9401295	Barcelona Knutsen	Knutsen OAS	Hanwha Ocean	173400	Membrane	Conventional	TFDE	2009
9713105	Bauhinia Spirit	MOL	Hanwha Ocean	263000	Membrane	FSRU	TFDE	2017
9613159	Beidou Star	MOL, China LNG	Hudong-Zhonghua	171800	Membrane	Conventional	SSD	2015
9256597	Berge Arzew	BW	Hanwha Ocean	138000	Membrane	Conventional	Steam	2004
9236432	Bilbao Knutsen	Knutsen OAS	IZAR	138000	Membrane	Conventional	Steam	2004
9691137	Bishu Maru	Trans Pacific Shipping	Kawasaki	164700	Spherical	Conventional	Steam reheat	2017
9845788	Bonito LNG	TMS Cardiff Gas	Hyundai	174000	Membrane	Conventional	X-DF	2020
9768394	Boris Davydov	Sovcomflot	Hanwha Ocean	172000	Membrane	Icebreaker	TFDE	2018
9768368	Boris Vilkitsky	Sovcomflot	Hanwha Ocean	172000	Membrane	Icebreaker	TFDE	2017
9766542	British Achiever	BP	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2018
9766554	British Contributor	BP	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2018
9766566	British Listener	BP	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2019
9766578	British Mentor	BP	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2019
9766530	British Partner	BP	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2018
9766580	British Sponsor	BP	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2019
9085651	Broog	J4 Consortium	Mitsui	137500	Spherical	Conventional	Steam	1998
9388833	Bu Samra	Nakilat	Samsung	266000	Membrane	Q-Max	SSD	2008
9796793	Bushu Maru	NYK Line, JERA	Mitsubishi	180000	Spherical	Conventional	STaGE	2019
9368302	BW Batangas	BW	Hanwha Ocean	162400	Membrane	FSRU	TFDE	2009
9230062	BW Boston	BW, Total	Hanwha Ocean	138000	Membrane	Conventional	Steam	2003
9368314	BW Brussels	BW	Hanwha Ocean	162500	Membrane	Conventional	DFDE	2009
9896933	BW Cassia	BW	Hanwha Ocean	174000	Membrane	Conventional	ME-GI	2022
9896921	BW ENN Snow Lotus	BW	Hanwha Ocean	174000	Membrane	Conventional	ME-GI	2022
9873852	BW Helios	BW	Hanwha Ocean	174000	Membrane	Conventional	ME-GI	2021
9724946	BW Integrity	BW, MOL	Samsung	173400	Membrane	FSRU	TFDE	2017
9873840	BW Lesmes	BW	Hanwha Ocean	174000	Membrane	Conventional	ME-GI	2021
9758076	BW Lilac	BW	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2018
9792591	BW Magna	BW	Hanwha Ocean	173400	Membrane	FSRU	TFDE	2019
9850666	BW Magnolia	BW	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2020
9792606	BW Pavilion Aranda	BW, Pavilion LNG	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2019
9850678	Bw Pavilion Aranthera	BW	Hanwha Ocean	170800	Membrane	Conventional	ME-GI	2020
9640645	BW Pavilion Leeara	BW, Pavilion LNG	Hyundai	162000	Membrane	Conventional	TFDE	2015
9640437	BW Pavilion Vanda	BW, Pavilion LNG	Hyundai	162000	Membrane	Conventional	TFDE	2015
9684495	BW Singapore	BW	Samsung	170200	Membrane	FSRU	TFDE	2015
9236626	BW Tatiana (ex-Gallina)	Shell	Mitsubishi	136600	Spherical	FSRU	Steam	2002
9758064	BW Tulip	BW	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2018
9246578	Cadiz Knutsen	Knutsen OAS	IZAR	138000	Membrane	Conventional	Steam	2004
9390680	Cape Ann	Hoegh, MOL, TLTC	Samsung	145000	Membrane	FSRU	DFDE	2010
9742819	Castillo De Caldelas	Elcano	Imabari	178800	Membrane	Conventional	ME-GI	2018
9742807	Castillo De Merida	Elcano	Imabari	178800	Membrane	Conventional	ME-GI	2018
9433717	Castillo De Santisteban	Elcano	STX	173600	Membrane	Conventional	TFDE	2010
9236418	Castillo De Villalba	Elcano	IZAR	138200	Membrane	Conventional	Steam	2003

Appendix 3: Table of global active LNG fleet (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cm)	Cargo Type	Vessel Type	Propulsion Type	Delivery Year
9864796	Celsius Canberra	Celsius Shipping	Samsung	180000	Membrane	Conventional	X-DF	2021
9878723	Celsius Carolina	Celsius Shipping	Samsung	180000	Membrane	Conventional	X-DF	2021
9878711	Celsius Charlotte	Celsius Shipping	Samsung	180000	Membrane	Conventional	X-DF	2021
9864784	Celsius Copenhagen	Celsius Shipping	Samsung	180000	Membrane	Conventional	X-DF	2020
9945435	Celsius Geneva	Celsius Shipping	Samsung	180000	Membrane	Conventional	MEGA	2023
9945447	Celsius Giza	Celsius Shipping	Samsung	180000	Membrane	Conventional	MEGA	2023
9945459	Celsius Glarus	Celsius Shipping	Samsung	180000	Membrane	Conventional	MEGA	2024
9672844	Cesi Beihai	China Shipping Group	Hudong-Zhonghua	174100	Membrane	Conventional	TFDE	2017
9672820	Cesi Gladstone	Chuo Kaiun/Shinwa Chem.	Hudong-Zhonghua	174100	Membrane	Conventional	DFDE	2016
9672818	Cesi Lianyungang	China Shipping Group	Hudong-Zhonghua	174100	Membrane	Conventional	DFDE	2018
9672832	Cesi Qingdao	China Shipping Group	Hudong-Zhonghua	174100	Membrane	Conventional	DFDE	2017
9694749	Cesi Tianjin	China Shipping Group	Hudong-Zhonghua	174100	Membrane	Conventional	DFDE	2017
9694751	Cesi Wenzhou	China Shipping Group	Hudong-Zhonghua	174100	Membrane	Conventional	TFDE	2018
9324344	Cheikh Bouamama	HYPROC, Sonatrach, Itochu, MOL	Universal	75500	Membrane	Conventional	Steam	2008
9324332	Cheikh El Mokrani	HYPROC, Sonatrach, Itochu, MOL	Universal	75500	Membrane	Conventional	Steam	2007
9737187	Christophe De Margerie	Sovcomflot	Hanwha Ocean	172000	Membrane	Icebreaker	TFDE	2016
9886732	Clean Cajun	Dynagas	Hyundai	200000	Membrane	Conventional	X-DF	2022
9886744	Clean Copano	Dynagas	Hyundai	200000	Membrane	Conventional	X-DF	2022
9943487	Clean Destiny	Dynagas	Hyundai	200000	Membrane	Conventional	MEGA	2023
9323687	Clean Energy	Dynagas	Hyundai	149700	Membrane	Conventional	Steam	2007
9655444	Clean Horizon	Dynagas	Hyundai	162000	Membrane	Conventional	TFDE	2015
9637492	Clean Ocean	Dynagas	Hyundai	162000	Membrane	Conventional	TFDE	2014
9637507	Clean Planet	Dynagas	Hyundai	162000	Membrane	Conventional	TFDE	2014
9943475	Clean Resolution	Dynagas	Hyundai	200000	Membrane	Conventional	MEGA	2023
9655456	Clean Vision	Dynagas	Hyundai	162000	Membrane	Conventional	TFDE	2016
9943499	Clean Vitality	Dynagas	Hyundai	200000	Membrane	Conventional	MEGA	2024
9869306	Cobia LNG	TMS Cardiff Gas	Hyundai	174000	Membrane	Conventional	X-DF	2021
9307205	Condor LNG	TMS Cardiff Gas	Samsung	145000	Membrane	Conventional	Steam	2006
9861031	Cool Discoverer	Thenamaris	Hyundai	174000	Membrane	Conventional	X-DF	2020
9640023	Cool Explorer	Thenamaris	Samsung	160000	Membrane	Conventional	TFDE	2015
9869265	Cool Racer	Thenamaris	Hyundai	174000	Membrane	Conventional	ME-GI	2021
9333606	Cool Ranger	BP	Hyundai	155000	Membrane	Conventional	DFDE	2008
9333591	Cool Rider	BP	Hyundai	155000	Membrane	Conventional	DFDE	2007
9333618	Cool Rover	BP	Hyundai	155000	Membrane	Conventional	DFDE	2008
9636797	Cool Runner	Thenamaris	Samsung	160000	Membrane	Conventional	TFDE	2014
9636785	Cool Voyager	Thenamaris	Samsung	160000	Membrane	Conventional	TFDE	2013
9693719	Coral Encanto	Anthony Veder	Ningbo Xinle Shipbuilding Co Ltd	30000	Type C	Small-scale	DFDE	2020
9955521	Coral Evolutionist	Anthony Veder	Hyundai	30000	Type C	Small-scale	X-DF	2023
9919890	Coral Nordic	Anthony Veder	Jiangnan	30000	Type C	Small-scale	X-DF	2022
9636711	Corcovado LNG	TMS Cardiff Gas	Hanwha Ocean	160100	Membrane	Conventional	TFDE	2014

Appendix 3: Table of global active LNG fleet (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cm)	Cargo Type	Vessel Type	Propulsion Type	Delivery Year
9491812	Cubal	Mitsui, NYK Line, Seapeak	Samsung	160000	Membrane	Conventional	TFDE	2012
9376294	Cygnus Passage	TEPCO, NYK Line, Mitsubishi	Mitsubishi	147000	Spherical	Conventional	Steam	2009
9308481	Dapeng Moon	China LNG Ship Mgmt	Hudong-Zhonghua	147200	Membrane	Conventional	Steam	2008
9937907	Dapeng Princess	Shenzhen Gas	Hudong-Zhonghua	80000	Membrane	Mid-scale	X-DF	2023
9369473	Dapeng Star	China LNG Ship Mgmt	Hudong-Zhonghua	147600	Membrane	Conventional	Steam	2009
9308479	Dapeng Sun	China LNG Ship Mgmt	Hudong-Zhonghua	147200	Membrane	Conventional	Steam	2008
9874454	Diamond Gas Crystal	NYK Line	Hyundai	174000	Membrane	Conventional	X-DF	2021
9862487	Diamond Gas Metropolis	NYK Line	Hyundai	174000	Membrane	Conventional	X-DF	2020
9779226	Diamond Gas Orchid	NYK Line	Mitsubishi	165000	Spherical	Conventional	STaGE	2018
9779238	Diamond Gas Rose	NYK Line	Mitsubishi	165000	Spherical	Conventional	STaGE	2018
9810020	Diamond Gas Sakura	NYK Line	Mitsubishi	165000	Spherical	Conventional	STaGE	2019
9874466	Diamond Gas Victoria	NYK Line	Hyundai	174000	Membrane	Conventional	X-DF	2021
9250713	Disha	MOL, NYK Line, K Line, SCI, Nakilat, Petronet	Hanwha Ocean	138100	Membrane	Conventional	Steam	2004
9085637	Doha	J4 Consortium	Mitsubishi	137300	Spherical	Conventional	Steam	1999
9863182	Dorado LNG	TMS Cardiff Gas	Samsung	174000	Membrane	Conventional	X-DF	2020
9337975	Duhail	Commerz Real, Nakilat, PRONAV	Hanwha Ocean	210200	Membrane	Q-Flex	SSD	2008
9265500	Dukhan	J4 Consortium	Mitsui	137500	Spherical	Conventional	Steam	2004
9750696	Eduard Toll	Seapeak	Hanwha Ocean	172000	Membrane	Icebreaker	TFDE	2017
9334076	Ejnan	K Line, MOL, NYK Line, Mitsui, Nakilat	Samsung	145000	Membrane	Conventional	Steam	2007
8706155	Ekaputra 1	P.T. Humpuss Trans	Mitsubishi	137000	Spherical	Conventional	Steam	1990
9884473	Elisa Aquila	NYK Line	Hyundai	174000	Membrane	Conventional	X-DF	2022
9852975	Elisa Larus	GazOcean	Hyundai	174000	Membrane	Conventional	X-DF	2020
9958640	Emei	Cosco Shipping Energy Transportation	Hudong-Zhonghua	174000	Membrane	Conventional	X-DF	2023
9626027	Energos Celsius	Energos	Samsung	160000	Membrane	Conventional	TFDE	2013
9624940	Energos Eskimo	Energos	Samsung	160000	Membrane	FSRU	TFDE	2014
9861811	Energos Force	Energos	Hudong-Zhonghua	174000	Membrane	FSRU	DFDE	2021
7361922	Energos Freeze	Energos	HDW	125000	Spherical	FSRU	Steam	1977
9303560	Energos Grand	Energos	Hanwha Ocean	145000	Membrane	Conventional	Steam	2005
9633991	Energos Igloo	Energos	Samsung	170000	Membrane	FSRU	TFDE	2014
9320374	Energos Maria	Energos	Hanwha Ocean	145000	Membrane	Conventional	Steam	2006
9785500	Energos Nanook	Energos	Samsung	170000	Membrane	FSRU	DFDE	2018
9861809	Energos Power	Energos	Hudong-Zhonghua	174000	Membrane	FSRU	DFDE	2021
9253715	Energos Princess	Energos	Hanwha Ocean	138000	Membrane	Conventional	Steam	2003
9256614	Energos Winter	Energos	Hanwha Ocean	138000	Membrane	FSRU	Steam	2004

Appendix 3: Table of global active LNG fleet (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cm)	Cargo Type	Vessel Type	Propulsion Type	Delivery Year
9269180	Energy Advance	Tokyo Gas	Kawasaki	147000	Spherical	Conventional	Steam	2005
9649328	Energy Atlantic	Alpha Gas	STX	159700	Membrane	Conventional	TFDE	2015
9405588	Energy Confidence	NYK Line, Tokyo Gas	Kawasaki	155000	Spherical	Conventional	Steam	2009
9854624	Energy Endeavour	Alpha Gas	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2021
9948695	Energy Endurance	Alpha Gas	Hyundai	174000	Membrane	Conventional	X-DF	2024
9540089	Energy Fidelity (ex-Jules Verne)	Alpha Gas	Hyundai	174000	Membrane	Conventional	X-DF	2023
9245720	Energy Frontier	Tokyo Gas	Kawasaki	147000	Spherical	Conventional	Steam	2003
9752565	Energy Glory	NYK Line, Tokyo Gas	Japan Marine	165000	Self-Supporting Prismatic	Conventional	TFDE	2019
9483877	Energy Horizon	NYK Line, TLTC	Kawasaki	177000	Spherical	Conventional	Steam	2011
9758832	Energy Innovator	MOL, Tokyo Gas	Japan Marine	165000	Self-Supporting Prismatic	Conventional	TFDE	2019
9859739	Energy Integrity	Alpha Gas	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2021
9881201	Energy Intelligence	Alpha Gas	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2021
9736092	Energy Liberty	MOL, Tokyo Gas	Japan Marine	165000	Self-Supporting Prismatic	Conventional	TFDE	2018
9355264	Energy Navigator	MOL, Tokyo Gas	Kawasaki	147000	Spherical	Conventional	Steam	2008
9854612	Energy Pacific	Alpha Gas	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2020
9274226	Energy Progress	MOL	Kawasaki	147000	Spherical	Conventional	Steam	2006
9269207	Energy Spirit	Jovo Group	Chantiers de l'Atlantique	74500	Membrane	Conventional	Steam	2006
9758844	Energy Universe	MOL, Tokyo Gas	Japan Marine	165000	Self-Supporting Prismatic	Conventional	TFDE	2019
9749609	Enshu Maru	K Line	Kawasaki	164700	Spherical	Conventional	Steam reheat	2018
9859820	Ertugrul Gazi	Turkish Petroleum Corp	Hyundai	170000	Membrane	FSRU	DFDE	2021
9666560	Esshu Maru	MOL, Tokyo Gas	Mitsubishi	153000	Spherical	Conventional	Steam	2014
9236614	Etyfa Prometheas	Natural Gas Infrastructure Company of Cyprus	Mitsubishi	135000	Spherical	FSRU	Steam	2002
9230050	Excalibur	Exmar	Hanwha Ocean	138000	Membrane	FSU	Steam	2002
9820843	Excelerate Sequoia	Excelerate Energy	Hanwha Ocean	173400	Membrane	FSRU	TFDE	2020
9252539	Excellence	Excelerate Energy	Hanwha Ocean	138000	Membrane	FSRU	Steam	2005
9239616	Excelsior	Excelerate Energy	Hanwha Ocean	138000	Membrane	FSRU	Steam	2005
9444649	Exemplar	Excelerate Energy	Hanwha Ocean	150900	Membrane	FSRU	Steam	2010
9389643	Expedient	Excelerate Energy	Hanwha Ocean	150900	Membrane	FSRU	Steam	2010
9638525	Experience	Excelerate Energy	Hanwha Ocean	173400	Membrane	FSRU	TFDE	2014
9361079	Explorer	Excelerate Energy	Hanwha Ocean	150900	Membrane	FSRU	Steam	2008
9361445	Express	Excelerate Energy	Hanwha Ocean	150900	Membrane	FSRU	Steam	2009
9381134	Exquisite	Excelerate Energy, Nakilat	Hanwha Ocean	150900	Membrane	FSRU	Steam	2009
9918157	Extremadura Knutsen	Knutsen OAS	Hyundai	174000	Membrane	Conventional	X-DF	2023
9768370	Fedor Litke	LITKE	Hanwha Ocean	172000	Membrane	Icebreaker	TFDE	2017
9918145	Ferrol Knutsen	Knutsen OAS	Hyundai	174000	Membrane	Conventional	X-DF	2023
9857377	Flex Amber	Flex LNG	Hyundai	174000	Membrane	Conventional	X-DF	2020

Appendix 3: Table of global active LNG fleet (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cm)	Cargo Type	Vessel Type	Propulsion Type	Delivery Year
9851634	Flex Artemis	Flex LNG	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2020
9857365	Flex Aurora	Flex LNG	Hyundai	174000	Membrane	Conventional	X-DF	2020
9825427	Flex Constellation	Flex LNG	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2019
9825439	Flex Courageous	Flex LNG	Hanwha Ocean	173400	Spherical	Conventional	ME-GI	2019
9762261	Flex Endeavour	Flex LNG	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2018
9762273	Flex Enterprise	Flex LNG	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2018
9862308	Flex Freedom	Flex LNG	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2021
9709037	Flex Rainbow	Flex LNG	Samsung	174000	Membrane	Conventional	ME-GI	2018
9709025	Flex Ranger	Flex LNG	Samsung	174000	Membrane	Conventional	ME-GI	2018
9851646	Flex Resolute	Flex LNG	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2020
9862475	Flex Vigilant	Flex LNG	Hyundai	174000	Membrane	Conventional	X-DF	2021
9862463	Flex Volunteer	Flex LNG	Hyundai	174000	Membrane	Conventional	X-DF	2021
9360817	Fraiha	NYK Line, K Line, MOL, Iino, Mitsui, Nakilat	Hanwha Ocean	210100	Membrane	Q-Flex	SSD	2008
9253284	FSRU Toscana	OLT Offshore LNG Toscana	Hyundai	137100	Spherical	FSRU	Steam	2004
9275359	Fuji LNG	TMS Cardiff Gas	Kawasaki	147900	Spherical	Conventional	Steam	2004
9256200	Fuwairit	MOL	Samsung	138300	Membrane	Conventional	Steam	2004
9877145	Gail Bhuwan	MOL	Hanwha Ocean	176500	Membrane	Conventional	X-DF	2021
9949027	Gail Urja	MOL	Hanwha Ocean	174000	Membrane	Conventional	X-DF	2024
9864928	Gaslog Galveston	GasLog	Samsung	174000	Membrane	Conventional	X-DF	2021
9707508	Gaslog Geneva	GasLog	Samsung	174000	Membrane	Conventional	TFDE	2016
9744013	Gaslog Genoa	GasLog	Samsung	174000	Membrane	Conventional	X-DF	2018
9864916	Gaslog Georgetown	GasLog	Samsung	174000	Membrane	Conventional	X-DF	2020
9707510	Gaslog Gibraltar	GasLog	Samsung	174000	Membrane	Conventional	TFDE	2016
9744025	Gaslog Gladstone	GasLog	Samsung	174000	Membrane	Conventional	X-DF	2019
9687021	Gaslog Glasgow	GasLog	Samsung	174000	Membrane	Conventional	TFDE	2016
9687019	Gaslog Greece	GasLog	Samsung	174000	Membrane	Conventional	TFDE	2016
9748904	Gaslog Hongkong	GasLog	Hyundai	174000	Membrane	Conventional	X-DF	2018
9748899	Gaslog Houston	GasLog	Hyundai	174000	Membrane	Conventional	X-DF	2018
9638915	Gaslog Salem	CDB Leasing	Samsung	155000	Membrane	Conventional	TFDE	2015
9600530	Gaslog Santiago	GasLog	Samsung	155000	Membrane	Conventional	TFDE	2013
9638903	Gaslog Saratoga	CDB Leasing	Samsung	155000	Membrane	Conventional	TFDE	2014
9352860	Gaslog Savannah	GasLog	Samsung	155000	Membrane	Conventional	TFDE	2010
9634086	Gaslog Seattle	GasLog	Samsung	155000	Membrane	Conventional	TFDE	2013
9600528	Gaslog Shanghai	CDB Leasing	Samsung	155000	Membrane	Conventional	TFDE	2013
9355604	Gaslog Singapore	GasLog	Samsung	155000	Membrane	FSU	TFDE	2010
9626285	Gaslog Skagen	CDB Leasing	Samsung	155000	Membrane	Conventional	TFDE	2013
9626273	Gaslog Sydney	CDB Leasing	Samsung	155000	Membrane	Conventional	TFDE	2013
9853137	Gaslog Wales	GasLog	Samsung	180000	Membrane	Conventional	X-DF	2020
9816763	Gaslog Warsaw	GasLog	Samsung	180000	Membrane	Conventional	X-DF	2019
9876660	Gaslog Wellington	GasLog	Samsung	180000	Membrane	Conventional	X-DF	2021
9855812	Gaslog Westminster	GasLog	Samsung	180000	Membrane	Conventional	X-DF	2020
9876737	Gaslog Winchester	GasLog	Samsung	180000	Membrane	Conventional	X-DF	2021
9819650	Gaslog Windsor	GasLog	Samsung	180000	Membrane	Conventional	X-DF	2020
9768382	Georgiy Brusilov	Dynagas	Hanwha Ocean	172600	Membrane	Icebreaker	TFDE	2018

Appendix 3: Table of global active LNG fleet (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cm)	Cargo Type	Vessel Type	Propulsion Type	Delivery Year
9750749	Georgiy Ushakov	Seapeak, China LNG Shipping	Hanwha Ocean	172000	Membrane	Icebreaker	TFDE	2019
9038452	Ghasha	National Gas Shipping Co	Mitsui	135000	Spherical	Conventional	Steam	1995
9360922	Gigira Laitebo	MOL, Itochu	Hyundai	155000	Membrane	Conventional	TFDE	2010
9845013	Global Energy	Maran Gas Maritime	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2020
9880465	Global Sea Spirit	Maran Gas Maritime	Hanwha Ocean	174000	Membrane	Conventional	X-DF	2021
9880477	Global Sealine	Maran Gas Maritime	Hanwha Ocean	174000	Membrane	Conventional	X-DF	2022
9859741	Global Star	Maran Gas Maritime, Nakilat	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2021
9253105	Golar Arctic	Golar	Hanwha Ocean	140000	Membrane	Conventional	Steam	2003
9655808	Golar Tundra	Snam	Samsung	170000	Membrane	FSRU	TFDE	2015
9321756	Golden Isaia (ex-Methane Shirley Elizabeth)	Sillo Maritime	Samsung	145000	Membrane	Conventional	Steam	2007
9946374	Gordonwaters Knutsen	Knutsen OAS	Hyundai	174000	Membrane	Conventional	X-DF	2023
9315707	Grace Acacia	NYK Line	Hyundai	150000	Membrane	Conventional	Steam	2007
9315719	Grace Barleria	NYK Line	Hyundai	150000	Membrane	Conventional	Steam	2007
9323675	Grace Cosmos	MOL, NYK Line	Hyundai	150000	Membrane	Conventional	Steam	2008
9540716	Grace Dahlia	NYK Line	Kawasaki	177400	Spherical	Conventional	Steam	2013
9884174	Grace Emelia	NYK Line	Hyundai	174000	Membrane	Conventional	X-DF	2021
9903920	Grace Freesia	NYK Line	Hyundai	174000	Membrane	Conventional	X-DF	2022
9338955	Grand Aniva	NYK Line, Sovcomflot	Mitsubishi	147000	Spherical	Conventional	Steam	2008
9332054	Grand Elena	NYK Line, Sovcomflot	Mitsubishi	147000	Spherical	Conventional	Steam	2007
9338929	Grand Mereya	MOL, K Line, Primorsk	Mitsui	147600	Spherical	Conventional	Steam	2008
9922988	Grazyna Gesicka	Knutsen OAS	Hyundai	174000	Membrane	Conventional	X-DF	2023
9878888	Gui Ying	CSSC Shpg Leasing	Hudong-Zhonghua	174000	Membrane	Conventional	X-DF	2021
9696266	Hai Yang Shi You 301	CNOOC	Jiangnan	30000	Membrane	Bunkering vessel	DFDE	2015
9872999	Hellas Athina	Latsco (London)	Hyundai	174000	Membrane	Conventional	X-DF	2021
9872987	Hellas Diana	Latsco (London)	Hyundai	174000	Membrane	Conventional	X-DF	2021
9155078	HL Muscat	H-Line Shipping	Hanjin H.I.	138000	Membrane	Conventional	Steam	1999
9061928	HL Pyeongtaek	H-Line Shipping	Hanjin H.I.	130100	Membrane	Conventional	Steam	1995
9176008	HL Ras Laffan	H-Line Shipping	Hanjin H.I.	138000	Membrane	Conventional	Steam	2000
9176010	HL Sur	H-Line Shipping	Hanjin H.I.	138300	Membrane	Conventional	Steam	2000
9941013	HLS Bilbao	Hyundai LNG Shipping	Hanwha Ocean	174000	Membrane	Conventional	ME-GI	2024
9780354	Hoegh Esperanza	Hoegh	Hyundai	170000	Membrane	FSRU	DFDE	2018
9653678	Hoegh Gallant	Hoegh	Hyundai	170100	Membrane	FSRU	DFDE	2014
9820013	Hoegh Galleon	Hoegh	Samsung	170000	Membrane	FSRU	TFDE	2019
9624914	Hoegh Gandria	Hoegh	Samsung	160000	Membrane	Conventional	TFDE	2013
9822451	Hoegh Gannet	Hoegh	Hyundai	170000	Membrane	FSRU	DFDE	2018
9762962	Hoegh Giant	Hoegh	Hyundai	170000	Membrane	FSRU	DFDE	2017
9674907	Hoegh Grace	Hoegh	Hyundai	170000	Membrane	FSRU	DFDE	2016
9250725	Hongkong Energy	Sinokor Merchant Marine	Hanwha Ocean	140500	Membrane	Conventional	Steam	2004

Appendix 3: Table of global active LNG fleet (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cm)	Cargo Type	Vessel Type	Propulsion Type	Delivery Year
9904209	Huelva Knutsen	Knutsen OAS	Hyundai	174000	Membrane	Conventional	X-DF	2022
9179581	Hyundai Aquapia	Hyundai LNG Shipping	Hyundai	135000	Spherical	Conventional	Steam	2000
9155157	Hyundai Cosmopia	Hyundai LNG Shipping	Hyundai	135000	Spherical	Conventional	Steam	2000
9372999	Hyundai Ecopia	Hyundai LNG Shipping	Hyundai	150000	Membrane	Conventional	Steam	2008
9075333	Hyundai Greenpia	Hyundai LNG Shipping	Hyundai	125000	Spherical	Conventional	Steam	1996
9183269	Hyundai Oceanpia	Hyundai LNG Shipping	Hyundai	135000	Spherical	Conventional	Steam	2000
9761853	Hyundai Peacepia	Hyundai LNG Shipping	Hanwha Ocean	174000	Membrane	Conventional	ME-GI	2017
9761841	Hyundai Princepia	Hyundai LNG Shipping	Hanwha Ocean	174000	Membrane	Conventional	ME-GI	2017
9155145	Hyundai Technopia	Hyundai LNG Shipping	Hyundai	135000	Spherical	Conventional	Steam	1999
9018555	Hyundai Utopia	Hyundai LNG Shipping	Hyundai	125200	Spherical	Conventional	Steam	1994
9326603	Iberica Knutsen	Knutsen OAS	Hanwha Ocean	138000	Membrane	Conventional	Steam	2006
9326689	Ibra LNG	Asyad Shipping, MOL	Samsung	147600	Membrane	Conventional	Steam	2006
9317315	Ibri LNG	Asyad Shipping, MOL, Mitsubishi	Mitsubishi	147600	Spherical	Conventional	Steam	2006
9946398	Ignacy Lukasiewicz	Knutsen OAS	Hyundai	174000	Membrane	Conventional	X-DF	2024
9629536	Independence	Hoegh	Hyundai	170100	Membrane	FSRU	DFDE	2014
9874820	Isabella	Maran Gas Maritime	Hanwha Ocean	173400	Membrane	Conventional	X-DF	2021
9035864	Ish	National Gas Shipping Co	Mitsubishi	137300	Spherical	FSU	Steam	1995
9854935	Jawa Satu	Jawa Satu Regas	Samsung	170000	Membrane	FSRU	DFDE	2021
9901350	John A Angelicoussis	Maran Gas Maritime	Hanwha Ocean	174000	Membrane	Conventional	ME-GI	2022
9157636	K. Acacia	Korea Line	Hanwha Ocean	138000	Membrane	Conventional	Steam	2000
9186584	K. Freesia	Korea Line	Hanwha Ocean	138000	Membrane	Conventional	Steam	2000
9373008	K. Jasmine	Korea Line	Hanwha Ocean	145700	Membrane	Conventional	Steam	2008
9373010	K. Mugungwha	Korea Line	Hanwha Ocean	151700	Membrane	Conventional	Steam	2008
9306495	Karadeniz LNGT Powership Anatolia	Karpowership	Chantiers de l'Atlantique	154472	Membrane	Conventional	DFDE	2006
9043677	Karmol LNGT Powership Africa	Karpowership, MOL	Mitsubishi	127386	Spherical	FSRU	Steam	1994
8608705	Karmol LNGT Powership Asia	Karpowership, MOL	Kawasaki	127000	Spherical	FSRU	Steam	1991
9020766	Karmol LNGT Powership Europe (ex-LNG Vesta)	Karpowership, MOL	Mitsubishi	128000	Spherical	FSRU	Steam	1994
9785158	Kinisis	Chandris Group	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2018
9636723	Kita LNG	TMS Cardiff Gas	Hanwha Ocean	160100	Membrane	Conventional	TFDE	2014
9333620	Kmarin Diamond	BP	Hyundai	155000	Membrane	Conventional	DFDE	2008
9654878	Kool Baltic	CoolCo	STX	170200	Membrane	Conventional	TFDE	2015
9635315	Kool Blizzard	CoolCo	Samsung	160000	Membrane	Conventional	TFDE	2015
9654880	Kool Boreas	CoolCo	STX	170200	Membrane	Conventional	TFDE	2015
9624926	Kool Crystal	CoolCo	Samsung	160000	Membrane	Conventional	TFDE	2014

Appendix 3: Table of global active LNG fleet (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cm)	Cargo Type	Vessel Type	Propulsion Type	Delivery Year
9864746	Kool Firn	CoolCo	Hyundai	174000	Membrane	Conventional	X-DF	2020
9655042	Kool Frost	CoolCo	Samsung	160000	Membrane	Conventional	TFDE	2014
9654696	Kool Glacier	CoolCo	Hyundai	162000	Membrane	Conventional	TFDE	2014
9626039	Kool Husky	CoolCo	Samsung	160000	Membrane	Conventional	TFDE	2014
9637325	Kool Ice	CoolCo	Samsung	160000	Membrane	Conventional	TFDE	2015
9654701	Kool Kelvin	CoolCo	Hyundai	162000	Membrane	Conventional	TFDE	2015
9870525	Kool Orca	CoolCo	Hyundai	174000	Membrane	Conventional	X-DF	2021
9613161	Kumul	MOL, China LNG	Hudong-Zhonghua	172000	Membrane	Conventional	SSD	2016
9915911	Kunlun	COSCO	Hudong-Zhonghua	174000	Membrane	Conventional	X-DF	2023
9721724	La Mancha Knutsen	Knutsen OAS	Hyundai	176000	Membrane	Conventional	ME-GI	2016
9845764	La Seine	TMS Cardiff Gas	Hyundai	174000	Membrane	Conventional	X-DF	2020
9905980	Lagenda Serenity	K Line	Hudong-Zhonghua	80000	Membrane	Mid-scale	X-DF	2022
9952816	Lagenda Setia	K Line	Hudong-Zhonghua	174000	Membrane	Conventional	X-DF	2023
9905978	Lagenda Suria	K Line	Hudong-Zhonghua	80000	Membrane	Mid-scale	X-DF	2022
9275347	Lalla Fatma N'soumer	HYPROC	Kawasaki	147300	Spherical	Conventional	Steam	2004
9922976	Lech Kaczynski	Knutsen OAS	Hyundai	174000	Membrane	Conventional	X-DF	2023
9629598	Lena River	Dynagas	Hyundai	155000	Membrane	Conventional	DFDE	2013
9064085	Lerici	MISC	Sestri	65000	Membrane	Conventional	Steam	1998
9388819	Lijmiliya	Nakilat	Hanwha Ocean	263300	Membrane	Q-Max	SSD	2009
9690171	LNG Abalamabie	BGT LTD	Samsung	175000	Membrane	Conventional	DFDE	2016
9690169	LNG Abuja II	BGT LTD	Samsung	175000	Membrane	Conventional	DFDE	2016
9262211	LNG Adamawa	BGT LTD	Hyundai	141000	Spherical	Conventional	Steam	2005
9870159	LNG Adventure	France LNG Shipping	Samsung	174000	Membrane	Conventional	X-DF	2021
9262209	LNG Akwa Ibom	BGT LTD	Hyundai	141000	Spherical	Conventional	Steam	2004
9320075	LNG Alliance	GazOcean	Chantiers de l'Atlantique	154500	Membrane	Conventional	DFDE	2007
7390181	LNG Aquarius	Hanochem	General Dynamics	126300	Spherical	Conventional	Steam	1977
9341299	LNG Barka	Asyad Shipping, Osaka Gas, NYK Line, K Line	Kawasaki	153600	Spherical	Conventional	Steam	2008
9241267	LNG Bayelsa	BGT LTD	Hyundai	137000	Spherical	Conventional	Steam	2003
9267015	LNG Benue	BW	Hanwha Ocean	145700	Membrane	Conventional	Steam	2006
9692002	LNG Bonny II	BGT LTD	Hyundai	177000	Membrane	Conventional	DFDE	2015
9322803	LNG Borno	NYK Line	Samsung	149600	Membrane	Conventional	Steam	2007
9256767	LNG Croatia	LNG Hrvatska	Hyundai	138000	Membrane	FSRU	Steam	2005
9262223	LNG Cross River	BGT LTD	Hyundai	141000	Spherical	Conventional	Steam	2005
9277620	LNG Dream	NYK Line	Kawasaki	145300	Spherical	Conventional	Steam	2006
9834296	LNG Dubhe	MOL, COSCO	Hudong-Zhonghua	174000	Membrane	Conventional	X-DF	2019
9329291	LNG Ebisu	MOL, KEPCO	Kawasaki	147500	Spherical	Conventional	Steam	2008
9893606	LNG Endeavour	NYK Line	Samsung	174000	Membrane	Conventional	X-DF	2021
9874492	LNG Endurance	NYK Line	Samsung	174000	Membrane	Conventional	X-DF	2021
9874480	LNG Enterprise	NYK Line	Samsung	174000	Membrane	Conventional	X-DF	2021

Appendix 3: Table of global active LNG fleet (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cm)	Cargo Type	Vessel Type	Propulsion Type	Delivery Year
9266994	LNG Enugu	BW	Hanwha Ocean	145000	Membrane	Conventional	Steam	2005
9690145	LNG Finima II	BGT LTD	Samsung	175000	Membrane	Conventional	DFDE	2015
9666986	LNG Fukurokuju	MOL, KEPCO	Kawasaki	165100	Spherical	Conventional	Steam reheat	2016
9892133	LNG Geneva	CSSC Shpg Leasing	Hudong-Zhonghua	174000	Membrane	Conventional	X-DF	2024
9917555	LNG Harmony	JP Morgan	Hyundai	174000	Membrane	Conventional	X-DF	2023
9311581	LNG Imo	BW	Hanwha Ocean	148500	Membrane	Conventional	Steam	2008
9200316	LNG Jamal	NYK Line, Osaka Gas	Mitsubishi	137000	Spherical	Conventional	Steam	2000
9769855	LNG Jia Xing	Landmark Capital	Xiamen Shipbuilding Industry	45000	Self-Supporting Prismatic	Small-scale	DFDE	2019
9774628	LNG Juno	MOL	Mitsubishi	177300	Spherical	Conventional	STaGE	2018
9341689	LNG Jupiter	NYK Line, Osaka Gas	Kawasaki	156000	Spherical	Conventional	Steam	2009
9666998	LNG Jurojin	MOL, KEPCO	Mitsubishi	155300	Spherical	Conventional	Steam reheat	2015
9311567	LNG Kano	BW	Hanwha Ocean	148300	Membrane	Conventional	Steam	2007
9372963	LNG Kolt	Pan Ocean	Hanjin H.I.	153000	Membrane	Conventional	Steam	2008
9692014	LNG Lagos II	BGT LTD	Hyundai	177000	Membrane	Conventional	DFDE	2016
9269960	LNG Lokoja	BW	Hanwha Ocean	148300	Membrane	Conventional	Steam	2006
8701791	LNG Maleo	MOL, NYK Line, K Line	Mitsui	127700	Spherical	Conventional	Steam	1989
9645748	LNG Mars	MOL, Osaka Gas	Mitsubishi	155000	Spherical	Conventional	Steam reheat	2016
9834325	LNG Megrez	MOL, COSCO	Hudong-Zhonghua	174000	Membrane	Conventional	X-DF	2020
9834301	LNG Merak	MOL, COSCO	Hudong-Zhonghua	174000	Membrane	Conventional	X-DF	2020
9322815	LNG Ogun	NYK Line	Samsung	149600	Membrane	Conventional	Steam	2007
9311579	LNG Ondo	BW	Hanwha Ocean	148300	Membrane	Conventional	Steam	2007
9267003	LNG Oyo	BW	Hanwha Ocean	145800	Membrane	Conventional	Steam	2005
9834313	LNG Phecda	MOL, COSCO	Hudong-Zhonghua	174000	Membrane	Conventional	X-DF	2020
9690157	LNG Port-Harcourt II	BGT LTD	Samsung	175000	Membrane	Conventional	DFDE	2015
9902938	LNG Prosperity	JP Morgan	Hyundai	174000	Membrane	Conventional	X-DF	2023
9262235	LNG River Niger	BGT LTD	Hyundai	141000	Spherical	Conventional	Steam	2006
9266982	LNG River Orashi	BW	Hanwha Ocean	145900	Membrane	Conventional	Steam	2004
9877133	LNG Rosenrot	MOL	Hanwha Ocean	174000	Membrane	Conventional	X-DF	2021
9774135	LNG Sakura	NYK Line, KEPCO	Kawasaki	177000	Spherical	Conventional	TFDE	2018
9696149	LNG Saturn	MOL	Mitsubishi	155700	Spherical	Conventional	Steam reheat	2016
9771913	LNG Schneeweisschen	MOL	Hanwha Ocean	180000	Membrane	Conventional	X-DF	2018
9216303	LNG Sokoto	BGT LTD	Hyundai	137000	Spherical	Conventional	Steam	2002
9645736	LNG Venus	MOL, Osaka Gas	Mitsubishi	155000	Spherical	Conventional	Steam	2014
9872949	LNGships Athena	TMS Cardiff Gas	Hyundai	174000	Membrane	Conventional	X-DF	2021
9875800	LNGships Empress	TMS Cardiff Gas	Samsung	174000	Membrane	Conventional	X-DF	2021
9872901	LNGships Manhatten	TMS Cardiff Gas	Hyundai	174000	Membrane	Conventional	X-DF	2021
9490961	Lobito	Mitsui, NYK Line, Seapeak	Samsung	160400	Membrane	Conventional	TFDE	2011

Appendix 3: Table of global active LNG fleet (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cm)	Cargo Type	Vessel Type	Propulsion Type	Delivery Year
9285952	Lusail	K Line, MOL, NYK Line, Nakilat	Samsung	145700	Membrane	Conventional	Steam	2005
9705653	Macoma	Seapeak	Hanwha Ocean	173000	Membrane	Conventional	ME-GI	2017
9770921	Magdala	Seapeak	Hanwha Ocean	173000	Membrane	Conventional	ME-GI	2018
9904182	Malaga Knutsen	Knutsen OAS	Hyundai	174000	Membrane	Conventional	X-DF	2022
9490959	Malanje	Mitsui, NYK Line, Seapeak	Samsung	160400	Membrane	Conventional	DFDE	2011
9682588	Maran Gas Achilles	Maran Gas Maritime	Hyundai	174000	Membrane	Conventional	DFDE	2015
9682590	Maran Gas Agamemnon	Maran Gas Maritime	Hyundai	174000	Membrane	Conventional	ME-GI	2016
9650054	Maran Gas Alexandria	Maran Gas Maritime	Hyundai	161900	Membrane	Conventional	DFDE	2015
9887217	Maran Gas Amorgos	Maran Gas Maritime	Hanwha Ocean	174000	Membrane	Conventional	X-DF	2021
9701217	Maran Gas Amphipolis	Maran Gas Maritime	Hanwha Ocean	173400	Membrane	Conventional	DFDE	2016
9810379	Maran Gas Andros	Maran Gas Maritime	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2019
9633422	Maran Gas Apollonia	Maran Gas Maritime	Hyundai	161900	Membrane	Conventional	DFDE	2014
9302499	Maran Gas Asclepius	Maran Gas Maritime, Nakilat	Hanwha Ocean	145800	Membrane	Conventional	Steam	2005
9753014	Maran Gas Chios	Maran Gas Maritime	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2019
9331048	Maran Gas Coronis	Maran Gas Maritime, Nakilat	Hanwha Ocean	145700	Membrane	Conventional	Steam	2007
9633173	Maran Gas Delphi	Maran Gas Maritime	Hanwha Ocean	159800	Membrane	Conventional	TFDE	2014
9627497	Maran Gas Efessos	Maran Gas Maritime	Hanwha Ocean	159800	Membrane	Conventional	DFDE	2014
9682605	Maran Gas Hector	Maran Gas Maritime	Hyundai	174000	Membrane	Conventional	DFDE	2016
9767962	Maran Gas Hydra	Maran Gas Maritime	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2019
9892717	Maran Gas Ithaca	Maran Gas Maritime	Hanwha Ocean	174000	Membrane	Conventional	X-DF	2021
9883742	Maran Gas Kalymnos	Maran Gas Maritime	Hanwha Ocean	174000	Membrane	Conventional	X-DF	2021
9682576	Maran Gas Leto	Maran Gas Maritime	Hyundai	174000	Membrane	Conventional	DFDE	2016
9627502	Maran Gas Lindos	Maran Gas Maritime	Hanwha Ocean	159800	Membrane	Conventional	DFDE	2015
9924869	Maran Gas Marseille	Maran Gas Maritime	Samsung	174000	Membrane	Conventional	X-DF	2023
9658238	Maran Gas Mystras	Maran Gas Maritime	Hanwha Ocean	159800	Membrane	Conventional	DFDE	2015
9732371	Maran Gas Olympias	Maran Gas Maritime	Hanwha Ocean	173400	Membrane	Conventional	TFDE	2017
9709489	Maran Gas Pericles	Maran Gas Maritime	Hyundai	174000	Membrane	Conventional	DFDE	2016
9633434	Maran Gas Posidonia	Maran Gas Maritime	Hyundai	161900	Membrane	Conventional	DFDE	2014
9844863	Maran Gas Psara	Maran Gas Maritime	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2020
9701229	Maran Gas Roxana	Maran Gas Maritime	Hanwha Ocean	173400	Membrane	Conventional	TFDE	2017
9650042	Maran Gas Sparta	Maran Gas Maritime	Hyundai	161900	Membrane	Conventional	TFDE	2015
9767950	Maran Gas Spetses	Maran Gas Maritime, Nakilat	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2018
9658240	Maran Gas Troy	Maran Gas Maritime	Hanwha Ocean	159800	Membrane	Conventional	TFDE	2015
9709491	Maran Gas Ulysses	Maran Gas Maritime	Hyundai	174000	Membrane	Conventional	TFDE	2017
9732369	Maran Gas Vergina	Maran Gas Maritime	Hanwha Ocean	173400	Membrane	Conventional	TFDE	2016

Appendix 3: Table of global active LNG fleet (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cm)	Cargo Type	Vessel Type	Propulsion Type	Delivery Year
9659725	Maria Energy	Tsakos	Hyundai	174000	Membrane	Conventional	TFDE	2016
9778313	Marshal Vasilevskiy	Gazprom	Hyundai	174000	Membrane	FSRU	TFDE	2018
9770438	Marvel Crane	NYK Line	Mitsubishi	177000	Spherical	Conventional	STaGE	2019
9759240	Marvel Eagle	MOL	Kawasaki	155000	Spherical	Conventional	TFDE	2018
9760768	Marvel Falcon	MOL	Samsung	174000	Membrane	Conventional	X-DF	2018
9760770	Marvel Hawk	MOL	Samsung	174000	Membrane	Conventional	X-DF	2018
9770440	Marvel Heron	MOL	Mitsubishi	177000	Spherical	Conventional	STaGE	2019
9760782	Marvel Kite	Meiji Shipping	Samsung	174000	Membrane	Conventional	X-DF	2019
9759252	Marvel Pelican	MOL	Kawasaki	155985	Spherical	Conventional	TFDE	2019
9880192	Marvel Swan	Navigare Capital Partners	Samsung	174000	Membrane	Conventional	DFDE	2021
9770945	Megara	Seapeak	Hanwha Ocean	173000	Membrane	Conventional	ME-GI	2018
9397303	Mekaines	Nakilat	Samsung	266500	Membrane	Q-Max	SSD	2009
9250191	Merchant	Sinokor Merchant Marine	Samsung	138200	Membrane	Conventional	Steam	2003
9337729	Mesaimeer	Nakilat	Hyundai	216300	Membrane	Q-Flex	SSD	2009
9243148	Metagas Everest	Eddie Steamship	Hanwha Ocean	138000	Membrane	Conventional	Steam	2003
9321768	Methane Alison Victoria	CNTIC Vpower Energy	Samsung	145000	Membrane	FSU	Steam	2007
9516129	Methane Becki Anne	GasLog	Samsung	170000	Membrane	Conventional	TFDE	2010
9321744	Methane Heather Sally	Huaxia Financial Leasing	Samsung	145000	Membrane	Conventional	Steam	2007
9307190	Methane Jane Elizabeth	GasLog	Samsung	145000	Membrane	Conventional	Steam	2006
9412880	Methane Julia Louise	MOL	Samsung	170000	Membrane	Conventional	TFDE	2010
9520376	Methane Mickie Harper	Meiji Shipping	Samsung	170000	Membrane	Conventional	TFDE	2010
9321770	Methane Nile Eagle	Shell, Gaslog	Samsung	145000	Membrane	Conventional	Steam	2007
9425277	Methane Patricia Camila	Meiji Shipping	Samsung	170000	Membrane	Conventional	TFDE	2010
9307188	Methane Rita Andrea	Shell, Gaslog	Samsung	145000	Membrane	Conventional	Steam	2006
9321732	Milaha Qatar	Nakilat, Qatar Shpg., SocGen	Samsung	145600	Membrane	Conventional	Steam	2006
9255854	Milaha Ras Laffan	Nakilat, Qatar Shpg., SocGen	Samsung	138300	Membrane	Conventional	Steam	2004
9305128	Min Lu	China LNG Ship Mgmt	Hudong-Zhonghua	147200	Membrane	Conventional	Steam	2009
9305116	Min Rong	China LNG Ship Mgmt	Hudong-Zhonghua	147600	Membrane	Conventional	Steam	2009
9885855	Minerva Amorgos	Minerva Marine	Samsung	174000	Membrane	Conventional	X-DF	2022
9877341	Minerva Chios	Minerva Marine	Samsung	174000	Membrane	Conventional	X-DF	2021
9869942	Minerva Kalymnos	Minerva Marine	Samsung	174000	Membrane	Conventional	X-DF	2021
9854375	Minerva Limnos	Minerva Marine	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2021
9854363	Minerva Psara	Minerva Marine	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2021
9885996	MOL Hestia	MOL	Hanwha Ocean	173400	Membrane	Conventional	X-DF	2021
9337755	Mozah	Nakilat	Samsung	266300	Membrane	Q-Max	SSD	2008
9074638	Mraweh	National Gas Shipping Co	Kvaerner Masa	135000	Spherical	Conventional	Steam	1996

Appendix 3: Table of global active LNG fleet (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cm)	Cargo Type	Vessel Type	Propulsion Type	Delivery Year
9878876	Mu Lan	CSSC Shpg Leasing	Hudong-Zhonghua	178000	Membrane	Conventional	X-DF	2021
9074626	Mubaraz	National Gas Shipping Co	Kvaerner Masa	135000	Spherical	Conventional	Steam	1996
9864837	Mulan Spirit	Jovo Group	Jiangnan	79800	Membrane	Mid-scale	X-DF	2023
9705641	Murex	Seapeak	Hanwha Ocean	173000	Membrane	Conventional	ME-GI	2017
9360805	Murwab	NYK Line, K Line, MOL, Iino, Mitsui, Nakilat	Hanwha Ocean	210100	Membrane	Q-Flex	SSD	2008
9770933	Myrina	Seapeak	Hanwha Ocean	173000	Membrane	Conventional	ME-GI	2018
9324277	Neo Energy	Tsakos	Hyundai	150000	Spherical	Conventional	Steam	2007
9385673	Neptune	Hoegh, MOL, TLTC	Samsung	145000	Membrane	FSRU	DFDE	2009
9929106	New Apex	Pan Ocean	Samsung	174000	Membrane	Conventional	X-DF	2023
9624938	NFE Penguin	Energos	Samsung	160000	Membrane	Conventional	TFDE	2014
9750660	Nikolay Urvantsev	MOL, COSCO	Hanwha Ocean	172000	Membrane	Icebreaker	TFDE	2019
9750725	Nikolay Yevgenov	Seapeak, China LNG Shipping	Hanwha Ocean	172000	Membrane	Icebreaker	TFDE	2019
9768526	Nikolay Zubov	Dynagas	Hanwha Ocean	172000	Membrane	Icebreaker	TFDE	2019
9294264	Nizwa LNG	Asyad Shipping, MOL	Kawasaki	147700	Spherical	Conventional	Steam	2005
9796781	Nohshu Maru	MOL, JERA	Mitsubishi	177300	Spherical	Conventional	STaGE	2019
9953509	North Air	NYK Line	Samsung	174000	Membrane	Conventional	X-DF	2023
9953511	North Mountain	NYK Line	Samsung	174000	Membrane	Conventional	X-DF	2024
9953523	North Star	NYK Line	Samsung	174000	Membrane	Conventional	X-DF	2024
8608872	Northwest Sanderling	Karpowership	Mitsubishi	126700	Spherical	Conventional	Steam	1989
8913150	Northwest Sandpiper	Karpowership	Mitsui	127000	Spherical	Conventional	Steam	1993
8608884	Northwest Snipe	Karpowership	Mitsui	126900	Spherical	Conventional	Steam	1990
9045132	Northwest Stormpetrel	Karpowership	Mitsubishi	126800	Spherical	Conventional	Steam	1994
7382744	Nusantara Regas Satu	Energos	Rosenberg Verft	125000	Spherical	FSRU	Steam	1977
9315692	Ob River	Dynagas	Hyundai	149700	Membrane	Conventional	Steam	2007
9698111	Oceanic Breeze	K Line, Inpex	Mitsubishi	155300	Spherical	Conventional	Steam reheat	2018
9397353	Onaiza	Nakilat	Hanwha Ocean	210200	Membrane	Q-Flex	SSD	2009
9902926	Orion Bohemia	JP Morgan	Hyundai	174000	Membrane	Conventional	X-DF	2022
9917543	Orion Jessica	JP Morgan	Hyundai	174000	Membrane	Conventional	X-DF	2023
9888766	Orion Monet	JP Morgan	Samsung	174000	Membrane	Conventional	X-DF	2022
9889904	Orion Sea	JP Morgan	Samsung	174000	Membrane	Conventional	X-DF	2022
9889916	Orion Sun	JP Morgan	Samsung	174000	Membrane	Conventional	X-DF	2022
9761267	Ougarta	HYPROC	Hyundai	171800	Membrane	Conventional	TFDE	2017
9621077	Pacific Arcadia	NYK Line	Mitsubishi	145400	Spherical	Conventional	Steam	2014
9698123	Pacific Breeze	K Line	Kawasaki	182000	Spherical	Conventional	TFDE	2018
9351971	Pacific Enlighten	Kyushu Electric, TEPCO, Mitsubishi, Mitsui, NYK Line, MOK	Mitsubishi	145000	Spherical	Conventional	Steam	2009
9743875	Pacific Mimosa	NYK Line	Mitsubishi	155300	Membrane	Conventional	Steam reheat	2018
9247962	Pacific Notus	TEPCO, NYK Line, Mitsubishi	Mitsubishi	137000	Spherical	Conventional	Steam	2003

Appendix 3: Table of global active LNG fleet (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cm)	Cargo Type	Vessel Type	Propulsion Type	Delivery Year
9636735	Palu LNG	TMS Cardiff Gas	Hanwha Ocean	160000	Membrane	Conventional	TFDE	2014
9750256	Pan Africa	Seapeak, China LNG Shipping, CETS Investment Management, BW	Hudong-Zhonghua	174000	Membrane	Conventional	DFDE	2019
9750232	Pan Americas	Seapeak	Hudong-Zhonghua	174000	Membrane	Conventional	DFDE	2018
9750220	Pan Asia	Seapeak	Hudong-Zhonghua	174000	Membrane	Conventional	DFDE	2017
9750244	Pan Europe	Seapeak	Hudong-Zhonghua	174000	Membrane	Conventional	DFDE	2018
9613135	Papua	MOL, China LNG	Hudong-Zhonghua	172000	Membrane	Conventional	SSD	2015
9946350	Paris Knutsen	Knutsen OAS	Hyundai	174000	Membrane	Conventional	X-DF	2023
9766889	Patris	Chandris Group	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2018
9862346	Pearl LNG	TMS Cardiff Gas	Samsung	174000	Membrane	Conventional	X-DF	2020
9629524	PGN FSRU Lampung	Hoegh	Hyundai	170000	Membrane	FSRU	DFDE	2014
9256602	Pioneer Spirit (ex-LNG Pioneer)	Jovo Group	Hanwha Ocean	138000	Membrane	Conventional	Steam	2005
9375721	Point Fortin	MOL, Sumitomo, LNG JAPAN	Imabari	154200	Membrane	Conventional	Steam	2010
9064073	Portovenere	MISC	Sestri	65000	Membrane	Conventional	Steam	1996
9246621	Portovyy	Gazprom	Hanwha Ocean	138100	Membrane	FSU	Steam	2003
9723801	Prachi	MOL, NYK Line, K Line, SCI, Nakilat, Petronet	Hyundai	173000	Membrane	Conventional	TFDE	2016
9264910	Prima Carrier (ex-Pacific Eurus)	Soechi Lines	Mitsubishi	137000	Spherical	Conventional	Steam	2006
9256793	Prima Concord	Soechi Lines	Samsung	138000	Membrane	Conventional	Steam	2004
9810549	Prism Agility	SK Shipping	Hyundai	180000	Membrane	Conventional	X-DF	2019
9810551	Prism Brilliance	SK Shipping	Hyundai	180000	Membrane	Conventional	X-DF	2019
9888481	Prism Courage	SK Shipping	Hyundai	174000	Membrane	Conventional	X-DF	2021
9904651	Prism Diversity	SK Shipping	Hyundai	180000	Membrane	Conventional	X-DF	2022
9630028	Pskov	Sovcomflot	STX	170200	Membrane	Conventional	DFDE	2014
9030814	Puteri Delima	MISC	Chantiers de l'Atlantique	130000	Membrane	Conventional	Steam	1995
9211872	Puteri Delima Satu	MISC	Mitsui	137500	Membrane	Conventional	Steam	2002
9248502	Puteri Firus Satu	MISC	Mitsubishi	137500	Membrane	Conventional	Steam	2004
9030802	Puteri Intan	MISC	Chantiers de l'Atlantique	130000	Membrane	Conventional	Steam	1994
9261205	Puteri Mutiara Satu	MISC	Mitsui	137000	Membrane	Conventional	Steam	2005
9030826	Puteri Nilam	MISC	Chantiers de l'Atlantique	130000	Membrane	Conventional	Steam	1995
9937945	Puteri Saadong	Hyundai LNG Shipping	Hyundai	174000	Membrane	Conventional	X-DF	2024
9030838	Puteri Zamrud	MISC	Chantiers de l'Atlantique	130000	Membrane	Conventional	Steam	1996
9245031	Puteri Zamrud Satu	MISC	Mitsui	137500	Membrane	Conventional	Steam	2004
9851787	Qogir	TMS Cardiff Gas	Samsung	174000	Membrane	Conventional	X-DF	2020
9253703	Raahi	MOL, NYK Line, K Line, SCI, Nakilat, Petronet	Hanwha Ocean	138100	Membrane	Conventional	Steam	2004

Appendix 3: Table of global active LNG fleet (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cm)	Cargo Type	Vessel Type	Propulsion Type	Delivery Year
9443413	Rasheeda	Nakilat	Samsung	266300	Membrane	Q-Max	ME-GI	2010
9874040	Ravenna Knutsen	Knutsen OAS	Hyundai	30000	Type C	Small-scale	X-DF	2021
9825568	Rias Baixas Knutsen	Knutsen OAS	Hyundai	180000	Membrane	Conventional	ME-GI	2019
9477593	Ribera Duero Knutsen	Knutsen OAS	Hanwha Ocean	173400	Membrane	Conventional	DFDE	2010
9721736	Rioja Knutsen	Knutsen OAS	Hyundai	176000	Membrane	Conventional	ME-GI	2016
9750713	Rudolf Samoylovich	Seapeak	Hanwha Ocean	172000	Membrane	Icebreaker	TFDE	2018
9946386	Saint Barbara	Knutsen OAS	Hyundai	174000	Membrane	Conventional	X-DF	2023
9300817	Salalah LNG	Asyad Shipping, MOL	Samsung	147000	Membrane	Conventional	Steam	2005
9904170	Santander Knutsen	Knutsen OAS	Hyundai	174000	Membrane	Conventional	X-DF	2022
9849887	SCF La Perouse	Sovcomflot	Hyundai	174000	Membrane	Conventional	X-DF	2020
9339260	Seapeak Arwa	Seapeak, Marubeni	Samsung	168900	Membrane	Conventional	DFDE	2008
9771080	Seapeak Bahrain	Seapeak	Hanwha Ocean	173400	Membrane	FSU	ME-GI	2018
9236420	Seapeak Catalunya	Seapeak	IZAR	138200	Membrane	Conventional	Steam	2003
9681687	Seapeak Creole	Seapeak	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2016
9247364	Seapeak Galicia	Seapeak	Hanwha Ocean	140500	Membrane	Conventional	Steam	2004
9781918	Seapeak Glasgow	Seapeak	Hyundai	174000	Membrane	Conventional	ME-GI	2018
9230048	Seapeak Hispania	Seapeak	Hanwha Ocean	140500	Membrane	Conventional	Steam	2002
9259276	Seapeak Madrid	Seapeak	IZAR	138000	Membrane	Conventional	Steam	2004
9342487	Seapeak Magellan	Seapeak, Marubeni	Samsung	165500	Membrane	Conventional	DFDE	2009
9336749	Seapeak Marib	Seapeak	Samsung	165500	Membrane	Conventional	DFDE	2008
9369904	Seapeak Meridian	Seapeak, Marubeni	Samsung	165500	Membrane	Conventional	DFDE	2010
9336737	Seapeak Methane	Seapeak, Marubeni	Samsung	165500	Membrane	Conventional	TFDE	2008
9681699	Seapeak Oak	Seapeak	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2016
9721401	Seapeak Vanvouver	Seapeak	Hanwha Ocean	173000	Membrane	Conventional	ME-GI	2017
9781920	Seapeak Yamal	Seapeak	Hyundai	174000	Membrane	Conventional	ME-GI	2019
9666558	Seishu Maru	Mitsubishi, NYK Line, Chubu Electric	Mitsubishi	153000	Membrane	Conventional	Steam	2014
9293832	Seri Alam	MISC	Samsung	145700	Membrane	Conventional	Steam	2005
9293844	Seri Amanah	MISC	Samsung	145700	Membrane	Conventional	Steam	2006
9321653	Seri Anggun	MISC	Samsung	145700	Membrane	Conventional	Steam	2006
9321665	Seri Angkasa	MISC	Samsung	145700	Membrane	Conventional	Steam	2006
9329679	Seri Ayu	MISC	Samsung	145700	Membrane	Conventional	Steam	2007
9331634	Seri Bakti	MISC	Mitsubishi	152300	Membrane	Conventional	Steam	2007
9331660	Seri Balhaf	MISC	Mitsubishi	157000	Membrane	Conventional	TFDE	2009
9331672	Seri Balqis	MISC	Mitsubishi	152000	Membrane	Conventional	TFDE	2009
9331646	Seri Begawan	MISC	Mitsubishi	152300	Membrane	Conventional	Steam	2007
9331658	Seri Bijaksana	MISC	Mitsubishi	152300	Membrane	Conventional	Steam	2008
9714305	Seri Camar	PETRONAS	Hyundai	150200	Membrane	Conventional	Steam reheat	2018
9714276	Seri Camellia	PETRONAS	Hyundai	150200	Membrane	Conventional	Steam reheat	2016
9756389	Seri Cemara	PETRONAS	Hyundai	150200	Spherical	Conventional	Steam reheat	2018
9714290	Seri Cempaka	PETRONAS	Hyundai	150200	Spherical	Conventional	ME-GI	2017

Appendix 3: Table of global active LNG fleet (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cm)	Cargo Type	Vessel Type	Propulsion Type	Delivery Year
9714288	Seri Cenderawasih	PETRONAS	Hyundai	150200	Spherical	Conventional	Steam reheat	2017
9896440	Seri Damai	MISC	Samsung	174000	Membrane	Conventional	X-DF	2023
9896452	Seri Daya	MISC	Samsung	174000	Membrane	Conventional	X-DF	2023
9338797	Sestao Knutsen	Knutsen OAS	IZAR	138000	Membrane	Conventional	Steam	2007
9414632	Sevilla Knutsen	Knutsen OAS	Hanwha Ocean	173400	Membrane	Conventional	DFDE	2010
9418365	Shagra	Nakilat	Samsung	266300	Membrane	Q-Max	SSD	2009
9035852	Shahamah	National Gas Shipping Co	Kawasaki	135000	Spherical	Conventional	Steam	1994
9253222	Shandong Juniper	Shell	Mitsubishi	135000	Spherical	Conventional	Steam	2004
9915894	Shaolin	COSCO	Hudong-Zhonghua	174000	Membrane	Conventional	X-DF	2022
9583677	Shen Hai	China LNG, CNOOC, Shanghai LNG	Hudong-Zhonghua	147600	Membrane	Conventional	Steam	2012
9791200	Shinshu Maru	MOL	Kawasaki	177000	Spherical	Conventional	DFDE	2019
9320386	Simaisma	Maran Gas Maritime, Nakilat	Hanwha Ocean	145700	Membrane	Conventional	Steam	2006
9238040	Singapore Energy	Sinokor Merchant Marine	Samsung	138000	Membrane	Conventional	Steam	2003
9693161	SK Audace	SK Shipping, Marubeni	Samsung	180000	Membrane	Conventional	X-DF	2017
9693173	SK Resolute	SK Shipping, Marubeni	Samsung	180000	Membrane	Conventional	X-DF	2018
9761803	SK Serenity	SK Shipping	Samsung	174000	Membrane	Conventional	ME-GI	2018
9761815	SK Spica	SK Shipping	Samsung	174000	Membrane	Conventional	ME-GI	2018
9180231	SK Splendor	SK Shipping	Samsung	138200	Membrane	Conventional	Steam	2000
9180243	SK Stellar	SK Shipping	Samsung	138200	Membrane	Conventional	Steam	2000
9157624	SK Summit	SK Shipping	Hanwha Ocean	138000	Membrane	Conventional	Steam	1999
9247194	SK Sunrise	SK Shipping	Samsung	138200	Membrane	Conventional	Steam	2003
9157739	SK Supreme	SK Shipping	Samsung	138200	Membrane	Conventional	Steam	2000
9902902	SM Albatross	Korea Line	Hyundai	174000	Membrane	Conventional	X-DF	2022
9902914	SM Bluebird	Korea Line	Hyundai	174000	Membrane	Conventional	X-DF	2022
9761827	SM Eagle	Korea Line	Hanwha Ocean	174000	Membrane	Conventional	ME-GI	2017
9917567	SM Golden Eagle	Korea Line	Hyundai	174000	Membrane	Conventional	X-DF	2023
9917579	SM Kestrel	Korea Line	Hyundai	174000	Membrane	Conventional	MEGA	2023
9761839	SM Seahawk	Korea Line	Hanwha Ocean	174000	Membrane	Conventional	ME-GI	2017
9210816	Sohar LNG	Asyad Shipping, MOL	Mitsubishi	137200	Spherical	Conventional	Steam	2001
9791212	Sohshu Maru	MOL, JERA	Kawasaki	177300	Spherical	Conventional	DFDE	2019
9634098	Solaris	GasLog	Samsung	155000	Membrane	Conventional	TFDE	2014
9482304	Sonangol Benguela	Mitsui, Sonangol, Sojlitz	Hanwha Ocean	160000	Membrane	Conventional	Steam	2011
9482299	Sonangol Etosha	Mitsui, Sonangol, Sojlitz	Hanwha Ocean	160000	Membrane	Conventional	Steam	2011
9475600	Sonangol Sambizanga	Mitsui, Sonangol, Sojlitz	Hanwha Ocean	160000	Membrane	Conventional	Steam	2011
9613147	Southern Cross	MOL, China LNG	Hudong-Zhonghua	168400	Membrane	Conventional	SSD	2015
9475208	Soyo	Mitsui, NYK Line, Seapeak	Samsung	160400	Membrane	Conventional	DFDE	2011
9361639	Spirit Of Hela	MOL, Itochu	Hyundai	177000	Membrane	Conventional	DFDE	2009
9315393	Stena Blue Sky	Stena Bulk	Hanwha Ocean	145700	Membrane	Conventional	Steam	2006

Appendix 3: Table of global active LNG fleet (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cm)	Cargo Type	Vessel Type	Propulsion Type	Delivery Year
9413327	Stena Clear Sky	Stena Bulk	Hanwha Ocean	173000	Membrane	Conventional	TFDE	2011
9383900	Stena Crystal Sky	Stena Bulk	Hanwha Ocean	173000	Membrane	Conventional	TFDE	2011
9322255	Summit LNG	Excelerate Energy	Hanwha Ocean	138000	Membrane	FSRU	Steam	2006
9330745	Symphonic Breeze	K Line	Kawasaki	147600	Spherical	Conventional	Steam	2007
9403669	Taitar No.1	CPC, Mitsui, NYK Line	Mitsubishi	145300	Spherical	Conventional	Steam	2009
9403645	Taitar No.2	MOL, NYK Line	Kawasaki	145300	Spherical	Conventional	Steam	2009
9403671	Taitar No.3	MOL, NYK Line	Mitsubishi	145300	Spherical	Conventional	Steam	2010
9403657	Taitar No.4	CPC, Mitsui, NYK Line	Kawasaki	145300	Spherical	Conventional	Steam	2010
9334284	Tangguh Batur	NYK Line, Sovcomflot	Hanwha Ocean	145700	Membrane	Conventional	Steam	2008
9349007	Tangguh Foja	K Line, PT Meratus	Samsung	154800	Membrane	Conventional	DFDE	2008
9333632	Tangguh Hiri	Seapeak	Hyundai	155000	Membrane	Conventional	DFDE	2008
9349019	Tangguh Jaya	K Line, PT Meratus	Samsung	155000	Membrane	Conventional	DFDE	2008
9355379	Tangguh Palung	K Line, PT Meratus	Samsung	155000	Membrane	Conventional	DFDE	2009
9361990	Tangguh Sago	Seapeak	Hyundai	155000	Membrane	Conventional	DFDE	2009
9325893	Tangguh Towuti	NYK Line, PT Samudera, Sovcomflot	Hanwha Ocean	145700	Membrane	Conventional	Steam	2008
9337731	Tembek	Nakilat, OSC	Samsung	216200	Membrane	Q-Flex	SSD	2007
7428433	Tenaga Empat	MISC	CNIM	130000	Membrane	FSU	Steam	1981
7428457	Tenaga Satu	MISC	Dunkerque Chantiers	130000	Membrane	FSU	Steam	1982
9892456	Tenergy	Tsakos	Hyundai	174000	Membrane	Conventional	X-DF	2022
9761243	Tessala	HYPROC	Hyundai	171800	Membrane	Conventional	TFDE	2016
9006681	Torman II (ex-LNG Flora)	NYK Line	Kawasaki	127700	Spherical	FSU	Steam	1993
9238038	Trader II	Capital Gas	Samsung	138000	Membrane	Conventional	Steam	2002
9213416	Trader III	Capital Gas	Mitsubishi	137500	Membrane	Conventional	Steam	2002
9216298	Trader IV	Capital Gas	Hyundai	137000	Spherical	Conventional	Steam	2002
9854765	Traiano Knutsen	Knutsen OAS	Hyundai	180000	Membrane	Conventional	ME-GI	2020
9350927	Trinity Glory	K Line	Imabari	155000	Membrane	Conventional	Steam	2009
9823883	Turquoise P	Pardus Energy	Hyundai	170000	Membrane	FSRU	DFDE	2019
9360829	Umm Al Amad	NYK Line, K Line, MOL, Iino, Mitsui, Nakilat	Hanwha Ocean	210200	Membrane	Q-Flex	SSD	2008
9074652	Umm Al Ashtan	National Gas Shipping Co	Kvaerner Masa	135000	Spherical	Conventional	Steam	1997
9308431	Umm Bab	Maran Gas Maritime, Nakilat	Hanwha Ocean	145700	Membrane	Conventional	Steam	2005
9372731	Umm Slal	Nakilat	Samsung	266000	Membrane	Q-Max	SSD	2008
9434266	Valencia Knutsen	Knutsen OAS	Hanwha Ocean	173400	Membrane	Conventional	DFDE	2010
9837066	Vasant 1	Triumph Offshore Pvt Ltd	Hyundai	180000	Membrane	FSRU	DFDE	2020
9630004	Velikiy Novgorod	Sovcomflot	STX	170200	Membrane	Conventional	DFDE	2014
9895238	Vivirt City LNG	H-Line Shipping	Hyundai	174000	Membrane	Conventional	X-DF	2021
9950105	Vivit Africa LNG	H-Line Shipping	Hyundai	174000	Membrane	Conventional	X-DF	2023
9864667	Vivit Americas LNG	TMS Cardiff Gas	Hyundai	170520	Membrane	Conventional	X-DF	2020
9902756	Vivit Arabia LNG	H-Line Shipping	Hyundai	174000	Membrane	Conventional	X-DF	2022
9750701	Vladimir Rusanov	MOL	Hanwha Ocean	172000	Membrane	Icebreaker	TFDE	2018

Appendix 3: Table of global active LNG fleet (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cm)	Cargo Type	Vessel Type	Propulsion Type	Delivery Year
9750658	Vladimir Vize	MOL	Hanwha Ocean	172000	Membrane	Icebreaker	TFDE	2018
9750737	Vladimir Voronin	Seapeak, China LNG Shipping	Hanwha Ocean	172000	Membrane	Icebreaker	TFDE	2019
9892121	Wen Cheng	CSSC Shpg Leasing	Hudong-Zhonghua	174000	Membrane	Conventional	X-DF	2023
9627954	Wilforce	Seapeak	Hanwha Ocean	160000	Membrane	Conventional	TFDE	2013
9627966	Wilpride	Seapeak	Hanwha Ocean	160000	Membrane	Conventional	TFDE	2013
9753026	Woodside Chaney	Maran Gas Maritime	Hyundai	174000	Membrane	Conventional	ME-GI	2019
9859753	Woodside Charles Allen	Maran Gas Maritime	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2020
9369899	Woodside Donaldson	Seapeak, Marubeni	Samsung	165500	Membrane	Conventional	DFDE	2009
9633161	Woodside Goode	Maran Gas Maritime	Hanwha Ocean	159800	Membrane	Conventional	DFDE	2013
9810367	Woodside Rees Wither	Maran Gas Maritime	Hanwha Ocean	173400	Membrane	Conventional	ME-GI	2019
9627485	Woodside Rogers	Maran Gas Maritime	Hanwha Ocean	159800	Membrane	Conventional	DFDE	2013
9915909	Wudang	COSCO	Hudong-Zhonghua	174000	Membrane	Conventional	X-DF	2022
9210828	Xinhang Energy	Xinhang Shipping Co. Ltd.	Mitsubishi	137000	Spherical	Conventional	Steam	2002
9750672	Yakov Gakkel	Seapeak, China LNG Shipping	Hanwha Ocean	172000	Membrane	Icebreaker	TFDE	2019
9636747	Yari LNG	TMS Cardiff Gas	Hanwha Ocean	160000	Membrane	Conventional	TFDE	2014
9629586	Yenisei River	Dynagas	Hyundai	155000	Membrane	Conventional	DFDE	2013
9879674	Yiannis	Maran Gas Maritime	Hanwha Ocean	174000	Membrane	Conventional	ME-GI	2021
9038816	YK Sovereign	SK Shipping	Hyundai	127100	Spherical	Conventional	Steam	1994
9431214	Zarga	Nakilat	Samsung	266000	Membrane	Q-Max	SSD	2010
9132818	Zekreet	J4 Consortium	Mitsui	137500	Spherical	Conventional	Steam	1998

Appendix 4: Table of global LNG vessel orderbook, end-of-February 2024

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cbm)	Propulsion Type	Delivery Year
9948700	Energy Fortitude	Alpha Gas	Hyundai Heavy Industries Group	174000	X-DF	2024
9958286	Aktoras	Capital Gas	Hyundai Heavy Industries Group	174000	MEGA	2024
9957737	Apostolos	Capital Gas	Hyundai Heavy Industries Group	174000	MEGA	2024
9957725	Assos	Capital Gas	Hyundai Heavy Industries Group	174000	MEGA	2024
Unknown	Unknown Hull No.	Unknown	Hyundai Heavy Industries Group	174000	MEGA	2024
9946829	Hull 2579	Celsius Shipping	Samsung Heavy Industries	180000	MEGA	2024
9948724	Hull 2584	Celsius Shipping	Samsung Heavy Industries	180000	MEGA	2024
9948736	Hull 2585	Celsius Shipping	Samsung Heavy Industries	180000	MEGA	2024
9988700	Hull 2651	Celsius Shipping	Samsung Heavy Industries	180000	MEGA	2024
9943504	Clean Future	Dynagas	Hyundai Heavy Industries Group	200000	MEGA	2024
9962407	Gaslog Italy	Gaslog	Hanwha Ocean	174000	ME-GI	2024
9962419	Marvel Phoenix	Gaslog	Hanwha Ocean	174000	ME-GI	2024
9918016	Lev Landau	Hanwha Ocean	Hanwha Ocean	172600	TFDE	2024
9918004	Pyotr Kapitsa	Hanwha Ocean	Hanwha Ocean	172600	TFDE	2024
9918028	Zhores Alferov	Hanwha Ocean	Hanwha Ocean	172600	TFDE	2024
9947691	Hull 2522	Hyundai LNG Shipping	Hanwha Ocean	174000	ME-GI	2024
9947598	Puteri Ledang	Hyundai LNG Shipping	Hyundai Heavy Industries Group	174000	MEGA	2024
9947603	Puteri Mahsuri	Hyundai LNG Shipping	Hyundai Heavy Industries Group	174000	MEGA	2024
9937957	Puteri Santubong	Hyundai LNG Shipping	Hyundai Heavy Industries Group	174000	X-DF	2024
9937969	Puteri Sejinjang	Hyundai LNG Shipping	Hyundai Heavy Industries Group	174000	X-DF	2024
9956604	Hull 2594	JP Morgan	Samsung Heavy Industries	174000	MEGA	2024
9977220	Hull 2596	JP Morgan	Samsung Heavy Industries	174000	MEGA	2024
9956587	Hull H2592	JP Morgan	Samsung Heavy Industries	174000	MEGA	2024
9977232	Hull H2597	JP Morgan	Samsung Heavy Industries	174000	MEGA	2024
9926922	Orion Sinead	JP Morgan	Hyundai Heavy Industries Group	174000	X-DF	2024
Unknown	Unknown Hull No.	JP Morgan	Hyundai Heavy Industries Group	174000	X-DF	2024
Unknown	Unknown Hull No.	JP Morgan	Hyundai Heavy Industries Group	174000	X-DF	2024
Unknown	Unknown Hull No.	JP Morgan	Hyundai Heavy Industries Group	174000	X-DF	2024
9926714	Hull 8100	Knutsen OAS	Hyundai Heavy Industries Group	174000	X-DF	2024

Appendix 4: Table of global LNG vessel orderbook (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cbm)	Propulsion Type	Delivery Year
9941518	Hull 2473	Maran Gas Maritime	Samsung Heavy Industries	174000	X-DF	2024
9941520	Hull 2474	Maran Gas Maritime	Samsung Heavy Industries	174000	X-DF	2024
9958298	Hull 2523	MOL	Hanwha Ocean	174000	MEGA	2024
9958303	Hull 2524	MOL	Hanwha Ocean	174000	MEGA	2024
9958315	Hull 2525	MOL	Hanwha Ocean	174000	MEGA	2024
9956953	Hull 2527	MOL	Hanwha Ocean	174000	MEGA	2024
9963449	Hull 2536	MOL	Hanwha Ocean	174000	MEGA	2024
9961477	Greenenergy Ocean	MOL	Hudong-Zhonghua	174000	X-DF	2024
9918030	Ilya Mechnikov	MOL	Hanwha Ocean	172600	TFDE	2024
9918042	Nikolay Basov	MOL	Hanwha Ocean	172600	TFDE	2024
9918054	Nikolay Semenov	MOL	Hanwha Ocean	172600	TFDE	2024
9953248	Hull H1790A	MOL, Cosco Shipping Energy Transportation	Hudong-Zhonghua	174000	X-DF	2024
9953250	Hull H1791A	MOL, Cosco Shipping Energy Transportation	Hudong-Zhonghua	174000	X-DF	2024
9928061	Hull 2393	NYK Line	Samsung Heavy Industries	174000	X-DF	2024
9928073	Hull 2394	NYK Line	Samsung Heavy Industries	174000	X-DF	2024
9963853	Hull 2604	NYK Line	Samsung Heavy Industries	174000	X-DF	2024
9953535	North Wind	NYK Line	Samsung Heavy Industries	174000	X-DF	2024
9926908	New Brave	Pan Ocean	Hyundai Heavy Industries Group	174000	MEGA	2024
9947500	New Green	Pan Ocean	Hyundai Heavy Industries Group	174000	X-DF	2024
9926910	New Nature	Pan Ocean	Hyundai Heavy Industries Group	174000	MEGA	2024
9947512	New Oasis	Pan Ocean	Hyundai Heavy Industries Group	174000	X-DF	2024
9903437	Hull 2316	Sinokor Maritime Co Ltd	Samsung Heavy Industries	174000	X-DF	2024
9903449	Hull 2317	Sinokor Maritime Co Ltd	Samsung Heavy Industries	174000	X-DF	2024
9903451	Hull 2318	Sinokor Maritime Co Ltd	Samsung Heavy Industries	174000	X-DF	2024
9903425	Pacific Success	Sinokor Maritime Co Ltd	Samsung Heavy Industries	174000	X-DF	2024
9964182	Marvel Dove	SK Shipping	Hyundai Heavy Industries Group	174000	X-DF	2024
9904546	Alexey Kosygin	Smart LNG	Samsung Heavy Industries	172600	TFDE	2024
9918781	Hull 047	Smart LNG	Zvezda Shipbuilding	172600	TFDE	2024
9918793	Hull 048	Smart LNG	Zvezda Shipbuilding	172600	TFDE	2024
9918808	Hull 049	Smart LNG	Zvezda Shipbuilding	172600	TFDE	2024
9904699	Konstantin Posiet	Smart LNG	Zvezda Shipbuilding	172600	TFDE	2024
9904675	Pyotr Stolypin	Smart LNG	Zvezda Shipbuilding	172600	TFDE	2024

Appendix 4: Table of global LNG vessel orderbook (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cbm)	Propulsion Type	Delivery Year
9972672	Hull 2635	TMS Cardiff Gas	Samsung Heavy Industries	174000	MEGA	2024
9958652	Hull H1835A	United Liquefied Gas	Hudong-Zhonghua	174000	X-DF	2024
Unknown	Unknown Hull No.	United LNG Transportation	Hudong-Zhonghua	174000	X-DF	2024
9928085	Hull 2395	Unknown	Samsung Heavy Industries	174000	X-DF	2024
9928097	Hull 2396	Unknown	Samsung Heavy Industries	174000	X-DF	2024
9965423	Jiangnan H2700	ADNOC L&S	Jiangnan	174000	X-DF	2025
9965435	Jiangnan H2701	ADNOC L&S	Jiangnan	174000	X-DF	2025
9972945	Jiangnan H2702	ADNOC L&S	Jiangnan	174000	X-DF	2025
9960588	Hull 2530	BW	Hanwha Ocean	174000	ME-GI	2025
9960590	Hull 2531	BW	Hanwha Ocean	174000	ME-GI	2025
9968932	Hull 2544	BW	Hanwha Ocean	174000	ME-GI	2025
9968944	Hull 2545	BW	Hanwha Ocean	174000	ME-GI	2025
9958999	Hull 2598	Celsius Shipping	Samsung Heavy Industries	180000	MEGA	2025
9959008	Hull 2599	Celsius Shipping	Samsung Heavy Industries	180000	MEGA	2025
9969223	Hull 2619	Celsius Shipping	Samsung Heavy Industries	180000	MEGA	2025
9970650	Dalian No 1 G175K-1	China Merchants Energy Shipping	Dalian Shipbuilding Industry Co	175000	X-DF	2025
9970662	Dalian No 1 G175K-2	China Merchants Energy Shipping	Dalian Shipbuilding Industry Co	175000	X-DF	2025
9989118	Dalian No 1 G175K-3	China Merchants Energy Shipping	Dalian Shipbuilding Industry Co	175000	X-DF	2025
Unknown	Dalian No 1 G175K-5	China Merchants Energy Shipping	Dalian Shipbuilding Industry Co	175000	X-DF	2025
9976147	Kool Panther	CoolCo	Hyundai Heavy Industries Group	174000	MEGA	2025
9976135	Kool Tiger	CoolCo	Hyundai Heavy Industries Group	174000	MEGA	2025
9967330	Clean Levant	Dynagas	Hyundai Heavy Industries Group	200000	X-DF	2025
9967328	Clean Mistral	Dynagas	Hyundai Heavy Industries Group	200000	X-DF	2025
9967342	Clean Srocco	Dynagas	Hyundai Heavy Industries Group	200000	X-DF	2025
9968451	Hull 8177	European owner	Hyundai Heavy Industries Group	174000	MEGA	2025
9968463	Hull 8178	European owner	Hyundai Heavy Industries Group	174000	MEGA	2025
9962421	Hull 2534	Gaslog	Hanwha Ocean	174000	ME-GI	2025
9962433	Hull 2535	Gaslog	Hanwha Ocean	174000	ME-GI	2025
9972359	HL Alyssa Warner	H-Line Shipping	Samsung Heavy Industries	174000	X-DF	2025
9972361	HL Edward Austin	H-Line Shipping	Samsung Heavy Industries	174000	MEGA	2025
9972373	HL Sea Eagle	H-Line Shipping	Samsung Heavy Industries	174000	MEGA	2025

Appendix 4: Table of global LNG vessel orderbook (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cbm)	Propulsion Type	Delivery Year
9982677	Al-Kheesha	H-Line Shipping	Samsung Heavy Industries	174000	X-DF	2025
9982689	Hull 2612	H-Line Shipping	Samsung Heavy Industries	174000	MEGA	2025
9974149	Hull 2631	H-Line Shipping	Samsung Heavy Industries	174000	MEGA	2025
9974151	Hull 2631	H-Line Shipping	Hyundai Heavy Industries Group	174000	X-DF	2025
9975040	Hull 8170	Hyundai Glovis	Hyundai Heavy Industries Group	174000	MEGA	2025
9947615	Puteri Mayang	Hyundai LNG Shipping	Hyundai Heavy Industries Group	174000	MEGA	2025
9956599	Hull 2593	JP Morgan	Samsung Heavy Industries	174000	MEGA	2025
9958846	Hull 2600	JP Morgan	Samsung Heavy Industries	174000	MEGA	2025
9958858	Hull 2601	JP Morgan	Samsung Heavy Industries	174000	MEGA	2025
9977244	Hull 2634	JP Morgan	Samsung Heavy Industries	174000	MEGA	2025
9977256	Hull 2637	JP Morgan	Samsung Heavy Industries	174000	MEGA	2025
9977268	Hull 2638	JP Morgan	Samsung Heavy Industries	174000	MEGA	2025
9977270	Hull 2641	JP Morgan	Samsung Heavy Industries	174000	MEGA	2025
9977282	Hull 2642	JP Morgan	Samsung Heavy Industries	174000	MEGA	2025
9977294	Hull 2643	JP Morgan	Samsung Heavy Industries	174000	MEGA	2025
9977309	Hull 2644	JP Morgan	Samsung Heavy Industries	174000	MEGA	2025
9977311	Hull 2645	JP Morgan	Samsung Heavy Industries	174000	MEGA	2025
9947639	Orion Gaugin	JP Morgan	Hyundai Heavy Industries Group	174000	X-DF	2025
9947627	Orion Hugo	JP Morgan	Hyundai Heavy Industries Group	174000	X-DF	2025
9997701	Hull H1894A	K Line, China Merchants Energy Shipping, CMC	Hudong-Zhonghua	174000	X-DF	2025
9997672	Hull H1895A	K Line, China Merchants Energy Shipping, CMC	Hudong-Zhonghua	174000	X-DF	2025
9997684	Hull H1896A	K Line, China Merchants Energy Shipping, CMC	Hudong-Zhonghua	174000	X-DF	2025
9976903	Hull 2546	K3 Consortium	Hanwha Ocean	174000	MEGA	2025
9976915	Hull 2547	K3 Consortium	Hanwha Ocean	174000	MEGA	2025
9976927	Hull 2548	K3 Consortium	Hanwha Ocean	174000	MEGA	2025
9976812	Hull 2602	K3 Consortium	Samsung Heavy Industries	174000	MEGA	2025
9976824	Hull 2603	K3 Consortium	Samsung Heavy Industries	174000	MEGA	2025
Unknown	Unknown Hull No.	K3 Consortium	Samsung Heavy Industries	174000	MEGA	2025
Unknown	Unknown Hull No.	K3 Consortium	Samsung Heavy Industries	174000	MEGA	2025

Appendix 4: Table of global LNG vessel orderbook (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cbm)	Propulsion Type	Delivery Year
9975507	Hull 3380	Knutsen OAS	Hyundai Heavy Industries Group	174000	X-DF	2025
9975519	Hull 3381	Knutsen OAS	Hyundai Heavy Industries Group	174000	X-DF	2025
9981374	Hull 3382	Knutsen OAS	Hyundai Heavy Industries Group	174000	X-DF	2025
9981386	Hull 3383	Knutsen OAS	Hyundai Heavy Industries Group	174000	X-DF	2025
9981398	Hull 3384	Knutsen OAS	Hyundai Heavy Industries Group	174000	X-DF	2025
9946362	Hull 8102	Knutsen OAS	Hyundai Heavy Industries Group	174000	X-DF	2025
9969388	Hull 8180	Knutsen OAS	Hyundai Heavy Industries Group	174000	X-DF	2025
9972218	Hull 8181	Knutsen OAS	Hyundai Heavy Industries Group	174000	X-DF	2025
9961398	Hull 2537	Maran Gas Maritime	Hanwha Ocean	174000	ME-GI	2025
9961403	Hull 2538	Maran Gas Maritime	Hanwha Ocean	174000	ME-GI	2025
9963815	Hull 2539	Maran Gas Maritime	Hanwha Ocean	174000	ME-GI	2025
9963827	Hull 2540	Maran Gas Maritime	Hanwha Ocean	174000	ME-GI	2025
Unknown	Unknown Hull No.	Meiji Shipping	Hanwha Ocean	174000	X-DF	2025
9986609	Hull H1797A	MISC, NYK Line, K Line, China LNG	Hudong-Zhonghua	174000	X-DF	2025
9986611	Hull H1798A	MISC, NYK Line, K Line, China LNG	Hudong-Zhonghua	174000	X-DF	2025
9970686	Hull 2551	MOL	Hanwha Ocean	174000	MEGA	2025
9961489	Hull H1881A	MOL	Hudong-Zhonghua	174000	X-DF	2025
9961491	Hull H1882A	MOL	Hudong-Zhonghua	174000	X-DF	2025
9953262	Hull H1792A	MOL, Cosco Shipping Energy Transportation	Hudong-Zhonghua	174000	X-DF	2025
9953274	Hull H1793A	MOL, Cosco Shipping Energy Transportation	Hudong-Zhonghua	174000	X-DF	2025
9980540	Hull 8049	NYK Line	Hyundai Heavy Industries Group	174000	X-DF	2025
1023906	Hull 8238	NYK Line	Hyundai Heavy Industries Group	174000	MEGA	2025
1023918	Hull 8239	NYK Line	Hyundai Heavy Industries Group	174000	MEGA	2025
9975521	Hull 3370	SK Shipping	Hyundai Heavy Industries Group	175000	MEGA	2025
9975533	Hull 3371	SK Shipping	Hyundai Heavy Industries Group	174000	MEGA	2025
9904704	Hull 045	Smart LNG	Samsung Heavy Industries	172600	TFDE	2025
9918779	Hull 046	Smart LNG	Zvezda Shipbuilding	172600	TFDE	2025
9918810	Hull 050	Smart LNG	Zvezda Shipbuilding	172600	TFDE	2025
9918846	Hull 053	Smart LNG	Zvezda Shipbuilding	172600	TFDE	2025
9918858	Hull 054	Smart LNG	Zvezda Shipbuilding	172600	TFDE	2025
9918860	Hull 055	Smart LNG	Zvezda Shipbuilding	172600	TFDE	2025
9904687	Sergei Witte	Smart LNG	Zvezda Shipbuilding	172600	TFDE	2025

Appendix 4: Table of global LNG vessel orderbook (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cbm)	Propulsion Type	Delivery Year
9958664	Hull H1836A	United Liquefied Gas	Hudong-Zhonghua	174000	X-DF	2025
1023865	Hull H1908A	United Liquefied Gas	Hudong-Zhonghua	174000	X-DF	2025
Unknown	Unknown Hull No.	United LNG Transportation	Hudong-Zhonghua	174000	X-DF	2025
Unknown	Unknown Hull No.	United LNG Transportation	Hudong-Zhonghua	174000	X-DF	2025
9972957	Jiangnan H2703	ADNOC L&S	Jiangnan	174000	X-DF	2026
9972969	Jiangnan H2704	ADNOC L&S	Jiangnan	174000	X-DF	2026
9972971	Jiangnan H2705	ADNOC L&S	Jiangnan	174000	X-DF	2026
9992880	Hull 8204	Asyad Shipping	Hyundai Heavy Industries Group	174000	MEGA	2026
9992878	Hull 8205	Asyad Shipping	Hyundai Heavy Industries Group	174000	MEGA	2026
9975337	Agamemnon	Capital Gas	Hyundai Heavy Industries Group	174000	MEGA	2026
Unknown	Alcaios I	Capital Gas	Hyundai Heavy Industries Group	174000	MEGA	2026
Unknown	Antaios I	Capital Gas	Hyundai Heavy Industries Group	174000	MEGA	2026
9975325	Archimidis	Capital Gas	Hyundai Heavy Industries Group	174000	MEGA	2026
1018676	Hull CMHI-282-01	Celsius Shipping	China Merchants Heavy Industries	180000	MEGA	2026
1018688	Hull CMHI-282-02	Celsius Shipping	China Merchants Heavy Industries	180000	MEGA	2026
9989120	Dalian No 1 G175K-4	China Merchants Energy Shipping	Dalian Shipbuilding Industry Co	175000	X-DF	2026
Unknown	Dalian No 1 G175K-6	China Merchants Energy Shipping	Dalian Shipbuilding Industry Co	175000	X-DF	2026
Unknown	Dalian No 1 G175K-7	China Merchants Energy Shipping	Dalian Shipbuilding Industry Co	175000	X-DF	2026
Unknown	Unknown Hull No.	CNOOC/CMES/NYK JV	Hudong-Zhonghua	174000	X-DF	2026
Unknown	Unknown Hull No.	CNOOC/CMES/NYK JV	Hudong-Zhonghua	174000	X-DF	2026
Unknown	Unknown Hull No.	CNOOC/CMES/NYK JV	Hudong-Zhonghua	174000	X-DF	2026
Unknown	Unknown Hull No.	CNOOC/CMES/NYK JV	Hudong-Zhonghua	174000	X-DF	2026
9994321	Hull H1890A	CNOOC/CMES/NYK JV	Hudong-Zhonghua	174000	X-DF	2026
1023669	Hull H1891A	CNOOC/CMES/NYK JV	Hudong-Zhonghua	174000	X-DF	2026
9994046	Hull 3435	Dynagas	Hyundai Heavy Industries Group	200000	MEGA	2026
Unknown	Hull No.YZJ2022-1475	European owner	Yangzijiang Shipbuilding	175000	X-DF	2026
Unknown	Hull No.YZJ2022-1476	European owner	Yangzijiang Shipbuilding	175000	X-DF	2026
9984209	Hull 3407	Excelerate Energy	Hyundai Heavy Industries Group	174000	TFDE	2026
9972385	HL Puffin	H-Line Shipping	Samsung Heavy Industries	174000	X-DF	2026
9974163	Hull 2633	H-Line Shipping	Samsung Heavy Industries	174000	X-DF	2026
Unknown	Unknown Hull No.	JP Morgan	Samsung Heavy Industries	174000	MEGA/XDF	2026
Unknown	Unknown Hull No.	JP Morgan	Hyundai Heavy Industries Group	174000	MEGA/XDF	2026

Appendix 4: Table of global LNG vessel orderbook (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cbm)	Propulsion Type	Delivery Year
1023401	Hull 2664	K Line	Samsung Heavy Industries	174000	MEGA/XDF	2026
1023413	Hull 2665	K Line	Samsung Heavy Industries	174000	MEGA/XDF	2026
Unknown	Unknown Hull No.	K Line	Samsung Heavy Industries	174000	MEGA	2026
9997696	Hull H1897A	K Line, China Merchants Energy Shipping, CMC	Hudong-Zhonghua	174000	X-DF	2026
9976939	Hull 2549	K3 Consortium	Hanwha Ocean	174000	MEGA	2026
9986051	Hull 2559	K3 Consortium	Hanwha Ocean	174000	MEGA	2026
9986087	Al-Slaimi	K3 Consortium	Hanwha Ocean	174000	MEGA	2026
9986116	Hull 2564	K3 Consortium	Hanwha Ocean	174000	MEGA	2026
9986075	Hull 2565	K3 Consortium	Hanwha Ocean	174000	MEGA	2026
9986104	Hull 2661	K3 Consortium	Hanwha Ocean	174000	MEGA	2026
9986063	Hull 2662	K3 Consortium	Hanwha Ocean	174000	MEGA	2026
9986099	Hull 2663	K3 Consortium	Hanwha Ocean	174000	MEGA	2026
9981403	Hull 3385	Knutsen OAS	Hyundai Heavy Industries Group	174000	X-DF	2026
9981415	Hull 3386	Knutsen OAS	Hyundai Heavy Industries Group	174000	X-DF	2026
9981427	Hull 3387	Knutsen OAS	Hyundai Heavy Industries Group	174000	X-DF	2026
9981439	Hull 3393	Knutsen OAS	Hyundai Heavy Industries Group	174000	X-DF	2026
9981441	Hull 3394	Knutsen OAS	Hyundai Heavy Industries Group	174000	X-DF	2026
9969376	Hull 8179	Knutsen OAS	Hyundai Heavy Industries Group	174000	X-DF	2026
9974606	Hull 2552	Maran Gas Maritime	Hanwha Ocean	174000	ME-GI	2026
9974618	Hull 2553	Maran Gas Maritime	Hanwha Ocean	174000	ME-GI	2026
9987445	Hull 2579	Maran Gas Maritime	Hanwha Ocean	174000	MEGA	2026
9991874	Hull 2568	Meiji Shipping	Hanwha Ocean	174000	MEGA	2026
9991903	Hull 2569	Meiji Shipping	Hanwha Ocean	174000	MEGA	2026
Unknown	Unknown Hull No.	Meiji Shipping	Hanwha Ocean	174000	X-DF	2026
Unknown	Unknown Hull No.	Meiji Shipping	Samsung Heavy Industries	174000	X-DF	2026
Unknown	Unknown Hull No.	Meiji Shipping	Samsung Heavy Industries	174000	X-DF	2026
9988023	Hull 2652	Minerva Marine	Samsung Heavy Industries	174000	X-DF	2026
9988035	Hull 2653	Minerva Marine	Samsung Heavy Industries	174000	X-DF	2026
9991915	Hull 2570	MISC	Hanwha Ocean	174000	X-DF	2026
9991927	Hull 2571	MISC	Hanwha Ocean	174000	X-DF	2026
Unknown	Unknown Hull No.	MISC	Samsung Heavy Industries	174000	X-DF	2026
Unknown	Unknown Hull No.	MISC	Samsung Heavy Industries	174000	X-DF	2026
9981491	Hull 3395	MISC, NYK Line, K Line, China LNG	Hyundai Heavy Industries Group	174000	X-DF	2026

Appendix 4: Table of global LNG vessel orderbook (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cbm)	Propulsion Type	Delivery Year
9981506	Hull 3396	MISC, NYK Line, K Line, China LNG	Hyundai Heavy Industries Group	174000	X-DF	2026
9981518	Hull 3397	MISC, NYK Line, K Line, China LNG	Hyundai Heavy Industries Group	174000	X-DF	2026
9981520	Hull 3398	MISC, NYK Line, K Line, China LNG	Hyundai Heavy Industries Group	174000	X-DF	2026
9981532	Hull 3399	MISC, NYK Line, K Line, China LNG	Hyundai Heavy Industries Group	174000	X-DF	2026
9981544	Hull 3400	MISC, NYK Line, K Line, China LNG	Hyundai Heavy Industries Group	174000	X-DF	2026
9981556	Hull 3401	MISC, NYK Line, K Line, China LNG	Hyundai Heavy Industries Group	174000	X-DF	2026
9986623	Hull H1799A	MISC, NYK Line, K Line, China LNG	Hudong-Zhonghua	174000	X-DF	2026
9986635	Hull H1800A	MISC, NYK Line, K Line, China LNG	Hudong-Zhonghua	174000	X-DF	2026
9986647	Hull H1801A	MISC, NYK Line, K Line, China LNG	Hudong-Zhonghua	174000	X-DF	2026
9970674	Hull 2550	MOL	Hanwha Ocean	174000	MEGA	2026
9983176	Hull 2558	MOL	Hanwha Ocean	174000	MEGA	2026
9989429	Hull 2576	MOL	Hanwha Ocean	174000	ME-GI	2026
9961506	Hull H1883A	MOL	Hudong-Zhonghua	174000	X-DF	2026
9961518	Hull H1884A	MOL	Hudong-Zhonghua	174000	X-DF	2026
9961520	Hull H1885A	MOL	Hudong-Zhonghua	174000	X-DF	2026
Unknown	Unknown Hull No.	MOL	Samsung Heavy Industries	174000	MEGA	2026
1023891	Hull 8210	NYK Line	Hyundai Heavy Industries Group	174000	MEGA/XDF	2026
1017646	Hull 3441	NYK Line	Hyundai Heavy Industries Group	174000	MEGA/XDF	2026
9976109	Hull 8188	SK Shipping	Hyundai Heavy Industries Group	174000	MEGA	2026
9976111	Hull 8189	SK Shipping	Hyundai Heavy Industries Group	174000	X-DF	2026
9918822	Hull 051	Smart LNG	Zvezda Shipbuilding	172600	TFDE	2026
9918834	Hull 052	Smart LNG	Zvezda Shipbuilding	172600	TFDE	2026
9992232	HSHI Hull 8200	TMS Cardiff Gas	Hyundai Heavy Industries Group	174000	X-DF	2026
9991939	Hull 2572	TMS Cardiff Gas	Hanwha Ocean	174000	MEGA	2026
9991941	Hull 2573	TMS Cardiff Gas	Hanwha Ocean	174000	MEGA	2026
9972684	Hull 2636	TMS Cardiff Gas	Samsung Heavy Industries	174000	MEGA	2026
9992220	Hull 8182	TMS Cardiff Gas	Hyundai Heavy Industries Group	174000	X-DF	2026
9992244	Hull 8201	TMS Cardiff Gas	Hyundai Heavy Industries Group	174000	MEGA/XDF	2026
1024754	Hull H1909A	United Liquefied Gas	Hudong-Zhonghua	174000	X-DF	2026
Unknown	Unknown Hull No.	Unknown	Samsung Heavy Industries	174000	MEGA/XDF	2026
Unknown	Unknown Hull No.	Unknown	Samsung Heavy Industries	174000	MEGA/XDF	2026

Appendix 4: Table of global LNG vessel orderbook (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cbm)	Propulsion Type	Delivery Year
9970569	Hull 2541	Venture Global	Hanwha Ocean	200000	MEGA	2026
9970571	Hull 2542	Venture Global	Hanwha Ocean	200000	MEGA	2026
9970583	Hull 2543	Venture Global	Hanwha Ocean	200000	MEGA	2026
9997634	Hull 2574	Venture Global	Hanwha Ocean	200000	MEGA	2026
9997658	Hull 2575	Venture Global	Hanwha Ocean	200000	MEGA	2026
Unknown	Archon	Capital Gas	Hyundai Heavy Industries Group	174000	MEGA	2027
9315379	Athlos	Capital Gas	Hyundai Heavy Industries Group	174000	MEGA	2027
1018690	Hull CMHI-282-03	Celsius Shipping	China Merchants Heavy Industries	180000	MEGA	2027
1018705	Hull CMHI-282-04	Celsius Shipping	China Merchants Heavy Industries	180000	MEGA	2027
1053004	Hull CMHI-282-05	Celsius Shipping	China Merchants Heavy Industries	180000	MEGA	2027
Unknown	Hull CMHI-282-06	Celsius Shipping	China Merchants Heavy Industries	180000	MEGA	2027
Unknown	Dalian No 1 G175K-8	China Merchants Energy Shipping	Dalian Shipbuilding Industry Co	175000	X-DF	2027
Unknown	Unknown Hull No.	China Taiping Insurance Holdings Co	Jiangnan	175000	X-DF	2027
Unknown	Unknown Hull No.	China Taiping Insurance Holdings Co	Jiangnan	175000	X-DF	2027
Unknown	Dalian No 1 G175K-9	Cosco Shipping Energy Transportation	Dalian Shipbuilding Industry Co	175000	X-DF	2027
Unknown	Dalian No 1 G175K-10	Cosco Shipping Energy Transportation	Dalian Shipbuilding Industry Co	175000	X-DF	2027
9994008	Hull 3433	Dynagas	Hyundai Heavy Industries Group	200000	MEGA	2027
9994034	Hull 3434	Dynagas	Hyundai Heavy Industries Group	200000	MEGA	2027
1017165	Hull 3452	Dynagas	Hyundai Heavy Industries Group	200000	MEGA	2027
1017177	Hull 3453	Dynagas	Hyundai Heavy Industries Group	200000	MEGA	2027
1032713	Hull 3454	Evalend Shipping	Hyundai Heavy Industries Group	174000	MEGA/XDF	2027
1032725	Hull 3455	Evalend Shipping	Hyundai Heavy Industries Group	174000	MEGA/XDF	2027
Unknown	Unknown Hull No.	Maran Gas Maritime	Hanwha Ocean	174000	MEGA	2027
Unknown	Unknown Hull No.	Maran Gas Maritime	Hanwha Ocean	174000	MEGA/XDF	2027
Unknown	Unknown Hull No.	Maran Gas Maritime	Hanwha Ocean	174000	MEGA/XDF	2027
Unknown	Unknown Hull No.	MOL	Samsung Heavy Industries	174000	MEGA	2027
Unknown	Unknown Hull No.	MOL	Samsung Heavy Industries	174000	MEGA	2027
Unknown	Unknown Hull No.	MOL	Hanwha Ocean	174000	MEGA	2027
Unknown	Unknown Hull No.	MOL	Hanwha Ocean	174000	MEGA	2027
9986570	Hull H1794A	MOL, Cosco Shipping Energy Transportation	Hudong-Zhonghua	174000	X-DF	2027
9986582	Hull H1795A	MOL, Cosco Shipping Energy Transportation	Hudong-Zhonghua	174000	X-DF	2027

Appendix 4: Table of global LNG vessel orderbook (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cbm)	Propulsion Type	Delivery Year
9986594	Hull H1796A	MOL, Cosco Shipping Energy Transportation	Hudong-Zhonghua	174000	X-DF	2027
Unknown	Unknown Hull No.	Nakilat	Hyundai Heavy Industries Group	174000	MEGA/XDF	2027
Unknown	Unknown Hull No.	Nakilat	Hyundai Heavy Industries Group	174000	MEGA/XDF	2027
Unknown	Unknown Hull No.	Nakilat	Hyundai Heavy Industries Group	174000	MEGA/XDF	2027
Unknown	Unknown Hull No.	Nakilat	Hyundai Heavy Industries Group	174000	MEGA/XDF	2027
Unknown	Unknown Hull No.	Nakilat	Hyundai Heavy Industries Group	174000	MEGA/XDF	2027
Unknown	Unknown Hull No.	Nakilat	Hyundai Heavy Industries Group	174000	MEGA/XDF	2027
Unknown	Unknown Hull No.	Nakilat	Hyundai Heavy Industries Group	174000	MEGA/XDF	2027
Unknown	Unknown Hull No.	Nakilat	Hyundai Heavy Industries Group	174000	MEGA/XDF	2027
Unknown	Unknown Hull No.	Nakilat	Hyundai Heavy Industries Group	174000	MEGA/XDF	2027
Unknown	Unknown Hull No.	Nakilat	Hyundai Heavy Industries Group	174000	MEGA/XDF	2027
Unknown	Unknown Hull No.	Nakilat	Hyundai Heavy Industries Group	174000	MEGA/XDF	2027
Unknown	Unknown Hull No.	Nakilat	Hyundai Heavy Industries Group	174000	MEGA/XDF	2027
Unknown	Unknown Hull No.	Nakilat	Hyundai Heavy Industries Group	174000	MEGA/XDF	2027
Unknown	Unknown Hull No.	Nakilat	Hyundai Heavy Industries Group	174000	MEGA/XDF	2027
Unknown	Unknown Hull No.	Nakilat	Hyundai Heavy Industries Group	174000	MEGA/XDF	2027
9980552	Hull 8174	NYK Line	Hyundai Heavy Industries Group	174000	MEGA/XDF	2027
1023877	Hull 8208	NYK Line	Hyundai Heavy Industries Group	174000	X-DF	2027
1023889	Hull 8209	NYK Line	Hyundai Heavy Industries Group	174000	MEGA/XDF	2027
1017658	Hull 3442	NYK Line	Hyundai Heavy Industries Group	174000	MEGA/XDF	2027
1017660	Hull 3443	NYK Line	Hyundai Heavy Industries Group	174000	MEGA/XDF	2027
1017672	Hull 3444	NYK Line	Hyundai Heavy Industries Group	174000	MEGA/XDF	2027
9992103	Hull 2656	Seapeak	Samsung Heavy Industries	174000	MEGA	2027
9992115	Hull 2657	Seapeak	Samsung Heavy Industries	174000	MEGA	2027
9992127	Hull 2658	Seapeak	Samsung Heavy Industries	174000	MEGA	2027
9992139	Hull 2659	Seapeak	Samsung Heavy Industries	174000	MEGA	2027
9992141	Hull 2660	Seapeak	Samsung Heavy Industries	174000	MEGA	2027
Unknown	Dalian No 1 G175K-12	Wah Kwong, China Gas, CSSC	Dalian Shipbuilding Industry Co	175000	X-DF	2027

Appendix 4: Table of global LNG vessel orderbook (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cbm)	Propulsion Type	Delivery Year
Unknown	Dalian No 1 G175K-13	Wah Kwong, China Gas, CSSC	Dalian Shipbuilding Industry Co	175000	X-DF	2027
Unknown	Unknown Hull No.	Capital Gas	Hyundai Heavy Industries Group	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Capital Gas	Hyundai Heavy Industries Group	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Capital Gas	Hyundai Heavy Industries Group	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Capital Gas	Hyundai Heavy Industries Group	174000	MEGA/XDF	2028
1022251	Hull 2668	Chevron	Samsung Heavy Industries	174000	MEGA/XDF	2028
1022263	Hull 2669	Chevron	Samsung Heavy Industries	174000	MEGA/XDF	2028
Unknown	Dalian No 1 G175K-11	Cosco Shipping Energy Transportation	Dalian Shipbuilding Industry Co	175000	X-DF	2028
1048839	Hull 3456	Evalend Shipping	Hyundai Heavy Industries Group	174000	MEGA/XDF	2028
1048841	Hull 3457	Evalend Shipping	Hyundai Heavy Industries Group	174000	MEGA/XDF	2028
1023841	Hull H1898A	MOL, Cosco Shipping Energy Transportation	Hudong-Zhonghua	174000	X-DF	2028
1023853	Hull H1899A	MOL, Cosco Shipping Energy Transportation	Hudong-Zhonghua	174000	X-DF	2028
1025198	Hull H1900A	MOL, Cosco Shipping Energy Transportation	Hudong-Zhonghua	174000	X-DF	2028
Unknown	Unknown Hull No.	Nakilat	Hyundai Heavy Industries Group	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Nakilat	Hyundai Heavy Industries Group	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Nakilat	Samsung Heavy Industries	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Nakilat	Samsung Heavy Industries	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Nakilat	Samsung Heavy Industries	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Nakilat	Samsung Heavy Industries	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Nakilat	Samsung Heavy Industries	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Nakilat	Samsung Heavy Industries	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Nakilat	Samsung Heavy Industries	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Nakilat	Samsung Heavy Industries	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Tianjin Southwest Maritime	Hudong-Zhonghua	174000	X-DF	2028
Unknown	Unknown Hull No.	Tianjin Southwest Maritime	Hudong-Zhonghua	174000	X-DF	2028
Unknown	Unknown Hull No.	Tianjin Southwest Maritime	Hudong-Zhonghua	174000	X-DF	2028
Unknown	Unknown Hull No.	Unknown	Hudong-Zhonghua	271000	X-DF	2028
Unknown	Unknown Hull No.	Unknown	Hudong-Zhonghua	271000	X-DF	2028
Unknown	Unknown Hull No.	Unknown	Hudong-Zhonghua	271000	X-DF	2028
Unknown	Unknown Hull No.	Unknown	Hudong-Zhonghua	271000	X-DF	2028

Appendix 4: Table of global LNG vessel orderbook (continued)

IMO Number	Vessel Name	Shipowner	Shipbuilder	Capacity (cbm)	Propulsion Type	Delivery Year
Unknown	Unknown Hull No.	Unknown	Samsung Heavy Industries	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Unknown	Samsung Heavy Industries	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Unknown	Samsung Heavy Industries	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Unknown	Samsung Heavy Industries	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Unknown	Samsung Heavy Industries	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Unknown	Hanwha Ocean	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Unknown	Hanwha Ocean	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Unknown	Hanwha Ocean	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Unknown	Hanwha Ocean	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Unknown	Hanwha Ocean	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Unknown	Hanwha Ocean	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Unknown	Hanwha Ocean	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Unknown	Hanwha Ocean	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Unknown	Hanwha Ocean	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Unknown	Hanwha Ocean	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Unknown	Hanwha Ocean	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Unknown	Hanwha Ocean	174000	MEGA/XDF	2028
Unknown	Unknown Hull No.	Unknown	Hudong-Zhonghua	271000	X-DF	2029
Unknown	Unknown Hull No.	Unknown	Hudong-Zhonghua	271000	X-DF	2029
Unknown	Unknown Hull No.	Unknown	Hudong-Zhonghua	271000	X-DF	2029
Unknown	Unknown Hull No.	Unknown	Hudong-Zhonghua	271000	X-DF	2029

Appendix 5: Table of Global LNG receiving terminals

Reference Number	Market	Terminal Name	Start Year	Regasification Capacity (MTPA)	Owners	Concept
1	Argentina	Bahia Blanca GasPort - Excelerate Exemplar	2021	3.80	YPF (50%); Stream JV (50%);	Floating
2	Argentina	GNL Escobar - Excelerate Expedient	2011	3.80	YPF (50%); Enarsa (50%);	Floating
3	Bahrain	Bahrain LNG	2020	6.00	NOGA (30%); Teekay Corporation (30%); Gulf Investment Corporation (20%); Samsung (20%);	Floating
4	Bangladesh	Moheshkhali - Excelerate Excellence	2018	3.75	Excelerate Energy (100%);	Floating
5	Bangladesh	Summit FSRU	2019	3.80	Summit Asia Pacific (75%); Mitsubishi (25%);	Floating
6	Belgium	Zeebrugge	1987	6.60	Fluxys LNG SA (100%);	Onshore
7	Brazil	Acu Port LNG	2020	5.60	Prumo Logistica (46.9%); Siemens (33%); BP (20.1%);	Floating
8	Brazil	Bahia LNG	2021	5.37	Petrobras (100%);	Floating
9	Brazil	Guanabara LNG	2020	8.05	Petrobras (100%);	Floating
10	Brazil	Sepetiba Bay FSRU	2022	2.27	Kapowership(50%); Mitsui OSK Lines(50%);	Floating
11	Brazil	Para LNG (Barcarena)	2024	6.00	Apollo (80%); New Fortress Energy (20%);	Floating
12	Brazil	Pecem LNG	2021	3.80	Petrobras (100%);	Floating
13	Brazil	Sergipe LNG	2020	5.64	Eneva (100%);	Floating
14	Canada	Saint John LNG	2009	7.50	Repsol (100%);	Onshore
15	Chile	GNL Mejillones	2014	1.50	ENGIE (63%); Ameris Capital (37%);	Onshore
16	Chile	GNL Quintero	2009	4.00	Fluxys (40%); EIG (40%); ENAP (20%)	Onshore
17	China	Caofeidian (Tangshan) LNG	2013	10.00	CNPC (51%); Beijing Enterprises Group Company (29%); Hebei Natural Gas (20%);	Onshore
18	China	Dalian LNG	2011	6.00	PipeChina (75%); Dalian Port (20%); Dalian Construction Investment Corporation (5%);	Onshore
19	China	Diefu LNG (Shenzhen)	2018	4.00	PipeChina (70%); Shenzhen Energy Group (30%);	Onshore
20	China	Fangchenggang LNG	2019	0.60	PipeChina (51%); Guangxi Beibu Gulf Port Group (49%)	Onshore
21	China	Fujian LNG	2009	6.30	CNOOC (60%); Fujian Investment and Development Co (40%);	Onshore
22	China	Guangdong Dapeng LNG	2006	6.80	CNOOC (33%); Guangdong Province Consortium (31%); BP (30%); HK & China Gas (3%); Hong Kong Electric (3%);	Onshore
23	China	Guangxi Beihai LNG	2016	6.00	PipeChina (80%); Guangxi Beibu Gulf Port Group (20%)	Onshore
24	China	Guangzhou Nansha LNG	2023	1.00	Guangdong Panyu Petrochemical Storage & Transportation Ltd. (100%)	Onshore
25	China	Hainan Shennan LNG	2014	0.28	Hainan CNPC Shennan Petroleum Technology Development (90%); Hainan Fushan Oil and Gas Chemical (10%);	Onshore
26	China	Hainan Yangpu LNG	2014	3.00	PipeChina (65%); China Energy Group Haikong New Energy (35%);	Onshore
27	China	Hong Kong FSRU	2023	6.13	Castle Peak Power Company Limited (70%); Hongkong Electric Co., Ltd. (30%);	Floating
28	China	Jiangsu Rudong LNG	2011	10.00	CNPC (55%); Pacific Oil and Gas (35%); Jiangsu Guoxin (10%);	Onshore
29	China	Jiangsu Yancheng Binhai LNG	2022	3.00	CNOOC (100%);	Onshore

Appendix 5: Table of Global LNG receiving terminals (continued)

Reference Number	Market	Terminal Name	Start Year	Regasification Capacity (MTPA)	Owners	Concept
30	China	Jiaxing Pinghu LNG	2022	1.00	Jiaxing Gas Group (51%); Hangzhou Gas (49%);	Onshore
31	China	Jieyang (Yuedong) LNG	2018	2.00	PipeChina (100%);	Onshore
32	China	Jovo Dongguan	2012	1.00	Jovo Group (100%);	Onshore
33	China	Qidong LNG	2017	5.00	Xinjiang Guanghui Petroleum (100%);	Onshore
34	China	Shandong (Qingdao) LNG	2014	11.00	Sinopec (99%); Qingdao Port(1%);	Onshore
35	China	Shanghai Wuhaogou LNG	2008	1.50	Shenergy (100%);	Onshore
36	China	Shanghai Yangshan LNG	2009	6.00	Shenergy Group (55%); CNOOC (45%);	Onshore
37	China	Shenzhen Gas LNG	2019	0.80	Shenzhen Gas (100%);	Onshore
38	China	Tangshan LNG	2023	5.00	Suntien Green Energy (100%);	Onshore
39	China	Tianjin Nangang LNG	2023	1.94	Beijing Gas (100%);	Onshore
40	China	Tianjin PipeChina LNG	2013	6.00	PipeChina (100%);	Onshore
41	China	Tianjin Sinopec LNG	2018	10.80	Sinopec (98%); Tianjin Nangang Industrial Zone Developemnt Co (2%);	Onshore
42	China	Wenzhou LNG	2023	3.00	Sinopec (41%); Zhejiang Energy Group (51%); Local firms (8%);	Onshore
43	China	Zhejiang Ningbo LNG	2012	6.00	CNOOC (51%); Zhejiang Energy Company (29%); Ningbo Power (20%);	Onshore
44	China	Zhoushan ENN LNG	2018	5.00	ENN (90%); Prism Energy (10%);	Onshore
45	China	Zhuhai LNG	2013	3.50	CNOOC (30%); Guangdong Energy (25%); Guangzhou Gas Group (25%); Local companies (20%);	Onshore
46	Chinese Taipei	Taichung LNG	2009	6.00	CPC (100%);	Onshore
47	Chinese Taipei	Yung-An	1990	10.50	CPC (100%);	Onshore
48	Colombia	SPEC FSRU	2016	3.00	Promigas (51%); Royal Vopak (49%);	Floating
49	Croatia	Krk LNG terminal	2021	2.13	HEP (85%); Plinacro (15%);	Floating
50	Dominican Republic	AES Andres LNG	2003	1.90	AES (80%); Grupo Linda (10%); AFI Popular (10%);	Onshore
51	El Salvador	El Salvador FSRU	2022	2.15	Energía del Pacífico (100%);	Floating
52	Finland	Hamina LNG-terminal	2022	0.12	Hamina LNG Oy (100%);	Onshore
53	Finland	Inkoo FSRU	2023	3.68	Gasgrid Finland (100%);	Floating
54	Finland	Pori LNG	2016	0.15	Gasum (100%);	Onshore
55	Finland	Tornio Manga LNG	2018	0.40	Outokumpu Group (45%); SSAB (25%); Gasum (25%); EPV Energy (5%);	Onshore
56	France	Dunkirk LNG	2017	9.60	Fluxys and AXA Investment Managers & Crédit Agricole Assurances (60.76%); IPM Group and Samsung Asset Management (39.24%);	Onshore
57	France	Fos Cavaou	2010	6.00	ENGIE (100%);	Onshore
58	France	Fos Tonkin	1972	1.10	ENGIE (100%);	Onshore
59	France	Le Havre FSRU	2023	3.68	TotalEnergies (100%);	Floating
60	France	Montoir-de-Bretagne	1980	8.00	ENGIE (100%);	Onshore
61	Germany	Elbehafen LNG	2023	3.68	RWE (100%);	Floating

Appendix 5: Table of Global LNG receiving terminals (continued)

Reference Number	Market	Terminal Name	Start Year	Regasification Capacity (MTPA)	Owners	Concept
62	Germany	Lubmin LNG	2023	3.82	Deutsche Regas (100%);	Floating
63	Germany	Mukran LNG	2024	9.93	Deutsche Regas (100%);	Floating
64	Germany	Wilhelmshaven LNG	2022	5.51	Uniper (100%);	Floating
65	Greece	Alexandroupolis LNG	2024	4.04	Gastrade S.A. (100%);	Floating
66	Greece	Revithoussa	2000	4.93	DESFA SA (100%);	Onshore
67	India	Dabhol LNG	2013	2.00	Gail (31.52%); NTPC (31.52%); Indian Financial Institutions (20.28%); MSEB Holding Co. (16.68%);	Onshore
68	India	Dahej LNG	2004	17.50	Petronet LNG (100%);	Onshore
69	India	Dhamra LNG	2023	5.00	Adani Group (50%); Total (50%);	Onshore
70	India	Ennore LNG	2019	5.00	Indian Oil Corporation (95%); Tamil Nadu Industrial Development Corporation (5%);	Onshore
71	India	Hazira LNG	2005	5.00	Shell (100%);	Onshore
72	India	Kochi LNG	2013	5.00	Petronet LNG (100%);	Onshore
73	India	Mundra LNG	2020	5.00	GSPC (50%); Adani Group (50%);	Onshore
74	Indonesia	Arun LNG	2015	3.00	Pertamina (70%); Aceh Regional Government (30%);	Onshore
75	Indonesia	Benoa LNG (Bali)	2016	0.30	PT Pelindo (50%); JSK Group (50%);	Floating
76	Indonesia	Cilamaya - Jawa 1 FSRU	2021	2.40	Pertamina (26%); Humpuss (25%); Marubeni (20%); MOL (19%); Sojitz (10%);	Floating
77	Indonesia	Lampung LNG - PGN FSRU Lampung	2014	1.80	LNG Indonesia (100%);	Floating
78	Indonesia	Nusantara Regas Satu - FSRU Jawa Barat	2012	3.80	Pertamina (60%); PGN (40%);	Floating
79	Indonesia	Powership Zeynep Sultan Amurang - Hua Xiang 8 FSRU	2020	0.10	PLT(50%); PT Humpuss (50%);	Floating
80	Israel	Hadera Deepwater LNG - Excelerate Expedient	2013	3.00	INGL (100%);	Floating
81	Italy	Adriatic LNG	2009	6.62	ExxonMobil (70.7%); Qatar Petroleum (22%); Snam (7.3%);	Offshore
82	Italy	HIGAS LNG terminal	2021	0.20	Avenir LNG (80%); Gas and Heat (10%); CPL Concordia (10%);	Onshore
83	Italy	Panigaglia LNG	1971	2.58	Snam (100%);	Onshore
84	Italy	Piombino FSRU	2023	3.68	Snam (100%);	Floating
85	Italy	Ravenna LNG	2021	0.70	Petrolifera Italo Rumena (51%); Edison S.p.A. (30%); Scale Gas Solutions (19%);	Onshore
86	Italy	Toscana - Toscana FSRU	2013	2.70	Snam (49.07%); First State Investments (48.24%); Golar LNG (2.69%);	Floating
87	Jamaica	Old Harbour FSRU	2019	3.60	New Fortress Energy (100%);	Floating
88	Japan	Akita LNG Terminal	2015	0.58	Tobu Gas (100%);	Onshore
89	Japan	Chikko Terminal	2003	0.20	Okayama Gas (100%);	Onshore
90	Japan	Chita LNG	1983	10.90	Chubu Electric (50%); Toho Gas (50%);	Onshore
91	Japan	Chita LNG	1977	7.50	JERA (50%); Toho Gas (50%);	Onshore

Appendix 5: Table of Global LNG receiving terminals (continued)

Reference Number	Market	Terminal Name	Start Year	Regasification Capacity (MTPA)	Owners	Concept
92	Japan	Chita Midorihama Works	2001	8.30	Toho Gas (100%);	Onshore
93	Japan	Futtsu LNG	1985	16.00	JERA (100%);	Onshore
94	Japan	Hachinohe	2015	1.50	JX Nippon Oil & Energy (100%);	Onshore
95	Japan	Hakodate-Minato Terminal	2006	0.22	Hokkaido Gas (100%);	Onshore
96	Japan	Hatsukaichi	1996	0.90	Hiroshima Gas (100%);	Onshore
97	Japan	Hibiki LNG	2014	2.40	Saibu Gas (90%); Kyushu Electric (10%);	Onshore
98	Japan	Higashi-Niigata	1984	8.90	Nihonkai LNG (58.1%); Tohoku Electric (41.9%);	Onshore
99	Japan	Higashi-Ohgishima	1984	14.70	JERA (100%);	Onshore
100	Japan	Himeji LNG Kansai	1979	14.00	Osaka Gas (100%);	Onshore
101	Japan	Hitachi LNG	2016	6.40	Tokyo Gas (100%);	Onshore
102	Japan	Ishikari LNG	2012	2.70	Hokkaido Gas (100%);	Onshore
103	Japan	Joetsu	2012	2.30	JERA (100%);	Onshore
104	Japan	Kagoshima	1996	0.20	Nippon Gas (100%);	Onshore
105	Japan	Kawagoe	1997	7.70	JERA (100%);	Onshore
106	Japan	Kushiro LNG	2015	0.50	Nippon Oil (100%);	Onshore
107	Japan	Matsuyama Terminal	2008	0.38	Shikoku Gas (100%);	Onshore
108	Japan	Mizushima	2006	4.30	Chugoku Electric (50%); JX Nippon Oil & Energy (50%);	Onshore
109	Japan	Nagasaki	2003	0.15	Saibu Gas (100%);	Onshore
110	Japan	Naoetsu LNG	2013	1.50	INPEX (100%);	Onshore
111	Japan	Negishi	1969	12.00	JERA (50%); Tokyo Gas (50%);	Onshore
112	Japan	Niihama LNG	2022	1.00	Tokyo Gas (50.1%); Shikoku Electric Power (30.1%); Other Japanese Partners (19.8%);	Onshore
113	Japan	Ohgishima	1998	9.90	Tokyo Gas (100%);	Onshore
114	Japan	Oita LNG	1990	5.10	Kyushu Electric (100%);	Onshore
115	Japan	Sakai LNG	2006	6.40	Kansai Electric (70%); Cosmo Oil (12.5%); Iwatani (12.5%); Ube Industries (5%);	Onshore
116	Japan	Sakaide LNG	2010	1.20	Shikoku Electric Power Co. (70%); Cosmo Oil Co. Ltd (20%); Shikoku Gas Co. (10%);	Onshore
117	Japan	Senboku I & II	1972	15.30	Osaka Gas (100%);	Onshore
118	Japan	Shin-Minato	1997	0.30	Gas Bureau (100%);	Onshore
119	Japan	Shin-Sendai	2015	1.50	Tohoku Electric (100%);	Onshore
120	Japan	Sodegaura	1973	29.40	JERA (50%); Tokyo Gas (50%);	Onshore
121	Japan	Sodeshi	1996	2.90	Shizuoka Gas (65%); ENEOS Corporation (35%);	Onshore
122	Japan	Soma LNG	2018	1.50	JAPEX (100%);	Onshore
123	Japan	Takamatsu Terminal	2003	0.40	Shikoku Gas (100%);	Onshore
124	Japan	Tobata	1977	6.80	Kitakyushu LNG (100%);	Onshore
125	Japan	Tokushima LNG Terminal	2019	0.18	Shikoku Gas (100%);	Onshore
126	Japan	Toyama Shinko	2018	0.38	Hokuriku Electric (100%);	Onshore
127	Japan	Yanai	1990	2.40	Chugoku Electric (100%);	Onshore
128	Japan	Yokkaichi LNG Center	1987	6.40	JERA (100%);	Onshore
129	Japan	Yokkaichi Works	1991	2.10	Toho Gas (100%);	Onshore
130	Japan	Yufutsu Terminal	2011	0.14	JAPEX (100%);	Onshore
131	Jordan	Jordan LNG - Golar Eskimo	2015	3.80	Jordan MEMR (100%);	Floating
132	Kuwait	Al-Zour LNG Import Facility	2021	11.30	Kuwait Petroleum Corporation (100%);	Onshore
133	Lithuania	Klaipeda LNG	2014	2.94	Klaipedos Nafta (100%);	Floating
134	Malaysia	Melaka LNG	2013	3.80	Petronas (100%);	Floating
135	Malaysia	Pengerang LNG	2017	3.50	PETRONAS (65%); Dialog Group (25%); Johor Government (10%);	Onshore
136	Malta	Electrogas Malta	2017	0.40	Reganosa (100%);	Floating
137	Mexico	Energia Costa Azul	2008	7.60	Sempra Energy (100%);	Onshore
138	Mexico	Pichilingue LNG	2021	0.80	New Fortress Energy (100%);	Onshore
139	Mexico	Terminal de LNG Altamira	2006	5.40	Vopak (60%); ENAGAS (40%);	Onshore
140	Mexico	Terminal KMS	2012	3.80	Samsung (37.5%); Mitsui (37.5%); KOGAS (25%);	Onshore
141	Myanmar	Thilawa LNG FSU	2020	0.40	CNTIC VPower (100%);	Floating
142	Myanmar	Thilawa Dolphin LNG	2020	3.00	CNTIC VPower (100%);	Onshore
143	Netherlands	Eemshaven FSRU	2022	5.88	Gasunie (100%);	Floating
144	Netherlands	Gate LNG terminal (LNG Rotterdam)	2011	11.76	Gasunie (50%); Vopak (50%);	Onshore
145	Norway	Fredrikstad LNG terminal	2011	0.10	Gasum (100%);	Onshore
146	Norway	Mosjøen LNG terminal	2007	0.40	Gasnor (100%);	Onshore
147	Pakistan	Pakistan GasPort	2017	5.20	Pakistan GasPort Limited (100%);	Floating
148	Pakistan	Port Qasim Karachi LNG	2015	4.80	Engro (56%); Royal Vopak (44%);	Floating
149	Panama	Costa Norte LNG	2018	1.50	AES (65%); Grupo Linda (35%);	Onshore
150	Philippines	Batangas Bay LNG terminal (AG&P FSU)	2023	5.00	Meralco PowerGen Corporation (40%); Aboitiz Power Corporation (30%); San Miguel Global Power Holdings Corp. (30%);	Floating
151	Philippines	First Gen LNG	2023	5.00	First Gen LNG (80%); Tokyo Gas (20%);	Floating
152	Poland	Swinoujscie LNG	2016	3.68	Gaz-System (100%);	Onshore
153	Portugal	Sines LNG Terminal	2004	5.80	REN (100%);	Onshore
154	Singapore	Jurong LNG	2013	11.00	SLNG (100%);	Onshore
155	South Korea	Boryeong LNG	2017	3.00	GS Caltex (50%); SK E&S (50%);	Onshore
156	South Korea	Gwangyang LNG	2005	3.10	POSCO (100%);	Onshore
157	South Korea	Incheon	1996	54.90	KOGAS (100%);	Onshore
158	South Korea	Jeju LNG	2019	1.00	KOGAS (100%);	Onshore
159	South Korea	Pyeongtaek LNG	1986	41.00	KOGAS (100%);	Onshore
160	South Korea	Samcheok LNG	2014	11.60	KOGAS (100%);	Onshore

Appendix 5: Table of Global LNG receiving terminals (continued)

Reference Number	Market	Terminal Name	Start Year	Regasification Capacity (MTPA)	Owners	Concept
161	South Korea	Tongyeong LNG	2002	26.50	KOGAS (100%);	Onshore
162	Spain	Bahía de Bizkaia Gas	2003	5.10	Enagas (50%); EVE (50%);	Onshore
163	Spain	Barcelona LNG	1969	12.60	Enagas (100%);	Onshore
164	Spain	Cartagena	1989	8.60	Enagas (100%);	Onshore
165	Spain	El Musel	2023	5.88	Enagas (100%);	Onshore
166	Spain	Huelva	1988	8.60	Enagas (100%);	Onshore
167	Spain	Mugardos LNG	2007	2.60	Tojeiro Group (51%); Sojitz (15%); Sonatrach (10%); the Government of Galicia (24%);	Onshore
168	Spain	Sagunto	2006	6.40	Enagas (72.5%); Osaka Gas (20%); Oman Oil (7.5%);	Onshore
169	Sweden	Lysekil LNG	2014	0.20	Skangas (100%);	Onshore
170	Sweden	Nynäshamn LNG	2011	0.40	AGA (100%);	Onshore
171	Thailand	Map Ta Phut	2011	11.50	PTT LNG (100%);	Onshore
172	Thailand	Nong Fab LNG	2022	7.50	PTT LNG (100%);	Onshore
173	Turkey	Aliaga Izmir LNG	2006	4.40	EgeGaz (100%);	Onshore
174	Turkey	Dortyol LNG terminal	2021	7.51	Botas (100%);	Floating
175	Turkey	Etki LNG terminal	2019	7.50	Etki Liman (100%);	Floating
176	Turkey	Gulf of Saros FSRU	2023	5.60	Botas (100%);	Floating
177	Turkey	Marmara Ereglisi	1994	5.90	Botas (100%);	Onshore
178	UAE	Dubai Jebel Ali	2015	6.00	DUSUP (100%);	Floating
179	United Kingdom	Dragon LNG	2009	5.60	Shell (50%); Ancala (50%);	Onshore
180	United Kingdom	Gibraltar LNG	2019	0.04	Shell (20%); Gibraltar government (80%);	Onshore
181	United Kingdom	Grain LNG	2005	15.00	National Grid Transco (100%);	Onshore
182	United Kingdom	Mowi LNG terminal	2021	0.22	Mowi (100%);	Onshore
183	United Kingdom	South Hook LNG	2009	15.60	Qatar Petroleum (67.5%); Exxon Mobil (24.25%); ELF Petroleum (8.35%);	Onshore
184	United States	Cove Point LNG	2003	11.00	Dominion Cove Point LNG (100%);	Onshore
185	United States	EcoElectrica	2000	2.00	Gas natural Fenosa (47.5%); ENGIE (35%); Mitsui (15%); GE Capital (2.5%);	Onshore
186	United States	Elba Island LNG	1978	12.00	Kinder Morgan (100%);	Onshore
187	United States	Everett	1971	5.40	Exelon Generation (100%);	Onshore
188	United States	Neptune Deepwater LNG Port	2010	5.40	Northeast Gateway Energy Bridge LLC (100%);	Onshore
189	United States	Northeast Gateway	2008	4.50	Excelerate Energy (100%);	Floating
190	United States	San Juan - New Fortress LNG	2020	1.10	New Fortress Energy (100%);	Floating
191	Vietnam	Thi Vai LNG	2023	3.00	PetroVietnam Gas (100%);	Onshore

Note:
1. Small-scale (<0.5 MTPA) regasification terminals which have impact on import market are included as well.
2. Croatia's Krk LNG Terminal expanded its receiving capacity from 1.9 MTPA to 2.1 MTPA at the existing facility.
3. Tianjin PipeChina LNG becomes an onshore terminal following its FSRU vessel left the terminal in March 2023.
4. Updated as of end-February 2024.

Appendix 6: Table of LNG receiving terminals under construction

Reference Number	Market	Terminal Name	Start Year	Nameplate Receiving Capacity (MTPA)	Ownership	Concept
192	Australia	Port Kembla LNG - Hoegh Galleon	2025	2.00	Andrew Forrest's Squadron Energy (100%);	Floating
193	Belgium	Zeebrugge 2 Expansion Step 1	2024	4.70	Fluxys LNG SA (100%);	Onshore
194	Belgium	Zeebrugge 2 Expansion Step 2	2026	1.30	Fluxys LNG SA (100%);	Onshore
195	Brazil	Sao Paulo LNG	2024	3.78	Cosan (100%);	Floating
196	Brazil	Terminal Gas Sul (TGS) LNG	2024	4.00	New Fortress Energy (100%);	Floating
197	China	Chaozhou Huaying LNG 1	2024	6.00	Huaying Investment Holding Group (50%); Sinopec Natural Gas Co Ltd (50%);	Onshore
198	China	China Resources Rudong LNG 1	2026	6.50	China resources gas Runxing Energy (50%); Jiangsu Yangkou Port (50%);	Onshore
199	China	CNPC Fuqing LNG	2025	3.00	PetroChina (100%);	Onshore
200	China	Guangxi Beihai LNG 3	2025	6.00	PipeChina (80%); Guangxi Beibu Gulf Port Group (20%)	Onshore
201	China	Guangzhou Nansha LNG 2	2024	1.00	Guangdong Panyu Petrochemical Storage & Transportation Ltd. (100%)	Onshore
202	China	Huafeng Zhongtian LNG	2025	4.00	Sinoenergy (55%); Chaozhou Huafeng Group (45%);	Onshore
203	China	Huizhou LNG 1	2024	6.10	Guangdong Energy Group (100%);	Onshore
204	China	Jiangsu Ganyu (Huadian) LNG	2026	3.00	China Huadian (51%); Lianyungang Port Group (20%); SK (14%); BP (10%); JERA (5%);	Onshore
205	China	Jiangsu Guoxin Rudong LNG 1	2024	6.00	Jiangsu Guoxin (95%); Jiangsu Yangkou Port (5%);	Onshore
206	China	Jiangsu Guoxin Rudong LNG 2	2025	3.05	Jiangsu Guoxin (95%); Jiangsu Yangkou Port (5%);	Onshore
207	China	Jiangsu Yancheng Binhai LNG 1 expansion	2024	6.00	CNOOC (100%);	Onshore
208	China	Jieyang (Yuedong) LNG 2	2026	2.00	PipeChina (100%);	Onshore
209	China	PipeChina Longkou Nanshan LNG 1	2024	5.00	PipeChina (60%); Nanshan Group (40%)	Onshore
210	China	Putian LNG	2026	5.65	Ningxia Hanas (100%);	Onshore
211	China	Qidong LNG 5	2025	5.00	Xinjiang Guanghui Petroleum (100%);	Onshore
212	China	Shanghai LNG 1	2025	3.00	Shenergy Group (60%); Zhejiang Energy (20%); CNOOC (20%);	Onshore
213	China	Shenzhen Gas LNG 2	2025	2.00	Shenzhen Gas (100%);	Onshore
214	China	Sinopec Longkou LNG	2024	6.50	Sinopec Gas (50%); Hengtong Logistics (32%); Longkou port (18%)	Onshore
215	China	Sinopec Zhoushan Liuheng LNG 1	2025	7.18	Sinopec (90%); Liuheng Tidal Flat Reclamation Co., Ltd. (10%)	Onshore
216	China	Tangshan LNG 2	2025	5.00	Suntien Green Energy (100%);	Onshore
217	China	Tangshan LNG 3	2030	2.00	Suntien Green Energy (100%);	Onshore
218	China	Tianjin Nangang LNG 2	2024	2.04	Beijing Gas (100%);	Onshore
219	China	Tianjin Nangang LNG 3	2025	1.02	Beijing Gas (100%);	Onshore
220	China	Tianjin PipeChina LNG 3	2026	6.50	PipeChina (100%);	Onshore
221	China	Tianjin Sinopec LNG 3	2026	0.85	Sinopec (98%); Tianjin Nangang Industrial Zone Developemnt Co (2%);	Onshore

Appendix 6: Table of LNG receiving terminals under construction (continued)

Reference Number	Market	Terminal Name	Start Year	Nameplate Receiving Capacity (MTPA)	Ownership	Concept
222	China	Wenzhou Huagang LNG 1	2024	3.00	Huafeng Group (100%);	Onshore
223	China	Wuhu LNG terminal	2024	1.50	Huaihe Energy (100%);	Onshore
224	China	Xiexin Huidong Jiangsu Rudong LNG 1	2025	3.00	Pacific Energy (49%); Xiexin Oil and Gas (26%); Huidon Investment (25%);	Onshore
225	China	Yangjiang LNG	2024	2.80	Guangdong Yangjiang Hailing Bay LNG (100%);	Onshore
226	China	Yantai West Port (Xigang) LNG	2024	5.90	China Urban-Rural Energy (35%); Shandong Poly-GCL Pan-Asia International Energy Co., Ltd. (33%); Circle Asia Energy International Distribution Center (32%);	Onshore
227	China	Yingkou LNG terminal	2025	6.20	China Urban Rural Energy (60%); Hebei Shenneng Industry Group (40%);	Onshore
228	China	Zhangzhou LNG 1	2024	3.00	PipeChina (60%); Fujian Investment and Development Co (40%);	Onshore
229	China	Zhangzhou LNG 2	2025	3.00	PipeChina (60%); Fujian Investment and Development Co (40%);	Onshore
230	China	Zhejiang Energy Liuheng LNG 1	2026	6.00	Zhejiang Energy International (40.8889%); New Industrial Limited (39.1111%); Zhoushan Putuo Liuheng Tial Flat Reclamation (10%); Zhejiang Energy Natural Gas Group (5.1111%); Shenzhen Energy (4.8889%)	Onshore
231	China	Zhejiang Ningbo LNG 3	2025	6.00	CNOOC (51%); Zhejiang Energy Company (29%); Ningbo Power (20%);	Onshore
232	China	Zhoushan ENN LNG 3	2025	5.00	ENN (90%); Prism Energy (10%);	Onshore
233	China	Zhuhai LNG 2	2024	3.50	CNOOC (30%); Guangdong Energy (25%); Guangzhou Gas Group (25%); Local companies (20%);	Onshore
234	Chinese Taipei	Taichung LNG 3 (expansion)	2026	4.50	CPC (100%);	Onshore
235	Chinese Taipei	Taoyuan LNG	2025	3.00	CPC (100%);	Onshore
236	Cyprus	Cyprus FSRU	2025	0.60	CMC Ltd (100%);	Floating
237	Estonia	Paldiski LNG	2024	1.80	Alexela (100%);	Floating
238	France	Fos Cavaou 2	2026	2.00	ENGIE (100%);	Onshore
239	Germany	Elbehafen LNG 2	2026	5.88	Kreditanstalt für Wiederaufbau (50%); Gasunie (40%); RWE (10%);	Onshore
240	Germany	Stade LNG	2024	3.68	Hanseatic Energy Hub (50%); Uniper (50%);	Floating
241	Ghana	Tema LNG terminal	2024	1.70	GNPC (50%); Helios (50%);	Floating
242	India	Andhra Pradesh LNG terminal	2026	4.00	H-Energy (100%);	Onshore
243	India	Chhara LNG	2026	5.00	HPCL (50%); Shapoorji Pallonji (50%);	Onshore
244	India	Dabhol LNG 2	2024	5.00	Gail (31.52%); NTPC (31.52%); Indian Financial Institutions (20.28%); MSEB Holding Co. (16.68%);	Onshore
245	India	Dabhol LNG Breakwater Completion	2024	3.00	Gail (31.52%); NTPC (31.52%); Indian Financial Institutions (20.28%); MSEB Holding Co. (16.68%);	Onshore
246	India	Dahej LNG 4 (capacity expansion phase I)	2025	2.50	Petronet LNG (100%);	Onshore

Appendix 6: Table of LNG receiving terminals under construction (continued)

Reference Number	Market	Terminal Name	Start Year	Nameplate Receiving Capacity (MTPA)	Ownership	Concept
247	India	Dahej LNG 4 (capacity expansion phase II)	2026	2.50	Petronet LNG (100%);	Onshore
248	India	H-Gas LNG Gateway (Jaigarh LNG) - Hoegh Giant	2025	6.00	Hiranandani Group (100%);	Floating
249	India	Jafrabad FSRU	2026	5.00	Swan Energy Limited (32.12%); Indian Farmers Fertiliser Cooperative Limited (30.87%); Mitsui Group (11%); Gujarat Maritime Board (15%); Gujarat State Petronet Ltd (11%);	Floating
250	India	Karaikal LNG	2025	5.00	AG&P (100%);	Floating
251	Italy	Ravenna FSRU (BW Singapore)	2025	3.68	Snam (100%);	Floating
252	Nicaragua	Puerto Sandino FSRU	2024	1.30	New Fortress Energy (100%);	Floating
253	Pakistan	Energas Terminal	2025	5.60	Energas (50%); Yunus Group (50%);	Floating
254	Pakistan	Pakistan Onshore LNG	2024	8.50	Vopak LNG Holding B.V. (50%); Engro Corporation (50%);	Onshore
255	Panama	Sinolam LNG (Gaslog Singapore)	2024	1.10	Sinolam Smarter Energy LNG Power Co. (100%);	Floating
256	Philippines	Filipinas LNG Gateway	2025	4.40	Excelerate Energy (100%);	Floating
257	Philippines	Pagbilao LNG	2025	3.00	Energy World Corporation (100%);	Onshore
258	Poland	Swinoujscie Phase 1 Jetty Expansion	2024	0.59	Gaz-System (100%);	Onshore
259	Poland	Swinoujscie Phase 1 Storage Expansion	2024	1.84	Gaz-System (100%);	Onshore
260	Poland	Swinoujscie Phase 2	2024	1.90	Gaz-System (100%);	Onshore
261	Senegal	Senegal FSRU (Karmol LNGT Powership Africa)	2024	2.50	Karadeniz Energy Group (100%);	Floating
262	South Korea	Gwangyang LNG 2	2025	2.10	POSCO (100%);	Onshore
263	Vietnam	Cai Mep LNG Terminal	2024	3.00	Hai Linh Co Ltd (51%); AG&P (49%);	Onshore
264	Vietnam	Hai Lang LNG	2026	1.50	T&T Group (40%); Hanwha (20%); KOSPO (20%); KOGAS (20%);	Onshore

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