Global Energy Monitor

Gas Bubble

2022

U.S. EDITION

Robert Rozansky and Baird Langenbrunner

Global Energy Monitor

ABOUT THE COVER

The cover photo shows LNG storage tanks at a regasification terminal. Image from iStock with credit to Sky_Blue.

ABOUT GLOBAL ENERGY MONITOR

Global Energy Monitor (GEM) develops and shares information on energy projects in support of the worldwide movement for clean energy. Current projects include the Global Gas Infrastructure Tracker, Asia Gas Tracker, Europe Gas Tracker, Inside Gas Newsletter, Global Gas Plant Tracker, Global Registry of Fossil Fuels, Global Coal Plant Tracker, Global Solar Power Tracker, Global Wind Power Tracker, Latin America Energy Portal, and GEM.wiki.

ABOUT THE GLOBAL GAS INFRASTRUCTURE TRACKER (GGIT)

The Global Gas Infrastructure Tracker (GGIT) is an online database that identifies, maps, describes, and categorizes natural gas transmission pipelines and LNG terminals. Originally released by GEM in January 2018 as the Global Fossil Infrastructure Tracker (GFIT), pipelines and terminals data are now within GGIT and each updated annually. The tracker uses footnoted wiki pages to document each pipeline or terminal. For further details see the tracker landing page and methodology overview.

AUTHORS

Robert Rozansky is a Research Analyst at Global Energy Monitor. Baird Langenbrunner is Project Manager of the Global Gas Infrastructure Tracker.

EDITING, PRODUCTION, AND OTHER CONTRIBUTIONS

Editing contributions from Julie Joly, James Browning, David Hoffman, and Greig Aitken. Design and page layout by David Van Ness. Figure 3 created by Scott Zimmerman. The authors would like to thank the other GEM staff involved in researching this LNG terminal update, Gregor Clark, Scott Zimmerman, Julie Joly, and Greig Aitken, and acknowledge data contributions from IEEFA's Clark Williams-Derry.

PERMISSIONS/COPYRIGHT

FURTHER RESOURCES

For additional data on proposed and existing LNG terminals and natural gas pipelines, see the GGIT Summary Tables. For links to reports based on GGIT data, see Reports & Briefings. To obtain primary data from the GGIT, visit the Download Data page.

Gas Bubble 2022

U.S. EDITION

Robert Rozansky and Baird Langenbrunner

INTRODUCTION

It has been a tumultuous year for economies dependent on the liquefied natural gas (LNG) trade. Following Russia's invasion of Ukraine, European countries have scrambled to secure shipments of the super-chilled fossil fuel as an alternative to piped Russian gas. A tight LNG market has sent prices skyrocketing, leaving Asian countries to pay exorbitant sums for shipments—or not, with some emerging economies undergoing blackouts. Companies exporting LNG from the United States and elsewhere have reaped enormous profits, at the expense of domestic consumers. All of this is occurring in a year in which heat waves, droughts, and floods continue to increase in frequency and severity, and a new report from the Intergovernmental Panel on Climate Change (IPCC) states that pathways to international climate goals do not have room for a gas expansion.

If anything, 2022 has underlined the risks of using LNG to fuel countries' electricity, heating, and industrial sectors. Yet by and large the global LNG build-out continues. In its annual survey of LNG terminals, Global Energy Monitor (GEM) has identified over 300 projects in pre-construction and construction phases with an estimated cost of US$797 billion. These LNG terminals in development comprise 682 million tonnes per annum (mtpa) of LNG import capacity (equivalent to 73% of global import capacity operating today) and 779 mtpa of LNG export capacity (or 173% of existing global export capacity). These projects could further expose the world's economies to a volatile commodity and lock in decades of new fossil fuel emissions.

This briefing presents the findings of GEM's annual LNG update to the Global Gas Infrastructure Tracker (GGIT) with a focus on the United States. The United States has emerged as the world's leading exporter of LNG during the first half of 2022 and is home to almost half of all global LNG export capacity under development.

The following are highlights of GEM's analysis:

1. **U.S. projects have advanced since Russia's invasion.** Since the beginning of the war in Ukraine in February 2022, two projects have announced final investment decisions (FIDs), a new offshore project has been proposed, and five projects have secured their first long-term sales and purchase agreements (SPAs) with buyers. The United States has close to half of all export capacity in development globally, with the remainder concentrated in the rest of North America, Russia, the Middle East, and Africa.

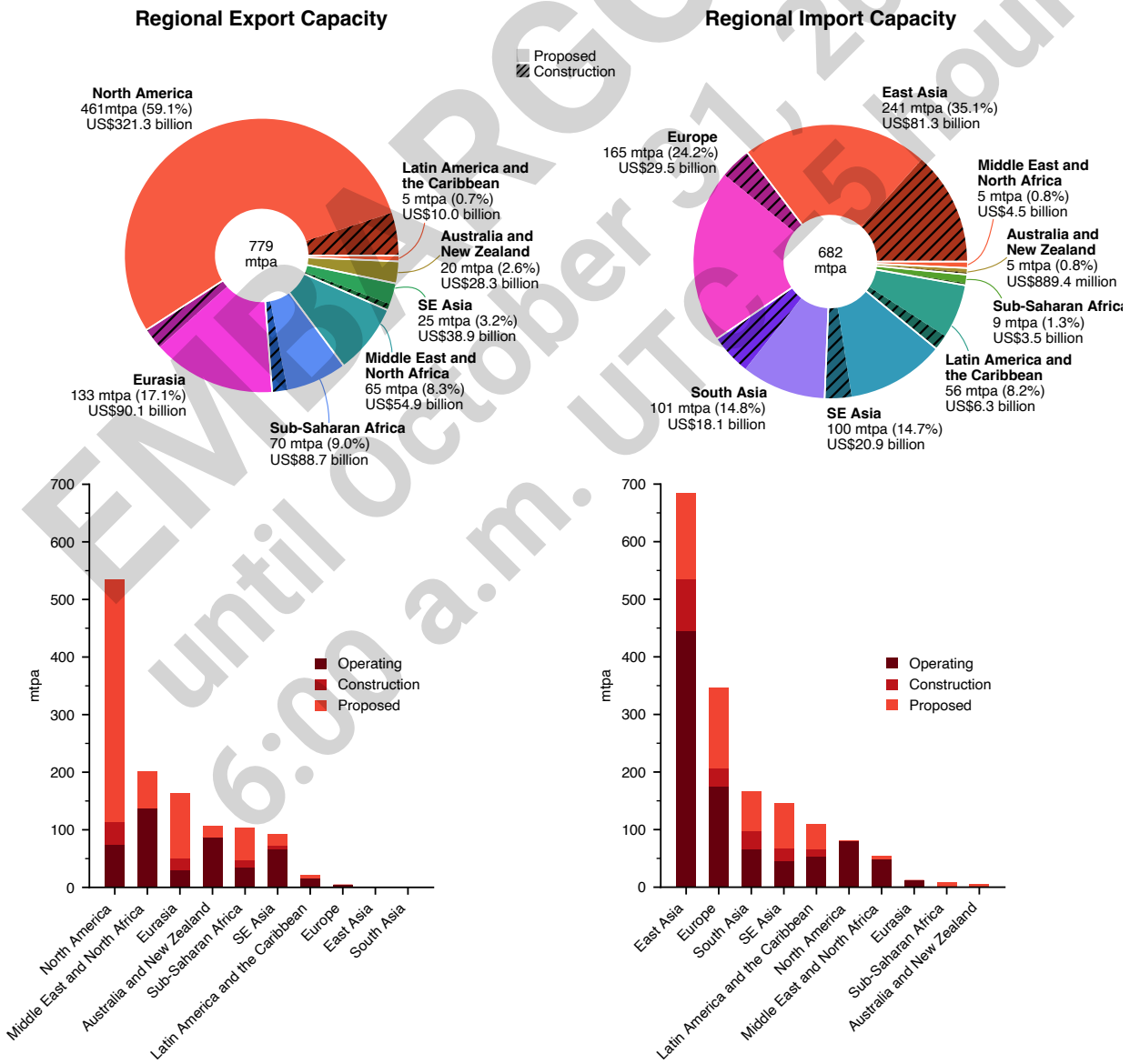
2. **European and Asian demand is fueling U.S. LNG ambitions.** Europe's energy crisis triggered a rush to build new import terminals on the continent, which total 165 mtpa in potential new capacity. Anticipating growing energy demands, Asia's economies are responsible for 442 mtpa LNG import

capacity in development. Combined, Europe and Asia account for nearly 90% of such capacity in development globally.

3. **A U.S. LNG build-out undermines national interests.** The Biden Administration has sought to ensure that gas is affordable for U.S. consumers, lead the international community in mitigating climate change, champion environmental justice, and grow U.S. industries that will thrive in the energy transition. Plans for new U.S. LNG terminals run counter to these objectives.

4. **The events of 2022 have highlighted LNG risks for buyers.** Imported LNG supplies are not inherently secure. Price volatility can impose significant or even prohibitive economic costs. And finally, LNG emissions contribute to dangerous global warming. The case for economies transitioning to clean energy is stronger than ever.

Figure 1: Global LNG Terminal Development



Source: Global Energy Monitor, Global Gas Infrastructure Tracker. Region definitions derived from the International Energy Agency (see Methodology).

1. U.S. PROJECTS HAVE ADVANCED SINCE RUSSIA'S INVASION

As of the end of 2021, proposals to build new LNG export terminals in the United States appeared stuck. Despite high prices for LNG abroad, a wide field of U.S. projects was failing to find the buyers and financiers needed to get built. Of more than two dozen export projects, just four had signed firm long-term contracts with buyers—a prerequisite for attracting financing—and over a year had passed in which no projects had reached a final investment decision (FID) indicating that they would move forward to construction.

In February 2022, Russia's invasion of Ukraine dramatically altered the global LNG landscape. The European Union (EU) committed in March to eliminate most imports of Russian gas within the year and all imports by 2030, in retaliation against Russia's aggression and fearing a potential gas supply cutoff (which appears to have materialized). The Biden Administration signaled its support for boosting U.S. LNG exports to Europe in an agreement with the EU, and gas industry lobbying ramped up to leverage Europe's crisis for federal support for new gas projects. Since then, a number of signs have pointed to accelerating progress in the U.S. LNG sector.

Two U.S. LNG projects have recently reached FID. In May, Venture Global announced FID for Phase 1 of its Plaquemines LNG Terminal, a greenfield project in Louisiana, which is expected to come online in 2024. Phase 1 of the project will have a capacity of 13.3 million tonnes per annum (mtpa). In June, Cheniere announced FID for the 11.5 mtpa Stage 3 expansion of its Corpus Christi LNG Terminal facility in Texas, which has been operating since 2018. The expansion is expected to be commissioned in 2024. Cheniere has also begun the process for developing a new Stage 4 expansion.

Meanwhile, developers are using Europe's energy crisis to advance new projects. Within weeks of the invasion, New Fortress proposed building the 2.8 mtpa Grande Isle FLNG Terminal off the coast of Louisiana. The company claims it will finance the facility on its own and construct it within a year using a modular installation technique. New Fortress has also suggested that it could build up to eight such facilities on the Gulf Coast. Another new export project has come to the public's attention this year: a proposal to build Penn LNG Terminal close to Philadelphia. The US$6.4 billion facility had been quietly discussed for five years, but the war in Ukraine may have increased pressure to build it. The developer Penn America Energy Holdings LLC is aiming to pre-file with federal regulators this year and reach FID by 2024.

Perhaps the clearest indicator of interest in U.S. export projects has been a steady drumbeat of new long-term purchase agreements signed by international oil and gas majors, trading companies, gas utilities, and others. From the beginning of the war through September 2022, U.S. developers have secured 32 binding sales and purchase agreements (SPAs) totaling 34.6 mtpa of contracted capacity. Now, eight pre-FID projects have secured contracts for at least part of their planned output: CP2, Commonwealth, a presumed Corpus Christi Stage 4, Delfin, Driftwood, Lake Charles, Plaquemines (Phase 2), and Rio Grande LNG Terminals. Of this list, five projects (all except Driftwood, Plaquemines, and Rio Grande LNG Terminals) signed their first firm contracts after the beginning of the war in Ukraine.

In the first half of 2022, the United States became the world's leading exporter of LNG. GEM data show that U.S. projects that have been proposed or are in construction amount to 323 mtpa of export capacity, or 41% of all projects at these stages globally (779 mtpa), as shown in Figures 1 and 3. Ranked by export capacity in development, the United States is followed by Russia (133 mtpa), Canada (76 mtpa), Mexico (63 mtpa), and Qatar (49 mtpa). Given the size of its LNG industry and potential for expansion, the United States will in large part be responsible for how much LNG is available for countries to consume and burn.

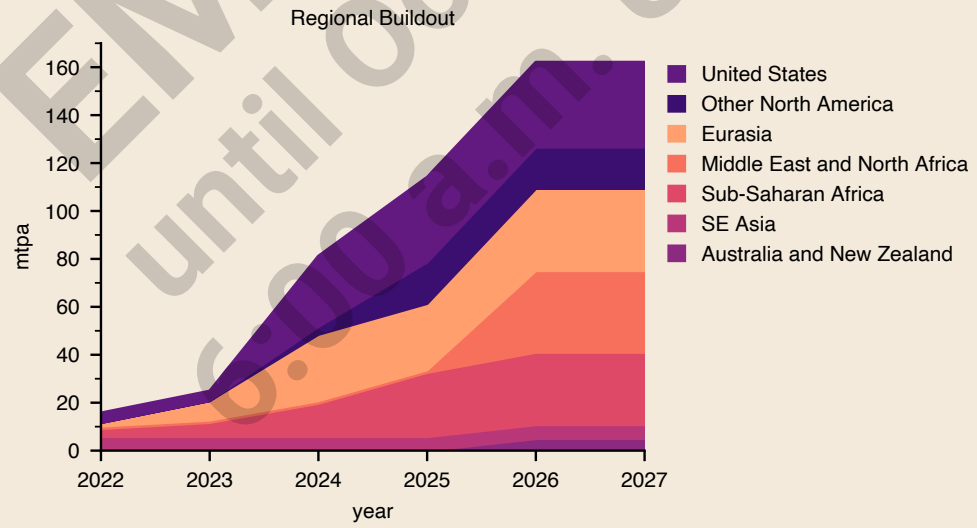
SANCTIONED LNG EXPORT PROJECTS IN THE UNITED STATES AND BEYOND

LNG projects likely to be built worldwide are set to increase global LNG export capacity by more than 35% by 2027. As shown in Figure 2, export projects that have already reached FID or begun construction, i.e., are sanctioned, total 161 mtpa of capacity or US$142 billion in investment. Three of these projects, totaling 35 mtpa, are in the United States: Calcasieu Pass, Golden Pass, and Plaquemines LNG Terminal (Phase 1). Other major sanctioned projects include the following:

- Qatar North Field LNG Terminal is a 49 mtpa export project proposed in Qatar, of which the first phase (33 mtpa) reached FID in 2021. The US$29 billion project is the largest of its kind in the world. Qatar's low-cost LNG may offer fierce competition to North American producers.
- Arctic LNG 2 Terminal is a 6.6 mtpa export project under construction in Russia. The project has been delayed and partially shelved due following Russia's invasion; this spring, it was abandoned by both TotalEnergies, a sponsor, and a Chinese firm contracted to build the project's second and third trains.
- LNG Canada Terminal is a 28 mtpa export project in British Columbia, Canada, half of which is under construction and half of which remains proposed. It is the only Canadian LNG export project under construction. Historically, most of Canada's projects have been delayed or abandoned due to regulatory hurdles, poor economics, and Indigenous resistance.
- Mozambique LNG Terminal is a 22.9 mtpa export project in development in Mozambique and the largest proposal in Sub-Saharan Africa. The first two trains totaling 12.9 mtpa were under construction, but the project has been halted due to an insurgency near the project site in Cabo Delgado Province.

A build-out of this scale already contradicts the global scientific consensus that new fossil development could prevent the world from reaching its climate targets. Continuing to sanction projects would threaten to drag international efforts further off course.

Figure 2: New LNG Export Capacity in Construction or Sanctioned (Post-FID)



Source: Global Energy Monitor, International Gas Union World LNG Report 2022

2. EUROPEAN AND ASIAN DEMAND IS FUELING U.S. LNG AMBITIONS

Most of the demand for more U.S. LNG facilities comes from Europe and Asia, as shown in Figures 1 and 3. LNG import capacity in development in Europe and Asia accounts for nearly 90% of the global total.

Europe relies on gas for powering industry, electricity generation, and, especially, residential heating, which accounts for 40% of Europe's total gas consumption. Reduced gas imports from Russia have left Europe with a large shortfall. In 2021, Europe imported 40% of its gas from Russia: 155 billion cubic meters (bcm). This quantity of piped gas is equivalent to 114 million tonnes of LNG.

Europe's energy crisis has triggered a flurry of new LNG import projects on the continent. There are 40 European LNG import terminals in development. Many of these projects would be floating storage and regasification units (FSRUs), which are vessels that can be deployed more quickly, cheaply, and flexibly than land-based projects. LNG import infrastructure in development in Europe totals 165 mtpa, or 24% of all such projects in development globally, and potential investment in these projects could be US$30 billion. A GEM analysis from April 2022 found that Europe actually already has sufficient gas import infrastructure to replace Russian supplies, though the European transmission pipeline network is not currently optimized to distribute it. New import projects may exacerbate a growing surplus of infrastructure and risk being stranded in Europe's energy transition.

Asia has the largest set of plans to build new LNG import infrastructure, 442 mtpa worth of such projects, as Asian economies anticipate growing energy needs and shift away from coal. These projects comprise 65% of the world's LNG import terminals in development and are estimated to cost US$120 billion. China is home to almost half of these plans (215 mtpa) as it seeks to grow its industrial sector and fuel a fleet of new gas-fired power plants. New LNG import projects in many developing countries such as Bangladesh (15 mtpa), the Philippines (22 mtpa), and Vietnam (38 mtpa) are primarily focused on gas for power generation. Asia's plans for a massive expansion of gas infrastructure predate Europe's energy crisis.

Sales and purchase agreements signed by U.S. developers since the beginning of the war in Ukraine reflect that Europe and Asia would be the main buyers of expanded U.S. LNG production. Of 34.6 mtpa of new contracted capacity, the identities of the buyers appear to 'earmark' approximately 15.5 mtpa for Asian consumers, including China, South Korea, and Malaysia, and 5 mtpa for European consumers, including Germany, Poland, and the United Kingdom.[1]

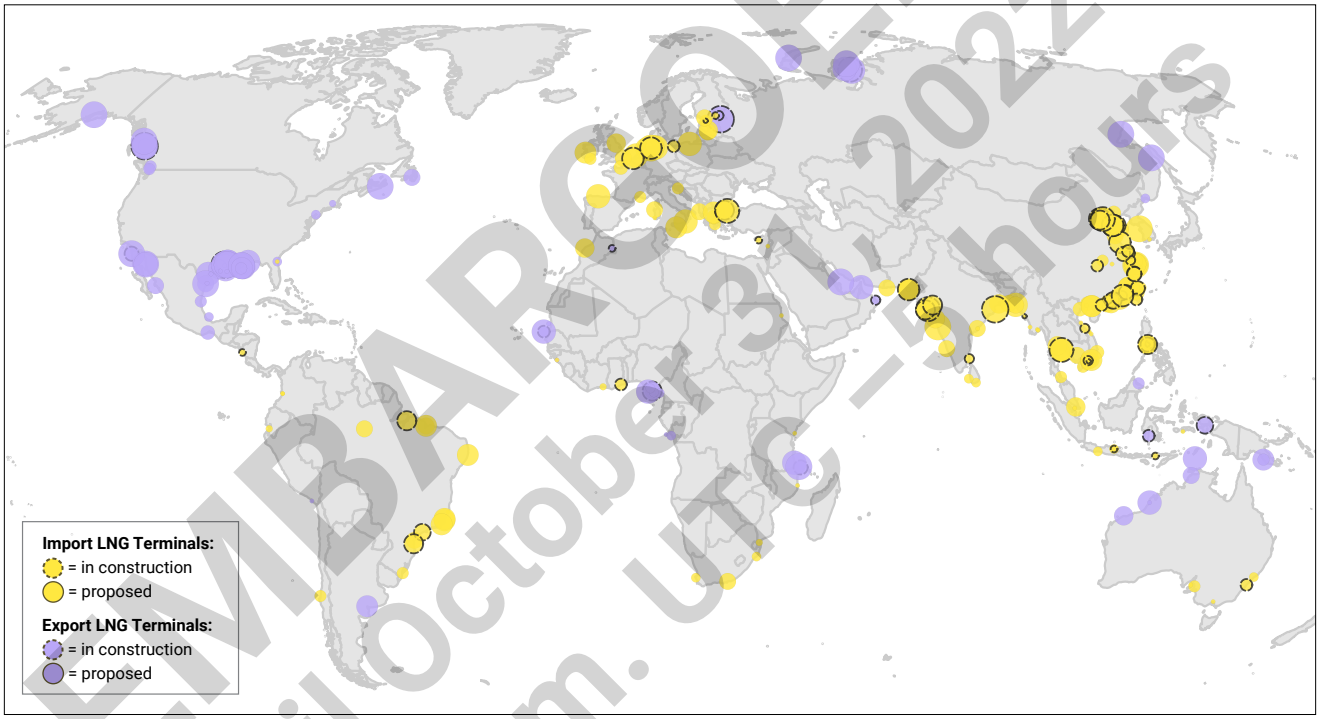
Yet even with such high interest from Europe and Asia, there are signs that demand for U.S. LNG could flag. The EU plans to reduce its emissions 55% by 2030 compared to 1990 levels, and its REPowerEU initiative to replace Russian gas elevates the speed and ambition of its decarbonization plans. The duration of contracts has reportedly emerged as a point of conflict between European countries and Qatar, which is looking to sign long-term contracts. U.S. projects that have not yet gotten off the ground will take years to come online and may not align with Europe's future gas needs. The 45–50% of European LNG imports that are not anchored by long-term contracts could well fade in Europe's energy transition.

Meanwhile, declining imports and stalled projects in Asia suggest that long-term Asian LNG demand may not be as robust as expected. Europe's energy crisis has squeezed a global LNG market that has already been tight since 2021 and further raised prices. In August, spot prices for LNG in Asia surged to over US$70 per million British thermal units (MMBtu), the highest since the war began. As of July, China's LNG imports were down 14.1% from the same month last year, India's were down 5.8%, and South Korea's

1. For this estimate, contracted capacity is considered 'earmarked' for a region if the buyers belong to countries in the region or typically operate there. For instance, it is assumed that LNG purchases from Chinese utility China Gas, Malaysian government-owned Petronas, and ExxonMobil LNG Asia Pacific would be directed to Asia. However, LNG delivery destinations can be flexible and highly dependent on demand.

were down 4.8%. Just one new LNG import project has come online in Asia since the beginning of the year, Niihama LNG Terminal (1 mtpa), and projects totaling only 19 mtpa came online the year before. As high LNG prices persist, major forecasting agencies have revised their outlooks to account for depressed demand for gas, and renewable power with storage is increasingly outcompeting LNG power in Asian markets.

Figure 3: Map of Global LNG Terminal Development



Source: Global Energy Monitor, Global Gas Infrastructure Tracker

HIGH INTEREST IN LNG, BUT MANY PROJECTS STUMBLE

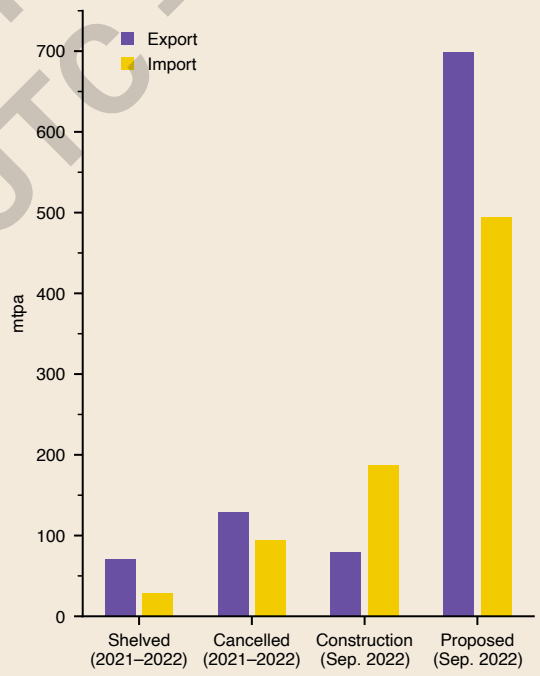
The war in Ukraine has pushed forward new projects to export LNG from the United States and import LNG into Europe. While interest in building new LNG projects remains high throughout the world, many projects fail to materialize. Global LNG import capacity and export capacity in development total 682 mtpa and 779 mtpa, respectively, but just 48 mtpa of import capacity and 21 mtpa of export capacity have come online since the beginning of 2021. Among all LNG terminals in development, GEM has found that projects totaling 465 mtpa have been delayed—likely a conservative estimate.[2]

Many projects in development have failed to move forward and are now considered shelved or cancelled.[3] There are 166 mtpa of import and export projects around the world that are considered shelved, of which 100 mtpa were shelved since the beginning of 2021. In total 223 mtpa import and export projects have been cancelled since the beginning of 2021. Figure 4 compares the scale of shelved and cancelled capacity to capacity actively in development.

Developers often are not explicit about the reasons behind project delays, shelvings, and cancellations, but some examples of struggling projects identify potential barriers:

- **Local Opposition:** The Philippine Movement for Climate Justice announced in August that it had successfully delayed eight proposed fossil projects including the import project Mariveles LNG Terminal (already presumed cancelled by GEM due to inaction).
- **High Gas Prices:** In August, the government of Bangladesh announced that it was stepping back from building the import project Payra LNG Terminal and its associated LNG-fired power plant due to the high cost of LNG on the global market.
- **Lack of Financing:** Tellurian has struggled to secure financing for its Driftwood LNG Terminal export project in Louisiana, even announcing the beginning of construction in early 2022 before reaching FID. In September, Tellurian scrapped a bond offering citing uncertainty in the junk-bond market. Shortly afterwards, its stock dropped 24% and two of its long-term purchase agreements were terminated.
- **Regulatory Hurdles:** The developers of Jordan Cove LNG Terminal cancelled the Oregon export project in late 2021 citing the project's inability to secure state permits. Among other unfavorable rulings from state and federal agencies, the U.S. Commerce Department found that the project's potential harm to the Pacific coast and Indigenous communities outweighed its benefits.
- **Poor Export Economics:** Pieridae Energy's Goldboro LNG Terminal export project in Canada was shelved in 2021 due to cost pressures and an inability to secure financing. The company is considering revamping the project as a floating terminal.

Figure 4: Shelved & Cancelled LNG Projects vs. Projects Actively in Development (Proposed & In Construction)



Source: Global Energy Monitor, Global Gas Infrastructure Tracker

2. GEM considers a project delayed when delays are reported or a project in development overshoots its originally-proposed start date.

3. GEM considers a project shelved if its sponsor has announced that the project has been shelved; its sponsor has publicly abandoned the project; or there have been no development updates in over two years. A project is considered cancelled if its sponsor has announced the project has been cancelled or there have been no development updates in over four years.

3. A U.S. LNG BUILD-OUT UNDERMINES NATIONAL INTERESTS

The U.S. Administration's actions since the beginning of the war in Ukraine have supported new LNG export development. In March, the Administration forged an agreement with the EU in which it agreed to help supply Europe with 15 additional billion cubic meters (bcm) of gas this year—a goal the United States has already blown past—and the Administration stated that it would maintain "an enabling regulatory environment" for LNG exports. The same month, the Federal Energy Regulatory Commission (FERC) backtracked from a new review process it had instituted in February that would have more stringently considered projects' impacts on nearby communities and climate change. In August, President Biden signed the Inflation Reduction Act of 2022 (IRA), which invests heavily in clean energy while also leasing more land for oil and gas development.

At the same time, the Biden Administration has sought to ensure that gas is affordable for U.S. consumers, lead the international community in mitigating climate change, champion environmental justice, and grow U.S. industries that will thrive in the energy transition. Building new LNG terminals runs counter to these objectives.

The hardship of rising energy prices for many Americans is exposing the Biden Administration's contradictory and self-defeating policies on the role of gas. High prices for gas make it more expensive for consumers to cool their homes in the summer and heat homes in the winter. Because of the interconnected nature of the economy, expensive gas increases the price of food, plastics, and other goods too. The June closure of an aluminum factory in Kentucky, due to high energy prices from the war in Ukraine, demonstrates the kind of harm that expensive gas can have on the workforce.

Exporting LNG makes domestic gas prices more expensive because of simple supply-demand economics and the sensitive nature of the gas market. With less gas supply, prices go up. U.S. gas prices have doubled over the past three years as LNG exports have doubled, even as domestic gas demand remained flat and gas production increased. In perhaps the clearest evidence of LNG exports' effects on the domestic gas market, U.S. gas prices fell by 12% in June immediately after a fire closed Freeport LNG Terminal, which is responsible for 16% of U.S. export capacity. As one energy analyst has written, "U.S. LNG is becoming a zero-sum game."

The United States committed to the Paris Agreement goal of limiting global warming to 1.5°C and signed the Global Methane Pledge to reduce methane emissions by 30% by 2030. The Biden Administration has set aggressive domestic climate targets including reducing emissions by 50% by 2030 with respect to 2005 levels. Building new LNG terminals will detract from these missions. The International Energy Agency has stated that, in a Paris-compliant scenario, "Also not needed are many of the [LNG] liquefaction facilities currently under construction or at the planning stage," and that global LNG exports should peak in the mid-2020s. According to the most recent report from the Intergovernmental Panel on Climate Change (IPCC), new investment in fossil infrastructure will make it difficult, if not impossible, to limit global warming to 1.5°C.

LNG liquefaction facilities are emissions-intensive on their own; the Environmental Integrity Project has found that all the terminals in development in Louisiana and Texas could emit as much greenhouse gas annually as 18 million passenger vehicles. The full life cycle emissions of new U.S. LNG exports would be much higher (per Figure 5) and would erode the United States's credibility as a global climate leader.

The Biden Administration elevated environmental justice as a federal priority. Its Justice40 initiative intends to direct 40% of federal investments in climate and clean energy to disadvantaged communities. LNG terminals can harm these same groups. Many existing and proposed LNG terminals are sited among neighborhoods and communities on the Gulf Coast that are predominantly people of color, predominantly low-income, and/or have pre-existing air quality issues. Lake

Charles, Corpus Christi, and Brownsville are among them. These communities are on the front lines of climate change, facing increasingly severe hurricane seasons, and have suffered from industrial pollution due to their proximity to the oil and gas industry. "I feel Southwest Louisiana has been made a sacrificial lamb," said Roishetta Ozane, a Lake Charles resident and HealthyGulf organizer.

A permitting reform bill that was under consideration in the Senate—and defeated—could further sacrifice communities on the Gulf Coast, if another version of the bill advances.[4] Known as the Energy Independence and Security Act of 2022, the legislation would condense timelines for environmental reviews under the National Environmental Policy Act (NEPA), impose shorter time limits on court challenges to projects, and designate energy projects such as LNG export terminals as national priorities. A letter from eight U.S. Democratic senators said, "We share the concerns of frontline communities and communities of color that the proposed permitting reforms take us in the wrong direction." The bill would "limit public input and lead to additional pollution, disproportionately impacting people who are already facing direct harm," and "undermine judicial review."

Finally, the Biden Administration has demonstrated an interest in building domestic energy industries through the Inflation Reduction Act and a June executive order to spur domestic energy manufacturing. But the LNG industry may be positioned to contract in the energy transition, and costly LNG terminals could be shuttered prematurely. The Financial Times has written, "At least some of these [U.S.] projects may therefore be stranded should Europe and other large consumers of LNG — Asia — move from fossil fuel use in future decades." The IPCC has found that limiting global warming to 2°C could result in US$4 trillion in stranded assets of fossil infrastructure by 2050, with that figure even higher if warming is limited to 1.5°C. Administration support for new LNG projects risks funneling resources into an industry with an expiration date and harming the workforces that grow around them.

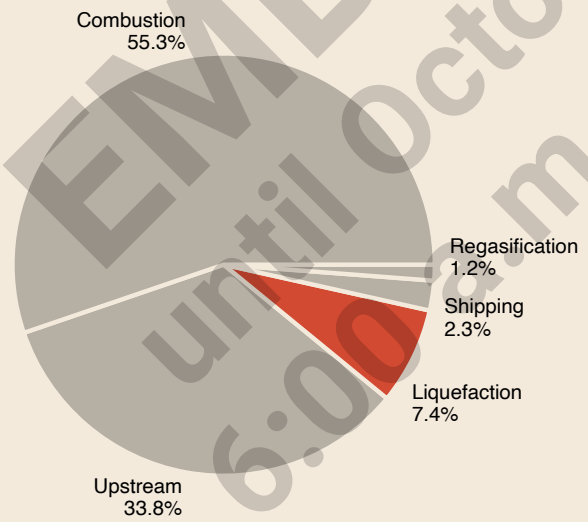
4. Senate Majority Leader Charles Schumer offered the passage of this permitting reform bill to Senator Joe Manchin as a concession to win his vote for the IRA. The pathway forward for these policies is uncertain.

"CLEAN" LNG PROPOSALS OFFER FALSE SOLUTIONS

The evidence is clear: LNG is not clean energy. LNG is mostly methane, a powerful greenhouse gas. Methane leaks along the entire LNG supply chain, for instance, from the wells in the Permian basin where it is fracked to gas boilers heating European homes. Superchilling gas into LNG at −260°F (−162.2°C) and transporting it across the ocean consumes a lot of additional energy. And when gas is burned, it releases carbon dioxide (CO_2). Research from the Natural Resources Defense Council has found that the near-term impacts of LNG are just a third lower than those of coal. Committed and potential new LNG capacity could consume over 20% of the world's emissions budget through 2050 to limit global warming to 1.5°C, according to a study of LNG's role in meeting Paris Agreement goals.

Recognizing that key stakeholders and the public are concerned about climate change, the developers of seven U.S. LNG facilities have proposed adding carbon capture and storage (CCS) projects to liquefaction facilities:

Figure 5: Life Cycle Emissions of U.S. LNG Exports by Stage of Supply Chain (100-Year Global Warming Potential)



Source: L. Abrahams et al, Life Cycle Greenhouse Gas Emissions From U.S. Liquefied Natural Gas Exports: Implications for End Uses, Published 2015.

Calcasieu Pass, Cameron, CP2, Freeport, G2, Plaquemines, and Rio Grande LNG Terminals. As E&E News writes, companies such as Cheniere, NextDecade, and Sempra are "voluntarily embracing the still sparsely deployed technology as a way to stay ahead of regulations at home and abroad and to maintain a social license to operate. . . ." However, capturing emissions from liquefaction facilities will likely do little to reduce LNG's overall life cycle emissions. Liquefaction is only responsible for about 7% of U.S. LNG's total life cycle emissions, as shown in Figure 5, and CCS projects would only address a fraction of liquefaction's emissions.[5] Sempra's Hackberry CCUS Hub would be designed to capture only 15% of Cameron LNG Terminal's direct emissions. A Venture Global CCS project would capture from Calcasieu Pass and Plaquemines LNG Terminals up to 400,000 tons of CO_2, which is only 4% of what the facilities are permitted to emit. Finally, it is far from guaranteed that these projects will perform as intended with a relatively new technology; the biggest CCS facility for LNG production in the world, Gorgon LNG Terminal, has been plagued by delays and has failed to capture as much CO_2 as planned.

CCS is just one measure LNG developers have used to brand their product as "clean" despite having a modest impact on overall emissions.

In May 2021, Cheniere shipped from its Sabine Pass LNG Terminal a "carbon-neutral" LNG cargo offset by nature-based projects. The carbon offset market is notoriously unregulated and opaque, and it is difficult to prove that carbon offset projects, such as forest management, meaningfully negate fossil emissions. Cheniere has also recently implemented life cycle emissions tags for individual cargoes, which systematically undercount methane leakage rates according to a Greenpeace analysis.

In Canada, several projects have proposed powering liquefaction with hydropower, including Kitimat and Woodfibre LNG Terminals and Cedar and Ksi Lisims Floating LNG (FLNG) Terminals. But again, liquefaction accounts for a relatively small fraction of total life cycle emissions, so renewable-powered liquefaction has little impact on total emissions.

(continued on next page)

5. Liquefaction is estimated to be responsible for 7% of U.S. LNG's emissions, assuming the gas is burned for power, evaluated on a 100-year time scale. On a 100-year time scale, methane's global warming potential is about 34 times that of CO_2 (compared to 86 times that of CO_2 on a 20-year time scale).

"CLEAN" LNG PROPOSALS OFFER FALSE SOLUTIONS *(continued)*

In Europe, several projects are being designed with an eye toward importing low-carbon fuels in the future, such as renewable energy-derived hydrogen. These projects include Wilhelmshaven, Brunsbüttel, and Eemshaven FSRUs and TES Wilhelmshaven LNG Terminal. Across the Atlantic, Canada's Prime Minister Justin Trudeau suggested that new LNG export infrastructure in the country could simply be switched to hydrogen to remain consistent with its climate goals. Proposals such as these overstate the promise of a liquefied hydrogen economy and underestimate the technical challenges involved in this transition. Shipping liquid hydrogen would be five times as expensive as shipping LNG and the current fleet of LNG vessels is unfit to transport hydrogen. Repurposing existing LNG infrastructure to accept hydrogen would require "extensive retrofitting at great expense."

LNG developers around the world are pursuing diverse pathways to brand LNG as clean. None of these projects have demonstrated that they can address the fundamental issue, that the emissions associated with new LNG projects will exacerbate climate change.

4. EVENTS OF 2022 HAVE HIGHLIGHTED LNG RISKS FOR BUYERS

This year's events have exposed as clearly as ever the hazards of consuming LNG. Relying on imported LNG has energy security risks. Price volatility can impose significant or even prohibitive economic costs. And emissions from LNG will make it difficult to mitigate climate change.

Russia's invasion of Ukraine has underscored that imported LNG supplies are inherently not secure. European countries' decisions to grow dependent on Russian gas were evidently mistakes. Russia holds immense leverage over Europe as it is invading another sovereign nation, and Europe is on the brink of a difficult winter if Russia continues to curtail supplies.

Now, as Europe rushes to find new gas suppliers, it is considering offering cash and political leverage to a number of other unsavory regimes. Among them are Iran, Egypt, Qatar, and Azerbaijan, all gas-rich nations with human rights issues. Even the United States could be an unreliable partner because of the Gulf Coast's increasing vulnerability to hurricanes. In 2020, Hurricane Laura caused a two-week disruption at Sabine Pass LNG Terminal. Imported gas cannot match the security of domestically-produced energy.

Spot prices for LNG have soared to unprecedented levels this year and buyers are paying the price. Europe's Dutch Title Transfer Facility (TTF) LNG benchmark hit a record of over US$100/MMBtu in August, about 10 times higher than its average level over the past decade. As the burden of high gas costs has fallen on consumers and businesses, European governments are implementing policies they hope will offer relief and "stave off an energy catastrophe this winter." EU countries have agreed to curb gas consumption by 15% over the coming months through measures such as extending coal plants' lifetimes and encouraging citizens to take shorter showers. The EU is also reportedly considering levying a tax on fossil fuel firms so that excess profits would be distributed to citizens struggling with high gas prices.

Spot prices for delivery of LNG to Asia also jumped to a record high in late August at over US$70/MMBtu. This summer, Pakistan and Bangladesh have had to enforce rolling blackouts to cope with energy shortages as cargo costs inflated by European demand have remained out of reach. Even long-term contracts have not shielded Pakistan from price volatility; its suppliers have defaulted on their contracts so that they may sell to European consumers at more attractive prices.

An expensive LNG market has stymied LNG projects already in development. Just one of seven proposed LNG import projects in the Philippines, the 3-mtpa

Philippines LNG Terminal, is set to begin this year as challenges securing LNG supply (along with local opposition) have slowed growth. Bangladesh's government announced in August that it would step back from a planned LNG-to-power project due to the current cost of LNG. The Institute for Energy Economics and Financial Analysis (IEEFA) has found that in today's expensive LNG market, "US$96.7 billion dollars of proposed LNG-related infrastructure projects in Pakistan, Bangladesh, Vietnam, and the Philippines will face a heightened risk of underutilization or cancellation." And, according to IEEFA and others, prices are expected to remain high for years.

This year, the worsening impacts of the climate crisis are impossible to ignore. Over 30 million people in Pakistan were affected by devastating floods that began in June. It is estimated that the floods were up to 50% worse due to global warming. Europe faced a heat wave in July that shattered existing heat records, and two-thirds of the continent is in drought as of September. The United States contended with a heat wave on the West Coast sending temperatures over 110°F as well as severe flooding in Kentucky and Missouri. Climate change will only increase the severity and frequency of these events. The IPCC's 2022 report stated that all new fossil fuel development, including LNG, is incompatible with global objectives to mitigate these disasters.

GEM has found that there are US$797 billion of LNG terminals in development globally. These projects could exacerbate climate, economic, national security, and environmental justice issues faced by countries entangled in the global LNG trade—against all warnings this year that dependency on LNG is accompanied by unacceptable risks. At the same time, the costs of renewable power with storage are plummeting and threaten to obsolete new LNG infrastructure before the end of its lifetime. In June, as countries considered doubling down on oil and gas in the wake of Russia's war, UN Secretary General António Guterres called new investments in fossil fuel infrastructure "delusional" given their impacts on climate change. "Had we invested massively in renewable energy in the past," he said, "we should not be so dramatically at the mercy of the instability of fossil fuel markets now."

METHODOLOGY

Data on LNG terminals are based on GEM's Global Gas Infrastructure Tracker (GGIT) as of July 2022, with minor updates as of September 2022. The July 2022 data are distributed under a Creative Commons CC BY-NC-SA 4.0 License and can be downloaded here. For more information see the GGIT Methodology page.

Region definitions are available here among GEM's GGIT data summary tables and are derived from IEA's World Energy Outlook 2021.

GEM estimated regional investment in LNG terminals in development by summing projected capital expenditures for each project within the region. Where available, GEM uses project cost estimates reported by the media, press releases, or other sources. Where reported project cost data are not available, GEM produces its own cost estimates based on global and regional averages. For more information, see the report's LNG Update 2022 Cost Methodology.

APPENDIX TABLES

The following tables present capacity and cost data by country and region. Data in Tables 1–3 are for export terminals, and data in Tables 4–6 are for import terminals.

In each table, countries and regions are ordered from most to least capacity/costs of projects in development (proposed + construction).

Export Terminals

Table 1: LNG Export Capacity by Status and Country

	Proposed (mtpa)	Construction (mtpa)	Proposed+Construction (mtpa)	Shelved (mtpa)	Cancelled (mtpa)	Operating (mtpa)
United States	300.4	22.1	322.5	2.7	163.9	73.9
Russia	113.4	19.6	133.0	14.4	16.4	30.4
Canada	61.6	14.0	75.6	9.6	275.2	0.1
Mexico	59.2	3.3	62.5	0.0	5.0	0.0
Qatar	49.0	0.0	49.0	0.0	0.0	77.4
Nigeria	16.0	8.0	24.0	0.0	22.0	23.0
Australia	20.1	0.0	20.1	7.2	45.8	87.6
Mozambique	15.2	3.4	18.6	22.9	0.0	0.0
Indonesia	9.5	5.8	15.3	0.0	3.0	19.5
Mauritania	7.5	2.5	10.0	0.0	0.0	0.0
Tanzania	10.0	0.0	10.0	0.0	0.0	0.0
United Arab Emirates	9.6	0.0	9.6	0.0	0.0	7.6
Papua New Guinea	8.0	0.0	8.0	1.5	6.0	8.3
Argentina	5.4	0.0	5.4	0.0	0.0	0.0
Israel	5.0	0.0	5.0	0.0	8.0	0.0
Equatorial Guinea	4.4	0.0	4.4	0.0	1.9	3.7
Malaysia	2.0	0.0	2.0	0.0	0.0	31.5
Republic of the Congo	1.4	0.0	1.4	1.2	0.0	0.0
Cameroon	1.3	0.0	1.3	0.0	3.5	2.4
Oman	0.0	1.0	1.0	0.0	0.0	10.4
Morocco	0.0	0.1	0.1	0.0	0.0	0.0
Egypt	0.0	0.0	0.0	0.0	5.0	12.2
Brazil	0.0	0.0	0.0	0.0	2.7	0.0
Algeria	0.0	0.0	0.0	0.0	0.0	29.3
Angola	0.0	0.0	0.0	0.0	0.0	5.2
Brunei	0.0	0.0	0.0	0.0	0.0	7.4
Yemen	0.0	0.0	0.0	0.0	0.0	0.0
Colombia	0.0	0.0	0.0	0.0	0.5	0.0
Venezuela	0.0	0.0	0.0	0.0	13.4	0.0
Libya	0.0	0.0	0.0	0.0	0.0	0.0
Peru	0.0	0.0	0.0	0.0	0.0	4.5
Norway	0.0	0.0	0.0	0.0	0.0	4.7
Turkmenistan	0.0	0.0	0.0	0.0	0.0	0.2
Cyprus	0.0	0.0	0.0	0.0	5.0	0.0
Iran	0.0	0.0	0.0	0.0	74.8	0.0
Djibouti	0.0	0.0	0.0	10.0	0.0	0.0
Kuwait	0.0	0.0	0.0	22.0	0.0	0.0
Timor-Leste	0.0	0.0	0.0	0.0	3.6	0.0
Trinidad and Tobago	0.0	0.0	0.0	0.0	0.0	12.0
Total	**698.9**	**79.8**	**778.7**	**91.5**	**655.6**	**451.1**

Source: Global Energy Monitor, Global Gas Infrastructure Tracker

Table 2. LNG Export Capacity in Development by Region

	Proposed (mtpa)	Construction (mtpa)	Proposed+Construction (mtpa)	Shelved (mtpa)	Cancelled (mtpa)	Operating (mtpa)
North America	421.2	39.4	460.5	12.3	444.1	73.9
Eurasia	113.4	19.6	133.0	14.4	16.4	30.6
Sub-Saharan Africa	55.8	13.9	69.7	34.1	27.4	34.3
Middle East and North Africa	63.6	1.1	64.7	22.0	87.8	136.9
SE Asia	19.5	5.8	25.3	1.5	12.6	66.7
Australia and New Zealand	20.1	0.0	20.1	7.2	45.8	87.6
Latin America and the Caribbean	5.4	0.0	5.4	0.0	16.6	16.5
East Asia	0.0	0.0	0.0	0.0	0.0	0.0
Europe	0.0	0.0	0.0	0.0	5.0	4.7
South Asia	0.0	0.0	0.0	0.0	0.0	0.0
Total	**698.9**	**79.8**	**778.7**	**91.5**	**655.6**	**451.1**

Source: Global Energy Monitor, Global Gas Infrastructure Tracker

Table 3: Cost Estimates for LNG Export Capacity in Development by Region

Proposed	Proposed (US$ billion)	Construction (US$ billion)	Proposed+Construction (US$ billion)	Shelved (US$ billion)	Cancelled (US$ billion)	Operating (US$ billion)
North America	291.1	30.2	321.3	11.2	255.7	42.7
Eurasia	71.0	19.1	90.1	14.9	11.7	18.0
Sub-Saharan Africa	73.7	15.0	88.7	24.7	17.4	27.0
Middle East and North Africa	54.3	0.6	54.9	12.0	58.6	68.1
SE Asia	36.6	2.4	38.9	0.9	12.0	55.6
Australia and New Zealand	28.3	0.0	28.3	17.3	30.9	176.8
Latin America and the Caribbean	10.0	0.0	10.0	0.0	8.7	6.5
East Asia	0.0	0.0	0.0	0.0	0.0	0.0
Europe	0.0	0.0	0.0	0.0	6.0	6.2
South Asia	0.0	0.0	0.0	0.0	0.0	0.0
Total	**565.0**	**67.3**	**632.2**	**80.9**	**401.0**	**400.9**

Source: Global Energy Monitor

Import Terminals

Table 4. LNG Import Capacity by Country and Status

	Proposed (mtpa)	Construction (mtpa)	Proposed+Construction (mtpa)	Shelved (mtpa)	Cancelled (mtpa)	Operating (mtpa)
China	129.7	85.3	214.9	25.8	45.9	96.3
India	32.0	33.0	65.0	5.0	46.7	47.5
Brazil	40.8	11.8	52.6	3.8	0.0	26.1
Germany	43.2	5.5	48.7	0.0	0.3	0.0
Vietnam	34.0	4.0	38.0	0.0	0.0	0.0
Thailand	17.8	7.5	25.3	0.0	8.0	11.5
Philippines	11.8	9.8	21.6	3.0	4.4	0.0
Pakistan	21.0	0.0	21.0	0.7	8.0	10.4
Greece	14.7	4.0	18.7	0.0	0.0	5.1
Italy	18.3	0.0	18.3	0.0	31.6	12.8
Bangladesh	15.1	0.0	15.1	0.0	26.3	7.3
Taiwan	8.5	4.8	13.3	0.0	0.0	15.5
South Korea	11.6	0.0	11.6	0.0	0.0	104.6
Poland	8.8	1.5	10.4	0.0	0.0	4.6
United Kingdom	8.2	0.0	8.2	0.0	20.0	35.3
Latvia	8.2	0.0	8.2	0.0	0.0	0.0
Ireland	7.9	0.0	7.9	0.0	2.9	0.0
Turkey	0.0	7.5	7.5	0.0	0.0	19.4
Netherlands	7.0	0.0	7.0	0.0	0.0	14.7
South Africa	6.0	0.0	6.0	0.0	2.0	0.0
Belgium	0.0	6.0	6.0	0.0	0.0	6.6
France	5.9	0.0	5.9	1.8	12.4	25.6
Spain	5.9	0.0	5.9	3.7	1.0	44.1
Singapore	5.3	0.0	5.3	0.0	0.0	11.0
Australia	3.3	1.9	5.2	0.0	1.8	0.0
Morocco	5.2	0.0	5.2	0.0	0.0	0.0
Indonesia	4.3	0.4	4.7	1.4	15.2	14.9
Finland	3.7	0.1	3.8	0.0	0.0	0.5
Cambodia	3.6	0.0	3.6	0.0	0.0	0.0
Albania	3.5	0.0	3.5	0.0	8.1	0.0
Croatia	2.4	0.0	2.4	0.0	7.0	2.1
Chile	2.3	0.0	2.3	2.7	4.3	5.5
Estonia	1.8	0.0	1.8	2.7	0.0	0.0
Sri Lanka	1.7	0.0	1.7	2.7	0.0	0.0
Ghana	0.0	1.7	1.7	0.0	0.0	0.0
Hong Kong	0.0	1.2	1.2	0.0	0.0	0.0
Cyprus	0.0	0.6	0.6	0.0	0.0	0.0

(continued on next page)

Table 4. LNG Import Capacity by Country and Status *(continued)*

	Proposed (mtpa)	Construction (mtpa)	Proposed+Construction (mtpa)	Shelved (mtpa)	Cancelled (mtpa)	Operating (mtpa)
Mozambique	0.5	0.0	0.5	0.0	0.0	0.0
Nicaragua	0.0	0.5	0.5	0.0	0.0	0.0
Côte d'Ivoire	0.4	0.0	0.4	0.0	0.0	0.0
Ecuador	0.4	0.0	0.4	0.0	0.0	0.0
United States	0.1	0.0	0.1	0.0	242.3	53.5
Gibraltar	0.0	0.0	0.0	0.0	0.0	0.1
Bahamas	0.0	0.0	0.0	0.0	6.4	0.0
Azerbaijan	0.0	0.0	0.0	0.0	0.0	9.5
Argentina	0.0	0.0	0.0	0.0	3.8	9.9
Bahrain	0.0	0.0	0.0	0.0	0.0	9.0
Kuwait	0.0	0.0	0.0	0.0	0.0	17.1
Nigeria	0.0	0.0	0.0	0.0	5.7	0.0
Benin	0.0	0.0	0.0	0.5	0.0	0.0
Ukraine	0.0	0.0	0.0	0.0	7.3	0.0
United Arab Emirates	0.0	0.0	0.0	7.6	8.0	9.8
Uruguay	0.0	0.0	0.0	0.0	0.1	0.0
Panama	0.0	0.0	0.0	0.0	0.0	1.5
Lithuania	0.0	0.0	0.0	0.0	0.0	2.9
Israel	0.0	0.0	0.0	0.0	0.0	3.5
Jamaica	0.0	0.0	0.0	0.0	0.0	4.1
Japan	0.0	0.0	0.0	0.0	8.6	227.7
Jordan	0.0	0.0	0.0	0.0	0.0	3.8
Lebanon	0.0	0.0	0.0	3.5	0.0	0.0
Malaysia	0.0	0.0	0.0	0.0	0.8	7.3
Norway	0.0	0.0	0.0	0.0	0.0	0.5
Malta	0.0	0.0	0.0	0.0	0.0	0.5
Mexico	0.0	0.0	0.0	0.0	8.9	20.1
Myanmar	0.0	0.0	0.0	4.0	0.0	0.4
Canada	0.0	0.0	0.0	0.0	17.2	7.5
El Salvador	0.0	0.0	0.0	0.0	0.5	0.5
Egypt	0.0	0.0	0.0	0.0	10.6	5.7
Dominican Republic	0.0	0.0	0.0	0.0	1.0	1.9
Denmark	0.0	0.0	0.0	0.1	0.0	0.0
Colombia	0.0	0.0	0.0	0.0	0.0	3.8
Portugal	0.0	0.0	0.0	0.0	0.0	5.6
Romania	0.0	0.0	0.0	6.0	0.0	0.0
Russia	0.0	0.0	0.0	0.0	0.0	2.7
Senegal	0.0	0.0	0.0	0.0	0.0	0.1
Sweden	0.0	0.0	0.0	0.0	0.6	0.6
Total	**494.6**	**187.1**	**681.7**	**74.8**	**567.6**	**931.1**

Source: Global Energy Monitor, Global Gas Infrastructure Tracker

Table 5. LNG Import Capacity by Region in Development

	Proposed (mtpa)	Construction (mtpa)	Proposed+Construction (mtpa)	Shelved (mtpa)	Cancelled (mtpa)	Operating (mtpa)
East Asia	149.8	91.3	241.0	25.8	54.5	444.1
Europe	139.4	25.3	164.7	14.2	91.2	181.0
South Asia	68.0	33.0	101.0	5.7	81.0	65.2
SE Asia	78.6	21.7	100.2	11.1	28.3	45.1
Latin America and the Caribbean	43.5	12.3	55.8	6.5	16.1	53.4
Sub-Saharan Africa	6.9	1.7	8.6	0.5	7.7	0.1
Australia and New Zealand	3.3	1.9	5.2	0.0	1.8	0.0
Middle East and North Africa	5.2	0.0	5.2	11.1	18.6	48.9
North America	0.1	0.0	0.1	0.0	268.4	81.1
Eurasia	0.0	0.0	0.0	0.0	0.0	12.2
Total	**494.6**	**187.1**	**681.7**	**74.8**	**567.6**	**931.1**

Source: Global Energy Monitor, Global Gas Infrastructure Tracker

Table 6. Cost Estimates for LNG Import Terminals in Development

	Proposed (US$ billion)	Construction (US$ billion)	Proposed+Construction (US$ billion)	Shelved (US$ billion)	Cancelled (US$ billion)	Operating (US$ billion)
East Asia	50.0	31.3	81.3	7.1	18.5	154.5
Europe	26.3	3.2	29.5	3.1	18.6	40.0
SE Asia	18.1	2.7	20.9	3.7	7.2	7.0
South Asia	11.5	6.5	18.1	0.9	15.7	14.3
Latin America and the Caribbean	4.6	1.7	6.3	0.9	4.4	8.8
Middle East and North Africa	4.5	0.0	4.5	1.5	5.0	8.6
Sub-Saharan Africa	3.2	0.4	3.5	0.1	1.1	0.0
Australia and New Zealand	0.7	0.2	0.9	0.0	0.2	0.0
North America	0.0	0.0	0.0	0.0	64.8	20.5
Eurasia	0.0	0.0	0.0	0.0	0.0	2.9
Total	**119.0**	**46.0**	**165.0**	**17.4**	**135.5**	**256.6**

Source: Global Energy Monitor