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Gas Run Aground

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PROPOSED PROJECTS TO EXPORT US LNG BY SHIP ARE STUCK WITH A SHALLOW POOL OF INVESTORS

Robert Rozansky

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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 Coal Mine Tracker, Global Coal Plant Tracker, Global Gas Infrastructure Tracker, Global Fossil Infrastructure Tracker, Europe Gas Tracker, CoalWire newsletter, Global Gas Plant Tracker, Global Registry of Fossil Fuels, Global Steel Plant 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), the pipelines and terminals data are now within GGIT and are updated twice annually. The tracker uses footnoted wiki pages to document each pipeline or terminal. For further details see the tracker landing page and methodology overview.

ABOUT THE COVER

The cover photo shows an unloading LNG tanker. Image from Adobe Stock.

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FURTHER RESOURCES

For additional data on proposed and existing LNG terminals and natural gas pipelines, see 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.

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EXECUTIVE SUMMARY

The United States has seen a new wave of proposed facilities to export liquefied natural gas (LNG) to international markets, but these projects face daunting challenges. Of 21 proposed export terminals in the United States, nearly all have struggled to secure the offtake contracts and financing needed to get built. New US LNG export terminals are confronting economic headwinds on multiple fronts including competition from lower-priced producers, a volatile gas market, and skepticism from climate-conscious governments and investors. These forces threaten to deter investors outright or, if projects are built, increase the risk that they will be unable to recover long-term returns on investment.

This report focuses on 21 LNG export terminals that are currently proposed in the United States, none of which have yet reached a final investment decision (FID). The report draws on an annual survey of midstream gas infrastructure conducted by Global Energy Monitor (GEM) along with research of financial databases. It includes the following highlights:

- **No proposed US LNG export terminals reached FID or advanced to the construction phase in 2021.**
- **New LNG export projects have received few of the purchasing commitments needed to demonstrate to potential financiers and investors that their product will find buyers.** Securing offtake contracts from oil and gas traders, utility companies, and other entities is a prerequisite to attracting financing. Companies have only secured purchasing agreements publicly linked to four new projects, out of 21 total. Of the four projects with offtake contracts, two are still far from demonstrating that a substantial share of production will be anchored with long-term commitments.
- **Few institutions are directly financing proposed LNG export terminals.** Of the 21 proposed terminals, GEM has identified only three that have received direct

project finance. Total project finance identified for these terminals amounts to US$1.6 billion, a drop in the bucket compared to the total cost of all projects estimated at around US$244 billion.

- **US and Japanese institutions are leading financiers in the US LNG buildout.** An in-depth financial analysis of six proposed terminals that are considered to have a higher chance of moving forward finds that Japan's SMBC Group, Mitsubishi UFJ Financial, and Mizuho Financial are leading creditors for these US LNG projects. The United States' BlackRock and Vanguard are leading bond and shareholders in the projects and their sponsors.

- **US LNG projects face stiff market headwinds and regulatory challenges.** New LNG projects now face a daunting set of challenges including (1) competition from lower priced producers such as Qatar; (2) domestic concerns over LNG exports raising gas prices; (3) recognition of the disproportionate impact of LNG terminals on low income communities and communities of color; (4) increased scrutiny from regulators and permitting challenges over environmental and community impacts; (5) international climate commitments inconsistent with increased LNG exports; (6) loss of social license internationally due to growing alarm over climate change; (7) volatile gas prices; (8) uncertain demand among Asian and European buyers; (9) a shift away from long-term LNG contracts across international gas markets; and (10) investors concerned that gas projects will be economically and environmentally untenable in the long run.

- **Increased US LNG exports are incompatible with efforts to avoid dangerous climate change.** The International Energy Agency and others have called for global LNG exports to peak in the mid-2020s for the world to remain on an emissions pathway consistent with limiting global warming to 1.5°C. An analysis by Oil Change International found that the combined lifecycle emissions of 19 of the proposed terminals would be 1 gigatonne of carbon dioxide equivalent per year, approximately the annual emissions of 250 coal plants.

- **Many new US LNG terminals are proposed near communities that are already struggling with industrial pollution.** Export terminals could further impact these communities, many of which have high proportions of low-income people and people of color, due to air pollution, fire and explosion risks, harm to local industries such as fishing and tourism, and other impacts. Of proposed terminal sites near populated areas, the majority have pre-existing air quality issues according to the U.S. Environmental Protection Agency.

- **Despite recent spikes in international LNG prices, new US LNG projects still face significant headwinds.** International demand is uncertain, high prices have highlighted financial risks for developing economies, and many governments are questioning LNG due to its climate impacts. An undersupplied market today may carry a few US projects to completion, but even then, recovering billions in investment over the coming decades is a risky proposition. Ultimately, investments in clean energy are likely to be less risky and more sustainable.

INTRODUCTION

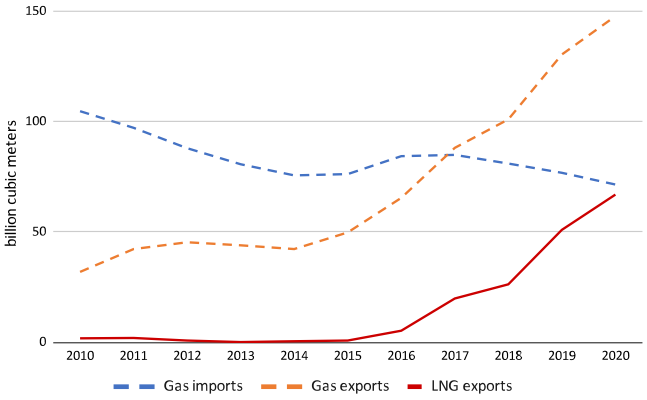
Surging domestic gas production and high international demand have encouraged US LNG developers to propose dozens of new export LNG facilities largely concentrated along the Gulf Coast. Yet for the last year, US LNG export projects have failed to secure the sales commitments and financing needed to move toward construction. Of 21 major LNG export projects proposed in the United States, none reached a final investment decision (FID) in 2021. Only two have publicly announced firm commitments from buyers for a substantial share of production, and only three have secured initial direct project financing, in deals (taken pre-FID) totaling just US$1.6 billion—far short of what is needed to begin construction. These proposed projects face serious economic and regulatory challenges, including competition from cheaper producers such as Qatar; domestic and international policy concerns with the economic, climate, and environmental justice impacts of LNG exports; and uncertain and shifting market conditions that increase the risk of long-term investment. Even if projects are built, these headwinds are indicative of the risks that LNG projects will face as they attempt to recover billions in capital costs selling an economically volatile, emissions intensive fuel during the transition to a low-carbon global economy.

BACKGROUND

The past two decades have seen a rapid transformation of the United States' gas industry. Advances in hydraulic fracturing, or fracking, have enabled producers to ramp up gas production to the highest levels in US history. Seeing an opportunity in international markets, the gas industry—with extensive support from the US government—pushed for expanding the production of liquefied natural gas, or LNG: a supercooled, liquefied form of gas that can be loaded onto tankers and shipped to more than 130 import terminals now operating in dozens of countries around the world.[1] In 2016, the United States began exporting LNG out of one terminal in Louisiana. By 2020, the United States was the third-largest LNG exporter after Qatar and Australia (EIA 2021f). That year, the United States exported 50 million tonnes of LNG, enough to fuel India's annual gas consumption and, if burned there, to produce over 150 million tonnes of carbon dioxide equivalent (Mt CO_2e)(EIA 2021c; EIA 2021d).[2,3] By December 2021, the United States was the leading global exporter of LNG, at least for that month, and it is expected to solidify its lead this year as facilities already in construction come online (IHS Markit 2022).

While the US LNG industry has demonstrated growth, new projects remain a risky bet. Even if a few proposed projects advance to construction, they will face significant economic challenges, not the least of which will be recovering billions in construction costs by selling fossil fuel over the coming decades as the world transitions to clean energy.

Figure 1: US Imports and Exports of Gas and LNG



Source: U.S. Energy Information Administration (2021b, 2021d)

1. At its destination, LNG can be regasified and burned for electric power or heat, used as a feedstock for industrial processes, or put to other uses.

2. For comparison, 150 Mt CO_2 is approximately the annual emissions of 40 coal plants (EPA 2021b).

3. This estimate calculates lifecycle emissions of LNG delivered to Asia using a 100-year global warming potential, following the emissions calculation methodology in GEM's briefing "Asia's Coal Bust Risks Being Followed by a Gas Boom" (GEM 2021a).

A New Global Gas Market

US investment in LNG is part of a broader evolution of the global gas market. Historically, most gas has been traded regionally. Until 2000, the United States exported only small amounts of gas by pipeline to Canada and Mexico (EIA 2021a). The gas industry views LNG as an opportunity to develop a more global and integrated trade, and to lock in higher consumption throughout the 21st century. High global LNG consumption well into the middle of the 21st century is at odds with many governments' stated climate policies and would intensify climate change (See the sidebar "The Climate Impacts of LNG" on the next page).

LNG exports, rather than imports, are the factor limiting the market's growth. Global LNG export capacity is smaller than global LNG import capacity, and LNG export terminals have higher rates of utilization (GEM 2019). The world has faced a tight gas market for part of 2020 and all of 2021, following a brief supply glut at the beginning of the Covid-19 pandemic. Supply shortages have caused gas prices to spike to record levels, all while US export facilities have operated at close to full capacity. Given the United States' standing as a major gas exporter and its potential for growth, the US LNG buildout is especially consequential: the amount of LNG infrastructure built in the United States will influence how much gas countries around the world can import, and burn, for decades. If proposed US LNG facilities move forward, the United States could remain the world's leading exporter of gas through much of the 2020s, even as Qatar is expected to commission a massive export project in 2025 (DiSavino 2021).

Several factors are driving the US effort to expand LNG exports. First, there are some market conditions favoring exports. The United States has extra gas to sell. In 2020, the United States produced about 10% more gas than it consumed (EIA 2021e). There is also increasing demand for gas abroad, especially in Asia. Many Asian economies are growing, shifting away from coal power, and turning to gas imports to fuel electric power, residential and commercial heating, industrial processes, and other applications (GEM 2021a). China, the world's leading importer of LNG, is expected to increase its gas demand by over 50% in the next decade, from 370 billion cubic meters (bcm) in 2021 to 600 bcm by 2030, according to analysts at investment research house Bernstein (Evans 2021). Asian countries are willing—or forced by supply shortages—to pay high prices for gas. In 2020 and 2021, monthly spot prices for LNG in Asia ranged between $2 and $36 per million British thermal units (MMBtu), compared to spot prices of $2 to $5.50 on the US market that same time period (S&P Global 2021, EIA 2021b).[4]

US producers and the US government have identified other strategic opportunities arising from exports. The gas industry sees exports as an opportunity to keep domestic gas supplies tight, so that producers can increase profits selling to US consumers. It's working. LNG exports have made gas more expensive for Americans in 2021. In the fall of 2021, the U.S. Energy Information Administration (EIA) forecast that Americans would pay 30% more on their heating bills that winter due to high gas prices (Eaton et al. 2021). An analyst with the Institute for Energy Economics and Financial Analysis (IEEFA), Clark Williams-Derry, wrote, "For America's fossil fuel industry, high natural gas prices are a feature, not a bug. In fact, fossil fuel interests predicted long ago that rising LNG exports would boost domestic gas prices" (IEEFA 2021b). Coal magnate Bob Murray reportedly lobbied President Trump to promote LNG exports so that high gas prices would allow coal to compete (Silverstein 2016). Trump in turn pressed Japan to invest in LNG expansion projects, threatening to take punitive action over Japan's trade surplus. In response, Japan increased LNG purchases, committed US$10 billion in new financing for Pacific Rim LNG projects, and entered into a formal energy cooperation agreement with the United States (GEM 2020).

4. Spot markets are trading arrangements under which LNG purchasers may buy one-off, near-term shipments of LNG outside of long-term contracts. Spot price benchmarks such as the Henry Hub Spot Price for the United States and the S&P Global Platts' JKM marker for Asia are indicators of the current regional cost of LNG based on demand and availability. About 30% of LNG in Asia is sold on the spot market, compared to 70% in Europe. The remainder of gas is sold through fixed-term contracts, traditionally linked to oil prices.

THE CLIMATE IMPACTS OF LNG

The global economy cannot expand the LNG trade without derailing international efforts to curb dangerous global warming. An analysis by Oil Change International (OCI) found that the combined lifecycle emissions of 19 proposed US terminals would be 1 gigatonne of carbon dioxide equivalent (Gt CO_2e) per year, approximately the annual emissions of 250 coal plants, when evaluated on a 20-year time frame (OCI 2021).[5]

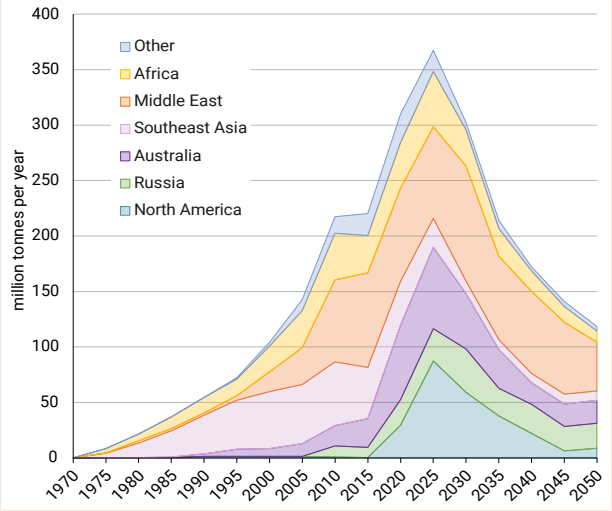
LNG production, transportation, and consumption is highly emissions intensive. The primary component in gas, methane, has a short atmospheric residency of about a decade, compared to carbon dioxide, which lasts in the atmosphere for centuries. However, during the time it remains in the atmosphere, methane's warming potential is far higher than that of CO_2. Evaluated over a century period, a tonne of methane is estimated to have 34 times the warming effect of CO_2; evaluated over a 20-year period, it is estimated to have 86 times the warming effect of CO_2 (Myhre et al. 2014).[6] The LNG supply chain leaks methane all along the fuel's journey from gas fields to pipelines, processing facilities, liquefaction terminals, tankers traversing oceans, regasification terminals, regional and local distribution networks, and ultimately homes, industrial facilities, power plants, and other buildings. And when gas is burned at its final destination, CO_2 is emitted. The near-term climate impacts of US LNG rival that of coal, according to the Natural Resources Defense Council (NRDC), because of associated CO_2 and methane emissions and the energy requirements of liquefaction, shipping, and regasification (NRDC 2020).

The US LNG supply chain is particularly emissions intensive, starting at the source. Nearly 4% of all gas extracted from the Permian Basin leaks into the atmosphere (Zhang et al. 2020). Evaluated on a 20-year time frame, these fugitive emissions alone could total over 9.5 Gt CO_2e by 2050. The Permian Climate Bomb project compares this rate of emissions to burning 50 standard mile-long trains of coal every day (PCB 2021).

The International Energy Agency (IEA) has called for LNG exports to peak this decade for the world to have a 50% chance of limiting global warming to 1.5°C (see Figure 2). IEA states, "No new natural gas fields are needed in the [Net Zero by 2050 Scenario] beyond those already under development. Also not needed are many of the [LNG] liquefaction facilities currently under construction or at the planning stage. Between 2020 and 2050, natural gas traded as LNG falls by 60%..." (IEA 2021a).

Developers of LNG export facilities have proposed carbon capture and storage (CCS) plants alongside liquefaction facilities to make LNG more "green."[7] CCS paired with LNG is a red herring from a climate perspective (GEM 2021b). For example, Venture Global's proposed CCS facility would capture 500,000 tonnes CO_2 annually from its Calcasieu Pass facility (under construction) and its Plaquemines facility (proposed), whereas these facilities are permitted to emit up to 12 million tonnes of CO_2e combined (evaluated on a 100-year time frame) (Venture Global 2021, EIP 2021a). Furthermore, capturing CO_2 produced during the liquefaction process can only address, at maximum, about 8–10% of the full life-cycle emissions of LNG (BNEF 2021).

Figure 2: LNG Exports under the International Energy Agency's Net Zero by 2050 Scenario



Source: IEA 2021a

5. OCI's emissions analysis includes one proposed project that was not analyzed for this report: the 13 mtpa G2 LNG Terminal in Louisiana. Of the terminals discussed in this report, OCI's analysis omits CP2, Delta, and West Delta LNG Terminals.

6. Methane has a greater global warming potential when evaluated over a 20-year time frame than over a 100-year time frame.

7. Developers have proposed CCS facilities for Rio Grande, G2, Calcasieu Pass, Plaquemines, CP2, and Freeport LNG Terminals.

The fervor to build more US LNG export facilities may also reflect LNG companies' recognition that, for many of the reasons discussed further in this report, they have a limited window to get projects off the ground. In particular, Qatar and Russia are set to commission low-cost LNG export facilities later this decade that may dominate the market with low-cost gas (Thompson 2021). As one reporter with S&P Global wrote, "The next several months could be pivotal for determining whether new U.S. LNG production capacity will make it to the construction stage. The global gas market appears likely to continue its recovery from pandemic-driven disruptions that muted investors' appetite for new multibillion-dollar LNG infrastructure. But this may also be a time when projects that have struggled for a long time finally fade away" (Paul 2021).

The US LNG Buildout

The United States is home to six major operating LNG export terminals with a combined capacity of 76.6 million tonnes per annum (mtpa) of LNG (see Table 1). Four are on the Gulf Coast in Texas and Louisiana, the epicenter of the proposed LNG buildout due to its proximity to the Permian Basin. Under construction are two new export terminals, Golden Pass and Calcasieu Pass LNG Terminals, which straddle the Texas-Louisiana border, and an expansion to the existing Sabine Pass LNG Terminal in Louisiana.[8] Their completion will increase US export capacity to 106.7 mtpa, at which point the United States is expected to have the largest LNG export capacity in the world.

The fleet of proposed US LNG export terminals is, by comparison, enormous. This report focuses on 21 major proposed projects that together comprise 255 mtpa of new export capacity (Note: this report does not analyze a few other proposed US LNG export facilities that have been largely dormant or made limited progress toward construction). If all of these 21 terminals were built, the United States would more than triple its export capacity. However, it is unlikely there would be market capacity or investor interest in bringing all of these projects to fruition.

Table 1: Major US LNG Export Terminals Operating and in Construction

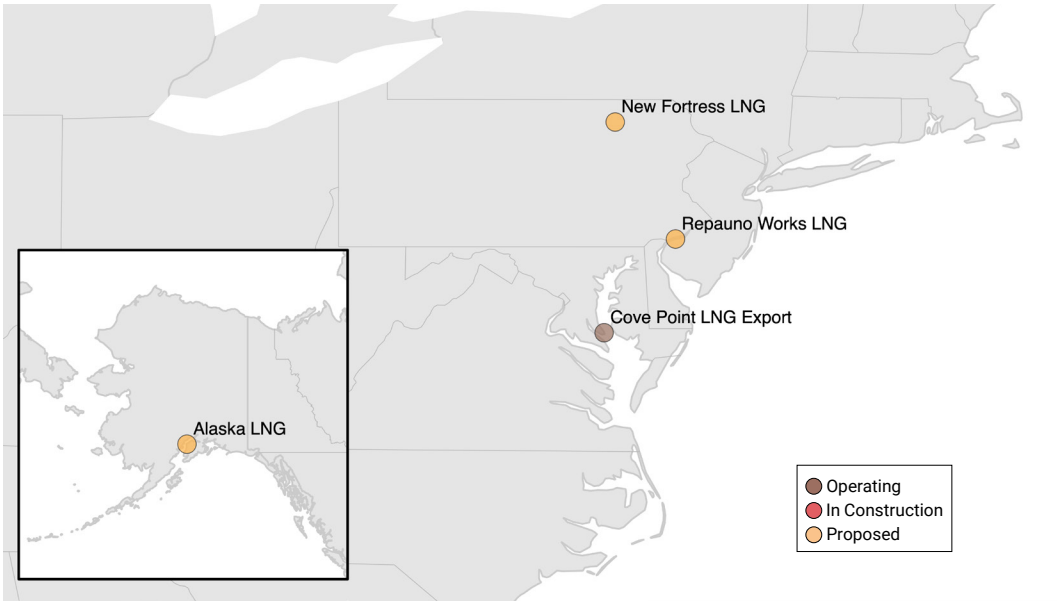
Operating		
Project	**State**	**Capacity (mtpa)**
Cameron LNG Terminal	Louisiana	13.5
Corpus Christi LNG Terminal	Texas	15
Cove Point LNG Terminal	Maryland	5.25
Elba Island LNG Terminal	Georgia	2.5
Freeport LNG Terminal	Texas	15.3
Sabine Pass LNG Terminal	Louisiana	25
Construction		
Calcasieu Pass LNG Terminal	Louisiana	10
Golden Pass LNG Terminal	Texas	15.6
Sabine Pass LNG Terminal, Train 6	Louisiana	4.5

8. Calcasieu Pass and Sabine Pass LNG Terminals are expected to come fully online this year.

Figures 3 through 6 show the location and status of LNG export terminals that are operating or in various stages of development .

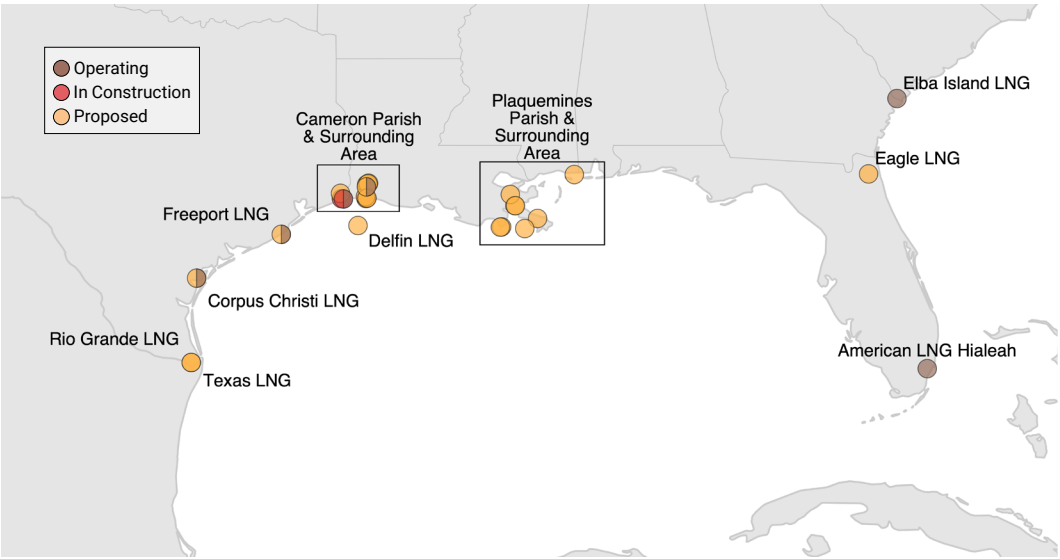
The majority of these terminals have obtained their required permits from the Federal Energy Regulatory Commission (FERC). With FERC approval, the next major challenge for companies is finding buyers and investors.

Figure 3: LNG Export Terminals in the Northern United States (Northeast & Alaska)



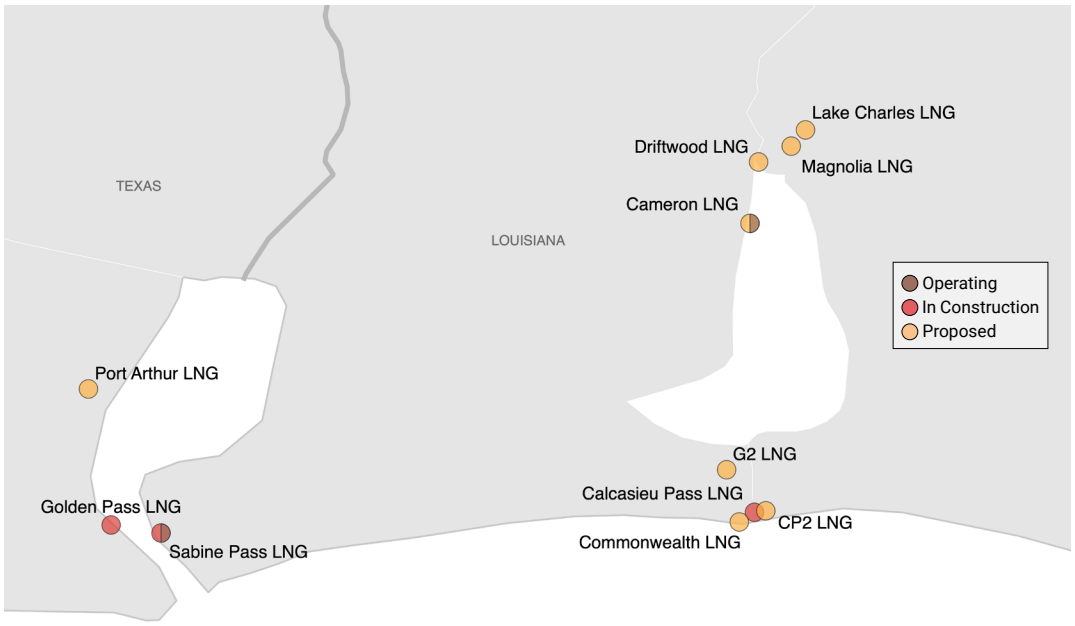
Source: Global Gas Infrastructure Tracker, Global Energy Monitor

Figure 4: LNG Export Terminals in the Southern United States



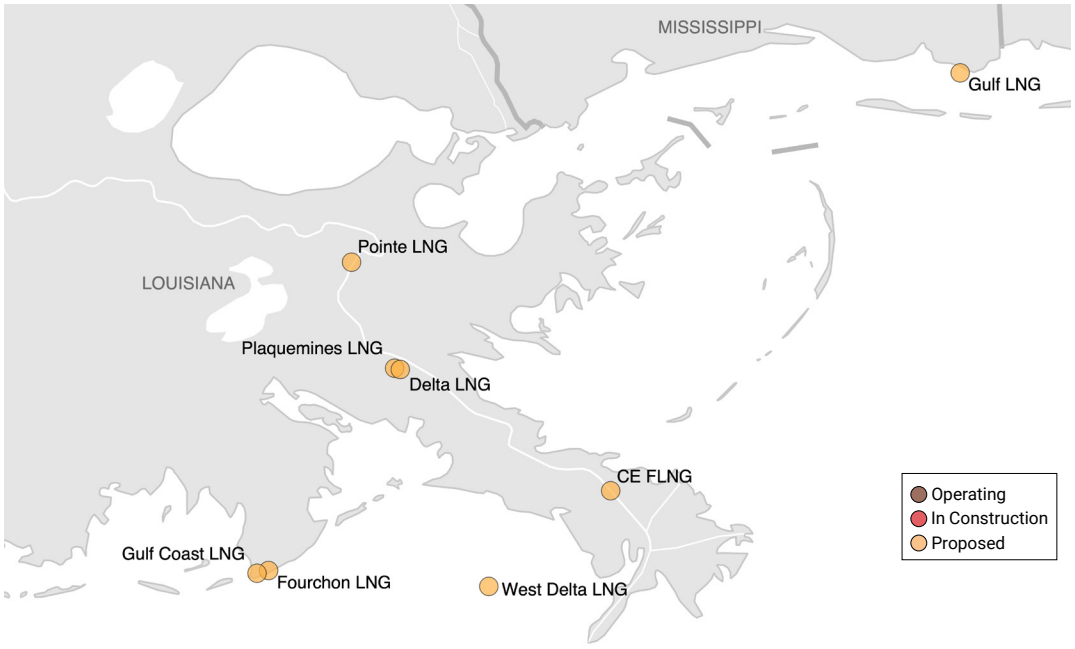
Source: Global Gas Infrastructure Tracker, Global Energy Monitor

Figure 5: LNG Export Terminals in Cameron Parish (LA) and the Surrounding Area



Source: Global Gas Infrastructure Tracker, Global Energy Monitor

Figure 6: LNG Export Terminals in Plaquemines Parish (LA) and the Surrounding Area



Source: Global Gas Infrastructure Tracker, Global Energy Monitor

US LNG FINANCE: A SHALLOW POOL

GEM's research on offtake contracts and financing for the proposed US LNG export terminals indicates a weak financing environment:

- Final investment decisions: No proposed US LNG export terminals advanced to the construction phase in 2021.
- Offtake contracts: Project owners have only secured purchasing agreements publicly linked to four new projects, out of 21 total. Of the four projects with contracts, two are still far from demonstrating that a substantial share of production will be anchored with long-term commitments.
- Financing: Of the 21 proposed terminals, GEM has identified only three terminals that have received direct project finance. Total project finance identified for these terminals amounts to US$1.6 billion, a drop in the bucket compared to the total cost of all projects estimated around US$244 billion.

Table 2 shows major proposed US LNG export terminals in the United States along with contracted output and project financing identified by GEM.

Table 2: Contracted Output and Project Financing of Proposed US LNG Export Terminals

Project	Capacity	Contracted Output	Cost	Project Financing	FID
Alaska LNG Terminal	20.1 mtpa	–	$32.2 billion	–	2021 (delayed)
Cameron LNG Export Terminal Phase 2	6 mtpa	–	$2.7 billion	–	Late 2022
Commonwealth LNG Terminal	8.4 mtpa	–	$4.8 billion	–	Early 2023
Corpus Christi LNG Terminal Stage 3	11.5 mtpa	0–6 mtpa[a]	$5.3 billion	–	2022
CP2 LNG Terminal	20 mtpa	–	$9.2 billion	–	–
Delfin LNG Terminal	12 mtpa	–	$7 billion	–	2021 (delayed)
Delta LNG Terminal	22.6 mtpa	–	$33.9 billion	–	–
Driftwood LNG Terminal	27.6 mtpa	9 mtpa	$30 billion[b]	US$0.075 billion (debt)	2022
Eagle LNG Terminal	1 mtpa	–	$0.542 billion	–	–
Fourchon LNG Terminal	5 mtpa	–	$2.3 billion[c]	–	–
Freeport LNG Terminal Train 4	5.1 mtpa	–	$2.3 billion	US$1 billion (debt)	mid-2022
Gulf LNG Terminal	10.86 mtpa	–	$8 billion	–	–
Lake Charles LNG Terminal	17.8 mtpa	–	$10.9 billion	–	2021 (delayed)
Magnolia LNG Terminal	8.8 mtpa	–	$13.2 billion	–	Late 2023
Plaquemines LNG Terminal	20 mtpa	11 mtpa	$13.1 billion[d]	US$0.5 billion (debt)	2021 (delayed)
Pointe LNG Terminal	6 mtpa	–	$4 billion	–	2022
Port Arthur LNG Terminal	13.5 mtpa	–	$8–9 billion	–	2023
Repauno Works LNG Terminal	1.5 mtpa	–	$0.45 billion	–	–
Rio Grande LNG Terminal	27 mtpa	2 mtpa	$40.5 billion	–	Late 2022
Texas LNG Terminal	4 mtpa	–	$6 billion	–	Late 2022
West Delta LNG Terminal	6.1 mtpa	–	$9.2 billion	–	–

Source: Global Energy Monitor. Costs in US$ are based on official projections where available or otherwise are GEM estimates. See methodology for more details. Contracted output includes only firm sale and purchase agreements (not preliminary agreements, memoranda of understanding, etc.) for 10 or more years of service. For references, see GEM.wiki pages.

a. Cheniere Energy has secured recent offtake agreements totaling 6 mtpa, but it is unclear which of its projects will fulfill these contracts. Cheniere is the owner of Sabine Pass LNG Terminal (operating/construction) in addition to Corpus Christi LNG Terminal.

b. The cost of Driftwood LNG Terminal's first 5.52 mtpa phase is US$12 billion.

c. The cost of Fourchon LNG Terminal's first 2 mtpa phase is US$888 million.

d. The cost of Plaquemines LNG Terminal's first 10 mtpa phase is US$8.5 billion.

ROLE OF OFFTAKE AGREEMENTS AND FINANCING IN TERMINAL DEVELOPMENT

LNG terminal developers must overcome multiple hurdles to prepare a project for a positive final investment decision (FID), i.e., deciding to build the project. Developers must apply for permits from regulators such as the Federal Energy Regulatory Commission (FERC); secure gas supply agreements from producers so they have access to gas for liquefaction; arrange for an engineering, procurement, and construction (EPC) contractor to build the project; and find committed buyers for the LNG. Long-term sale and purchase agreements (SPAs) with buyers such as oil and gas companies, trading companies, or utilities demonstrate that a project will generate cash flow.

Crucially, because LNG export terminals are so expensive to build and operate, developers must find parties willing to finance projects, primarily through debt. Commercial banks are often the financiers of LNG projects, and they typically provide financing in syndicates to minimize individual institutions' exposure to risk. Potential financiers evaluate these contracts, relationships, and permits, along with factors such as the developers' credit rating and equity stake in the project (Williams-Derry 2022).

While all of these factors are important for a project's FID, the abilities to secure financing and find committed buyers (a prerequisite for bank financing) are usually the two most challenging hurdles, and those that are likely to determine which projects are viable.

Final Investment Decisions

No US export terminals reached FID in 2021. The global picture for export terminal development is similarly grim. GEM's June 2021 update on the LNG industry "Nervous Money" found that only one terminal globally had reached FID over the previous year (GEM 2021c). The dates for FIDs are based on project developers' own expectations, and delayed FIDs indicate that terminal owners are not finding the investors and buyers needed to move forward. In 2021, the owners of Rio Grande, Driftwood, and Port Arthur LNG Terminals all delayed projects' intended FIDs from that year to 2022.

Slow progress has consequences for projects. Port Arthur LNG Terminal lost contract agreements with Saudi Aramco and Polish Oil Mining and Gas Extraction (PGNiG) after both companies cited the project's delays. And in October 2021, FERC canceled its permitting review of Pointe LNG Terminal because of the project's inactivity.

If any projects do arrive at FIDs in 2022, it may be those that have secured ample offtake contracts, such as Plaquemines LNG Terminal, or those that are expansions to existing terminals operated by well-established companies, such as Corpus Christi Stage 3 or Freeport Train 4. Although Driftwood LNG Terminal has attracted attention from media and analysts, the terms of its offtake agreements dare investors to take a major gamble on future cash flow (more on this below).

Any projects that do proceed to construction will face significant challenges over the coming years, described further in Challenges Ahead for US LNG.

Offtake Contracts

For an LNG terminal company to reach FID, firm, long-term contracts are typically required for about 80% of a terminal's capacity (DOE et al. 2017). Only four LNG companies have secured offtake contracts linked to new projects: Driftwood, Plaquemines, and Rio Grande LNG Terminals and Corpus Christi Stage 3. Of those, only Plaquemines LNG Terminal and Corpus Christi Stage 3 likely have substantial shares of their capacities grounded in firm, long-term commitments. Plaquemines LNG Terminal has 20-year SPAs signed with PGNiG, Electricité de France, Sinopec, and CNOOC, accounting for 11 mtpa of output (Phase 1 is only planned to be 10 mtpa). Cheniere has recently finalized 6 mtpa of offtake agreements, but it has not been publicly specified whether this capacity will come from its proposed Corpus Christi Stage 3 expansion, or other segments of its Corpus Christi LNG Terminal (operating) or Sabine Pass LNG Terminal (operating/construction). Cheniere has stated that it has about 6 mtpa of contracted capacity available for the project (Cheniere 2021).

Tellurian, the owner of Driftwood LNG Terminal, has announced 9 mtpa worth of contracts with Shell and international commodity traders Vitol and Gunvor Group, but these agreements are relatively short term (10 years) and tied to spot market benchmark prices for LNG. These agreements leave investors at the whim of future prices in the volatile LNG market and future agreements with unknown buyers on unknown terms, long before the terminal's capital costs are paid off (IEEFA 2021a). The fact that Tellurian is using these contract terms to entice financiers suggests it was unable to find buyers on more advantageous and traditional terms.

Finally, Rio Grande LNG Terminal only has 2 mtpa of capacity contracted out to Shell, which is little of the terminal's full planned 27 mtpa of capacity.

Financing

LNG export terminals are some of the most expensive projects ever built. The projects in Table 2 range from half a billion to 30 billion dollars, averaging about US$0.8 billion per mtpa of capacity. It is for this reason that there are typically many financiers involved in a given project, and that the risk in executing projects is so high.

In a survey of *IJGlobal Project Finance and Infrastructure Journal*, GEM identified relatively few financing deals directly for LNG projects. In total, three loans granted to Driftwood, Freeport, and Plaquemines LNG Terminals add up to about US$1.6 billion. This is not a positive sign for US LNG financing. At the same time, it does not indicate a complete lack of interest. Projects typically do not receive much direct financing prior to FID, and there are other avenues of financing projects indirectly, for instance, supporting projects via general corporate finance and supporting the owners of LNG projects. The next section, Financing the Leading Proposed US LNG Projects, examines corporate financing and financing of projects' owners in greater detail for several of the projects.

Table 3 (on the next page) lists financial institutions and companies that are or have been involved in proposed US LNG export terminals as financiers, financial advisors, and buyers.

Table 3: Financial Institutions and Companies Involved in Proposed US LNG Export Terminals as Financiers, Financial Advisors, and Buyers

	Financial Institutions		Companies and Traders	
Project	**Institution**	**Role**	**Company**	**Role**
Alaska LNG Terminal	Goldman Sachs	Financial advisor	Sinopec	Potential offtaker
	Bank of China	Financial advisor and potential creditor		
	CIC Capital	Potential equity		
Cameron LNG Export Terminal Phase 2	JP Morgan Chase	Financial advisor	TotalEnergies	Potential equity or offtaker
			Mitsui & Co.	Potential equity or offtaker
			Mitsubishi Corporation	Potential equity or offtaker
Commonwealth LNG Terminal	SMBC Group	Financial advisor	Gunvor Group	Potential offtaker
			Summit Oil & Shipping	Potential offtaker
			Woodside Energy	Potential offtaker
Corpus Christi LNG Terminal Stage 3	–	–	Glencore	Potential offtaker
			ENN Natural Gas	Potential offtaker
			Engie	Potential offtaker
			Foran Energy Group	Potential offtaker
			Sinochem Group	Potential offtaker
			NFE North Trading	Potential offtaker
			Posco	Potential offtaker
CP2 LNG Terminal	–	–	–	–
Delfin LNG Terminal	–	–	–	–
Delta LNG Terminal	–	–	–	–
Driftwood LNG Terminal	Goldman Sachs	Financial advisor	Gunvor Group	Offtaker
	Société Générale	Financial advisor	Vitol	Offtaker
	UBS	Loan (US$75 M)	Shell	Offtaker
Eagle LNG Terminal	–	–	–	–
Fourchon LNG Terminal	–	–	–	–
Freeport LNG Terminal Train 4	Westbourne Capital	Loan (US$1 B)	JERA	Equity and potential offtaker
			SMBC Group	Potential offtaker
Gulf LNG Terminal	–	–	–	–
Lake Charles LNG Terminal	JP Morgan Chase	Financial advisor	–	–
Magnolia LNG Terminal	–	–	–	–
Plaquemines LNG Terminal	Bank of America	Loan (US$1.25 M)	PGNiG	Offtaker
	JP Morgan Chase	Loan (US$1.25 M)	Electricité de France	Offtaker
	Mizuho Financial	Loan (US$1.25 M)	Mizuho Financial	Offtaker
	Morgan Stanley	Loan (US$1.25 M)	CNOOC	Offtaker
Pointe LNG Terminal	Whitehall & Co	Financial Advisor	–	–
Port Arthur LNG Terminal	JP Morgan Chase	Financial Advisor	–	–
Repauno Works LNG Terminal	–	–	–	–
Rio Grande LNG Terminal	Macquarie Capital	Financial Advisor	Shell	Offtaker
	Société Générale	Financial Advisor		
Texas LNG Terminal	–	–	–	–
West Delta LNG Terminal	–	–	–	–

Source: Global Energy Monitor. Note: potential offtaker indicates that a company has expressed interest in being an offtaker but not signed a formal purchasing agreement. For more information, see terminal profiles in the Appendix and GEM.wiki.

Financing the Leading Proposed US LNG Projects: A Deep Dive

GEM commissioned Profundo, a not-for-profit research organization, to conduct an in-depth study of financing for six projects that are considered relatively likely candidates to move forward: CP2, Driftwood, and Plaquemines LNG Terminals and expansions at Cameron, Corpus Christi, and Freeport LNG Terminals (see Table 4).

Whereas the analysis on pages 11–14 focuses on project finance deals, which represent debt or equity financing extended directly to LNG project companies, Profundo's study cast a wider net on LNG terminal financing by examining

1. General corporate finance transactions (i.e., financial support for a company not earmarked for a particular project);[9]
2. Financing of LNG project companies *and* their sponsors (i.e., the companies that own or have participation in the project companies, and are the ultimate owners of the project)(see Table 4); and
3. These transactions over the time frame 2016 to 2021.

This data can help identify other financiers who have supported LNG projects, if less directly than through recent project finance. By examining historical financing and project sponsors' financing, it is also possible to identify institutions that might support LNG projects in the future.

This study is split in two parts by the type of relationship financiers have with the projects: (1) creditors and (2) bond and shareholders. Data is presented in aggregate for the six projects. For more information on the top financiers of each of these six projects individually, see the supplementary document Financing the Leading Proposed US LNG Projects (Individual Project Analyses).

Table 4: LNG Projects Analyzed by Profundo, with Associated Project Companies and Sponsors

Project name	Project company	Sponsors
Cameron LNG Export Terminal	Cameron LNG	Sempra LNG Mitsui & Co. TotalEnergies Mitsubishi Corporation Nippon Yūsen Kabushiki Kaisha
Corpus Christi Liquefaction Stage 3	Cheniere Energy	Cheniere Energy
CP2 LNG Terminal (Phase 1 & 2)	Venture Global LNG, Inc.	Venture Global LNG, Inc.
Driftwood LNG Terminal	Driftwood LNG, LLC	Tellurian Inc.
Freeport LNG Terminal	Freeport LNG Development	Zachry Hastings Osaka Gas Dow Chemical Company Global Infrastructure Partners Freeport LNG
Plaquemines LNG Terminal	Venture Global Plaquemines LNG, LLC	Venture Global LNG, Inc.

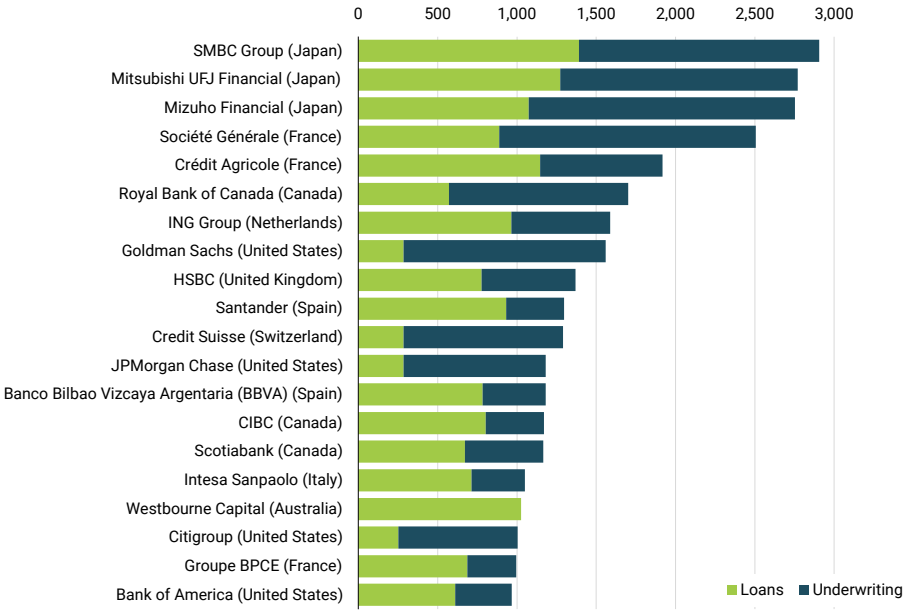
9. Corporate financing includes financial support for a company that, as opposed to project finance, is not isolated within the structure of a particular project. Corporate financing is less clearly linked to a particular project, especially if its recipient has a diversified business. It is, however, relevant because corporate financing supports terminal sponsors' operations and may be invested directly in LNG projects via companies' balance sheets.

Creditor Analysis

The creditor analysis focuses on financiers that have extended loans to LNG project companies and their sponsors, or underwritten bond or share issuances for these entities. Figure 7 lists the top creditors of five LNG projects in terms of the total value of loans and underwriting services offered. To identify loans and underwriting services affiliated with the LNG projects, this data set only includes transactions directly attributable to the projects in Table 4, via their project companies and sponsors (CP2 was excluded here—see footnote).[10]

The top three creditors of these LNG projects and their sponsors are Japanese institutions: SMBC Group, Mitsubishi UFJ Financial, and Mizuho Financial. Japan has long been among the top supporters of LNG internationally; in 2020, GEM found that Japan's institutions had provided at least US$23.4 billion to LNG projects globally over the previous three years (GEM 2020). The next two creditors on the ranking are French: Société Générale and Crédit Agricole. Goldman Sachs, JP Morgan Chase, Citigroup, and Bank of America were also among the top 20 creditors. Rainforest Action Network (RAN) found these banks were among the top financiers of LNG globally in its 2021 Banking on Climate Chaos report. Citigroup, JP Morgan Chase, and Bank of America held the second through fourth places on RAN's list, respectively (RAN 2021).

Figure 7: Loans and Underwriting Services Directly Attributable to Select LNG Projects, by Financier, 2016–2021 (million US dollars)



Source: Profundo. This figure includes loans and underwriting services directed to the project companies and sponsors of Cameron, Corpus Christi, Driftwood, Freeport, and Plaquemines LNG Terminals.

10. The creditor analysis only included transactions that could be directly attributed to the six LNG projects. It was not possible to include data for CP2 LNG Terminal among financing deals attributable to these projects, because the project company for CP2, which is Venture Global, has two other LNG terminal projects: Calcasieu Pass (under construction) and Delta LNG (proposed) LNG Terminals. Therefore, loans and underwriting services for Venture Global could have been directed to either of these other projects.

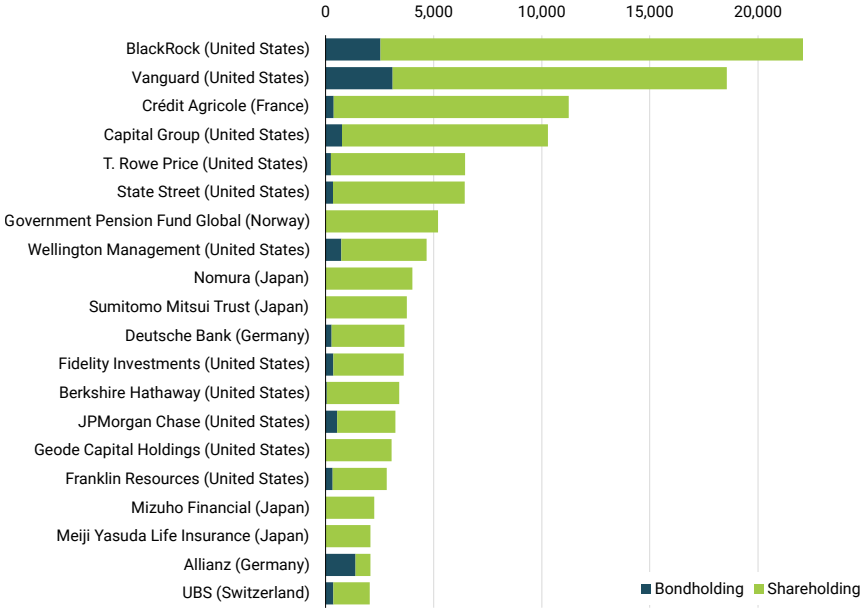
Bond and Shareholder Analysis

The bond and shareholder analysis focuses on financiers that have purchased bonds or shares issued by the project companies or sponsors. Figure 8 lists the top financiers of all six LNG projects in terms of the total value of bonds and shares owned.

This data set includes financial transactions that are associated with the project companies and sponsors, but may not be *directly* attributable to a project because of companies' other operations. For instance, it includes financiers that own bonds or shares of Cheniere, even though Cheniere owns other LNG terminals beyond Corpus Christi, and it includes financiers that own bonds or shares of TotalEnergies, even though TotalEnergies has assets beyond LNG facilities. Investors in the project companies and sponsors also indirectly own the LNG projects and can therefore be considered accountable for them.

The US investment groups BlackRock and Vanguard are the two leading bond and shareholders in the project companies and their sponsors. Both announced in March 2021 that they would join an international investors' initiative to drive portfolio companies' emissions to net-zero by 2050 (Kerber 2021). These asset managers' outsize role in LNG is also noteworthy because much of their investments come from personal retirement funds, pension funds, and other retail investments. Share price volatility of oil and gas companies puts these savings and pension funds at risk, and the growing popularity of sustainable investing will inevitably make such investments less tenable over time. In late 2021, the world's 8th largest pension fund, ABP, announced it would divest from fossil fuel producers completely in response to climate concerns (ABP 2021).

Figure 8: Bond and Shareholding Directly and Indirectly Attributable to Select LNG Projects, by Financier, 2021 (million US dollars)



Source: Profundo. This figure includes bond and shareholding directed to the project companies and sponsors of Cameron, Corpus Christi, CP2, Driftwood, Freeport, and Plaquemines LNG Terminals.

CHALLENGES AHEAD FOR US LNG

In the 2010s, the United States was experiencing rapid expansion of cheap, domestic shale gas, while LNG markets were growing in Europe and Asia. Major investments in LNG could be seen as low-risk propositions offering decades of business. Today, although Asian and European buyers are paying exorbitant prices for US LNG, the calculus for long-term investments in LNG has changed. US LNG export projects now face challenges on multiple fronts, including (1) competition from lower priced producers such as Qatar; (2) domestic concerns over LNG exports raising gas prices; (3) recognition of the disproportionate impact of LNG terminals on low income communities and communities of color; (4) increased regulatory scrutiny and permitting challenges over environmental and community impacts; (5) international climate commitments inconsistent with increased LNG exports; (6) loss of social license internationally due to growing alarm over climate change; (7) volatile gas prices; (8) uncertain demand among Asian and European buyers; (9) a shift away from long-term LNG contracts across international gas markets; and (10) investors concerned that gas projects will be economically and environmentally untenable in the long run.

International Competition

According to Wood Mackenzie's forecasts, by 2030, global LNG demand will grow to 560 mtpa, and liquefaction facilities that are operating or in construction today around the world could account for 515 mtpa of this demand (Jaganathan 2021). That leaves a relatively small shortfall between supply and demand, 45 mtpa, which—for scale—is about the combined size of the operating and in construction phases of Corpus Christi and Sabine Pass LNG Terminals in the United States. The 21 proposed LNG export facilities discussed in this report, totaling 255 mtpa of capacity, will be competing with one another for this share of global production. They will also be competing with the rest of the world.

Qatar and other countries can undercut US LNG producers on price. A 2019 analysis by Rystad found that new projects in Qatar, Russia, and Mozambique would be able to provide LNG to East Asia more cheaply than new US projects such as Driftwood LNG Terminal and the expansion at Freeport LNG Terminal (Rystad 2019). Qatar has historically been the world's leading LNG exporter, with easily accessible gas and proximity to Asia (Shiryaevskaya et al. 2021). Qatar's proposed North Field LNG Terminal would be the world's largest project at 48 mtpa. Bloomberg New Energy Finance has projected that 10 US projects, including Rio Grande and Texas LNG Terminals could be unable to secure financing because of competition with Qatar (Shiryaevskaya et al. 2021). Russia, another cheap gas producer, supplies over one third of Europe's gas, and its Arctic LNG 2 project under construction will have almost 20 mtpa of capacity to supply Chinese state oil companies CNPC and CNOOC as well as others (Twidale 2021).

When these projects and others are commissioned in the middle of the decade, they could challenge US producers' ability to turn a profit. A Wood Mackenzie Vice Chairman noted that there will be "abundant LNG supply coming to market in the 2026–2028 period … setting the scene for renewed price pressure" (Thompson 2021). In a February 2022 research note, Bank of America wrote of Driftwood LNG Terminal that "An excess of U.S. LNG export capacity over the next several years could result in lower pricing or delays/cancellations of incremental expansion plans" (BofA 2022). Planning new US LNG projects that would enter the market in a gas supply glut is risky, to say the least.

Domestic and International Policy Concerns

US plans to export LNG are confronting domestic and international policy concerns. In the United States, industries that rely on natural gas and domestic consumers are experiencing high gas prices due to low supplies from exports. In September 2021, the Industrial Energy Consumers of America wrote a letter to U.S. Department of Energy (DOE) Secretary Jennifer Granholm encouraging DOE to require LNG exporters to reduce export rates (IECA 2021). A group of Democratic US senators led by Jack Reed and Angus King also wrote to Secretary Granholm in February 2022 urging DOE to reconsider whether LNG exports are in the public interest (Office of Jack Reed 2022). Australia experienced the same phenomenon, and a similar public backlash, when exports of Australian gas raised domestic prices from AUS$3-$4 per gigajoule in 2013 to AUS$10 per gigajoule in 2019 (Denniss 2020).

The proposed US LNG terminals are increasingly seen as an environmental justice issue because many of them would exacerbate pollution in low-income communities and communities of color. There is a long history of industrial pollution disproportionately harming marginalized communities, especially along the Gulf Coast. Only in recent years have environmental justice concerns begun to hold more sway in the top levels of government, with the Biden Administration committing to ensuring that 40 percent of relevant federal climate investments benefit disadvantaged communities (White House 2021). For more information, see the sidebar on LNG Terminals & Environmental Justice.

LNG and other gas projects have faced challenges to the permitting process on environmental justice and environmental grounds, and in response, FERC instituted a new, more stringent review process for gas projects in February 2022. Policy changes include an elevated threshold for demonstrating that projects are in the public interest and new criteria for evaluating projects' impacts on nearby communities and climate change. In his dissent, Republican commissioner Mark Christie said, "There is no question that [this new certificate policy] will be wielded against every single natural gas project, making the cost and uncertainties of even pursuing a project exponentially more daunting" (Knight 2022). BNN Bloomberg has reported that many US gas projects will be immediately affected by the changes, including Driftwood LNG Terminal (Freitas Jr. 2022). These policy changes follow losses in court for FERC over its failures to critically evaluate project impacts. In August 2021, a court ruled that FERC must redo its environmental analyses for Rio Grande and Texas LNG Terminals because it did not sufficiently take into account the projects' greenhouse gas emissions and impacts on low-income and minority communities (Malo 2021).

With respect to international policy concerns, increased production and consumption of LNG is at odds with global commitments to confront climate change. As discussed in the sidebar on The Climate Impacts of LNG, increased LNG exports throughout the coming decades are incompatible with scenarios consistent with limiting global warming to 1.5°C, such as IEA's Net Zero by 2050 Scenario (IEA 2021a). A US buildout of LNG would undermine its commitment to limiting global warming ideally to 1.5°C under the Paris Agreement and its agreement under the Global Methane Pledge to reduce methane emissions by 30% over the coming decade.

International buyers are also becoming more concerned with the climate impacts of their fuel imports. In October 2021, India's oil minister said the country would seek emissions data for each imported cargo of LNG (Verma 2021). The LNG industry has responded to such interest by establishing a framework for declaring LNG cargoes "carbon-neutral." However, "carbon-neutral" shipments represent less than 1% of total global shipments and have been criticized by environmental advocates as greenwashing (Twidale et al. 2021; Stapczynski et al. 2021). Whether buyers will accept the idea that LNG can be low-emissions or carbon-neutral remains to be seen.

A factor recently invoked in support of expanded US LNG export capacity is the ongoing crisis in Ukraine. The crisis has come at a time when Russia, which supplies more than a third of Europe's gas, had already cut its piped gas to Europe by 23 percent in Q4 2021 compared to Q4 2020, while global gas spot prices are at record highs due to pandemic-related supply imbalances (Holder et al. 2022).

Such rationales tend to conflate short-term and long-term considerations. While increased US LNG exports to Europe have helped provide a stopgap in the short term, the Ukraine crisis does not provide a strong justification for increasing US LNG export capacity on a long-term basis. One reason is that proposed terminals will not be able to export gas for three to five years, at which point the geopolitical landscape may not be favorable for US producers. A second is the underlying resilience of the existing European system. An analysis released in 2020 by the energy analytics firm Artelys considered the specific "stress test" for that system of a full-year disruption in all gas transit through Ukraine (Artelys 2020). Due to the availability of alternative suppliers including Norway, Azerbaijan, and Turkey, as well as additional LNG supplies from other global LNG suppliers, the analysis found "no additional loss of load" compared to the case without disruption. As discussed throughout this section, new projects that come online in the mid-2020s are likely to face fierce competition from lower-cost producers, and the rapid fall in the cost of renewables makes gas demand less certain. Indeed, a key takeaway from the European gas crisis is that imported fossil fuels are not more inherently secure than a robust renewable power and storage sector.

Shifting Market Conditions

New US LNG projects face market conditions that may make it difficult to find buyers or recover upfront costs. First, the global LNG market is extremely volatile. Between 2020 and 2021, Asian spot prices fluctuated by a factor of 18 (S&P Global 2021). The year of 2020 was disastrous for LNG producers as demand and prices cratered, and costly for contractually obliged LNG purchasers; customers of Cheniere paid US$708 million to cancel LNG cargoes between April and June. As energy analyst Seb Kennedy has written, "'Going long on LNG' means betting against another black swan-type event that tanks the global economy and energy demand" (Kennedy 2022). While Asian and European buyers are willing to pay high prices for LNG today, there is no guarantee that these advantageous conditions for US suppliers will persist. Proposed US terminals may not be commissioned for three to five years, at which point US LNG may not be as profitable.

Future Asian and European demand for gas is also uncertain. Even before the start of the pandemic, Japan and South Korea had begun reducing LNG imports. In China, LNG power has been unprofitable for gas utilities, and in India and Southeast Asia the need to build up energy markets to absorb LNG faces obstacles due to the complex coordination that would be required among governments, capital markets, and LNG developers. In Europe, ambitious climate objectives and increasing skepticism of gas could cool interest in importing US LNG (IEEFA 2021c). US LNG is relatively dirty even compared to Europe's other gas options; data from the UK government shows that LNG from the US was more emissions intensive than gas from Qatar, Algeria, Norway, and other countries (UK Oil & Gas Authority)

There is evidence that high gas prices have softened demand for gas in Asia and Europe. In India, where spot prices soared to US$49.35 per MMBtu late last year, LNG imports in January 2022 were down by 9.4% with respect to the previous month and 6.5% with respect to January 2021 (Russell 2022). In Europe, where benchmark gas prices tripled last year, gas demand is forecast to drop 4.5% this year after increasing 5.5% last year (Shiryaevskaya et al. 2022). A report by Ember found that over the second half of 2021 renewables primarily replaced gas-fired power generation in Europe, a deviation from the coal-to-renewable switching that dominated the 2010s

(Ember 2022). Plunging renewable costs may only accelerate these trends.

There has also been a marked shift by LNG purchasers away from long-term contracts and toward the spot market, leaving producers with less stability and guarantee of long-term profit. The drop in spot prices over the second half of the 2010s encouraged purchasers to adopt shorter-term contracts in order to avoid locking themselves into unnecessarily high price structures. While spot prices are high today, a global surge of cheap renewable power has also served to discourage buyers from committing to long-term LNG contracts that may soon be pricier than solar and wind power (Economist 2021). Japan's largest LNG purchaser, JERA, recently signaled a shift away from long-term LNG contracts due to attractive deals on the spot market and its longer-term objectives to decarbonize its economy (RBN 2021a).

Finally, investors are increasingly turning away from fossil fuel investments. A managing director at the Houston-based Pickering Energy Partners told the *Wall Street Journal,* "A few years ago, no one would have been worried about making long-term investments in natural gas…Now for everybody there's definitely a concern on hydrocarbon demand" (Spegele 2021). Credit-rating firms Moody's Investor Services and Standard & Poor's have warned that fossil fuel investments could be risky as governments and financial institutions become more focused on climate impacts of investments (Patterson 2021). While unmet global demand for LNG today might otherwise usher investment in new gas pipelines and terminals, RBN Energy has written that one of the greatest barriers to midstream development is investors' environmental concerns (RBN 2021b).

Combined, these shifting market conditions threaten the long-term viability of new US LNG export facilities. It takes decades for billion-dollar LNG facilities to recover initial costs, and there is a high risk that new projects could fail to recover costs, especially if competition, with other producers or cheap renewables, or domestic or international policy drives facilities to operate at reduced capacity or to close before the end of their intended lifetimes. IEA finds that under its Net Zero by 2050 Scenario, most of the projects around the world that are in construction will not recover their initial investments, and that overinvestment in gas export infrastructure could result in US$75 billion in stranded assets (IEA 2021b). As US climate envoy John Kerry said at a virtual meeting of the World Economic Forum, "If we build out a huge infrastructure for gas now and continue to use it as the bridge fuel, we haven't really exhausted the other possibilities, we're gonna be stuck with stranded assets in 10 or 20 or 30 years" (Tobin 2021).

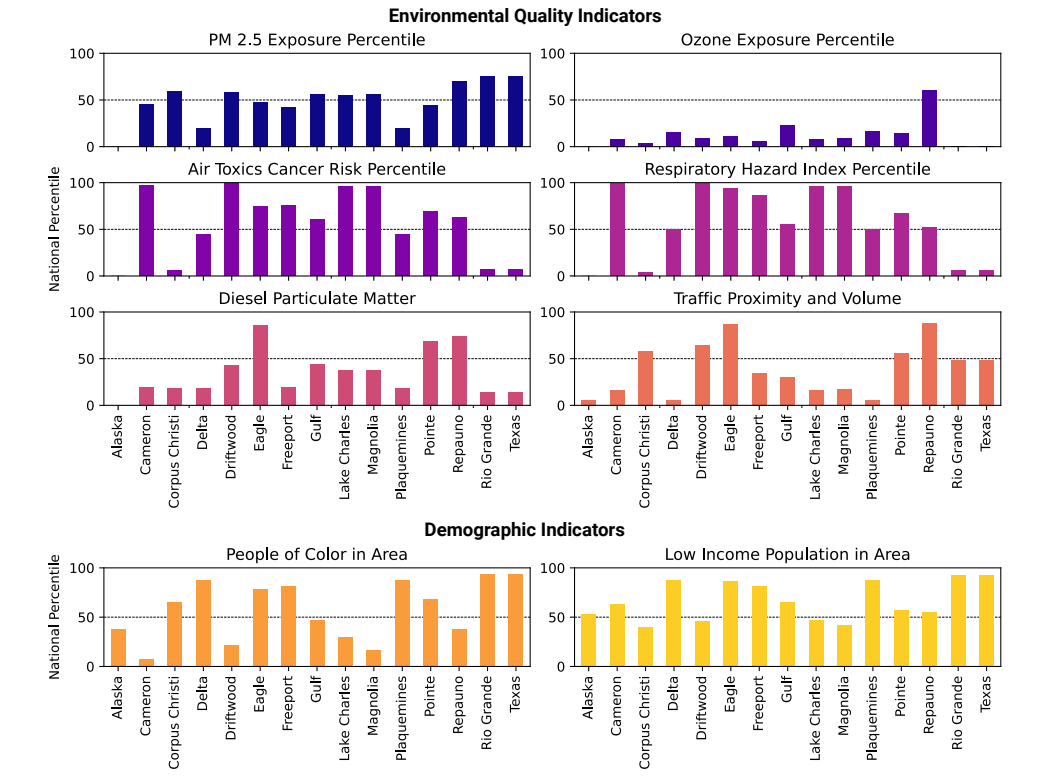
SIDEBAR: LNG TERMINALS & ENVIRONMENTAL JUSTICE

The US LNG buildout is an environmental justice issue. Communities along the Gulf Coast have long borne health and environmental impacts from their proximity to the oil and gas industry. Many of the proposed terminal sites are near communities that are predominantly people of color, including Brownsville, Corpus Christi, and Port Arthur. Dr. Robert Bullard, known as the father of environmental justice, penned a *New York Times* op-ed on the US LNG expansion in which he wrote, "This correlation is not unusual. Discrimination in housing forced Black and brown people into areas near polluting industries that threatened their health and safety and continue to do so" (Bullard 2021). The highly industrialized stretch of the Mississippi River in between Baton Rouge and New Orleans has earned the name "Cancer Alley" because cancer rates are roughly 50% higher than the national average, with predominantly Black populations and low-income populations experiencing higher rates than those that are predominantly white and those that are high-income (James et al. 2012). Plaquemines, Delta, and Pointe LNG Terminals are planned along this stretch.

The U.S. Environmental Protection Agency (EPA) has developed a tool that can help screen whether a site, such as an LNG project, may have environmental justice concerns (see Figure 9). For a selected area, EPA's EJSCREEN provides a series of indicators on demographics and existing environmental quality (EPA 2021a). GEM screened the proposed terminal sites by recording two of EPA's indicators on demographics, the percentages of the population that are low

Figure 9: EJSCREEN Demographic and Environmental Indicators for Proposed US LNG Export Facilities.

Note: Figures are based on impacts from existing emissions at each location and do not include the additional impact of proposed LNG projects.



Source: EPA 2021a.

income and people of color, and six indicators of existing environmental quality: concentration of particulate matter (PM 2.5) in air, concentration of ozone in air, concentration of diesel particulate matter in air, traffic proximity and volume, and EPA's indexes for air toxics cancer risk and respiratory hazard. Figure 9 plots the EJSCREEN indicators for the locations of proposed LNG export facilities, for which there are sufficient populations in the vicinity.[11] This data describes the current environmental quality of the sites and does not incorporate the additional impacts of the proposed projects. For more information on the terminals' potential air quality impacts, see the Environmental Integrity Project's Oil and Gas Watch website here, which provides emissions and other information on hundreds of US oil and gas projects (EIP 2021b).

As shown in Figure 9, eight proposed terminals are sited in communities in which the proportion of people of color is above the 50th percentile—i.e., the national median—and eleven proposed terminals are sited in communities in which the proportion of low-income people is above the 50th percentile.

Many proposed projects are sited in communities with pre-existing air quality issues, especially projects such as Cameron, Driftwood, Lake Charles, and Magnolia LNG terminals. Including those projects, there are nine sited in communities for which EPA's indexes for air toxics cancer risk and respiratory hazard are over the 50th percentile. New LNG terminals would exacerbate these air quality issues. LNG export terminals emit soot and particulate matter (PM 2.5), ozone-forming nitrogen oxides and volatile organic compounds, sulfur dioxide, and carbon monoxide, all of which are regulated by EPA because of their potential impacts on human health. These emissions are associated with lung damage, asthma, heart attacks, and cancer (EIP 2020).

The potential impacts of LNG terminals extend beyond air quality. Export terminals are at risk of vapor cloud explosions, in which refrigerants used in the liquefaction process vaporize and ignite. Three such explosions have occurred at petrochemical facilities in the United States and Latin America since 2009, resulting in fatalities and property damage, and engineers have argued that US industry calculations underestimate LNG facility explosion risks (Englund 2021). LNG projects can also cause chemical leaks, gas leaks into local water supplies, and increased traffic (with associated air pollution). In the small fishing town of Port Isabel, TX, close to the proposed Texas and Rio Grande LNG projects, residents fear that the terminals would harm local industries such as shrimping and tourism. As the Port Isabel city manager told the *Washington Post*, "A facility like this threatens our way of life" (Englund 2021).

Many of the U.S.'s proposed LNG terminals are sited in or near communities that are already facing compounding problems due to disasters, the long-ingrained impacts of systemic racism, and petrochemical facilities. As Roishetta Ozane and John Beard wrote in the *Houston Chronicle*, predominantly Black communities in Port Arthur and Lake Charles (home to the eponymous LNG projects) are regularly battered by hurricanes, receive less disaster aid than surrounding whiter and more affluent towns, and face abnormally high cancer rates—likely associated with industrial pollution (Ozane et al. 2021).

11. GEM recorded EJSCREEN data for proposed terminal sites with at least 250 people within a three-mile radius.

CONCLUSION

Efforts to develop new LNG export terminals have slowed to a crawl, with no US projects reaching FID in 2021. Even as the pandemic's impacts on global infrastructure investment fade, the outlook for new US LNG export projects is decidedly mixed. Although soaring international LNG spot prices and a short global supply make US LNG exports momentarily attractive, growing awareness of the industry's risks and impacts challenge the wisdom of developing long-term LNG assets. From an economic perspective, new US LNG projects are a risky bet that domestic production can outcompete plunging renewable energy costs and cheap foreign competition for decades, and that projects will outlast dwindling support for fossil fuels in a global energy transition. On climate, new LNG projects could lock in unacceptable levels of emissions well through the middle of the century, pushing the world further off the pathway to only 1.5°C of warming and sapping US authority on the global stage. For marginalized communities neighboring project sites, pollution from new LNG export facilities would be a grave injustice, threatening lives and livelihoods. All in all, the shortfalls of new LNG exports have made such projects a tough sell.

APPENDIX: THE TERMINALS

The following profiles describe the 21 major proposed US LNG export terminals covered in this report. For more information, see the terminals' pages on GEM.wiki.

Alaska LNG Terminal

Under development in Nikiski, Alaska, by the Alaska Gasline Development Corporation (AGDC), this project would include 3 trains providing 20.1 million tonnes per annum (mtpa) of capacity. The project would deliver methane gas extracted from Alaska's North Slope and transported through the proposed 800-mile Alaska LNG Pipeline (AKLNG). Together, the proposed terminal and pipeline have been described as the most expensive energy undertaking in North American history, with a combined price tag of $38.7 billion.

In November of 2017, China's biggest state oil company, Sinopec, along with one of China's top banks and its sovereign wealth fund, agreed to fund development. The announcement, made with fanfare as part of U.S. President Donald Trump's state visit to China, lacked details about binding offtake agreements or financing. In May 2020, the Federal Energy Regulatory Commission (FERC) authorized the project. FERC's approval has been challenged by a coalition of environmental and Alaska Native groups.

In February 2021, S&P Global reported that AGDC was shifting to a shorter and less expensive pipeline that would deliver gas from the North Slope to the central part of the state. According to Larry Persily, a former federal coordinator for Alaska gas pipeline projects under the Obama administration, Alaska's new plan is likely to fail: "The project is dead. It's been dead for a while, and reconfiguring it to be a smaller dead project is the same outcome.... Do they really think the Biden administration, this Congress and this country is going to contribute US$4.5 billion to a fossil fuel pipeline in the Arctic in 2021?"

Anticipated final investment decision: 2021 (delayed)
Offtake contracts: None confirmed
FERC: Approved
Proposed Carbon Capture and Storage: No

Cameron LNG Export Terminal Phase 2

Cameron LNG is an export terminal situated along the Calcasieu Channel in Hackberry, Louisiana. It is owned by a consortium that includes Sempra LNG 50.2%, Mitsui Group 16.6%, TotalEnergies 16.6%, Mitsubishi Corporation 11.6%, NYK Line 5.0%. A first phase of three trains was commissioned in 2019 and 2020, with a combined capacity of 13.5 million tonnes per annum. A second phase was originally proposed at 10 mtpa, but in June 2021, Sempra announced that Phase II was being scaled back to 6 mtpa, with the company aiming to take FID at the end of 2022.

Anticipated final investment decision: Late 2022
Offtake contracts: None confirmed
FERC: Approved
Proposed Carbon Capture and Storage: No

Commonwealth LNG Terminal

If built, Commonwealth LNG Terminal, located in Cameron Parish, Louisiana, will have 6 trains with a total capacity of 8.4 mtpa, estimated to cost $4.8 billion. In January 2018, Sumitomo Mitsui Banking Corporation (SMBC) was appointed as the project's financial advisor by Commonwealth LNG. In June of 2019, Commonwealth Projects and Gunvor Group Ltd signed a heads of agreement (HOA), which finalized a 15-year sale and purchase agreement (SPA) for 1.5 mtpa. In September of 2019, FERC formally accepted Commonwealth LNG's filing application; however, in March 2020, FERC suspended the environmental review due to delays in receiving key data from the company. In November of 2019, Commonwealth LNG, LLC announced a deal with Gunvor, in which the commodities trader will take 3 million metric tons of production from the plant and help Commonwealth LNG land contracts to sell the rest of the facility's production on the global market.

A filing by the National Marine Fisheries Service (NMFS) to FERC pointed out that an assessment that addresses the project's potential impacts to essential fish habitat is incomplete. NMFS also said that the project's main permitting review has been paused for more than a year due to the delay in the availability of a

draft Environmental Impact Statement (EIS). In August 2021, Commonwealth LNG asked FERC to reject calls to invalidate the plant's license on the grounds that no new evidence had been introduced since the license was granted in 2019. In October 2021, the company said that FID was delayed to 2023 owing to delays with the project receiving a permit certificate from FERC. The permitting from FERC was now anticipated by late 2022. In August 2021, the company signed a preliminary agreement with Bangladesh's Summit Oil & Shipping to potentially contract for up to 1 mtpa. Company president Varello also spoke of "substantial progress" on other contract agreements, representing more than half of the 7–7.5 mtpa commitment level needed for FID.

Anticipated final investment decision: Early 2023
Offtake contracts: None confirmed
FERC: Pending
Proposed Carbon Capture and Storage: No

Corpus Christi Liquefaction Stage 3

Currently, Corpus Christi LNG comprises three trains of 5 mtpa each, which began operating between 2018 and 2021. The facility is located on the La Quinta Channel in San Patricio County, Texas, and is owned by Cheniere Energy. A third stage of seven trains, totaling 11.5 mtpa, has been proposed, with the first train aimed at 2024 operation.

In 2020, the expected FID for the project was delayed due to a Covid-related global decline in demand for LNG. In June 2021, Cheniere entered into an SPA with the French utility Engie for 0.4–1.1 mtpa over 11 years, although it was not specified whether this volume would come from the existing terminal or from the proposed expansion. By July 2021, Cheniere had made three, 15-year gas supply deals tied to the expansion with US gas producers Apache and EOG Resources. and the Canadian oil and gas producer Tourmaline. Combined, the three integrated product marketing agreements represent a total of 2.55 mtpa of the facility's expected capacity of 10 mtpa. In September 2021, Cheniere announced that it expected to take FID in 2022. In October and November, Cheniere announced a series of new purchase agreements, though in each case the company did not specify whether the gas would come from the existing terminal or the proposed new stage. Companies agreeing to SPAs include China's ENN Natural Gas (a 13-year term 0.9 mtpa), Swiss-based commodities trader Glencore and Cheniere Energy for 0.8 mtpa of LNG (also a 13-year term), Sinochem Group Co., Ltd. (a 17.5-year term starting at 0.9 mtpa and increasing to 1.8 mtpa), and Foran Energy Group Co., Ltd. (a 20-year term for 0.3 mtpa).

Anticipated final investment decision: 2022
Offtake contracts: Potential contracts with Glencore, ENN Natural Gas, Engie, Foran Energy Group, Sinochem Group, NFE North Trading, and/or Posco (unconfirmed which will supply Corpus Christi Stage 3)
FERC: Approved
Proposed Carbon Capture and Storage: No

CP2 LNG Terminal (Phases 1 & 2)

Located in Cameron Parish, Louisiana, Venture Global's CP2 LNG Terminal would include 24 mtpa of capacity, built in two phases. If built, this will be Venture's second LNG export terminal; the company also owns the Calcasieu Pass LNG Terminal and is seeking to build the Plaquemines LNG Terminal and the Delta LNG Terminal. The CP2 project would include the CP Express Pipeline, an 87.5-mile pipeline running from Jasper County, Texas, to the facility, and a 1,400 MW combined cycle gas-turbine power station. In December 2021, Venture Global submitted an application to FERC for authorization to build the terminal and the pipeline. Construction is aimed to begin in the second quarter of 2023, with first deliveries planned for 2025 and full commercial operations by mid-2026. Construction on the first phase would begin with the receipt of regulatory approvals; the second phase would depend on market conditions.

Anticipated final investment decision: Unknown
Offtake contracts: None confirmed
FERC: Pending
Proposed Carbon Capture and Storage: Yes

Delfin LNG Terminal

Delfin is a deepwater port and four floating liquefaction (FLNG) vessels that would be located about 50 miles off the coast of Louisiana. Each of the four FLNG vessels will have a capacity of 3 mtpa capacity; according to the company, each will have its own independent

FID. Since its application to export LNG was approved by the U.S. Department of Energy in 2017, the project has received three extensions. The project is owned by Fairwood Peninsula Energy Company.

Anticipated final investment decision: 2021 (delayed)
Offtake contracts: None confirmed
FERC: Approved
Proposed Carbon Capture and Storage: No

Delta LNG Terminal

The Delta LNG Terminal is located in Plaquemines Parish, Louisiana and is owned by Venture Global LNG; initial certification of the project was received from FERC in 2021. Phase I construction was scheduled to commence in 2021 but did not. Commercial operations are expected in 2024. Phase II construction is expected to begin in 2022, with commercial operations expected in 2025. If fully constructed, the facility would comprise 36 0.626 mtpa liquefaction trains, configured in 18 blocks, four 200,000 cubic meter full containment LNG storage tanks, three marine loading berths for ocean-going vessels, and 1,240 megawatts of combined cycle on-site power generation.

Anticipated final investment decision: Unknown
Offtake contracts: None confirmed
FERC: Approved
Proposed Carbon Capture and Storage: No

Driftwood LNG Terminal

Owned by Tellurian Inc., Driftwood is a proposed LNG export terminal on the brink of beginning construction in Calcasieu Parish, Louisiana. If the entire project moves forward, Driftwood LNG Terminal will have 4 phases. The first phase is a two-plant, 9.2 mtpa capacity while the remaining phases each have 6 mtpa capacity for a total capacity of 27.2 mtpa.

Tellurian filed an application to FERC in 2017 which has been approved. Tellurian secured a US$75 million loan for the Driftwood Terminal from Swiss bank UBS in 2019, with Goldman Sachs, and Société Générale acting as financial advisors. The total anticipated cost for all 4 phases is US$30 billion. In June of 2020, Tellurian confirmed that the construction start for the Driftwood terminal would be delayed until 2021 and further disclosed that LNG production at the terminal would also be delayed until the end of 2024, with full operations expected by 2026 or 2027. The company's difficulties in securing partners for the project along with the downturn in LNG prices, which has been exacerbated by Covid-19, were cited as reasons. Nonetheless, in May, June, and July of 2021, Tellurian announced three 10-year SPAs with commodity trader Gunvor Group for 3 mtpa, the global energy trading business Vitol for 3 mtpa, and with Shell for a further 3 mtpa of LNG. However, also in July 2021, Tellurian said that it had terminated a stock purchase agreement signed in 2019 with TotalEnergies which would have seen the French energy giant invest up to US$700 million and take up to 2.5 million metric tons of LNG per year from the Driftwood terminal, possibly due to a failure to reach FID by July 10 of that year. A summer 2021 report found that Driftwood "looks extremely likely to go ahead next year."

Securing financing for the project from banks and other investors, however, remained challenging as its SPAs for 10-year terms rather than the 20-year contracts which underpinned the first wave of US LNG terminals, according to an August 2021 report by the Institute for Energy Economics and Financial Analysis. The report additionally noted that Tellurian also needs to acquire about 1.5 billion cubic feet per day of upstream gas production to feed the facility. Tellurian has said it will not proceed with a FID for the project until it secures sufficient upstream reserves – about 1.5 billion cubic feet per day – for the first phase. The company currently expects to have only 100 million cubic feet per day in production by the end of 2021 from its drilling program in the Haynesville Shale. Yet, in February 2022 Tellurian's Executive Chairman Charif Souki announced that Driftwood would begin construction in April 2022, even without having reached FID by that date. As of this report's writing, it is unclear what construction activities would be taking place and how Tellurian would move the project forward without it being financed.

Anticipated final investment decision: 2022 (Phase I)
Offtake contracts: Three 10-year SPAs with Gunvor Group, Vitol, and Shell
FERC: Approved
Proposed Carbon Capture and Storage: No

Eagle LNG Terminal

This project, also known as the Jacksonville LNG Terminal, will serve as a dual import and export terminal for the general Jacksonville, Florida area. The Eagle LNG Terminal received approval from FERC in April of 2019. The project was initially to begin construction in 2019, but construction has been delayed due to the Covid-19 pandemic. Construction of the export terminal is now expected to begin no later than May of 2022 with a 2026 target date for start of operations. Unidentified Central American and Caribbean Island nations are the intended targets of Eagle LNG's export drive. With an export capacity of 1 mtpa, the terminal's aim is to use smaller LNG carrier ships to target lower volume, under-served markets. Ferus Inc. is the owner of Eagle LNG Terminal and is expected to spend US$542 million in construction costs for the project. The project has been provided a Recapture Enhanced Value Grant of up to US$23 million from the city of Jacksonville.

Anticipated final investment decision: Unknown
Offtake contracts: None confirmed
FERC: Approved April, 2019
Proposed Carbon Capture and Storage: No

Fourchon LNG Terminal

The Fourchon LNG Terminal is proposed to be built in two phases, the first phase having a capacity of 2 mtpa and the second adding a further 3 mtpa. The terminal would be built to the west of Belle Pass on a 150-acre site located on property owned by the Greater Lafourche Port Commission, outside of the existing developments of Port Fourchon, Louisiana. The cost of the project is estimated to be US$888 million for the first phase; cost estimates for the second phase were not provided. The terminal's parent owner, Energy World, had anticipated that construction and operations of the first phase of the project would have begun already in Q2 of 2021 and that the second phase would be operational by 2023. Energy World has filed an application with FERC but approval is pending on a number of assessments that have delayed the project by at least two years.

Anticipated final investment decision: Unknown
Offtake contracts: None confirmed
FERC: Pre-filing
Proposed Carbon Capture and Storage: No

Freeport LNG Terminal Train 4

The Freeport LNG Terminal began export operations in 2019 with a total capacity of 15.3 mtpa. An expansion to add a fourth train to the terminal is in development that would add an additional 5.1 mtpa capacity with an expected start year of 2026. The terminal is owned by Freeport LNG Development which in turn has multiple ultimate owners including Zachary Hastings, Osaka Gas, Dow Chemical Company, and Global Infrastructure Partners. The terminal is located in Freeport, Texas. Financing for the initial phase was provided in 2014 from the Japan Bank for International Cooperation (US$2.6 billion) and from various Japanese commercial banks and Dutch bank ING (US$1.67 billion), with the private financing portion insured by Nippon Export and Investment Insurance (NEXI).

The FID for the Train 4 expansion was delayed beyond the original FID timing of 2020 citing Covid-19, plunging demand and the crash in oil prices as the reasons for the delay, and in August of that year Freeport LNG asked FERC for an additional three years until May 2026 to complete the expansion. Freeport LNG has secured a loan of approximately US$1 billion from Westbourne Capital, an Australian investment manager, to cover the cost of Train 4 construction, though FID for the Train 4 expansion is still not expected until summer of 2022. The expansion project had a preliminary agreement signed in 2018 by Japan's SMBC for the purchase of 2.2 mtpa of LNG from Train 4, however the agreement expired without being finalized. Recently, Japan's largest power generation company JERA announced that it would take a 25.7% equity stake in Freeport LNG Development and will work with them to further development of the Train 4 expansion. In November 2021, Freeport announced plans to develop a carbon capture and sequestration (CCS) project adjacent to their gas pretreatment facilities. In mid-September 2021, a power outage caused by Tropical Storm Nicholas led to all three liquefaction trains at the plant going offline. The timing of the terminal's startup remained unclear as of this writing.

Anticipated final investment decision: Mid-2022
Offtake contracts: None confirmed
FERC: Approved
Proposed Carbon Capture and Storage: Yes

Gulf LNG Terminal

Gulf LNG Terminal is currently a mothballed import terminal with plans to add liquefaction and export capabilities. The terminal is located near the City of Pascagoula in Jackson County, Mississippi. The proposed export project consists of two trains, each with a 5.43 mtpa capacity. If the roughly US$8 billion project proceeds, the terminal would retain its current capacity to import, store, and deliver natural gas; therefore the Gulf LNG Terminal would be bi-directional. The project is owned by Gulf LNG Energy which is in turn owned by Kinder Morgan (50%), GE (40%), and AES (10%). FERC approval for the export terminal was received in July 2019 by a 3–1 vote. FID for the project is unknown and no known contracts are confirmed.

Anticipated final investment decision: Unknown
Offtake contracts: None confirmed
FERC: Approved
Proposed Carbon Capture and Storage: No

Lake Charles LNG Terminal

Lake Charles LNG, formerly Trunkline LNG, is a liquefied natural gas import and regasification plant in Lake Charles, Louisiana that is a wholly owned subsidiary of Energy Transfer. An export terminal expansion project is proposed at the site. The proposal includes three production trains, with 5.93 mtpa of capacity each. As of September 2021, no LNG supply agreements or contracts have been announced by the project developer, and the FID has been delayed by Energy Transfer. The project is also waiting for approval of an air permit from the Louisiana Department of Environmental Quality and the approval of two export capacity applications. In February 2022, Energy Transfer asked FERC for a three-year extension to build the facility following delays.

Anticipated final investment decision: 2021 (delayed)
Offtake contracts: None confirmed
FERC: Approved
Proposed Carbon Capture and Storage: No

Magnolia LNG Terminal

The Magnolia LNG Terminal is a proposed LNG export terminal in Lake Charles, Calcasieu, Louisiana and is being advanced by the Glenfarne Group. The project is to be developed in 2 phases, each with 2 trains (2.2 mtpa per train). Magnolia LNG received its FERC permit in April of 2016, authorizing the project's construction and operation. However, the FID and construction start dates have been delayed several times. Magnolia LNG asked FERC for another five years—out to April 2026—to complete the project and associated facilities that would supply the terminal. In September 2021, Glenfarne Group's Project Director John Baguley stated that the project's FID was further delayed, probably out to the end of 2023.

Anticipated final investment decision: Late 2023
Offtake contracts: None confirmed
FERC: Approved
Proposed Carbon Capture and Storage: No

Plaquemines LNG Terminal

Located in Plaquemines Parish, Louisiana, this project is owned by Venture Global LNG. The project encompasses two phases, each with 18 trains, and is set to have an overall capacity of 20 mtpa if fully developed. In September 2019, the project received full FERC approval. FERC also approved the associated Gator Express Gas Pipeline system, which is intended to bring natural gas from existing pipelines to the new facility. The project has SPAs with Electricité de France SA (EDF) for 1 mtpa and the Polish Oil & Gas Company (PGNiG) for 4 mtpa. Although FID has not been reached, initial construction activities were reported to have started at the project site in September 2021. The project is expected to be operational in 2024–2025.

In May 2021, Venture Global LNG announced that it plans to capture and sequester carbon at both its Plaquemines LNG Terminal and Calcasieu Pass Terminal in Louisiana. The company estimates that it will capture and sequester an estimated 500,000 tons of carbon per year from both Plaquemines and Calcasieu. Commenting on the CCS project in June 2021, the company's CEO Michael Sabel said: "We don't need any new technology to do it. We don't need any additional outside funds to do it. We're able to do it as soon as the permitting process allows us to go forward." From a climate perspective, the emissions mitigation from such a facility would be minimal; combined

Plaquemines and Calcasieu Pass LNG Terminals are permitted to emit up to 12 million tonnes of CO_2e (evaluated on a 100-year time frame), and emissions from liquefaction are a fraction of LNG's total lifecycle emissions.

Anticipated final investment decision: 2021 (delayed)
Offtake contracts: Five 20-year SPAs with PGNiG, Electricité de France, Sinopec, and CNOOC
FERC: Approved
Proposed Carbon Capture and Storage: Yes

Pointe LNG Terminal

This project, in Plaquemines Parish, Louisiana, will have a capacity of 6 mtpa, oversized storage tanks and dock for possible future growth, a pipeline, and a liquefaction plant. The project is expected to be supplied by Kinder Morgan's existing Tennessee Gas Pipeline and Southern Natural Gas (SNG) Pipeline. In December 2020, Pointe LNG disclosed that it had a letter of intent from a customer to buy 1.5 mtpa of LNG. The company declined to disclose the buyer, citing a confidentiality agreement. In November 2021, FERC terminated a pre-filing review for the export terminal, citing no progress since 2018. A co-founder of the project stated that Pointe LNG was raising funds to complete the permitting process and reach FID within 24 months thereafter.

Anticipated final investment decision: 2022
Offtake contracts: None confirmed
FERC: Pre-filing review terminated due to inaction
Proposed Carbon Capture and Storage: No

Port Arthur LNG Terminal

Port Arthur LNG Terminal is a proposed LNG terminal in Port Arthur, Texas. The proponents of the project are Sempra LNG & Midstream and Woodside Energy. Phase I will include 2 trains with a total of 11 mtpa production capacity; this phase has been approved by FERC. Phase II will have an additional 2 trains and another 11 mtpa production capacity, bringing the proposal to 4 trains with a total of 22 mtpa.

In 2018, PGNiG announced a 20-year SPA agreement for supply of LNG, and in 2019, Saudi Aramco agreed to buy a stake in the Port Arthur LNG terminal. Both deals have since fallen through and the FID has been delayed several times. Sempra has said that the expansion of its Cameron LNG Terminal, predicted to reach FID by the end of 2022, is now more of a priority than Port Arthur, which suggests that FID for the project has now been pushed out to 2023 at the earliest.

Local community group Port Arthur Community Action Network (PACAN) has raised many issues with the Texas Commission on Environmental Quality (TCEQ) over Sempra's request for air emission permits for phase II of the terminal project. In August 2021, PACAN succeeded in gaining an additional hearing after TCEQ officials asked to learn more about their concerns. The scale of the project and the emissions it could create are thought to have influenced certain of the officials to opt for additional time and effort to further consider the permitting process.

Anticipated final investment decision: 2023
Offtake contracts: None confirmed
FERC: Approved (Phase 1), Pending (Phase 2)
Proposed Carbon Capture and Storage: No

Repauno Works LNG Terminal

The Repauno Works LNG Terminal is a proposed export terminal in Greenwich Township, New Jersey. The project's sponsor is Delaware River Partners, owned by Fortress Transportation and Infrastructure Investors, LLC. The project has a total estimated cost of US$450 million to develop an export capacity of 1.5 mtpa along with an expanded underground storage cavern and a rail-unloading facility. The terminal would receive Marcellus shale gas by trucks or rail cars from the proposed New Fortress LNG Terminal in Wyalusing, Pennsylvania. This plan followed federal approval by the Pipeline and Hazardous Materials Safety Administration (PHMSA) in July 2020 of the United States' first LNG-by-rail permit which would allow trains to carry LNG across the country. Fourteen states—including Pennsylvania, New Jersey and Delaware—and the District of Columbia filed a legal challenge to the new federal rule as they say it poses health, safety, and environmental risks. In November 2021, PHMSA announced that it would suspend authorization for LNG transport by rail car. The project has met resistance from local government bodies, health

professionals, and environmental groups due to the risks of LNG transport by rail, impacts communities of color and low-income communities, and other environmental factors. Delaware River Partners has petitioned FERC for an order that would make the site's operations not subject to the agency's approval.

Anticipated final investment decision: Unknown
Offtake contracts: None confirmed
FERC: Developers dispute FERC authority over permit
Proposed Carbon Capture and Storage: No

Rio Grande LNG Terminal

Originally planned with six production trains of 4.5 mtpa each, for a total capacity of 27 mtpa, NextDecade's Rio Grande LNG Terminal project has since been reduced to 5 trains. However, the capacity of each train was increased to 5.4 mtpa, maintaining a total capacity of 27 mtpa. The facility is planned to be located in Cameron County, Texas.

FID for the project has been delayed several times, though in August 2021, NextDecade continued to maintain that FID for an initial two-train, 11 mtpa phase was being targeted before the year's end, despite having secured only one contract with Shell for 2 mtpa. FERC's 2019 approval of the project and the US Army Corps of Engineer's water permit have been challenged in court by several opposition groups. In August 2021, the U.S. Court of Appeals for the District of Columbia found that FERC did not go far enough in considering environmental justice and climate impacts in their approval of both the Rio Grande LNG Terminal and the Texas LNG Terminal. The court remanded the orders authorizing the projects but did not vacate them, finding that FERC "is likely to remedy any deficiencies" of its previous ruling on the projects. The promoters of Rio Grande LNG and Texas LNG reacted to the ruling by suggesting that it will likely not end the commercial development of the facilities.

In November 2021, NextDecade submitted a proposal to FERC to incorporate a carbon capture and storage system to the project that it said would capture at least 90% of emissions from the terminal.

Anticipated final investment decision: Late 2022
Offtake contracts: One 20-year SPA with Shell
FERC: Initially approved, but FERC must redo assessment per court order
Proposed Carbon Capture and Storage: Yes

Texas LNG Terminal

This proposed LNG terminal in the Port of Brownsville, Texas is being developed by Alder Midstream and Samsung Engineering. FID, which has been delayed several times, is now expected at the end of 2022. If completed, the project will have a capacity of 4 mtpa (2 mtpa per train). As discussed above, FERC's approval of this project was successfully challenged, but the promoters remain confident that the project will proceed.

Anticipated final investment decision: Late 2022
Offtake contracts: None confirmed
FERC: Initially approved, but FERC must redo assessment per court order
Proposed Carbon Capture and Storage: No

West Delta LNG Terminal

LNG 21, through its subsidiary, West Delta LNG, is developing the West Delta LNG Export Deepwater Port in federal waters offshore Plaquemines Parish, Louisiana. The project is based upon a new concept design, with a fixed-platform LNG production facility in uncongested open-waters with easy access for LNG carriers. The project is designed to include six modular natural gas liquefaction trains, each with a nameplate capacity of 0.833 mtpa and the potential for up to 1.02 mtpa each, providing a total optimal capacity of 6.1 mtpa of LNG. The project is expected to begin operating in 2023–2024.

Anticipated final investment decision: Unknown
Offtake contracts: None confirmed
FERC: Pending application with US Maritime Administration (MARAD)
Proposed Carbon Capture and Storage: No

METHODOLOGY

Data on LNG terminals is based on GEM's Global Gas Infrastructure Tracker as of February 2022. Excluding Profundo's analysis, data on LNG terminal financing and contracting was collected from the *IJGlobal Project Finance & Infrastructure Journal* and other online reporting.

To provide capital expenditures for proposed LNG facilities, GEM used official projected costs where available and otherwise estimated costs using global averages. The International Gas Union (IGU) has found that onshore greenfield and brownfield LNG export terminals cost US$1501 and US$458 per tonne, respectively (IGU 2018). Greenfield costs were used to estimate the costs of any deepwater LNG facilities, for which there is little data available. Whether a given terminal's cost was estimated by GEM is shown in Table 5.

Profundo's financial analysis sought to study the financial flows to the projects, project companies, and sponsors in Table 4. The creditor analysis used the financial databases Refinitiv, Bloomberg, as well as TradeFinanceAnalytics, IJGlobal project finance database, annual reports, company websites and other company publications, to identify the financial institutions providing loans and issuance underwriting services to the selected projects, project companies and sponsors. Creditor links were researched for the period 2016–2021 (September). The bond and shareholder analysis used Thomson EMAXX and Refinitiv to identify the investors in the bonds and stock-listed shares of the project companies and sponsors where relevant. Investor links were researched at the most recent filing date available in December 2021.

The environmental justice analysis collected data from EPA's EJSCREEN tool. For a selected area, EJSCREEN provides a series of indicators on demographics and existing environmental quality issues based on 2014–2018 American Community Survey estimates and US Census block groups (EPA 2021a). GEM screened the proposed terminal sites by recording two of EPA's indicators on demographics, the percentages of the population that are low income and people of color, and six indicators of existing environmental air quality: concentration of particulate matter (PM 2.5) in air, concentration of ozone in air, concentration of diesel particulate matter in air, traffic proximity and volume, and EPA's indexes for air toxics cancer risk and respiratory hazard. GEM only presented EJSCREEN data for facilities that were onshore and had at least 250 people within 3 miles of the site. Site locations were derived from GEM data, with support from Healthy Gulf.

Table 5: LNG Export Terminal Costs Estimates and Sources

Terminal	Cost (US billions)	Cost Source
Alaska LNG Terminal	$32.2	Official/GEM[a]
Cameron LNG Export Terminal Phase 2	$2.7	GEM
Commonwealth LNG Terminal	$4.8	Official
Corpus Christi LNG Terminal Stage 3	$5.3	GEM
CP2 LNG Terminal	$9.2	GEM
Delfin LNG Terminal	$7	Official
Delta LNG Terminal	$33.9	GEM
Driftwood LNG Terminal	$30	Official
Eagle LNG Terminal	$0.542	Official
Fourchon LNG Terminal	$2.3	Official/GEM[b]
Freeport LNG Terminal Train 4	$2.3	GEM
Gulf LNG Terminal	$8	Official
Lake Charles LNG Terminal	$10.9	Official
Magnolia LNG Terminal	$13.2	GEM
Plaquemines LNG Terminal	$13.1	Official/GEM[c]
Pointe LNG Terminal	$4	Official
Port Arthur LNG Terminal	$8.5	Official
Repauno Works LNG Terminal	$0.45	Official
Rio Grande LNG Terminal	$40.5	GEM
Texas LNG Terminal	$6	GEM
West Delta LNG Terminal	$9.2	GEM

Source: Global Energy Monitor. For more information, see GEM.wiki.

a. The official estimate for the cost of the Alaska LNG Terminal and associated pipeline is US$38.7 billion. GEM estimated the cost of the pipeline using data from (Smith 2020, p.2), and subtracted that estimate from the total official cost.

b. The official estimate for the 2 mtpa Phase 1 of Fourchon LNG Terminal is US$888 million. GEM added the estimated (brownfield) cost of the remaining 3 mtpa in Phase 2.

c. The official estimate for the 10 mtpa Phase 1 of Plaquemines LNG Terminal is US$8.5 billion. GEM added the estimated (brownfield) cost of the remaining 10 mtpa in Phase 2.

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