Global Energy Monitor

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LNG Industry Plans to Capture Carbon

CARBON CAPTURE AND STORAGE AT LNG EXPORT TERMINALS WOULD ADDRESS ONLY A SMALL FRACTION OF THIS FUEL'S EMISSIONS

Summary

In recent months, the US natural gas industry has begun announcing plans to capture carbon dioxide (CO_2) emissions at facilities that export liquefied natural gas (LNG), loading it onto tankers that ship it thousands of miles away, typically to Europe or Asia.

Carbon capture and storage (CCS) has become a key part of industry claims for "green LNG," "carbon neutral LNG," and "net-zero LNG." With such claims, the industry has portrayed LNG as environmentally friendly, and consistent with the Paris Agreement that aims to drastically reduce greenhouse gas emissions.

However, gas industry plans for CCS at LNG export terminals often do not hold up to scrutiny, amounting to greenwashing. If CCS is applied to LNG export facilities, it would capture only a small fraction of the total life-cycle emissions occurring from the extraction, transport, and use of natural gas.

Even when CO_2 is captured, historically its primary use has been for enhanced oil recovery (EOR), a technique used to extract more oil from the ground. The process of capturing CO_2 and using it for EOR leads to increased greenhouse emissions overall, tarnishing the supposed "green" image of LNG with CCS.

Finally, many claims of "green LNG" rely heavily on purchasing carbon offset credits to ostensibly cancel out other emissions that occur in the gas supply chain. However, offset credits are often of questionable quality, leading to no verifiable emissions sequestration or reduction; high-quality offset credits, on the other hand, have been limited in scale.

Industry claims

One of the companies seeking to build an LNG CCS export terminal, NextDecade, has claimed that its proposed Rio Grande LNG terminal in Texas, with gas export capacity of 27 million tons per year (mtpa), will become the "greenest LNG project in the world." In a June presentation to investors, the company also billed itself "a clean energy company accelerating the path to a net-zero future."

Another company seeking to scale LNG CCS—G2 Net Zero LNG, with a proposed terminal in Louisiana with capacity of 13 mtpa—has also stated that by 2027 it will become the first lifecycle "net zero" greenhouse gas emissions exporter of LNG.

Venture Global also plans to apply CCS at its Calcasieu Pass LNG Terminal, now under construction with 10 mtpa capacity, and its proposed Plaquemines LNG Terminal (20 mtpa capacity). The company may also apply CCS at its proposed CP2 LNG Terminal (24 mtpa capacity).

Two other U.S.-based LNG exporting companies, Cheniere Energy and Sempra, have also declared interest in beginning to use LNG CCS. For example, in June 2021, Sempra incorporated an LLC focused on carbon sequestration in Louisiana for emissions from its Cameron LNG terminal, with 13.5 mtpa capacity that began operation in 2019–20, and an additional 6 mtpa capacity proposed.

The proposed LNG CCS projects are part and parcel of a bigger vision conveyed by the global natural gas industry to go "carbon neutral" and pursue what the industry sometimes refers to as "green LNG." Yet to-date, LNG CCS has proven more of a talking point and less of a reality.

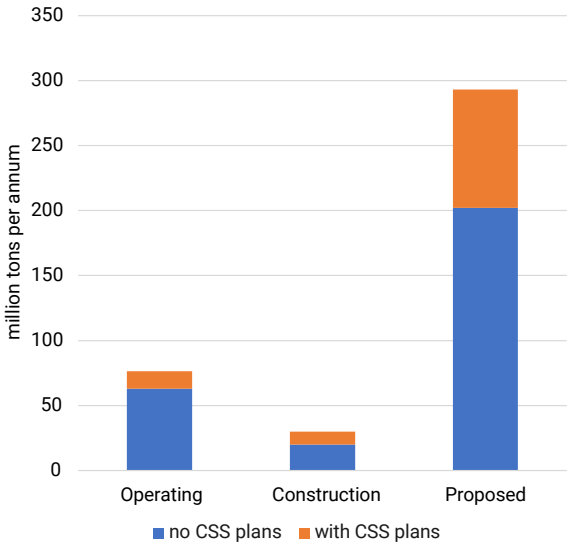
Today, only two LNG CCS facilities exist globally, in Norway and Australia, with another in Qatar scheduled to start operation in 2025. As described below, the Australian site has faced persistent technological difficulties and delays.

Emissions from LNG

In addition to plans for CCS at LNG terminals that are already operating or under construction, proposed LNG terminals with CCS—Rio Grande, G2 LNG, Plaquemines, CP2, and an expansion of Cameron—would add another 91 mtpa of LNG export capacity, greater than the United States' current operating LNG export capacity of 77 mtpa (Figure 1).

Figure 1. US LNG export terminal capacity by status.

Terminals with plans to add CCS are shown in orange.
CCS may capture only a small fraction of the terminals' emissions.



Source: Global Energy Monitor, Global Fossil Infrastructure Tracker

LNG export facilities use prodigious amounts of energy to supercool natural gas to enable it to be loaded onto tankers. For example, Venture Global's LNG terminals at Calcasieu Pass and Plaquemines annual greenhouse gas emissions would be 12 million tons of CO_2 equivalent, according to permitting data gathered by the Environmental Integrity Project. Based on data from the Environmental Protection Agency, the emissions from these two LNG terminals would be equivalent to that of 2.6 million typical cars. Venture Global announced that it would capture and store only half a million tons of CO_2 annually from these terminals—less than 5% of the emissions from the terminals.

The climate impact of LNG is much greater than the emissions from the export terminals, since most of the emissions from the whole life cycle for LNG occur in steps either before or after liquefaction at an export terminal. A 2019 study on emissions from US LNG exports published by the Department of Energy concluded that only 6 to 7% of the total life cycle greenhouse gas footprint comes from the liquefaction process.

The biggest source of emissions is from burning the gas for end use, for example in a power plant, and those uses rarely include CCS, so the emissions escape into the atmosphere.

Other major sources of emissions include the steps of extraction and transmission of the gas through pipelines, including significant amounts of leakage of gas. Natural gas is composed mainly of methane, and when methane leaks, this adds a large amount of additional emissions to the total life cycle emissions. In studies of life cycle emissions from LNG, methane leaks from liquefaction, shipping, and regasification are typically assumed to be zero—but this may be underestimating the true emissions.

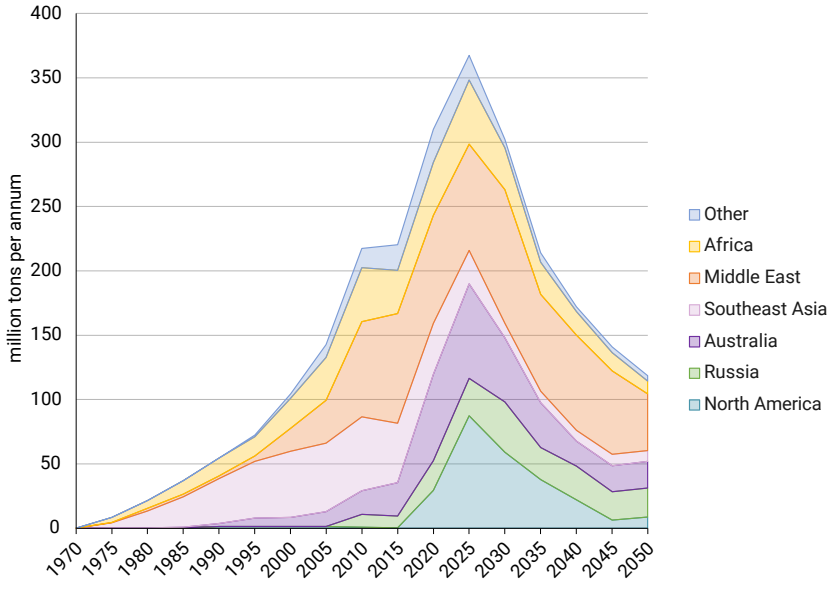
Some plans call for capturing nearly all of the emissions from LNG terminals. For example, NextDecade announced plans to add CCS to the Rio Grande LNG terminal, claiming the ability to cut emissions by more than 90%. Yet even if all emissions from LNG export terminals were captured and stored, that would address only a small fraction of the total emissions from LNG.

Meanwhile, some proposals for LNG CCS would capture only a fraction of the terminals' emissions. Venture Global's plans for Calcasieu Pass and Plaquemines terminals, for example, would capture only half a million tons of CO_2, compared with over 105 million tons of CO_2 equivalent emissions, according to permitting data gathered by the Environmental Integrity Project—so LNG CCS would capture less than 0.5% of the total life cycle emissions from the gas they export.

Last year, the French government expressed concerns about the high life cycle emissions from US LNG, including from large methane leakage, so that importing US LNG would not be in line with French and European climate targets. In response, in November 2020 the major French company Engie decided against a contract to import gas from the Rio Grande LNG terminal.

But even if CCS were added to LNG export terminals, a proliferation of LNG would run counter to the needed reduction in LNG trade foreseen by a landmark International Energy Agency report, Net Zero by 2050, published earlier this year. That report developed a scenario for cost-effectively achieving the goals of the Paris Agreement, concluding that "many of the liquefied natural gas (LNG) liquefaction facilities currently under construction or at the planning stage" are "not needed." The scenario foresees LNG exports globally peaking in 2025, and then declining sharply, with LNG trade decreasing 68% from 2025 to 2050 (Figure 2). In this scenario, LNG exports from North America would decline even more dramatically, falling 90% from 2025 to 2050.

Figure 2. Global LNG trade in IEA's *Net Zero by 2050* report, which details a scenario consistent with the Paris Agreement.



Source: IEA *Net Zero by 2050* report

Failures and cost overruns

Even if the emissions-cutting premise of LNG CCS is taken on its face, the application of CCS has been fraught with difficulty.

For example, the Gorgon gas extraction and LNG export project in Australia—billed by its operator, Chevron, as "the world's largest commercial-scale carbon dioxide injection project"—has been beset by technical problems and cost overruns. Gorgon's natural gas is rich in CO_2, which must be removed prior to liquefying the gas for shipping as LNG. The Western Australia state government requires Gorgon to capture and store 80% of this CO_2, measured on a five-year rolling average basis.

But Gorgon's CCS component has faced many years of delays and technological turmoil, including a recently commenced five-month hiatus due to injection failures. Meanwhile, gas production and LNG exports have continued with the CO_2 vented into the air. The facility exported LNG for three years before it finally began successful capture of any of its CO_2 emissions. During the years of delays and technological problems, emissions from the facility have far exceeded the targets, with the facility becoming one of the top greenhouse gas emitting sources in the country. After five years of operation, "all components of the CO_2 injection system are yet to work simultaneously," according to an Australian news site Boiling Cold, adding that "up to mid-2020, seven million tonnes of CO_2 was vented to the atmosphere that should have been buried."

Gorgon has also run into economic issues, with cost overruns for building and maintaining the facility, soaring from its initial sticker price of US$ 37 billion in 2009, when the final investment decision was made, to over US$ 55 billion as of 2017.

In a July 19 press release, Chevron noted that Gorgon has failed to meet the five-year regulatory mandate for burying carbon underground via its capture facility—but did not disclose exact numbers. Reportedly the project managed to capture only 30% of the CO_2 that was targeted, and now the project may be forced to negotiate a new emissions target with the Western Australia government. Due to this failure, the project may be levied with high costs to purchase offset credits, perhaps AU$ 100 million (US$ 74 million), in an attempt to cancel out the emissions that occurred.

Attempts to apply CCS at coal- and natural gas-fired power plants have also run into similar issues in the US. There were three such facilities in the US that were highly touted, but were ultimately scuttled upon cost overruns and technological snafus: the FutureGen coal-fired power plant in Illinois, the Petra Nova coal-fired power plant in Texas, and the Kemper Project coal gasification power plant in Mississippi. Nonetheless, Mitsubishi—the company responsible for the CCS technology at both Petra Nova and Kemper—is also developing the CCS technology for NextDecade's proposed Rio Grande LNG Terminal.

Even Venture Global LNG, which is now proposing to use LNG CCS, has expressed skepticism about the performance of LNG CCS technology. The company told the Federal Energy Regulatory Commission (FERC) in 2019 that "CCS is not economically feasible" and that it "would cause significant adverse energy and environmental impacts due to the additional water and energy needs for system operation, with the associated generation of additional GHGs and other criteria pollutants from natural gas firing in combustion units."

CO_2 for Oil Recovery

Currently the primary use of captured CO_2 is for enhanced oil recovery (CO_2 EOR), a technique used to extract more oil from the ground, done under the banner of carbon capture, utilization and storage (CCUS).

Oil extraction appears central for one of the proposed LNG CCS facilities, G2 Net Zero LNG, which has cited CO_2 enhanced oil recovery (EOR) as a key end-use for the carbon captured at the facility.

NET Power, which plans to supply the CO_2 capture technology for the G2 LNG Terminal, also touted its ability to produce usable carbon for the CO_2 EOR process during its foundational days, stating in 2012: "Unlike traditional carbon capture technologies, the NET Power cycle inherently produces pipeline-ready CO_2 for sequestration or use in enhanced oil recovery." The company, in a 2016 presentation, also listed CO_2 EOR as one of the top end-uses for the carbon captured at its facilities.

As of a 2014 US Department of Energy study, 97% of industrial marketed CO_2 was used for EOR. Multiple studies have indicated that utilizing carbon for CO2 EOR leads to net-positive greenhouse gas emissions under all scenarios.

Role of Tax Credits

Two of the three proposed LNG CCS facilities, G2 Net Zero LNG and Rio Grande LNG, have stated intentions to utilize the 45Q tax credit granted by the US Internal Revenue Service. Currently, 45Q provides tax credits of $31.77 per ton for CO_2 captured and stored when simply buried underground, and $20.22 per ton when used for CO_2 EOR. Enacted in 2008 and extended and amended in 2018 by Congress, the tax credit has proven economically vital for facilitating CO_2 EOR, even as the major CCS power plant facilities reliant on that tax credit have failed to scale in Texas, Illinois, and Mississippi. But this means that taxpayers may soon be subsidizing the application of CCS to reduce the climate impacts of LNG.

The 2018 amendments to the 45Q tax credit made it more economically feasible to build CCS facilities, at least in theory, changing the cap on allowable tax credit claims from 75 million tons of CO_2 captured to a simple time window of 12 years and ending the CO_2 tonnage limit.

Congress and the Biden administration are also currently considering a "direct pay" provision for claiming 45Q tax credits. "Direct pay" would provide a more easily accessible upfront payment for project developers, rather than obtaining the tax credits post-construction. Thus direct pay makes projects less reliant on the financially limited tax equity financing market and potentially cuts out the need for the financial services industry middle man. NextDecade has praised President Joe Biden's American Jobs Plan's proposal to reform 45Q via a "direct pay" option.

Some members of Congress have also introduced legislation in recent months calling for an increased price per ton for CO_2 captured or stored under 45Q, as well as extending the currently mandated deadline from 2026 to 2030 for when an eligible project must begin construction.

Tax credits from 45Q, though, have been subject to poor oversight from the Internal Revenue Service, leading to the claiming of hundreds of millions of dollars for storage that may not have occurred, according to an investigation by environmental watchdog Clean Water Action and a report by the Inspector General of the US Treasury Department.

Offsetting emissions

Most of the emissions from LNG occur from steps other than at the export facility, so most plans for "net-zero" or "carbon neutral" LNG would rely heavily on mechanisms known as carbon offsets to ostensibly cancel out emissions from outside the export facility. Carbon offsets entail a trade-off between emissions from a facility, such as an LNG terminal, and a project elsewhere that sequesters carbon or avoids emissions.

Several proponents of new LNG terminals have indicated interest in using carbon offsets as a means of achieving carbon neutrality in their LNG marketing. For example, Goldboro LNG terminal in eastern Canada proposed using offsets, but has faced financial trouble and is now on indefinite hiatus. Cheniere, the first company to land an LNG export terminal permit for the Sabine Pass LNG terminal, announced in March that it had shipped its first "carbon neutral" tanker of LNG abroad, in a partnership with Shell. G2 Net Zero LNG has also stated that it aims to produce "LNG with no emissions from the natural gas producing reservoir, through treatment and transportation, to liquefaction and delivery to the dock for loading on ships."

The IEA's recently published "Gas Market Report Q3-2021" expressed concerns with the rise of potential greenwashing. "LNG carbon offset mechanisms would benefit from greater transparency and a standardised MRV [monitoring, reporting and verification] framework across the industry," the report said, noting that there are various proposed LNG export facilities in which stakeholders "can agree to buy carbon credits to offset GHG emissions from the LNG value chain." The IEA report further notes that the European Commission is currently considering "legislative proposals for a compulsory [monitoring, reporting, and verification] framework for all energy-related methane emissions in 2021."

There is no feasible way to purchase high-quality offsets linked to LNG exports due to a lack of global standardization, according to a report published in July by Columbia University researchers. The International Group of Liquified Natural Gas Importers are currently working on such a standard, the report notes, to be rolled out at the United Nations' COP 26 climate talks scheduled for November.

Carbon offsets have suffered from persistent problems of verifiability, coming under question by investigative journalists, political economists, and scientists, including the former chair of the Intergovernmental Panel on Climate Change. Creating high-quality offsets at a large scale may prove difficult, and would require extensive monitoring—so the use of offsets deserves more scrutiny.

About Global Energy Monitor

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