Troubled Waters for LNG:

The COVID-19 Recession and Overproduction Derail Dramatic Expansion of Liquefied Natural Gas Terminals

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ENVIRONMENTAL INTEGRITY PROJECT

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This report was written and researched by Alexandra Shaykevich of the Environmental Integrity Project, with analysis by Courtney Otto.

THE ENVIRONMENTAL INTEGRITY PROJECT

The Environmental Integrity Project (http://www.environmentalintegrity.org) is a nonpartisan, nonprofit organization established in March of 2002 by former EPA enforcement attorneys to advocate for effective enforcement of environmental laws. EIP has three goals: 1) to provide objective analyses of how the failure to enforce or implement environmental laws increases pollution and affects public health; 2) to hold federal and state agencies, as well as individual corporations, accountable for failing to enforce or comply with environmental laws; and 3) to help local communities obtain the protection of environmental laws.

For questions about this report, please contact EIP Director of Communications
Tom Pelton at (443) 510-2574 or
tpelton@environmentalintegrity.org.

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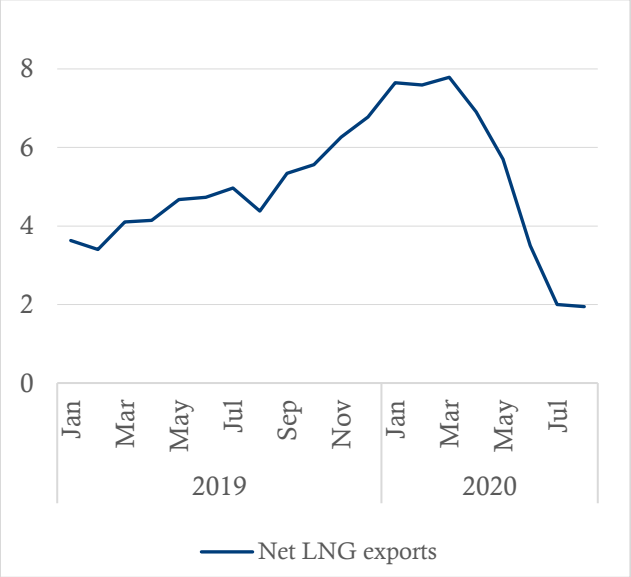
The Covid-19 Recession and Overproduction Derail Planned Construction of Liquefied Natural Gas Terminals

Executive Summary

The coronavirus pandemic has sent shockwaves through global energy markets. Last year, the United States became a net exporter of natural gas and one of the largest exporters of liquefied natural gas (LNG) in the world. This year, U.S. LNG exports have fallen by more than half[1] and companies are delaying final investment decisions on proposed LNG export terminals amid rock-bottom energy prices and unprecedented declines in energy demand. The result is that six proposed LNG projects that regulators have approved for construction have been postponed by at least one year because companies have failed to make final investment decisions expected by now. On top of these six projects are another four that were significantly delayed before the March 2020 outbreak of the coronavirus. If built, these 10 new terminals and expansions – located in Texas, Louisiana, and Oregon – have permits that would allow them to emit 45.6 million tons of greenhouse gases a year. That's more climate-warming pollution than from 10 large coal-fired power plants operating around the clock for a year, or from 8.9 million additional cars and trucks on America's roads.[2]

Figure 1. Net U.S. LNG Exports (Billion Cubic Feet per Day), Jan 2019 – Aug 2020



Source: U.S. EIA, Short-Term Energy Outlook (July 7, 2020), Table 5a. U.S. Natural Gas Supply, Consumption, and Inventories. Note: Net LNG exports are the difference between gross exports and gross imports.

LNG is natural gas that has been cooled to a liquid state, allowing it to be exported on tankers to overseas markets that would otherwise be inaccessible through pipeline transport. It is produced using liquefaction units – called "trains" by the industry – which remove impurities and then liquefy or condense the gas at sub-zero temperatures.

The COVID-19 recession came at a time when the world was already swimming in natural gas. In February, before the impacts of the crisis began to take effect, the U.S. Energy Information Administration (EIA) reported that natural gas storage volumes were on track to reach the highest level ever recorded, partially as a result of additional production growth spurred by new and expanding LNG terminals.[3]

The LNG industry had been expanding dramatically before the pandemic. On top of the 10 projects with known delays mentioned at the beginning of this report (because companies have failed to make final investment decisions expected by now) are another 7 projects that have received federal or state authorizations within the last 18 months whose status is unclear. In these cases, no construction has begun, but final investment decisions by the companies are not expected until later in 2020 or in future years. If all 17 of these projects become operational, they would have the potential to emit over 67 million tons of greenhouse gases annually. That figure also represents the greenhouse gases that could potentially be avoided if they are never built.

That outcome is looking increasingly likely for many of these projects, with a majority already experiencing documented delays. The COVID-19 recession threatens to compound a situation for the LNG industry that was already tenuous because of overproduction, chronically low energy prices, and waning energy demand.[4]

This report attempts to analyze the scope of the LNG infrastructure buildout that is planned in the U.S., as well as its viability and environmental impact. Our analysis highlights which projects have already been delayed, as well as the emissions that could be avoided if projects that have not been constructed never materialize. The LNG terminals included in our analysis have been approved by the Federal Energy Regulatory Commission[5] or have been issued final Clean Air Act construction permits by state agencies.

To better illustrate the emissions impacts associated with the LNG infrastructure buildout, this report also takes into account potential emission increases from new or expanding compressor stations that are related to existing or proposed LNG terminals and their associated pipeline networks, but that have obtained separate major Clean Air Act construction permits.

In addition to greenhouse gases, LNG terminals also release air pollutants that threaten the health of local residents, including tons of sulfur dioxide (which damages the lungs), nitrogen oxides and volatile organic compounds (both of which contribute to smog), microscopic soot or particulate matter (which can trigger asthma and heart attacks), and carbon monoxide (which can inhibit oxygen intake to the heart and brain).

Although the COVID-19 recession is a tragedy, it might also be an opportunity for companies and regulators to re-think projects that might not be necessary, given the glut of gas, the impact on the climate and public health, and the availability of increasingly cheap alternative energy sources. At the core of this issue is the question of what is really "necessary" for America's future? Is it the Trump Administration's policy of "energy dominance," which is a backdrop for growing American LNG exports? Or are there cleaner (and sometimes cheaper) ways to meet our energy needs without compromising public health or fueling global warming?

Key Findings of this Report:

- Companies have been authorized to construct, but have yet to break ground on, 12 new LNG terminals and 5 expansions, including additions to plants already operating. Together, these 17 projects have the potential to emit over 67 million tons of greenhouse gases per year. That's more climate-warming pollution than is released from 16 coal-fired power plants operating around the clock for a year.
- Included in these 17 projects are 10 with known delays that have the potential to emit 45.6 million tons of greenhouse gases per year. These delayed projects – six new terminals and four expansions – are expected to add 20 billion cubic feet per day of liquefaction capacity to the U.S. LNG sector by 2026.
- In addition to greenhouse gases, LNG terminals also release air pollutants that are hazardous to human health. If all 17 projects that have been authorized for construction by government but not yet built become operational, they could release up to 4,000 tons per year of particulate matter, as well as 17,900 tons of nitrogen oxides, 27,000 tons of volatile organic compounds, 1,200 tons of sulfur dioxide, and 42,300 tons of carbon monoxide.
- LNG terminals also are reliant on supporting infrastructure, such as pipelines and compressor stations. Our findings show that compressor stations alone could add more than 8 million tons of greenhouse gases to the LNG sector's emissions footprint. That's almost equivalent to the carbon output of two new coal-fired power plants.
- Construction of LNG terminals and their associated pipelines and compressors could harm local air quality by stirring up dust and particulate matter in the short-term and release nearly 11 million tons of greenhouse gases over a period of three to eight years.
- Many of these massive projects have been planned in minority or lower-income communities. About 38 percent of the people living within three miles of proposed LNG facilities are people of color and Hispanics or Latinos, and 39 percent are low-income (defined as households earning less than $24,120 annually).[6]
- Six of the delayed LNG projects, including four new terminals and two expansion projects, have federal Clean Air Act permits that were issued more than three years ago. And two of these projects had permits whose extensions expired this year. In Jefferson County, Texas, the Port Arthur LNG terminal's permit extension expired on August 17. In Calcasieu Parish, Louisiana, the Magnolia LNG terminal's extension expired on September 21.

Policy Recommendations:

- Several studies have shown that long-term exposure to air pollution increases the risk of illness or death from COVID-19.[7] Local and state permitting authorities need to carefully consider the added health risks of proposed projects during this unprecedented public health crisis. Because communities of color and low-income populations are more likely to live near industrial facilities and other major pollution sources, policymakers also need to consider the disproportionate health burden they bear when approving permits.

- The natural gas industry has been struggling for years to finance proposed projects as a result of chronic oversupply, depressed energy prices, and public opposition. Despite the challenging economic climate, policymakers have continued to offer tax breaks and government incentives to risky LNG projects that threaten air quality while locking-in future demand for fossil fuels. Regulators need to take market realities into account, and stop allowing oil and gas companies' volatile financing schedules to dictate project planning.
- The Clean Air Act requires facilities to begin construction within a reasonable amount of time after receiving the necessary permit approvals. Six of the planned LNG projects have permits that were issued more than three years ago. Given the significant impacts these projects would have on global warming and local air quality, and the shrinking global demand for LNG, state environmental agencies should consider canceling these permits and deferring approval of any more applications.

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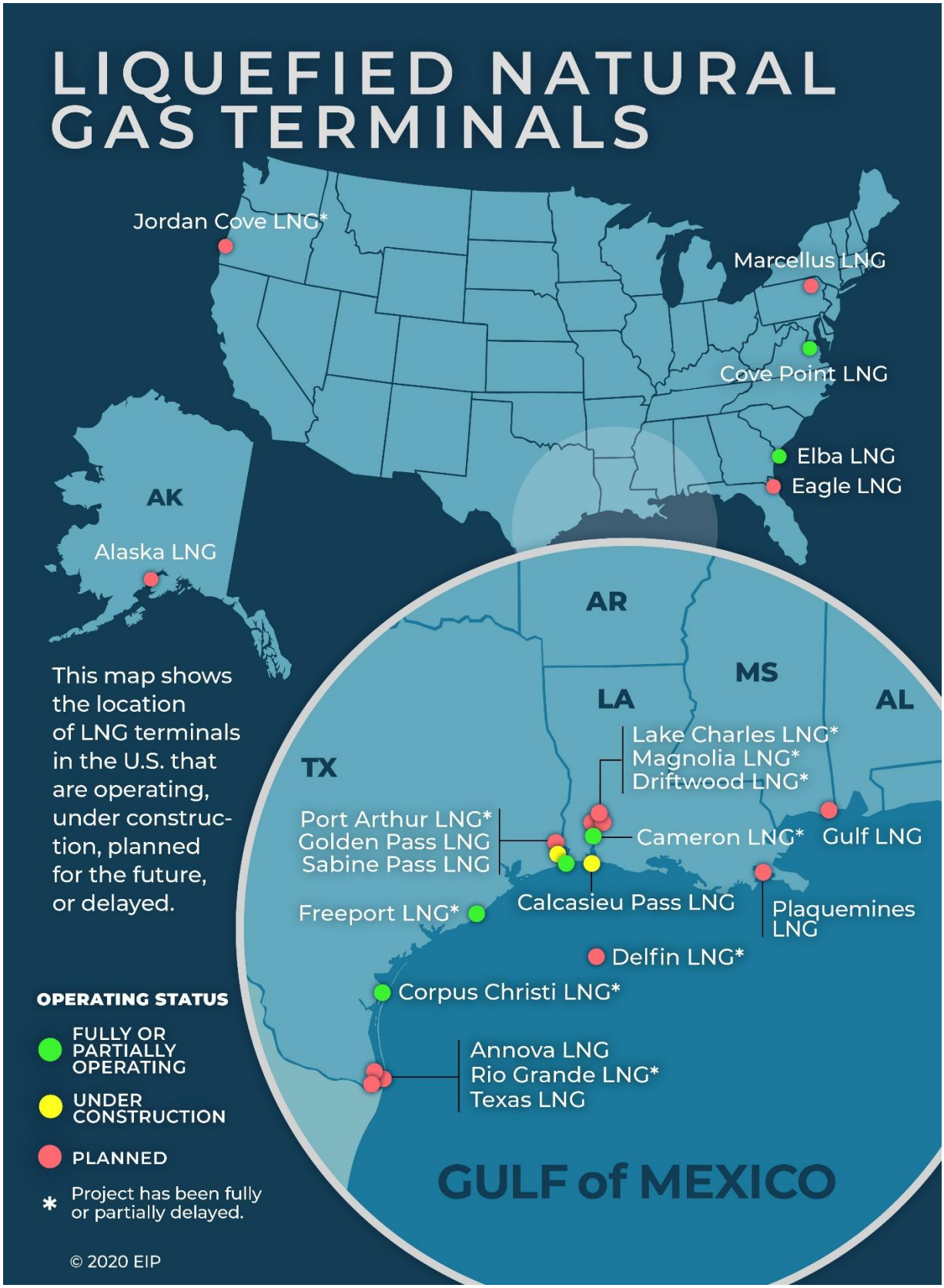
Figure II: Map of Existing and Proposed LNG Terminals



The Growth of the Liquefied Natural Gas Industry

In less than a decade, the shale revolution and the rise of hydraulic fracturing turned the U.S. into one of the largest producers of natural gas in the world. Years of record-breaking production and cheap energy prices spurred billions of dollars of investments in natural gas infrastructure. Producers sought new ways to bring increasingly larger volumes of fracked gas to market, resulting in an explosion of new construction on LNG export terminals.

Six LNG terminals are currently operating in the U.S. They are located in southern Maryland (the Dominion Energy Cove Point LNG Terminal in Calvert County); on the Georgia coast (the Elba Island LNG Terminal, near Savannah); in Texas (in Corpus Christi and Freeport); and in Louisiana (the Cameron and Sabine Pass LNG terminals in Cameron Parish). Two more (the Golden Pass LNG terminal in Port Arthur, Texas, and the Calcasieu Pass LNG terminal in Cameron Parish, Louisiana) are still under construction.

Many LNG facilities expand incrementally and are built in phases, one liquefaction unit at a time. Only two terminals – Cove Point and Elba Island – are fully constructed and operational today. The remaining four have some liquefaction units currently operating or under construction, and have been issued final Clean Air Act permits to place more into service. The locations of these four partially operating LNG terminals are highlighted in Figure III (on the following page), along with the number of liquefaction units currently in-service at each one.

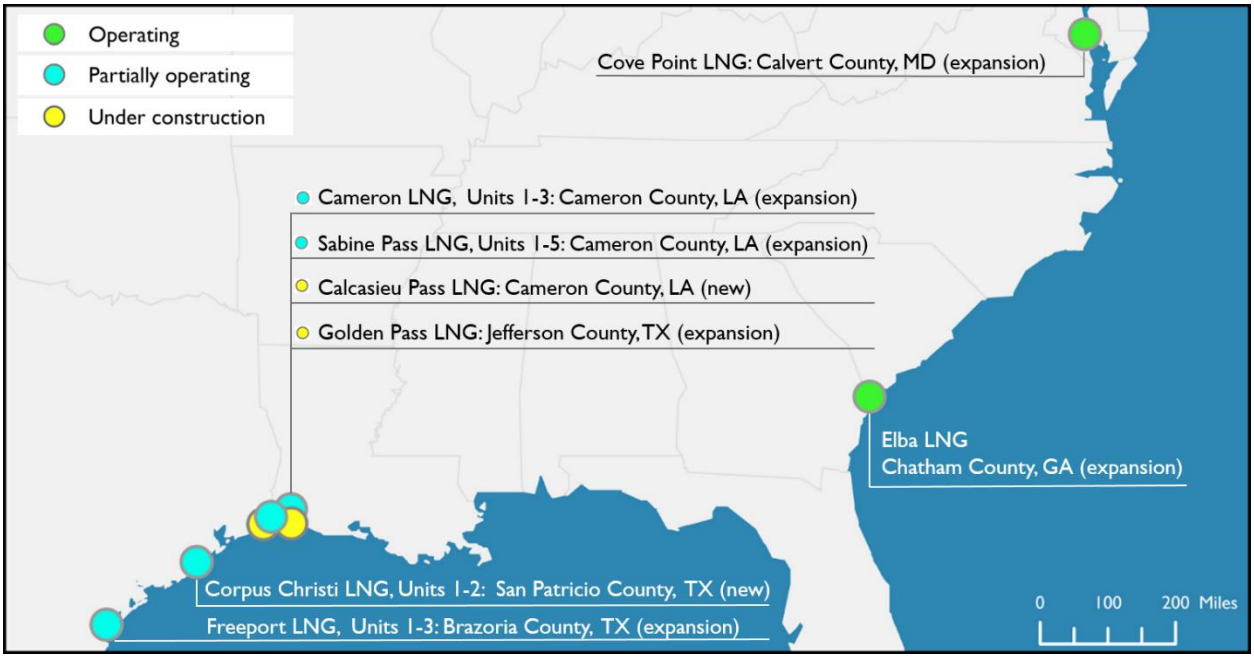
If all of the existing terminals pictured in Figure III on the next page become fully operational, they would be authorized to emit 37.4 million tons of greenhouse gases per year. In addition to greenhouse gases, these eight facilities would also have the potential to increase annual emissions by up to 1,250 tons per year of particulate matter ($PM_{2.5}$), 15,000 tons of nitrogen oxides (NOx), 250 tons of sulfur dioxide (SO_2), 14,500 tons of carbon monoxide (CO), and 1,400 tons of volatile organic compounds (VOCs).

Table I. Liquefaction Capacity Operating or Under Construction

Operating Status	No. of Terminals	No. of Liquefaction Units	Liquefaction Capacity (bcf/d)	Potential Annual GHG Emissions
Fully operational	2	11	1.2	2,409,451
Under construction	2	21	3.4	8,910,673
Partially operating and expanding	4	15	9.1	26,089,211
TOTAL	**8**	**47**	**13.6**	**37,409,335**

Note: Greenhouse gases are measured in carbon dioxide equivalents (CO2e), expressed in tons per year. Liquefaction capacity is measured in billion cubic feet per day, and corresponds to the number of units currently operating and/or under construction. This table excludes planned capacity expansions that have been delayed.

Figure III. LNG Terminals Currently Operating or Under Construction



The map above shows the locations of LNG terminals that are fully operational (green dots) and under construction (yellow dots), as well as four "partially operating" (blue dots) terminals and the liquefaction units currently in-service at each one. Terminals labeled "new" are those that are being newly constructed; those labeled "expansion" are import terminals that are being modified and expanded to handle exports.

The U.S. went from exporting no LNG in 2015 to becoming a major competitor in global trade with the construction of these projects, which added over 9 billion cubic feet per day of liquefaction capacity in the span of just five years. An additional 3 billion cubic feet per day has yet to be placed into service and is expected to come online by 2026, if companies are able to secure the financing required for these multi-billion dollar investments.

However, a number of planned expansions at these sites have been delayed. Economic uncertainty and persistent oversupply have proven to be significant impediments for the LNG industry. In January, the company behind the Cameron LNG export terminal asked the Federal Energy Regulatory Commission for a 72-month extension to construct the fourth and fifth liquefaction units,[8] which were initially authorized by the Commission on May 5, 2016 and were expected to become fully operational in 2020. The Lake Charles, Magnolia, and Jordan Cove LNG terminals have also been struggling for years to get off the ground – long before the novel coronavirus began to wreak havoc on global energy markets (see Table III on page 13 for more details).

The following section will take a closer look at these four delayed projects, as well as six more that were postponed following the March 2020 outbreak of the coronavirus.

An Overview of Project Delays Affecting the LNG Sector

The size and complexity of LNG projects requires substantial investments of capital and time. Companies must spend millions on project development and engineering before a final investment decision can be made, and investors assess companies' compliance with regulatory requirements and government approvals before making a capital commitment. These financial milestones are key to determining if a particular project is economically viable enough to move forward.[9]

Demand for LNG has been decreasing. Following coronavirus stay-at-home orders, energy demand fell between 18 and 25 percent globally, according to International Energy Agency estimates.[10] As many as 90 LNG shipments leaving terminals along the U.S. Gulf Coast were canceled in June and July, and an estimated 45 more in August, as U.S. LNG exports became less profitable because of low international gas prices.[11] The demand outlook is also highly uncertain, with the EIA projecting that natural gas demand will fall by 3.1% in 2020 and by an additional 4.5% the following year.

Six LNG terminals for which final investment decisions were expected this year have been delayed following the March 2020 outbreak of the coronavirus, signaling that companies expect the pandemic to limit LNG demand growth further. These six projects together represent 32 million tons of potential greenhouse gas emissions.

Table II. LNG Projects Delayed Since COVID-19

Terminal or Project (County/Parish, State)	Delayed GHG Emissions	Delayed Liquefaction Capacity (bcf/d)	Revised Decision Date
Driftwood LNG (Calcasieu, LA)	9,513,442	3.63	2023
Rio Grande LNG (Cameron, TX)	8,198,227	3.55	2021
Port Arthur LNG (Jefferson, TX)	7,741,200	3.55	2021
Delfin LNG (Gulf of Mexico, LA)	4,958,424	1.71	2021
Corpus Christi, Stage 3 (San Patricio, TX)	900,845	1.32	2021
Freeport: Train 4 (Brazoria, TX)	448,222	0.66	2021
TOTAL	**31,760,360**	**14.42**	

Note: Greenhouse gases are measured in carbon dioxide equivalents (CO2e), expressed in tons per year. The "decision dates" refer to final investment decisions, which are current as of August 31, 2020.

On top of these six projects postponed since March 2020 are another four that were experiencing significant delays before the pandemic. That makes a total of 10 projects with known delays that could add 20 billion cubic feet per day of liquefaction capacity and emit 45.6 million tons of greenhouse gases a year. In addition to greenhouse gases, these 10 would be permitted to emit up to 2,152 tons per year of particulate matter (PM 2.5), plus 12,495 tons of nitrogen oxides, 1,995 tons of volatile organic compounds, 527 tons of sulfur dioxide, and 27,376 tons of carbon monoxide.

Although COVID-19 caused delays for projects for which companies had not made final investment decisions, even before the pandemic, low energy prices were already prompting major oil and gas companies to restructure their portfolios.

Shell announced that it would sell its Appalachian shale assets earlier this year, at a price nearly nine times lower than what the company paid a decade ago.[12] The announcement came months after a similar decision by Chevron, which cut funding for natural gas-related investments after incurring billions of dollars in losses in 2019.[13]

The past year was also witness to a growing number of bankruptcies. Forty-two oil and gas producers filed for bankruptcy in the U.S. in 2019, a 50 percent increase from the previous year. According to Haynes and Boone's Bankruptcy Monitor, an additional 23 companies sought bankruptcy protection in the first two quarters of 2020, including prominent shale producers like Chesapeake Energy and Whiting Petroleum.[14]

The Magnolia LNG terminal proposed for Calcasieu Parish, Louisiana, was another casualty in the wave of recent bankruptcies sweeping through the oil and gas sector. Initially permitted in March 2016, the project has repeatedly failed to secure the purchase agreements necessary for it to move forward. The Australian parent company behind the project filed for the equivalent of Chapter 11 bankruptcy earlier this year, and the engineering and construction company contracted to build the terminal announced it would withdraw from most LNG and energy projects due to the sector's waning profitability.[15]

These trends are likely to continue, as many oil and gas companies have found themselves heavily indebted in the race to build massive, multi-billion-dollar infrastructure projects. In its latest financial review the EIA estimates that the oil and gas industry accrued $55 billion in debt in the first quarter of 2020 – the highest surge since 2015 – and that the total value of companies' publicly traded stocks fell more than $1 trillion compared to the same period in 2019.[16]

As with oil, natural gas markets are subject to volatility and political uncertainty. The trade war with China prompted a 25 percent tariff on American LNG shipments last year, as well as retaliatory tariffs on other high-value energy exports that rely on natural gas as an ingredient or feedstock. Developers of the Delfin LNG terminal proposed for Louisiana's Gulf Coast cited the trade dispute as the reason why contract negotiations for their floating liquefaction vessels have been significantly delayed. The company's second permit extension request also mentions the uncertainty of the LNG marketplace and depressed natural gas prices as reasons why the project has failed to progress.[17] Although LNG exports to China resumed in April, the truce could prove short-lived if tensions escalate or China fails to meet its purchase targets.[18]

Permit Extensions for LNG Projects Are the Norm

A number of projects holding Clean Air Act construction permits that were issued three to five years ago have yet to break ground and have been granted multiple permit extensions by state agencies. Because of their significant potential to emit, most LNG facilities are

required to obtain major "New Source Review" permits before they can begin construction. These are permits required under the federal Clean Air Act that determine whether additional pollution control technologies need to be installed before a new facility is constructed or an existing facility expands significantly enough that it could be considered a "new source" of air pollution. New Source Review permitting requirements are triggered by any project likely to increase greenhouse gas emissions by more than 75,000 tons per year, while also significantly increasing emissions of certain criteria pollutants known to harm public health.

Under federal regulation, the largest pollution sources are required to commence construction within 18 months after receiving the necessary permitting approvals. The permittee must provide satisfactory showing that an extension to the initial 18-month deadline is justified, and it is under the discretion of the permitting authority to grant the extension. This regulatory process has been established to ensure that air quality considerations and emissions limits remain current. It also allows for state agencies to reevaluate the best available control technology requirements and to update permitting conditions if advancements have been made.

In theory, a second extension to the commencement of construction deadline would only be justified in rare circumstances. In practice, however, permitting authorities are more than likely to grant extensions for massive infrastructure projects.

The Lake Charles LNG Export Terminal proposed for Calcasieu Parish, Louisiana was initially issued a construction permit by the Louisiana Department of Environmental Quality on May 1, 2015. Two 18-month extensions to the commencement of construction deadline were issued after Energy Transfer cited delays following an acquisition by Royal Dutch Shell.[19] Shell pulled out of the project in March, attributing the decision to low oil and gas prices. The facility's construction permit expired last November and the company applied for a modification permit that would effectively serve as a third extension. That bought Energy Transfer an extra 18 months to make a final investment decision on a project that has yet to commence construction after five years.

Table III on the next page highlights ten proposed LNG projects that have been delayed by at least one year and are still waiting for final investment decisions to be taken by project owners or investors. The right-hand column identifies when permits expire, with bolded dates indicating projects that are approaching the end of their second 18-month extensions. The ten projects featured in Table III have the potential to emit 45.6 million tons of greenhouse gases per year and represent nearly 68 percent of planned emission increases from new or expanding LNG terminals. That's more than the greenhouse gas output from ten large coal-fired power plants operating around the clock at full capacity. Four of the projects below are approaching their final permit expiration dates. (For more details, see Appendix A, which has tables providing breakdowns of the capacity and emissions increases associated with the 10 delayed projects listed below.)

Table III: Overview of LNG Project Delays and Commencement of Construction Deadlines

Terminal Name (County/Parish, State)	Project Status	Initial CAA Permit Issuance Date	Permit Expiration Date
Port Arthur LNG (Jefferson, TX)	A final investment decision was originally expected in 2020, but has been delayed to 2021. A 20-year sales agreement signed with Saudi Aramco in 2019 was put on hold once the delay was announced.[20] The Base Project, which would consist of two liquefaction units, has been issued two extensions to the commencement of construction deadline and expired on August 17, 2020. A draft permit for the Expansion Project (Units 3 and 4) was issued on June 5, 2020.	2/17/2016	**8/17/2020**
Magnolia LNG (Calcasieu, LA)	The Australian parent company of Magnolia LNG was finally able to sell the project in late-May after two (more profitable) deals fell through. The following month, the company contracted to offer engineering and construction services for the terminal announced it would withdraw from most LNG and energy projects.[21]	3/21/2016	**9/21/2020**
Driftwood LNG (Calcasieu, LA)	A final investment decision was originally expected in 2020 but has been delayed by three years. Tellurian, the company behind the project, laid off 40 percent of its workforce in March and is restructuring to push the project forward. Previous negotiations for offtake agreements have failed to materialize or have expired.[22]	7/10/2018	7/10/2021
Delfin LNG (Gulf of Mexico, LA)	Shipments were expected to begin next year, but the final investment decision that was anticipated in 2018 has been pushed back to 2021. Delfin LNG has already applied for two extensions with both the Federal Energy Regulatory Commission (FERC) and the Louisiana Department of Environmental Quality. Once constructed, this facility has plans to expand capacity by up to 1 billion cubic feet per day.[23]	7/18/2016	**7/18/2021**
Rio Grande LNG (Cameron, TX)	The Port of Brownsville amended their lease with the project developers, stating that they will enter into the agreement once a final investment decision has been made for the first phase of the project. The contract was extended through May 6, 2021 and could be postponed by another year if written notice is given. A final investment decision was expected in 2020, but could be pushed back as far as 2022.[24]	12/17/2018	12/19/2021
Cameron LNG, Trains 4 and 5 (Cameron, LA)	In a letter submitted to FERC on January 24, 2020, the developers of Cameron LNG asked for a 72-month extension (until May 5, 2026) to construct Trains 4 and 5. The company cited the withdrawal of one of its joint-venture partners as the reason for the delay. A final investment decision is expected in the middle of next year.[25] The permit expiration date shown here corresponds to the facility's most recently authorized modification permit (PSD-LA-766-M3), issued on February 17, 2017.[26]	3/3/2016	2/17/2022

Terminal Name (County/Parish, State)	Project Status	Initial CAA Permit Issuance Date	Permit Expiration Date
Lake Charles LNG (Calcasieu, LA)	Energy Transfer will evaluate various alternatives to advance the project, including the possibility of reducing its size from 2.2 to 1.5 billion cubic feet per day. Energy Transfer said it expected to make a final investment decision by early 2021 on whether to build the plant, a one year delay from its earlier timeline.[27]	5/1/2015	3/3/2022
Corpus Christi LNG, Stage 3 Project (San Patricio, TX)	At least two LNG shipments leaving the Corpus Christi terminal were canceled in April. A final investment decision on the Stage 3 Project was delayed to 2021, but could materialize sooner.[28] The permit issuance and expiration dates shown here correspond to the Stage 3 project (permit no. GHGPSDTX157), which would consist of seven mid-scale liquefaction units. The first three units were initially authorized on February 27, 2015 under a separate Clean Air Act construction permit.	2/14/2017	**6/28/2022**
Freeport LNG, Train 4 (Brazoria, TX)	A final investment decision was originally expected in 2020, but has been delayed to at least 2021. The project has secured billions in loans and is likely to have sufficient capital to finance construction of Train 4.[29] The permit expiration date shown here corresponds to the facility's most recently authorized modification permit (no. 100114), issued on February 6, 2018.[30]	7/16/2014	7/16/2024
Jordan Cove LNG Terminal (Coos, OR)	The Oregon Department of Environmental Quality denied (without prejudice) a Section 401 Water Quality Certification on May 6, 2019. On April 20th the state appealed FERC's issuance of a Certificate of Public Convenience and Necessity because it was issued notwithstanding the Department's denial of a water quality certification. Pembina, the company responsible for constructing the terminal and associated pipeline, filed a petition for a declaratory order with FERC on April 21st claiming that the state failed to act within one year of the request. A final investment decision was originally expected in 2019 and no new target date has been set by developers. A new permit application is expected in 2020.[31]	3/19/2020*	

*According to the Oregon Department of Environmental Quality, the state has "not received any complete permit applications."[32] The issuance date shown here corresponds to the FERC authorization date (Order Granting Authorizations Under Sections 3 and 7 of the Natural Gas).[33]

Note: Project and financial status is current as of August 31, 2020. Bolded dates indicate projects approaching the end of their second 18-month permit extensions.

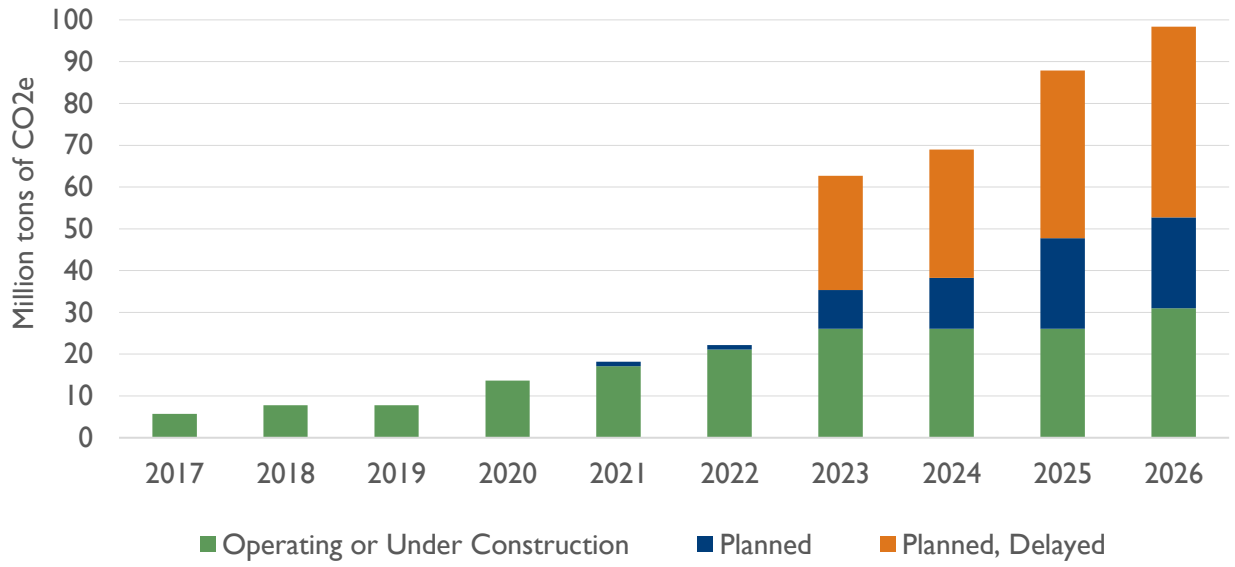
Authorized Emissions Increases from LNG Terminals

In January, the Environmental Integrity Project published a report[34] that examined the growth of greenhouse gas emissions from the oil, gas, and petrochemical sectors, based on data submitted to EPA's Greenhouse Gas Reporting Program. Our findings showed that greenhouse gas emissions from LNG facilities have grown faster than those from any other reporting segment, with a nearly ten-fold increase between 2012 and 2018. These emissions only reflect 9 percent of total processing capacity[35] being proposed from the construction of new or expanding LNG terminals throughout the country.

In addition to the eight LNG export terminals that are currently operating or under construction (see Table I on page 8), companies have been authorized to build another seven facilities with the potential to emit nearly 22 million tons of greenhouse gases per year. Together with the 10 delayed projects discussed in the previous section, they represent 67 million tons of annual greenhouse gas emissions. That's almost as much climate-warming pollution as is emitted from 16 large coal-fired power plants operating around the clock for a year. That figure – 67 million – also represents the amount of greenhouse gas emissions that could potentially be avoided if these projects are never constructed.

Figure V shows the cumulative emissions increases that could result if all the terminals inventoried in this report are constructed and become fully operational, as planned (for a full breakdown of operating dates and permit authorizations, please see Table V at the end of this report). The orange and blue colors correspond to avoidable emissions, if all new terminals and expansion projects that have yet to break ground are never built. However, these emission increases are just one piece of a larger puzzle.

Figure V. Cumulative GHG Emissions from Authorized LNG Terminals[36]



Source: Environmental Integrity Project, Emission Increase Database, August 2020. Note: Greenhouse gases are measured in carbon dioxide equivalents (CO2e), expressed in tons per year. Emissions reflect projects' maximum potential to emit, once fully-constructed, as specified in their New Source Review permits or federal environmental impact statements.

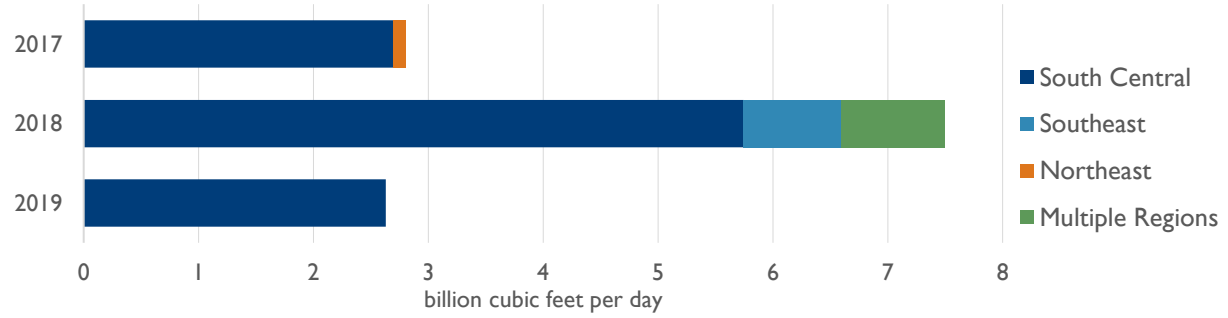
Emissions Increases from LNG Supporting Infrastructure

LNG terminals rely on supporting infrastructure, such as pipelines that transport natural gas from points of production and compressor stations that add pressure to the gas stream in order to move the product through pipeline networks to liquefaction facilities. Many LNG terminals require that new pipelines be constructed or that existing pipelines be modified to reverse flow or make operational changes. Once an LNG terminal is built, the additional processing capacity it brings to the region introduces a need for more "takeaway capacity," meaning infrastructure that moves additional volumes of gas to market.

With unconventional oil production soaring and over 8 billion cubic feet of Gulf Coast liquefaction capacity commissioned since 2016, the rush to expand pipeline capacity has accelerated in recent years. Our review of the EIA's Natural Gas Pipeline Projects database found that 134 pipelines capable of transporting 57 billion cubic feet of natural gas were built between 2017 and 2019. More than a third of those projects were built to bring additional takeaway capacity to the South Central region, which encompasses the Texas and Louisiana Gulf Coast where the majority of LNG terminals are located. At least 16 new or expanding gas pipelines were built to bring additional takeaway capacity to the LNG terminals inventoried in this report, representing roughly 23 percent of all pipeline capacity expansions that took place between 2017 and 2019.

This supporting infrastructure is essential to terminal design and function, but is subject to different permitting requirements that may obscure the long-term air quality impacts resulting from terminal operation. To better illustrate the emissions impacts associated with the LNG infrastructure buildout, this report takes into account potential emission increases from new or expanding compressor stations that are directly related to existing or proposed LNG terminals, but have obtained separate minor or major Clean Air Act construction permits. We also consider potential impacts from compressors that are associated with auxiliary pipeline projects[37] that have been constructed or proposed specifically to add takeaway capacity to LNG terminals or export hubs located along the Gulf Coast.

Figure VI. Pipeline Capacity Additions Associated with the LNG Buildout



Source: EIA Natural Gas Pipeline Projects Dataset (published March 5, 2020).[38] Note: Pipelines associated with the LNG buildout added 12.9 billion cubic feet per day of takeaway capacity between 2017 and 2019. Ten more projects capable of delivering 13.7 billion cubic feet per day of additional pipeline capacity have been proposed and are expected to come online by 2023. Another five pipelines have been announced and could add 6 billion cubic feet per day of additional capacity between 2021 and 2024.

Twenty new or expanding compressor stations were identified that are directly related to existing or proposed LNG terminals. While six are already operating, the rest have yet to commence construction and have the potential to emit almost 4.6 million tons of greenhouse gases per year. Thirteen additional compressor stations were identified that are indirectly associated with LNG terminals or export hubs. Five of these compressors are already operating or are under construction, but the rest are planned and have the potential to emit almost 1.6 million tons of greenhouse gases per year. Together, these 33 compressor stations could potentially add 8.4 million tons of greenhouse gases to the U.S. LNG sector's emissions footprint. That's almost equivalent to the carbon output of two new coal-fired power plants.

Table IV. Summary of Potential Emissions Increases from LNG Terminals and Associated Compressor Stations

	Potential Annual GHG Emissions	NOx	SO_2	VOC	CO	$PM_{2.5}$
Proposed and existing LNG terminals	98,361,237	31,603	1,505	28,159	53,884	4,946
Compressors directly associated with existing and proposed LNG terminals	6,197,914	3,052	183	736	3,021	398
Compressors associated with auxiliary pipelines	2,238,609	804	141	210	1,323	169
Sum of additional emissions impacts:	8,436,523	3,856	324	947	4,343	567
Total emissions impacts:	**115,234,283**	**39,315**	**2,153**	**30,052**	**62,571**	**6,080**

Source: Environmental Integrity Project, Emission Increase Database, August 2020. Note: Greenhouse gases are measured in carbon dioxide equivalents (CO2e). All emissions estimates are expressed in tons per year and reflect projects' maximum potential to emit, once fully-constructed, as specified in their New Source Review permits or federal environmental impact statements.

Because our analysis only considers compressor stations that have obtained or are seeking major New Source Review permits, at least a dozen "minor" sources are excluded from the totals presented in Table IV above. These compressors do not trigger greenhouse gas permitting requirements, but collectively have the potential to emit thousands of tons of global warming gases and dangerous pollutants. Our analysis also excludes overlooked and often underreported sources of air emissions, like those that occur outside of normal operating conditions.

The under-reporting of methane leaks from natural gas pipelines and compressor stations has come into spotlight in recent years, as satellite data continues to reveal the industry's overlooked contribution to climate change. Research has shown that equipment leaks are one of the largest sources of excluded emissions from natural gas operations. A recent study[39] concluded that leaky equipment accounts for 21 percent of emissions from the production segment and that emission rates were approximately 60 percent higher than estimates provided in the EPA's annual Greenhouse Gas Inventory. When underreported

methane emissions are taken into account across the entire supply chain, the additional global warming impact is comparable to the annual carbon dioxide emissions from all U.S. coal-fired power plants operating in 2015.

Short-Term Emissions Impacts from Construction

Terminal and pipeline construction also constitute significant sources of short-term air emissions that are never reported or accounted for in state-issued construction permits. These temporary emissions impacts are realized after the start of construction and before a terminal or pipeline starts operating. The duration and magnitude of construction-related air quality impacts vary depending on the size of the project and its proximity to existing natural gas infrastructure, with new LNG terminals generally taking longer to build because no previous infrastructure exists to shorten the construction period. For the LNG projects tracked in this report, emissions are realized between three and eight years after construction begins.

Construction-related air quality impacts could result from site preparation activities (such as land clearing and excavation), fuel combustion from vehicle and construction equipment, marine and road traffic, and fugitive dust generated by construction equipment, general site work, and earth-moving activities. As a result of these and other activities, local pollutant levels could intermittently increase during the lengthy construction period and have adverse effects on vulnerable populations, water quality, wildlife, and vegetation.

To estimate the construction-related air quality impacts associated with the LNG infrastructure buildout, this report relied on emissions estimates provided in environmental impact statements and environmental assessments issued by the Federal Energy Regulatory Commission, as well as Deepwater Port License Applications submitted to the U.S. Department of Transportation's Maritime Administration.[40]

The way that construction emission estimates are presented in federal environmental documents varies significantly by project. While some include year-on-year emission increases for every project component (e.g. associated pipelines and transmission lines, liquefaction facilities, compressor stations, etc.), others only include emissions totals or estimates based on phased construction intervals without yearly divisions.

Our numbers include total project construction emission estimates from every construction-related activity included in the relevant air quality analysis, summed for the entire duration of the construction period. Our review found that construction emissions from LNG terminals and their associated pipelines and compressors result in an additional 11.4 million tons of greenhouse gas emissions during construction, which could last anywhere from three to eight years for the LNG projects surveyed herein.

Excluded from this figure are excess emissions from the commissioning and start-up of newly built facilities, which could take several years for large terminals with multiple liquefaction units. For example, the Rio Grande LNG project proposed for Cameron

County, Texas, could release 2.2 million tons of greenhouse gases over a four-year period during the commissioning of each liquefaction train.[41]

Public Health Risks from LNG Industry Air Pollution

Once fully-constructed and operational, all of the LNG terminals inventoried in this report would have the potential to increase annual emissions by up to 4,900 tons of microscopic soot-like particles (particulate matter, or $PM_{2.5}$), 31,600 tons of nitrogen oxides (NOx), 1,500 tons of sulfur dioxide (SO_2), 53,800 tons of carbon monoxide (CO), and 28,100 tons of volatile organic compounds (VOCs). These pollutants are regulated by health-based air quality standards established under the Clean Air Act to prevent asthma, respiratory diseases, heart disease, preterm birth, cancer, and other adverse health effects.

Several studies have shown that long-term exposure to air pollution increases the risk of illness and death from COVID-19. A nationwide study published by Harvard University in April found that an increase of one microgram per cubic meter of fine particulate matter resulted in an eight percent increase in coronavirus death rates.[42] Similar studies conducted in Germany, the Netherlands, and Italy all concluded that greater exposure to particle pollution – meaning inhalable particles with diameters of 10 (PM_{10}) or 2.5 micrometers or less – resulted in higher numbers of coronavirus-related hospitalizations and deaths.[43]

These findings are supported by an extensive body of scientific literature that links particle pollution with respiratory failure, decreased lung function, and premature death in people with preexisting heart or lung conditions.[44] These and other well-documented health effects are what prompted the Environmental Protection Agency to reduce the National Ambient Air Quality Standard for $PM_{2.5}$ from 15 to 12 microgram per cubic meter in 2012. However, the rapid buildout of industrial infrastructure that has since taken place threatens hundreds of vulnerable communities already overburdened with air pollution and, now, facing a contagious disease outbreak.

Local and state permitting authorities need to carefully consider the added health risks that proposed projects have during this unprecedented public health crisis. Because communities of color and low-income populations are more likely to live in close proximity to industrial facilities and other major pollution sources, policymakers also need to consider the disproportionate health burden they bear when issuing permit approvals or extensions.

For this report, the Environmental Integrity Project used the U.S. Environmental Protection Agency's Environmental Justice Screening and Mapping Tool (EJSCREEN) dataset to estimate demographic characteristics for populations living within three miles of LNG terminals. We performed a distance-based analysis to measure the following demographic indicators:

1. The number and percentage of people of color and Hispanics or Latinos, defined as all people other than non-Hispanic white individuals.
2. The number and percentage of people considered low-income, defined as individuals living in households where the household income is less than or equal to twice the federal poverty level.

A three-mile radius was chosen because most LNG terminals, especially new export facilities capable of processing billions of cubic feet of natural gas per day, are constructed in or near industrial centers that can stretch for miles. We used approximate data point locations to represent the center of each facility from which the three-mile radius was drawn, and calculated the percentage area of each block group intersected by the buffer. These proportions were then applied to the population variables to estimate the number of people living within the three-mile boundary.

According to our results, an estimated 21,884 people live within three miles of an existing LNG terminal and another 64,428 could be affected by proposed projects. Facilities that have been proposed or announced are more likely than existing terminals to impact people of color and Hispanics or Latinos, which represent 38 percent of the population living within three miles of proposed LNG terminals – 10 percent higher than those living in proximity to existing terminals. Low-income individuals are also more impacted. Approximately 39 percent of the population living within three miles of proposed or announced LNG terminals is low income, significantly higher than the national average of 33 percent.

People of color and Hispanics or Latinos make up the largest portion of the population residing within three miles of the proposed Annova LNG terminal in South Texas (93 percent), as well as the Rio Grande LNG (81 percent), and Texas LNG (78 percent) terminals. All three facilities are proposed to be constructed in Cameron County, Texas, where 90 percent of the population are people of color or Hispanic or Latino and nearly two-thirds are low-income.

Community organizers and environmental groups in Cameron County have already filed multiple lawsuits against the three terminals, highlighting potential environmental justice concerns and the projects' impact on local communities, livelihoods, and the environment.[45] Despite the lawsuits, the Texas Commission on Environmental Quality issued initial permit approvals to Annova and Texas LNG and granted a permit extension request to Rio Grande LNG earlier this year.

The Plaquemines LNG terminal proposed for Plaquemines Parish, Louisiana, has the highest percentage of low-income households living within a three-mile radius of a proposed plant. Plaquemines Parish falls within an area known as "Cancer Alley," which is home to hundreds of industrial facilities that release high levels of toxic air pollution. Around 83 percent of people living within close proximity of the Plaquemines LNG terminal is low-income. For reference, the average percentage of low-income households in Plaquemines Parish is 33 percent (and the state average is 39 percent). After the three Cameron County facilities discussed above, Plaquemines LNG has the highest percentage of people of color and Hispanics or Latinos living nearby, with 74 percent.

These communities are also more likely to be exposed to dangerous levels of particle pollution. According to the EPA's EJSCREEN dataset, average $PM_{2.5}$ concentrations in

Cameron County and Plaquemines Parish were respectively 8.63 and 8.14 micrograms per cubic meter in 2016, the most recent year for which national-level data is available. The most affected census block groups in Cameron County fall within the 24th percentile for particulate matter exposure, and the most affected communities in Plaquemines Parish fall within the 17th percentile. When population and demographics are taken into account, communities living in Plaquemines Parish score within the 5th percentile for particulate matter exposure, according to the EJ Index.

Conclusion and Recommendations

The LNG terminal projects tracked in this report and their associated compressor stations have the potential to emit almost 105 million tons of greenhouse gas emissions and thousands of tons of other air pollutants such as sulfur dioxide that threaten human health. Compressors associated and auxiliary pipelines contribute another 2.2 million tons, expanding the LNG sector's footprint to just over 115 million tons of greenhouse gases. Emissions from terminal construction, which could negatively impact local air quality by stirring up fugitive dust and particulate matter in the short-term, add nearly 11 million tons of greenhouse gases in the span of three to eight years. These emissions disproportionately affect communities of color and Hispanics or Latinos, as well as low-income individuals, who are overrepresented in the communities living within three miles of proposed LNG terminals.

Our estimates likely underestimate the industry's long-term contribution to climate change, as they don't consider "minor" sources of air pollution, unaccounted for emissions from methane leaks, and other downstream sources such as transportation emissions or those resulting from end-use.

Given the chronically oversupplied state of the global gas market and the compounding effects of the novel coronavirus, which threatens to depress gas prices and global demand for LNG, the outlook for proposed projects that have yet to secure financing is highly uncertain. Recent project delays indicate that the industry expects market conditions to remain unsupportive of future LNG exports.

The oil and gas industry has long touted natural gas as a bridge fuel for the clean energy transition, on the premise that gas produces fewer greenhouse gas emissions than coal. However, the total emissions footprint of the natural gas industry is substantial and threatens to lock-in demand for fossil fuels while slowing the transition to renewables and other sustainable sources of energy.

This Report Makes the Following Policy Recommendations:

1) Several studies have shown that long-term exposure to air pollution increases the risk of illness or death from COVID-19.[46] Local and state permitting authorities need to

carefully consider the added health risks of proposed projects during this unprecedented public health crisis. Because communities of color and low-income populations are more likely to live near industrial facilities and other major pollution sources, policymakers also need to consider the disproportionate health burden they bear when approving permits.

2) The natural gas industry has been struggling for years to finance proposed projects as a result of chronic oversupply, depressed energy prices, and public opposition. Despite the challenging economic climate, policymakers have continued to offer tax breaks and government incentives to risky LNG projects that threaten local air quality while locking-in future demand for fossil fuels. Regulators need to take market realities into account, and stop allowing oil and gas companies' volatile financing schedules to dictate project planning.
3) The federal Clean Air Act requires facilities to begin construction within a reasonable amount of time after receiving the necessary permit approvals. At least six LNG projects – including four new export terminals and two expansion projects – are still waiting for construction to begin three or more years after having been issued final Clean Air Act construction permits from state regulators. Given the significant impacts these projects would have on global warming and local air quality, and the shrinking global demand for LNG, state environmental agencies should consider canceling these permits and deferring approval of any more applications.

Table V: Overview of Capacity, Emissions, and Permitting for Existing and Proposed LNG Terminals

Terminal Name (County/Parish, State)	Capacity (bcf/d)	Potential Annual GHG Emissions	Federal Authorization Type (issuance date)	Initial Clean Air Act Permit No. (issuance date)	Operating or Expected Operating Year(s)
LNG terminals that are fully- or partially-operating, or under construction					
Cove Point LNG (Calvert, MD)	0.69	2,030,998	NGA §3 & 7 (9/29/2014)	9318 (5/30/2014)	2018
Elba LNG (Chatham, GA)	0.46	378,453	NGA §3 & 7 (6/1/2016)	4922-051-0263-V-01-0 (6/23/2015)	2020
Sabine Pass LNG (Cameron, LA)	3.55	10,707,668	NGA §3 (2/20/2014)	PSD-LA-703(M3) (12/6/2011)	2016-2023
Cameron LNG, (Cameron, LA)*	2.96	9,029,617	NGA §3 (6/19/2014)	PSD-LA-766 (10/1/2013)	2019-2026
Corpus Christi LNG (San Patricio, TX)*	3.09	4,314,030	NGA §3 (12/30/2014)	GHGPSDTX123 (2/27/2015)	2018-2024
Freeport LNG (Brazoria, TX)*	2.63	2,037,896	NGA §3 (7/30/2014)	100114 (7/16/2014)	2019-2026
Calcasieu Pass LNG (Cameron, LA)	1.31	3,970,601	NGA §3 & 7 (2/21/2019)	PSD-LA-805 (9/21/2018)	2022
Golden Pass LNG (Jefferson, TX)	2.05	4,940,072	NGA §3 & 7 (12/21/2016)	GHGPSDTX100 (9/11/2015)	2024-2026
LNG terminals that have not commenced construction					
Alaska LNG (Kenai Peninsula, AK)	2.63	8,572,968	NGA §3 (5/21/2020)	AQ1539CPT01 (draft, 9/11/2020)	2025
Annova LNG (Cameron, TX)	0.79	353,072	NGA §3 (11/22/2019)	144829 (4/16/2020)	2025
Eagle LNG (Duval, FL)	0.13	74,511	NGA §3 (9/19/2019)	0310623-001-AC (5/8/2019)	2021-2023
Gulf LNG (Jackson, MS)	1.32	2,885,787	NGA §3 (7/16/2019)	1280-00132 (submitted 9/30/2015)	2024
Marcellus LNG (Bradford, PA)	0.29	1,107,679	N/A	08-00058A (7/24/2019)	2021
Plaquemines LNG (Plaquemines, LA)	2.63	8,144,463	NGA §3 & 7 (9/30/2019)	PSD-LA-808 (4/25/2019)	2023
Texas LNG (Cameron, TX)	0.53	604,087	NGA §3 (11/22/2019)	139561 (5/12/2020)	2025
Delfin LNG (Gulf of Mexico, LA)*	1.71	4,958,424	MARAD License (3/13/2017) NGA §7 (9/28/2017)	0560-00990-V0 (7/18/2016)	2023
Driftwood LNG (Calcasieu, LA)*	3.63	9,513,442	NGA §3 (4/18/2019)	PSD-LA-824 (7/10/2018)	2023
Jordan Cove LNG (Coos, OR)*	1.03	1,969,795	NGA §3 & 7 (3/19/2020)	Type B State NSR (submitted 9/2017)	2025
Lake Charles LNG (Calcasieu, LA)*	2.16	4,321,253	NGA §3 & 7 (12/17/2015)	PSD-LA-785 (5/1/2015)	2025
Magnolia LNG (Calcasieu, LA)*	1.16	2,506,994	NGA §3 (4/15/2016)	PSD-LA-792 (3/21/2016)	2024
Port Arthur LNG, (Jefferson, TX)*	3.55	7,741,200	NGA §3 (4/18/2019)	GHGPSDTX134 (2/17/2016)	2023-2025
Rio Grande LNG (Cameron, TX)*	3.55	8,198,227	NGA §3 & 7 (11/22/2019)	GHGPSDTX158 (12/17/2018)	2023
TOTAL:	**41.88**	**98,361,237**			

*Project is fully or partially delayed

Appendix A: Data and Methods

Table A. Overview of Emissions Totals from 10 Delayed LNG Projects

Terminal or Project Name	Total Capacity (bcf/d)	Delayed capacity (bcf/d)	Total Emissions (CO2e tpy)	Delayed Emissions (CO2e tpy)
Partially delayed	**9.01**	**3.29**	**15,381,543**	**6,420,172**
Cameron LNG Trains 4 and 5	3.29	1.32	9,029,617	5,071,105
Corpus Christi LNG, Stage III Project (Trains 4-10)*	3.09	1.32	4,314,030	900,845
Freeport LNG Train 4*	2.63	0.66	2,037,896	448,222
Fully delayed	**16.80**	**16.80**	**39,209,335**	**39,209,335**
Delfin LNG*	1.71	1.71	4,958,424	4,958,424
Driftwood LNG*	3.63	3.63	9,513,442	9,513,442
Jordan Cove LNG	1.03	1.03	1,969,795	1,969,795
Lake Charles LNG	2.16	2.16	4,321,253	4,321,253
Magnolia LNG	1.16	1.16	2,506,994	2,506,994
Port Arthur LNG*	3.55	3.55	7,741,200	7,741,200
Rio Grande LNG*	3.55	3.55	8,198,227	8,198,227
Grand Total	25.81	**20.09**	54,590,878	**45,629,507**

*Projects marked with an asterisk delayed final investment decisions following the March 2020 outbreak of the coronavirus.

All of the LNG terminals included in our analysis have been issued final Clean Air Act construction permits by state agencies or have been approved by the Federal Energy Regulatory Commission (FERC), defined as any facility or project that has been issued an authorization under Sections 3 and/or 7 of the Natural Gas Act.

Table V, on the previous page, provides an overview of facilities' planned baseload capacity and maximum potential to emit, once fully-constructed and operational. Entries highlighted in yellow have been issued federal or state authorizations within the past 18 months, and have the potential to emit 21,742,567 tons of greenhouse gases per year (see page 15). The right-hand column shows the year in which the facility began operating or is expected to begin operating. Because LNG terminals are often constructed in phases, a date range indicates when the first and last liquefaction units entered or are expected to enter service.

Permit issuance dates reflect when the initial Clean Air Act permit that authorized terminal construction was issued. Some of the facilities included in Table V have been issued multiple permits for expansion projects at previously-authorized terminals. These permit numbers and issuance dates are not included in Table V. Two facilities (the Jordan Cove and Eagle LNG terminals) have submitted New Source Review permit applications to state regulators, but have not been issued final construction permits. One facility (the Marcellus LNG terminal in Pennsylvania) is not an export facility and does not require FERC

authorization before construction can begin. For more information, please refer to EIP's Oil, Gas, and Petrochemical Inventory, available at: https://environmentalintegrity.org/oil-gas-infrastructure-emissions/. When accounting for emissions from phased projects that have only been issued one permit, emissions have been allocated to the final train/phase under the assumption that emissions totals will only be realized once the last train enters service. When accounting for emissions from phased projects that have been issued multiple modification permits, emissions increases (when not explicitly provided in the permit) represent the difference between the two most recent permits authorizing construction. For example, Cameron LNG was issued four permits to construct five liquefaction trains: PSD-LA-766, PSD-LA-766(M1), PSD-LA-766(M2), and PSD-LA-766(M3):

- PSD-LA-766 authorized construction of Trains 1-3, but was later modified to account for design changes. The final emissions authorized under PSD-LA-766(M1) for construction of Trains 1, 2, and 3 are allocated to Train 3.
- PSD-LA-766(M2) authorized construction of Trains 4 and 5, but was later modified to update the facility description and incorporate 2 diesel tanks into the permit. Because PSD-LA-766(M3) incorporates emissions from all 5 trains, the emissions allocated to Train 5 are the *difference* between PSD-LA-766(M3) and PSD-LA-766(M1).

This approach ensures that emissions totals for phased projects sum to the total potential to emit authorized under the most recent permit modification.

Table B. Example of Emissions Accounting for Phased Projects with Multiple Permit Modifications, Cameron LNG

Terminal or Project Name	Potential Annual GHG Emissions	Permit Issuance Date	Permit History (Permit No., Issuance Date)
Cameron: Train 1		6/26/2014	PSD-LA-766 (issued 10/1/2013), PSD-LA-766(M1) (issued 6/26/2014)
Cameron: Train 2		6/26/2014	PSD-LA-766 (issued 10/1/2013), PSD-LA-766(M1) (issued 6/26/2014)
Cameron: Train 3	3,958,512	6/26/2014	PSD-LA-766 (issued 10/1/2013), PSD-LA-766(M1) (issued 6/26/2014)
Cameron: Train 4		2/17/2017	PSD-LA-766(M2) (issued 3/3/2016), PSD-LA-766(M3) (issued 2/17/2017)
Cameron: Train 5	5,071,105	2/17/2017	PSD-LA-766(M2) (issued 3/3/2016), PSD-LA-766(M3) (issued 2/17/2017)
TOTAL	**9,029,617**		

Note: Greenhouse gases are measured in carbon dioxide equivalents (CO2e), expressed in tons per year. In this analysis the permit issuance date reflects the permit used to determine emissions totals, not necessarily the initial or most recent permit. This methodology is not used in EIP's Emissions Increase Inventory, which groups phased projects together and uses the term 'partially operating' to denote operating status if a facility is in various stages of construction.

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[35] Approximately 3.72 billion cubic feet per day of liquefaction capacity came online in 2018 or earlier (Cove Point, Corpus Christi Train 1, Sabine Pass Trains 1-4). If all 22 terminals inventoried in this report are constructed and become fully operational, they would be capable of processing 42.27 billion cubic feet of LNG per day.

[36] Because our analysis only considers projects that have been approved by the Federal Energy Regulatory Commission or been issued final Clean Air Act construction permits, several facilities have been excluded from consideration. Three new LNG export terminals have been proposed and have initiated the pre-filing process, but have yet to be authorized by the Federal Energy Regulatory Commission or submit Clean Air Act permit applications to state agencies. These include the Commonwealth LNG terminal proposed for Cameron Parish, LA, and the Delta and West Delta LNG terminals, both proposed for Plaquemines Parish, LA. These three projects could add another 12 million tons of potential greenhouse gas emissions to the U.S. LNG sector by 2025. EIP is also tracking seven announced projects for which potential air emissions impacts have yet to be determined. These are either in the pre-filing phase and have yet to submit Resource Reports to the Federal Energy Regulatory Commission, or have been announced but have yet to initiate the pre-filing process. Together these seven announced projects could add 7.8 billion cubic feet of liquefaction capacity to the U.S. LNG sector by 2028.

[37] The term "auxiliary pipeline" is used throughout this report to refer to infrastructure projects that have been constructed or proposed (either wholly or partially) to bring additional volumes of natural gas to LNG terminals for export. Oftentimes, these pipeline projects are constructed and operated by the same companies as the receiving LNG terminal.

[38] Regional definitions: South Central: AL, AR, KS, LA, MS, OK, TX; Northeast: DC, ME, MD, MA, NH, NJ, NY, OH, PA, RI, VT, VA, WV; Southeast: FL, GA, NC, SC

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