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Climate and Health Risks of Liquified Natural Gas

PSR 1985 NOBEL PEACE PRIZE PHYSICIANS FOR SOCIAL RESPONSIBILITY

Credit: U.S. Coast Guard photo by Petty Officer 2nd Class Luke Pinneo/Wikimedia Commons

Introduction

The years between 2005-2018 witnessed a dramatic rise in "natural" gas (methane) production in the United States, driven by the use of horizontal hydraulic fracturing, or fracking, an extraction process that injects highly pressurized water and chemicals underground to fracture rock formations.

Once fracked, the gas is typically transported and distributed domestically through a vast network of pipelines. However, when the gas is intended for export to another continent, pipelines are not an option. Instead, the gas is liquified and transported in special cryogenic tankers for overseas delivery.

Liquified Natural Gas (LNG) is methane that is filtered (or "purified" to use the industry term) and supercooled to -260° F, turning it from gas to liquid. Liquefaction reduces the gas's volume by 600 times, making it easier to store and transport in large quantities.

This white paper examines LNG's implications for our environment, health and climate.

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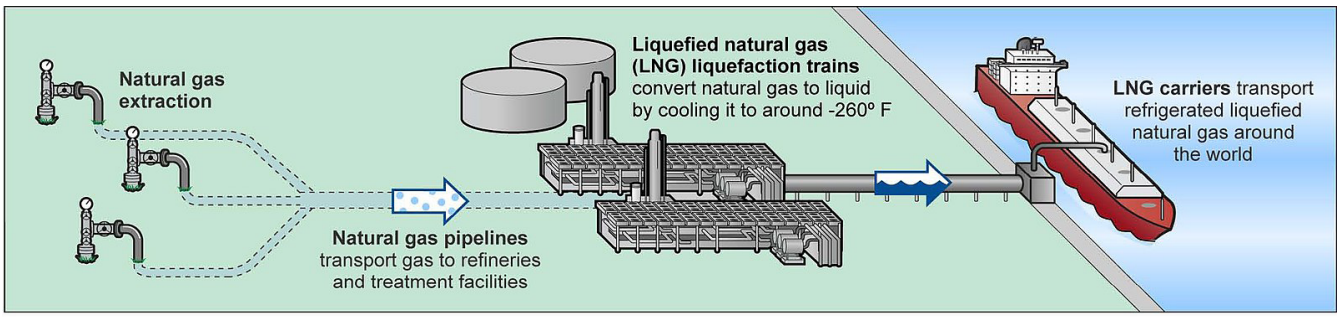

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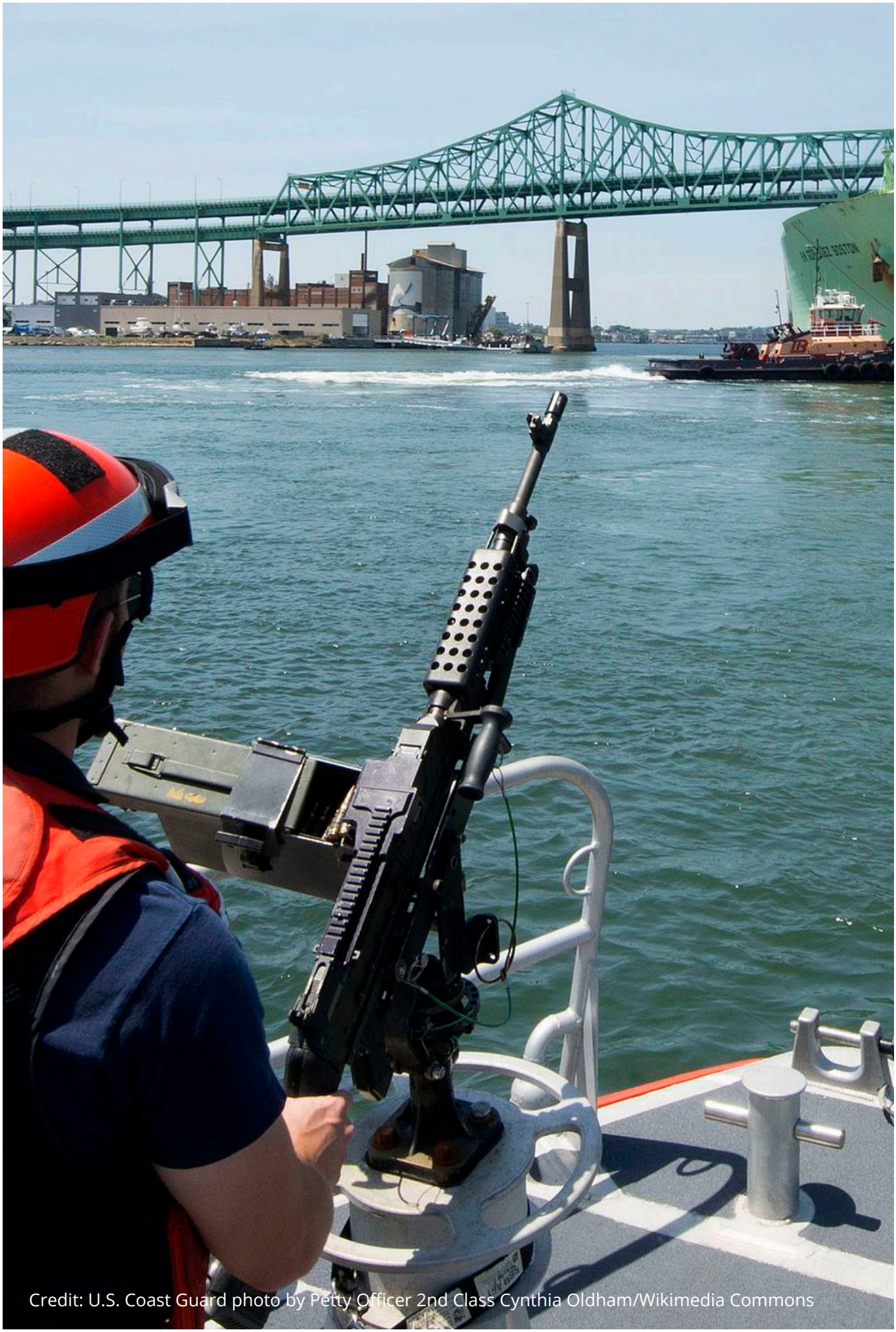


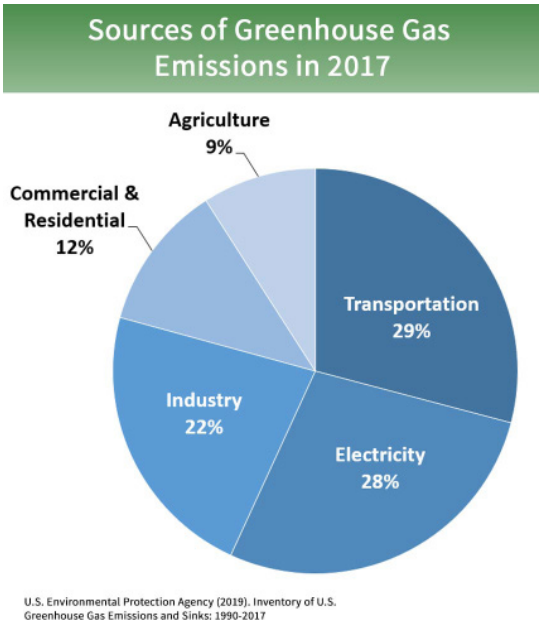
Credit: U.S. Coast Guard photo by Petty Officer 2nd Class Cynthia Oldham/Wikimedia Commons

LNG and Health: The Warming Planet

Credit: Fletcher6/Wikimedia Creative Commons/https://commons.wikimedia.org/wiki/File:National_Grid_LNG_Tank.jpg

LNG contributes heavily to the health emergency created by climate change. LNG is primarily methane, a greenhouse gas 86 times more potent at trapping heat than carbon dioxide over its first 20 years in the atmosphere.[1]

In addition, LNG may be more carbon-intensive than piped gas. To be liquified, the gas is stripped of any carbon dioxide (CO_2) it may be carrying; that CO_2 is then generally released through venting to the atmosphere. Furthermore, the liquefaction process itself requires a high amount of energy. This, in combination with gas releases and leaks from the gas wellsite and the compressor stations that keep gas flowing through the pipelines, results in an estimated 12-13 percent of the original fuel being lost or consumed throughout the entire LNG supply chain.[2]



The 2018 Intergovernmental Panel on Climate Change (IPCC) special report on climate change documents that human activities, primarily the use of fossil fuels, have already increased the earth's temperature by 1° C compared to pre-industrial levels.[3] The 2018 Lancet Countdown outlined the health impacts at the then-current levels of warming. In the U.S., 24 million more Americans were exposed to extreme heat in 2011 than in 2010, and 12.3 million more in 2016 when compared to the same baseline. Heat exposure can cause potentially lethal heat stroke.[4] Extreme weather events like hurricanes resulted in damage to healthcare infrastructure and increases in waterborne illnesses and mental health illnesses. Wildfires increased mortality. Coastal areas saw an increase in Vibrio bacteria due to warmer oceans, as other regions experienced an increase in mosquito- and flea-borne illnesses. The IPCC, the U.S. Global Change Research Program and the Lancet have all called for a rapid, unprecedented shift away from all fossil fuels in order to prevent potentially catastrophic climate change effects.

LNG and Health: A Polluting Supply Chain

Credit: Wikimedia Commons (public domain)

LNG and methane in general are marketed as a "clean" fossil fuel. But this is a relative term and applies only when comparing combustion emissions of methane to combustion of coal, a notorious polluter. A full assessment of LNG's pollution impacts must consider the upstream effects of methane extraction, processing and transport.

The hydraulic fracturing extraction process injects a slurry of chemicals and millions of gallons of water thousands of feet underground at high pressure. Many of the chemicals used in fracking are not disclosed, but of the ones that are known, many have significant health effects. In 2016, a Yale study found that of the 1,021 chemicals identified in fracking fluids, only 241 had toxicity information available. Of these, 157 were deemed toxic to the reproductive system or human development, and of those, 67 had federal guidelines regulating them.[5] However, due to passage of the "Halliburton loophole" in the 2005 Energy Policy Act, fracking operations are exempt from meeting the federal standards set in the Safe Drinking Water Act and Clean Water Act. Regulation is left to the states, and restrictions on fracking chemicals are weak to nonexistent.

The fracked gas itself, like any other fossil fuel, is a source of pollutants, some of which are major health concerns. Fracked gas as it comes out of the ground is a mixture containing methane, volatile organic compounds (VOCs), particulate matter, and nitrogen oxides (NOx). Among the VOCs are the BTEX group, consisting of benzene, toluene, ethylbenzene and xylene. Benzene has been classified as a carcinogen and major human health concern with no safe levels of exposure. Meanwhile, toluene and xylene both have detrimental impacts on the nervous system, and long-term exposure to ethylbenzene may lead to blood disorders.[6]

Particulate matter, especially PM 2.5 and smaller particles, contributes to heart disease and is implicated in strokes, asthma, and cancer.[7,8] Nitrogen oxides are a reactive chemical that can combine with VOCs to form ground-level ozone, which contributes to lung diseases and asthma attacks and can aggravate pre-existing heart diseases.[9] Nitrogen oxides also contribute to the formation of nitric acid vapor, acid rain, particulate matter and other harmful chemicals.[10]

Emissions of methane and toxic gases can occur when fracked gas is transported via pipelines, which are subject to leaks and explosions. Leaks also occur from compressor stations and pipelines. To be liquified, the fracked gas must undergo a process that removes CO2, mercury and some heavy hydrocarbons to create an end product that is primarily methane, which is then supercooled into a liquid. Little public research has been conducted as to where the byproducts of the concentration or "purification" process go. These chemicals may cause serious harm. Mercury is a well-known neurotoxin; exposure in utero can result in lifelong impairments in cognitive thinking, memory, language, and attention.

The presence of LNG terminals also leads to poorer air quality. Loading and offloading tankers results in fugitive emissions of methane as well as NOx, VOCs, ozone and particulate matter.[11] In addition, the increase in traffic from trucks and tankers, often fueled by diesel, adds to air pollution. With LNG terminals often sited in areas that fail to meet National Ambient Air Quality Standards, these extra air pollutants exacerbate the health risks that already face heavily burdened communities.

Finally, when LNG is returned to a gaseous form in the importing country, it can again leak into the atmosphere, and, when used to generate electricity, can displace the development of clean, safe, renewable forms of energy.

Safety & Security Threats

LNG is a volatile and potentially explosive material, so plants pose challenges to safety.

In 2014 in Plymouth, Washington, LNG processing equipment exploded, injuring five employees while leaking enough gas to prompt the evacuation of residents within a two-mile radius. The incident highlights serious gaps in oversight of the LNG industry: The injuries were not reported, since the employees were able to leave the hospital the same day. Shrapnel from the explosion pierced multiple storage tanks causing LNG leaks. However, these leaks went unreported. Why? The accidents are not in the reportable category because, when LNG comes in contact with the air, it evaporates. Thus the leaks are never reported as "spills". [12]

As LNG plants are located in coastal areas, they are vulnerable to the impacts of extreme weather events such as hurricanes and coastal flooding—events made more frequent and stronger due to climate change.

LNG also poses grounds for concern in regard to national security. A full LNG tanker carries the energy equivalent of 55 atomic bombs, making it a potential target for terrorist attacks, especially when at port near population centers.[13]

Environmental Justice

LNG contributes to environmental justice problems, as liquefaction and export facilities often have disproportionate impacts on minority and sensitive populations. These facilities are often placed in areas that are predominantly home to African American, Native American and Hispanic families and families of lower socioeconomic status, and may be sited close to schools and nursing homes. Such proximity, often reflecting these communities' lack of political power, intensifies the impact on vulnerable populations and people with pre-existing health conditions.

Two cases illustrate how vulnerable communities fare when industrial projects move into the area. Brownsville, Texas, a city with one of the nation's highest poverty rates and a population that is over 90 percent Hispanic, had three separate LNG export facilities being proposed as of 2018. The Texas Commission on Environmental Quality (TCEQ) reported that at least one of those plants would emit significant amounts of particulate matter, greenhouse gases and hydrogen sulfide, Hazardous Air Pollutants, sulfur dioxide, and sulfuric acid mist.[14] Concerned citizens and environmental groups submitted over 2,000 comments to TCEQ, citing their concerns that the plant, proposed to be sited just upwind from local schools, would put children at even greater risk for exacerbation of asthma or other respiratory illnesses. [15]

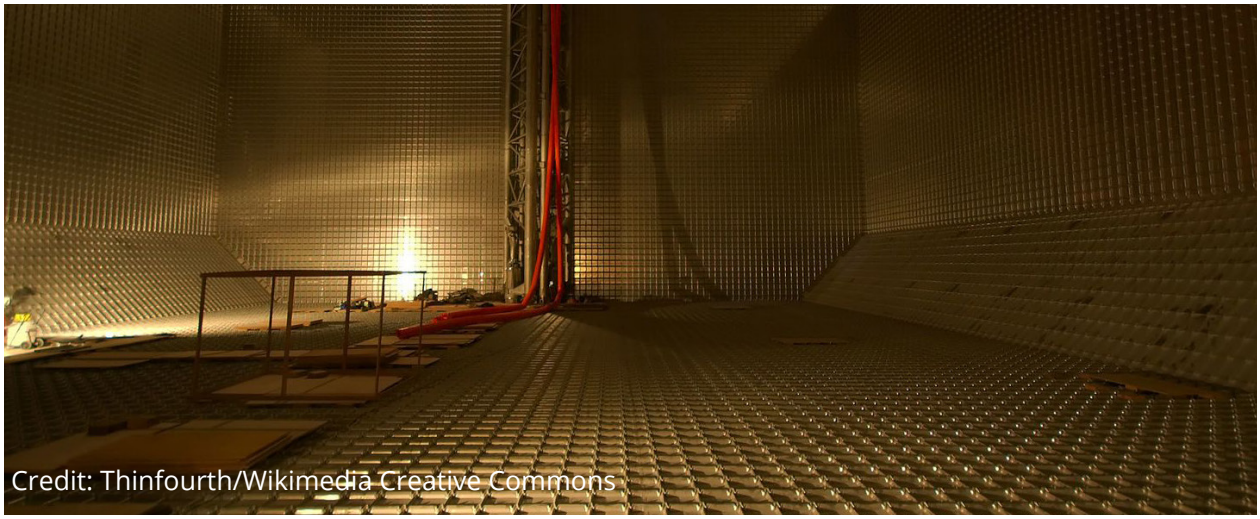
Concern was also raised over the damage the facilities could inflict on the environment and tourism economy. Although the city passed resolutions opposing development,

construction of the Brownsville export terminal was approved by the Federal Energy Regulatory Commission (FERC) in late November 2019. Simultaneously, FERC also approved two other LNG export facilities in the Rio Grande Valley, as well as the expansion of another export facility in Corpus Christi.

Similarly, in Providence, Rhode Island, construction of the Fields Point LNG processing plant has begun, despite concerns over environmental justice issues expressed by Providence's mayor, state senator and U.S. representative.

The Department of Environmental Management and the Rhode Island Coastal Resources Management Council both determined the project was permissible under state policy; however, their determinations can be preempted.

Yet in its final decision, FERC ruled that the executive order requiring consideration of potential impacts on minority and low-income populations was not applicable to an independent commission such as itself.[16]



Credit: Thinfourth/Wikimedia Creative Commons

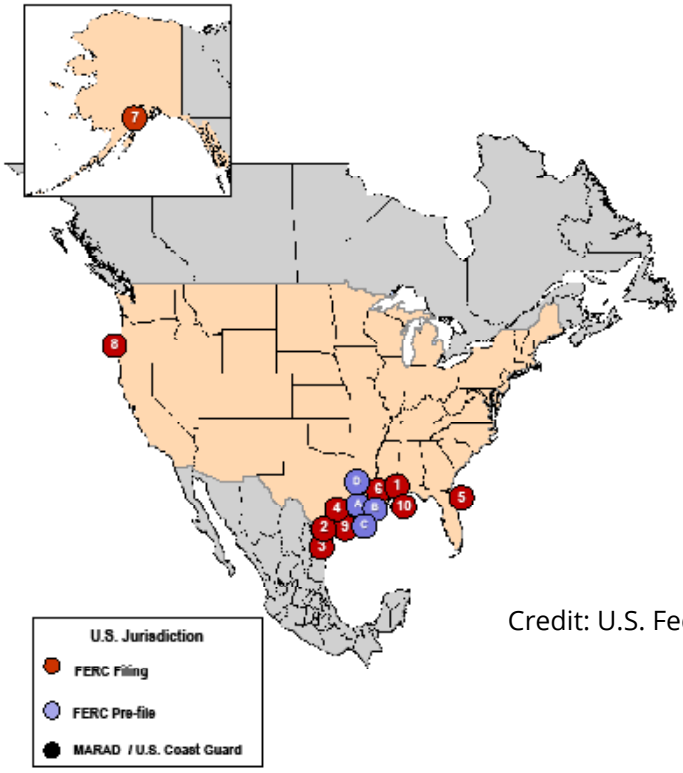
The Race for LNG

The U.S., having entered the LNG export market in the past few years, is now rapidly building out its export capacity.

As of May 2019, there were 10 LNG export terminals in North America proposed to FERC, as well as several more projects in pre-filing stages. This is in addition to 14 import/export terminals, most of them in the Gulf of Mexico, that have already been approved by either FERC or the Maritime Administration/ U.S. Coast Guard.

This expansion would increase polluting and potentially dangerous extraction and transport processes, while sinking billions of dollars into infrastructure that would lock the U.S. into greenhouse emissions for decades to come and squeeze out clean, safe, health-protective renewable energy sources.

North American LNG Export Terminals
Proposed



UNITED STATES

PROPOSED TO FERC
Pending Applications:
1. Pascagoula, MS: 1.5 Bcfd (Gulf LNG Liquefaction) (CP15-521)
2. Brownsville, TX: 0.55 Bcfd (Texas LNG Brownsville) (CP16-116)
3. Brownsville, TX: 3.6 Bcfd (Rio Grande LNG – NextDecade) (CP16-454)
4. Brownsville, TX: 0.9 Bcfd (Annova LNG Brownsville) (CP16-480)
5. Jacksonville, FL: 0.132 Bcf/d (Eagle LNG Partners) (CP17-41)
6. Plaquemines Parish, LA: 3.40 Bcfd (Venture Global LNG) (CP17-66)
7. Nikiski, AK: 2.63 Bcfd (Alaska Gasline) (CP17-178)
8. Coos Bay, OR: 1.08 Bcfd (Jordan Cove) (CP17-494)
9. Corpus Christi, TX: 1.86 Bcfd (Cheniere Corpus Christi LNG) (CP18-512)
10. Sabine Pass, LA: NA Bcfd (Sabine Pass Liquefaction) (CP19-11)

Projects in Pre-filing:
A. Cameron Parish, LA: 1.18 Bcfd (Commonwealth, LNG) (PF17-8)
B. LaFourche Parish, LA: 0.65 Bcfd (Port Fourchon LNG) (PF17-9)
C. Galveston Bay, TX: 1.2 Bcfd (Galveston Bay LNG) (PF18-7)
D. Plaquemines Parish, LA: 0.9 Bcfd (Pointe LNG) (PF18-8)

CANADA
For Canadian LNG Import and Proposed Export Facilities:
https://www.nrcan.gc.ca/energy/natural-gas/568

Credit: U.S. Federal Energy Regulation Commission (FERC)

As of May 17, 2019

Take Action!

- Share information about the health risks of LNG. Identify areas of unknown health risks and call for greater transparency and more scientific study.
- Advocate for rapid transition to clean, safe renewable energy solutions such as solar, wind and geothermal.
- Work with Physicians for Social Responsibility to protect a healthy, livable planet.
- For further information, contact Barbara Gottlieb at bgotttlieb@psr.org.

www.psr.org

Graphic design by Jeanne Le Bras (jeannelb93@mail.com)

END NOTES

1. Intergovernmental Panel on Climate Change. (2014) AR 5 Synthesis Report: Climate Change 2014. https://www.ipcc.ch/report/ar5/syr

2. Wood M. (2017) Upstream carbon emissions: LNG vs pipeline gas. https://www.woodmac.com/reports/macroeconomics-risks-and-global-trends-upstream-carbon-emissions-lng-vs-pipeline-gas-46686809

3. Intergovernmental Panel on Climate Change. (2018) Special Report: Global Warming of 1.5 C. https://www.ipcc.ch/sr15/

4. Salas R.N., Knappenberger P., Hess J. (Nov. 28, 2018) 2018 Lancet Countdown on Health and Climate Change Brief for the United States of America. https://www.apha.org/-/media/files/pdf/topics/climate/2018_us_lancet_countdown_brief.ashx?la=en&hash=99279F373B9F005C9EC364AB02EB7F636F1380CF

5. Elliott E., Ettinger A., Leaderer B., Bracken M., Deziel N. (2016) A systematic evaluation of chemicals in hydraulic-fracturing fluids and wastewater for reproductive and developmental toxicity. Journal of Exposure Science and Environmental Epidemiology, 27. https://www.ncbi.nlm/.nih.gov/pubmed/26732376

6. U.S. Environmental Protection Agency. Outdoor Air—Industry, Business, and Home: Oil and Natural Gas Production— Additional Information. Last updated Feb. 21, 2016. https://archive.epa.gov/airquality/community/web/html/oil-gas_addl_info.html

7. U.S. Environmental Protection Agency. Health and Environmental Effects of Particulate Matter (PM). https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm

8. Lee K.K., Miller M.R., Shah A.S.V. (January 2018) Air Pollution and Stroke. Journal of Stroke, 2018 Jan; 20(1): 2–11. https://www.j-stroke.org/journal/view.php?number=212

9. Fann N., Baker K.R., Chan E.A.W., Eyth A., Macpherson A., Miller E., Snyder J. (2018) Assessing Human Health PM2.5 and Ozone Impacts from U.S. Oil and Natural Gas Sector Emissions in 2025. Environmental Science & Technology 52 (15), pp. 8095-8103. https:/pubs.acs.org/doi/10.1021/acs.est.8b02050

10. U.S. Environmental Protection Agency. (1998) NOx: How Nitrogen Oxides Affect The Way We Live and Breathe. https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P10006ZO.txt

11. Afon Y., Ervin D. (2008) An assessment of air emissions from liquified natural gas ships using different power systems and different fuels. Journal of the Air and Waste Management Association. https://tandfonline.com/doi/abs/10.3155/1047-3289.58.3.404

12. Powell T. (2016) How industry and regulators kept public in the dark after 2014 LNG explosion in Washington. Sightline Institute. https://www.sightline.org/2016/02/08/how-industry-and-regulators-kept-public-in-the-dark-after-2014-lng-explosion-in-washington/

13. Super Tanker [Television series episode]. (2011) In Richard Hammond's Engineering Connections. BBC Two.

14.,15. Reagan M. (March 26, 2018) LNG opponents deliver public comment to TCEQ. The Brownsville Herald. https://www.brownsvilleherald.com/news/lng/lng-opponents-deliver-public-comment-to-tceq/article_913f129c-78e6-11e8-9b2a-474d755619d1.html

16. Federal Energy Regulatory Commission. (2018) Field Points Liquefaction Project−Environmental Assessment. https://www.ferc.gov/industries/gas/enviro/eis/2018/06-25-18-EA/CP16-121-EA.pdf