Liquefied Natural Gas (LNG) Export Terminal Study

Presented to the
Joint Legislative Commission on Energy Policy
&
Environmental Review Commission

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Introduction and Key Findings

Session Law 2014-4 (the "Energy Modernization Act" ratified on May 29, 2014) directs the North Carolina Department of Commerce, in consultation with the Department of Environment and Natural Resources, the North Carolina Ports Authority, and the Department of Administration, to "study the desirability and feasibility of siting, constructing, and operating a liquefied natural gas (LNG) export terminal in North Carolina." [1] The legislation asks the Department to identify the relevant regulatory programs, statutory barriers, and infrastructure needed for an LNG export terminal as well as to conduct a cost-benefit analysis for the construction and operation of a terminal. In addition, the study asks the Department to examine the potential economic, environmental, and social impacts of constructing and operating a terminal as well as any other pertinent issues the agencies deem relevant to an LNG export facility in the state.

This report begins by providing an overview of existing and proposed LNG export terminals within the United States as well as the pipeline infrastructure required to support such terminals. Next, the process for permitting, approving, siting, constructing, and operating an LNG export terminal and associated pipeline is described in detail. The feasibility of establishing an LNG export terminal in North Carolina is then discussed, including an examination of needed and available infrastructure and the potential for underutilized or unused state-owned land and infrastructure to be made available. A range of potential environmental, social, and economic impacts are discussed, drawn largely from existing, approved and proposed terminal applications at the federal level. Based on the best available information described above, a cost-benefit analysis from the perspective of the state is carried out. In addition to reviewing publicly available documents and literature, input was solicited from a variety of industry experts with knowledge of LNG export facilities.

In assessing the desirability and feasibility of constructing and operating an LNG export terminal, it is important to note that most of the necessary activity involved will occur on the part of the private sector, including the regulatory application, financing, building, and operation of such a facility. The goal of this study is not to conduct a market analysis or consider the costs and benefits to individual private companies, which can be expected to make investment decisions based on global market conditions. Rather, this study considers the potential costs and benefits of this activity to the state of North Carolina and examines how existing state regulations and assets could potentially facilitate or hinder this type of

[1] Full text available at http://www.ncleg.net/Sessions/2013/Bills/Senate/PDF/S786v8.pdf. See Appendix for Sections 22.(a) and (b).

development. In addition, this study does not assess any particular proposed project or make specific recommendations as to the desirability of specific locations. Finally, although natural gas is not yet currently being produced in North Carolina, this study considers both potential in-state and current out-of-state sources of production. Although the potential exists for offshore production of oil and natural gas, seismic testing has only recently been approved and therefore it is too early to develop specific scenarios for this source.

Key Findings

- Over the past few years, large increases in the available domestic natural gas supply as well as strong foreign demand have resulted in new opportunities for exporting LNG from the US.
- LNG export facilities are applied for, financed, constructed, and operated by private companies based on global market conditions, access to multiple sources of natural gas supply, transportation costs of both natural gas and LNG, and available infrastructure.
- The primary regulatory framework for permitting, approving, constructing and operating an LNG terminal is led by the Federal Energy Regulatory Commission (FERC) within the US Department of Energy (DOE).
- The biggest obstacle to establishing an LNG export facility is the time required to move through the regulatory process and construction—there are currently one existing and four approved LNG export facilities in the US, with 16 more in permitting the queue.[2]
- The majority of potential export sites in the US are in the Gulf of Mexico. Along the Atlantic coast, a facility in Maryland was recently approved and others in Georgia and Maine are in the application queue.
- North Carolina does not currently have the necessary infrastructure to support an LNG export terminal, particularly a diverse pipeline network covering multiple sources, subsurface natural gas storage capacity, or an existing LNG import facility which could be converted for exports.
- North Carolina's Ports at Wilmington and Morehead City may have the channel depth to support an LNG export terminal; other infrastructure would be required.
- The potential economic impact of establishing and operating an LNG export terminal in North Carolina could result in 3,000-3,500 temporary construction job-years[3] (over 2-4 years) and 75-160 permanent, full-time jobs to operate the facility. These jobs operating the facility may pay

[2] According to industry experts, the export market may end up requiring no more than a dozen facilities, and perhaps far fewer.
[3]Construction jobs are typically measured in job-years; as an example, 50 job years could be filled by ten workers employed over five years or fifty workers employed over one year.

an average of $80,000 plus benefits. A range of 600-650 indirect jobs could result from the jobs and investment involved in constructing and operating the terminal.

- The majority of direct costs to the state would be in the granting of land and tax exemptions that may be offered to incent development. The benefits would primarily be the income and sales tax associated with the jobs and investment mentioned above.

Background to Liquefied Natural Gas (LNG) Exports

Liquefied Natural Gas (LNG) exporting involves the collection, processing, and cooling of natural gas to a liquid state in which it can be stored and transported by shipping vessels to foreign import facilities. As recently as 2006, natural gas production in the US was flat and was expected to decline beginning in 2016.[4] However, technological advances in horizontal drilling and hydraulic fracturing have enabled access to unconventional sources of natural gas, resulting in a rapid increase in the available supply of domestic natural gas and lowering prices for domestic consumers. At the same time, opportunities to export became a desirable option for producers due to the price differential between natural gas in the United States compared to the cost of fuel used to generate electric power for the rest of the world—particularly in Europe and Asia. While domestic production has brought domestic natural gas prices down in the United States, the demand is still strong from many industrialized and industrializing nations, resulting in increased profit potential for US exporters.

In order to export LNG, several steps are involved. On the regulatory side, permission to export LNG must be granted by the US Department of Energy, while permitting and approval of the facilities occurs through a process led by Federal Energy Regulatory Commission (FERC). Following a lengthy review process, construction of liquefaction facilities, storage facilities, and associated pipelines can begin. Once pipeline grade natural gas is transported to the facility through pipelines, the gas can be further purified, cooled to a liquid, and stored and loaded into a specialized vessel for transport.

Because LNG export facilities require infrastructure such as pipelines to transport the gas to a facility as well as natural gas and LNG storage capacity, many existing *import* facilities are attempting to convert to *export* facilities. In these cases, instead of shipping vessels delivering LNG to a facility which then vaporizes the gas and transports it to domestic consumers though pipelines, the process is reversed. The

[4] USDOE/EIA, Annual Energy Outlook, 2006

conversion of the facility for exports requires constructing new liquefaction facilities, but much of the existing infrastructure can be used in the export process.

The time required to move through the permitting and approval process can be lengthy--two years or more is common, according to industry experts.[5] The process does seem to have accelerated within the past year as FERC has made policy adjustments to project prioritization. However, these changes have not been in place long enough to know the true impact on the permitting timeline. In addition, currently debated federal legislation[6] may further shorten the time required for approval. Once approval is granted, construction of the facility itself can take three to four years to complete. Companies seeking to export LNG generally always have foreign customers identified and signed to long-term contracts before construction even begins. These contracts are often "put or pay contracts" that ensure a revenue stream for the company regardless of whether delivery of the product is taken or not. Having these guaranteed customers, as well as access to numerous sources of natural gas through a diverse network of pipelines, helps companies secure funding for the construction of these facilities. Construction costs can range from $3.5 to $14 billion to build, in addition to any necessary pipeline, storage, or other infrastructure construction.[7]

Because of the necessity for access to abundant natural gas supplies, pipelines, and other infrastructure, most of the planned LNG export terminals are located in the Gulf of Mexico, including three large recently approved facilities in Louisiana and Texas. The only currently operational export terminal is in Alaska, with plans for a nearby significantly larger facility currently in the application process. Outside of those two areas, the Atlantic Coast has one recently approved export terminal in Cove Point, Maryland, and two other mid-sized facilities seeking approval in Georgia and Maine. On the Pacific Coast, two new export terminals are proposed for construction in Oregon.

The following section provides an overview of the existing, approved, and proposed LNG export terminals and associated pipelines and infrastructure in the United States.

[5] Description of process provided by industry experts. See Appendix for list of industry sources.
[6] The US House of Representatives passed H.B. 6 on 6/25/14. https://www.congress.gov/bill/113th-congress/house-bill/6
[7] Projected costs vary widely, depending on whether the project is a new or converted facility, as well as the size/capacity of the facility. More detailed project descriptions can be found in the following section.

Overview of LNG Export Terminals

Exporting liquefied natural gas is a relatively new phenomenon for the United States. In fact, only one facility in the US is currently operational. However, the line to convert or build new terminals is already long. Given the high construction costs of an export facility and the global supply and demand needs, the potential number of viable LNG export facilities is likely to be limited, according to industry experts. The sheer number and applications for potential projects may not reflect what the actual state of LNG exports will look like in a few years.

Existing Export Terminals

The Kenai LNG facility in Kenai, Alaska was the world's largest LNG plant when it was built in 1969. It is the only current LNG export facility in the United States. After almost 40 years of exporting to Tokyo Electric and Tokyo Gas, the terminal was temporarily shut down in 2011. When market conditions created a greater demand for LNG, ConocoPhillips applied for permission to restart export operations. In April 2014, the facility received permission to export 20 BCF of LNG per year for two years.[8] Compared to recently approved projects, this is a smaller facility.

Approved Export Terminals

In 2011, as market forces picked up and technology allowed more gas to be produced, LNG became an attractive export option. In May 2011, Cheniere Energy received authorization from the U.S. Department of Energy to build the first LNG export terminal in the contiguous United States (Sabine, Louisiana). Export facilities are expected to be operational beginning in 2015.[9] Since 2011, three other applications to construct export facilities have been approved. As of December 3, 2014, there were 16 proposed LNG export terminal applications and an additional 12 potential sites identified by project sponsors.

A common feature of the approved export terminals is that they have all previously been importers of LNG. While the facilities needed to export LNG differ from those needed to import LNG, much of the needed infrastructure is already in place at the existing import facilities. As a result, companies that already have LNG import operations are at a significant advantage in becoming an exporter of LNG. In

[8] Kenai Fact Sheet: http://alaska.conocophillips.com/Documents/Fact%20Sheet_Kenai%20LNG_CURRENT.pdf
[9] Press Release: http://www.gov.louisiana.gov/index.cfm?md=newsroom&tmp=detail&articleID=2928; Cheniere FERC application: http://www.cheniere.com/CQP_documents/SPLQ%20Export%20FERC%20Application%201-31-2011.pdf

particular, these operations have already had Environmental Impact Statements (EIS) from the Federal Energy Regulatory Commission (FERC). Although new facilities require additional EIS's, many of the necessary plans are already in place from their import operations.

The four approved LNG export terminals provide relevant contextual information in understanding the market for LNG. The facilities to be constructed vary significantly in export capacity in the range of 0.74 Bcf/d to 2.0 Bcf/d. All but one (Cove Point, Maryland) are located in the Gulf Coast, likely due to extensive existing infrastructure. Overall facility capacity is dependent upon the availability of gas supplies and how many liquefaction trains[10] are being constructed. It is also important to note that these approved projects already have 20-year contracts in place with companies that will buy the LNG produced. Many of the companies that will buy the LNG have also supplemented investment in constructing the facility upfront. These facts are summarized in Figure 1 and discussed below.

Sabine LNG in Sabine, Louisiana[11]

Cheniere Energy has operated an LNG import terminal in Cameron Parish since 2008. In July 2011, the company announced plans to expand its existing facility and transform the Sabine Pass terminal into a bi-directional facility capable of exporting LNG, as well as receiving LNG for regasification. Construction began on the facility in 2012 and is expected to be completed at the end of 2015. When the facility comes on-line, it will likely be the first domestic export LNG terminal in the contiguous United States and is permitted to export up to 16 million metric tons of LNG.[12] The company has already secured non-binding deals for 9.8 million metric tons annually.

Cameron LNG in Hackberry, Louisiana[13]

On October 23, 2014, Sempra Energy broke ground on a new $6 billion liquefaction processing complex in Hackberry, Louisiana. The LNG facility already has long-term agreements with Mitsubishi Corporation and Mitsui & Co. (based in Japan), as well as GDF Suez SA (based in France) who will purchase the LNG exports produced at the facility. Initial LNG shipments will begin by the end of 2017 and full operations will be in place by 2019. In order to accommodate the project, two major new electrical transmission

[10] Liquefaction trains, or LNG trains are the facilities where the liquefaction takes place. Gas is purified and then cooled until it is liquefied.
[11] Press Release: http://www.gov.louisiana.gov/index.cfm?md=newsroom&tmp=detail&articleID=2928; Louisiana Economic Development: http://www.opportunitylouisiana.com/page/cheniere-energy
[12] The Department of Energy uses a conversion factor of 1 Bcf/d = 7.82 mtpa (million metric tons per year).
[13] Press Release: http://gov.louisiana.gov/index.cfm?md=newsroom&tmp=detail&articleID=4720

lines and a new substation in Hackberry are being installed to provide sufficient electrical current. At full capacity, the facility will be capable of producing 12 million metrics tons of LNG annually.

Freeport LNG in Freeport, Texas[14]

In July 2014, Freeport LNG received FERC authorization to site, construct and operate a liquefaction project. Final approvals were issued by the DOE and FERC in November 2014. The current facility at Freeport has an LNG receiving, storage, and regasification terminal. The additional project will allow Freeport LNG to export approximately 13.2 million metric tons annually. The Eagle Ford, Barnett, and Haynesville shale gas deposits are expected to be significant sources of supply for the project.
The Freeport LNG facility will consist of three LNG trains. 20-year agreements have already been signed for the entire capacity of the first two trains; companies include Osaka Gas, Chubu Electric, and BP Energy. Tolling agreements have also been signed by Toshiba Corporation and SK E & S for the remaining facility capacity in train three.

Cove Point LNG in Cove Point, Maryland[15]

On September 29, 2014, the Cove Point LNG project became the fourth approved LNG export terminal in the contiguous United States. On October 30, 2014, Dominion announced that it had begun construction activities on the Cove Point LNG project. The existing Cove Point facility has been an LNG import terminal for almost 40 years. The new project will create one LNG train that will have the capacity to export 5.75 million metric tons of LNG annually. No new pipelines or storage tanks are needed at the facility and export operations are set to begin in late 2017.

[14] Freeport LNG: http://www.freeportlng.com/
[15] Dominion: https://www.dom.com/corporate/what-we-do/natural-gas/dominion-cove-point)

Figure 1: Approved and Existing LNG Export Terminals

Approved/Existing North American Export Terminal	Company	Total Export Capacity (Bcf/d)	Contracts
Kenai, AK	ConocoPhillips	0.2	Tokyo Gas, Japan Tokyo Electric, Japan
Sabine, LA	Cheniere Energy	2.0	BG Gulf Coast LNG, United Kingdom Gas Natural Fenosa, Spain Korea Gas Corporation, South Korea GAIL (India) Limited, India Total Gas & Power NA Centrica plc, United Kingdom
Freeport, TX	Freeport LNG	1.7	Osaka Gas, Japan Chubu Electric, Japan BP Energy Toshiba Corporation, Japan SK E & S, South Korea
Hackberry, LA	Sempra Energy	1.5	Mitsubishi Corporation, Japan Mitsui & Co., Japan GDF Suez SA, France
Cove Point, MD	Dominion	0.74	Pacific Summit Energy, LLC, Japan GAIL Global (USA) LNG, LLC, India

Source: FERC: http://www.ferc.gov/industries/gas/indus-act/lng.asp; contracts information was obtained from a variety of sources, see text for individual company details.

Proposed Export Terminals

As of December 3, 2014, there were 16 proposed LNG export terminal applications. At least four of the proposed terminals already have existing LNG import operations in place. As previously discussed, these four locations will be at a significant advantage to begin LNG export operations due to existing infrastructure. At least three of the remaining proposed locations are very close to a current import facility or import facility that is converting to export facility.

The map in Figure 11 in the Appendix shows the location of the proposed export terminals. Ten of the sixteen proposed terminals are located in the Gulf Coast. Of the remaining proposed terminals, two are located on the west coast (Oregon and Washington), three are located on the east coast (Maine, Georgia, Florida), and one is located in Alaska.

The proposed export terminals again vary significantly in export capacity in the range of 0.075 Bcf/d to 2.55 Bcf/d. It is worth noting that 4 of the 16 proposed export terminals would have a capacity greater than 2.0 Bcf/d.

At least two of the proposed terminals are far along in the process of becoming an approved export terminal. Corpus Christi LNG had a final Environment Impact Statement issued by the FERC on October 8, 2014. Jordan Cove Energy Project had a final Environmental Impact Statement issued May 1, 2009, but was given several areas to address before continuing the permitting process.[16]

[16] FERC: http://www.ferc.gov/industries/gas/enviro/eis/2014/10-08-14-eis.asp; FERC: http://www.ferc.gov/industries/gas/enviro/eis/2009/05-01-09-eis.asp

Figure 2: Proposed LNG Export Terminals

Proposed North American Export Terminal	Company	Export Capacity (Bcf/d)	Current Import Terminal?
Corpus Christi, TX	Cheniere - Corpus Christi LNG	2.1	no
Coos Bay, OR	Jordan Cove Energy Project	0.9	no
Lake Charles, LA	Southern Union - Trunkline LNG	2.2	yes
Astoria, OR	Oregon LNG	1.25	no
Lavaca Bay, TX	Excelerate Liquefaction	1.38	no
Elba Island, GA	Southern LNG Company	0.35	yes
Sabine Pass, LA	Sabine Pass Liquefaction	1.4	no, but existing one nearby
Lake Charles, LA	Magnolia LNG	1.07	no, but existing one nearby
Plaquemines Parish, LA	CE FLNG	1.07	no
Sabine Pass, TX	ExxonMobil - Golden Pass	2.1	yes
Pascagoula, MS	Gulf LNG Liquefaction	1.5	yes
Plaquemines Parish, LA	Louisiana LNG	0.3	no
Robbinston, ME	Kestrel Energy - Downeast LNG	0.45	no
Cameron Parish, LA	Venture Global	1.4	no
Jacksonville, FL	Eagle LNG Partners	0.075	no
Nikiski, AK	ExxonMobil, ConocoPhillips, BP, TransCanada, and Alaska Gasline	2.55	no, but existing one nearby

Source: FERC: http://www.ferc.gov/industries/gas/indus-act/lng.asp

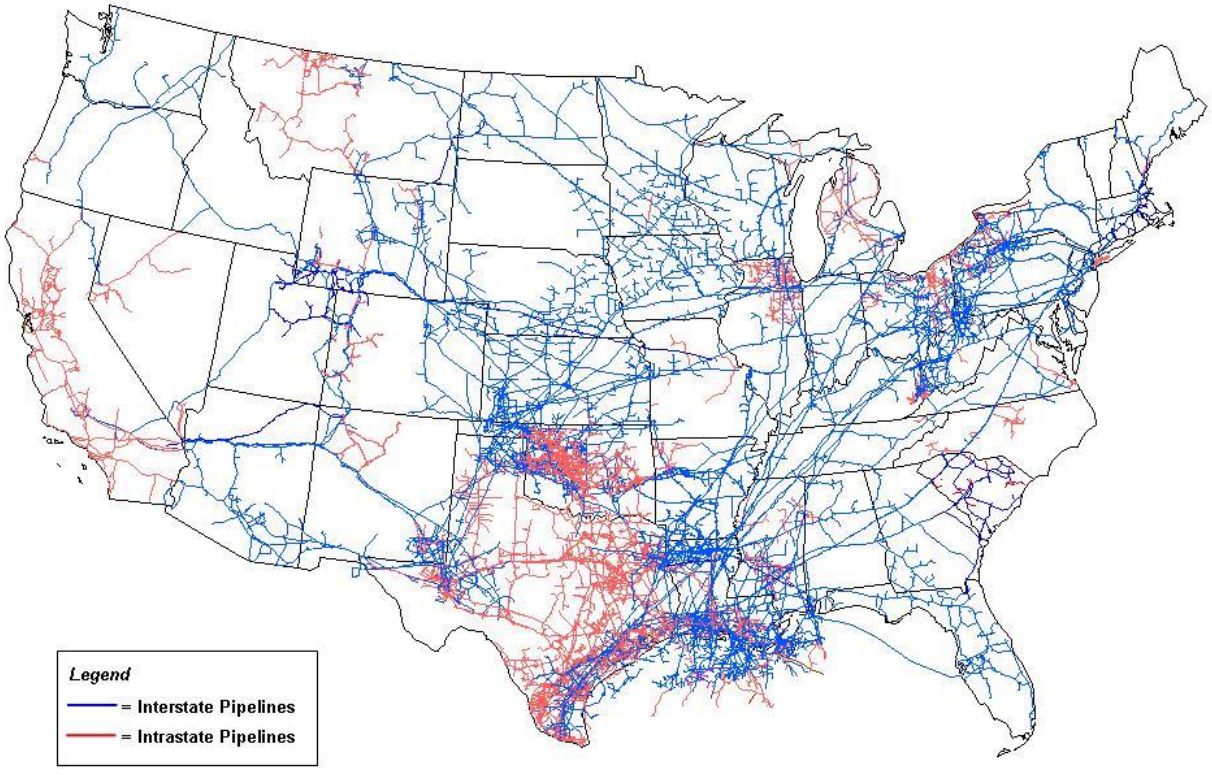
Potential Export Terminals

As of December 3, 2014, there were 12 additional LNG export terminal sites identified by project sponsors as having favorable potential for development. The capacity of these facilities would vary from 0.2 Bcf/d to 3.22 Bcf/d. Two of the potential sites – Gulf of Mexico and Brownsville, Texas – have a potential capacity greater than 3.0 Bcf/d. All of these potential sites are located in the Gulf Coast and have access to a vast network of existing pipelines and storage facilities.

Pipeline Distribution

Pipelines are an essential part of the infrastructure network necessary to support an LNG export facility. The map below shows why the Gulf Coast is a particularly attractive area for companies looking to export LNG. Any export facility would require multiple sources of natural gas to offset any potential supply disruption.

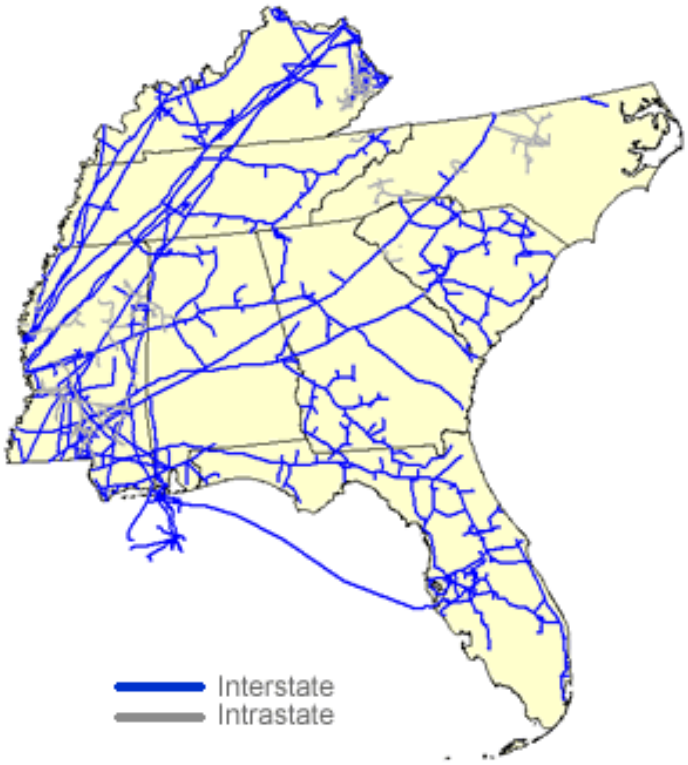
Figure 3: Natural Gas Pipeline Network in the Continental United States, 2009



Source: Energy Information Administration, Office of Oil & Gas, Natural Gas Division, Gas Transportation Information System

Although the Gulf Coast is clearly the most connected in terms of pipelines, the Marcellus shale area in Pennsylvania, Ohio, and West Virginia is also well connected. A regional map shows the existing pipelines in North Carolina more closely, current as of 2009. This map does not include the recently constructed Piedmont Natural Gas pipeline, connecting Charlotte to Wilmington or the proposed Atlantic Coast Pipeline, connecting West Virginia to North Carolina and running along the I-95 corridor in North Carolina. The addition of these pipelines increases North Carolina's domestic supply of natural gas but that supply is already contracted to customers in the state. Therefore, these pipelines would not be available to support an export facility.[17]

Figure 4: Natural Gas Pipeline Network in the Southeast Region, 2009



Source: Energy Information Administration, http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/southeast.html3

[17] Bruce McKay, Dominion Resources

Federal and State Regulatory Framework

Natural Gas Exportation Regulation

The Natural Gas Act requires that anyone who wishes to import or export natural gas, including LNG from or to a foreign country first obtain approval from the Department of Energy (DOE) Office of Fossil Energy.[18] Parties who want to enter into natural gas transactions with foreign sellers and buyers must file for an import and/or export authorization under the rules and procedures found in Part 590 of DOE regulations.[19]

LNG Export Terminal Regulation

DOE's Federal Energy Regulatory Commission (FERC) acts as the lead agency in coordinating federal authorizations necessary to site and construct an onshore and near-shore LNG export terminal and for the purposes of complying with the National Environmental Policy Act of 1969 (NEPA).[20] Authorization decisions from FERC are intended to be consistent with the public interest, though "public interest" is not legislatively defined and no timeline is prescribed for FERC decision-making.

As required by NEPA, FERC prepares environmental assessments or environmental impact statements for proposed LNG facilities under its jurisdiction. During this process, FERC evaluates a wide range of project impacts, including impacts on geology, soils, water resources, vegetation, wildlife, fisheries, special status species, land use, visual resources, socioeconomics, cultural resources, air quality, noise, and safety. FERC also recommends mitigation measures to minimize or avoid these impacts. Numerous federal agencies are involved in this process, often including the U.S. Coast Guard; the U.S. Environmental Protection Agency (EPA); the U.S. Army Corps of Engineers (COE); the U.S. Department of Interior's Fish and Wildlife Service (FWS); the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries); and the U.S. Department of Transportation (DOT).

- The Coast Guard has authority over the safety and security of LNG carriers, and the waterway for LNG marine traffic. The Coast Guard provides the determination of a waterway's suitability for LNG marine traffic.[21] LNG facilities must also satisfy the Coast Guard's requirements for seismic design of LNG waterfront facilities.[22]
- EPA has responsibilities under the Clean Air Act and the Clean Water Act.

[18] 15 U.S. Code § 717b
[19] 10 CFR Part 590
[20] 15 U.S. Code § 717n(b)
[21] P.L. 111-281, Section 813
[22] 33 CFR 127.103

- COE has authority to issue dredging and wetland permits for the project under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act.
- FWS and NOAA Fisheries are consulted to identify federally listed endangered or threatened species that potentially occur in the vicinity of the proposed project.
- DOT serves as the subject matter expert in ensuring that LNG facilities satisfy the design requirements of National Fire Protection Association.[23]

Also required in the FERC environmental review process are:

1) An Upland Erosion Control, Revegetation, and Maintenance Plan and
2) Wetland and Waterbody Construction and Mitigation Procedures.

At the state level, FERC and project sponsors also coordinate with many state agencies to collect information necessary for FERC authorization and to ensure that state regulations are observed in the construction and operation of an LNG export terminal. North Carolina state government agencies likely to be involved in this process include:

- Department of Environment and Natural Resources (DENR)
    - Division of Air Quality
    - Division of Coastal Management
    - Division of Energy, Mineral, and Land Resources
    - Division of Marine Fisheries
    - Division of Water Resources
- N.C. Wildlife Resources Commission
- N.C. State Ports Authority
- Department of Cultural Resources
    - State Historic Preservation Office

Prior to the environmental review process of a proposed LNG export terminal, FERC provides stakeholders and interested parties the opportunity to provide input on environmental issues that should be addressed during the environmental review process. FERC also conducts public meetings in the project area to provide an opportunity for the public to learn more about the project and to

[23] 49 CFR 193

comment on relevant environmental issues. Upon publication of a draft environmental impact statement, FERC again accepts public comments and holds additional public meetings.

Once LNG export terminals are approved and built, FERC also has the responsibility to ensure their safe and reliable operation.[24]

Natural Gas Pipeline Regulation

Regulation of natural gas pipelines differs significantly depending upon the pipeline's status as *inter*state (a pipeline that crosses state boundaries) or *intra*state (a pipeline whose footprint falls completely within North Carolina).

Interstate Pipelines

FERC is also responsible for authorizing LNG interstate natural gas pipelines under the Natural Gas Act, and is the lead federal agency for the purposes of complying with the requirements of NEPA.[25] FERC approves the location, construction, and operation of natural gas pipelines and storage facilities. Prior to construction, companies are required to perform an environmental impact analysis (similar to and frequently in conjunction with the environmental impact analysis required of proposed LNG export terminals), in which endangered species and historic buildings have some regulatory protections.

FERC would coordinate with DENR to ensure appropriate permitting and compliance with North Carolina environmental regulations. The pipeline project sponsor could also apply to construct a proposed pipeline along the North Carolina Department of Transportation (NCDOT) right-of-way. NCDOT has the authority to allow public utilities to locate their infrastructure along state, county, or township roads. For this purpose, gas pipelines are included in the definition of public utilities.[26] However, after conversations with NCDOT and NC Utilities Commission Public Staff, it is unclear if a pipeline constructed for the sole purpose of natural gas exportation would classify as a public utility.[27]

Despite the possible use of NCDOT right-of-way, the pipeline would likely cut through the properties of many North Carolinians, requiring negotiations between affected property owners and the pipeline

[24] 15 U.S. Code § 717
[25] 15 U.S. Code § 717n(b)
[26] North Carolina G.S. 136-18(2)
[27] North Carolina G.S. 62-3(23)

project sponsor. If negotiated easements could not be secured, the pipeline project sponsor would have the authority to seize land through eminent domain in creating the easement necessary for the construction and maintenance of the pipeline.[28] In addition, the pipeline operator will require permanent access for maintenance, including prohibiting buildings and trees in the easement.

If natural gas pipelines affect any active military installation, FERC enters into a memorandum of understanding with the U.S. Department of Defense (DOD) on the siting, construction, expansion, or operation of that pipeline.[29]

Once interstate natural gas pipeline projects become operational, safety is regulated, monitored, and enforced by the U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA).[30]

Intrastate Pipelines

FERC is not involved in the authorization of intrastate pipelines. The construction and safety of intrastate pipelines in North Carolina (those that originate and end within the state) is regulated by the North Carolina Utilities Commission (NCUC).[31] However, under current state law, it is unclear if an intrastate pipeline providing exclusive service to an export terminal would fall under NCUC's jurisdiction over pipeline safety. This issue may require statutory clarification.

State Regulatory Barriers

In states with a strong LNG industry presence, certain LNG-related regulatory infrastructure exists that is currently absent in North Carolina.

Alaska is the only state with an LNG export terminal currently in operation. Established by the U.S. Congress in 2004, the Office of the Federal Coordinator for Alaska Natural Gas Transportation Projects helps expedite and coordinate federal permitting for construction of a pipeline to move Alaska natural gas to North American markets. The office coordinates with more than 20 federal agencies, the state of

[28] North Carolina G.S. 40A-3(a)(1)
[29] 15 U.S. Code § 717b(f)
[30] 49 U.S. Code § 5121
[31] North Carolina G.S. 62-50

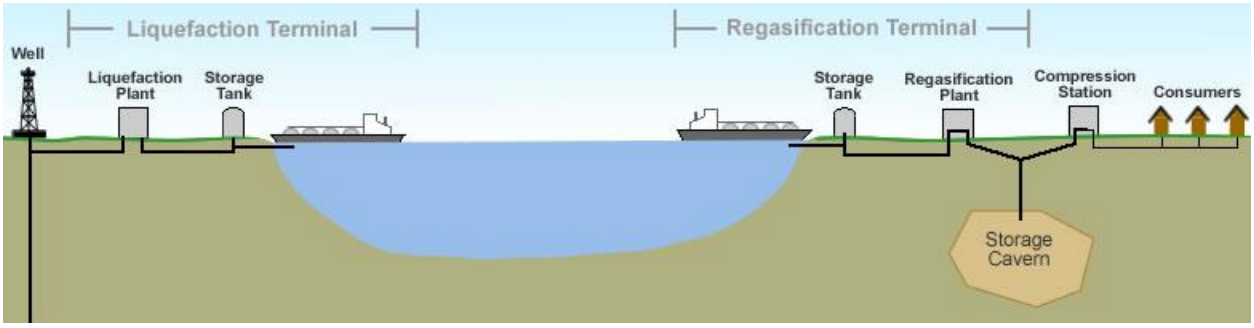
Alaska, tribal governments, and other stakeholders, including the project sponsors, in the multibillion-dollar development.

A similar state-level coordination effort is administered in Oregon, where an LNG export terminal has been proposed to FERC. The Oregon Department of Energy's Energy Facility Siting Division is responsible for overseeing Oregon's interests in the siting of LNG terminals in the state. The Division's activities include coordinating the state's review and comments of draft resource reports submitted by LNG developers, coordinating the state's review and comments of FERC's draft and final EISs, and coordinating other state activities involving the federal siting process.

Feasibility of LNG Export Terminals in North Carolina

Assuming a company has received regulatory approval from FERC, it would then need to begin the construction process. An LNG export terminal requires a vast network of infrastructure. Key pieces of this infrastructure include storage facilities and pipelines.

Figure 5: How an LNG export terminal works



Source: http://geology.com/articles/lng-liquefied-natural-gas/lng-terminals.jpg

The diagram above shows the basic operation of an LNG export and import terminal. Gas is produced and transmitted via pipeline to the liquefaction plant (also known as an LNG train). Gas must be treated to remove impurities such as carbon dioxide, mercury, hydrogen sulphide, and water. Once the gas is purified, it is cooled to -260 degrees Fahrenheit (-161 degrees Celsius) and stored in liquid form in LNG storage tanks. These tanks are connected to LNG transfer lines and loading arms that are used to move the LNG to LNG carriers. The carriers transport the LNG internationally to an import, or receiving terminal.

At the LNG import terminal, the LNG is unloaded into a storage tank and piped into a regasification plant where it can be converted to natural gas that is ultimately used by consumers. Although the focus of this report is on LNG export operations, it is helpful to understand LNG import operations, as several approved LNG export terminals in the United States are converting from LNG import terminals. Although current import terminals need to construct liquefaction plants, they benefit from having storage tanks, pipelines, and dock connections already in place.

In this section, the major infrastructure components needed to support an LNG export terminal are discussed. The facilities at Cove Point, Maryland and Elba Island, Georgia are frequently used to discuss specific details.[32] Both of these facilities have submitted detailed draft resource reports to FERC that are publicly available. They are also mid-size facilities and located on the east coast.

Land requirements

Land requirements for an LNG export terminal vary depending on the size of the facility, how many LNG trains will be constructed, and what import operations are already in place. In Cove Point, Maryland, the current property owned by Dominion encompasses more than 1,000 acres. Roughly 130 of these acres lie within an existing fence around the operating industrial area. New liquefaction facilities will be installed inside this fence, utilizing approximately 40-60 acres. In Elba Island, Georgia, the existing LNG import terminal occupies approximately 230 acres. Approximately 80 additional acres will be utilized in new export operation facilities.

Both the Cove Point and Elba Island facilities are current import terminals. Most proposed LNG export terminals have import operations and have detailed plans available electronically. The Jordan Cove Energy Project in Oregon is one such project. The Jordan Cove project has a total land size of almost 300 acres. Approximately 250 of these acres would be temporarily affected by construction, while a total of almost 200 acres will ultimately be permanently affected by operations.[33]

North Carolina Sites

The North Carolina Ports Authority owns and manages three potential sites that could be sold or leased for an LNG terminal – two adjacent to the Port of Wilmington and one at Radio Island near Morehead.

[32] Specific details related to Cove Point, Maryland and Elba Island, Georgia were obtained from their draft resource report 1, available here: http://elibrary.ferc.gov/idmws/file_list.asp?document_id=14039887; and here: http://elibrary.ferc.gov/idmws/file_list.asp?document_id=14132014

[33] Jordan Cove: http://www.jordancoveenergy.com/ferc_application_and_resource_reports_1-13.htm#rr1

The sites range in size from 90 to 140 acres. The suitability of these sites to potential energy companies is unknown and would be assessed in part on the desired facility size. In addition, the Ports Authority owns a 600 acre plot in Brunswick County originally planned for the North Carolina International Port.

Storage facilities

Storage facilities are a vital part of the LNG export infrastructure network. Above ground storage tanks are needed to store the LNG once it is liquefied. The LNG is kept in the storage tank until an LNG carrier arrives to transport the LNG to another location. Current LNG import locations already have above ground LNG storage tanks as well as additional storage caverns or subsurface gas storage reservoirs where regassified gas is held until it is delivered to the gas pipeline distribution system.
Storage capacity varies depending on the size of the facility. Elba Island, Georgia currently has five LNG storage tanks with a total capacity of 11.5 Bcf. Cove Point, Maryland currently has seven LNG storage tanks with a total capacity of 14.6 Bcf.

Pipelines

Pipelines are another crucial part of the LNG export infrastructure network. Pipelines are the mechanism by which natural gas is transmitted from the regions in which it is produced to LNG export facilities. Networks of pipelines often take many years to construct. Regions such as the Gulf Coast are at a distinct advantage because these pipelines are already in place. The diversity of supply is extremely important when considering the longevity of an LNG project; it is not enough to have one pipeline connected to a single supply source because the risk is too great that unforeseen events may occur to limit the consistent availability of that single source.

The Elba Island facility is directly connected to three major pipelines and indirectly connected to two others, making it readily accessible from both southeast and mid-Atlantic supply areas. The Cove Point facility is directly connected to the Marcellus shale. The Cove Point region has already experienced a surge in pipeline expansions as gas producers look for ways to get their gas to markets.

North Carolina Pipelines

North Carolina has few large-scale existing pipelines in place. The Transco pipeline is the nation's largest-volume interstate natural gas pipeline system and consists of 10,200 miles of pipelines, part of which passes through western North Carolina. The system is a major provider of cost-effective natural

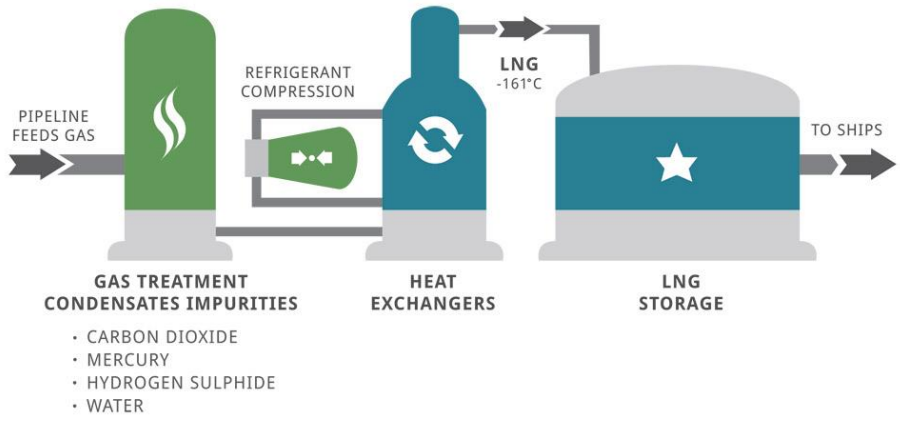
gas services that reach U.S. markets in 12 Southeast and Atlantic Seaboard states, including major metropolitan areas in New York, New Jersey and Pennsylvania. The pipeline currently flows south to north, but modifications are expected to be completed in December 2015 to allow gas produced in the Marcellus shale region to be transported south when needed.[34]

The Atlantic Coast Pipeline (ACP) is a proposed pipeline that will connect West Virginia to North Carolina when constructed. The ACP will follow the I-95 corridor and bring gas supplies to the middle of North Carolina.[35] This pipeline will be owned by Dominion who already has current contracts in place with customers.[36] As such, this pipeline will supply natural gas to customers within North Carolina and may not be available for a potential LNG export terminal.

Liquefaction Facilities (LNG Trains)

Treatment facilities are needed to further treat the pipeline grade natural gas prior to passing through the liquefaction facilities used to convert the gas to LNG. Both of these processes are accomplished with sophisticated technology. The exact processes used to treat and cool the feed gas likely differ marginally by facility; in general, the feed gas undergoes some process to remove impurities such as carbon dioxide, mercury, hydrogen sulphide, and water. Once the gas has been purified, it is cooled through a multi-stage refrigeration process until it becomes liquefied. The refrigerants used to cool the natural gas include nitrogen, methane, ethylene, propane, and isopentane.

Figure 6: How an LNG Train Works



Source: www.goldborolng.com/about-lng/what-is-lng/

[34] Transco Pipeline: http://co.williams.com/operations/atlanticgulf-operations/transco/
[35] See Figure 15 in Appendix.
[36] Bruce McKay, Dominion Resources

Berths/Shipping facilities

Shipping facilities are necessary to transfer the cooled LNG contained in storage tanks to LNG carriers and ultimately to an LNG import location. Typically, a system exists to pump LNG from the storage tanks to the LNG carrier through LNG transfer lines and loading arms. Berths of sufficient size are necessary to accommodate the LNG carrier. As an example, Elba Island has two marine berths, constructed in a berthing pocket just off the main channel of the Savannah River. Each berth is designed to accept LNG carriers up to the following criteria:

- Length Overall (max.): 345 meters (1132 ft)
- Beam (max.): 55 meters (180 ft)
- Cargo Capacity: 267,000 cubic meters (max.)
- Displacement: 177,000 Tonnes (max.)

Ports

Current LNG projects are dredging to a depth of 40 feet.[37] North Carolina has two ports that both meet this depth requirement.

Port of Wilmington

The Port of Wilmington is 26 miles from open sea and offers facilities to handle containerized, bulk and break-bulk cargoes. Wilmington is one of the few South Atlantic ports with readily available berths and container storage areas and equipment. It has a 42 foot channel and berth depth. [38]

Port of Morehead City

The Port of Morehead City is only four miles from open sea and specializes in break-bulk and bulk cargo. The port has nine berths. The channel depth is 45 feet with berths ranging from 38-42 feet in depth. [39]

Roads

In general, the impact of an LNG export terminal on roads is mostly minimal. Almost all of the processes related to exporting LNG are contained at the facility. As an example, at the Elba Island LNG export terminal, it is necessary to truck out impurities removed from the incoming natural gas and truck in refrigerant to the facility. The impurities will be trucked at a rated of approximately two trucks per day while the truck frequency for refrigerants is approximately 6 trucks per month. At times, waste water is

[37] "Future LNG Exports to Impact Traffic, Tug Requirements": http://www.marinelink.com/news/exports-traffic-future381819.aspx
[38] Port of Wilmington: http://www.ncports.com/elements/media/files/port-wilmington-fact-sheet.pdf
[39] Port of Morehead City: http://www.ncports.com/elements/media/files/port-morehead-city-fact-sheet.pdf

also trucked out of the facility. Amine associated with the acid gas removal system will be trucked approximately six times per year.

Other Considerations

As part of the environmental regulations, LNG export terminals have to have storm water drainage, spill containment, and fire water systems in place. As with any new industrial development, an LNG export terminal would bring increased need for services including schools, law enforcement, and development. However, these needs are not likely to be great because of the relatively small number of people employed by an LNG export terminal.

Potential Environmental and Social Impacts

Environmental Impacts

It is not possible to gauge the particular environmental impacts of an LNG export terminal without a specific proposed site for that terminal. However, regardless of the terminal's site, environmental impacts of proposed LNG export terminals are assessed through the FERC authorization process.

In conducting environmental impact analyses, FERC accounts for a wide variety of potential environmental impacts resulting from proposed natural gas facilities. FERC proposes project-specific mitigation measures on geology, soils, water resources, vegetation, wildlife, fisheries, special status species, and air quality. For each project, FERC identifies issues such as soil content and erosion control; impacts on drinking water and wetlands; sensitive wildlife habitat and dredging-related impacts; forest clearing; and federally listed endangered and threatened species.

Any release of LNG at a facility would present a fire risk in the presence of an ignition source. However, an unignited release would vaporize and dissipate into the atmosphere as it warmed with contact with the ambient soils, water and air. Methane is non-toxic; therefore, no environmental impact to the soil, water or groundwater would occur and no impact to the biota would occur unless by asphyxiation or freezing.

Social Impacts

Similar to the evaluation of environmental impacts, it is not possible to gauge the particular social impacts of an LNG export terminal without a specific proposed site for that terminal. However, various social impacts are also incorporated into the FERC authorization process.

FERC proposes project-specific mitigation measures on visual resources, socioeconomics, cultural resources, recreation, land use, and noise. For each project, FERC identifies issues such as the proximity of residences to the proposed site and pipelines; the proximity of public land or recreation areas to the proposed site and pipelines; visibility of the terminal from residences and at key observation points; impacts on archaeological and historic sites; impacts on sites of religious or cultural importance to Native American tribes; impacts on commercial, recreational, and fishing boat activity; and noise impacts from construction and operation.

Potential Economic Impacts

The potential economic impacts of an LNG export terminal consist primarily of jobs created as well as new and induced spending. Investment and potential tax revenue are also central to the issue of economic impacts. Because there is no specific project under consideration, existing and approved LNG export terminals and their associated economic impacts are examined in this section.

Kenai LNG in Kenai, Alaska[40]

The Kenai LNG facility in Kenai, Alaska is a relatively small operation, exporting 0.2 Bcf/d to Japan. As of 2011, the facility employed roughly 60 employees. Approximately 50 indirect employees were associated with the facility. These direct and indirect jobs together paid a total of $17 million annually.

Sabine LNG in Sabine, Louisiana[41]

Cheniere Energy's $6 billion project in Sabine, Louisiana will retain 77 jobs and create 148 new direct, full-time jobs that will feature an annual compensation and benefits package that exceeds an average of $100,000. An additional 589 new indirect jobs will be supported by the direct investment. In addition to

[40] Kenai Fact Sheet: http://alaska.conocophillips.com/Documents/Fact%20Sheet_Kenai%20LNG_CURRENT.pdf; 2011 Economic Impact Information: http://www.akrdc.org/membership/events/breakfast/0910/clark.pdf

[41] Press Release: http://www.gov.louisiana.gov/index.cfm?md=newsroom&tmp=detail&articleID=2928; Louisiana Economic Development: http://www.opportunitylouisiana.com/page/cheniere-energy

the jobs created from the operation of the facility, the construction of the facility will create a total of 3,000 one-time construction jobs.

Cheniere Energy was granted the Louisiana Industrial Tax Exemption; under this program the company will pay no property taxes for ten years on the new facility. The company's incentive package also included the Quality Jobs program, which will provide a cash rebate to the company and LED FastStart, which will provide worker recruitment and training.

Cameron LNG in Hackberry, Louisiana[42]

The Cameron LNG facility in Louisiana will retain 60 jobs while creating 140 new direct, full-time jobs. Salaries of these jobs will average $80,000 annually plus benefits. An additional 657 new indirect jobs will be supported by the direct investment.

Construction on the facility will generate 3,000 one-time construction jobs. Louisiana has two incentive programs – Quality Jobs and Industrial Tax Exemption – which are expected to be utilized by Sempra Energy. Under these programs, Sempra Energy would receive abatement of local property taxes for up to ten years and up to a 6 percent cash rebate on annual payroll expenses.

Freeport LNG in Freeport, Texas[43]

Construction began on the Freeport LNG facility in November 2014, with commercial operation expected to begin in late 2018. Approximately 3,500 construction jobs will be created during the construction phase. Once the facilities are operational, 160 new full-time employees will be hired. The project will require roughly $14 billion in direct investment; this investment will create hundreds of indirect and induced jobs.

According to the company, Freeport LNG currently pays almost $8 million in taxes annually to the State of Texas and other local jurisdictions, as well as $1 million annually to the Town of Quintana. These amounts are expected to increase once the project's proposed facilities are in operation and tax abatements on existing facilities expire.

[42] Press Release: http://gov.louisiana.gov/index.cfm?md=newsroom&tmp=detail&articleID=4720
[43] Freeport LNG: http://www.freeportlng.com/

Cove Point LNG in Cove Point, Maryland[44]

As part of the Cove Point LNG project, Dominion will retain 100 jobs and create 75 new full-time positions. Construction of the facility will cost between $3.4 and $3.8 billion. As a result of this investment, approximately 620 indirect jobs are expected to be supported. Approximately 3,000 one time construction jobs will be created during the construction phase.

Dominion already pays $15.7 million in property taxes annually on the LNG import facility; with the additional export facility, property tax revenues are expected to increase by $40 million.

Jobs in North Carolina

Operations

The approved LNG export terminals show remarkably similar levels of projected job creation. These facts are summarized in Figure 7 and were provided by company estimates. Direct jobs are those created by the project at the LNG export facility. Indirect jobs are created as a result of the direct investment; other businesses are impacted by the increase in demand for resources and materials and respond by supplying these needs.

Figure 7: Jobs Associated with Approved LNG Export Terminals

Approved North American Export Terminal	Company	Permanent, Direct Project Jobs	Permanent, Indirect Jobs	Temporary, One-time Construction Job-Years*
Sabine, LA	Cheniere Energy	148	589	3,000
Freeport, TX	Freeport LNG	160	unavailable	3,500
Hackberry, LA	Sempra Energy	140	657	3,000
Cove Point, MD	Dominion	75	620	3,000

*Construction jobs are measured in job-years; as an example, 50 job years could be filled by ten workers employed over five years or fifty workers employed over one year.
Source: Company estimates, see text for details.

All of the approved terminals already have LNG import operations; as a result, many of these facilities are retaining employment and creating new jobs. Because North Carolina does not have any existing LNG import operations, direct jobs created by an LNG export terminal would likely fall in the higher end of the direct project job range of 75-160.

[44] Dominion: https://www.dom.com/corporate/what-we-do/natural-gas/dominion-cove-point/economic-benefits

Although an LNG export terminal would bring significant investment to the state of North Carolina, it is unlikely that an extensive supply chain would follow. Supply chains for oil and gas operations are already well established in other areas of the United States and would likely not relocate to North Carolina. Because of these considerations, indirect job creation in North Carolina would likely fall in the lower end of the range (589-657) of existing facilities.

Construction

The approved LNG export terminals also show remarkably similar levels of projected construction job creation in the range of 3,000-3,500 jobs. It is important to note that these jobs are temporary, one-time jobs and cease after the construction is complete. In addition, construction jobs are typically measured in job-years. In the economic impact software, there is no distinction between ten workers employed over five years and fifty workers employed in one year. As a result, the actual number of construction jobs created by an LNG export terminal may vary significantly from initial estimates.

Based on the referenced projects, North Carolina could expect similar, but higher levels of construction job creation from the construction of an LNG export terminal due to a lack of existing infrastructure. Pipeline construction would bring its own job creation and is described in the next section.

Pipeline Construction

Because North Carolina does not have pipeline infrastructure in place to connect gas sources to a potential export terminal, multiple pipelines would have to be constructed. The impact of pipeline construction would be in addition to the impact of construction of the export facility.

As of 2011, the cost of building pipelines in shale regions was approximately $200,000/inch-mile[45] (the cost per pipeline diameter inch per mile). A more recent project in North Carolina, the Atlantic Coast Pipeline, connecting West Virginia, Virginia, and North Carolina, is expected to be constructed from 2014 to 2019. As a result, this pipeline project provides recent figures on construction costs and jobs created. The Atlantic Coast Pipeline project involves constructing 548 miles of natural gas pipeline, 178 of which will be constructed in North Carolina. Pipe diameter is 36 inches in North Carolina and 42 inches in West Virginia and Virginia. The pipeline runs along the I-95 corridor, employing the path of least resistance in

[45] Ziff Energy Group: http://www.ziffenergy.com/download/pressrelease/PR20110629-01.pdf

terms of right-of-ways. The average projected cost of building the pipeline in all three states was $171,320/inch-mile.[46]

The Atlantic Coast Pipeline will require a capital investment of $1.2 billion in North Carolina and will support approximately 738 jobs in the state each year over the six-year period of construction (2014-2019). Once the pipeline is in full operation, it is expected that 52 jobs in North Carolina will be supported annually by pipeline operations.

The job impacts from building a new pipeline would likely be similar, but would ultimately depend on the actual distance of the pipeline. [47]

Potential sources of revenue for North Carolina

North Carolina would receive tax revenue from the construction of an LNG export facility and pipeline. The exact amounts cannot be determined at this point; instead, we detail the revenue categories that North Carolina would benefit from.

Property Taxes

The largest source of ongoing revenue from an LNG export terminal is in the form of property taxes. Export terminal facilities require billions of dollars of investment. However, property taxes are collected by local jurisdictions and will not affect the state's general fund. The four approved LNG export terminals show very different levels of property tax revenues, depending on the property tax rate and what incentives a company received to locate in a state. Property tax revenue is summarized in Figure 8.

[46]This cost was calculated as following: (Total approximate construction cost*percent of construction spent on pipelines)/Total inch-miles in all three states

[47] Dominion: https://www.dom.com/library/domcom/pdfs/gas-transmission/atlantic-coast-pipeline/acp-chmura-report-091014.pdf

Figure 8: Investment and Tax Revenue Associated with Approved LNG Export Terminals

Approved North American Export Terminal	Company	Export Capacity (Bcf/d)	Investment ($Billion)	Projected Property Tax Revenue
Sabine, LA	Cheniere Energy	2.8	$6	none
Freeport, TX	Freeport LNG	1.8	$14	$9 million*
Hackberry, LA	Sempra Energy	1.7	$6	none
Cove Point, MD	Dominion	0.82	$3.4-$3.8	$40 million

*Freeport LNG does not break out taxes by type.
Source: FERC, company estimates, see text for details.

The largest amount of property tax will be paid by Dominion for its Cove Point LNG facility. The facility currently pays approximately $15 million in property tax; the additional export facility will add $40 million in property tax annually.[48] The Freeport, Texas LNG facility currently pays roughly $8 million in tax revenue to the state of Texas and other jurisdictions and $1 million to the Town of Quintana. These amounts are set to increase when current tax abatements expire.[49] Both approved facilities in Louisiana will be exempt from property tax for the next 10 years as part of their incentive packages.[50]

Corporate Income Taxes

North Carolina would likely receive greater corporate income tax revenue from companies that come to North Carolina to export LNG. Because any LNG export project is associated with significant new construction spending, North Carolina could expect to receive greater corporate income tax revenue from construction companies as well. Any pipeline construction would create additional corporate income tax revenue from the companies involved in construction.

Individual Income Taxes

Individual income taxes would likely be the largest source of revenue for the state of North Carolina. New job creation from the LNG export facility and associated construction would increase individual income tax revenue, particularly because direct facility jobs are often associated with higher wages.

[48] Dominion: https://www.dom.com/corporate/what-we-do/natural-gas/dominion-cove-point/economic-benefits
[49] Freeport LNG: http://www.freeportlng.com/Liquefaction_FAQs.asp#taxbase
[50] Press Release: http://www.gov.louisiana.gov/index.cfm?md=newsroom&tmp=detail&articleID=2928; Press Release: http://gov.louisiana.gov/index.cfm?md=newsroom&tmp=detail&articleID=4720

Cost-benefit analysis

This section considers the costs and benefits of constructing and operating an LNG export terminal to the state. This analysis assumes North Carolina would not assist in the financing or maintain an ownership stake in the operation of the facility, as this has not been the case for other states in the US. Therefore, the majority of both the costs as well as the benefits of constructing and operating an LNG export facility would accrue to the private companies involved.

Costs

The primary costs to the state would be in the case that publicly owned land or infrastructure was granted to private companies for the purpose of locating an export facility. The value of this land would depend on the specific value of the parcel of land. In addition, any tax exemptions provided on manufacturing equipment or sales and use tax (as is done in states such as Louisiana) would be a cost to the state. Finally, any financial incentive programs offered to the private companies would constitute a cost to the state.

Additional state personnel may be required to assist with regulatory compliance of the FERC process, including potentially the Department of Environment and Natural Resources, the Utilities Commission, and the NC Port Authority. Alaska and Oregon, for example, both have a dedicated office to help comply with federal requirements on the part of state agencies. In addition, if associated intrastate pipelines are built in the state, the North Carolina Utilities Commission may need additional personnel to assist in this process.

Finally, various environmental and social costs, including issues of public safety in cases of spills or leaks, may accrue to the state, although in most cases the responsibility for mitigating these impacts would fall to the private entities rather than the state.

Benefits

The possible job growth associated with the construction and operation of an LNG facility has been detailed in the economic impact section of this report. In addition, the state may experience the economic benefits of increased spending related to capital expenditures and increased employment detailed in the potential economic impact section.

Estimates for direct facility jobs range from 75 to 160. All the approved and proposed projects with impact studies currently have import facilities that are being retrofitted for export, implying that a new North Carolina facility would likely involve large direct impacts closer to 160 jobs. The on-going operations will also support an additional 600-700 multiplier jobs in the economy. There are also one time construction impacts of 3,000-3,500 job-years during the 2-4 year construction process**.** Because of the specialized skills and expertise required in these facilities, as well as the lack of existing similar industries in the state, many of the initial jobs may be filled by in-migrants to the state.

The state would also benefit from the income, sales, and corporate tax associated with these jobs and investment. Property tax would be a benefit to the individual county in which a facility is located, unless property tax exemptions were granted.

North Carolina taxes natural gas production within the state at the point of initial production through a severance tax.[51] It is possible that any connection to an export terminal in North Carolina or other states could encourage additional natural gas production in the state and increase the amount of severance tax collected.

Natural gas pipeline companies charge a transmission fee for natural gas transported through their pipelines. If a North Carolina based company were to construct a pipeline or pipelines through which natural gas was delivered to an LNG facility, the state would receive the tax revenues associated with any related corporate profits.

[51] N.C.G.S. § 113-387. Retrieved December, 2014 from http://www.ncleg.net/gascripts/statutes/statutelookup.pl?statute=113

Appendix

A. Session Law 2014-4 (Senate Bill 786-Ratified)

PART VII. STUDIES

SECTION 22.(a) The Department of Commerce, in consultation with the Department of Environment and Natural Resources, the North Carolina Ports Authority, and the Department of Administration, shall study the desirability and feasibility of siting, constructing, and operating a liquefied natural gas (LNG) export terminal in North Carolina. At a minimum, as a part of the study, the agencies shall:

(1) Identify the State, federal, and local regulatory programs under which LNG export terminals are permitted and approved.

(2) Identify any State statutory or regulatory barriers to siting, constructing, or operating a LNG export terminal in the State.

(3) Evaluate infrastructure needs and impacts as follows:

a. Identify the infrastructure that is necessary to support a LNG export terminal.

b. Identify any idle publicly owned infrastructure that may be utilized to support LNG export terminal operations.

c. Identify publicly owned unutilized or underutilized lands that may be used to support LNG export terminal operations.

d. Identify potential impacts on infrastructure, including roads, pipelines, and water and wastewater services, and other provision of services by local governments including schools, law enforcement, and development.

(4) Conduct a cost-benefit analysis for the construction and operation of an LNG export terminal. The analysis shall evaluate scenarios in which the State is the primary producer of the exported natural gas and scenarios in which the State is not the primary producer of the exported natural gas.

(5) Examine potential economic impacts, including:

a. Possible sources of revenue that could accrue to the benefit of the State if LNG is exported from a terminal in North Carolina.

b. The number of jobs that may be expected as a result from the construction and operation of a LNG export terminal.

(6) Identify and evaluate potential environmental impacts of construction and operation of a LNG export terminal. In examining this issue, the agencies shall gather information on regulatory programs in other states where LNG export terminals are in operation.

(7) Identify potential social impacts, including impacts of construction and operation of a LNG export terminal on nearby communities and quality of life within those communities, recreational activities, and commercial and residential development.

(8) Examine any other pertinent issues that the agencies deem relevant to the construction and operation of a LNG export facility in the State.

SECTION 22.(b) The Department of Commerce shall report its findings and recommendations to the Joint Legislative Commission on Energy Policy and the Environmental Review Commission on or before January 1, 2015.

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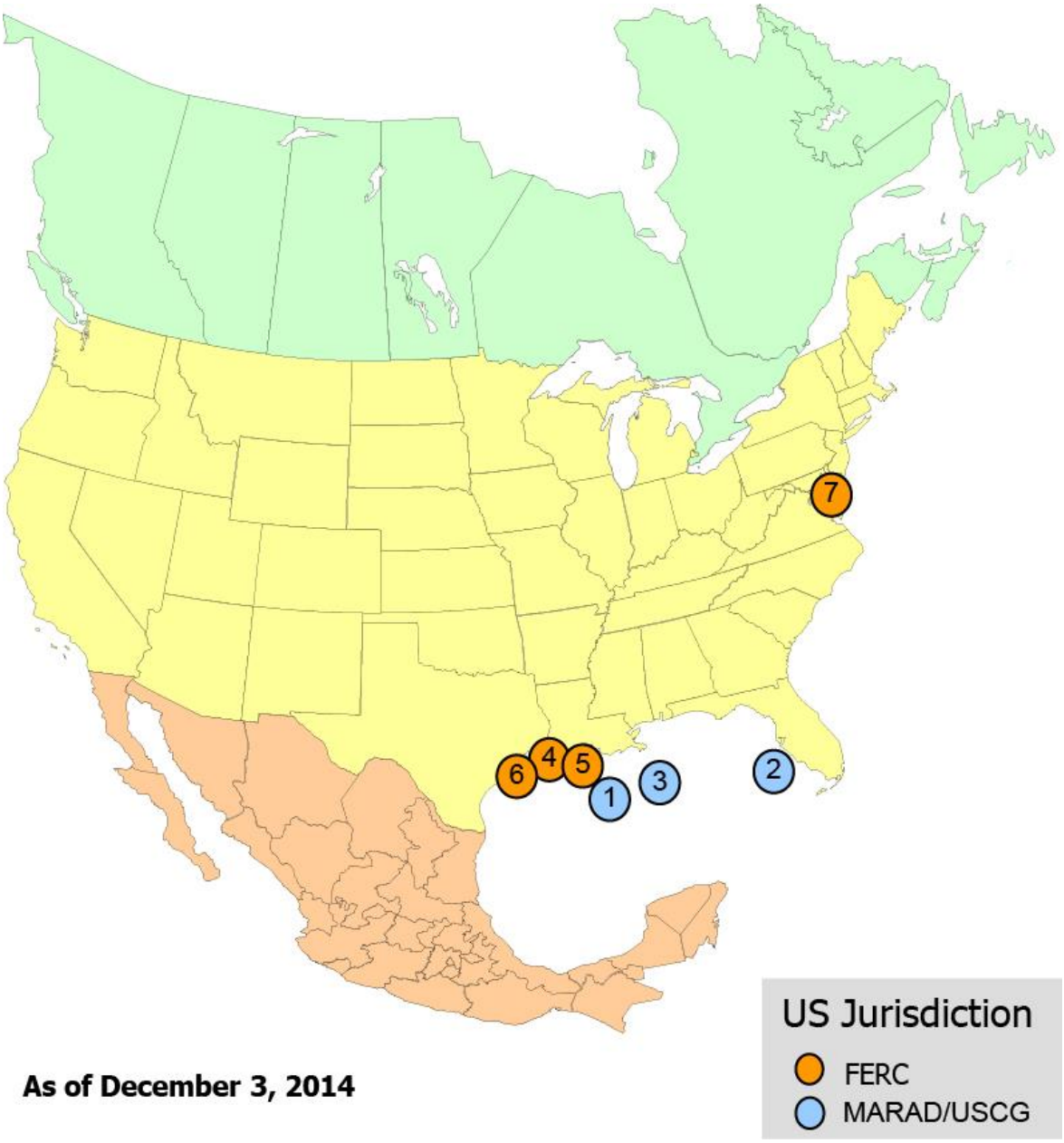
Figure 9: LNG Export Terminals: Existing and Proposed in Alaska

As of December 3, 2014

Locations: 1) Kenai, Alaska – Current export terminal 2) Nikiski, Alaska – Proposed export terminal

Source: FERC, http://www.ferc.gov/industries/gas/indus-act/lng/alaska.pdf

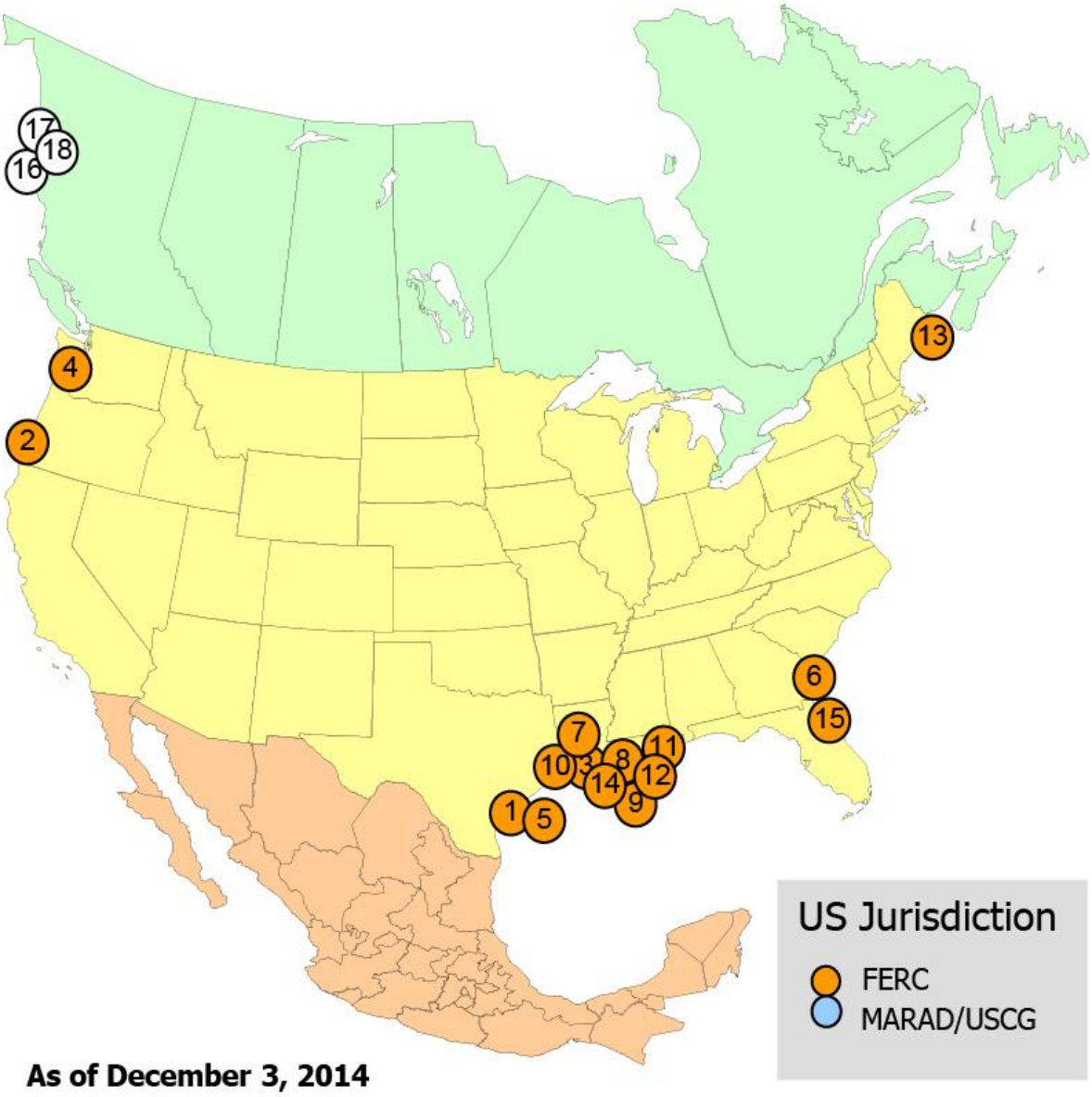
Figure 10: LNG Export Terminals: Approved Locations in Contiguous United States



Locations: 1-3 are import locations. 4) Sabine, Louisiana, 5) Hackberry, Louisiana 6) Freeport, Texas 7) Cove Point, Maryland.

Source: FERC, http://www.ferc.gov/industries/gas/indus-act/lng/lng-approved.pdf

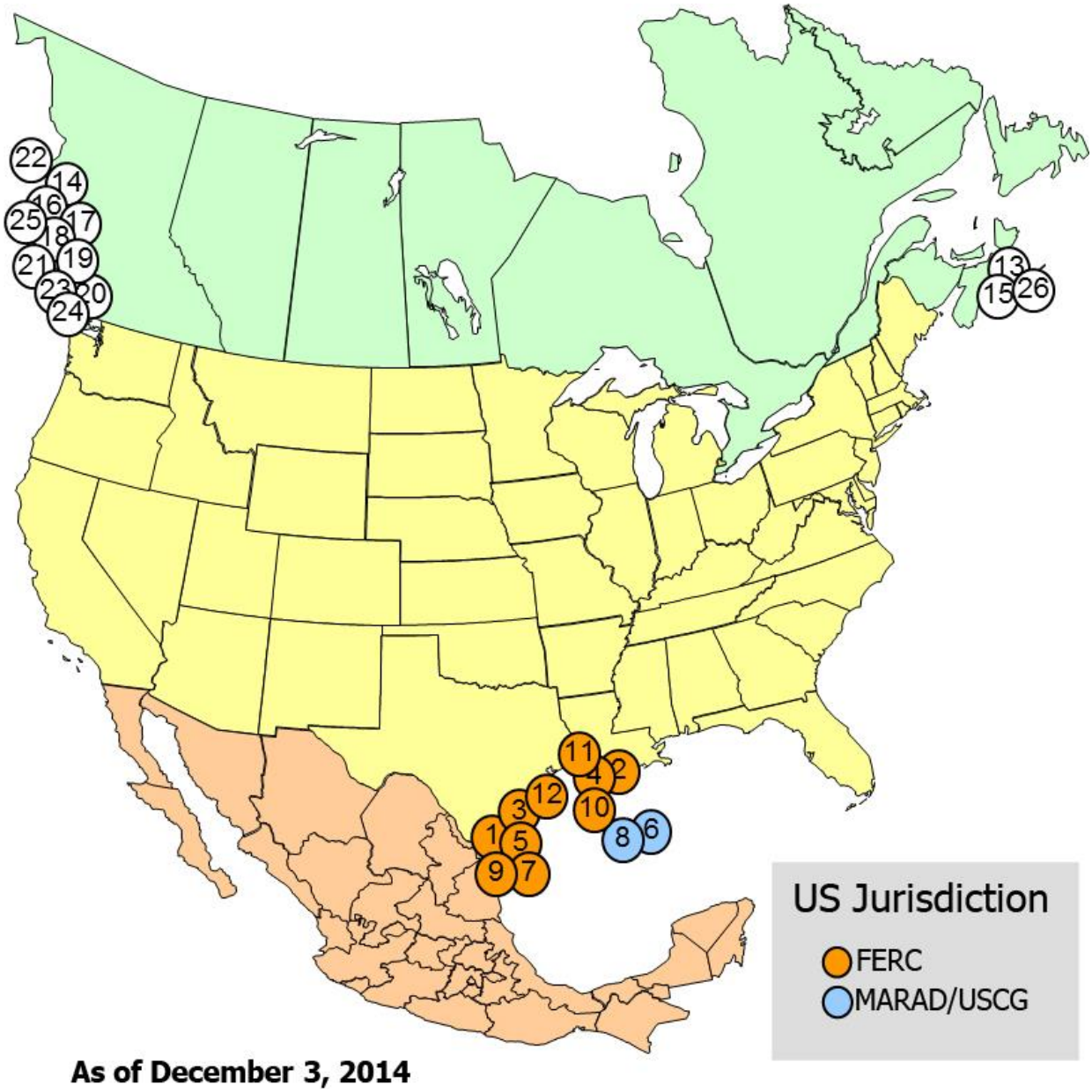
Figure 11: LNG Export Terminals: Proposed Locations in Contiguous United States



Locations: 1) Corpus Christi, Texas, 2) Coos Bay, Oregon, 3) Lake Charles, Louisiana, 4) Astoria, Oregon, 5) Lavaca Bay, Texas, 6) Elba Island, Georgia, 7) Sabine Pass, Louisiana, 8) Lake Charles, Louisiana, 9) Plaquemines Parish, Louisiana, 10) Sabine Pass, Texas, 11) Pascagoula, Mississippi, 12) Plaquemines Parish, Louisiana, 13) Robbinston, Maine, 14) Cameron Parish, Louisiana, 15) Jacksonville, Florida. 16-18 are locations in Canada.

Source: FERC, http://www.ferc.gov/industries/gas/indus-act/lng/lng-export-proposed.pdf

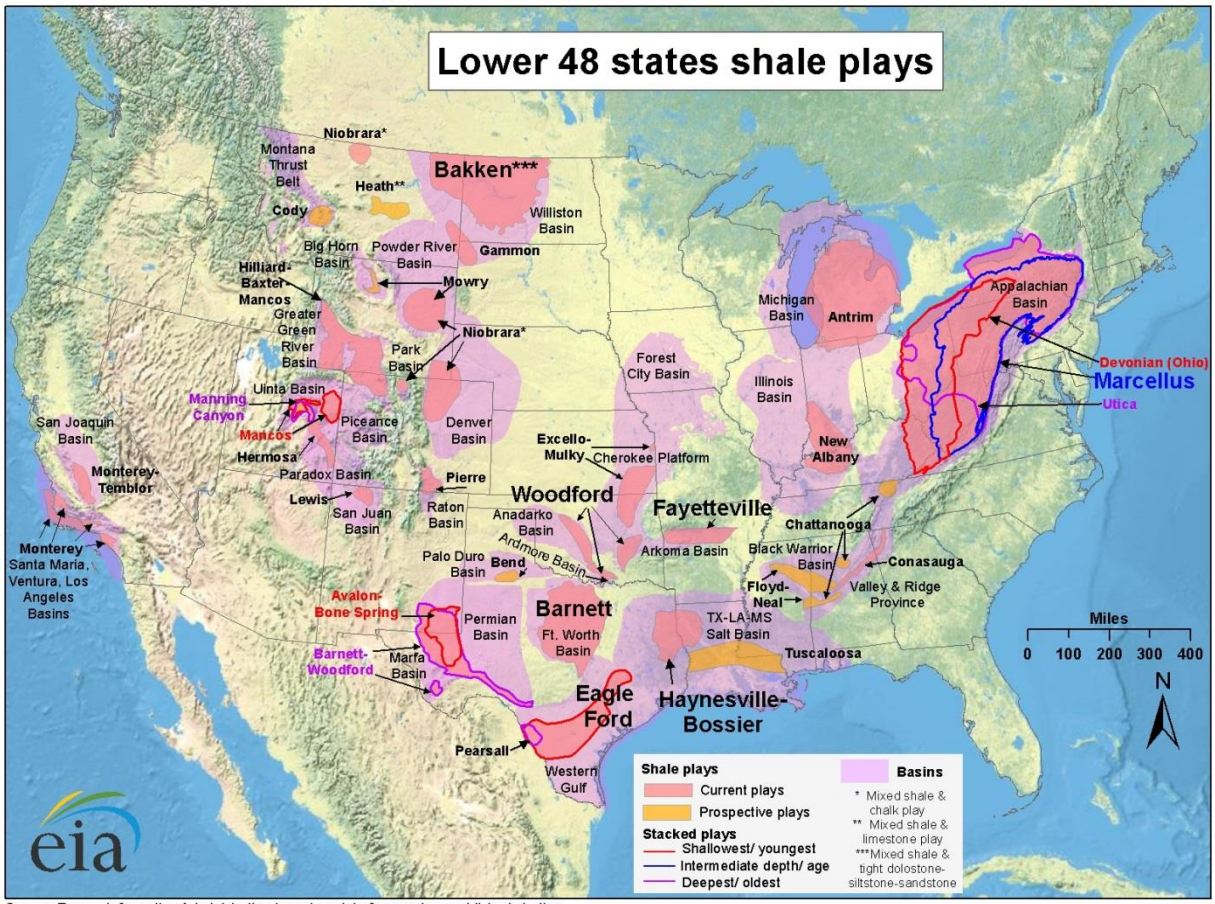
Figure 12: LNG Export Terminals: Potential Locations in Contiguous United States



Locations: 1) Brownsville, Texas, 2) Cameron Parish, Louisiana, 3) Ingleside, Texas, 4) Cameron Parish, Louisiana, 5) Brownsville, Texas, 6) Gulf of Mexico, 7) Brownsville, Texas, 8) Gulf of Mexico, 9) Brownsville, Texas, 10) Cameron Parish, Louisiana, 11) Port Arthur, Texas, 12) Galveston, Texas. 13-26 are locations in Canada.

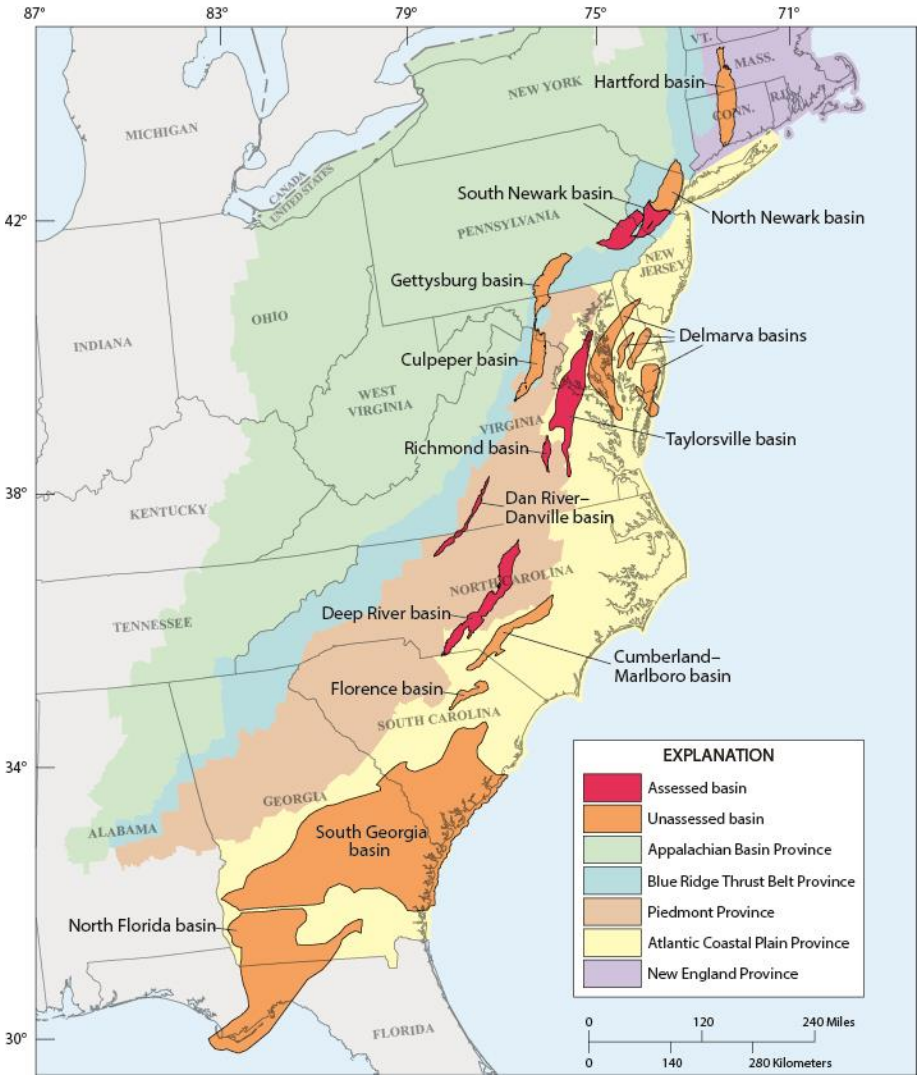
Source: FERC, http://www.ferc.gov/industries/gas/indus-act/lng/lng-export-potential.pdf

Figure 13: Major Shale Plays in the Lower 48 United States



Source: Energy Information Administration, http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/maps/maps.htm

Figure 14: Assessment of Undiscovered Oil and Gas Resources of the East Coast Mesozoic Basins, 2011

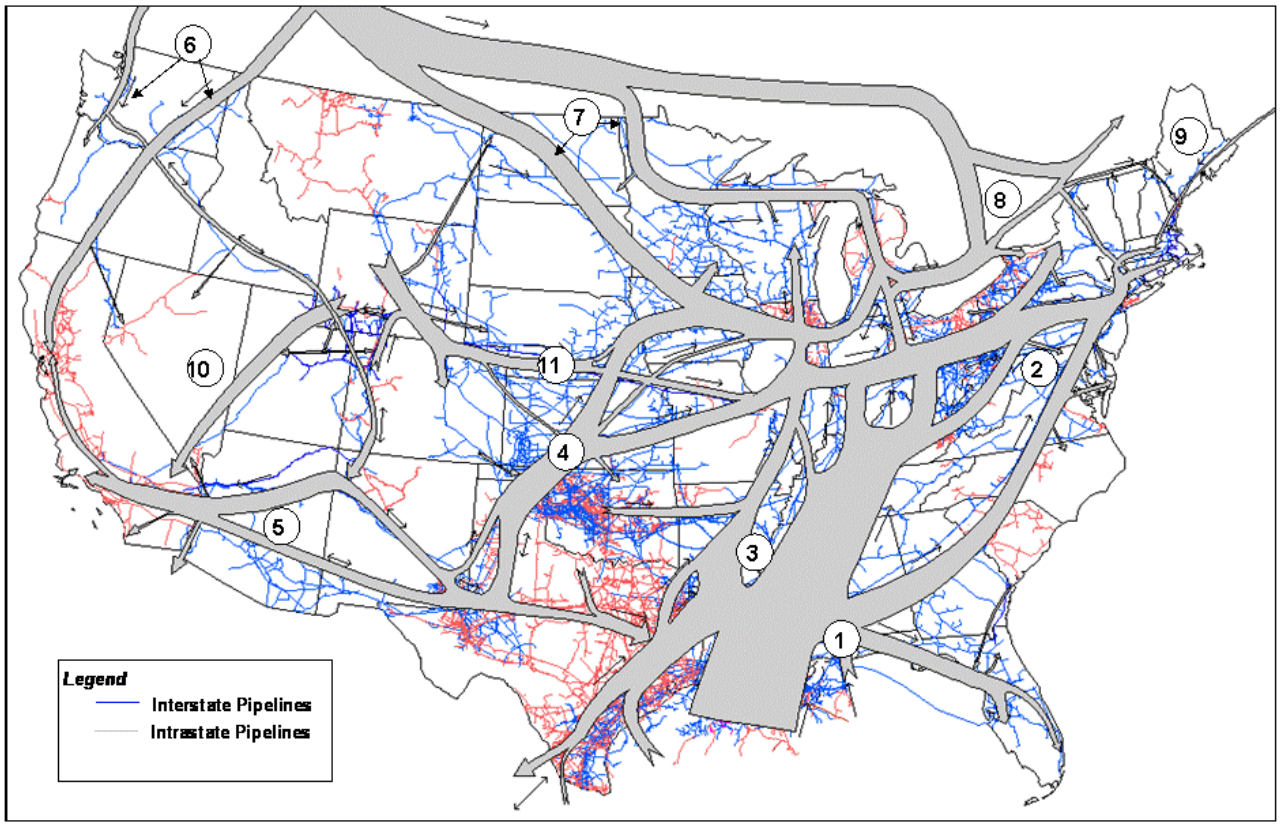


Source: United States Geological Survey, http://pubs.usgs.gov/fs/2012/3075/

Figure 15: Map of the Proposed Atlantic Coast Pipeline

Source: Dominion, https://www.dom.com/library/domcom/pdfs/gas-transmission/atlantic-coast-pipeline/acp-chmura-report-091014.pdf

Figure 16: Major Natural Gas Transportation Corridors in the Lower 48 United States, 2008



Source: Energy Information Administration, Office of Oil and Gas, Natural Gas Division, GasTran Gas Transportation Information System.

The EIA has determined that the informational map displays here do not raise security concerns, based on the application of the Federal Geographic Data Committee's *Guidelines for Providing Appropriate Access to Geospatial Data in Response to Security Concerns*.

Source: Energy Information Administration, http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/transcorr_map.html