Moving Texas Exports
Examining the role of transportation in the liquefied natural gas export supply chain
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The freight transportation system of a state has a direct and indirect impact on international trade. The mode of transportation has a direct impact on the cost, efficiency, and reliability of moving export products to overseas markets. So too does the capacity of the transportation infrastructure. Freight infrastructure investments that increase system capacity could reduce travel times and costs, which can translate into increased economic productivity, as well as enhanced labor and market access. Better labor and market access, in turn, could contribute to increased economic competitiveness (3), which can result in increased exports. The Organization for Economic Cooperation and Development reported that most countries with high-quality infrastructure rank high in the world index for overall competitiveness (4). Specifically, quality infrastructure is a key indicator of international economic competitiveness because it determines the scale, volume, and efficiency of international trade.

Introduction

In 2014, U.S. exports of goods and services amounted to $2.34 trillion, with Texas accounting for $289 billion of that amount (1). Furthermore, in 2013, Texas’ exports supported approximately 1.1 million jobs (2). There is no doubt that Texas’ transportation system—its roads, rail, ports, pipelines, airports, and border crossings—facilitates export trade.

The objective of this series of papers is to describe the supply chains for six of Texas’ major export commodities and identify the role of transportation in the supply chain. The study examined the transportation concerns of exporters, transportation policies and regulations affecting the costs of exports, and infrastructure concerns. This is the fifth paper in the series and documents the role of transportation in the liquefied natural gas export supply chain and key transportation issues and concerns that were documented and shared with the study team.
Background

In 2012, the oil and gas industry made up 17 percent of Texas’ gross domestic product and in 2013 employed 290,100 Texans (5). Texas is the leading producer of natural gas in the United States, accounting for almost 30 percent of the United States’ marketed natural gas production in 2013 (6).

Natural gas is primarily extracted in four areas of Texas:

- The Anadarko Basin in the Texas Panhandle stretching into Oklahoma.
- The Barnett Shale in the Dallas/Fort Worth and Arlington region.
- The Bossier/Haynesville Shale of East Texas stretching into Louisiana.
- The Eagle Ford Shale in South Texas.

Figure 1 shows the increasing trend in marketed natural gas production in Texas between 2004 and 2014. In 2014, Texas’ natural gas marketed production reached 7.95 trillion cubic feet (compared to 5.07 trillion cubic feet in 2004) (7). This increase in production is mainly attributed to advanced drilling technologies and hydraulic fracturing technology that enabled the exploration of the Barnett and Eagle Ford Shales (8).

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1The marketed production is the “gross withdrawals less gas used for repressuring, quantities vented and flared, and nonhydrocarbon gases removed in treating or processing operations,” according to the U.S. Energy Information Administration (http://www.eia.gov/dnav/ng/TblDefs/ng_prod_sum_tbldef2.asp).
Natural gas is an important input for domestic industry. Texas consumes approximately one-seventh of the nation’s total natural gas, specifically in the industrial and electric power industries. These two industries represent approximately 80 percent of Texas’ natural gas consumption (8). Texas also produces more natural gas than it consumes. The state had approximately 98,279 producing natural gas wells in 2014 (9) and among the highest natural gas storage capacity in the country with 37 active storage facilities (8).

Texas also has an extensive system of natural gas pipelines and is home to the most natural gas market hubs; areas of exchange and trade that intersect along this large network of pipelines. The largest hubs are in Carthage, Henry, and Egan in East Texas (10). Figure 2 shows the natural gas pipeline network in Texas.
The export of LNG involves several government agencies that must approve the transfer and delivery of natural gas as an export commodity.

Note: Landed prices are based on a netback calculation².

Figure 3. Estimated Global Natural Gas Prices (Dollars per Million British Thermal Unit) in January 2015.

Source: (12).

Low Cost U.S. Natural Gas
The interest in exporting liquefied natural gas (LNG) has largely been fueled by lower U.S. natural gas prices resulting from the increased production of shale gas. Figure 3 provides the estimated global price of natural gas on the global market in January 2015.

² Netback pricing is the price to the producer at the wellhead. In other words, the netback price of natural gas is the market price of the natural gas minus the cost of transporting the natural gas between the production and market location (http://naturalgas.org/regulation/history/).
Federal Regulations
The export of LNG involves several government agencies that must approve the transfer and delivery of natural gas as an export commodity. Section 3 of the Natural Gas Act (15 U.S. Code Section 717b) stipulates that the Department of Energy’s (DOE’s) Office of Fossil Energy must approve export of the commodity, and the Federal Energy Regulatory Commission (FERC) must approve the related facilities. For LNG exports, FERC must approve the construction of liquefaction facilities, the expansion of existing LNG terminals, and any storage tanks, compressors, piping, and other equipment used in the export of LNG.

These permit approvals by DOE and FERC are federal actions that are subject to environmental review under the National Environmental Policy Act. Some of the other agencies that may have a role in considering the environmental impacts of proposed LNG export facilities include:

- U.S. Environmental Protection Agency.
- State environmental protection agencies.
- U.S. Fish and Wildlife Service.
- U.S. Army Corps of Engineers.
- U.S. Coast Guard.
- Advisory Council on Historic Preservation.
- State Historic Preservation Office.

Because of safety and security concerns, the following agencies may also be involved:

- Pipeline and Hazardous Materials Safety Administration.
- Federal Emergency Management Agency (13).

LNG Export Facilities
As of January 2015, 48 permit applications are pending FERC approval for constructing either liquefaction facilities at existing LNG import facilities (also termed regasification facilities) or new LNG export facilities (10).

As of August 6, 2015, two FERC-approved LNG export terminals are under construction in Freeport and Corpus Christi. The liquefaction and export terminal in Freeport will allow for the export of 1.8 billion cubic feet of LNG per day (14). The estimated benefits of the $14 billion investment in the Freeport facility are:

- Employment for 3,500 workers during a four- to five-year construction period.
- Employment opportunities during the production of natural gas.
- Between $5.1 billion and $7.4 billion in total annual economic benefits to the United States.
- A reduction of approximately 1 percent in the U.S. foreign trade imbalance resulting from LNG (15).

DOE approved U.S.-produced LNG exports from the Freeport facility to non-Free Trade Agreement countries (10). Two countries that present substantial markets for LNG exports that have not entered into a Free Trade Agreement with the United States are Japan and China (16).¹

The Chenier LNG facility currently under construction in Corpus Christi will have an export capacity of 2.14 billion cubic feet of LNG per day upon completion (12).

A number of LNG export terminals are proposed in Texas and are pending application (i.e., Lavaca Bay, Sabine Pass, and Freeport) or are projects in pre-filing (i.e., Brownsville, Port Arthur, Freeport, and Corpus Christi) (17). Texas will thus be well positioned to serve the growing global demand for LNG in Asia (specifically China) (18).

¹Japan is one of 12 countries that are currently in negotiations to finalize the Trans-Pacific Partnership agreement. It is unclear when the agreement will be finalized.
Liquefied Natural Gas Export Supply Chain

The LNG export supply chain consists of three components:

- Exploration and production.
- Processing/liquefaction.
- Storage/shipping.

The export of LNG begins at the well where the natural gas is mined. From the well, natural gas is transferred via pipeline to be processed and liquefied at a gas processing and liquefaction plant. At the plant:

- Any contaminants found in the natural gas are removed to prepare the natural gas for cooling. Contaminants are removed to prevent damage to equipment and to meet pipeline specifications. The removal of contaminants can purify the LNG to where it is almost 100 percent methane.
- Liquefaction entails the cooling of the cleaned LNG to −256 °F. Once the LNG is cooled, the volume of LNG is reduced to 1/600th of what would be required for the same volume of natural gas at room temperature and atmospheric pressure.

“**The typical LNG tanker can transport approximately 125,000 to 138,000 cubic meters of LNG, which will provide about 2.6–2.8 billion standard cubic feet of natural gas.**”

—Michelle Michot Foss (19)

From the liquefaction plant, the LNG is shipped by pipeline to storage tanks. LNG is stored in double-walled tanks at atmospheric pressure. From the tank, the LNG is piped into LNG tankers—double-hulled ships designed to prevent leakage or rupture in case of an accident. The LNG tankers are specifically designed to maintain the LNG at atmospheric pressure and at −256 °F (19). The LNG export supply chain thus relies primarily on pipelines and double-hulled ships to reach the export destinations. Figure 4 highlights the components of the LNG export supply chain.
The LNG export supply chain thus relies primarily on pipelines and double-hulled ships to reach the export destinations.

Figure 4. Export Supply Chain for Liquefied Natural Gas.
Lack of Pipeline Capacity

While Texas’ natural gas pipeline network is extensive (see Figure 4), pipeline capacity is a concern given the development of Texas’ shale formations (specifically the Eagle Ford Shale). Concern has also been expressed about insufficient pipeline capacity serving Texas ports (18).

The Railroad Commission of Texas (RRC) has authority over pipelines that originate and end within Texas (intrastate pipelines), for pipeline safety, and for pipeline rate regulation (20). In Texas, the pipeline owner or operator can be a gas utility or a private company. If the owner is a private company, the pipeline can be operated as a common carrier or a private pipeline. According to RRC, “common carrier pipelines are those that transport oil, oil products, gas, carbon dioxide, salt brine, sand, clay, liquefied minerals or other mineral solutions” (20). In general, common carrier pipelines in Texas have a statutory right of eminent domain, but RRC does not determine which pipelines are common carriers or regulate any “pipelines with respect to the exercise of their eminent domain powers” (20). In Texas, there are no permit requirements for building intrastate pipelines. The fixed cost to build a pipeline is, however, very high and is typically recovered over the 60- to 70 year life of the pipeline (18). The exercise of eminent domain and the condemnation of private property for pipelines can be a very lengthy process. Inadequate pipeline infrastructure creates bottlenecks in the supply chain of natural gas, which add costs to the supply chain and increase the price of LNG exports.

Transportation Issues

The LNG export supply chain relies primarily on pipelines and double-hulled ships to reach the export destinations. Without pipeline infrastructure, natural gas cannot be transported cost-effectively by truck or rail and is typically flared.

Complex Regulatory Process

As mentioned previously, FERC must approve not only the construction of the liquefaction facilities or the expansion of existing LNG terminals, but also the storage tanks, compressors, piping, and other equipment used in the export of LNG. The permit approval is also subject to environmental review. Given the complexity and the number of federal agencies that can be involved, receiving permit approvals for the infrastructure required for LNG exports can be a lengthy process.

1 FERC approves the location, construction, and operation of interstate pipelines, as well as the facilities and storage fields used in transporting natural gas across state boundaries (http://www.ferc.gov/about/ferc-does.asp). DOE and FERC also regulate natural gas import and export activities. Specifically, FERC is responsible for the review and approval of the “siting, construction, and operation of natural gas import and export facilities,” according to the U.S. Energy Information Administration (http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/impex.html).
Panama Canal Expansion

Most of the attention relating to the expanded Panama Canal has focused on the potential impacts on container shipments, but Amdal and Howlett (16) argue that LNG exports could potentially benefit more from the Panama Canal expansion. Today, the Panama Canal can only serve ships of a maximum length of 286.9 meters, maximum width of 32.31 meters, depth of 12.04 meters, and air draft of 57.91 meters. In other words, the Panama Canal can only serve about 8 percent of the LNG tanker fleet today. The $5.25 billion canal expansion project will allow the canal to handle ships with a maximum length of 366 meters, maximum width of 49 meters, depth of 15.2 meters, and air draft of 59.71 meters. The expanded Panama Canal will therefore be able to accommodate 80 percent of the world’s LNG tanker fleet (21).

Using the expanded Panama Canal will decrease the distance from the Gulf Coast ports to Asia by approximately 9,000 miles. The canal’s expansion could thereby reduce overall LNG shipping costs by approximately 25 percent (21). Texas will be well positioned to serve global demand for LNG given the two FERC-approved export LNG terminals currently under construction in Freeport and Corpus Christi and the increased competitiveness offered by the expanded Panama Canal through lower overall LNG shipping costs. Serving the LNG terminals, however, will increase the demand for transporting natural gas from the wells to the gas processing and liquefaction plants. Concern has been expressed about the state’s pipeline capacity serving increased demand and specifically serving Texas ports (18).
Inadequate LNG Tanker Fleet
As mentioned previously, LNG is exported in specially
designed double-hulled ships to prevent leakage or
rupture in the case of an accident. A standard LNG tanker
can cost more than $200 million (22) and can typically be
chartered at a cost of $100,000 per day (23). In 2013, the
world tanker fleet included 357 LNG tankers (22). Industry
expressed concern about shortages in the LNG tanker
fleet (i.e., inadequate ship capacity) to serve the foreseen
increase in LNG exports from Gulf Coast ports, including
Freeport (18).
Key Findings

The following are the key findings from this research:

- Receiving permit approvals can be a lengthy process because of the complexity and number of federal agencies that can be involved in the approval of LNG exports and the infrastructure required for LNG exports.
- Pipeline capacity is a concern given the development of Texas’s shale formations. Specifically, concern has been expressed about insufficient pipeline capacity serving Texas ports.
- An expanded Panama Canal will be able to handle 80 percent of the world’s tanker fleet (as opposed to 8 percent currently), thereby reducing overall LNG shipping costs by approximately 25 percent.
- Industry expressed concern about shortages in the LNG tanker fleet (i.e., inadequate ship capacity) to serve the foreseen increase in LNG exports from Gulf Coast ports, including Freeport.
References


18. Personal communication with Port of Freeport, June 25, 2015.


