

LIQUEFIED NATURAL GAS: ISSUES FOR THE INDUSTRY

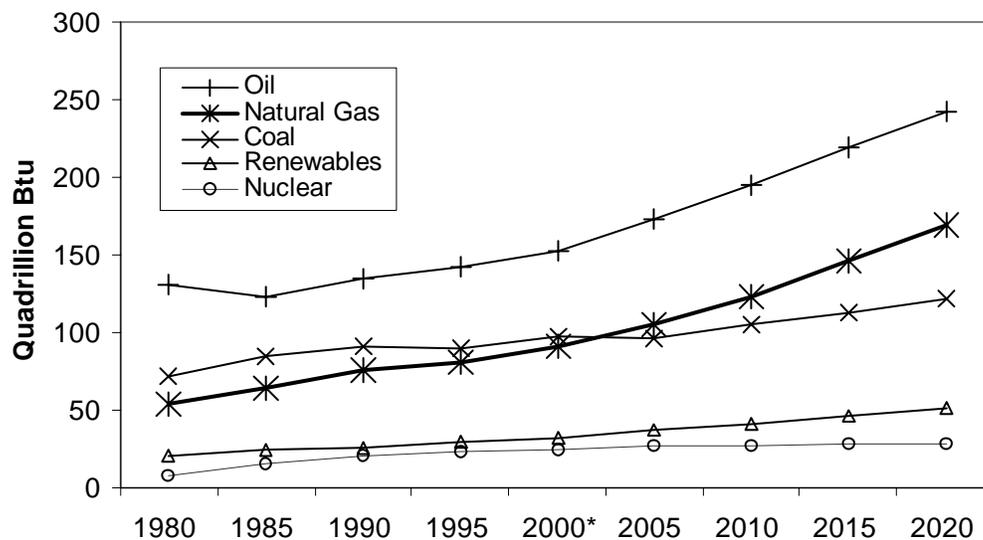
By Sara Banaszak

Natural gas imports are an important source of gas supply in the United States. They represented about 16 percent of natural gas consumption in 2001. Although most U.S. gas imports are delivered by pipeline, a small but growing percentage are received as liquefied natural gas (LNG), which can be a significant source of supply in some local markets. Quantities of LNG imports into the United States rose dramatically in recent years – the level more than doubled from 85 billion cubic feet in 1998 to 235 billion cubic feet in 2001.

The LNG industry in North America of both today and tomorrow is tied to the global industry, which has been experiencing continuous expansion. As interest in the global LNG industry has increased, numerous announcements have recently been made about new plans and facilities for importing LNG to North America. This article highlights some key issues for the LNG industry, particularly in North America. It begins by setting the context for discussing natural gas and then continues with a focus on the LNG industry, first globally and then specific to North America. Additional discussion highlights North American LNG infrastructure and commodity flows. Finally, this article concludes with an examination of the outlook for LNG.

Natural Gas in the Global Fuel Mix

Figure 1. World Energy Consumption by Fuel Type, 1980-2020



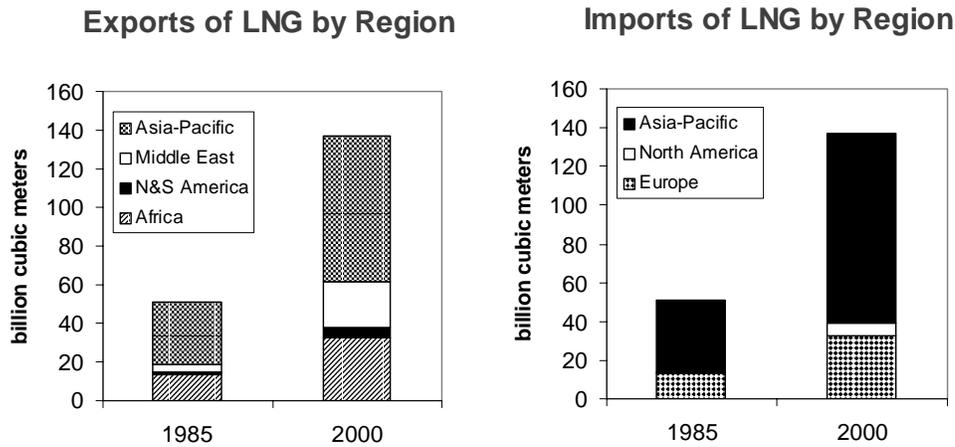
Source: Energy Information Administration, *International Energy Outlook 2000* (data thru 2000) and *International Energy Outlook 2002*; see: <http://www.eia.doe.gov>

- **Figure 1** shows global energy consumption by fuel type, including historical data back to 1980 and the Energy Information Administration's published forecast to 2020. This figure makes apparent the rising role of natural gas in the global fuel mix both historically and as forecasted. Historically, the share of natural gas in global energy consumption has grown from 19 percent in 1980 to 23 percent in 2000 (rising from 54 quadrillion Btu equivalent in 1980 to 90 quadrillion Btu equivalent in 2000).
- When focusing on LNG specifically or even natural gas, it is important to keep in mind that the demand for natural gas and the state of the gas industry are influenced by *interfuel competition*. That is, natural gas competes with other sources of energy in meeting end-user demands such as heating, lighting, and transportation services.
- The use of natural gas and interfuel competition are, in turn, influenced by economics and technology. For example, in the transportation sector, the most economically competitive technologies – such as automobiles and airplanes -- have relied on products of crude oil. Transportation technologies that use natural gas (such as vehicles running on compressed natural gas) have not been sufficiently competitive to date so as to replace oil use at a significant level. In the electricity sector, this competition among fuels has proven quite fierce, with changes and improvements in technologies leading to the concurrent use of various fuels and technologies for power generation.
- How well natural gas competes with other fuels in meeting end-user demands affects very much the state of the industry and the outlook for LNG.

Global LNG Trade

- **Figure 2** (below) depicts imports and exports of LNG by region for 1985 and 2000. This figure includes intra-regional trade, so that LNG that is shipped, for example, from Indonesia to Japan is included as part of both Asian exports and Asian imports.
- The dramatic growth in LNG trade over the last 15 years is illustrated in Figure 2 by the increase in the bar heights between 1985 and 2000. Global LNG trade during this period grew steadily from around 1.8 trillion cubic feet or tcf (equaling 51 billion cubic meters or bcm) to about 4.8 tcf (137 bcm).
- Global LNG trade over the last 15 years has been dominated by imports and exports in the Asia-Pacific region, as shown by the top portion of each bar in Figure 2. Asian LNG exporters include Indonesia, Malaysia, Australia, and Brunei. Asian importers include Japan, Korea, and Taiwan.

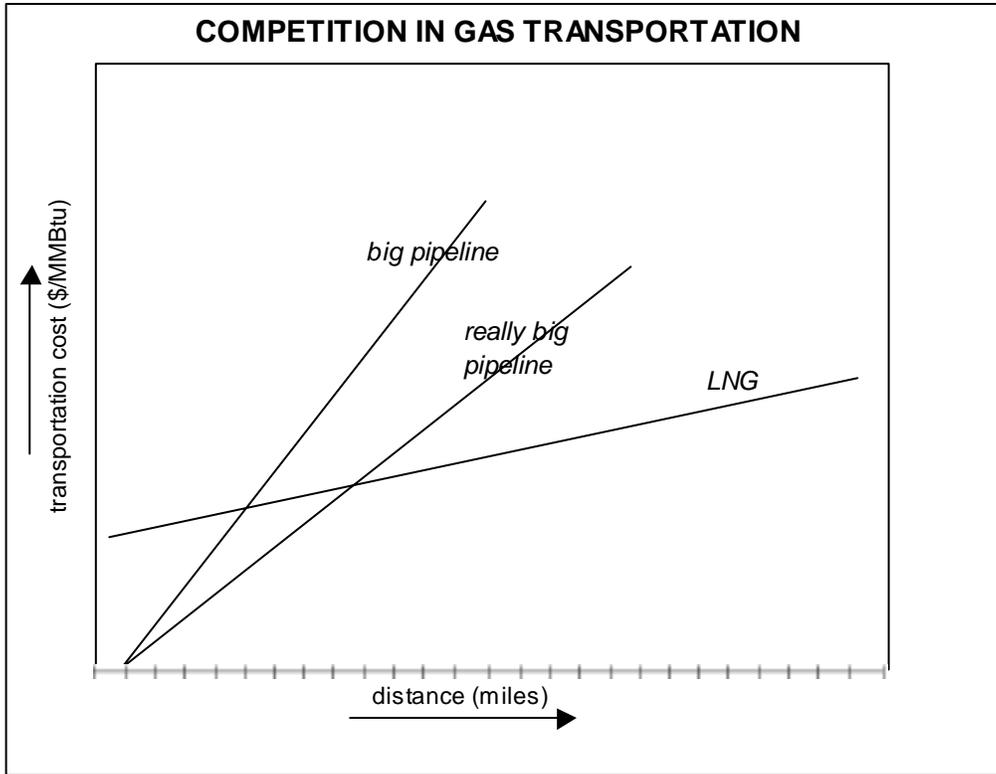
Figure 2.



- Figure 2 also illustrates the growing role of the Middle East in exporting LNG. The Middle East is the most gas rich region in the world with relatively more limited current and projected demand for natural gas.
- In the Americas, only Trinidad and Tobago and the U.S. export LNG. The volumes are small compared to global trade, although exports from Trinidad are growing. The U.S. is the only importer in the region and the only country in the world to both import and export LNG. (The U.S. exports LNG from Alaska to Japan and imports LNG on the east and gulf coasts.)
- Despite growth in the trade of LNG, the future of this industry is affected not only by natural gas demand and interfuel competition but also by how well LNG competes with pipelines in transporting natural gas to markets.

LNG As Natural Gas Transportation

- **Figure 3** illustrates generically the competition between LNG and pipelines in transporting natural gas. This figure shows the cost of transporting gas on the y-axis as a function of the distance that the gas must be transported (for example, the cost may be expressed as dollars per MMBtu of gas transported a distance of miles).

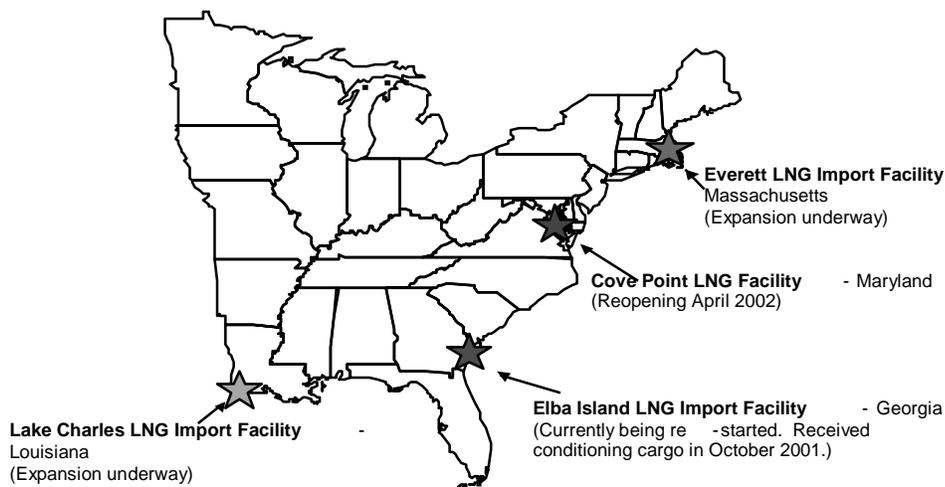


- The line for LNG in Figure 3 has a relatively flat slope but a high initial cost (y-intercept). This reflects the initial investment required in LNG infrastructure (liquefaction facility, LNG ships, and receiving terminal), and the relatively low cost of transporting gas an additional mile via LNG ship. The lines for pipelines rise more steeply because each additional mile of transportation requires an additional mile of pipeline – in other words, additional steel, pipeline construction, and installation.
- In Figure 3, the x- and y-axes are not marked with specific units because the precise comparison between pipeline and LNG transportation is specific to each project. In the United States, for instance, the cost of building LNG infrastructure might be higher than in China or India. Or perhaps in Japan, the cost of building pipelines is relatively higher than in the U.S. Cost differences between projects can reflect economy-specific pricing, regulatory structures, location of resources, different geography and terrains, etc.
- In addition, the general relationship between pipeline and LNG transportation costs is not static, but changes with developments in technology and new innovations. LNG costs have fallen in recent years, primarily due to engineering improvements. Competing pipeline costs have also fallen with, for example, the development of new grades of steel, new pipe-laying techniques, and the ability to operate pipelines at higher pressures.

- How LNG competes with pipelines in natural gas transportation will continue to change. For LNG, the initiation of offshore (or floating) liquefaction and receiving terminals could be a major breakthrough.
- Within the U.S., gas markets are also affected by regional or local conditions, and the economics of LNG imports at specific locations will not necessarily be the same all over the U.S. So where do current LNG imports enter the U.S. system?

LNG Infrastructure and Commodity Flows in the U.S.

Figure 4. Existing U.S.* LNG Import Facilities
 (*Excluding Puerto Rico facility)



Location	Sendout (MMcf/Day)	Storage (Bcf)	Possible Capacity Expansion
Everett, MA	450 100 by truck	3.5	165 MMcf/d - sendout (2 x 300 MMcf/d regas)
Lake Charles, LA	700	6.3	300 MMcf/d - sendout
Elba Island, GA	440	4.1	360 MMcf/d - sendout
Cove Point, MD	1000 (nameplate)*	5.0	2.8 Bcf - storage

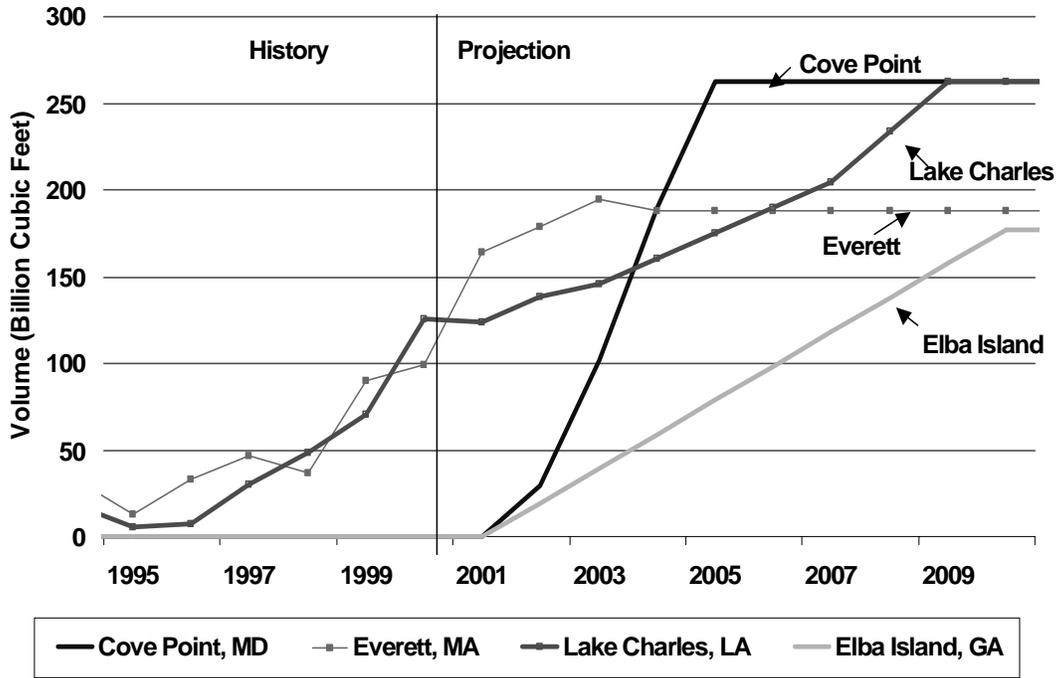
- As **Figure 4** indicates, there are four existing facilities in the continental U.S. previously built to receive LNG imports: 3 on the East Coast and one in the Gulf of Mexico. In recent years, only two of these facilities -- Everett, MA, and Lake Charles, LA -- have been supplying imported gas to U.S. markets. The Elba Island, GA, facility restarted operations at the end of 2001.

- The Cove Point, MD facility has operated as a storage (/peakshaving) facility since 1995. In December 2001, FERC reaffirmed authorization to reactivate and expand this terminal. LNG import operations at Cove Point could resume in late 2002 or 2003.
- Terminal expansion is also taking place at the Lake Charles, LA and the Everett, MA facilities, while further expansion is still possible at these already existing terminals. The expansion of existing facilities is often more economic than building new ones.
- Many proposed new LNG terminals for North America have been in the news, but none are certain to go forward so far. Proposed projects -- including offshore facilities -- are reported for the east and west coasts (including eastern Canada), for the Gulf coast, for Mexico (esp. Baja and east coast), and for the Bahamas with a pipeline connection to Florida.
- LNG imports into the U.S. have grown rapidly in recent years, more than doubling between 1998 and 2000 (from 85 Bcf to 224 Bcf). Record high domestic gas prices during the year 2000 and strong demand provided increased momentum for LNG trade.
- In 2001, a total of 235 Bcf of LNG was imported, the highest level of LNG imports since 1979 (252 Bcf). Imports were light during the 4th quarter of 2001 when domestic gas prices were also low, while during the first three quarters imports were 25% higher than during the same period in 2000.

Outlook for LNG

- LNG in the U.S. is facing a set of challenges and opportunities that include issues surrounding siting, regulation, security and safety. These can be rather interconnected matters.
- Security and safety issues, for example, were highlighted in the post-September 11 period. Boston Harbor temporarily closed to LNG deliveries (to the Everett, MA terminal) and plans to re-open the Cove Point terminal were re-examined by FERC.
- A package of materials on this topic may be found on the Department of Energy's Fossil Energy website: http://www.fossil.energy.gov/oil_gas/lngworkshop/ (One can also access the materials from the Fossil Energy Home Page – www.fossil.energy.gov -- by clicking on "Oil/Gas R&D" in the upper menu bar, then scrolling down to "Special Reports & Presentations.")

**Figure 5. U.S. LNG Import Projections by Receiving Facility
(Excluding Puerto Rico facility)**



- **Figure 5** shows the EIA forecast for LNG imports. The projected growth in imports would increase the role of LNG in natural gas use, with LNG rising from 1.3% of U.S. consumption to more than 3% by 2008.
- The outlook for LNG and new terminals must be considered within the context of what will happen with domestic production, including Alaskan gas, deep off-shore resources, unconventional gas, etc. One advantage with LNG is the potential to supply gas at the ‘skinny’ end of the pipe (i.e., into areas with insufficient pipeline infrastructure).
- The framework of global markets and interfuel competition also affect the U.S. outlook. Because the LNG market has relatively few buyers and sellers, the appearance of competing importers (India, China) or new suppliers can impact the options available to U.S. LNG importers. In the long term, as the U.S. and global LNG markets grow, they will develop increased fluidity and robustness, reinforcing LNG as a constructive option for energy supply.

For more information on this LNG feature, please contact Sara Banaszak at (202) 586-2066.