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New Gas Market Fundamentals

The Prospects for Liquefied Natural Gas

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An increasingly volatile market price for U.S. natural gas, the inadequacy of domestic natural gas reserves, and the continuing development of new natural gas-based electric generation capacity have created a heightened interest in imported liquefied natural gas (LNG), and plans are underway to add more LNG to the U.S. fuel mix. Current costs for moving LNG from several foreign sources into the U.S. pipeline transmission system make its price competitive with wholesale natural gas in the U.S. gas market.

Current projections of the U.S. Department of Energy show the LNG share of the U.S. gas market increasing from a current level of 0.75 percent to 6.1 percent by 2025, or a volume of 2.14 trillion cubic feet (tcf). Industry projections expect a considerably larger share, anticipating that LNG can capture a significant portion of the expected 12 tcf of growth in the U.S. gas market. In any case, the current projections and research imply a major penetration of LNG into the U.S. gas market. What are the long-term prospects for a significant LNG market? And what impact will such a market have on Texas market conditions?

The Recent LNG Market

LNG imports into the continental United States amounted to 229 bcf of natural gas equivalent in 2002. In total, the United States received LNG from seven countries: Trinidad, Algeria, Qatar, Nigeria, Oman, Brunei, and Malaysia. LNG volumes from Trinidad (currently, the largest source of LNG to the United States) grew more than 50 percent (to 151 bcf) from 2001 volumes.

A number of LNG ports in the United States have recently initiated expansions, including the Lake Charles port in Louisiana. In addition, several new onshore and offshore terminals are in various stages of planning and Federal Energy Regulatory Commission (FERC) approval, including two in the Gulf Coast area, a terminal at Hackberry, Louisiana, and another at Freeport, Texas. Developers are considering additional terminals in Corpus Christi, Brownsville, and Sabine Pass, Louisiana. Two offshore applications have been submitted to the U.S. Coast Guard (Chevron Texaco in December 2002 and El Paso in January 2003). Note that the capacity of existing, proposed, and planned terminals (if brought to completion) would increase to 6.4 tcf from the current capacity of 1.3 tcf per year (table 1).

Natural Gas Market Conditions and the Demand for New LNG Terminals

For most of the period since deregulation took full effect in 1985 the wellhead price of U.S. natural gas has remained in the $1.75 to $2.50 per mcf range, a price level considerably below the current LNG cost of delivery to U.S. ports. The 2001 average

Glossary of Acronyms

bcfd--billion cubic feet per day
EIA--Energy Information Administration
FERC--Federal Energy Regulatory Commission
LNG--liquefied natural gas
mcf--million cubic feet
mmBtu--million British thermal units
NGPA--Natural Gas Policy Act
tcf--trillion cubic feet

Table 1
LNG Terminals: Existing and Prospective

	Current capacity (bcfd)	Planned/expanded capacity (bcfd)	Expansion/Operation Date
Existing facility			
Everett, MA	0.715	0.715	now
Cove Point, MD	1.000	1.000	2006
Elba Island, GA	0.675	1.200	2006
Lake Charles, LA	1.000	1.300	2006
Guayanilla Bay, P.R.	0.093	0.093	now
Proposed facility			
Hackberry, LA		1.500	2006
Freeport, TX		0.550	2005+
Planned facility			
Corpus Christi, TX		2.000	2005
Brownsville, TX		0.550	2006
Gulf of Mexico		1.000	2005
St. John, New Brunswick		0.500	2005
Bahamas		0.500	2005
Tampa, FL		0.500	2005+
Altamira, Tamulipas: 0.5-1bcfd, 2004		1.000	2004
California: 0.5 bcfd, 2005		0.500	2005
Mare Island, CA: 1.3 Bcfd, 2008		1.300	2008
Baja California: 0.7bcfd, 2005 (El Paso)		0.700	2005
Baja California: 1.0 bcfd, 2005 (Marathon)		1.000	2005
Baja California: 0.5 bcfd, 2005 (Chevron Texaco)		0.500	2005
Baja California: 1.0 bcfd, 2005 (CMS Energy)		1.000	2005
Potential capacity (bcfd)	3.483	17.408	
Potential capacity (tcf/yr)	1.3	6.4	

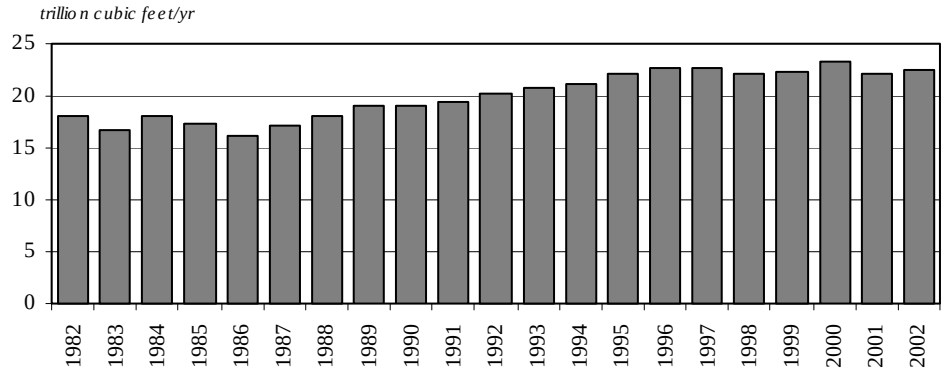
Source: Robert Cupina, Deputy Director, Office of Energy Projects, FERC, "Liquefied Natural Gas Imports," presentation to the United States Department of Energy and the Algerian Ministry of Energy and Mines Ministerial LNG Summit, November 2002, Washington, D.C.
Note: A more recent summary of planned locations than that in table 1 adds terminal plans at Sabine Pass (2.0 bcfd), Radio Island, North Carolina (0.27 bcfd), and Tampa, Florida (0.55 bcfd).

The projected growth in U.S. natural gas demand will be increasingly met with imports from Canada, Alaskan production, and LNG.

wellhead price jumped to $4.12 per mcf, spurring a renewed interest in LNG as well as in the transport of Alaskan natural gas to markets in the lower 48 states. A major developer of LNG terminals in the Texas Gulf Coast area puts the delivered cost of LNG to U.S. markets under current conditions at $2.50 to $3.50/mmBtu, depending mainly on the source of the gas and the transportation distance. It appears that the price is right. But what about the size of the market prospect?

The rapid growth in U.S. natural gas demand, which increased from about 16 tcf per year in 1986 to the current 22 tcf level (see figure), has been met with U.S. production in the lower 48 and offshore, with modest increases in imports from Canada. The projected growth to about 32 tcf by 2020 will be increasingly met with imports from Canada, Alaskan production, and LNG, even as lower 48 production rises to 25 tcf (table 2). The Energy Information Administration (EIA) expects LNG imports

U.S. Natural Gas Consumption, 1982-2002



Sources: Energy Information Administration and U.S. Bureau of Labor Statistics.

Ultimately, large investments in tanker fleets and terminal facilities amounting to several hundred million dollars per project must be repaid by market price.

to provide from 1.1 to 2.1 tcf of gas by 2020. This projection, however, reflects a range of Alaskan production of 0.5 to 2.4 tcf delivered to the lower 48 via a major pipeline. If the controversial pipeline is delayed or never built, however, then the EIA 2020 projections of LNG delivery would increase to a range of from 1.7 to 4.5 tcf per year.

EIA expects the annual long-term wellhead price of natural gas to be in the range of $3.17 to $4.90 per mcf. Such prices are in line with recent prices paid for LNG. While the typical market arrangement is a long-term contract with the consumer, adequate to repay the large investment costs of these expensive projects, recent developments have created an active spot market for LNG. (The February 2003 prices have ranged from $5.84 to $10.49.) Ultimately, however, large investments in tanker fleets and terminal facilities amounting to several hundred million dollars per project must be repaid by the market price. Although the range of costs is high among the various LNG projects, depending on the source, transit distance, and local terminal costs, a typical cost of replacement plus a market return on investment for a Trinidad to Lake Charles project translates into approximately $2.33 per mcf of delivered gas ($0.50 for supply, $1.25 for liquefaction, $0.43 for shipment, and $0.16 for regasification).

Changed Market Fundamentals

The development of the LNG terminals (1978-1982) followed a period of growing gas market curtailments that reached 16 percent of the market for natural gas. By the time the terminals were built, the shortage had turned to surplus as the effects of the price incentives of the Natural Gas Policy Act of 1978 (NGPA) took effect. Following passage of the NGPA, new deep-well gas and certain high-cost gas were allowed high incentive prices prior to full deregulation, and these incremental sources of U.S. domestic gas sold for $7.31 per mcf in 1982 ($41 per barrel of oil equivalent).

Four conditions have changed since the aborted attempt to establish a LNG market in the United States in the early 1980s. First, developers were targeting a shrinking market that had been bedeviled by U.S. wellhead price controls, market shortages, and the widespread belief that reserves of natural gas were running out. Long-term price signals were very confused because of the increasingly complex regulatory system and the related volatility of the world oil market. In short, there seemed to be a place for $6.00 per mcf LNG ($32/ barrel of oil equivalent) in the U.S. fuels market. The reality of $15 to $25 per barrel oil prices and U.S. gas prices in the $1.75 to $2.50 range that followed full deregulation in 1985 made it clear that the LNG market development was premature. Current LNG developers face an expanding gas market supported by certain growth in electric generation based on natural gas and heightened interests in gaseous transportation fuels. Wellhead prices are now fully deregulated and an active futures market exists with which to hedge market price volatility.

Second, new LNG sources, especially Trinidad, have developed closer to the U.S. Gulf Coast. This major project, which began

operation in 1999, provides the nearest, and therefore the most competitive, LNG project now making deliveries to the United States.

Third, the transportation and liquefaction parts of the chain from production to utilization have undergone major technological innovations. For example, an improved optimization process at the Trinidad location uses three refrigeration circuits—propane, ethylene, and methane—to cool the gas before it is loaded on to insulated tanks aboard tankers. A modest amount of the liquid vaporizes in route, making it important to minimize travel time for delivering the cargo. Plans are in place to increase tanker sizes to 4 bcf, thus reducing the unit transit cost. The unit operating and capital cost, plus the value of gas loss due to "boiloff," for the 4 bcf tanker is approximately $0.380/mcf of delivered gas to Corpus Christi from Trinidad, as compared to $0.449/mcf with the smaller 3 bcf tanker.

Finally, prompted by a long period of sustained gas market growth, driven by the environmental advantages of natural gas, producers are drilling deeper onshore and relying more on relatively expensive offshore reserves. These higher-cost sources will become the marginal supply source, along with LNG and more expensive gas transported via pipeline from Alaska to market in the lower 48 states, that now defines the market clearing price. These considerations bring most analysts to the conclusion that the market clearing price in

The development of a large number of natural gas-based power plants, as well as the growth in industrial, commercial, and residential demand that accompanies quick population growth, will result in rapid increases in natural gas consumption in the West-South region of the United States.

Table 2
U.S. Natural Gas Market and LNG Outlook

	2001	2010	2015	2020	2025
Lower 48 wellhead price (2001/$mcf)					
Low economic growth		3.17	3.26	3.58	3.83
Reference case	4.12	3.29	3.55	3.69	3.90
High economic growth case		3.59	3.71	3.63	4.50
Total U.S. consumption (tcf)					
Low economic growth		26.29	28.38	30.30	31.78
Reference case	22.64	27.06	29.50	32.14	34.93
High economic growth case		28.13	30.90	34.59	37.48
Net Canadian imports					
Low economic growth		3.83	4.12	4.45	5.23
Reference case	3.61	4.05	4.42	5.08	5.31
High economic growth case		4.38	5.00	5.03	5.46
Alaskan production (tcf)					
Low economic growth		0.48	0.51	0.54	0.57
Reference case		0.48	0.51	0.55	2.64
High economic growth case		0.48	0.51	2.39	2.85
Net LNG imports (tcf)					
Low economic growth		0.99	1.01	1.11	1.45
Reference case	0.17	0.99	1.03	1.51	2.14
High economic case		0.99	1.27	2.08	2.84
Net Mexican imports (tcf)					
Low economic case		-0.27	-0.24	-0.16	0.09
Reference case	-0.13	-0.26	-0.19	0.07	0.20
High economic growth case		-0.23	0.07	0.47	0.78

Source: Energy Information Administration, U.S. Department of Energy, Annual Energy Outlook 2003 with Projections to 2025, Washington, D.C., January 2003.

the long term will remain in the $2.50 to $3.50 range, up from the $1.75 to $2.50 range typical of the 1987 to 2000 period.

Importance to Texas Market Conditions

As a location for LNG terminals, the Gulf Coast region offers several advantages. First, transportation costs for LNG shipments are competitive with East Coast and West Coast alternatives. Second, the development of a large number of natural gas-based power plants, as well as the growth in industrial, commercial, and residential demand that accompanies quick population growth, will result in rapid increases in natural gas consumption in the West-South region of the United States. Third, the Texas Gulf Coast provides easy access to major interstate and intrastate pipelines to move the gas to market. These pipelines were constructed to market production from onshore fields, which have seen significant declines in recent years; pipeline capacity therefore is ample in many cases. The local area pipelines will be available for LNG product.

Historically, a small part of the U.S. natural gas market, the LNG market filled the role of satisfying peak demand and served as an alternative to underground storage of natural gas for peak demand purposes. Currently, however, LNG is seen more and more as a viable option for satisfying part of the future base load of the nation. LNG terminals are being located near the large markets in the northeast states, in the Gulf Coast, and in southern California. In order to make the entire LNG operation economically efficient, easy access to pipeline capacity is required to handle the flow on an ongoing basis. A continuous flow minimizes tanker travel and wait time, onshore storage requirements, and therefore total delivered cost.

All of the right conditions can be found in the LNG project at Freeport, Texas. Only 71 miles farther from Trinidad than Lake Charles, the proposed facility is designed for 1.5 bcf per day, has a contract with nearby Dow for one-third of the terminal's capacity, provides easy access to the Gulf, and needs only a 9.4 mile pipeline to reach Stratton Ridge, a major point of interconnection with the Texas intrastate pipeline system.

Competitive locations in Corpus Christi, Sabine Pass, and possibly Brownsville make the Texas Gulf Coast a likely delivery point for approximately 8 bcf of regasified LNG per day (1.9 tcf of annual capacity). Because of the concentration of both intra- and interstate pipelines within a few miles of the Gulf, these terminals will provide important capacity for imports.

Conclusions

Improvements in the technologies of liquefaction and transportation of LNG, the proximity of new offshore supplies, and a fundamental shift in the U.S. natural gas market bodes well for the development of a significant LNG market. The Texas Gulf Coast is a relatively good location for new marine terminal capacity, the development of which will add significantly to the Texas and national natural gas supply capability.

In addition, the economic development effect of a new LNG terminal is significant. The construction cost of an average 2.0 bcf/d LNG terminal is approximately $400 million, including the costs of storage tanks, pipeline connections, and unloading/docking facilities. The annual cost of operation, including debt service and fuel costs for regasification, will likely be in the range of $90 to $100 million per year. Net of fuel costs and debt service, and allowing for use at less than capacity, the annual addition to the local economy around a new LNG terminal will likely be in the range of $25 to $50 million. Therefore, the economic impacts on a local economy will be significant, although the impacts on the U.S. or Texas markets will be small. The effect of the LNG influence will be to create an additional source of marginally priced gas in competition with expensive Alaskan and offshore Gulf sources, shifting the benefits somewhat to terminal area economies at the expense of other marginal suppliers.

The national capacity of current expansion and planned new terminal capacity will amount to about 7 tcf of capacity to deliver gas to the U.S. market. This much capacity is enough to supply 60 percent of the projected growth in U.S. gas demand to 2025. LNG will be competing with other marginal sources including gas from offshore formations, Alaska, and Canada. It is unlikely that all of the terminals now in the planning stage will finally be developed, but a significant number of them seem destined to become new features at major U.S. ports, including Texas.◆

Liquefied natural gas is seen more and more as a viable option for satisfying part of the future base load of the nation.

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