Proposed LNG Terminals Mask a Cloudy Near Term Supply Outlook
by
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The U. S. relies on imports of natural gas to meet annual natural gas demand, both pipeline imports (principally from Canada) and LNG imports through 4 regasification terminals located in the contiguous lower 48 states (Figures 1 & 2). As a result of the anticipated growing international trade in liquefied natural gas, the U. S. has experienced a large number of filings for new regasification terminals. This brief overview addresses a few of the key geopolitical and economic issues that may diminish the nation’s ability to fully utilize these proposed terminals.

Figure 1. U. S. Natural Gas Demand Outstrips Domestic Supply

Figure 2. Pipeline Exports from Canada are Slowing as Internal Canadian Consumption Grows and Global Competition is Escalating for LNG Imports, Increasing U. S. Competition for Gas Supply
U. S. production of natural gas has remained almost constant over the past 11 years, and deliverability capacity is estimated to have remained steady. Therefore, the surplus deliverability margins have remained quite small in relation to demand (Figure 3).

Figure 3. Time Series of Natural Gas Production, Productive Capacity, Surplus Margins

![Graph showing time series of natural gas production, productive capacity, and surplus margins from January 1994 to April 2003.](image)

Taken together, the escalating competition for imports and the failure to increase domestic natural gas deliverability capacity, the nation’s gas supply is operating at close to capacity utilization; so close that prices have become much more volatile than is healthy for any market and business investment planning (Figure 4).

Figure 4. As in Any Sector of the Economy, as Capacity Utilization Increases, Prices Rise

![Graph showing exponential rise in Henry Hub price as capacity utilization exceeds 92% from January 1994 to April 2003.](image)

Source: Energy Information Administration (EIA) natural gas data series
Including Alaska and Puerto Rico in the picture, the U.S. has 7 LNG terminals as of 2006. One is a liquefaction terminal in Alaska. Alaskan LNG is shipped to Japan. A second terminal, a regasification terminal, is located in Puerto Rico where imports serve as the source for power generation and water desalinization for the island residents. In the lower 48 states, a 5th regasification terminal called “Energy Bridge” became operational in the Gulf of Mexico during 2005. The other 4 have been operational for several years (Figure 5 & Table 1).

Figure 5. There Were 4 Main Regasification Terminals Serving the Lower 48 States in 2004

Table 1. Trinidad & Tobago Has Become the primary source of LNG for the U.S.

<table>
<thead>
<tr>
<th>Country of Origin</th>
<th>Cove Point, MD</th>
<th>Lake Charles, LA</th>
<th>Everett, MA</th>
<th>Elba Island, GA</th>
<th>Totals MMcf</th>
<th>Country %</th>
</tr>
</thead>
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<td>Algeria</td>
<td>33,554</td>
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<td>14,990</td>
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<td>Brunei</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.00%</td>
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<tr>
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<td>19,999</td>
<td>0</td>
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<td>Nigeria</td>
<td>2,986</td>
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<td>0</td>
<td>11,817</td>
<td>1.82%</td>
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<td>Oman</td>
<td>0</td>
<td>9,412</td>
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<td>0</td>
<td>9,412</td>
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<tr>
<td>Qatar</td>
<td>0</td>
<td>11,854</td>
<td>0</td>
<td>0</td>
<td>11,854</td>
<td>1.82%</td>
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<tr>
<td>Trinidad &amp; Tobago</td>
<td>172,753</td>
<td>10,364</td>
<td>173,780</td>
<td>105,203</td>
<td>462,100</td>
<td>71.04%</td>
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<td>UAE</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td><strong>2004 Totals</strong></td>
<td><strong>209,293</strong></td>
<td><strong>162,239</strong></td>
<td><strong>173,780</strong></td>
<td><strong>105,203</strong></td>
<td><strong>650,515</strong></td>
<td><strong>100.00%</strong></td>
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<tr>
<td><strong>2004 %</strong></td>
<td><strong>32.17%</strong></td>
<td><strong>24.94%</strong></td>
<td><strong>26.71%</strong></td>
<td><strong>16.17%</strong></td>
<td><strong>100.00%</strong></td>
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</table>

Source: Natural Gas Annual 2004 Energy Information Administration (EIA)

The Federal Energy Regulatory Commission (FERC) and U.S. Dept. of Transportation Maritime Administration (MARAD) have approved 13 new regasification terminals totaling 16.870 billion cubic feet per day (Bcf/D) deliverability capacity as of March 8, 2006 (Table 2). Will these all be built? As of this writing only Pelican Point has been canceled. Many approved terminals are under construction. Proposed capacity expansion approaches 30% of existing deliverability capacity. This is a significant expansion that,
if completed, would provide substantial surplus deliverability margin to the nation’s natural gas capacity. (Note: In addition, Mexico has approved 3.1 Bcf/D of new capacity and Canada has approved 2.0 Bcf/D.)

Table 2. From the Federal Energy Regulatory Commission as of March 8, 2006

<table>
<thead>
<tr>
<th>Constructed LNG Terminals</th>
<th>Location</th>
<th>Regasification Capacity - Bcf/D</th>
<th>Owner</th>
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<tbody>
<tr>
<td>Everett, MA</td>
<td>1.035</td>
<td>SUEZ/Tractebel-DOMAC</td>
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<tr>
<td>Cove Point, MD</td>
<td>1</td>
<td>Dominion-Cove Point LNG</td>
<td></td>
</tr>
<tr>
<td>Elba Island, GA</td>
<td>1.2</td>
<td>El Paso-Southern LNG</td>
<td></td>
</tr>
<tr>
<td>Lake Charles, LA</td>
<td>1.5</td>
<td>Southern Union-Trunkline LNG</td>
<td></td>
</tr>
<tr>
<td>Gulf of Mexico</td>
<td>0.5</td>
<td>Gulf Gateway Energy Bridge-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Excelarate Energy</td>
<td></td>
</tr>
<tr>
<td><strong>Total Constructed</strong></td>
<td><strong>5.235</strong></td>
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</table>

<table>
<thead>
<tr>
<th>Approved by FERC</th>
<th>Location</th>
<th>Regasification Capacity - Bcf/D</th>
<th>Owner</th>
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</thead>
<tbody>
<tr>
<td>Lake Charles, LA</td>
<td>0.6</td>
<td>Southern Union-Trunkline LNG</td>
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<tr>
<td>Hackberry, LA</td>
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<td>Cameron LNG-Sempra Energy</td>
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<tr>
<td>Bahamas</td>
<td>0.84</td>
<td>AES Ocean Express1/</td>
<td></td>
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<tr>
<td>Bahamas</td>
<td>0.83</td>
<td>Calypso Tractebel1/</td>
<td></td>
</tr>
<tr>
<td>Freeport, TX</td>
<td>1.5</td>
<td>Cheniere/Freeport LNG Development</td>
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<td>Sabine, LA</td>
<td>2.6</td>
<td>Cheniere LNG</td>
<td></td>
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<tr>
<td>Corpus Christi, TX</td>
<td>2.6</td>
<td>Cheniere LNG</td>
<td></td>
</tr>
<tr>
<td>Corpus Christi, TX</td>
<td>1</td>
<td>Vista Del Sol-ExxonMobil</td>
<td></td>
</tr>
<tr>
<td>Fall River, MA</td>
<td>0.8</td>
<td>Weaver's Cove Energy/Hess LNG</td>
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<td>Sabine, TX</td>
<td>1</td>
<td>Golden Pass-ExxonMobil</td>
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<td>Corpus Christi, TX</td>
<td>1</td>
<td>Ingleside Energy-</td>
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<td></td>
<td></td>
<td>Occidental Energy Ventures</td>
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<td><strong>Total Approved FERC</strong></td>
<td><strong>14.27</strong></td>
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</table>

<table>
<thead>
<tr>
<th>Approved by MARAD/Coast Guard</th>
<th>Location</th>
<th>Regasification Capacity - Bcf/D</th>
<th>Owner</th>
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<tr>
<td>Port Pelican</td>
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<td>ChevronTexaco</td>
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<tr>
<td>Louisiana Offshore</td>
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<td>Gulf Landing-Shell</td>
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<td><strong>Total MARAD</strong></td>
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<tr>
<td><strong>Grand Total Approved</strong></td>
<td><strong>16.87</strong></td>
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Current Estimated Deliverability Capacity = 57 Bcf/D
Approved LNG Construction % of Current Capacity= 30%

It is well known that natural gas burns with the lowest carbon emissions of the fossil fuels. One hundred fifty-five (155) nations were signatories to the Kyoto Protocol, agreeing to reduce carbon emissions over a predetermined time period. Using the best available sources for global natural gas production and international trade, it seems that internal consumption in many nations, particularly those who are
natural gas exporters, is reducing the quantity of natural gas available for export. Two major pipeline exporters, Canada and Russia, have reduced exports over the past 5 years (Table 3).

Table 3. Growth of Global Production has Exceeded Growth in International Exports. The Proportion of Natural Gas Dedicated to International Trade has Declined.

<table>
<thead>
<tr>
<th>Year</th>
<th>Production1/</th>
<th>Pipeline Exports2</th>
<th>LNG Exports3</th>
<th>P/L &amp; LNG % Production</th>
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<tr>
<td>2000</td>
<td>235.3</td>
<td>49.9</td>
<td>13.2</td>
<td>26.84%</td>
</tr>
<tr>
<td>2001</td>
<td>240.9</td>
<td>51.8</td>
<td>13.9</td>
<td>27.28%</td>
</tr>
<tr>
<td>2002</td>
<td>244.8</td>
<td>54.2</td>
<td>14.6</td>
<td>28.09%</td>
</tr>
<tr>
<td>2003</td>
<td>253.1</td>
<td>57.3</td>
<td>16.3</td>
<td>29.10%</td>
</tr>
<tr>
<td>2004</td>
<td>260.3</td>
<td>48.6</td>
<td>17.2</td>
<td>25.25%</td>
</tr>
</tbody>
</table>

Units are billions of cubic feet per day (Bcf/D)
1/ from BP Statistical Review of World Energy June 2005
2/ from Cedigaz Statistical Data Files
3/ from Cedigaz Statistical Data Files
2003 is estimate
2004 is Provisional as provided to BP
2004 is Provisional as provided to BP

Japan and South Korea are the two largest importers of LNG (2004). Both nations are recognized as major industrial powers with limited natural resources. The U. S. is the third largest. But the U. S. is a small component of the global LNG trade. Several European nations are also noteworthy importers of LNG.

Table 4. U. S. Imports Represent Only 10.4% of Global LNG Trade

<table>
<thead>
<tr>
<th>Gas: Trade Movements 2004 - LNG *</th>
<th>To USA</th>
<th>Trinidad &amp; Tobago</th>
<th>Oman</th>
<th>Qatar</th>
<th>UAE</th>
<th>Algeria</th>
<th>Libya</th>
<th>Nigeria</th>
<th>Australia</th>
<th>Brunei</th>
<th>Indonesia</th>
<th>Malaysia</th>
<th>Total Imports</th>
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<td>USA</td>
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<td>-</td>
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<td>-</td>
<td>-</td>
<td>0.57</td>
<td></td>
<td>18.47</td>
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<td>Dominican Republic</td>
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<td>-</td>
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<td>-</td>
<td>-</td>
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<td>-</td>
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<td>7.48</td>
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<td>8.29</td>
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<td>-</td>
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<td>5</td>
<td>4.05</td>
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<td>9.03</td>
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<td>25.75</td>
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<td>12.59</td>
<td>12.17</td>
<td>9.5</td>
<td>33.49</td>
<td>27.68</td>
<td>177.95</td>
</tr>
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</table>

* LNG (Liquefied Natural Gas)

Note: Flows are on a contractual basis and may not correspond to physical gas flows in all cases
Source: Cedigaz (provisional)
If there is a significant underinvestment in new natural gas productive capacity around the globe where would the U. S. look for LNG investment that might be made competitively available to the U. S. market?

Table 5. Top 30 Reserve Countries and Their Exports

<table>
<thead>
<tr>
<th>Country</th>
<th>Reserves Tcf 1-1-05</th>
<th>Consumption 2004 Bcf/day</th>
<th>Production 2004 Bcf/day</th>
<th>LNG Plant Capacity 2002 Bcf/day</th>
<th>LNG Plant Capacity Proposed 2010 Bcf/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia</td>
<td>1,694.40</td>
<td>38.9</td>
<td>57</td>
<td>0</td>
<td>1.2</td>
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<tr>
<td>Iran</td>
<td>970.8</td>
<td>8.4</td>
<td>8.3</td>
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<td>Qatar</td>
<td>910.1</td>
<td>1.5</td>
<td>3.8</td>
<td>2.9</td>
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<td>213.9</td>
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<td>16.9</td>
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<td>8.7</td>
<td>0.1</td>
<td>N/R</td>
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<td>Equatorial Guinea</td>
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<td>N/R</td>
<td>N/R</td>
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<td>Rest of World</td>
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N/R = not reported
1/ is from BP's World Energy Review, 2005
2/ is from BP's World Energy Review, 2005
3/ is from NPC Study, 2003

Tables 4 & 5 illustrate one key problem area. Most of the existing, known natural gas reserves are located in areas that are geographically closer to other markets, such as Europe or Asia Pacific. Only Venezuela, Trinidad & Tobago, Bolivia and Peru are in the Western Hemisphere, and they
represent only 3.5% of the existing known natural gas reserves of the top 30 reserve holding nations.

With the exception of Trinidad & Tobago, in these other South American countries there has developed some significant anti-American sentiment. These attitudes inhibit the role American private sector companies can play in developing these potential LNG resources. The current state of relations with Venezuela is well publicized so geographic distance and foreign policy are 2 key issues that may reduce the quantity of LNG available to the U. S. market.

If natural gas in the form of LNG is a fungible commodity as it is, “other investors” may develop these resources thereby making available some of the existing capacity to the U. S. But who might these “other investors” be? So far the national oil companies have not shown a willingness to develop and make available for international export their global natural gas reserves. China and India, two rapidly growing economies, are interested in securing supplies to sustain their own internal growth consumption.

This leads to a third key issue: the enormous investment cost of a complete LNG delivery system, from reservoir(s) through liquefaction, shipping, domestic liquefied storage and regasification (Table 6). First given the fixed investment cost in liquefaction and regasification terminals, a supply of natural gas for a 20 year life will be a requirement for long term financing. A 1 Bcf/D liquefaction terminal would require nearly 7 Tcf (trillion cubic feet) of reserves dedicated to the supply. Such an investment in reserves and deliverability could easily approach $7 billion dollars (@ $1.00/Mcf exploration and development costs).

| Table 6. The Total System Cost Approaches $10 Billion (U. S.) for a 1 Bcf/d System ($7 billion for Reserves, $2 Billion for Terminals, $1 Billion for 4 LNG Ships) |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
| Liquefaction Train              | Description     | Capex           | IRF             | $/MMBTU         |
|                                 | $1.5-$1.7 billion per 1 Bcf/day | $1.5 billion | 0.18548 | $278.22 | $0.83 |
|                                 | 1.5-2.5%\%/year of Capex | $30 MM/yr | 335 Bcf/yr | $0.09 | $0.09/MBTU |
| Total Projected Costs, Capex and Opex, for Liquefaction Terminal |                      |                |                | $0.92  |
| Regasification                  |                  |                |                |                  |
|                                 | Capex            | $500 MM per 1 Bcf/day | $500 MM | 0.179 | $89.50 | $0.27 |
|                                 | 21.76-27.34cents/mmmbtu fixed | | | $0.27 |
|                                 | 2.7-2.99 cents/mmmbtu variable | | | $0.03 |
|                                 | 1.66% fuel loss | $3.50/mmmbtu | | $0.06 |
| Total Projected Costs, Capex and Opex, for Regasification Terminal | $0.36 | $0.36 |
| Combined Total Projected Terminal Costs | $1.28 |

Just as the liquefaction terminal requires a 20 year supply of natural gas, so is there a requirement for long term contracts (20 years) from customers. This has been a problem for Local Distribution Companies (LDCs) in the U. S. Regulatory agencies in the U. S. have been reluctant to approve such lengthy contracts to this point in time, although those attitudes may now be changing.

How critical might these impediments be to U. S. strategic and economic security? Natural gas is the most ubiquitous of the energy sources. It is used in every sector of the economy: residential; commercial; industrial; utility; transportation. When the market shares of each sector are squared (an Herfindahl-
Hirschman (HHI) index), then added together, natural gas is the most pervasive energy source of all. But in 2001, following the run-up in prices in 2000, its role began to decline as measured by the HHI index (Figure 6).

Figure 6. Crude Oil Commands the Largest Market Share, but Natural Gas is More Pervasive in the Economy

The importance of a stable and dependable source of natural gas to the economy is further illuminated by the change in the rate of growth in civilian employment in 2001. Since the rise in natural gas prices beginning in 2000, the rate of growth of employment has been about half that of the previous economic expansion of the 1990s (Figure 7).

Figure 7. Because of the Pervasive Role of Natural Gas in the Economy, Price Volatility Reduces Employment Growth

By all economic and physical measures, a stable and dependable supply of natural gas is critical for the security of the U. S. economy. Energy security is closely integrated with the nation’s domestic, foreign, and environmental policies. Unless all policy issues can be aligned, it may not be possible to build the proposed regasification capacity currently planned, further exacerbating natural gas price volatility and domestic business investment uncertainty.

Proposed LNG Terminals Mask a Cloudy Near Term Supply Outlook 8 March 2006