Prospects for LNG Exports from North America

JOGMEC Petroleum Seminar
February 7, 2013
Tokyo

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Energy Policy Research Foundation, Inc. (EPRINC)
Washington, DC
Four Questions

1. How big is the U.S. natural gas production opportunity (hint: it’s about technology, not reserves).

2. How sensitive is U.S. natural gas production to the price of natural gas i.e., what is the shape of the supply curve?

3. What is the potential for the U.S. to contribute to world LNG supplies (which is not the same as the amount of LNG the U.S. will actually contribute).

4. What role will the U.S. Government play in regulating natural gas production and LNG exports?
Projected Imports of LNG vs. Actual
(or why forecasters should have humility)

Source: EIA data and forecasts

Prices at $3.34/mcf
December 2012
Rig Count and Permits

Source: Photo Baker Hughes Interactive Rig Count Jan 25, 2012
Hydraulic Fracturing

Hydraulic Fracturing or “fracking” involves the injection of more than a million gallons of water, sand and chemicals at high pressure down and across into horizontally drilled wells as far as 10,000 feet below the surface. The pressurized mixture causes the rock layer to crack. These fissures are held open by the sand particles so that oil from the shale can flow up the well.

Source: goodyearlake.org
Shale Gas is Manufactured
Will Public Opposition Stop the Shale Gale?

Security concerns zap EPA meeting

September eyed as earliest date, but site uncertain

By Jon Campbell
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Staff Writer

It was on. It was moved. Now, it's off — at least until September.

Less than 24 hours after the U.S. Environmental Protection Agency announced it was moving its marathon public meeting from Binghamton University to the Oncenter Complex in Syracuse, the agency Tuesday postponed the event because of security concerns expressed by Onondaga County officials.

Matthew Miles, deputy county executive for physical services for Onondaga, said public safety officials at BU told Onondaga to expect up to 8,000 people to show for the event.

About 1200 people had pre-registered to attend the hearing, but a large walkup crowd was expected.

“It was just impossible to put together a plan that would ensure public health and safety for a crowd of that size in this period of time,” Miles said.

This was the latest in a number of twists and turns for the meeting, which was set for Thursday. On Monday it was moved to Syracuse because of a week’s contract dispute between the EPA and BU.

The agency now intends to hold the meeting according
<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Average Gallons of Water Used per MMBtu of Energy Produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biofuels (irrigated)</td>
<td>2500+</td>
</tr>
<tr>
<td>Synfuel - Fisher Tropsch (Coal)</td>
<td>50</td>
</tr>
<tr>
<td>Oil Sands Petroleum</td>
<td>47</td>
</tr>
<tr>
<td>Oil Shale Petroleum</td>
<td>39</td>
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<tr>
<td>Coal (with slurry transport)</td>
<td>23</td>
</tr>
<tr>
<td>Synfuel - Coal Gasification</td>
<td>18</td>
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<tr>
<td>Conventional Oil</td>
<td>14</td>
</tr>
<tr>
<td>Nuclear (processed Uranium)</td>
<td>11</td>
</tr>
<tr>
<td>Coal (with no slurry transport)</td>
<td>5</td>
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<tr>
<td>Conventional Natural Gas*</td>
<td>2</td>
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<tr>
<td>Chesapeake Deep Shale Natural Gas*</td>
<td>1.25</td>
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</tbody>
</table>

Source: U.S. DOE, Chesapeake
Source: Bentek, NDPA Williston Basin natural gas study, “The Williston Basin: Greasing the Gears for Growth in North Dakota”
South Texas’ Eagle Ford Reservoir Liquid and Gas Production

Source: HPDI Dec 23 2012, liquid volumes includes condensate, estimated condensate volumes are up to 40% of liquids production
Niobrara Production

Source: EIA data and forecasts.
High Volumes of Associated Gas and Wet Plays Sustain U.S. Output

$2/mcf vs. $5/mcf

Source: Bentek
Source: Baker Hughes
U.S. Natural Gas Capacity Likely to Continue Growing

Source: Bentek
Petrochemical Cost Curve By Country -- 2012

Cash Costs ($/Pound)

High

Japan

Western Europe

Other Northeast Asia

China

Canada

United States

Low

Middle East

Low

United States

Cumulative Supply Quantity (Billion Pounds)

Source: American Chemistry Council
Opposition to U.S. LNG Exports-----
How Realistic is a 55 bcf/d growth in natural gas demand
From 2012 to 2035?

Source: Dow Chemical Corporation

PROJECTED NATURAL GAS DEMAND
Transportation Sector

<table>
<thead>
<tr>
<th>Bcf/d</th>
<th>DOW Chemical*</th>
<th>AEO 2011</th>
<th>AEO 2012</th>
<th>AEO 2013</th>
<th>AEO 2012 Hi Heavy Truck Potential Case**</th>
<th>ICF Base Case**</th>
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<tbody>
<tr>
<td></td>
<td>17</td>
<td>0.44</td>
<td>0.44</td>
<td>1.6</td>
<td>5.3</td>
<td>0.3</td>
</tr>
</tbody>
</table>
Proposed U.S. Projects Far Exceed Demand – Many Will Not Reach FID

* Does not include recently added 3 bcf/d of FTA applications and 24.8 of Non FTA Applications.

Sources: Poten Group, ICF, U.S. DOE, Facts, BG Group, Credit Suisse
Possible Timing of Four LNG Export Projects

- **Sabine Pass Exports**
- **Cameron Exports**
- **Freeport Exports**
- **Cove Point Exports**
- **Total US Capacity**

Axis:
- **Bcf/d** (Billion cubic feet per day)
- **Years** (2016 to 2020)

Legend:
- Blue
- Purple
- Turquoise
- Red
Permitting and Construction Timelines for FERC Approval

Design work and start FEED; begin environmental review and analysis

Year 1

Finish permitting

Year 2

Construction

Year 3

Train 2 & 3 Commissioning

Year 4

Finish FEED and environmental review; start permitting – File FERC DOE applications

Train 1 Commissioning

Year 5

Start Construction Train 1 (the subsequent trains are started 9 months apart)

Year 6

Train 4 Commissioning

Year 7

Year 8

Facility Complete & in Commercial Operation

Year 9

Sources: Poten Group, ICF, U.S. DOE, Facts, BG Group, Credit Suisse
Conclusions

• Aside from **Sabine Pass Trains 1-4**, which has completed FERC permitting, there are only three projects that have exited the **pre-Filing process**: Corpus Christi Liquefaction (Cheniere), Freeport LNG and Cameron LNG (Sempra).

• Maximum of five to six projects, with a maximum of 12 bcf/d, but given world LNG competition, U.S. exports likely to be limited to 6-8 bcf/d over next 20 years.

• U.S. LNG exports highly unlikely to harm U.S. manufacturing advantage, supply curve will remain flat due to technology advances and continued access to natural gas on private lands. U.S. has massive natural gas expansion capacity.

• Only pay attention to those projects that exit the pre-filling process at FERC as this is where a major commitment is made, engineering and environmental assessment with an approximate cost of $100 million.

• DOE will permit several export licenses for Japan in the next 2-6 months.