THE U.S. POTENTIAL AS A SWING SUPPLIER IN THE ATLANTIC BASIN

Hannah Gagarin & Carly Page
USAEE/IAEE North American Conference
November 12th-15th, 2017
OVERVIEW

• Purpose
• Methods
• Results
• Conclusion
• Further research
What is the potential for the United States to operate as a marginal supplier of LNG to the Atlantic Basin between 2016 and 2030?
METHODS

1. Assess the global gas market through 2030

2. Evaluate risks to relevant sources of supply and demand within the Atlantic Basin

3. Assess the U.S.’s cost to produce with regards to other producers
### SOURCES OF SUPPLY AND DEMAND

#### Indirect Supply

<table>
<thead>
<tr>
<th>Supply</th>
<th>Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria</td>
<td>Australia</td>
</tr>
<tr>
<td>Angola</td>
<td>Indonesia</td>
</tr>
<tr>
<td>Equatorial Guinea</td>
<td>Malaysia</td>
</tr>
<tr>
<td>Nigeria</td>
<td>Qatar</td>
</tr>
<tr>
<td>Norway</td>
<td></td>
</tr>
<tr>
<td>Oman</td>
<td></td>
</tr>
<tr>
<td>Trinidad &amp; Tobago</td>
<td></td>
</tr>
<tr>
<td>Yemen</td>
<td></td>
</tr>
</tbody>
</table>

*European Union

#### Demand

<table>
<thead>
<tr>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
</tr>
<tr>
<td>The Caribbean</td>
</tr>
<tr>
<td>Europe*</td>
</tr>
<tr>
<td>South America</td>
</tr>
</tbody>
</table>
RELEVANT SOURCES OF SUPPLY AND DEMAND

Source: Author
Europe and South America considered the most likely recipients of U.S. LNG out to 2030

• Barbados and Puerto Rico have imported LNG using ISO tanks, but not on a large scale.
RISKS TO COMPETITOR SUPPLY

UPSIDE
• Efficiencies in technology
• Lifting of fracking bans

DOWNSIDE
• Supply disruptions
• Falling domestic production
• Increased domestic demand
• High project costs
RISKS TO DEMAND FOR U.S LNG

**UPSIDE**

- Falling domestic production
- GHG-reduction policies
- Geopolitical motivations
- Weather variation
- Economic growth

**DOWNSIDE**

- Competition with renewables in the long-term (past 2030)
## COST TO PRODUCE: SHORT RUN VS. LONG RUN MARGINAL COST

<table>
<thead>
<tr>
<th>Short Run Marginal Cost</th>
<th>$/mmBtu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Henry Hub</td>
<td>4.00</td>
</tr>
<tr>
<td>Liquefaction (HHx1.15)</td>
<td>.60</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>4.60</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Long Run Marginal Cost</th>
<th>$/mmBtu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Henry Hub</td>
<td>4.00</td>
</tr>
<tr>
<td>Liquefaction (HHx1.15)</td>
<td>.60</td>
</tr>
<tr>
<td>Tolling ($3.00)</td>
<td>3.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>7.60</td>
</tr>
</tbody>
</table>
RESULTS: ASSESSING THE MARKET

Net supply vs. net demand in the basin
BCF/D

UK  Rest of Europe  Brazil  Chile/Rest  Total net supply in basin
RESULTS: RISKS TO SUPPLY AND DEMAND

• Europe most realistic source of (marginal) demand for U.S. LNG
  o Slowing domestic production
  o Europe’s GHG-reduction policies strongly favor LNG
  o Russia’s dominance in European gas market.
RESULTS: RISKS TO SUPPLY AND DEMAND (CONT’D.)

- South America likely to be a source of demand only during volatile weather events

Electricity Generation in Brazil by Source
Billion Kwh

Source: EIA
RESULTS - COST TO PRODUCE

Marginal Cost Curve

- **SRMC (green)**
- **LRMC (green + blue)**
- **Tolling/fixed (capital)**
- **Liquefaction/op. cost**
- Henry Hub

$/mmBtu
RESULTS - COST TO PRODUCE VS. UK NBP

Marginal Cost Curve

- Henry Hub
- Liquefaction/op. cost
- LRMC (green + blue)
- SRMC (green)
- Tolling/fixed (capital)
- NBP 2016 average

Cost to produce vs. UK NBP

- Cost: $/mmBtu

Graph showing the marginal cost curve with various cost components.
U.S. LNG MAY NOT BE ABLE TO CONSISTENTLY COMPETE IN REGIONAL MARKETS, CREATING UNCERTAINTY FOR U.S. LNG PROJECTS*

<table>
<thead>
<tr>
<th>U.S. Costs to Produce ($/mmBtu)</th>
<th>Short Range Marginal Cost</th>
<th>Long Range Marginal Cost</th>
<th>Profit/(Loss) for movement from US Gulf to Europe ($/mmBtu)</th>
<th>Short Range Marginal Cost</th>
<th>Long Range Marginal Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Henry Hub</td>
<td>3.00</td>
<td>3.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Cost (15% of Henry Hub)</td>
<td>0.45</td>
<td>0.45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amortization/Tolling</td>
<td>-</td>
<td>3.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freight to Europe</td>
<td>0.45</td>
<td>0.45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regasification</td>
<td>0.30</td>
<td>0.30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Henry Hub Lay-down Cost in Europe</td>
<td>4.20</td>
<td>7.20</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Economics based on Cheniere Sabine Pass contract specifications plus freight and gasification estimates from Barclays “EU gas for those that never cared” Barclays Commodity Research 7 June 2017.
• Global oversupply in the 2020’s
• The U.S. will likely operate on the margin
• Policy and geopolitical motivations make Europe the most realistic “sink” for U.S. LNG, out to 2030
• Uncertainty and U.S. LNG: 
  • Role of renewables and U.S. cost to produce
Q&A
FURTHER RESEARCH

• Floating Storage and Regasification Units (FSRU’s)
  • LNG can reach non-traditional markets

• Transportation and shipping
  • Natural gas vehicles
  • Bunkering