U.S. Natural Gas and the Potential for LNG Export Growth

Presentation to:
2018 Wyoming Oil & Gas Fair

By:
John Harpole
It is not a scarce resource anymore


Source: Rick Allen, S&P Global Platts, The Energy Summit – COGA 2018 presentation, August 22, 2018
U.S. Dry Shale Gas Production

million cubic feet per day

- Permian (TX NM)
- Utica (OH PA WV)
- Rest of US
- Marcellus (PA WV OH NY)
- Haynesville (LA TX)
- Eagle Ford (TX)
- Fayetteville (AR)
- Barnett (TX)
- Woodford (OK)
- Bakken (ND)
- Antrim (MI IN OH)

Source: EIA Natural Gas Weekly Update, 03 May 2018
©LNG Allies, 2018

U.S. Natural Gas Production, Consumption, Imports

trillion cubic feet per year

Source: EIA Annual Energy Outlook - 2018

©LNG Allies, 2018

US supply growing again; largest year-over-year gain in history

Source: S&P Global Platts Analytics

Source: Rick Allen, S&P Global Platts, The Energy Summit – COGA 2018 presentation, August 22, 2018
U.S. Natural Gas Production and Consumption

Source: EIA Annual Energy Outlook 2018 (Reference Case)

©LNG Allies, 2018
U.S. Natural Gas Production and Consumption

trillion cubic feet per year

Dry Gas Production
Domestic Consumption

Difference between production and consumption = volume available for export by LNG and pipeline.

Source: EIA Annual Energy Outlook 2018 (High Oil & Gas Case) ©LNG Allies, 2018
Domestic demand growth slows, global demand drives price and production

US Domestic Demand (2018-2023) +4.8 Bcf/d

US Export Demand (2018-2023) +10.3 Bcf/d

Source: Rick Allen, S&P Global Platts, The Energy Summit – COGA 2018 presentation, August 22, 2018
U.S. Natural Gas Consumption by Sector

trillion cubic feet per year (Tcf/y)

- Residential
- Commercial
- Industrial
- Transportation
- Electric Power
- Pipeline Exports (Net)
- LNG Exports (Net)

Source: EIA Annual Energy Outlook 2018 (Reference Case) ©LNG Allies, 2018
U.S. Natural Gas Pipeline Exports to Mexico

Million Cubic Feet

Source: U.S. Energy Information Administration

Source: www.eia.gov/dnav/ng/hist/n9132mx2m.thm accessed 08/20/2018
Major delays on Mexico’s interior gas pipelines

**Mexican Pipeline Construction Tracker**

<table>
<thead>
<tr>
<th>Pipeline</th>
<th>Import Corridor</th>
<th>Capacity MMcf/d</th>
<th>Original ISD</th>
<th>Estimated Start 6/1/2018</th>
<th>Days Delayed</th>
</tr>
</thead>
<tbody>
<tr>
<td>El Encino - La Laguna</td>
<td>West Texas</td>
<td>1,500</td>
<td>Apr-17</td>
<td>Mar-18</td>
<td>334</td>
</tr>
<tr>
<td>El Encino - Topolobampo</td>
<td>West Texas</td>
<td>670</td>
<td>Oct-16</td>
<td>Jun-18</td>
<td>608</td>
</tr>
<tr>
<td>Nueva Era</td>
<td>South Texas</td>
<td>504</td>
<td>Jun-17</td>
<td>Dec-18</td>
<td>548</td>
</tr>
<tr>
<td>Tula - Villa de Reyes</td>
<td>South Texas</td>
<td>886</td>
<td>Dec-17</td>
<td>Jul-18</td>
<td>212</td>
</tr>
<tr>
<td>La Laguna - Aguascalientes</td>
<td>West Texas</td>
<td>1,189</td>
<td>Dec-17</td>
<td>Nov-18</td>
<td>335</td>
</tr>
<tr>
<td>Villa de Reyes - Agus. - Guadalajara</td>
<td>West Texas</td>
<td>886</td>
<td>Dec-17</td>
<td>Nov-18</td>
<td>335</td>
</tr>
<tr>
<td>Samalayuca - Sasabe</td>
<td>West Texas</td>
<td>472</td>
<td>Jun-17</td>
<td>Nov-18</td>
<td>518</td>
</tr>
<tr>
<td>Sur de Texas - Tuxpan</td>
<td>South Texas</td>
<td>2,600</td>
<td>Jun-18</td>
<td>Oct-18</td>
<td>122</td>
</tr>
<tr>
<td>Tuxpan - Tula</td>
<td>South Texas</td>
<td>886</td>
<td>Mar-17</td>
<td>Dec-19</td>
<td>1,005</td>
</tr>
</tbody>
</table>

**Average Delay**

- 4.7 Bcf/d delayed downstream of West Texas
- 4.9 Bcf/d delayed downstream of South Texas
- Average delay over **400 days**
- Most new capacity delayed past 2018
- US pipeline exports will remain capacity constrained until 2019

Source: SENER, S&P Global Platts Analytics

Downstream constraints alleviated in 2019

Imports peak at ~4.9 Bcf/d in Oct-18
Imports peak at ~6.2 Bcf/d in Jul-19

Source: S&P Global Platts Analytics

Source: Rick Allen, S&P Global Platts, The Energy Summit – COGA 2018 presentation, August 22, 2018
## Permitting Status of U.S. LNG Export Projects

<table>
<thead>
<tr>
<th>Project Stage</th>
<th>Projects</th>
<th>MTPA</th>
<th>Bcm/yr</th>
<th>Bcf/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating / Under Construction</td>
<td>6</td>
<td>70.9</td>
<td>97.7</td>
<td>10.0</td>
</tr>
<tr>
<td>Fully Permitted (Major Projects)</td>
<td>4</td>
<td>68.9</td>
<td>95.0</td>
<td>9.7</td>
</tr>
<tr>
<td>Fully Permitted (Small Projects)</td>
<td>N/A</td>
<td>9.0</td>
<td>12.4</td>
<td>1.3</td>
</tr>
<tr>
<td>Formal FERC Review</td>
<td>11</td>
<td>146.9</td>
<td>202.6</td>
<td>20.9</td>
</tr>
<tr>
<td>FERC Pre-Filing</td>
<td>2</td>
<td>24.0</td>
<td>33.1</td>
<td>3.3</td>
</tr>
<tr>
<td>Total</td>
<td>23</td>
<td>310.7</td>
<td>428.5</td>
<td>44.0</td>
</tr>
</tbody>
</table>

Notes: (1) Projects = individual projects. (2) Additional trains for existing projects not included in the project count, but in the MTPA, Bcm/year, and Bcf/day totals (Sabine Pass #6, Corpus Christi #3, Cameron #4 #5, Freeport #4).

Source: Federal Energy Regulatory Commission & LNG Allies (17 April 2018) ©LNG Allies, 2018
Major U.S. LNG Export Projects - Existing & Proposed

Sources: LNG Allies, EIA, DOE (Dec. 2017)

©LNG Allies, 2017

High Utilization of US LNG Expected to Persist

US LNG Feedgas Capacity and Forecast

Source: S&P Global Platts Analytics

Latin America and Asia main markets US LNG

1,240 BCF US LNG exports shipped to 27 countries

37% to Americas
17% to India and Middle-East
36% to Asia
10% to Europe

*Numbers may not add up to 100% due to rounding

Source: S&P Global Platts Analytics

Source: Rick Allen, S&P Global Platts, The Energy Summit – COGA 2018 presentation, August 22, 2018
Asia Clearly Driving LNG Demand

LNG Demand in Asia expected to account for roughly 50% of the total LNG demand growth 2023 v 2018

Source: S&P Global Platts Analytics

Source: Rick Allen, S&P Global Platts, The Energy Summit – COGA 2018 presentation, August 22, 2018
China almost 30% of growth in global LNG demand (2018 to 2023)

Source: S&P Global Platts Analytics

Source: Rick Allen, S&P Global Platts, The Energy Summit – COGA 2018 presentation, August 22, 2018
North America LNG Outlook

- North America LNG supply competitive with rest of world for delivery to Asia
- Deliveries to Europe are competitive but margins are thinner
- Cost competitiveness is not the only factor in determining market share

**Asian Landed Cost by Export Location**

<table>
<thead>
<tr>
<th>Location</th>
<th>Hub Price</th>
<th>Pipeline Costs</th>
<th>Liquefaction Costs</th>
<th>Liquefaction Fuel</th>
<th>Shipping Costs</th>
<th>Estimate</th>
<th>JCC 2023 Proxy</th>
<th>JKM (Jul, 2018)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gulf Coast LNG</td>
<td>$8.51</td>
<td>$2.00</td>
<td>$0.52</td>
<td>$2.50</td>
<td>$0.15</td>
<td>$3.34</td>
<td></td>
<td>$8.76</td>
</tr>
<tr>
<td>Costa Azul</td>
<td>$8.83</td>
<td>$1.10</td>
<td>$0.68</td>
<td>$2.50</td>
<td>$1.68</td>
<td>$2.87</td>
<td></td>
<td>$8.26</td>
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<tr>
<td>Jordan Cove</td>
<td>$9.14</td>
<td>$0.96</td>
<td>$0.68</td>
<td>$2.88</td>
<td>$1.62</td>
<td>$2.88</td>
<td></td>
<td>$8.76</td>
</tr>
<tr>
<td>BC LNG</td>
<td>$9.83</td>
<td>$0.84</td>
<td>$0.78</td>
<td>$2.81</td>
<td>$2.40</td>
<td>$2.81</td>
<td></td>
<td>$9.26</td>
</tr>
<tr>
<td>Alaska LNG</td>
<td>$10.36</td>
<td>$0.84</td>
<td>$0.62</td>
<td>$4.75</td>
<td>$3.65</td>
<td>$4.75</td>
<td></td>
<td>$10.36</td>
</tr>
<tr>
<td>Russia</td>
<td>$8.76</td>
<td></td>
<td></td>
<td></td>
<td>$0.50</td>
<td>$0.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>East Africa</td>
<td>$9.26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$9.26</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: Landed cost components are based on projected average 2023 prices. Source: Platts Gas/LNG Daily, KM Analysis*
Projected Net North America LNG Exports

KM/ICF US
KM/ICF Can
Wood Mac N.A.
Wood Mac Can

N.A. expected to pick up 4-6 Bcf/d Between 2022 and 2027

Source: Greg Ruben, KinderMorgan, Colorado Oil and Gas Association Trade presentation, August 21, 2018
World LNG Estimated Landed Prices: May-18

Note: Includes information and Data supplied by IHS Global Inc. and its affiliates ("IHS"); Copyright (publication year) all rights reserved. Prices are the monthly average of the weekly landed prices for the listed month. Landed prices are based on a netback calculation.
Ruby Pipeline Map

- 680 miles of 42-inch Opal to Malin
- 1.3-1.5 Bcf/d expandable to 2.0 Bcf/d
- 1,440 psig MAOP
- Measurement – 8 locations
- 64%+/- Public Land
- 2 National Forests – Cache and Fremont
Uinta and Piceance to Pacific

Source: Veresen Corporate Presentation, November 2014
Pacific Connector Pipeline

Source: Oregon Green Energy Guide
Key L/T Fundamental Trends

- **Permian & NE Supply**
  - NE +17.1 Bcf/d
  - Permian +9.5 Bcf/d
  - DJ +3.4 Bcf/d

- **LNG Exports**
  - +11.2 Bcf/d

- **U.S. Power Gen Demand**
  - +9.4 Bcf/d

- **Continued supply increases**
  - U.S. becomes net exporter
  - More Gas-fired generation

- **U.S. Res/Ind Demand**
  - Ind +2.8 Bcf/d
  - Res +1.9 Bcf/d

- **Imports from Canada**
  - -1.4 Bcf/d

- **Exports to Mexico**
  - +3.0 Bcf/d

Source: ICF model with Kinder Morgan Assumptions

Source: Greg Ruben, KinderMorgan, Colorado Oil and Gas Association Trade presentation, August 21, 2018
Key Takeaways

• Forecasted North American production growth is highly dependent on global export markets; more exports to Mexico and LNG (10.3 Bcf/d) than organic demand growth in Canada and US (5.7 Bcf/d)

• Global demand for LNG continues growing; expect a “second wave” of LNG liquefaction capacity

• Gas infrastructure development is required to connect supply centers with emerging demand

• U.S. natural gas producers are dependent upon export growth

Source: Rick Allen, S&P Global Platts, The Energy Summit – COGA 2018 presentation, August 22, 2018
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