U.S. LNG Exports – Catch a Wave!

USEA 12th Annual Energy Supply Forum
Oct. 2, 2019
Shale Changes Everything
Permian, Utica, Marcellus Shale Gas Production

Source: EIA Natural Gas Weekly Update (07 Aug. 2019) ©LNG Allies, 2019
Monthly Henry Hub Spot Prices - Past 10 Years

$ per mmbtu

10 Yr. Average = $3.38/mmbtu

Source: EIA & Thomson Reuters (Data to June 2019)
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Will It (The Shale Revolution) Last?
Oil and Natural Gas Supply Categories

Stylized representation of oil and natural gas categorizations (not to scale)

- Remaining Oil & Natural Gas In-Place
- Technically Recoverable Resources
- Economically Recoverable Resources
- Proved Reserves
- Cumulative Production to Date

less certain   certainty of resource estimate   more certain

Source: U.S. Energy Information Administration  ©LNG Allies, 2019
U.S. Natural Gas Production and Consumption

Source: EIA Annual Energy Outlook - 2019 (Reference Case) ©LNG Allies, 2019
U.S. Natural Gas Production and Consumption

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

Source: EIA Annual Energy Outlook - 2019 (High Oil & Gas Case) ©LNG Allies, 2019
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 2019 (High Oil & Gas Case) ©LNG Allies, 2019
U.S. Natural Gas Price Forecasts (Henry Hub)

$2018 per mmbtu

$5.00

$4.00

$3.00

$3.00

$2.00

$1.00

HH Average (2009-2019) = $3.38/mmbtu

Reference Case

High Oil & Gas Case

2020

2025

2030

Source: EIA Annual Energy Outlook - 2019

©LNG Allies, 2019
U.S. LNG Export Industry
U.S. LNG Export Industry

- Eight major brownfield (import) terminals adding/planning liquefaction capabilities
- Another 20+ greenfield projects proposed
- Midstream players and special purpose entities; IOCs mostly offtakers not project sponsors (XOM, Total, minority owners)
## Permitting Status of Major 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>Permitted &amp; Under Construction</td>
<td>8</td>
<td>107.9</td>
<td>148.8</td>
<td>14.2</td>
</tr>
<tr>
<td>Permitted Pre-FID</td>
<td>6</td>
<td>101.5</td>
<td>140.0</td>
<td>13.4</td>
</tr>
<tr>
<td>Formal FERC Review</td>
<td>8</td>
<td>105.0</td>
<td>144.8</td>
<td>13.8</td>
</tr>
<tr>
<td>FERC Pre-Filing</td>
<td>4</td>
<td>61.0</td>
<td>83.6</td>
<td>8.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>26</strong></td>
<td><strong>375.4</strong></td>
<td><strong>517.3</strong></td>
<td><strong>49.4</strong></td>
</tr>
</tbody>
</table>

Notes: (1) Projects = individual projects. (2) Additional trains for existing projects not included in the project count, but in mtpa, bcm/year, and bcf/day totals (Sabine Pass #6, Cameron #4 #5, Freeport #4, Port Arthur #3 #4). (3) This table only includes projects with a liquefaction capacity of 1.0 mtpa or greater.

Major U.S. LNG Export Projects - Existing & Proposed

Includes Stage 3 - Pending at FERC (10.0 MTPA)

Sources: LNG Allies (30 Sept. 2019)

©LNG Allies, 2019
U.S. LNG Liquefaction Capacity Growth

U.S. LNG Exports
Top 12 U.S. LNG Export Destinations - July 2019

Source: DOE LNG Monthly (Data through July 2019) ©LNG Allies, 2019
Regional Distribution of U.S. LNG - Past 12 Months

Source: DOE LNG Monthly (Data through July 2019) ©LNG Allies, 2019
Environmental Benefits of U.S. Natural Gas
CO₂ Emissions from U.S. Electric Power Sector

Electric power sector CO₂ emissions have fallen in the USA as natural gas and renewables have grown in past ten years

Source: EIA Monthly Energy Review, July 2019
©LNG Allies, 2019
U.S. Electric Sector CO2 Reductions - Past 10 Years

million metric tons of CO2 reduced


Natural Gas Renewables

### Powerplant Air Emissions Comparison

<table>
<thead>
<tr>
<th>Tons per year per thousand households</th>
<th>Biomass (wood)</th>
<th>Coal</th>
<th>Natural Gas</th>
<th>Nuclear Renew.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Monoxide</td>
<td>CO</td>
<td>11</td>
<td>7.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>CO₂</td>
<td>14,264</td>
<td>9,832</td>
<td>4,076</td>
</tr>
<tr>
<td>Nitrogen Oxides</td>
<td>NOx</td>
<td>5.9</td>
<td>2.9</td>
<td>0.3</td>
</tr>
<tr>
<td>Particulate Matter</td>
<td>PM</td>
<td>0.73</td>
<td>0.48</td>
<td>0.17</td>
</tr>
<tr>
<td>Volatile Organic Comp.</td>
<td>VOC</td>
<td>0.15</td>
<td>0.14</td>
<td>0.17</td>
</tr>
<tr>
<td>Sulfur Dioxide</td>
<td>SO₂</td>
<td>0.0</td>
<td>4.77</td>
<td>0.03</td>
</tr>
<tr>
<td>Mercury</td>
<td>Hg</td>
<td>0.0</td>
<td>0.0001</td>
<td>0.0</td>
</tr>
</tbody>
</table>

- **Most Emissions**: Dark Red
- **Middle Emissions**: Blue
- **Least Emissions**: Light Green

Source: RW Beck | Emissions from Powerplant Operations Only ©LNG Allies, 2019
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