The LNG Industry: Redefined by North America

SPEE Houston Chapter Meeting
February 16, 2017

Dee Patterson
Moyes & Co
Key Points

- LNG is the fastest growing segment in the global energy business
  - Demand grows with supply
  - Increasing fungibility

- Significant new capacity recently added in Australia
  - Not all new capacity sold at startup

- Business transforming from “End User” buyer to “Trader” buyer

- US Unconventional Resource Plays drive North America into the LNG Export Business

- North America LNG Exports will be a disruptive to the Global LNG Industry

- It Will be good for LNG Consumers

- It Will be a threat for traditional LNG Producers

- It Will be a good business for US LNG Producers

- The LNG Offtake Owners have significant exposure

- ????? For North America Gas Producers
LNG History and Outlook

Source: IGU, EIA, Moyes data

1 BCFD ~ 7 MMTPA

5% CAGR

7% CAGR

9% CAGR

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Growing LNG Volumes Trading under Non Long Term Contracts

![Graph showing the growth of LNG volumes trading under non-long-term contracts from 1995 to 2015. The graph illustrates a significant increase in trading volumes, particularly a sharp rise around 2011. Source: IGU Data.]
Estimated Volume from Expiring LNG Contracts

Estimated 17 BCFPD of Contracts to Expire

Source: IGU Data

<table>
<thead>
<tr>
<th>Year</th>
<th>BCFPD</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>1.5</td>
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<td>2017</td>
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<td>2018</td>
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<td>2019</td>
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<tr>
<td>2023</td>
<td>2.2</td>
</tr>
<tr>
<td>2024</td>
<td>3.4</td>
</tr>
</tbody>
</table>
Japan LNG Prices vs HH Spot Prices
Global Estimated Landed LNG Prices
($/MMBTU)

- Lake Charles: 2.66 / 3.34
- Cove Point: 2.94 / 6.66
- Altamira: 3.17 / 7.94
- Bahia Blanca: 15.05 / 8.20
- Rio de Janeiro: 13.90 / 7.99
- UK: 8.67 / 5.86
- Spain: 10.24 / 6.76
- Belgium: 8.49 / 5.58
- Japan: 14.55 / 8.77
- Korea: 14.55 / 8.77
- India: 14.15 / 8.62
- China: 14.15 / 8.62

Source: Waterborne Energy / FERC

August 2012 / December 2016
Of the 44 proposed terminals, only 5-8 need to be built to meet the LNG import Demand. Aligning with the right LNG Project and securing off-take is the key for these projects to move forward.

Existing and Proposed North American LNG Terminals

- **Existing Terminals with Approved Expansions**
  - Everett, MA: 1.035 Bcf/d (Tractebel - DOMAC)
  - Cove Point, MD: 1.0 Bcf/d (Dominion - Cove Point LNG)
  - Elba Island, GA: 1.2 Bcf/d (El Paso - Southern LNG)
  - Lake Charles, LA: 1.2 Bcf/d (Southern Union - Trunkline LNG)

- **Approved Terminals**
  1. Hackberry, LA: 1.5 Bcf/d (Sempra Energy)
  2. Port Pelican: 1.6 Bcf/d (Chevron Texaco)*
  3. Bahamas: 0.84 Bcf/d (AES Ocean Express)*
  4. Gulf of Mexico: 0.5 Bcf/d (El Paso Energy Bridge GOM, LLC)
  5. Bahamas: 0.63 Bcf/d (Calypso Tractebel)*
  6. Freeport, TX: 1.5 Bcf/d (Cheniere/Freeport LNG Dev.)

- **Proposed Terminals and Expansions – FERC**
  7. Fall River, MA: 0.8 Bcf/d (Weaver's Cove Energy/ mess LNG)
  8. Long Beach, CA: 0.7 Bcf/d (Mitsubishi/ConocoPhillips – Sound Energy Solutions)
  9. Corpus Christi, TX: 2.6 Bcf/d (Cheniere LNG Partners)
  10. Sabine, LA: 2.6 Bcf/d (Cheniere LNG)
  11. Corpus Christi, TX: 1.0 Bcf/d (Vista Del Sol – ExxonMobil)
  12. Sabine, TX: 1.0 Bcf/d (Golden Pass - ExxonMobil)
  14. Lake Charles, LA: 0.6 Bcf/d (Southern Union – Trunkline LNG)
  15. Bahamas: 0.5 Bcf/d (Seabank - El Paso/PLL)
  16. Corpus Christi, TX: 1.0 Bcf/d (Occidental Energy Ventures)
  17. Providence, RI: 0.5 Bcf/d (Keyspan & BG LNG)
  18. Port Arthur, TX: 1.5 Bcf/d (Sempra)

- **Proposed Terminals – Coast Guard**
  19. California Offshore: 1.5 Bcf/d (Cabrillo Port – BHP Billiton)
  20. Louisiana Offshore: 1.0 Bcf/d (Gulf Landing – Shell)
  21. So. California Offshore: 0.5 Bcf/d (Crystal Energy)
  22. Louisiana Offshore: 1.0 Bcf/d (Main Pass McAslan Exp.)
  23. Gulf of Mexico: n/a (Compass Port - ConocoPhillips)

- **Planned Terminals and Expansions**
  - Brownsville, TX: n/a (Cheniere LNG Partners)
  - Mobile Bay, AL: 1.0 Bcf/d (ExxonMobil)
  - Somerset, MA: 0.65 Bcf/d (Somerset LNG)
  - Belmar, NJ Offshore: n/a (El Paso Global)
  - Altamira, Tamulipas: 1.12 Bcf/d (Shell)
  - Baja California, MX: 1.0 Bcf/d (Sempra & Shell)
  - Baja California - Offshore: 1.4 Bcf/d (Chevron Texaco)
  - California - Offshore: 0.75 Bcf/d (Chevron Texaco)
  - St. John, NB: 0.5 Bcf/d (Cananda – Irving Oil)
  - Point Tupper, NS: 1.0 Bcf/d (Bear Head LNG – Access Northeast Energy)
  - Pleasant Point, ME: 0.5 Bcf/d (Quaddy Bay, LLC)
  - Quebec City, QC: n/a (Enbridge/Gaz Met/Gaz de France)
  - Lázaro Cárdenas, MX: 0.5 Bcf/d (Tractebel/Repsol)
  - Gulf of Mexico: 1.0 Bcf/d (Pearl Crossing - ExxonMobil)
  - Mobile Bay, AL: 1.0 Bcf/d (Cheniere LNG Partners)
  - St. Helens, OR: 0.7 Bcf/d (Port Westward LNG LLC)
  - Cove Point, MD: 0.5 Bcf/d (Dominion)
  - Puerto Libertad, MX: 1.3 Bcf/d (Sonora Pacific LNG)
  - Offshore Boston, MA: 0.8 Bcf/d (Northeast Gateway – Excelerate Energy)
  - Kitimat, BC: 0.54 Bcf/d (Galveston LNG)
  - Prince Rupert, BC: 0.30 Bcf/d (WestPac Terminals)

*US pipeline approved: LNG terminal pending in Bahamas

Office of Energy Projects
Japan LNG Prices vs HH Spot Prices

$/MMBTU


Japan LNG  Henry Hub

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New LNG Capacity will rotate from Australia Centric to US Centric

Global Nameplate Capacity
YE 2015: 44 BCFD
YE 2020: 63 BCFD
LNG Export Facilities Have a Global Reach

![World map showing LNG export facilities]

**Recently Completed Projects**

<table>
<thead>
<tr>
<th>Project</th>
<th>Year</th>
<th>Capacity (MMTPA)</th>
<th>Total Project Cost ($BN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNG LNG</td>
<td>2014</td>
<td>6.9</td>
<td>19.0</td>
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<tr>
<td>QCLNG</td>
<td>2015</td>
<td>8.5</td>
<td>23.7</td>
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<tr>
<td>Gorgon T1/T2</td>
<td>2016</td>
<td>10.4</td>
<td>54.0</td>
</tr>
<tr>
<td>AusPac LNG</td>
<td>2016</td>
<td>9.0</td>
<td>24.7</td>
</tr>
<tr>
<td>Gladstone</td>
<td>2016</td>
<td>7.8</td>
<td>21.6</td>
</tr>
<tr>
<td>Sabine Pass T1/T2</td>
<td>2016</td>
<td>9.0</td>
<td>22.5</td>
</tr>
</tbody>
</table>
Sabine Pass LNG  Re-Purpose LNG Import Terminal
Reduces Cost

Current Facility
- ~1,000 acres in Cameron Parish, LA
- 40 ft. ship channel 3.7 miles from coast
- 2 berths; 4 dedicated tugs
- 5 LNG storage tanks (~17 Bcf of storage)
- 5.3 Bcf/d of pipeline interconnection

Liquefaction Trains 1 – 5: Fully Contracted
- Lump Sum Turnkey EPC contracts w/ Bechtel
- T1 & T2 EPC contract price ~$4.1B
  - Overall project ~95% complete (as of 9/2015)
  - Operations estimated late 2015/2016
- T3 & T4 EPC contract price ~$3.8B
  - Overall project ~74% complete (as of 9/2015)
  - Operations estimated 2016/2017
- T5 EPC contract price ~$3.0B
  - Construction commenced June 2015

Liquefaction Train 6
- FID upon obtaining commercial contracts and financing

Design production capacity is expected to be ~4.5 mtpa per train, using ConocoPhillips’ Optimized Cascade® Process

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LNG Plant Costs

Source: WoodMac
US LNG Export Projects

- 65 MMTPA of capacity being constructed for export
  - 59 MMTPA (8.5 BCFD) has been contracted via takeoff agreements
  - Additional ~34 MMTPA (4.8 BCFD) approved by FERC not currently under construction
  - Pending applications account for additional ~70 MMTPA (10 BCFD) of export volumes
US Liquefaction Projects

- **Corpus Christi LNG**
  - 2 Trains 9 MMTPA
  - $8.4B
  - Offtake: Pertamina, Endesa, Iberdrola, GNF, Woodside, EDF

- **Sabine Pass**
  - 5 Trains 22.5 MMTPA
  - $15.6B
  - Offtake: BG, GNF, KOGAS, GAIL, TOTAL, Contixo

- **Cameron LNG**
  - 3 Trains 12 MMTPA
  - $10B
  - Offtake: GDF Suez, Mitsubishi, Sempra

- **Magnolia LNG (Lake Charles)**
  - 4 Trains 8 MMTPA
  - $4.4B
  - Offtake: Meridian (UK), GNF, LNG Holdings, AES LA, Brightshore

- **Golden Pass LNG**
  - 3 Trains 15.6 MMTPA
  - $10B
  - Offtake: Exxon (South Hook UK), Qatar

- **Southern LNG**
  - 1 Train 2.5 MMTPA
  - $1.5B
  - Offtake: Shell

- **Cove Point**
  - 1 Train 5.25 MMTPA
  - $3.8B
  - Offtake: Sumitomo, GAIL

- **End users account for only 1/3 of contracted U.S. volumes currently under construction**
US Natural Gas Supply & Demand

2016 EIA Annual Energy Outlook Reference Case

Estimated surplus of 10 BCFD by 2020 (Net Exports)
Sabine Pass Economics

- 1-7 Year gas supply agreements averaging $-0.10 discount to Henry Hub
  - Supply contracts currently cover about 50% of required supply for trains 1-4
- LNG sold to customer at 115% of Henry Hub price
- Customers provide annual fixed fees ranging from $274MM - $723MM ($2.78/MMBTU Avg)
- LNG supply contracts are for 20 years (“Take or Pay”)
LNG Plant Tolling Fees needed to earn a 10% Pre-Tax IROR

- Cheniere appears to be structuring fixed capacity fees to receive 10% pre tax ROR on liquefaction capital

<table>
<thead>
<tr>
<th>Project</th>
<th>MMTPA</th>
<th>$/MMBTU Fixed Fee</th>
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</thead>
<tbody>
<tr>
<td>Magnolia</td>
<td>8.0</td>
<td>2.50</td>
</tr>
<tr>
<td>Sabine Pass</td>
<td>22.5</td>
<td>2.78</td>
</tr>
<tr>
<td>Cove Point</td>
<td>5.25</td>
<td>2.90</td>
</tr>
<tr>
<td>Cameron</td>
<td>12.0</td>
<td>3.34</td>
</tr>
<tr>
<td>Freeport</td>
<td>13.9</td>
<td>4.04</td>
</tr>
<tr>
<td>QC LNG</td>
<td>8.5</td>
<td>4.41</td>
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<tr>
<td>Gladstone</td>
<td>7.8</td>
<td>4.81</td>
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<tr>
<td>AUSPAC</td>
<td>9.0</td>
<td>5.51</td>
</tr>
<tr>
<td>Ichthys</td>
<td>8.9</td>
<td>5.86</td>
</tr>
<tr>
<td>Gorgon</td>
<td>15.6</td>
<td>7.31</td>
</tr>
</tbody>
</table>

*Only considers estimated liquefaction capital for Australian projects*
Australian LNG Project Economics
Full Cycle, After Tax, Pre Transportation, LNG Only

*Liquids not considered in analysis
Estimated LNG Shipping Costs
($/MMBTU)

Basic Assumptions (Jan. 2017):
$50/BBL Fuel Costs
155,000 m³ ship capacity
$40,000/day charter rate
Includes boiloff, maintenance etc

Source: Moyes & Co. Estimates
HH LNG delivered to Europe vs Europe Prices

Assumes $1.25/MMBTU for transportation, regas etc.
HH LNG Delivered to Japan vs Japan LNG Prices

Assumes $2.25/MMBTU for transportation, regas etc.
LNG Competitiveness against Futures Pricing

At present, US cargoes should target Asian markets (Buyers?)

Europe Gas Futures Strip is +/- $2.00 Less than HH LNG to Europe Futures Strip

Marginal Cost is Less $2.78 Fixed Capacity Charge

Feb. 1, 2017 Futures Strips
European Natural Gas Snapshot

- 2015 Production: 11.4 BCFD
- 2015 Net Imports: 27.1 BCFD
- 2015 Consumption: 38.5 BCFD

- Russia/Norway account for approximately 75% of EU imports in 2015 or 20 BCFD
- Security and pricing worries, particularly regarding reliance on Russian imports
Assuming $3.00/MMBTU HH Gas, Sabine Pass Pricing/Fee Structure

<table>
<thead>
<tr>
<th>Henry Hub Price ($/MMBTU)</th>
<th>Price at Plant Outlet ($/MMBTU)</th>
<th>Delivered EU Price ($/MMBTU)</th>
<th>Differential to HH ($/MMBTU)</th>
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<tr>
<td>2.00</td>
<td>5.08</td>
<td>6.33</td>
<td>4.33</td>
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<td>3.00</td>
<td>6.23</td>
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<td>4.00</td>
<td>7.38</td>
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<td>5.00</td>
<td>8.53</td>
<td>9.78</td>
<td>4.78</td>
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<td>6.00</td>
<td>9.68</td>
<td>10.93</td>
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<td>7.00</td>
<td>10.83</td>
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<td>5.08</td>
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<td>8.00</td>
<td>11.98</td>
<td>13.23</td>
<td>5.23</td>
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2016 EU Gas Prices ($/MMBTU)

<table>
<thead>
<tr>
<th>Month</th>
<th>UK NBP</th>
<th>RU - GER</th>
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<tbody>
<tr>
<td>January</td>
<td>4.68</td>
<td>5.09</td>
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<tr>
<td>February</td>
<td>4.24</td>
<td>4.79</td>
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<tr>
<td>March</td>
<td>3.98</td>
<td>4.09</td>
</tr>
<tr>
<td>April</td>
<td>4.00</td>
<td>4.02</td>
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<tr>
<td>May</td>
<td>4.48</td>
<td>3.99</td>
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<tr>
<td>June</td>
<td>4.86</td>
<td>4.04</td>
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<tr>
<td>July</td>
<td>4.95</td>
<td>4.30</td>
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</table>

Assumes $1.25/MMBTU for transportation, regas etc.

At $3.00/MMBTU HH gas, Cheniere can theoretically deliver LNG into Europe for as low as ~$4.25/MMBTU as a result of the take or pay style contracts. Is this situation likely to happen?
U.S. LNG Export Snapshot

- US LNG volumes are tied up in long-term “take or pay” style contracts with little to no spare capacity available for dedicated short-term or spot deliveries.
- 65% of contracted volumes taken by marketers, not end users.
- Some purchasers such as BP, Woodside and Shell have significant investments in other LNG ventures.
- Gas going to Europe is being marketed by these buyers who are paying the contracted prices for these volumes.

## Contracted Volumes

<table>
<thead>
<tr>
<th>Location</th>
<th>Volumes (BCFD)</th>
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<tr>
<td>Sabine Pass</td>
<td>~8.5</td>
</tr>
<tr>
<td>Cameron</td>
<td></td>
</tr>
<tr>
<td>Freeport</td>
<td></td>
</tr>
<tr>
<td>Cove Point</td>
<td></td>
</tr>
<tr>
<td>CC LNG</td>
<td></td>
</tr>
<tr>
<td>Southern (Elba)</td>
<td></td>
</tr>
</tbody>
</table>

## Spare Capacity

- ~8.5 BCFD (100% utilization)
- 0.9 BCFD (90% utilization)
- 0 BCFD (0 BCFD)

## Spot Markets, Short Term Contracts

### US LNG Contract Buyers

<table>
<thead>
<tr>
<th>Company</th>
<th>End User</th>
<th>Marketer</th>
<th>Volume (BCFD)</th>
</tr>
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<tbody>
<tr>
<td>BG Group</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Gas Natural Fenosa</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Kogas</td>
<td>x</td>
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<td>0.5</td>
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<tr>
<td>GAIL Limited</td>
<td>x</td>
<td></td>
<td>0.9</td>
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<tr>
<td>Total</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Centrica</td>
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<td>GDF Suez (Engie)</td>
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<tr>
<td>Mitsubishi/Mitsui</td>
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<td>BP</td>
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<td>Osaka Gas</td>
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<td>Chubu Electric</td>
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<tr>
<td>Pacific Summit (Sumitomo)</td>
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<td>Pertamina</td>
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<td>Shell</td>
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<td>EDF</td>
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<tr>
<td><strong>Totals</strong></td>
<td>7</td>
<td>13</td>
<td>3.0 5.6</td>
</tr>
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[www.moyesco.com](http://www.moyesco.com)
European Market with U.S. LNG Exports

- Significant price and market share disruptions not foreseen as a result of US LNG
- Threat of US LNG imports may help stabilize prices, setting a soft floor/ceiling
  - Lithuania and Poland use construction of LNG regas facilities as leverage in price negotiations with Russia
- Offtakers unlikely to forego contracted volumes unless Asian and EU prices drop and remain very low
  - Russian oil linked gas contracts
  - Low coal prices
- Upcoming US projects have minimal spare capacity available for dedicated spot and short-term cargoes
- South American markets currently more attractive for U.S. spot cargoes that do become available
  - Estimated Landed LNG prices currently $1.00 – 1.50/MMBTU more in South America
- Decreased demand in Asia may free up more cargoes that could find their way to Europe
- European regasification and pipeline infrastructure not well distributed, hard to access Eastern Europe with U.S. volumes
Conclusions

- LNG is now a global commodity business with changing dynamics
  - LNG Demand is expected to grow at 9%/yr for next several years
  - Increasing fungibility of LNG
  - Increased short term contracts

- Major LNG Markets:
  - Asia- Provide basic fuel for power generation and heating.
  - Europe- Alternative to Russian Gas
  - South America- Back-up gas supply

- New LNG projects in Australia suffered from major cost overruns resulting in high cost supply.
  - Projects may face financial impairments (e.g. Gladstone)
  - Significant uncontracted volumes

- North America will become a major force in the LNG Industry
  - Offtake volumes secured from Credit Worthy Buyers
  - Will quickly become No.3 supplier?
  - Delay or Mothballing of “New Projects”

- North America LNG will disrupt traditional price indexing basis

- North America LNG will harmonize LNG pricing for new global contracts

- Offtake Contractors carry significant risk
  - Traders cannot force high cost gas to consumers
  - Higher cost than alternative supplies at Futures Based Pricing

- Will it have an impact on North America Natural Gas Prices?
Sabine Pass

- First of new U.S. projects to come online
- 27 MMTPA eventual nameplate capacity, 6 Trains
- Plant received first gas in late 2015
- First LNG cargo 1Q 2016
- Train 2 now operational
## Sabine Pass 2016 Cargoes

<table>
<thead>
<tr>
<th>Date of Departure</th>
<th>Name of Exporter</th>
<th>Supplier</th>
<th>Docket Number</th>
<th>Country of Destination</th>
<th>Name of Tanker</th>
<th>Departure Terminal</th>
<th>Volume (Mcf of Natural Gas)</th>
<th>Price at Export Point ($/MMBtu)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/24/2016</td>
<td>Sabine Pass Liquefaction, LLC</td>
<td>Sabine Pass Liquefaction, LLC</td>
<td>15-171-LNG</td>
<td>Brazil</td>
<td>Asia Vision</td>
<td>Sabine Pass Liquefaction, LLC</td>
<td>1,993,109</td>
<td>$3.35</td>
<td>[S] [C]</td>
</tr>
<tr>
<td>3/15/2016</td>
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<td>Sabine Pass Liquefaction, LLC</td>
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<td>Brazil</td>
<td>Gaslog Salim</td>
<td>Sabine Pass Liquefaction, LLC</td>
<td>2,843,675</td>
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US LNG Into Europe – What They’re Saying

“It’s the start of the price war between US LNG and pipeline gas,” said Thierry Bros, an analyst at Société Générale, quoted by the WSJ.

“LNG coming out of the U.S. is probably the single most important thing that will transform the future LNG market,” Melissa Stark, energy managing director and global LNG lead at Accenture, said by e-mail. “It heralds the arrival of a global market.”

Wood Mackenzie said in a report in March that Russia’s export strategy has a major influence, however, prices of other commodities like oil and coal are more likely to have a stronger effect on US LNG exports. Coal prices could have the most impact since it “will determine European spot prices through coal-gas switching in the power sector.”

“U.S. LNG supply to Europe may have strong geopolitical symbolism, but its current volume impact will be negligible, until the big volumes come on stream in 2018-19, and cargoes will probably go to higher value markets in Latin America and elsewhere,” Jonathan Stern, chairman and founder of the natural gas research program at the Oxford Institute for Energy Studies, said by e-mail.