The Global Context for Alaskan Oil and LNG

PRESENTED TO
LSI Energy in Alaska Conference

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December 12, 2016
Agenda

- What’s changed since last year?
- The evolution of oil & gas prices
  - Is “the gap” still important for LNG economics?
- Prospects for global LNG trade now that the U.S. is exporting
  - Long term LNG supply and demand forecasts
- LNG and renewables
- The global positioning of Alaska LNG
- Key indicators to watch going forward
What’s changed since last year?

- An OPEC agreement to cut oil production
- US shale production costs have continued to decline
- New Australian and US Gulf Coast LNG exports are a reality
  - Global LNG market is glutted
  - Spot LNG prices have fallen further putting new LNG project economics “under water”
- New LNG project FID’s delayed in US and Canada
- Majors have backed away from the Alaska LNG project and the State has stepped forward
Oil Prices – will they recover?

- OPEC cut is interesting in the short run, but faces significant headwinds in the longer run
  - Even if successful, the volume of cuts is relatively insignificant
  - Inventories have grown tremendously and cuts may (or may not) be offset by withdrawal from storage
  - Success of OPEC deal will depend on non-OPEC supply response (including Russia) and global demand response
  - Higher prices will induce greater US shale production

- US shale marginal costs of production support continued development at prices >= $30/bbl
The Economist cover Dec 5, 2014
Non-OPEC production growth swamps OPEC cut

OPEC's struggle

The Organization of the Petroleum Exporting Countries agreed in Algeria on Sept. 28 to limit supply, with special conditions given to Libya, Nigeria and Iran, whose output has been hit by wars and sanctions. OPEC ministers met in Vienna on Nov. 30 and agreed to curb production by around 1.2 million barrels per day from January, in the first output cut since 2008.

Crude oil inventories are impressively high

U.S. Commercial Crude Oil Stock
(million barrels)

Source: Short-Term Energy Outlook, August 2016

Note: Colored band around storage levels represents the range between the minimum and maximum from Jan. 2011 - Dec. 2015.
U.S. shale oil cost of production has continued to fall

The Falling Cost of US Shale Oil Production, 2013 to 2016

Wellhead Breakeven Price ($/bbl)

Source: Reuters.

The oil supply curve does not support high future prices

Source: https://www.ft.com/content/0a7a817a-4863-11e6-8d68-72e9211e86ab
Oil/gas prices and LNG economics

- It used to be conventional wisdom that the larger the “gap” between oil and natural gas prices, the better the economics of new LNG projects
  - Price available for incremental LNG (in Asia) was defined by the next best alternative (oil for power generation)
  - Long term LNG contracts were priced in relation to oil (JCC)
  - The post-financial crisis “gap” spawned a glut of new liquefaction

- The “gap” has now been closed for several years and world LNG prices have converged in the face of the LNG supply increase
  - What role will oil prices play (if any) in future LNG economics?
  - Will oil-linkage continue to be used for long-term LNG contracting?

- Future LNG projects will compete on the basis of feedstock gas supply economics, infrastructure costs, and distance to market
The oil/gas price “gap” has closed

Crude Oil vs. Henry Hub vs. U.K. NBP
Prompt Month Prices
January 2000 - November 30, 2016

Source: The Brattle Group, data sourced from Bloomberg and EIA.
Asian LNG prices have also collapsed

Before the Collapse

Natural Gas Overview: World LNG Prices

Federal Energy Regulatory Commission • Market Oversight • www.ferc.gov/oversight

World LNG Estimated November 2013 Landed Prices

Source: Waterborne Energy, Inc. Data in SUS/MMBtu

Updated: October 7, 2013

After the collapse

World LNG Estimated Landed Prices: Oct-16

Source: Waterborne Energy, Inc. Data in SUS/MMBtu. Landed prices are based on a netback calculation. 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.
Wood Mac’s view of LNG economics

Estimated Delivered Breakeven Cost for pre-FID projects (to North Asia) Vs. Asian DES Price Range at $70/bbl

Notes:
Breakeven costs are calculated on the basis of a 12% return
UG Gulf Coast (USGC) LT HH ~$3.41 avg real price 2019-2030; gas cost is grossed up at 15% for losses etc

Near-term LNG oversupply

- Global LNG markets are oversupplied
- LNG exports from the US started in 2016
- Increase in LNG exports from new Australian/Papua New Guinea projects (up to 5 Bcf/d will come on-line between 2017-2018)
- Sharp slowdown in Chinese demand growth
- No growth/reduction in Japanese and Korean demand, in part due to nuclear fleet restart
- Some evidence that certain buyers have over-committed to long-term contracts, hence cargo redirections and contract on-sales
- Apparent slowdown in long-term contracting for new supplies
- Five LNG export projects have been canceled or suspended in 2014-2015 (9 Bcf/d) and one plant has been switched off (3.3 Bcf/d); in 2016, Jordan Cove became the first LNG export project to be denied a permit by FERC
Exports of U.S. Gulf Coast LNG began in 2016

Source: Platts Analytics’ Bentek Energy
Spot and short-term LNG trades increasing rapidly

- Many players in LNG markets are looking to procure flexible volumes of LNG, resulting in a large increase in short to medium-term duration portfolio deals

- Global spot and short-term trades
  - 9.2 Bcf/d in 2014
  - 29% of total trade
  - 7% increase from 2013 to 2014

- Main sources of spot and short-term LNG
  - Middle East (43%)
  - Atlantic Basin (36%)
  - Asia Pacific (21%)

- Several Asian countries (Japan, China, Singapore) are contemplating trading hubs
And new project economics are “under water’

**US Gulf Coast Project:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Range</th>
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<tbody>
<tr>
<td>HH Price</td>
<td>$2.00 – $4.00/MMBtu</td>
</tr>
<tr>
<td>115% HH</td>
<td>2.30 – 4.60</td>
</tr>
<tr>
<td>Liquefaction cost</td>
<td>3.00 – 3.50</td>
</tr>
<tr>
<td>Transport to Asia</td>
<td>2.30 – 2.30</td>
</tr>
<tr>
<td>Delivered price</td>
<td>$7.60 - $10.40/MMBtu</td>
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**New LNG spot/contract prices**  $5.00 - $7.00/MMBtu

Deliveries will continue to be made from completed projects even if fixed liquefaction costs are not fully recovered, but new projects will not be forthcoming.
WEO gas forecast by region (New Policies Scenario) shows predominant growth in China, Middle East, Africa and India

Gas demand growth to 2040 expected to be particularly strong in China (40 Bcf/d), the Middle East (35 Bcf/d), Africa (18 Bcf/d), and India (13 Bcf/d)

- Expected to decline in Japan and Russia
  - Japan: nuclear restarts reducing reliance on natural gas imports

- Europe forecasted to grow but at a much slower pace

- LNG market growth likely to depend heavily on China and India demand growth

- Gas demand growth remains highly uncertain and can be met by indigenous production, pipeline imports, and/or LNG imports
China has competitive alternatives for its supply

- Natural gas demand has grown 10x between 1995 and 2014
- Future Russian pipeline gas imports:
  - In May 2014, a 30-year deal was signed with Russia for ~3.7 Bcf/d (beginning 2019) through the “eastern route”
  - In May 2015, a 30-year HOA was signed with Russia for ~3.0 Bcf/d through the “western route,” but there are now indefinite delays due to a decline in Chinese pipeline gas demand
- Domestic production (under the WEO New Policies Scenario)
  - Conventional gas output to remain between 7.7-9.7 Bcf/d
  - Shale gas production expected to increase to 8.7 Bcf/d by 2040
  - Other unconventional gas sources (e.g. tight gas, coalbed methane, coal-to-gas projects) projected to produce between 4.4-6.3 Bcf/d by 2040
- LNG options
  - China LNG imports from Australia set to increase by ~2.0+ Bcf/d by 2017
  - Russian LNG also an alternative
Cost of wind generation at high capacity factor is already competitive with generation using LNG in China

Breakeven Analysis for Wind Renewables and Gas-Fired Combined Cycle in China
Based on Forecasted Delivered Cost of LNG from US to China

Source: Brattle Group analysis.
Cost of PV is not competitive with generation using LNG currently in China, but could change by 2025

Breakeven Analysis for Solar Renewables and Gas-Fired Combined Cycle in China
Based on Forecasted Delivered Cost of LNG from US to China

Source: Brattle Group analysis.
Status of proposed new LNG projects outside the U.S.

**Australia/Papua New Guinea**
- 5 Bcf/d of LNG export projects under construction (with on-line dates 2017-2018)
- Large projects (capital costs of $30-$60 billion per project)
  - Projects facing substantial cost overruns
  - Not all fully subscribed (e.g., Gorgon LNG)
  - Asian buyers looking for cheaper alternatives
- 6 Bcf/d proposed
- 8 Bcf/d currently operational

**Canada**
- 44 Bcf/d of proposed LNG export projects
  - Most in British Columbia; some in Nova Scotia and Quebec
- None under construction
- Chinese companies participating in some Canadian projects
  - PetroChina (LNG Canada), Sinopec (Pacific NorthWest LNG), CNOOC (Aurora LNG)
- Government announced tax breaks for LNG development in Feb 2015

**Africa**
- Large gas fields offshore East Africa
  - Mozambique (250 trillion cubic feet)
  - Tanzania (30 trillion cubic feet)
- Andarko and Eni have plans to build four Mozambique LNG plants with 30 million tons of annual production
- Asian governments (Thailand, India, Japan, and others) are securing early stakes in East African projects
Status of proposed U.S. projects ~56.0 Bcf/d

Most (50.2 Bcf/d) proposed in the Gulf Coast
- 2.4 Bcf/d East Coast, 1.2 Bcf/d West Coast, 2.6 Bcf/d project in Alaska

5 plants under construction (Sabine Pass, Freeport, Cameron LNG, Cove Point, and Corpus Christi)

11 (15.2 Bcf/d) with DOE approval for exports to non-FTA countries
- Sabine Pass (4.1 Bcf/d), Freeport (1.8 Bcf/d), Lake Charles (2.0 Bcf/d), Cameron (3.5 Bcf/d), Cove Point (0.8 Bcf/d), Jordan Cove (0.8 Bcf/d), Carib Energy (0.04 Bcf/d), Corpus Christi (2.1 Bcf/d), American LNG Marketing (0.01 Bcf/d), Floridian Natural Gas Storage Company (0.04 Bcf/d), and Flint Hills (0.01 Bcf/d).

8 (15 Bcf/d) with FERC approval
- Sabine Pass (2.8 Bcf/d), Freeport (2.1 Bcf/d), Cameron (3.5 Bcf/d), Dominion Cove Point (0.8 Bcf/d), Corpus Christi (2.1 Bcf/d), Lake Charles (2.2 Bcf/d), Magnolia (1.1 Bcf/d), Southern LNG (0.4 Bcf/d)

The first US LNG exports began in early 2016 (Cheniere)
To what extent will global demand call for additional export capacity?

Global LNG Export Capacity and Demand: Current and Forecasted

Source and Notes:
2015 Existing Export Capacity - Data sourced from © OECD/IEA 2016 World Energy Outlook. IEA Publishing. License: http://www.iea.org/tbs/termsandconditions/, Figure 4.1.
2025 Existing Demand - Data sourced from GRIIGNL Annual Report - 2016 Edition
2025 Low Demand Forecast - Data sourced from McKinsey Energy Insights (June 2015); assumes no additional demand from Europe from 2015 levels and low Asian demand growth.
2025 High Demand Forecast - Data sourced from OIES (July 2015); assumes high Chinese LNG demand, base case European demand, Russia supports European hub prices, no oil price collapse.
Key risk factors for Alaska LNG

- Project cost
- Insufficient demand growth post-2020 to rebalance the market
  - China/India uncertainties
  - Climate policy and renewables
- Supply competition
  - Ability of US Gulf Coast and Australian projects to expand cheaply
  - Pipeline substitutes for LNG in key markets (e.g., China)
  - Indigenous shale gas production growth in Asia
  - Technology – small-scale floating LNG
  - Will Alaska project be sufficiently “inframarginal” that customers will be willing to commit to LT contracts in advance of construction?

- Higher US domestic gas price is unambiguously good for Alaska LNG
Wood Mac’s view of LNG economics

Estimated Delivered Breakeven Cost for pre-FID projects (to North Asia) Vs. Asian DES Price Range at $70/bbl

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Key Indicators to Watch Going Forward

- Lower-48 gas production, Gulf Coast exports, and the evolution of Lower-48 prices (higher prices are better for Alaska)

- Does a sustained LNG glut and low oil-price/high feedstock gas-price environment result in a moratorium on new competing LNG projects, including expansions?

- Will China’s economy grow sufficiently to drive post-2020 demand for gas/LNG?

- Will a change in climate and renewables policies affect the global demand for gas/LNG?

- Can the Alaska project’s capital costs be controlled sufficiently to make it economic relative to competing projects and expansions?
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- Market Design and Competitive Analysis

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