The Global Context for Alaskan Oil and LNG

PRESENTED TO

LSI Energy in Alaska Conference

PRESENTED BY

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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.



Source: http://fingfx.thomsonreuters.com/gfx/rngs/OPEC-MEETING/010021V94JT/index.html

Crude oil inventories are impressively high

U.S. Commercial Crude Oil Stock

(million barrels)



eja 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.

Source: An Early Christmas Present for Shale Producers: The New Economics of Oil Will Prevail, Notes at the Margin, Volume XX, No. 49, December 5, 2016.

The oil supply curve does not support high future prices



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



Source: Kah, Marianne, "World Oil & Gas Markets – Impact on Alaska," ConocoPhillips, data sourced from Bloomberg.

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 \$US/MMBtu

October 2013

Updated October 7, 2013

Accessed at https://www.ferc.gov/market-oversight/mkt-gas/overview/2013/10-2013-ngas-ovr-archive.pdf on December 4, 2015

After the collapse

National Natural Gas Market Overview: World LNG Landed Prices

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

World LNG Estimated Landed Prices: Oct-16



Source: Waterborne Energy, Inc. Data in \$US/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.

Updated: Nov-16

Wood Mac's view of LNG economics



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

CHENIERE ENERGY'S EXPORTS FROM SABINE PASS TERMINAL



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





Spot & Short-Term Flows by Exporting Region

And new project economics are "under water'

US Gulf Coast Project:

Delivered price	\$7.60 - \$10.40/MMBtu
Transport to Asia	2.30 - 2.30
Liquefaction cost	3.00 - 3.50
115% HH	2.30 - 4.60
HH Price	\$2.00 – \$4.00/MMBtu

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

Natural Gas Demand by Region in WEO Reference Case: New Policies Scenario (Bcf/d)

Region/Country	2014	2020	2025	2030	2040	2025 Demand less 2014 Demand	2040 Demand less 2014 Demand
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Americas	91	96	98	100	108	7	17
United States	73	77	78	79	81	5	8
Europe	45	48	50	50	50	5	5
Asia Oceania	21	20	19	20	20	(2)	(1)
Japan	12	10	9	9	9	(3)	(3)
OECD	157	164	167	171	177	10	20
E. Europe/Eurasia	64	63	64	66	70	1	7
Russia	44	42	42	42	43	(2)	(0)
Asia	47	61	75	90	118	28	71
China	18	29	37	46	59	19	40
India	5	6	9	12	18	4	13
Middle East	43	49	55	64	78	12	35
Africa	13	14	17	20	30	4	18
Latin America	16	16	17	19	26	1	10
Non-OECD	182	203	228	259	322	46	141
World	339	367	395	429	500	57	161

Sources and Notes:

The Brattle Group.

[2] - [6]: © OECD/IEA 2016 World Energy Outlook, IEA Publishing. License: http://www.iea.org/t&c/termsandconditions/. 🗆

[8]: [6] - [2]

The New Policies Scenario takes account of policy plans and commitments announced by countries, regardless of the degree of implementation of these plans.

- 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

^{[7]: [4] - [2]}

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, coalto-gas projects) projected to produce between 4.4-6.3 Bcf/d by 2040



China's Production and Consumption of Natural Gas (2006-2014)

Sources: The Brattle Group, data sourced from BP Statistical Review of World Energy 2007-2015.

- LNG options
 - China LNG imports from Australia set to increase by ~2.0+ Bcf/d by 2017
 - Russian LNG also an alternative
- Will demand growth continue? Effect of population growth? Competition with renewables? Government environmental regulations?

Cost of wind generation at high capacity factor is already competitive with generation using LNG in China



Cost of PV is not competitive with generation using LNG currently in China, but could change by 2025



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:

2016 Existing Export Capacity - Data sourced from © OECD/IEA 2016 World Energy Outlook, IEA Publishing. License: http://www.iea.org/t&c/termsandconditions/, Figure 4.1. 2025 Cumulative Growth - Data sourced from IHS Energy, taken from Kah, Marianne, "World Oil & Gas Markets - Impact on Alaska," ConocoPhillips. 2015 Existing Demand - Data sourced from GIIGNL Annual Report - 2016 Edition

Low Demand Forecast - Data sourced from McKinsey Energy Insights (June 2015); assumes no additional demand from Europe from 2013 levels and low Asian demand growth.

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



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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