

The Global Context for Alaskan LNG

PRESENTED TO

LSI Energy in Alaska Conference

PRESENTED BY

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December 7, 2015



THE **Brattle** GROUP

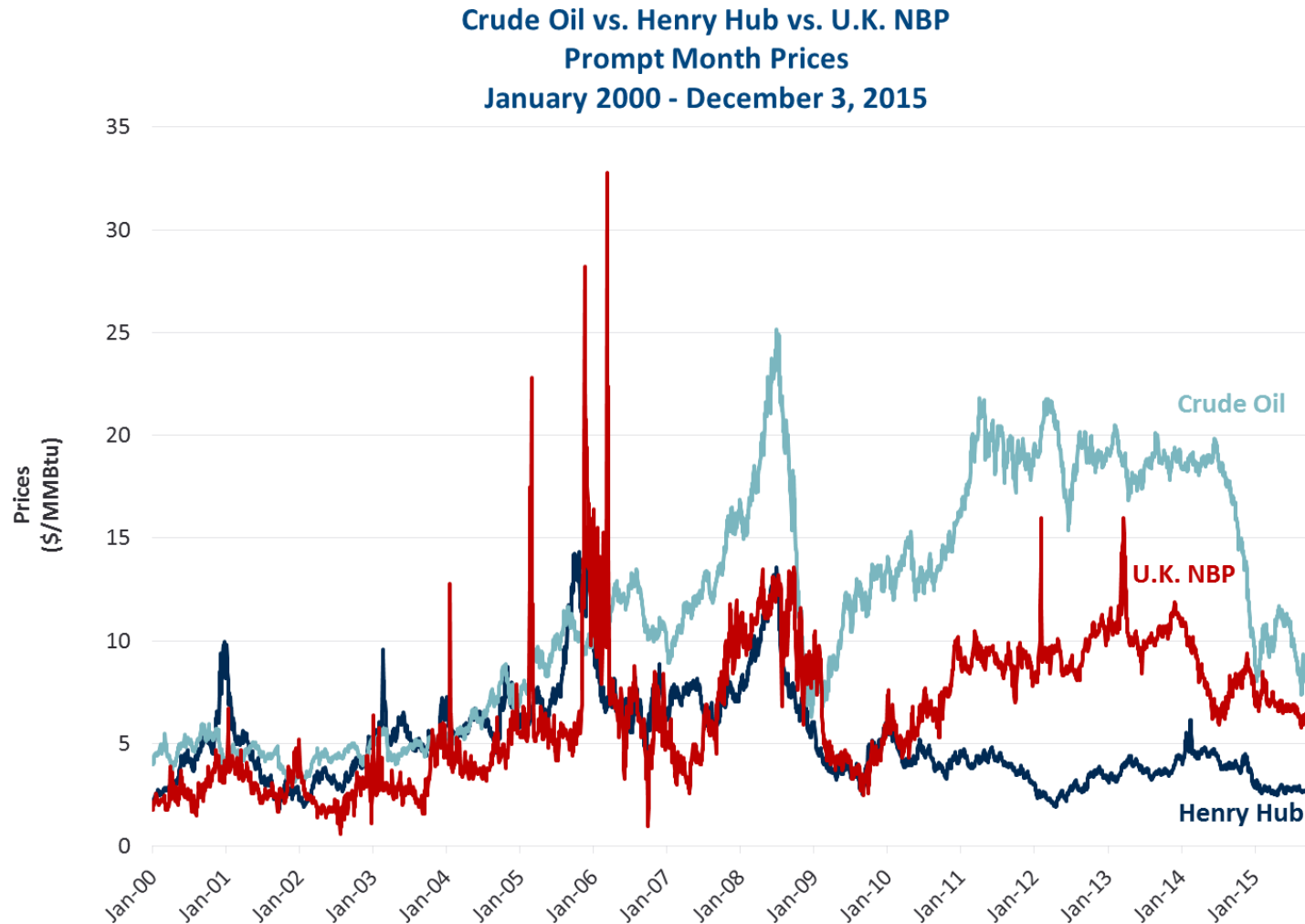
Agenda

- 12-18 months into the oil price collapse
 - What have we learned?
- Will the “gap” in oil and gas prices return?
- Recent changes in LNG markets – temporary or permanent?
- Alaska LNG Project risks
 - Insufficient demand, supply competition, or both?
- Key indicators to watch going forward

Previous themes at this conference

- 2011: Shale gas creates massive uncertainty for pipeline project to Lower-48
- 2012: Shift in focus of Alaska P/L project to LNG exports due to the rise of North American shale gas.
 - The potential effect of shale on global LNG prices
 - The rise of LNG supply competition
- 2014: Collapse in oil prices and the closing of the oil/gas price “gap”
 - New uncertainties for Alaska LNG project
- 2015: ??

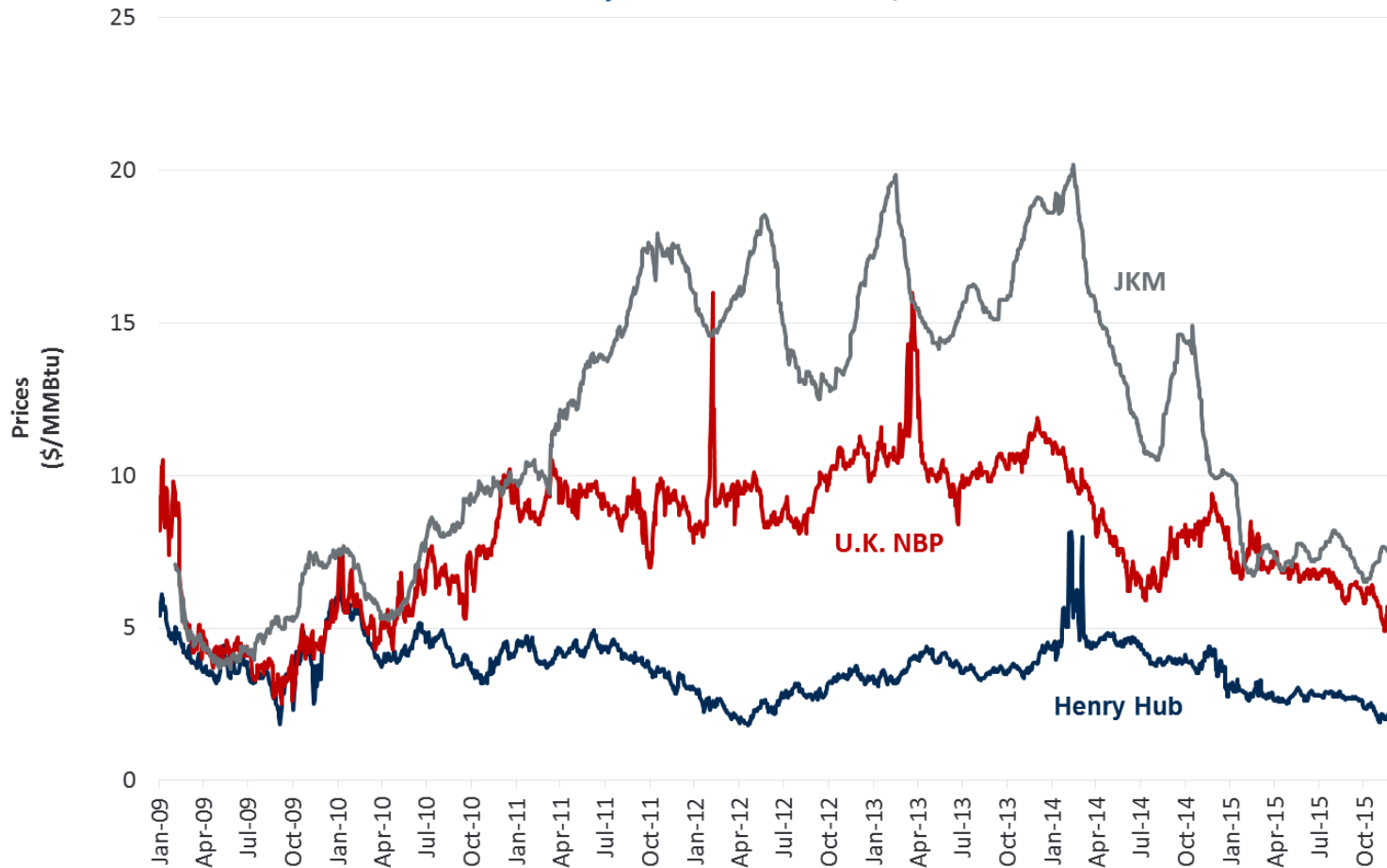
The crude oil price has collapsed and the oil/gas price “gap” has closed



Source: The Brattle Group, data sourced from Bloomberg and EIA.

Asian LNG prices have also collapsed

Henry Hub and U.K. NBP Spot Prices,
JKM Prompt Month Prices
January 2009 - December 3, 2015



Source: The Brattle Group, data sourced from Bloomberg, EIA, and Platts LNG Daily newsletters.

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

3024

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 October 2015 Landed Prices



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 traded during the prior month.

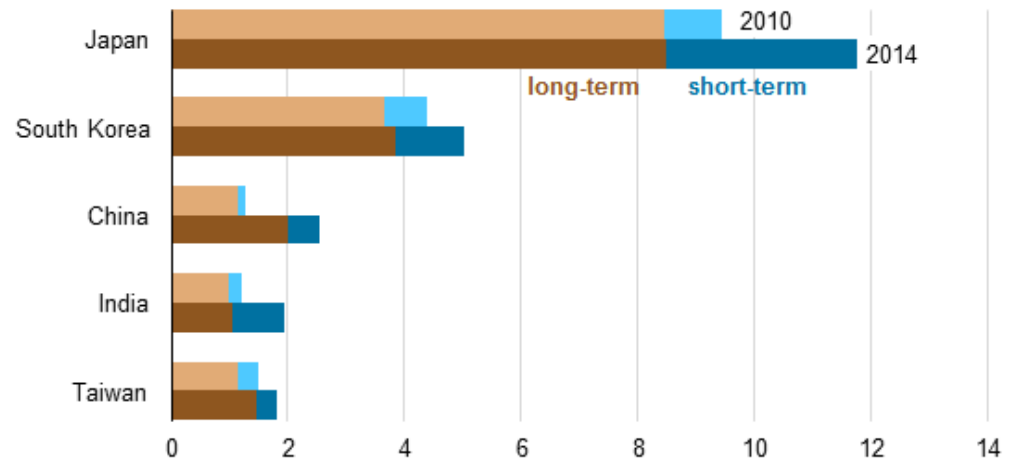
Updated: November 2015

Accessed at <https://www.ferc.gov/market-oversight/mkt-gas/overview/ngas-ovr-Ing-wld-pr-est.pdf> on December 4, 2015

Spot and short-term LNG trades increasing rapidly

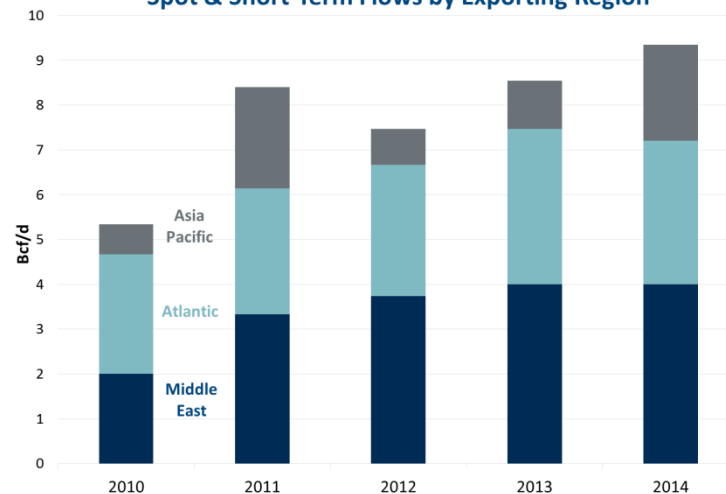
- Many players in LNG markets are looking to procure flexible volumes of LNG, resulting in a large increase in short to medium-term duration portfolio deals
- Global spot and short-term trades
 - 69.6 million tons in 2014
 - 29% of total trade
 - 7% increase from 2013 to 2014
- Main sources of spot and short-term LNG
 - Middle East (43%)
 - Atlantic Basin (36%)
 - Asia Pacific (21%)
- Several Asian countries (Japan, China, Singapore) are contemplating trading hubs

Asia Pacific natural gas trade by contract type (2010 and 2014)
billion cubic feet per day



Source: EIA (September 2015), accessed at <https://www.eia.gov/todayinenergy/detail.cfm?id=23132> on December 4th 2015

Spot & Short-Term Flows by Exporting Region



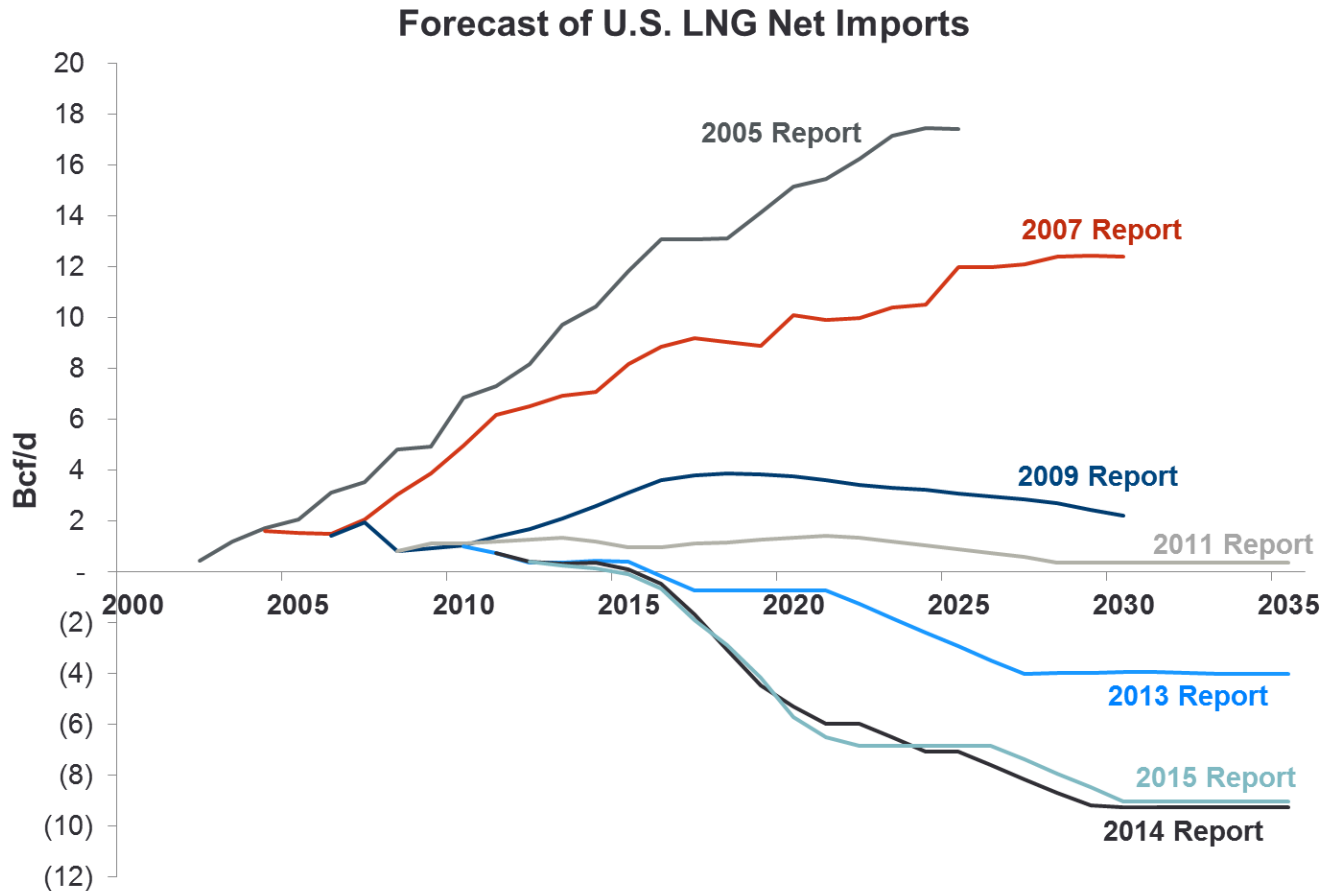
Source: The Brattle Group, data sourced from "The LNG Industry," GIIGNL, 2014.

Near-term LNG oversupply?

- It appears that a near-term LNG glut is in the offing
- Increase in LNG exports from new Australian/Papua New Guinea projects (up to 7 Bcf/d will come on-line between 2015-2017)
- 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)

And U.S. LNG exports are just beginning

Pre-shale EIA outlook of 12-18 Bcf/d of net imports by 2025;
April 2015 outlook of 8.5 Bcf/d of net exports by 2030



Source: © OECD/IEA 2005, 2007, 2009, 2011, 2013, 2014, 2015 *World Energy Outlook*, IEA Publishing. License: <http://www.iea.org/t&c/termsandconditions/>

Are we close to reaching the uneconomic tipping point for US gas exports?

US Gulf Coast Project:

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

[Cheniere estimates its breakeven LNG pricing range at \$7.70 - \$8.40 delivered in Asia, based on \$3.00 HH]

Oil-linked Asian Contracts:

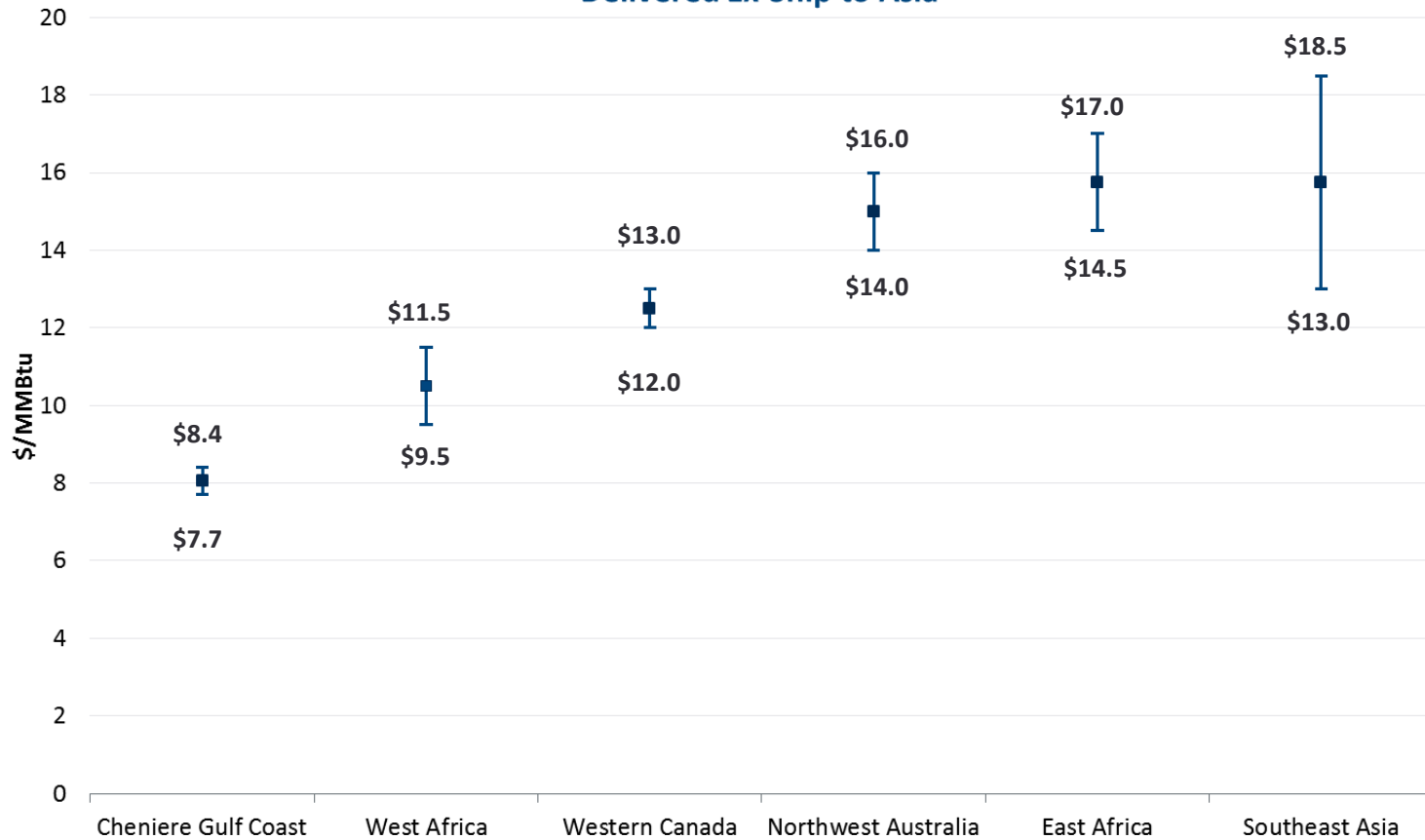
Brent at \$60 = \$10/MMBtu in Japan [Credit Suisse]

\$75 = \$11

\$85 = \$13

Competitiveness of LNG exports

Cheniere's Estimate for Breakeven LNG Price Range for Proposed LNG Projects
Delivered Ex-Ship to Asia



Source: The Brattle Group, data sourced from Cheniere Research, Wood Mackenzie, company filings and investor materials.

Note: Breakeven prices derived assuming unlevered after-tax returns of 10% on Canadian projects and 12% on all other projects over construction plus 20 year of operation. Henry Hub at \$3.00/MMBtu.

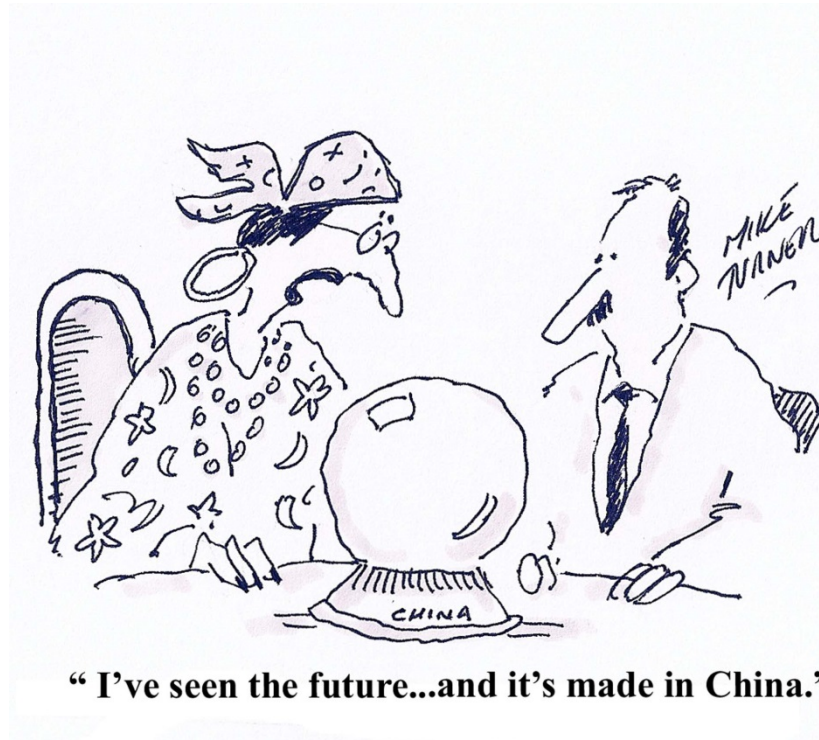
Key risk factors for Alaska LNG

- Insufficient demand growth post-2020
 - 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
 - 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 Lower-48 gas price is unambiguously good for Alaska LNG

Is It All About China?

"The China growth story is going to be the story of the next 30-40 years. The 20th century was the American century, but every year wasn't the American year. And it's going to be the same case with China."

- Lloyd C Blankfein, CEO, Goldman Sachs



"I've seen the future...and it's made in China."

Source: CartoonStock, Presentation License 2015.

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	2013	2020	2025	2030	2040	2025 Demand	2040 Demand
						less 2013 Demand	less 2013 Demand
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Americas	89	97	98	100	109	8	19
<i>United States</i>	72	78	77	78	82	5	10
Europe	50	48	51	51	51	1	2
Asia Oceania	21	20	20	21	21	(1)	(0)
<i>Japan</i>	12	10	10	10	10	(3)	(2)
OECD	160	165	169	172	181	8	21
E. Europe/Eurasia	67	65	67	69	73	(0)	6
<i>Russia</i>	47	43	43	43	45	(4)	(2)
Asia	45	63	77	90	116	32	72
<i>China</i>	17	30	39	47	57	22	41
<i>India</i>	5	7	9	12	17	4	12
Middle East	41	48	54	61	71	14	31
Africa	12	14	16	19	28	5	16
Latin America	15	17	18	21	27	3	12
Non-OECD	179	207	232	260	315	53	136
World	339	372	400	432	496	61	157

Sources and Notes:

The Brattle Group.

[2] - [6]: © OECD/IEA2015 World Energy Outlook, IEA Publishing. License: <http://www.iea.org/t&c/termsandconditions/>. □

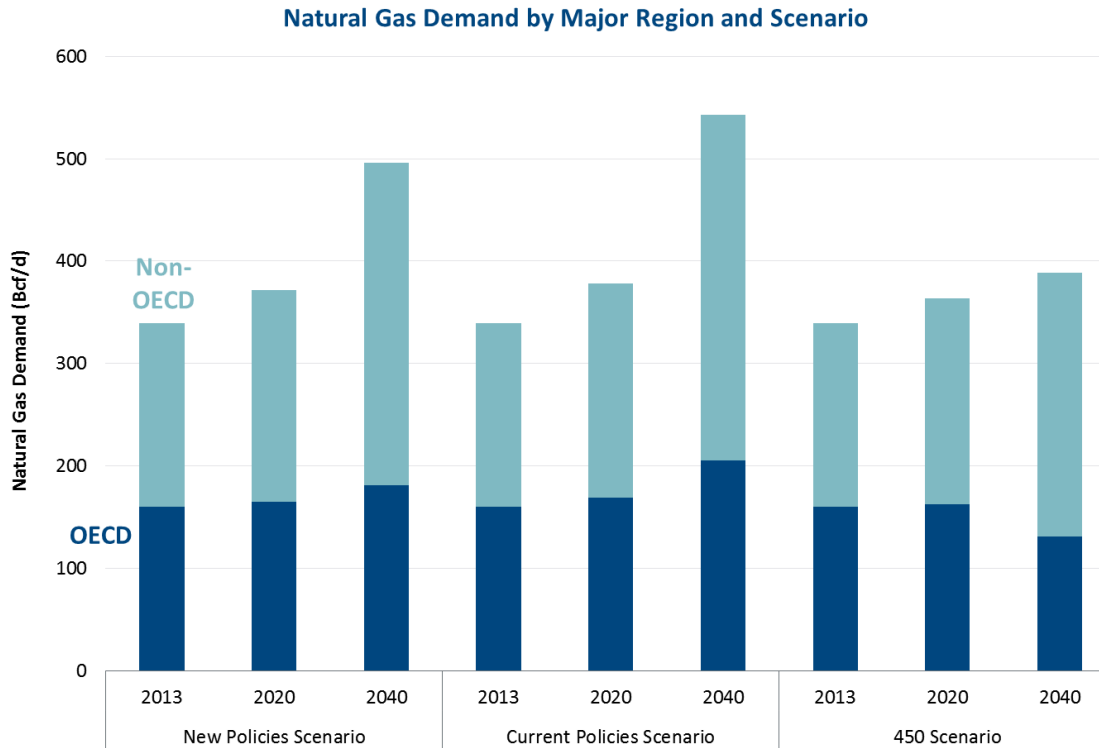
[7]: [4] - [2]

[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 (41 Bcf/d), the Middle East (31 Bcf/d), Africa (16 Bcf/d), and India (12 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

WEO forecast by major region and scenario

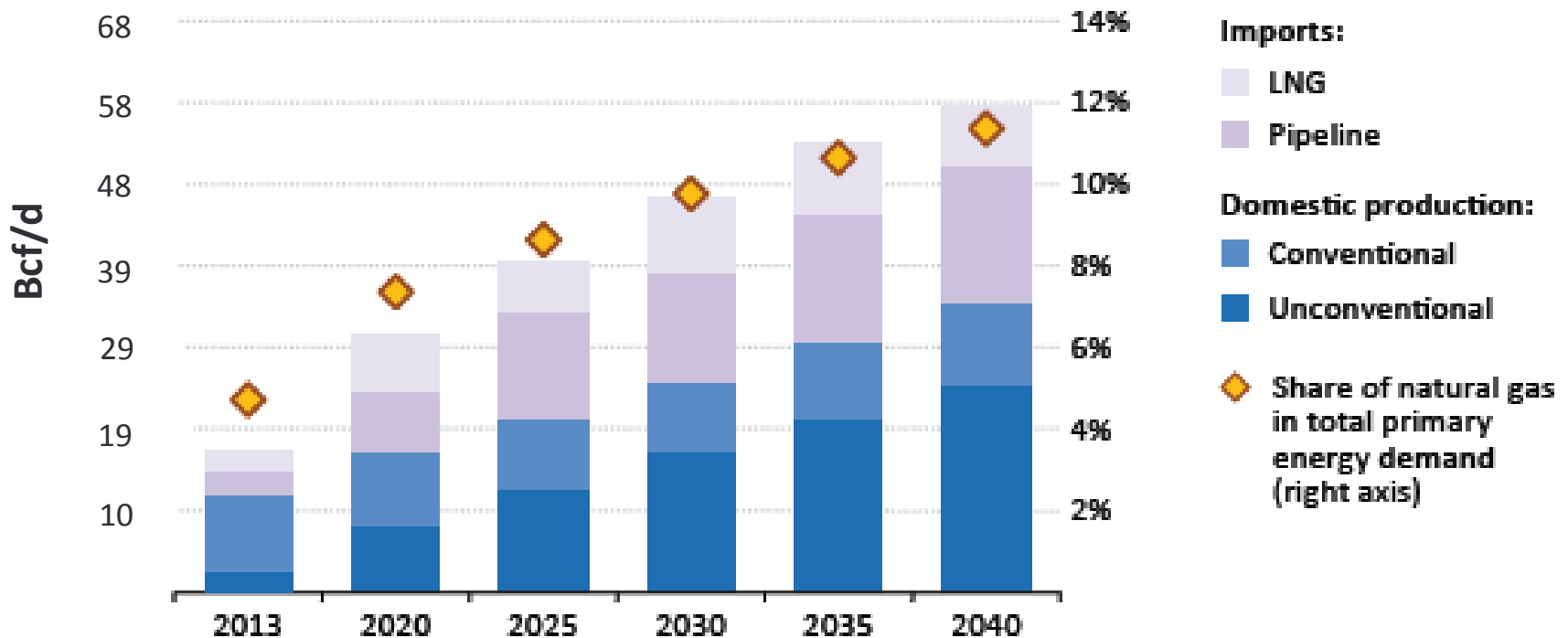


Source and Notes: The Brattle Group.
 Data sourced from © OECD/IEA 2015 *World Energy Outlook*, IEA Publishing. License: <http://www.iea.org/t&c/termsandconditions/>.
 2013 uses historical data; 2020 and 2040 are forecasts.

- **New Policies Scenario:** the IEA baseline scenario in which all policy commitments and plans are taken into account, regardless of the status of their implementation
- **Current Policies Scenario:** assumes that there will be no changes to the policies in place in mid-2015
- **450 Scenario:** assumes energy policies that are consistent with the goal of limiting atmospheric CO₂ levels to 450 ppm

WEO's forecast for China gas demand/supply balance

Figure 6.11 ▶ Natural gas balance in China in the New Policies Scenario

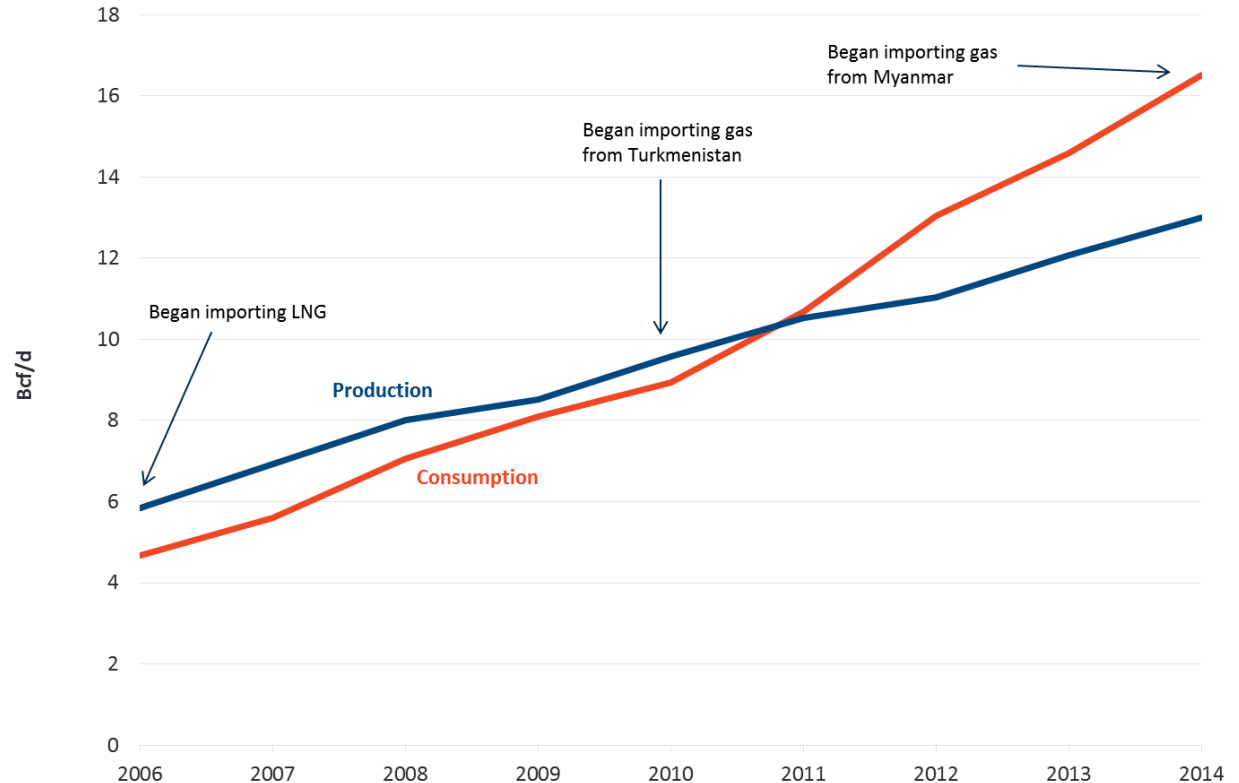


Source: © OECD/IEA 2015 *World Energy Outlook*, IEA Publishing. License: <http://www.iea.org/t&c/termsandconditions/>.

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
- **Will demand growth continue:** Effect of population growth? Competition with renewables? Government environmental regulations?

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.

With Japan restarting nuclear reactors, LNG demand growth seems unlikely

- **Japan is the world's largest LNG importer**
 - Consumed 12.8 Bcf/d of natural gas in 2014, ~98% of which were LNG imports and the rest being domestically produced
- **However, the Japanese demand for LNG is expected to remain steady or decrease slightly, mainly because of the restart of its nuclear activity**
 - Japan resumed first post-Fukushima commercial operation of a nuclear plant on August 11, 2015 (Sendai 1)
 - A second reactor (Sendai 2) was restarted in October 2015, bringing Japan's nuclear generating capacity factor to 2.7% in October (it was 2.2% in September)
 - There are 43 reactors that remain shut and are awaiting allowance to restart from Japan's Nuclear Regulation Authority
 - The government hopes to continue the re-start of additional nuclear plants, with an aim of producing 20-22% of electric generation in Japan by 2030

Will Korean demand slow as well?

- **South Korea is the second largest Asian importer of LNG, but its demand appears to be steady**
 - 2014 imported LNG: 4.9 Bcf/d
 - 2013 imported LNG: 5.2 Bcf/d
 - No pipeline connections, and virtually no domestic production
 - Any increase in future natural gas demand must be met by LNG imports
- **The stagnation of Korean LNG demand is, similarly to Japan, largely due to the restart of nuclear reactors in 2014**
 - Reactors were closed in 2012 following the Fukushima disaster and because of forged quality certificates
 - The closed plants had supplied 5% of Korea's energy demand
- **However, South Korea continues to actively diversify energy sources and to sign on to new LNG projects**
 - Plans to import from the Sabine Pass terminal in the U.S. starting in 2017
 - Talks of importing from Prelude and Gladstone in Australia as they come online

Indian domestic natural gas production likely to stagnate – LNG imports to meet demand

■ Gas supply:

- 2014 gas demand: 3.1 Bcf/d of domestic production & 1.8 Bcf/d of imported LNG (four regasification terminals)
- Two supply sources:
 - Domestic production for priority uses (e.g. city gas for household and transport, fertilizer plants) with a low price fixed by the government
 - Imported LNG available at contracted prices (often higher than the priority use prices); talks of subsidy schemes which could increase demand in the power sector
- Gas is 6% of energy mix – a relatively small role because it is unable to compete with coal
- Domestic gas production decreasing due to low output from offshore fields, specifically KG-D6, and due to a lack of price incentive
- Under-utilized gas assets: LNG terminals and gas-fired power plants are running at very low capacity factors

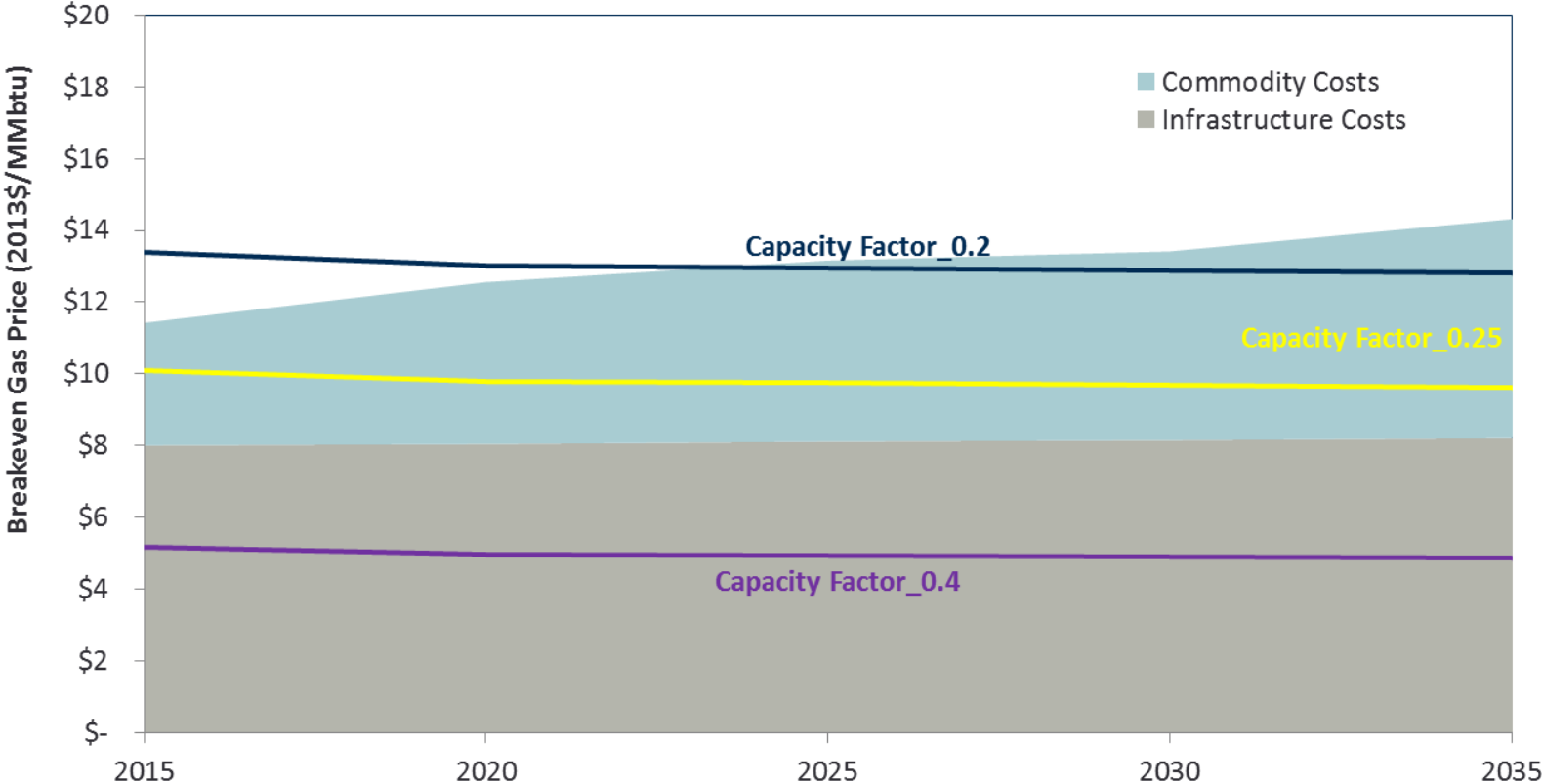
■ Gas demand

- Power generation and fertilizer are the sectors with greatest gas demand, and both sectors are increasing as India's population and agriculture increase
- However, infrastructure (i.e. a fully integrated national gas grid) is still lacking, particularly in southern and eastern India

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

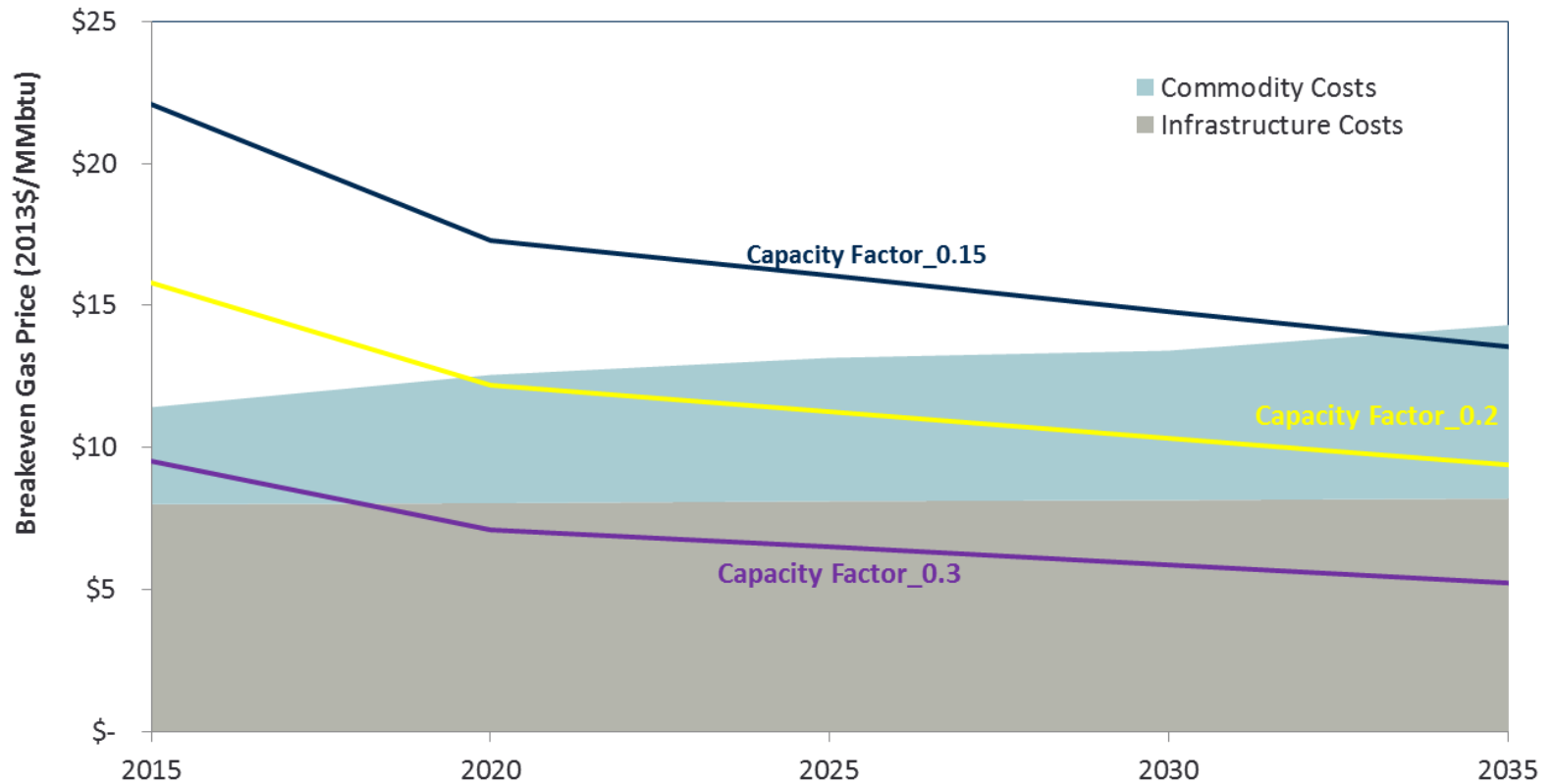
Based on Forecasted Delivered Cost of LNG from US to China



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.

Europe Has Unutilized Import Capability

Utilization of European LNG Import Terminals					
Country		Number of LNG Import Terminals [a]	Import Capacity (Bcf/d) [b]	2014 LNG Imports (Bcf/d) [c]	Utilization of Terminals [d]
Belgium	[1]	1	0.87	0.28	32.1%
France	[2]	3	2.30	0.69	30.0%
Greece	[3]	1	0.48	0.05	9.6%
Italy	[4]	3	1.49	0.44	29.5%
Lithuania	[5]	1	0.39	0.01	3.5%
Netherlands	[6]	1	1.16	0.05	4.6%
Portugal	[7]	1	0.74	0.12	16.2%
Spain	[8]	6	5.81	1.50	25.7%
Turkey	[9]	2	1.18	0.70	59.6%
United Kingdom	[10]	4	5.17	1.09	21.1%
Total Europe	[11]	23	19.59	4.93	23.19%

Sources and Notes:

The Brattle Group

[1]-[10],[a]-[b]: Data sourced from GIIGNL 'The LNG Industry 2014'

[1]-[2],[4],[8]-[10],[c]: Data sourced from BP Statistical Review of World Energy 2014

[3],[6],[7],[c]: Data sourced from GIIGNL 'The LNG Industry 2014'

[11],[d]: Average for Europe

Some projects have been put on hold since the oil price collapse, but many more are already “in the pipe”

Australia/Papua New Guinea

- 7 Bcf/d of LNG export projects under construction (with on-line dates 2015-2017)
 - Large projects (capital costs of \$20-\$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
- 5 Bcf/d currently operational

Canada

- 31-47 Bcf/d of proposed LNG export projects
 - Most in British Columbia; some in Nova Scotia
- 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

~51.0 Bcf/d of Proposed FTA U.S. LNG Export Capacity

Most (43.6 Bcf/d) proposed in the Gulf Coast

- 2.3 Bcf/d East Coast, 2.5 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)

10 (14.0 Bcf/d) with DOE approval for exports to non-FTA countries

- Sabine Pass (3.6 Bcf/d), Freeport (1.8 Bcf/d), Lake Charles (2.0 Bcf/d), Cameron (1.7 Bcf/d), Cove Point (0.8 Bcf/d), Jordan Cove (0.8 Bcf/d), Oregon LNG (1.3 Bcf/d), Carib Energy (0.04 Bcf/d), Cheniere and Corpus Christi (2.1 Bcf/d), and American LNG Marketing (0.01 Bcf/d).

5 (9.2 Bcf/d) with FERC approval

- Sabine Pass (2.8 Bcf/d), Freeport (1.8 Bcf/d), Cameron (1.7 Bcf/d), Dominion Cove Point (0.8 Bcf/d), Corpus Christi (2.1 Bcf/d)

The first US LNG exports are expected in early 2016 (Cheniere)

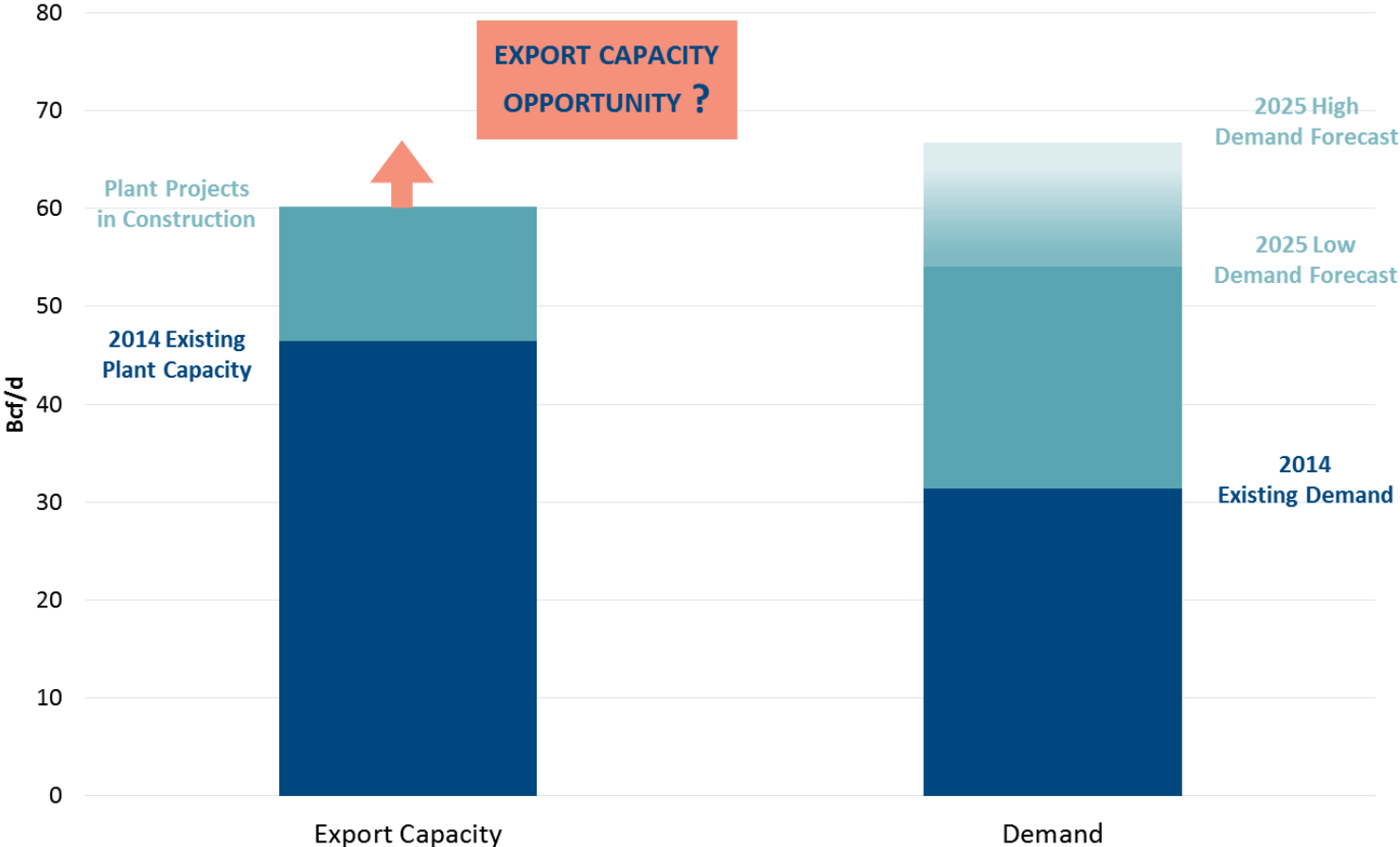
Expansions of U.S. Gulf Coast Projects Could Provide Significant Competition

“We no longer have to enter into long-term contracts to finance additional capacity because the cash flow two years from today will be sufficient to justify construction of additional trains entirely from cash flow.”

- Charif Souki, Cheniere CEO, 19 August 2015

To what extent will global demand call for additional export capacity?

Global LNG Export Capacity and Demand: Current and Forecasted



Source and Notes:
 Existing Export Capacity - Data sourced from © OECD/IEA 2015 World Energy Outlook, IEA Publishing. License: <http://www.iea.org/t&c/termsandconditions/>, Figure 5.9
 Plants In Construction - To be opened 2016-2021; data sourced from company websites, press releases, and public documents.
 2014 Existing Demand - Data sourced from OIES, July 2015, Howard Rogers.
 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 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 low oil price environment result in a shake-out amongst competing LNG projects, including delayed expansions?
- Will China's economy grow sufficiently to drive post-2020 demand for gas/LNG?
- Does more aggressive climate policy and the rise of renewables 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, particularly in a low oil and gas price environment?

The Brattle Group

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Renewables

Risk Management

Market Design and Competitive Analysis

Paul Carpenter specializes in the economics of the natural gas, oil and electric utility industries. He holds a PhD in Applied Economics and an MS in Management from the Massachusetts Institute of Technology, and a BA in economics from Stanford University. He is a Principal and Chairman of The Brattle Group