Changing Times – New Uncertainties: Assessing Their Effects on Global Energy and LNG Export Markets

LSI Energy Markets and Regulation in Alaska Conference

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This week's *Economist* cover

Agenda

- Changing times – new uncertainties
- The global price paths of oil and natural gas
  - Are the gaps closing? Domestic oil vs. gas? Global gas?
- Oil prices and shale gas production
- China's gas status and Russia's "Eastern Pivot"
- Implications for LNG export projects and Alaska

Changing Times, New Uncertainties

- Dec 2011 Conference
  - "The Uncertain Future of ANS Natural Gas in the Lower-48"
    - Competition from shale gas in Lower-48
- Dec 2012 Conference
  - "The Uncertain Future for ANS LNG Exports"
    - Competition from proposed LNG export projects

- Dec 2014: Have any of the risks been resolved? What new uncertainties do we need to assess?

Known Unknowns

A man was reprieved from a death sentence by the King of France, on condition that within a year he teach the King's favorite horse to speak. "Don't worry about it," he told a friend, "Within a year the King may die, or the horse may die, or I may die – or the horse may speak!"

- M. A. Adelman, *The Supply and Price of Natural Gas,* Oxford: Basil Blackwell, 1962, p.9.

Even if the need is not urgent, it is important to look through the medium to the long-term. The indefiniteness of the long-term does not make it any less real!

Summary of Uncertainties Facing LNG Export Projects – A recap from last time

Demand Uncertainty

- Need for LNG post-2020 is very uncertain (*e.g.*, China's needs will depend upon its natural gas demand growth as well as growth in its indigenous production) – Growth now shows signs of slowing, indigenous production uncertainty remains

Competition Uncertainty

- Competition between Australia, British Columbia, Gulf Coast, Alaska and other LNG projects – Shakeout about to occur?
- Competition from indigenous production and pipeline import options – Sino/Russian gas deals now a reality, but execution uncertain

Pricing/ Project Economics Uncertainty

- Oil-linked or gas-linked – Are we witnessing the start of long-term convergence?
- Panama Canal toll uncertainty – In the process of resolution
- Project cost uncertainty (*e.g.*, Australian cost overruns) – A reality. Will it be repeated in other greenfield projects?

Upstream Infrastructure Development Uncertainty

- Infrastructure challenges seen for British Columbia and Alaskan LNG exports since contingent upon large pipeline build-out – Challenge has grown in BC. Alaska?
- Possible siting advantage in U.S. Gulf Coast due to existing infrastructure – Confirmed

Level of Government Support

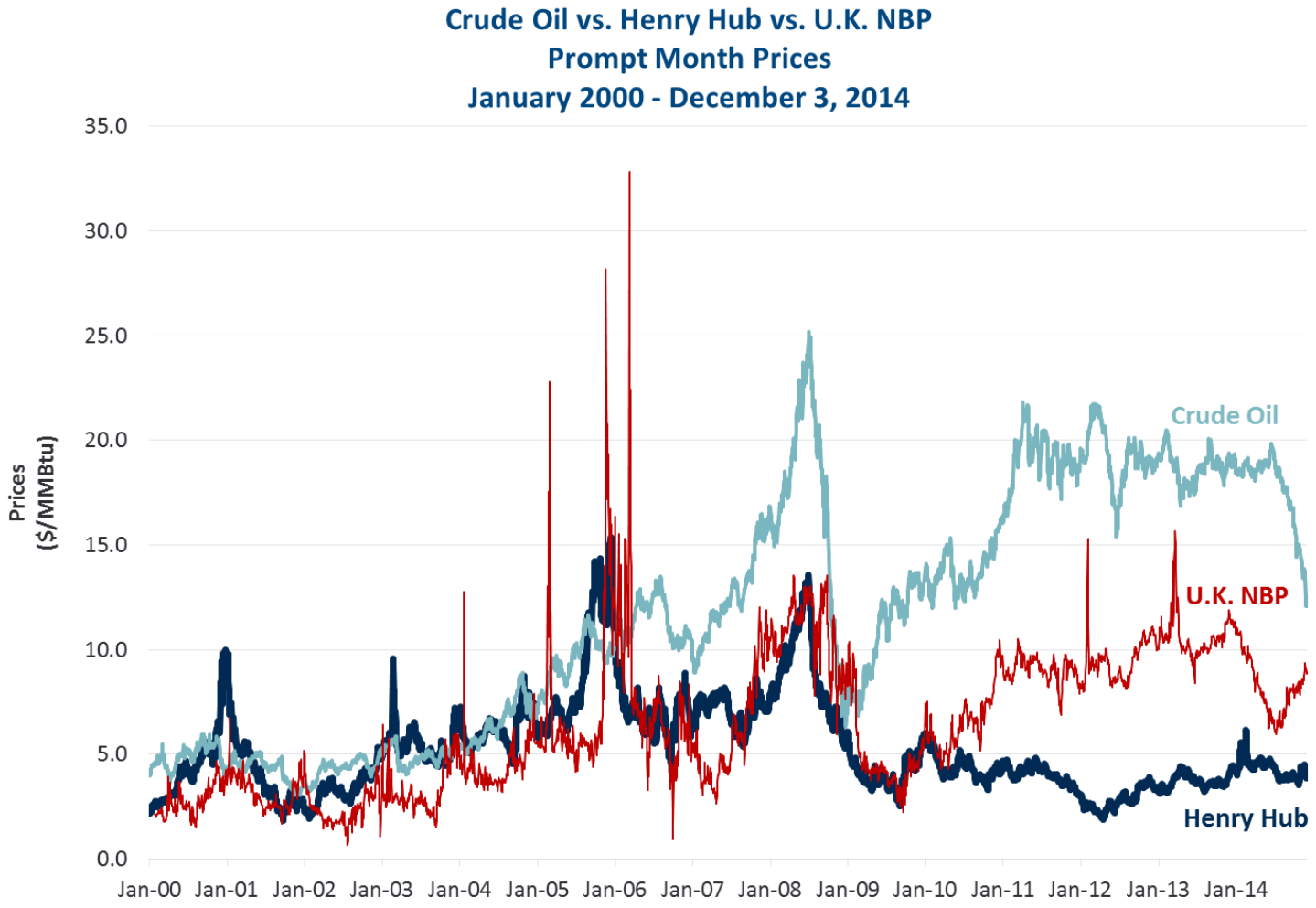
- Large "stranded gas" advantage in British Columbia and Alaska, but pipeline infrastructure disadvantage -- Unchanged
- Uncertainty in U.S. export permit process – Approvals, and more clarity

The Global Price Paths of Oil and Gas

- *Not* on my Dec 2012 list was uncertainty over the long-run persistence of the oil/gas price "gap" – critical to new LNG exports because they are all about geographic price arbitrage between oil-linked Asian contract prices and North American gas prices

- We're now in the midst of another global oil price "event"
  - How likely is it to be sustained, and what will be its affects?

Is the "Gap" Closing?



Source: Bloomberg.

Some Simple LNG Arithmetic

US Gulf Coast Project:

HH Price	$4.00 - $6.00/MMBtu
115% HH	4.60 – 6.90
Liquefaction cost	3.50
Transport to Asia	2.30
Delivered price	$10.40 - $12.70/MMBtu

[Cheniere is quoted as forecasting its delivered price in Asia at $11.90 based on $4.00 HH]

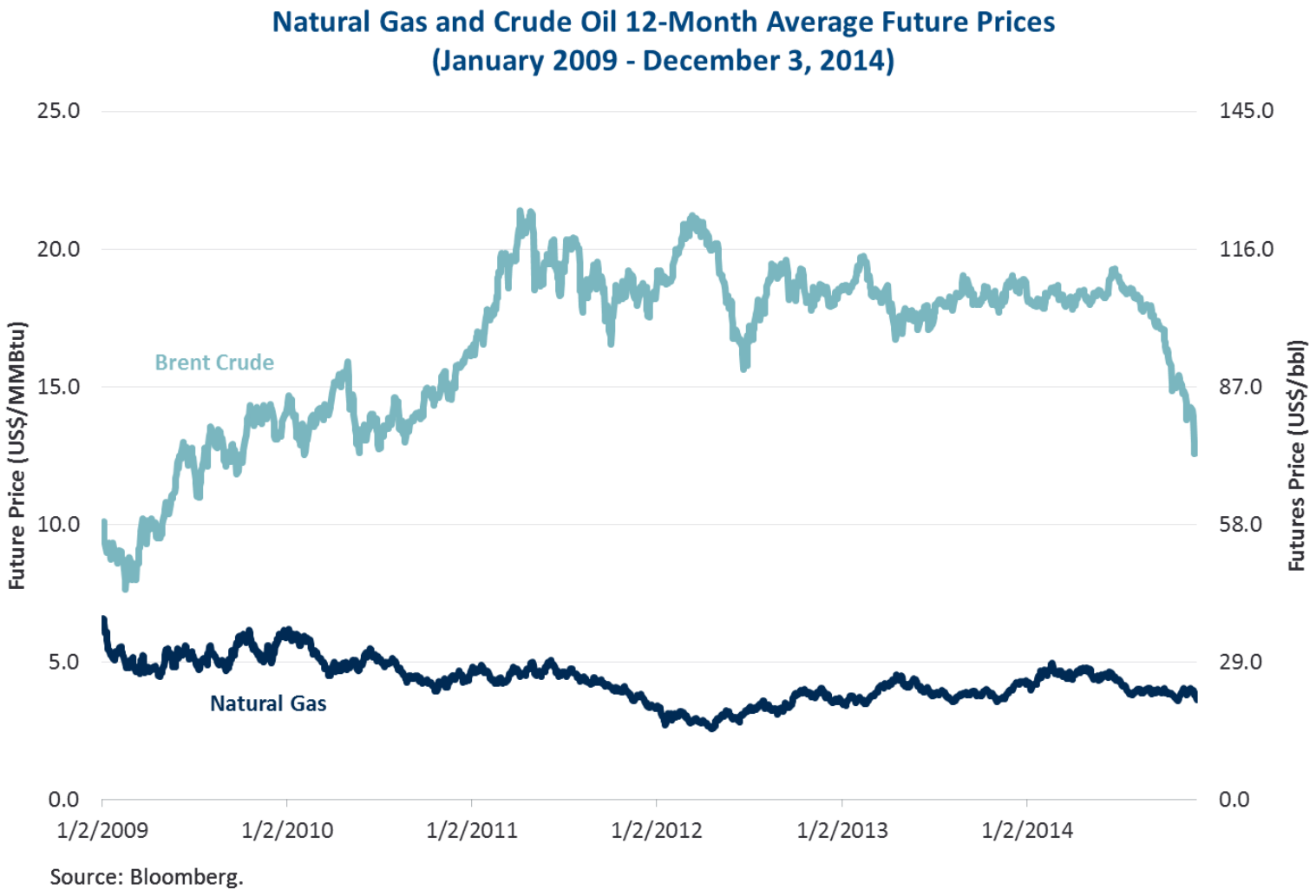
Oil-linked Asian Contracts:

Brent at $75 = $11/MMBtu in Japan [Credit Suisse]

$85 = $13

$60 = $10

Recent Oil Price Decline Not Just a "Spot" Phenomenon



Source: Bloomberg.

Prof. Morris Adelman (MIT) had it right 40 years ago

"Once the [oil] price leaped ahead (with the 1st Arab embargo), I suggested that it would fluctuate in a wide band between a competitive floor and a monopoly ceiling. "

"I wrote in 1973, before the embargo: The monopoly ceiling is set by the competition for more expensive sources of crude oil, or by consumers' reducing their expenditures on oil products. This ceiling is very far above even the current price, and hence we must expect the cartel to keep raising the price throughout the 1970's. But for the longer run, the crystal ball becomes clouded, because there are factors working both to strengthen and to weaken the cartel. The net effect is a residual, which is basically unstable. Small changes can produce large effects. But at least we can try to set out what forces are worth watching carefully."

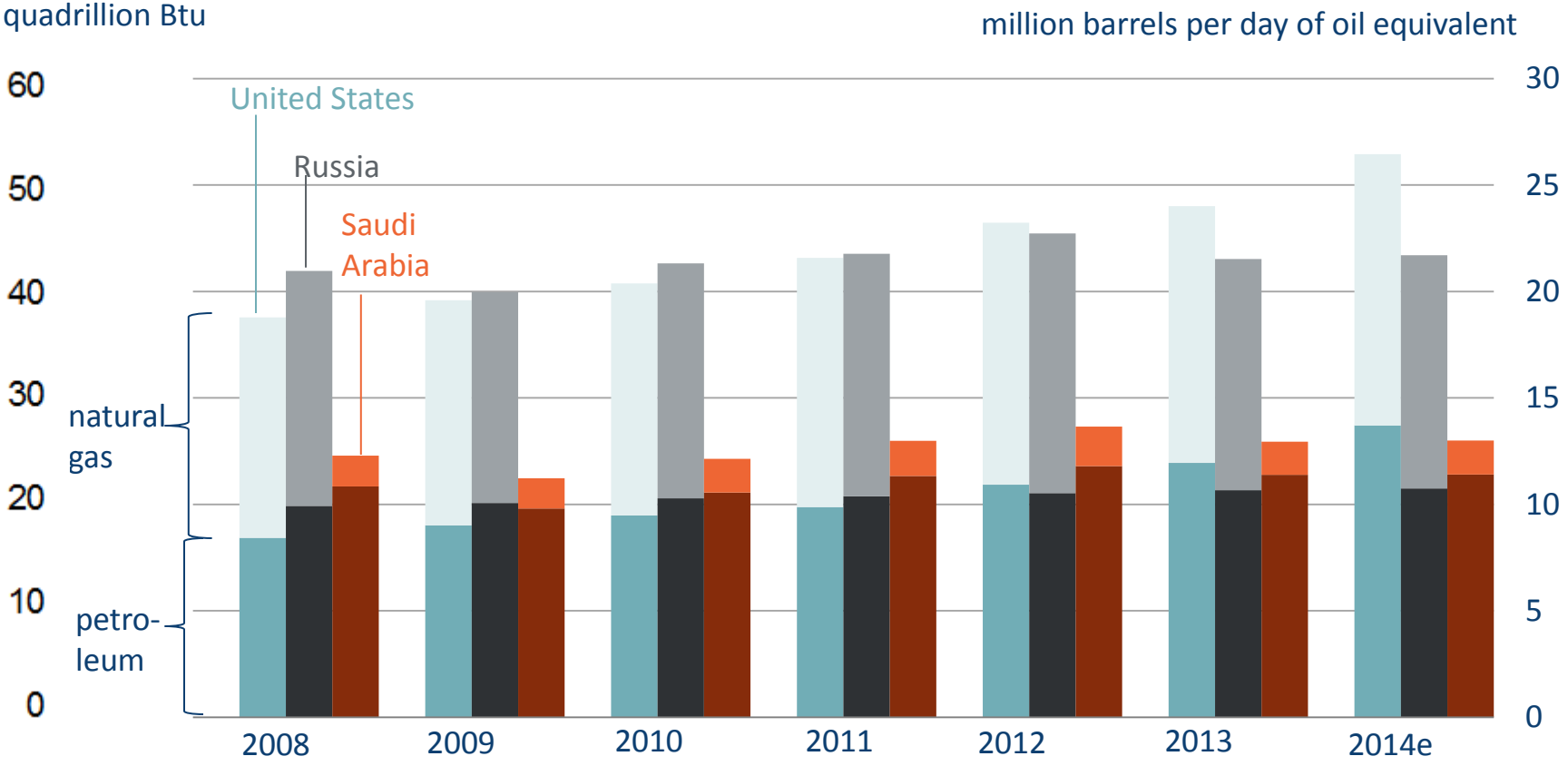
- M.A. Adelman, *The Economics of Petroleum Supply*, MIT Press, 1993.

What forces should we be watching for today?

- OPEC crude and US shale oil are very much in direct competition
- What is our market share?
- The competitive floor price may be quite low in the short run. What is the floor in the long run?
- Shale technology has made the US a low(er) cost supplier. But are the Saudi's costs even lower?
- How far do prices have to fall for US shale oil production to be affected?

U.S. is the now largest producer of petroleum and natural gas in the world

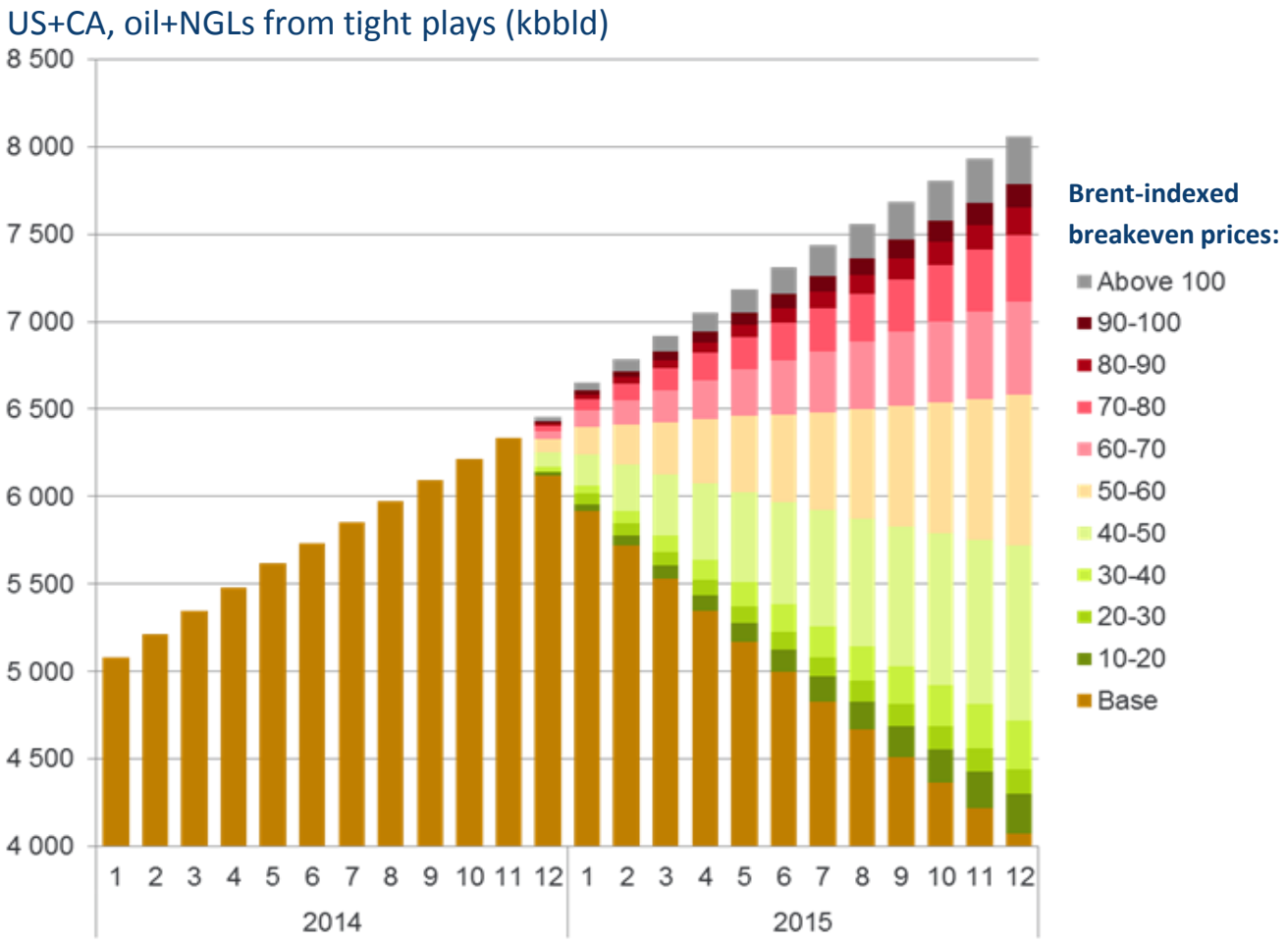
estimated U.S., Russia, and Saudi Arabia petroleum and natural gas production



Source: U.S. Energy Information Administration

Note: Petroleum production includes crude oil, natural gas liquids, condensates, refinery processing gain, and other liquids, including biofuels; barrels per day oil equivalent were calculated using a conversion factor of 1 barrel oil equivalent=5.55 million British thermal units (Btu)

Effect of low oil prices on North American shale oil production



Source: Rystad Energy North America Quarterly Shale Report

Production cost is not the whole story

- Much of US production is hedged forward, and so short-term declines in oil prices may not affect production volume until hedges start running off (2016?)

But:

- There are already reports of 2015 drilling and development budget cutbacks
- There may be a financial contagion if low oil prices are sustained [J.P. Morgan]
  - At <$65/bbl, 40% of all energy junk bonds could default over next several years
  - Energy companies account for 18% of all outstanding high-yield bonds, up from 9% in 2009

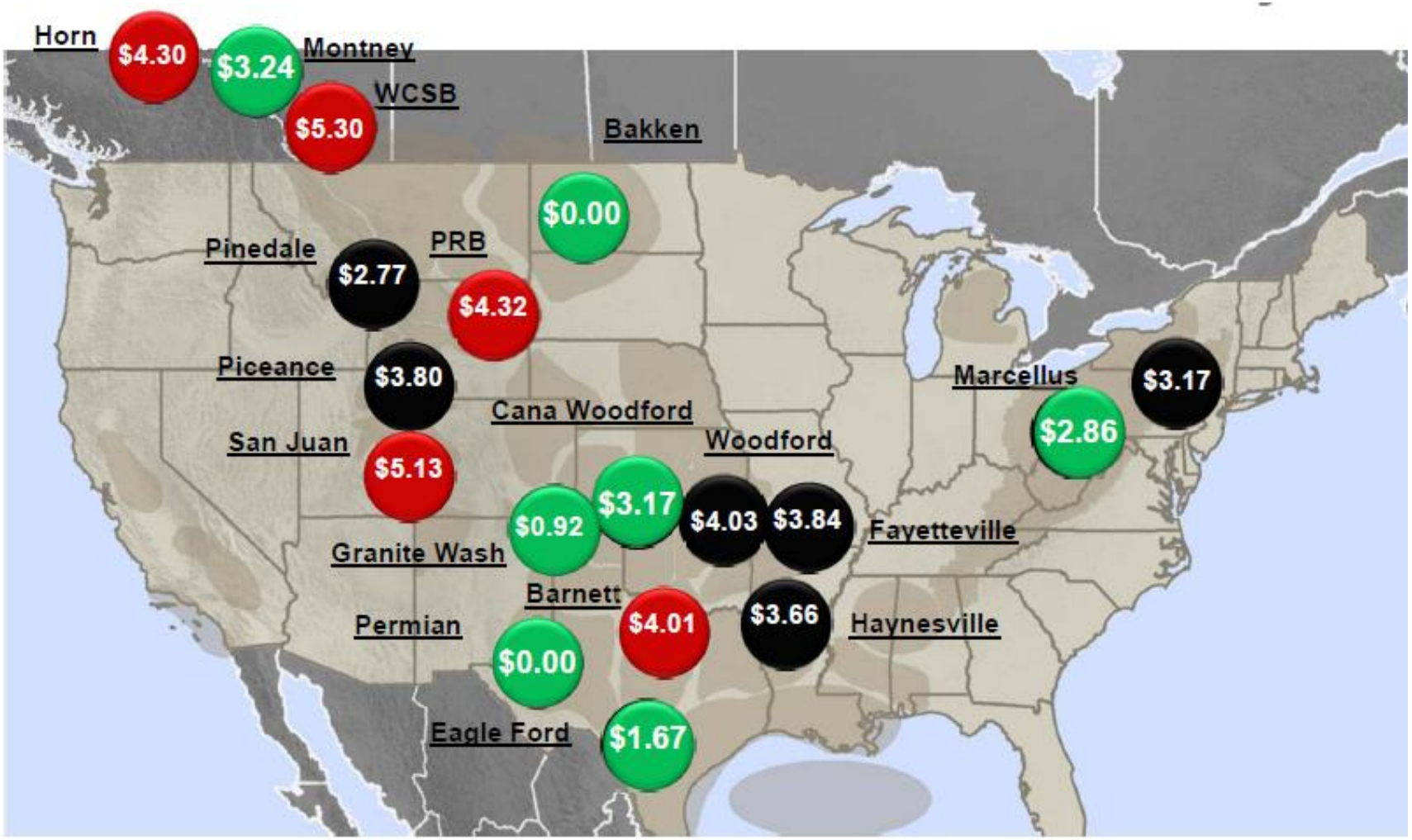
Oil Prices and Shale Gas Production

- What happens to the lower-48 natural gas price if oil prices stay low?

- The most valuable shale gas wells have been those in liquids-rich plays (60% of new gas wells produce both oil and gas – EIA)
  - Marcellus
  - Eagle Ford

- If oil prices fall to $50-60/bbl, gas prices may have to rise to $5.00-$6.00/MMbtu to break even [FACTS Global Energy estimate]

Shale Gas Breakeven at $80 Oil



Note: Breakevens computed at 12:1 Crude Ratio and 1:1 NGL Ratio
Green Circles Breakeven's Computed at $80 Crude and 1:3 NGL Ratio
Based on 3Q2010 Financials and State Production Data

Source: BENTEK

BENTEKENERGY.COM

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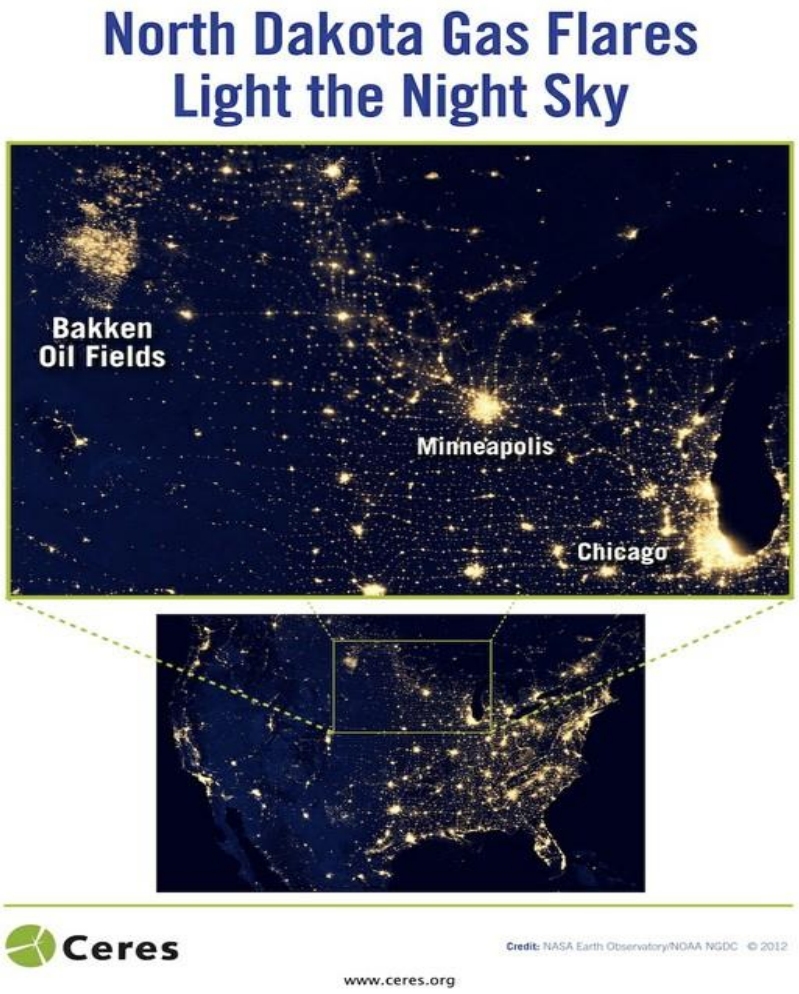
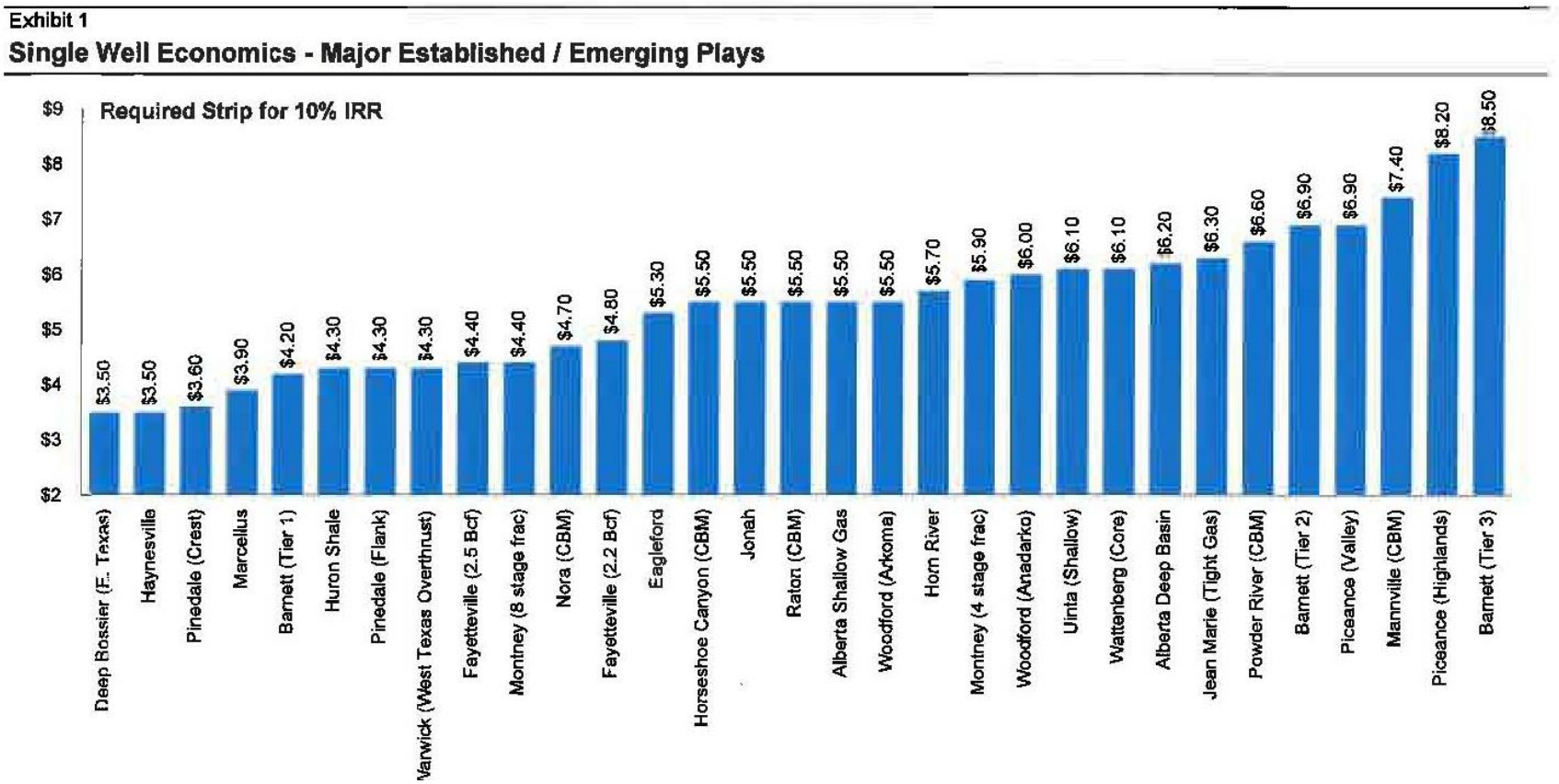
The result of a $0.00 Bakken breakeven



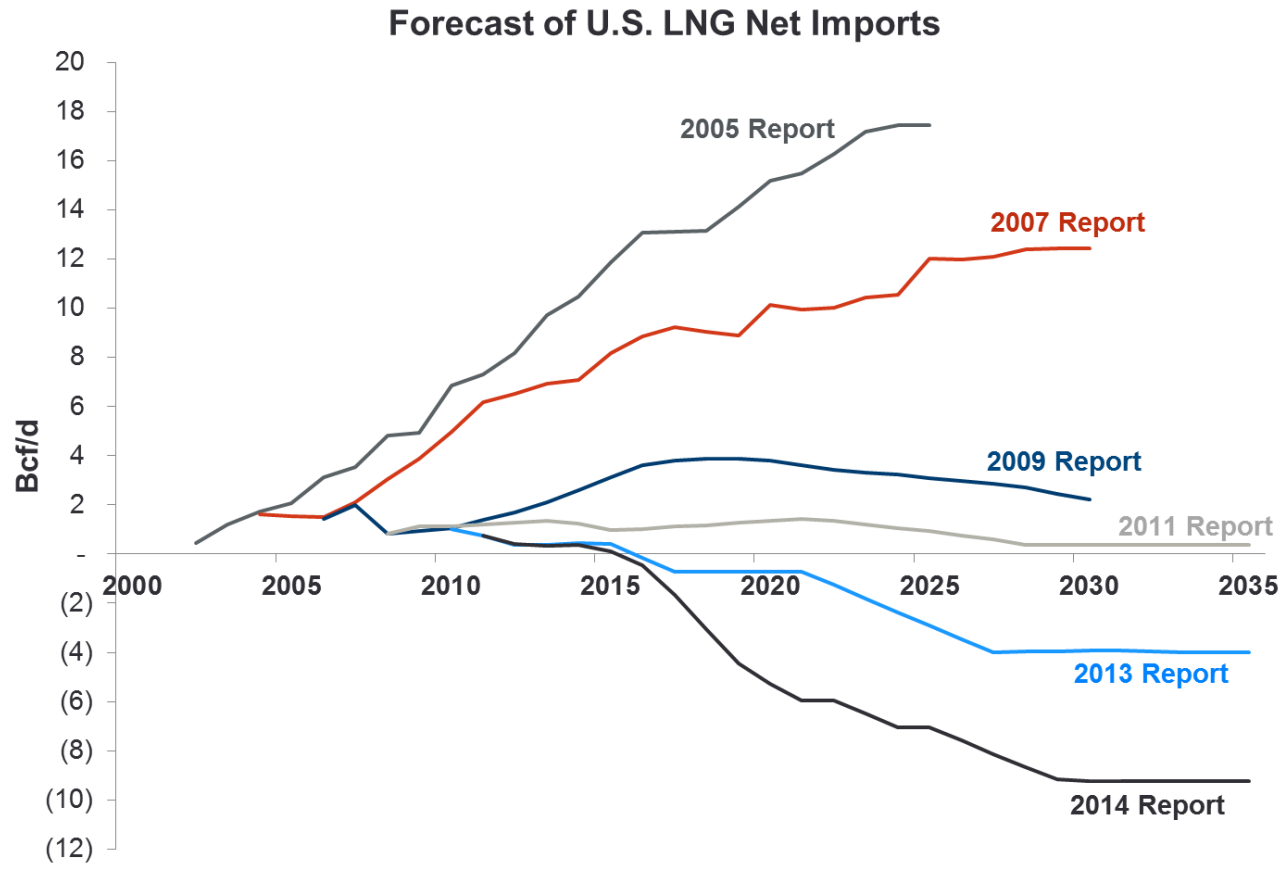
One potential supply curve

Natural Gas Supply Costs



Shale Changed U.S. Outlook in World Gas Markets

Pre-shale EIA outlook of 12-18 Bcf/d of net *imports* by 2025; April 2014 outlook of 9 Bcf/d of net *exports* by 2030



Source: EIA, Annual Energy Outlook for the years 2005, 2007, 2009, 2011, 2013, and 2014.

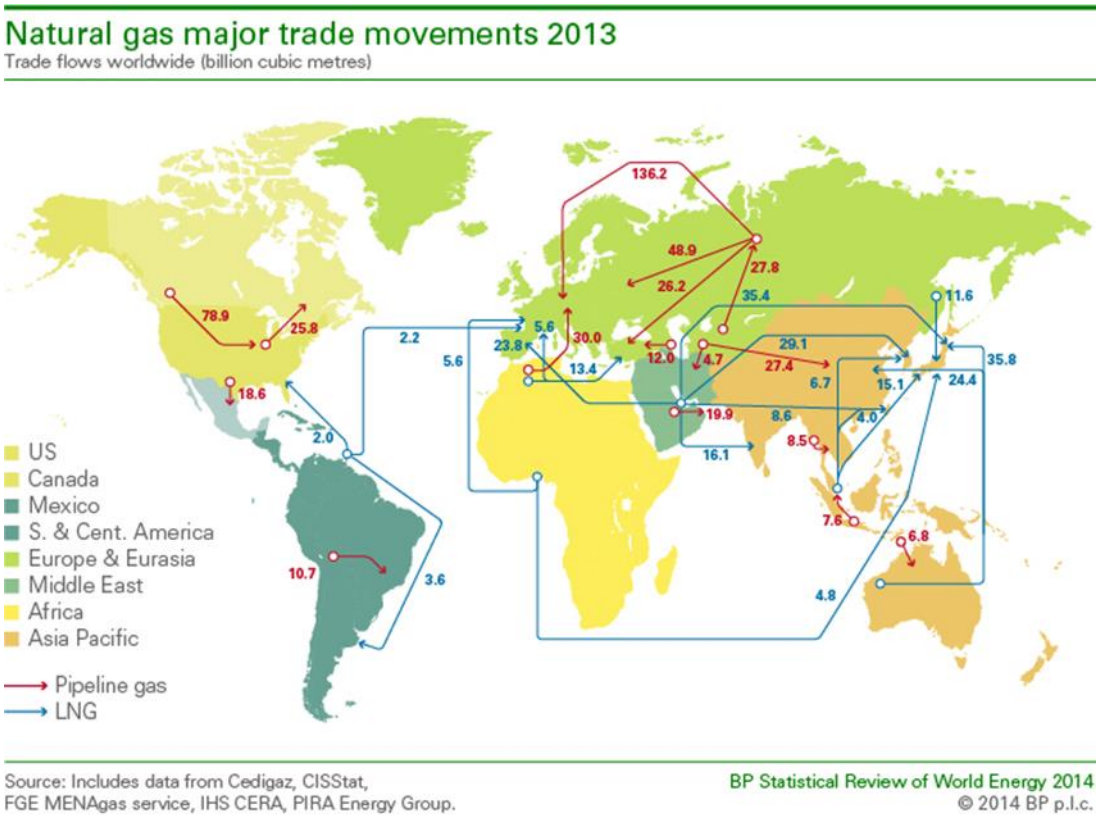
But what were the EIA's assumed oil and gas prices?

(2012 $/Bbl, $/MMBtu)	2020	2030
Brent Reference Case	**$ 97**	$119
Brent High Oil Case	$150	$174
Brent Low Oil Case	**$ 69**	$ 72
HH Reference Case	**$4.38**	$6.03
HH High Oil Case	$4.73	$6.88
HH Low Oil Case	**$4.35**	$5.75

US DOE EIA, *Annual Energy Outlook 2014*, April 2014, Table C-1

Major Natural Gas Trade Flows in 2013

- Three distinct regional markets, Asia (oil-linked contract prices), Europe (mix of oil-linked and spot gas pricing), and North America (Henry Hub + "basis" pricing)
- Some diversions of spot cargoes between regions (spot market)
  - ~27% by volume in spot/short-term trades in 2013



Source: BP Statistical Review of World Energy 2014.

IEA Gas Demand Forecast (Golden Rules Case) Shows Largest Demand Growth in Asia

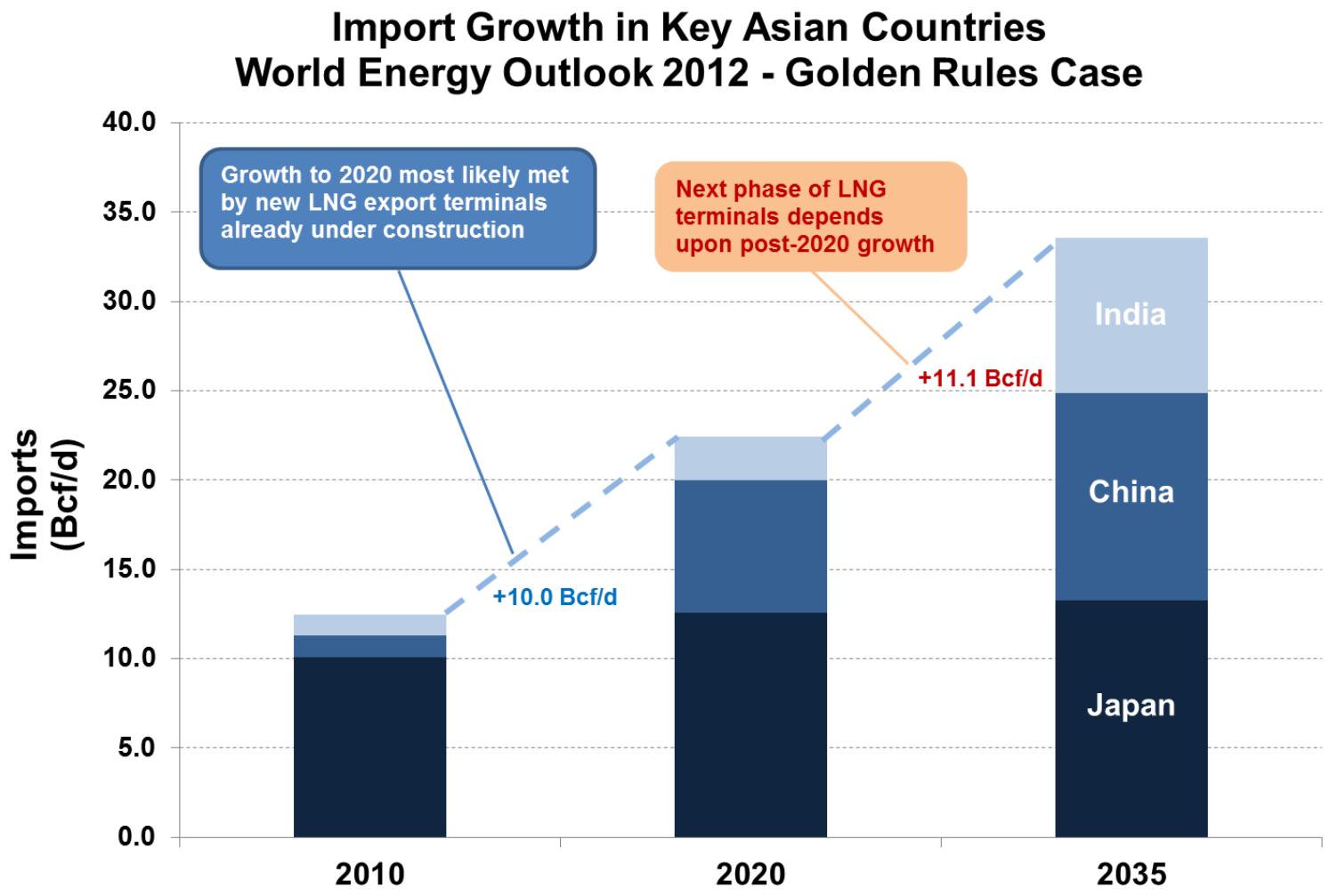
Natural Gas Demand by Region in the Golden Rules Case (Bcf/d)

Region/Country		2010	2035	2035 Demand less 2010 Demand
[1]		[2]	[3]	[4]
Americas	[a]	**81**	**102**	**20**
United States	[b]	66	76	10
Europe	[c]	**56**	**67**	**11**
Asia Oceania	[d]	**17**	**23**	**6**
Japan	[e]	10	13	3
OECD	[f]	**155**	**192**	**37**
E. Europe/Eurasia	[g]	**64**	**84**	**20**
Russia	[h]	43	54	11
Asia	[i]	**39**	**116**	**77**
China	[j]	11	57	47
India	[k]	6	19	13
Middle East	[l]	**35**	**62**	**27**
Africa	[m]	**10**	**16**	**6**
Latin America	[n]	**14**	**24**	**10**
Non-OECD	[o]	**162**	**303**	**141**
World	[p]	**316**	**495**	**178**

Sources:
[2] - [3]: World Energy Outlook 2012_GoldenRulesReport p78

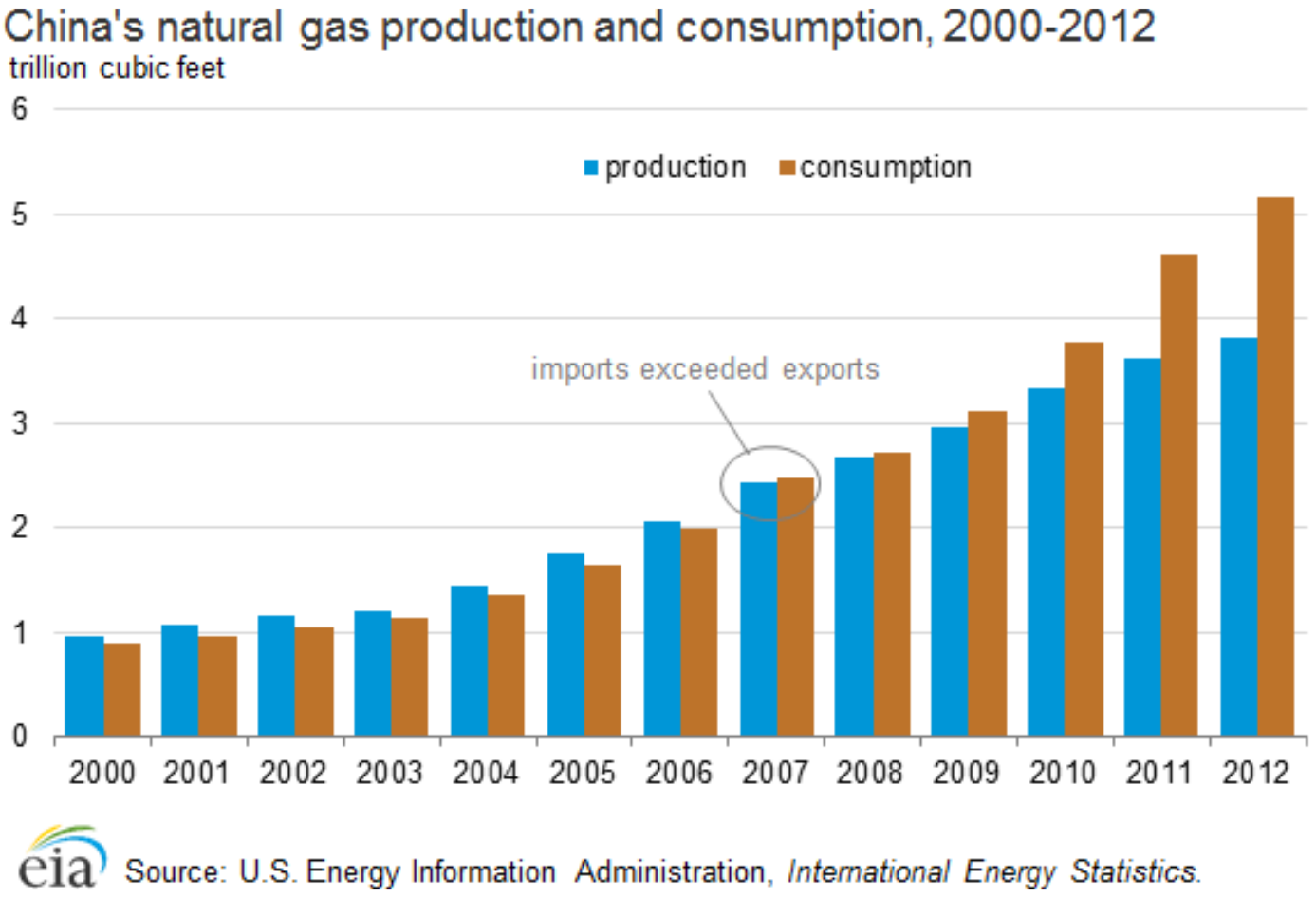
- Gas demand growth to 2035 expected to be particularly strong in China (47 Bcf/d), Middle East (27 Bcf/d), and India (13 Bcf/d)
- But gas demand growth is highly uncertain and can be met by indigenous production, pipeline imports and/or LNG imports
- Part of the uncertainty relates to electric sector gas demand (and the future generation mix of nuclear, coal, gas and renewables)
- LNG market growth likely to depend heavily on China and India demand growth
- Japan and South Korea (currently ~50% of LNG demand) forecasted to grow at much slower pace
- Europe also forecasted to grow but at slower pace

Potential Import Growth in Key Asian Countries



Note: Imports calculated as demand less indigenous production.

China's Gas History



Significant Uncertainty in Unmet Gas Demand Post-2020

Global LNG outlook depends in part on supply-demand dynamics in China

- China has competitive alternatives for gas supply—pipeline imports and LNG options
- Recently signed a 30-year deal with Russia for pipeline gas for ~3.7 Bcf/d (beginning 2019)
- Gas started flowing on the Myanmar-China pipeline on July 28, 2013 (expected to receive ~0.4 Bcf/d over 30-years).
- China LNG imports from Australia set to increase by ~2+ Bcf/d by 2017
- Russian LNG also an alternative for China
- Some estimates suggest China has 1,115 Tcf of shale gas reserves (~10x the size of Marcellus)
  - But, difficulty in realizing this potential
- Demand for natural gas/LNG is also uncertain
  - Environmental considerations -> + demand
  - Competition with renewables -> - demand

CHINA'S PIPELINE GAS IMPORT OPTIONS

Source: Gazprom, CNPC, Energy Intelligence

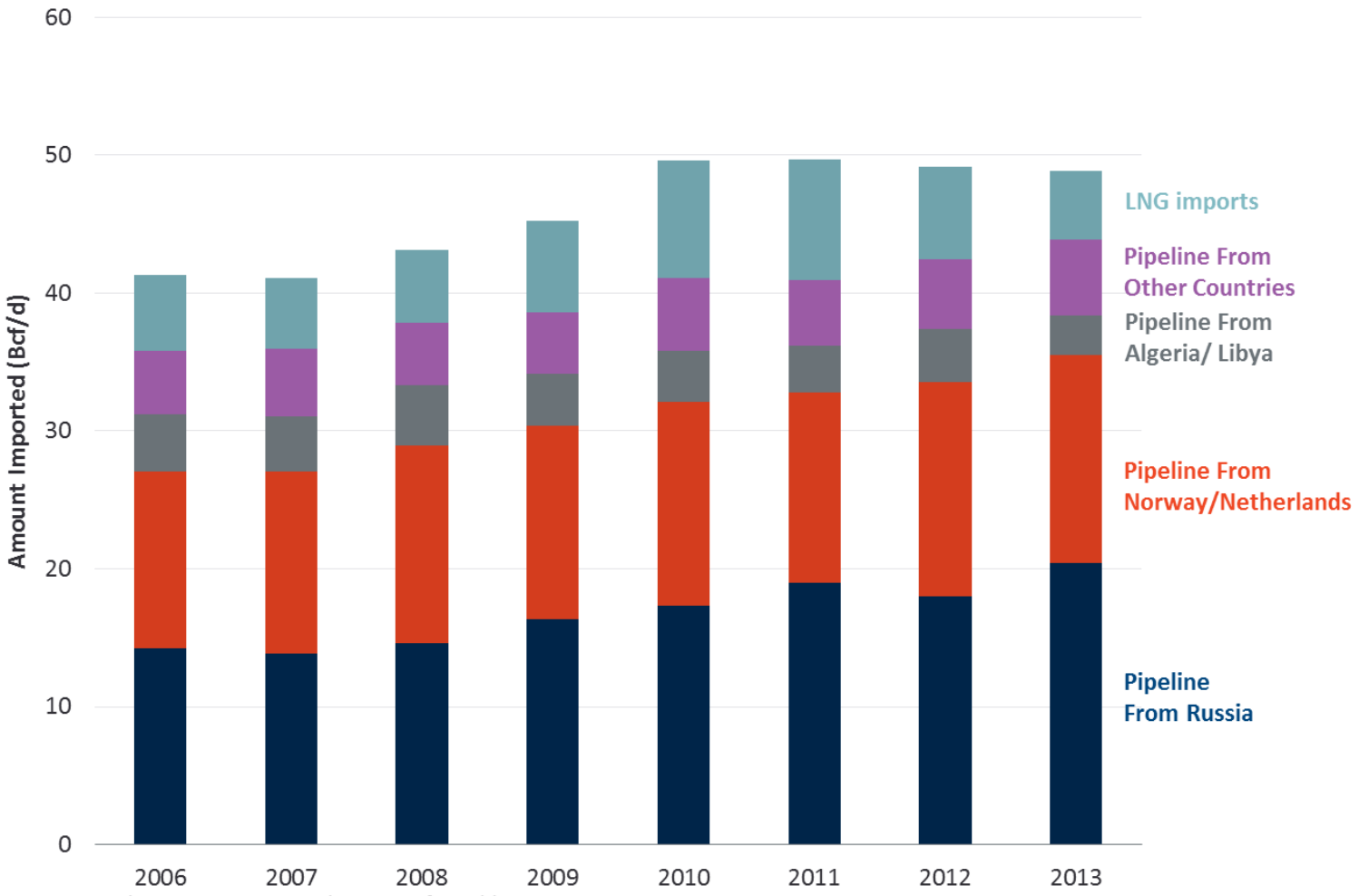
Source: "China Keeps Import Options Wide Open," World Gas Intelligence, July 25, 2012

Russia's Eastern Gas Strategy

- Develop significant Siberian gas reserves and sell to Asian markets
- Requires significant scale to achieve economies due to infrastructure requirements
- Chinese pipeline deals viewed as key to achieving reserve development scale to make LNG exports from east coast viable
  - Accelerated in importance to Putin after Ukraine/sanctions response by EU and West

Source: *Russia Today*

Russia is a Major Supplier of Natural Gas in Europe; LNG is a Small Component of Supply

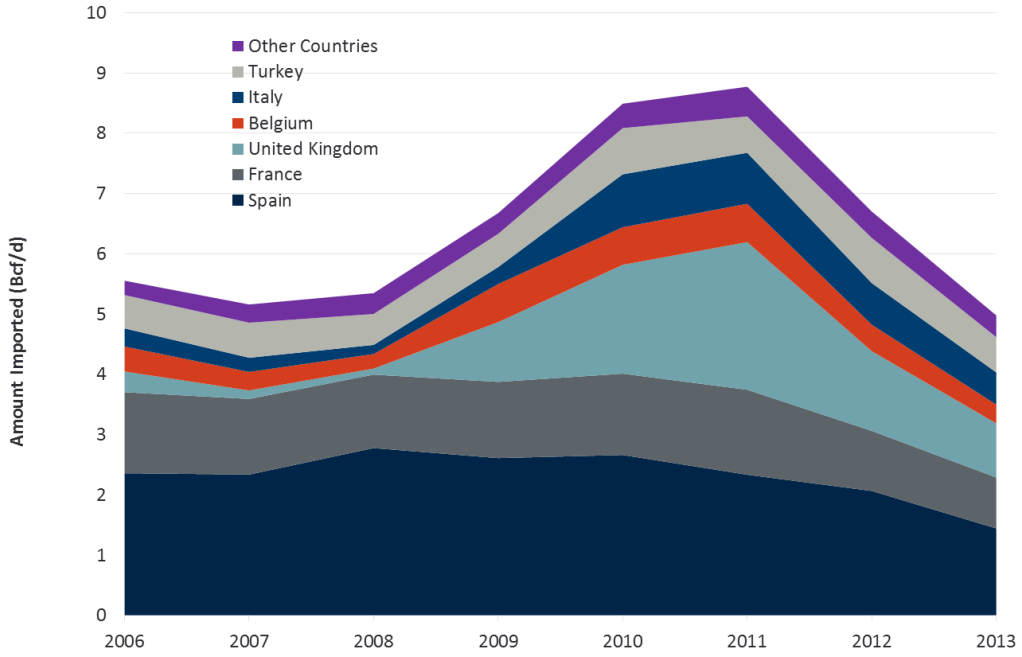


Sources and Notes: BP Statistical Review of World Energy 2007-2014

Europe as defined here consists of the OECD's Europe plus Belarus, Bulgaria, Lithuania, Romania, and 'Other Europe and Eurasia' as defined by the BP Statistical Review of World Energy

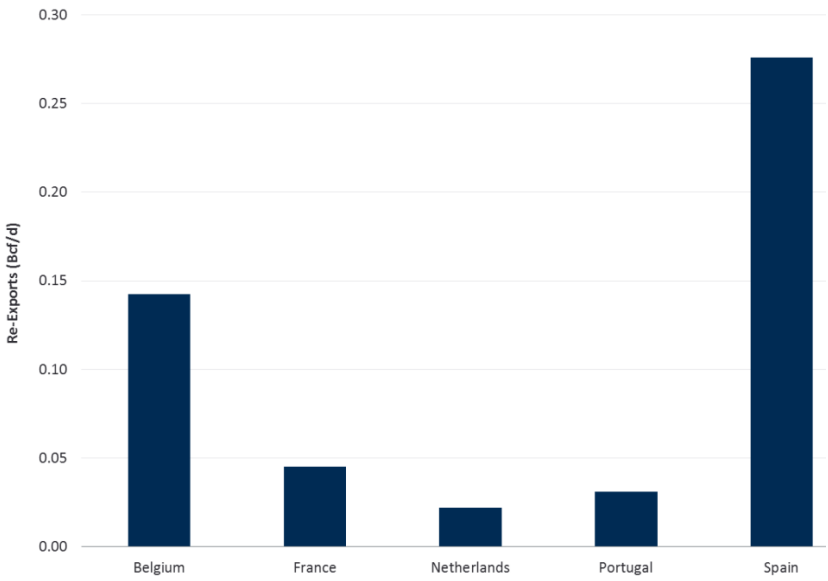
European LNG Imports Have Declined; LNG is Being Re-Exported

LNG Imports by European Countries



Sources and Notes: BP Statistical Review of World Energy 2007-2014
Europe as defined here consists of the OECD's Europe plus Belarus, Bulgaria, Lithuania, Romania, and 'Other Europe and Eurasia' as defined by the BP Statistical Review of World Energy
Includes re-exports

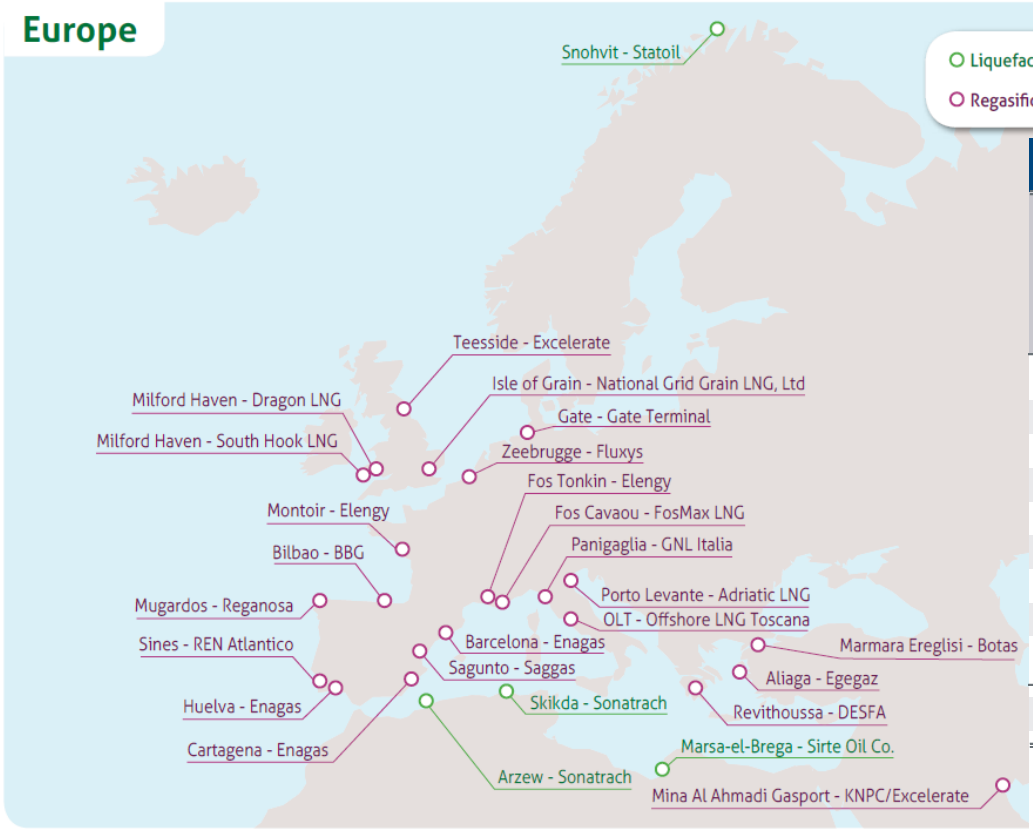
LNG Re-Exports by European Countries



Source: GIIGNL 2013 report.

- Oversupply due to long-term supply commitments, declining natural gas demand (from economic downturn, renewables, cheap coal, low CO2 prices, etc.)
- Strong competition from Asian/South American market ➔ Re-exports to Asia and South America

Low Utilization of European LNG Import Terminals



Source: GIIGNL 'The LNG Industry 2013'

Utilization of European LNG Import Terminals

Country		Number of LNG Import Terminals [a]	Import Capacity (Bcf/d) [b]	2013 LNG Imports (Bcf/d) [c]	Utilization of Terminals [d]
Belgium	[1]	1	0.87	0.31	35.7%
France	[2]	3	2.30	0.85	36.8%
Greece	[3]	1	0.48	0.06	11.6%
Italy	[4]	3	1.49	0.53	35.8%
Netherlands	[5]	1	1.16	0.04	3.8%
Portugal	[6]	1	0.74	0.18	25.0%
Spain	[7]	6	5.81	1.45	24.9%
Turkey	[8]	2	1.18	0.59	49.6%
United Kingdom	[9]	4	5.17	0.90	17.4%
Total Europe	[10]	22	19.21	4.90	26.74%

Sources and Notes:
[1]-[9],[a]-[b]: GIIGNL 'The LNG Industry 2013'
[1]-[2],[4],[7]-[9],[c]: BP Statistical Review of World Energy 2014
[3],[5],[6],[c]: GIIGNL 'The LNG Industry 2013'
[10],[d]: Average for Europe

LNG Supply Competition

Australia

- 9 Bcf/d of LNG export projects under construction (with on-line dates 2014-2016)
  - 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
- 5 Bcf/d proposed
- 3 Bcf/d currently operational

Canada

- 21-37 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)

~43 Bcf/d of Proposed U.S. LNG Export Capacity

Most (35 Bcf/d) proposed in the Gulf Coast

- 1.7 Bcf/d East Coast, 2.5 Bcf/d West Coast, 2.5 Bcf/d project in Alaska

One plant under construction (Sabine Pass); one about to start construction (Freeport); another (Cameron LNG) has made its final investment decision

8 (10.6 Bcf/d) with DOE approval for exports to non-FTA countries

- Sabine Pass (2.2 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), and Carib Energy (0.04 Bcf/d).

4 (6.5 Bcf/d) with FERC approval

- Sabine Pass (2.2 Bcf/d), Freeport (1.8 Bcf/d), Cameron (1.7 Bcf/d), Dominion Cove Point (0.8 Bcf/d)

Contracts/Agreements by Project

Project		Importing Entity	Type of Buyer	Contracted Capacity Bcf/d
Sabine Pass	[1]	GASNATURAL FENOSA	Portfolio	0.5
	[2]	GAIL	Asian	0.5
	[3]	KOGAS	Asian	0.5
	[4]	BG Group	Portfolio	0.7
	[5]	Total	Portfolio	0.3
	[6]	Centrica	European	0.2
Freeport	[7]	Osaka Gas	Asian	0.3
	[8]	Chubu Electric	Asian	0.3
	[9]	BP	Portfolio	0.6
	[10]	SK E&S LNG	Asian	0.3
	[11]	Toshiba Corporation	Asian	0.3
Lake Charles	[12]	BG Group	Portfolio	1.9
Cove Point	[13]	GAIL	Asian	0.3
	[14]	Sumitomo Corporation	Asian	0.3
Cameron	[15]	Japan LNG Investment LLC (Mitsubishi Corp/NYK)	Asian	0.5
	[16]	Mitsui & Company, Ltd.	Asian	0.5
	[17]	GDF SUEZ	Portfolio	0.5
Corpus Christi	[18]	GASNATURAL FENOSA	Portfolio	0.2
	[19]	Pertamina	Asian	0.2
	[20]	Endesa Generacion SA	European	0.3
	[21]	Iberdrola SA	European	0.1
	[22]	Woodside Energy Trading Singapore Pte. Ltd	Portfolio	0.1
	[23]	Électricité de France	European	0.1
Magnolia	[24]	GASNATURAL FENOSA	Portfolio	0.2
	[25]	GUNVOR	Portfolio	0.2
	[26]	LNG Holdings Corp	Portfolio	0.2
	[27]	AES Latin American Development, Ltd	Other	0.1
Total	[28]			10.2

Sources and Notes:
[1]-[27]: The Brattle Group Research, GIIGNL reports, company websites.
[1]-[27]: Includes both binding and non-binding contracts and agreements.
[1]-[27]: Includes LNG sales contracts and tolling agreements.
[3]: Adjusted to reflect sale of KOGAS' capacity at Sabine Pass to Total
[14]: Sumitomo has sold almost all of its capacity at Cove Point to Tokyo Gas and Kansai Electric
[15],[16]: Tokyo Electric Power has bought capacity from both Mitsubishi and Mitsui at Cameron
Tokyo Gas has bought capacity from Mitsui at Cameron
[24],[25]: Does not include interruptible capacity

- Majority of the contracts (5.5 Bcf/d) are with portfolio players (e.g., BG, BP) with no specific destinations
- 3.9 Bcf/d contracted by Asian buyers
- 0.7 Bcf/d contracted by European buyers

Implications for LNG Projects and Alaska

- Timing is everything: there may be a near-term supply glut as Australian and US projects come on stream
  - Asian spot LNG price has already dropped below $10.00/MMBtu
- If oil/gas price gap stays closed, then there will be an LNG project "shakeout" in the US and Canada
  - Petronas just announced the delay of FID for its Pacific Northwest LNG project in BC, saying that at $70 oil the project was not economic
- Given the post-2025 timing of the Alaska LNG project, perhaps a shakeout of the first-moving competition would be a good thing?
- When uncertainties reign, there is option value in waiting.

With constant changes in supply, demand and technology, relative advantages must change, and some fuels or demands or sellers are under pressure to give ground to others…. An orderly retreat is, of all military manoeuvers, the hardest to carry out.

- M.A. Adelman, *The Supply and Price of Natural Gas,* Oxford: Basil Blackwell, 1962.

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- Risk Management
- Market Design and Competitive Analysis

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Steven Levine is a Principal of The Brattle Group who specializes in energy and regulatory economics, with a particular focus on the natural gas and petroleum industries. He received a B.A. in economics from Brandeis University and an M.B.A. with a concentration in finance from Columbia Business School.

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Appendix

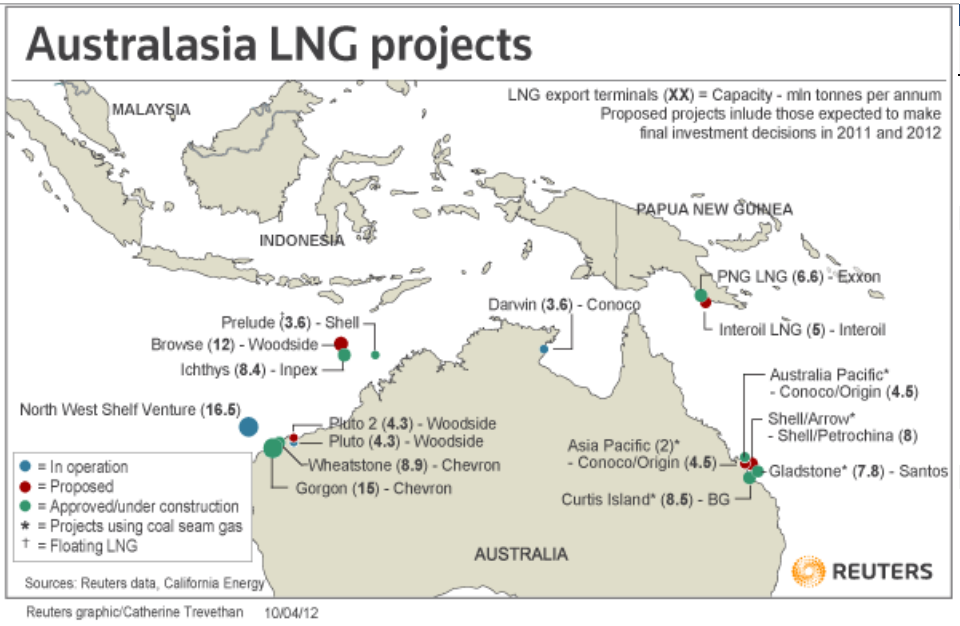
~43 Bcf/d of Proposed U.S. LNG Export Capacity

Project		Capacity FTA (Bcf/d)	Capacity Non-FTA (Bcf/d)	Status FTA	Status non-FTA	Status FERC	Announced Online Date
[1]		[2]	[3]	[4]	[5]	[6]	[7]
Lower 48:							
Sabine Pass Liquefaction, LLC	[a]	2.2	2.2	Approved	Approved	Approved	2016/2017
Sabine Pass Liquefaction, LLC	[b]	1.4	1.4	Approved	Under DOE Review	Under FERC Review	
Freeport LNG Expansion, L.P. and FLNG Liquefaction, LLC	[c]	2.8	1.8	Approved	Approved	Approved	2018
Lake Charles Exports, LLC	[d]	2.0	2.0	Approved	Approved	Under FERC Review	2019
Dominion Cove Point LNG, LP	[e]	1.0	0.8	Approved	Approved	Approved	2017
Carib Energy (USA) LLC	[f]	0.0	0.0	Approved	Approved	Not Required	
Jordan Cove Energy Project, L.P.	[g]	1.2	0.8	Approved	Approved	Under FERC Review	2017
Cameron LNG, LLC	[h]	1.7	1.7	Approved	Approved	Approved	2019
Gulf Coast LNG Export, LLC	[i]	2.8	2.8	Approved	Under DOE Review	Not Filed	2018
Gulf LNG Liquefaction Company, LLC	[j]	1.5	1.5	Approved	Under DOE Review	Under FERC Review	2019/2020
LNG Development Company, LLC (d/b/a Oregon LNG)	[k]	1.3	1.3	Approved	Approved	Under FERC Review	2019
SB Power Solutions Inc	[l]	0.1	n/a	Approved	n/a	Not Filed	
Southern LNG Company, L.L.C.	[m]	0.5	0.5	Approved	Under DOE Review	Under FERC Review	
Excelerate Liquefaction Solutions I, LLC	[n]	1.4	1.4	Approved	Under DOE Review	Under FERC Review	2018
Golden Pass Products LLC	[o]	2.0	2.0	Approved	Under DOE Review	Under FERC Review	2018/2020
Cheniere Marketing, LLC	[p]	2.1	2.1	Approved	Under DOE Review	Under FERC Review	2018
Main Pass Energy Hub, LLC / Freeport-McMoran Energy LLC	[q]	3.2	n/a	Approved	n/a	Not Filed	2016/2017
CE FLNG	[r]	1.1	1.1	Approved	Under DOE Review	Under FERC Review	2018
Waller LNG Services, LLC	[s]	0.2	0.2	Approved	Under DOE Review	Not Filed	
Pangea LNG (North America) Holdings, LLC	[t]	1.1	1.1	Approved	Under DOE Review	Not Filed	2019/2020
Magnolia LNG, LLC	[u]	0.5	n/a	Approved	n/a	Under FERC Review	2018
Magnolia LNG, LLC	[v]	0.5	1.1	Approved	Under DOE Review	Under FERC Review	2018
Gasfin Development USA, LLC	[w]	0.2	0.2	Approved	Under DOE Review	Not Filed	2019
Venture Global LNG, LLC	[x]	1.3	1.3	Approved	Under DOE Review	Under FERC Review	2019
Advanced Energy Solutions	[y]	0.0	n/a	Approved	n/a	Not Filed	
Argent Marine Management, Inc.	[z]	0.0	n/a	Approved	na	Not Filed	
Eos LNG LLC	[aa]	1.6	1.6	Approved	Under DOE Review	Not Filed	
Barca LNG LLC	[ab]	1.6	1.6	Approved	Under DOE Review	Not Filed	
Delfin LNG LLC	[ac]	1.8	1.8	Approved	Under DOE Review	Not Filed	2017/2021
Annova LNG LLC	[ad]	0.9	n/a	Approved	n/a	Not Filed	2019
Texas LNG LLC	[ae]	0.3	0.3	Approved	Under DOE Review	Not Filed	2018
Louisiana LNG Energy LLC	[af]	0.3	0.3	Approved	Under DOE Review	Under FERC Review	
Alturas LLC	[ag]	0.2	n/a	Pending Approval	n/a	Not Filed	
Strom Inc.	[ah]	0.1	0.0	Approved	Under DOE Review	Not Filed	
SCT&E LNG, LLC	[ai]	0.7	0.7	Pending Approval	n/a	Not Filed	
Sabine Pass Liquefaction, LLC	[aj]	0.6	n/a	Pending Approval	n/a	Under FERC Review	
Downeast LNG, Inc.	[ak]	0.5	0.5	Pending Approval	Under DOE Review	Under FERC Review	
Subtotal (Lower 48)	[al]	**40.6**	**33.5**				
Alaska	[am]	2.5	2.5			Under FERC Review	2021/2024
Total United States	[an]	**43.1**	**36.0**				

~29 Bcf/d to 45 Bcf/d Proposed in Canada

Project		Province	Ownership	Start Year	LNG Capacity (mmtpa)	LNG Capacity (Bcf/d)	Status/Notes
[1]			[2]	[3]	[4]	[5]	[6]
LNG Canada	[a]	British Columbia	Shell / KOGAS / Mitsubishi / PetroChina	2019	12.0 - 24.0	1.6 - 3.1	25 year export license approved
Pacific Northwest LNG	[b]	British Columbia	PETRONAS / SINOPEC / JAPEX/ Indian Oil/ PetroleumBrunie	Originally 2019 but FID Delayed	13.1 - 19.7	1.7 - 2.5	25 year export license approved
Kitimat LNG	[c]	British Columbia	Chevron and Apache Corp	2017	5.0 - 10.0	0.6 - 1.3	20 year export license approved
Prince Rupert LNG	[d]	British Columbia	BG Group	2020	14.0 - 21.6	1.8 - 2.8	25 year export license approved
Douglas Channel LNG	[e]	British Columbia	LNG Partners / Haisla Nation /AltaGas	2016	0.9 - 1.8	0.1 - 0.2	20-year export license approved (for 1.8 mmtpa)
WCC LNG	[f]	British Columbia	Exxon Mobil Canada / Imperial Oil Resources	2021	10.0 - 30.0	1.3 - 3.9	25 year export license approved (for 30.0 mmtpa)
Woodfibre LNG	[g]	British Columbia	Woodfibre Natural Gas Limited	2017	2.1	0.3	25 year export license approved
Triton LNG	[h]	British Columbia	AltaGas / Idemitsu Kosan	2017	2.3	0.3	25 year export license approved
Aurora LNG	[i]	British Columbia	CNOOC / INPEX / JGC Exploration Canada	2021	24.0	3.1	25 year export license approved
Kitsault Energy	[j]	British Columbia	Krishnan Suthanthiran	2018	10.0 - 20.0	1.3 - 2.6	Applied for 25 year export license
WesPac Midstream – Vancouver LLC	[k]	British Columbia	WesPac Midstream LLC	2016	3.0	0.4	Applied for 25 year export license
Steelhead LNG	[l]	British Columbia	Steelhead LNG Limited Partnership	2019	30.0	3.9	Applied for 25 year export license
Cedar LNG	[m]	British Columbia	Cedar LNG Export Development Ltd.	2020	14.5	1.9	Applied for 25 year export license
Woodside Energy Holdings Pty Ltd	[n]	British Columbia	Woodside Petroleum Ltd.	2021	15.0 - 20.0	1.9 - 2.6	Applied for 25 year export license
Discovery LNG	[o]	British Columbia	Quicksilver Resources Canada Inc.	2021	5.0 - 20.0	0.6 - 2.6	Applied for 25 year export license
Orca LNG	[p]	British Columbia	Orca LNG Ltd.	2019	24.0	3.1	Applied for 25 year export license
Canada Stewart Energy Group	[q]	British Columbia	Canada Stewart Energy Group Ltd	2017	5.0-30.0	0.6 - 3.9	Application incomplete. Resubmission not filed yet
Goldboro LNG	[r]	Nova Scotia	Pieridae Energy Limited	2019	5.0 - 10.0	0.6 - 1.3	Applied for 20 year export license
Bear Head LNG	[s]	Nova Scotia	Liquefied Natural Gas Limited	2019	12.0	1.6	Applied for 25 year export license
Melford Project	[t]	Nova Scotia	H-Energy	2020	13.5	1.7	Have not applied yet
GNL Québec	[u]	Québec	GNL Québec Inc.	2020	11.0	1.6	Applied for 25 year export license

Australia Ahead of the Pack with ~9 Bcf/d Under Construction



Australian LNG Projects

Project		Status	Owner	Capacity (Bcf/day)	Cost	Online
	[1]	[2]	[3]	[4]	[5]	[6]
North West Shelf Venture	[a]	Operational		2.20		1989
Darwin	[b]	Operational	Conoco	0.48		Early 2006
Pluto	[c]	Operational	Woodside	0.57	$15 Billion	2013
Subtotal	[d]			**3.26**		
Gorgon	[e]	Approved/Under Construction	Chevron	2.08	$57 Billion	2015
Wheatstone	[f]	Approved/Under Construction	Chevron	1.19	$35 Billion	2016
Curtis Island	[g]	Approved/Under Construction	BG	1.13	$34 Billion	2014
Ichthys	[h]	Approved/Under Construction	Inpex	1.12	$43 Billion	Q4 2016
Gladstone	[i]	Approved/Under Construction	Santos	1.04	$30 Billion	2015
PNG LNG	[j]	Approved/Under Construction	Exxon	0.92	$19 Billion	2014
Australia Pacific	[k]	Approved/Under Construction	Conoco/Origin	1.20	$37 Billion	2015
Prelude	[l]	Approved/Under Construction	Shell	0.48		
Subtotal	[m]			**9.17**		
Browse	[n]	Proposed	Woodside	1.60		
Shell/Arrow	[o]	Proposed	Shell/Petrochina	1.07	$20 Billion	2017
Interoil LNG	[p]	Proposed	Interoil	1.07	$7 Billion	2015
Asia Pacific	[q]	Proposed	Conoco/Origin	0.60		
Pluto 2	[r]	Proposed	Woodside	0.57	$15 Billion	
Subtotal	[s]			**4.91**		
Grand Total	[t]			**17.33**		

Sources:
Reuters, CNN Money, Bloomberg.

- Australian LNG projects facing substantial cost overruns and competitive pressures
- Korea Gas has reportedly walked away from a non-binding agreement to purchase 1.5 mmtpa (~200 MMcf/d) from Gorgon LNG
- Only 65% of Chevron's share of Gorgon LNG is committed under long-term contracts
- Asian buyers looking for cheaper source of supply