

Energy for the 21st Century: Opportunities and Challenges for LNG

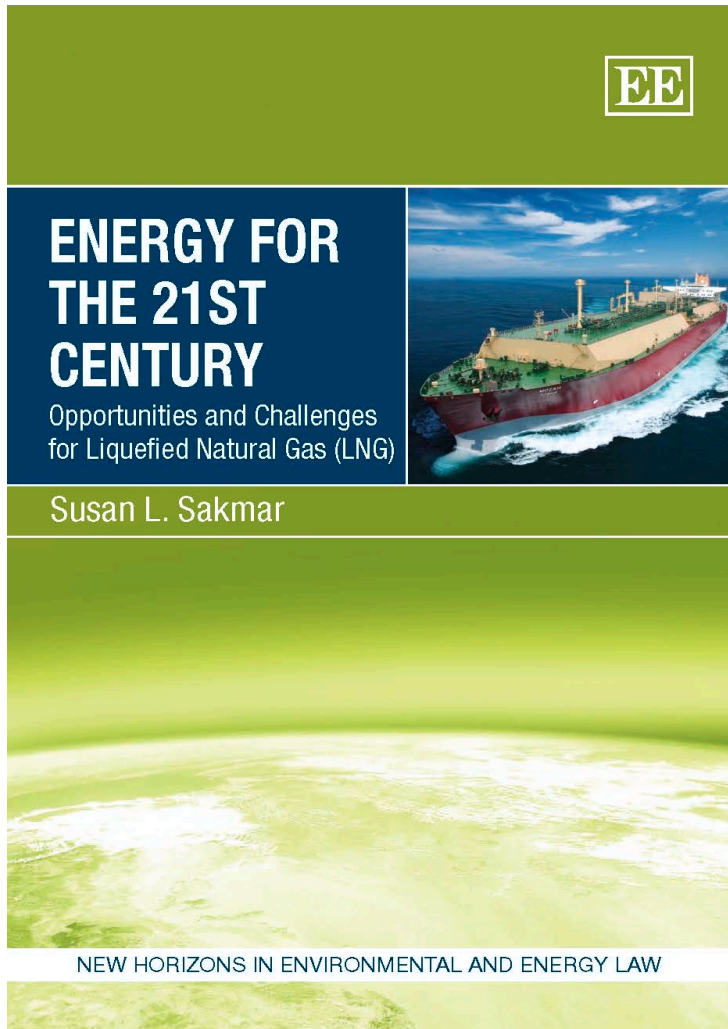
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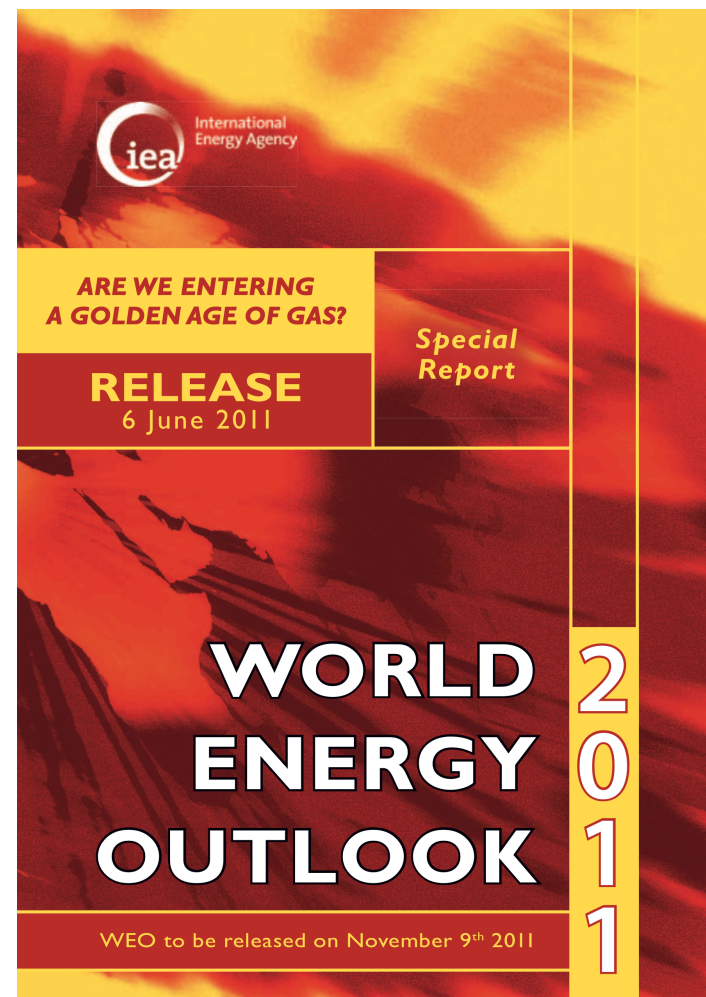
The Most Recent LNG Book



1. The Golden Age of Gas.
2. The role of LNG as the “glue” linking global gas markets.
3. The globalization of LNG.
4. The commoditization of LNG?
5. The future of oil linked prices.
6. US LNG Exports.

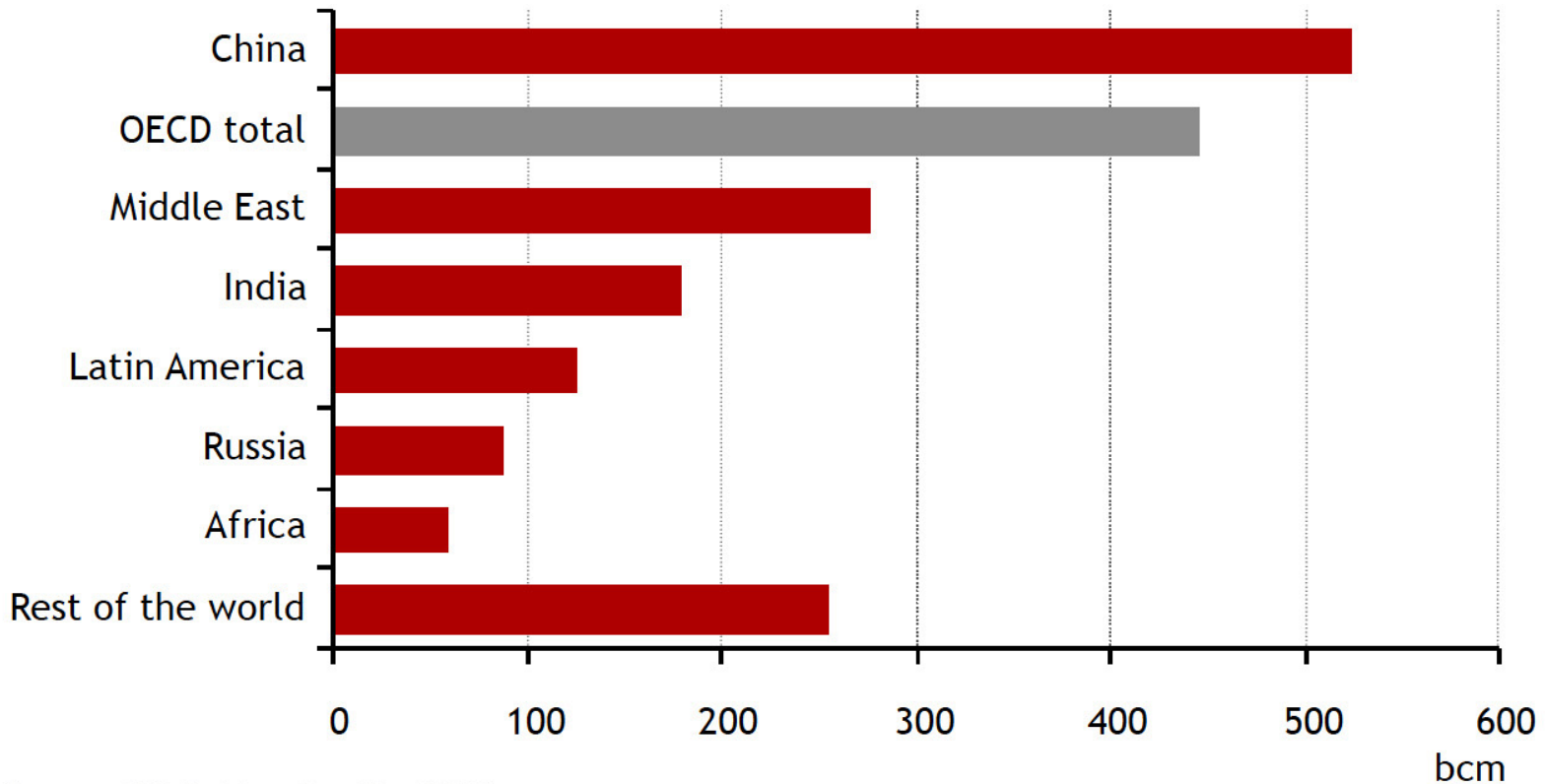
The Golden Age of Gas

- Growth in demand.
- Japan's Fukushima.
- Natural gas for transportation.
- Energy Poverty.
- Shale Gas.
- Expansion of LNG trade.



Natural Gas Consumption

Increase in natural gas consumption in the GAS scenario, 2010-2035

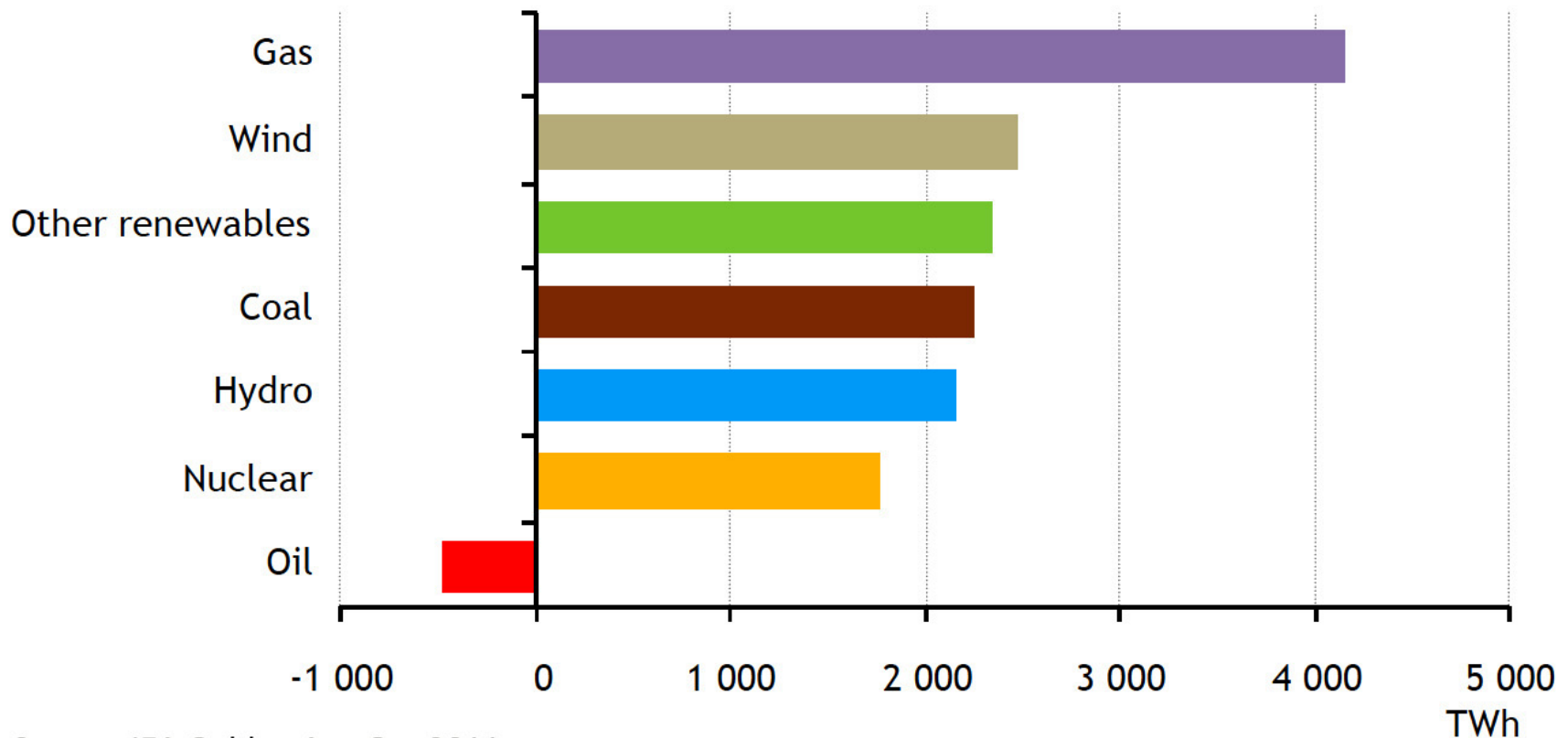


Source: IEA Golden Age Gas 2011

Non-OECD countries account for 80% of demand growth – China alone makes up nearly 30% of global growth & uses as much gas as the EU by 2035

Power Sector Drives Gas Demand

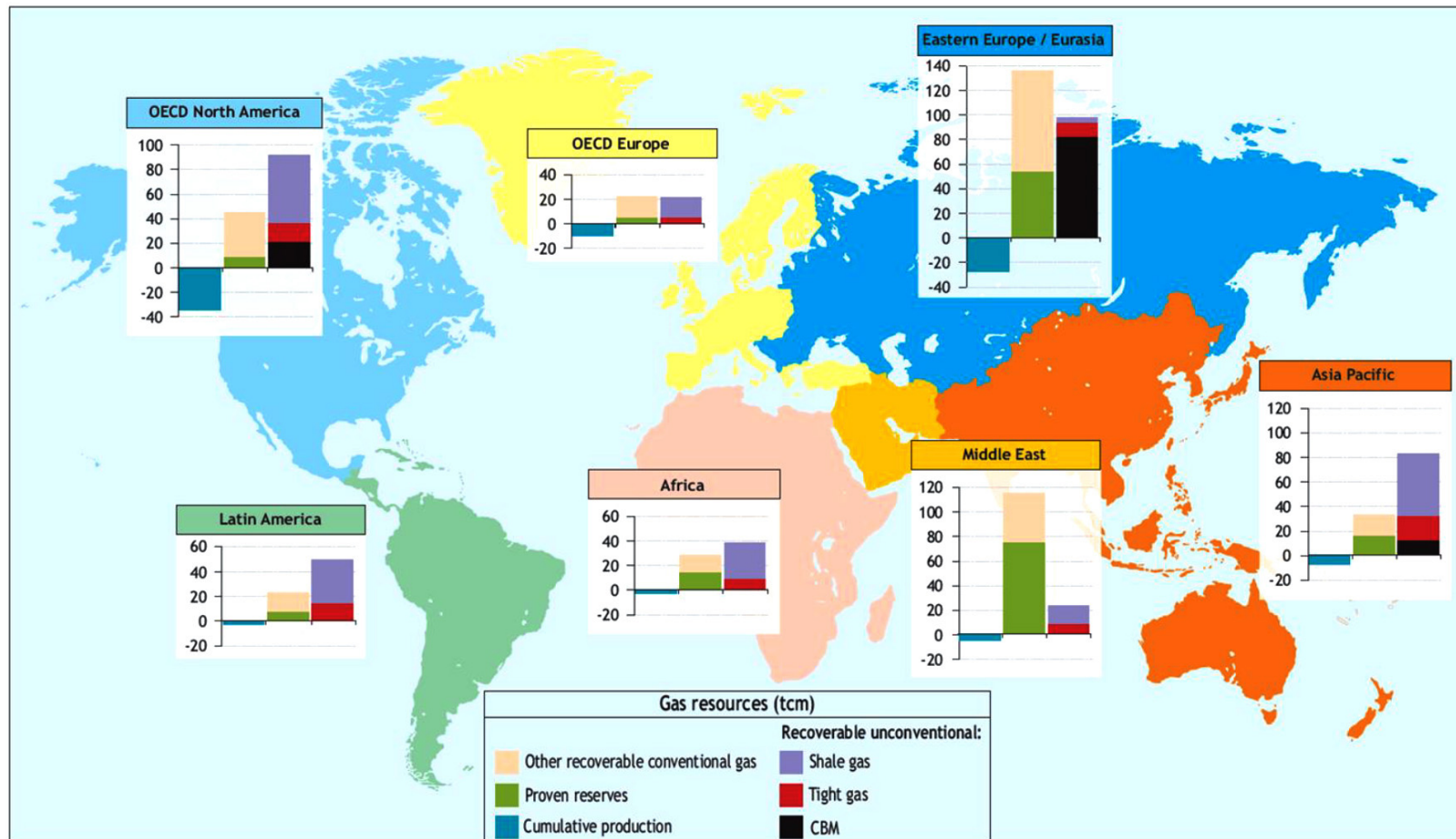
Change in power generation by fuel in the GAS scenario, 2010-2035



Source: IEA Golden Age Gas 2011

Total electricity demand increases 70% by 2035, underpinned by a near doubling of gas-fired generation

A World of Opportunity



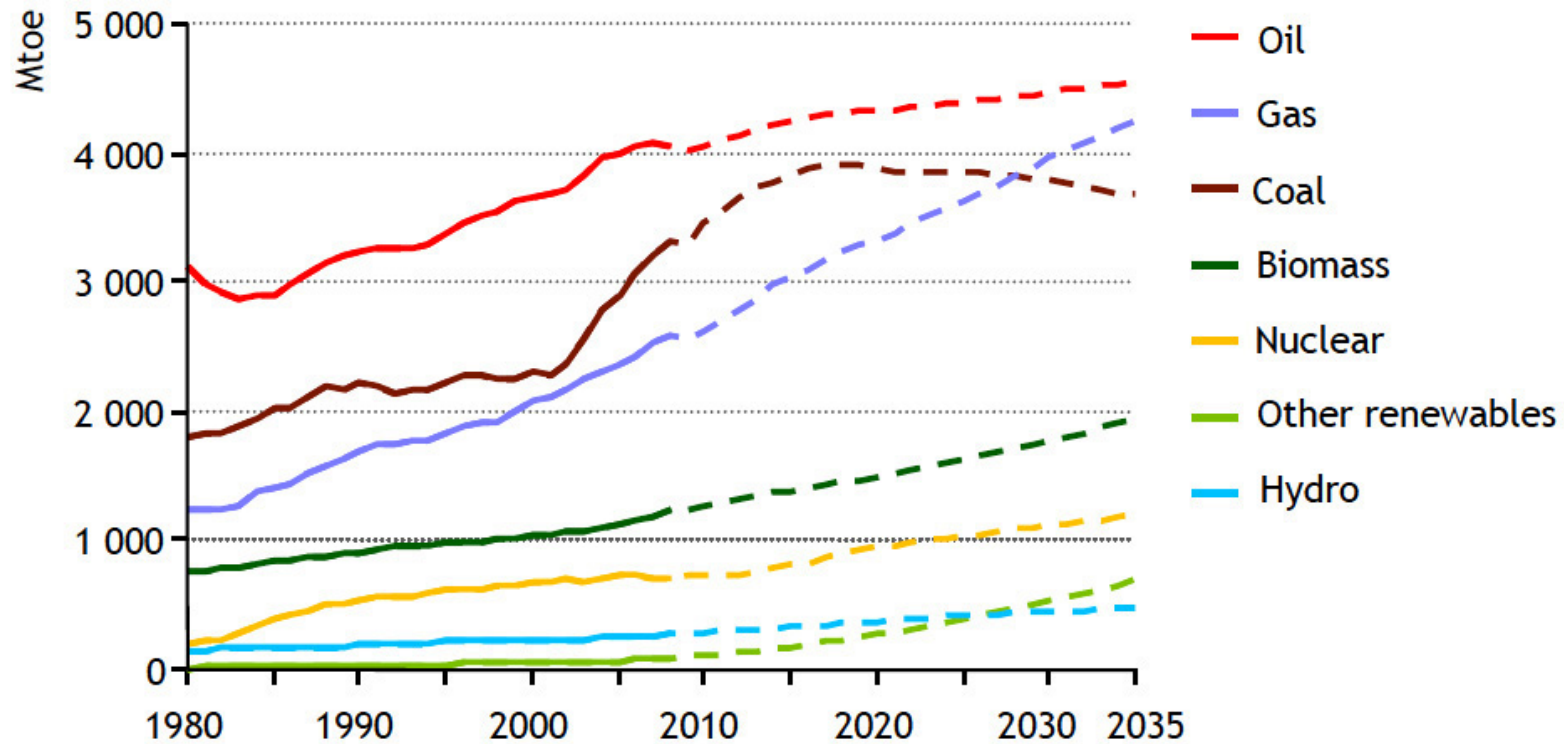
This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map.

Source: IEA Golden Age Gas 2011

Natural gas can enhance security of supply: global resources exceed 250 years of current production; while in each region, resources exceed 75 years of current consumption

The Golden Age of Gas

World primary energy demand by fuel in the GAS Scenario

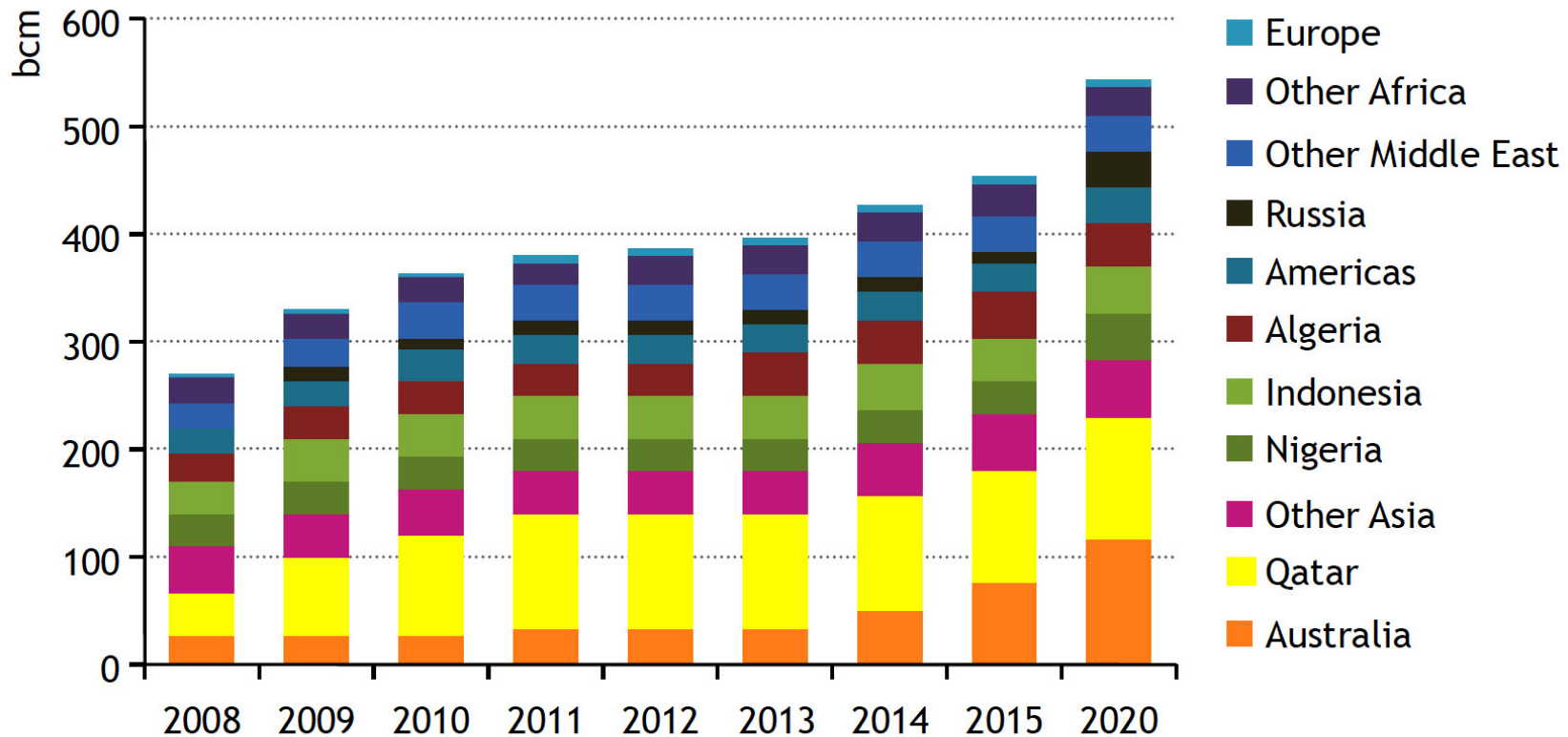


Source: IEA Golden Age Gas 2011

Gas meets 25% of global energy demand by 2035

LNG Supply Is Growing

Projected LNG liquefaction capacity by country

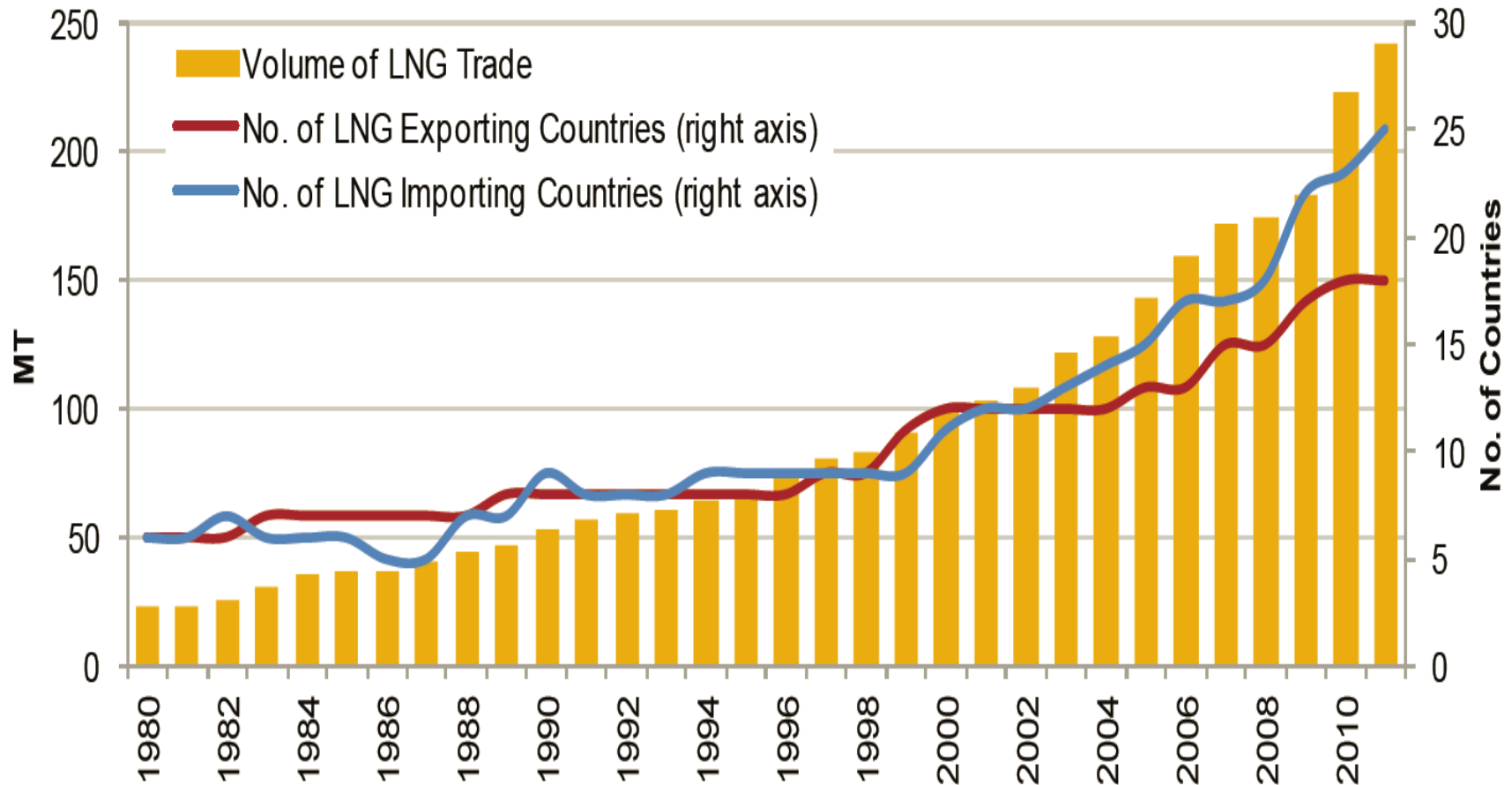


Source: IEA Golden Age Gas 2011

Trade in natural gas between major regions doubles to over 1 tcm by 2035, with Australia becoming a leading LNG supplier

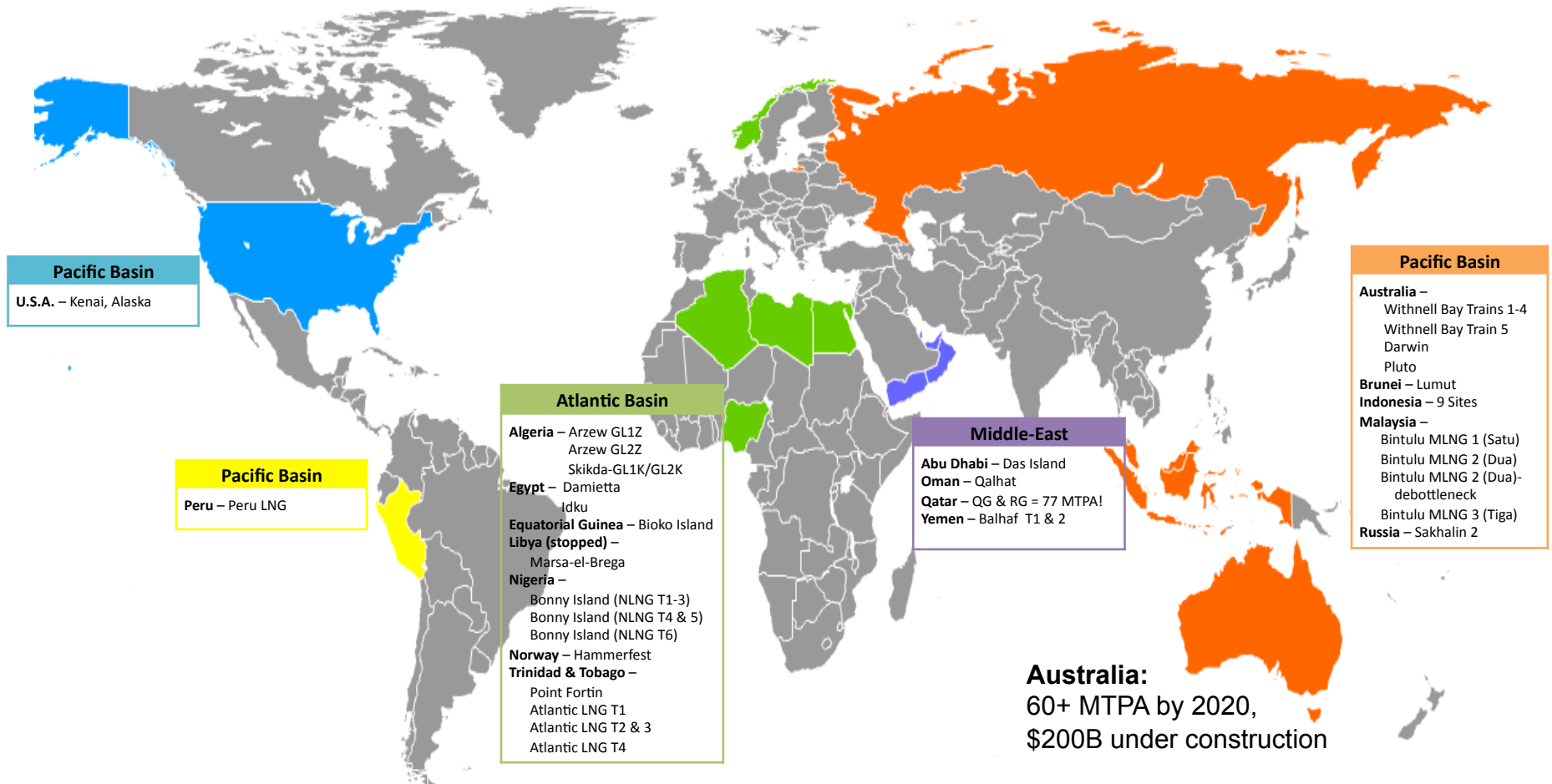
LNG Trade Is Growing

LNG Trade Volumes, 1980-2011



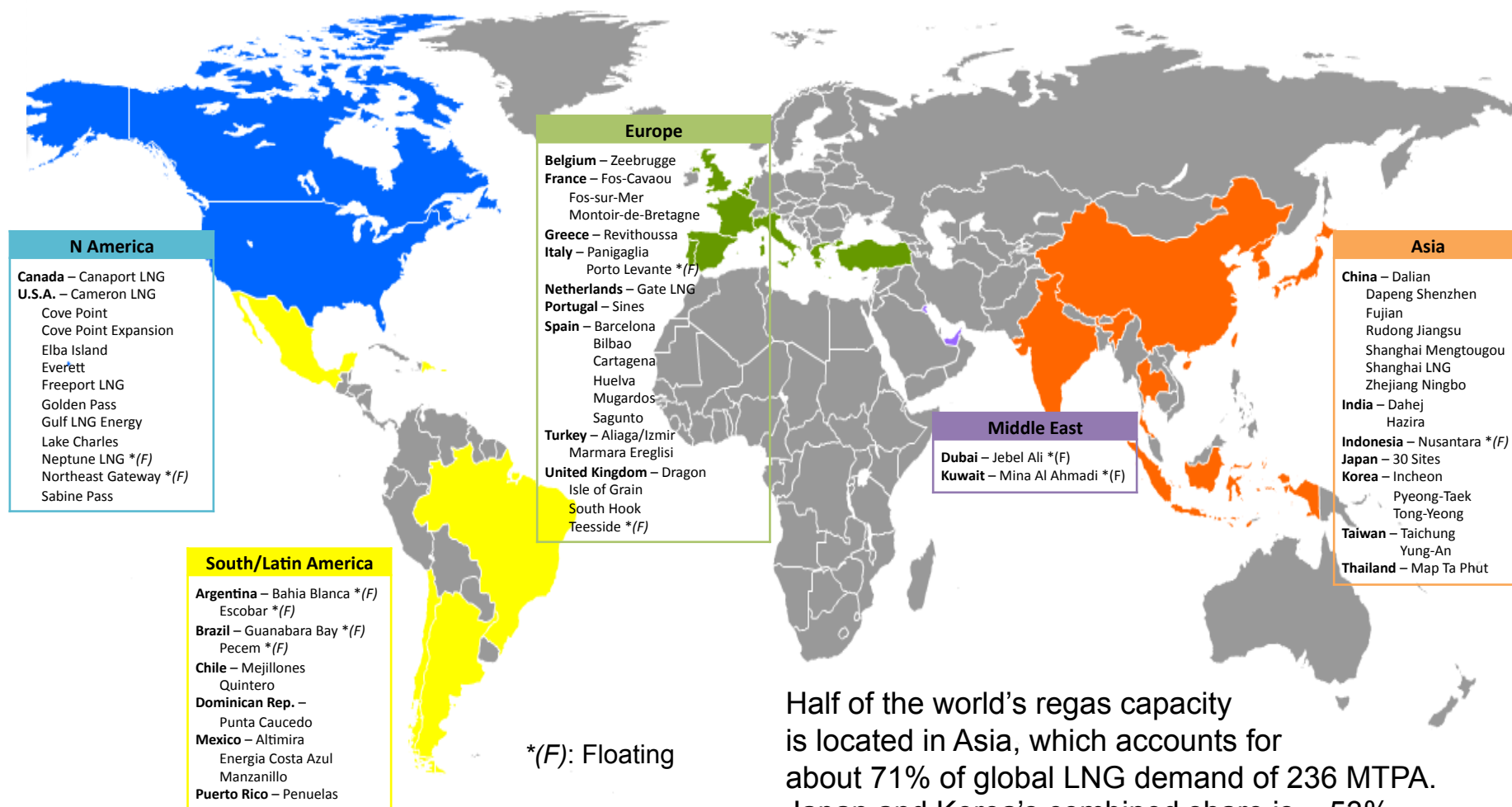
Liquefaction Plants 2012

89 liquefaction trains (282 MTPA) in operation in 18 exporting countries + more planned!



Regasification Terminals 2012

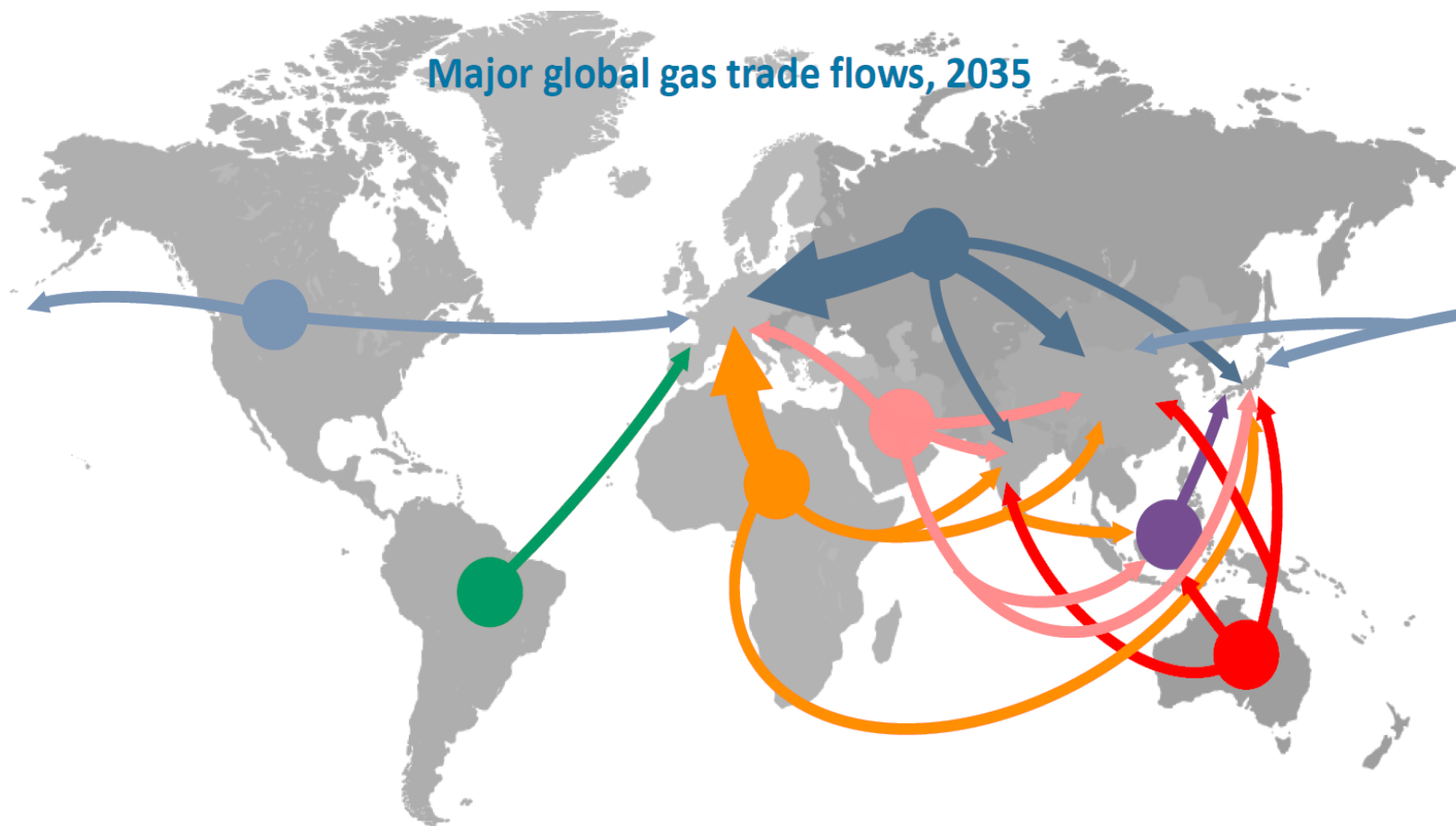
93 LNG regas terminals (668 MPTA) in 26 importing countries + more planned!



Half of the world's regas capacity is located in Asia, which accounts for about 71% of global LNG demand of 236 MTPA. Japan and Korea's combined share is ~ 53%.

LNG Is The Glue!

Increased supplies of unconventional gas and LNG help to diversity trade flows, putting pressure on suppliers and oil-linked pricing mechanisms.



Source: IEA WEO 2012

Globalized But Not Yet Commoditized!

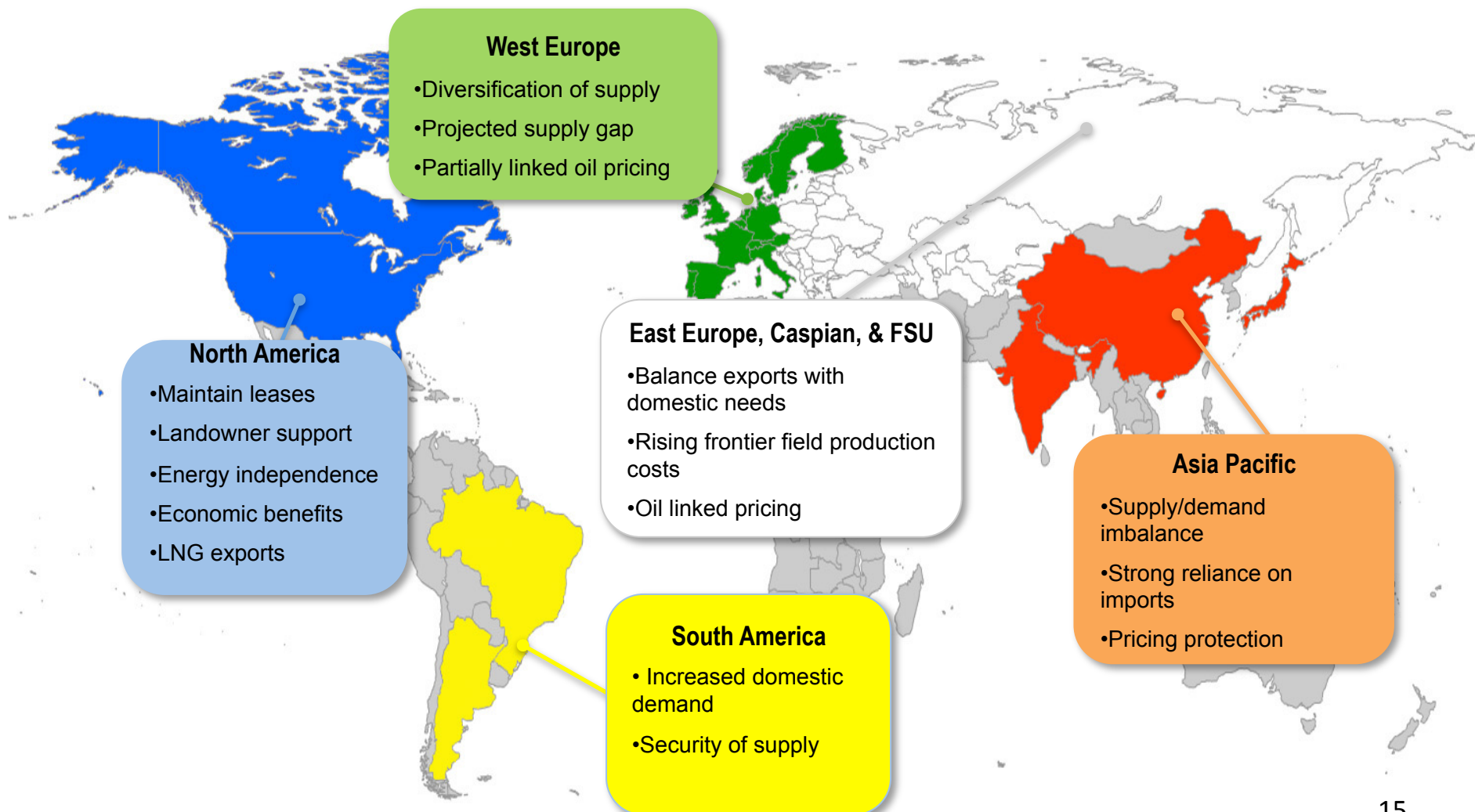
World LNG Estimated March 2013 Landed Prices (\$US/MMBtu)



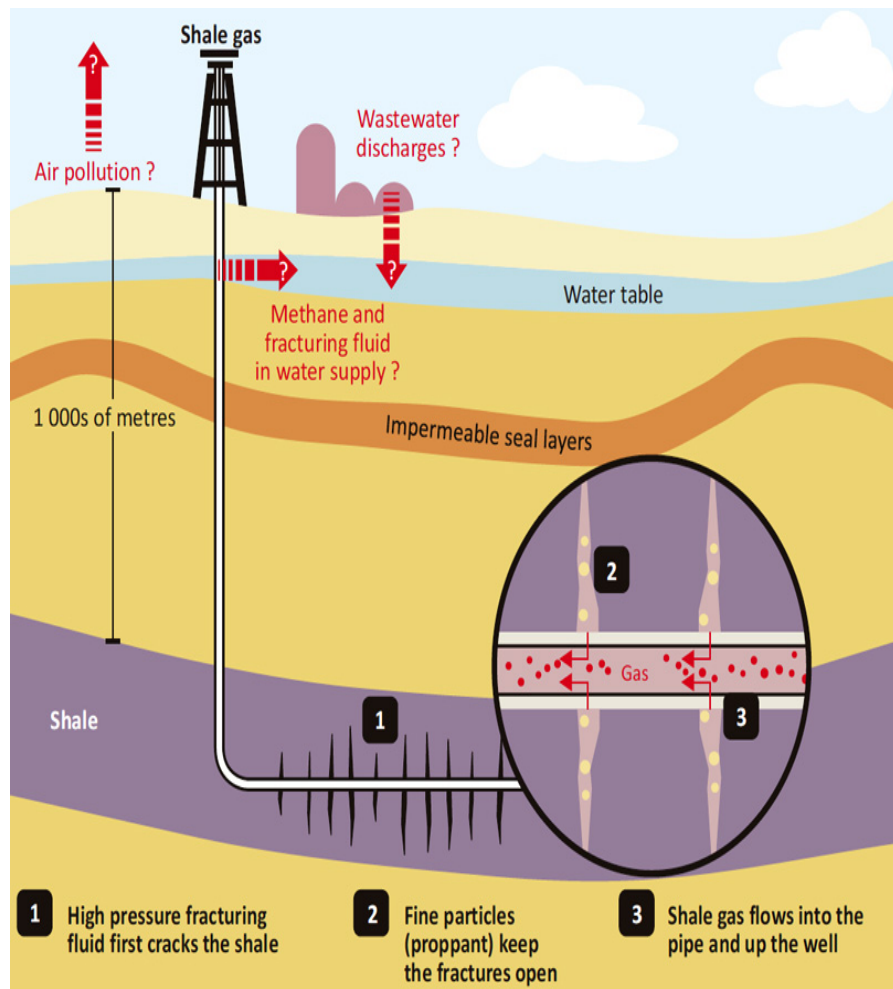
Will Shale go Global?



Global Shale Gas Drivers

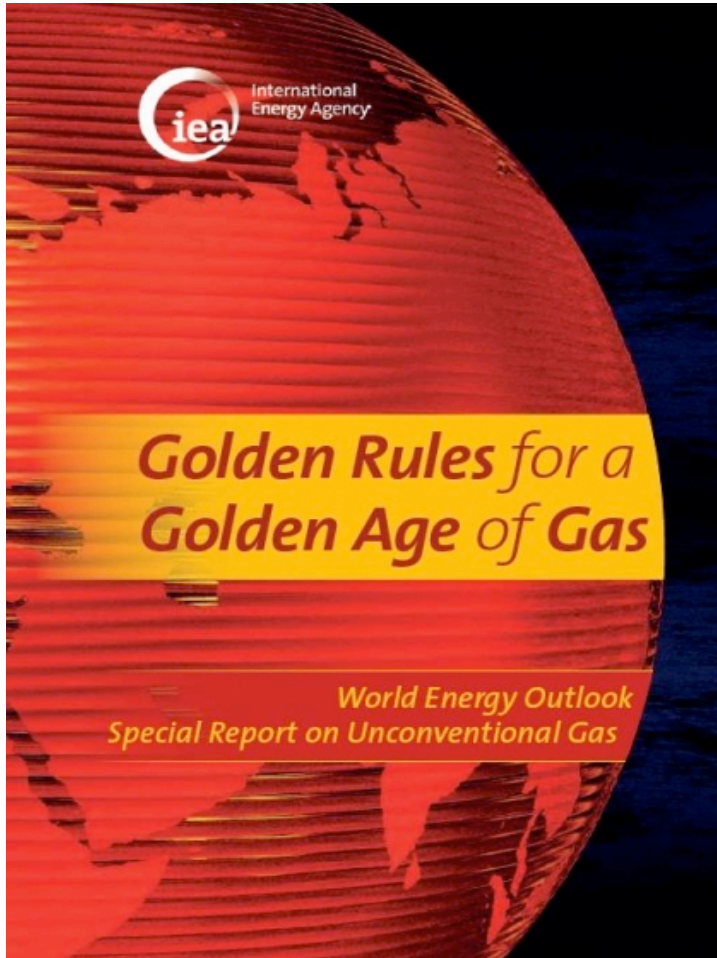


Environmental Concerns



- Water Lifecycle
 - Water Use
 - Water Disposal
 - Water Contamination
- Well Integrity
- Disclosure of Chemicals
- Induced Seismicity – Earthquakes
- Emissions

Golden Rules

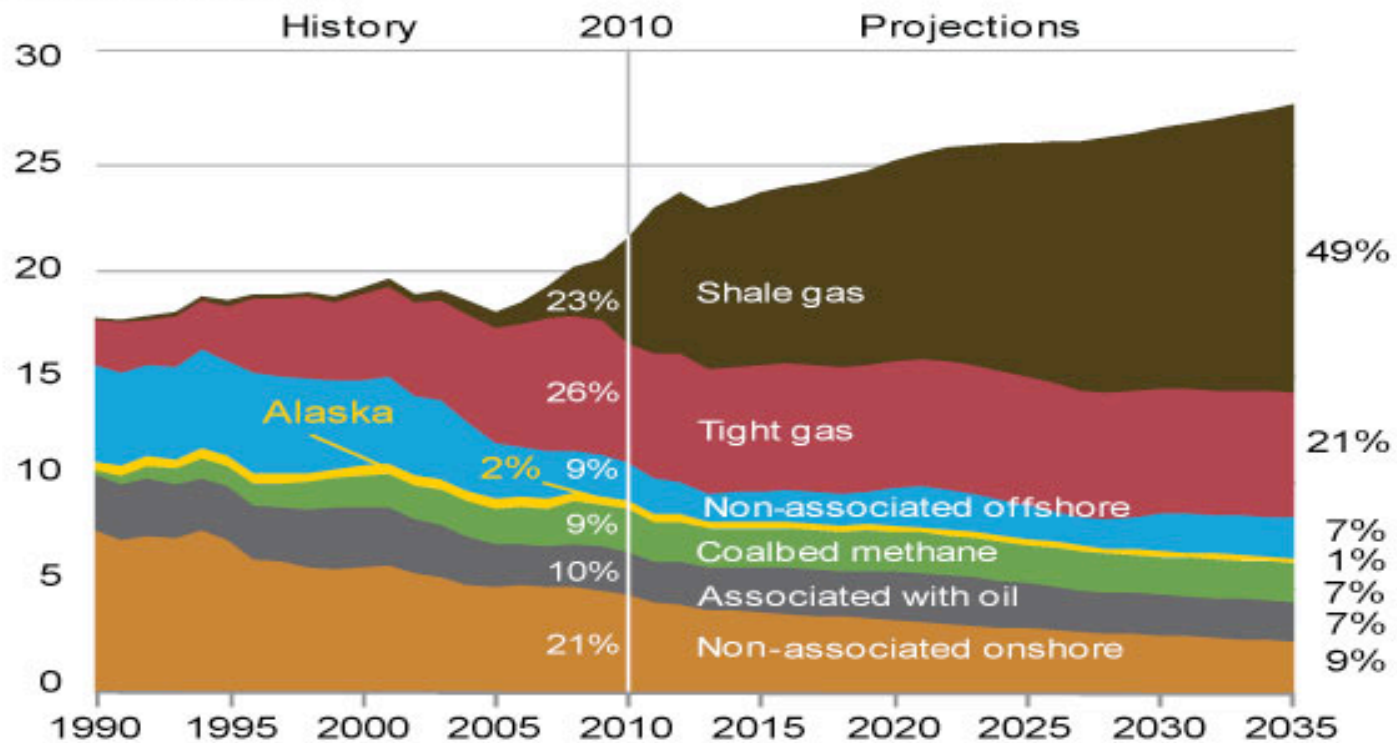


- Measure, disclose & engage
- Watch where you drill
- Isolate well & prevent leaks
- Treat water responsibly
- Eliminate venting, minimise flaring & other emissions
- Be ready to think big
- Ensure a consistently high level of environmental performance.

A Golden Age for the US

U.S. Natural Gas Production, 1990-2035

trillion cubic feet



Source: U.S. Energy Information Administration, AEO2012 Early Release Overview, January 23, 2012.

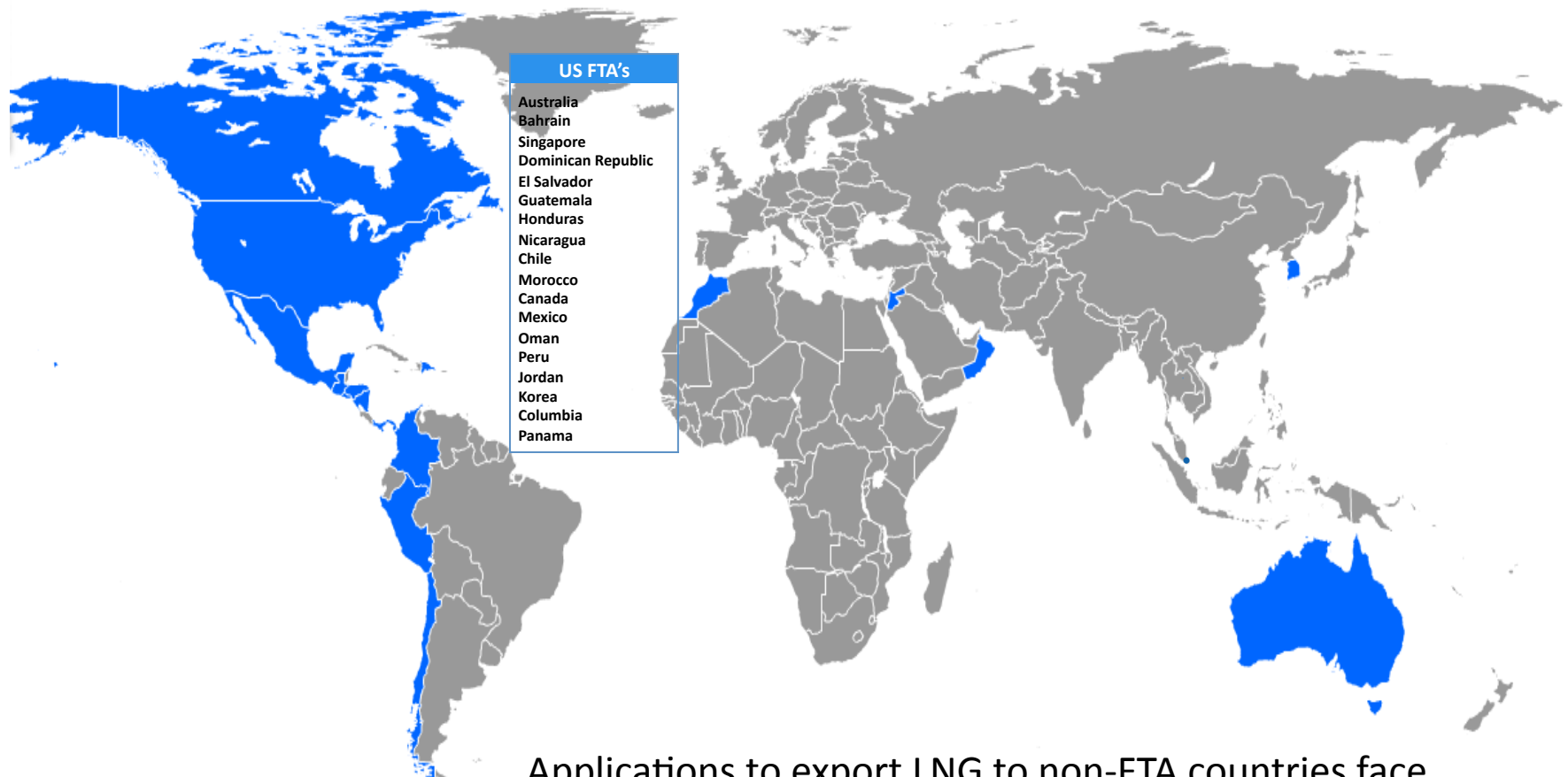
From Shale to LNG Exports



- Exports provide markets for US over-supply.
- Low utilization of US LNG terminals (~10%).
- Market fundamentals:
 - ✓ Low Henry Hub (HH) price
 - ✓ High oil price
 - ✓ Abundant US supply
- Exports provide customers with access to US natural gas supply at HH pricing.
- Need export permits from DOE/FE and FERC approval for liquefaction facilities.

Export Approval - FTA v. Non-FTA

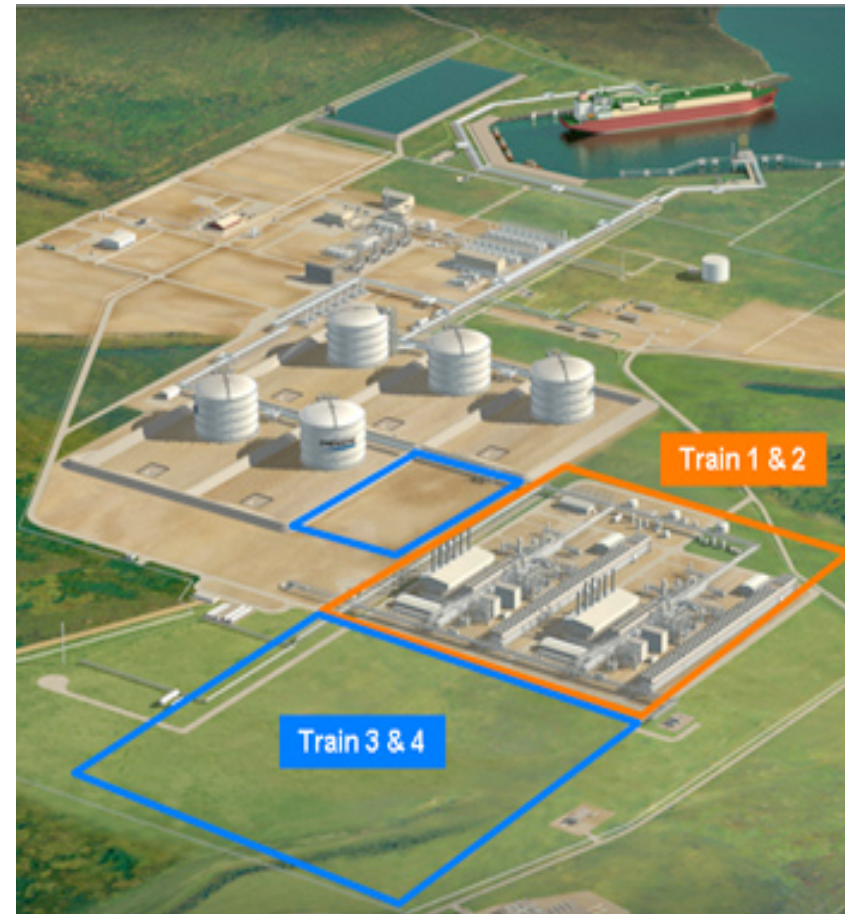
Applications to export LNG to FTA nations are deemed to be in the public interest and must be granted without modification or delay by the DOE.



Applications to export LNG to non-FTA countries face greater scrutiny and “public interest determination.”





Sabine Pass Liquefaction

- DOE export approval for up to 4 trains with total capacity of approx. 16 mtpa for 20 year period to non-FTA countries.
- World's first bi-directional facility.
- Est. start-up 2015+.



Sabine Pass LT Contracts

Long-term, “take-or-pay” style commercial contracts equating to ~16 mtpa

	 BG GROUP BG Gulf Coast LNG ⁽¹⁾	 Gas Natural Fenosa ⁽¹⁾	 Korea Gas Corporation	 GAIL (India) Limited ⁽¹⁾
Annual Contract Quantity (MMBtu)	286,500,000	182,500,000	182,500,000	182,500,000
Annual Revenue	~\$723 MM	~\$454 MM	~\$548 MM	~\$548 MM
Revenue \$/MMBtu ⁽²⁾	\$2.25 - \$3.00	\$2.49	\$3.00	\$3.00
Term ⁽⁴⁾	20 years	20 years	20 years	20 years
Guarantor	BG Energy Holdings Ltd.	Gas Natural SDG S.A.	Korea Gas Corporation	N/A
Guarantor Credit Rating ⁽³⁾	A2/A	Baa2/BBB	A / A1	Baa2/NR/BBB-
Fee During Force Majeure	Up to 24 months	Up to 24 months	N/A	N/A
Contract Start Date	Train 1 + additional volumes with Trains 2,3,4	Train 2	Train 3	Train 4

Price Impact of US LNG Exports

Study-by-study comparison of the Average Price Impact from 2015-2035 of 6 bcf/day of LNG exports (unless otherwise noted)

Study	Average Price without Exports (\$/MMBtu)	Average Price with Exports (\$/MMBtu)	Average Price Increase (%)
EIA*	\$5.28	\$5.78	9%
Deloitte	\$7.09	\$7.21	2%
Navigant (2010)** (2 bcf/day of exports)	\$4.75	\$5.10	7%
Navigant (2012)***	\$5.67	\$6.01	6%
ICF International***	\$5.81	\$6.45	11%

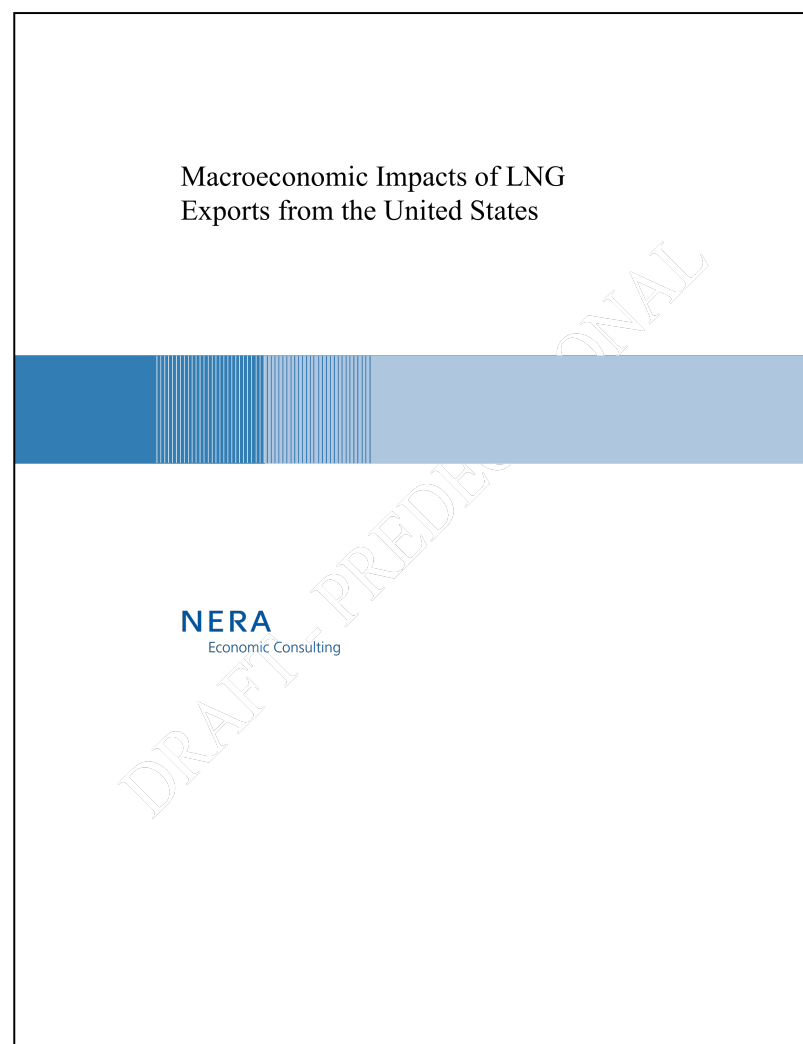
* Price impact figure for EIA study reflects the reference case, low-slow export scenario.

** The Navigant study did not analyze exports of 6 bcf/day.

*** Navigant (2010 and 2012) and ICF International studies are based on Henry Hub price.

Benefits of Exports

- Released on December 5th, 2012.
- All scenarios studied concluded "net economic benefits from allowing LNG exports" for the US.
- Net economic benefits increase as level of LNG exports increases.
- Public comment period closed Jan. 24, 2013, reply briefs Feb. 25, 2013.



Opposition to US LNG Exports

American jobs rely on a balanced energy policy

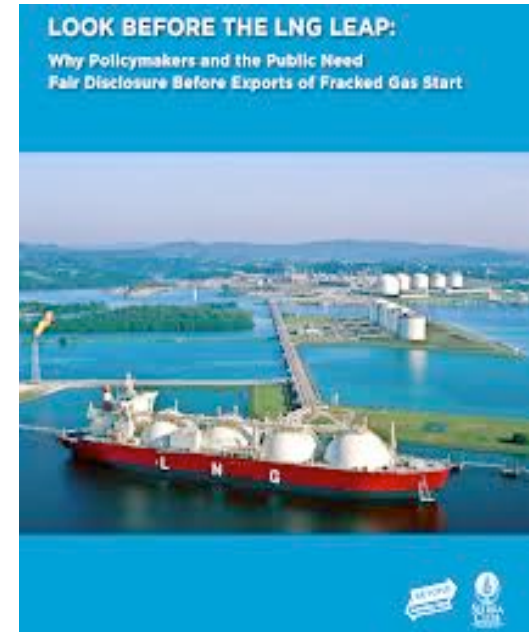
The U.S. Department of Energy is considering applications for the export of liquefied natural gas (LNG). **When we use natural gas at home, manufacturing thrives and more jobs are created as compared to simply exporting this valuable resource.** For example:

For every 5 bcf/d* of natural gas used as raw material and energy for American manufacturing ...	Exporting the same amount of gas ...
we'd create 180,000 new American jobs	would create 22,000 new American jobs
\$4.9 billion	\$2.3 billion
we'd add \$4.9 billion directly to the U.S. economy.	would add \$2.3 billion directly to the U.S. economy.
Using domestic natural gas in manufacturing has a broad national impact.	Exporting natural gas focuses benefits on a few port cities.
Ongoing employment expected from investing 5 bcf/d of natural gas in U.S. manufacturing.	Ongoing employment expected from 5 bcf/d of natural gas exported.

Share this infographic

Source: "US Manufacturing and LNG Exports: Economic Contributions to the US Economy and Impacts on US Natural Gas Prices" — Charles River Associates, February 23, 2013. Read the full report: www.americasenergyadvantage.com/CRA

America's Energy Advantage



Pending Export Applications

**Applications Received by DOE/FE to Export Domestically Produced LNG
from the Lower-48 States (as of October 12, 2012)**

All Changes Since September 21, 2012 Update Are In Red

Company	Quantity ^(a)	FTA Applications ^(b) (Docket Number)	Non-FTA Applications ^(c) (Docket Number)
Sabine Pass Liquefaction, LLC	2.2 billion cubic feet per day (Bcf/d) ^(d)	Approved (10-85-LNG)	Approved (10-111-LNG)
Freeport LNG Expansion, L.P. and FLNG Liquefaction, LLC	1.4 Bcf/d ^(d)	Approved (10-160-LNG)	Under DOE Review (10-161-LNG)
Lake Charles Exports, LLC	2.0 Bcf/d ^(e)	Approved (11-59-LNG)	Under DOE Review (11-59-LNG)
Carib Energy (USA) LLC	0.03 Bcf/d: FTA 0.01 Bcf/d: non-FTA ^(f)	Approved (11-71-LNG)	Under DOE Review (11-141-LNG)
Dominion Cove Point LNG, LP	1.0 Bcf/d ^(d)	Approved (11-115-LNG)	Under DOE Review (11-128-LNG)
Jordan Cove Energy Project, L.P.	1.2 Bcf/d: FTA 0.8 Bcf/d: non-FTA ^(e)	Approved (11-127-LNG)	Under DOE Review (12-32-LNG)
Cameron LNG, LLC	1.7 Bcf/d ^(d)	Approved (11-145-LNG)	Under DOE Review (11-162-LNG)
Freeport LNG Expansion, L.P. and FLNG Liquefaction, LLC ^(b)	1.4 Bcf/d ^(d)	Approved (12-06-LNG)	Under DOE Review (11-161-LNG)
Gulf Coast LNG Export, LLC ⁽ⁱ⁾	2.8 Bcf/d	Pending Approval (12-05-LNG)	Under DOE Review (12-05-LNG)
Gulf LNG Liquefaction Company, LLC	1.5 Bcf/d ^(d)	Approved (12-47-LNG)	Under DOE Review (12-101-LNG)
LNG Development Company, LLC (d/b/a Oregon LNG)	1.25 Bcf/d ^(d)	Approved (12-48-LNG)	Under DOE Review (12-77-LNG)
SB Power Solutions Inc.	0.07 Bcf/d	Approved (12-50-LNG)	n/a
Southern LNG Company, L.L.C.	0.5 Bcf/d ^(d)	Approved (12-54-LNG)	Under DOE Review (12-100-LNG)
Excelerate Liquefaction Solutions I, LLC	1.38 Bcf/d	Approved (12-61-LNG)	Under DOE Review (12-146-LNG)
Golden Pass Products LLC	2.6 Bcf/d	Approved (12-88-LNG)	n/a
Cheniere Marketing, LLC	2.1 Bcf/d ^(d)	Pending Approval (12-99-LNG)	Under DOE Review (12-97-LNG)
Main Pass Energy Hub, LLC	3.22 Bcf/d	Pending Approval (12-114-LNG)	n/a
CE FLNG, LLC	1.07 Bcf/d ^(d)	Pending Approval (12-123-LNG)	Under DOE Review (12-123-LNG)
Waller LNG Services, LLC	0.16 Bcf/d	Pending Approval (12-152-LNG)	n/a
Total of all Applications Received		27.58 Bcf/d	21.06 Bcf/d

On Hold



LNG Export Madness

US LNG Exports: March Madness and the Road to the Final Four Projects

Sweet 16 *	Elite Eight	Final Four	Championship	Winners
<p>(1) Freeport LNG Expansion, L.P. & FLNG Liquefaction, LLC (1.4 Bcf/d) Freeport filed its DOE application on 12/17/2010, soon after Cheniere filed for Sabine Pass. With eager Japanese buyers (Osaka Gas Co and Chubu Electric Power Co.), Freeport has been impatiently waiting. The DOE's approval of at least this project would have the added benefit of relieving some of the political pressure on the White House to approve exports to Japan.</p> <p>(16) Pangea LNG (North America) Holdings, LLC (1.09 Bcf/d)</p>	<p>(1) Freeport LNG Expansion</p>	<p>(1) Freeport LNG Expansion</p>	<p>(1) Freeport</p>	
<p>(8) Cheniere Marketing, LLC (2.1 Bdf/d) Cheniere Marketing filed for approval for a proposed export facility at Corpus Christi. Excelerate is seeking to build out a portfolio of FLNG projects. Because Cheniere was savvy enough to get Sabine Pass done, I'm giving this close match to Cheniere's Corpus Christi. I also predict Cheniere will move forward on this project on the basis of FTA approval alone - especially if the process continues to be bogged down by a Rulemaking. Excelerate may also be able to move forward on an FTA only basis as well.</p> <p>(9) Excelerate Liquefaction Solutions J, LLC (1.38 Bcf/d)</p>	<p>(8) Cheniere - Corpus Christi</p>			
<p>(5) Cameron LNG, LLC (1.7 Bcf/d) Cameron LNG, a wholly owned subsidiary of Semptra Energy, has commitments for the full capacity of 3 trains with total export capability of 12 Mtpa with Mitsubishi, Mitsui and GDF SUEZ. Shell and Southern Liquefaction, a Kinder Morgan company, intends to form a LLC to develop the LNG facility in two phases at Southern LNG's existing Elba Island LNG Import Terminal near Savannah, Georgia. This is the closest match of all of the export projects but I'm giving it to Cameron because it's higher on the list.</p> <p>(12) Southern LNG Company, L.L.C. (0.5 Bcf/d)</p>	<p>(5) Cameron</p>	<p>(5) Cameron</p>		
<p>(4) Freeport LNG Expansion L.P. & FLNG Liquefaction, LLC (1.4 Bcf/d) It's not entirely clear how DOE intends to process the multiple Freeport applications which were apparently filed to request additional amounts. Since Freeport (1) advanced, I'm giving this to Gulf LNG which is looking to add liquefaction facilities to an existing import terminal near Pascagoula, Mississippi.</p> <p>(13) Gulf LNG Liquefaction Company, LLC (1.5 Bdf/d)</p>	<p>(13) Gulf LNG</p>			
<p>(6) Jordan Cove Energy Project, L.P. (1.2 Bcf/d: FTA, 0.8 Bcf/d: non-FTA) All LNG projects in Oregon, whether import or export, are challenging due to community opposition so I'm giving this to Gulf Coast. The majority owner of Gulfoast is Michael Smith who is also founder and CEO of Freeport.</p> <p>(11) Gulf Coast LNG Export, LLC (2.8 Bcf/d)</p>	<p>(11) Gulf Coast</p>			
<p>(3) Dominion Cove Point LNG, LP (1.0 Bcf/d) Dominion's Cove Point is an existing LNG import terminal that has always faced community opposition backed by the local (Maryland) chapter of the Sierra Club. Despite the opposition, Dominion recently announced it has fully subscribed the marketed capacity of the project to Pacific Summit Energy, a US affiliate of Japanese trading company Sumitomo, and GAIL Global, a US affiliate of GAIL (India). CE FLNG focus is on exporting LNG from the US to small and mid-size power generation markets where there is no natural gas pipeline.</p> <p>(14) CE FLNG, LLC (1.07 Bcf/d)</p>	<p>(3) Dominion</p>	<p>(3) Dominion</p>		
<p>(7) LNG Development Company, LLC (d/b/a Oregon LNG) (1.25 Bdf/d) Carib Energy plans to transport LNG from liquefaction facilities using approved 40-foot LNG ISO containers transported on ocean-going carriers. There are other similar small-scale projects pending and it's not clear how DOE intends to process these.</p> <p>(10) Carib Energy (USA) LLC (0.03 Bcf/d: FTA, 0.01 Bdf/d: non-FTA)</p>	<p>(10) Carib Energy</p>		<p>(2) Lake Charles</p>	
<p>(2) Lake Charles Exports, LLC (2.0 Bcf/d) Trunkline LNG et al, subsidiaries of Southern Union Company are second in line for approval of their 3 train, 15 mtpa project. Southern Union Co. and BG Group have created Lake Charles Exports to export the LNG to foreign countries. Because BG is a portfolio player, it's possible this project moves forward on the FTA approval only. Golden Pass is an existing LNG import terminal with big sponsors - Qatar Petroleum and ExxonMobil. But because the project is so far down the list, I predict Golden Pass will not move forward and Exxon will focus its efforts on my Wildcard pick - The Alaska LNG Project.</p> <p>(15) Golden Pass Products LLC</p>	<p>(2) Lake Charles Exports</p>			

Sabine Pass Liquefaction

In this hard fought battle of projects, Cheniere's Sabine Pass is the hands down winner being the first to identify the opportunity to export and the first to obtain DOE approval to export to non-FTA countries. But, Cheniere has had the first mover advantage before so let's hope it goes better this time around.

Freeport LNG Expansion

Rulemaking? While all four of the Final Four are solid projects, I predict it is only a matter of time before the Sierra Club and/or the manufacturers file a Petition for Rulemaking with the DOE.

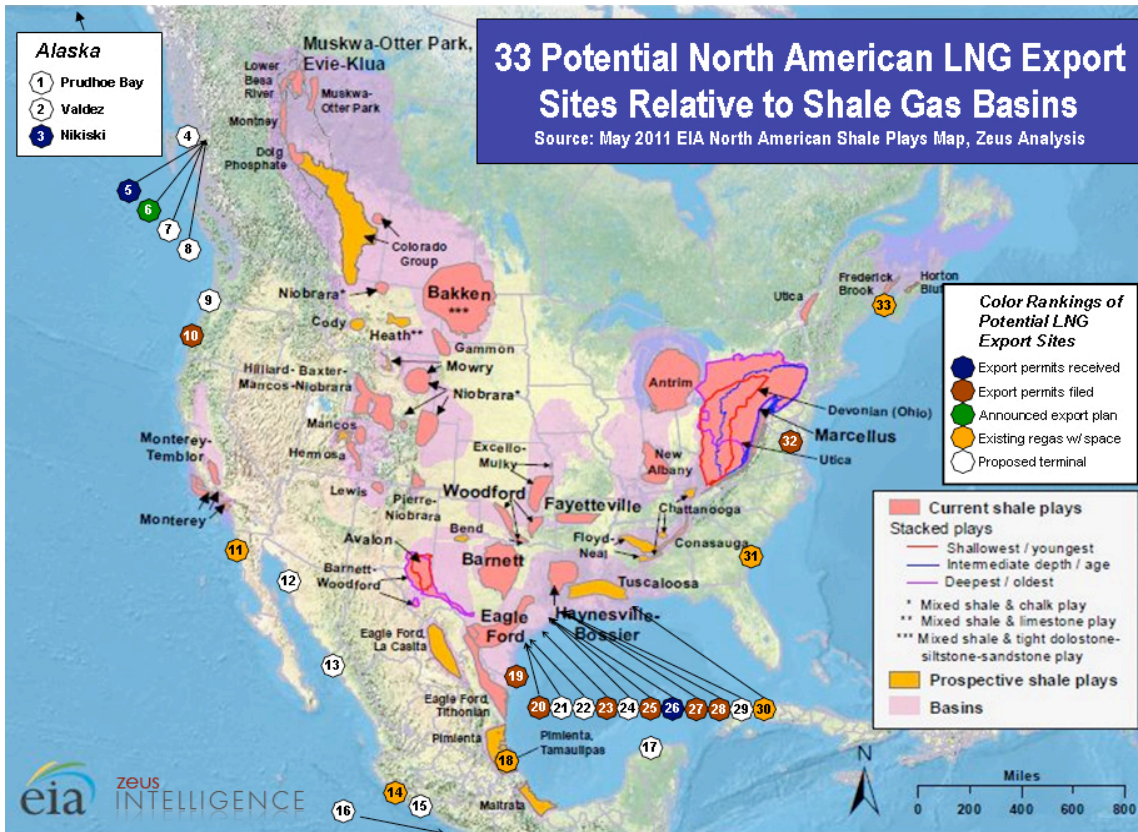
What's this? In this context, it would be a Petition requesting DOE to clarify its policies and procedures regarding the approval process for LNG exports. Since the process is no doubt unclear, I suspect DOE would have to grant the Petition. This would delay the approval process even further and require public comment periods. At best, DOE might approve Freeport before the Petition is filed and possibly Lake Charles at the same time.

WILDCARD: ALASKA LNG Project

The Alaska LNG Project is my Wildcard pick of projects. ExxonMobil, ConocoPhillips, BP and TransCanada are assessing a \$45-60 billion, 15-18 mtpa LNG export project that includes a gas treatment plant on Alaska's North Slope, a roughly 800-mile pipeline, and a liquefaction plant at a site TBD. While still in the early stages, this project is close to key Asia-Pacific markets if the price and timing is right. This project falls under a different regulatory process and requires a "Presidential permit" to be issued before exports are allowed. This permit may turn out to be easier to get than the DOE/FE permit for non-FTA countries.

* Sweet 16: The DOE has indicated it will process export applications in the order that the applicant received FERC Approval to begin the pre-filing process. What about the rest of the projects? It's not quite clear but presumably, the DOE will decide these AFTER ruling on the Sweet 16.

Will the U.S. be the next Qatar?



Proposed Projects ~ 176+ MTPA



77 MTPA

Contact Information

NEW FROM EDWARD ELGAR PUBLISHING

ENERGY FOR THE 21ST CENTURY

Opportunities and Challenges for Liquefied Natural Gas (LNG)

Susan L. Sakmar, University of Houston Law Center and University of San Francisco School of Law, US

'Professor Sakmar's book is a must read for anyone interested in gaining a better understanding of the most dynamic segment of the global energy industry.'

— Jay Copan, Executive Director, LNG 17

Countries around the world are increasingly looking to liquefied natural gas (LNG) – natural gas that has been cooled until it forms a transportable liquid – to meet growing energy demand. Energy for the 21st Century provides critical insights into the opportunities and challenges LNG faces, including its potential role in a carbon-constrained world.

This comprehensive study covers topics such as the LNG value chain, the historical background and evolution of global LNG markets, trading and contracts, and an analysis of the various legal, policy, safety and environmental issues pertaining to this important fuel. Additionally, the author discusses emerging issues and technologies that may impact global LNG markets, such as the development of shale gas, the potential role of the Gas Exporting Countries Forum and floating LNG. The author contextualizes the discussion about the importance of LNG with an analysis of why the 21st century will be the 'golden age' of natural gas.





Accessible and non-technical in nature, this timely book will serve as an essential reference for practitioners, scholars and anyone else interested in 21st century energy solutions.

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