Summary from North Slope Gas & LNG Symposium

Anchorage, AK: November 22, 2013

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Testimony to House Resources Committee

PFC Energy

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Executive Summary

- There is growing demand for gas and LNG, in particular in Asia, and most countries need to secure additional LNG to meet their energy needs post 2020. Alaska's proximity to Asia makes it a natural supply source, although it will face competition from a growing number of new supply sources.

- Shale gas in the United States Lower 48 and in Western Canada will compete with Alaska—and the L48 in particular are a primary destination for suppliers seeking long-term LNG. But higher prices in the United States will potentially undermine the competitiveness of LNG from the Lower 48.

- The companies that are involved in Alaska's upstream and will likely be involved in LNG have substantial experience with and expertise in LNG. As such, the question is not whether they can do an LNG project but rather will they choose to given competing priorities and outlets for their capital.

- An LNG project from Alaska can be competitive with other projects that are seeking to supply Asian markets—but its competitiveness will depend critically on fiscal terms and on keeping costs down.

- LNG projects are big, complex, risky, multi-stakeholder endeavors that take a lot of time (often decades) and money (billions) to complete. There are multiple ways to structure an LNG project (who participates in which part and in what way) and it is important to develop a structure that aligns all the different partners and project participants and meets their risk-reward appetites.

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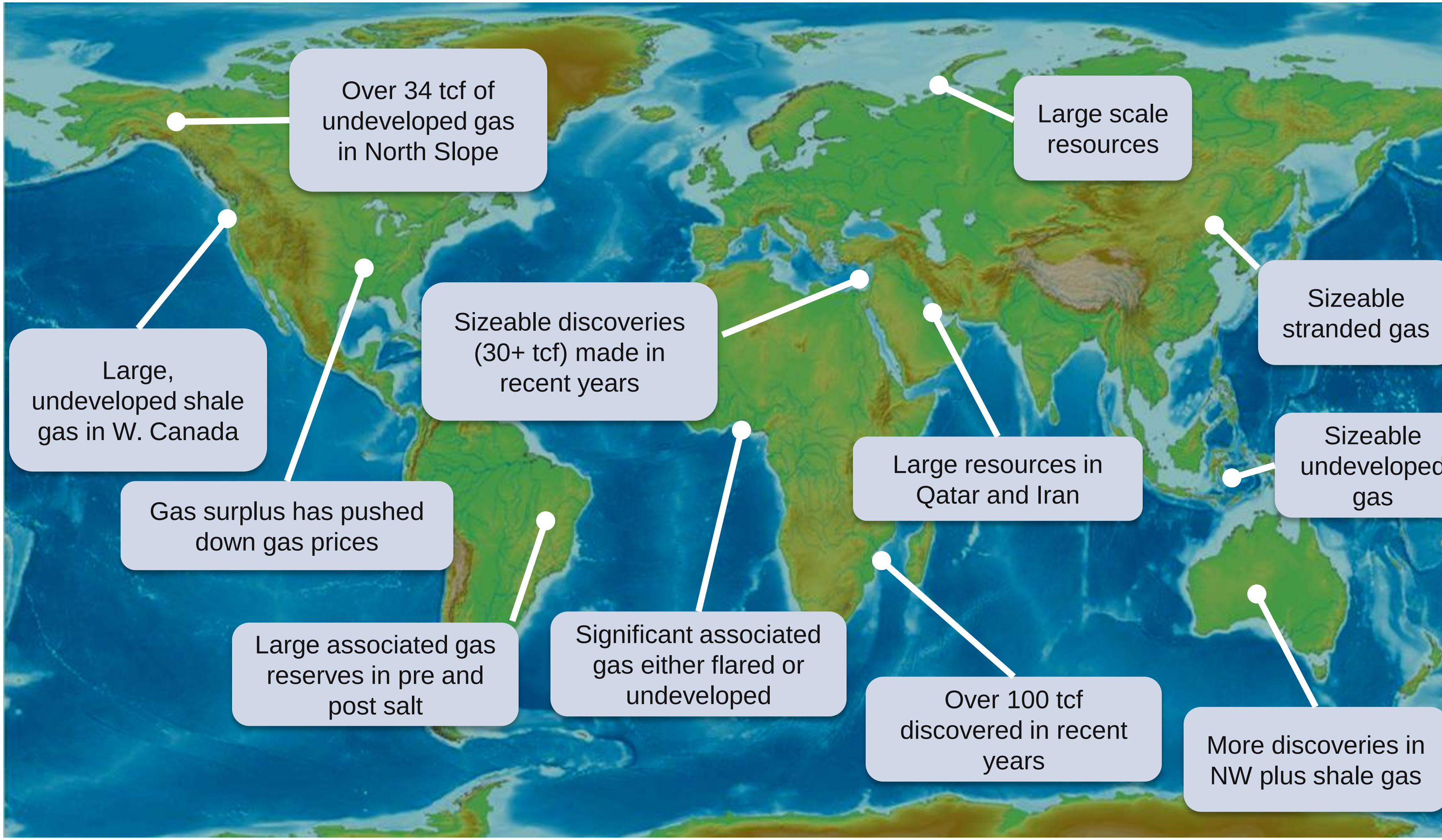
The New Geography of Global LNG: Many Options…



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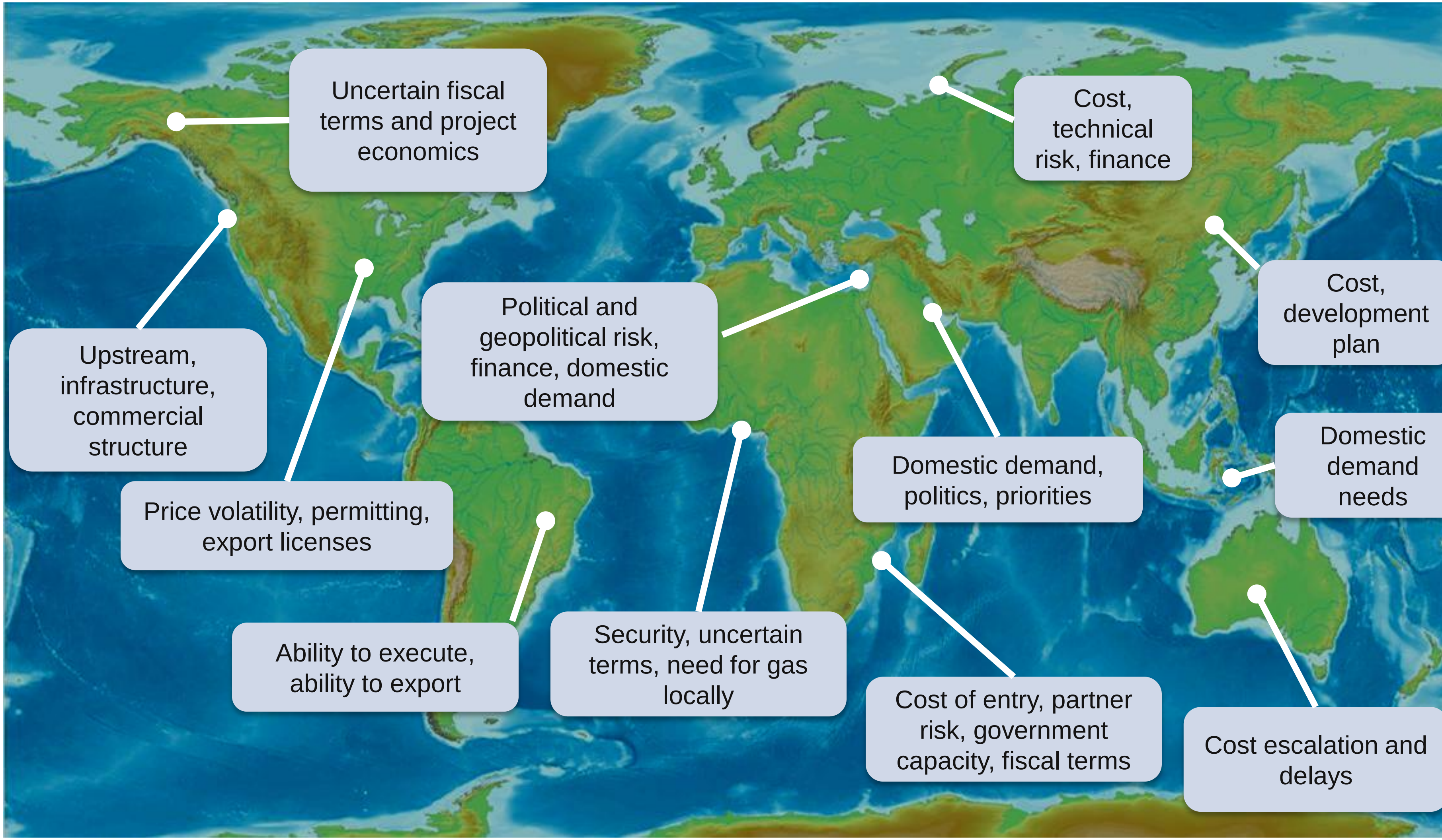
… But Also Risks



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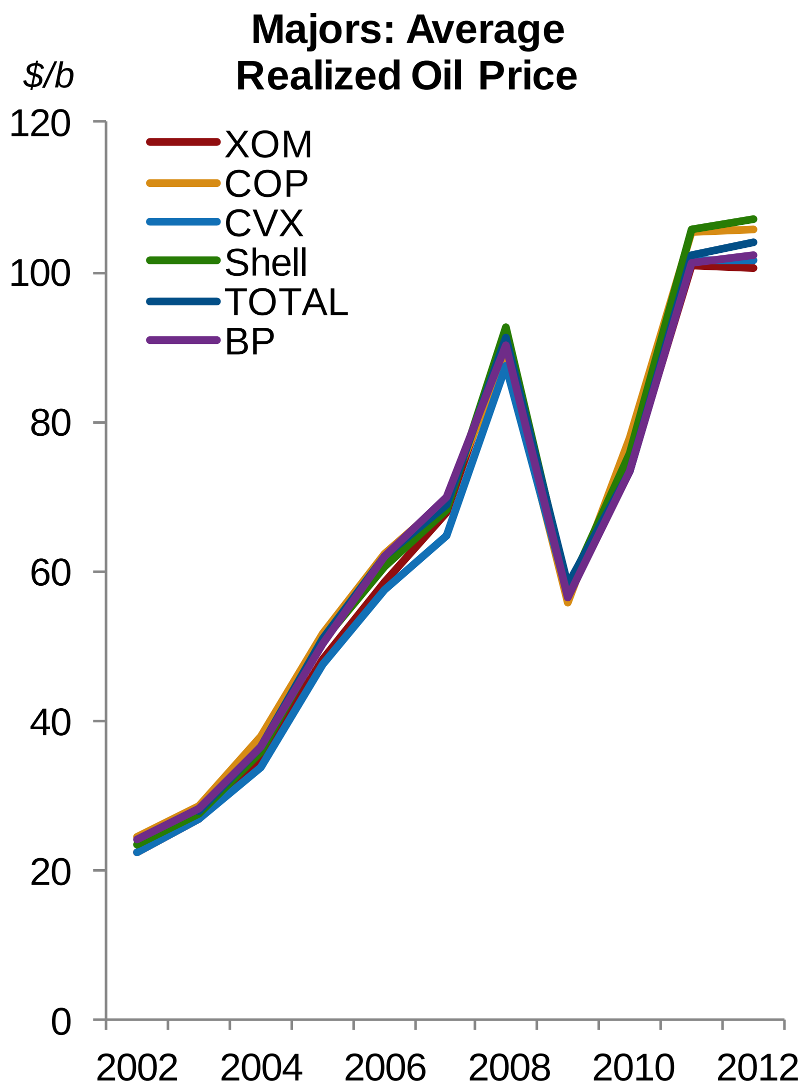
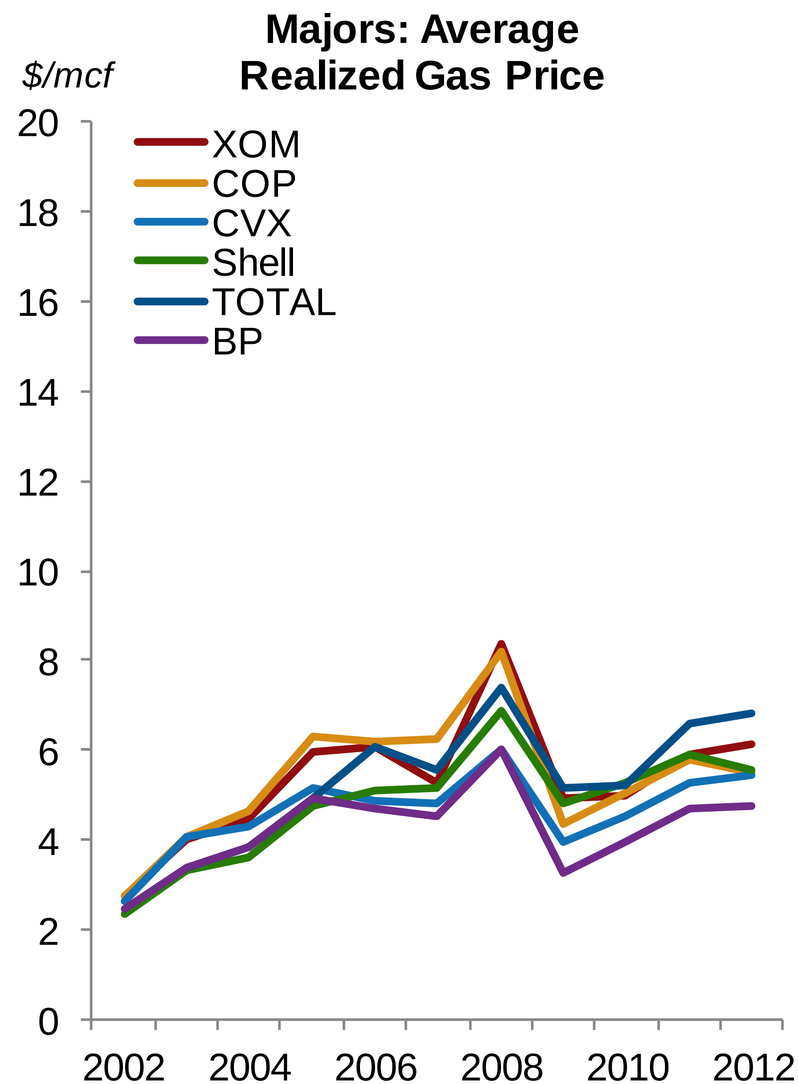
Think Micro, Not Macro; Gas is Not a Global Market





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Gas is Very Different Than Oil

	Oil		Gas	
Production	86.1 mmb/d (2012)		54 mmboe/d (2012)	
	Middle East	32.5%	Europe/Eurasia	30.7%
	Europe/Eurasia	20.3%	North America	26.8%
	North America	17.5%	Middle East	16.3%
Reserves	1,669 bn boe (2012)		1,102 bn boe (2012) (ex. shale)	
	Middle East	48.4%	Middle East	43.0%
	C. And S. America	19.7%	Europe/Eurasia	31.2%
	North America	13.2%	Asia Pacific	8.2%
Prices	Brent: $111/b		Henry Hub: $2.86/MMBtu ($17.2/b)	
	WTI: $94.1/b		NBP (UK): $9.47/MMBtu ($56.8/b)	
			Germany: $10.86/MMBtu ($65.1/b)	
			Japan (LNG): $16/MMBtu ($96/b)	
End-users	Transportation	53%	Power	40%
	Non-energy	15%	Industry	17%
	Industry	8%	Distribution	15%
Trade	64% crosses border to be consumed		31% crosses border to be consumed	
Marketing	Global market; produce and then decide where / to whom to sell		Needs a market before it is produced	

Sources: BP Statistical Review of World Energy, International Energy Agency, national sources, PFC Energy

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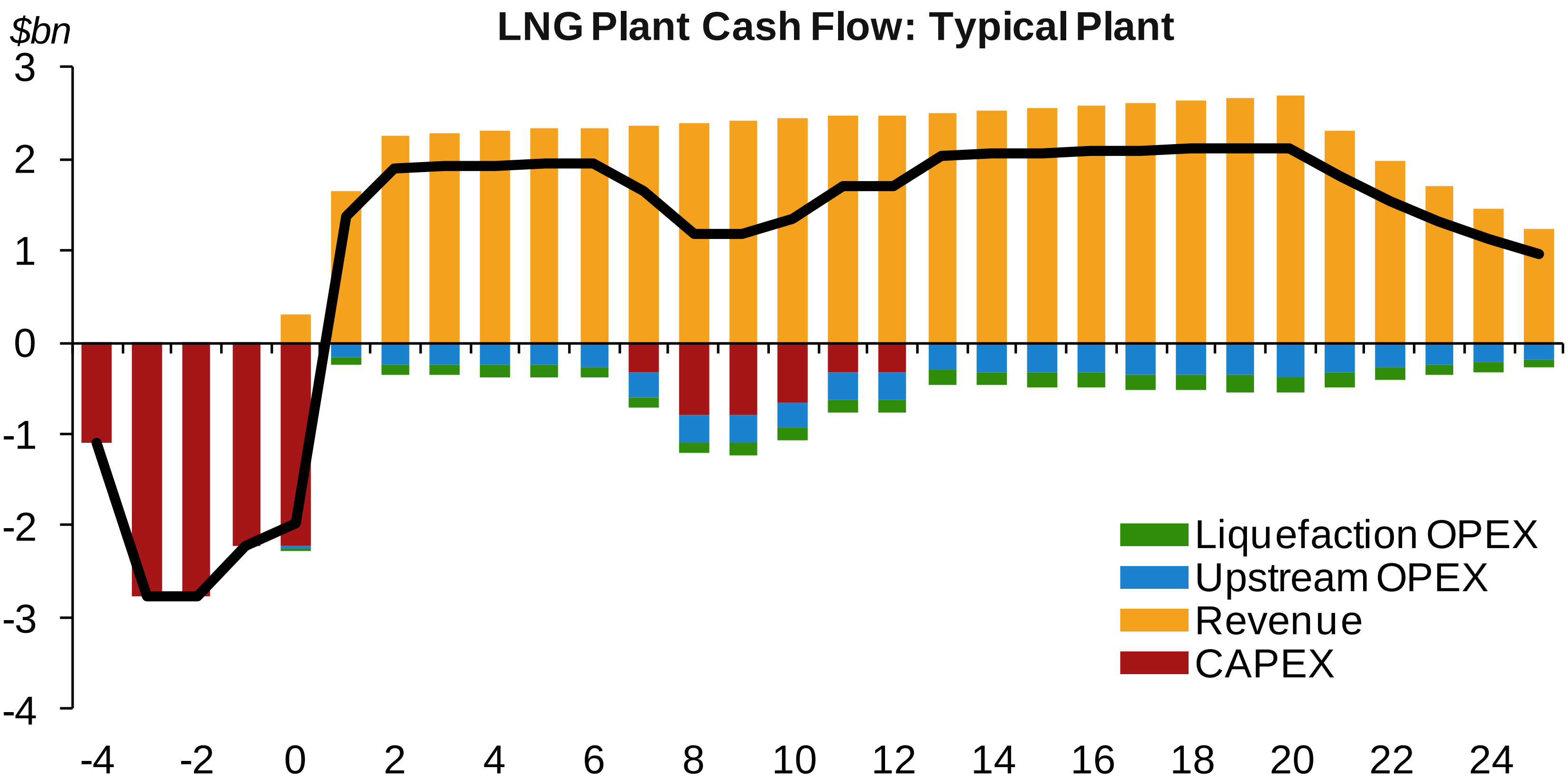
What Does an LNG Plant Look Like?



- Long lead time (4 years to build, several years to prepare to build)
- Large, upfront investment needed to develop the project (usually, tens of billions)
- Minimal operating expenses (only a small fraction of initial investment)
- Long-term cash flow (expected revenues for 20+ years)

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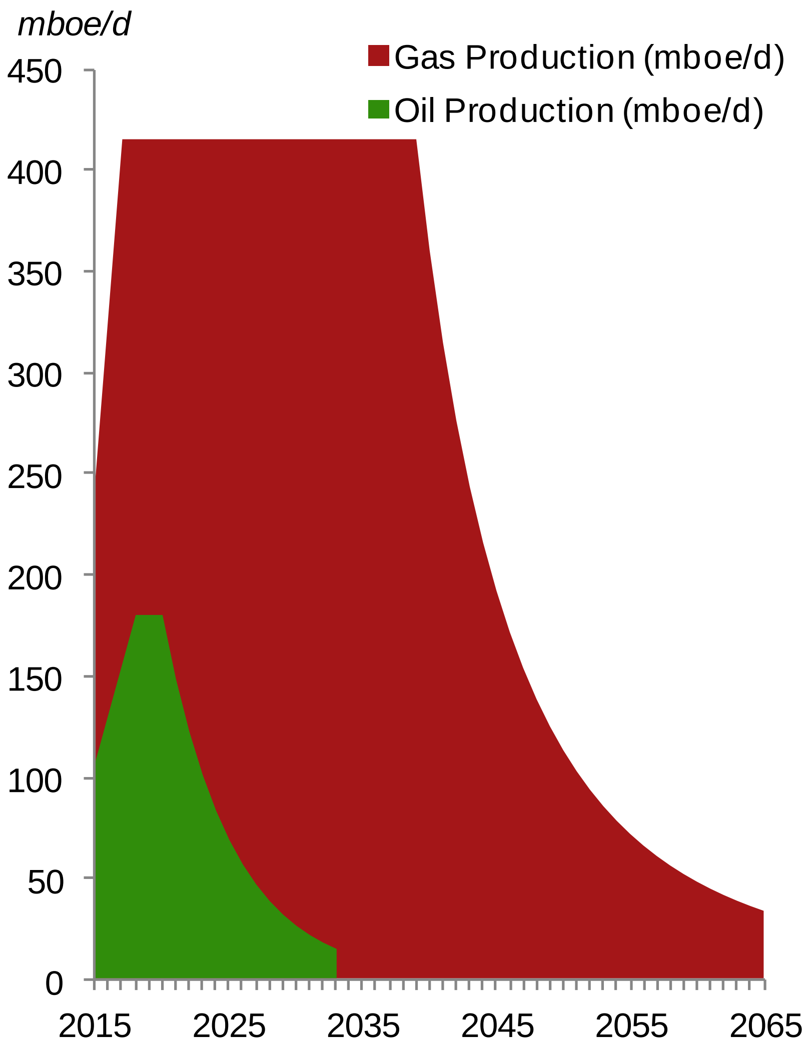
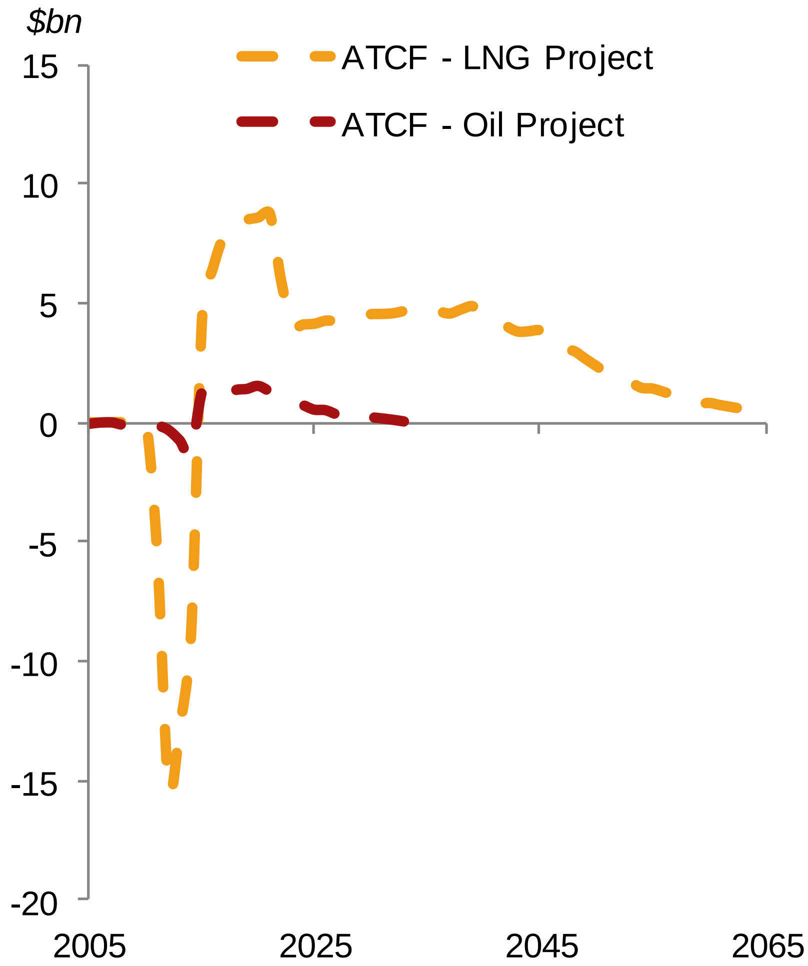
Oil and Gas Have Different Production / Economic Profiles…

LNG Project vs. Deepwater Oil Project @ $80/bbl





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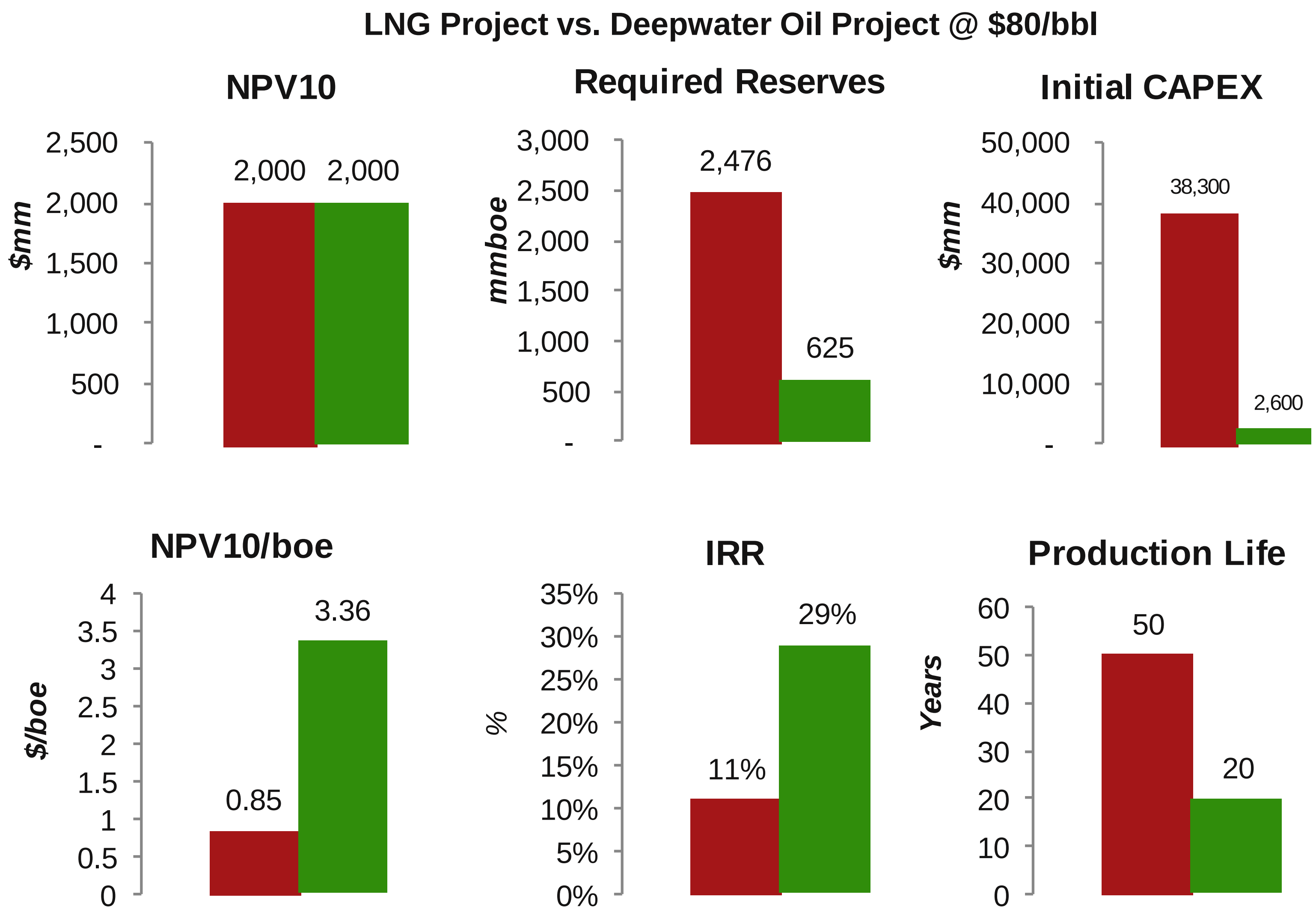
… and Different Economic Outcomes



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LNG is Big, Complex, Risky and Multi-Stakeholder

Most of the money is spent after taking a Final Investment Decision (FID); before FID, the project developers:

- Certify **reserves** to ensure that the gas is there
- Sign sales and purchase agreements (**SPAs**) with buyers, which reassure the project developers that they will be able to sell their product. These are usually long-term and obligate the buyer to take the gas.
- Secure **financing**, often external and often non-recourse (whereby the debt is guaranteed by the cash flow of the SPA). External financing is supported by loans and equity from the sponsors.
- Award an engineering, procurement and construction (EPC) contract to a company/consortium to **build** the plant
- Finalize all **approvals** (country/federal, state, local)

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The LNG Value Chain

Upstream

- The companies that will **develop the gas fields** and supply the gas to be liquefied and exported. Usually projects have a primary supply source, but projects will often source gas from multiple fields and/or areas.

Liquefaction

- The companies that will **own and operate the liquefaction facility**. These companies will assign one or more EPC (engineering, procurement and construction) contractors to build the plant.

Shipping

- Either the **buyer or the seller handles the shipping**. If the buyer arranges for shipping, the sale is considered FOB (Free on Board). If the sellers arranges for shipping, it is consider CIF (Cost, Insurance, Freight) or DES (Delivered Ex Ship).

Buyer

- The buyer can purchase LNG through a short, medium or long-term **contract** or they can purchase an **individual** cargo (called a spot transaction). The buyer can deliver the gas to an end-user (e.g. power plant) or can re-sell the gas.

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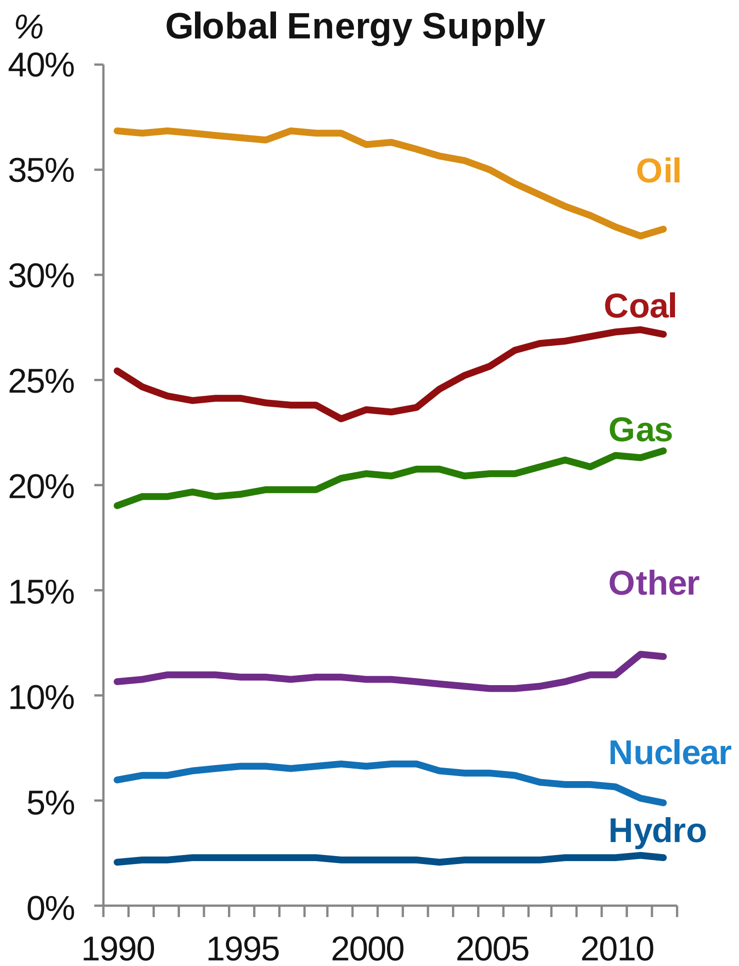
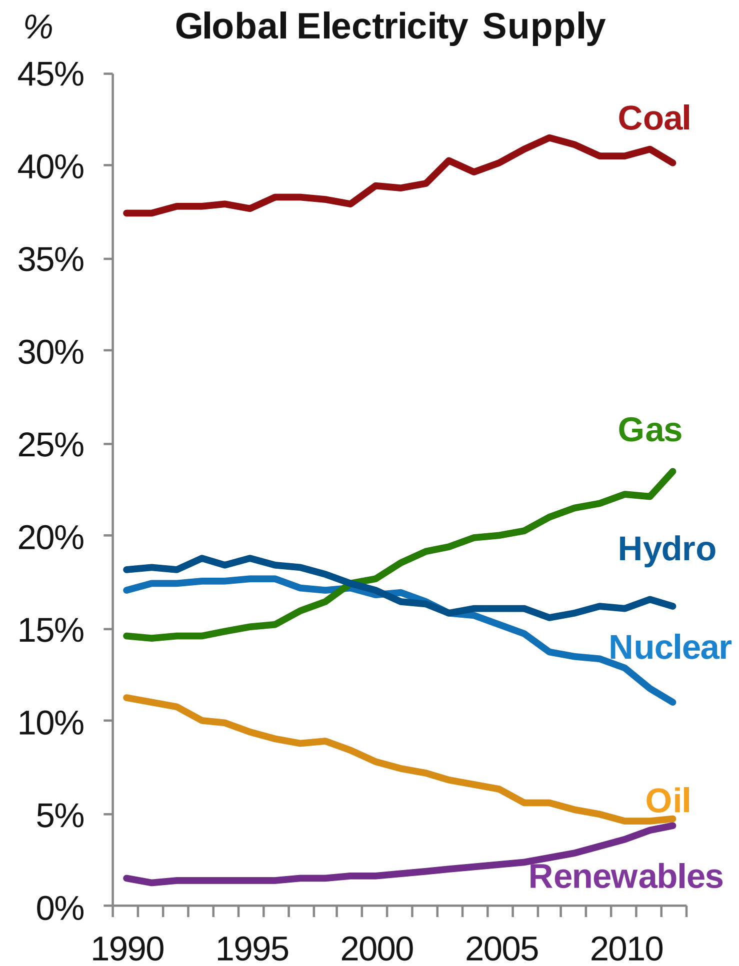
The World is Turning More and More To Gas





Gas share has risen from 19 to 22%

Gas share has risen from 15 to 24%

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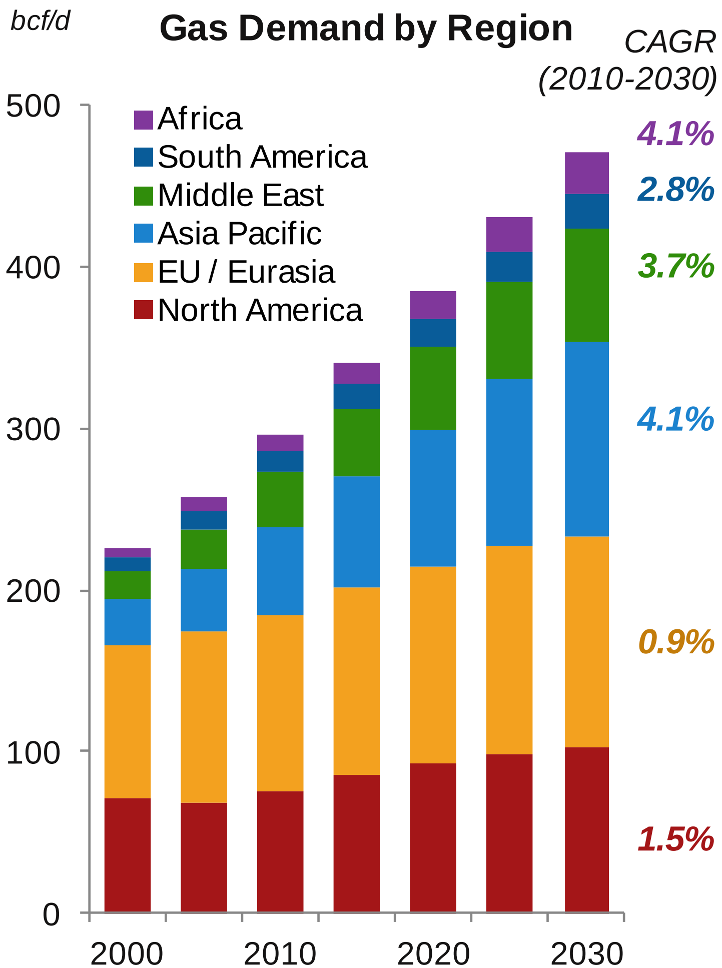
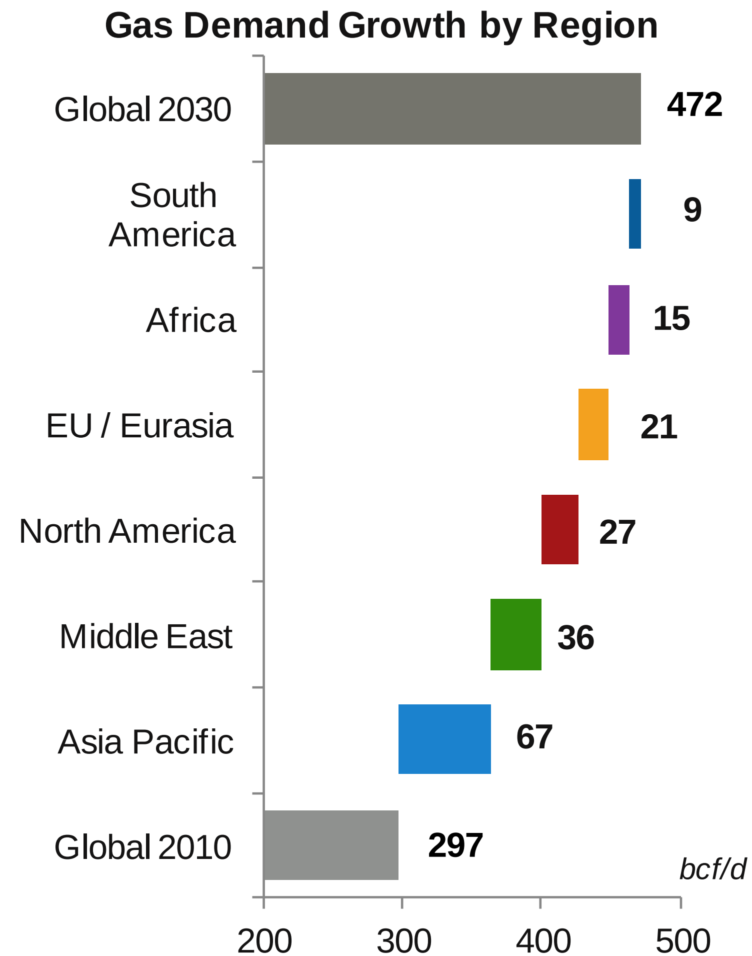
Growth at 2.3% per Year Driven by Asia





Global demand growth of 2.3% p.a.

+175 bcf/d = ~3X US 2010 demand

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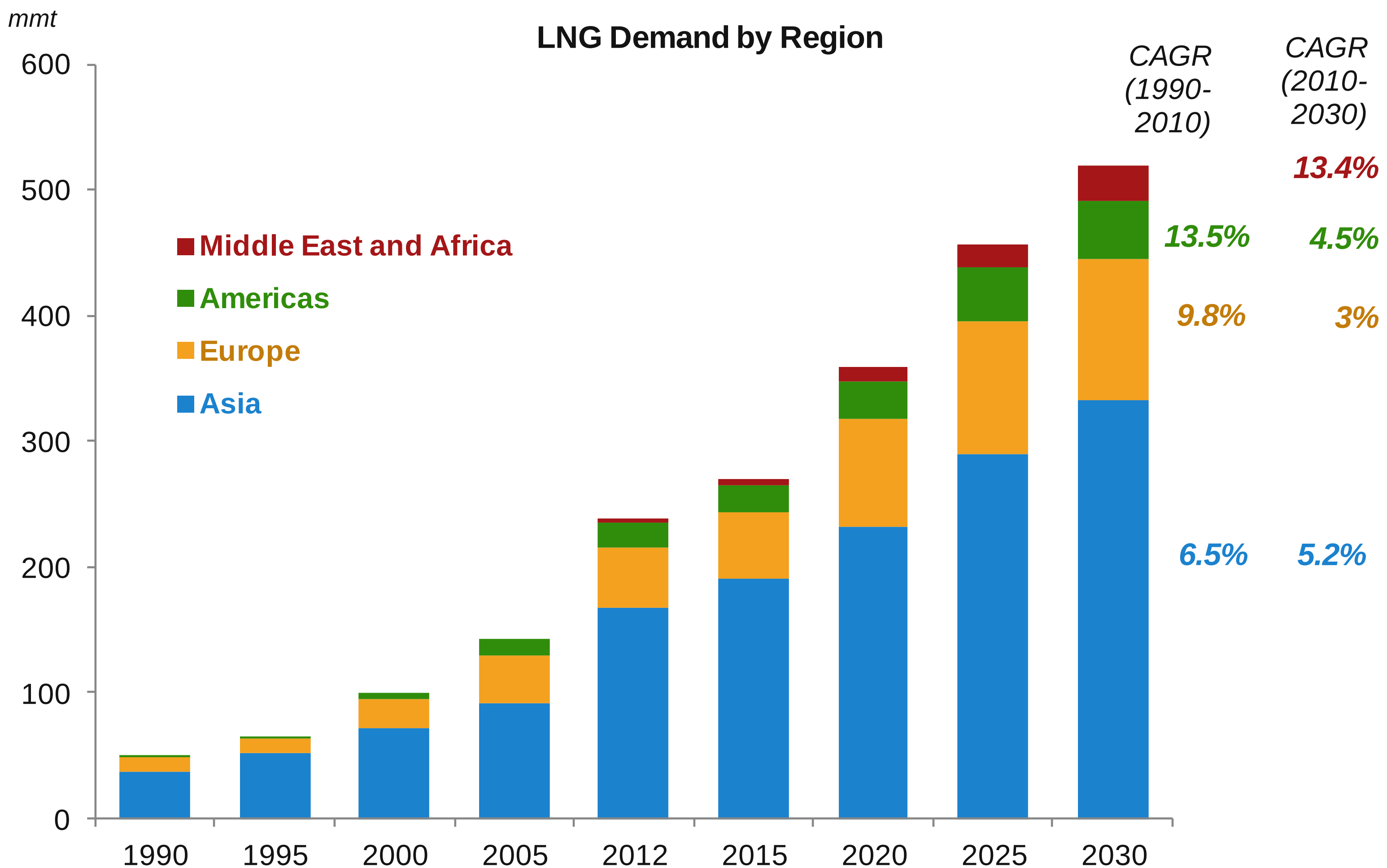
Asia Drives LNG Demand As Well



Asia accounted for 2/3 of growth since 1990 and will make up 2/3 of new demand

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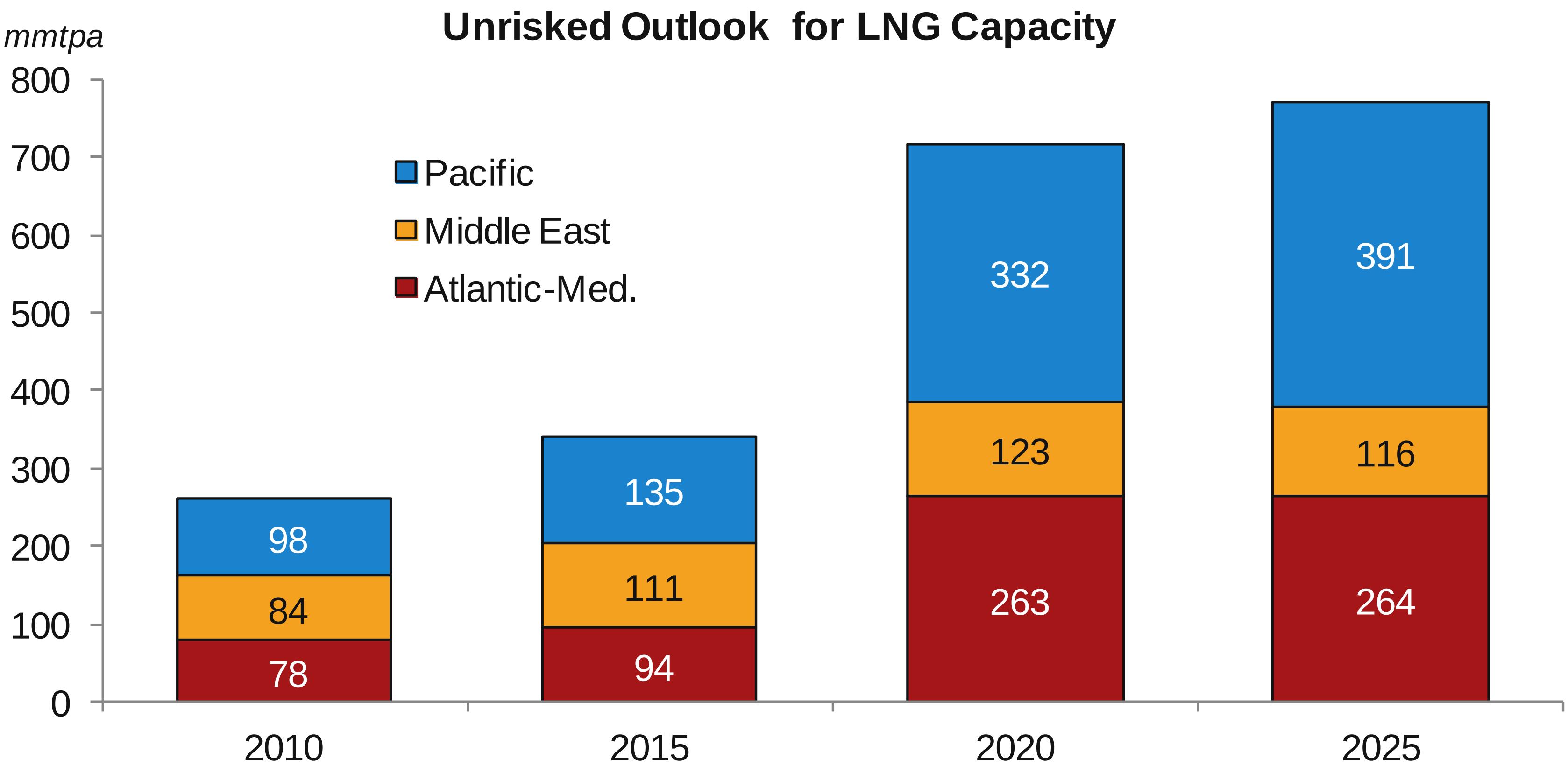
Industry Has Responded with Many and Big Proposals



- If **all LNG projects** were to move ahead according to plan, LNG capacity would grow from 281 mmtpa (2012) to 771 mmtpa in 2030. Clearly, such a build-out is unrealistic.

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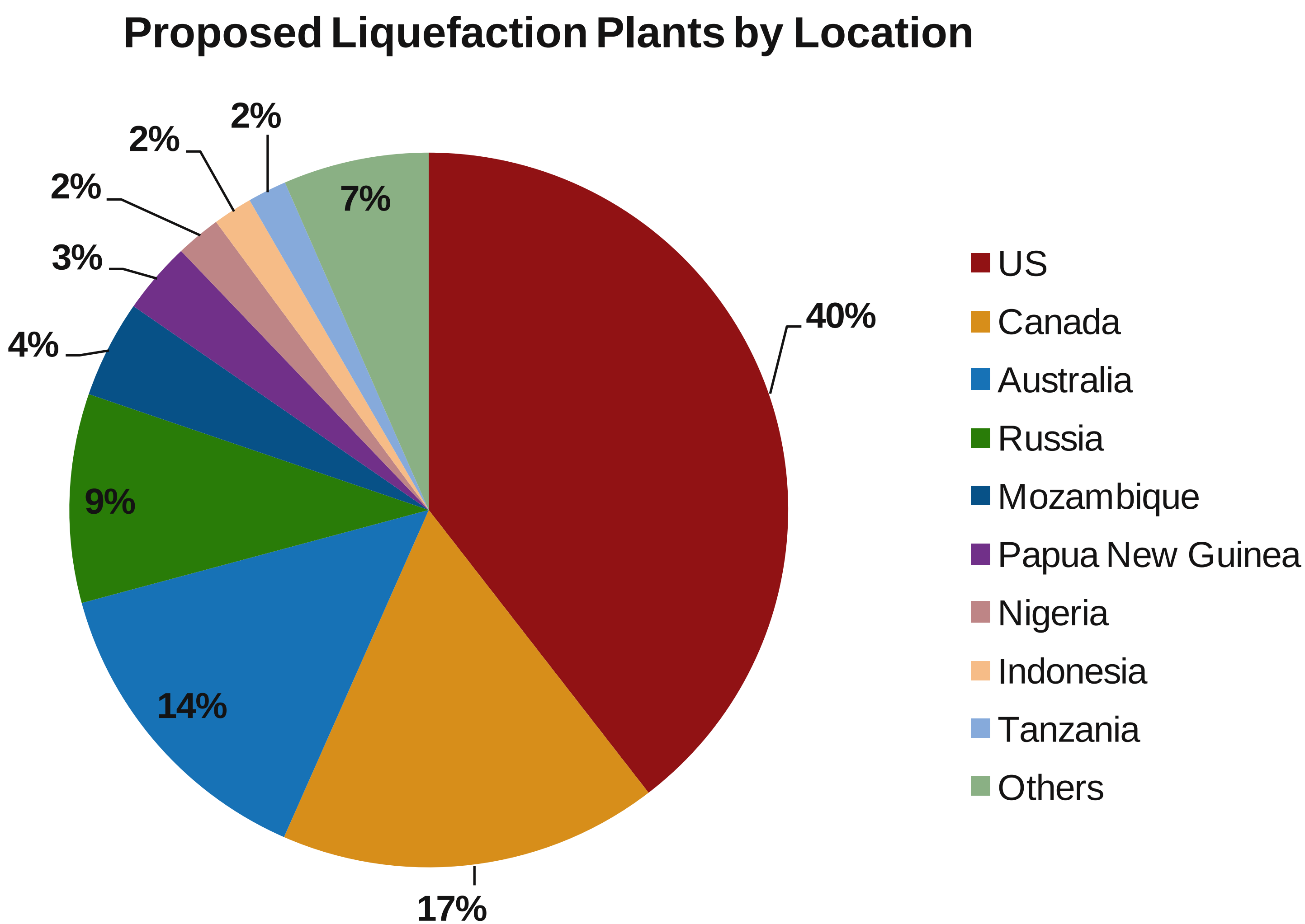
North America is Largest Prospective Supplier



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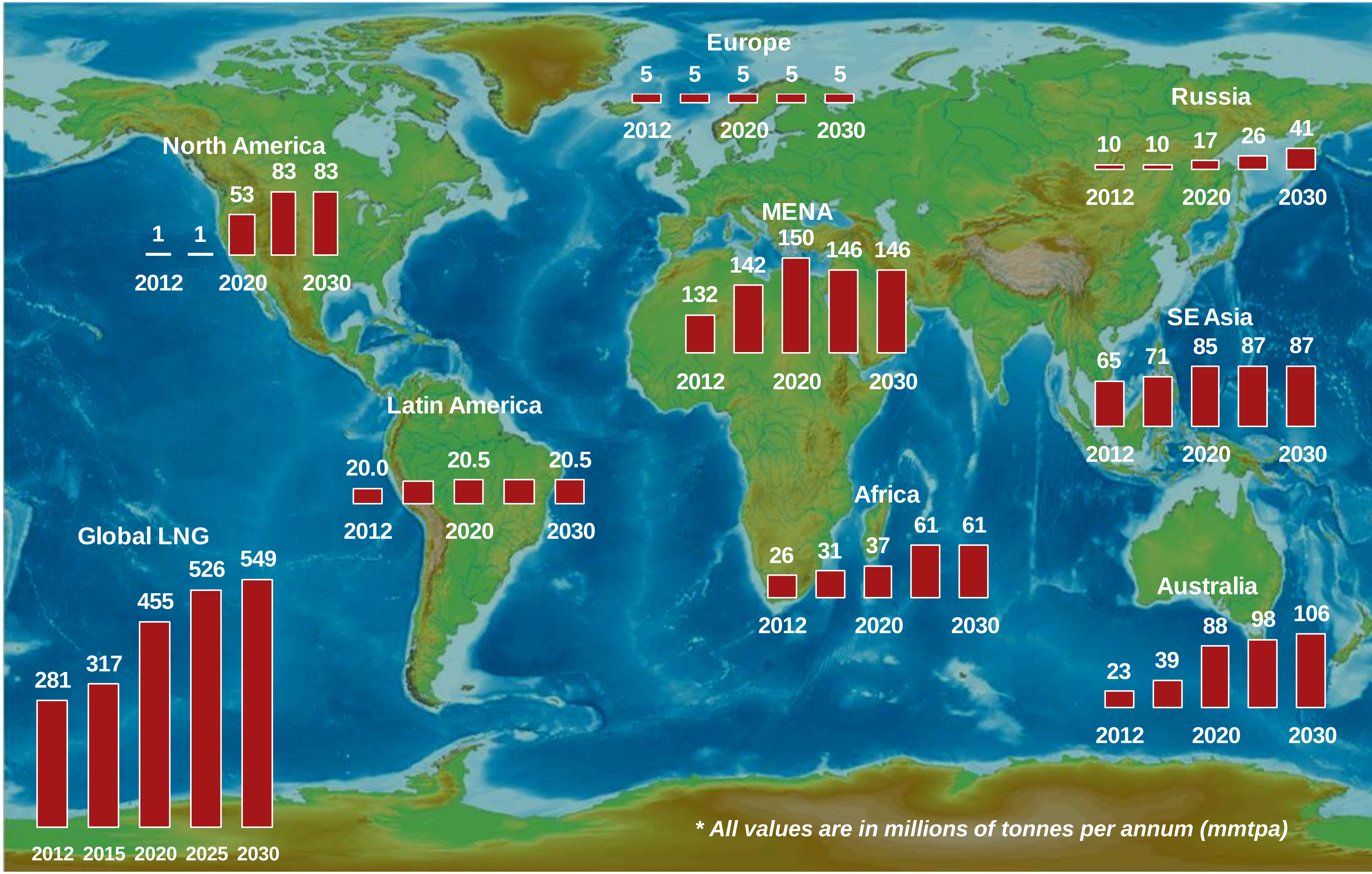
Growth Clustered: N. America, Africa, Australia



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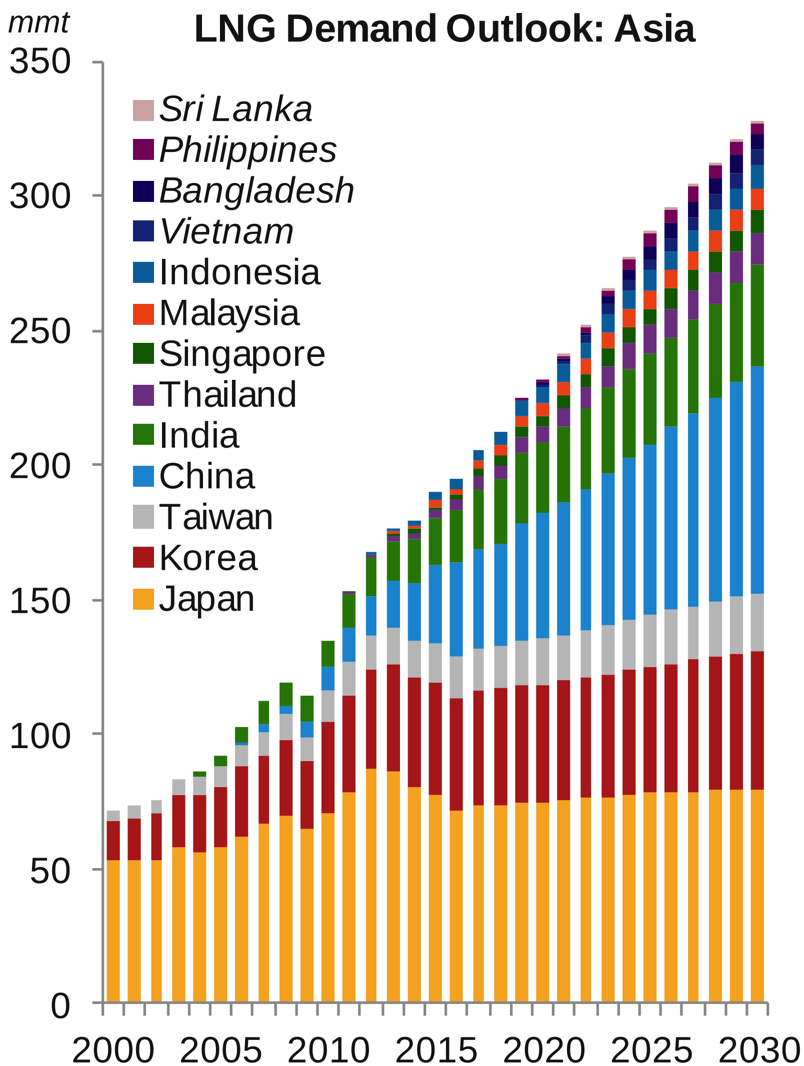
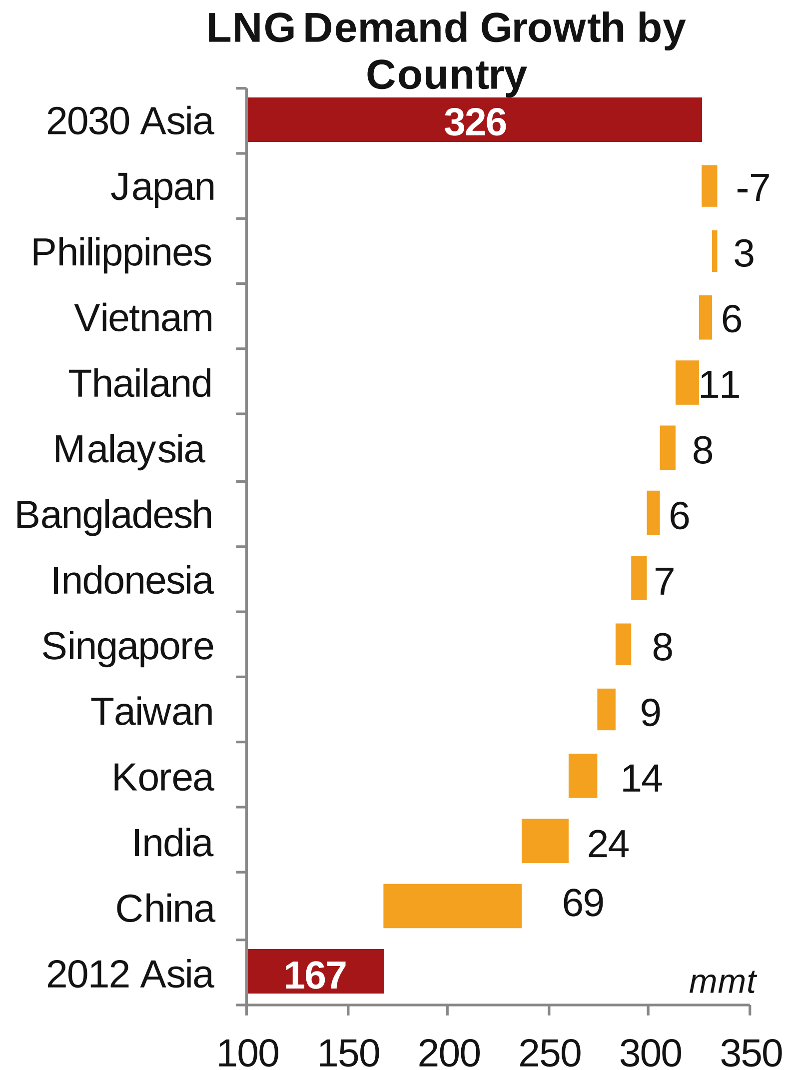
Widespread Growth in Asian LNG Demand





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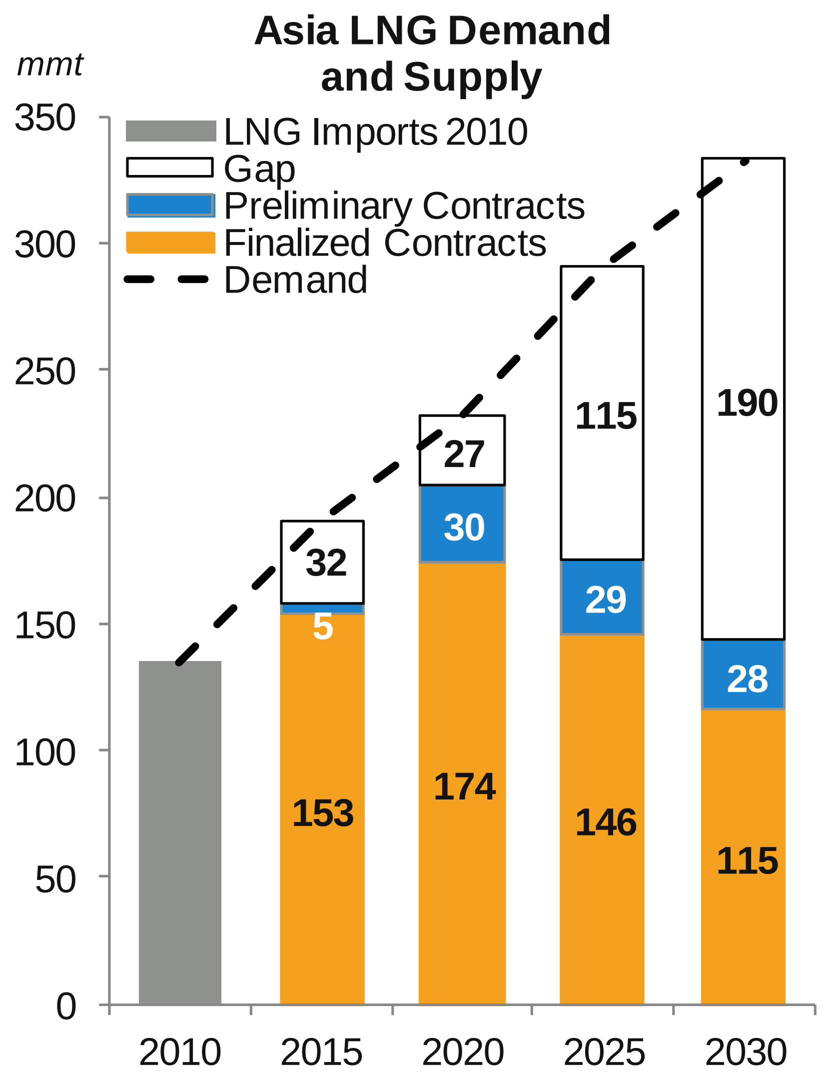
Window into Asia: Small by 2020, Grows Post 2020

- Based on finalized and preliminary contracts, there is still a window for additional LNG sales into Asia by 2020; the window widens post 2020
- Suppliers must compete to displace the preliminary contracts or must lower price to access new markets



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What Price Can Alaska Expect?

- When buyers have lots of choice, prices tend to fall to the marginal cost of supply; when sellers have lots of choice, prices tend to rise to the cost of alternative fuels / demand destruction
- The pricing band is quite wide with new projects needing $8-$11/MMBtu to break-even but cost of alternative fuels (oil) being much higher at $16-$18/MMBtu.
- Asian consumers are no longer willing to pay alternative-fuel pricing levels—they demand lower prices and they open to challenging oil indexation system that prevails in Asia
- Today's market for long-term supply (post 2016) tends towards a buyer's market, for e.g. contracts signed for LNG from the United States reflect the marginal cost of supply
- Evolution of market pricing will hinge on how rapidly new projects around the world advance—if projects get stuck, prices will rise; if projects move forward according to plan, prices will fall
- Projects can also protect themselves from volatility by offering to give up upside in order to defend against downside risk.

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Oil-Indexed Pricing to Asian Markets

Contract Sales Price Slope --->	0.13x	0.14x	0.15x	0.16x
$60/bbl Brent	$7.80	$8.40	$9.00	$9.60
$80/bbl Brent	$10.40	$11.20	$12.00	$12.80
$100/bbl Brent	$13.00	$14.00	$15.00	$16.00
$120/bbl Brent	$15.60	$16.80	$18.00	$19.20
$140/bbl Brent	$18.20	$19.60	$21.00	$22.40

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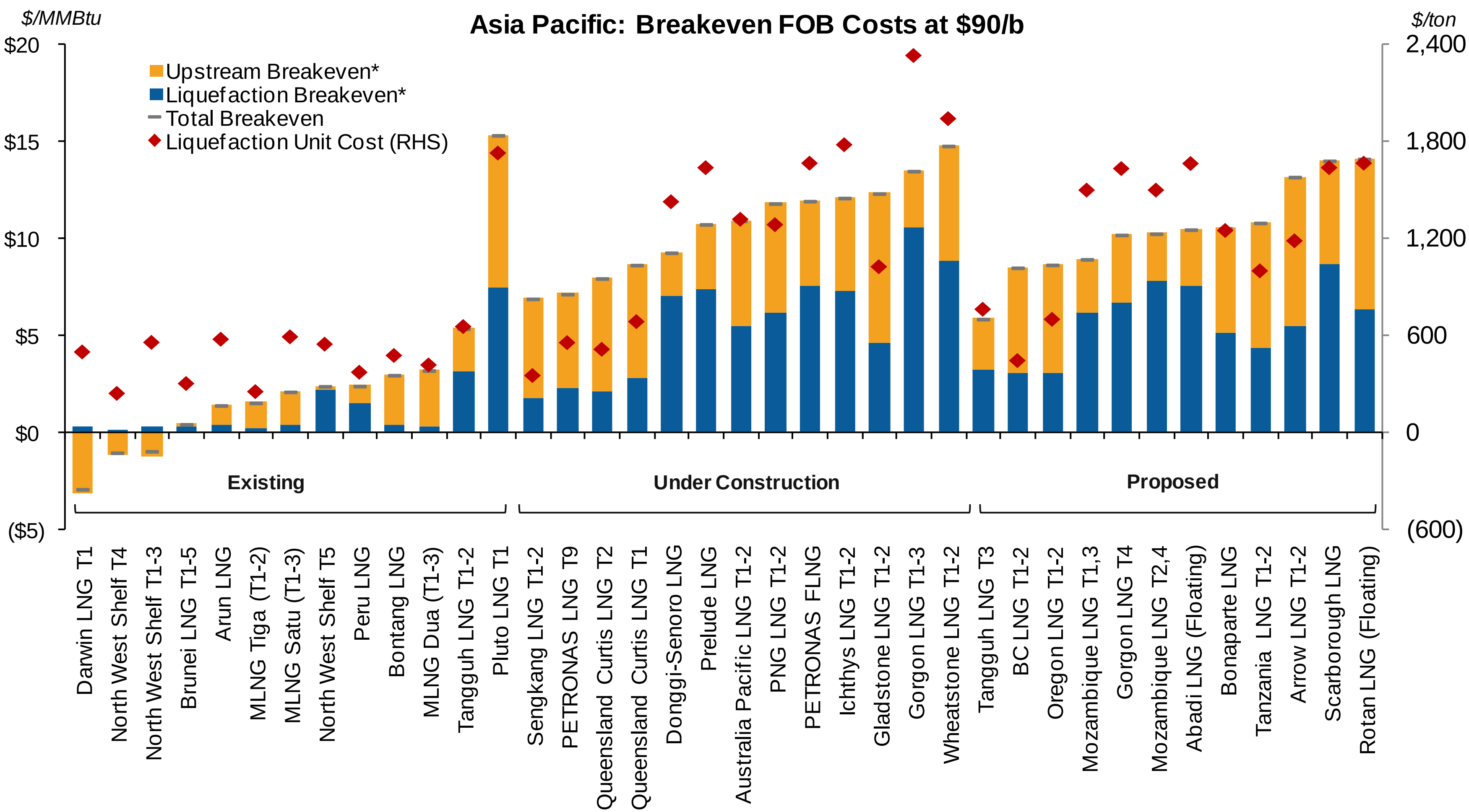
New LNG Projects are Expensive



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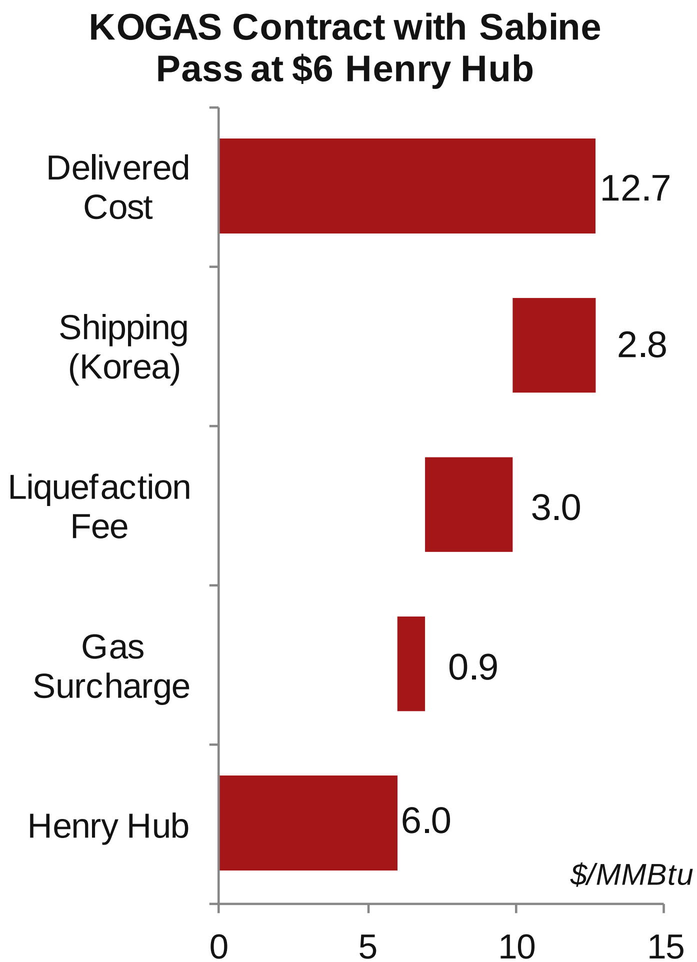
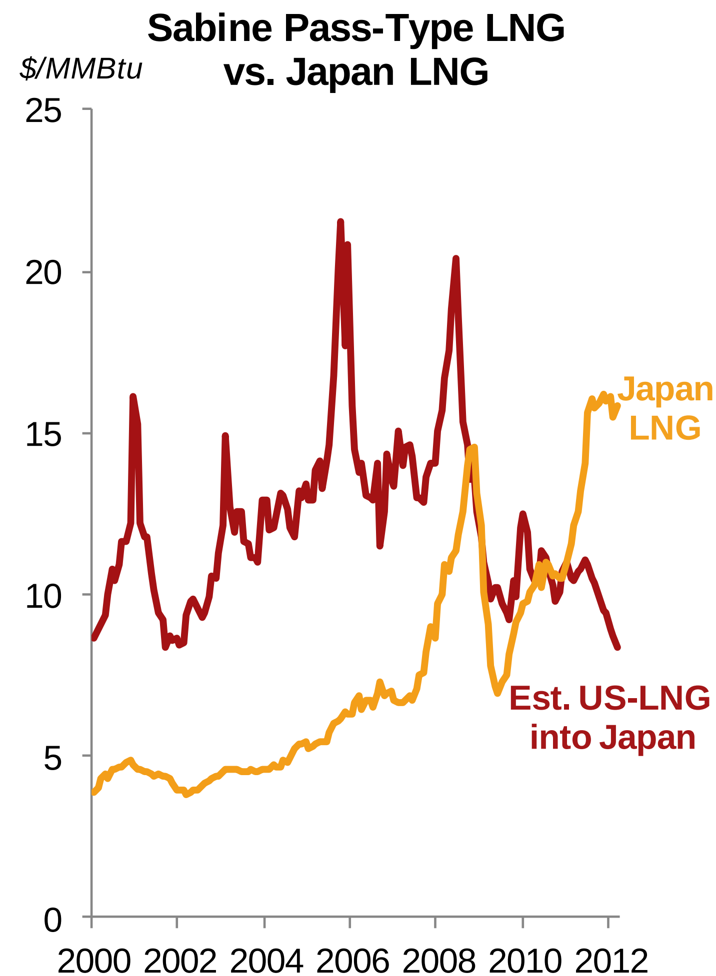
Lower 48 is An Alternative—But Not Necessarily Cheap; & It is Volatile





At $6/MMBtu, US is not that cheap

Source: Global LNG Service

Hub can be cheap but also volatile

Source: Global LNG Service

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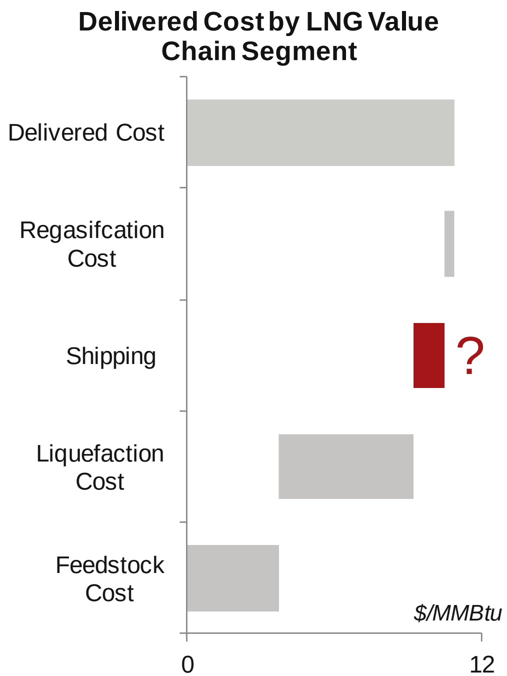
Does Alaska Have a Shipping Advantage?



Shipping Cost ($/MMBtu) – Panama Canal Access

	Japan / S. Korea	China	India
Southern Alaska	0.67	0.83	1.44
Western Canada	0.82	0.99	1.65
US - GOM	1.89	2.06	1.88
Australia	0.60	0.60	0.62
East Africa	1.18	0.97	0.58

- All costs along the value chain are variable and depend on the LNG project
- Shipping costs depend on:
  - Type of Vessel
  - Cost of Vessel
  - Size of Cargo
  - Voyage Distance
  - Running Costs
  - Charter Rate

- Alaska's shipping costs are an advantage
  - Generally superior to East Africa
  - Considerably less than expected shipping costs from projects located in US GOM
  - But more expensive than Australia

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AK South Central LNG Concept

SCLNG Concept Summary - Upstream

Alaska SCLNG Project
Concept Information

PTU (62 miles east of PBU/GTP area)
- Initial Production System (IPS) project in progress - 2016 SU
- Preliminary SCLNG design basis for PTU:
  – Leverage IPS facilities, add fourteen new wells
  – Add new gas facilities to existing central pad / facilities
  – New 30" gas line from PTU to GTP in Prudhoe Bay
  – Peak workforce – 500-1,500 people

PTU Field Layout

PBU Tie-in (adjacent to proposed GTP location)
- Installation / tie-in managed by Prudhoe Bay Operator
  – Tie into existing CGF, deliver gas to new Gas Treatment Plant
  – Gas project / deliveries tied to future PBU operations
- Preliminary plan is to inject CO_2 using existing injection systems as appropriate

PBU Central Gas Facility Tie-in

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Work Product In Progress

SCLNG - Concept Summary – Downstream

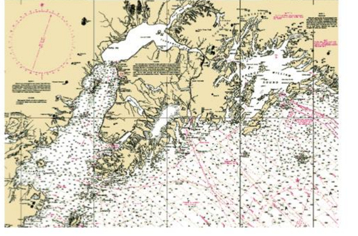
Alaska SCLNG Project
Concept Information

LNG Plant and Storage
- Three 5.8 million tons per annum (MTA) LNG trains
  - Plant receives 2.2 - 2.5 billion cubic feet per day to liquefy
  - LNG production varies with ambient temp (4.9 - 6.3 MTA)
  - Small volume of stabilized condensate produced (~1,000 bbl/day)
- Integrated utility system with all utilities on site
- Two-three 160,000 cubic meter LNG storage tanks
- Peak workforce – 3,500 – 5,000 people

SCLNG Plant and Storage

Marine Offloading Facility
- Conventional jetty and trestle design
- Two berths
- Design based on 15-20 LNG carriers
- Marine support system includes required tugs, security boats
- Peak workforce – 1,000 – 1,500 people

South Central Marine Map



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Work Product In Progress

SCLNG - Concept Summary - Midstream

Alaska SCLNG Project
Concept Information

NS Gas Treatment Plant
- Designed to remove gas impurities
- Four amine trains with compression, dehydration and chilling
- Prime power generation (5 units, 54kHP)
- All required utilities, infrastructure and camps
- Facility will be modularized, sealifted to location
- Peak workforce – 500-2,000 people

NS Gas Treatment Plant Design

Gas Pipeline and Compression Stations
- 800+ mile 42" x80 pipeline
- 3-3.5 billion cubic feet gas per day
- Eight compressor stations (30kHP each)
- Pipeline contents will be treated gas, impurities removed
- Designed to manage continuous and discontinuous permafrost regions
- Expansion potential with additional compression if appropriate
- Five off-take points for Alaska gas delivery
- Peak workforce – 3,500 - 5,000 people

3

Work Product In Progress

Estimated total cost:
$45 - $60 bn (2011 real dollars)

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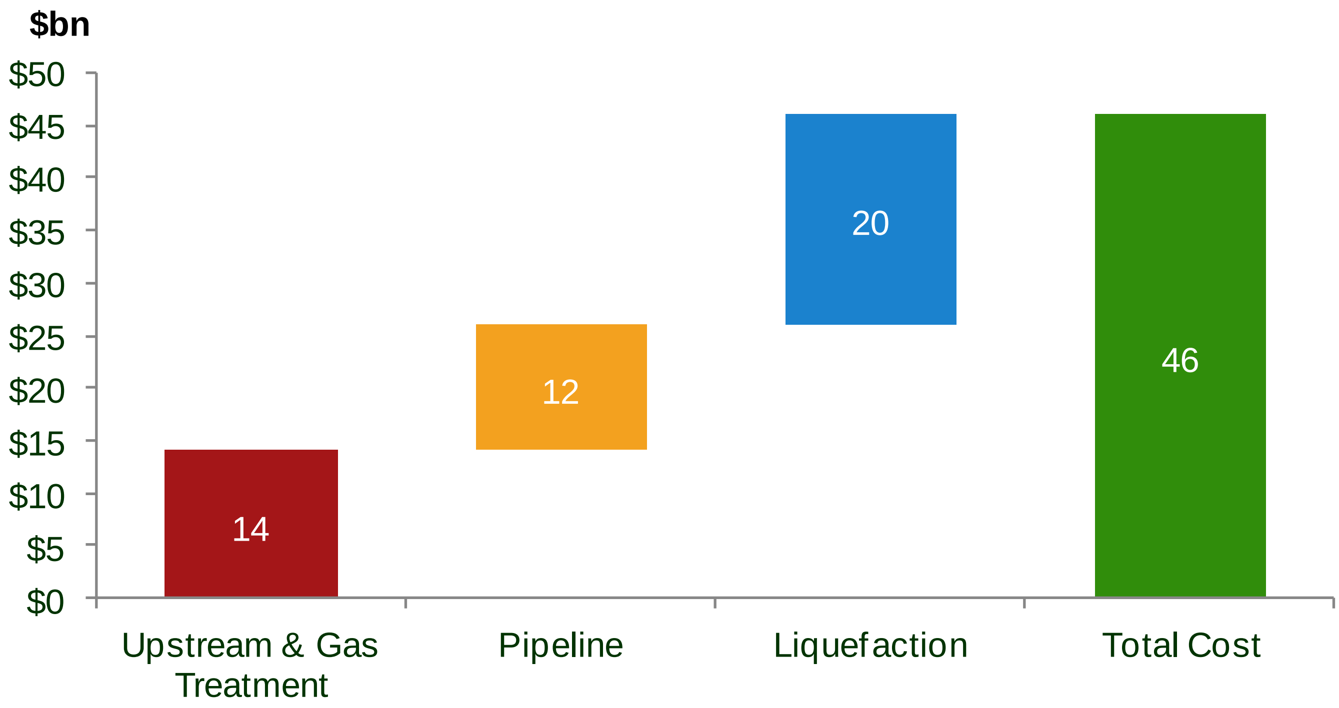
Hypothetical Cost Breakdown



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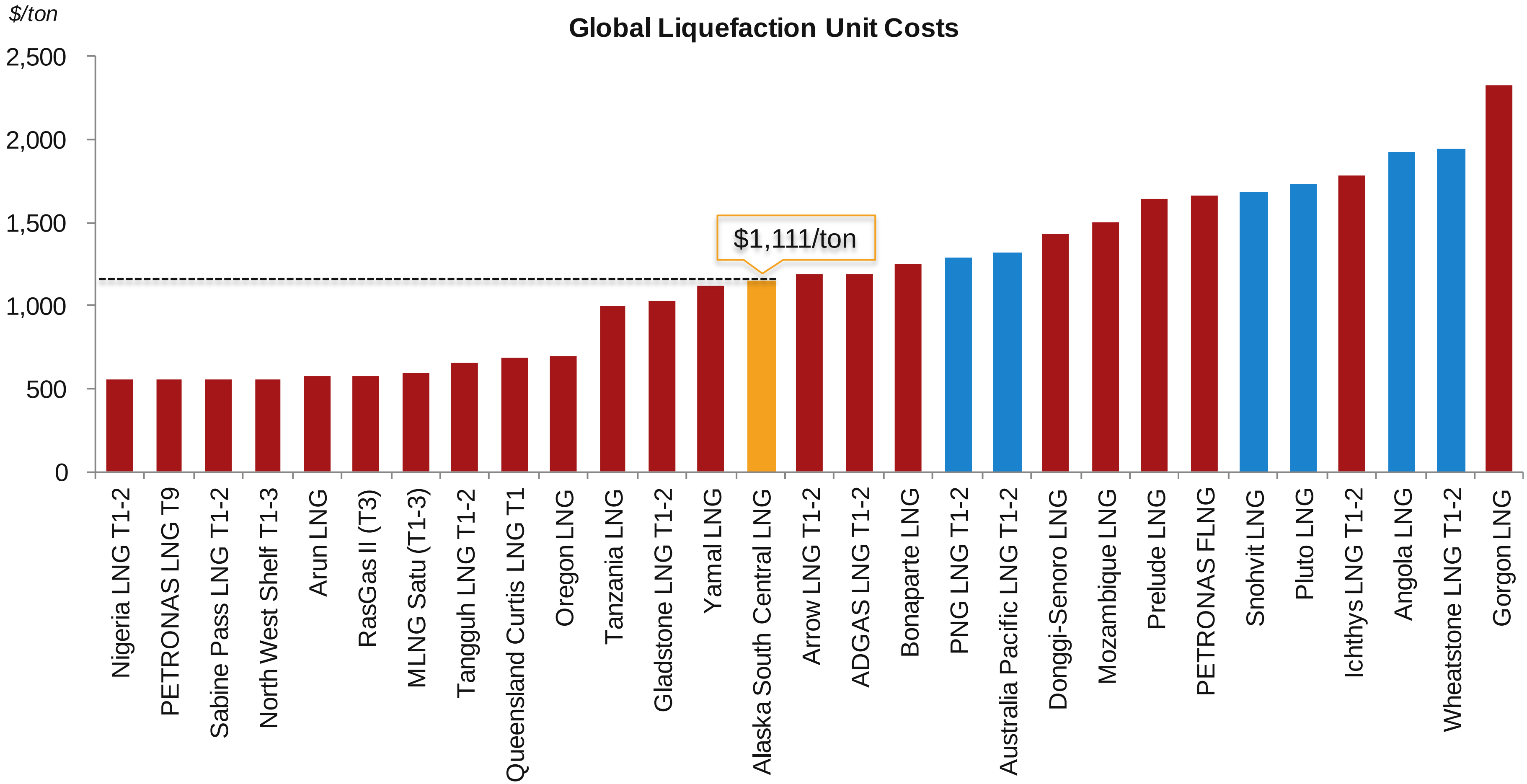
How Would $20bn for an 18 mmtpa Liquefaction Facility Compare With Other Recent Projects?



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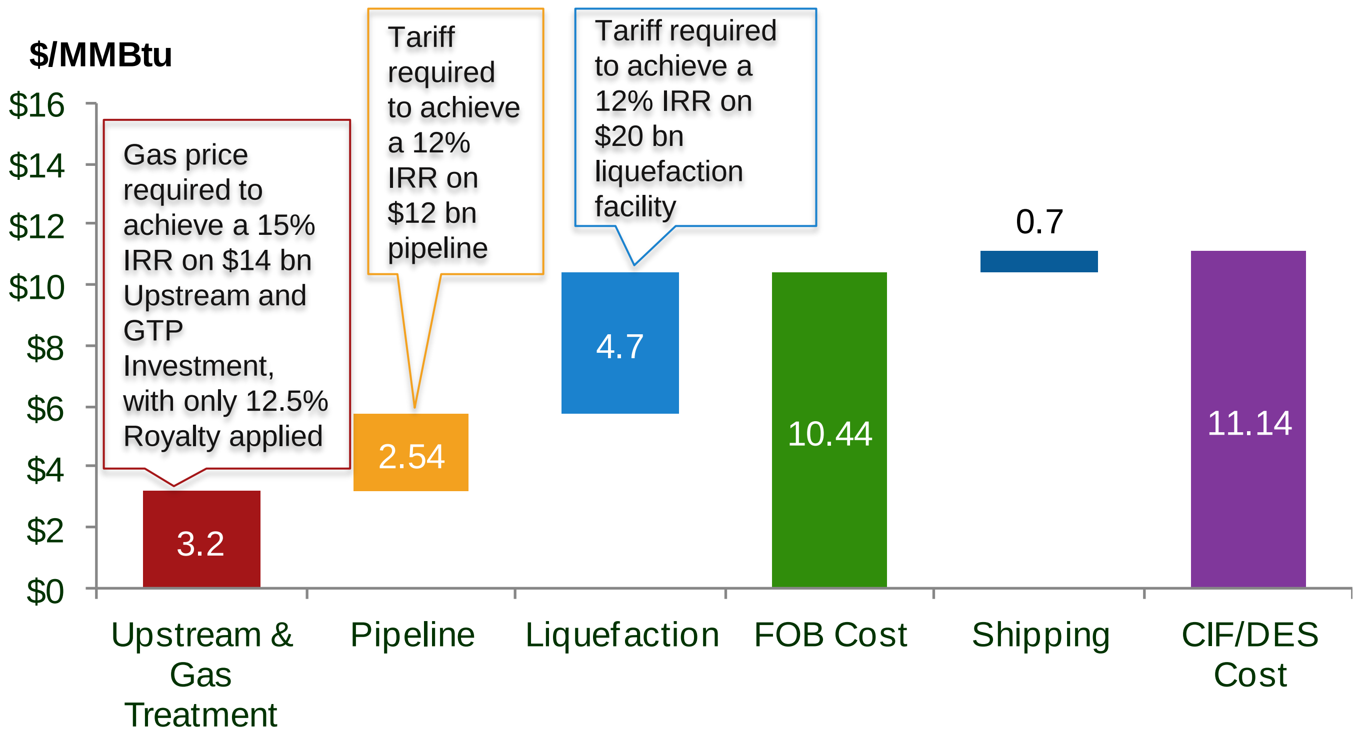
Breakeven Economics for Hypothetical $46bn Project

~$1,111/ton
At this unit cost level, liquefaction spend would be ~$20bn



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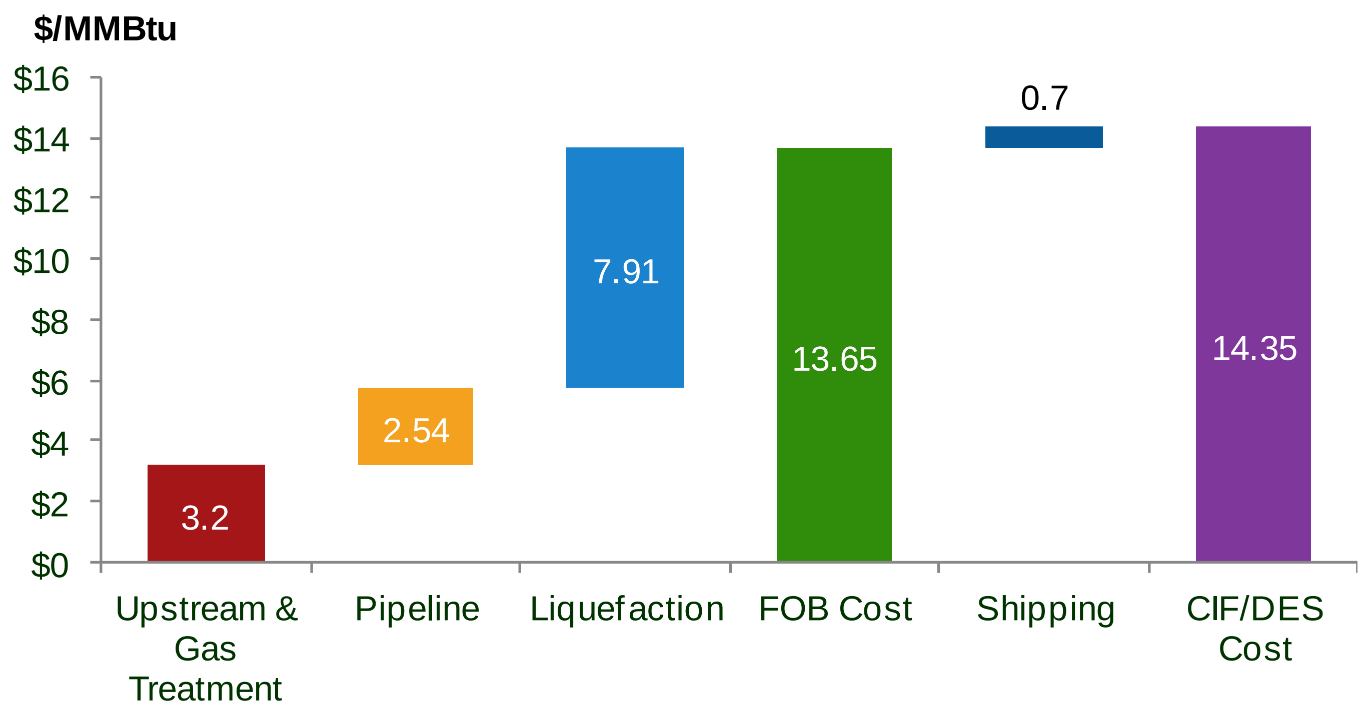
What if Liquefaction reached $/ton costs of Angola LNG or Wheatstone LNG?

~1,900/ton
At this unit cost level, liquefaction spend would be ~$33.6bn



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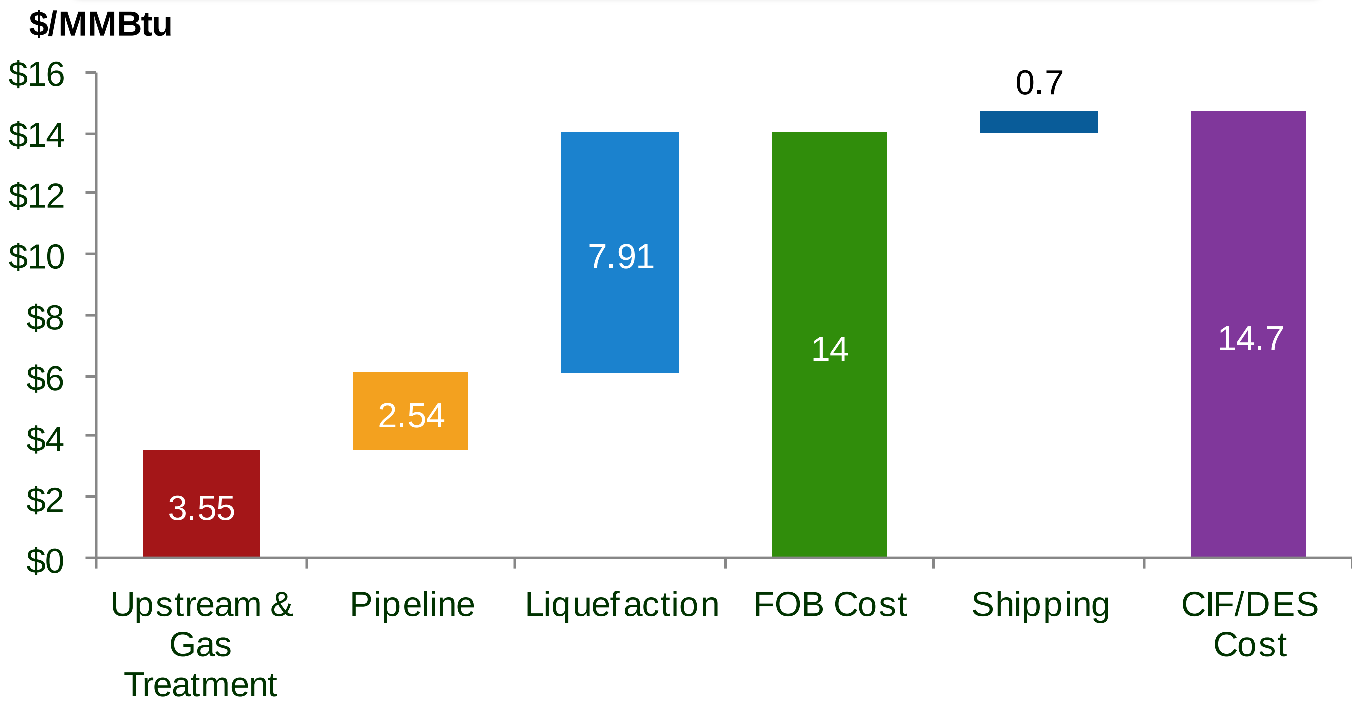
What if Upstream Production Also Faced a 16.7% Royalty and a 35% Production Tax?

~1,900/ton
At this unit cost level, liquefaction spend would be ~$33.6bn
Total Project Spend would be ~$58/bn



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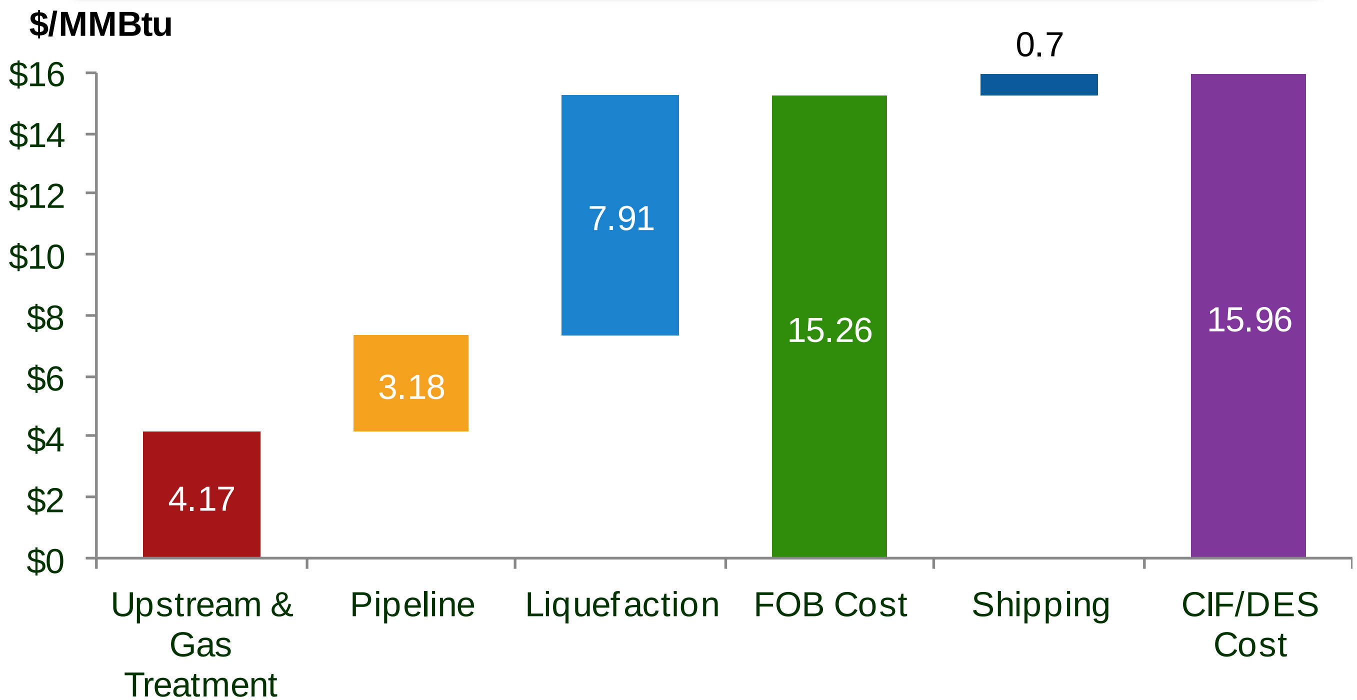
And What If Upstream and Pipeline Costs Were Also 25% Above Base Case?

~1,900/ton
At this unit cost level, liquefaction spend would be ~$33.6bn
Total Project Spend would be ~$64.5/bn



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Lots Needed Before Companies Spend Real Money

Most of the money is spent after taking a Final Investment Decision (FID); before FID, the project developers:

- Certify **reserves** to ensure that the gas is there
- Sign sales and purchase agreements (**SPAs**) with buyers, which reassure the project developers that they will be able to sell their product. These are usually long-term and obligate the buyer to take the gas
- Secure **financing**, often external and often non-resource (whereby the debt is guaranteed by the cash flow of the SPA). External financing is supported by loans and equity from the sponsors
- Award an engineering, procurement and construction (EPC) contract to a company/consortium to **build** the plant
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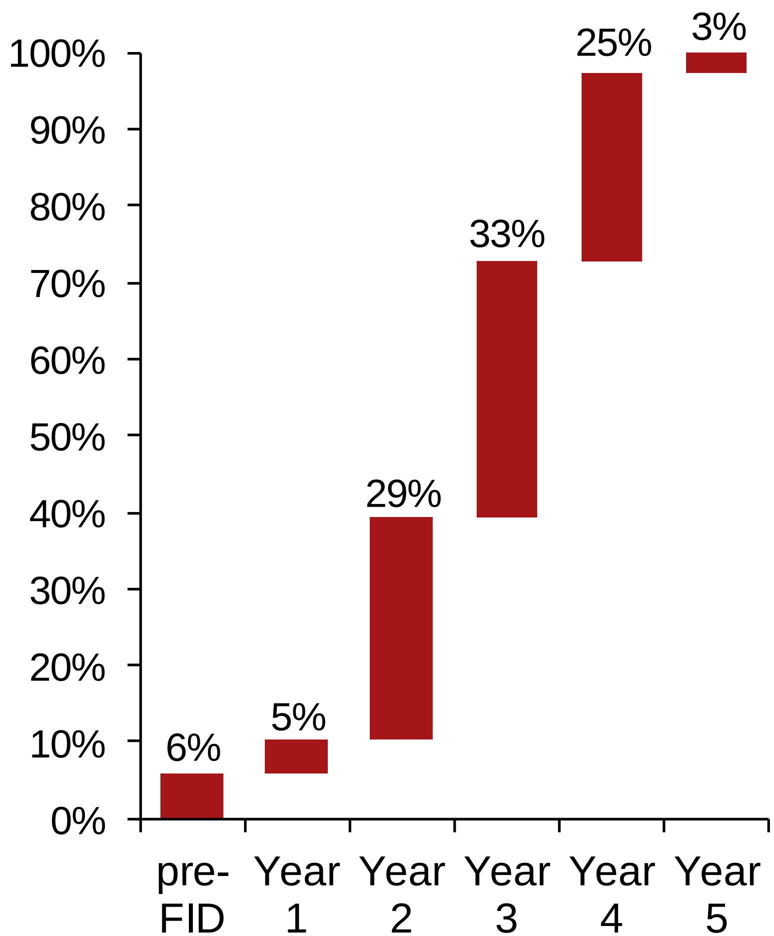
Indicative CAPEX for Integrated LNG Project



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Main Provisions of an LNG Contract

Pricing	Most LNG contracts are priced relative to oil. In Asia, the predominant oil benchmark is the Japan Customs Cleared Price, the average price of oil imported into Japan. Typically, contracts include a ratio / discount relative to oil. In Europe, gas prices are linked either to oil (heavy / light fuel oil) or to regional hubs—the relative prevalence of the two depends on the market with some markets being almost exclusively oil-linked or hub-based. Increasingly, buyers are interested in LNG contracts that are priced against Henry Hub (the US price marker).
Duration	Long-term contracts (15-20 years) remain essential for project sanction, while there is a growing tendency to sign medium (5-10) or short-term (<5) contracts.
Destination Flexibility	In the past, LNG contracts were sold for delivery to a specific market, and the buyer could not deliver the gas to a different destination. Over time, this rigidity has lessened. Destination clauses are now illegal for contracts going into Europe. Contracts with flexible destination clauses are almost a given in the Atlantic Basin, rare in the Asia-Pacific, and have been growing in the Middle East due to Qatar.
Volume Flexibility	Buyers typically have an upward and downward allowance of ~10-20% of contracted volumes. The rest of the volumes is sold under a take-or-pay provision (where the buyer has to pay for the gas even if they choose not to lift some cargoes).
Profit Sharing	Some contracts allow the original seller to share the profit in case a cargo is diverted from its original source. Such agreements are illegal in Europe, while the lack of profit sharing has created tension in several contracts (e.g. Equatorial Guinea, Egypt, Trinidad).
Non-Compliance	Most contracts have arbitration provisions.
Renegotiation Provisions	Most contracts have some price review provisions. These may occur every 3 to 4 years, though buyers or sellers can trigger a review outside this cycle in exceptional circumstances.

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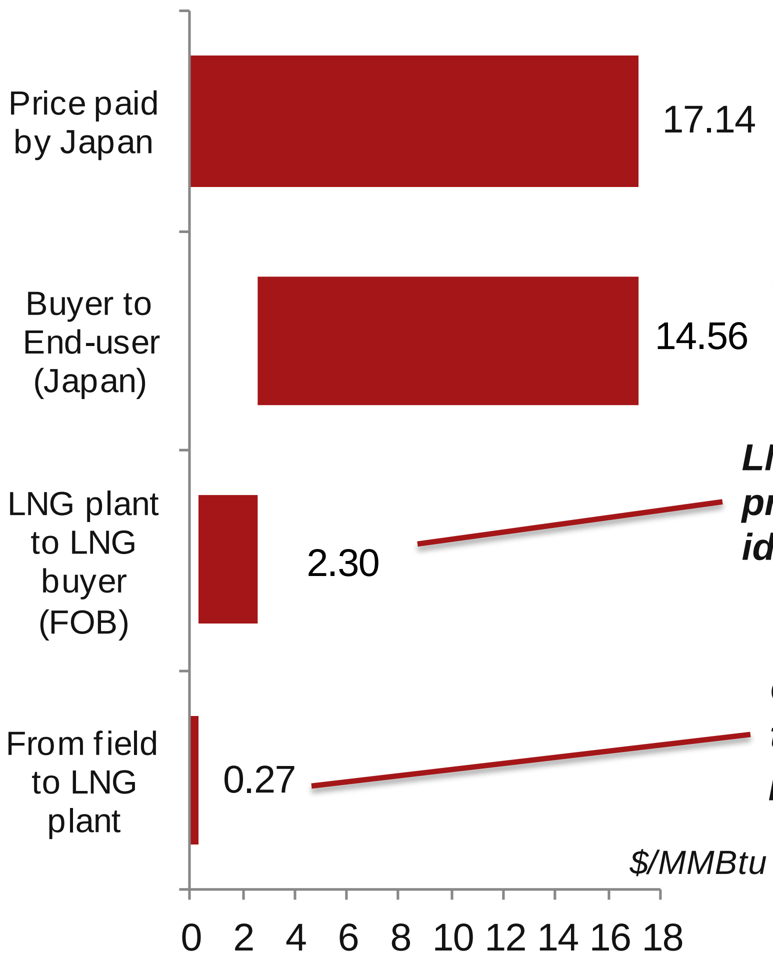
Project Structure Really Matters

Equatorial Guinea to Japan Value Chain



But the LNG can be sold anywhere, and high prices in Asia mean that more of the LNG has gone there; but without the upside flowing back through the chain

LNG is sold free on board (at the plant) for a price linked to Henry Hub because the original idea was to market this gas to the United States

Gas is sold for a price of $0.27/mcf because the revenues from oil production drive project economics for the field

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The LNG Value Chain

Upstream

- The companies that will **develop the gas fields** and supply the gas to be liquefied and exported. Usually projects have a primary supply source, but projects will often source gas from multiple fields and/or areas.

Liquefaction

- The companies that will **own and operate the liquefaction facility**. These companies will assign one or more EPC (engineering, procurement and construction) contractors to build the plant.

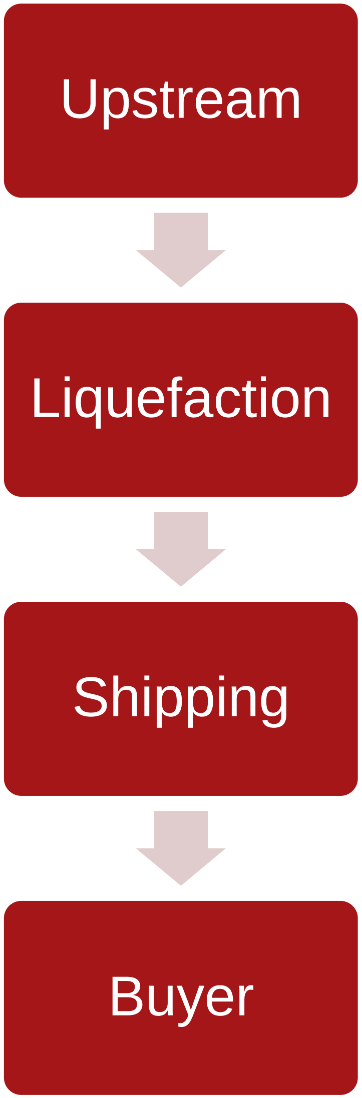
Shipping

- Either the **buyer or the seller handles the shipping**. If the buyer arranges for shipping, the sale is considered FOB (Free on Board). If the sellers arranges for shipping, it is consider CIF (Cost, Insurance, Freight) or DES (Delivered Ex Ship).

Buyer

- The buyer can purchase LNG through a short, medium or long-term **contract** or they can purchase an **individual** cargo (called a spot transaction). The buyer can deliver the gas to an end-user (e.g. power plant) or can re-sell the gas.

Options for Alaska to Participate



Option #1: Receive revenues through royalty gas

- In this case, the state receives a share of the production in the form of royalty (cash); the project partners have full responsibility and ownership to pipe the gas, liquefy it and sell the gas (FOB or CIF/DES).
- The key goal in this commercial structure is to create a “fair” transfer price:
  - Delivers value to the state of Alaska
  - Recognizes the risk/reward and capital commitment of each partner

Option #2: Participate as an equity partner

- In this case, the state of Alaska participates as an equity partner in the LNG project. Usually this is done through either a national oil company or other state-sponsored investment vehicle. In this structure, the state of Alaska could take royalty in kind and be a supplier into the project.
- The key questions are: where in the chain will the state participate (upstream, pipeline, liquefaction, shipping); with what equity stake; and in what form?

Selecting the proper option depends on

- What is the appetite for risk and what kind of risk?
- How to create better alignment between the project partners?
- What kind of commitment will the state make?

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Conclusions

- There is growing demand for gas and LNG, in particular in Asia, and most countries need to secure additional LNG to meet their energy needs post 2020. Alaska's proximity to Asia makes it a natural supply source, although it will face competition from a growing number of new supply sources.
- Shale gas in the United States Lower 48 and in Western Canada will compete with Alaska—and the L48 in particular are a primary destination for suppliers seeking long-term LNG. But higher prices in the United States will potentially undermine the competitiveness of LNG from the Lower 48.
- The companies that are involved in Alaska's upstream and will likely be involved in LNG have substantial experience with and expertise in LNG. As such, the question is not whether they can do an LNG project but rather will they choose to given competing priorities and outlets for their capital.
- An LNG project from Alaska can be competitive with other projects that are seeking to supply Asian markets—but its competitiveness will depend critically on fiscal terms and on keeping costs down.
- LNG projects are big, complex, risky, multi-stakeholder endeavors that take a lot of time (often decades) and money (billions) to complete. There are multiple ways to structure an LNG project (who participates in which part and in what way) and it is important to develop a structure that aligns all the different partners and project participants and meets their risk-reward appetites.

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Glossary and Units

Glossary

CAGR: Compound Annual Growth Rate

CAPEX: Capital Expenditure

CIF: Cost Insurance Freight

DES: Delivered Ex-Ship

EPC: Engineering Procurement and Construction

FEED: Front-End Engineering and Design

FID: Final Investment Decision

FOB: Free on Board

FSRU: Floating Storage and Regasification Unit

HOA: Heads of Agreement (preliminary contract)

IOC: International Oil Company

JV: Joint Venture

JCC: Japan Customs Cleared

MENA: Middle East and North Africa

MOU: Memorandum of Understanding (preliminary contract)

NOC: National Oil Company

OECD: Organization Economic Cooperation and Development

PSC: Production Sharing Contract

SPA: Sales and Purchase Agreement (finalized contract)

Units

$/B: Dollars per barrel (oil)

BCF/D: Billion cubic feet per day

BCM: Billion cubic meters

CM: Cubic meters

KTOE: Thousand tons of oil equivalent

MMBTU: Million British thermal units

MMCF/D: Million cubic feet per day

MMT: Million tons (LNG)

MMTOE: Million tons of oil equivalent

MMTPA: Million tons per annum (LNG)

Unit Conversions

Natural gas (NG) and liquefied natural gas (LNG)

From	To: billion cubic metres NG	billion cubic feet NG	million tonnes oil equivalent	million tonnes LNG	trillion British thermal units	million barrels oil equivalent
	Multiply by					
1 billion cubic metres NG	1	35.3	0.90	0.74	35.7	6.60
1 billion cubic feet NG	0.028	1	0.025	0.021	1.01	0.19
1 million tonnes oil equivalent	1.11	39.2	1	0.82	39.7	7.33
1 million tonnes LNG	1.36	48.0	1.22	1	48.6	8.97
1 trillion British thermal units	0.028	0.99	0.025	0.021	1	0.18
1 million barrels oil equivalent	0.15	5.35	0.14	0.11	5.41	1

Source: BP Statistical Review of World Energy 2013