



# Indicative Costs and Economics for LNG Projects

Anchorage, AK  
August 5-9, 2013

North Slope Gas & LNG Symposium

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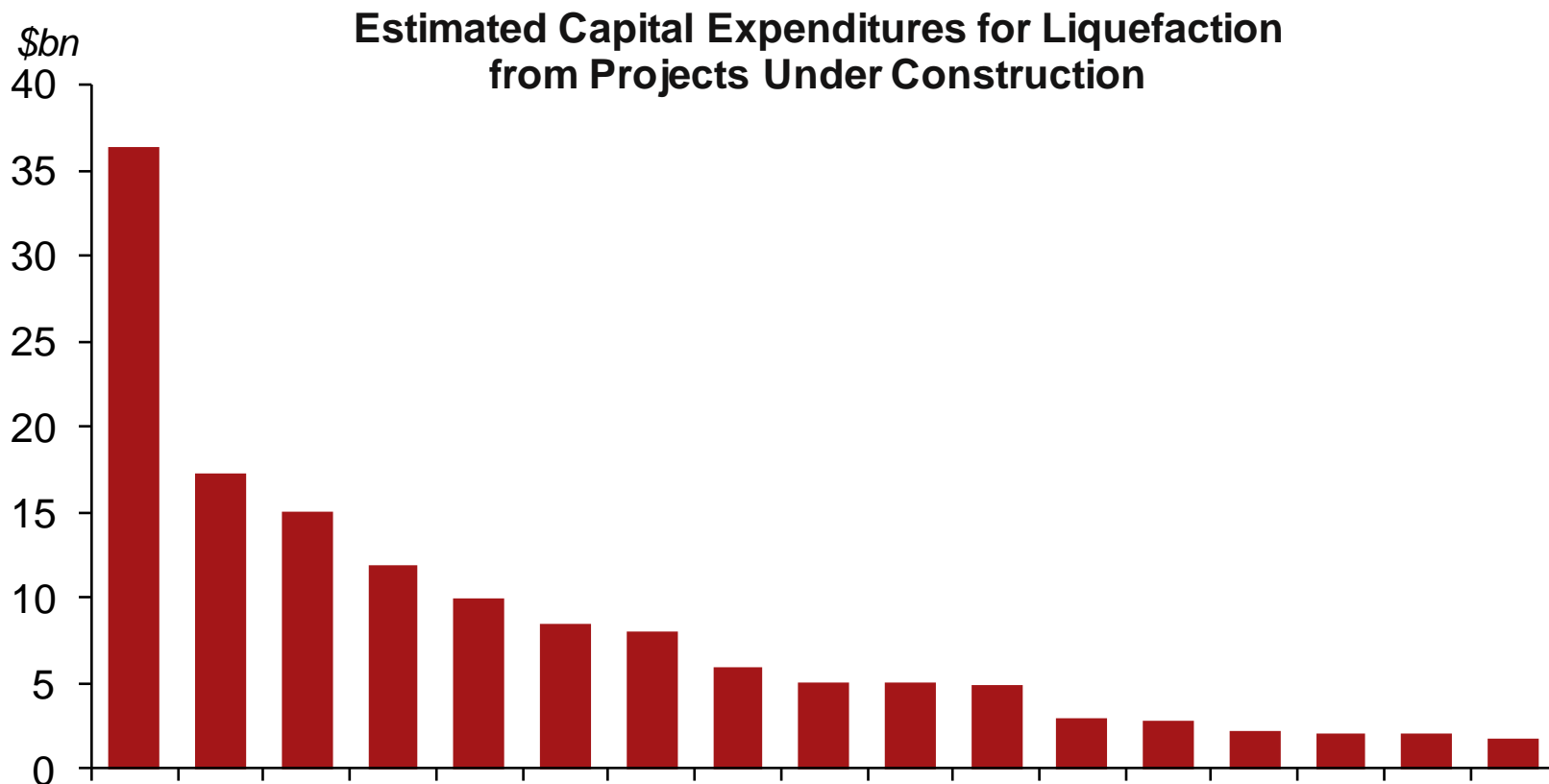
## **Economics of an LNG project**

Cost Escalation Trends

Competition vs US L48

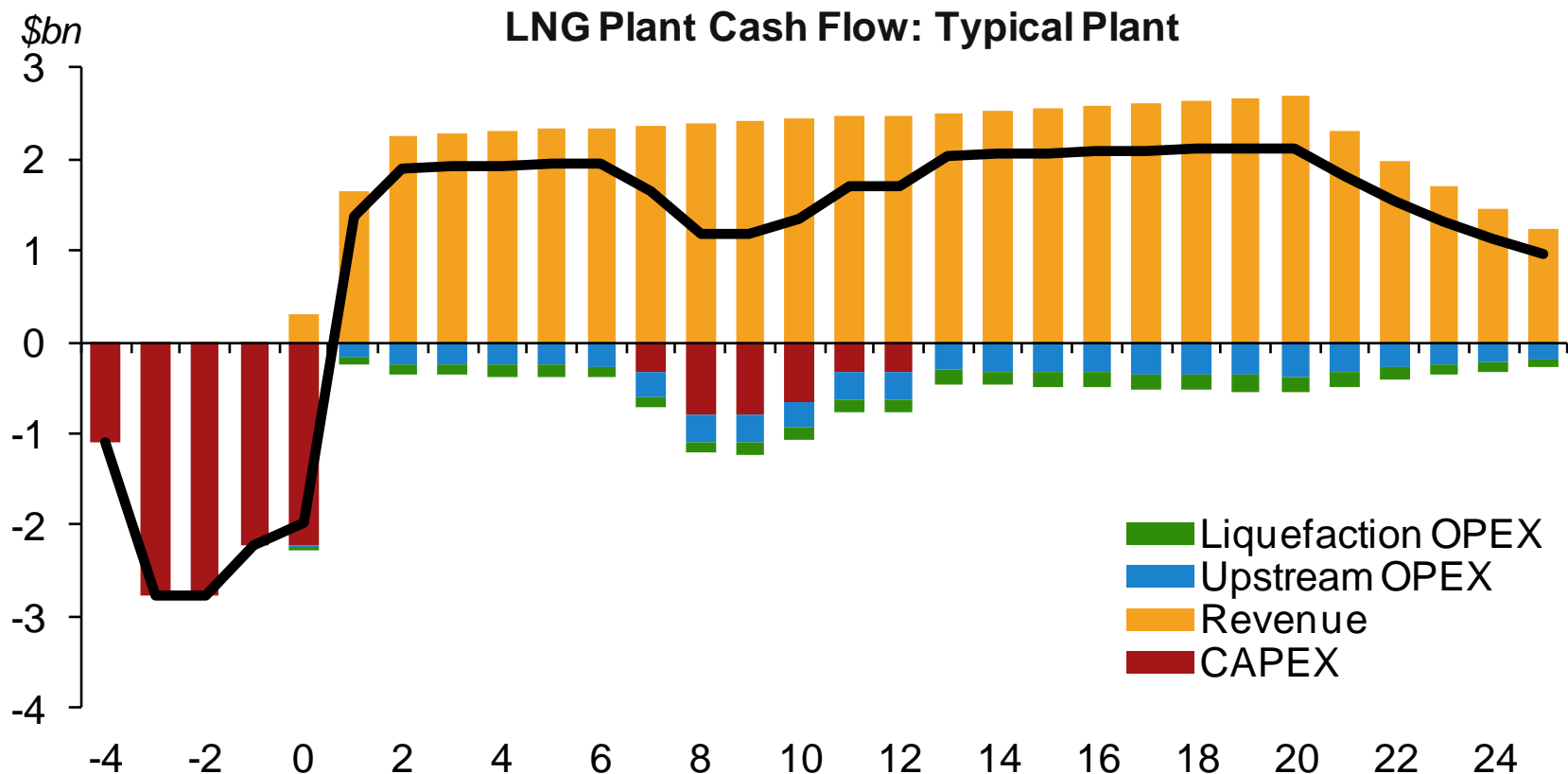
Alaska LNG Competitiveness – Sensitivities

# LNG Projects Require Sizeable Investments



- Of LNG projects under construction, 5 will spend over **\$10 billion** just on liquefaction
- Even “cheaper” need ~\$2 billion in liquefaction investment

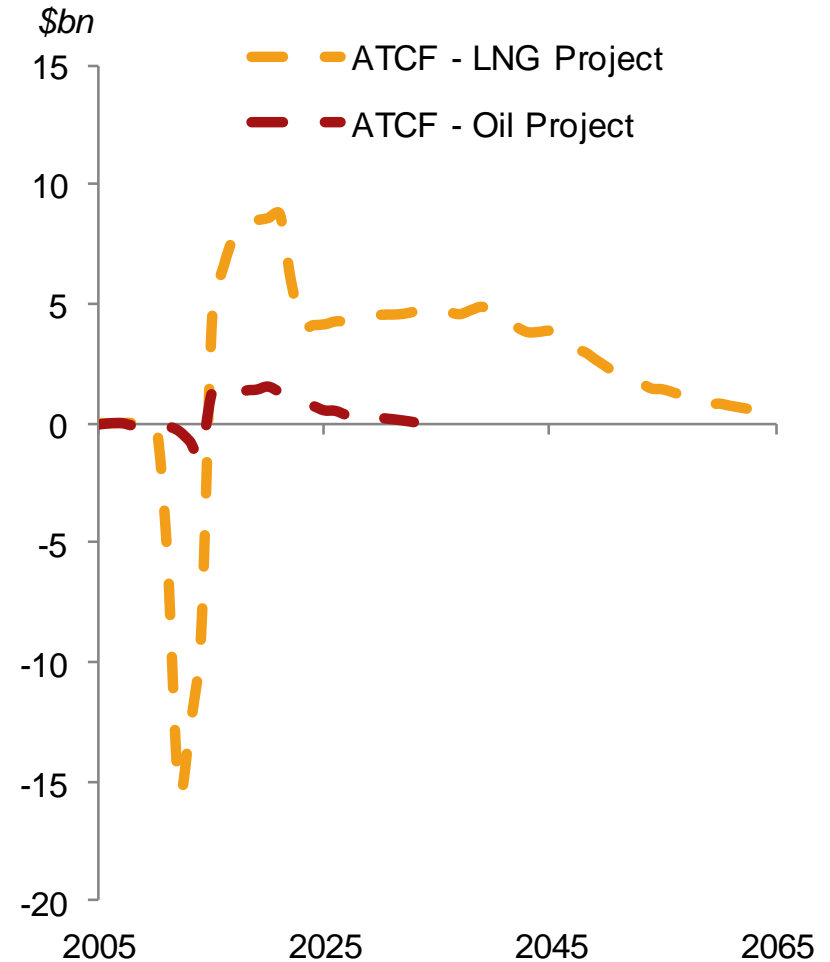
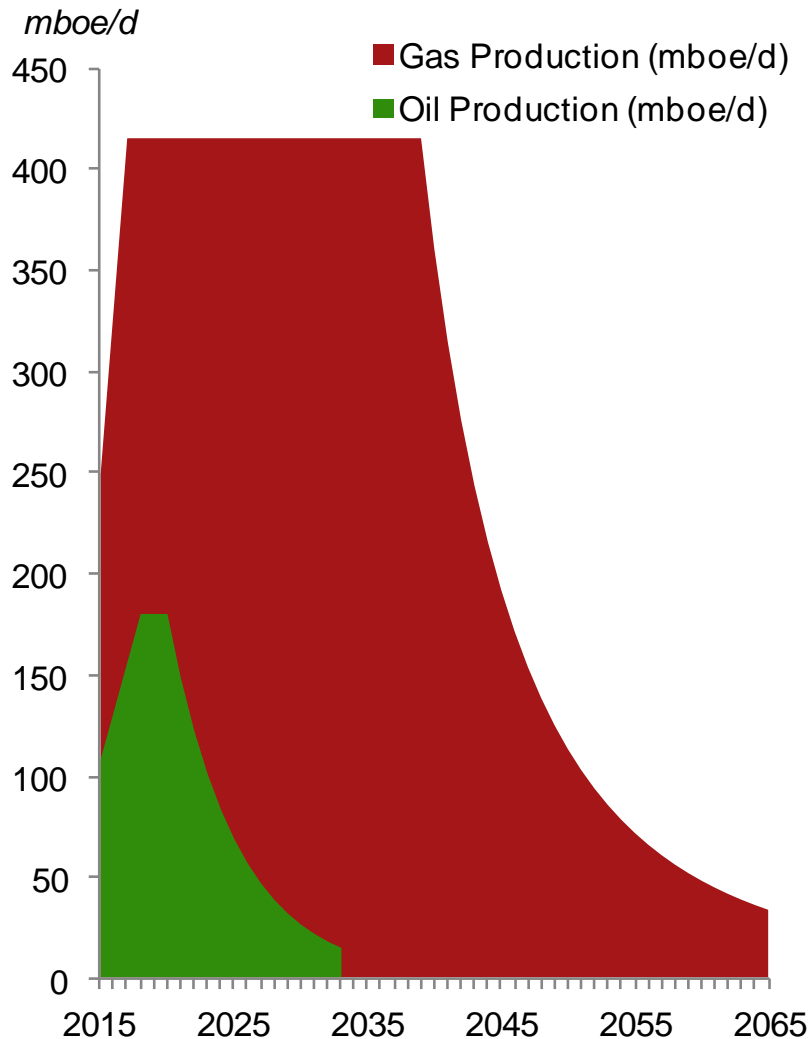
# What Does an LNG Liquefaction Plant Look Like?



- 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)

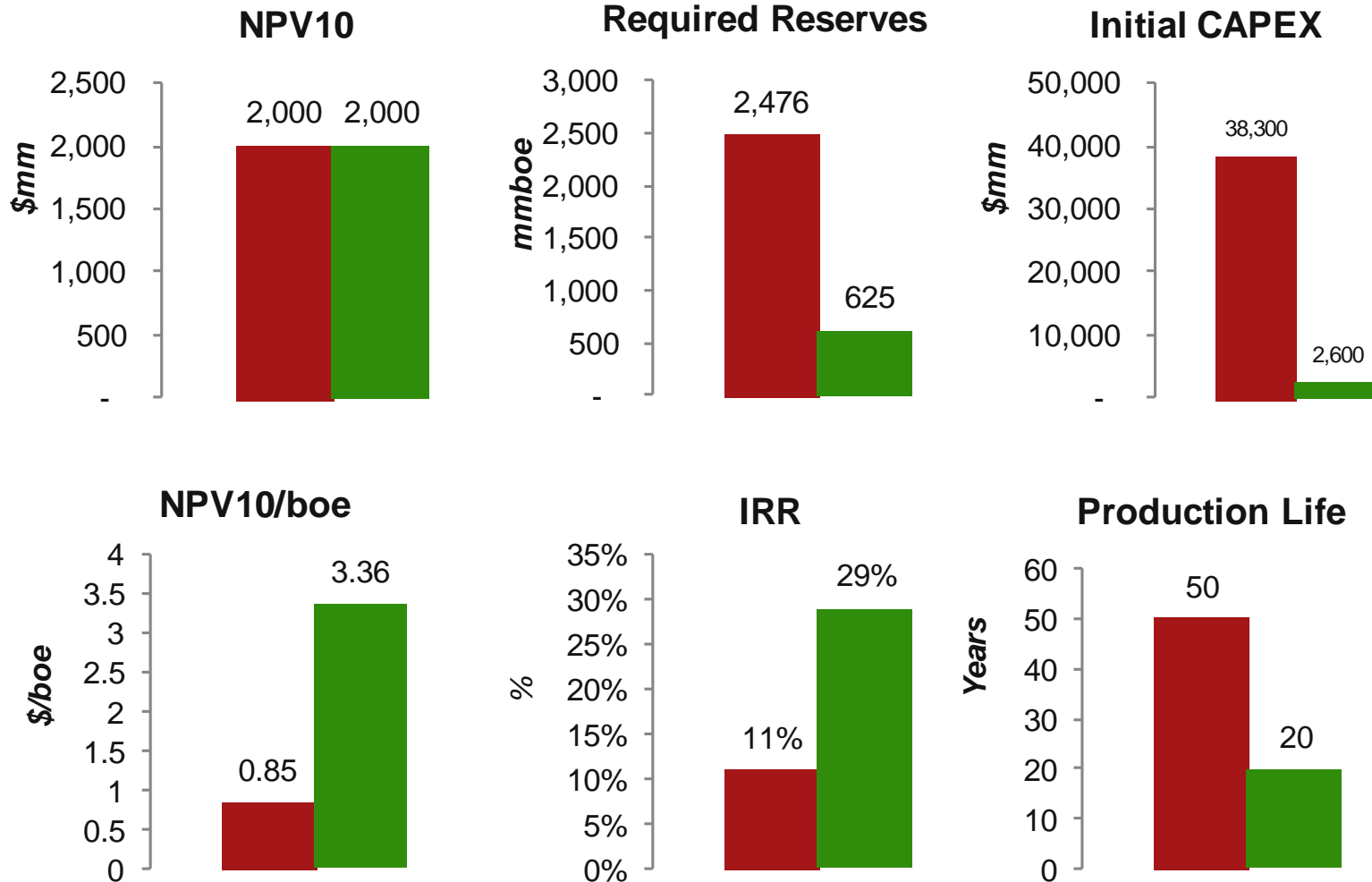
# Oil and Gas Have Different Production / Economic Profiles...

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



# ... and Different Economic Outcomes

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



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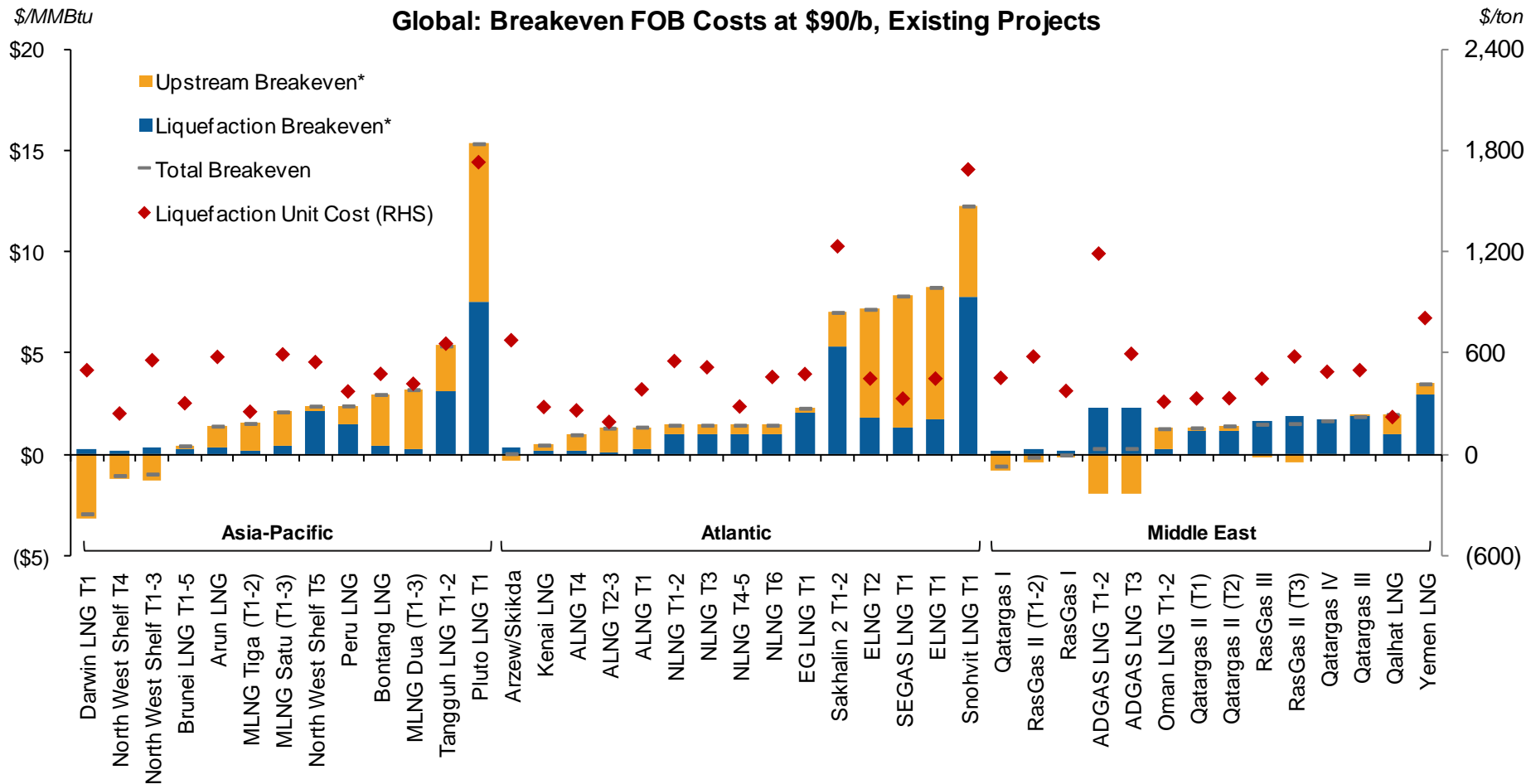
Alaska LNG Competitiveness – Sensitivities

# Oil-Indexed Pricing to Asian Markets

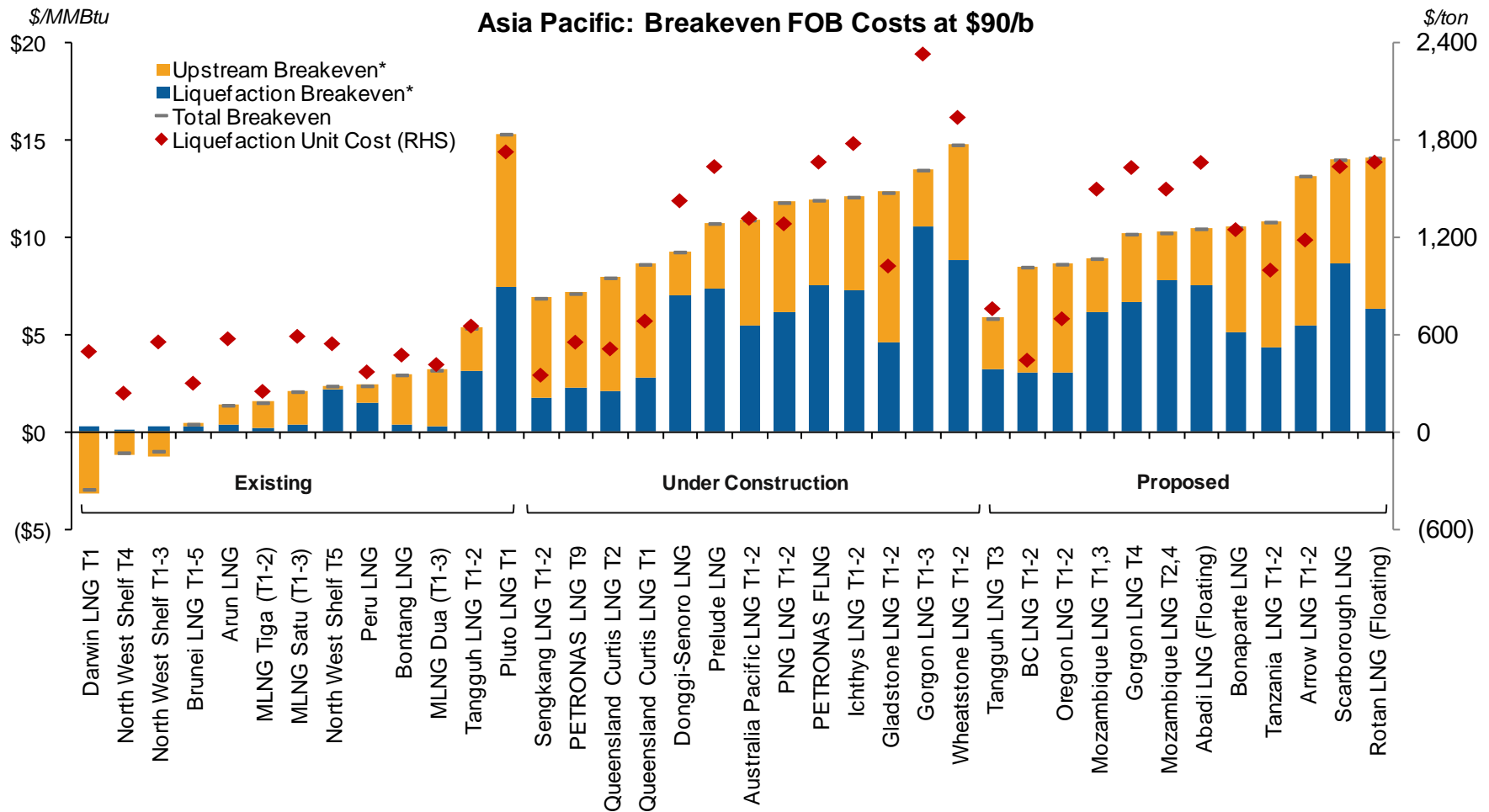
Contract Sales Price Slope --->	0.13x	0.14x	0.15x	0.16x
\$60/bbl Brent	\$7.80	\$8.40	\$9.00	\$9.60
\$80/bbl Brent	\$10.40	\$11.20	\$12.00	\$12.80
\$100/bbl Brent	\$13.00	\$14.00	\$15.00	\$16.00
\$120/bbl Brent	\$15.60	\$16.80	\$18.00	\$19.20
\$140/bbl Brent	\$18.20	\$19.60	\$21.00	\$22.40



# Newer LNG Projects Have Needed Highest Breakeven Prices Yet Seen...



# ...a Trend Continued by Projects Under Construction in Asia-Pacific, Largely Due to Australia Cost Escalation



# Project Cost Escalation Drivers

Recent Cost Revisions at Major LNG Projects						
Project	At FID		Latest		% Change	
	\$/ton	\$/MMBtu	\$/ton	\$/MMBtu	\$/ton	\$/MMBtu
Gorgon LNG T1-3	2,467	10.42	3,712*	13.72	50%	32%
Pluto LNG T1	2,256	11.84	3,477	15.34	54%	30%
PNG LNG T1-2	2,273	10.15	2,754	12.99	21%	28%
QC LNG T1-2	1,765	6.54	2,400	8.43	36%	29%
Gladstone LNG T1-2	2,051	9.79	2,372	10.95	16%	12%
Angola LNG T1	1,346	7.18	1,923	10.91	43%	52%

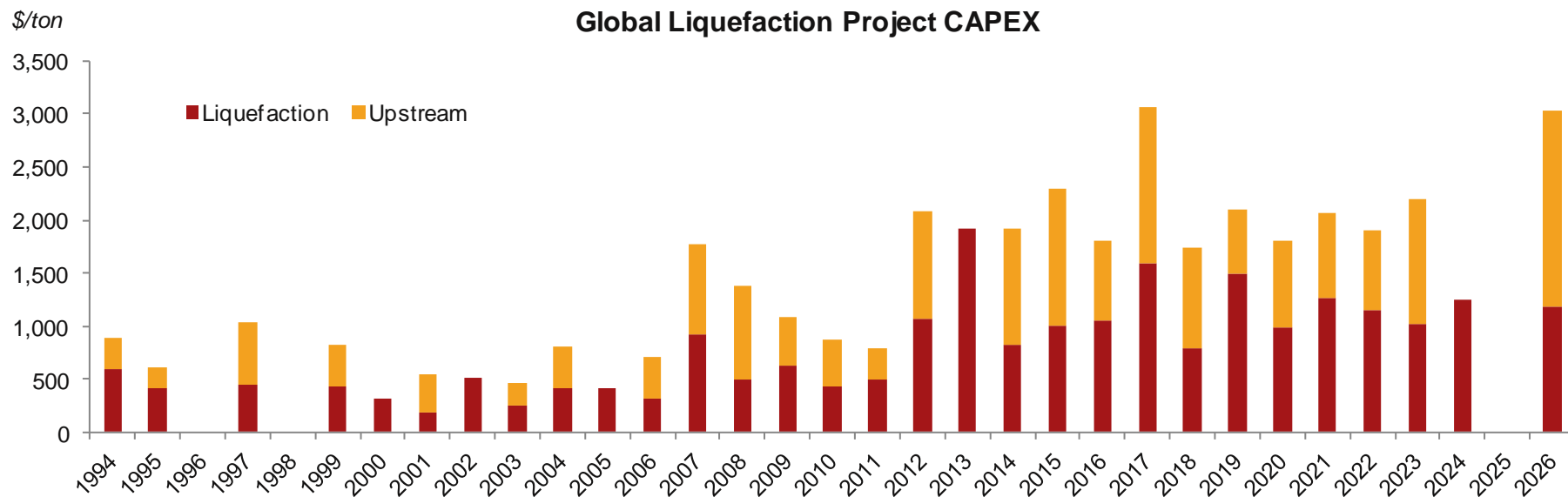
\*Press indicates Gorgon LNG's cost review will reveal a substantial increase.

- Five sanctioned projects announced cost increases in 2012 alone
  - Costs rose 30% on average relative to figures quoted at FID.
- Major factors:
  - **Australia:** Rising labor costs; Australian dollar appreciation; weather-related delays; labor union disputes; local content cost increases; scope of work changes; additional regulatory compliance costs; acceleration of upfront upstream capital
  - **Papua New Guinea:** Australian dollar appreciation; land rights disputes; weather-related delays
  - **Angola:** Rising construction costs

# Average LNG Project Segment Costs

- Total spending on liquefaction projects has increased dramatically over the past decade
- Global liquefaction CAPEX increased from an average of \$505/ton between 2000 and 2009 to a projected \$1,043/ton between 2010 and 2019

Greenfield Asia Pacific Projects	Liquefaction	Upstream
	\$/ton	
Existing	640	558
Under Construction	1,331	1,308
Proposed	1,168	1,121



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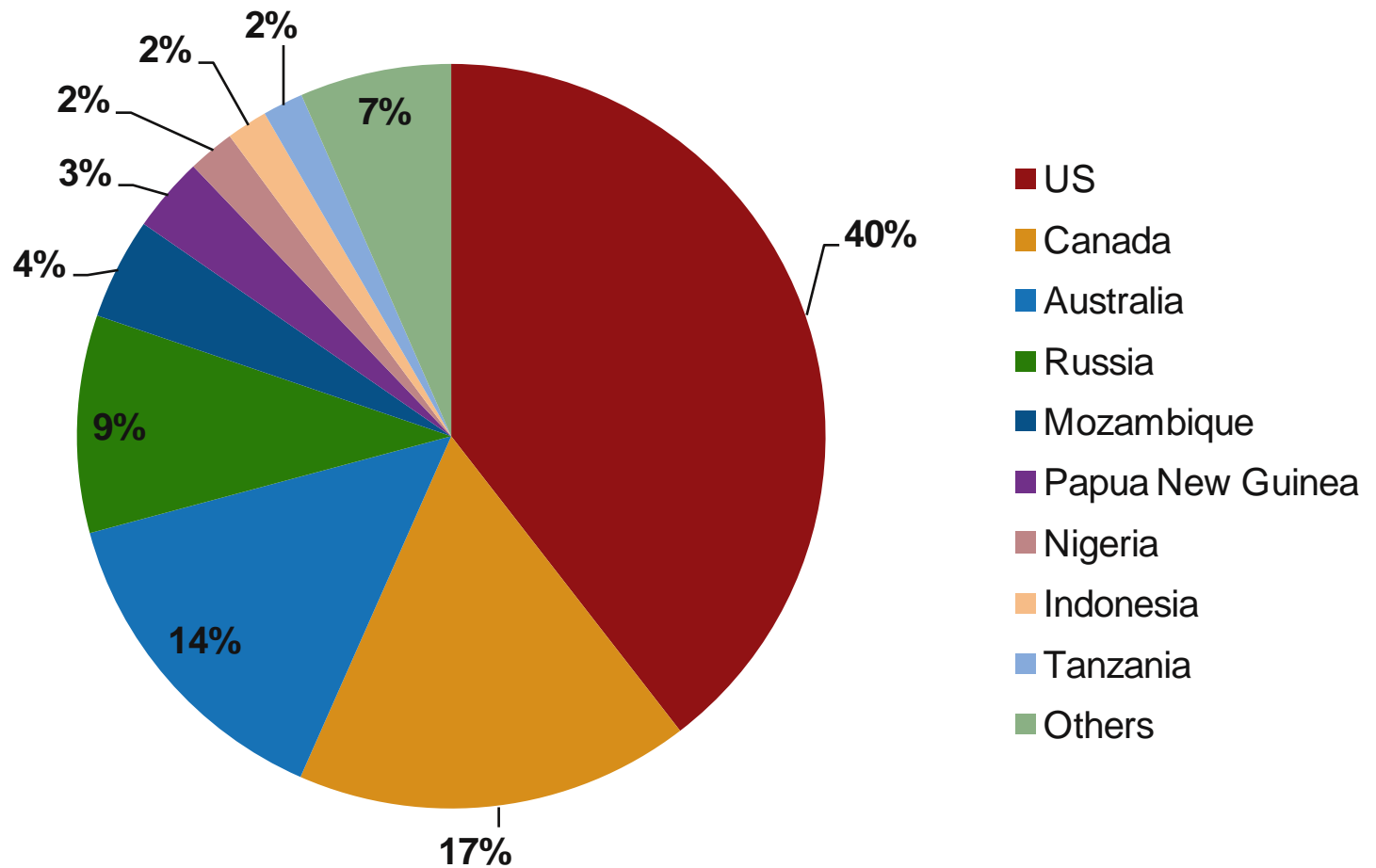
Cost Escalation Trends

**Competition vs US L48**

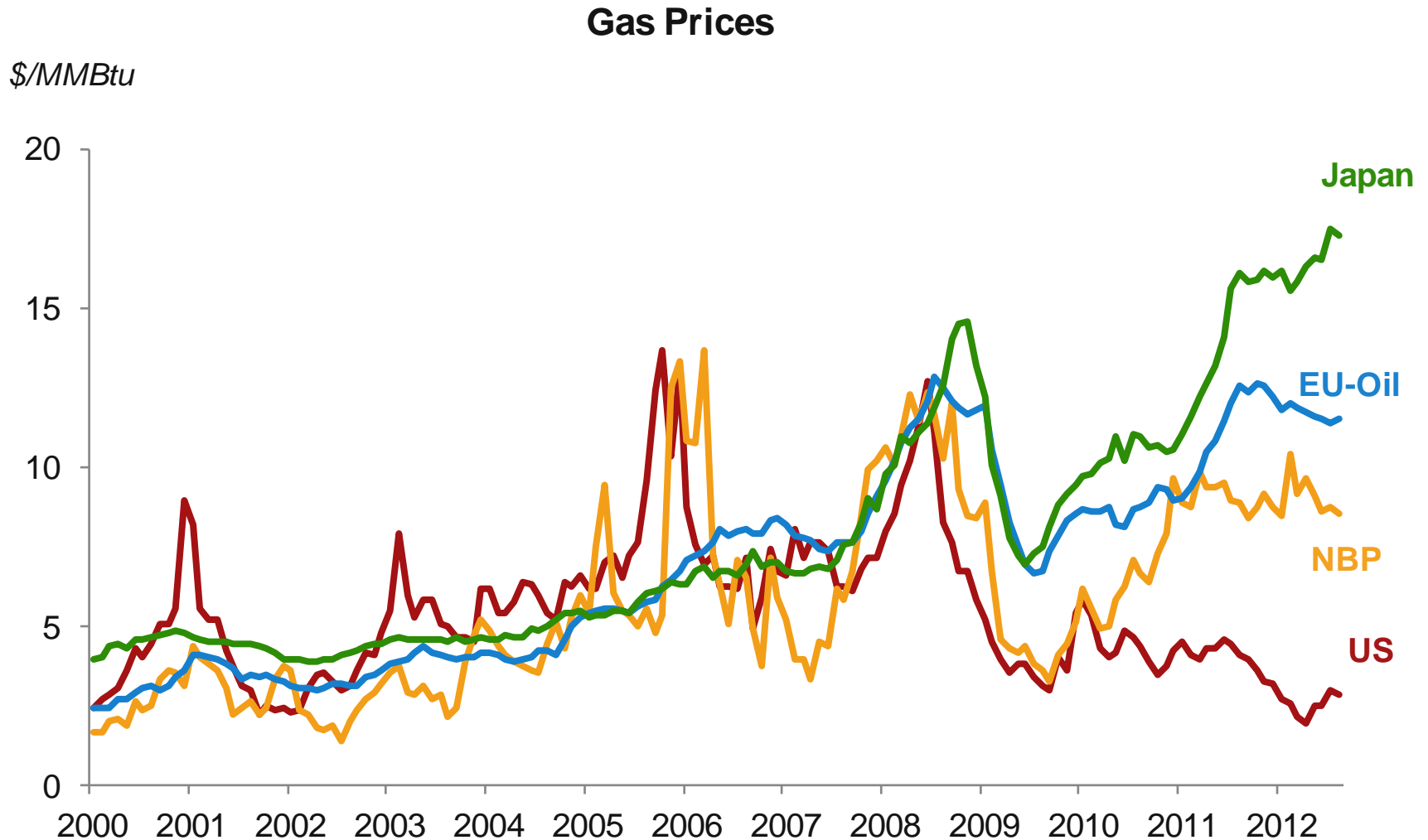
Alaska LNG Competitiveness – Sensitivities

# North America is Largest Prospective Supplier

Proposed Liquefaction Plants by Location

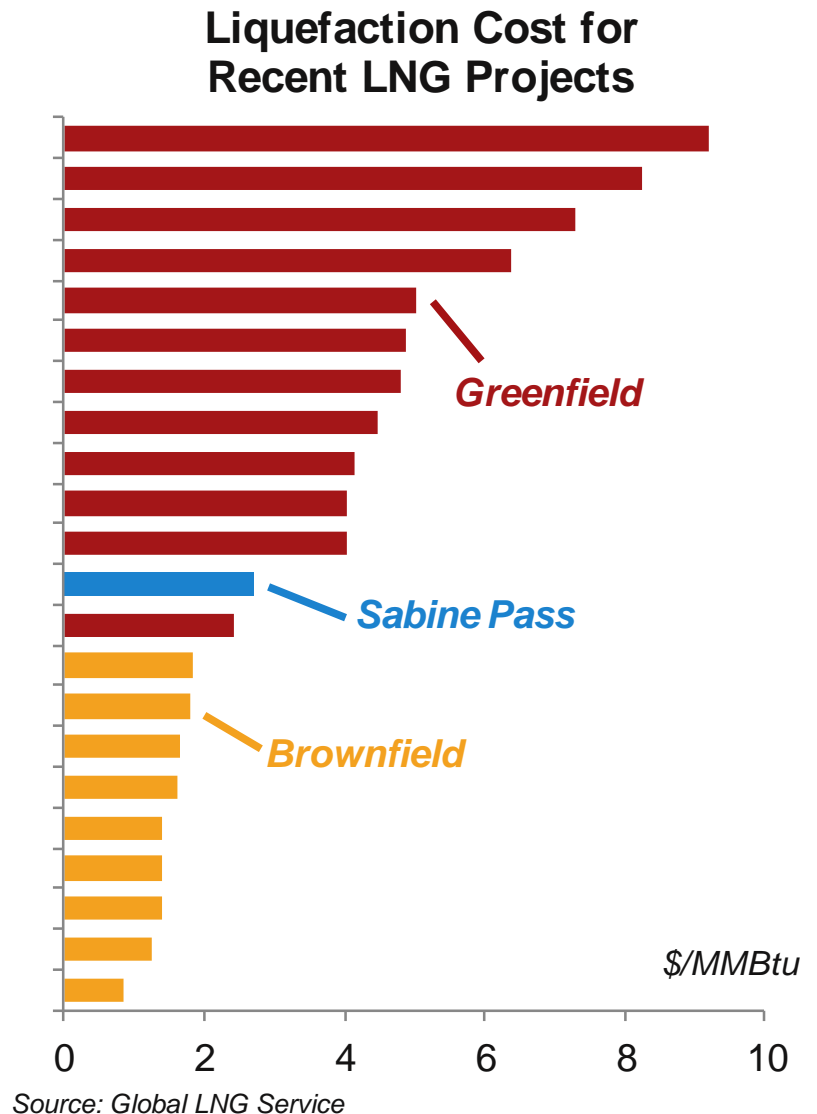


# North American Export Projects Driven by Divergence in Gas Prices...



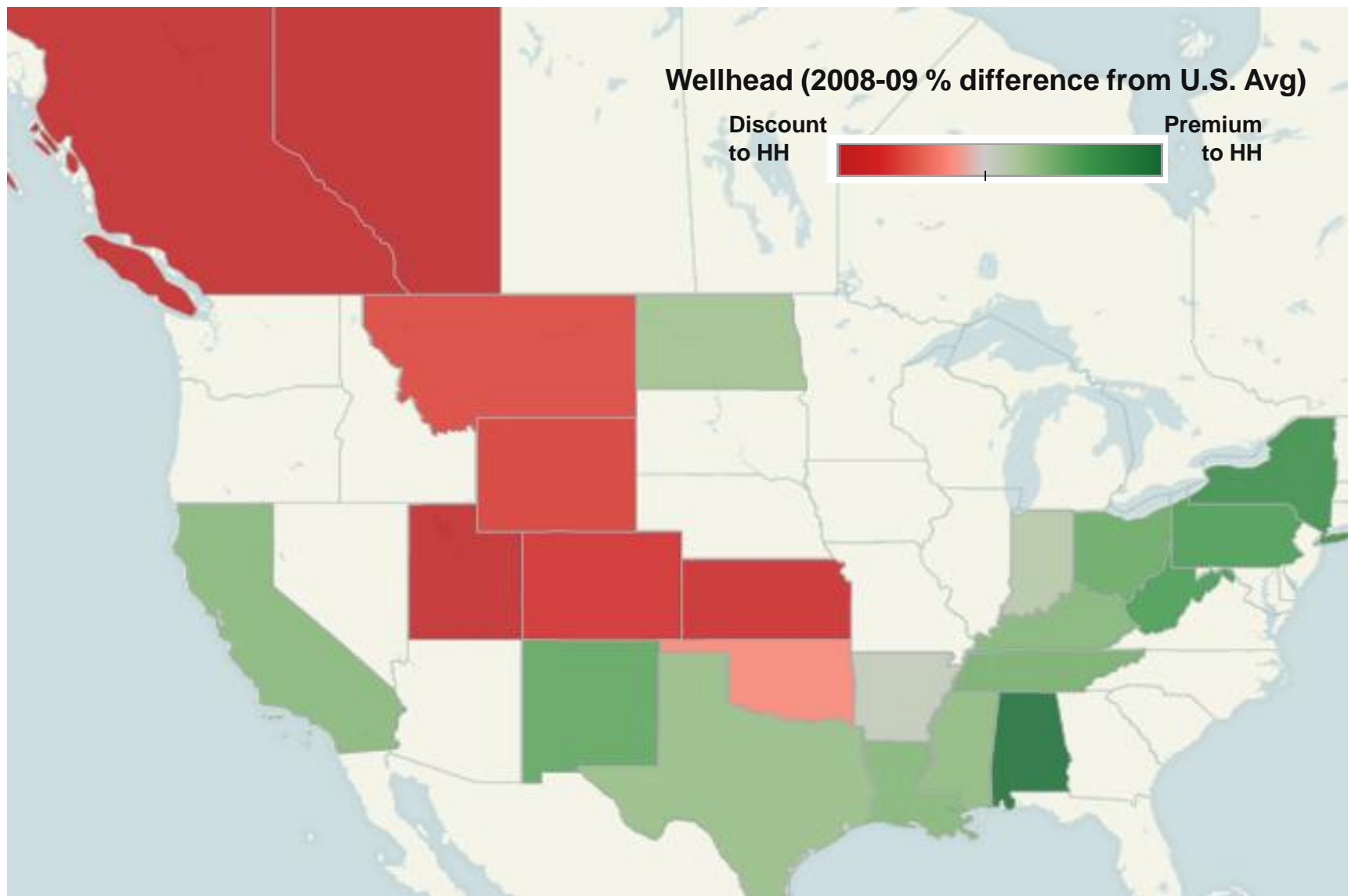
# ...As Well as the Benefits of Brownfield Economics...

- Building liquefaction facilities on the site of a regasification terminal yields a lower unit cost
- Sabine Pass' average charge of \$2.72/MMBtu is on below almost all recently sanctioned or recently completed brownfield facilities



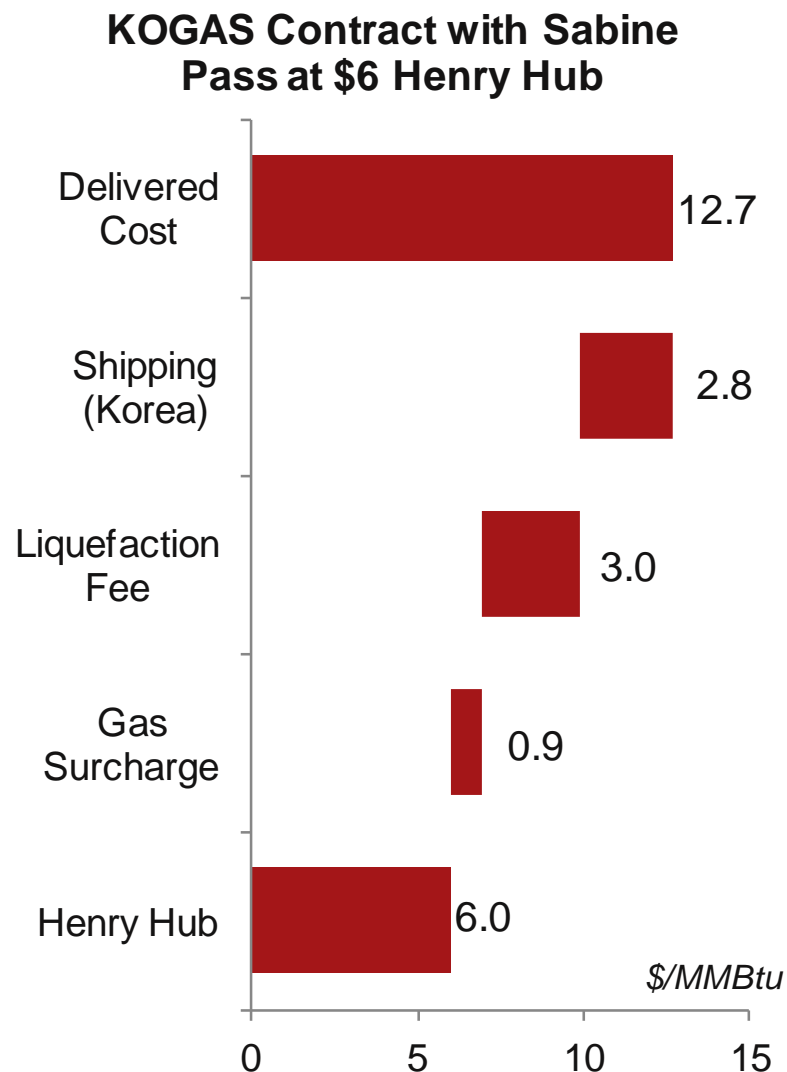


# ...and Substantial Amounts of Semi-Stranded Gas



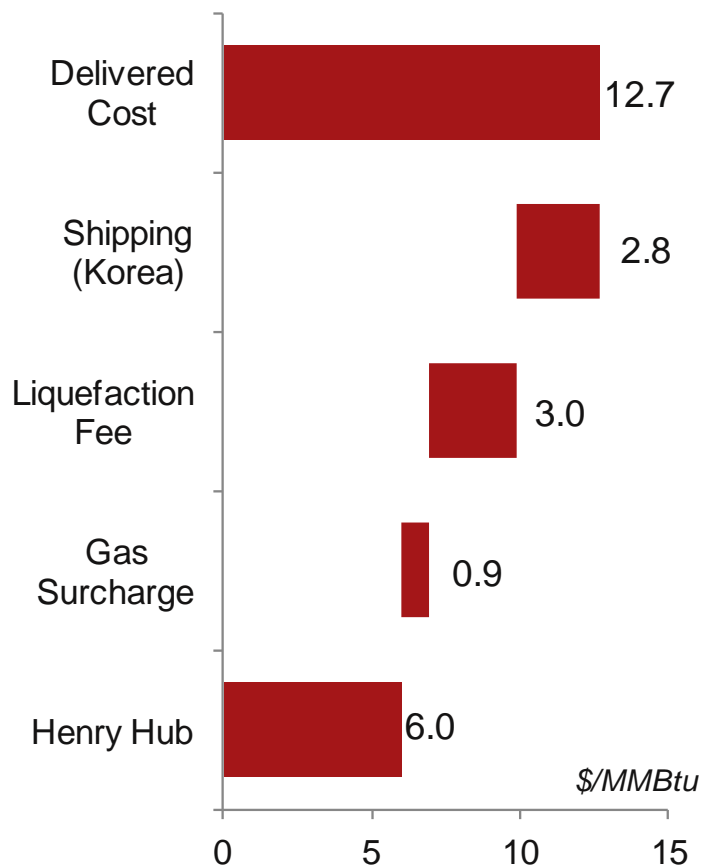
# How LNG From the Lower 48 is Priced

- As the first US-based LNG project to start construction, Sabine Pass set the pricing expectations for US-based LNG. The Sabine Pass contracts are structured as follows:
- Henry Hub x 115%.** The 15% “mark-up” covers the gas lost during the conversion process (6-8%) as well as any basis differentials and other risks that Cheniere undertakes in procuring the gas.
- Liquefaction charge.** Ranging from \$2.25/MMBtu (first contract) to \$3/MMBtu, this covers the CAPEX for the facility.
- Shipping.** This cost is taken on by the buyer. Shipping to Europe is estimated at \$1/MMBtu and shipping to Asia is estimated at \$2 to \$3/MMBtu (India / NE Asia).
- Regasification.** In Europe, comparing US-based LNG to pipeline gas would require regasification charges of \$0.40 to \$1/MMBtu.
- Although other projects will not track these economics 100%, they are assumed to be similar.



# US-Based LNG Not Necessarily Cheap; & Volatile

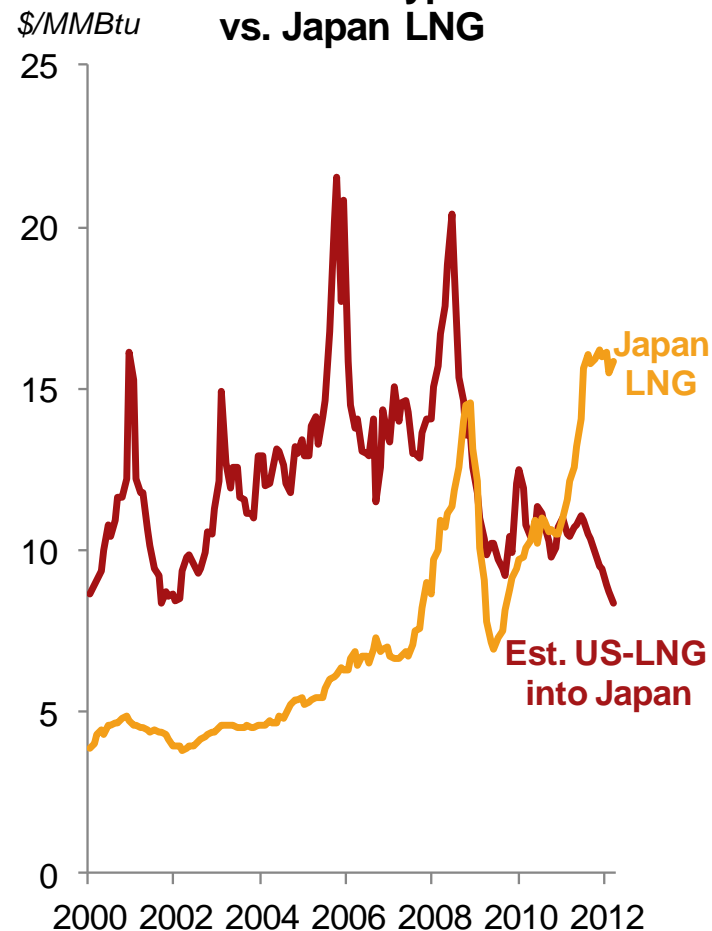
**KOGAS Contract with Sabine  
Pass at \$6 Henry Hub**



**At \$6/MMBtu, US is not that cheap**

Source: Global LNG Service

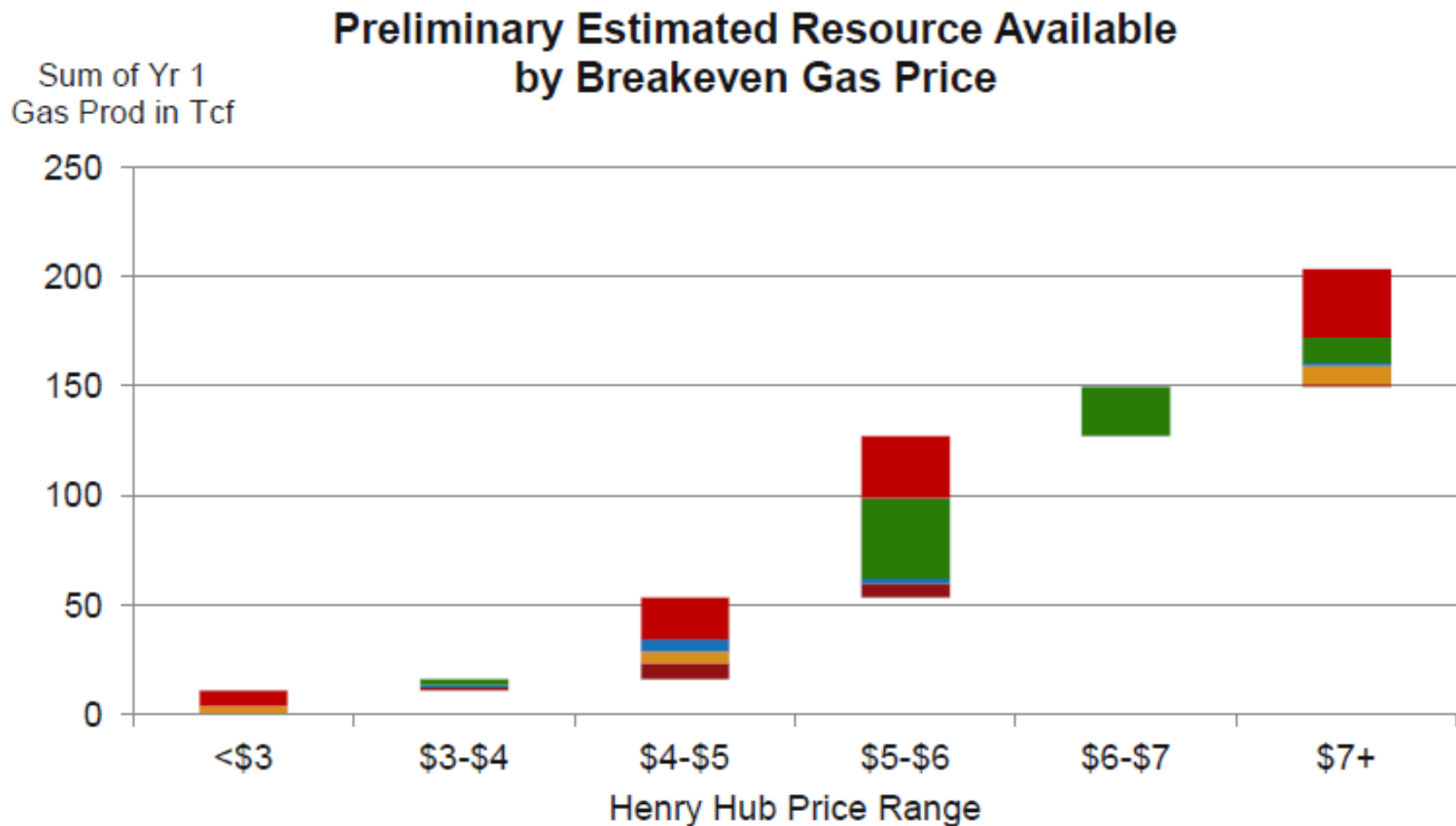
**Sabine Pass-Type LNG  
vs. Japan LNG**



**Hub can be cheap but also volatile**

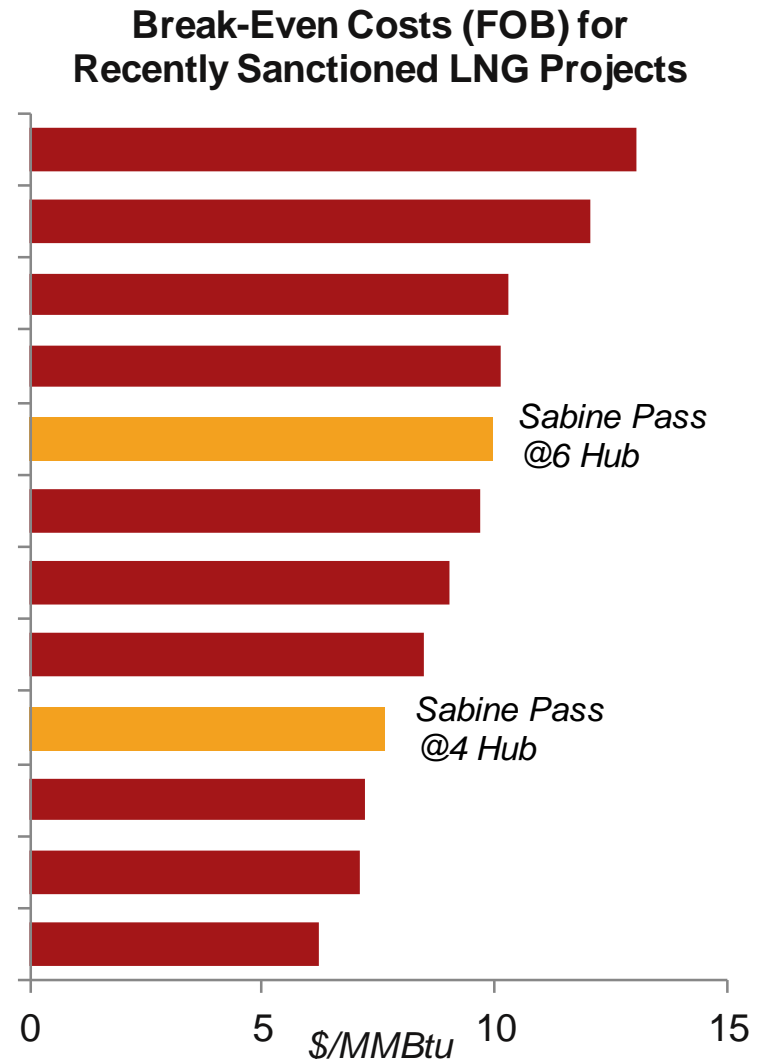
Source: Global LNG Service

# US Gas Supply Cost Curve



# How Competitive is US L48 LNG @ \$4 or \$6 Henry Hub?

- Given cost inflation in Australian LNG projects, US LNG exports (following the Cheniere structure) can be competitive at \$4/MMBtu Henry Hub
- Exports are less competitive at \$6/MMBtu, especially given the extra shipping cost from the Gulf of Mexico to Asia
- Can US LNG exports compete with brownfield expansions in the 2020 timeframe?



Source: Global LNG Service

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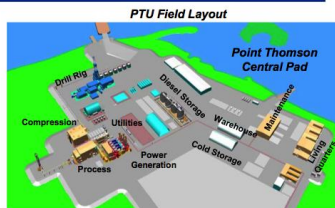
# AK South Central LNG Concept

## 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



### PBU Central Gas Facility Tie-in

### 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<sub>2</sub> using existing injection systems as appropriate



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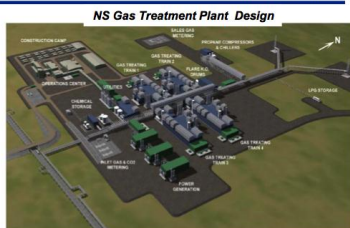
Work Product In Progress

## 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



### 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



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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

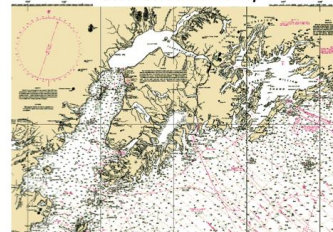
### SCLNG Plant and Storage



### 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

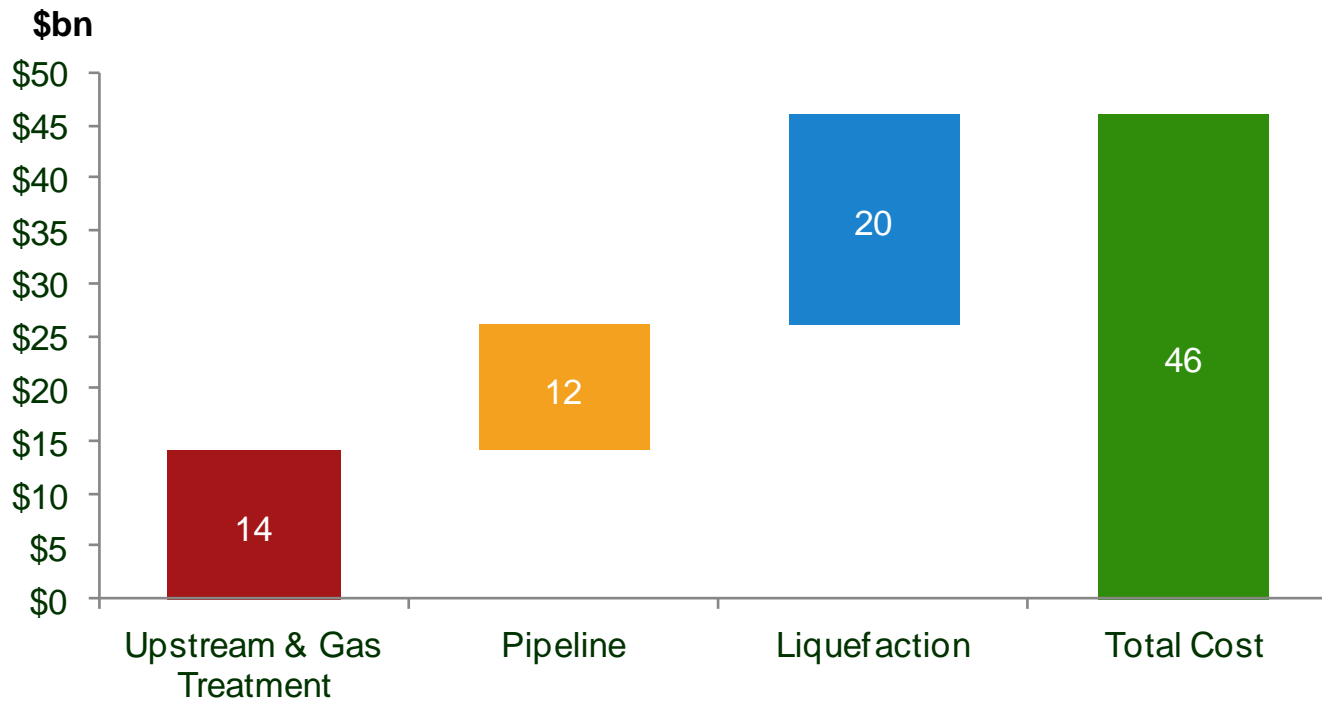


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Work Product In Progress

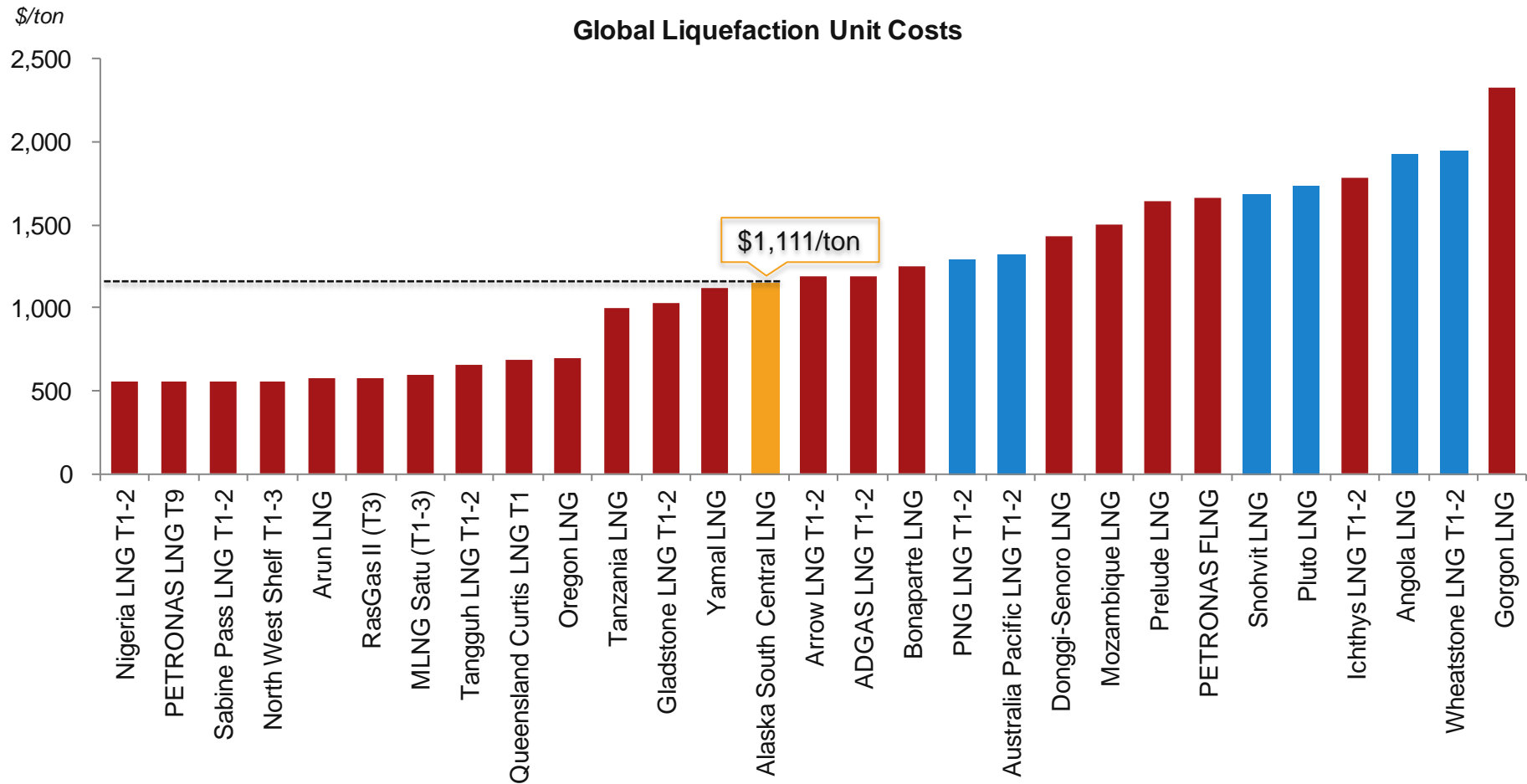
**Estimated total cost:**  
**\$45 - \$60 bn (2011 real dollars)**

# Hypothetical Cost Breakdown

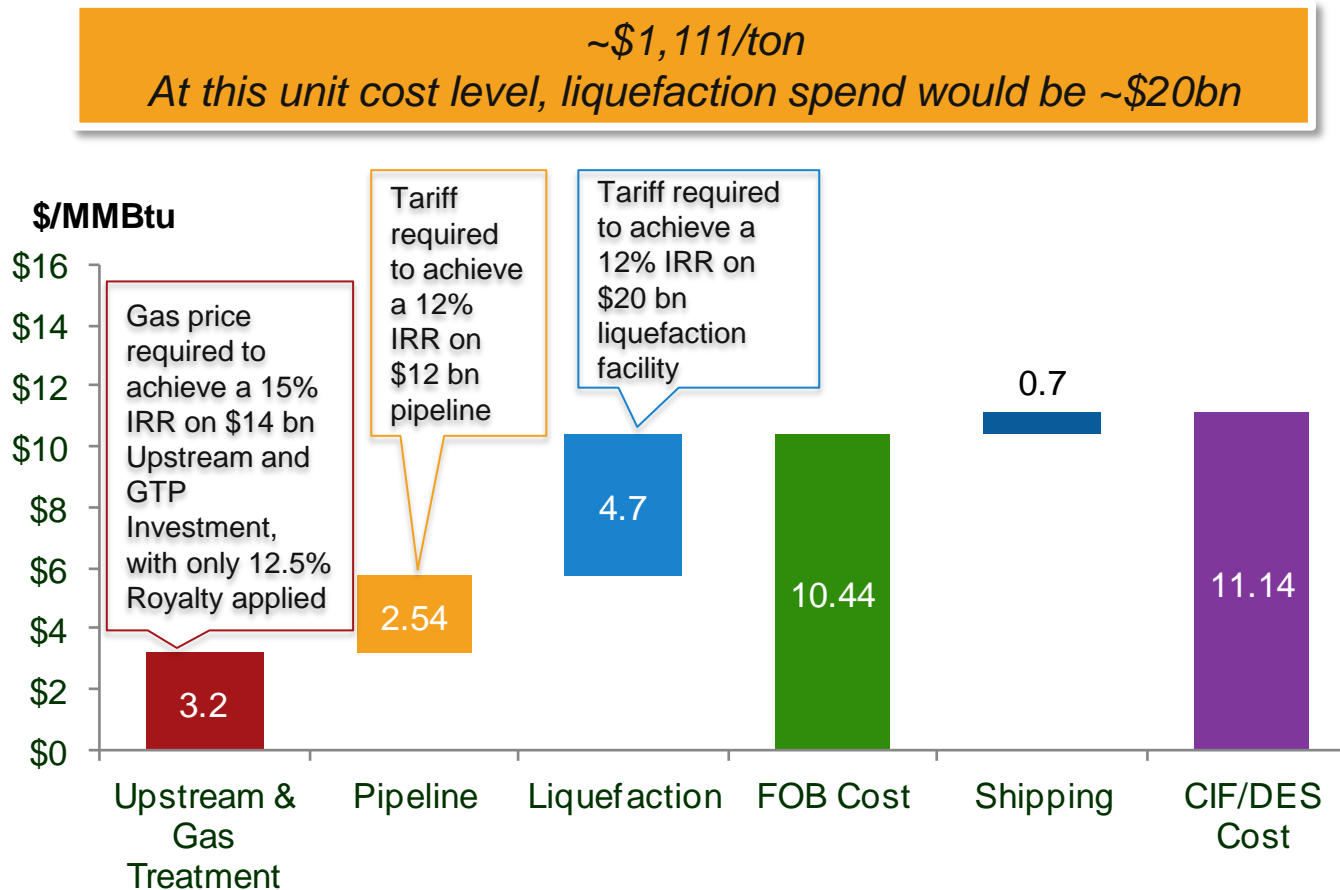




# How Would \$20bn for an 18 mmtpa Liquefaction Facility Compare With Other Recent Projects?



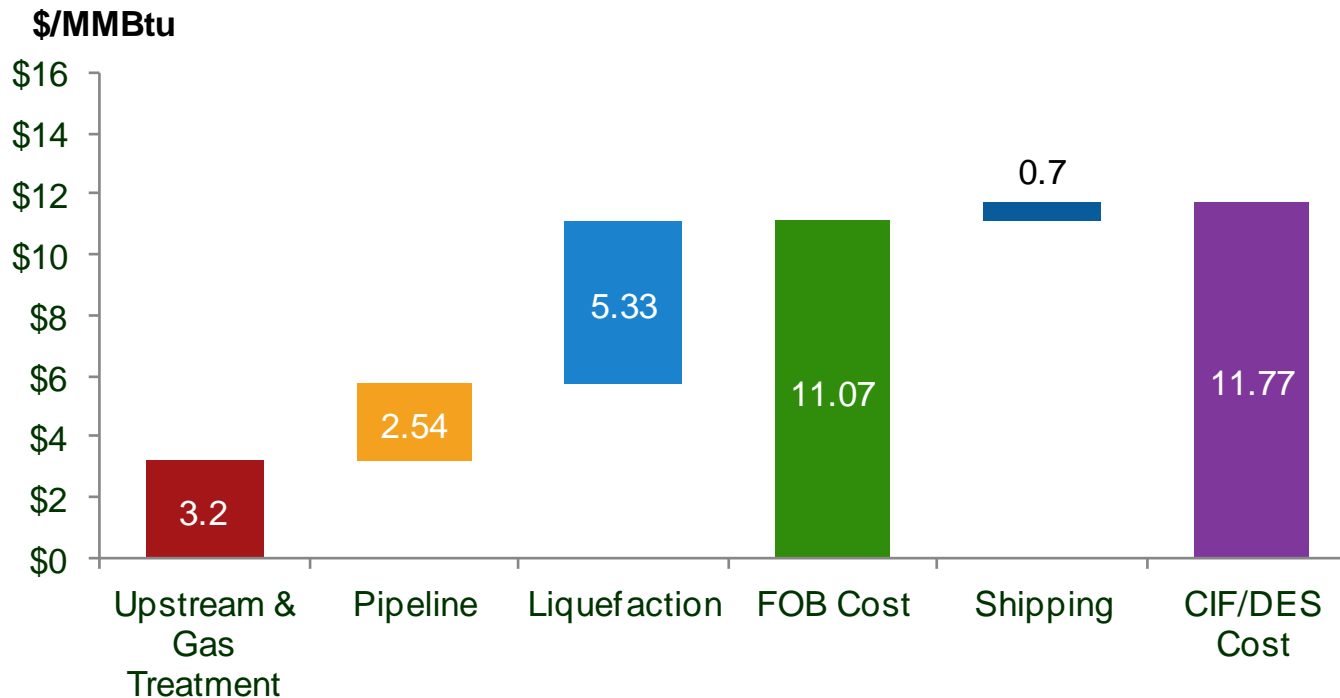
# Breakeven Economics for Hypothetical \$46bn Project



# What if Liquefaction Cost Reached \$/ton Costs of Asia-Pacific LNG or PNG LNG?

~\$1,300/ton

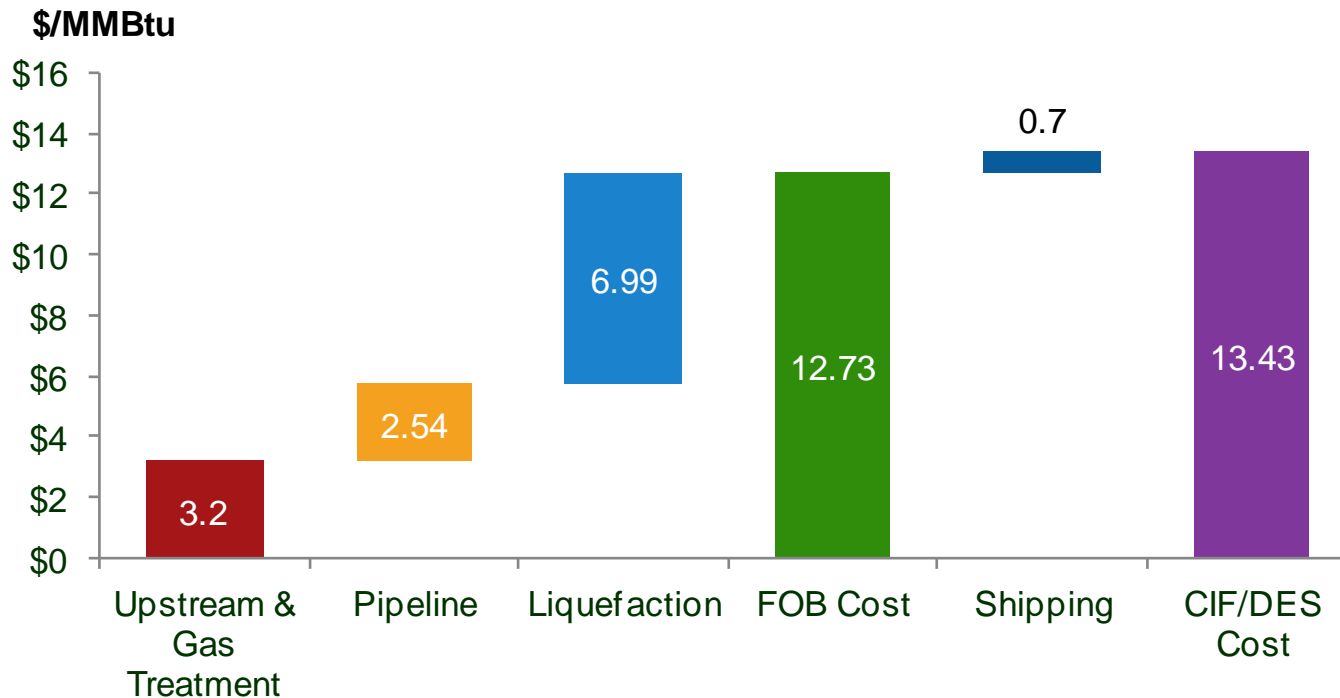
*At this unit cost level, liquefaction spend would be ~\$22.7bn*



# What if Liquefaction reached \$/ton costs of Pluto LNG or Snohvit LNG?

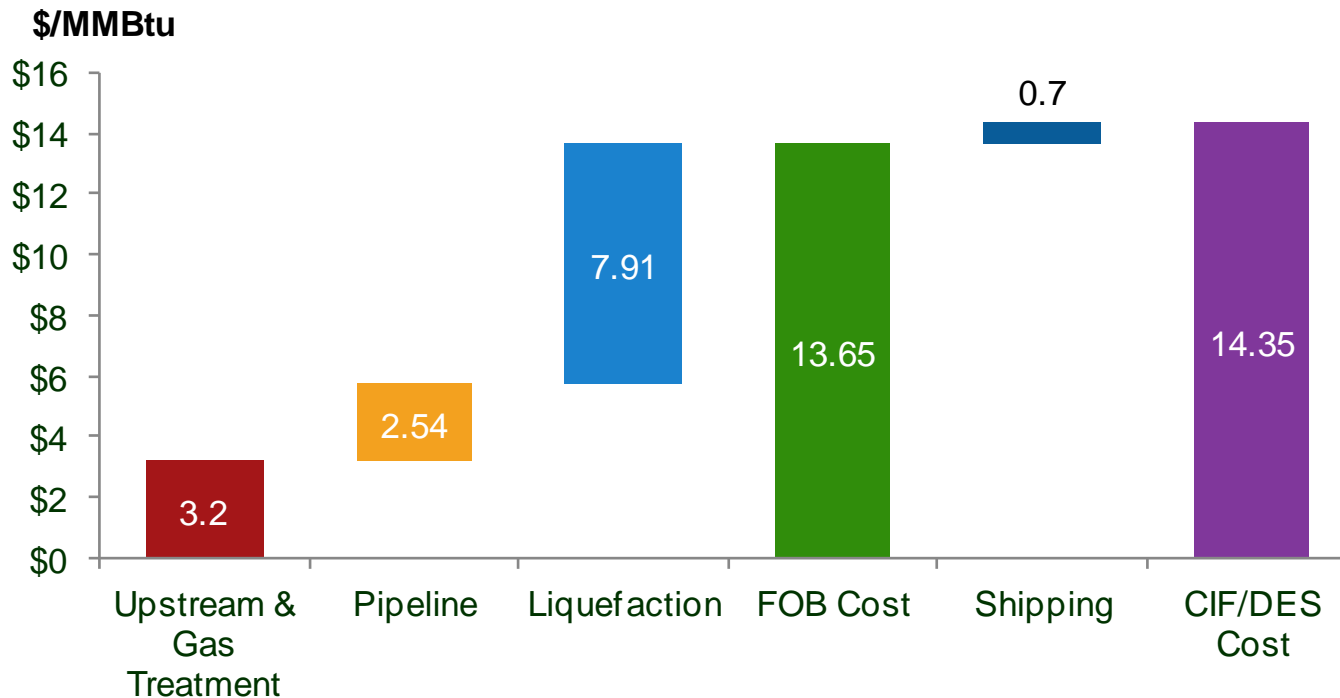
~1,700/ton

*At this unit cost level, liquefaction spend would be ~\$29.7bn*

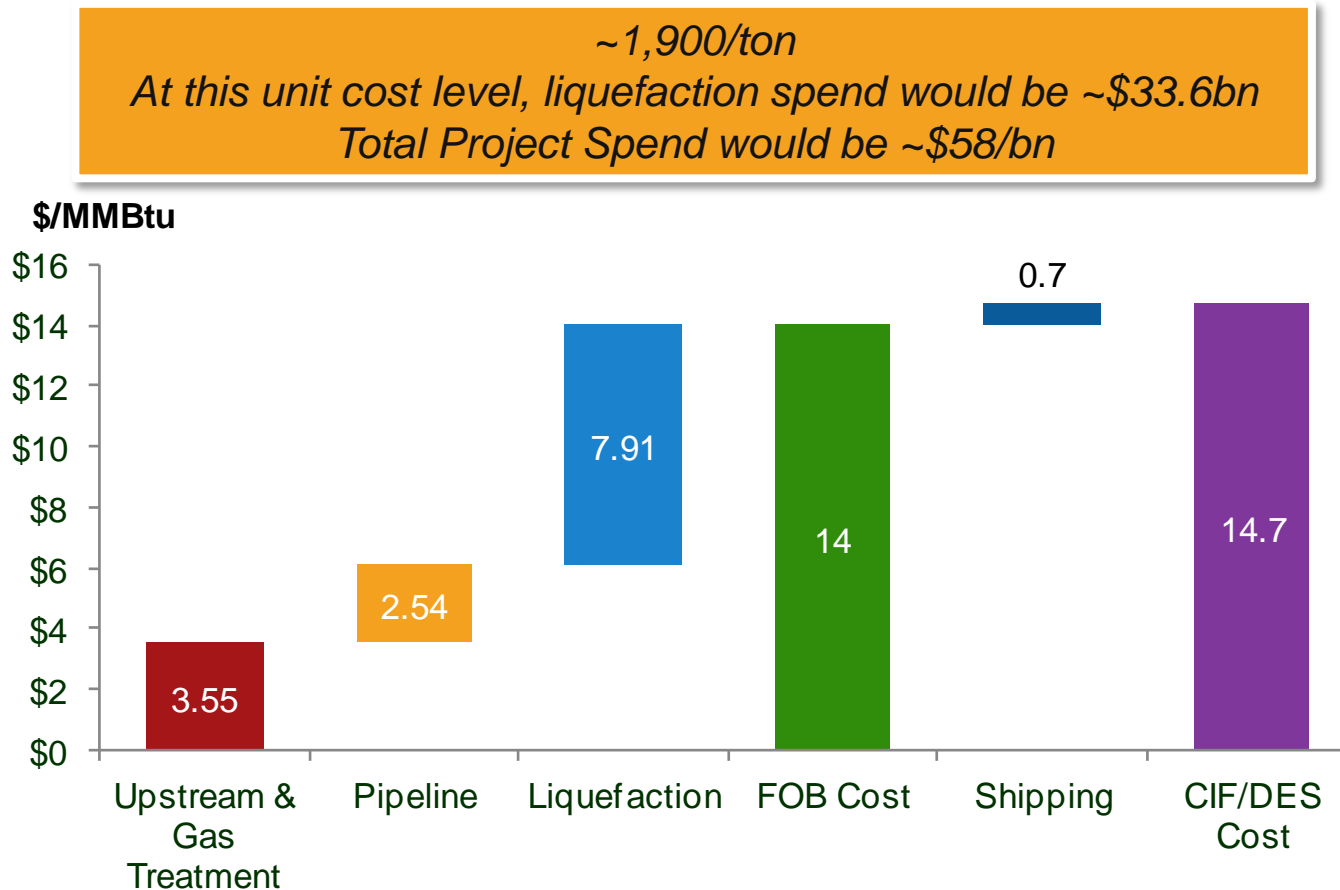


# What if Liquefaction reached \$/ton costs of Angola LNG or Wheatstone LNG?

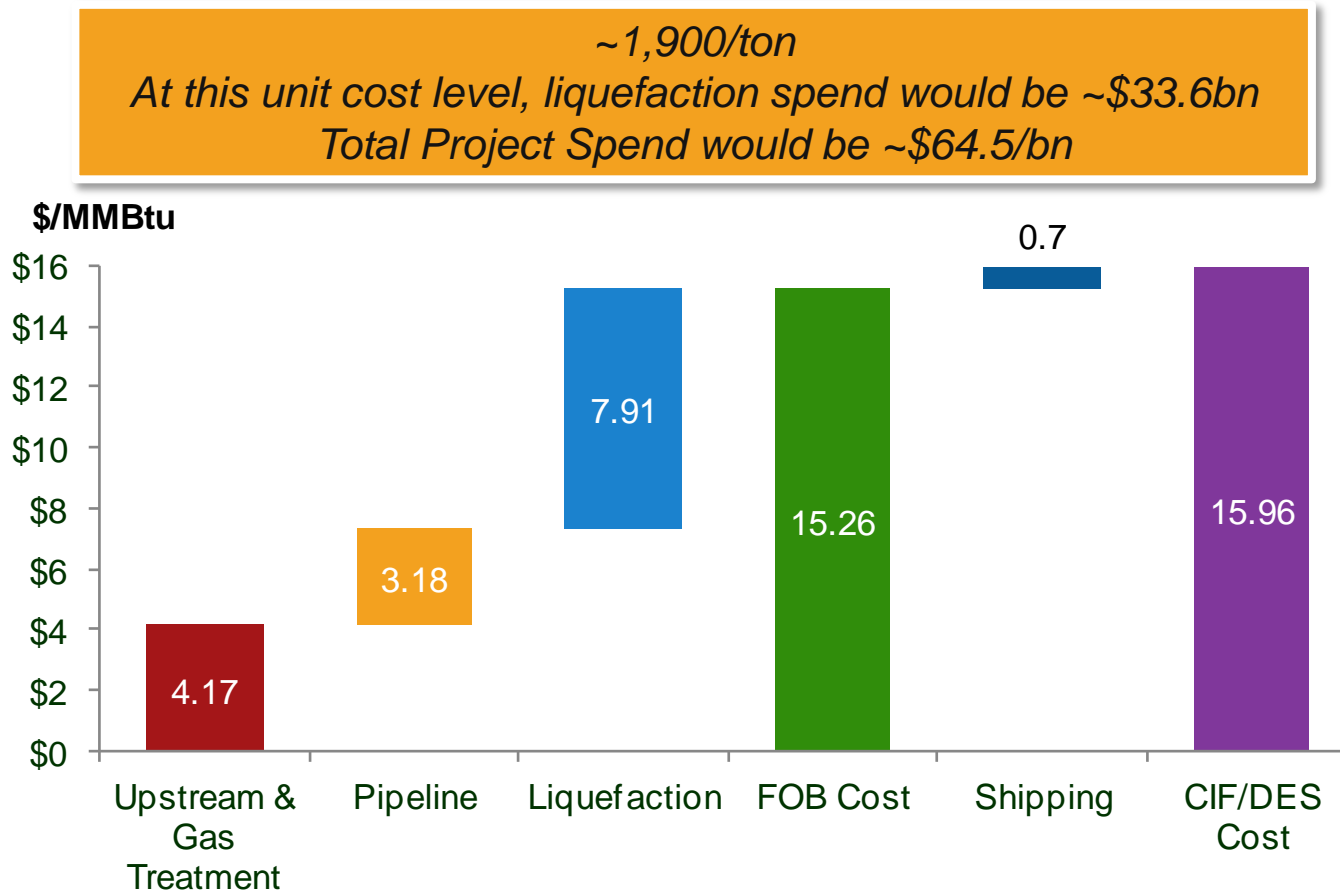
~1,900/ton  
*At this unit cost level, liquefaction spend would be ~\$33.6bn*



# What if Upstream Production Also Faced a 16.7% Royalty and a 33% Production Tax?



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



# Benchmark Against Asia Pacific Breakeven Costs

