LNG Shipping

Anchorage, AK
August 5-9, 2013

North Slope Gas & LNG Symposium

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Executive Summary

- Shipping costs impact the LNG delivery cost
- Shipping costs serve as a benchmarking tool to compare one project to another
- New projects are typically associated with newbuild orders delivered in coordination with the projects' start date
- Decisions regarding new vessels are largely dependent on the type of LNG contracts (FOB vs. Ex-Ship) signed by project

Middle of the LNG Value Chain: Shipping

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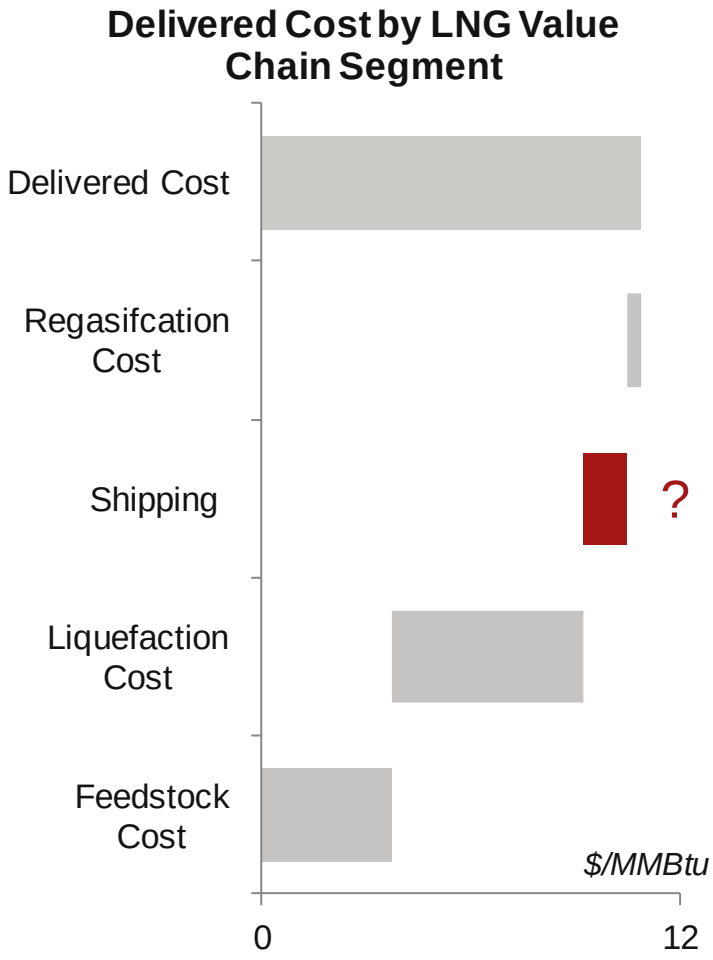
On a Cargo Basis, Shipping Cost is Not Insignificant

- 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



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Global LNG Fleet: Key Figures

- **~360** LNG vessels in the global fleet
  - Average age of existing fleet is ~11 years
- **111** vessels on order as of July 2013
- **~146,000 cm** is the average size of the existing fleet
  - LNG vessels range in size from 7,000 cm to 266,000 cm
  - Similar to a Panamax container vessel
- **56%** of the current fleet was built in South Korea
- **24** shipyards delivered vessels during last decade

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Global LNG Fleet: Key Figures (continued)

- **75+** equity ownership consortia, typically using JV structures
  - Independent Shipping Companies
    - Teekay, NYK Line, MOL, Dynagas
  - International Oil Companies
    - BG, BP, Shell
  - Utility Companies
    - TEPCO, Tokyo Gas, GDF SUEZ
  - Liquefaction Projects
    - North West Shelf, Angola LNG

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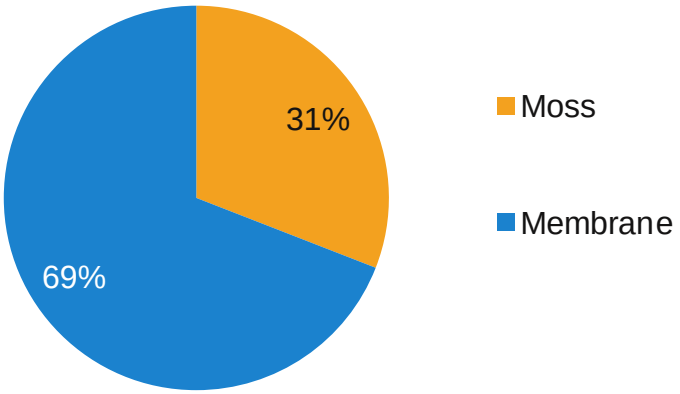
Vessel Types: Moss vs. Membrane Containment

	Moss	Membrane
Visibility	–	+
Filling Limit	–	+
Boil Off	–	+
Pressure Discharge	+	–

Moss Type: *LNG Ebisu*

Global Fleet by Containment Type



Membrane Type: *GasLog Singapore*

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Vessel Types: Ice Class / Winterized

- Additional Insulation
- Additional Heating & De-icing Systems
- Stronger Hull
  - Ice
  - Lower Temperatures
- Higher Charter Rate
- Used by Snøhvit LNG project in Norway

Arctic Lady

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Vessel Types: Q-Series

- Larger Capacity
  - Q-Flex: ~213,000 cm
  - Q-Max: ~266,000 cm
- Unable to pass through expanded Panama Canal
- Unable to deliver to all regasification terminals given size

Al Khuwair

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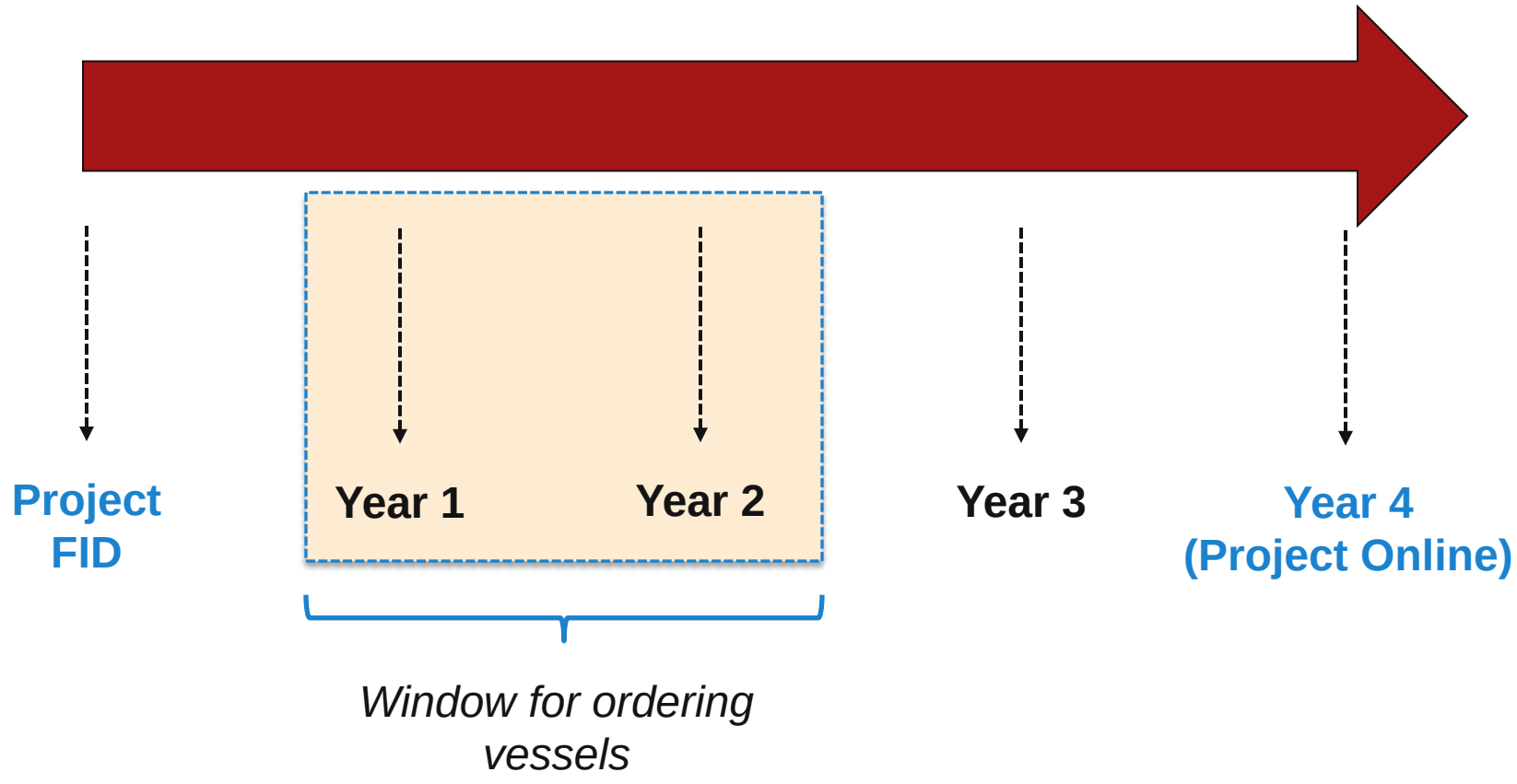
LNG Project Timeline: Ordering Vessels



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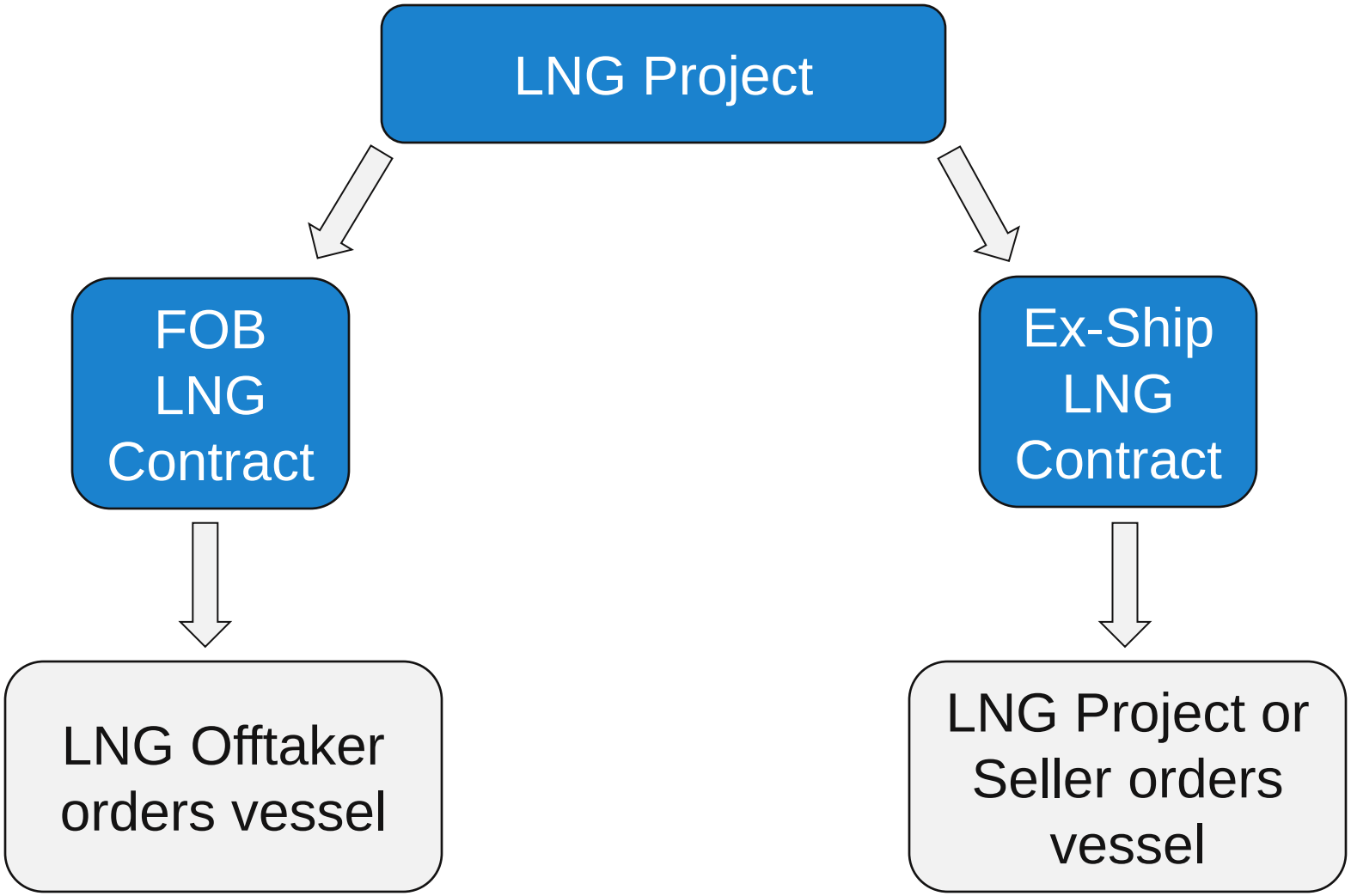
LNG Contracts Determine Who Orders the Vessels



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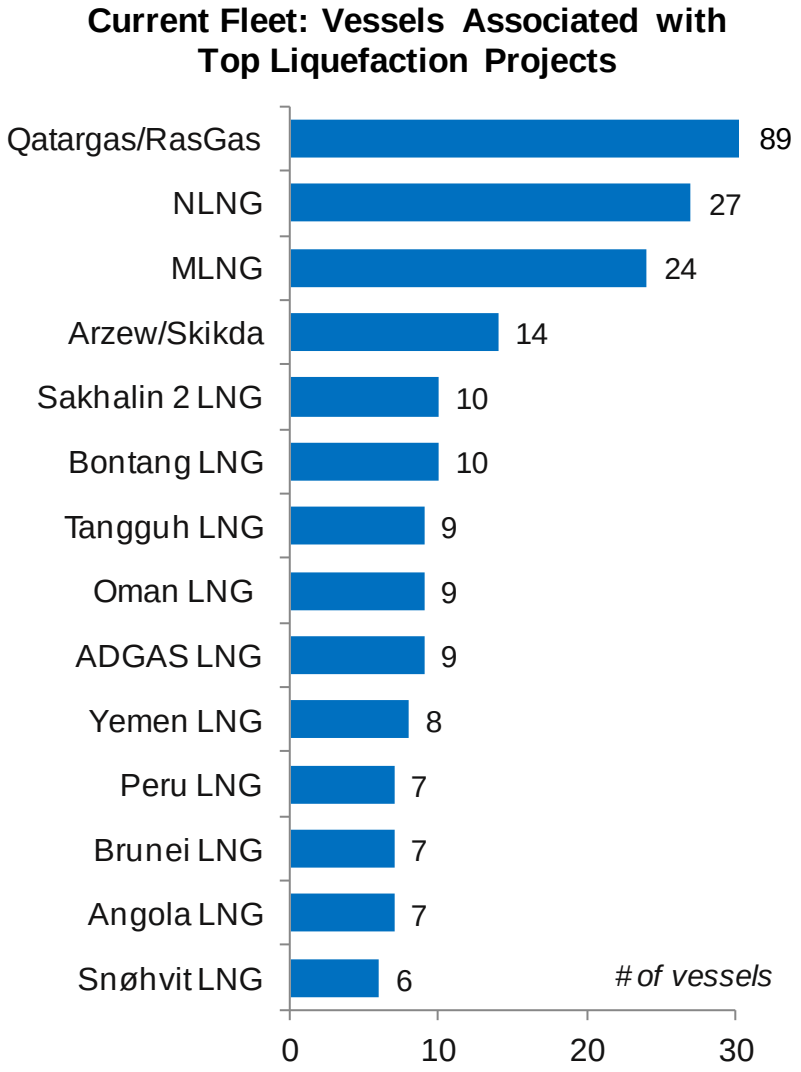
Liquefaction Project Association

- **LNG projects are typically associated with a group of vessels**

- **Number of associated vessels depends on:**
  - Production volume of liquefaction project
  - Number of offtakers from project
  - FOB / Ex-ship LNG offtake contracts
  - Distance to end markets
  - Size of vessels
  - Vessel Ownership
  - Nature of charter agreements



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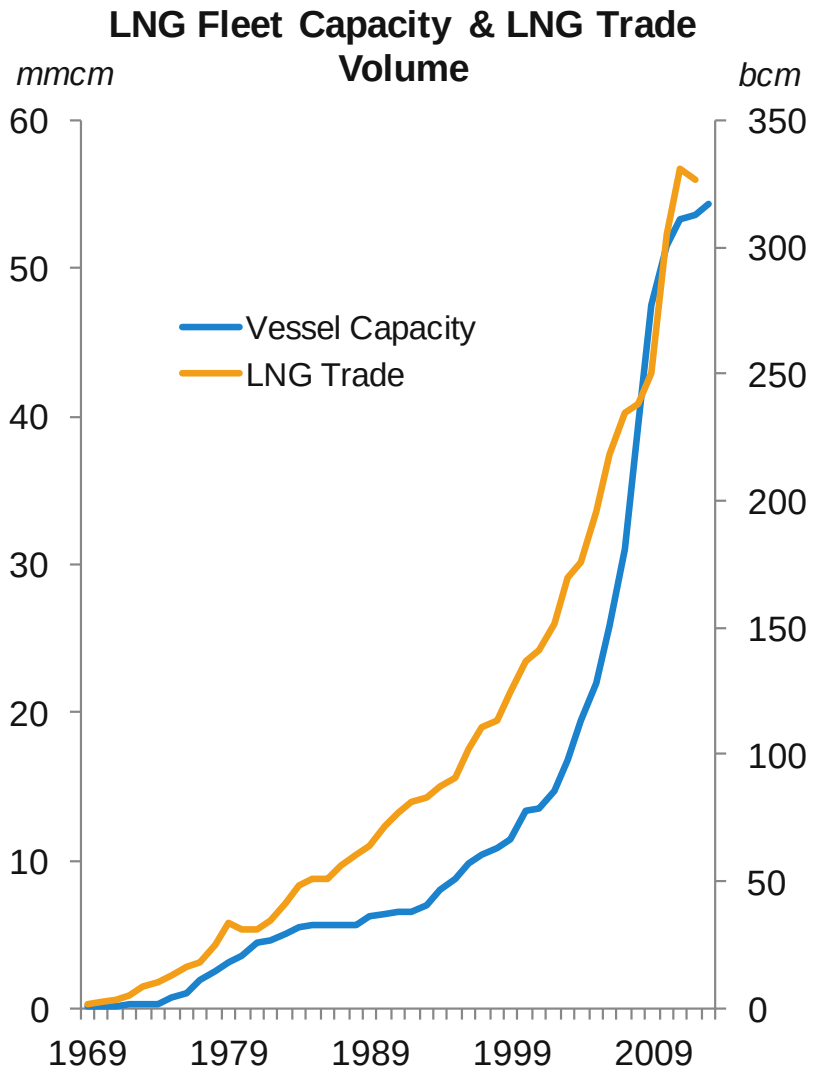
Growth of Current LNG Vessel Fleet

- **Orders typically made prior to new supply**
  - Vessel orders placed 3 years in advance of new supply
  - Vessel orders by liquefaction projects
  - Vessel orders by LNG offtakers
- **Growth in trade routes**
  - Europe, Japan and Korea dominated early decades of LNG imports
  - Growth in Asian demand
  - Growth in non-OECD LNG demand
  - Demise of U.S. as a LNG importer
  - Growth of trade between Atlantic and Pacific basins



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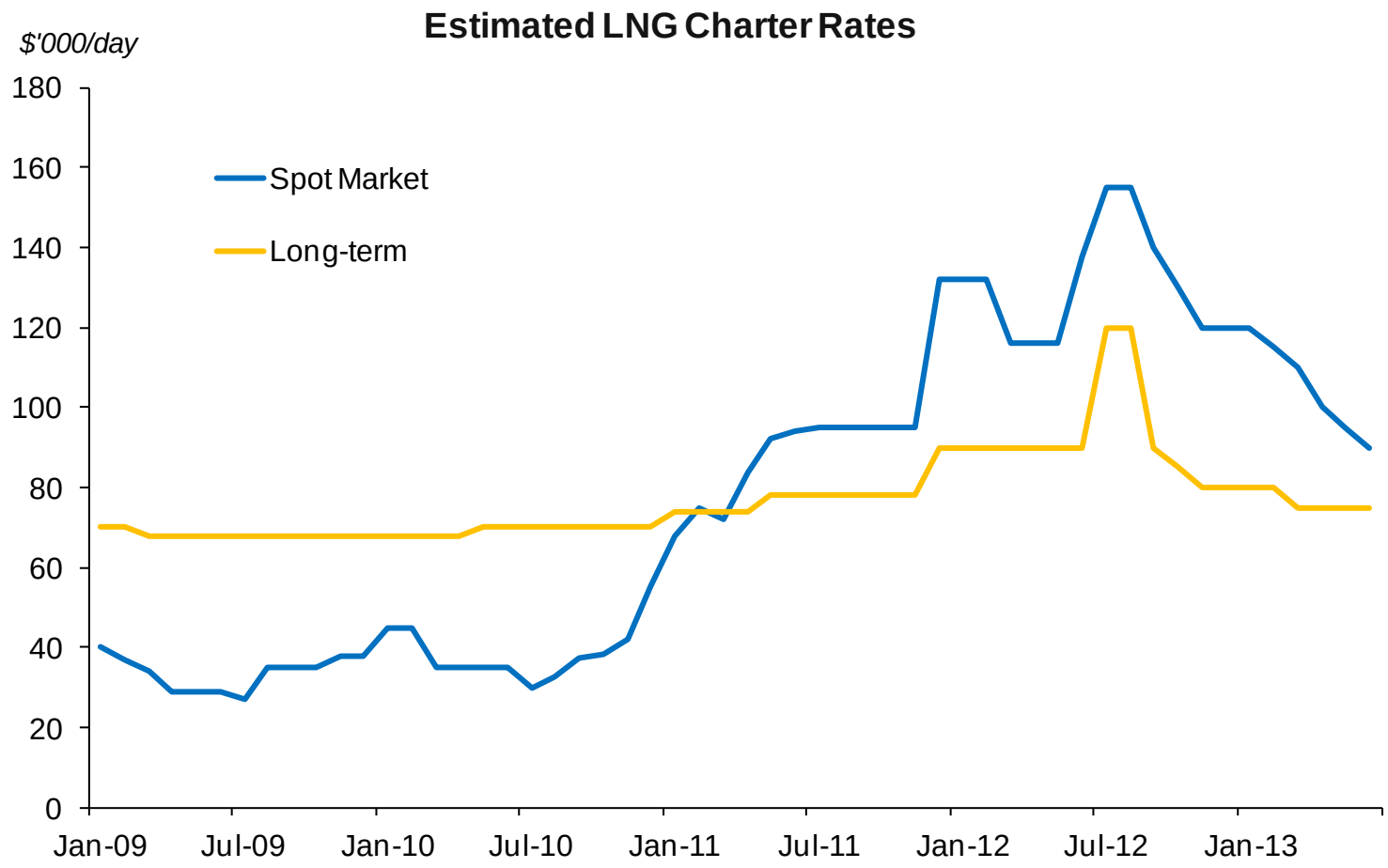
LNG Shipping Market Dynamics: Spot vs. Long Term



- **Long Term:** Charters of 4-5 years or more
- **Spot / Short Term:** 3 months to 3 years

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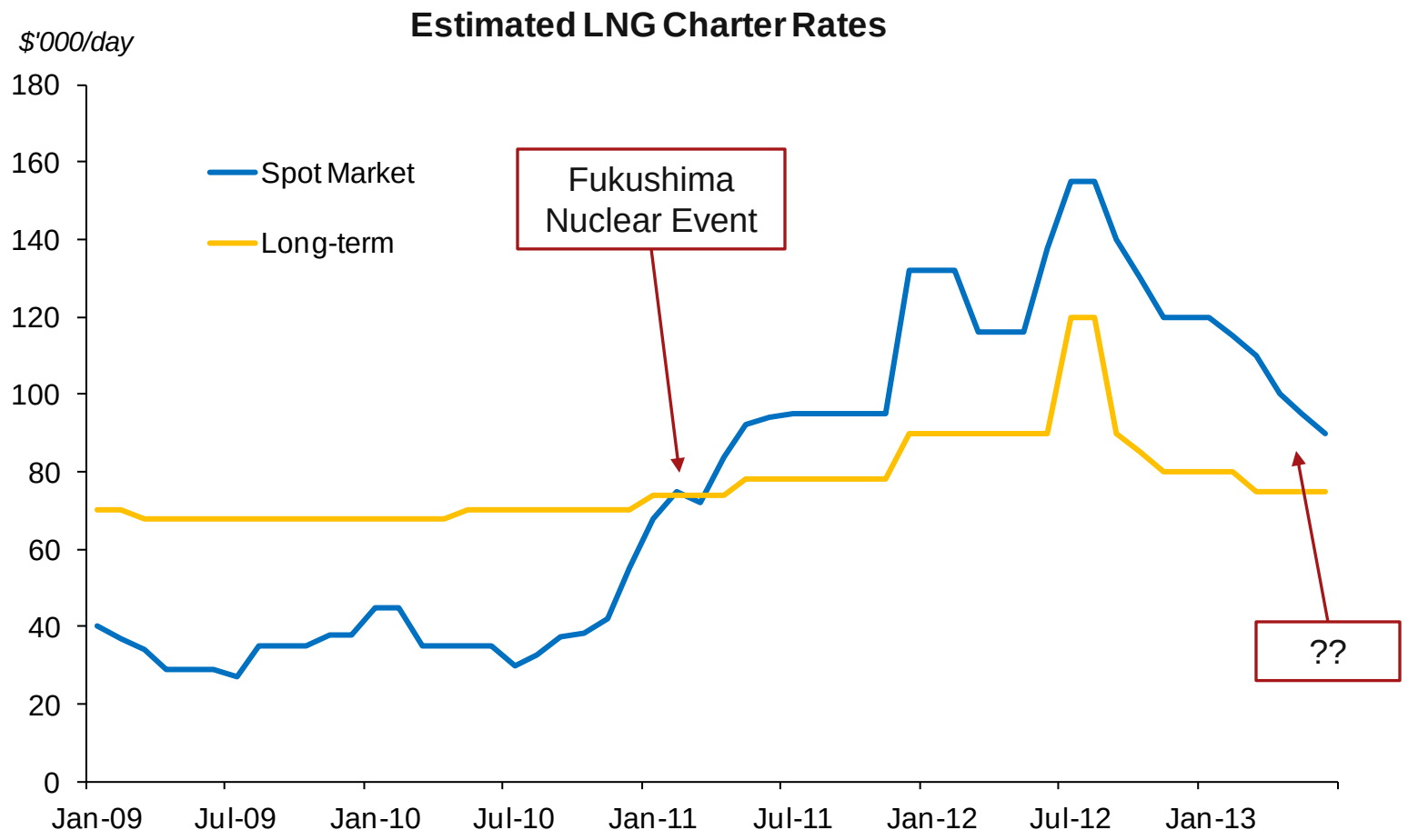
LNG Shipping Market Dynamics: Role of Fukushima



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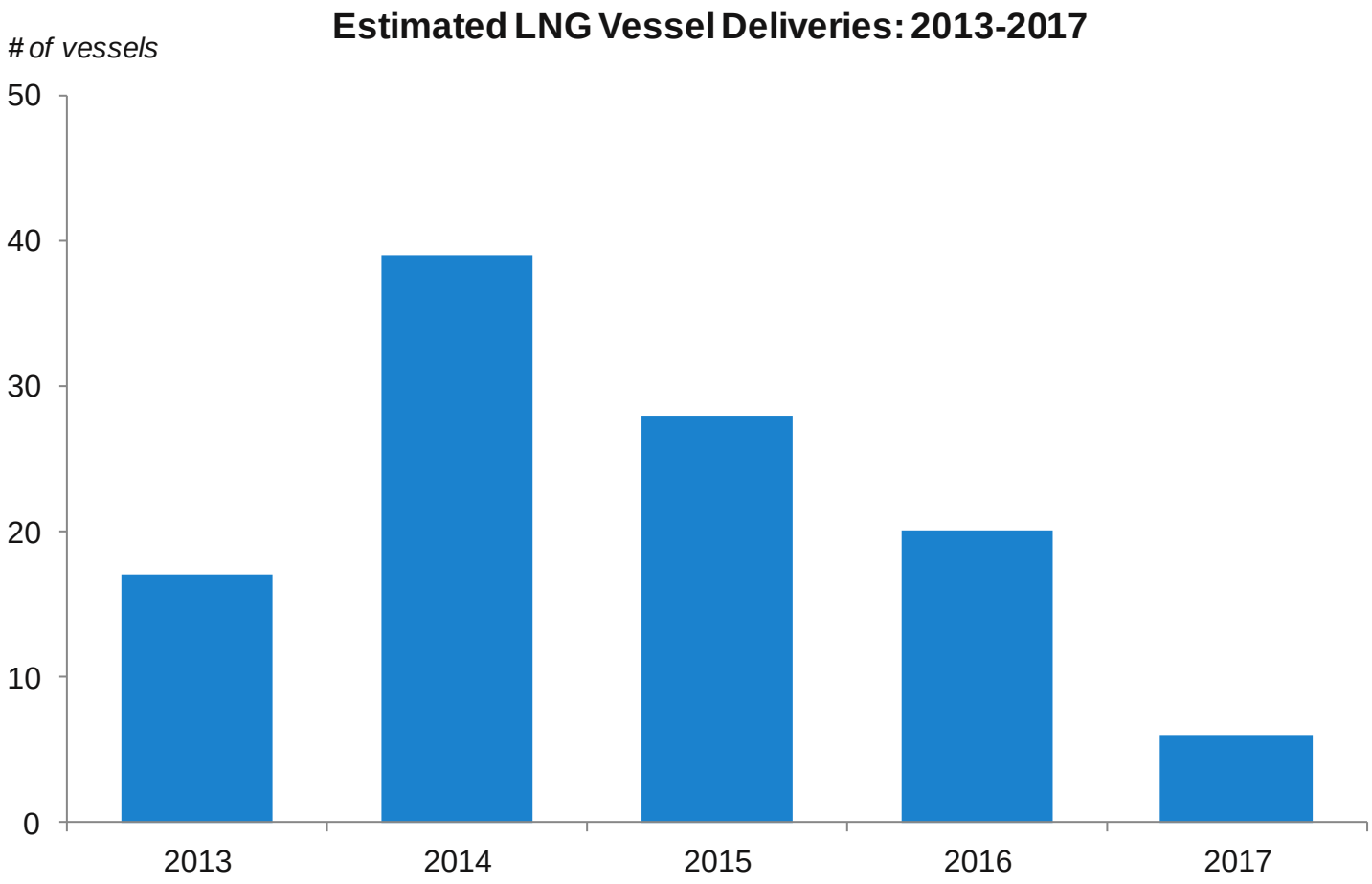
LNG Shipping Market Dynamics: Cyclicality



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What Does This Mean for an Alaskan LNG Project?

- **LNG projects and offtakers typically order new vessels to serve the duration of a specific LNG contract associated with a specific LNG project**
  - LNG contract durations range, but are typically 15-25 years

- **Focus on the long-term rate due to long-term duration of LNG contracts**

- Long-term charter rates are predominantly a function of the NPV value of the underlying vessel asset. Key drivers of the rate include:
  - Sticker price (i.e. shipyard cost)
  - Financing terms and interest rates

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Shipping Costs

Basic variables to consider when calculating cost

Criteria	Assumption
Ship size (m^3) LNG	170,000
Vessel Cost (mn)	$200
Charter Rate ($/day)	75,000
Vessel sailing speed (knots)	18.5
Vessel sailing speed (mi/hr)	21
HFO price/ton	$600
Marine diesel price/ton	$900
Port charges/call	$50,000
Canal passage/trip	$250,000

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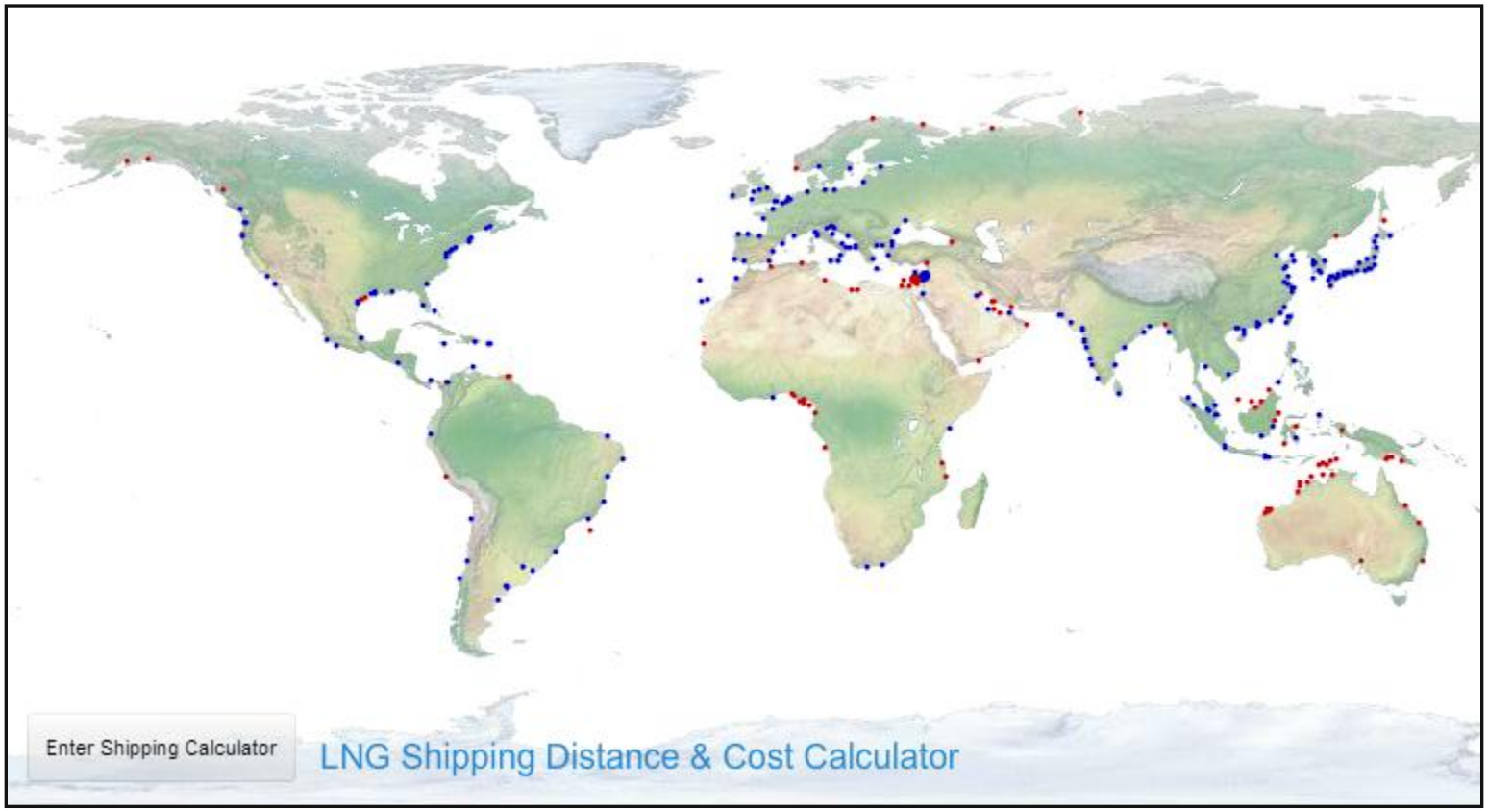
Shipping Costs



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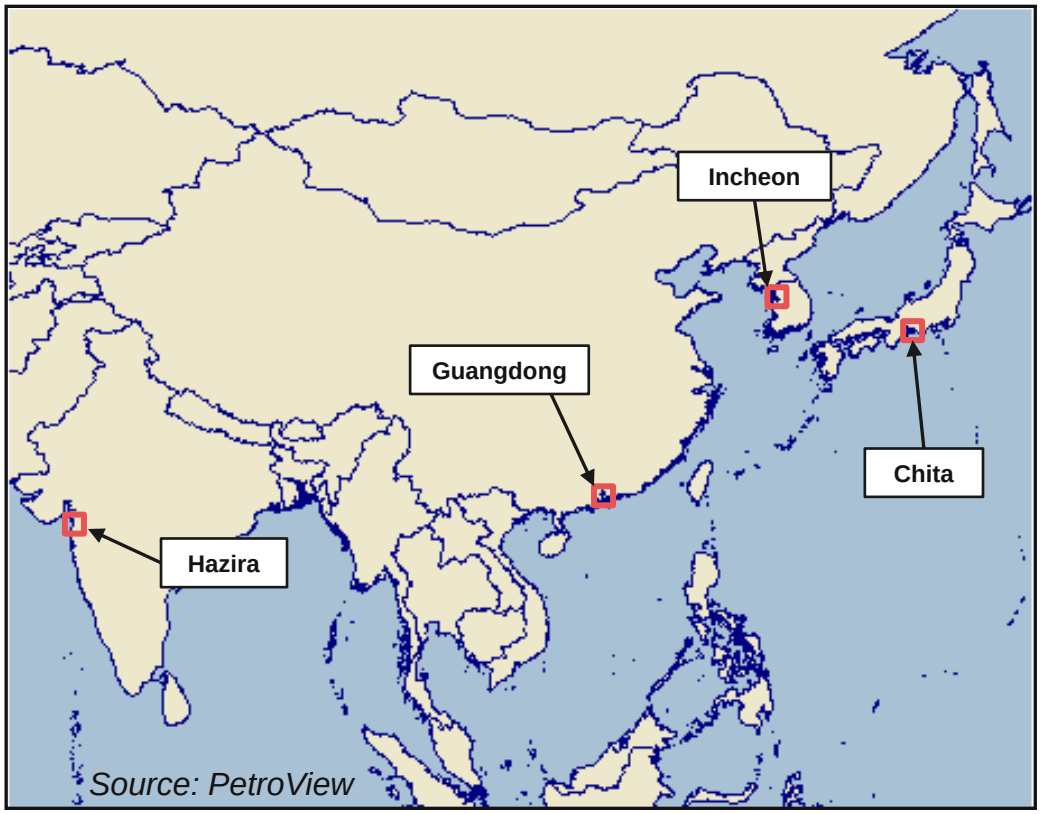
Southern Alaska to Pacific Basin

Shipping Destinations	Japan - Chita	South Korea - Incheon	China – Guangdong	India – Hazira	Mexico - Costa Azul
Shipping Cost ($/MMBtu)	$0.62	$0.71	$0.83	$1.44	$0.41
One-Way Distance (nautical miles)	3,612	4,158	4,953	8,905	2,223
Round Trip Time (days)	15	17	22	38	10



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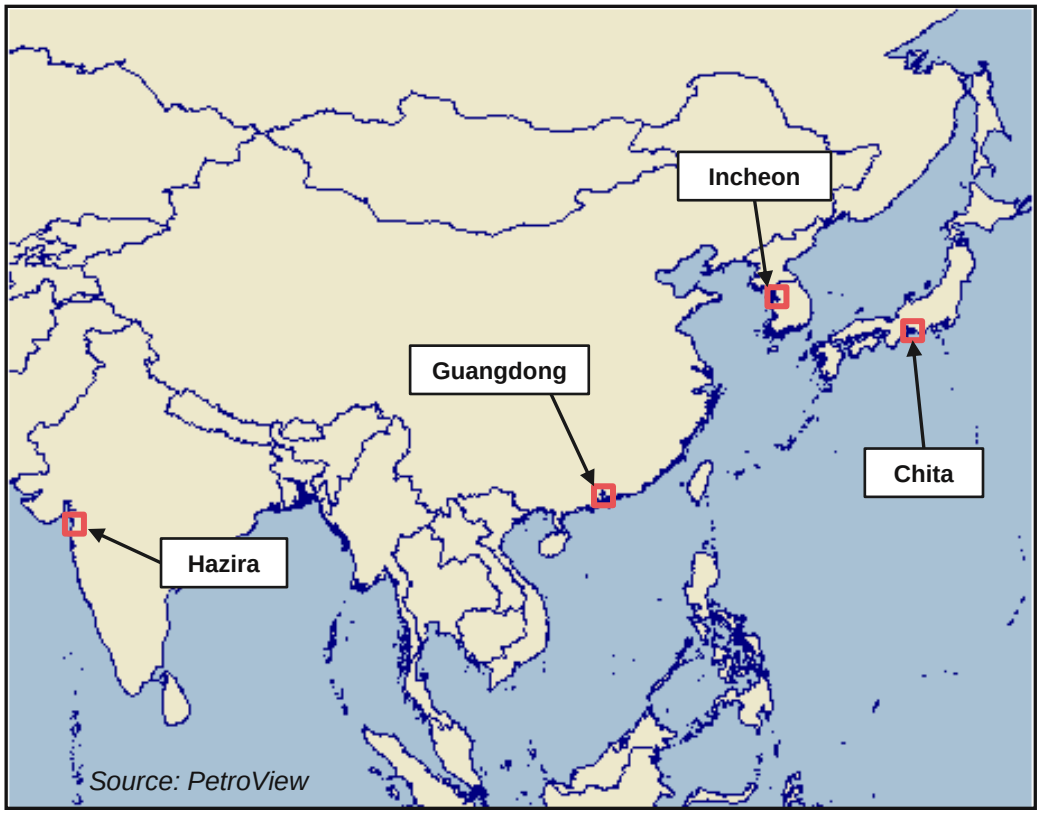
Gulf of Mexico to Pacific Basin (via Suez Canal)

Shipping Destinations	Japan - Chita	South Korea - Incheon	China – Guangdong	India – Hazira	Mexico - Costa Azul
Shipping Cost ($/MMBtu)	$2.67	$2.63	$2.44	$1.88	$2.16
One-Way Distance (nautical miles)	14,544	14,328	13,194	9,744	13,316
Round Trip Time (days)	62	61	56	41	57



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Panama Canal Expansion

- Online by end-2015
- Expansion accommodates LNG vessels up to 180,000 cm
- Panama Canal transit tariff system has yet to be announced
- For LNG projects located in US GOM, could save 20%-30% of shipping cost depending on tariff system

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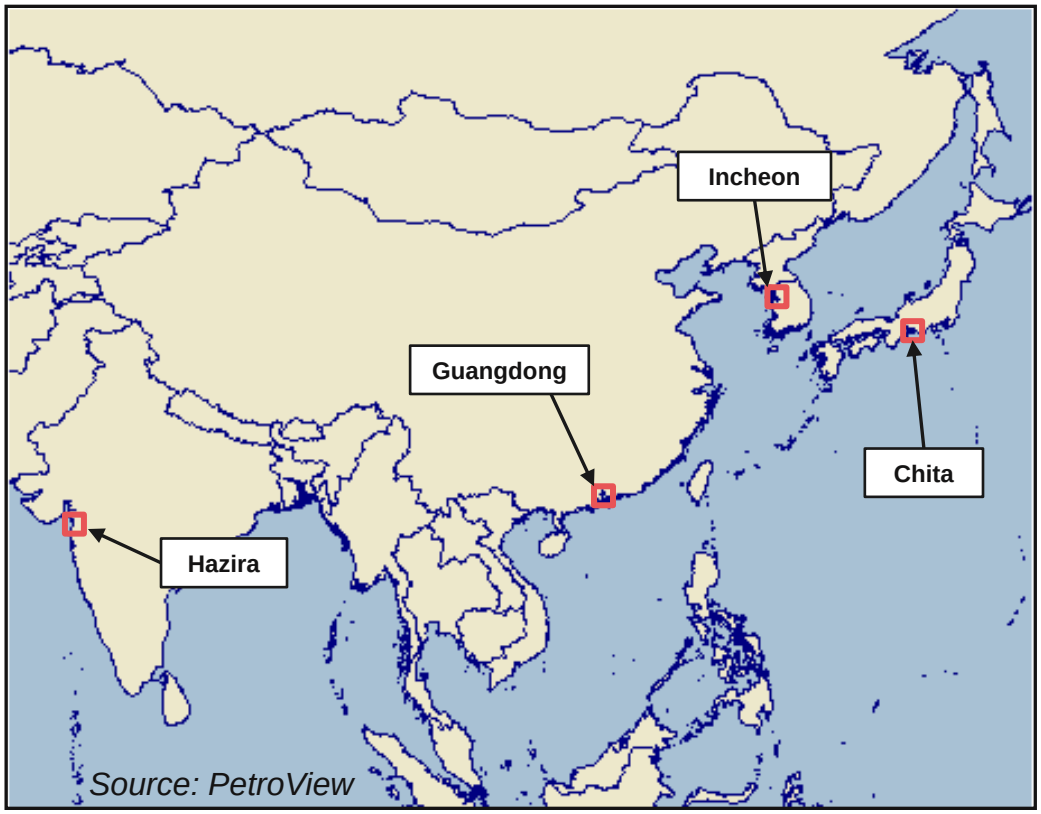
Gulf of Mexico to Pacific Basin (Panama Canal Access)

Shipping Destinations	Japan - Chita	South Korea - Incheon	China – Guangdong	India – Hazira	Mexico - Costa Azul
Shipping Cost ($/MMBtu)	$1.83	$1.94	$2.06	N/A	$1.03
One-Way Distance (nautical miles)	9,471	10,160	10,866	N/A	4,407
Round Trip Time (days)	40	43	46	N/A	19



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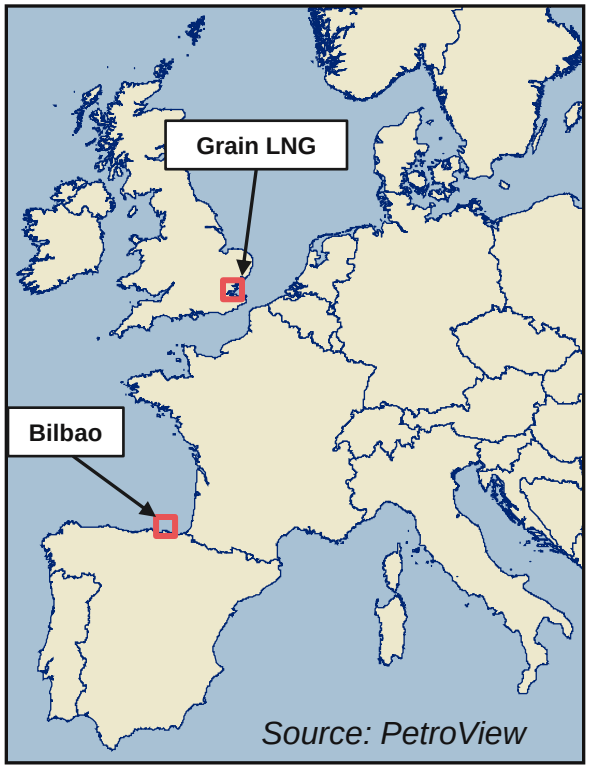
Southern Alaska to Atlantic Basin (Panama Canal Access)

Shipping Destinations	UK – Grain LNG	Spain - Bilbao	Brazil - Guanabara LNG	Brazil – Pecém
Shipping Cost – Round Trip ($/MMBtu)	$2.20	$2.15	$2.13	$1.83
One-Way Distance (nautical miles)	9,863	9,570	9,502	7,880
Round Trip Time (days)	43	42	42	36



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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

- 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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Conclusion

- An Alaskan LNG project is not directly exposed to the volatility of charter market for LNG vessels
- It is potentially exposed to the shipyard cost to build a vessel and the cost of financing a vessel

- Exposure will ultimately depend on the nature of LNG contracts (FOB vs. Ex-Ship) and whether the project or the offtakers take responsibility for shipping the LNG
  - In the event that **FOB contracts** account for all LNG production, the project is not exposed to the shipping portion of the value chain
  - If all contracts are signed on an **Ex-Ship basis**, the project has complete responsibility for shipping

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