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Gaffney, Cline & Associates (GCA) Global LNG Markets

Municipal Advisory Gas Project Review Board

Anchorage, 5/6 August, 2014

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GCA Representatives

Bob George - Vice President

Nick Fulford - Global Head of Gas and LNG

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GCA Overview

Experts in the Business of Energy

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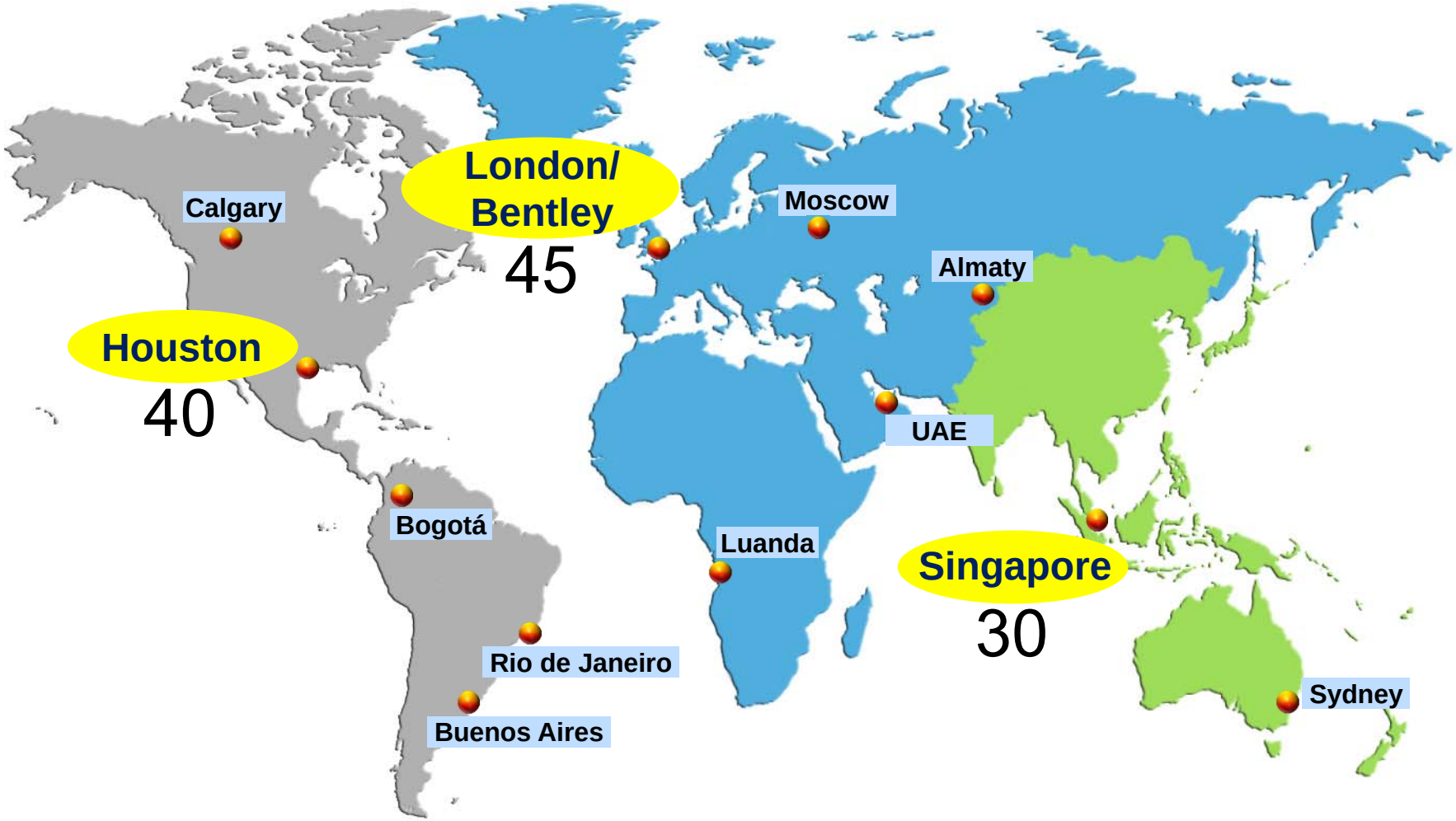
GCA Offices and Regional Professional Capacity



Americas
EMEA (Europe, Middle East & Africa)
AP (Asia Pacific)

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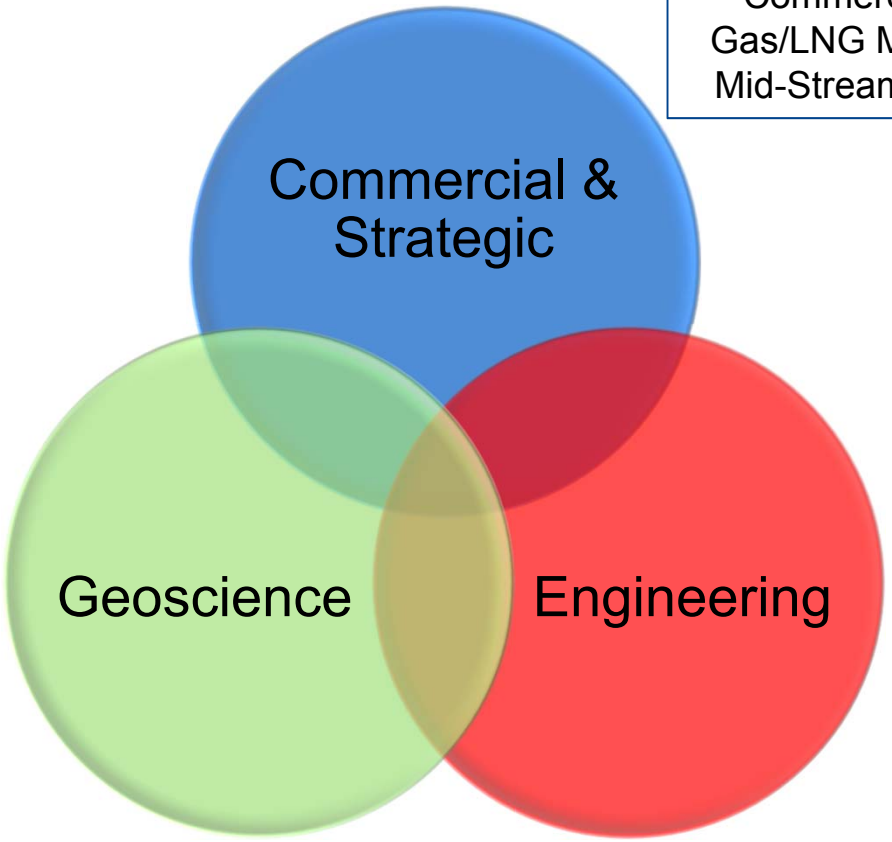
Core Disciplines

Management Consultants
Petroleum Economists
Commercial Advisors
Gas/LNG Market Experts
Mid-Stream and Markets



Geophysicists
Geologists
Petrophysicists

Reservoir Engineers
Petroleum Engineers
Drilling Engineers
Facilities Engineers
Pipeline and Refinery Engineers

Core Disciplines….
Across the full value chain

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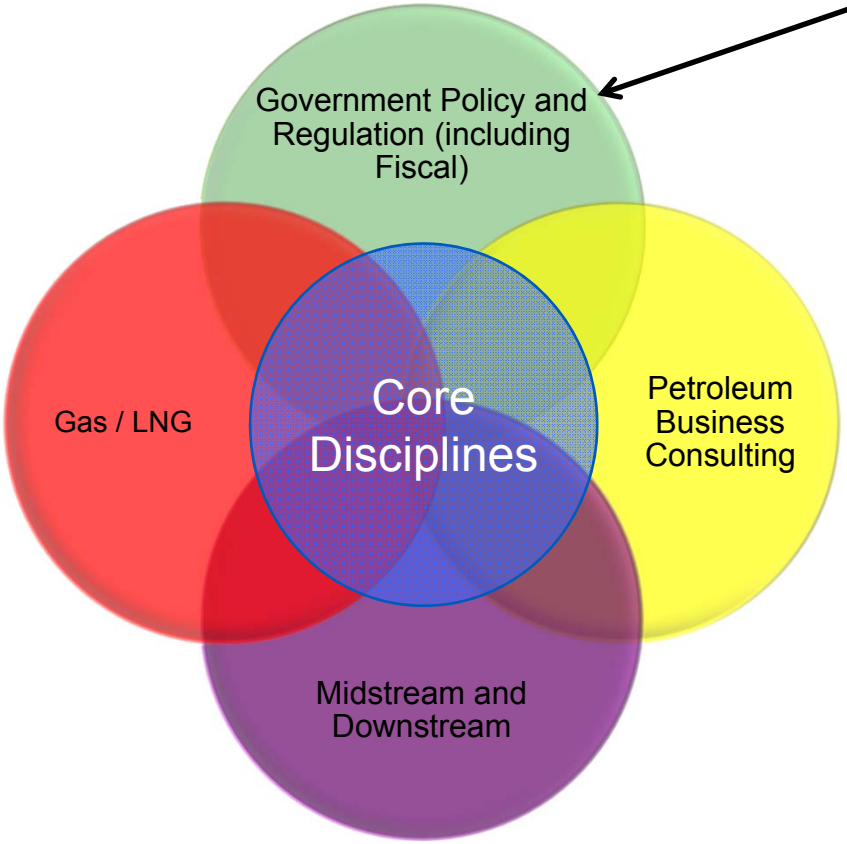
GCA Business Practices



Bob George (Vice President, GCA)

- 42 years industry, of which 37 years GCA
  - Overall strategy and management role for GCA business worldwide
  - Regional management roles for GCA in Americas, Asia Pacific
- Government Policy and Regulation
  - Alaska (Profits Tax, AGIA, Fiscal 2007-Present)
  - Licensing and Contracts/Regulations (Afghanistan, Brazil, Colombia, Greenland, Iraq, Kuwait, Nova Scotia, Palau, Saudi Arabia, Venezuela)
- Expert Reports and Testimony
  - ICC, ICSID, Stockholm, Alberta and Ontario courts, Australian Federal Court
- Market Listings and Valuation
  - NYSE, LSE, TSX/TSXV, ASX, NZSX, SGX, BM (Malaysia), Oslo, BOVESPA (Brazil), MERVAL (Argentina)

… applying 50+ years of experience

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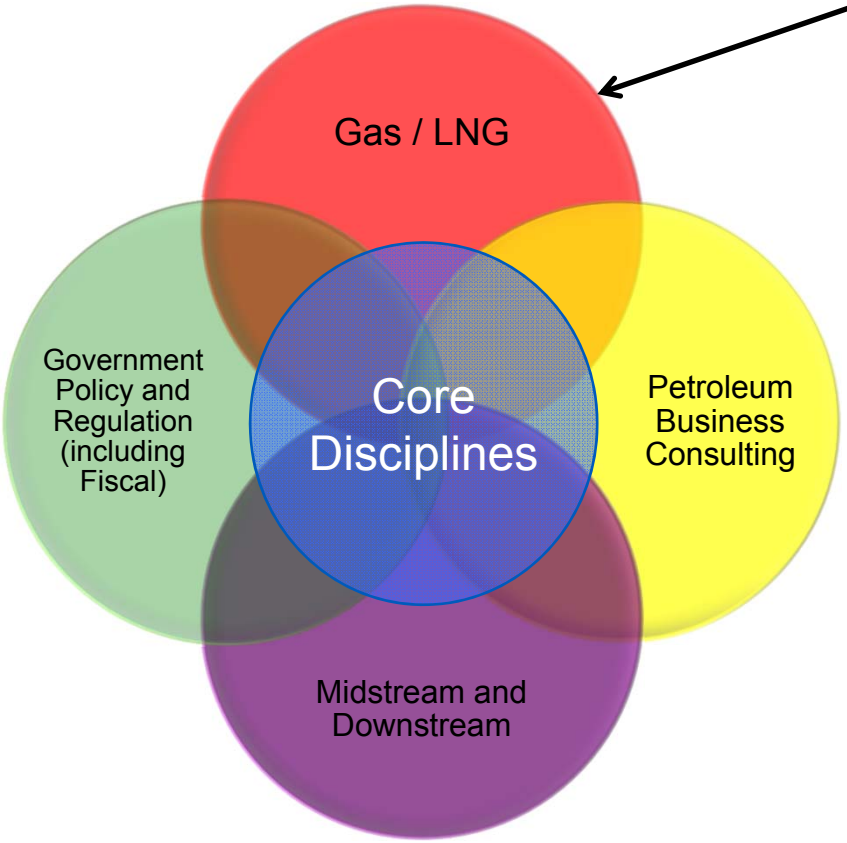
GCA Business Practices



Nick Fulford (Global Head of Gas and LNG)

- 30 years British Gas, Centrica/Direct Energy
  - Experience across entire value chain – upstream/LNG, regulatory and policy, and customer insights
- Focal point for entire natural gas/LNG value chain
  - Emphasis on leveraging geoscience insights with understanding of fiscal terms, supply/transmission costs and demand trends
  - Gas utilisation innovations – e.g. mini/micro LNG, GTL, transport fuel
- Capitalising on long GCA track record
  - Due diligence for Asian buyers/investors
  - Facilities/cost estimation
  - LNG supply chain economics/feasibility
  - Market supply/demand
  - Gas Master Planning

… applying 50+ years of experience

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Who does GCA work for?

Oil & Gas Companies

Sovereigns

Financial Institutions

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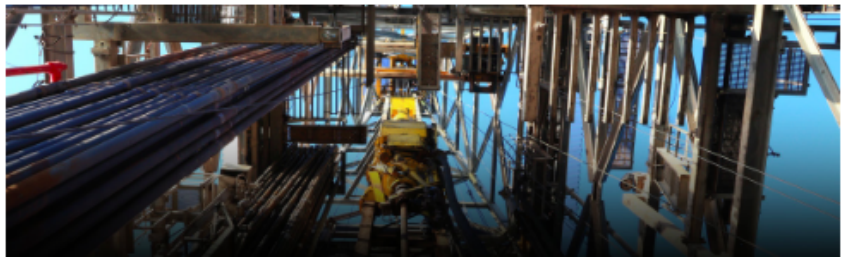
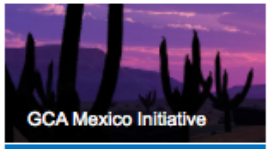
Shale Gas – North America's Economic Turbocharger – Can the Phenomenon be Exported?





Categories

- ▶Mexico
- ▶Business of Energy
- ▶Gas & LNG
- ▶Midstream & Downstream
- ▶Africa

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History and Current Status of LNG Market

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LNG basics

- LNG is not LPG
- It is natural gas (predominantly Methane) that has been refrigerated to the point that it remains liquid at atmospheric pressure
  - LNG is never stored under pressure, unlike LPG
- Liquid phase exists at a temperature of -162C (-259F)
- Its typically at or slightly below its boiling point with vapour constantly being generated
  - So-called “boil-off gas”
  - Can be reliquefied or used as fuel (in ships for example)

Photo: Osaka Gas

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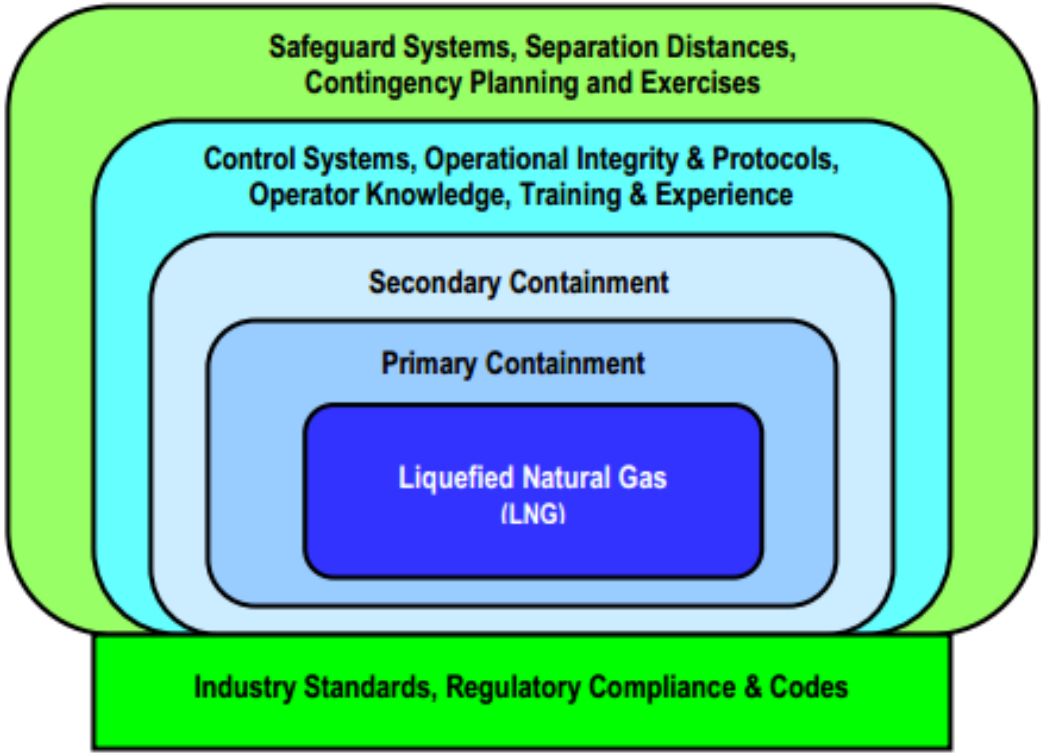
LNG is a safe and efficient way of moving gas

- There are widespread misunderstandings about LNG safety
- It is stored in tanks which have secondary containment mechanisms
- LNG will evaporate quickly, if spilled
- The LNG industry has an exemplary record of safety
- Operators are highly trained and professional
- LNG carriers are very highly specified and maintained
  - 135,000 voyages with no major incident
- LNG safety philosophy is a combination of physical containment, controls, and other safeguards



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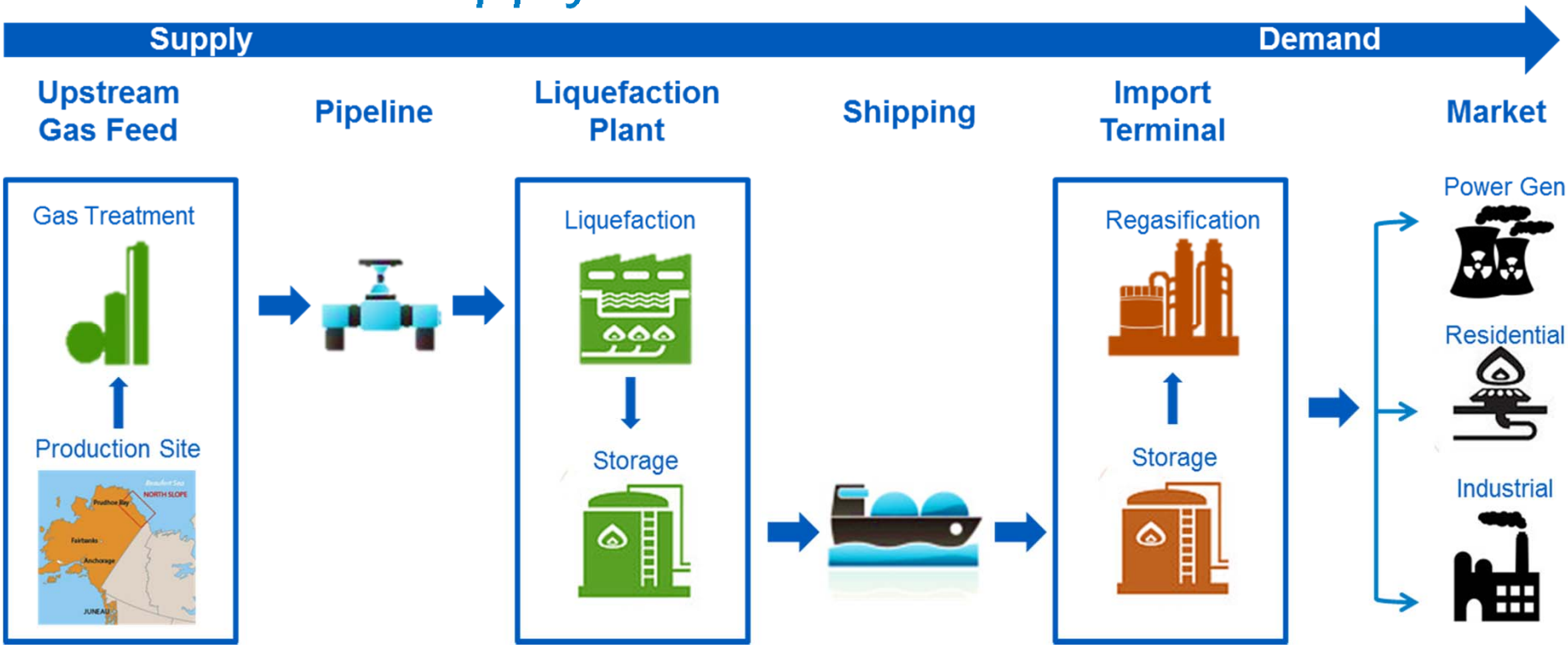
Source: GIIGNL

The LNG Supply Chain



- ***Gas Treatment***
  - Remove moisture/condensate
- ***Pipeline***
  - Transmission between field and coastal LNG plant
- ***Liquefaction***
  - Successive stages of cooling/liquids removal
- ***Shipping***
  - Vessels similar size to very large crude carriers
  - Insulated, non-pressurised double containment tanks
- ***Regas***
  - Heat the LNG so that it becomes gaseous/ambient temperature
  - Inject into conventional gas transmission infrastructure

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Shrinkage and Fuel Usage

Demo	Stage	Typical %	Explanation
	Dry Gas Produced	**100%**	
	GTP	**1.0%**	Processing losses
	Pipeline	**8.0%**	Compression fuel
	LNG	**5.0%**	Power Generation
	Loading	**0.2%**	Extra boil-off from pumping returned for reliquefaction
	Shipping	**2.0%**	Boil-off gas, 0.125%/day
	Unloading	**0.2%**	Extra boil-off – usually into LP Main
	LNG Received	**~80-90%**	

Further reduction on regasification

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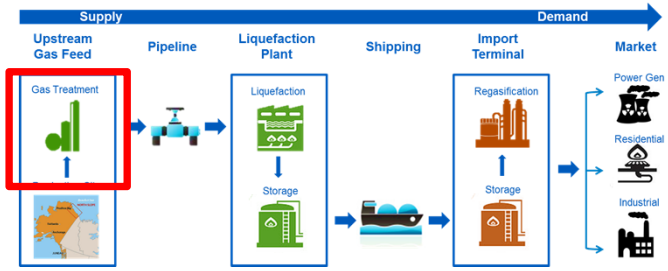
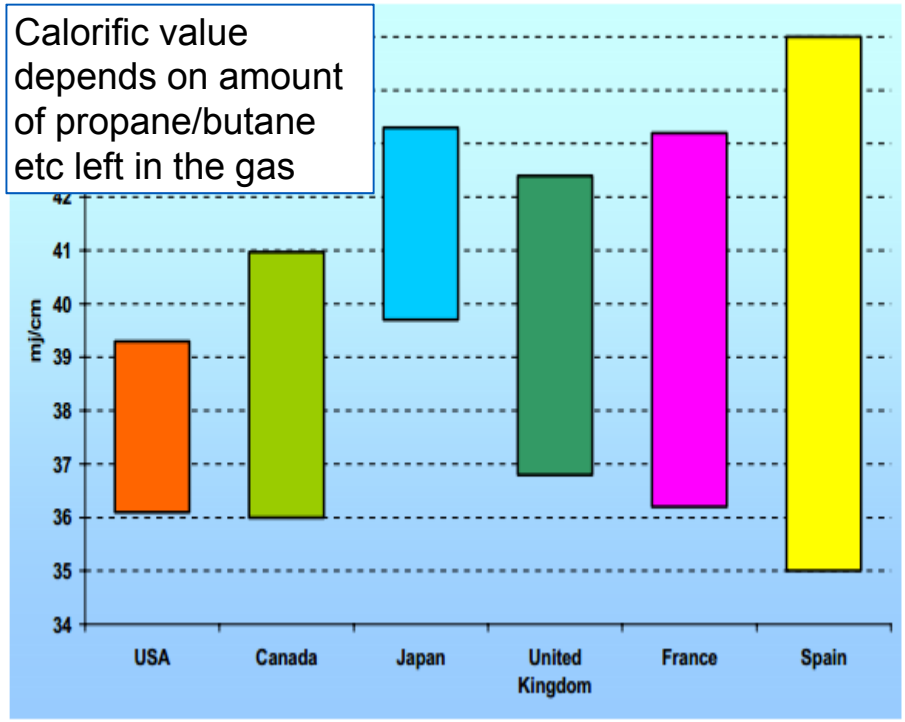
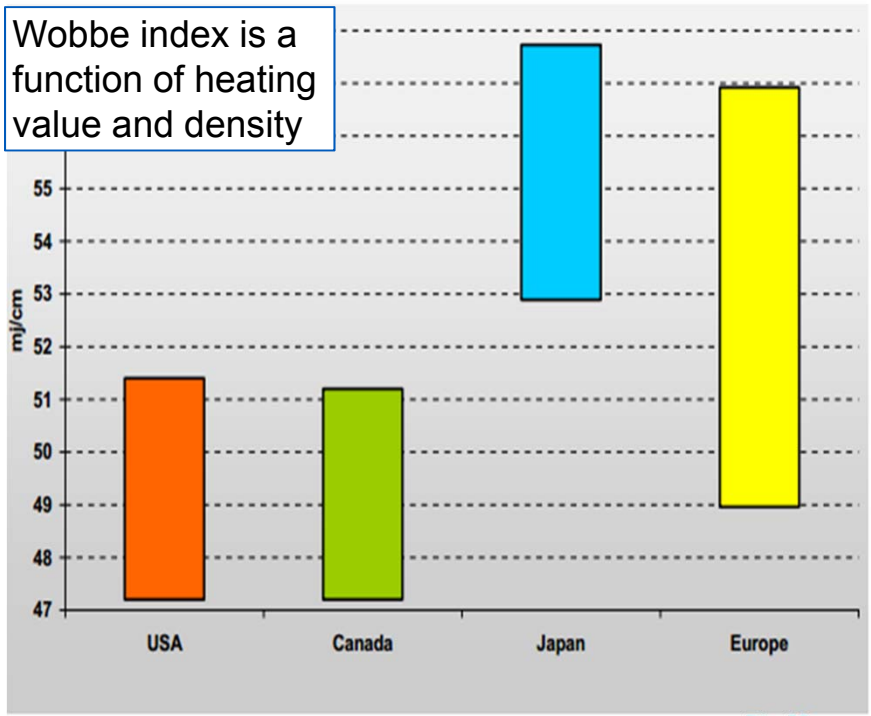
Gas Treatment



- LNG composition/quality is important
  - Not all LNG is the same
- Most importers have technical standards for
  - Calorific value
  - Wobbe Index (safety related)
- Value implications





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Source: IGU Research

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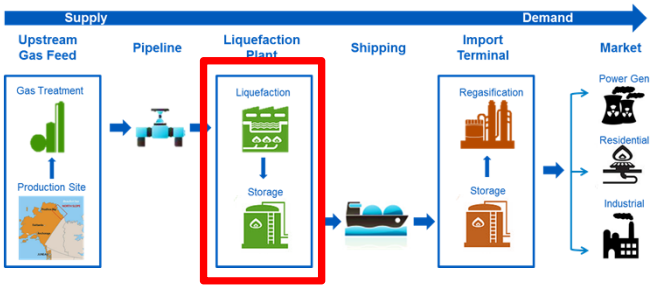
Liquefaction



- ***Kenai, Alaska***
- Built 1969
- Capacity 1 x 1 million tonnes
- Power consumption 63MW
- Fuel consumption ~15% of throughput*
- Time taken to complete: 2 yrs

- ***Qatargas II, Qatar***
- Built 2009
- Capacity 2 x 7.8 million tonnes
- Power consumption 1GW
- Fuel consumption ~8% of throughput
- Time taken to complete: 2yrs

* Typical of early LNG plants

Source: Hydrocarbon Processing, Kenai Picture: LNG World News

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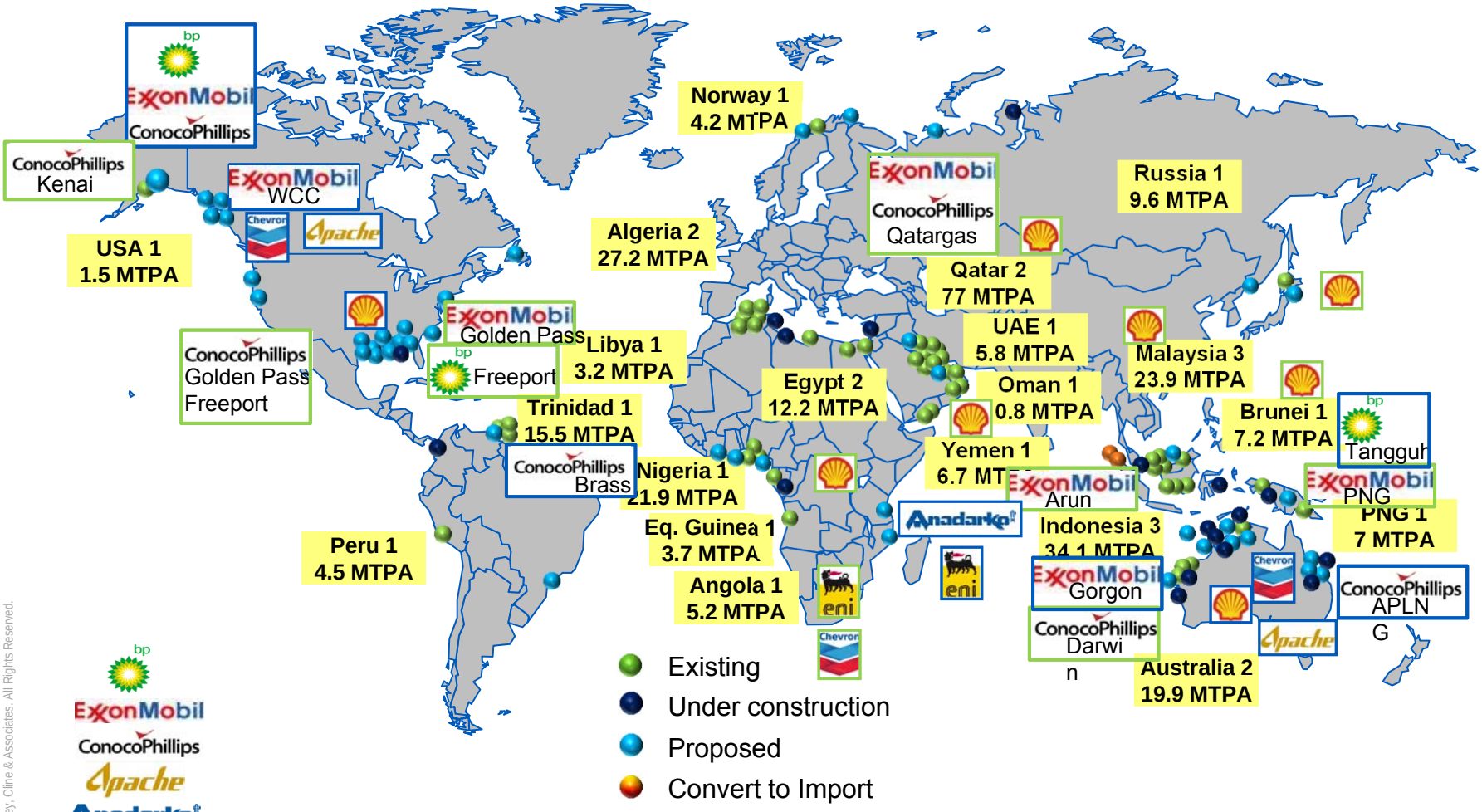
LNG Liquefaction Plants: 2015 onward



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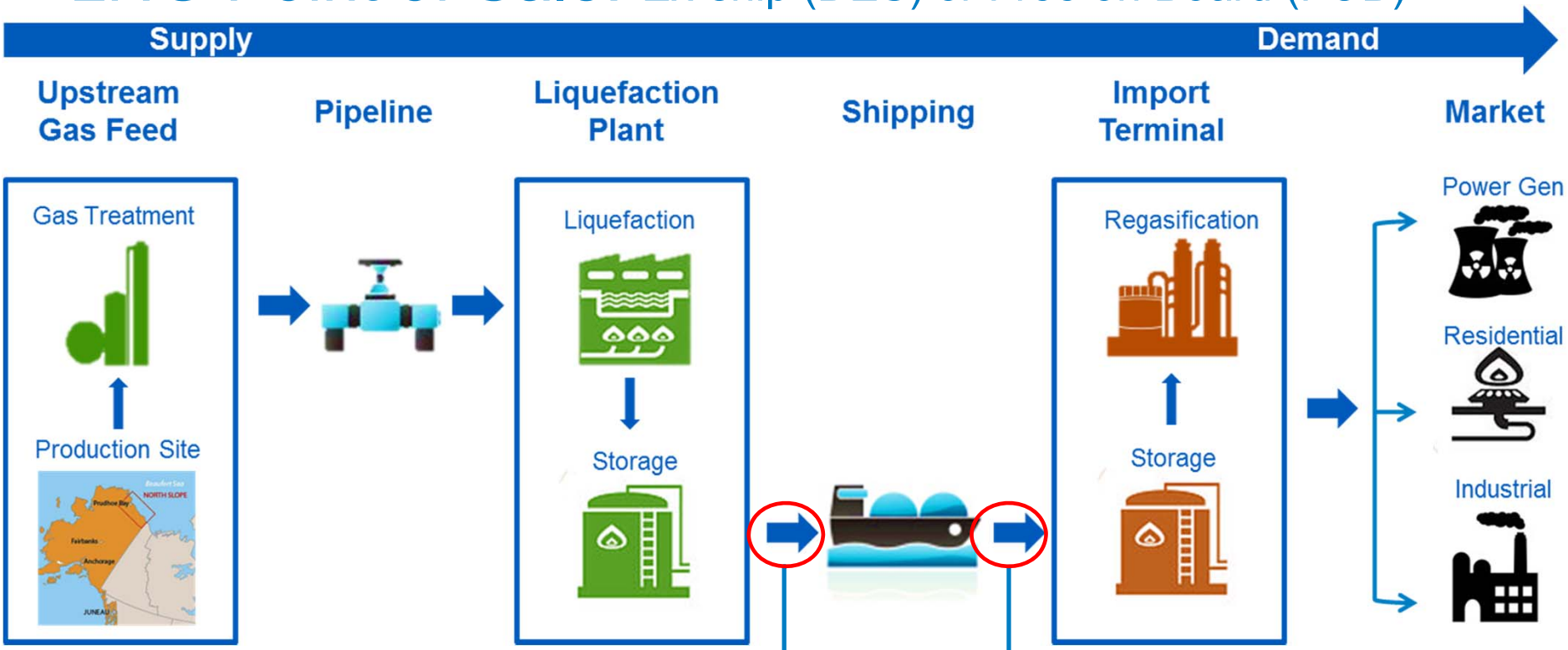
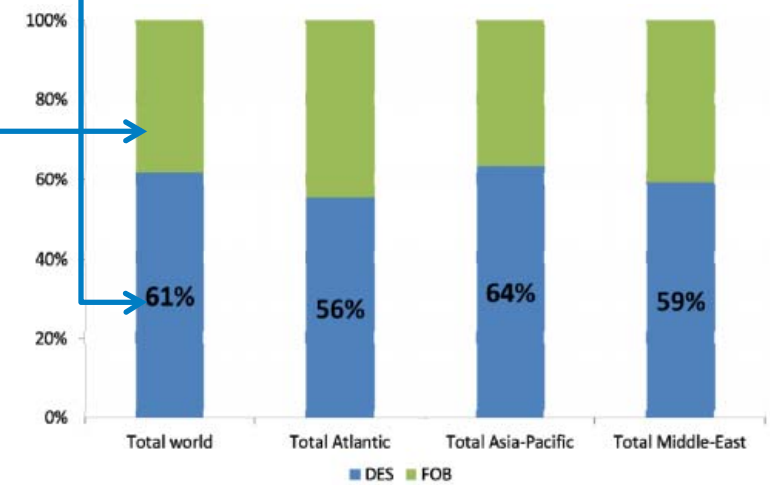
LNG Point of Sale: Ex-ship (DES) or Free on Board (FOB)



- Around a third of LNG is collected by the buyer at the sellers terminal
- The remainder is transported to the buyers terminal in ships operated by the LNG seller
- The emergence of a spot trade is making Ex-ship deliveries more popular



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Source: GIIGNL

LNG Carriers – Scale Transformation

Phillips Marathon Nikiski LNG Terminal March 1969:
Asia-Pacific first: ‘Arctic Tokyo’
82,000 cubic metres

British Gas Isle of Grain LNG Terminal November 2008:
Maiden voyage: ‘Al Khuwair’
219,000 cubic metres

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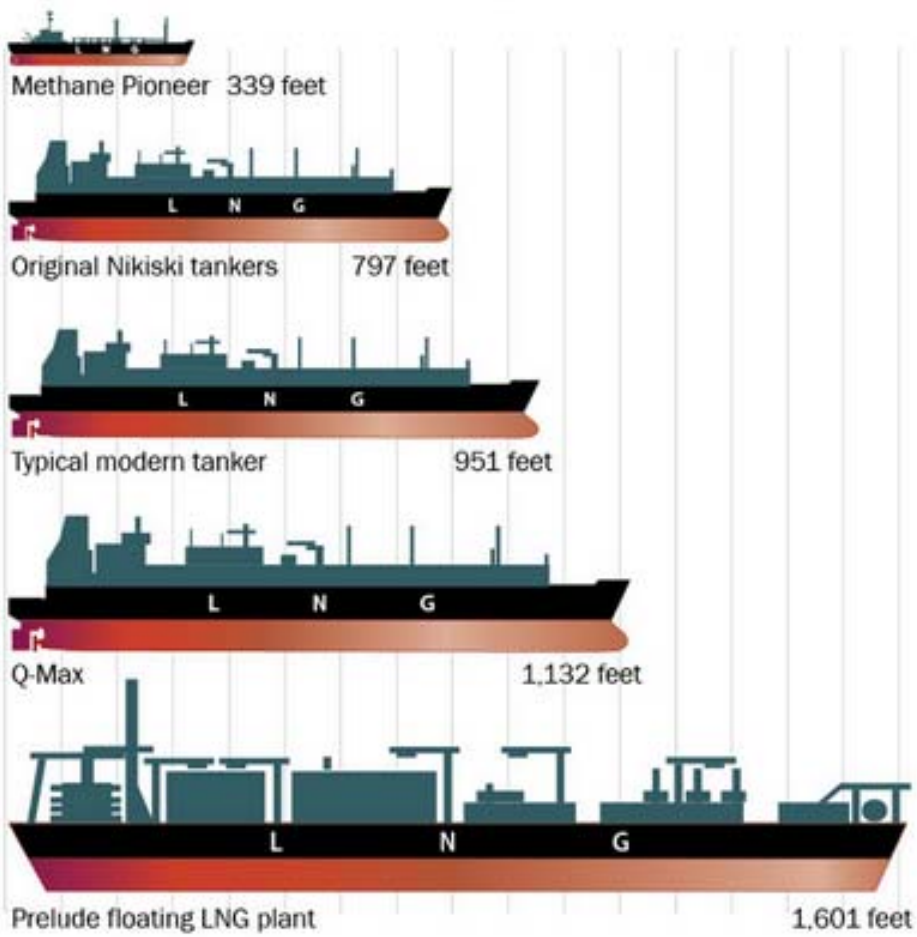
Shipping Development

LNG Ship Trends

- ***1960s***
  - Start of LNG industry
  - Ships of approx. 25,000 to 30,000 cu.m
  - Gas equivalent of 600 bcf or 12,000 tonnes
- ***Late 1960s***
  - Eg Nikiskii – Yokohama trade
  - Ships of 82,000 cu. M
  - Gas equivalent of circa. 2 bcf or 40,000 tonnes
- ***70s and 80s***
  - Asian LNG trade established
  - Ships standardised around 125,000 cu. m level
  - 3bcf or 60,000 tonnes
- ***2000s***
  - Qatar project underway
  - Established Q-Flex circa. 215,000 cu m or 105,000 tonnes
  - Latest design Q-Max circa. 266,000 cu m or 130,000 tonnes
- ***2015***
  - Prelude Floating LNG (FLNG) Australia



Source: Ron Engstrom, Clarksons

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Floating LNG – Potential to be a game changer

FLNG May Represent a Technology Risk to Conventional LNG Projects

- In the last 18 months or so, FLNG has gained substantial attention
- Partly driven by Shell's Prelude FLNG vessel in Australia, and many "me, too" follow on announcements
- Has benefits of lower, modular cost, transportable and quick to construct
- Impact not yet fully apparent – a potential game changer for LNG industry
- May enable multiple smaller projects to proceed faster

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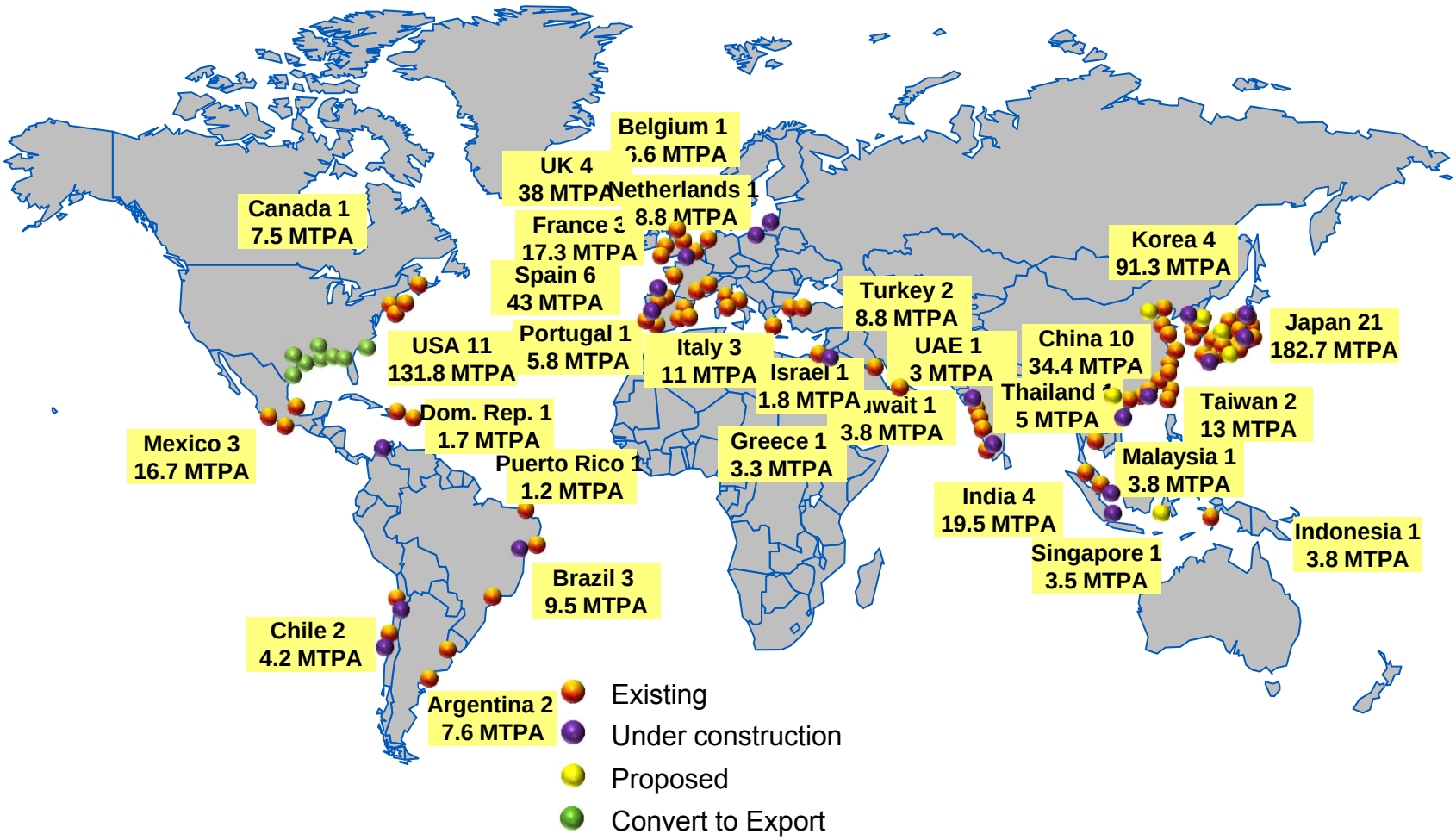
LNG Receiving Terminals: 2015 onward



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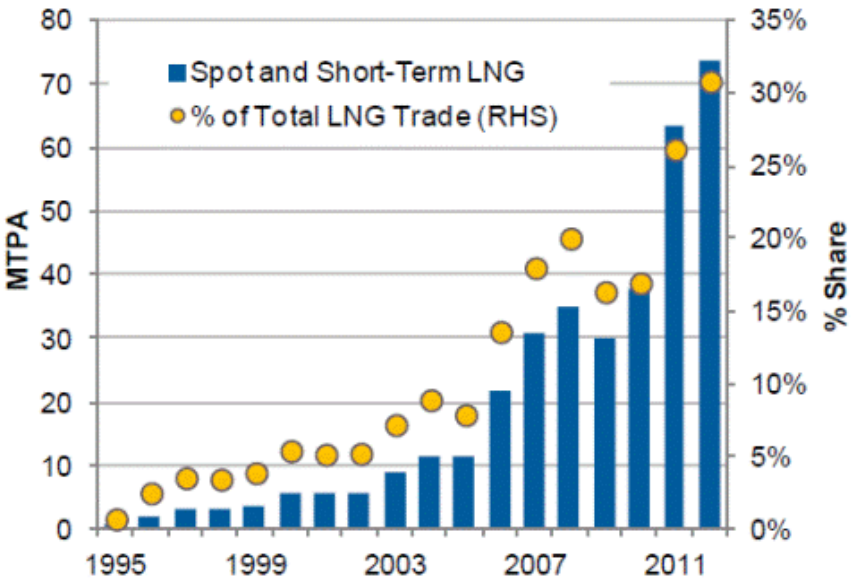
LNG Market Characteristics

- ***Global Oil/Lower 48 Gas***
  - Deep liquid market
  - Demand/Supply Balance sets price
  - Anyone can be a price taker



- ***Global LNG Market***
  - Predominantly governed by direct buyer/seller contract
  - Price largely set by contract formula
  - Accessing spot market is complex and logistically challenging
  - Very small group of buyers and sellers
  - Small but growing group of aggregators (traders)

Graph: King and Spalding

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Long Term LNG Contracts

- ***Traditional LNG Contract***
- Term
  - 20-25 yrs
- Quantity
  - Fixed number of cargoes
  - Take or Pay
  - Mechanism for additional cargoes
- Price and Indexation
  - Base Price
  - Typically oil indexation
- Logistics
  - Unloading/loading slots
  - Point of delivery
  - Destination Flexibility
- Force Majeure

- ***Gulf Coast Tolling LNG Contract***
- Term
  - 20-25 yrs
- Quantity
  - Fixed number of loading slots
  - Ship or Pay
- Price
  - Liquefaction plant fixed tariff
  - Pass-through of input gas cost + fuel
- Logistics
  - Loading slots
- Force Majeure

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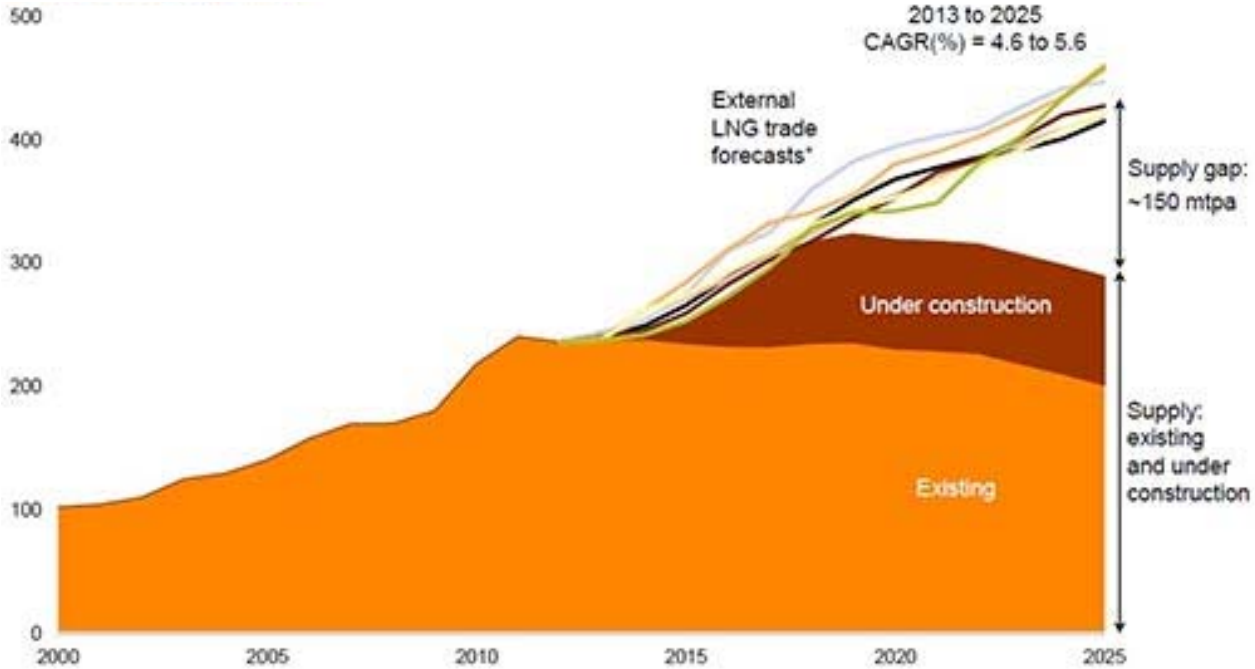
Filling the Demand Gap

- LNG demand uncertainty 2025 and beyond
  - Global economy
  - Unconventional gas
  - Geopolitics
- Base assumptions:
  - Gas demand is growing globally
  - Existing LNG supplies will become constrained
- Alaska is competing in a very competitive global market

Global LNG Supply MTPA



Sources: Supply: BG Group interpretation of Wood Mackenzie data (Q4 2013); as of Q4 2013 Yamal LNG not included in under-construction
*Trade: various research house views; (2014): Wood Mackenzie, PFC Energy, IHS CERA, Poten & Partners, FACTS Global Energy, (2013): PIRA, Gas Strategies

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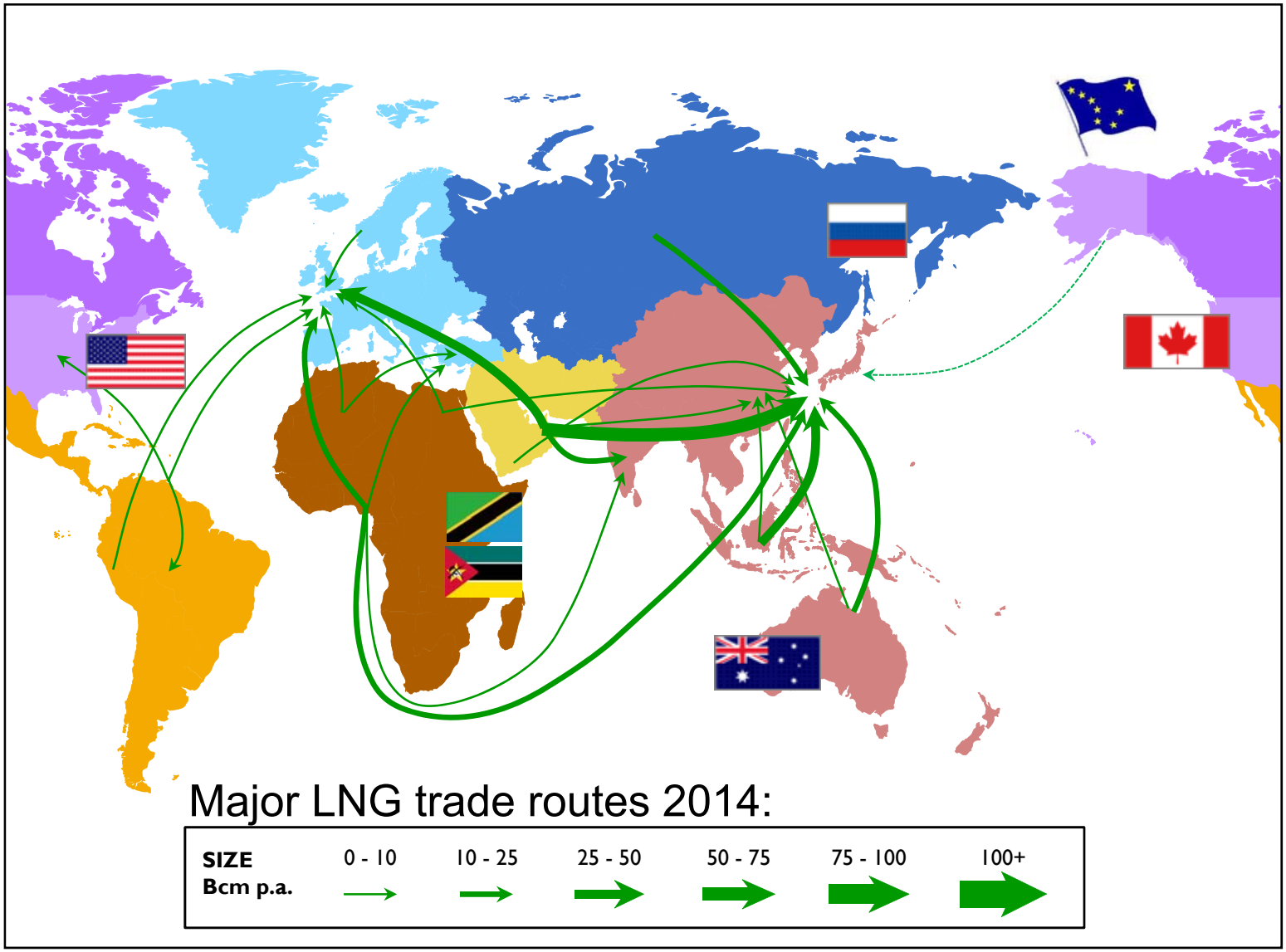
Areas of Competing LNG Export Activity



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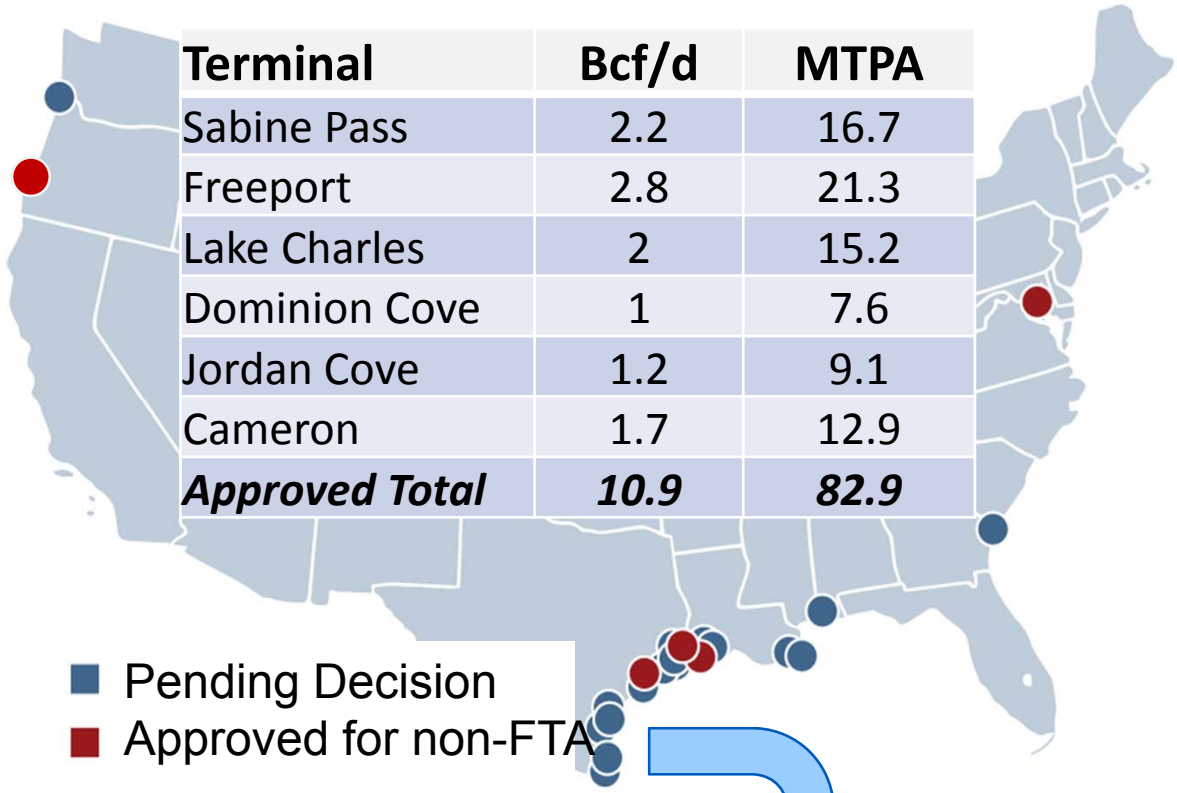
US LNG Exports

Outlook

- Permits awarded for over 80 MTPA of LNG exports from Lower 48
- Another 170 MTPA under consideration in July 2014
- AK LNG adds another ~20 MTPA
- Questions:
  - Panama Canal impact 2016+
  - Gas sourced from "Henry Hub" vs Alaska dedicated supply
  - Sustainability of Shale Gas?
  - How will US govt respond to sustained export pressures.

Key Locations

Terminal	Bcf/d	MTPA
Sabine Pass	2.2	16.7
Freeport	2.8	21.3
Lake Charles	2	15.2
Dominion Cove	1	7.6
Jordan Cove	1.2	9.1
Cameron	1.7	12.9
Approved Total	***10.9***	***82.9***



Panama Canal represents significant uncertainty

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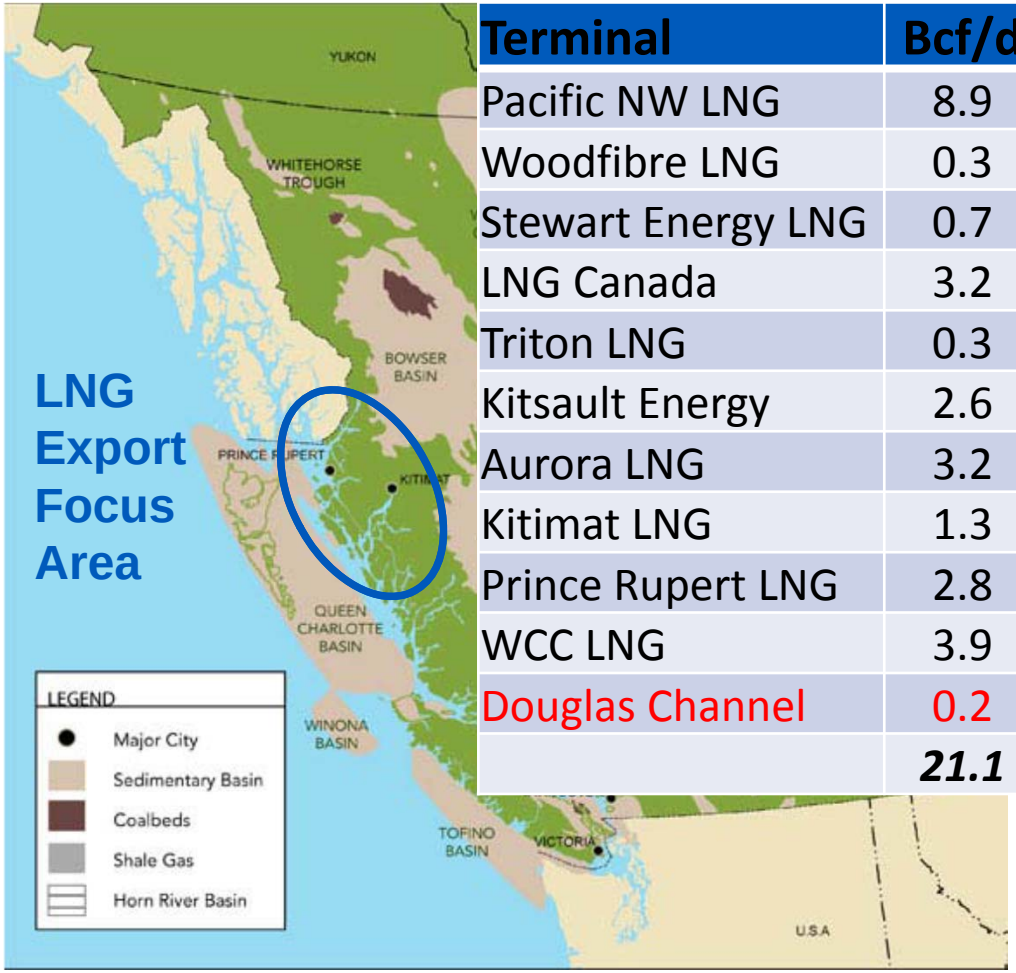
Canadian LNG Exports

Outlook

- 15 proposed LNG export projects in British Columbia, none of which are expected to reach FID by 2015
- Questions:
  - Which projects will survive attrition process
  - Mixture of dedicated supply and Alberta Hub
  - Cost of Rockies pipeline crossing
  - Shale gas resource comparable cost to L48
  - Buyer Confusion?

West Coast Canada Key Locations



Terminal	Bcf/d	MTPA
Pacific NW LNG	8.9	19.7
Woodfibre LNG	0.3	2.1
Stewart Energy LNG	0.7	5
LNG Canada	3.2	24
Triton LNG	0.3	2.3
Kitsault Energy	2.6	20
Aurora LNG	3.2	24
Kitimat LNG	1.3	10
Prince Rupert LNG	2.8	21.6
WCC LNG	3.9	30
Douglas Channel	0.2	1.8
	21.1	***160.5***

Source: BC Ministry of Mines/National Energy Board

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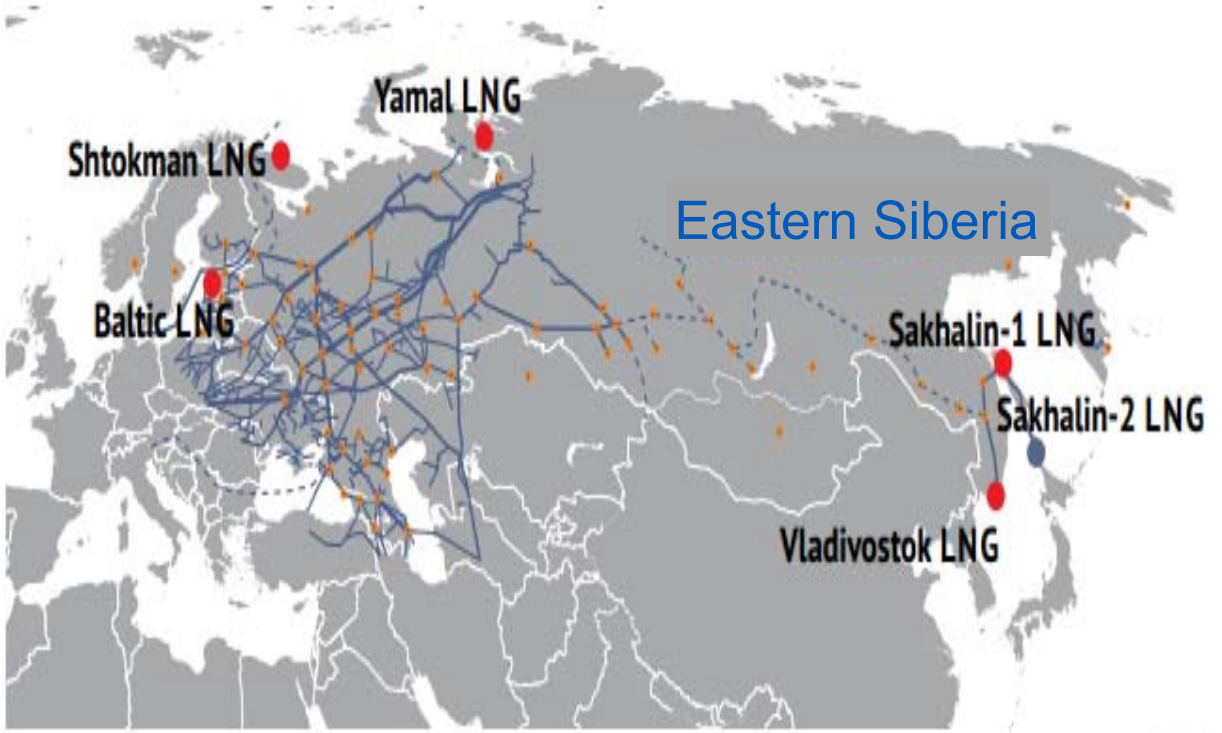
Russian LNG Exports

Outlook

- Several Asia-Pacific LNG proposals
- Major technical risks
- East Siberian gas supply has been earmarked for export pipeline to China
- Questions:
  - Security of supply
  - Regulatory and political certainty

Key Locations



Source: ERI RAS

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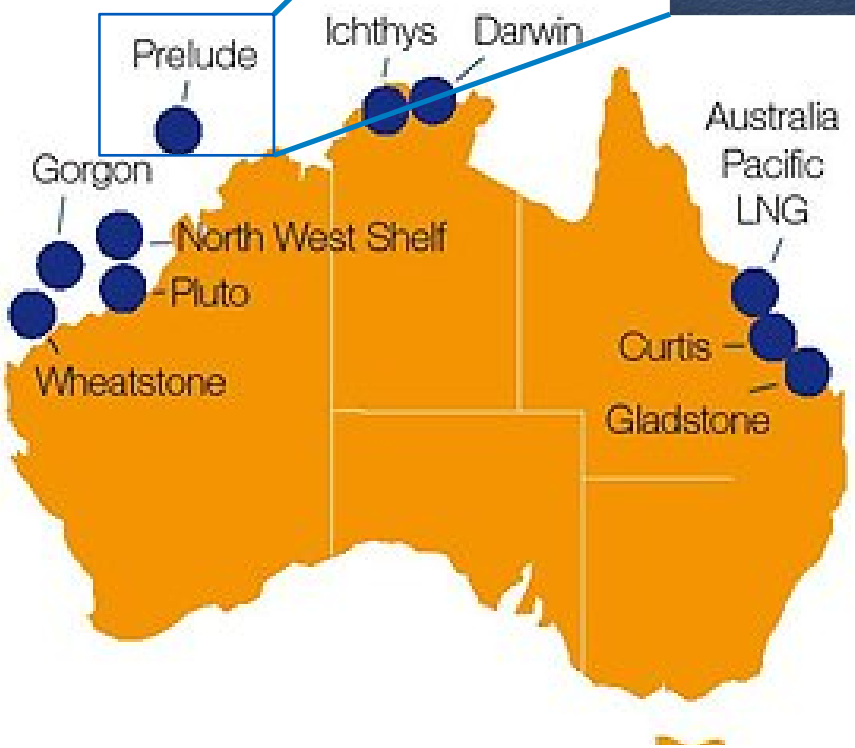
Australian LNG Exports

Outlook

- Australia is expected to account for the largest share of global LNG supply growth in the next decade
- Questions:
  - Substantial cost overruns
  - Sustainability of gas supplies, especially Coal Seam Gas
  - Upstream productivity
  - Labour costs
  - FLNG future developments

Key Locations



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East African LNG Exports

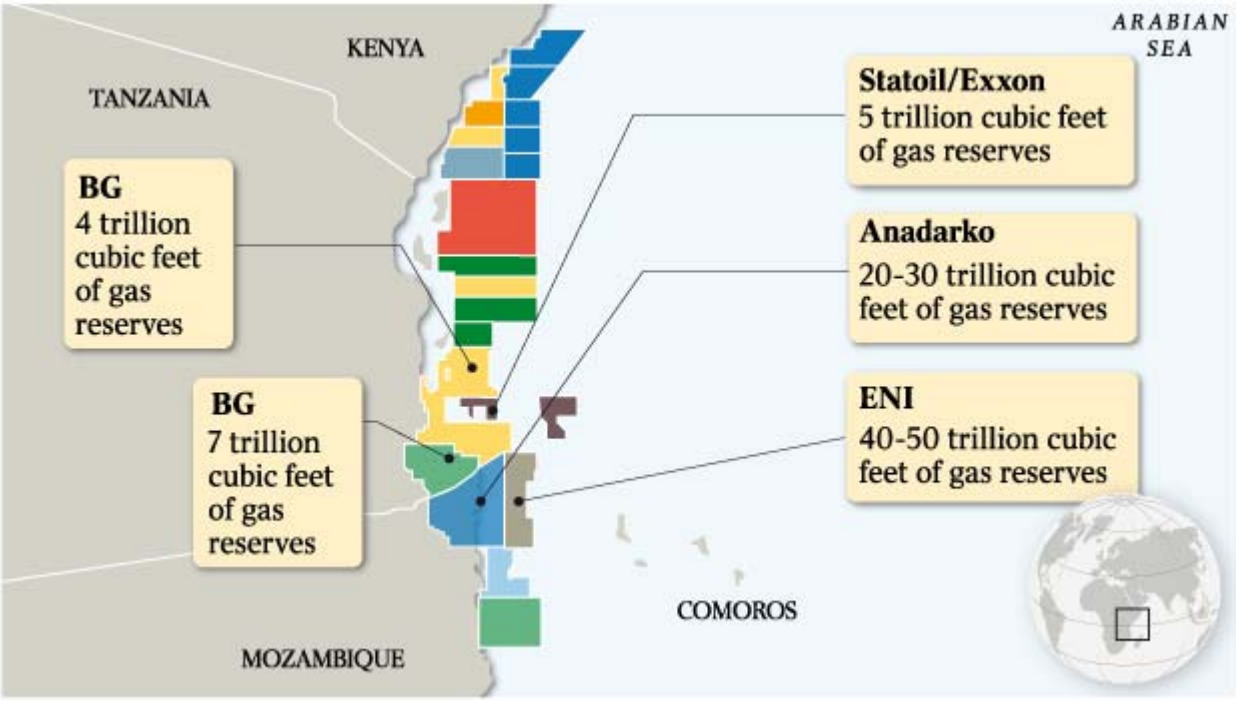
Outlook

- Large conventional gas discoveries off Mozambique and Tanzania
- Mozambique targeting 2018 start-up
- Questions:
  - Uncertain regulatory environment
  - Legacy of poor governance
  - Lack of supply chain, skilled workforce and intrastructure

Key Locations

- Onshore LNG x 2 then possible FLNG
- Operators with less LNG experience
- 2018

- LNG facility in Mnazi Bay
- Well-established LNG players
- 2021



Source: The Australian

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Questions?

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