Executive Summary

Anchorage, AK
August 5-9, 2013
North Slope Gas & LNG Symposium
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Introduction to global gas concepts
Global gas markets and macro fundamentals
Impact of shale gas
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LNG shipping
Executive Summary

- Gas is a fast growing segment of the global energy system—and LNG is the fastest growing segment within gas.

- Much of the growth in energy, gas and LNG is coming from Asia—meaning that Alaska is well positioned geographically to capture this market.

- But the opportunity set for the gas producers and for LNG buyers are widening; the question is why Alaska? Why should a company invest in Alaska? Why should a buyer come to Alaska to secure LNG?
Where Does Alaska Fit?

- Reserves, Infrastructure, Gas Price
- Feedstock Price, Export Permitting
- Domestic Demand
- Security, Politics, Upstream Investment
- Lack of Infrastructure, Politics, Upstream Unitization
- Cost-Escalations
- Security, Politics, Domestic Demand, Upstream Resource
- Politics, Upstream Cost, Project Economics

Domestic Demand
Feedstock Price
Reserves, Infrastructure
Security, Politics, Upstream Investment
Lack of Infrastructure, Politics, Upstream Unitization
Cost-Escalations
Security, Politics, Domestic Demand, Upstream Resource
Politics, Upstream Cost, Project Economics
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Think Micro, Not Macro; Gas is Not a Global Market

![Graph showing realized oil and gas prices for major companies from 2002 to 2012.](image)

- **XOM**
- **COP**
- **CVX**
- **Shell**
- **TOTAL**
- **BP**

**Majors: Average Realized Oil Price**

**Majors: Average Realized Gas Price**
## Gas is Very Different Than Oil

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

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)
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-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
- Finalize all approvals (country/federal, state, local)
The LNG Value Chain

- 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.

- 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.

- 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).

- 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.
Oil Indexation Systems

Oil Parity
Slope of 0.167
(0.167x Oil price in $/bbl = Gas price in MMBtu)

Below oil parity
(~0.08x to 0.16x)

S-Curve
(Slope flattens at high and low oil prices)

Flat price (not linked to oil)
Varying Degrees of Oil Linkage Around the World

- **Korea**: $R^2 = 0.991$
- **Germany**: $R^2 = 0.967$
- **United Kingdom**: $R^2 = 0.8381$
- **United States**: $R^2 = 0.0445$
New Gas Pricing Expectations

- Companies are increasingly demanding or expecting a change in gas pricing systems. Change is driven by several dynamics, some temporary, others permanent; and some change leads to lower prices, some to higher:
  - An unprecedented boom in LNG capacity which rose 36% from 2008 to 2011 from projects in Qatar, Russia, Indonesia, Peru, Yemen and Malaysia.
  - More shale gas in the United States, which reduced that country’s demand for imports. It also raised expectations that other countries with shale would soon replicate its success, and that the United States could start exporting.
  - Low gas demand in Europe—courtesy of a weak economy, the growth of renewables and the drop in carbon prices, which led to a mini-renaissance of coal at the expense of gas.
  - Cost escalation made new LNG projects more expensive, making it necessary to sign new long-term contracts at high (and oil-linked) prices.
  - The Great East Japan Earthquake of March 2011 altered both short and long-term demand dynamics in Japan, the world’s largest LNG buyer.

- Besides altering expectations, these trends produced wide and sustained disparities in prices. In North America, shale gas has pushed Henry Hub to a decade-long low; in Asia, Japan is paying more for LNG than even before; and in Europe, a hybrid system that combined oil-linked and hub-based prices meant that gas was available at (at least) two pricing systems that, at one point or another, were either equal or diverged by a factor greater than two.
## Regional Perceptions of Gas Pricing / Abundance

<table>
<thead>
<tr>
<th>Producers / Sellers</th>
<th>North America</th>
<th>Europe</th>
<th>Asia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Belief in scarcity until 2008; consensus on abundance since then</td>
<td>Belief in scarcity until 2008; divergent views on long-term balance from scarce (Gazprom) to less scarce (Statoil)</td>
<td>Belief in scarcity given ability to secure contracts and take FIDs; less sure about scarcity in 2012</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Importers / Buyers</th>
<th>North America</th>
<th>Europe</th>
<th>Asia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Belief in scarcity until 2008; consensus on abundance since then</td>
<td>Belief in scarcity until 2007-2009; near consensus on relative abundance through 2020 with low interest in securing long-term supply</td>
<td>Belief in scarcity until 2008; brief respite in 2009; rapid FIDs to secure LNG in 2010-2011; belief / hope of abundance in 2012</td>
</tr>
</tbody>
</table>
## How Oil Prices Will Affect Gas?

<table>
<thead>
<tr>
<th><strong>Gas Scarce</strong></th>
<th><strong>Gas Abundant</strong></th>
</tr>
</thead>
</table>
| **Oil Scarce** | - Opportunistic oil-to-gas switching  
- Equal investment focus to oil and gas  
- Oil indexation works (more or less)  
- Focus on alternatives to oil and gas  | - High levels of oil-to-gas switching  
- Companies shift investment focus to oil  
- Buyers reject oil indexation; sellers cling to oil indexation; buyers (eventually) triumph  
- Focus on alternatives to oil  
- Low impetus to find alternatives to gas  |
| **Oil Abundant** | - Limited oil-to-gas switching  
- Companies shift investment focus to gas  
- Sellers reject oil indexation; buyers cling to oil indexation; sellers (eventually) triumph  
- Focus on alternatives to gas  | - Limited oil-to-gas switching  
- Oil more favored investment than gas  
- Oil indexation works (more or less)  
- Low impetus to develop alternatives to oil and gas  |
A New Gas Pricing System: What Can Alaska Expect?

- Asian buyers are demanding lower priced gas—and they are also keen to avoid oil indexation. There is a clear downward pressure on LNG prices.
- Don’t mix cost (what you need to break-even) with price (what you can sell gas for).
- A tight market pushes price towards the level of demand destruction; a loose market pushes the price towards the level of production.

<table>
<thead>
<tr>
<th>Market Context</th>
<th>Desire to Change</th>
<th>Ability to Change</th>
<th>Fundamentals Create Floor</th>
<th>Fundamentals Create Ceiling</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Is the current system fair and does it reflect market fundamentals? Who gains from the new system; and are the gains sustainable?</td>
<td>What is the relative bargaining power of buyers and sellers? Is there consensus on what the new system will look like?</td>
<td>What is the price that stimulates new demand that leads to higher prices? What is the price at which new supply can no longer be justified?</td>
<td>At what price does the consumer either cease consumption altogether or switch fuels? At what price does new, cheaper supply come in to lower prices?</td>
</tr>
</tbody>
</table>
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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%
Growth at 2.3% per Year Driven by Asia

Gas Demand by Region

- Africa
- South America
- Middle East
- Asia Pacific
- EU / Eurasia
- North America

CAGR (2010-2030)

- Africa: 4.1%
- South America: 2.8%
- Middle East: 3.7%
- Asia Pacific: 4.1%
- EU / Eurasia: 0.9%
- North America: 1.5%

Global demand growth of 2.3% p.a.

+175 bcf/d = ~3X US 2010 demand
Asia Drives LNG Demand As Well

Asia accounted for 2/3 of growth since 1990 and will make up 2/3 of new demand.
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.
North America is Largest Prospective Supplier

Proposed Liquefaction Plants by Location

- US: 40%
- Canada: 17%
- Australia: 14%
- Russia: 9%
- Mozambique: 4%
- Papua New Guinea: 3%
- Nigeria: 2%
- Indonesia: 2%
- Tanzania: 2%
- Others: 7%

PFC Energy
But Lots of Supply Competition

*All values are in millions of tonnes per annum (mmtpa)*
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Fossil Fuel Boom, Driven by Unconventionals

United States: Fossil Fuel Production

Pre-2011 peak (1998)

Q btus


United States: Fossil Fuel Production

Q btus


Gas
Coal
Crude
NGPL
United States: Major Lower-48 Gas Basins

Note: shaded areas represent well activity since 2001.

Source: PFC Energy
US Gas Production Can Keep Growing—Driven by Shale

Lwr-48 Gross Natural Gas Production Estimate

Production in bcf/d


67.6 69.7 70.6 72.1 73.9 75.3 77.3 80.9 82.2 83.6 83.8 84.4 84.7 85.5 85.8 86.3

Haynesville DUC
Marcellus DUC
Marcellus PA
Marcellus WV
Eagleford
Granite Wash
Haynesville
Woodford
Pinedale
Fayetteville
Barnett
GOM Deepwater
GOM Shelf
CBM
Oil (Other)
Gassy Oil (Other)
Wet Gas (Other)
Dry Gas (Other)
Total
Will Other Countries Follow? The Shale Gas Cocktail

- Rock characteristics/resource base quality
- Resource base quantity
- Responsiveness to fracking
- Well control
- Land Tenure/Parcel Size
- Local advocates and beneficiaries
- Lease structure forcing establishment of production
- High number of operators/dispersion
- Company ability/willingness to spend significant capital quickly
- High company risk appetite for trial and error
- Service sector availability
- Rapid transmission of learning via leaky service sector and external company orientation
- Pipes, Gathering to allow processing/delivery
- Water and other essential fracking materials
- Skilled oil and gas labor pool
- Favorable natural gas prices and available markets
- Cooperative governments and incentives
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Widespread Growth in Asian LNG Demand

LNG Demand by Country

- 2012 Asia:
  - China: 77 mmt
  - Malaysia: 6 mmt
  - Japan: 1 mmt
  - India: 28 mmt
  - Philippines: 3 mmt
  - Bangladesh: 6 mmt
  - Singapore: 7 mmt
  - Thailand: 6 mmt
  - Taiwan: 7 mmt
  - Korea: 16 mmt
  - Other Asia: 10 mmt

- 2030 Asia:
  - China: 346 mmt
  - Malaysia: 4 mmt
  - Japan: 9 mmt
  - India: 28 mmt
  - Philippines: 7 mmt
  - Bangladesh: 7 mmt
  - Singapore: 7 mmt
  - Thailand: 6 mmt
  - Taiwan: 6 mmt
  - Korea: 3 mmt
  - Other Asia: 10 mmt

LNG Demand Outlook: Asia

- 2000: 60 mmt
- 2030: 300 mmt
S-D Imbalance Grows Post 2020

- Preliminary Contracts
  - MOU: Memorandum of Understanding
  - HOA: Heads of Agreement
- Finalized Contracts (15-20 years)
  - SPA: Sales and Purchase Agreement
  - Equity Offtake (small portion of total)
- Markets have different preferences for the share of demand not tied to long-term supply contracts
  - Short-term contracts
  - Spot volumes

![Chart showing Asia LNG Demand and Supply](chart.png)
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BP, COP and XOM are Major LNG Players

Net Equity Liquefaction Capacity in 2012 and 2020
(By PFC Energy Estimated Start)
The Companies Can Execute, but Will they Invest?

North America Unconventionals

US GOM

Offshore Brazil

West Africa

Offshore East Africa

Offshore Australia

China Unconventionals

Offshore Arctic

Russian Arctic

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New LNG Projects are Expensive

Asia Pacific: Breakeven FOB Costs at $90/b

- Upstream Breakeven*
- Liquefaction Breakeven*
- Total Breakeven
- Liquefaction Unit Cost (RHS)

[Bar chart showing LNG projects with their respective breakeven costs]
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

KOGAS Contract with Sabine Pass at $6 Henry Hub

Delivered Cost

Shipping (Korea)

Liquefaction Fee

Gas Surcharge

Henry Hub

$/MMBtu

Sabine Pass-Type LNG vs. Japan LNG

$/MMBtu


Japan LNG

Est. US-LNG into Japan

Source: Global LNG Service

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Breakeven Economics for Hypothetical $46bn Project

~$1,111/ton

At this unit cost level, liquefaction spend would be ~$20bn

<table>
<thead>
<tr>
<th>Component</th>
<th>Cost ($/MMBtu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upstream &amp; Gas Treatment</td>
<td>3.2</td>
</tr>
<tr>
<td>Pipeline</td>
<td>2.54</td>
</tr>
<tr>
<td>Liquefaction</td>
<td>10.44</td>
</tr>
<tr>
<td>FOB Cost</td>
<td>11.14</td>
</tr>
<tr>
<td>Shipping</td>
<td>0.7</td>
</tr>
<tr>
<td>CIF/DES Cost</td>
<td>11.14</td>
</tr>
</tbody>
</table>

Gas price required to achieve a 15% IRR on $14 bn Upstream and GTP Investment, with only 12.5% Royalty applied.

Tariff required to achieve a 12% IRR on $12 bn pipeline.

Tariff required to achieve a 12% IRR on $20 bn liquefaction facility.

~$1,111/ton at this unit cost level, liquefaction spend would be ~$20bn.
What’s an Upper Boundary for the LNG Project?

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

$/MMBtu

- Upstream & Gas Treatment: 4.17
- Pipeline: 3.18
- Liquefaction: 7.91
- FOB Cost: 15.26
- Shipping: 0.7
- CIF/DES Cost: 15.96

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What Does an LNG Plant Look Like?

LNG Plant Cash Flow: Typical Plant

- **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)
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
- Finalize all **approvals** (country, local)
## Main Provisions of an LNG Contract

<table>
<thead>
<tr>
<th>Pricing</th>
<th>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).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>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 (&lt;5) contracts.</td>
</tr>
<tr>
<td>Destination Flexibility</td>
<td>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.</td>
</tr>
<tr>
<td>Volume Flexibility</td>
<td>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).</td>
</tr>
<tr>
<td>Profit Sharing</td>
<td>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).</td>
</tr>
<tr>
<td>Non-Compliance</td>
<td>Most contracts have arbitration provisions.</td>
</tr>
<tr>
<td>Renegotiation Provisions</td>
<td>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.</td>
</tr>
</tbody>
</table>
The LNG Value Chain

- 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.

- 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.

- 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 arrange for shipping, it is considered CIF (Cost, Insurance, Freight) or DES (Delivered Ex Ship).

- 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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LNG shipping
Alaska Doesn’t Have to Worry About Ships—Yet

Window for ordering vessels
The Geography of LNG Shipping

LNG Shipping Distance & Cost Calculator
### Does Alaska Have a Shipping Advantage?

#### Shipping Cost ($/MMBtu) – Panama Canal Access

<table>
<thead>
<tr>
<th></th>
<th>Japan / S. Korea</th>
<th>China</th>
<th>India</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southern Alaska</td>
<td>0.67</td>
<td>0.83</td>
<td>1.44</td>
</tr>
<tr>
<td>Western Canada</td>
<td>0.82</td>
<td>0.99</td>
<td>1.65</td>
</tr>
<tr>
<td>US - GOM</td>
<td>1.89</td>
<td>2.06</td>
<td>1.88</td>
</tr>
<tr>
<td>Australia</td>
<td>0.60</td>
<td>0.60</td>
<td>0.62</td>
</tr>
<tr>
<td>East Africa</td>
<td>1.18</td>
<td>0.97</td>
<td>0.58</td>
</tr>
</tbody>
</table>

- 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
Executive Summary

- Gas is a fast growing segment of the global energy system—and LNG is the fastest growing segment within gas.

- Much of the growth in energy, gas and LNG is coming from Asia—meaning that Alaska is well positioned geographically to capture this market.

- But the opportunity set for the gas producers and for LNG buyers are widening; the question is why Alaska? Why should a company invest in Alaska? Why should a buyer come to Alaska to secure LNG?