Indicative Costs and Economics for LNG Projects

Anchorage, AK
August 5-9, 2013
North Slope Gas & LNG Symposium
Table of Contents

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

- Gas Production (mboe/d)
- Oil Production (mboe/d)
- ATCF - LNG Project
- ATCF - Oil Project
... and Different Economic Outcomes

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

NPV10

Required Reserves

Initial CAPEX

NPV10/boe

IRR

Production Life

Alaska Gas Costs | © PFC Energy 2013 | Page 6
Table of Contents

Economics of an LNG project
Cost Escalation Trends
Competition vs US L48
Alaska LNG Competitiveness – Sensitivities
## Oil-Indexed Pricing to Asian Markets

<table>
<thead>
<tr>
<th>Contract Sales Price Slope ---&gt;</th>
<th>0.13x</th>
<th>0.14x</th>
<th>0.15x</th>
<th>0.16x</th>
</tr>
</thead>
<tbody>
<tr>
<td>$60/bbl Brent</td>
<td>$7.80</td>
<td>$8.40</td>
<td>$9.00</td>
<td>$9.60</td>
</tr>
<tr>
<td>$80/bbl Brent</td>
<td>$10.40</td>
<td>$11.20</td>
<td>$12.00</td>
<td>$12.80</td>
</tr>
<tr>
<td>$100/bbl Brent</td>
<td>$13.00</td>
<td>$14.00</td>
<td>$15.00</td>
<td>$16.00</td>
</tr>
<tr>
<td>$120/bbl Brent</td>
<td>$15.60</td>
<td>$16.80</td>
<td>$18.00</td>
<td>$19.20</td>
</tr>
<tr>
<td>$140/bbl Brent</td>
<td>$18.20</td>
<td>$19.60</td>
<td>$21.00</td>
<td>$22.40</td>
</tr>
</tbody>
</table>
Newer LNG Projects Have Needed Highest Breakeven Prices Yet Seen…

Global: Breakeven FOB Costs at $90/b, Existing Projects

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

Breakeven Costs by Region:
- Asia-Pacific
- Atlantic
- Middle East
...a Trend Continued by Projects Under Construction in Asia-Pacific, Largely Due to Australia Cost Escalation

Asia Pacific: Breakeven FOB Costs at $90/b

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

Breakeven Costs:
- Existing
- Under Construction
- Proposed

Liquefaction Unit Cost (RHS)
- Existing
- Under Construction
- Proposed

Breakeven Costs:
- Asia Pacific: Breakeven FOB Costs at $90/b

Projects:
- Darwin LNG T1
- North West Shelf T4
- North West Shelf T1-3
- Brunei LNG T1-5
- Arun LNG
- MLNG Tiga (T1-2)
- MLNG Satu (T1-3)
- North West Shelf T5
- Peru LNG
- Bontang LNG
- MLNG Dua (T1-3)
- Tangguh LNG T1-2
- Pluto LNG T1
- Sengkang LNG T1-2
- PETRONAS LNG T9
- Queensland Curtis LNG T1
- Donggi-Senoro LNG
- Prelude LNG
- Australia Pacific LNG T1-2
- PNG LNG T1-2
- PETRONAS FLNG
- Ichthys LNG T1-2
- Gladstone LNG T1-2
- Gorgon LNG T1-3
- Wheatstone LNG T1-2
- Tangguh LNG T3
- BC LNG T1-2
- Oregon LNG T1-2
- Mozambique LNG T1-3
- Gorgon LNG T4
- Mozambique LNG T12.4
- Abadi LNG (Floating)
- Bonaparte LNG
- Tanzania LNG T1-2
- Arrow LNG T1-2
- Scarborough LNG
- Rotan LNG (Floating)
Project Cost Escalation Drivers

Recent Cost Revisions at Major LNG Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>At FID</th>
<th>Latest</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$/ton</td>
<td>$/MMBtu</td>
<td>$/ton</td>
</tr>
<tr>
<td>Gorgon LNG T1-3</td>
<td>2,467</td>
<td>10.42</td>
<td>3,712*</td>
</tr>
<tr>
<td>Pluto LNG T1</td>
<td>2,256</td>
<td>11.84</td>
<td>3,477</td>
</tr>
<tr>
<td>PNG LNG T1-2</td>
<td>2,273</td>
<td>10.15</td>
<td>2,754</td>
</tr>
<tr>
<td>QC LNG T1-2</td>
<td>1,765</td>
<td>6.54</td>
<td>2,400</td>
</tr>
<tr>
<td>Gladstone LNG T1-2</td>
<td>2,051</td>
<td>9.79</td>
<td>2,372</td>
</tr>
<tr>
<td>Angola LNG T1</td>
<td>1,346</td>
<td>7.18</td>
<td>1,923</td>
</tr>
</tbody>
</table>

*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

<table>
<thead>
<tr>
<th></th>
<th>Liquefaction</th>
<th>Upstream</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing</td>
<td>640</td>
<td>558</td>
</tr>
<tr>
<td>Under Construction</td>
<td>1,331</td>
<td>1,308</td>
</tr>
<tr>
<td>Proposed</td>
<td>1,168</td>
<td>1,121</td>
</tr>
</tbody>
</table>
Table of Contents

Economics of an LNG project
Cost Escalation Trends
**Competition vs US L48**
Alaska LNG Competitiveness – Sensitivities
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%

Alaska Gas Costs | © PFC Energy 2013 | Page 14
North American Export Projects Driven by Divergence in Gas Prices…

Gas Prices

$/MMBtu

0 20 10 15 16 17 18 19 20


US NBP EU-Oil Japan

Alaska Gas Costs | © PFC Energy 2013 | Page 15
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.

As Well as the Benefits of Brownfield Economics…

Liquefaction Cost for Recent LNG Projects

Source: Global LNG Service
...and Substantial Amounts of Semi-Stranded Gas
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 requires 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

At $6/MMBtu, US is not that cheap

Hub can be cheap but also volatile

Source: Global LNG Service
US Gas Supply Cost Curve

Preliminary Estimated Resource Available by Breakeven Gas Price

Sum of Yr 1 Gas Prod in Tcf

Henry Hub Price Range

- <$3
- $3-$4
- $4-$5
- $5-$6
- $6-$7
- $7+

© PFC Energy 2013
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?

Break-Even Costs (FOB) for Recently Sanctioned LNG Projects

Source: Global LNG Service
Table of Contents

Economics of an LNG project
Cost Escalation Trends
Competition vs US L48
Alaska LNG Competitiveness – Sensitivities
AK South Central LNG Concept

**SCLNG Concept Summary - Upstream**

- PTU (82 miles east of Pribilof A&P area)
  - Initial Production System (IPS) project in progress - 2016 SP
  - 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 Tie-in (adjacent to proposed GTP location)
  - Installation / tie-in managed by Prudhoe Bay Operator
  - Tie into existing CTF, deliver gas to new Gas Treatment Plant
  - Gas project / deliveries tied to future PBU operations

- Preliminary plan is to inject CO₂ using existing injection systems as appropriate

**SCLNG Concept Summary - Midstream**

- NS Gas Treatment Plant
  - Designed to remove gas impurities
  - Four amine trains with compression, dehydration and chilling
  - Prime power generation (3 units, 64kWIP)
  - All required utilities, infrastructure and camps
  - Facility will be modularized, Xaillled to location
  - Peak workforce - 500-2,000 people

- Gas Pipeline and Compression Stations
  - 800+ mile 42" x 80 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 - 6,800 people

**SCLNG Concept Summary - Downstream**

- 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

- 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

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

- Upstream & Gas Treatment: $14bn
- Pipeline: $12bn
- Liquefaction: $20bn
- Total Cost: $46bn
How Would $20bn for an 18 mmtpa Liquefaction Facility Compare With Other Recent Projects?

Global Liquefaction Unit Costs

- $1,111/ton
Breakeven Economics for Hypothetical $46bn Project

Gas price required to achieve a 15% IRR on $14 bn Upstream and GTP Investment, with only 12.5% Royalty applied:
- Upstream & Gas Treatment: $3.2
- Pipeline: $2.54
- Liquefaction: $4.7
- FOB Cost: $10.44

Tariff required to achieve a 12% IRR on $12 bn pipeline:
- Upstream & Gas Treatment: $0
- Pipeline: $0.7
- Liquefaction: $11.14

Tariff required to achieve a 12% IRR on $20 bn liquefaction facility:
- Upstream & Gas Treatment: $0
- Pipeline: $0.7
- Liquefaction: $11.14

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

<table>
<thead>
<tr>
<th>Cost</th>
<th>$/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>5.33</td>
</tr>
<tr>
<td>FOB Cost</td>
<td>11.07</td>
</tr>
<tr>
<td>Shipping</td>
<td>0.7</td>
</tr>
<tr>
<td>CIF/DES Cost</td>
<td>11.77</td>
</tr>
</tbody>
</table>
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

<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>7.91</td>
</tr>
<tr>
<td>FOB Cost</td>
<td>13.65</td>
</tr>
<tr>
<td>Shipping</td>
<td>0.7</td>
</tr>
<tr>
<td>CIF/DES Cost</td>
<td>14.35</td>
</tr>
</tbody>
</table>
What if Upstream Production Also Faced a 16.7% Royalty and a 33% Production Tax?

- $33.6bn liquefaction spend
- $58bn total project spend

At this unit cost level, liquefaction spend would be ~$33.6bn. Total Project Spend would be ~$58/bn.
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 ~$64.5bn
Benchmark Against Asia Pacific Breakeven Costs

Asia Pacific: Breakeven FOB Costs at $90/b

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

Existing
Under Construction
Proposed

$/MMBtu

$/ton

Darwin LNG T1
North West Shelf T4
North West Shelf T3
Brunei LNG T1-5
Arun LNG
MLNG Tiga (T1-2)
MLNG Satu (T1-3)
North West Shelf T5
Peru LNG
Bontang LNG
MLNG Dua (T1-3)
Tangguh LNG T1-2
Pluto LNG T1
Sangkung LNG T1-2
PETRONAS LNG T9
PNG LNG T1-2
PETRONAS FLNG
Ichthys LNG T1-2
Gladstone LNG T1-2
Gorgon LNG T1-3
Wheatstone LNG T1-3
Tangguh LNG T3
BC LNG T1-2
Oregon LNG T1-2
Mozambique LNG T1-3
Gorgon LNG T4
Mozambique LNG T2-4
Abadi LNG (Floating)
Bonaparte LNG
Bonaparte LNG
Arrow LNG T1-2
Scabaroung LNG
Rotan LNG (Floating)