The Effect of LNG Shipping Charter Rates on LNG Prices in Asian Market

Group 3
2013 Management Imperative
Nov. 4th
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- Meng Meng
Content

- Review of the LNG Shipping Market (Martin)
  - The LNG Value Chain
  - Shipping Market – Past and Present
- LNG Shipping Cost
- Shipping Cost Model and Analysis
- Development in the Future
The LNG Value Chain

Upstream: Gas Production
Pipeline: Pipeline
Liquefaction: Pre-treatment, Liquefaction, Storage, Loading
Shipping: Shipping
Re-Gas: Treatment, Re-gas, Storage, Unloading
Marketing:

Diagram shows the flow from Gas Production through Pipeline, Pre-treatment, Liquefaction, Storage, Loading, and Shipping, with Re-Gas and Marketing processes connected as well.
Shipping Market – Past and Present

- LNG Vessel Capacity
  - Traditional LNG vessel: 138,000~145,000 m$^3$
  - Q-Flex: 216,000 m$^3$
  - Q-Max: 266,000 m$^3$

- Propulsion Technology
  - Diesel engine
  - Steam turbine
  - Electrical propulsion
  - ............

- Ship charter
  - Long-term charter: >15 year
  - Short-Medium/Spot charter
Content

- Review of the LNG Shipping Market
- LNG Shipping Cost (Neil)
  - Single Round Voyage
  - Components of Shipping Cost
  - LNG Shipping Charter Rate
- Shipping Cost Model and Analysis
- Development in the Future
Single Round Voyage

LNG Loading Terminal

Loading

Laden voyage

Ballast voyage

Discharge

LNG Receiving Terminal
Shipping Costs

Charter rate: 100,000 USD per day for 147,000 m³ vessel
Distance: 10,767 NM (from Bonny Island Nigeria to Sakai Japan)
Fuel oil: 600 USD per ton, 180 ton per day consumption @ 19.0knots
Includes laden voyage only

MMBtu = million British thermal unit
LNG Ship Charter Rate
Content

- Review of the LNG Shipping Market
- LNG Shipping Cost
- Shipping Cost Model and Analysis (Meng)
  - Single Voyage Shipping Cost Calculation
  - Idea of the Model
  - Results and Analysis
- Development in the Future
Shipping Cost Calculation

- LNG shipping cost is discussed instead of LNG price because it is
  - Passed through in DES mode
  - Directly born in FOB mode
- For single voyage calculation
  - Chartering costs
  - Fuel costs
  - Port & Canal costs
- Assumptions
  - Type of LNG ship & capacity
  - Speed
  - Fuel consumption & price
- Real Question
  - How to represent the average shipping cost of Japan or South Korea by single voyage calculation?
Idea of the Model

Composition of LNG Import in 2012

<table>
<thead>
<tr>
<th>Countries</th>
<th>Port</th>
<th>Weight Coefficient</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Karratha</td>
<td>20%</td>
<td>3676 NM</td>
</tr>
<tr>
<td>Qatar</td>
<td>RasLaffan</td>
<td>19%</td>
<td>6493 NM</td>
</tr>
<tr>
<td>Malaysia</td>
<td>Bintulu</td>
<td>18%</td>
<td>2490 NM</td>
</tr>
<tr>
<td>Russia</td>
<td>Sakhalin</td>
<td>10%</td>
<td>1341 NM</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Bontang</td>
<td>8%</td>
<td>2542 NM</td>
</tr>
<tr>
<td>Brunei</td>
<td>Lumut</td>
<td>7%</td>
<td>2369 NM</td>
</tr>
<tr>
<td>U ARB E</td>
<td>Abu Dhabi</td>
<td>7%</td>
<td>6398 NM</td>
</tr>
<tr>
<td>Nigeria</td>
<td>Bonny</td>
<td>6%</td>
<td>10710 NM</td>
</tr>
<tr>
<td>Oman</td>
<td>Qalhat</td>
<td>5%</td>
<td>5962 NM</td>
</tr>
<tr>
<td>Japan</td>
<td>Tokyo</td>
<td></td>
<td>4309 NM</td>
</tr>
</tbody>
</table>

Japan: 4309 NM
South Korea: 4768 NM
The impact of LNG ship charter rate upon the LNG shipping cost was linear. 10,000 USD/day charter rate increasing will cause shipping cost:
- 0.06 USD/MMBtu ↑ for Japan
- 0.07 USD/MMBtu ↑ for South Korea

South Korea is more vulnerable to the charter rate as its weighted-average shipping distance is longer.
Content

- Review of the LNG Shipping Market
- LNG Shipping Cost
- Shipping Cost Model and Analysis
- Development in the Future (Silver)
  - Typical LNG Ship (Container)
  - Typical LNG Ship (Propulsion)
  - Performance Comparison
Typical LNG Ship (Container)

- Moss type (BOR: 0.10% per day)
- Membrane type
  - TGZ Mark III (BOR: 0.150% - 0.09% per day)
  - GTNO 96 (BOR: 0.150% - 0.125% per day)
Typical LNG Ship (Propulsion)

- Dual-fuel steam turbine mechanical propulsion (DFSM)
- Dual-fuel (medium-speed) diesel electric propulsion (DFDE)
- Single-fuel diesel mechanical propulsion with re-liquefaction (SFDM+R)
- Dual-fuel gas turbine electric propulsion (DFGE)
- Dual-fuel diesel mechanical propulsion (DFDM)
Performance Comparison

<table>
<thead>
<tr>
<th>Type</th>
<th>Mechanical Utilization Efficiency</th>
<th>Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>COx</td>
</tr>
<tr>
<td>DFSM</td>
<td>30%</td>
<td>High</td>
</tr>
<tr>
<td>SFDM+R</td>
<td>&gt;50%</td>
<td>High</td>
</tr>
<tr>
<td>DFDE</td>
<td>48%</td>
<td>Low</td>
</tr>
<tr>
<td>DFGE</td>
<td>50%</td>
<td>Low</td>
</tr>
<tr>
<td>DFDM</td>
<td>45%</td>
<td>Low</td>
</tr>
</tbody>
</table>

The trend of future development of the LNG shipping industry is higher mechanical utilization efficiency, lower emission and lower LNG shipping cost.
Conclusion

- Key words of our project: Mathematical
- A simplified LNG shipping cost calculation model was built
- A weighted-average methodology was introduced to represent the LNG shipping cost for Japan and South Korea
- Future development was reviewed which focus on higher efficiency, lower emission and lower cost
Thank You!
Port & Canal Costs

● Port Costs
  ➢ Different ports can be significantly different, but normally less than 500,000 USD

● Canal Costs
  ➢ Normally around 800,000 USD for single round voyage of a traditional LNG vessel
Model Assumptions

- **LNG vessel**
  - 100% LNG driven
  - 155,000 m$^3$

- **LNG vessel speed**
  - 17 knots

- **Fuel consumption**
  - 140 tons fuel oil per day (one cubic meter of LNG equivalent to 0.5104 tons of fuel oil)
  - 14.85%*JCC