LNG SHIPPING OVERVIEW
1. FLEET EVOLUTION & SHIPPING COSTS
   • Worldwide traded volumes
   • Countries involved in LNG (1990, 2003, 2013, Future?)
   • LNG Spot Charter Rates
   • Shipping costs

2. FLEET FEATURES
   • General Features
   • Orderbook to be delivered 2013-2015

3. TRENDS
   • Fleet trends
   • Propulsion technologies
   • Cargo containment system
   • Floating LNG (FLNG)
   • Regasification projects
   • Mini-LNG carriers
   • Compressed Natural Gas (CNG)
   • Contracts

4. CONCLUSIONS
FLEET EVOLUTION & SHIPPING COSTS
In 2012, the interbasin trade grew by 31%...

- Increased spot demand in the Far East (post Fukushima)
- Reduced spot demand in Europe (recession)
Countries involved in LNG shipping

- U.S.
- Spain
- France
- Italy
- Algeria
- Belgium
- UK
- Malaysia
- Indonesia
- Brunei
- Australia
- S. Korea
- Japan
- Taiwan
- Libya
- UAE

1993
Countries involved in LNG shipping

Portugal
T&T
Greece
Turkey
Oman
Puerto Rico
Countries involved in LNG shipping

Peru
Chile
Argentina
Brazil
Mexico
Canada
Norway
Lituania
Netherlands
Brunei
Angola?
Yemen
Russia
India
China
Thailand
Kuwait

Egypt
Nigeria
Equatorial Guinea
Future

Countries involved in LNG shipping

- Colombia
- Israel
- Papua N.G.
- Poland
- Singapore

- Iran?
- Jamaica?
- Bahamas?
- Germany?
- Venezuela?
- Uruguay?
- Tanzania?

- Croatia?
- Cyprus?
- Pakistan?
- Philippines?
- Cameroon?
- Mozambique?
The maturing of the LNG shipping business and its expansion worldwide has led to increased trades, mainly interbasin. The effect of this has been seen in the spot rates over the last couple of years and record hires have been paid (150 k$/day).

Source: Fearnleys AS
**MARKET EVOLUTION (IV)**

Costs in US$ per Mmbtu delivered (Non-spot shipping)

<table>
<thead>
<tr>
<th></th>
<th>138K ST</th>
<th>170K DFDO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Distance (Miles)</strong></td>
<td>4,000</td>
<td>4,000</td>
</tr>
<tr>
<td></td>
<td>12,870</td>
<td>12,870</td>
</tr>
<tr>
<td><strong>Delivered Quantity (TBtu)</strong></td>
<td>3.05</td>
<td>3.84</td>
</tr>
<tr>
<td></td>
<td>2.90</td>
<td>3.65</td>
</tr>
<tr>
<td><strong>Total Cost (MM$)</strong></td>
<td>3.23</td>
<td>2.77</td>
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<tr>
<td></td>
<td>9.53</td>
<td>8.03</td>
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<tr>
<td><strong>Unit Price (US$/MMBtu)</strong></td>
<td>1.06</td>
<td>0.72</td>
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<tr>
<td></td>
<td>3.28</td>
<td>2.20</td>
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<table>
<thead>
<tr>
<th><strong>Assumptions</strong></th>
<th>138K ST</th>
<th>170K DFDO</th>
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</thead>
<tbody>
<tr>
<td>Charter rate (US$)</td>
<td>80,000</td>
<td>80,000</td>
</tr>
<tr>
<td>Bunker Price (US$)</td>
<td>600</td>
<td>HFO 600 / MDO 900</td>
</tr>
<tr>
<td>Port Costs (US$)</td>
<td>200,000</td>
<td>200,000</td>
</tr>
<tr>
<td>LNG Price ($/MMBtu)</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Boil Off (%/day)</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>Speed (Knots)</td>
<td>18.5</td>
<td>18.5</td>
</tr>
<tr>
<td>Propulsion</td>
<td>Steam Turbine</td>
<td>Dual Fuel Diesel Electric</td>
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</table>
Furthermore, a strong global market under expansion has lead to:

- More players (new owners, producers and traders)
- More vessels
- Diversity of technology solutions
- Innovation
- New contracting models
FLEET FEATURES
FLEET FEATURES (I)

Fleet evolution

Num. Vessels vs. Year

Producers: RasGas, QatarGas, NLNG, Tangguh, Sonatrach, etc.
Majors: Stream, BG, GdF-Suez, BP, etc.
Traders: Vitol, Trafigura, MorganStanley, Gunvor, etc.
New building orderbook to be delivered 2013-2017

**Shipbuilder**
- STX Offshore&Shipbuilding: 16
- Daewoo: 5
- Hyundai Heavy Industries: 4
- Samsung: 8
- Kawasaki Heavy Industries: 3
- Mitsubishi Heavy Industries: 27

**Cargo containment**
- GT NO 96: 31 (31%)
- Mark III: 62 (62%)
- Moss: 7 (7%)

**Cargo capacity**
- 170,000 - 180,000 m³: 30
- 145,000 - 165,000 m³: 70

**Owner**
- Alpha: 5
- Awilco LNG: 5
- Brunei Gas Carriers: 5
- BW Gas: 13
- Cardiff: 4
- Chevron: 9
- Dynagas: 15
- GasLog LNG: 12
- Golar LNG: 4
- SK Shipping/Marubeni: 2
- K-Line: 4
- Chevron: 9
- Dynagas: 15
TRENDS
Fleet trends

- New “conventional” vessel size established in 155/165,000 cbm. The Q-Flex/Q-Max sizes have been project specific.

- New players

- Spot Market development

- Potential underutilised in backhauls

- New technologies in both shipping and floating liquefaction and regasification
Propulsion technologies

Images from LNG journal & MHI.co.jp
### Consumptions comparison

<table>
<thead>
<tr>
<th>Speed (kn)</th>
<th>ST (140,000 m³)</th>
<th>DFDE (170,000 m³)</th>
<th>SS-RL (210,000 m³)</th>
<th>SSDF (170,000 m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ldn (T/day)</td>
<td>Bllst (T/day)</td>
<td>Ldn (T/day)</td>
<td>Bllst (T/day)</td>
<td>Ldn (T/day)</td>
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<tr>
<td>16</td>
<td>126</td>
<td>122</td>
<td>76</td>
<td>87</td>
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<td>18</td>
<td>148</td>
<td>140</td>
<td>104</td>
<td>106</td>
</tr>
<tr>
<td>19.5</td>
<td>180</td>
<td>173</td>
<td>136</td>
<td>131</td>
</tr>
</tbody>
</table>
Containment system

Preferred systems for NBs:

- **NO96, 31% of the orders:**
  - Consists of a thin, flexible (primary membrane), which is in contact with the cargo, a layer of plywood boxes filled with Perlite called (primary insulation), a second flexible membrane similar to the first (secondary membrane) and a second layer of boxes also filled with Perlite in contact with the inner hull (secondary insulation).
  - The first and the second barriers are identical and are fabricated from cryogenic Invar.

- **Mark III, 62% of the orders**
  - Consists of a thin flexible membrane as primary barrier (1.2 mm stainless steel), which bears against a supporting insulation structure embodying a secondary barrier (triplex scab) and further secondary insulation bolted to the inner hull.
  - Insulation sandwich panels consisting of two layers of foam assembled by bonding with polyurethane or epoxy glue.
New cargo containment systems (under development)

- **ACT-IB (Aluminium Cargo Tank – Independent Type B):**
  - Developed by Daewoo Shipbuilding and Marine Engineering.
  - Cargo capacity up to 210,000 m$^3$
  - Independent prismatic tanks.
  - Aluminium and Polyurethane Insulation
  - Increased security and flexibility in partial loads

- **ADBT (Aluminium Double Barrier Tank System):**
  - Developed by Aker yards and DNV.
  - For operations in harsh environments such as the Arctic.
  - Independent prismatic tank barriers built in Aluminium.
  - Capacities from 1,000 to 150,000 m$^3$
  - Short building time and cost efficient.

- **FSP (Flat-Panel, Semi-Membrane, Prismatic-Shaped)**
  - Developed by General Dynamics and Wavespec.
  - Semi-membrane prismatic tanks.
  - Small-scale applications, offshore tanks or storage units.
  - Short and cheap building processes.
Floating LNG (FLNG)

- Facilities
  - Platform.
  - Anchoring and swelling systems.
  - Liquefaction system.
  - Cargo containment.
  - Unloading system.

Firm Projects;
- Prelude (Australia)
- Malaysia
- Colombia
Regasification projects

- Vessels with facilities to regasificate LNG to high-pressure natural gas.
- Annual emission capacities up to 7 bcm.
- Tank capacity up to 170,000 cbm in last generation vessels.
- More than 20 potential projects under study
Mini-LNG carriers

- Vessels designed for small scale LNG distribution.
- LNG bunkering trade.
- Double manifold height.
- C-Type pressurized tanks (3 – 5 bar).
- No Boil-off management system.
- Ship to ship operation capability.
• Compressed Natural Gas (CNG)

• CNG Market opportunities

• Reduced distance between production and clients.
• Reduced gas volume.
• Lack of infrastructure.
Contracts

Time charter party still the most frequent choice
- Spot, medium and long term contracts
- ShellLNGtime1 used on spot fixtures
- Charterer specific formats for long term

However, backhaul opportunities and a market progressively more focused on the spot (more liquidity) demand new solutions:

- Contracts of affreightment
- Voyage charter party

…but the LNG shipping is very rigid due to the Take or Pay contracts characteristic of the business tied together with very narrow laycans so these formats are challenging to implement.
There has been a dramatic increase in the fleet and players over the last 10 years.

The traffics have become globalised and the fleet has suffered the corresponding constraints, very well reflected in the spot market rates.

The increase in vessel sizes and the implementation of new technologies in propulsion have reduced the unit shipping costs significantly.

There have been no significant breakthroughs in cargo containment technologies.

LNG shipping has expanded somewhat into the liquefaction and regasification ends of that part of the value chain and this tendency is here to stay.

Developments in mini-LNG and CNG are at their first stages.

The Time Charter Format is still the most frequent choice but there are interesting challenges that may require more flexible contract formats; Voyage Charters, Contracts of Afreightment, etc.
Thanks for your attention