LNG enabling a more sustainable marine transport

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› IMO standards
› Polluting emissions
› Technical barriers
› Logistics solutions
› LNG competitiveness
› Potential LNG bunkering market
› Attractiveness of Spain
› Gas Natural Fenosa
IMO standards

New IMO standards will imply a significant change in the LNG bunkering implementation process.

-current ECA areas
-D Potential expansion of ECA areas

<table>
<thead>
<tr>
<th>Territorial and international waters</th>
<th>ECA</th>
<th>Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>1.5-3.5%</td>
<td>01/01/2020</td>
</tr>
</tbody>
</table>
One large container ship at sea (using 3% bunker fuel) emits the same amount of sulphur oxide gases as 50 million diesel-burning cars.

Ship emissions have significant human health and environmental costs. Strong policy responses are needed, in order to reduce these costs and mitigate the toxic pollution impacts.
LNG is the most respectful solution with the environment with less polluting emissions (SOx, Nox, CO2 and particulates) and lower environmental noise.

**Polluting emissions: comparative**

<table>
<thead>
<tr>
<th></th>
<th>SOx</th>
<th>NOx</th>
<th>CO2</th>
<th>PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>HFO</td>
<td>0.4</td>
<td>0.4</td>
<td>630</td>
<td>1.5</td>
</tr>
<tr>
<td>MGO</td>
<td>0</td>
<td>0</td>
<td>630</td>
<td>0.25</td>
</tr>
<tr>
<td>LNG</td>
<td>13</td>
<td>12</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

*Source: Wartsila; Webb Institute*
Polluting emissions: CO2 life cycle

Engines with high pressure gas injection guarantee a considerable reduction in CO2 emissions

<table>
<thead>
<tr>
<th>gr. CO2 eq./MJ</th>
<th>Traditional fuel</th>
<th>Vs.</th>
<th>Gas propulsion with imported LNG</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MGO (0.1%S)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>HFO (3.5%S)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LSHFO (0.5%S)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>73</td>
<td>78</td>
<td>73</td>
<td>56</td>
</tr>
<tr>
<td>15</td>
<td>10</td>
<td>16</td>
<td>18</td>
</tr>
<tr>
<td>88 gr.CO2/MJ</td>
<td></td>
<td></td>
<td>12.5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4.5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>18</td>
</tr>
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<td></td>
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</tr>
</tbody>
</table>

(1) Equivalent CO2 emissions with diesel engine technology in diesel cycle with high pressure gas injection
(2) Emissions of CO2 with the latest technology developed for Otto CL engines with low pressure gas injection
(3) Average value of CO2 emissions emitted by a sample of vessels already operating with DF engines with low pressure gas injection (Sintef Ocean 2017)
Source: “LNG as a marine Fuel” elaborado por el Webb Institute (1 November 2017)
Technical barriers

1. Bunkering availability
   - Egg and chicken dilemma

2. First mover tax
   - First movers will have the initial investment costs and accept the risk premium in demand

3. New technology and safety concerns
   - LNG as marine fuel is relatively new but experience with LNG transport ships is a solid foundation

4. Impacts on space and range
   - Manageable in new ships and more complex in ships in operation
Technical barriers: tank volume

Required tank volume to store the same amount of energy compared to HFO

This impact will depend on individual vessel type. Vessels that will not be converting to LNG will also lose space and range, as they will have to install additional equipment.

Source: Methaship
Logistics solutions

The industry offers different logistic solutions to service all bunkering needs on the market.
Competitiveness of the LNG as maritime fuel

LNG is the most competitive solution against the MGO and the ULSFO with scrubber at the prices of the current energy scenario.

![Graph showing competitive pricing between MGO, ULSFO, and GNL against Brent prices]
• The Bunkering market is starting and the most important LNG marketers in the world are already actively promoting their development.

• It is expected that by 2025 the market volume will reach 30 bcm, and that in 2035 will reach the 65 bcm, covering 22% of the global liquid bunkering market.

Source: Informe Oxford Institute: “The Impact of Lower Gas and Oil Prices on Global Gas and LNG Markets”
Potential LNG bunkering market

Segmentation of LNG ships

- **Car-Ferry-Cruise**: 31 units (26 in operation, 9 in order)
- **Gas-Oil-Chemical**: 23 units (9 in operation, 14 in order)
- **Platform**: 8 units (8 in operation, 0 in order)
- **Container**: 13 units (13 in order, 0 in operation)
- **Tug**: 5 units (5 in operation, 6 in order)
- **Other**: 9 units (10 in operation, 0 in order)

Source: DNV-GL
Attractiveness of Spain for the LNG sector

Spain has the largest regasification plant access and reloading capacity in Europe.

Leader in the number discharge and regasification terminals with **36.5% of the total capacity**.

Gas Natural Fenosa contributes to capacity with:
- Over **70%** of the **supply** of Spain.
- LNG contract and **long term** reserved capacity with all Spanish regasification plants.
- Fleet of LNG carriers.

Spain is well located in the Mediterranean to lead LNG marketing.
Gas Natural Fenosa marine LNG experience
Maritime transport division

- Reference operator since 1969
- Supply portfolio of 30 bcm
- Fleet of 11 tankers
- Pioneers in innovation in our own fleet:
  - Use of dual fuel four-stroke engines in 2007
  - Use of dual fuel two-stroke engines in 2013
- Operator with the most experience in LNG ship-to-ship operations, with more than 300 actions since 2007
- Experience in new buildings: more than 16 carriers
Gas Natural Fenosa intends to be the leader in introducing and boosting LNG in the maritime sector:

- Sustainable mobility is a commitment of the company
- It contributes to the growth of natural gas

1. Fuel is **more competitive** than current options.
2. Less polluting **emissions** and lower environmental **noise**.
3. **Technology is already available** for use with LNG-fuelled engines.
4. **Extensive availability** of LNG in the two main basins.
Thank you