DELIVERING CLEAN TRANSPORT

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Korea Pavilion

LNG in the crossroads of the SEA
Transport Global situation

Figure 2.19 - Oil demand in transport by mode (left) and change in transport energy use by scenario in 2050 relative to today

Oil demand in transport falls to 20 mb/d by 2050 in the Sustainable Development Scenario and increasingly concentrates in transport modes where low-carbon options are limited.

Source: IEA WEO 2019

Heavy Haul
Don’t have a roadmap toward a 100% Green Solution

+ 50% emissions came from Heavy Haul sector
Maritime Sector specific situation

At global level, various international bodies have decided on targets for reducing greenhouse gas emissions, in particular IMO has intervened on maritime emissions.

**GreenHouse Gas**

Pathways for international shipping’s CO₂ emissions

- **2015 to 2018**: Initial reductions
- **2030**: Significant reduction targets
- **2050**: Final targets

**Medium-Long Term (2030 - 2050)**

- Reduction CO₂ < 40%
- Strategy on reduction of GHG emissions from ships

**Need to act as soon as possible**

GHG emissions Targets IMO (MPC72)

- 2008 as base year
- Peak as soon as possible
- Intensity: 40% reduction by 2050
- Zero emissions as soon as possible within this century

**Matters to consider**

- Carbon intensity measured as CO₂ emissions per tonne-km, while Total is the absolute GHG emissions from international shipping
Abatement Potential Alternatives

**WTW GHG Emission Abatement Potential**

- **Business as usual**
- **IMO TARGETS**
- **9% Reduction of Fossil Fuels**
- **17% Average Capacity Growth**
- **52% Newbuildings + Retrofits**
- **22% GNL + Biomethane**
  - To a lesser degree
- **20% GHG Fugitive emissions**
  - Take steps to reduce them
  - **Boost Motorizations:**
    1. Lean-Burn principle (OTTO)
    2. HPDF

**Efficiency in exchange for:**
- Investment
- Investigation

**Difficult to achieve**

*Fuente: Informe NGVA / Thinkstep, IEA 2017ª Mobility Model, Elaboración Propia*
Shipping sector is responsible for 3% of annual global greenhouse gas (GHG) emissions on a CO₂-equivalent basis.

**Key points from Shipping (I)**

- **Deep sea**
  - Bulkcarriers, containers, oil and chemical tankers
  - Represent 20% of the global shipping fleet.

- **Shortsea**
  - Ferries, Tugs, Car-Carriers, Yatch, Medium Containers and Tankers

- **World Fleet by size**
  - 90,000 ships
  - Very Large: 7%
  - Large: 13%
  - Medium: 43%
  - Small: 37%

- **Source:** Irena

**Additional points:**
- Ferries, Tugs, Car-Carriers, Yatch, Medium Containers and Tankers are responsible for 85% of the net GHG emissions associated with the shipping sector.
- Ferries, Tugs, Car-Carriers, Yatch, Medium Containers and Tankers are responsible for air quality in the Port Cities (Sox, Nox and PM).
Key points from Shipping (II)

According to the recent IRENA study, the average age of each type is grouped by size of vessel. The age of the fleet is a key aspect for the conversion or construction of new LNG ships.

1. Small and medium size: has a higher average age of fleet, this type of ships perform SSS with long stay in port damage the air quality in cities

2. Large and Very Large size: has a lower average age compared to the other segment, great impact on deepsea
A huge range of power is required...

Up to + 100,000 HP
## Alternative Solutions Catalog

<table>
<thead>
<tr>
<th>Technology</th>
<th>2020 Availability</th>
<th>2020 SOx Emissions</th>
<th>2020 Availability</th>
<th>2030 GHG Emissions</th>
<th>COST</th>
<th>COMMENTS</th>
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<tbody>
<tr>
<td>Scrubbers + HFO</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Medium</td>
<td>Uncertainty where to download residues of the scrubbers (possible taxes..)</td>
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<tr>
<td>LSFO</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>High</td>
<td>Uncertainty about the cost production</td>
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<tr>
<td>LNG</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Medium</td>
<td><strong>LNG meet emissions reduction targets, SOₓ and GHG. It’s available now</strong></td>
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<tr>
<td>Electricity (e⁺)</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
<td>?</td>
<td>High</td>
<td>Doubt technological availability, batteries storage and production</td>
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<tr>
<td>Hydrogen (H₂)</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
<td>✓</td>
<td>High</td>
<td>Problems about the Hydrogen storage, need to develop new technologies</td>
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<tr>
<td>Methanol</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>High</td>
<td>Lack of infrastructure to satisfy demand and too expensive solution</td>
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<tr>
<td>Low Carbon Liquid Fuels</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
<td>High</td>
<td>High investment in R&amp;D and adapting refineries would increase Bio-fuels costs</td>
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Abatement Potential

According to the recent ThinkStep study “Life Cycle GHG Emission Study on the Use of LNG as Marine Fuel”

The study showed that on an engine technology basis, the absolute Well-to-Wake emissions reduction benefits for gas fuelled engines today compared with HFO fuelled ships are between 14% to 21% for 2-stroke slow speed engines, and between 7% to 15% for 4-stroke medium speed engines.

![Graph showing emissions reduction benefits](image)

Fuente: ThinkStep Study and CORE LNGas hive project
Logistics has the KEY - competitiveness

Escenarios coste suministro

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<th>Producto</th>
<th>LOGISTICA</th>
<th>Total</th>
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<tr>
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<td>Optim</td>
<td>Medio</td>
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<tr>
<td>MGO</td>
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<td>HFO</td>
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<td>2,1</td>
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<tr>
<td>LNG</td>
<td>21</td>
<td>4,2</td>
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Costes comparativo de combustibles €/MWh

Justifies investment scrubbers
Justifies investment GNL
[Sim título]
DELIVERING CLEAN TRANSPORT

Logistics has the KEY – the “Spanish case” (I)


Development of the NATIONAL POLICY FRAMEWORK with the contribution in the maritime part of the CORE LNGas hive project

COMPLIANCE with the NPF resulting from the European directive 5 YEARS BEFORE, being able to supply LNG in all ports of the Core network of the Iberian Peninsula.
Logistics has the KEY – the “Spanish case” (II)
Logistics has the KEY – the “Spanish case” (III)

- First European country that complies with the provisions of the directive for infrastructure for alternative fuels in the maritime sector, five years before the established
- 15 years of demand attention without the need for investments in fixed infrastructures

An emerging market under development...

**Bunkering LNG in Spain (m³)**

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<tr>
<td>Value</td>
<td>50,000</td>
<td>68,454</td>
<td>110,349</td>
<td>150,000</td>
<td>200,000</td>
<td>220,000</td>
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*LNG Forecast 2020 related to CORE LNGAs hive Project, Low Scenario*

- **26 STS operations**
- **81 TTS operations**

Demand for Natural Gas as fuel for mobility (Maritime, road and train) will reach between 3-4 TW (equivalent to 1% of Spanish Natural Gas demand)

The volume of bunkering LNG in Spain during 2019 has reached 68,500 m³ compared to 48,900 m³ in the Port of Rotterdam (the third largest bunkering port in the world).

5 LNG-Fuelled vessels in Spain

6 LNG-Bunker vessels in Spain
Nine types of ships have been studied, comparing the different alternatives available to comply with emission regulations.

- RoPax
- Portacontenedores de 1000 TEU
- RoRo de unos 1400 vehículos
- Petrolero de 20.000 TPM,
- Remolcadores puerto
- ULContainer
- Crucero
- Barcos de pesca
- Granelero Panamax,

- MGO
- HFO with scrubbers
- LNG
- LPG
- Methanol
- ULSFO

**CAPEX**
Logistic cost
Coste molécula €/MWh

**OPEX**

Results for new construction and retrofit
Short Term, only?, opportunities for H2 in the maritime sector:

Horizon 1: Medium term
Fossil H₂ with CCUS to be the initiator and accelerator of the H₂ society

Horizon 2: Long term
Renewable H₂ to become dominant through successive /disruptive innovation & significant cost reduction

Hythane

Emissions from all materials used in passenger cars
Million tonnes of CO₂ per year, globally

Towards a Sustainable Future?