



SHELL LNG - MARINE

Kivi-Niria Oil & Gas lecture

30 October 2012



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1

LNG Marine Fuel

2

Shell and Global LNG

3

Shell's role in market development

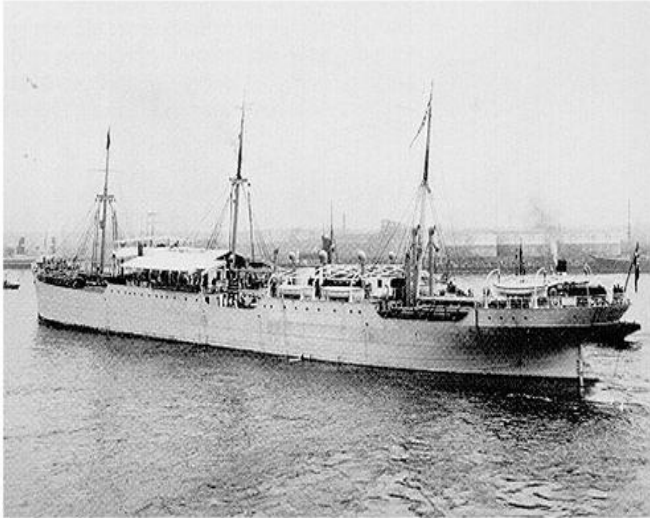
4

Collaboration

MARINE EVOLUTION

Environmental

M/s Selandia switched from steam to diesel in 1912



Switch from diesel to LNG



Total costs of ownership

EMISSION COMPLIANCE

| | | 2004 | 2005 | 2006 | 2007 | 2008 | 09 | 2010 | 11 | 2012 | 13 | 14 | 2015 | 16 | 17 | 2018 | 19 | 2020/2025 | | |
|---------|--|--|------|------|------|------|----|--------|--------|--|--------------------------|---|------|--|---|--------|---|---|--|--|
| SOx | IMO Global | 4.5% S | | | | | | | | | | 3.5% S | | | | | Review | 0.5% S | | |
| | IMO SECA | | | | | | | 1.5% S | 1.0% S | | | 0.1% S | | | | | | | | |
| | Outside SECA (EU) proposed not yet ratified | | | | | | | | | | 1.5% S (Passenger Ships) | | | | | 0.5% S | | | | |
| | New SECA (US) | | | | | | | | | | 3.5% S (Cargo) | | | | | | | | | |
| | Potential ECAs (TBC) Not confirmed; No timeline | | | | | | | | | | 1.0% S (Aug'12) | | | 0.1% S | | | | | | |
| | | | | | | | | | | | | | | | MEDITERRANEAN (EU), MEXICO, SINGAPORE, HK, TOKYO BAY | | | | | |
| NOx | Based on Year of Construction | TIER I (2000-2011) | | | | | | | | TIER II (2011-2015) | | | | TIER III (2016 onwards) | | | | | | |
| | Tier I ↓ Tier II ↓ Tier III | 15%-25% reduction 80% reduction | | | | | | | | <ul style="list-style-type: none">Diesel engine installed on ships constructed between 1st Jan 2000 - 1st Jan 2011TIER I NOx is 11g/kWh | | | | <ul style="list-style-type: none">Ships constructed after 1st Jan 2011Tier II can be achieved by engine designTIER II NOx is 8.5 g/kWh | | | | <ul style="list-style-type: none">New Ships constructed after 1st Jan 2016, operating in the ECATIER III NOx is 2 g/kWh,Only be achieved by selective catalytic reduction (SCR) | | |
| Options | New Builds and Retrofits | 1. LSFO 1.0% (ECA), HSFO 3.5% 2. MGO 0.5% (ECA and outside) | | | | | | | | | | 1. HSFO+ Scrubber (ECA); HSFO (outside) 2. MGO 0.1% (ECA), MGO 0.5% outside 3. LNG | | | | | 1. HSFO + Scrubber 2. MGO 0.1% (ECA), MGO 0.5% 3. LNG | | | |
| | New Builds only | For NBs, engine Design able to meet NOx | | | | | | | | | | SCR required for NBs | | | | | | | | |

CHALLENGE: ENVIRONMENTAL REGULATIONS

EMISSION CONTROL AREAS



- ECAs in force in North Sea, Baltics & North America
- Inland waterways use low-S Diesel (NO_x and PM post 2016)
- More stringent specs for NO_x
- Particulates, GHG in future
- Options shipping segment:
 1. Low sulphur fuels
 2. Scrubbers + HSFO
 3. LNG

WHAT ARE THE OPTIONS FOR SHIP OWNERS?

1

Conventional Fuel (HFO) + Scrubber

- Same fuel
- Requires vessel modifications, also waste management issues remain

2

Low Sulphur Fuel (MGO)

- MGO simplest solution to change
- Premium price for fuel
- If price gap between Fuel Oil and MGO widens, scrubbing economical

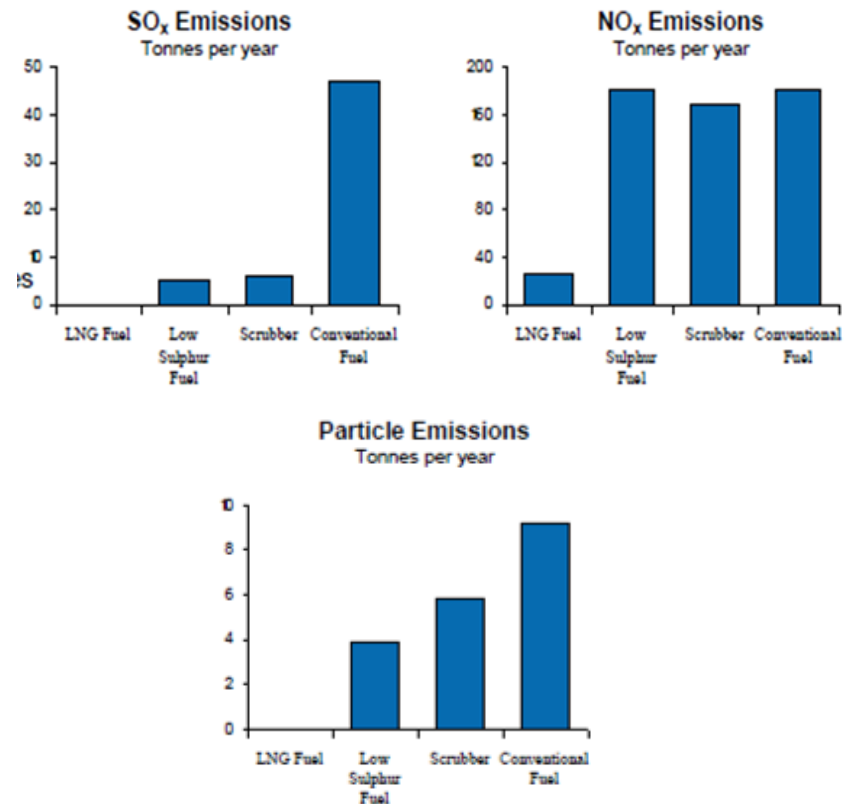
3

Natural Gas (LNG)

- Lower cost than MGO
- Cleaner, meeting IMO Tier-III limits
- Vessel and Engine technology available, mainly for new ship builds
- New infrastructure

- LNG as Marine fuel meets a long term ECA compliant fuel
- Dual Fuel engines currently offering flexibility to operate with LNG, HFO and MGO

Environmental Emissions Typical Baltic Sea Ship



INTEGRATED LNG/GAS LEADERSHIP

Exploration & Production



One of the world's largest gas producers

Liquefaction



Largest LNG supplier

LNG Shipping



Largest ship operator

Regas, pipelines, storage



Strategic positions, active portfolio management

Marketing & trading



Global positions and capabilities

Technology



Leader in LNG and gas conversion technologies



- 1 ltr diesel equals ca 1.6 ltr LNG or 0.7 kg LNG
- 1 ltr of LNG equals 600 ltr of natural gas (atm)

Note: Among International Oil Companies

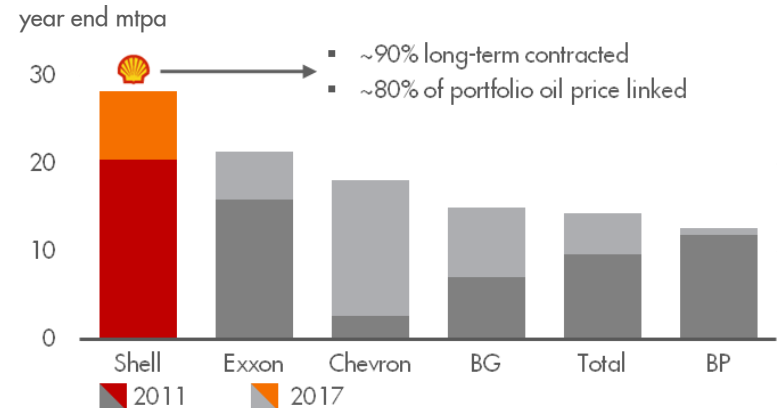
LEADERSHIP IN GLOBAL LNG

SHELL LNG SUPPLY PORTFOLIO



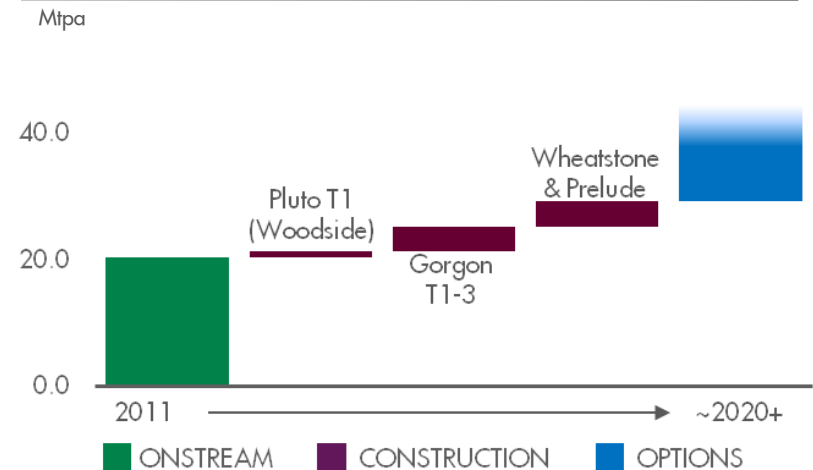
- Shell ventures delivered >30% of 2011 global LNG volumes
- ~ 20 mtpa onstream
- ~ 8 mtpa under construction
- ~15 mtpa of future LNG options

SHELL LNG LEADERSHIP

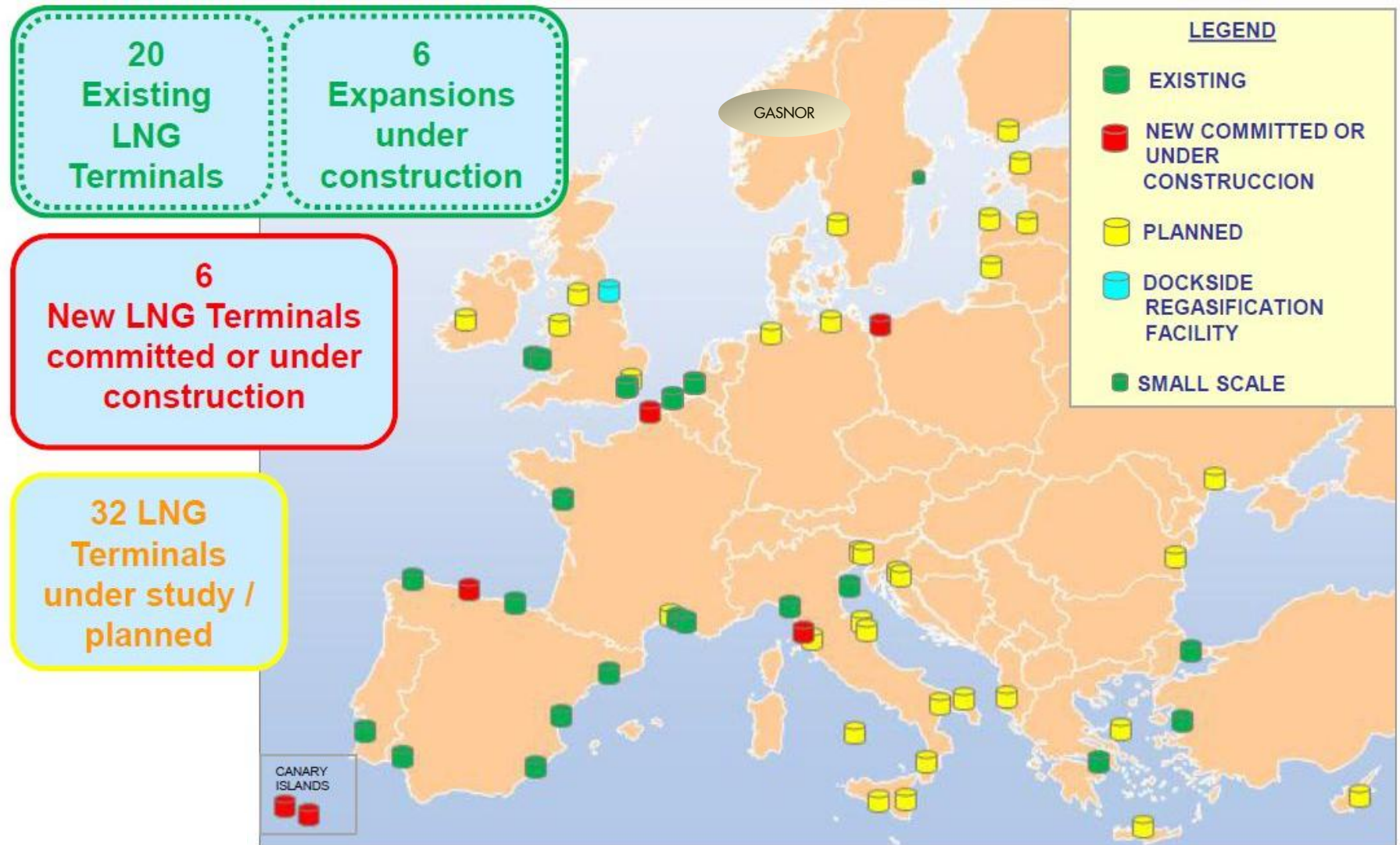


PROJECTS IN OPERATION OR UNDER CONSTRUCTION

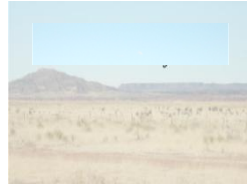
SHELL GLOBAL LNG CAPACITY GROWTH



LNG TERMINALS IN EUROPE



A CROSS-BUSINESS MODEL WILL ALLOW SHELL TO DELIVER VALUE ACROSS THE ENTIRE VALUE CHAIN



Stranded Gas



Coal Bed Methane



Pipeline Gas



Extended Well Test



Small scale liquefaction



Existing LNG Infrastructure



Global Marine, ECA, inland marine



Heavy duty Road Transport



Mining



Rail



Stationary Power

Upstream

Downstream

MARINE LNG FUEL

The 3 KEY BENEFITS OF LNG FUEL IN INTERNATIONAL MARINE



1

Cost competitive fuel to MGO
Reduces total costs of ownership
Enhances profitability



2

Cleaner burning fuel , with zero SOx, reduced NOx & PM



3

Reliable solutions based on experience. Technology
Partnerships with marine engine manufacturers.



LNG is a clean burning and cost competitive fuel option

LNG MARKET IN NW EUROPE DEVELOPING

LNG-powered Cruise Ferry Keel Laid

Press Release – Viking Line

Wednesday, March 07, 2012

Keel-laying at STX Finland Yard for Viking Lines New 'Viking Grace'



Image credit Viking Line

New LNG-powered ferry has started services in Western Norway

The 'Edøyfjord' will serve the Edøya-Sandvika route to Smøla in Nordmøre district. It was built by joint venture Fiskerstrand BLRT for the transport company Fjord1, and designed by Multi Maritime. The ferry's hull and pre-outfitting works were manufactured at Western Baltija Shipbuilding in Klaipeda, Lithuania, and final outfitting, testing and finalizing was done by Fiskerstrand Verft AS in Ålesund, Norway.



A cleaner solution for Baltic Sea area

24.02.12 LNG / H2 / Blends

AGA will deliver LNG to Viking Line's new eco-friendly cruise ship

The new vessel with the project name "NB 1376" will operate on the stretch Stockholm-Abo from January 2013. It is being manufactured at the STX boatyard in Abo and has a capacity of 2,800 passengers, as well as large space for vehicles. It will be powered by LNG that will be stored in purpose-built tanks.



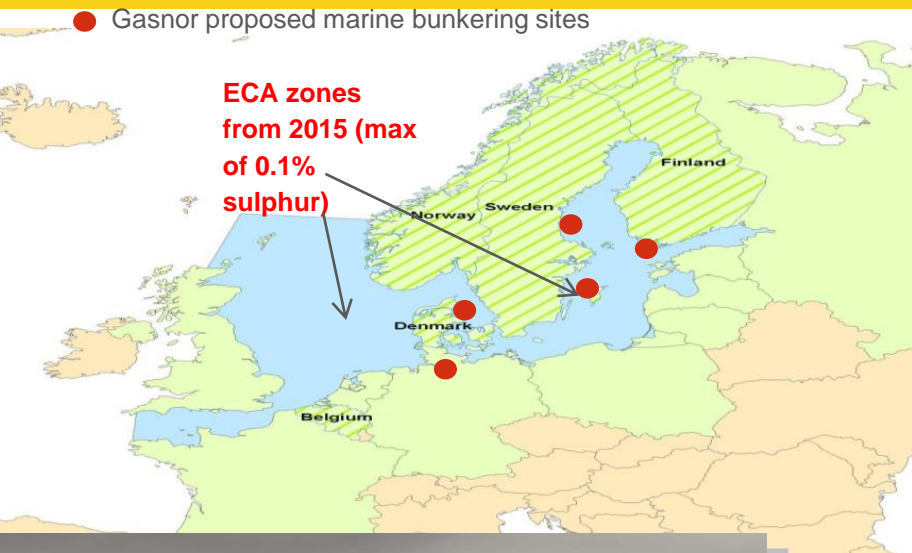
The Linde Group and the Hamburg Port Authority (HPA) have agreed to advance the use of liquefied natural gas (LNG) in the port of Hamburg.

European ECO2 inland waterway vessel to be LNG-fueled



Order book promises a 'quadrupling' of LNG-fuelled vessels

SHELL ONGOING PROJECTS: EUROPE



- GASNOR acquisition to accelerate the market growth
- Drive synergies, capabilities between Shell and Gasnor in expansion into NW market for coastal marine traffic

MARINE: IWW, COASTAL

- LNG fuel propelled barges, operating from Rotterdam to Basel with ISB/Peter Shipyard
- Barges carry oil products to customers in the Netherlands, Belgium, Germany and Switzerland.

RETAIL COMMERCIAL FLEET

- LNG refueling stations in NL (2013), followed by others

INFRASTRUCTURE LAYOUT

- Strategic control point in Rotterdam to establish fuel supply security
- GATE terminal offers high probability of success supply chain development
- Shell has signed HOA with Vopak, Gasunie for GATE terminal arrangement

GASNOR LNG INFRASTRUCTURE

3 LNG production plants



18 semitrailers LNG



6 semitrailers CNG



2 tankers



30 terminals



NEW LNG EQUIPMENT AND SAFE DESIGNS

TRANSFER SYSTEMS

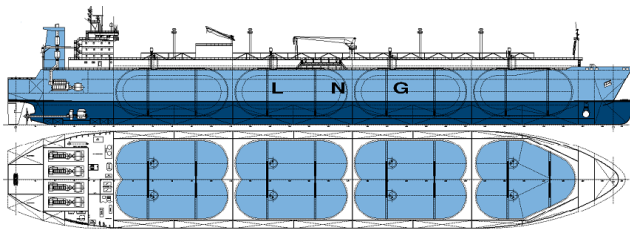
Shore to ship

- Truck bunkering
- Jetty bunkering



Ship to ship

- Small LNG barge
- Small LNG carrier



INDUSTRY PRACTICES, STANDARDS, REGULATIONS

Regulations development across the industry

- Ship design
- Bunkering systems
- Permitting

Robust and harmonized industry guidelines for

- Bunkering operations
- Custody transfer
- Fuel specification and gas quality

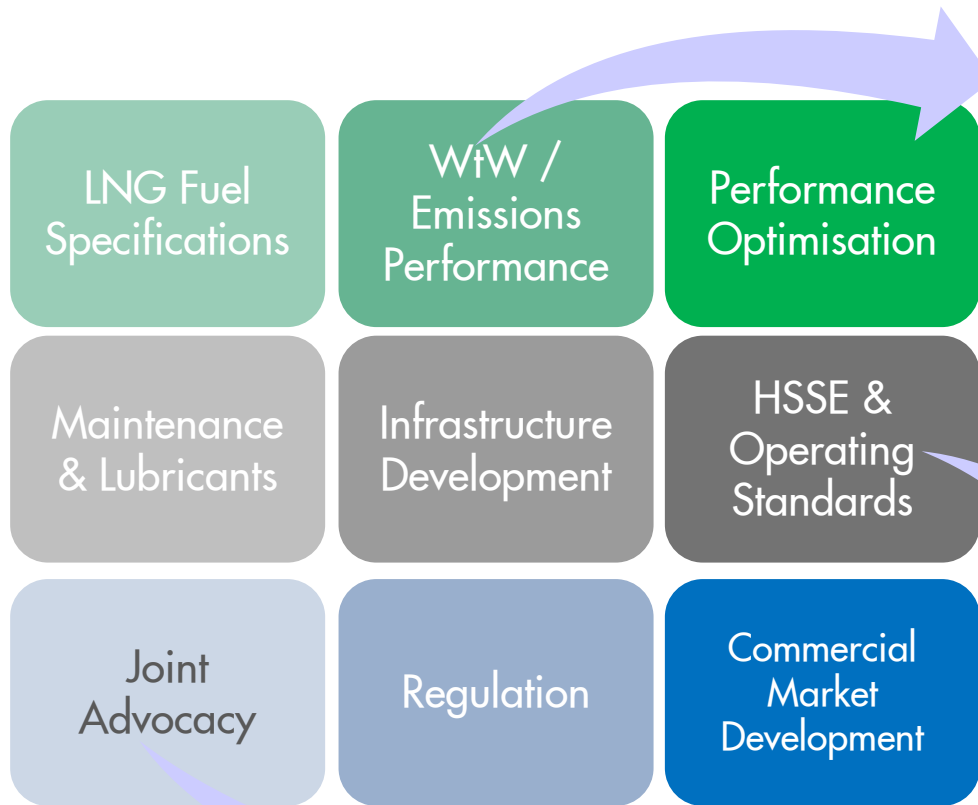
Robust and harmonized Quantitative Risk Assessment

- Methodologies for small scale
- Safety distances for bunkering

Training and experience

- Operators
- Developers
- Regulatory authorities

IN-DEPTH UNDERSTANDING AND OEM COLLABORATION



- Important regulatory and advocacy issues for LNG in transport
- Well-to-Wheel/Wake, local & GHG emissions and comparison to MGO/HFO/diesel
- Gas quality impact on engine performance and range
- Key collaboration with OEMs and joint programs developed



- Regulations, Codes and standards
- Suppliers
- Technical design, HSE, Operations



LNG IS A CLEAN, VIABLE, LONG TERM SOLUTION

- ECAs and global sulphur cap will drive the economic incentives for marine industry to seek scrubber or LNG options
- LNG is attractive for newbuilds and in some regions, for retrofits.
- Around 20% of global fleet could be powered by LNG by 2030 across various segments
- Maturation of safe bunkering solutions and standards
- Robust and harmonised regulations
- LNG is a long term viable solution compared to alternatives

Joint efforts with stakeholders (such as OEMs, Port Authority, Regulators) can derisk customer's upfront investments into LNG fueled ships.

