EXMAR's World's first oceangoing Ammonia Fuelled Ships

November 2024 – Ammonia Energy Association

EXMAR's activities

Infrastructure activities & engineering

OPTI-EX® FPS

LNG/ LPG FSUs

Accommodation barges

FLNGs

FSRUs

Drilling participations

Shipping activities

Fully Pressurized Carriers

Midsize Gas Carriers

Very Large Gas Carriers

References

LPG

equinor, TRAFIGURA, SHV, TotalEnergies, eni, IndianOil, PETRON

Ammonia / Petrochem

Nutrien, MA'ADEN معادن, YARA, Trammo, NIPPON GAS LINE CO. LTD.

Achievements

- Active along the entire LNG value chain: owning & operating
- Pioneer in FSRU (2005), STS Transfer (2006) and FLNG (2017)
- Developed OPTI production platform licence
- +200 engineers with expertise in gas / floating activities
- Shareholder in Vantage & Ventura drilling, 100% owner EOC and DVO

gasunie, eni, TotalEnergies, Woodside, Sonangol, snam, bp, Beacon OFFSHORE ENERGY, LLOG exploration, MURPHY OIL CORPORATION

Achievements

- Largest Owner in the Midsize LPG/Ammonia segment
- Leading innovator in gas shipping with ships from 3,500 up to 88,000 m^3
- World's first LPG-fuelled VLGCs delivered in June and Sept 2021
- Pivotal position in ammonia seaborne transport (+100 MTPA)
- World's first NH_3-fuelled seagoing MGCs with delivery in 2026

40 years of Ammonia Shipping

1983
First NH_3 Carrier
24,000 m^3

1990
Next generation
MGC 33,000 m^3

1997
10 Million tons
NH_3 transported

2005
Next generation
MGC 38,000 m^3

2014
12 new generation
eco-friendly 38,000 m^3

2022
First NH_3
STS Operation

2023
100 Million tons
NH_3 transported

2023
First Full Cargo of
Blue Ammonia

2026
First Ammonia Fuelled
46,000 m^3 MGC's

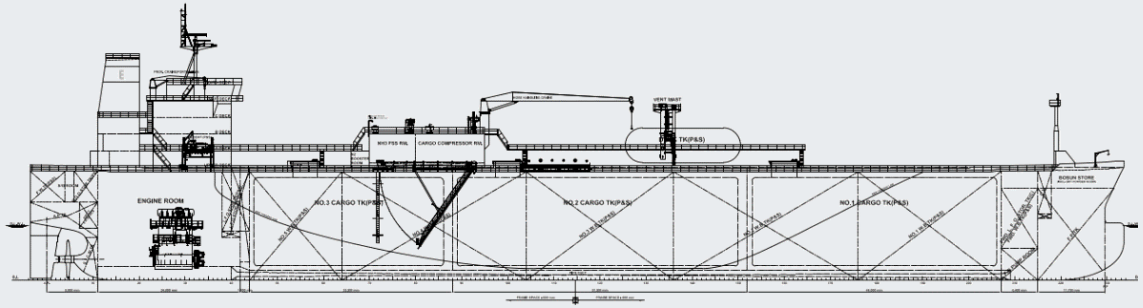
Key take away

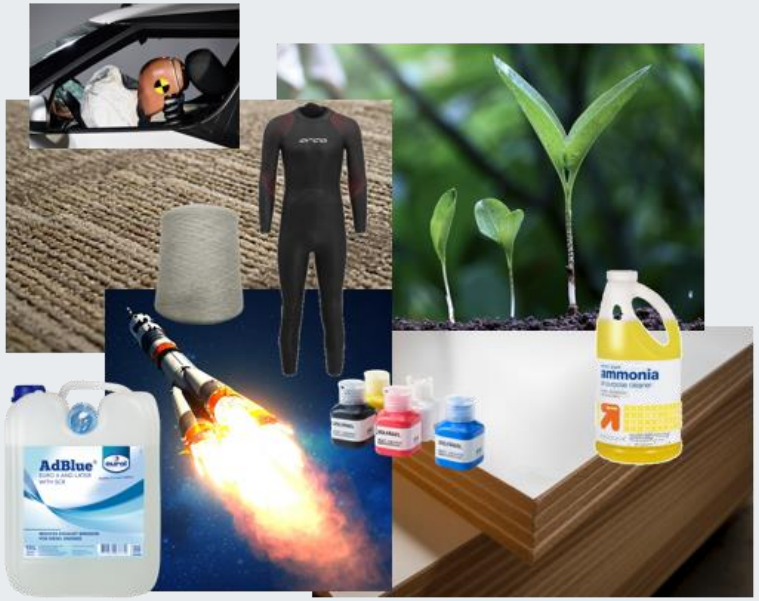
"Using NH_3 as fuel can reduce the CO_2 equivalent emissions of sailing vessels with 90%"

Ammonia transport and usage

Ammonia transport is not new

- Haber-Bosch in 1909
- Production of 180 MTPA (Million Ton Per Annum)
- 70% for fertilizers
- Transported by train wagons, trucks, pipelines and ships
- At the base of the global food supply chain



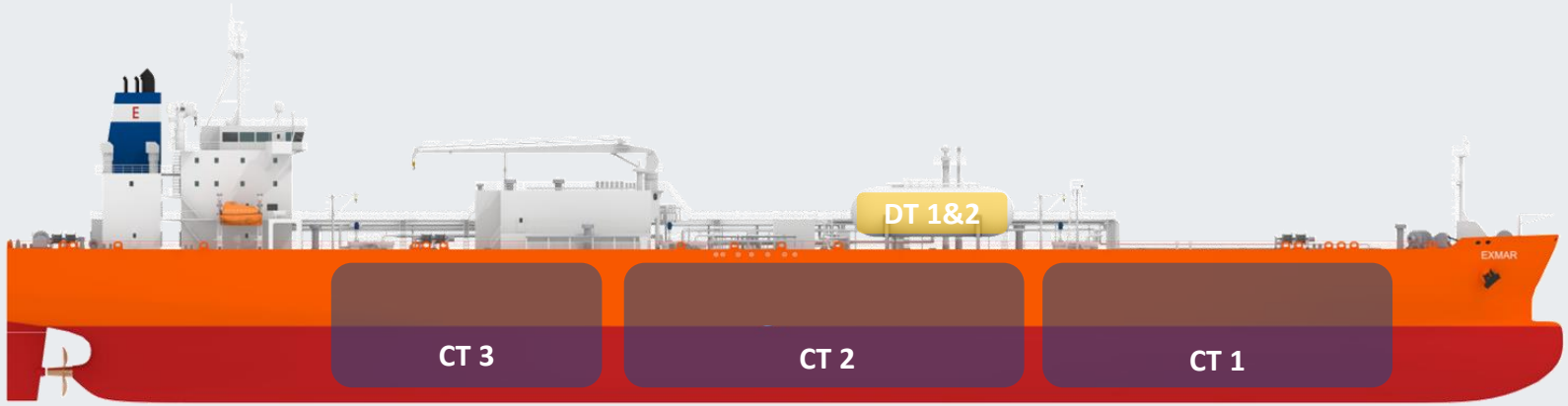


Midsize ammonia carrier

- Type A cargo tanks and Type C deck tanks
- Liquid refrigerated at -33°C or pressurized at 8 barg
- Highly toxic

46,000m³ dual fuel LPG / NH_3 carrier

- Main dimensions
  - ✓ L_{OA}: 190 m
  - ✓ Beam: 30.4 m
  - ✓ Draft: 10.6 m
  - ✓ Deadweight: abt. 33,000 ton



- **Four** ships **NH_3 Dual fuel** & Shaft Generator in **2026**
- HD **Hyundai** Mipo (HMD), South Korea
- 45,000m³ cargo tank volume & 1,000m³ deck tank volume
- **ECO** class notation, combined compressor & motor room, improved accommodation layout, improved material selection, double hull, lessons learned from previous projects
- Basic design of the **ammonia fueled ammonia carrier** including fuel supply system is completed. Detailed design, including safety studies, is being finalized. Construction will start end of this year

Safe by Design, Reliable by Operations

Risk Based Design

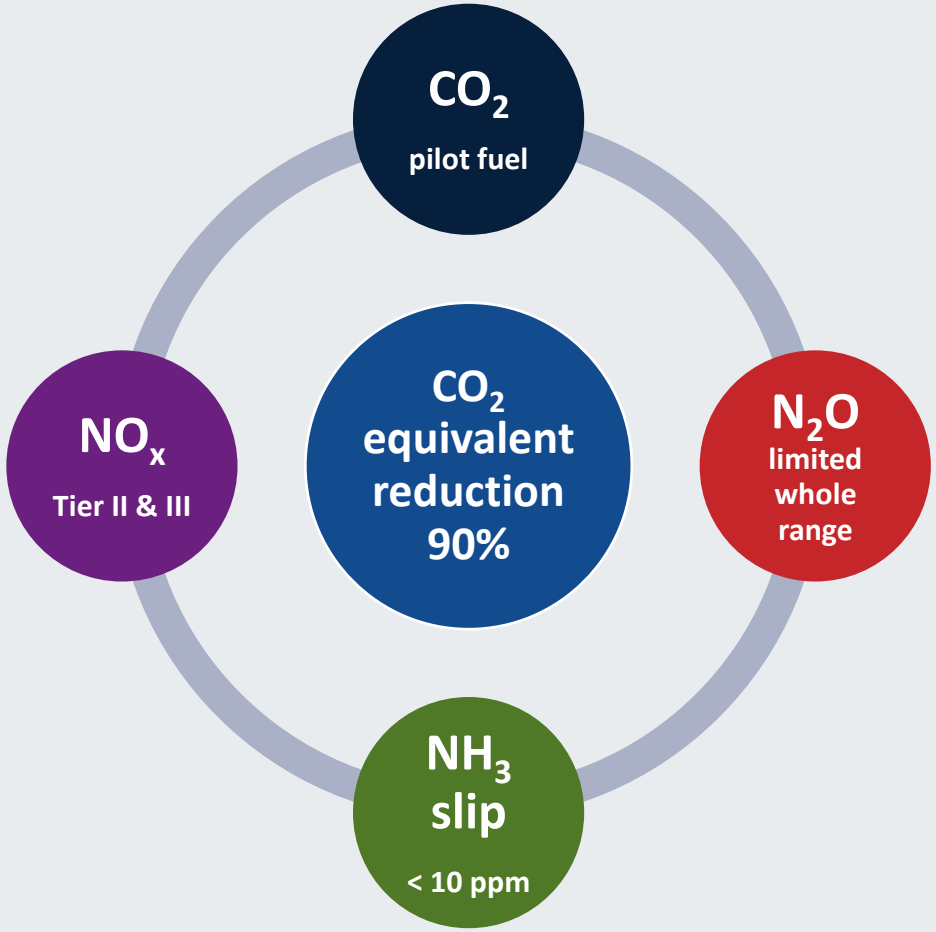
Different stakeholders

Similar to LPG fuel

Dedicated Seafarers

Tank to Wake emissions

- **90% CO_2 Reduction**: Ammonia-powered ships cut CO_2-equivalent emissions by up to 90% compared to diesel engines.
- **NO_X Compliance**: Selective Catalytic Reducer technology ensures NO_X emissions meet Tier II and III standards, with active and passive modes.
- **N_2O Control**: Diesel cycle combustion reduces N_2O emissions without additional treatment.
- **Ammonia Slip**: Limited to 10 ppm after SCR
- **Pilot Fuel**: Minimal CO_2 from Marine Gas Oil, contributing only 5% of fuel energy.
- **Well-to-Wake**: Emissions depend on ammonia production, with blue and green ammonia promising lower lifecycle impact.



Safety Aspects

- HAZID
- Double walled pipes
- HAZOP
- Training
- Dispersion analysis
- Equivalent level of Safety
- Gas detection
- Maintenance procedures
- Material selection

Conclusions

Ammonia as a Marine Fuel: Ammonia has significant potential to reduce greenhouse gas (GHG) emissions in the shipping industry, with CO_2-equivalent emissions projected to be up to 90% lower than conventional diesel-powered vessels. The development of low-carbon (blue and green) ammonia production technologies will be key to maximizing the environmental benefits of ammonia as a sustainable marine fuel.

Safety Considerations: The toxic nature of ammonia necessitates rigorous safety measures, including double-walled ammonia supply pipes, gas detection systems, and HAZID/HAZOP safety studies, to mitigate risks.

IMO

International Gas Code (IGC) Amendment: Currently IGC 16.9.2 prohibits the use of NH_3 as fuel. IMO has approved amendments to the IGC Code (expected to be adopted at MSC109), allowing ammonia to be used as fuel for ammonia carriers by July 2026, with optional early implementation starting in 2024. Ongoing regulatory advancements, such as changes to the IGC Code, play a critical role in enabling the safe adoption of ammonia fuel in maritime operations, with guidelines expected to evolve further, in order to meet IMO's GHG reduction goals.

EXMAR

Operational Expertise: EXMAR's ammonia-fueled ships are designed to accumulate operational knowledge, which can later be applied to other vessel types, enhancing the future scalability of ammonia as a fuel.

Thank you for your attention

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