TGE MARINE

Innovations for Greener Shipping

Jakob Nielsen – Sales Director

Greentech Athens 12th November – 2024

THE GAS EXPERTS | Innovations for Greener Shipping

Agenda

1. Company introduction & Current Developments
2. Fuel Gas Systems, Fuel Ready Solutions & Ammonia FSS Development
3. Ammonia Gas Carriers VLACs & LNG Bunker Vessels

Company Introduction & Current Developments

TGE Marine Gas Engineering

German Engineering and EPC-S contractor specialised in Gas Handling Systems & Fuel Gas Systems

Majority shareholder:

MITSUI E&S

NH_3

Energy Transport

Ammonia Gas Carrier -VLAC
Ammonia Gas Carrier ULAC
Fuel gas Supply System

Alternative Marine Fuels
Ammonia Fuel Gas System

For gas carriers and gas-fuelled vessels

CO_2

Carbon Capture Storage & Transport

Large CO_2 Carriers with FGS
&
CO_2 Reliquefaction system

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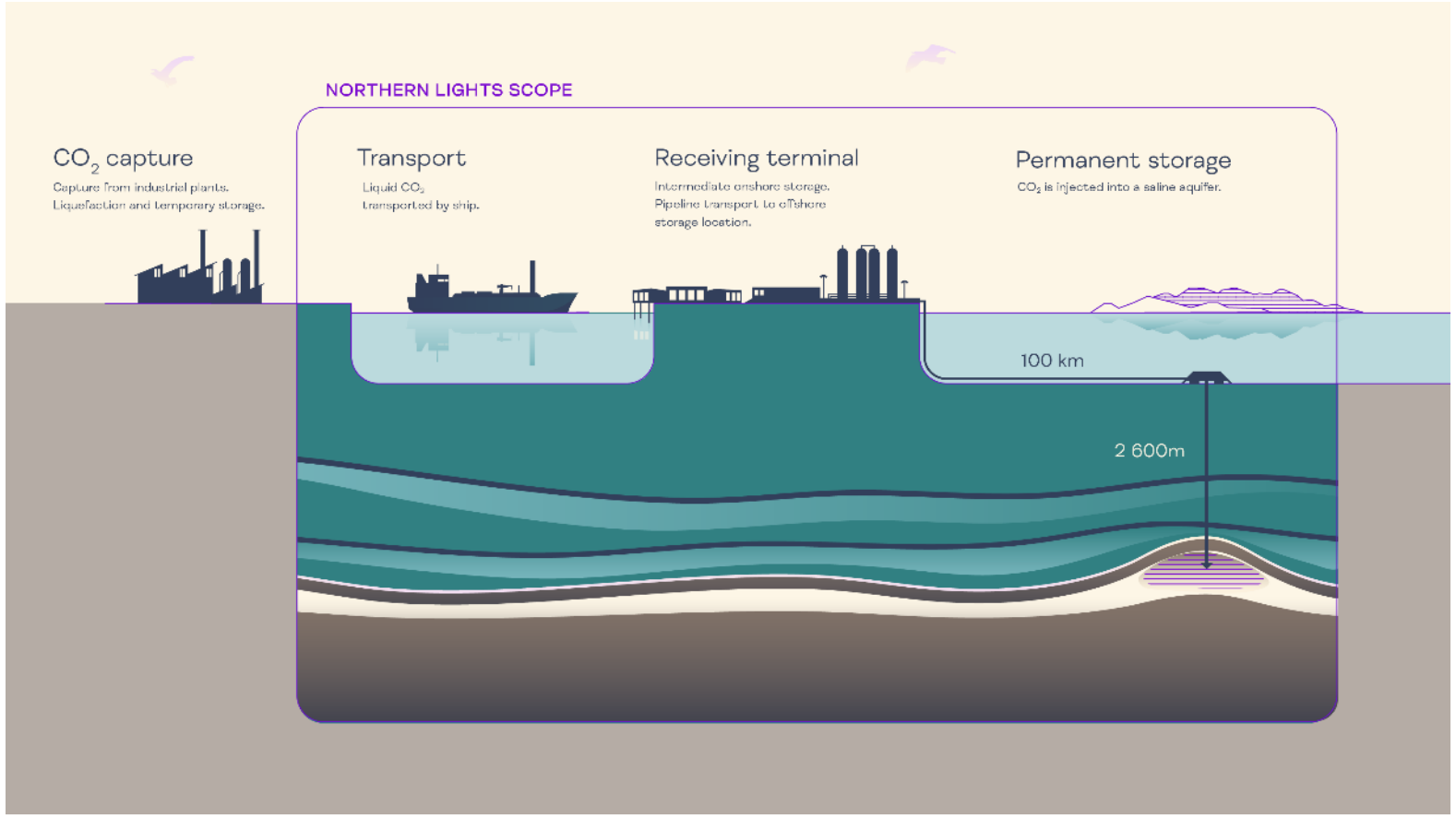
Northern Lights – First Contracts in the Industry



Facts & Figures

Joint Venture: Shell – Equinor – TotalEnergies

- Norwegian initiative (east-to-west transport of CO2)
  - Part of the "Longship Project" (NOR government initiative)
  - 2024: 1,5 Mt annually
  - Future: 5 Mt annually

- Phase I: 2+1+1 7,500m³ carriers
- Phase II: TBD (7,500, 12,000 or 20,000 m³) carriers
- CO_2 Injection underground offshore (Terminal Øygarden). To be opened 26th September 2024
- TGE awarded with CHS design for shuttle carriers for Phase I.
  - Bidding for Phase II

LCO_2 Carrier Development – TGE Marine approach

Vapour return?	Ambient conditions?	Pressure selection?	Alternative cargoes?	Voyage time?	CO2- composition?	Tank volumes?	Tank materials?

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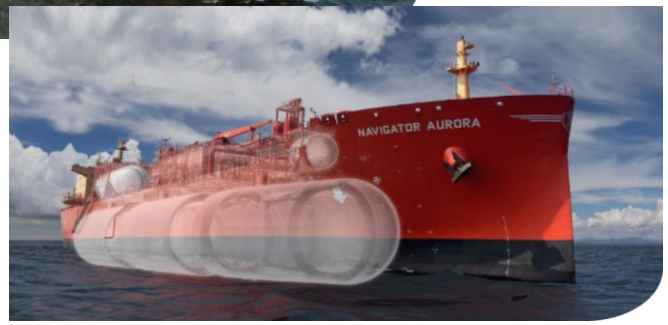
First Mover with Fuel Gas Supply Systems...

References for 100+ Fuel Gas Supply Systems

- LNG low pressure systems (4 stroke / WinGD)
- LNG high pressure systems (MAN ME-GI)
- LPG systems
- Ethane system
- 5 conversion projects from oil-based fuels to LNG



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Natural Boil-off Gas (N-BOG)

N-BOG Determination

Determination of **average k-value** for the insulation performance

Considering…

- Areas with reduced insulation (supports, nozzles….)
- Insulation application tolerances
- Experience of 450 insulated tanks
- Natural insulation degradation over time
- Safety factors

Insulation application – Utmost importance

- Qualification of the insulation company
  → appropriate application process

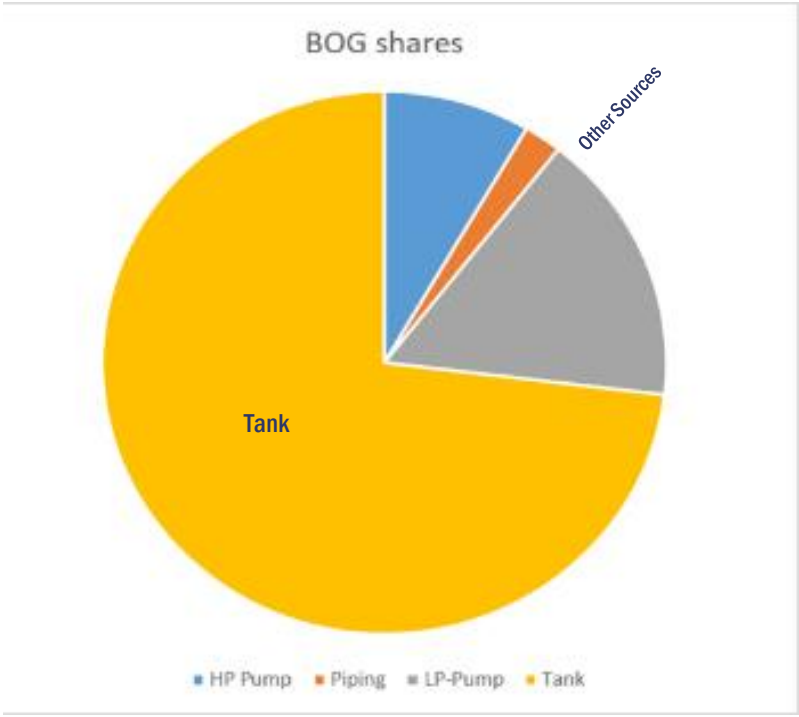
- Application of additional TGE Marine QC measures
  → Ensures TGE Marine Quality Standards

Operational BOG (OP-BOG)

Several factors will increase the BOG quantity

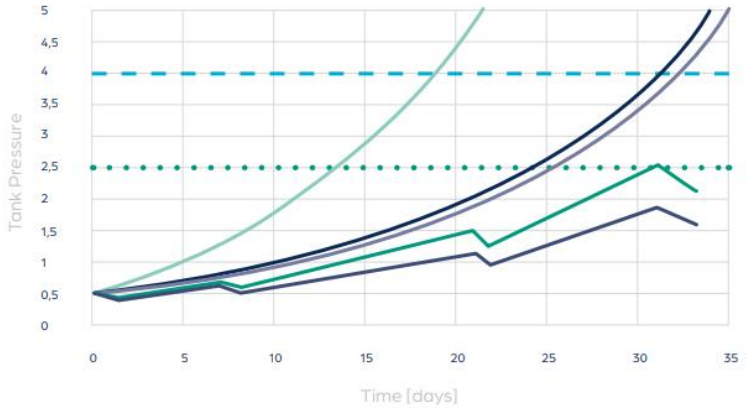
→ Some of these factors are difficult to predict → experience required

→ The actual BOG is always significantly higher than the N-BOG and is fluctuating



TGE Marine Reconomiser - BOG Treatment Package

Ship Voyage Study



- Maximum Allowable Relief Valve Settings (MARVS)
- recommended max. operating pressure
- System Set-up 1
- System Set-up 2
- System Set-up 3
- System Set-up 4
- System Set-up 5 - RECONOMISER/Power Take Off (PTO) Setting

Benefits:

Low Capital Expenditure Costs (CAPEX) and Operational Expenditure Costs (OPEX) by:

- → Allows the application of shaft generators with Power-take-off (PTO) as well as cold ironing
- → Supports the application of batteries, solar panel etc.
- → Elimination/significant reduction of genset operation at sea and port
- → Reduction of fuel gas consumption and Green-House-Gas (GHG) emissions
- → Significant reduction of operational cost

Example
Case Study: Potential savings with a MAN ME-GI/ RECONOMISER/PTO set-up within 5-years

OPEX

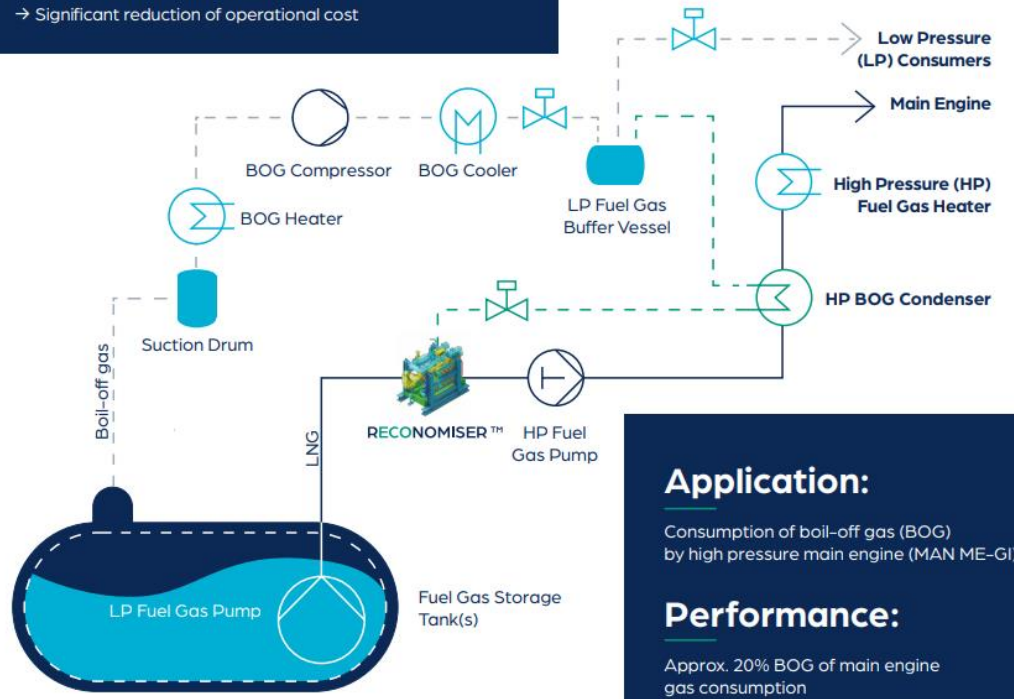
Fuel cost:	about 2.5 million US$
Maintenance cost A/Es(*1):	about 1.0 million US$
Total savings:	about 3.5 million US$

EMISSIONS

Methane Slip:	about 100 t
CO_2 eq. emissions:	about 9,000 t

Investment cost savings versus an HP fuel gas compressor: **RECONOMISER™ application has 20% less in CAPEX**

(*1) Auxiliary/Engines



Extraordinary benefit in combination with type C tanks – pressure accumulation

TGE Marine services:

- → Consultancy for defining BOG treatment solution considering ship operational requirements
- → Execution of ship voyage studies
- → Design and supply of BOG treatment system as part of the fuel gas supply system

For further information please email:
sales@tge-marine.com

Particular features:

- → **Robust advanced control concept**
- → Ensuring reliable operation of high pressure pumps
- → Reliable operation during rough sea conditions
- → High BOG treatment performance
- → **Safe operation by reduced LNG systems**

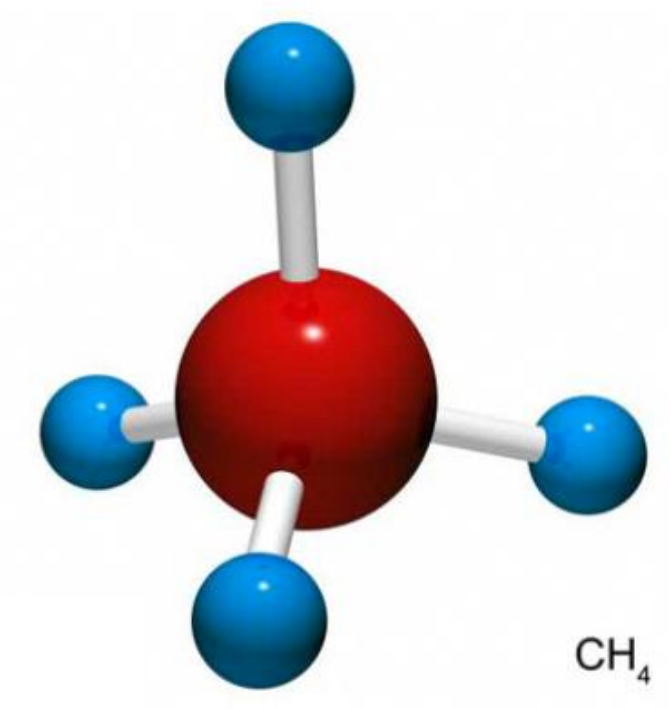
Application:

Consumption of boil-off gas (BOG) by high pressure main engine (MAN ME-GI)

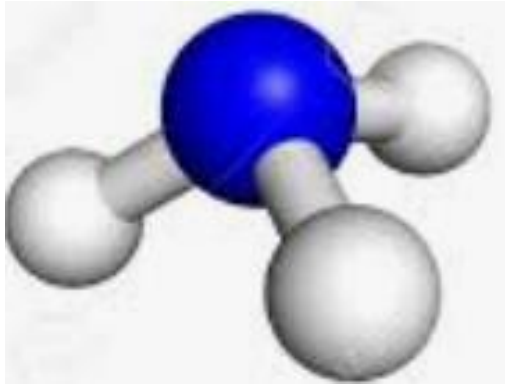
Performance:

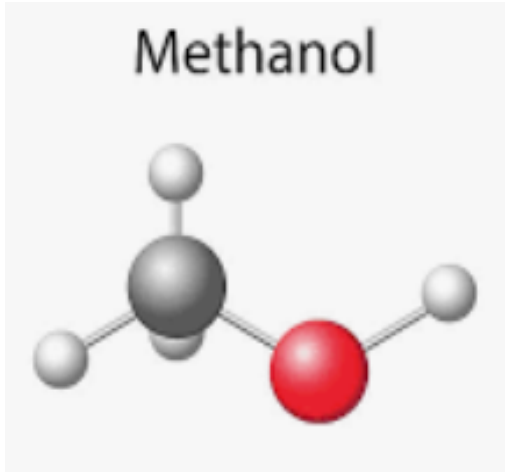
Approx. 20% BOG of main engine gas consumption

Ammonia FSS Development - Ready Solutions



Ammonia





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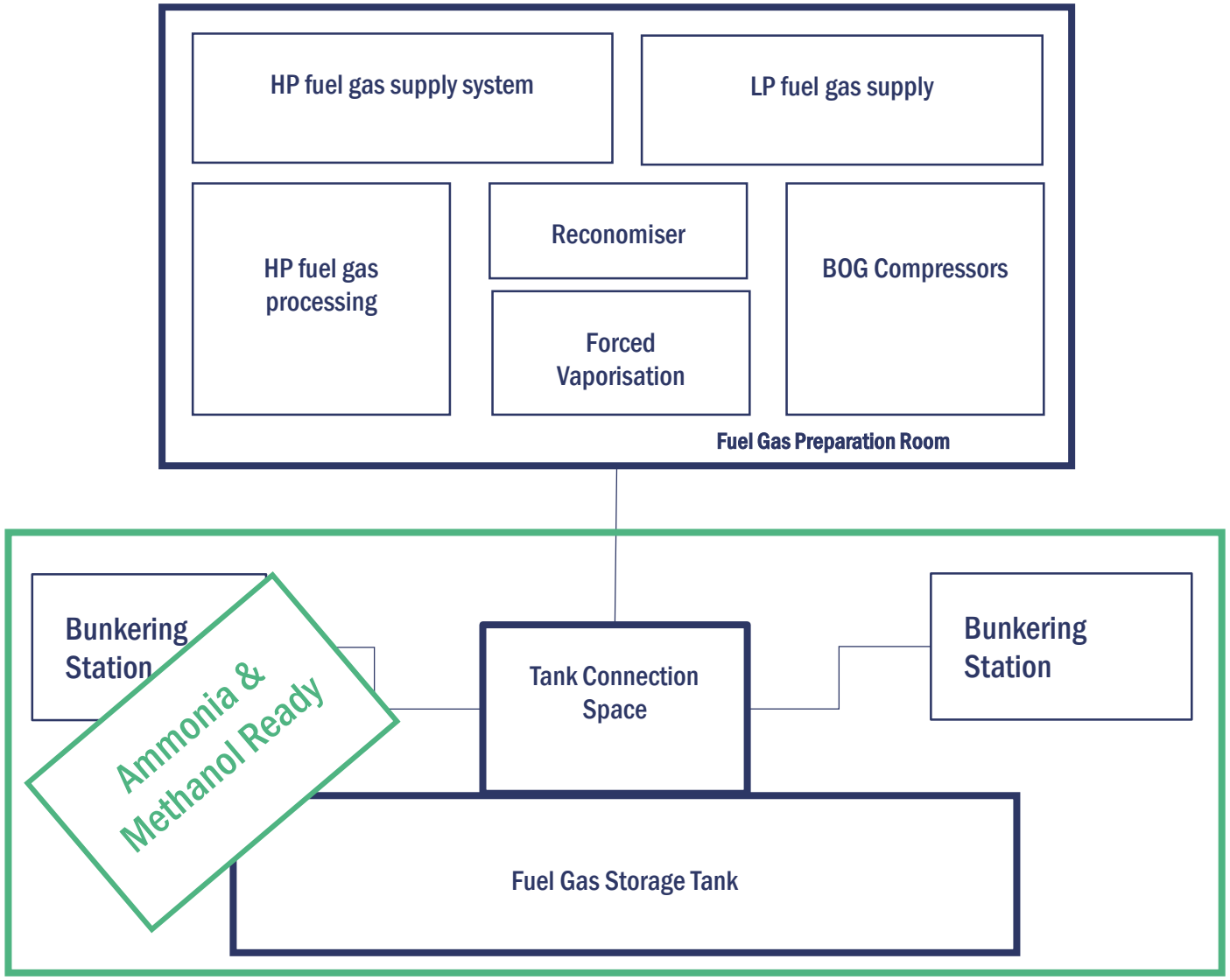
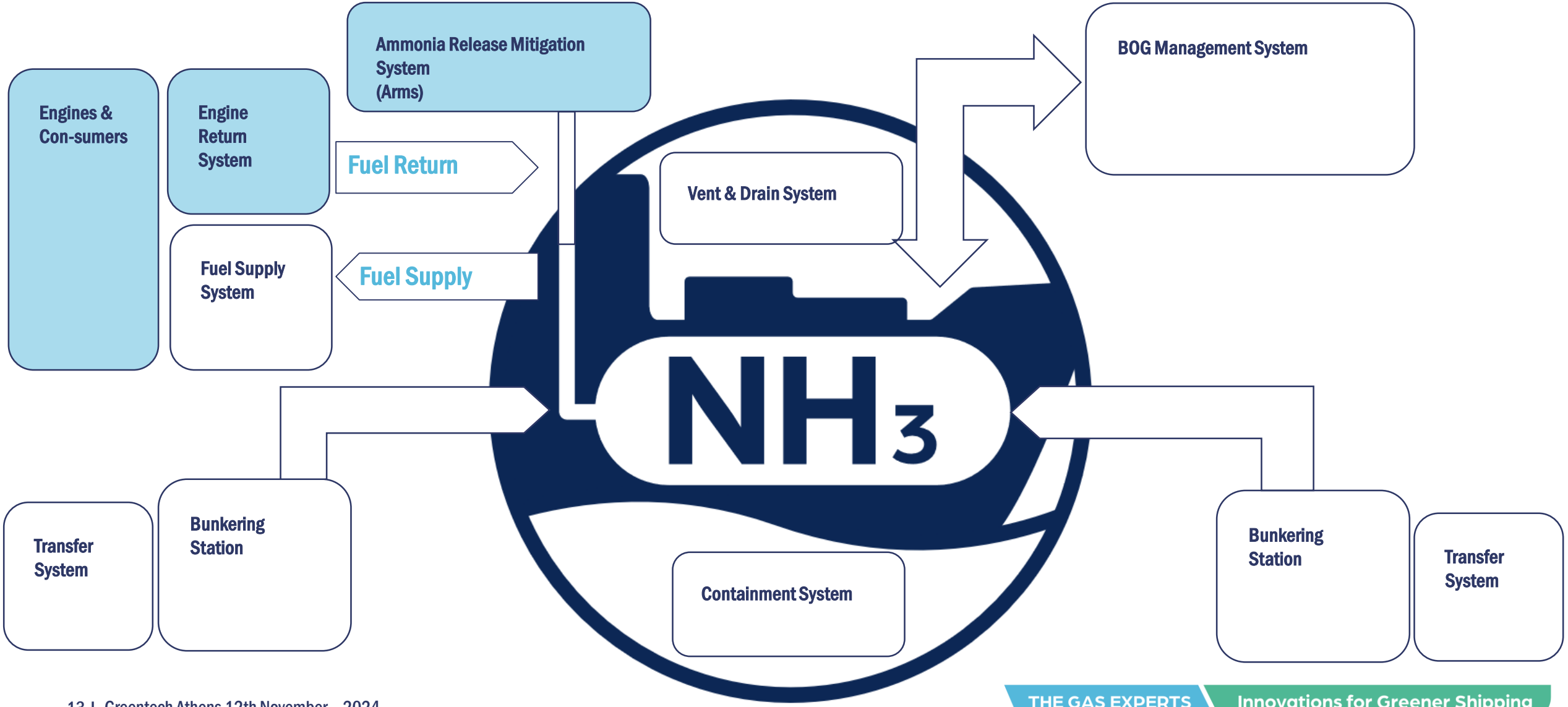


Special features:

- World's first NH_3-ready PCTCs
- Multi-Fuel capability since fuel gas tank can also receive Methanol
- Some process equipment is already suitable for NH_3 use

Ammonia FSS Development – FSS Development



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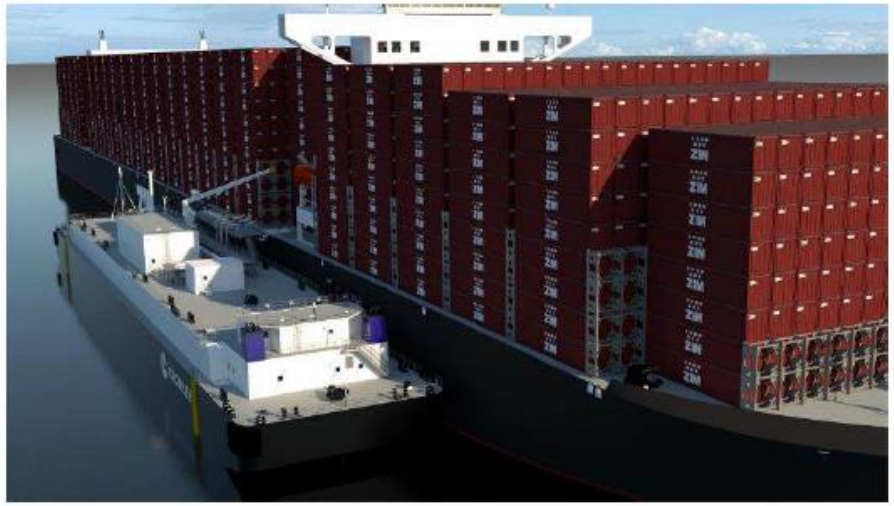
Bunker Vessels

5 LNG BVs in Operation

9 LNG BVs under contract / construction

1 x 4k m3
3 x 7,6k m3
2 x 12k m3
3 x 20k m3

2 +1 LNG BV (“Ammonia Ready”) in advance discussion

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