LNT

Enabling Efficient Storage
& Transportation of Energy

LNG: Transitioning towards zero emissions

Containership Tech & Ops Day • September 2nd, 2021 • Kjetil Sjølie Strand, CEO, LNT Marine

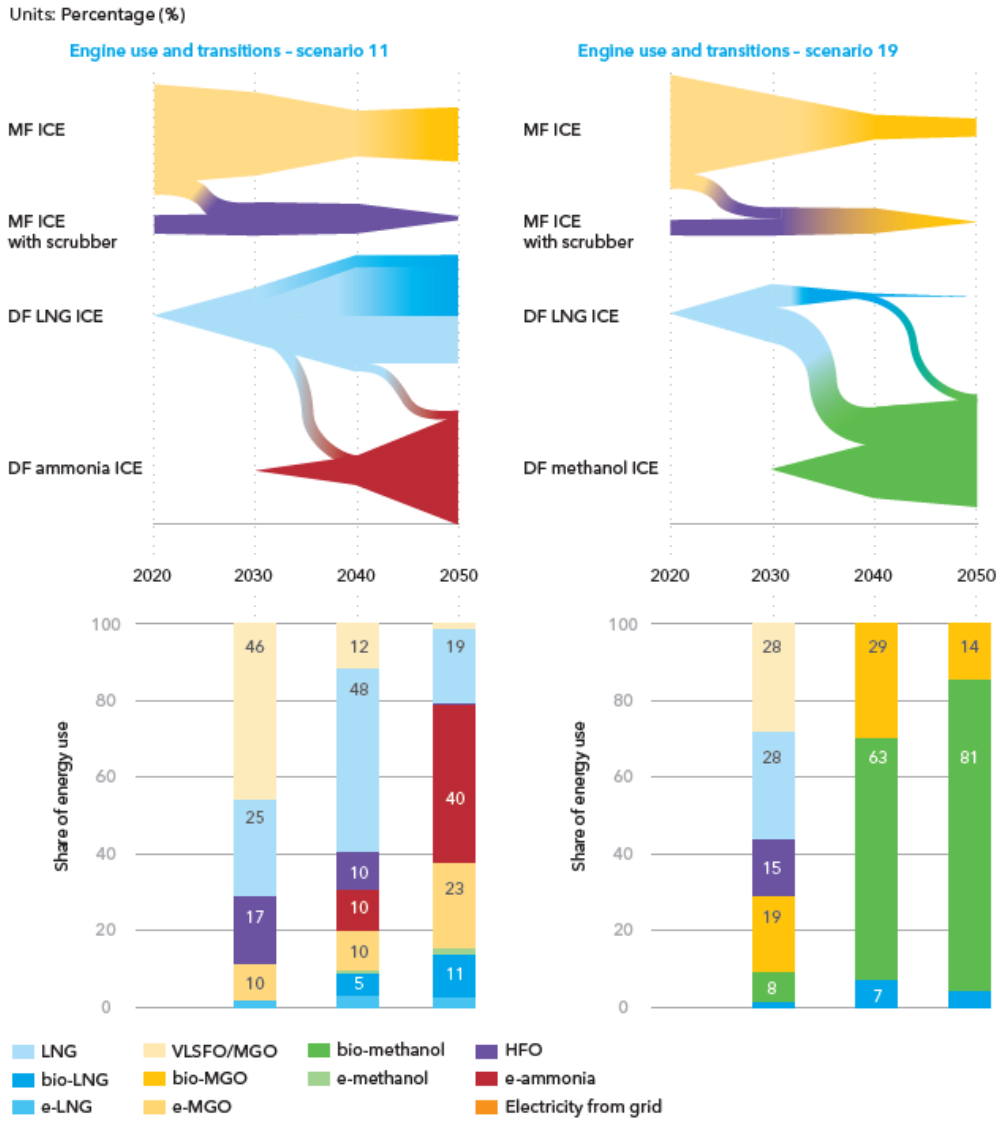
DISCLAIMER

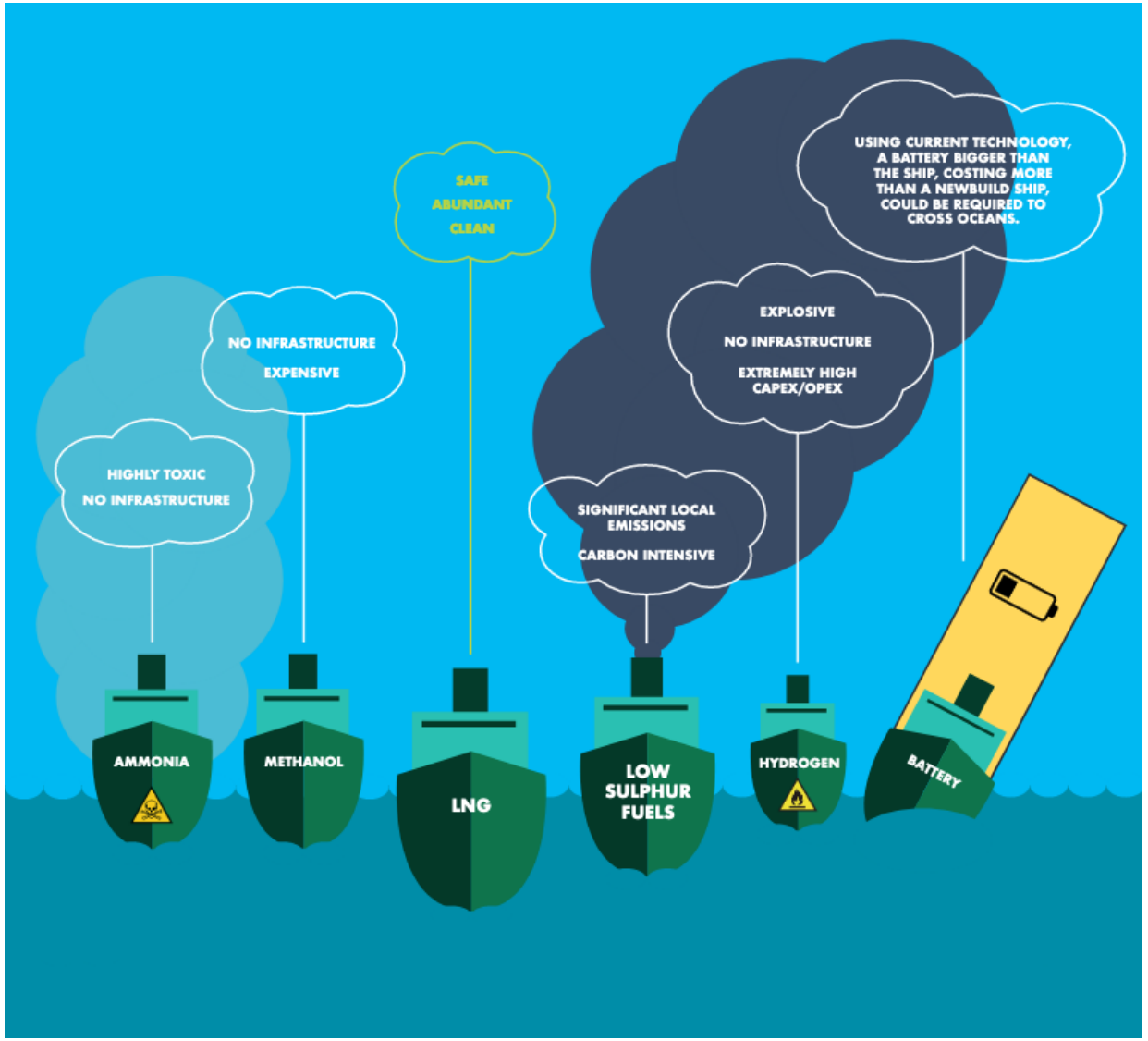
This presentation has been prepared by the management of LNT Marine Pte.,Ltd. (the Company) using commercially reasonable efforts to provide estimates and information about the Company and prospective markets.

The presentation includes and is based, inter alia, on forward-looking information and statements that are subject to risks and uncertainties. In addition, important factors that could cause actual results to differ materially from those expectations include, among others, economic and market conditions in the geographic areas and industries that are- or will be major markets for the Company's business, market acceptance, changes in governmental regulations, interest rates, fluctuations in currency exchange rates and such other factors as may be discussed from time to time in the Presentation.

The Company is making no representation or warranty, expressed or implied, as to the accuracy, reliability or completeness of the information contained in the Presentation, and neither the Company nor any of its directors, officers or employees will have any liability to you or any other persons resulting from your use of the information in the Presentation.

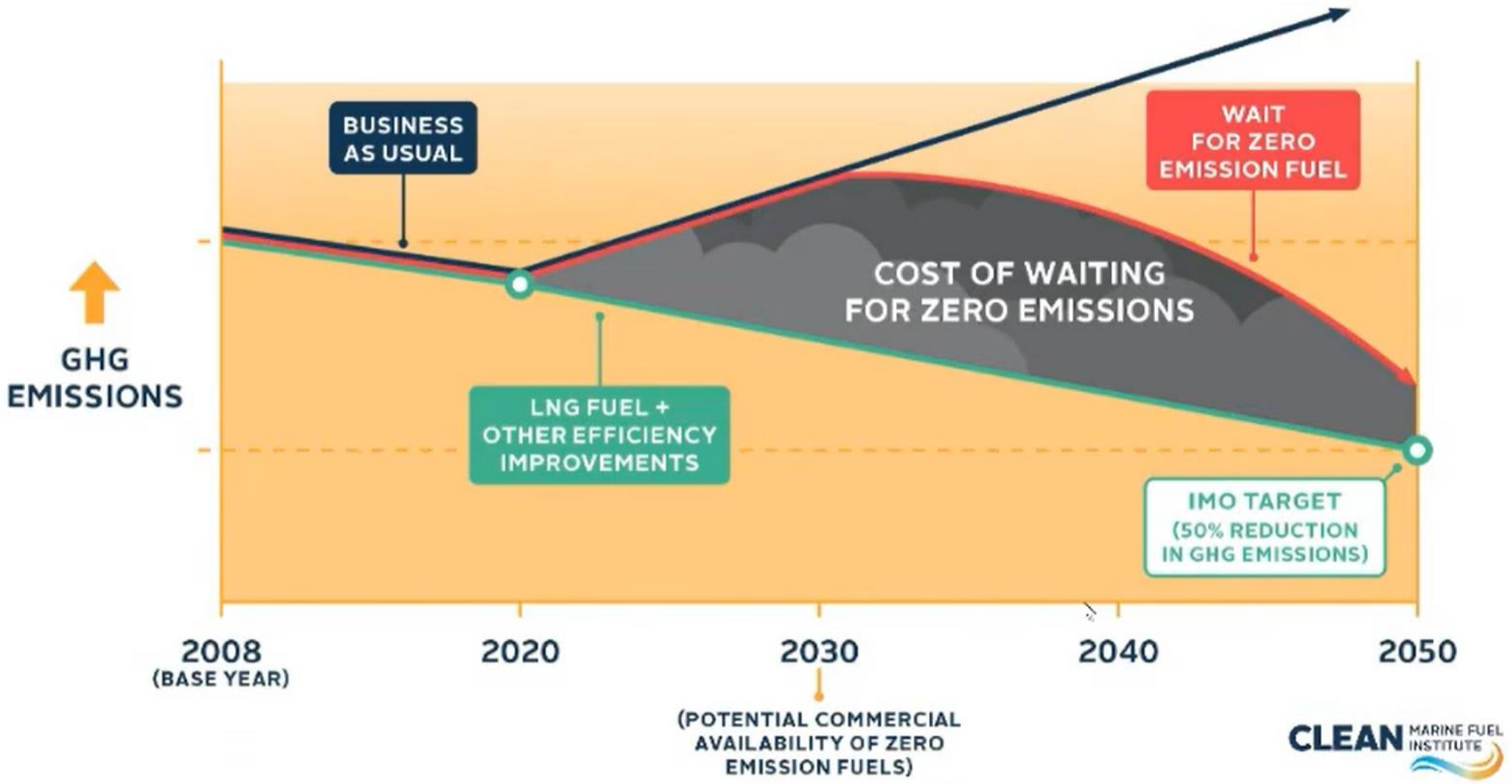
MARITME FUEL OPTIONS





Source: DNV Energy Transition Outook 2020, SEA-LNG 2021

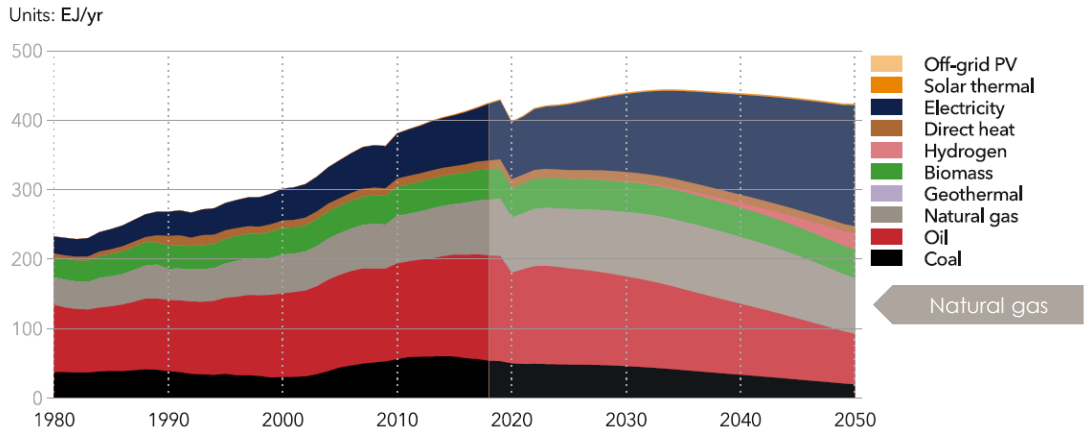
THE COST OF INACTION



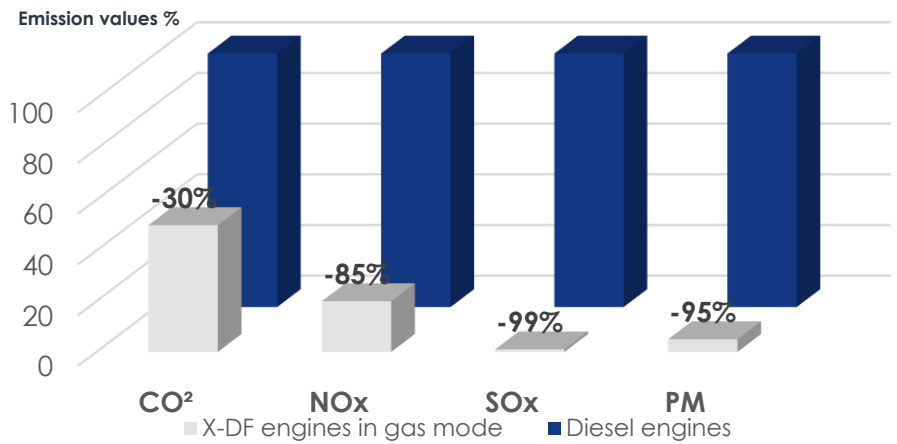
Source: [1]) Clean Marine Fuel Institute

LNG: THE MOST ATTRACTIVE AND REALISTIC FUEL TODAY

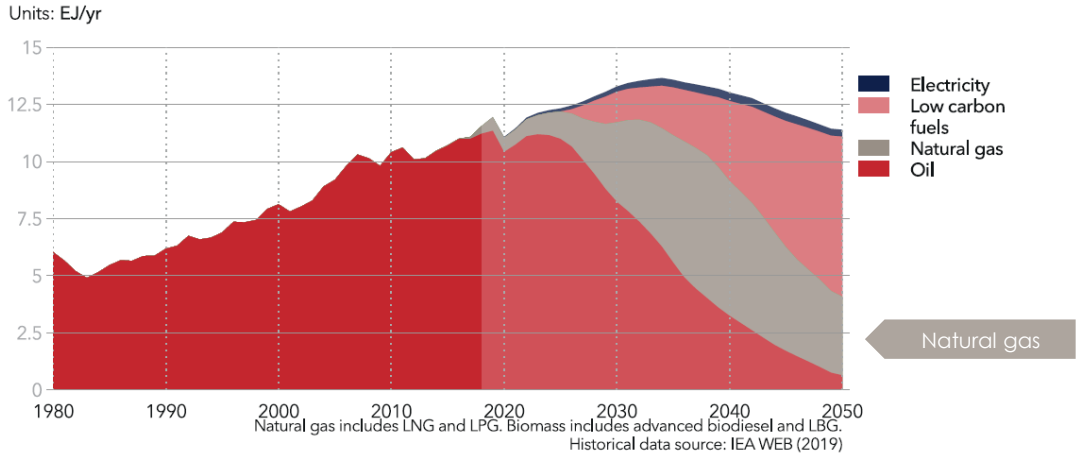
World final energy demand by carrier[1]



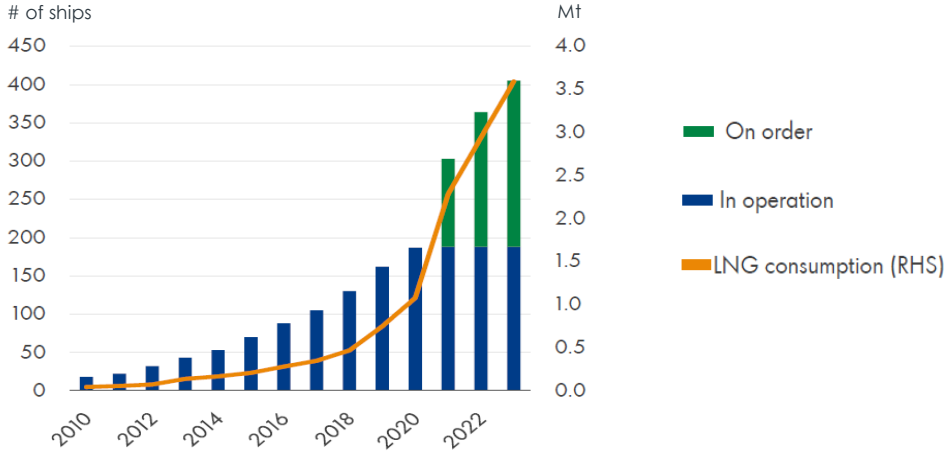
Emissions from LNG as fuel[3]



World maritime subsector energy demand[2]



LNG fuelled ships and consumption[4]



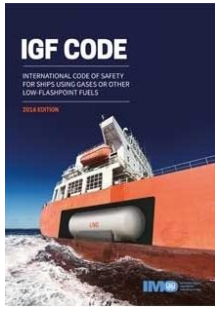
Source: [1]) DNV GL Energy Transition Outlook 2020, [2]) IEA Web 2019, [3]) Shell LNG Outlook 2021, [4]) WinGD

FUEL TANK SYSTEM REQUIREMENTS

Main functional requirements for containment of liquefied gases:

- Provide strength to withstand the defined loads
- Maintain the cargo in liquid state
- Protect the hull structure from low temperature exposure
- Prevent ingress of water or air into the containment system

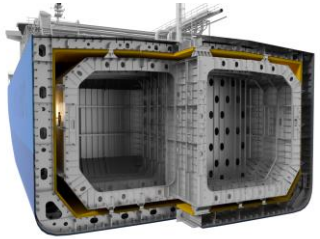
IMO



Containment Systems for Liquefied Gas

- **MEMBRANES**

- **INDEPENDENT TANKS**
  - **Type A**



  - **Type B**
    - *Prismatic*

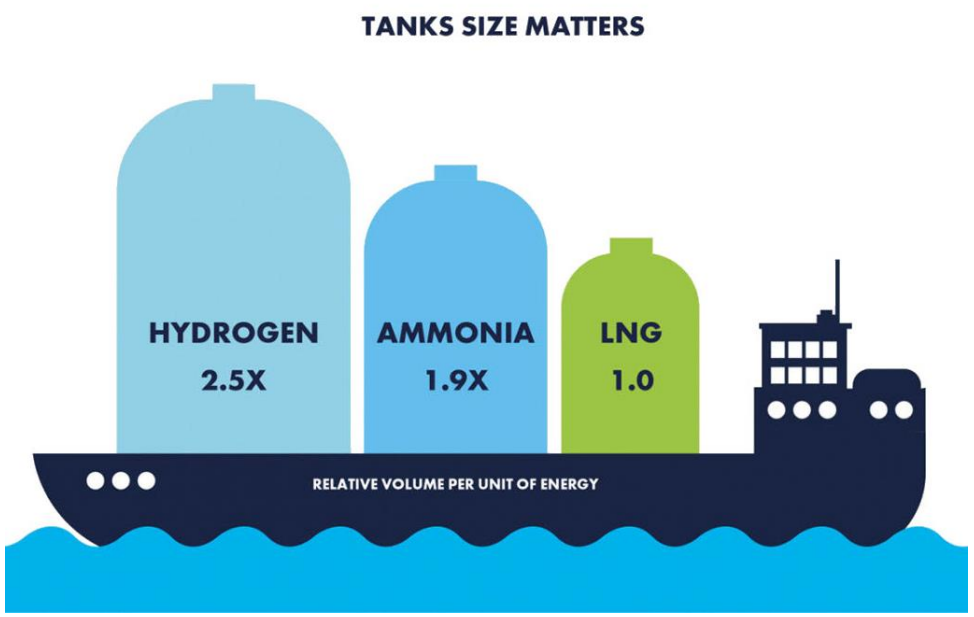
    - *Spherical*

  - **Type C**
    - *Cylindrical*

    - *Bi-lobes*

MARITIME FUELS PROPERTIES

	Density	Temperature	Flammability	Energy	
	[ton/m3]	[°C]	[-]	Per weight	Per volume
				[MJ/kg]	[MJ/l]
VLSFO/MGO	0.85	Ambient		48	37
LNG	0.48	-163	5-15%	53	22
Hydrogen – LH2	0.07	-253	4-75%	143	10
Ammonia – NH3	0.73	-33	15-28%	18	12
Methanol	0.79	Ambient	6-36%	19	15



- *VLSFO/MGO phasing out considering emissions*
- *Liquid hydrogen is attractive as a zero emission alternative, but will inevitable be very expensive and imply more risks due to its extremely low temperature, high flammable range and low volume efficiency.*
- *Ammonia is a more manageable fuel, but not yet mature and available for shipping.*
- *Methanol seems like a good alternative, but uncertain availability and price.*

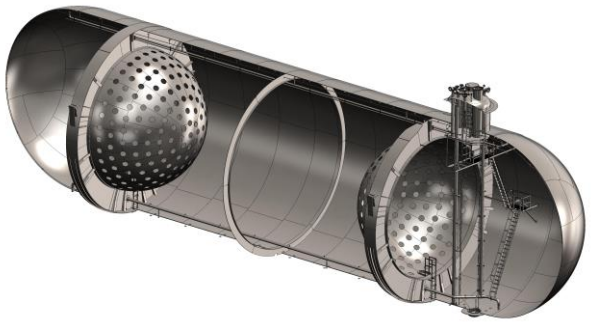
- ***LNG is commercially the most attractive fuel today and in foreseeable future***
- ***It complies with all existing emission legislations***
- ***Proven technology with excellent safety record.***
- ***Bunkering infrastructure is developing faster than for any other fuel***
- ***Fully replaceable by bio- or synthetic natural gas with the same infrastructure***

DIFFERENT SOLUTIONS FOR DIFFERENT APPLICATIONS

Small vessels

&

short-sea shipping

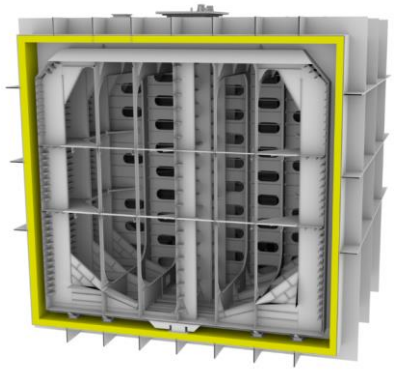


IMO type C tanks are typically the simplest and most cost-efficient solution for smaller sizes

Large volume sensitive ships

&

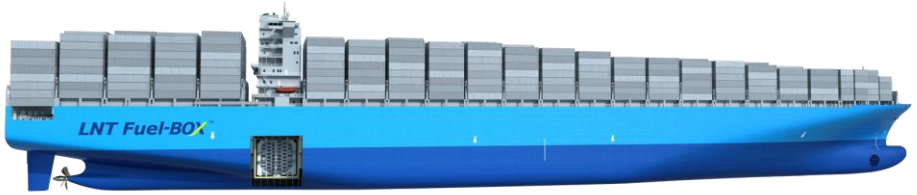
deep-sea shipping



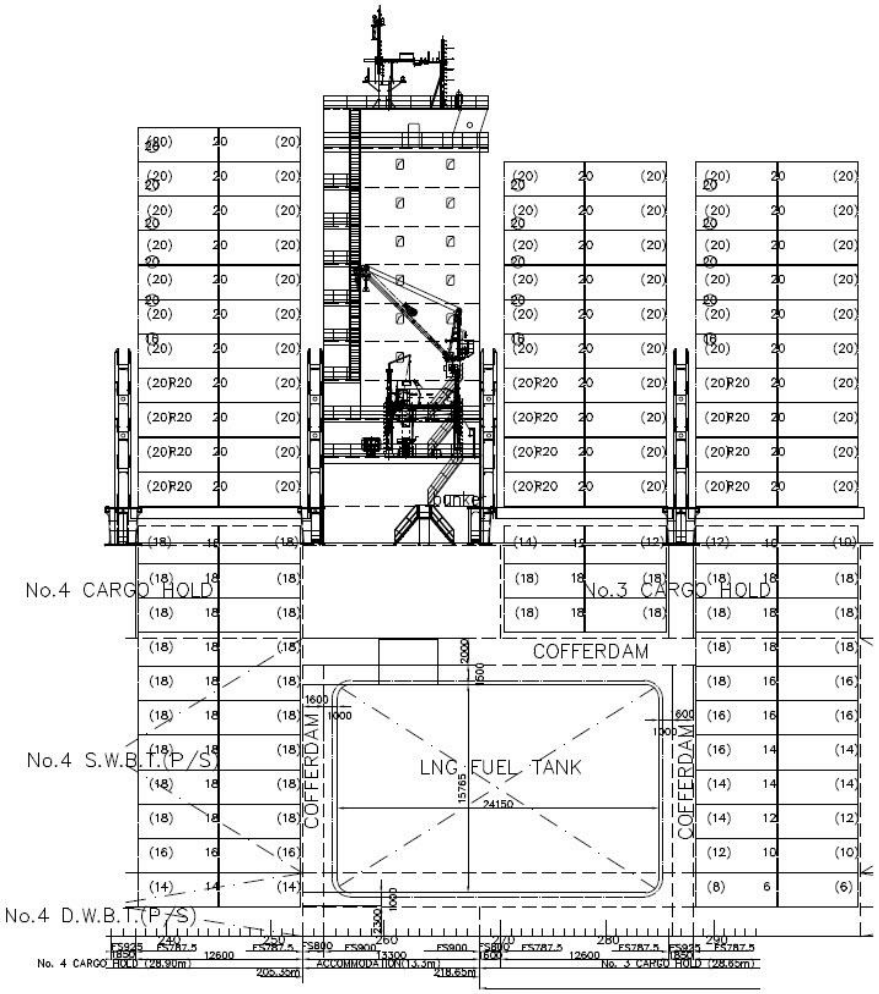
Prismatic tank types, like for instance type A, are more efficient for the larger sizes.

LNT Fuel-BOX™

- based on the principles of the LNT A-BOX®, optimized for LNG fuel storage.



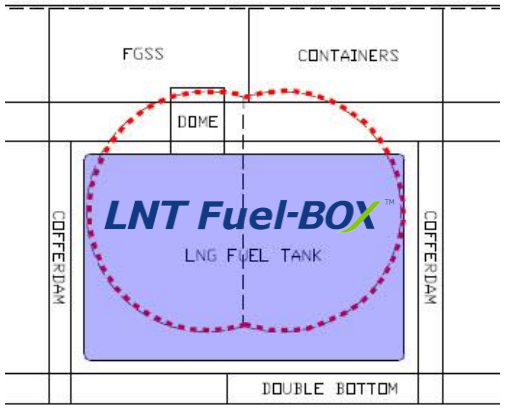
VOLUME UTILIZATION

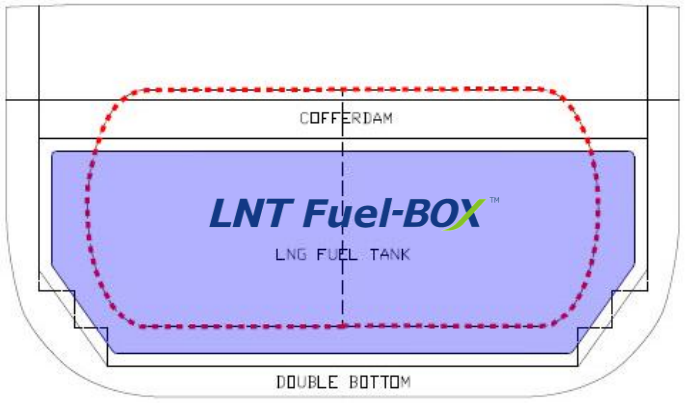


- Especially for larger vessel sizes and large capacity fuel tanks, the difference in volume utilization can be significant (15-25% compared to type C tanks).

→ Better volume utilization for the LNT Fuel-BOX™ offers:

- ✓ ***More cargo capacity (payload)***
- ✓ ***Longer trading range and bunkering interval***



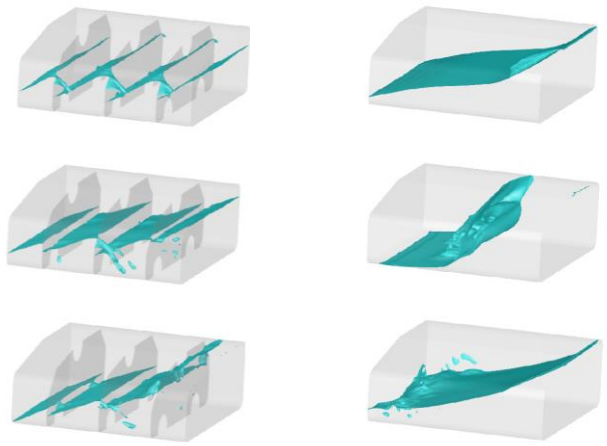


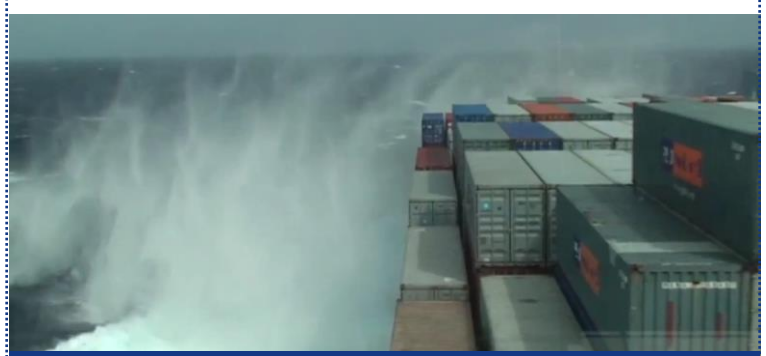
OTHER KEY FACTORS FOR THE SELECTION OF FUEL TANKS

SLOSHING

LNT Fuel-BOX™ with internal structure

Tank systems without internal structure

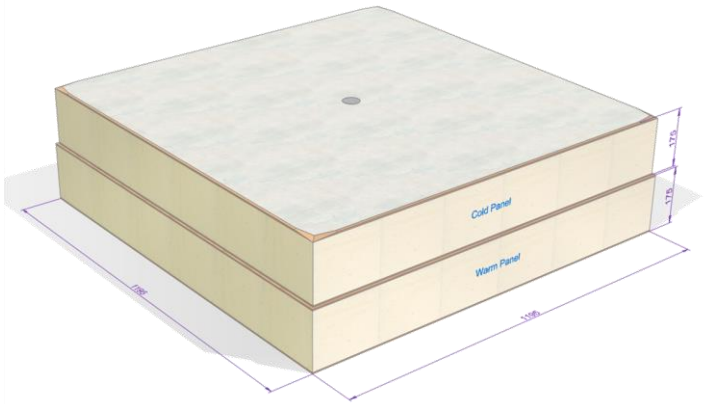




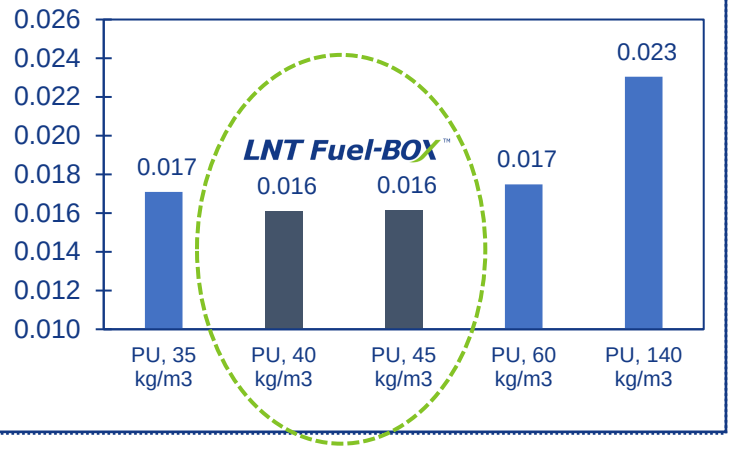
Due to its internal structure sloshing is mitigated in LNT Fuel-BOX™ tanks, and filling level is no concern.

BOIL-OFF

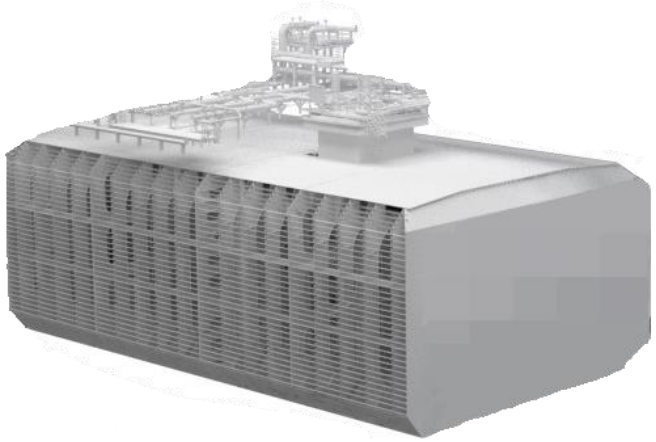
LNT Fuel-BOX™



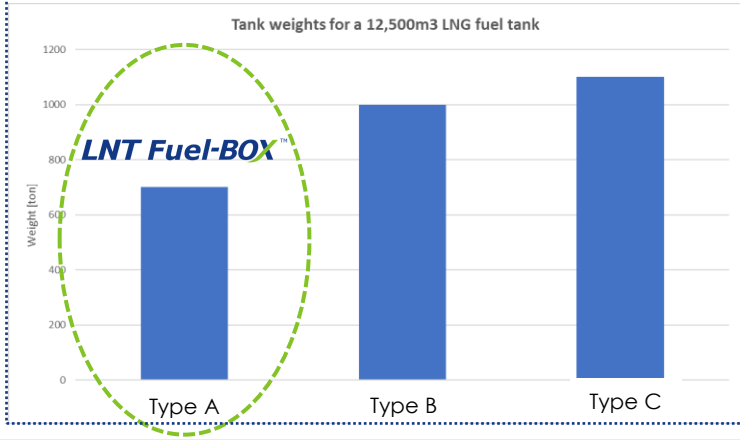
Average Thermal Conductivity [W/mK] vs Density



WEIGHT & COSTS



Tank weights for a 12,500m3 LNG fuel tank



PREPARED FOR THE GREEN TRANSITION – "AMMONIA-READY"

- Ammonia (NH3) is a zero-carbon fuel, and a hydrogen carrier that is considered to be among the most attractive alternative fuels.
- Most LNG tanks can be made capable of carrying ammonia, if this is considered from the design stage.
- Since ammonia has higher density than LNG, the structural design of the tank has to take this into account since all loads such as sloshing loads will increase.
- In addition, material selection and compatibility need to be considered and nickel content in excess of 5% is not acceptable for ammonia. Stainless steel however, is fully compatible with NH3.
- By designing and installing an «ammonia-ready» tank systems, owners can install a flexible fuel tank that can carry LNG today, and use ammonia when this becomes commercially available.

The LNT Fuel-BOX™ is an ammonia ready technology

THANK YOU

LNT Marine

www.lntmarine.com

LNT OFFICES

LNT Marine Pte.,Ltd.
3 International Business Park #04-07/08
609927 Singapore
SINGAPORE

LNT Marine AS
Bragernes Torg 1
3017 Drammen
NORWAY

LNT Marine Sp.z o.o.
Street Leborska 3b
80-386 Gdansk
POLAND

LNT Marine (Shanghai) Co.,Ltd.
1518 Minsheng Road, Jinying Plaza, Building B, Room 502B
Pudong New District, Shanghai
P.R.CHINA