Moving into green shipping – Maersk's next newbuildings driven by methanol

Kristian Agdrup
Lead Naval Architect
Maersk – Fleet Technology

AGENDA

Moving into green shipping –
Maersk's next newbuildings driven by methanol

1) why shall we decarbonize?

2) what are Maersk's ambitions?

3) which green fuels are we considering?

4) why choose methanol?

5) where shall the green methanol come from?

6) how will Maersk's next newbuildings look?

7) what is needed to move forward?

MAERSK

Decarbonizing global supply chains is a strategic imperative for Maersk

Our customers need us to decarbonize their supply chains in order to uphold their global footprint.

Investors and financial institutions expect sustainability and will reward decarbonization leaders.

Shipping accounts for ~3% of global GHG emissions. Urgent action to mitigate climate change is needed, and society (and our employees) expect us to act.

- **We must decarbonize our entire operations.**
- **We need to meet our customers' expectation for a decarbonized supply chain.**
- **If we do not take action to decarbonize, we will become irrelevant to our customers.**
- **We need to decarbonize as fast as technically and commercially possible – it is a strategic imperative.**

MAERSK

Roadmap to deliver net zero by 2040

TODAY

2018 — Net zero ambition launched

2019 — ECO Delivery ocean transport introduced

2020 — Priority future fuels defined

2021 — Investment in 13 green methanol-enabled vessels

2022 — New decarbonisation vision and accelerated commitments

2023 — World's first container ship in operation on green methanol

2024 — Twelve 16,000 TEU methanol-enabled vessels into operation

2030
- Aligned with a Science Based Targets initiative 1.5-degree pathway
- Industry-leading green customer offerings across the supply chain

2040 — Net zero across our business and 100% green solutions to customers

OUR DECARBONISATION COMMITMENTS

2030: Industry-leading green customer offerings across the supply chain

- Ocean: Min. 25% of cargo transported with green fuels.
- Air: Min. 30% of cargo transported with Sustainable Aviation Fuels.
- Contract logistics and cold chain: Min. 90% green operations (scope 1 and 2).
- Inland: Industry leading green offering - quantitative target to be defined during 2022.

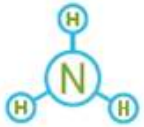
2030: Aligned with a Science Based Targets initiative 1.5-degree pathway

- Ocean ~50% reduction in emission intensity (2020 baseline).
- Terminals ~70% absolute reduction of scope 1 and 2 emissions (2020 baseline).
- Natural Climate Solutions used above and beyond 1.5-degree target to sequester at least 5 million tonnes GHG in 2030.

2040: Net zero across our business and 100% green solutions to customers

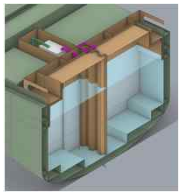
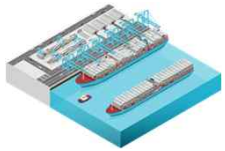
- 100% green solutions to our customers.
- Net zero greenhouse gas emission across all scopes and businesses.
- Aligned with the Net Zero criteria of the Science Based Targets initiative and a pathway to limit global warming to 1.5 degree.

We pursue four priority fuels for net zero emissions shipping – each has key advantages and limitations

Fuel	Key advantages	Key limitations/ risks
 **Biodiesel**	• Can be used as drop-in fuel in existing vessels and engines	• Limited availability of biomass feedstock • Price pressure due to competing demand
 **Methanol/ Ethanol** (bio- and e-)	• Already in operation as marine fuel and engine is available • Liquid at normal condition and well-known handling	• Bio-methanol: Limited availability of biomass feedstock • E-methanol: Availability of biogenic CO2 source
 **Lignin fuels** (New biofuel based on lignin-alcohol blends)	• Potentially the most price-competitive net zero fuel, could be almost on par with fossil fuels • Same engine requirements as for methanol	• In development stage with production still to be scaled up • Additional handling of contaminants may be required in fuel system and engine
 **Ammonia** (green ammonia)	• Fully zero emissions fuel • Can be produced at scale from renewable electricity alone	• Safety and toxicity challenges • Infrastructure challenges at ports • Future costs depends on cost of renewable electricity and electolyzer

MAERSK

From a ship design & operations point of view, methanol is the "sweet spot", considering technology readiness, simple storage & supply system onboard

	✓ Economical to store on board (liquid at room temperatures, non cryogenic, low pressure / no BOG) ✓ Relatively simple fuel supply system installation ✓ Requires less systems and design modifications compared to other alternative fuels
	✓ Proven fuel ✓ Ready and available technology (Main Engines, Auxiliary engines, fuel system)
	✓ Existing liquid fuel infrastructure can be repurposed enabling rapid transition from conventional fuel types ✓ Methanol infrastructure already available in +100 ports globally
	✓ EEDI and CII benefit ✓ No SOx & Soot emissions while less NOx emissions ✓ Highly biodegradable with low risk of marine environment impact

MAERSK

Maersk has made partnerships with seven green fuel pioneers that will accelerate the green fuel transition

Ørsted

- 300,000 tonnes per year
- First delivery in 2025
- United States

CIMC ENRIC 中集安瑞科

- 50,000 tonnes per year
- First delivery in 2024
- China

PROMAN

- 200,000 tonnes per year
- First delivery in 2025
- Multiple locations

EUROPEAN ENERGY

- 2 – 300,000 tonnes per year
- First delivery in 2025/2026
- South America & United States

Green Technology Bank

- 50,000 tonnes per year
- First delivery in 2024
- China

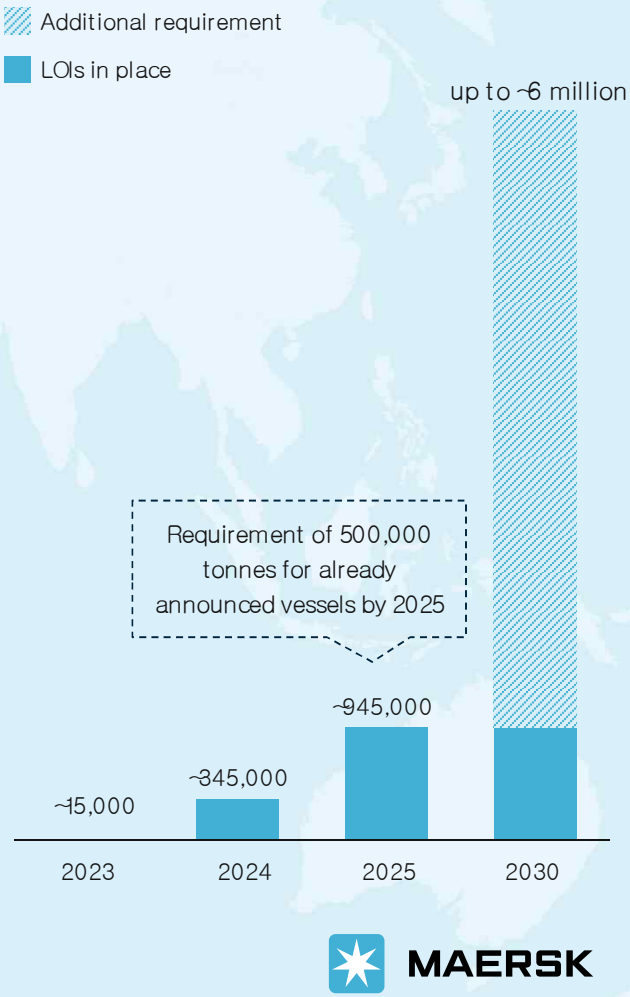
WASTEFUEL

- 30,000 tonnes per year
- First delivery in 2024
- South America

德博能源 DEBO ENERGY

- 200,000 tonnes per year
- First delivery in 2024
- China

Fuel supply from partnerships
(End of year production capacity)



MAERSK

Maersk Methanol Vessel Orderbook per Sep 2022

One 1,900 TEU Feeder
Delivery May 2023
from HMD Ulsan

MAN G50 Engine
1,500 m3 methanol tanks

Twelve 16,000 TEU Container vessels
Delivery from primo 2024 to mid 2025
from HHI Ulsan

MAN G95 Engine
16,000 m3 methanol tanks

MAERSK

Compact and efficient 16,000 TEU methanol fueled container vessels with high deployment flexibility

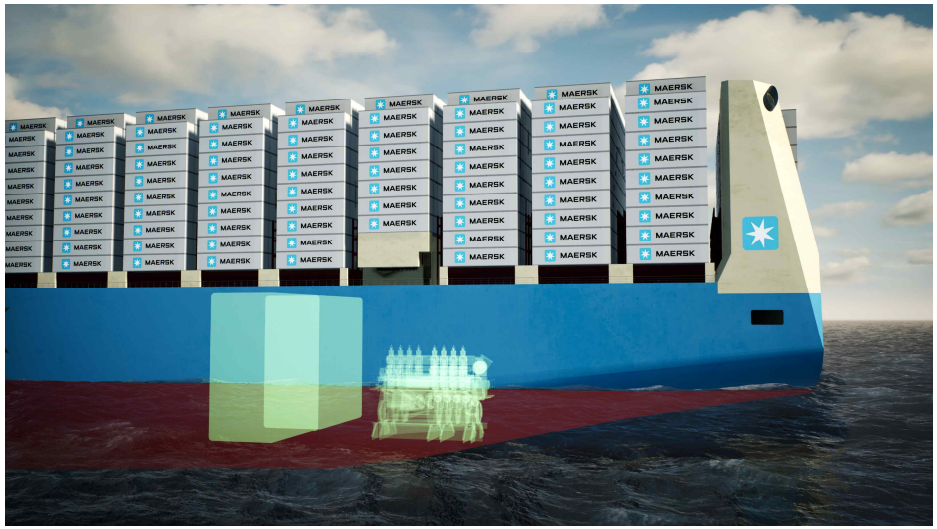
Different from Maersk's previous 15k vessels from HHI:

- ✓ **Methanol as Fuel** – having methanol dual fuel engines and able to operate 100% carbon neutral
- ✓ **Forward Accommodation** – increasing cargo intake and thereby transport efficiency
- ✓ **Aft Funnel** – increasing cargo intake and thereby transport efficiency
- ✓ **Improved port efficiency** – with all container accessible by terminal cranes without obstructions
- ✓ **Deeper hull** – increasing cargo intake and thereby transport efficiency

✓ **Overall: 20% more efficient than industry average & 1.5 mio ton CO_2 saved with 12 vessels per year operating on green methanol**

MAERSK

Design features of the 16.000 TEU methanol vessels



Main dimensions: 349 m x 53.5 m x 33 m

Capacity: 16,000 TEU incl. reefers 2000 FEU

Main engine: MAN 8G95ME-C10.5-LGIM (HHI-EMD)

Aux engines: Himsen 6W32M / 9W32M + Shaft generator

Methanol capacity: 16,000 m3 in two tanks

Class: ABS

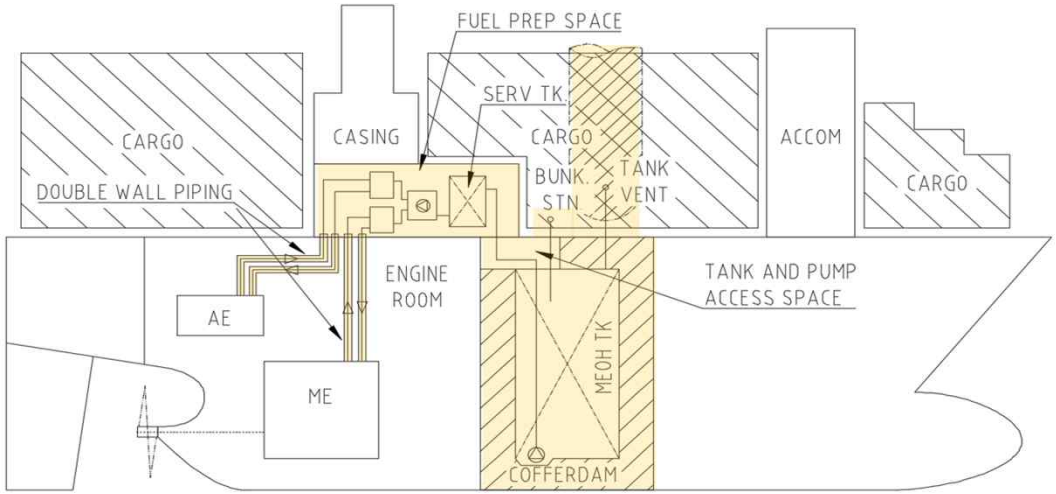
Flag: Danish

Challenges solved in design:

- ✓ **Methanol** supply and safety systems
- ✓ **Bunkering** of methanol and other fuels
- ✓ **Exhaust pipes** routed to aft portside funnel
- ✓ **Torsional strength** related to accommodation forward
- ✓ **Crew comfort** in accommodation
- ✓ **Perception of course** from navigational bridge
- ✓ **Lifesaving** from all areas of vessel
- ✓ **Navigation light** related to COLREG
- ✓ **Fuel saving** by various technologies

MAERSK

Key principles in design of a methanol container vessel



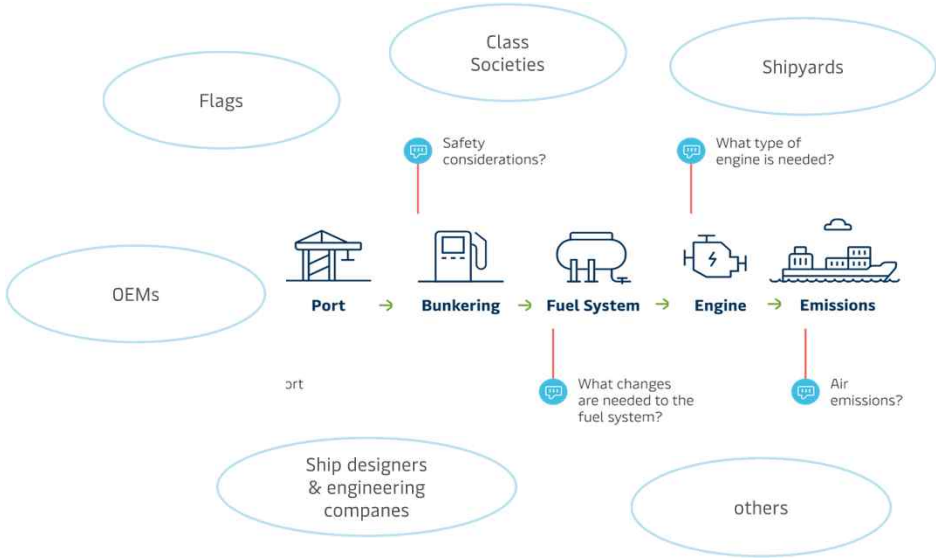
Hazardous areas

1. Inorganic zinc silicate coated Methanol tank, free of stiffening inside & split longitudinally (PS/SB)
2. Double barriers (cofferdam) protection surrounding methanol tanks
3. Fuel preparation room containing one service tank & 10-13bar fuel supply system
4. Separate supply system with LP ME & HP AEs
5. Tank venting safety system controlled by PV valves
6. Ventilated double wall piping for supply lines to AE/ME
7. Storage tanks and piping systems have nitrogen inertization & automatic purging system
8. Pilot fuel and other non-methanol fuel transferred via separate standard fuel system to AE & ME

MAERSK

Where should we work together to scale methanol as the short term solution for green shipping?

Improve	Regulatory framework & unified interpretations
Minimize	Hazardous zones
Improve	Methanol tank venting arrangement
Remove/Reduce	Methanol tank cofferdam towards shell below waterline
Define	Bunkering standards
Get approval	For key global ports & terminals (bunkering during cargo operations)



MAERSK

Kristian Agdrup
Lead Naval Architect
Maersk – Fleet Technology