MAN Energy Solutions
Future in the making

Status of DF conversion



Contens

1 Market status and outlook of alternative fuels

2 Methanol: the up-and-coming alternative fuel

3 Ammonia engine development update

4 Summary

5 Questions & Answers

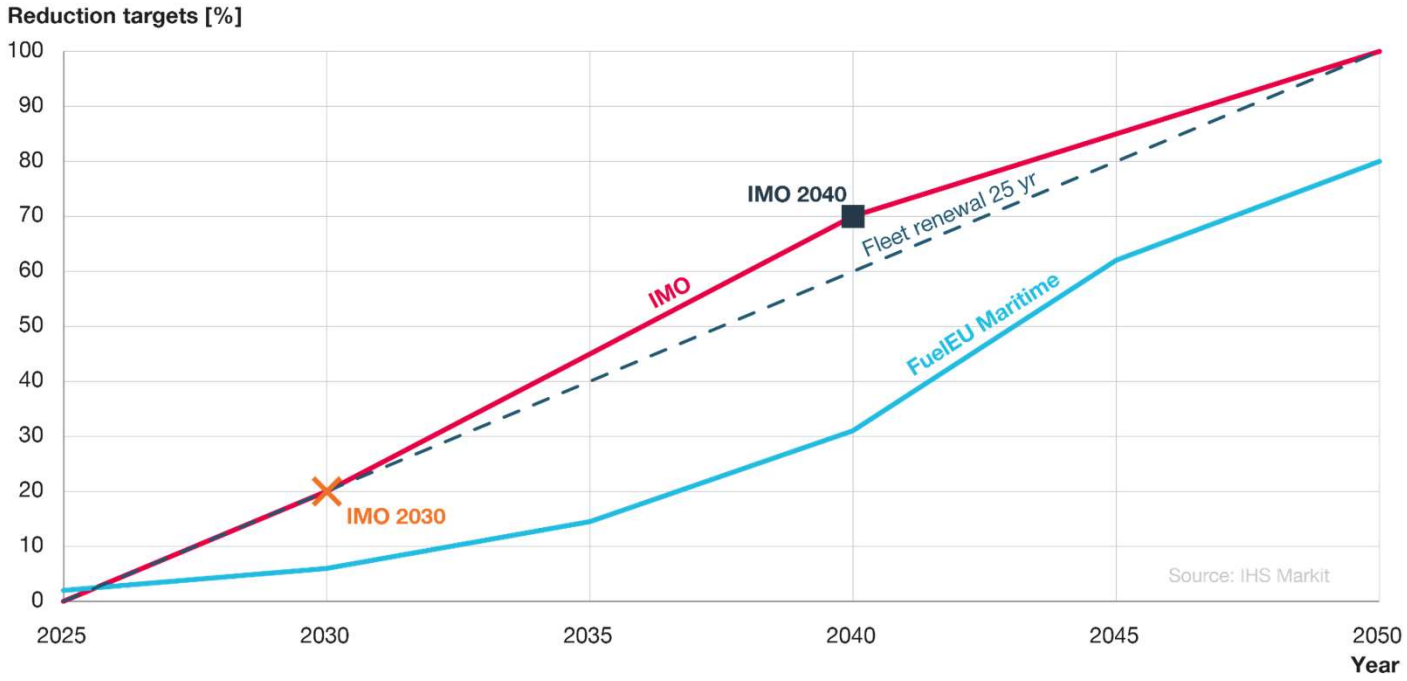


1 Market status and outlook of alternative fuels

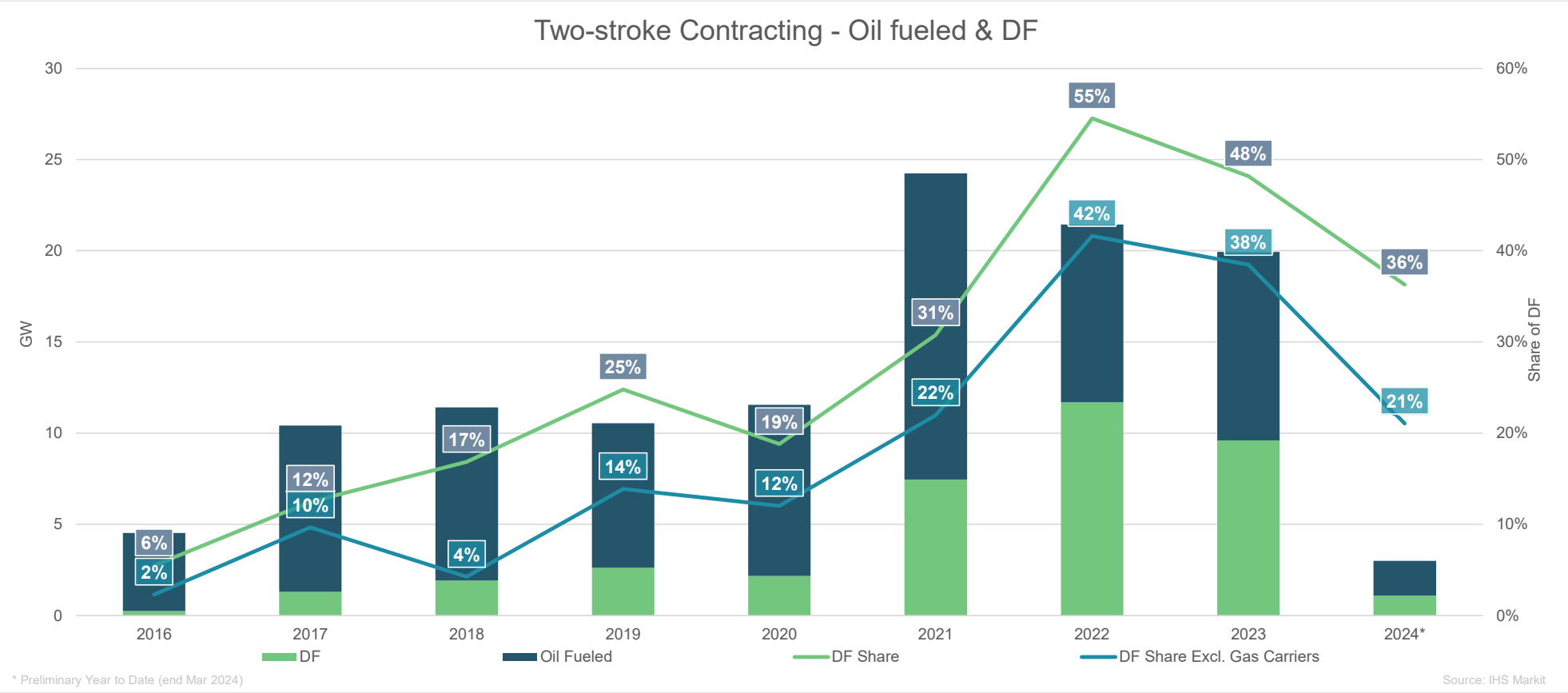
IMO targets will be the lighthouse for the energy transition

But the industry needs clarity on market measures which will make it possible to reach the goals. Bio-fuel oils and retrofits will be essential for existing fleet to reach mid-term targets

IMO	2025	2030	2035	2040	2045	≈2050
To 2008	-0%	**-20%**	-45%	**-70%**	-85%	**-100%**

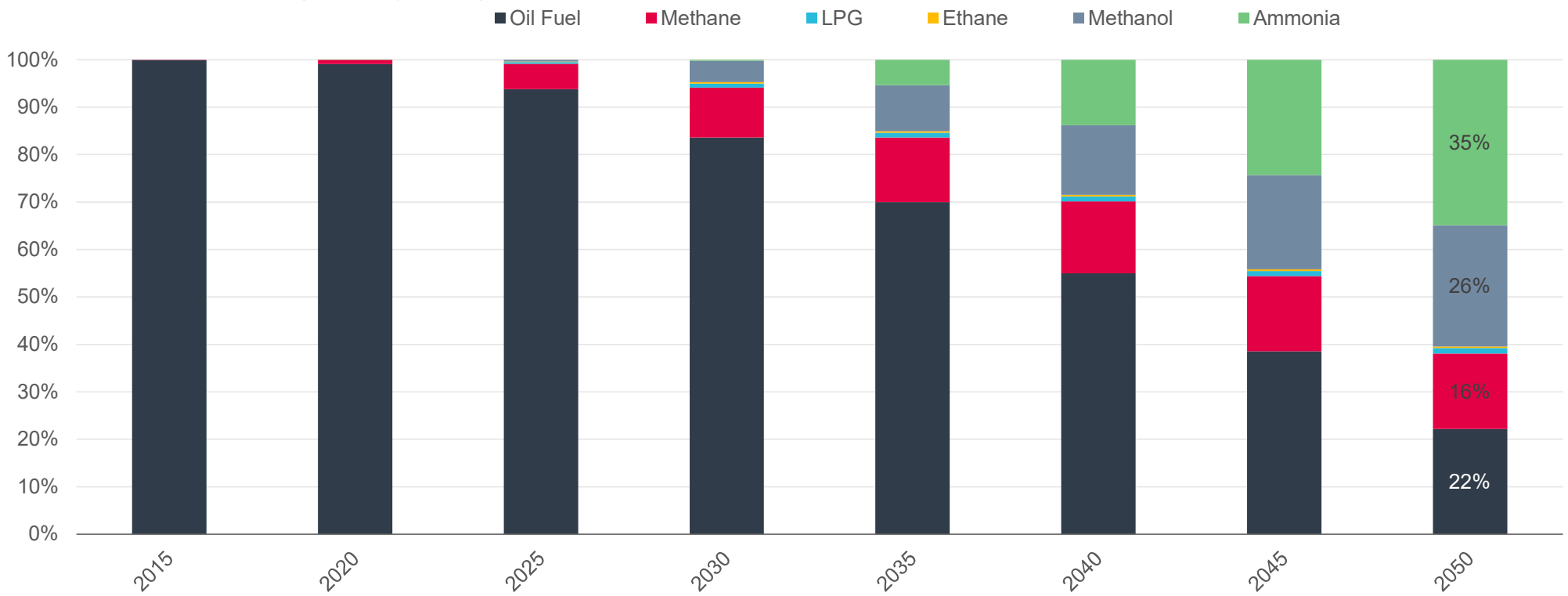


The maritime energy transition is picking up with two-stroke dual-fuel contracting



A multi-fuel two-stroke future fuel mix is expected

*After MEPC 80 scenario is Work in Progress and subject to changes



Multiple pathways are expected as part of the fuel mix. Many technologies are available already today with ammonia next in line.



Methane
ME-GI & ME-GA
696 274
17.7 GW. 3.9 GW.

LPG
ME-LGIP
198
2.8 GW.

Methanol
ME-LGIM
187
6 GW.

Ammonia
→

Ethane
ME-GIE
63
1 GW.

1400+
dual-fuel engine orders

Retrofits are essential to reach IMO targets

For the Existing fleet retrofits to fuels such as methanol, ammonia or methane, will play an important role to reach IMO targets



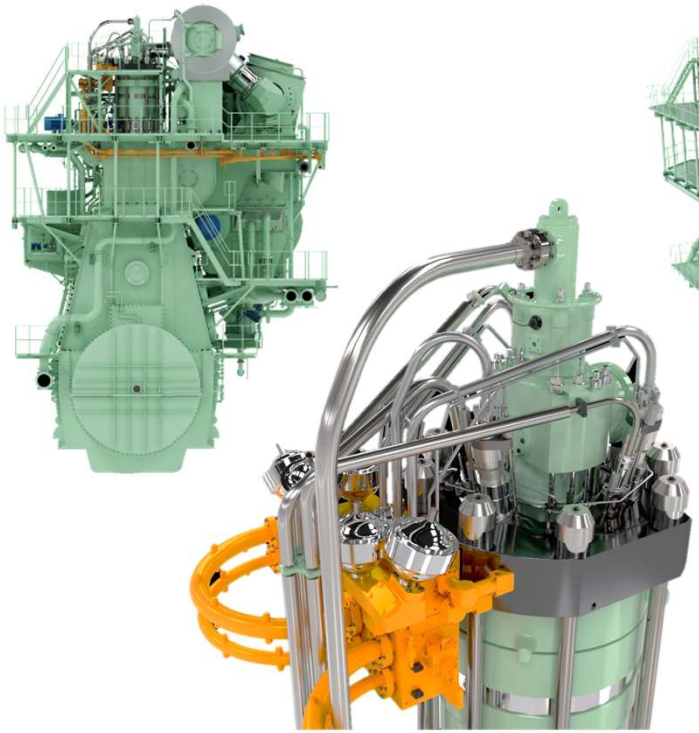
Retrofit scope related to auxiliary systems

Service tank



Low flashpoint fuel supply system





Fuel Valve Train



ME-LGIM ventilation



Nitrogen purging



Engineering	Production & transporation	Conversion / installation	Sea and gas trial
5 months Pending on final scope	9 months	1-2 months	¾ months



2 Methanol: the up-and-coming alternative fuel

MAN B&W ME-LGIM engine development milestones

2015 — 7S50ME-B9.3-LGIM Mitsui, Japan



2015 — Engine demonstration in Research Centre Copenhagen



2016 — 1st sea trial



2016 — 7G50ME-B9.3-LGIM HHI, S.Korea



2018 — G95-LGIM Introduced



2019 — First order for non-methanol tanker



2021 — G80-LGIM Introduced



2022 — First methanol powered container ship in service



2023 — G45 / S60 / G60 introduced



2024 — First 8G95ME-C10.5-LGIM in service



2024 — G70 introduced



When one shipowner turned, the marine market turned towards methanol





Pacific Basin Selects Methanol for Next Gen Dry Bulkers



Evergreen follows Maersk with $4bn methanol container ship push, despite fuel bill fears



China Merchants places order for methanol-fuelled VLCC

CONTAINER NEWS

COSCO places orders for 12 methanol-powered giant ships

October 31, 2022



Brookes Bell Home Marine Services Laboratory Services

HMM Orders Nine Methanol-Fuelled Containerships

Ship & Bunker

CMA CGM Moves Ahead of Maersk on Methanol Powered Ship Orders

by Ship & Bunker News Team

Wednesday April 12, 2023

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Kambara Kisen orders methanol-powered bulker, inks charter deal with MOL



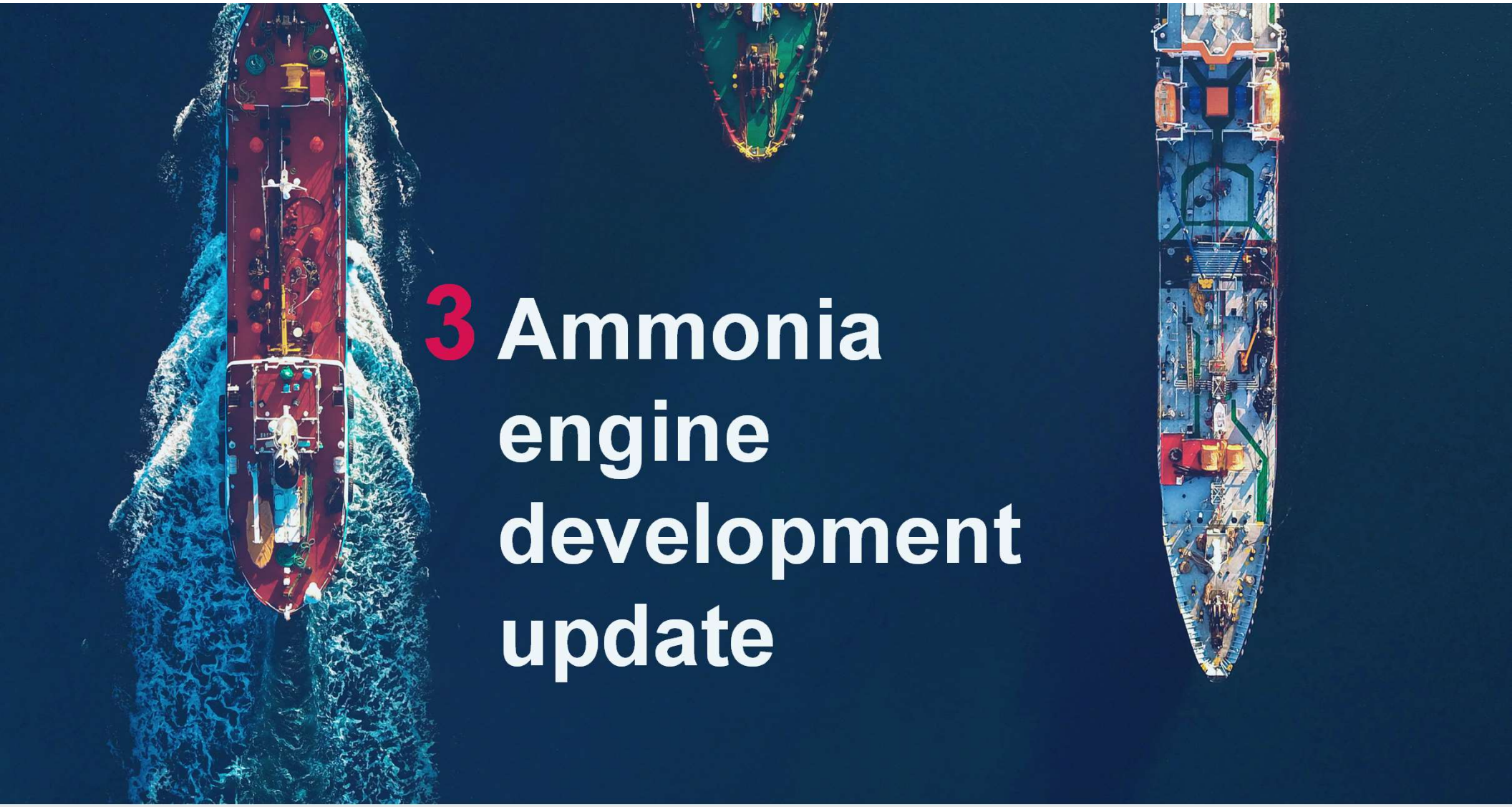
OFFSHORE ENERGY NEWS PREMIUM EDITORIALS PARTNERS JOBS

X-Press Feeders orders six methanol dual-fuel boxships

China Merchants Orders Large, Methanol-Fueled Vehicle Ro-Ros



China Merchants plans up to six Ro-Ros fueled by methanol (China Merchants file photo)



3 Ammonia engine development update

Two-stroke ammonia engine combustion

Important focus areas

N_2O

Combustion slip

Auto ignition temperature

Flamespeed



Two-stroke ammonia engine combustion

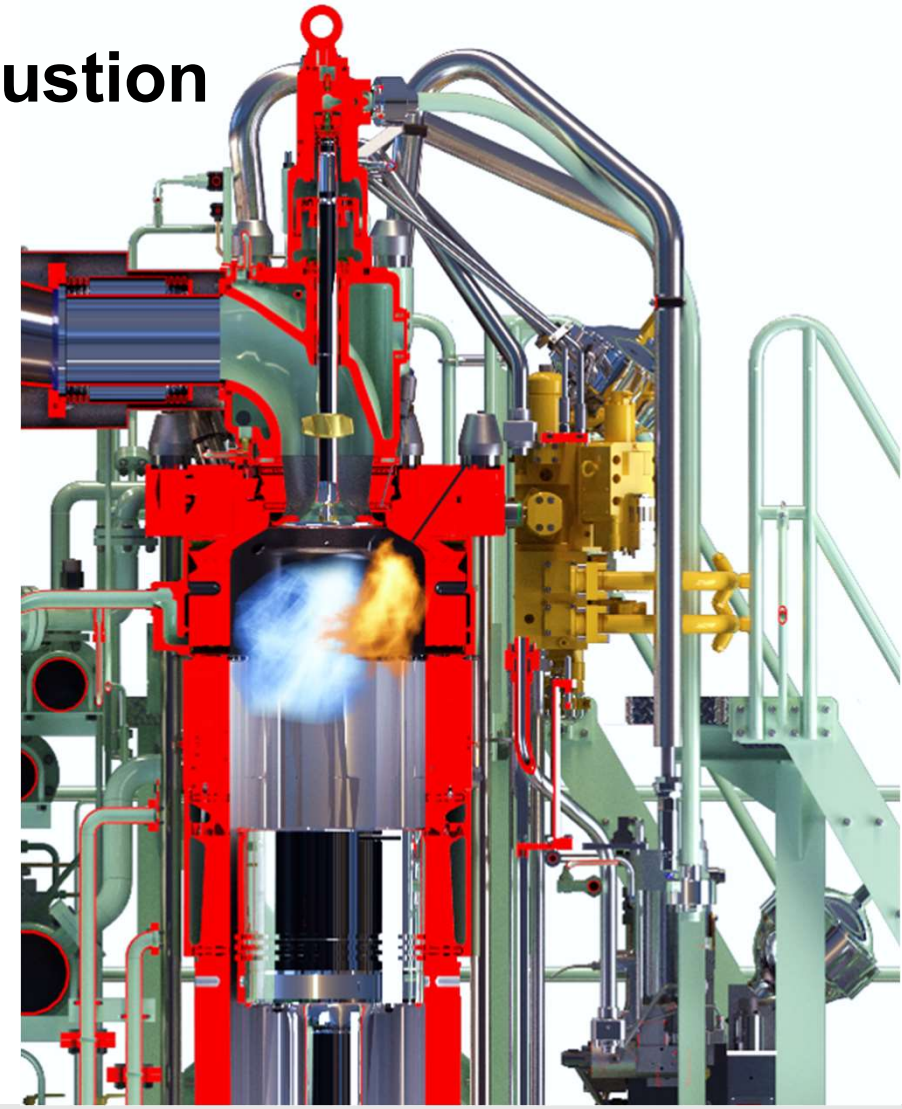
The MAN B&W ME-LGIA design philosophy

“Ammonia mode”:

- Small pilot flame needed.
- Target of 5% **S**pecific **P**ilot **O**il **C**onsumption at 100% load for L1-rated engines has been reached.
- We target to obtain same heat rate as “fuel oil mode”.

“Fuel oil mode”:

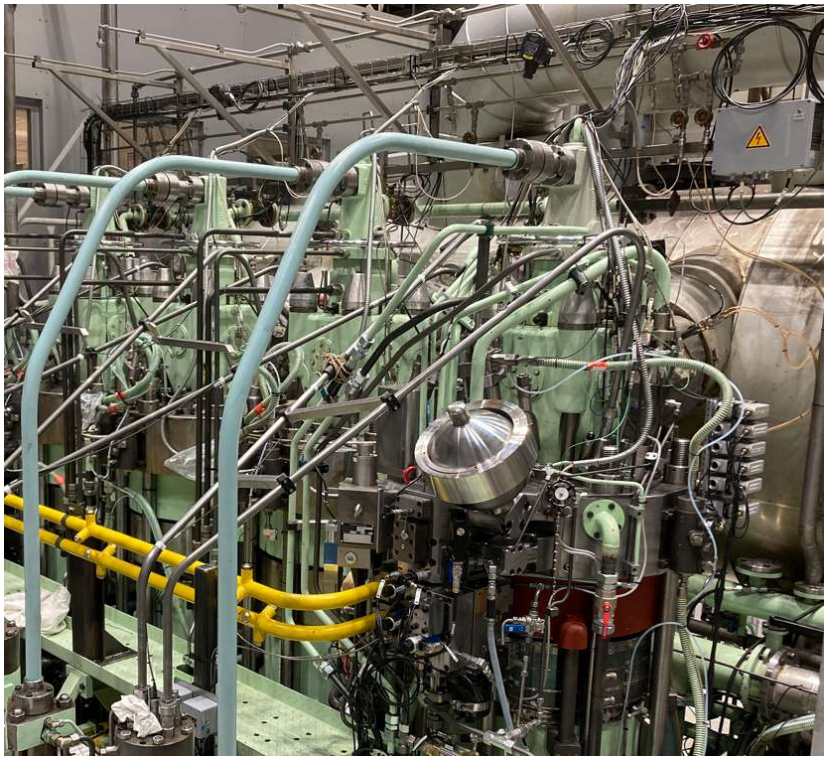
- We target identical performance as a conventionally fueled Diesel engine.



Two-stroke ammonia engine combustion

Status on the ammonia engine testing

- 3rd of July 2023: First two-stroke ammonia combustion
- Over 300 tests and 175,000 R&D man hours clocked
- Engine testing includes both performance and emissions tests in load points from 10-100% load
- Pilot oil energy fractions similar to other LGI engines
- N_2O emissions are extremely low and are handled by engine tuning alone
- NOx emissions approximately 40% lower than conventional fuel oil. Can be adjusted according to final engine tuning
- Ammonia slip is minimized by design and performance modifications



Upcoming test campaign steps in Research Centre Copenhagen

1-cylinder testing

- Reducing NH3 slip further
- Balancing NOx/NH3: exploring performance handles
- Diesel atomizer optimization and pilot oil testing
- FBIV-A injector type testing



4-cylinder testing

- Full engine performance testing with optimization of turbo charging incl., EGB etc.
- Testing of SCR and emission control strategies

7S60ME-C10.5-LGIA at Mitsui E&S Co., Ltd.

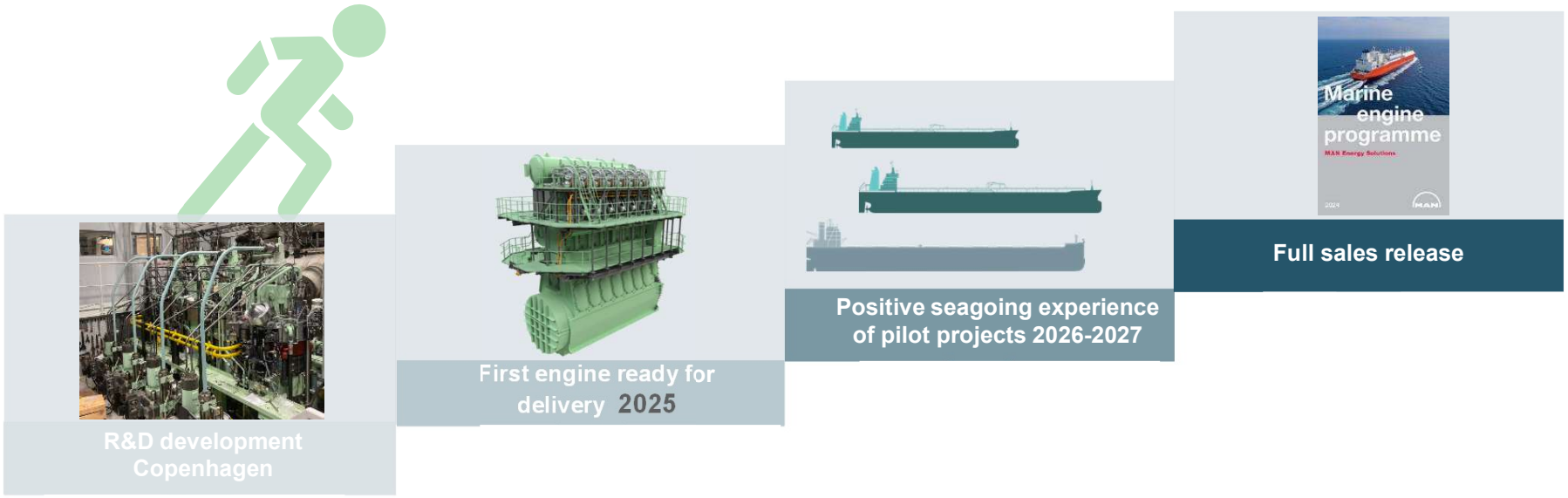
Assembly well underway. Currently some components remain to be mounted. Start on diesel in Jun with Ammonia running scheduled by August.

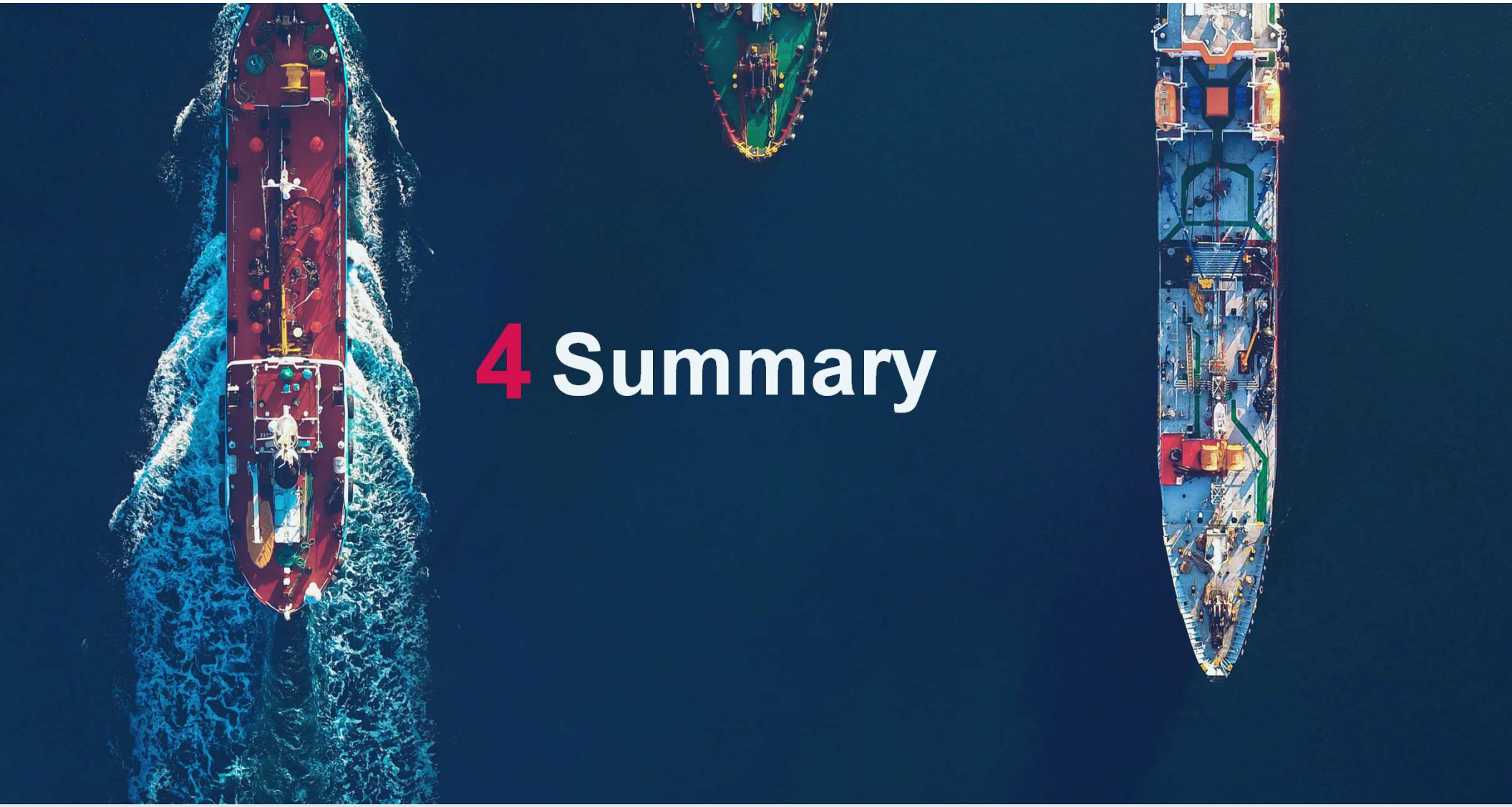


Two-stroke ammonia engine main development timeline

Pilot projects in Korea, Japan and China.

Release of G50, S60, G60, G70 and G80 ME-LGIA to the market as soon as the first vessel or vessels have demonstrated positive seagoing service experience operating on Ammonia. As such the actual time schedule will be pending shipyard delivery schedule. A best guess time estimate for sales release is end of 2026



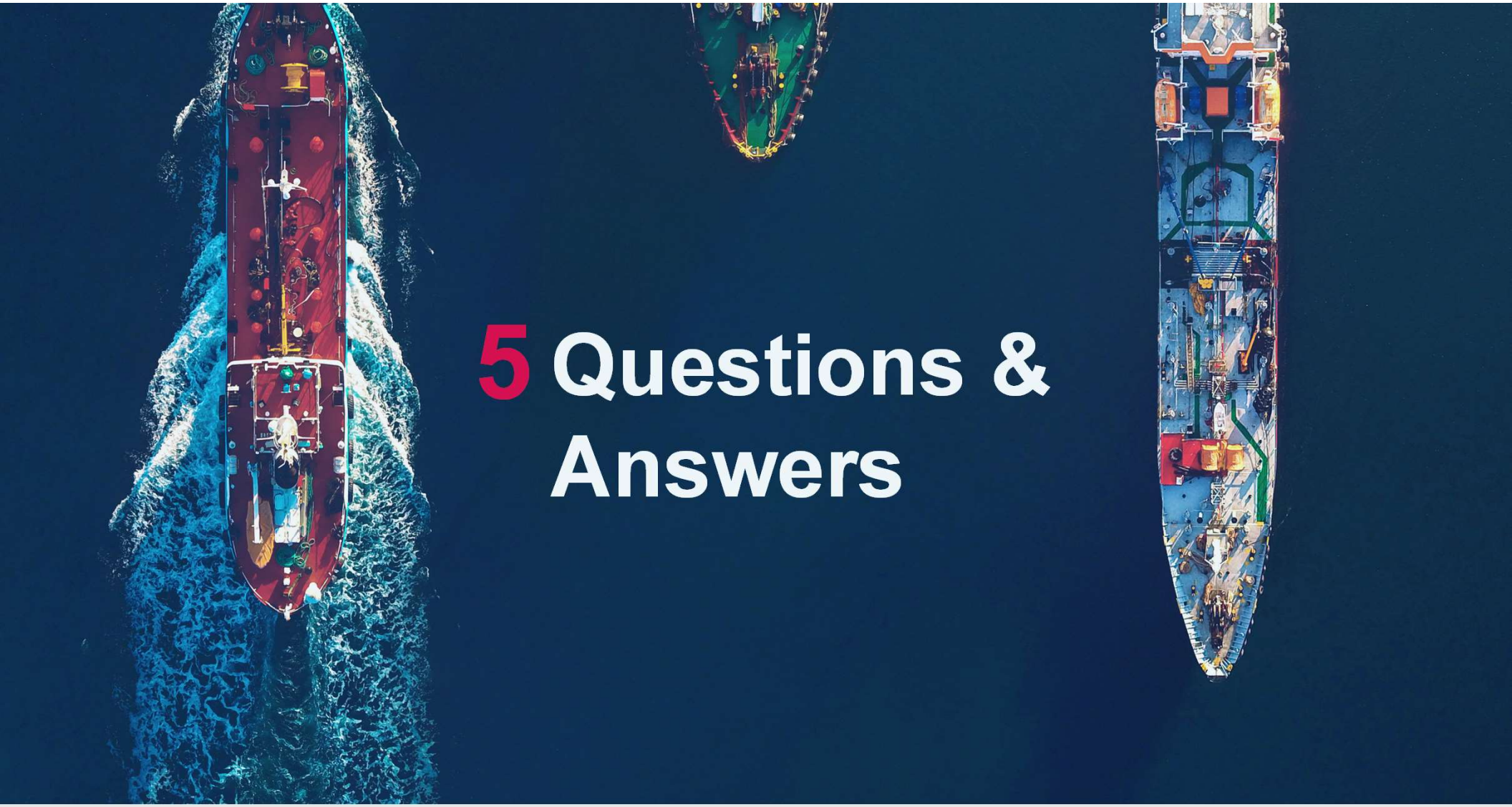


4 Summary

Summary: The maritime energy transition has started, and the sector is *now scaling and implementing green* tech

1. The market measures to reach IMO GHG targets will be agreed upon in 2025 and in force by 2027
2. Dual-fuel engines, in combination with energy-saving technologies, can be selected for newbuildings now
3. For existing electronically controlled engines, a dual-fuel conversion can be advantageous in order to reach IMO targets
4. A diverse future fuel mix is expected, many engines powered by methanol will be delivered in upcoming years
5. Ammonia development successful. Pilot projects for G50, S60, G60, G70 and G80. Full sales release after positive seagoing service experience. A best guess time estimate for sales release is end of 2026




5 Questions &
Answers

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Thank you very much!



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