A new chapter - ammonia two-stroke engines

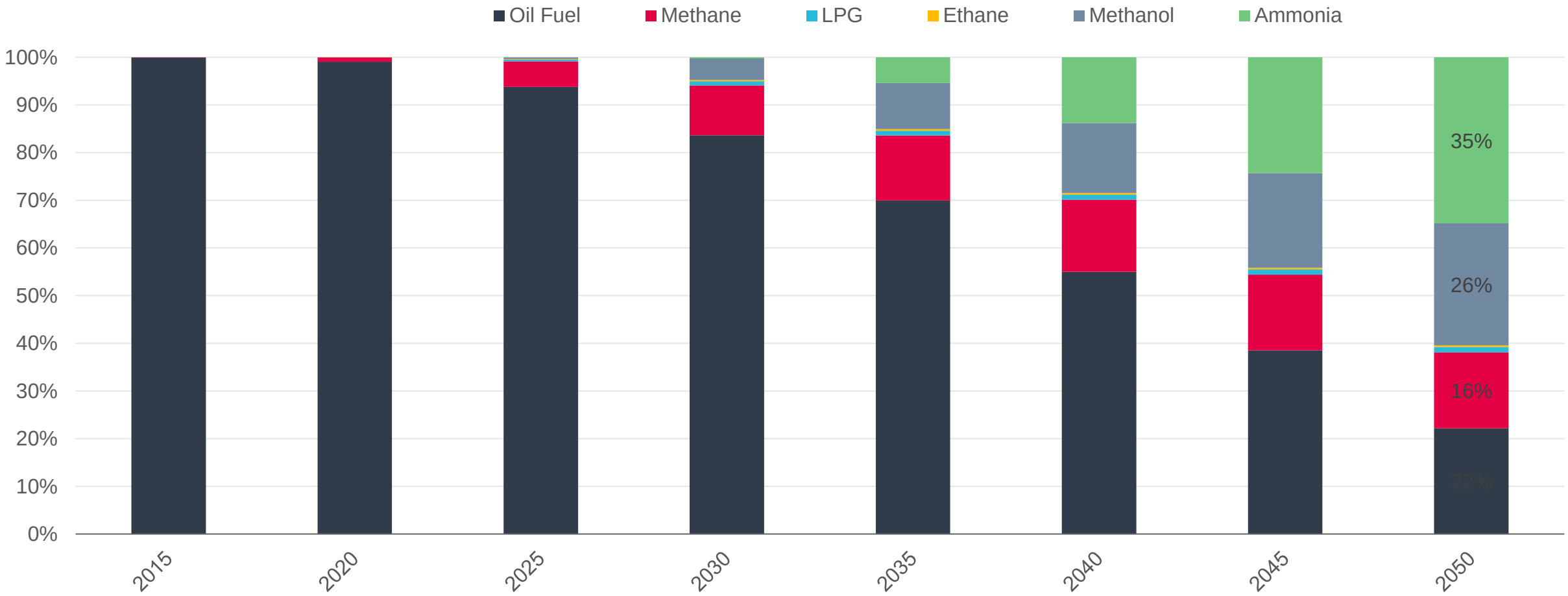
MAN Energy Solutions
Future in the making

Powering the maritime energy transition

Rasmus Holm Bidstrup
Head of Two-Stroke Promotion, Newbuildings
Rasmus.Bidstrup@man-es.com

Ammonia is expected to be the most prominent fuel by 2050

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



Unlocking the potential of ammonia as marine fuel

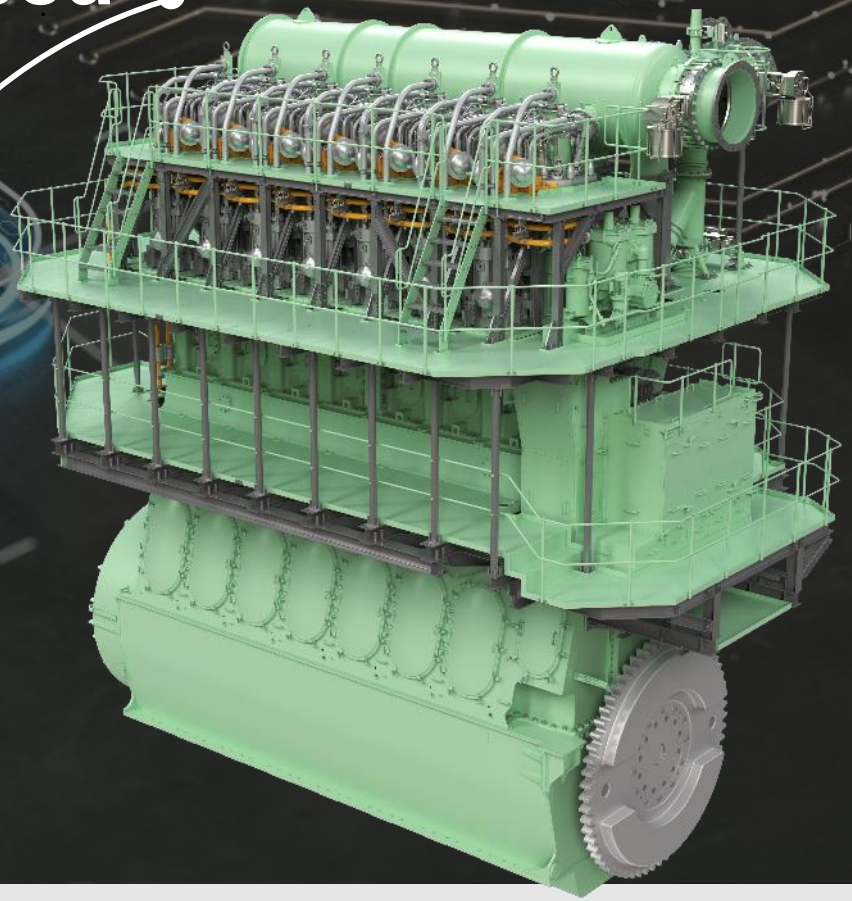
Important focus areas

Flamespeed

Auto ignition temperature

Combustion slip

N_2O



Findings after one year of R&D engine testing

Status on the ammonia engine testing

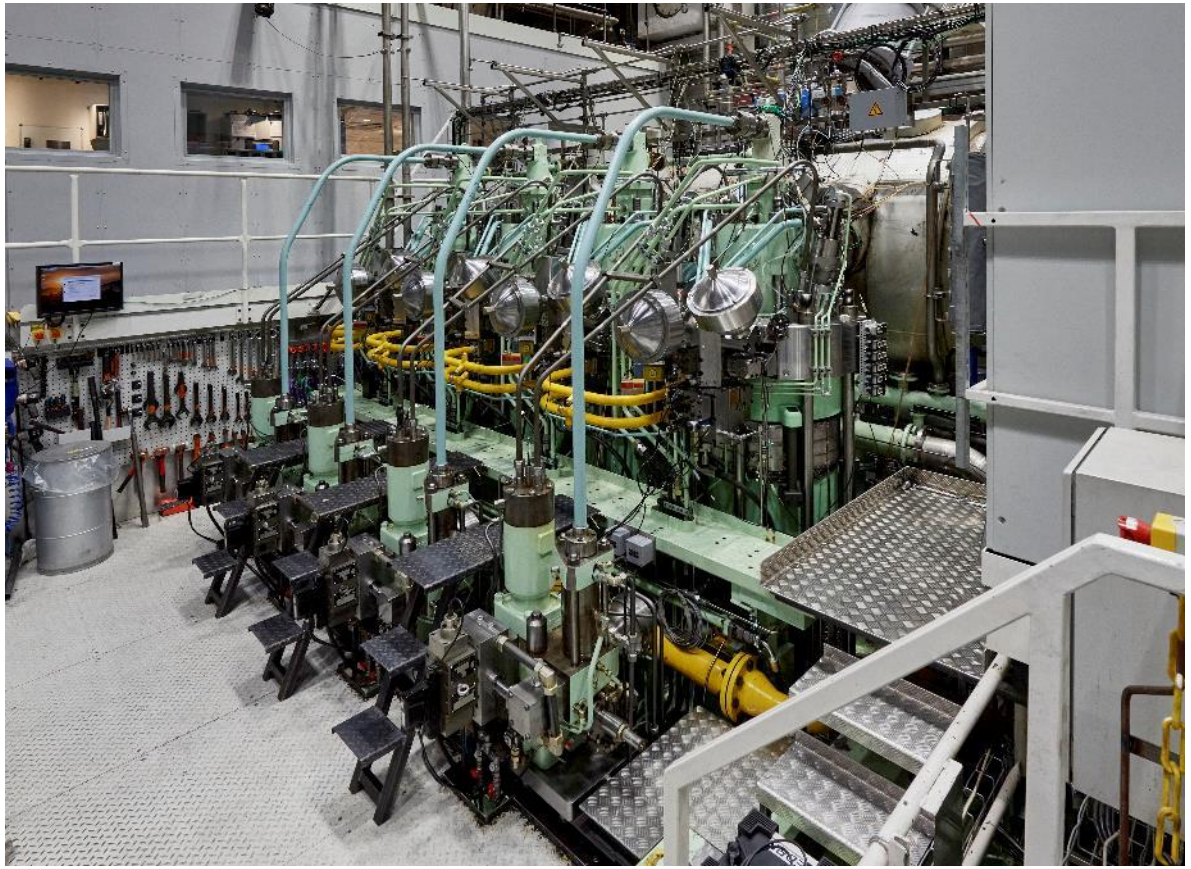
– Good combustion stability.

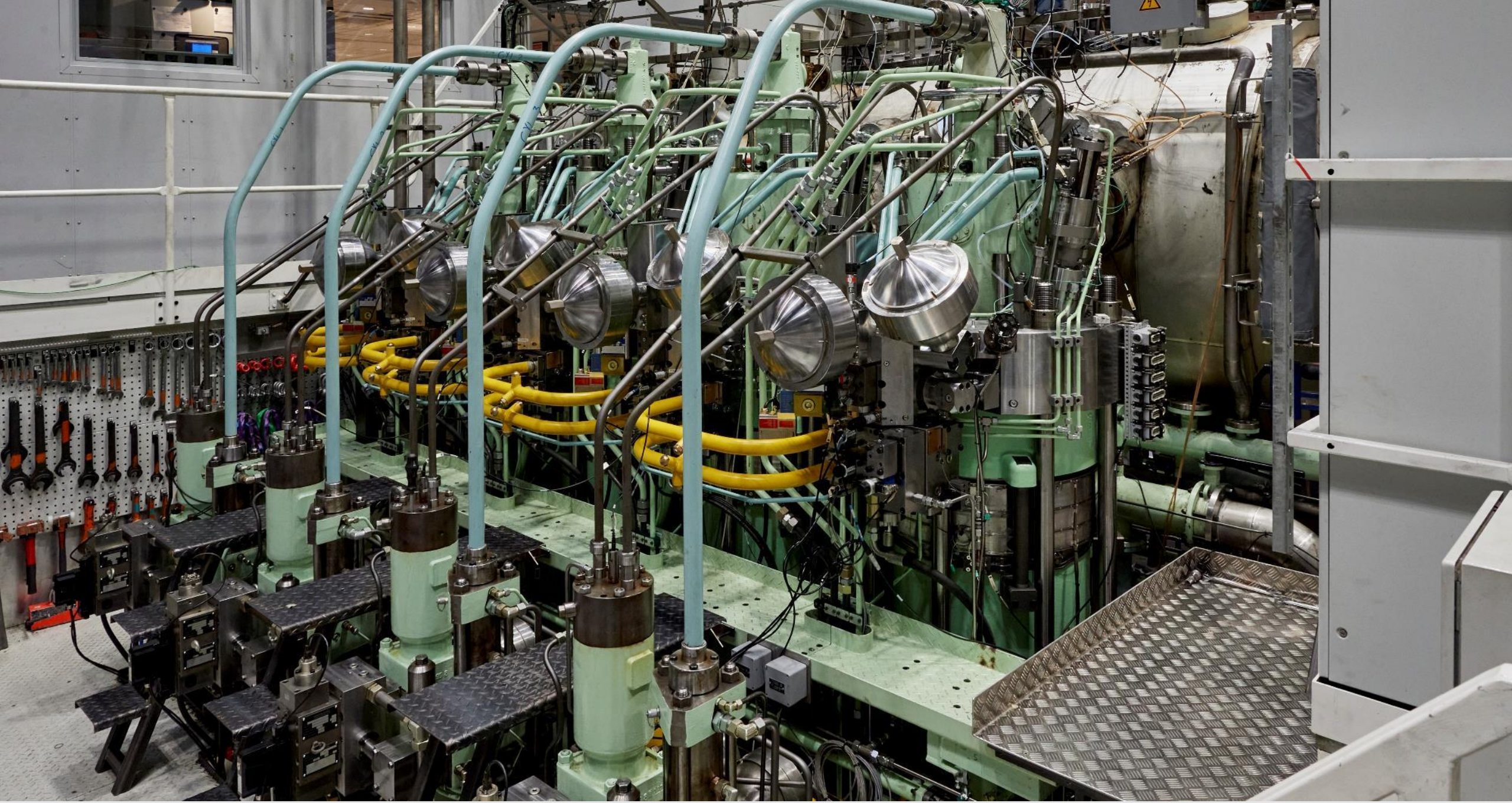
– Pilot oil energy fractions similar to methanol and LPG.

– N_2O emissions are extremely low and are handled by engine tuning alone.

– NO_x emissions approximately 40% lower than conventional fuel oil.

– Ammonia slip is minimized by design and performance modifications.





7S60ME-C10.5-LGIA at MES has been operated on Diesel. Currently the ammonia auxiliary systems are being finalized. Delivery time schedule will be pending shipyard delivery schedule.

Additional safety systems are required to handle the toxicity levels of ammonia

Ammonia service tank

Ammonia supply and recirculation system

Fuel valve and return train

Nitrogen purging

Double wall ventilation and absorber

Ammonia catch system

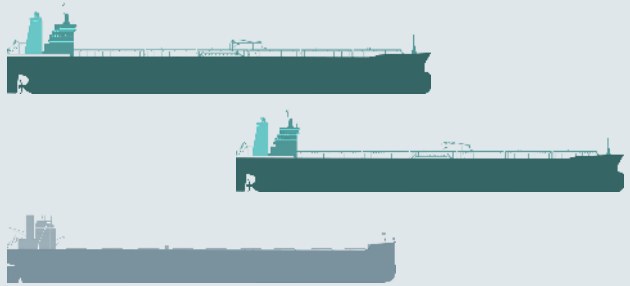
Two-stroke ammonia engine market introduction strategy

Pilot projects in Korea, Japan and China.

We have engaged in a number of pilot projects in order to safeguard the introduction of ammonia as marine fuel. Full sales 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 of these engines is end of 2026.
- The pool primarily includes VLAC, large bulk carriers as well as PCTCs.

R&D development Copenhagen



Positive seagoing experience of pilot projects 2026-2027

Full sales release

Summary

- Very high expectations to ammonia as a marine fuel due to high PtX efficiency.
- Positive R&D results based on one year of 2-stroke engine testing.
- Full sales release expected by end of 2026 based on positive seagoing-experience.
- Pilot projects with different engine and vessel types, will enable a fast uptake once the engines are introduced for full sales release.
- The toxicity challenge of ammonia as a marine fuel remain a crucial focus are and requires a responsible introduction of ammonia as marine fuel.

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Thank you very much!