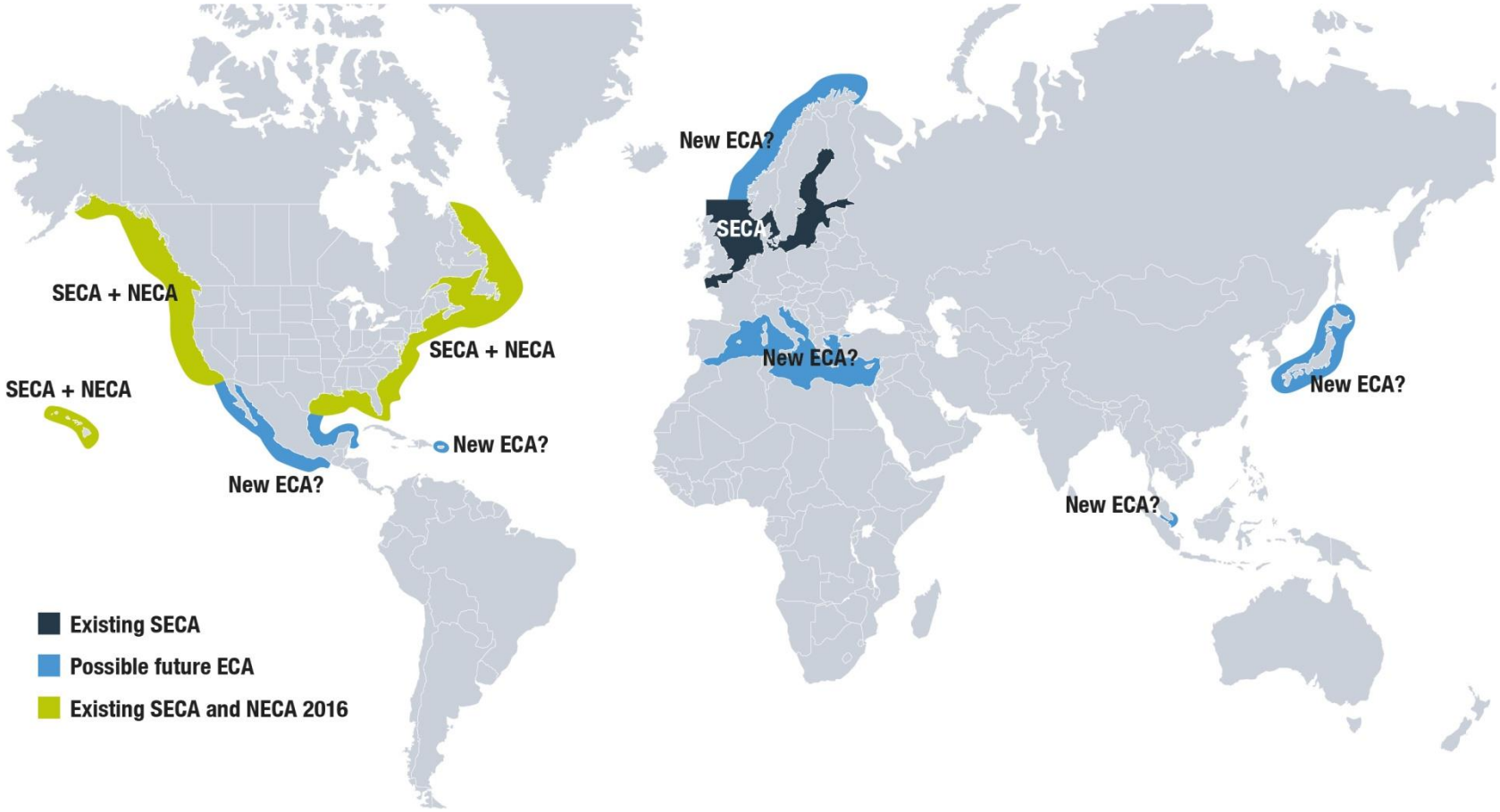
CIMAC Circle at SMM September 2016.

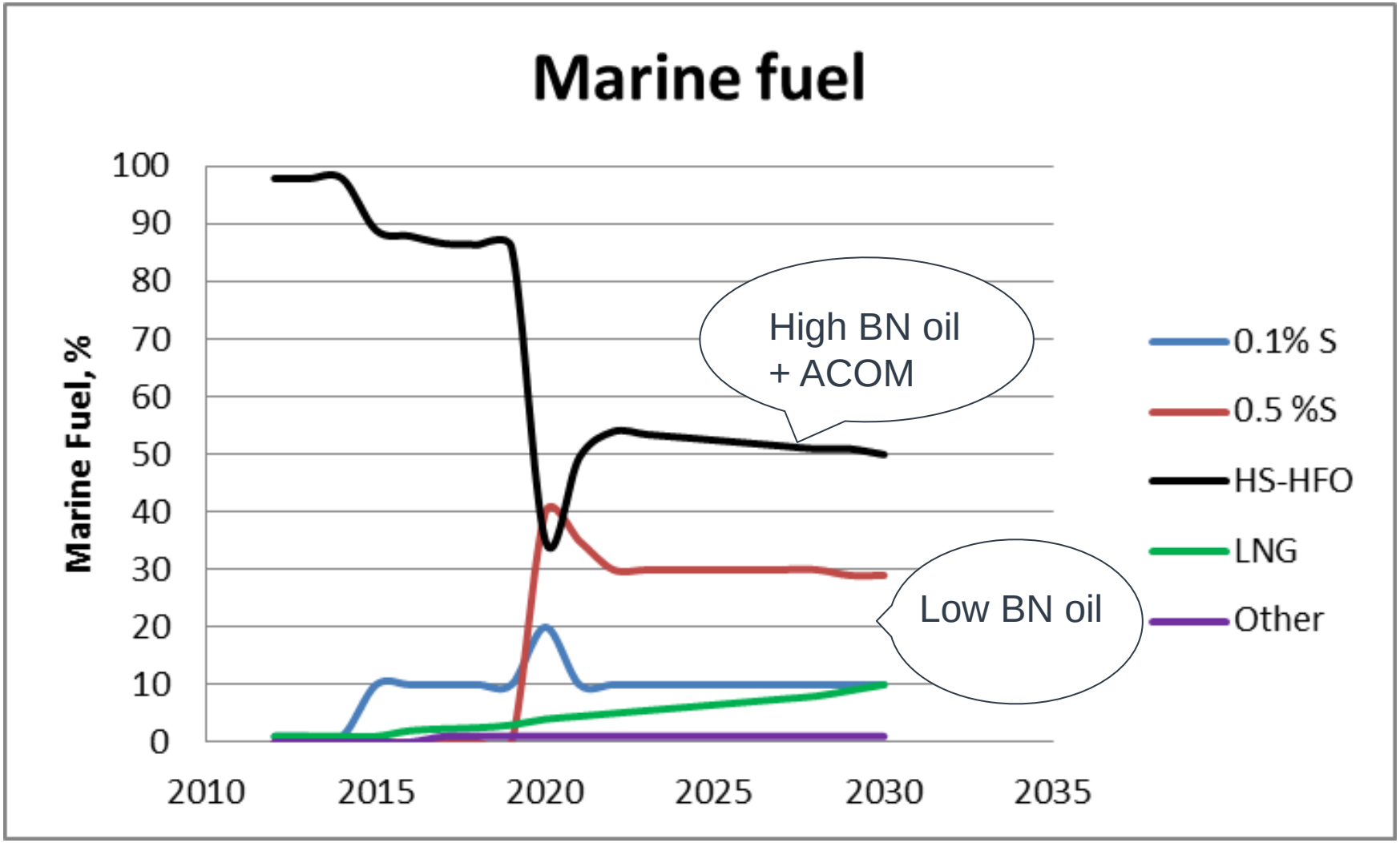
"IMO Tier III strategies under the light of changes in the oil market"

Presented by Kjeld Aabo
Director Customer support
MAN Diesel & Turbo
Copenhagen, Denmark

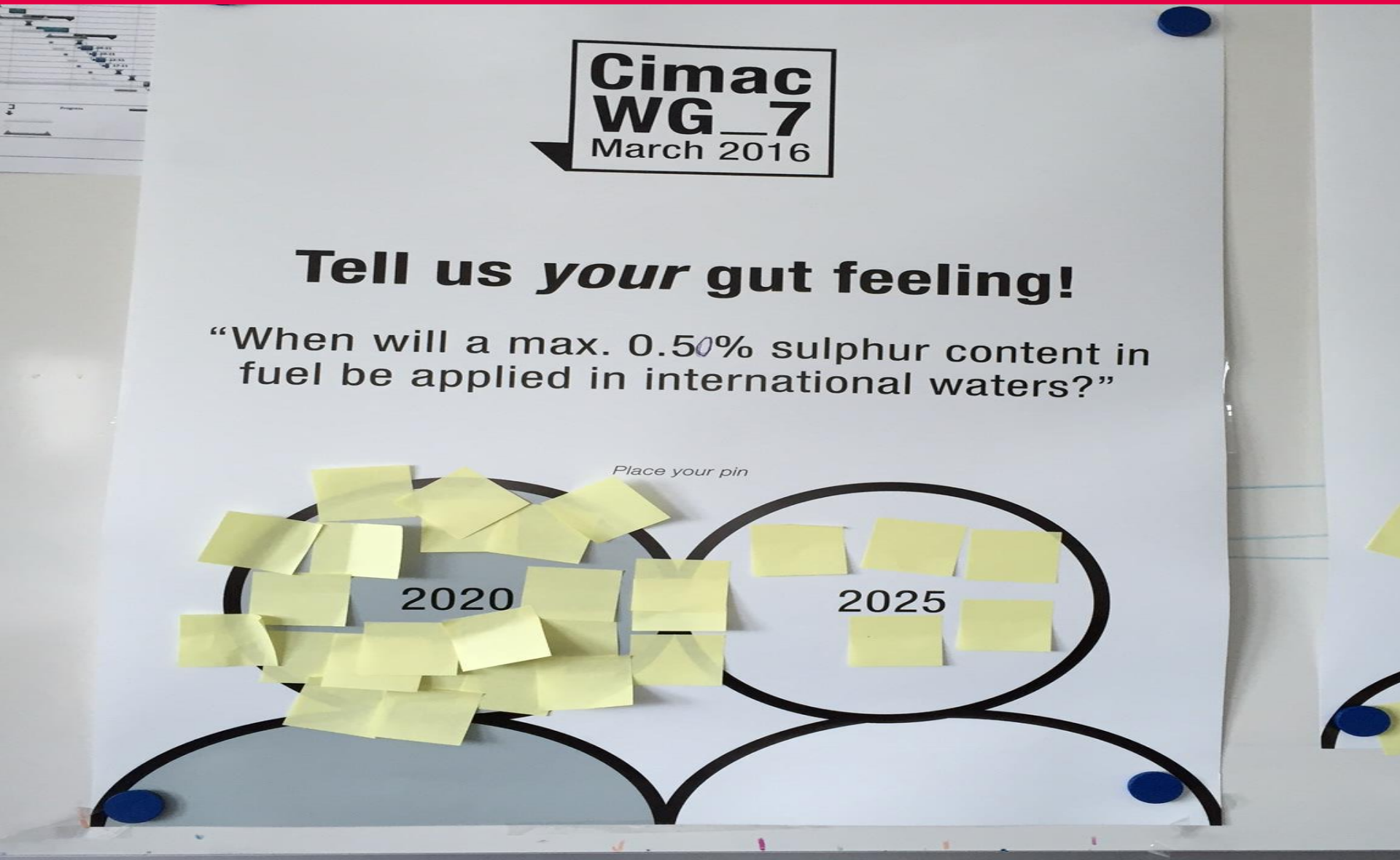
Existing and Future ECA Areas (DNV)



MDT Future Fuel Outlook, 2016



0.5% Sulphur Limit in International Waters 2020 or 2025?



NO_x Reduction Technologies

Available Methods

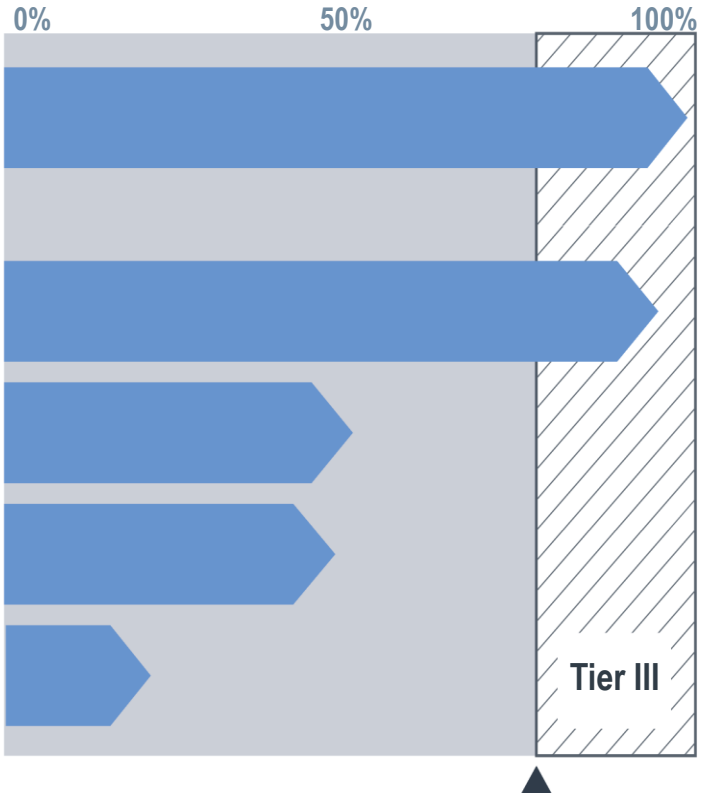
After Treatment

- SCR, HP or LP

Primary method

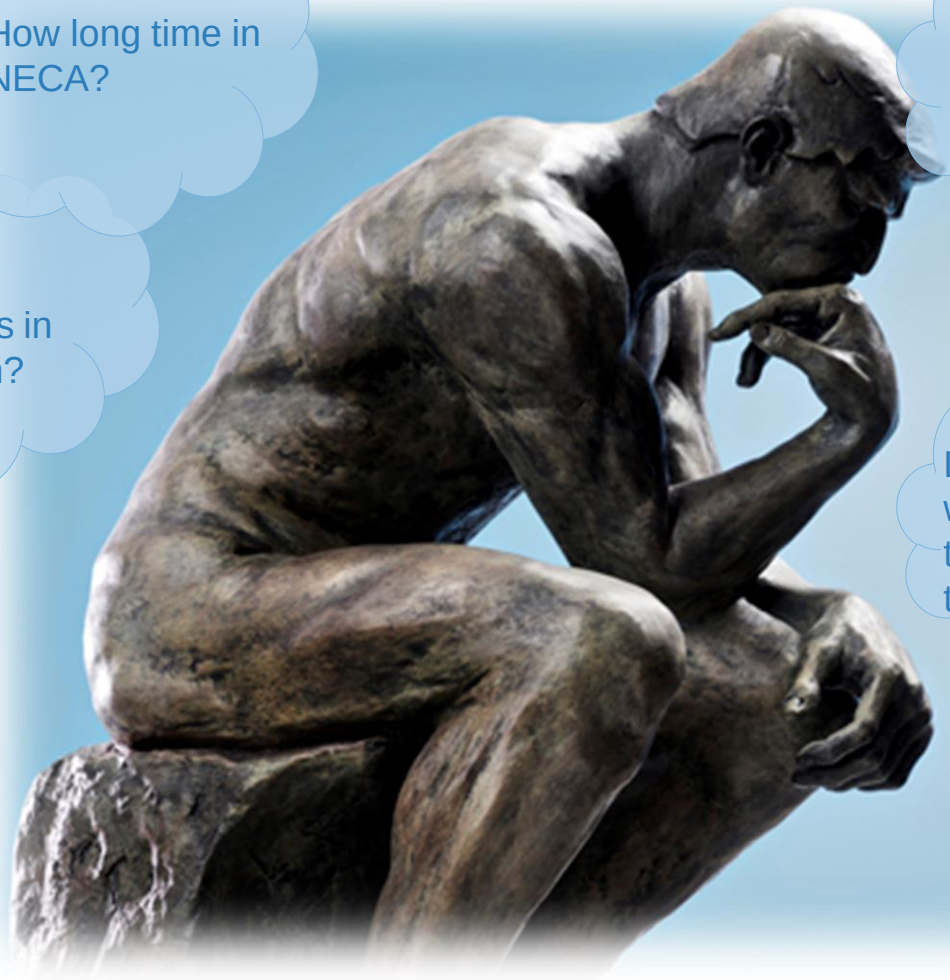
- EGR, HP or LP
- Emulsion fuel
- Water injection
- Engine tuning

Possible NO_x Reduction



SCR: Selective Catalytic Reduction System; **EGR:** Exhaust Gas Recirculation System
Combination of Methods also being pursued

Tier III questions



How long time in NECA?

Which fuels?

Space requirements in engine room?

Which Tier III technology?

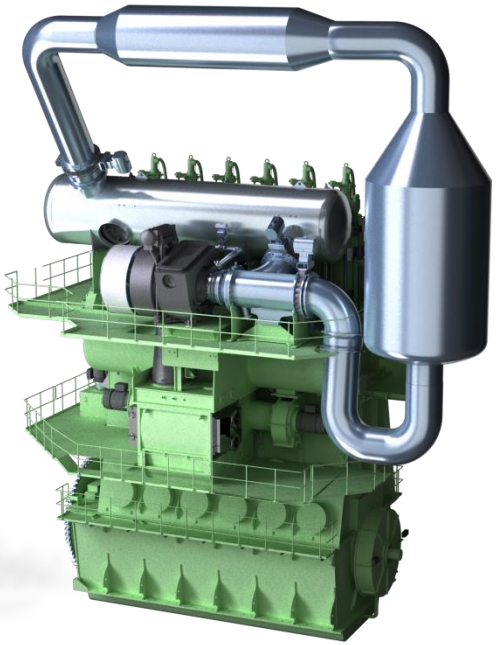
Logistical issues with bunkering and tank emptying of tanks?

SOx compliance strategy

MDT Tier III Technologies

EGR

HP-SCR



LP-SCR

EGR = Exhaust Gas Recirculation

SCR = Selective Catalytic Reduction

EGR and SCR

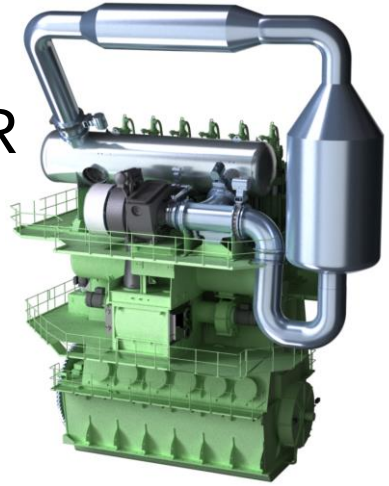
Fully documented and specified

ERCS for EGR and SCR

Emission Reduction Control System (ERCS)

EGR

HP SCR



- Control of all valves
- Measurement of O_2 in scavenging air
- Control of NO_X reduction through control of recirculation rate (EGR blower rpm), determining scavenging air O_2
- ”Near limit” control of EGR to avoid smoke

- Control of all valves
- Measurement of NO_X in exhaust gas
- Control of NO_X reduction through control of NH_3 dosing (urea dosing signal)
- Limiters for high and low NH_3 in order to avoid NH_3 slip and ABS formation
- Too low reactor inlet T=> by-pass SCR

Selection of Tier III Technology

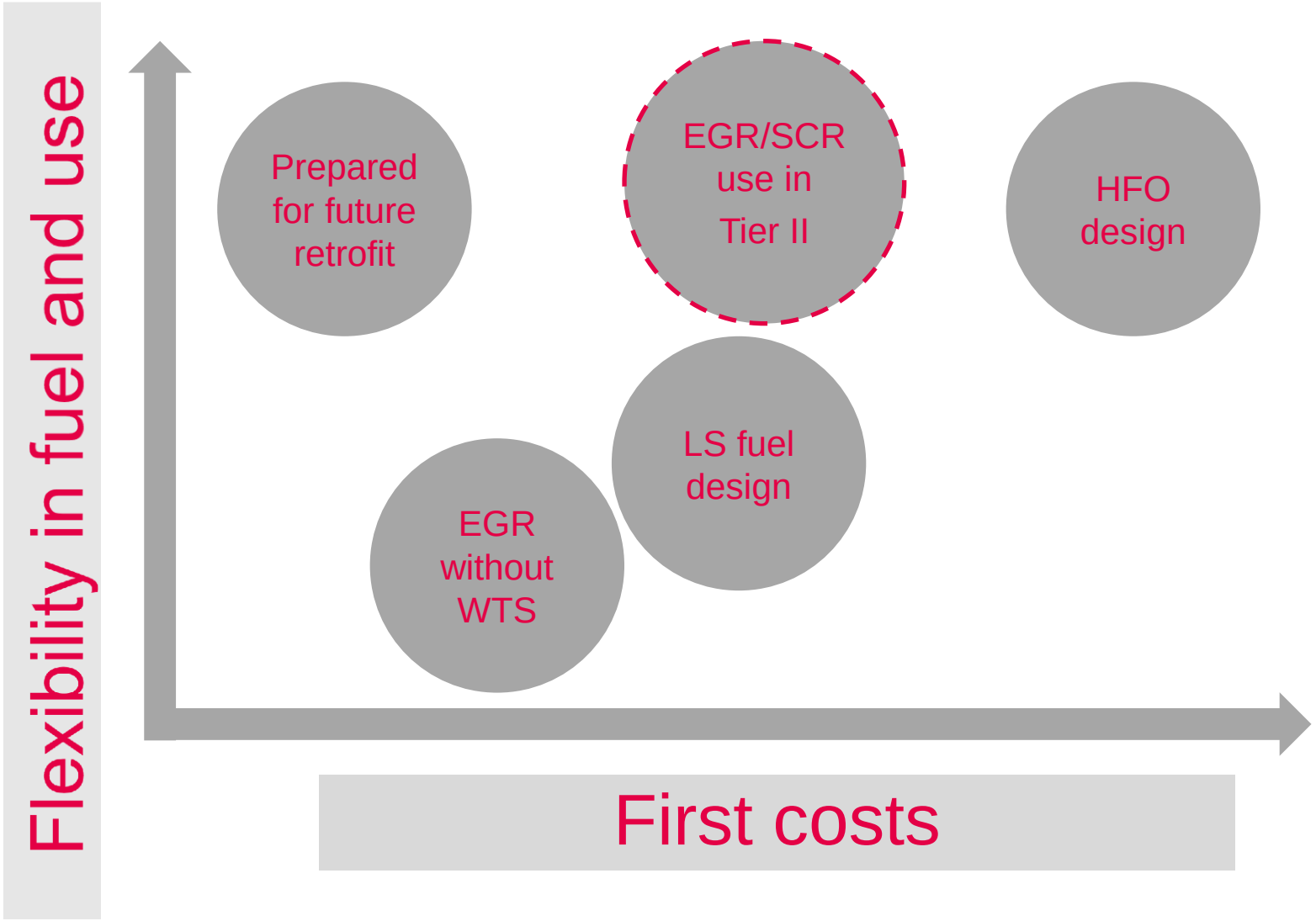
EGR
On-Engine

SCR
HP or LP

Deciding factors:

- Yard preferences
  - First cost (CAPEX)
  - Space requirements
  - Installation flexibility
- Owner preferences
  - Operation cost (OPEX)
  - Operation simplicity
  - Reliability
  - Maintenance cost
  - Waste disposal cost

Tier III Solutions Layout



Interested in more information?

MDT 2-stroke ”Emission Project Guide”

Find it at www.mandieselturbo.com under:

”Marine Engines and Systems” /

”Two Stroke” /

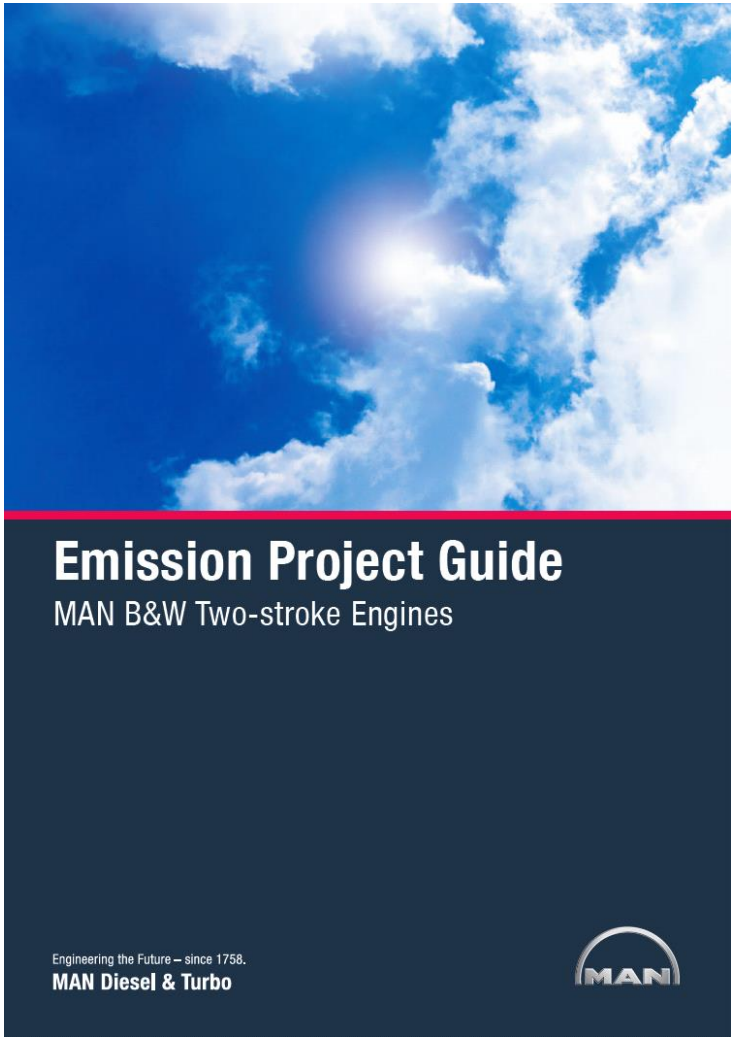
”Project Guides” /

” Other Guides” /

” Emission Project Guide”

NOTE: this also includes info on:

- SOx scrubbers
- Combined EGR + SOx scrubber
- SFOC penalties
- All consumptions
- Installation issues
- Compliance



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With MAN B&W engines

Thank you for your attention