

MAN Energy Solutions
Future in the making



MAN B&W Dual Fuel Engines



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We are committed to decarbonization

~ **80-90%** of global freight is transported by sea.

Shipping is responsible for ~ **3 %** of the global CO₂ emissions.

~ **50 %** of global freight is transported by a MAN ES engine.

Our engines are responsible for ~ **1.5 %** of the global CO₂ emissions, so we have a significant impact on the global maritime sustainability agenda.

CO₂ emissions: IMO and EU

Overview Future Fuels & Emissions

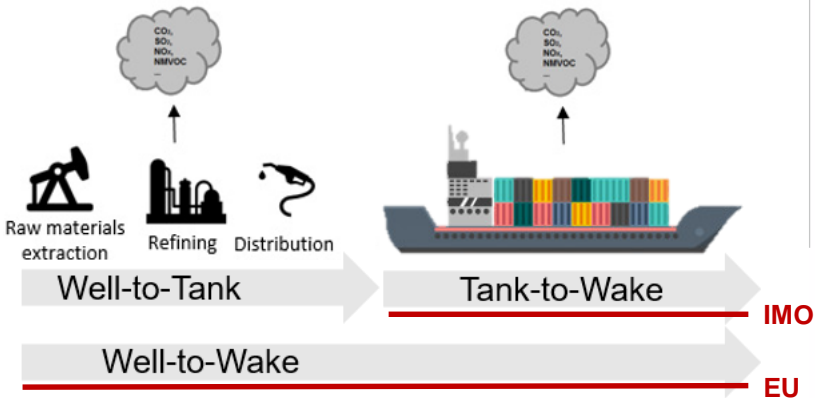
IMO:

- Focus on **Tank-to-Wake** emission of GHG (this is likely to change however)

40% reduction per transport work by 2030 relative to 2008

70% reduction per transport work by 2050 relative to 2008

50% reduction of GHG emissions by 2050 relative to 2008



EU Proposal “Fit for 55” FuelEU Maritime:

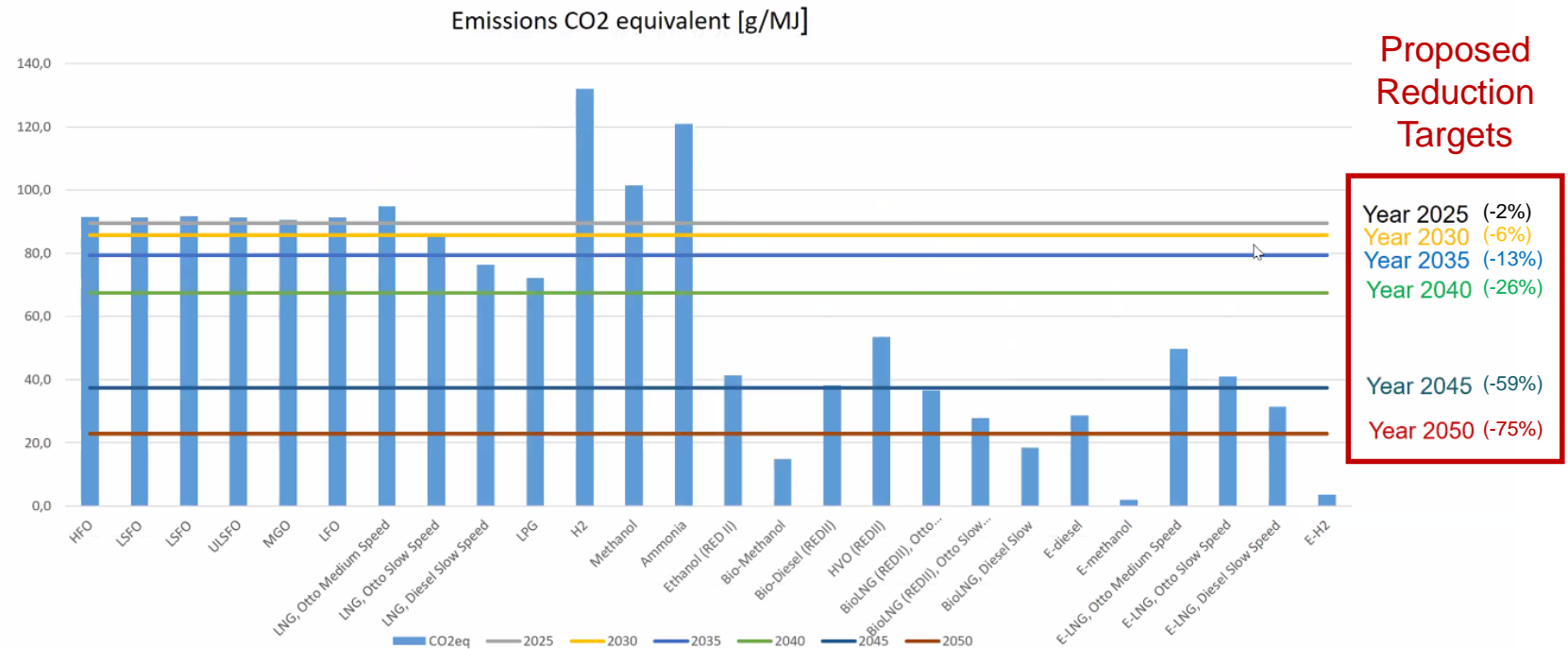
- Focus on **Well-to-Wake** emission of GHG

CO₂ emission compliance based only on fuel type, not efficiency nor technology

Non-compliance can lead to fines

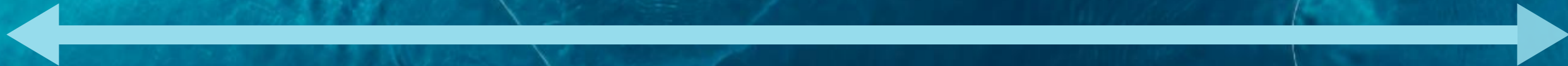
Mix of fuels possible to bring down fuel's CO₂eq

Cross-fleet compliance trading is possible



Powering sustainable shipping by **opening clear routes**

MAN Energy Solutions supports all



Methane

Ethane

Methanol

LPG

Ammonia

Test at RCC
2011

Development
2019

Development
2016

Development
2015

Test at RCC
2018

Development
2020

ME-GI

ME-GA

ME-GIE

ME-LGIM

ME-LGIP

→ **2024**

499 engines
180 in service

192 engines

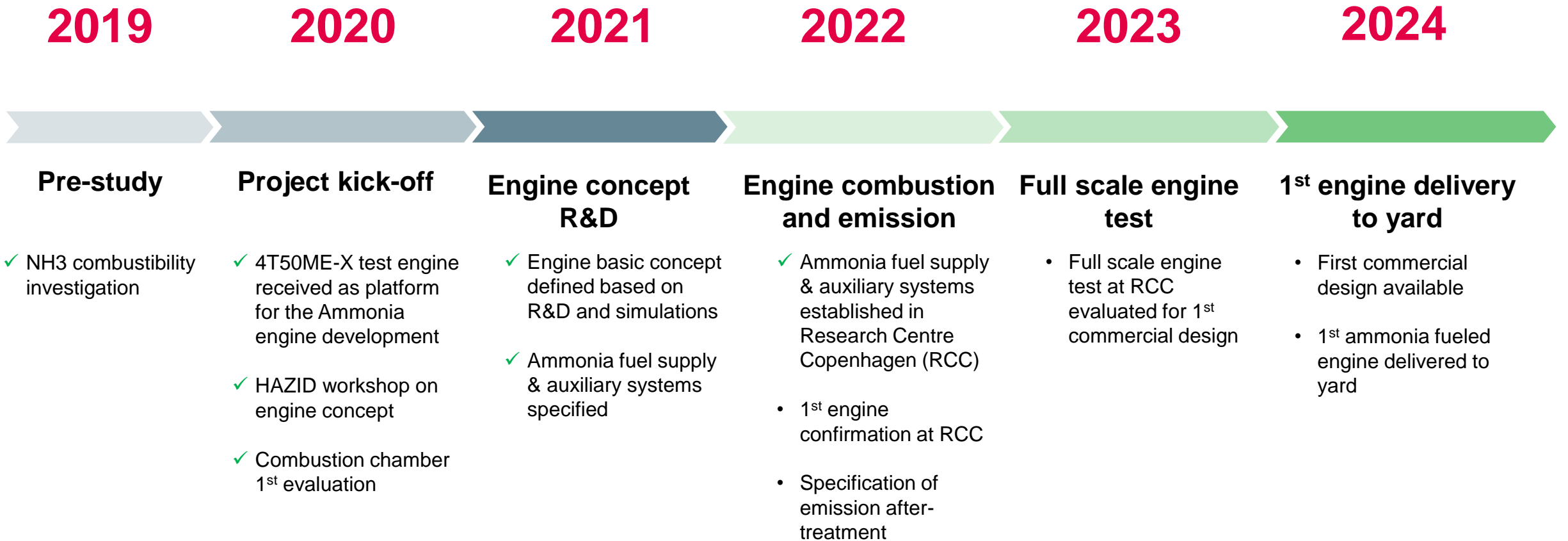
31 engine
14 in service

72 engines
17 in service

126 engines
41 in service

RCC: Research Center Copenhagen

Two-stroke ammonia engine development schedule



HAZID: Hazard Identification
HAZOP: Hazard & Operability

AmmoniaMot – towards a climate neutral future



Supported by:



on the basis of a decision by the German Bundestag

Project description - overview

the project partners



Fuel Communications 11 (2022) 100068

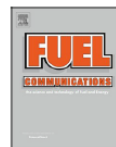


ELSEVIER

Contents lists available at [ScienceDirect](https://www.sciencedirect.com/journal/fuel-communications)

Fuel Communications

journal homepage: www.sciencedirect.com/journal/fuel-communications



Ignition and combustion characteristics of diesel piloted ammonia injections

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Chair of Thermodynamics, Technical University of Munich, Boltzmannstrae 15, Garching 85748, Germany

Available online 14 May 2022

facts and figures

- AmmoniaMot ... “green Ammonia as future fuel for Marine IC-engines for a decarbonized world”
- project duration: 12/2020 – 12/2023
- project costs: 5M€
- funded by: Federal Ministry for Economic Affairs and Energy (Germany)
- start of engine test Q2 2022

project scope

- fundamental research concerning combustion and ignition properties (Rapid Compression Expansion Machine)
- fundamental investigation of combustion concepts on a SCE High Speed engine (high speed = high challenge concerning combustion)
- upscaling of technology to Medium Speed
- engine periphery, fuel handling, safety and regulations (IGF)

Modular design enables **extensive retrofit** options

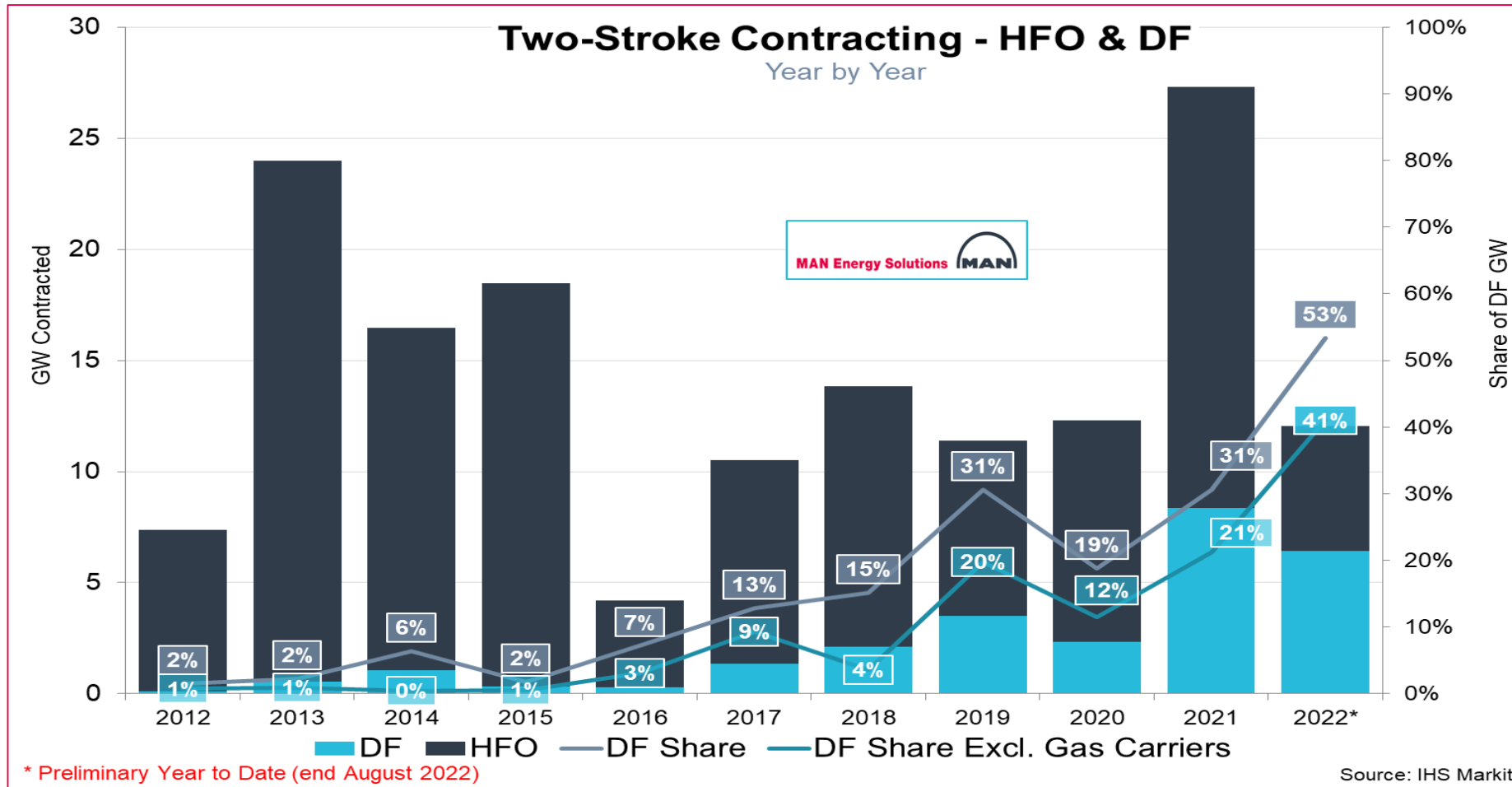
By ensuring full fuel flexibility and extensive retrofit capabilities with a proven record, MAN Energy Solutions future proof your investment

Fuel types	ME-C	ME-GI	ME-GA	ME-GIE	ME-LGIM	ME-LGIP
Fuel oil	✓	✓	✓	✓	✓	✓
LNG	Retrofit	✓	✓	Retrofit	Retrofit	Retrofit
LEG (Ethane)	Retrofit	Retrofit	-	✓	Retrofit	Retrofit
Methanol	Retrofit	Retrofit	-	Retrofit	✓	Retrofit
LPG	Retrofit	Retrofit	-	Retrofit	Retrofit	✓
Ammonia	Retrofit	Retrofit	-	Retrofit	Retrofit	Retrofit

22 retrofits references until now

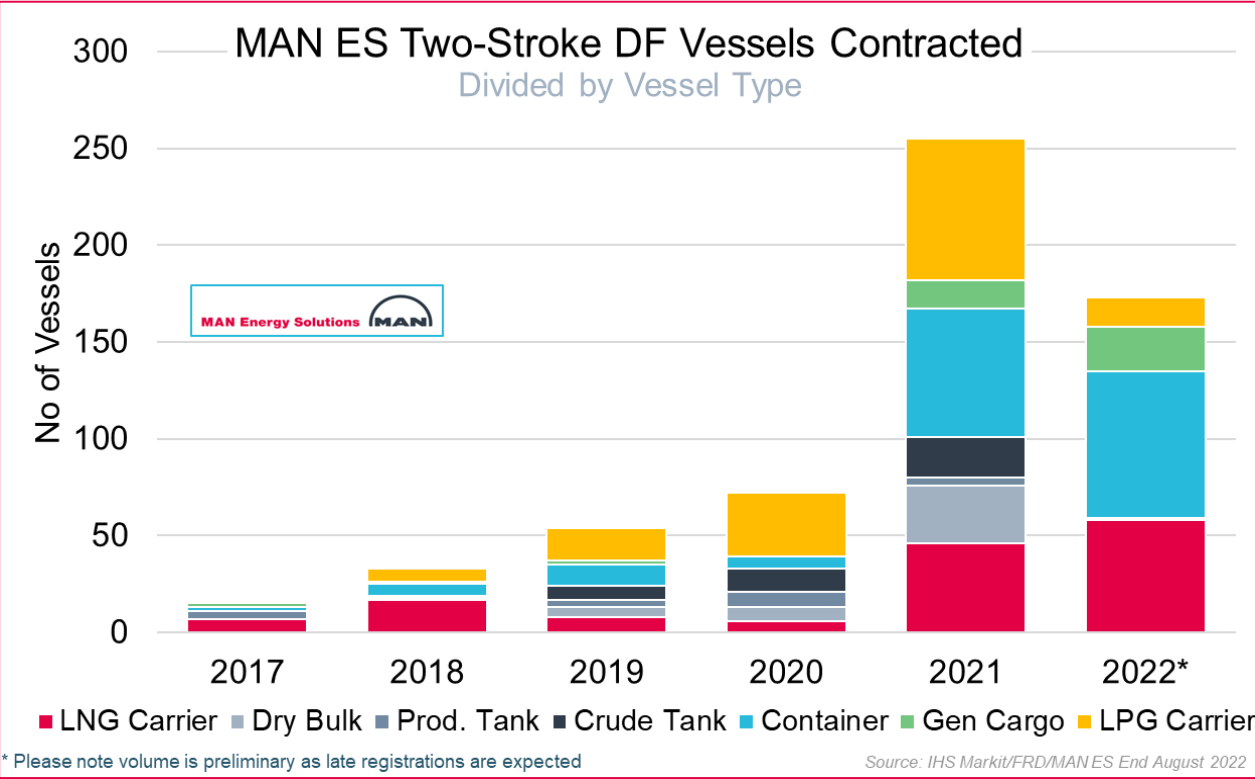
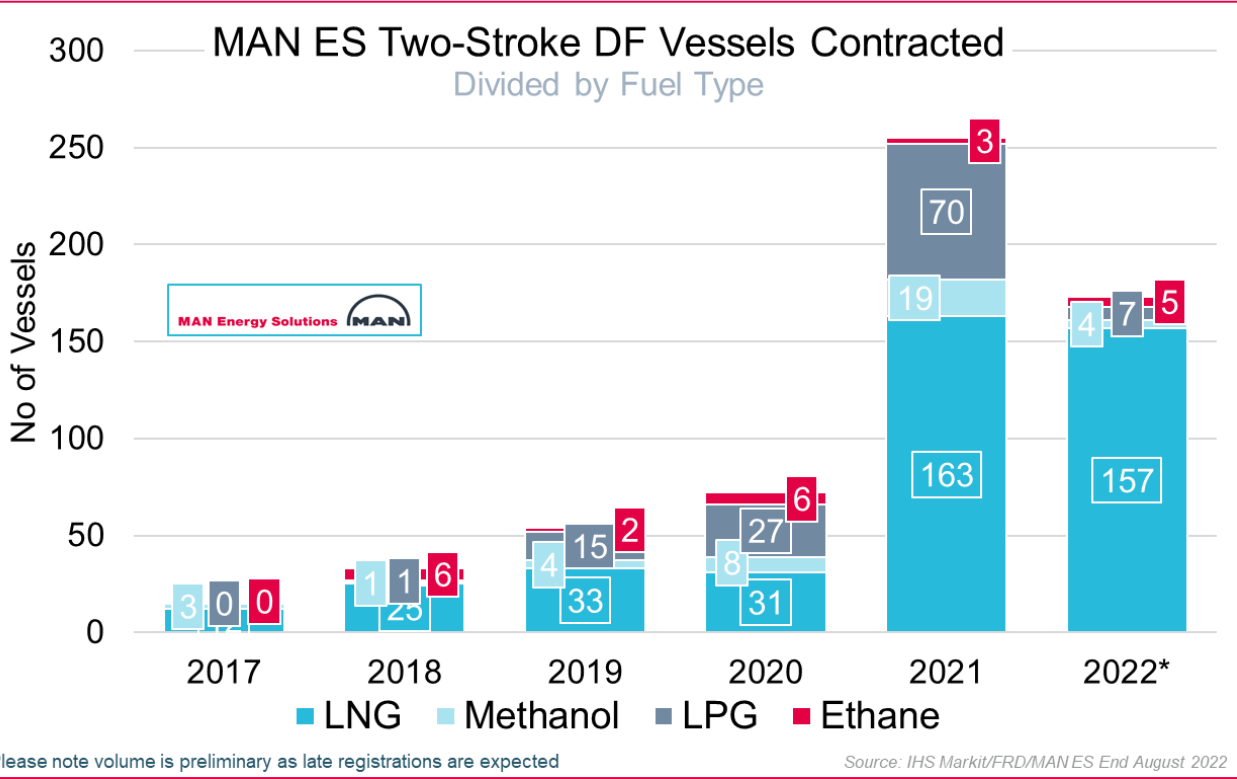
Conventional and DF Two-Stroke Vessel Contracting

In 2021, DF contracting gained pace in a large volume market and the trend is persistent. Furthermore, the majority of DF contracting is on South Korean shipyards



Both Fuel type and DF Vessel type is now Diversifying

Though LNG propulsion dominates, new fuel technologies and vessel segments are gaining traction



Disclaimer

All data provided in this document is non-binding.

This data serves informational purposes only and is especially not guaranteed in any way.

Depending on the subsequent specific individual projects, the relevant data may be subject to changes and will be assessed and determined individually for each project. This will depend on the particular characteristics of each individual project, especially specific site and operational conditions.

Thank you very much!