

# Framtidens framdriftssystem med funktion och miljö i fokus

Roger Göthberg  
MAN Energy Solutions  
September 18, 2019

Powering a better future

1758



**MAN Energy Solutions**  
Future in the making



# MAN Energy Solutions a part of Volkswagen Group



Nutzfahrzeuge



MOIA



14 car brands

10 Million vehicles per year

Half of the worlds fleet powered by MAN engines

# Drivers of our company strategy

What we do to power the change

# Decarbonization

**calls for new technologies**

- Limit global warming to below 2° Celsius
- Carbon neutrality until 2050

# Our strategic business areas



## Engines & Marine Systems



## Power Plants



## Turbomachinery



## Aftersales MAN PrimeServ

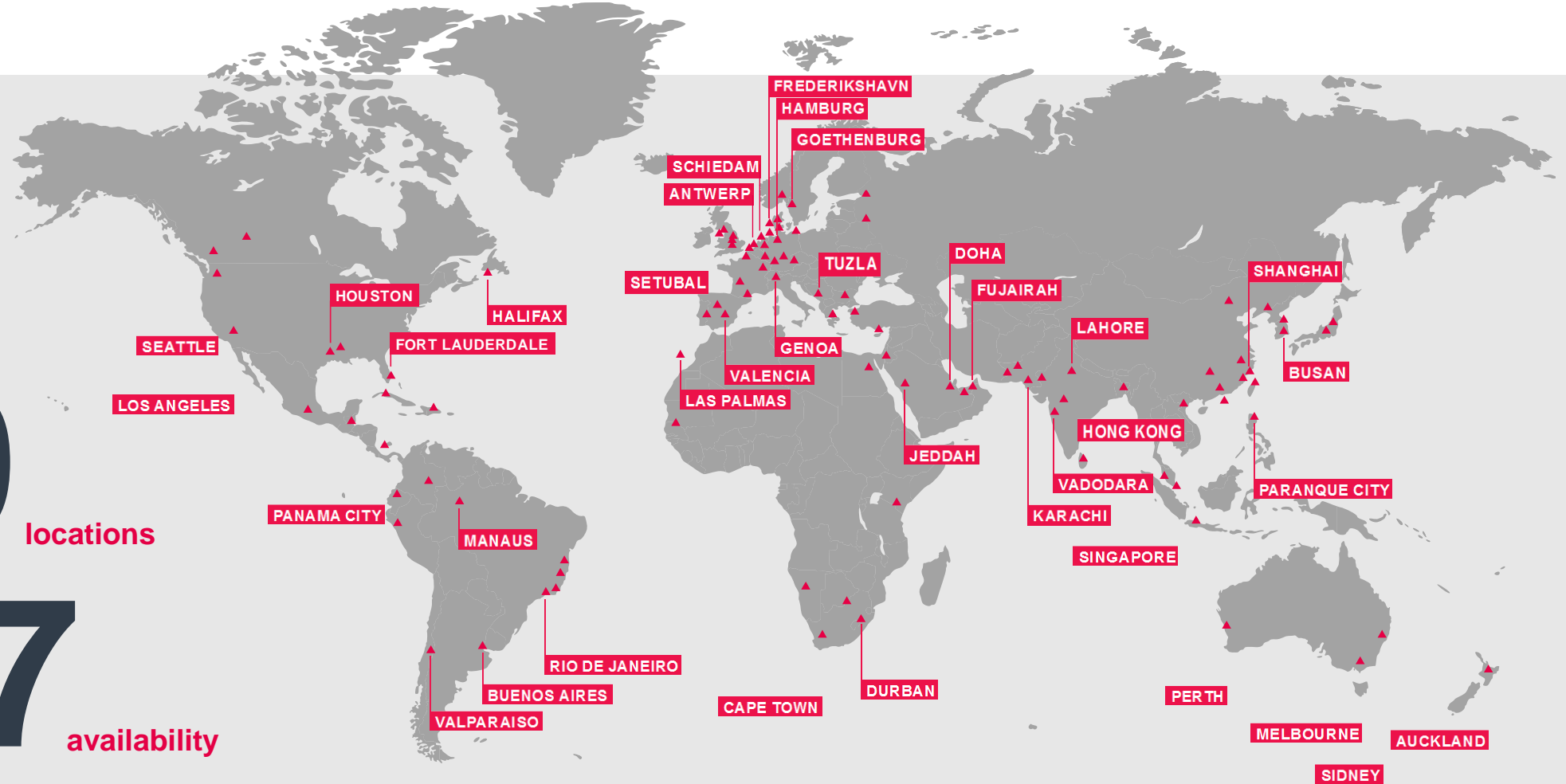


# Our global aftersales network

MAN PrimeServ

**120** locations

**24/7** availability



# What is the right way?



LNG

Methanol

LPG

Bio-LNG

Ethane

Hybrid

LSFO

H2

HFO

ULSFO

Gas Oil

Scrubber

EGR

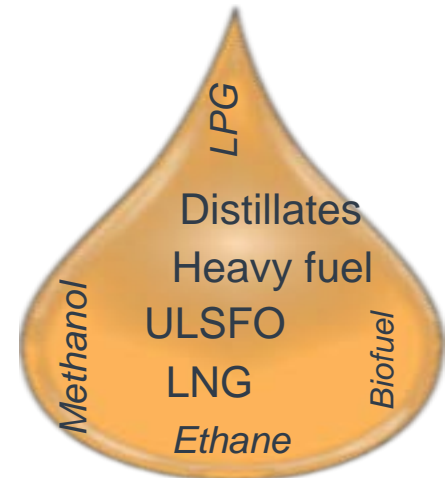
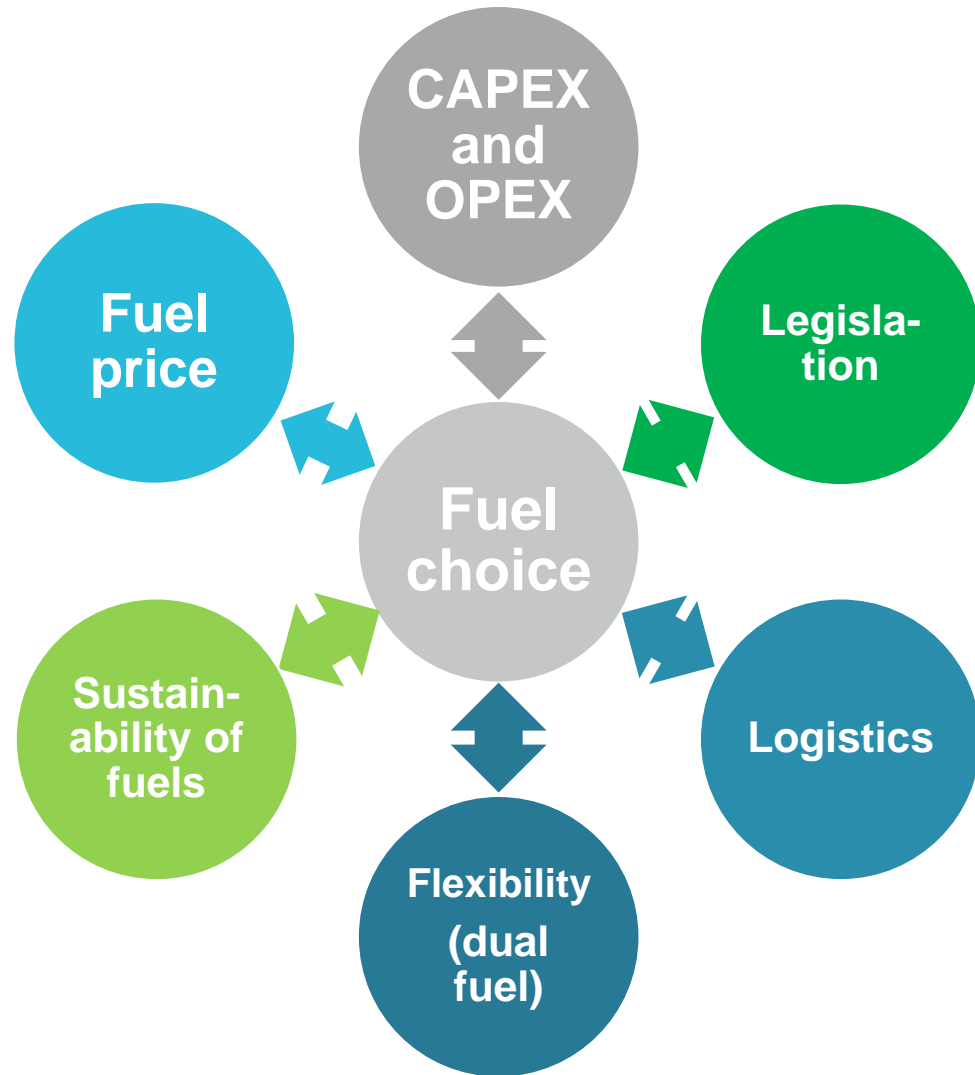
SCR

Power-in-port

Ammonia

Battery

# Influencing Factors on Fuel Choice





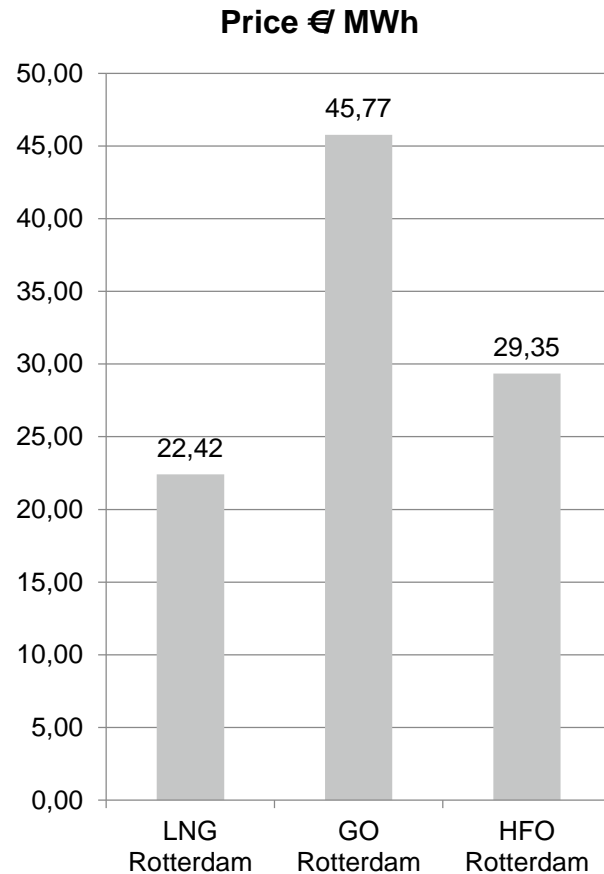
# LNG has never been more competitive, ever!

Price for GO;

600 USD/ ton

Price of LNG;

Ca 22.4 EUR/ MWh NCV



Example;

Consumption appr. 16000 mt LNG/ year

Equals 220 000 MWh

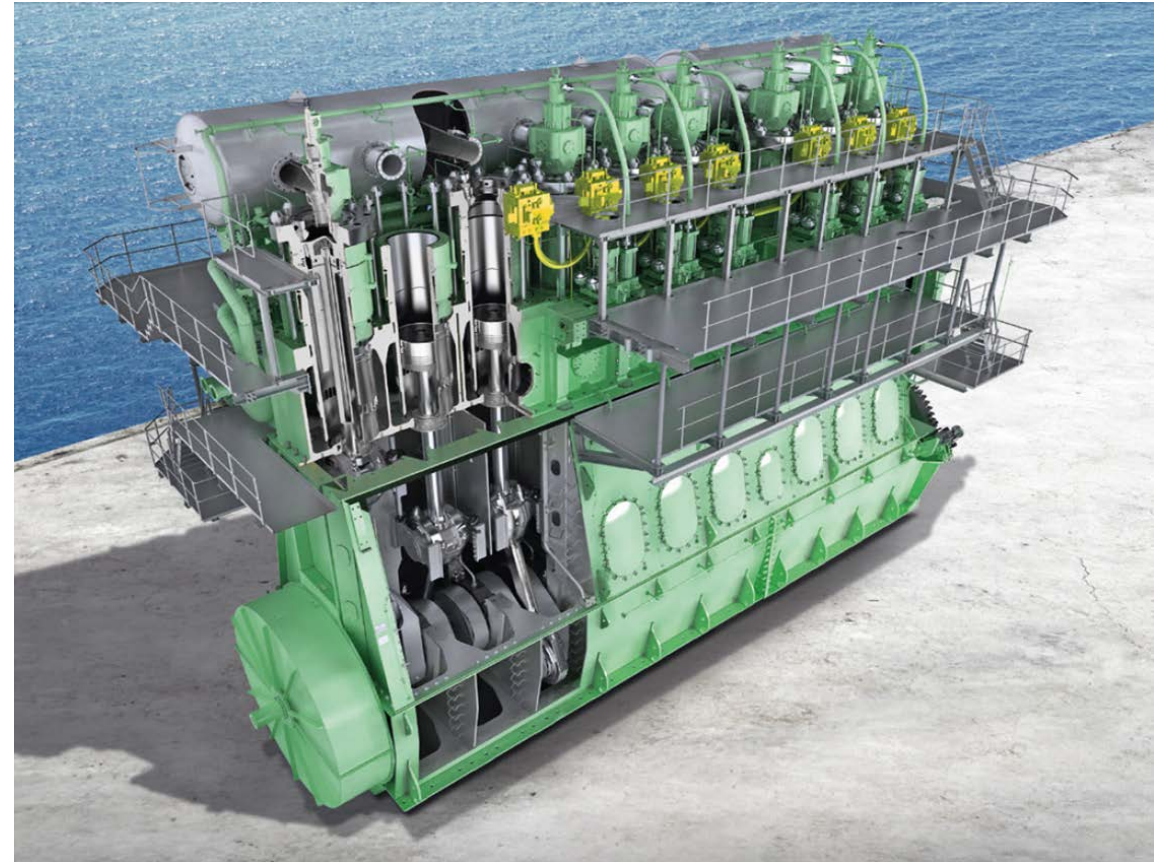
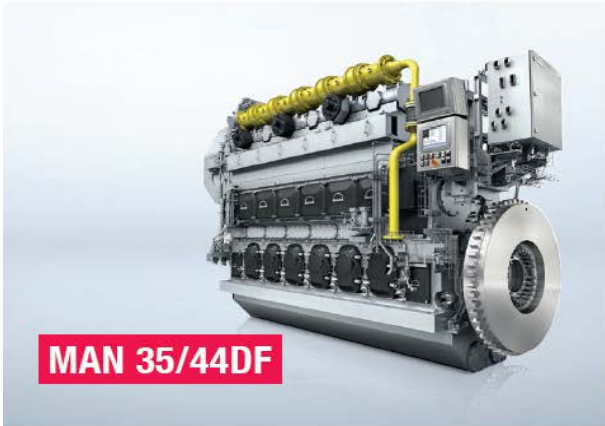
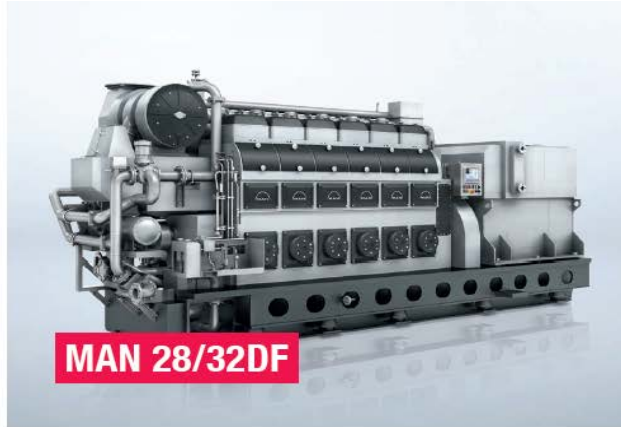
Price diff GO =  $22.4 / 45.7 = 23.4$  EUR/ MWh

**= 5 100 000 EUR/ year in fuel cost savings!**



# MAN's 4-stroke Medium Speed & 2-stroke Slow Speed DF Engines

Covering Power Range from 625 kW to 80,000 kW



# Accelerate the change

Retrofit's for existing vessels to improve environmental performance

LNG conversion 4-str & 2-str engines

LPG, Ammonia, Ethane & Methanol conversions for 2-str engines

Propeller optimization

Hybridization

Turbo charger upgrades



# World's first conversion to Dual-Fuel Operation

MAN PrimeServ Retrofit: 99% less sulfur oxides, 90% less particulates, 80% less nitric oxides and up to 20% less CO<sub>2</sub> emissions in gas mode



Retrofitting of the 1,036-teu feeder container ship 'Wes Amelie's' MAN 8L48/60B main engine to a multi-fuel, four-stroke MAN 51/60DF

# Hapag Lloyd Project

# ME-GI Rertrofit

Hapag Lloyd Case

## Project Details

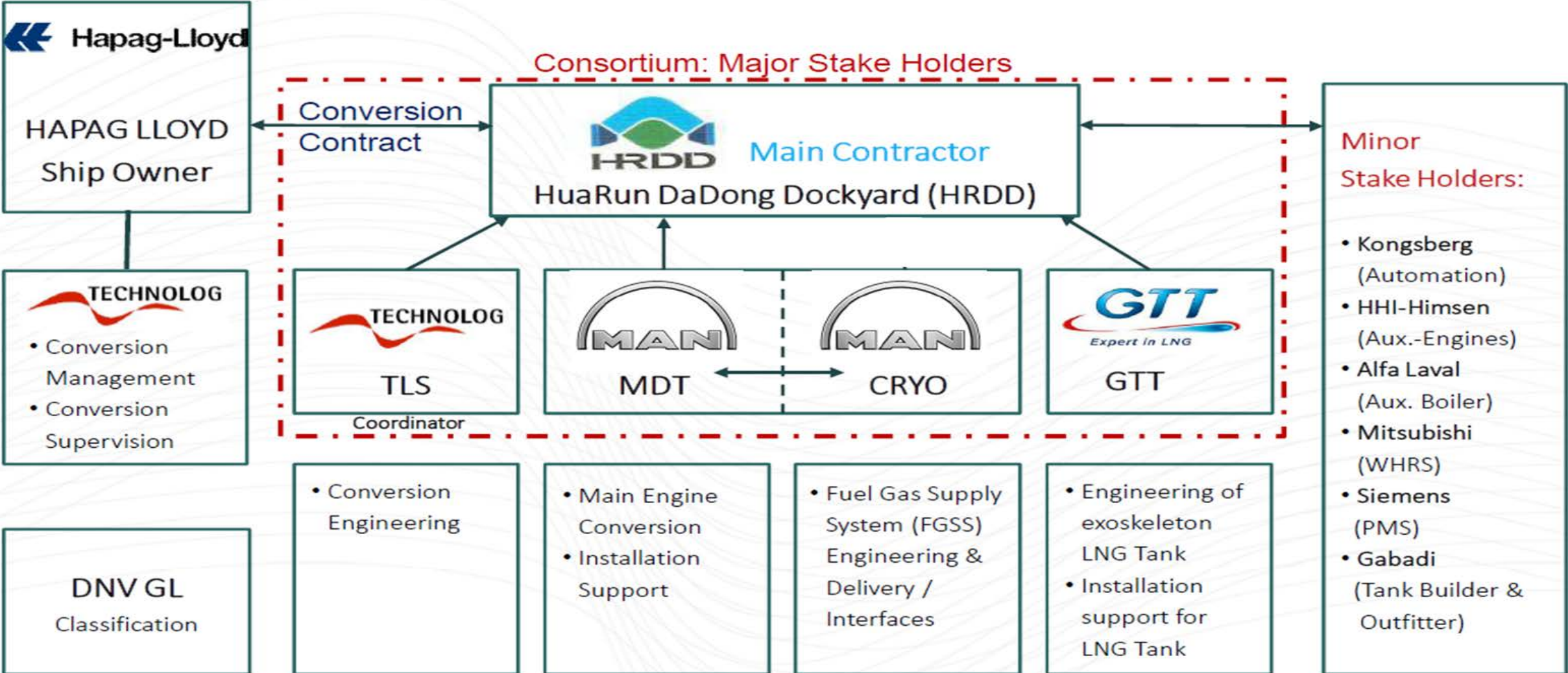
- Owner: Hapag Lloyd
- Vessel Name: SAJIR
- Engine Type: 9S90ME-C
- Size: 15.000 TEU Mega Carrier
- New Engine Type: 9S90ME-C-GI
- Conversion Yard: HRDD

**First VLCV in the world to be retrofitted to be fueled with LNG**



# ME-GI Retrofit

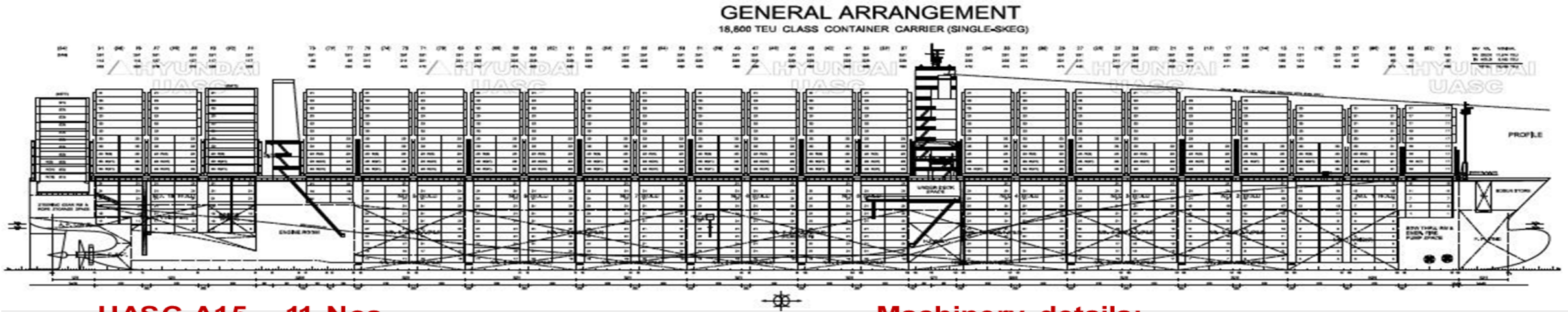
## Hapag Lloyd Case



# ME-GI Retrofit

## Hapag Lloyd Case

Strictly  
confidential



### UASC A15 – 11 Nos. Years built 2014 - 2016

Length over all	368.00 m
Length betw. Perp.	352.00 m
Breadth (moulded)	51.00 m
Depth (moulded)	30.35 m
Draught (design)	14.50 m
Draught (scantling)	15.50 m
Container Capacity	14,500 TEU
Reefer Capacity	1,000 TEU
Catch-up Speed (Ts)	22.0 kts

### Machinery details:

Main Engine: MAN 9S90ME-C10.2  
Power MCR: 54,900 kW / 84 RPM  
Power NCR: 32,625 kW / 68.7 RPM  
Aux. Engines: Himsen 9H35DF (4,320 kW) x 4  
WHRS / PTO-PTI: installed

Daily Fuel Consumption (av.):	62.8 t
Yearly Fuel Consumption of string:	248,000 t
Transport Cost per TEU/nm:	1,53 ct
CO <sub>2</sub> output per TEU/nm:	63.2 g
output of string per year:	0.8 Mio. t

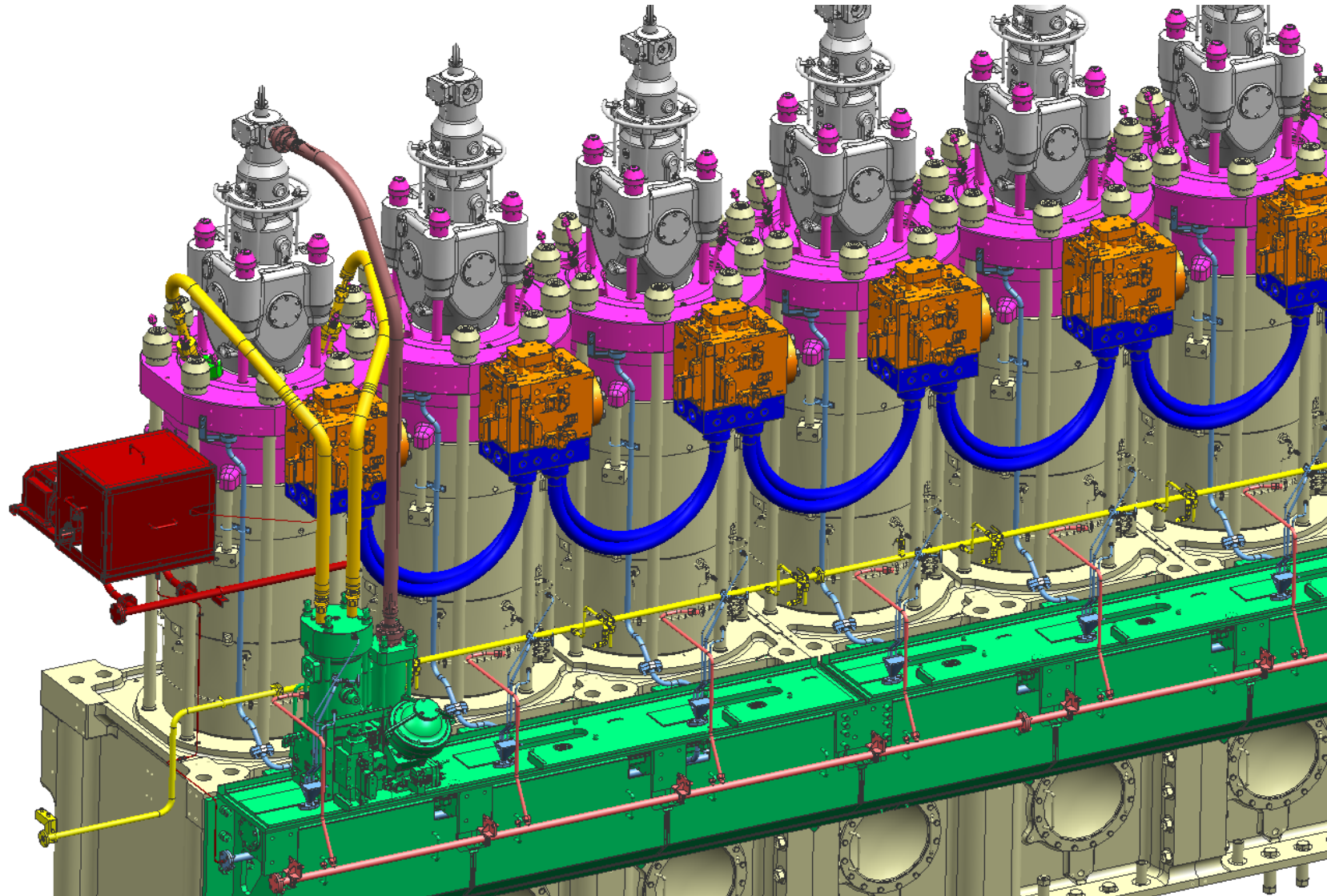


# ME-GI Retrofit

Hapag Lloyd Case

## Main Engine Scope

- Cermet coated Piston rings
- Piston
- Sealing oil system
- GI(E) control system
- HP fuel pipes
- Gas injectors
- Cylinder cover
- Cylinder liners
- Gas control block
- Adaptor block
- Gas chain pipes
- LP oil system
- Compression shims

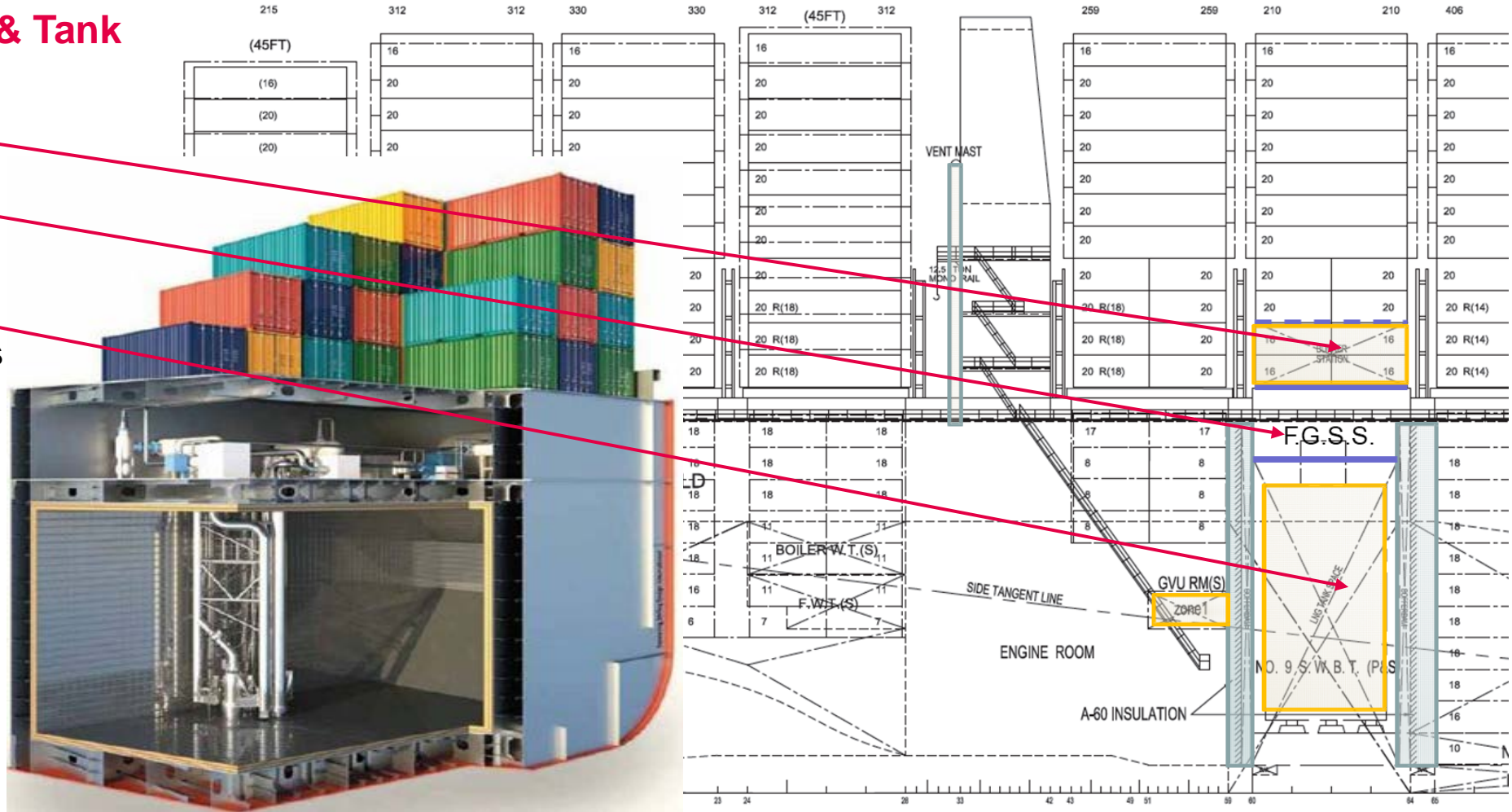


# ME-GI Retrofit

Hapag Lloyd

## Fuel Gas Supply System & Tank

- Bunker Stations
- FGSS incl. PVU
- LNG Tank
- Loss in Capacity: 350 slots



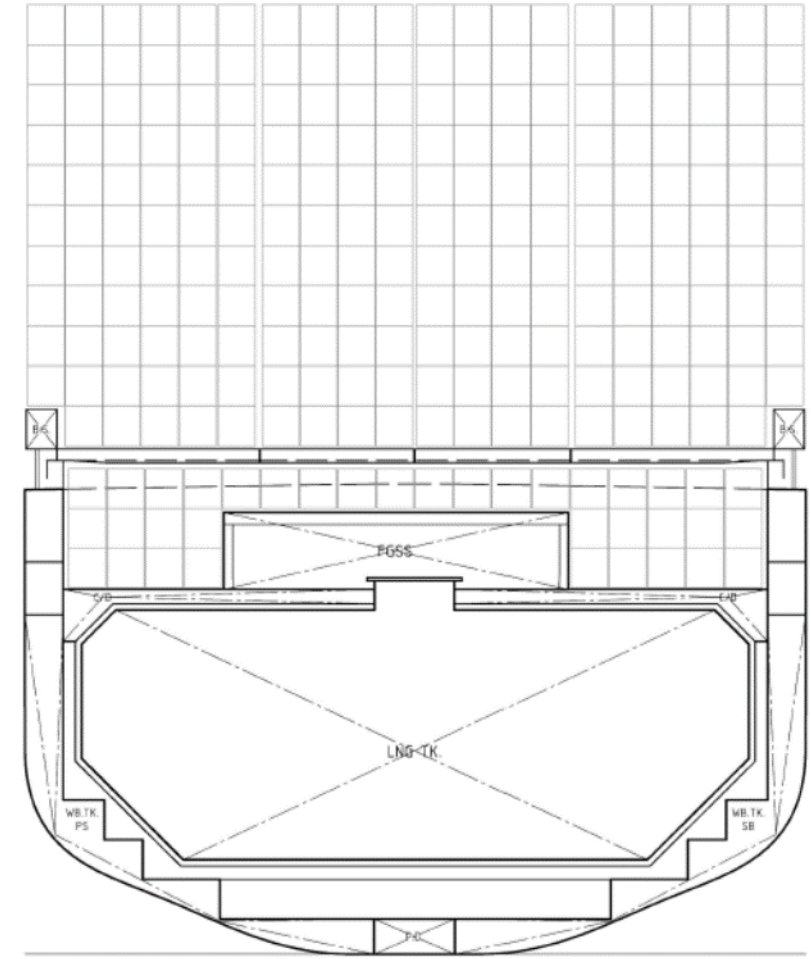
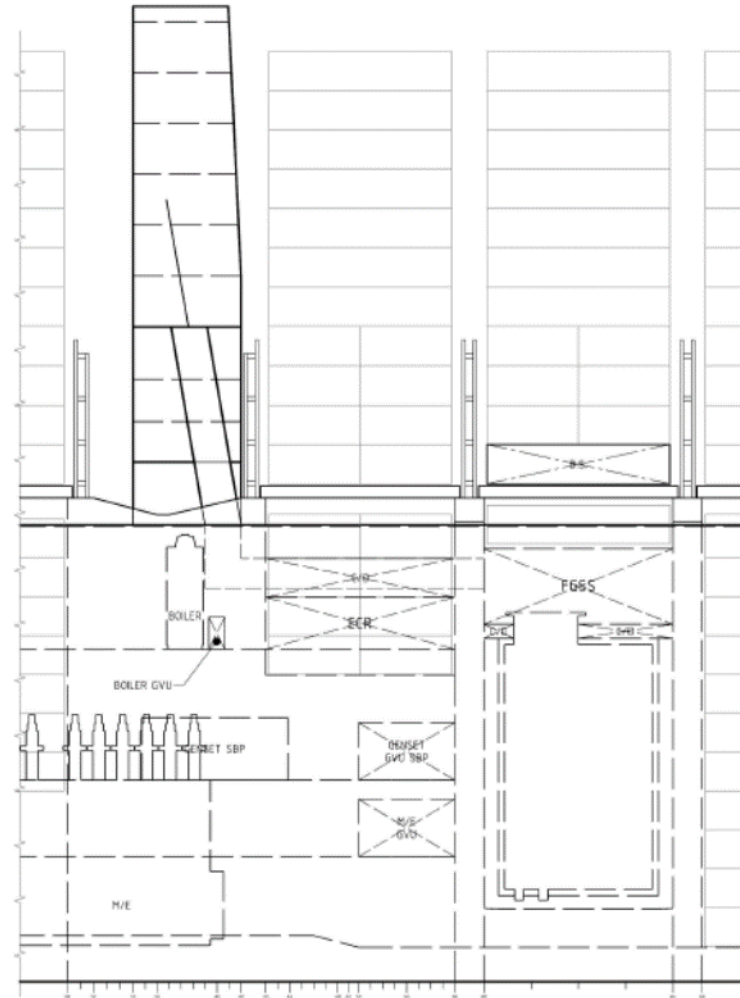
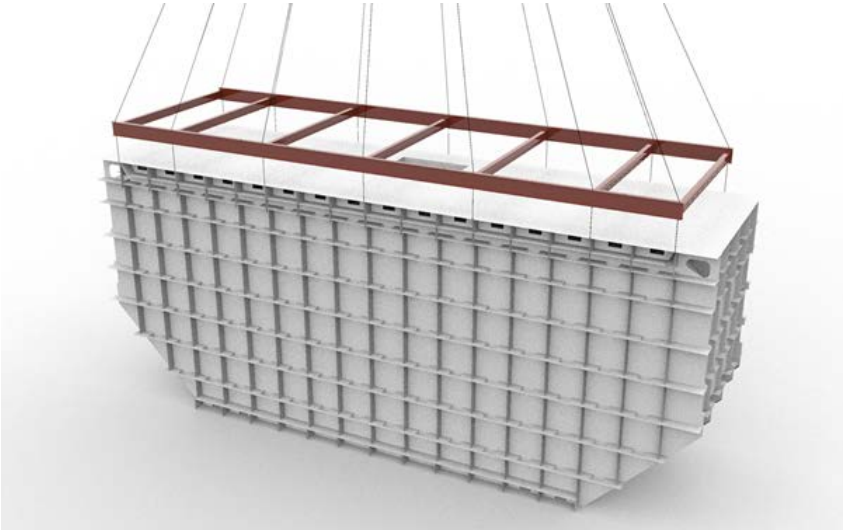
# ME-GI Retrofit

Hapag Lloyd Case

Strictly  
confidential

## LNG Tank Specifications

- Type: Membrane Tank build in exoskeleton structure
- Size: 6.800 m<sup>3</sup>
- Endurance: Europe – Asia (one-way)

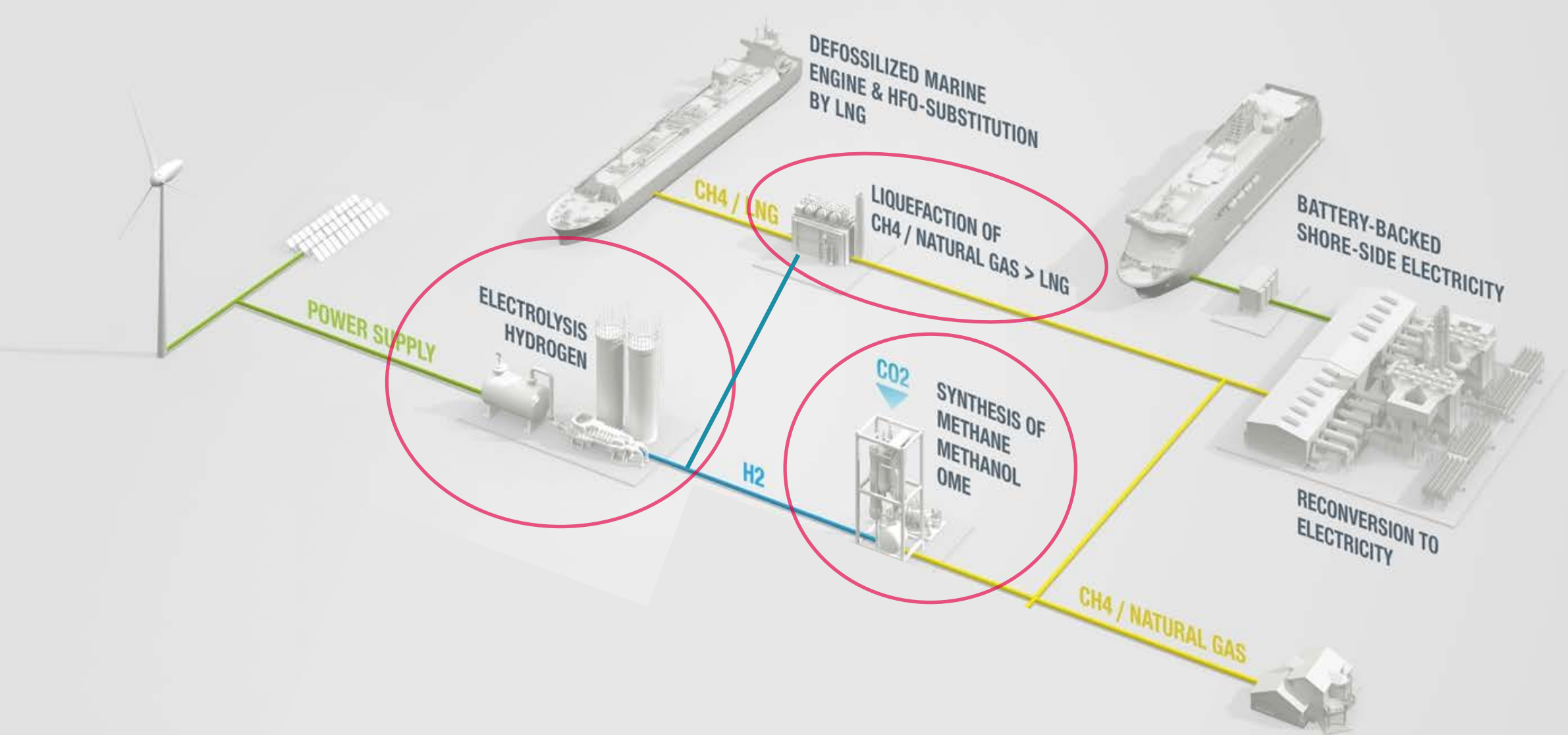


# Taking the next step towards Carbon neutral Shipping



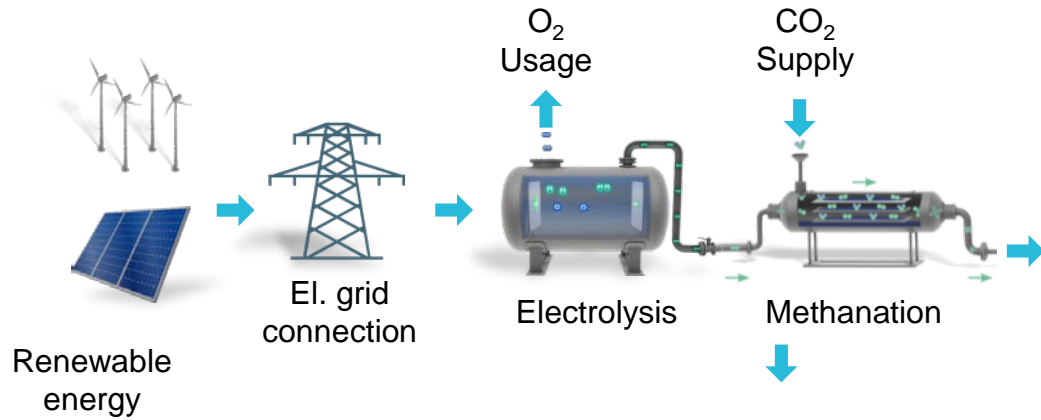
# P2G - Converting electricity to Hydrogen & Synthetic Gas



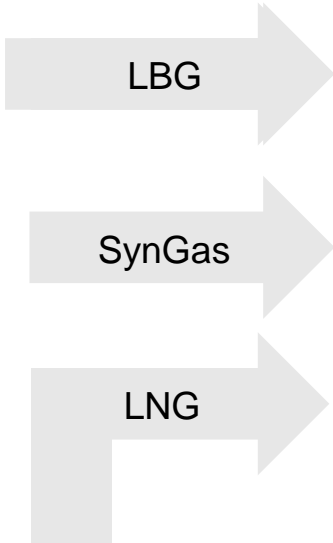


# Combined solutions

## Digestion & electrolysis



Gas grid



# MAN Power to Gas - Audi

MAN customer reference in Werlte



## Key facts:

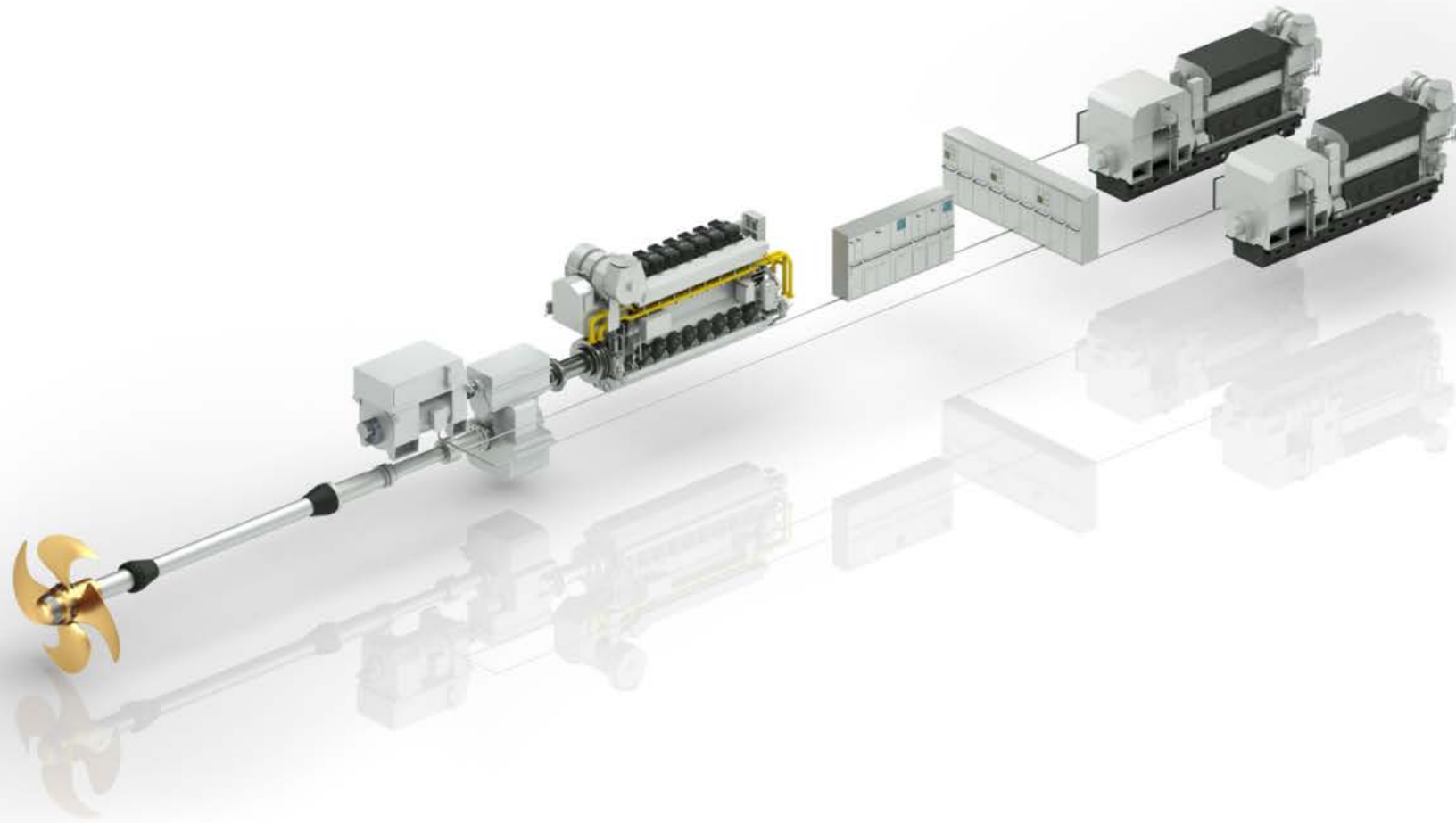
- 6,3MW power input for alkaline Electrolysis
- SNG used as e-fuel for Audi customers
- Methanation reactor by MAN Deggendorf

**Commercial operation since December 2013**

Picture source: Audi



# Electric & Hybrid propulsion



Hybrid solution

# Project Seaspan

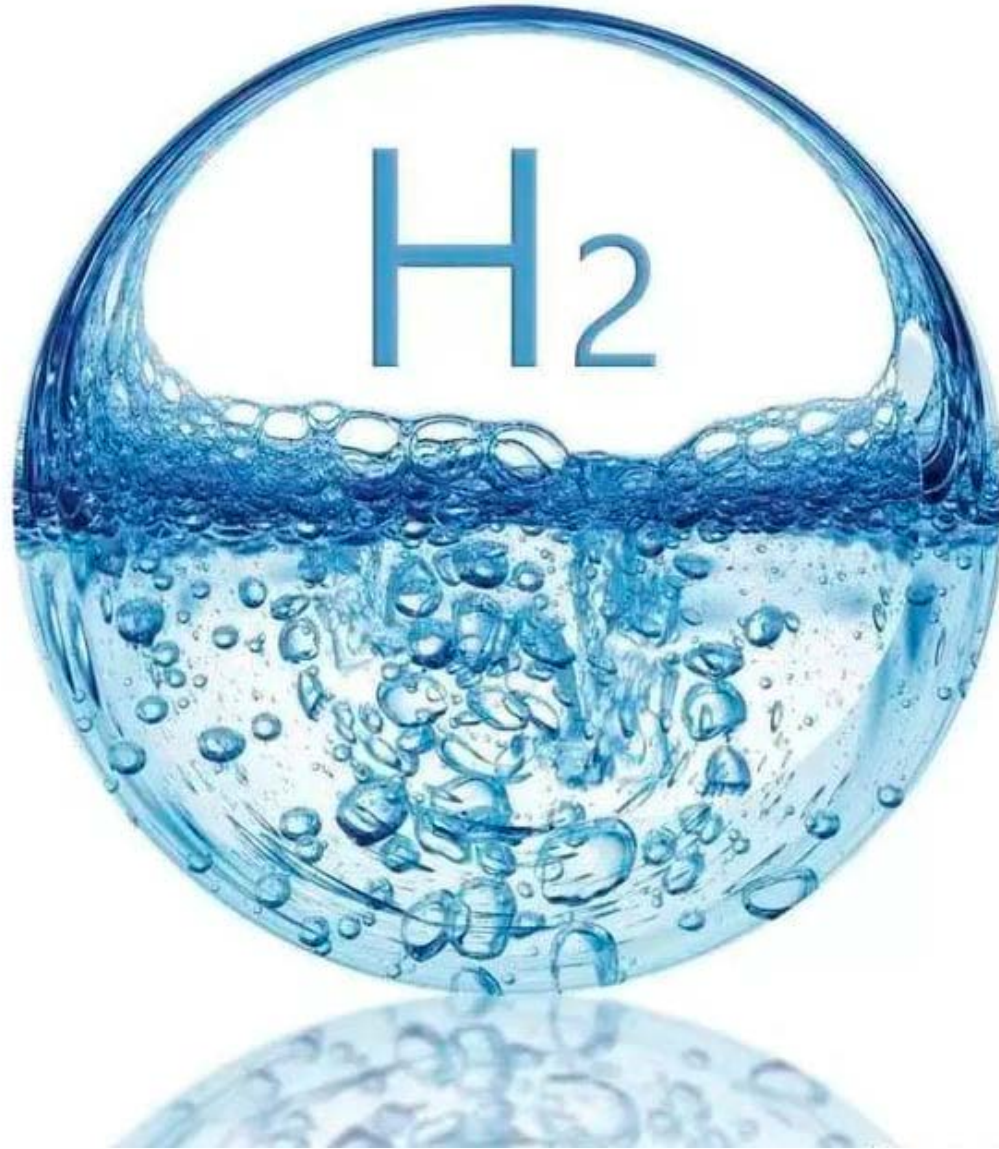
LNG Battery Hybrid propulsion

- 2 x MAN 35/44 DF engines (one always in stand-by)
- Pure Gas start
- Excellent load pick-up capability
- MAN AKA Battery Hybrid system
- MAN Cryo Fuel Gas Supply System

Peak power support from batteries to optimize engine performance, fuel consumption and emissions



# Hydrogen – an alternative to batteries



Picture from Best Water Inc

# Cooperation for a cleaner future



Electrolysers  
Fuel stacks  
Hydrogen fueling solutions



Batteries  
Hybrid systems  
Energy storage

## MAN Cryo

Cryogenic solutions

# Liquid Hydrogen – fuel gas system



**Class approved**

- For fuel cell feed
- Approval in principal by class
- Ready to be delivered
- Tank size 10 – 400 cbm

# Bunkering solutions LH2 & LNG

Complete solutions from well-to-propel



Flexible bunkering solutions for

- LNG
- Hydrogen



**MAN Energy Solutions**  
Future in the making



Thank you!

Roger Göthberg

[roger.goethberg@man-es.com](mailto:roger.goethberg@man-es.com)

