

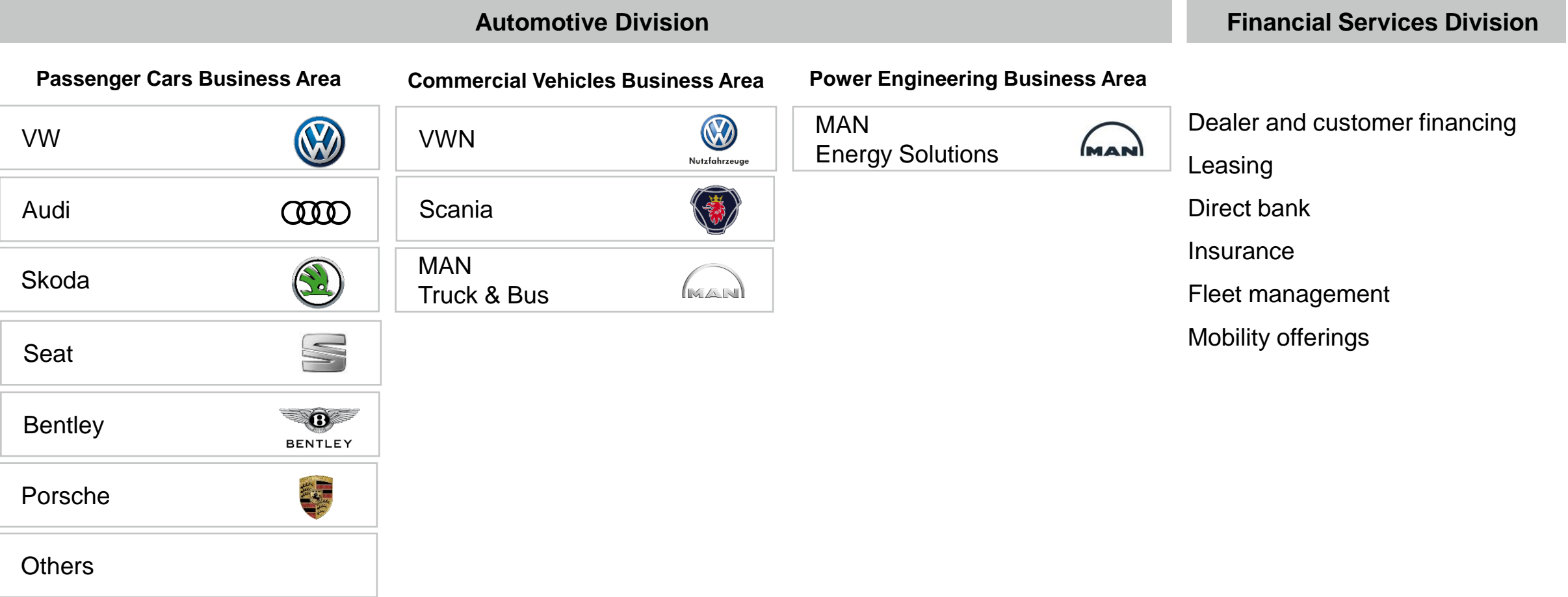
# Soluções para Sintetização e Uso de Combustíveis Alternativos na Area Marítima

FIEC Summit, Fortaleza  
13th of August 2024

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# Member of the Volkswagen Group

MAN Energy Solutions is part of a brand family



# 50% of world trade powered by MAN engines

Two-stroke engine for the CSCL Globe



Powering one of the world's largest container ships:  
The "CSCL Globe" is propelled by a MAN B&W 12S90ME-C two-stroke engine with 56,800 kW



**Our Strategy**  
How we get the job done

# Moving big things to zero

We engineer systems for deep decarbonization in sectors that matter most

## Heat pumps

Decarbonization of heat supply in industry and households



## Carbon Capture

Solutions for unavoidable process emissions and carbon cycles



## PEM-Elektrolysis

Where electrification stops, H<sub>2</sub> will play a crucial role



## Green propulsion

CO<sub>2</sub>-neutral propulsion systems for shipping and power generation



## Retrofits

Decarbonization of our customers' existing fleets



**Decarbonization & digitalization are the drivers of our strategic development into an energy solutions provider**

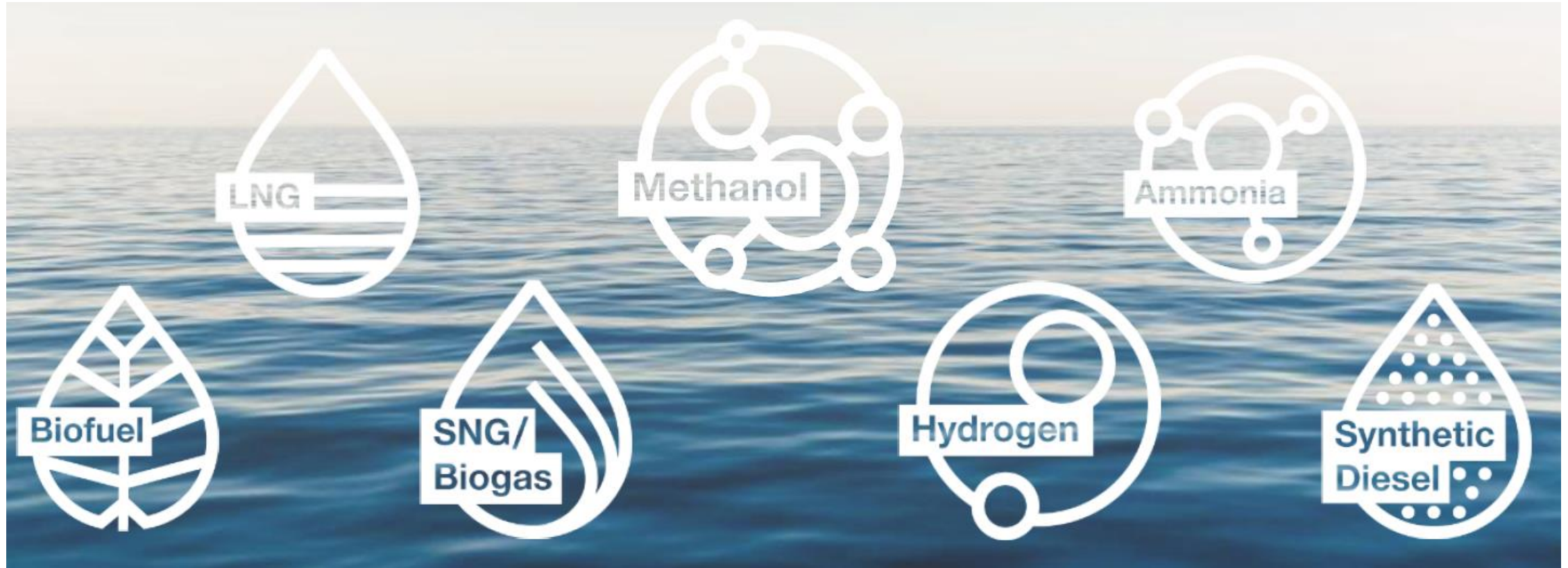


# Uso de Combustíveis Alternativos



# Marine & Power Generation

Future Fuels

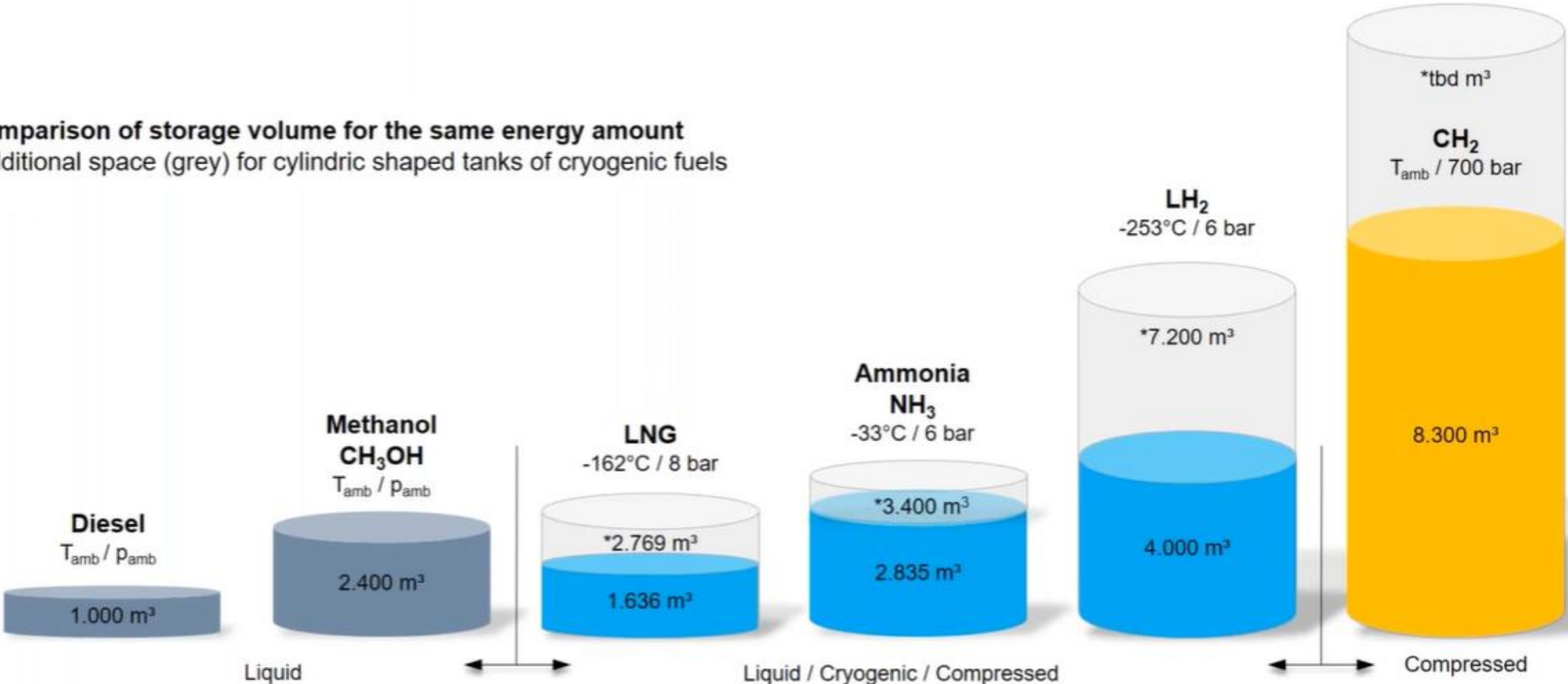


# Alternative fuels have much lower density than diesel



Visualization of the Tank size demand (Source: DNV Comparison of Alternative Marine Fuels)

Comparison of storage volume for the same energy amount  
 \*additional space (grey) for cylindric shaped tanks of cryogenic fuels





# Marine & Power Generation



Roadmap future fuels

## 2-Stroke Engines



### Today

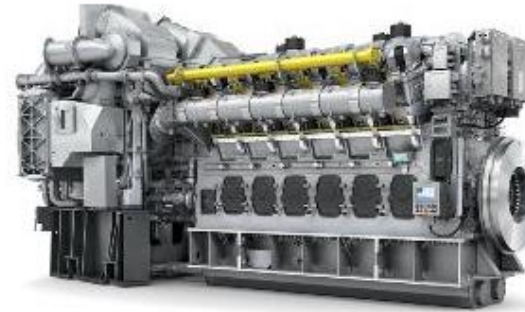
- Natural Gas/ SNG ✓
- Methanol, LPG, Ethane ✓

### Tomorrow

- Ammonia (2024)
- 100% Hydrogen Operation (depending on market demand)

SNG: Synthetic Natural Gas

## 4-Stroke Engines



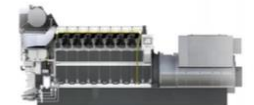
### Today

- Carbon neutral SNG (100%) ✓
- Natural Gas/ SNG blend with Hydrogen (25%) ✓
- Methanol

### Tomorrow

- 100% Hydrogen Operation (~2025-2030 engines)
- Ammonia

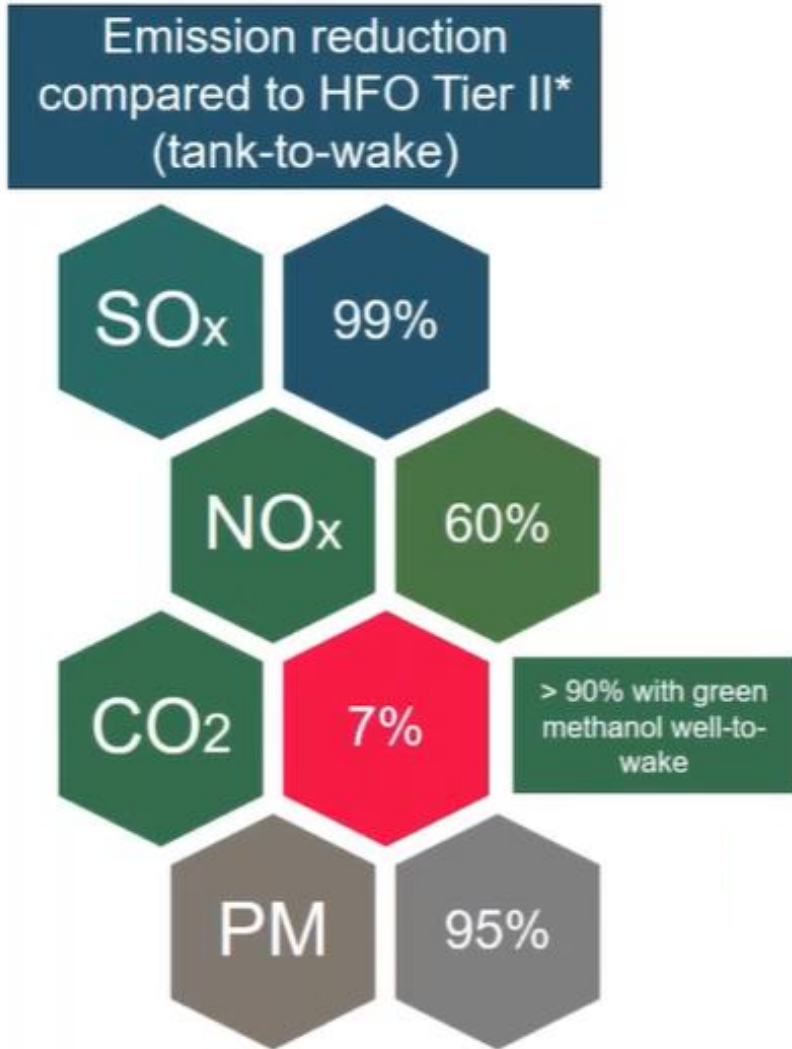
– Green propulsion results in a high demand for green methanol gensets.





# Methanol – CH<sub>3</sub>OH – MeOH

## Overview Future Fuels & Emissions



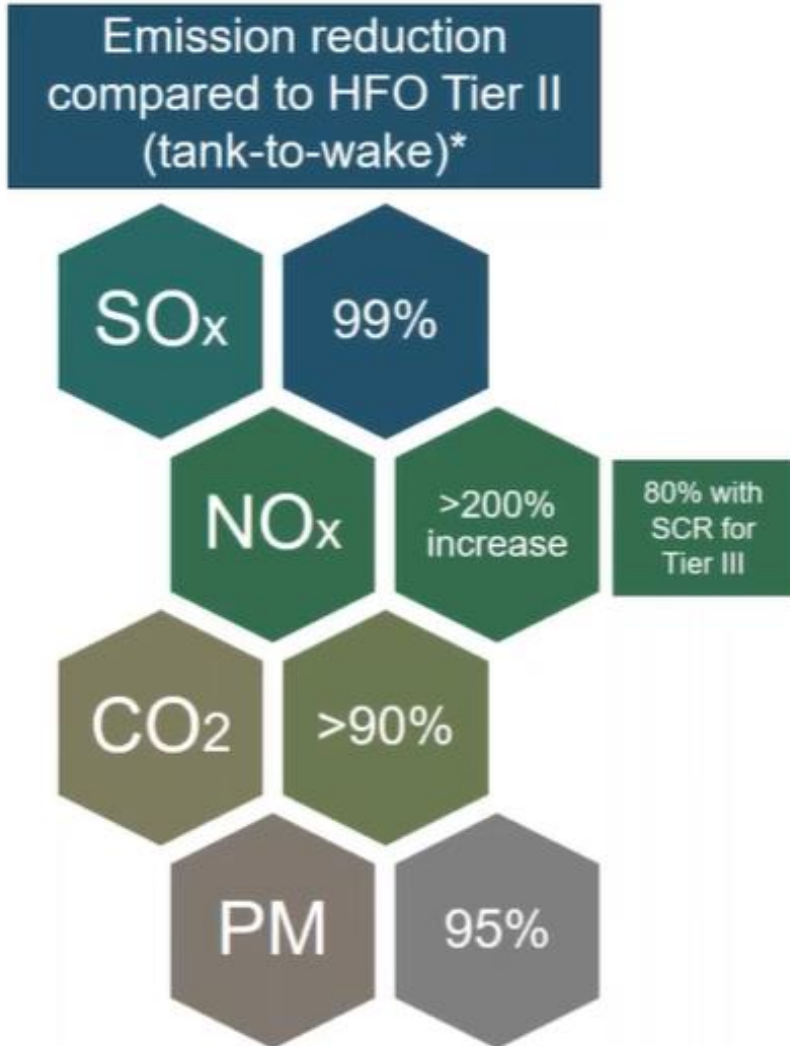
- CO<sub>2</sub>e [g/MJ]  
acc. to Fuel EU Fit for 55
- Efficiency
- Equivalent tank volume  
(includes tank shape)
- Storage
- Ignitability
- Challenges

- Storage similar to gasoline (liquid)
- Stable with indefinite shelf life

- 102 (conventional)  
4 (green)
- Similar to current DF engines
- 2,4 x Diesel
- Room temperature /  
ambient pressure
- With diesel
- Toxic, corrosive and highly  
flammable

# Ammonia – NH3

## Overview Future Fuels & Emissions



- CO<sub>2</sub>e [g/MJ]  
acc. to Fuel EU Fit for 55
- Efficiency
- Equivalent tank volume  
(includes tank shape)
- Storage
- Ignitability
- Challenges

- 121 (conventional)  
0 (green)
- Similar to current DF engines
- 3,4 x Diesel
- 33°C / 6 bar
- With diesel
- Highly toxic  
Odour

➤ Grey Ammonia is CO<sub>2</sub> neutral only tank-to-wake, for well-to-wake CO<sub>2</sub> neutrality green ammonia is needed



# We play an important role in decarbonization of global shipping

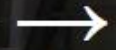
**Methane**

**ME-GI & ME-GA**  
696 - 274

**Methanol**

**ME-LGIM**  
183

**Ammonia**



**Ethane**

**ME-GIE**  
63

**LPG**

**ME-LGIP**  
198

# 1400+

**dual-fuel engine orders**



# Brazil pushing for ethanol



- Big ethanol producers push for ethanol in marine engines
- Supported by specs for new boats tendered by Petrobras
- MAN ES will test in the next 12 month

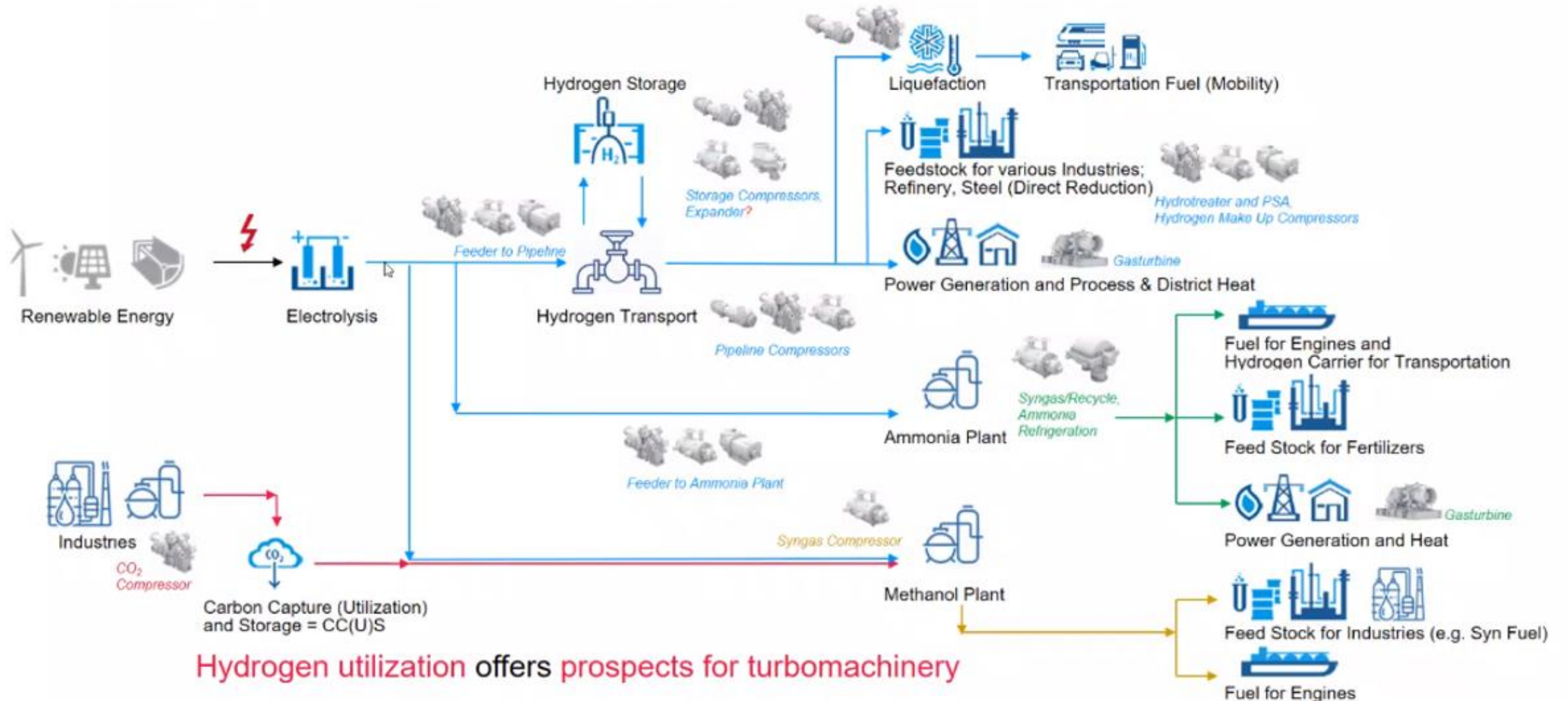


# Sintetização de Combustíveis Alternativos



# Power to X

## Hydrogen Utilization Added Value Chain and MAN ES Turbomachinery Products



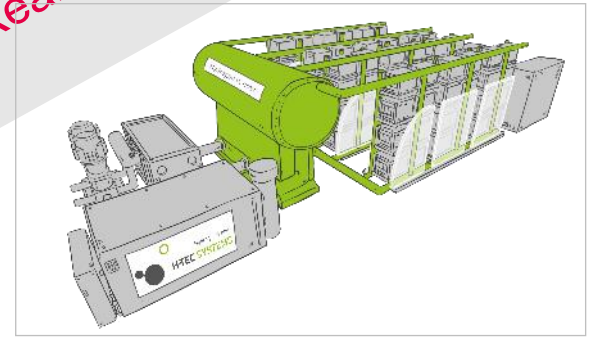
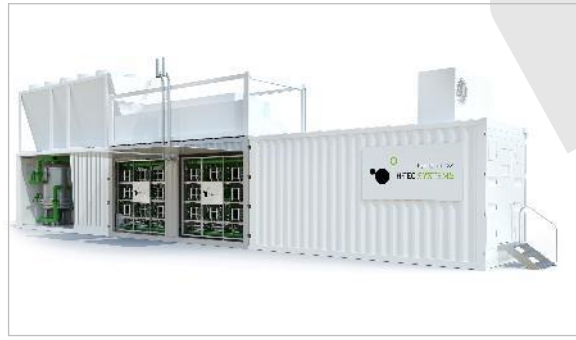
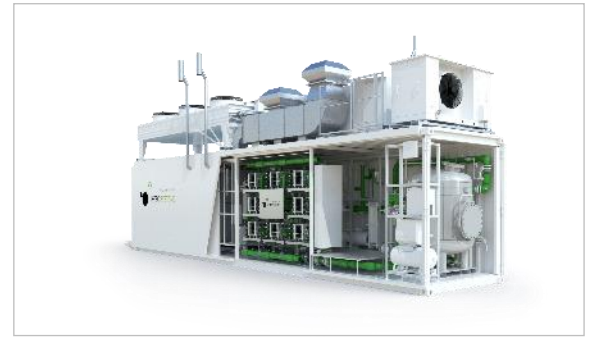
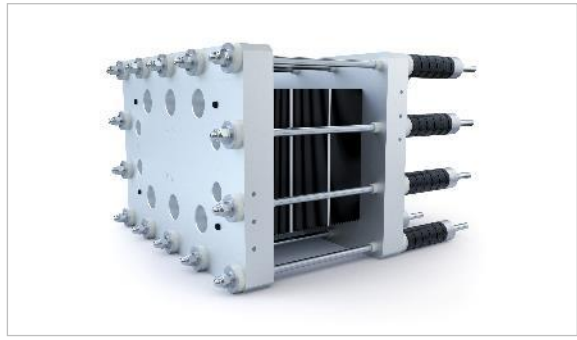


# Moving big things to zero with **PEM** Electrolyzers

H-TEC Systems



Reality in Europe!!



Proven design in field since 2017

Based on reliable S450 Technology Platform with efficiency of 75% / 78% guaranteed on system level<sup>2</sup>

## PEM Stack S450

- In-house development and production in Germany
- >70.000 running hours in field

## PEM Electrolyzer ME450

- Turnkey solution for sector integration
- Optimized for 1-2 MW

## HCS<sup>1</sup> Containerized

- Modular system with 2 MW / Cube
- Optimized for 4-10 MW

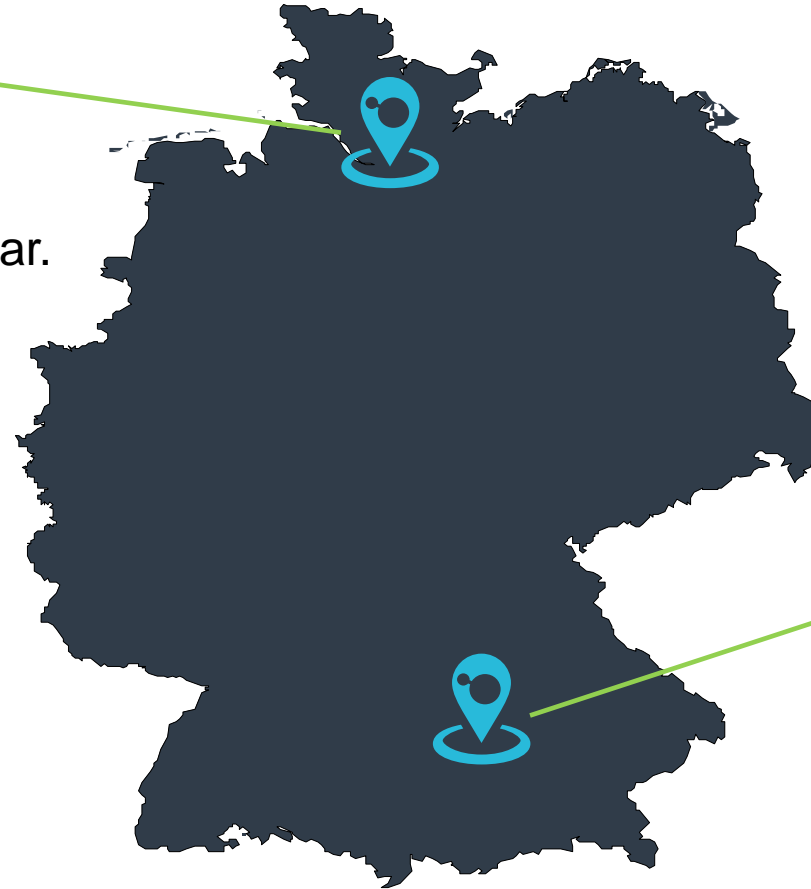
## 10 MW Electrolyzer

- Modular indoor solution with 10 MW / skid
- Optimized for 10-100 MW

# Our production sites are close to many hydrogen development projects

## Hamburg, Germany

- PEM Stack Development & Production
- Gigafactory to start running this year.
- Service Hub



Utilizing **MAN PrimeServ's** global Sales & Service Network:



## Augsburg, Germany

- PEM Electrolyzer Development & Production
- Technical Service Center (TSC) Base

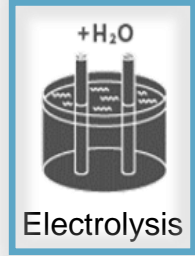


# Power-to-X

An overview

## Green Hydrogen production

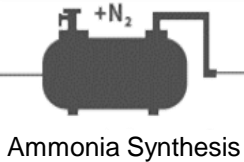
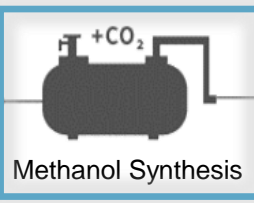
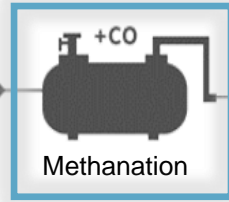
MAN portfolio



green hydrogen

## Synthetic fuel production

MAN portfolio



## Power Fuels

Hydrogen

SNG

Methanol

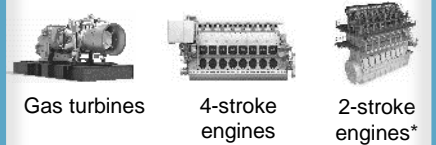
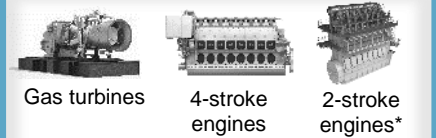
Ammonia

## Ways of transport



## Power Generation

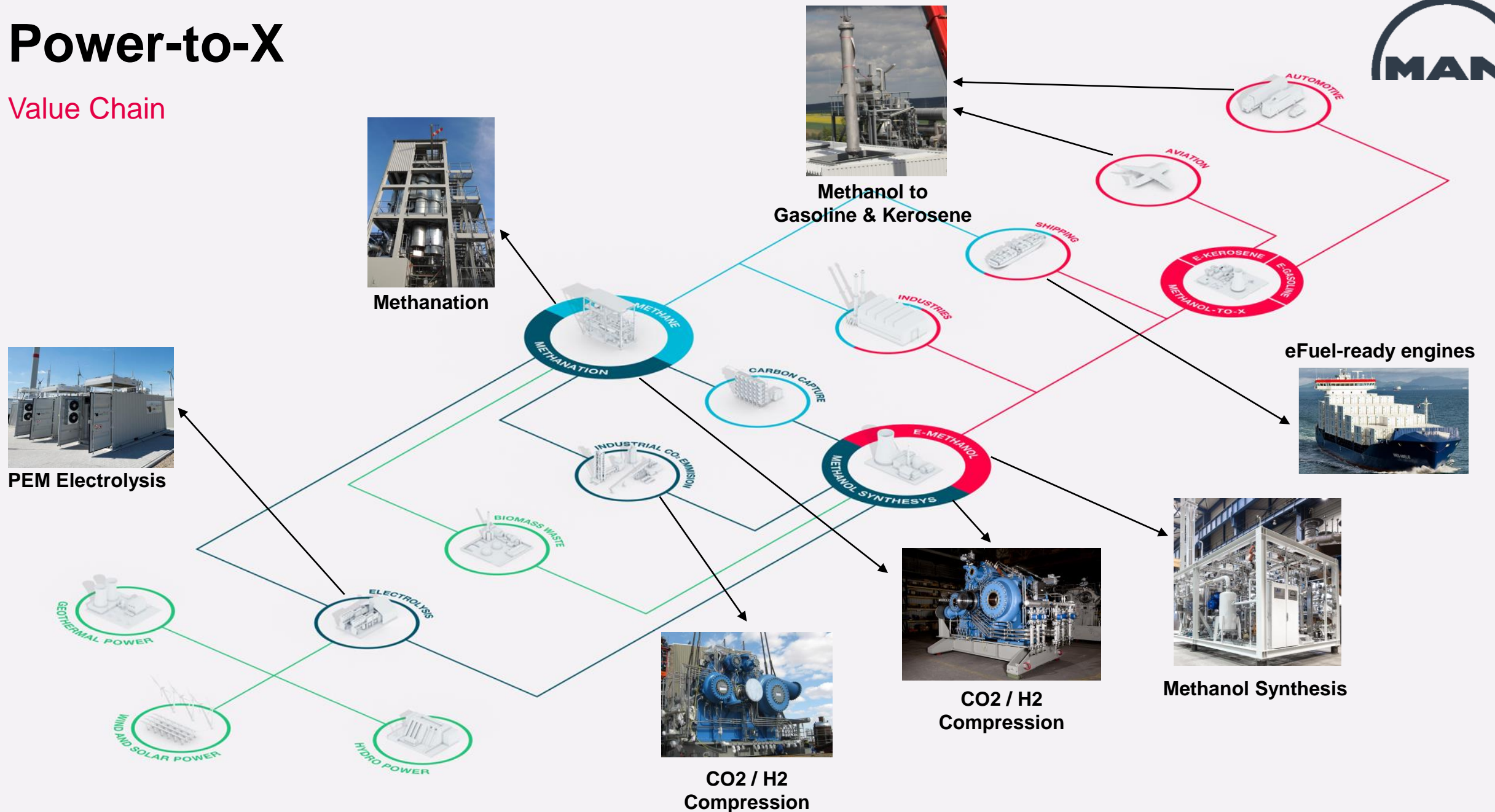
MAN portfolio



\* Engines built by MAN licensees

# Power-to-X

## Value Chain





# kiwi's industrial SNG plant is the "sample factory" for the SNG and PtX rollout



1 Three electrolyzers  
Source: kiwi AG



2 Biogas treatment plant



3 Methanation reactor



4 Liquefier and e-LNG filling Station



5 Hydrogen filling station



6 Grid injection plant



# Haru Oni Project



Converting renewable energy into synthetic fuels (1MW e-gasoline plant)



MAN Energy Solutions supports Porsche AG and HIF in its Haru Oni PtL project in Chile



Methanol skid based on JM technology ready to ship



# bse methanol partnered up with MAN Energy Solutions

## MAN DWE® power-to-liquid solutions

New cooperation partner bse methanol

### MAN Energy Solutions cooperates with licensor bse methanol

- MAN Energy Solutions and bse Methanol cooperate in the field of modular skid based methanol plants
- MAN Energy Solutions supplies the complete equipment for the *FlexMethanol*® Skids
- Further joint development of *FlexMethanol*® Skids
- Pre-fabricated skids *FlexMethanol*® 10 & *FlexMethanol*® 20 are ready for market



1<sup>st</sup>, **MAN** has the highest reputation in chemical reactors manufacturing.

2<sup>nd</sup>, tests on pilot stands by **bse** and **BASF** have been confirmed by independent tests of **MAN Energy Solutions**.

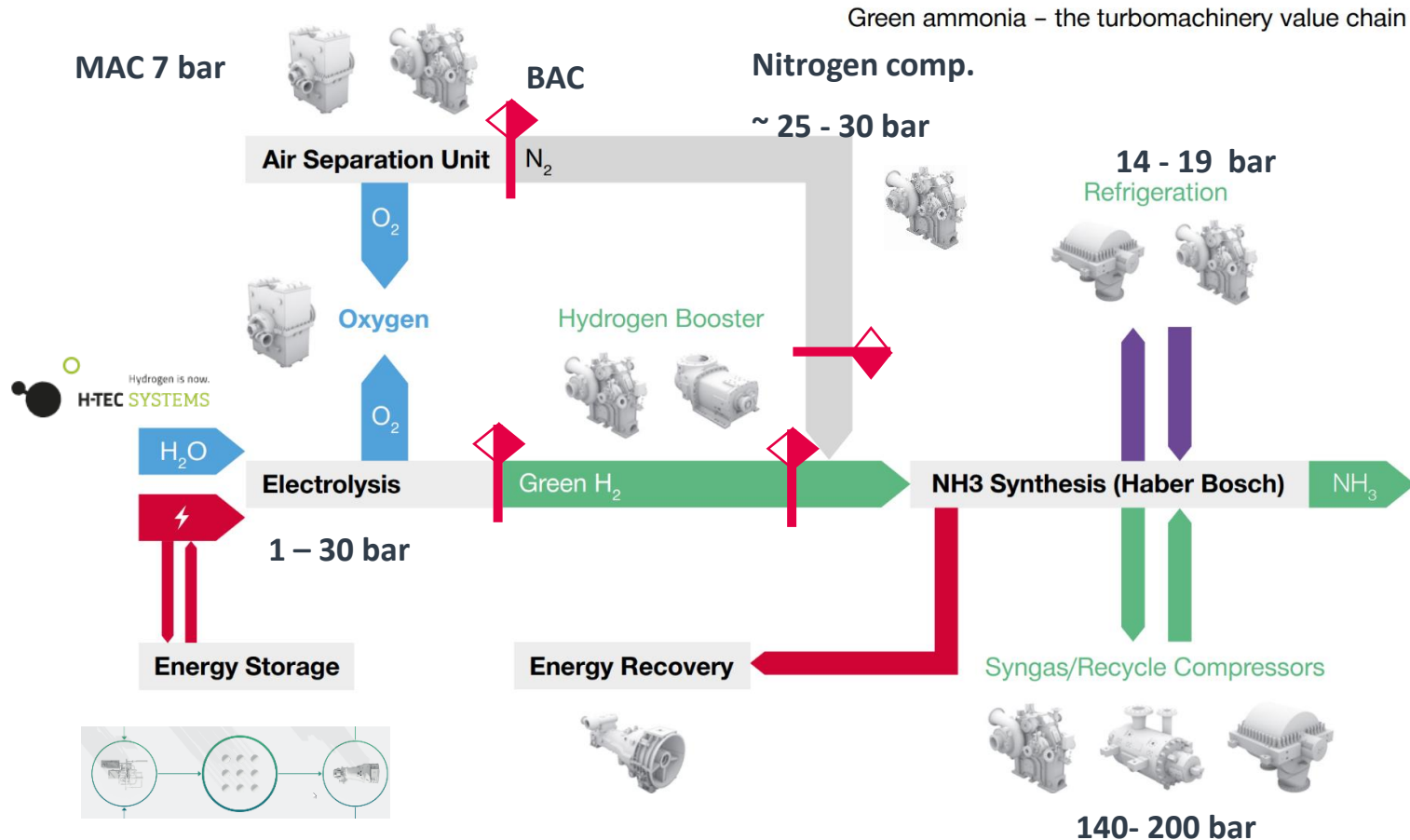
### Conclusion:

The most competent team of **BASF**, **bse** and **MAN** complement ideally by technology and by scope of supply in the implementation.

Grid injection plant

# Green Ammonia

Optimized battery limits & improved configurations



## MAN portfolio for green ammonia plants

- ASU compressors
- Syngas compressors + Ammonia refrigeration compressors
- Hydrogen compressors (booster after electrolysis)
- Train integrated steam turbines for utilization of heat / steam from ammonia reaction

### Additional

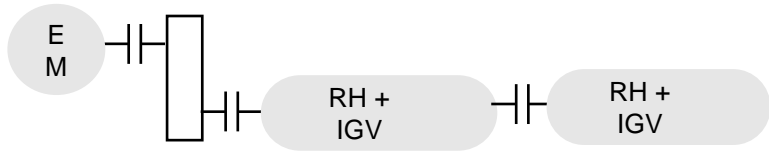
- Energy storage systems (LAES / CAES/ CO2 battery)
- Oxygen compressors
- Electrolysers
- Hydrogen expander

Full spectrum available with MAN.

# Green Ammonia

Possible train arrangements refrigeration compressor train

A1



Std. motor  
IGV control

A2



Highspeed motor  
Speed control

A4: integrally geared compressor,

Fix speed, inlet guide vanes

Intercooling between last stages

=> Lowest OPEX, lowest CAPEX

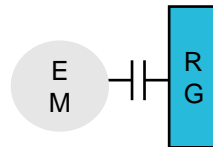
A5: power recovery via coupled steam turbine

A3

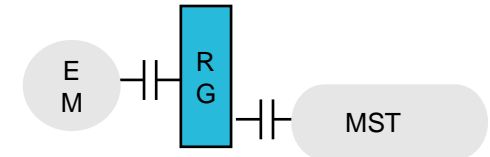


Std. motor  
Speed control

A4



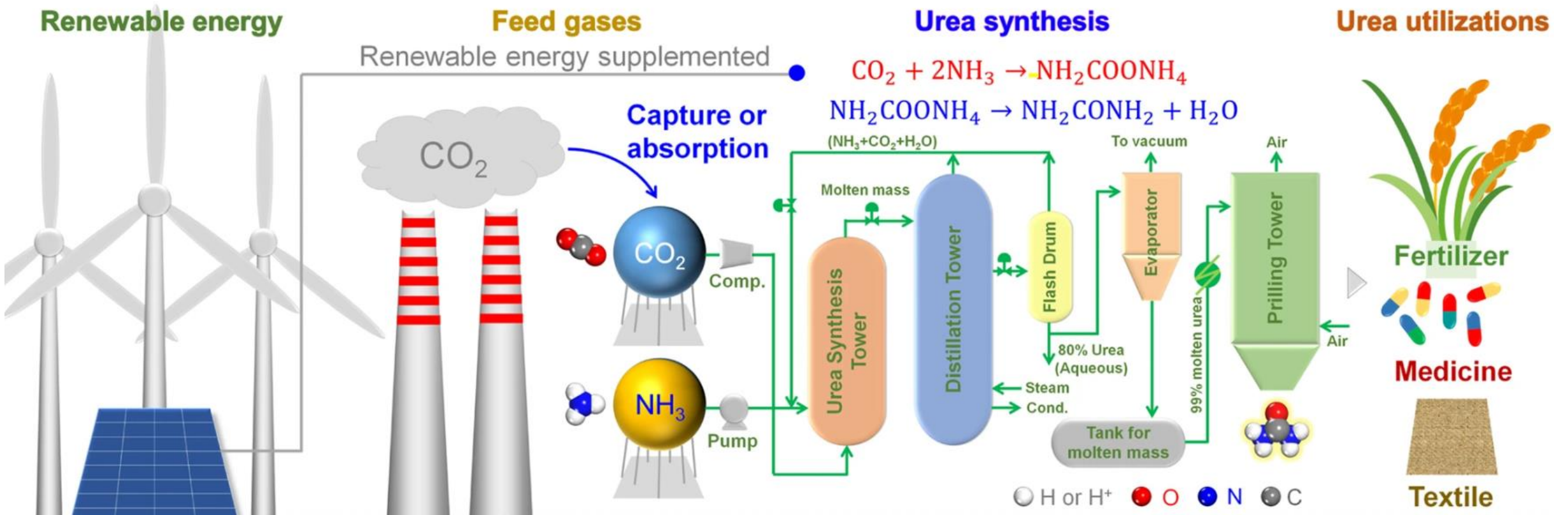
A5





# CO2 compressors for Urea synthesis

Integrally geared compressors



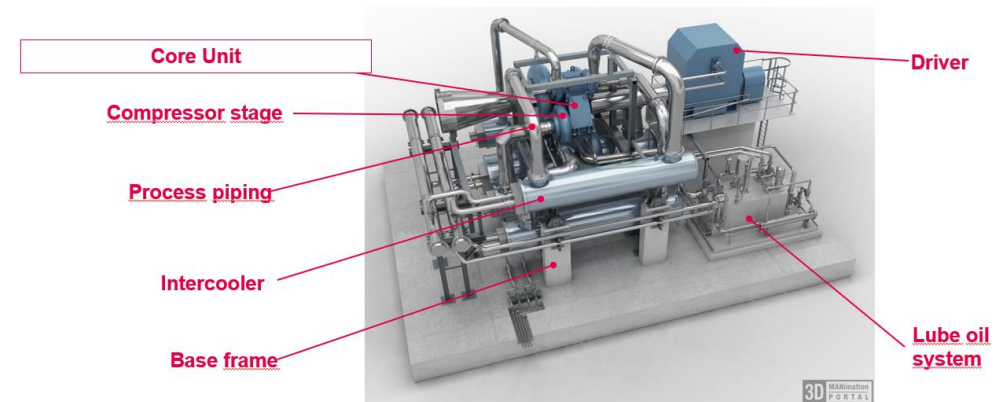
Source: Fig. 1: Urea synthesis process from carbon dioxide and ammonia and the challenges and strategies to achieve high production rate with low carbon intensity and energy demand. | Nature Communications

# CO2 compressors for Urea synthesis

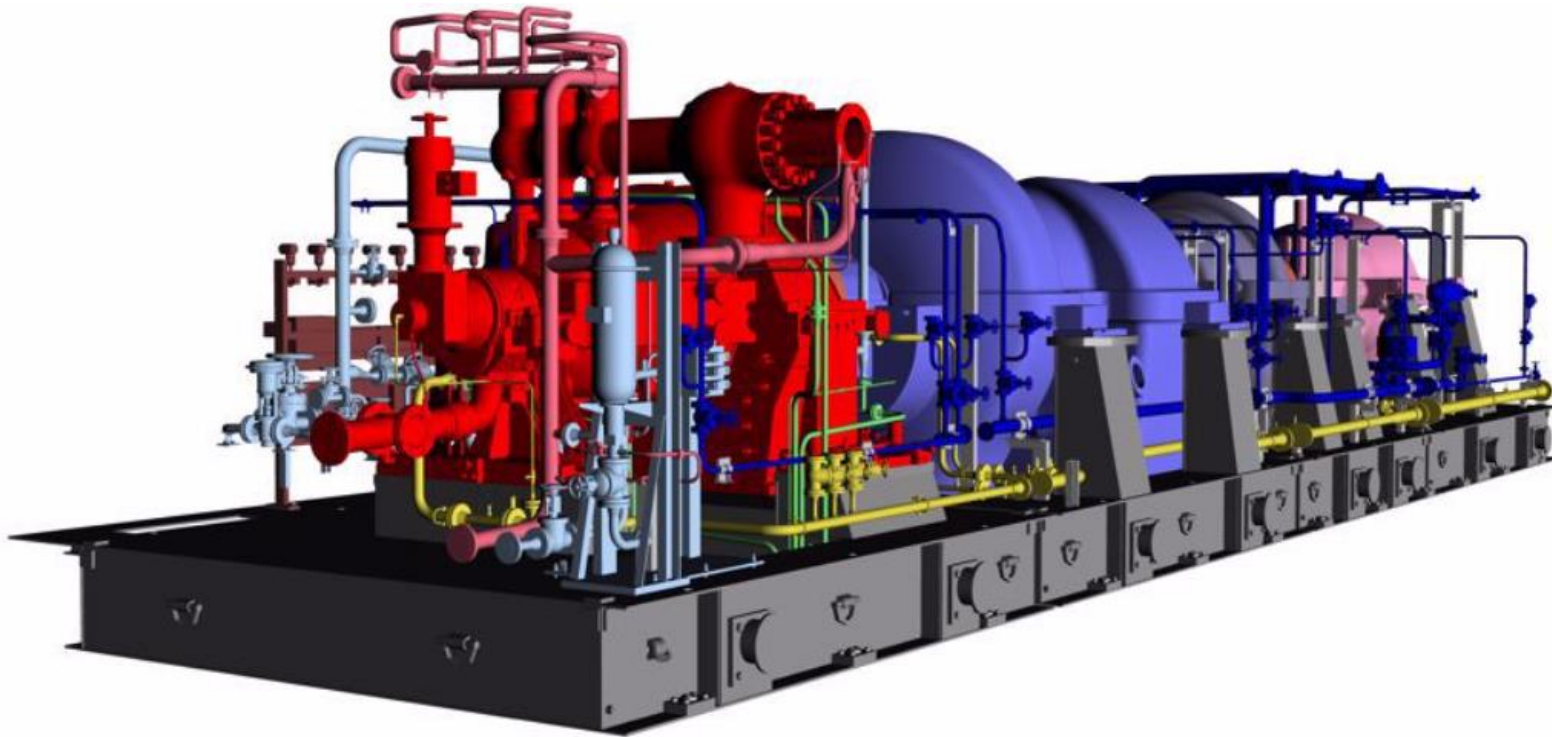
Integrally geared compressors



– MAN would suggest integrally geared compressors for high efficiency.



# NAMAX – Modular **Nitric Acid** Train Package



– Nitric acid trains are among MAN's most complex machine trains, as they combine extremely different types of turbomachinery. MAN ES offers trains with outputs of 200 to 4,000 metric tons a day and is the market leader for dual-pressure processes in the HNO<sub>3</sub> segment.

**Reasons for MAX1 Development – Increase of Power Density.**



# Seu Parceiro mais completo para plantas de Ammonia/Fertilizantes





# Comprehensive service solutions

New state-of-the-art workshop

## Featured Enhancements

- 2,400 m2 of usable area
- Expanded scope of services
- Full integration with MAN PrimeServ Petrópolis complex repair center
- Greater lifting capacity of up to 40 tons
- State-of-the-art technology with new equipment for in-house repairs
- Ultrasonic tank for cleaning of components
- Significant increase of the area for loading and unloading
- Fast and easy access without restrictions
- MAN PrimeServ Academy integrated



24  
horas / dia

365  
dias / ano

MAN PrimeServ



# PrimeServ Academy Niterói

Training at its Best





# MAN PrimeServ Brazil

Complex repairs and reverse engineering solutions for OEM and 3rd party rotating equipment



## Manufacturing Capacity

Turning Center:	Ø1.600 x 6.000 mm
Milling:	W 3 .000 x L 2.000 x H 1.200 mm
Boring-Milling:	W 1.700 x L 1.600 x H 1.600 mm
Grinding (Tang./ Cilind.):	Ø 1.200 x 6.000 mm
Wire Erosion CNC :	750 x 750 mm
Special Welding	TIG / MIG / Coated Electrodes

Metallisation:	Dual Wire / HVOF / Flame Spray
Low-Speed Balancing:	Ø1.600 x 3.000 mm ( capacity 8 tons)
Engineering Projects:	CAD / CAM – Solidworks / Inventor / 3D
Non Destructive Tests:	NDT According to API/ ASTM / ASME
Cleaning:	Hydro e Micro spheres(Grit Blasting - API)



Connection rods repair



Dynamic Balancing



Gearbox maintenance and repair



Sealing Strips Manufacturing

High-tech  
fully  
fledged  
local repair  
workshop.  
**Complex  
Repairs  
Made in  
Brazil.**



# PrimeServ Assist

Remote Operation Centers SBU Turbo



- In 3 time zones („Follow the Sun“)
- 24/7 Availability of Engineers for Trouble Shooting and Quick Response over the phone
- Proactive evaluation and support



ROC Americas - Brazil



ROC Europe – Germany (Oberhausen)



ROC Asia – China (Shanghai)



# Thank you very much!

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