

# MAN ES PtX

Webinaire GDR EMR

Energies Marine Renouvelables et Power-to-X,  
Enjeux et Perspectives

# MAN Energy Solutions Business areas

## Overview

### Engines & Marine Systems



### Turbomachinery



### Power Plants



EPC competence  
worldwide

### Aftersales *MAN PrimeServ*



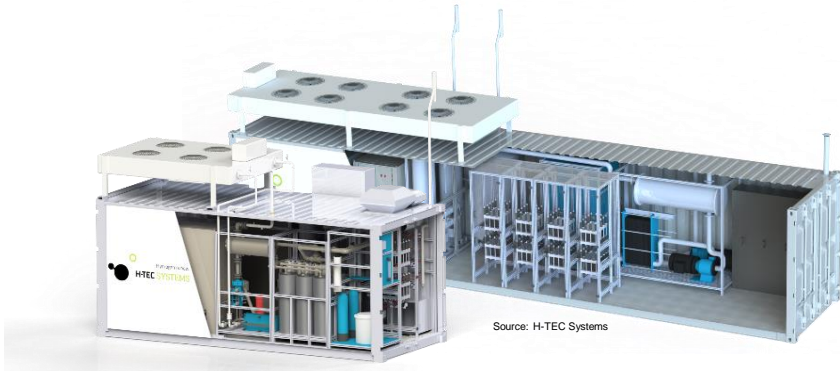
### *New business area: New Solutions*

→ Power-to-X, Hydrogen/Electrolysers, Hybrid solutions, LNG-to-Power, Turnkey solutions, MOSAS, ETES, CSP

# MAN Energy Solutions and Hydrogen

Growing range of solutions - Own portfolio, strategic investments & partnerships

## Examples:



Production...



...Storage



# Drivers of our company strategy

# Decarbonization

## calls for new technologies

- Limit global warming to below 2° Celsius
- Greenhouse gas emissions -50% by 2030 (EU)
- Carbon neutrality until 2050



# Decarbonization, new hurdles ahead

Current and coming changes raise new challenges



Electrical grid



Industrial feedstock and heating



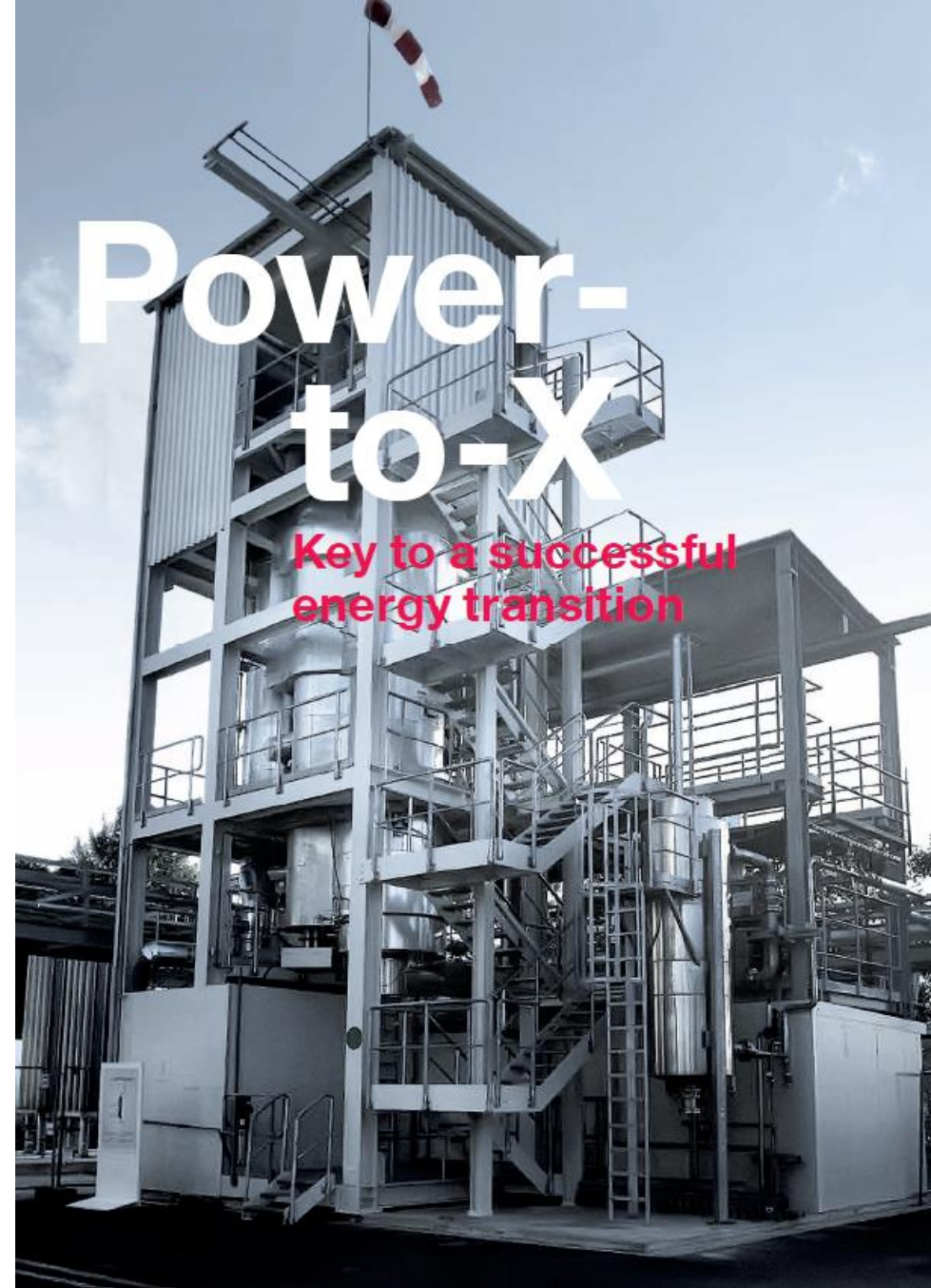
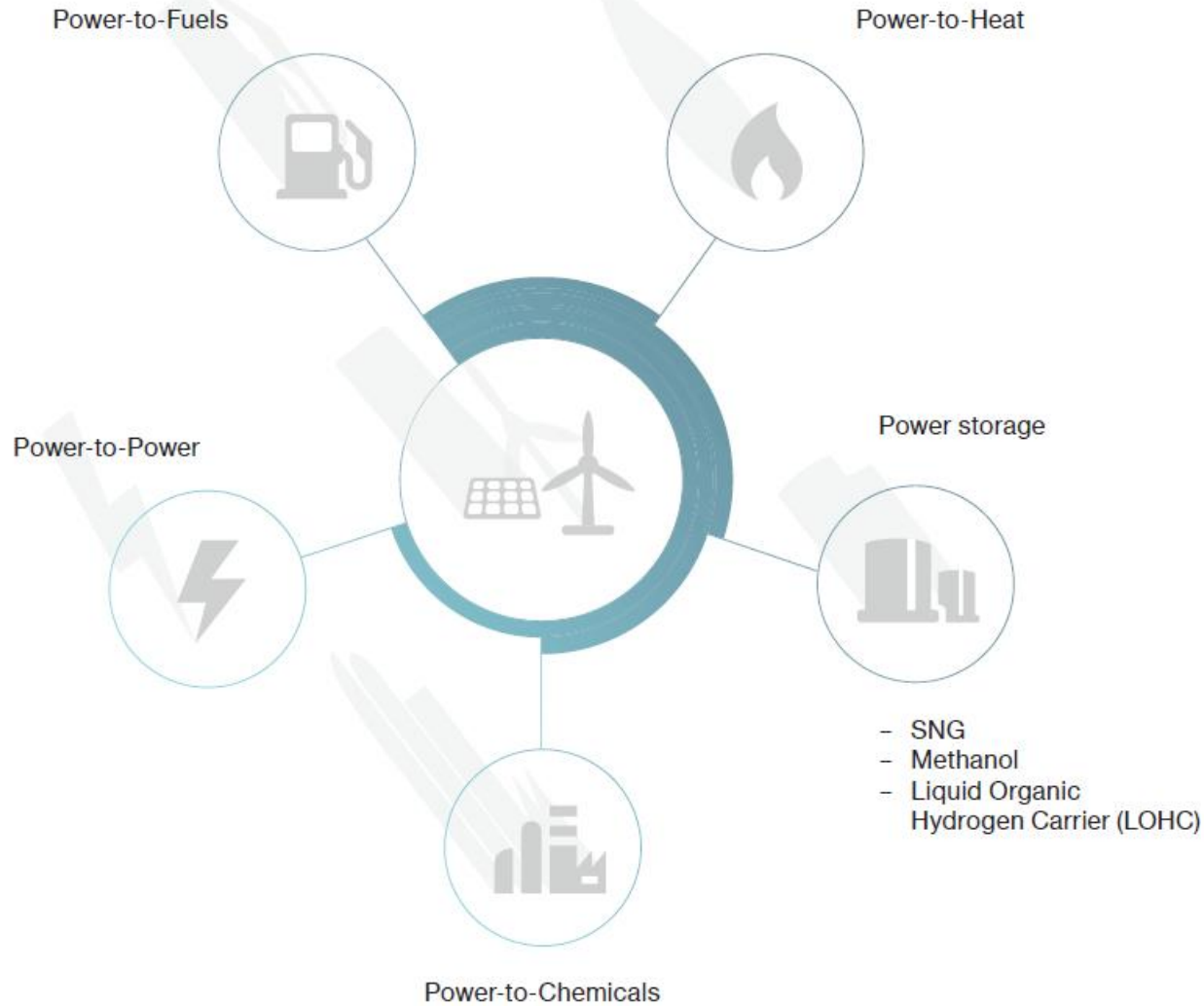
Long range and heavy duty transportation



Building heating

# Power-to-X

A key to decarbonization

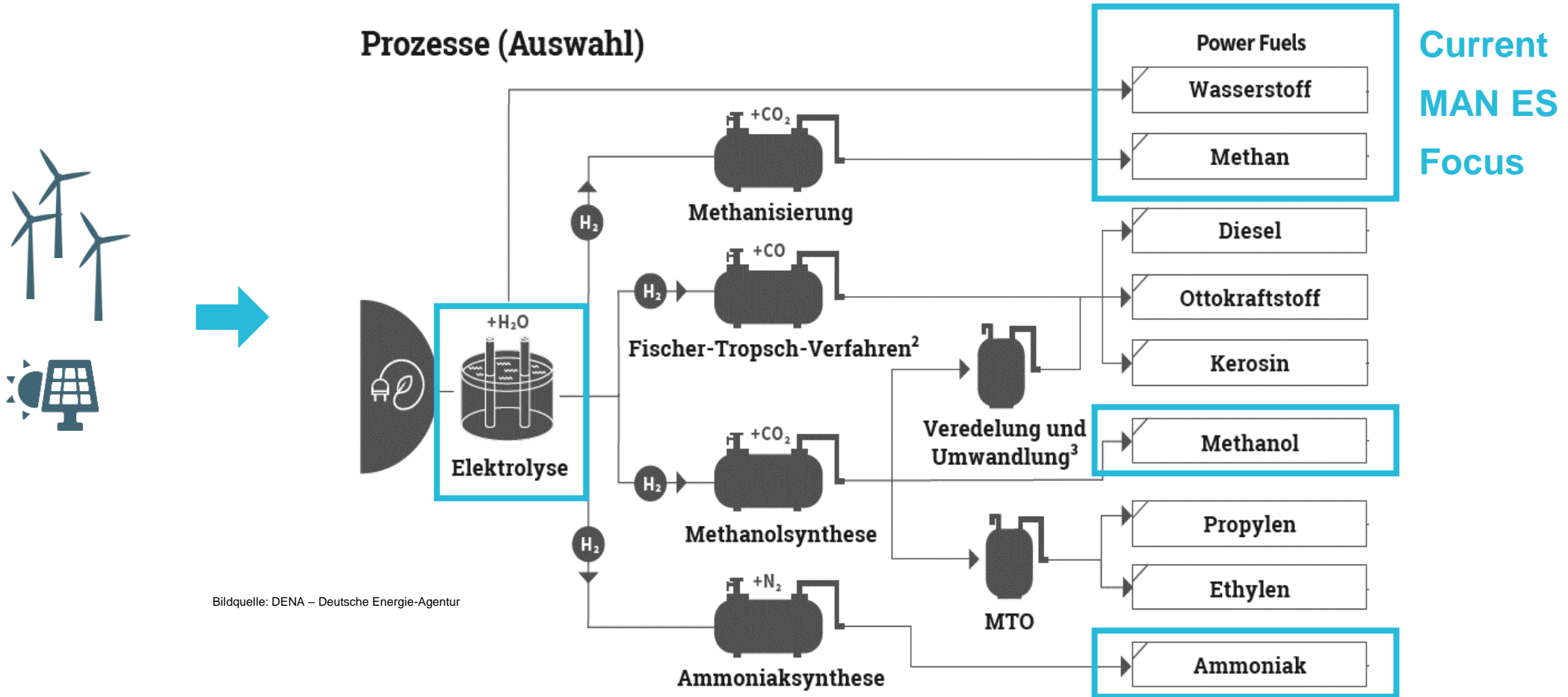




# Decarbonization thanks to Power-to-X



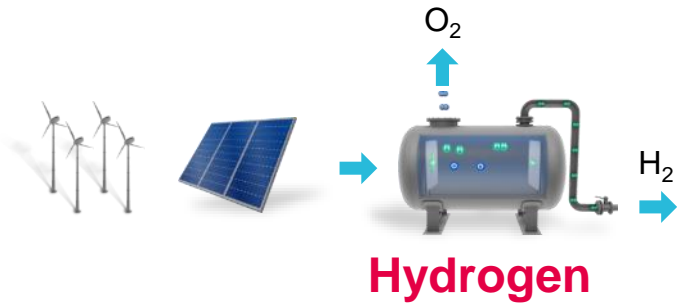
How it works



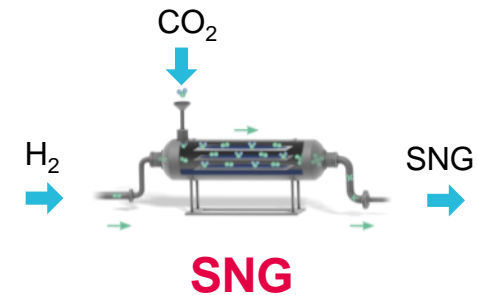
Bildquelle: DENA – Deutsche Energie-Agentur

# Evaluation of hydrogen and SNG

There are use cases for both energy vectors



- ✓ No  $CO_2$  emissions from  $H_2$  usage
- ✓ Lower production cost
- ✗ Development in new technology (engines, turbines etc.) necessary: only fuel cell available
- ✗ Limited infrastructure existing, e.g.  $H_2$  grids, fuel stations
- ✗ Limitations in existing natural gas grid



- ✓ Existing fossil fuel consumers are ready for SNG (i.e. direct reduction of  $CO_2$ , as SNG is  $CO_2$  neutral)
- ✓ Existing gas grid can be used without limitations
- ✓ Solution for marine and aviation (Emission reduction)
- ✓ Lower cost for transport and storage
- ✗ Usage of SNG emits  $CO_2$
- ✗  $CO_2$  required; Higher production cost

SNG: Synthetic Natural Gas

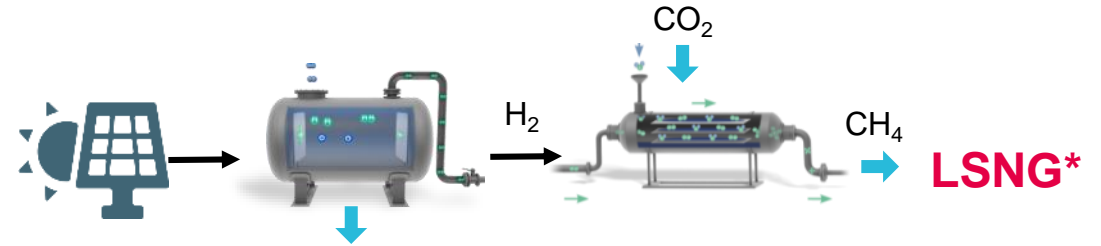
➔ Markets for both  $H_2$  and SNG will develop in parallel



# Renewable Marine Energies powering P2X

Opening new fields for far offshore wind farms implementation

- Long distance Transport today as LSNG\*



- Outlook: Hydrogen logistic with LOHC Technology

**hydrogenious**  
LOHC TECHNOLOGIES

**FRAMES**

**MAN**  
MAN Energy Solutions



Bild: Hydrogenious

P2X allows operation of Offgrid wind farms...

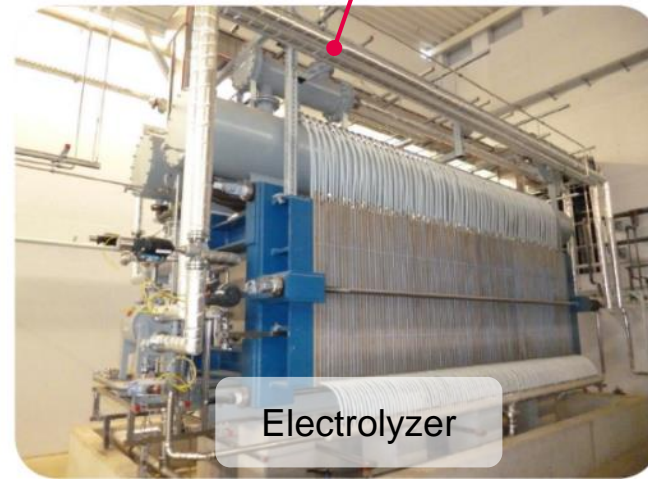
... but raises new stakes of Long distance H<sub>2</sub> shipping...

... or Offshore Chemical conversion into e-fuels ?

\* LSNG = Liquefied Synthetic Natural Gas

# MAN ES power-to-SNG reference in Werlte

A demonstrator in operation since 2013



## Key facts:

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

➔ Plant In commercial operation since 2013

Picture source: Audi



# DWE®Reactors Methanation Technology

1st vs. 2nd Generation

DWE®Reactors Methanation 1st-Generation  
6,3 MW – in operation since 2013

## Achievement

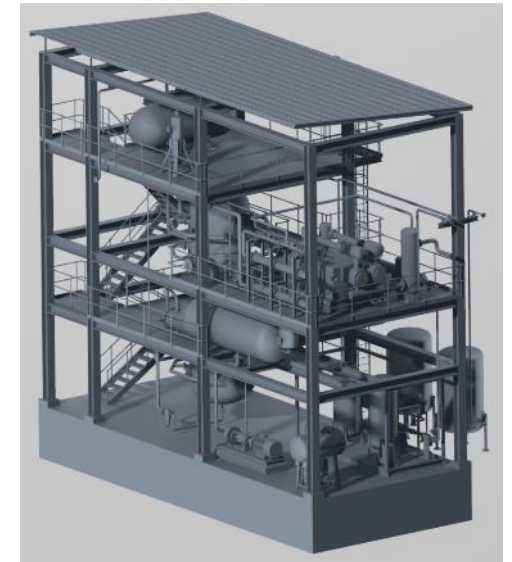
Methane Content:	92-95%
Dynamic Operation:	70-100%
Footprint (lxbxh):	8 x 4 x 15,5 m <sup>3</sup>
Unit size ratio	78m <sup>3</sup> /MWel
Specific Capex Costs:	100%



DWE®Reactors Methanation 2nd-Generation  
50MW – reference plant

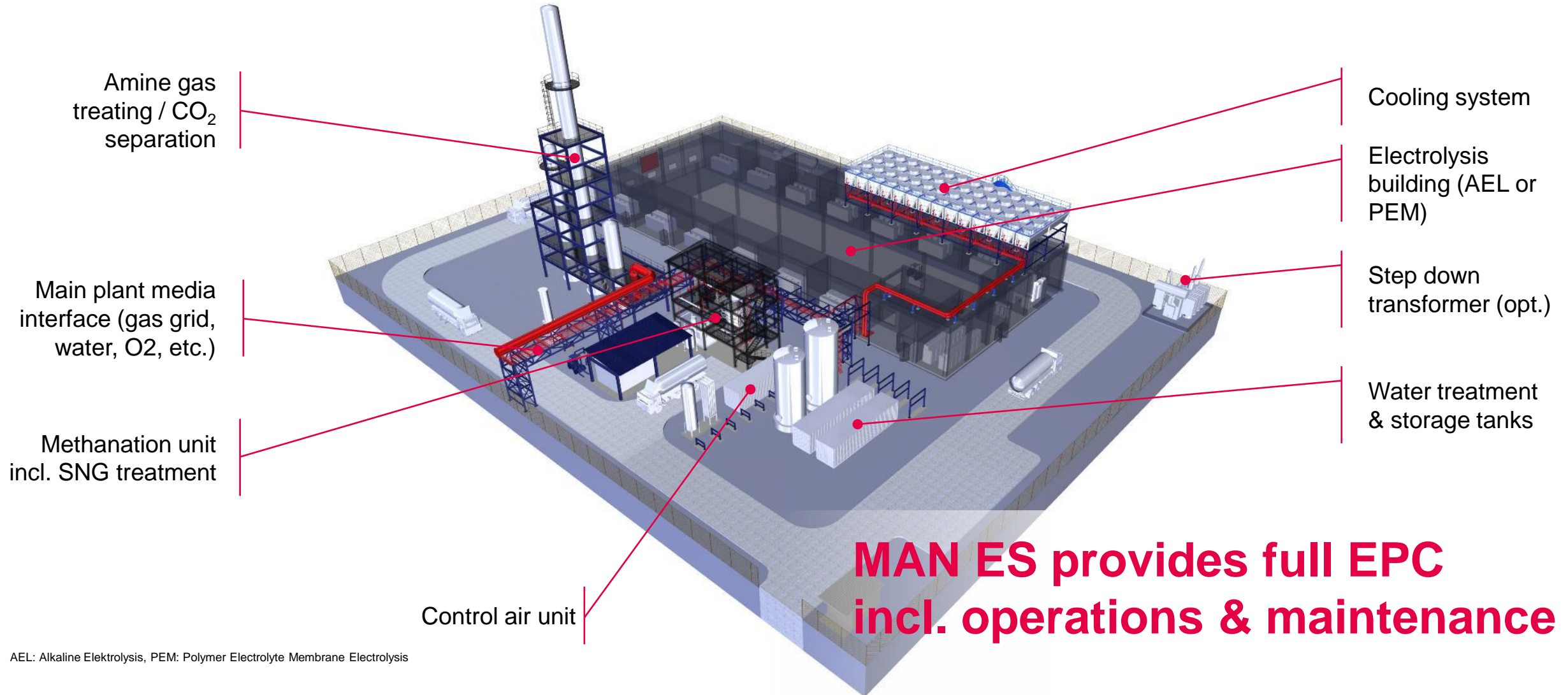
## Achievement

Methane Content:	95-97%
Dynamic Operation:	50-100%
Footprint (lxbxh):	14,5 x 6 x 10 m <sup>3</sup>
Unit size ratio:	17,4 m <sup>3</sup> /MWel
Specific Capex Costs:	60%



# MAN ES Power-to-Gas reference plant

MAN ES 50 MW PtG plant layout - preliminary





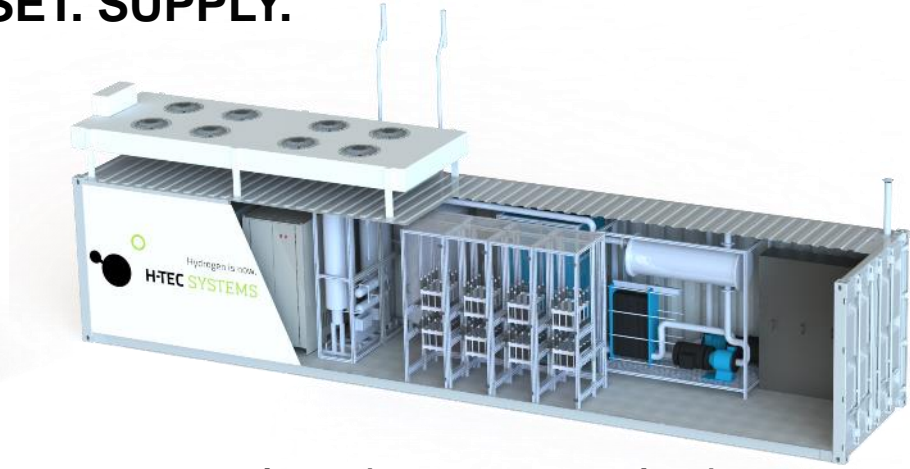
# MAN ES / H-TEC SYSTEMS Electrolysers solutions

H-TEC-SYSTEMS, privileged MAN Energy Solutions partner (40% shareholder)

## ELECTROLYSERS - READY. SET. SUPPLY.

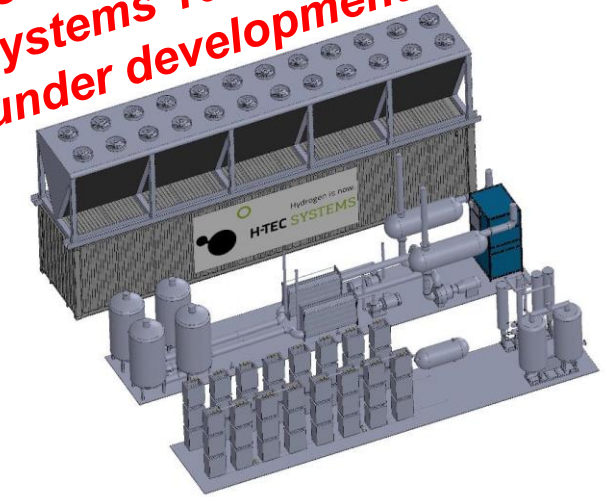


ME 100/350 (225kW, 100kg H<sub>2</sub>/day)



ME450/1400 (1MW, 450kg H<sub>2</sub>/day)

**Modular PEM Electrolyser  
Systems 10 / 50 / 100 MW  
under development**



Under development: 10MW, 4,5tons H<sub>2</sub>/day

### H-TEC SYSTEMS Series-ME electrolysers

- Compact design in an ISO container
- Capable of dynamic part load operation to enable grid balancing services
- High conversion efficiency (74%), additional heat integration
- 5.0 hydrogen quality suitable for refuelling applications
- Readily available product for effective sector integration solutions

### H-TEC SYSTEMS next generation

- Compact design in three ISO containers
- Perfectly suited for industrial P2X plants
- Available for commissioning in 2023

# Green marine fuel

CO<sub>2</sub> neutral shipping with MAN PtX



**11,000 TEU**

Typical container vessel  
MAN ME-GI gas engine

**18,000 ton/yr LNG**

Main fuel consumption per year,  
7.5 roundtrips Dubai – Genua - Dubai

**61MW**

PtG plant operating 8000 hrs./year

**100% CO<sub>2</sub> neutrality**

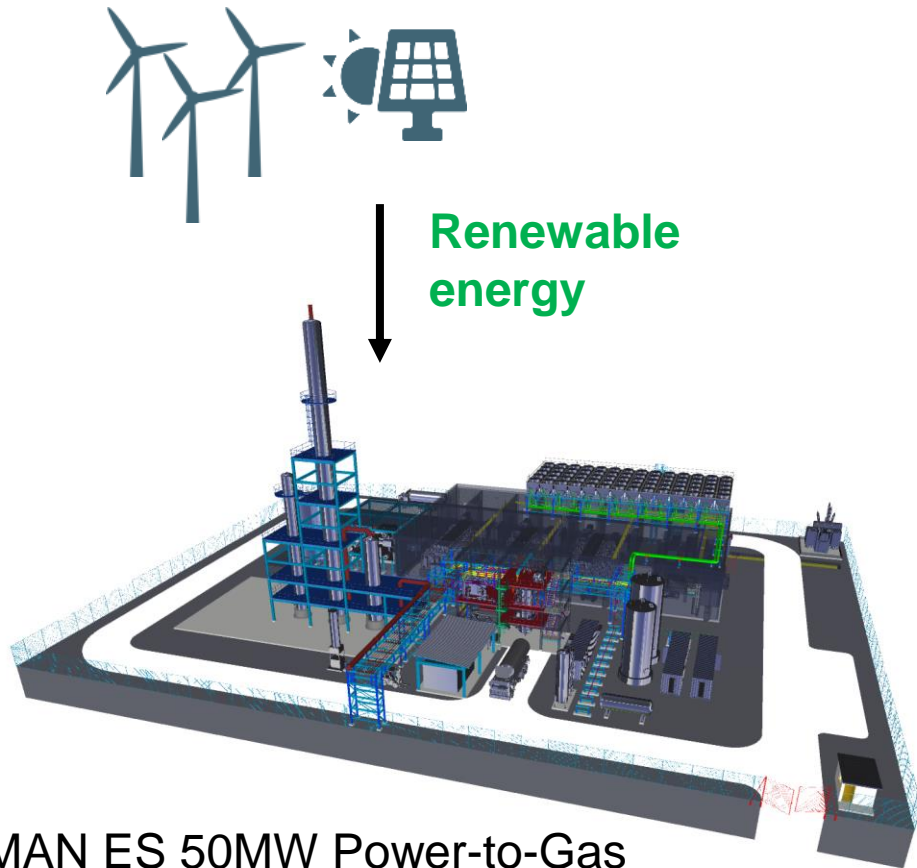
Teu: Twenty-foot equivalent unit

Source: MAN Study „11,000 teu container vessel – An ME-GI powered vessel fitted with fuel gas supply system and boil-off gas handling“, 2018



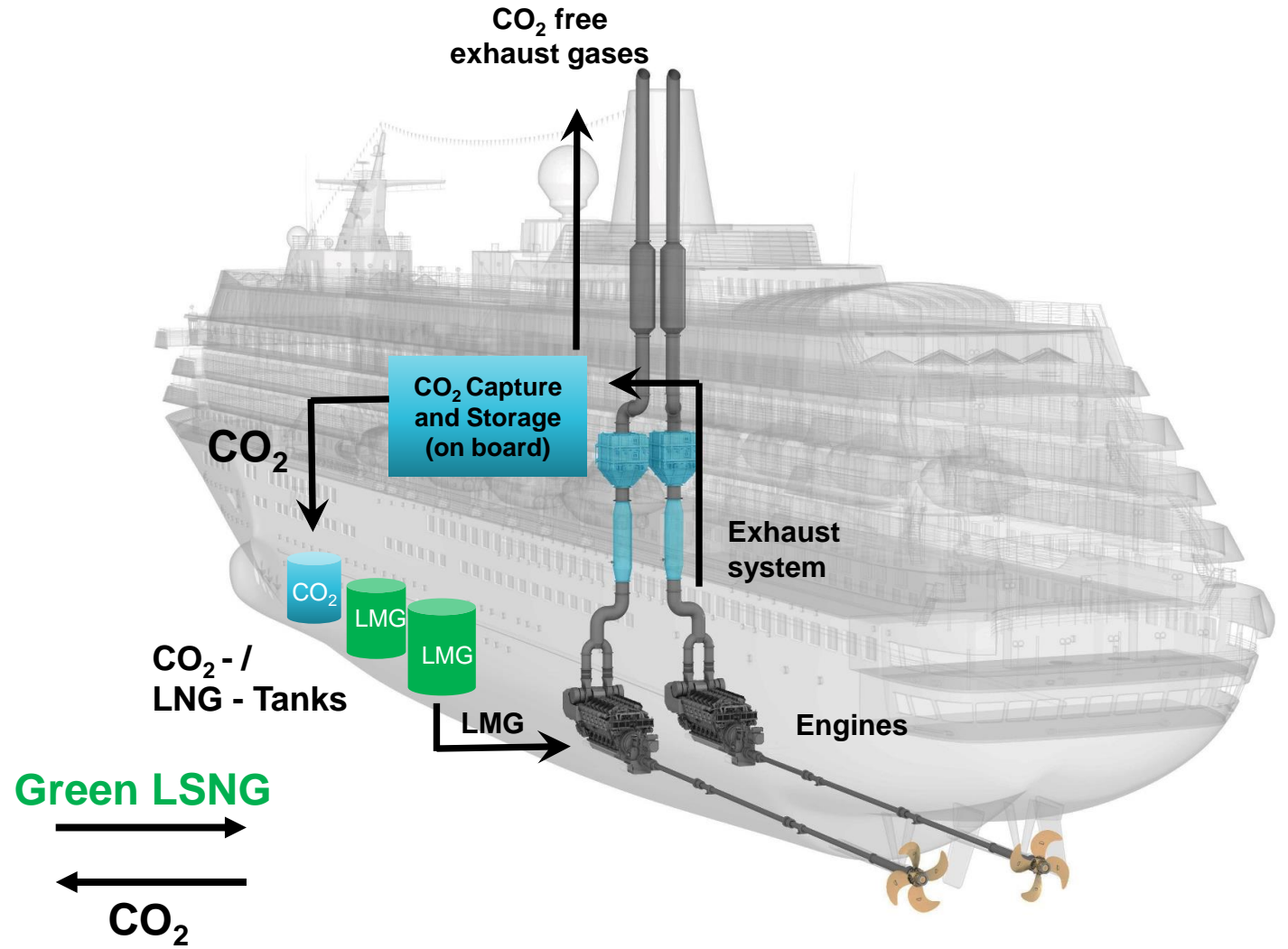
# Carbon neutral shipping with MAN ES Technology

Sector coupling with Power-to-Gas



MAN ES 50MW Power-to-Gas (SNG) Plant

SNG = Synthetic Natural Gas (CH<sub>4</sub>) – LMG = Liquefied Methane Gas



# Take Aways

- Power to X is a key to decarbonization, especially for challenging fields of industry or transports,
- Long distance green Hydrogen transport remains a challenge, today tackled with SLNG, on long term with e-fuels, ammonia, etc,
- MAN Energy Solutions developing EPC P2X plants,
- Own proprietary technology for Electrolysers and Methanation reactors,
- Long experience in methanation, proposing already 2<sup>nd</sup> generation reactors,



# Thank you very much!

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July 2020





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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.