

MAN ES Intro – H2 & P2X Overview





- 1 About MAN ES & New Solutions**
- 2 Power-to-X Overview & MAN in H2 value Chain**
- 3 H2 & E-Fuels Production**

1 About MAN ES & New Solutions

Our Purpose

What we do and why we do it



Moving big things to zero

We engineer systems for
deep decarbonization in sectors
that matter most

Our strategic business fields



Marine



Energy & Storage



Industries



Aftersales MAN PrimeServ









Member of the Volkswagen Group

MAN Energy Solutions is part of a brand family

Automotive Division


Passenger Cars Business Area

VW	
Audi	
Skoda	
Seat	
Bentley	
Porsche	
Others	

Commercial Vehicles Business Area

VWN	 <small>Nutzfahrzeuge</small>
Scania	
MAN Truck & Bus	

Power Engineering Business Area

MAN Energy Solutions	
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Key figures 2022

14,571

employees worldwide

3.6 bn €

revenue

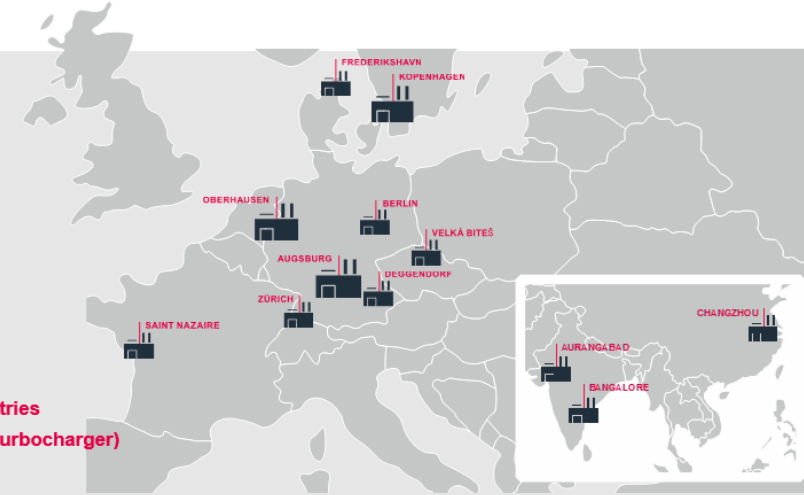
Sites across Europe and Asia

9
3
30

Production sites
in Europe

Production sites
in Asia

Licensees in 7 countries
(two- and 4-stroke, turbocharger)



Our Purpose

What we do and why we do it



The industries we serve are crucial for the world economy. Most of them are also hard to decarbonize. This gives us the opportunity to have big impact on the global energy transition. That's why we get out of bed every morning.

Dr. Uwe Lauber, CEO MAN Energy Solutions

**Shipping
Heating & Cooling
Energy Generation
Chemicals
Cement
Refinery**

These are the technologies we rely on to help our clients achieving the target of 'net zero'.



PEM-Electrolysis



Green Engines



Retrofits



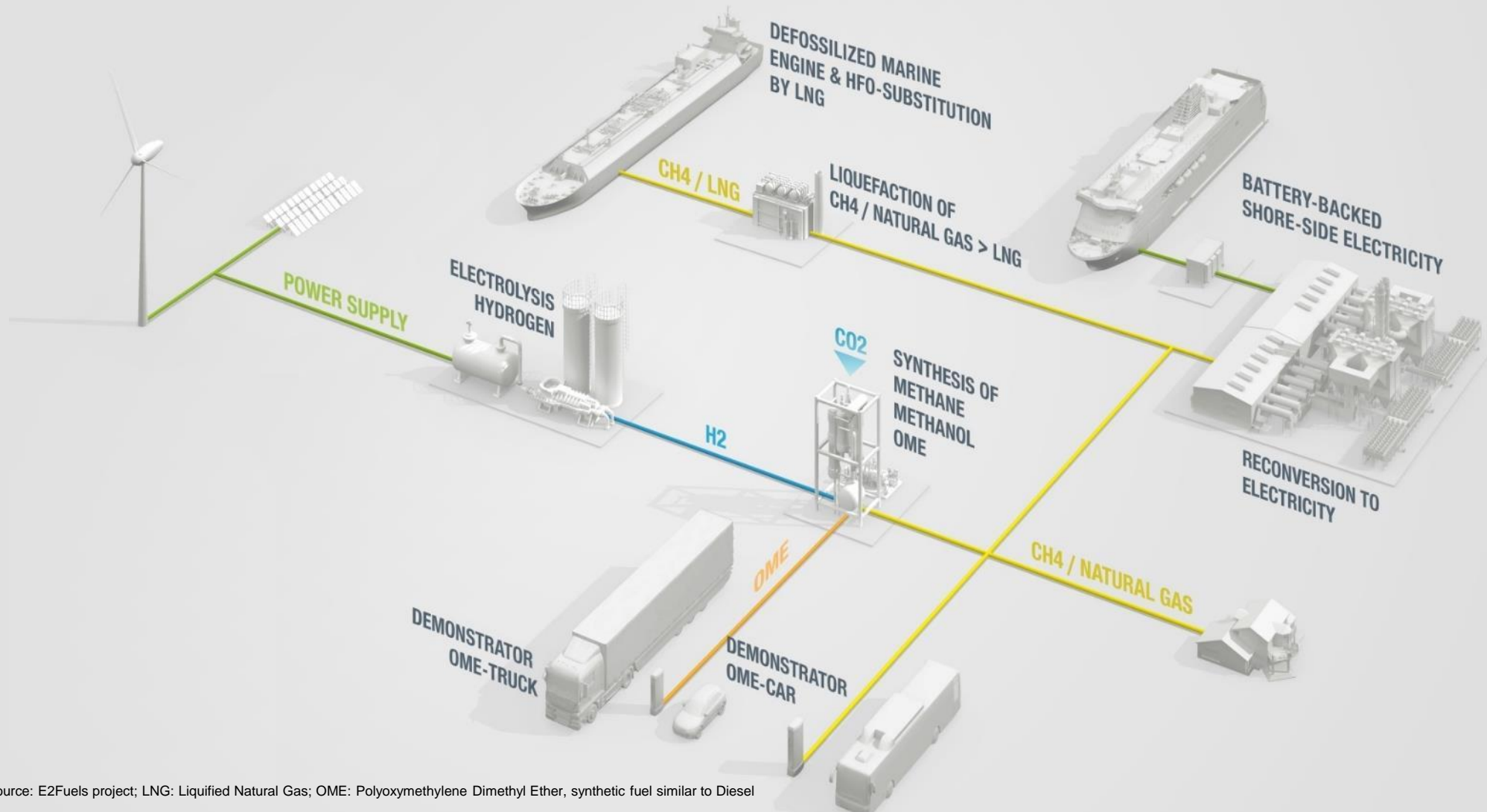
Carbon Capture



Heat Pumps

2 Power-to-X Overview & MAN in H2 Value Chain

PtX – Definition & use cases



Source: E2Fuels project; LNG: Liquefied Natural Gas; OME: Polyoxymethylene Dimethyl Ether, synthetic fuel similar to Diesel

MAN ES: bringing it all together...in a meaningful way



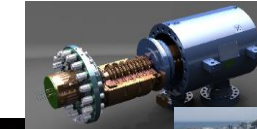
"Green" Hydrogen & eFuel Value Chain



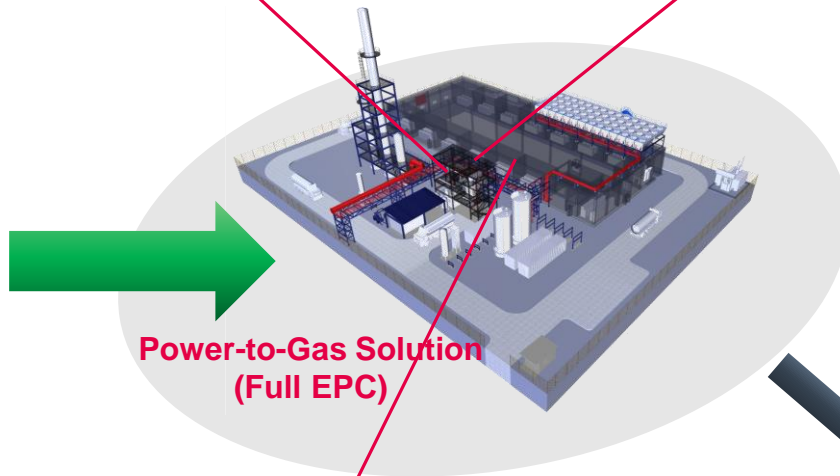
CO₂-Compressors



**eFuel Reactors
& Process
Technology**



**SNG Compressors & LSNG-to-
Power Infrastructure Solutions**



**Power-to-Gas Solution
(Full EPC)**



**PEM
Electrolysers**



&



H₂ & eFuel-ready Engines



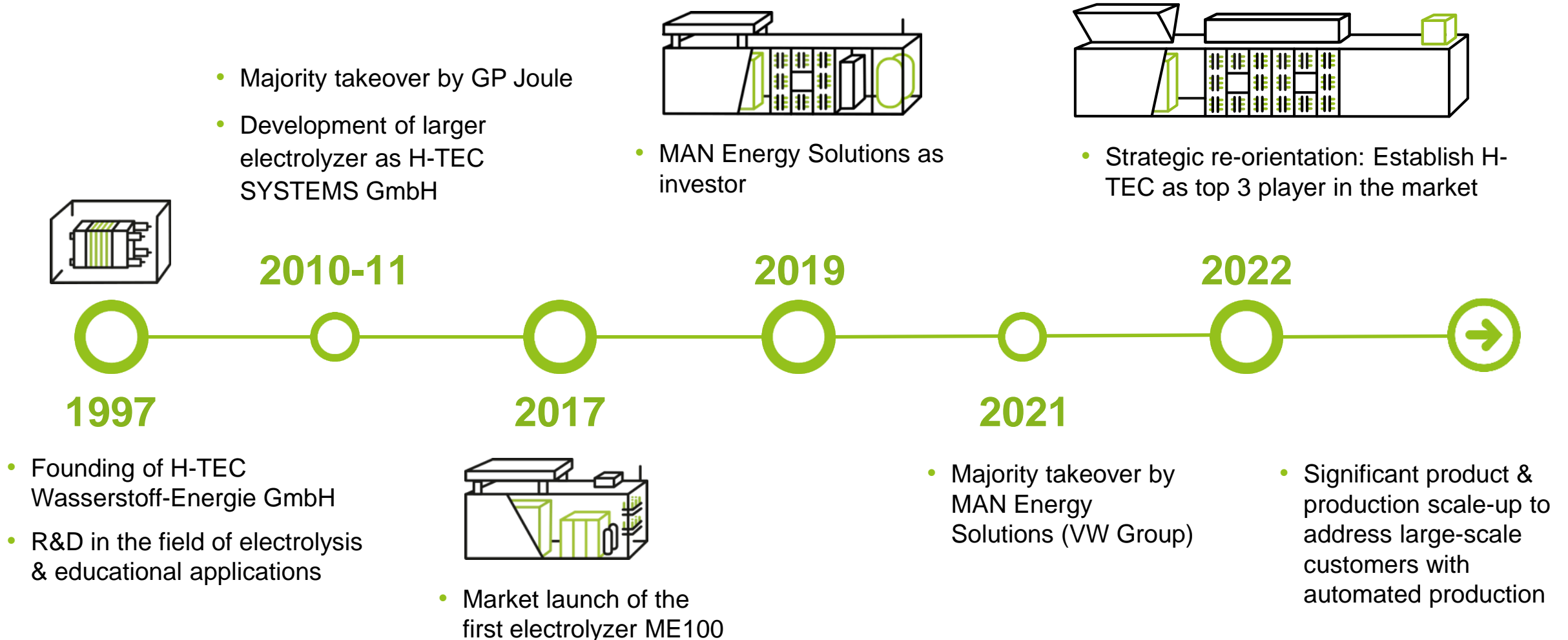
**Compressors for Blend (H₂/NG)
& pure H₂ Grid Structures**



SNG = Synthetic Natural Gas | LSNG = Liquefied Synthetic Natural Gas

3 H2 & E-Fuels Production

H-TEC has 25 years of experience in PEM Electrolysis



Advantages of H-Tec Electrolyzers



World's best efficiency in PEM:
74% (plant level, 30bar)

Fast ramp-up & load changes:
30s (standby to full load)

High reliability: Proven stack
platform & inherent redundancy

World's **smallest footprint** for
1 MW container

No toxic chemicals: approved for
Swiss natural protected reserve

Bankability, proven project
execution capabilities (MAN ES)

Lowest levelized cost of hydrogen:

- ~75% of LCOH¹ are **electricity** cost making **high efficiency** an extremely high priority
- **Fast ramp-up/load changes** are key to not "waste" valuable electricity
- **Highest reliability** with **unique service network** crucial for plant amortization

Reduce land cost, logistic cost, and fit
into available plots

No risk of environmental hazards, no
insurance cost

Decisive experience in the project
execution area

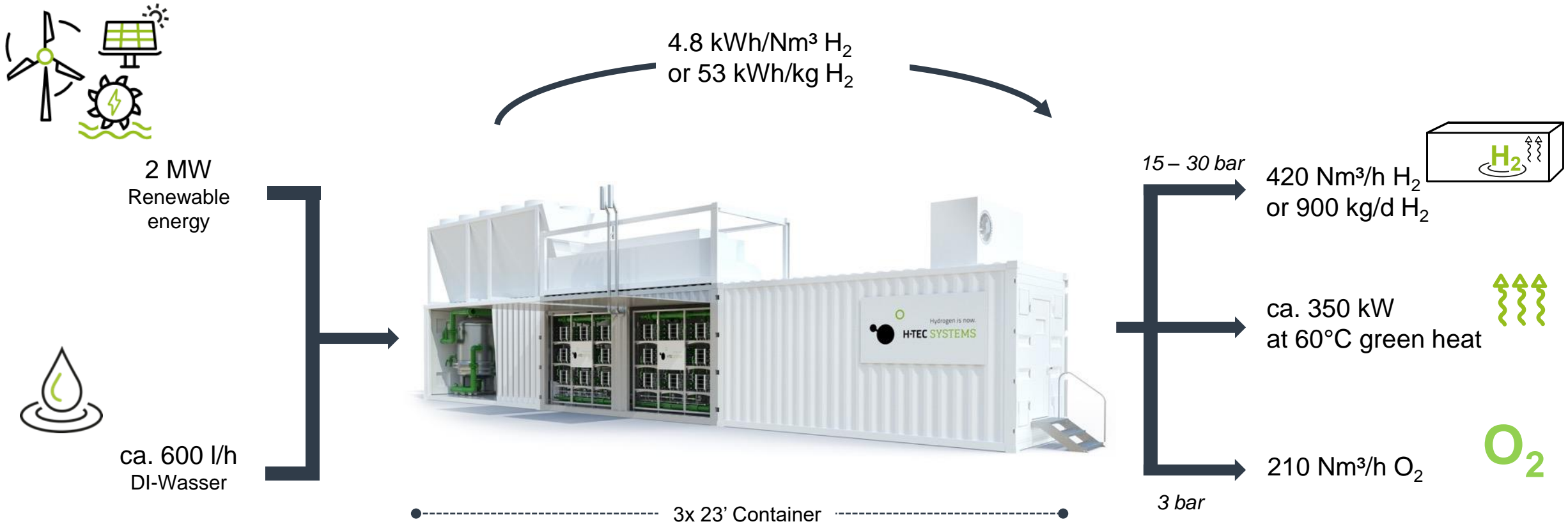


ME450
1 MW container



Hydrogen Cube System (HCS):
4-10MW systems
made of 2 MW container modules

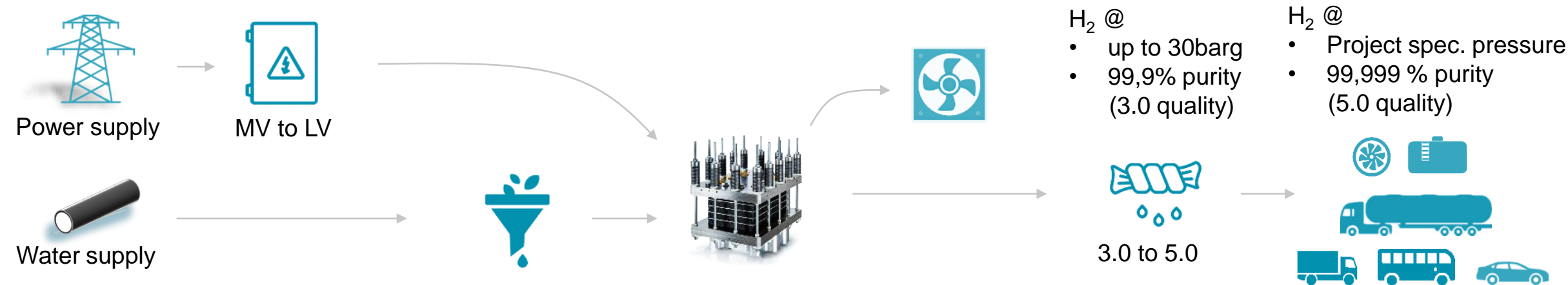
Hydrogen Cube System for a multi MW power range



Overall efficiency
74 % at nominal load*

**higher with heat utilisation*

Comprehensive Scope of supply covered by H-tec & MAN ES portfolio



H-TEC product	Transformer	Water Treatment	Electrolysis system	Cooling System	Hydrogen Drying	Compression, Storage & Dispensing
HCS – 10MW	MAN	MAN / H-TEC	H-TEC	MAN	H-TEC	MAN

Comprehensive supply by MAN up to EPC (subject to project specific requirements)

...and many references!



2 MW Electrolyser

Electrolysers for providing green hydrogen for mobility and heating solutions in Northern Germany.

Model:	ME450/1400
Technology:	PEM
Nominal Load:	2 MW
H₂ Production:	900 kg/d

Note: Contracts signed, projects to be disclosed later this year



1 MW Electrolyser

First project in Austria to provide green hydrogen for fueling the public transport of a metropolitan region.

Model:	ME450/1400
Technology:	PEM
Nominal Load:	1 MW
H₂ Production:	450 kg/d



1 MW Electrolyser

R&D project in Northern Germany to provide green hydrogen for testing fueling and heating technologies.

Model:	ME450/1400
Technology:	PEM
Nominal Load:	1 MW
H₂ Production:	450 kg/d

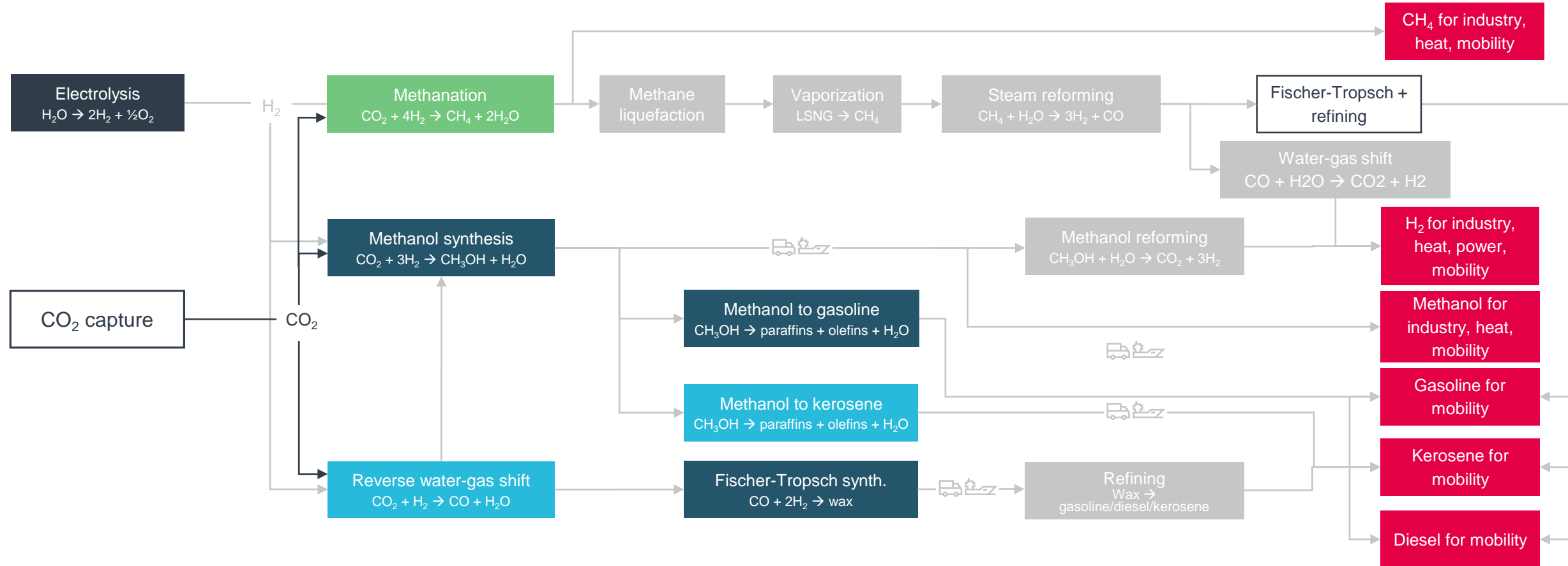
MAN Solutions in e-fuels production



H₂ production

Synthesis and conversion

Infrastructure/distribution and application



- MAN DWE product
- MAN product
- MAN DWE manufacturer
- In development
- No action
- End product

MAN power-to-SNG Plant by Kiwi AG

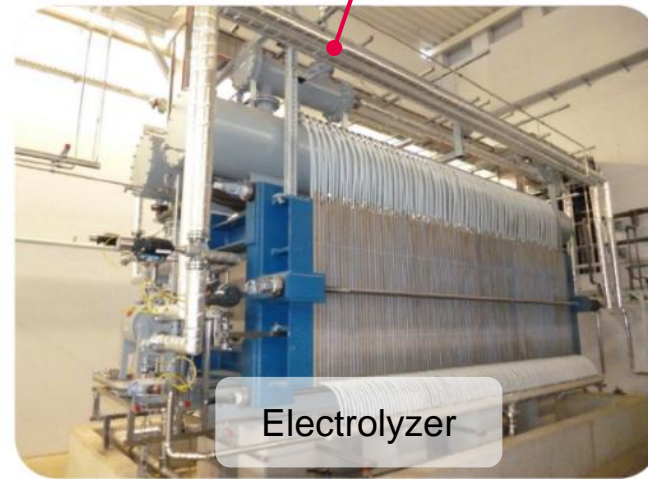
the “reference factory” for the SNG and PtX rollout in Werlte, Lower Saxony, Germany



Methanation System



Biogas plant



Electrolyzer

Key facts:

- 6 MW power input for alkaline Electrolysis
- SNG used as e-fuel (1,000 tons/y)
- Methanation system by MAN Deggendorf

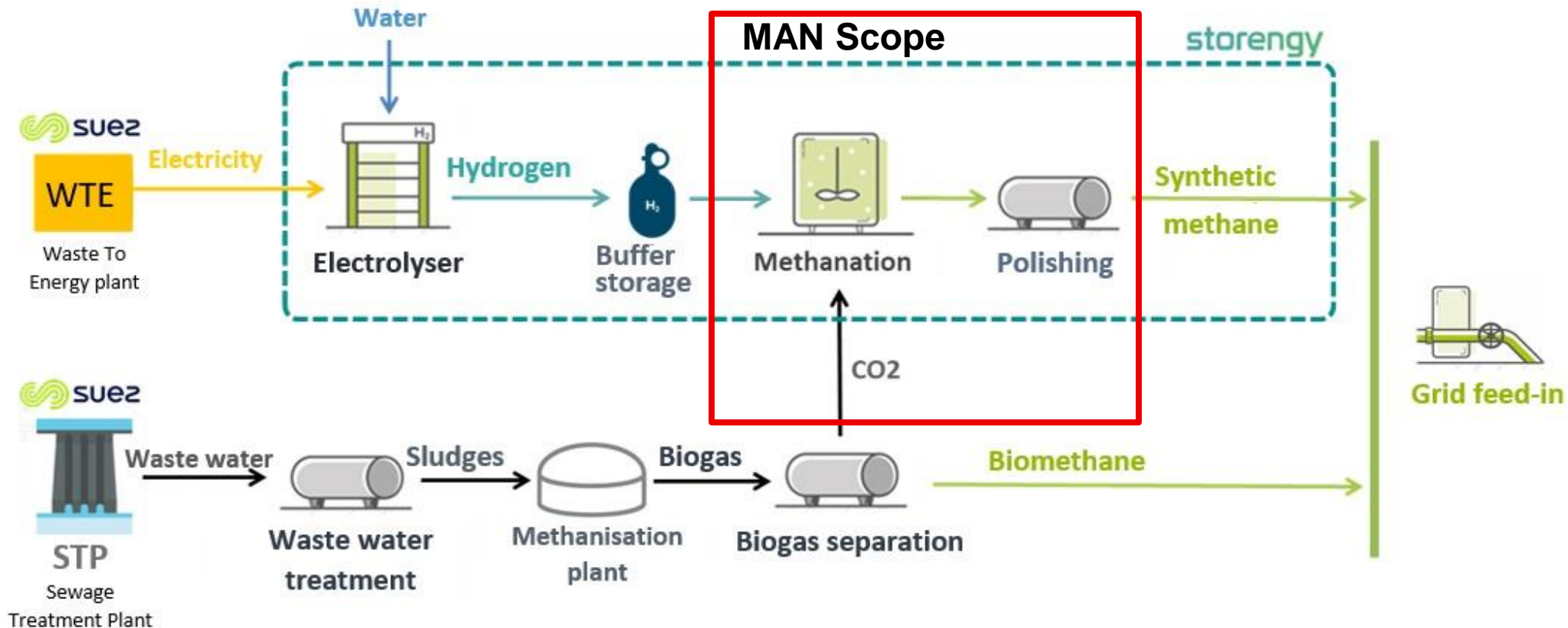
➔ Plant In commercial operation since 2013

Picture source: KIWI AG

Converting Waste Water & Waste Energy into Green Synthetic Methane



MAN Methanation Reactor for the conversion of biogenic CO₂ and green H₂ into synthetic Gas



A new sludge treatment unit for a wastewater treatment plant for biogenic CO₂ and biomethane production & a new Methanation Plant for Green Methane Production from WTE plant, in France. The awarded consortium led by Suez Eau selected MAN ES (2022) for the methanation plant (1MW) along with the balance of the plant.

Green Methanol Reference Project

Haru Oni, Phase 0 – Demonstration plant renewable Methanol & Gasoline (Porsche / HIF)



MAN Energy Solutions supports PORSCHE AG in Power-to-Liquid-project in Chile



MeOH skid based on JM technology ready to ship

Thank you very much!

Questions / Project enquiries please feel free to send to us

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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.

