

# MAN's Solution Offering for FutureEnergy A/S

Overview



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# MAN Energy Solutions Business Areas

## Overview

### Marine



### Energy & Storage



### Oil & Gas / Process Industry



### Aftersales MAN PrimeServ



#### Business Activity - New Solutions

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

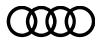
### Key Figures

**15,000** employees worldwide (2020)

**3.1 bn €** revenue (2018)

# Member of the Volkswagen Group

MAN Energy Solutions is part of a brand family

Automotive Division			Financial Services Division
<b>Passenger Cars Business Area</b>	<b>Commercial Vehicles Business Area</b>	<b>Power Engineering Business Area</b>	
VW 	VWN 	MAN Energy Solutions 	Dealer and customer financing Leasing
Audi 	Scania 		Direct bank
Skoda 	MAN Truck & Bus 		Insurance
Seat 			Fleet management
Bentley 			Mobility offerings
Porsche 			
Others			

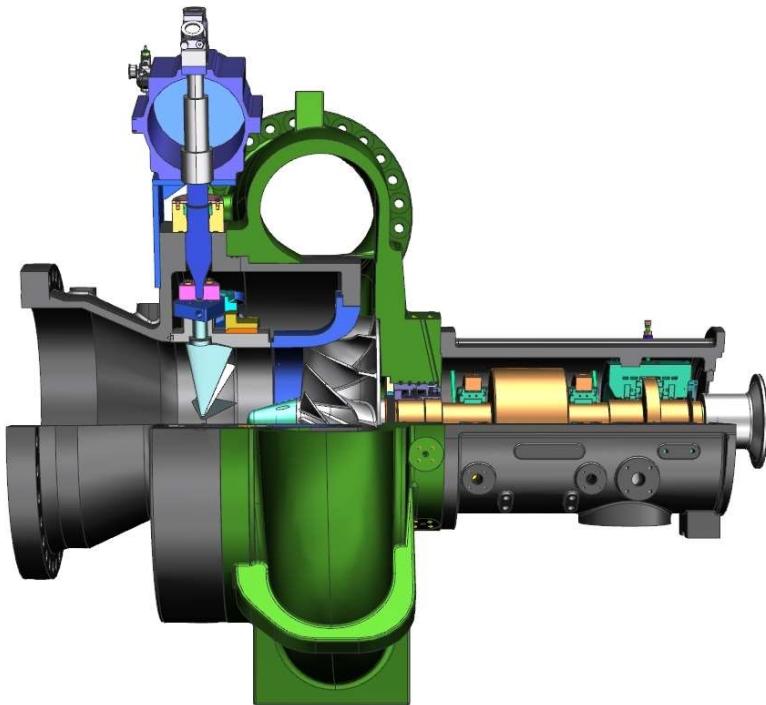
# CO<sub>2</sub> Compressor for Carbon Capture and Sequestration

2



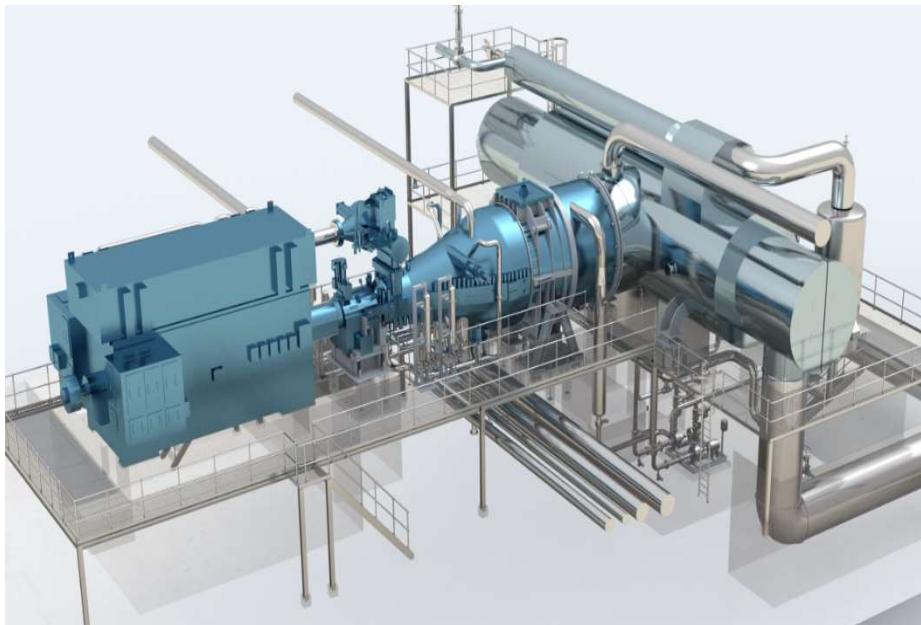
# Heatpump Compressor

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# Steam Turbines

4



# MAN PtX for carbon-neutral synthetic fuel production and long term energy storage

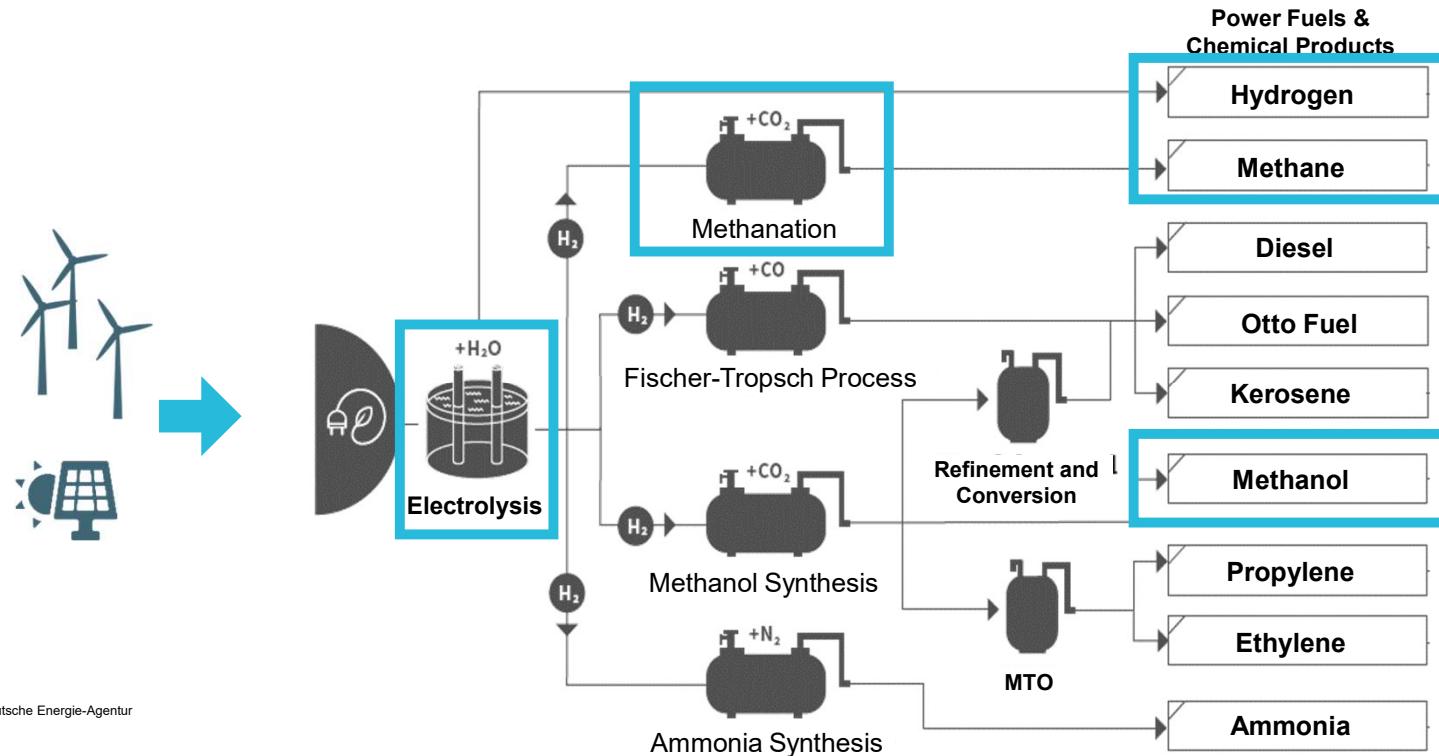


- Renewable electricity is converted into carbon-neutral synthetic fuels which can be stored and later used in mobility, electricity, heat
- Decarbonization of all sectors with existing assets, available today
- Solution for CO<sub>2</sub>-neutral mobility, such as marine and long-haul trucking
- Proven MAN Energy Solutions technology: Audi eGas plant operational since 2013

# MAN focusing on several Power-to-X processes with the highest market potential in the mid term

Overview: PtX processes (exemplaric)

 Main focus areas of MAN ES



Source: DENA – Deutsche Energie-Agentur

# Use Case: Production of synthetic fuels with 50 MW MAN Power to Gas plant

A 50 MW P2G plant produces at 8,000 h/a...



**21.250.000 m<sup>3</sup> SNG**

Enough to provide CO2 neutral fuel for...



**19,800 cars<sup>1</sup>**



**470 buses<sup>2</sup>**



**2 car carriers<sup>3</sup>**



**MAN provides full EPC for PtX plants incl. operations & maintenance**

<sup>1</sup>15,000 km/a; 5 kg/100km; <sup>2</sup>60,000 km/a; 52,7 kg/100km; <sup>3</sup>Transport capacity: ~4500 vehicles, 7 roundtrips per year

# MAN Power-to-SNG customer reference in Werlte

5



## Key facts:

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

→ Plant In commercial operation since 2013

Picture source: Audi

# MAN ES & H-Tec Systems – PEM electrolyzers

## Product Overview

### ELECTROLYSIS STACKS

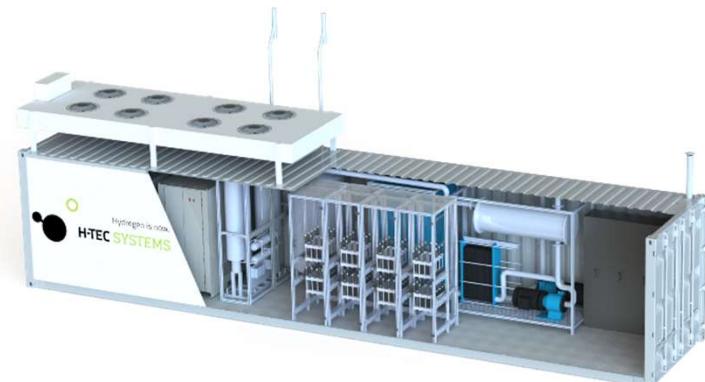


Series-S30 stacks (1 to 5 kW)

### ELECTROLYSERS - READY. SET. SUPPLY.



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



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

#### H-TEC SYSTEMS Series-S electrolyser stacks

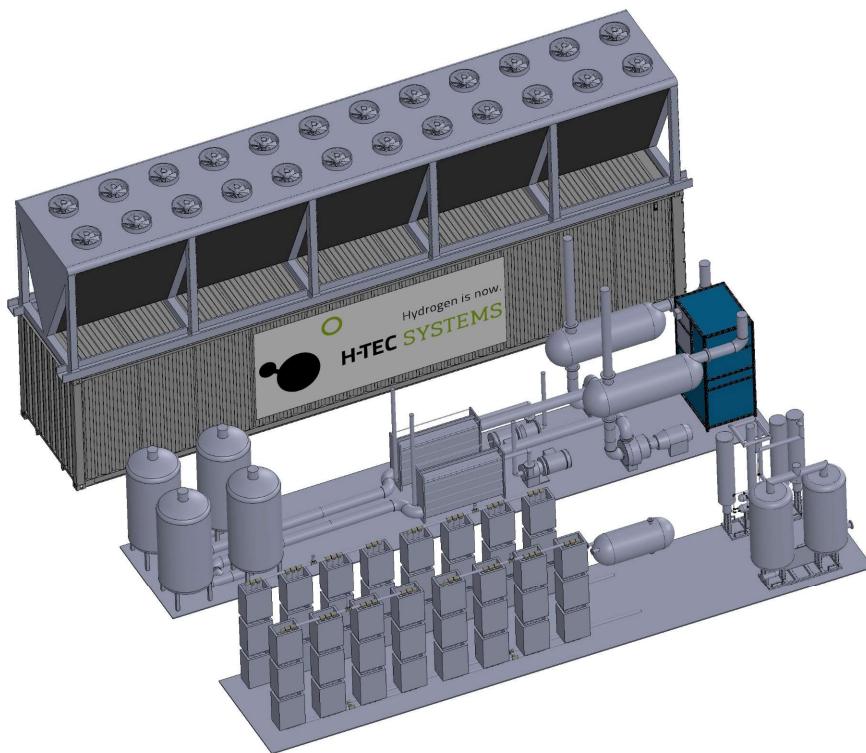
- Nominal power from 1 kW to 100kW
- High power density
- Low transformation costs
- High efficiency
- Suited for integrated solutions

#### H-TEC SYSTEMS Series-ME electrolyzers

- 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

# MAN ES & H-Tec Systems – Electrolyzers

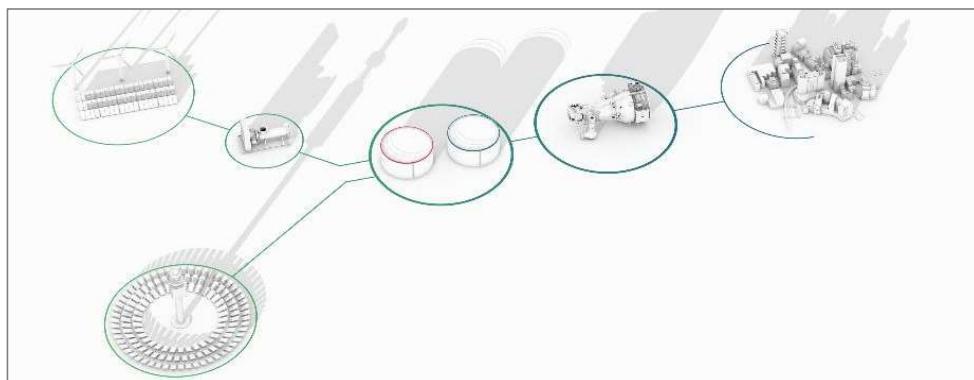
## Product Overview



### Key parameter of the 10 MW Electrolyser

- Based on proprietary stack technology
- Nominal energy consumption: 10 MW – base for modular concept for 20...100 MW and more
- H2- production: 2100 Nm<sup>3</sup>/h resp. 4500kg/d
- Very high efficiency of 74%
- Perfectly suited for the integration into industrial PtX plants
- Available for commissioning in 2023

# MAN Molten Salt Energy Storage (MOSAS)



- **Technology:** Renewables are used to generate heat directly or via a electrical heat exchanger. The thermal energy is stored in molten salt and later used to produce steam for power generation when needed.
- **Power & capacity**
  - Industrial installations starting from ~25 MW, reaching multiple 100 MW for large scale installations
  - Very large capacities (1 GWh+) possible

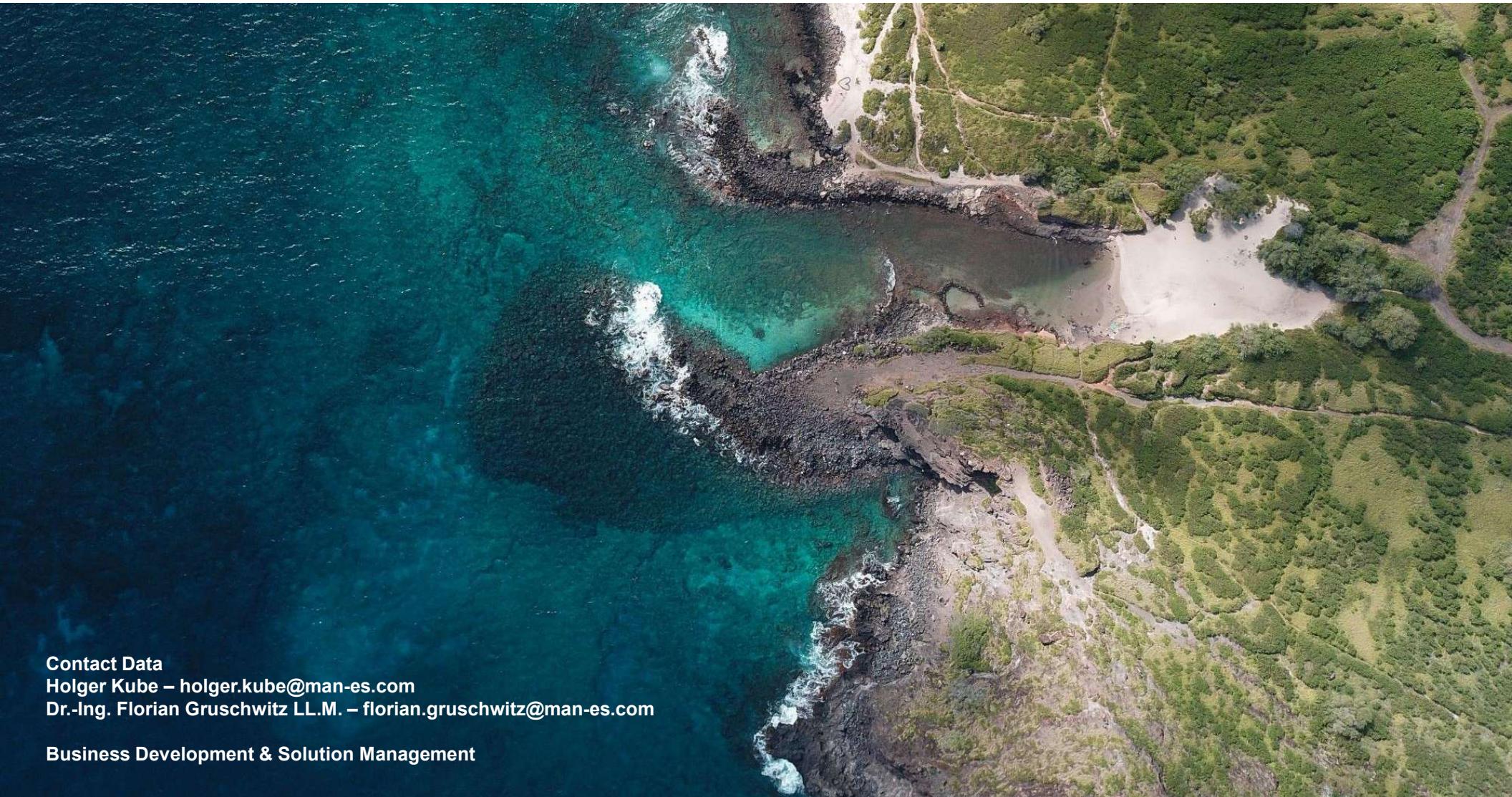
## Applications

### High power and medium to long duration applications

- Retrofit of conventional plants, e.g., coal-fired power plants
- Concentrated solar power: dispatchable renewable generation
- Energy recovery in industrial processes

## Key benefits

- **Usable in several applications**
  - Stand alone or retrofit of thermal plants
  - CSP
  - Industrial energy management & optimization
- **Peak shaving** of volatile renewables through conversion into heat and reconversion on demand into electricity
- MAN with **long-term experience of using molten salt** as a heat transfer medium in the chemical industry
- MAN provides the **molten salt system as a complete solution** including EPC for CSP



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**Business Development & Solution Management**

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