

# MAN CCUS

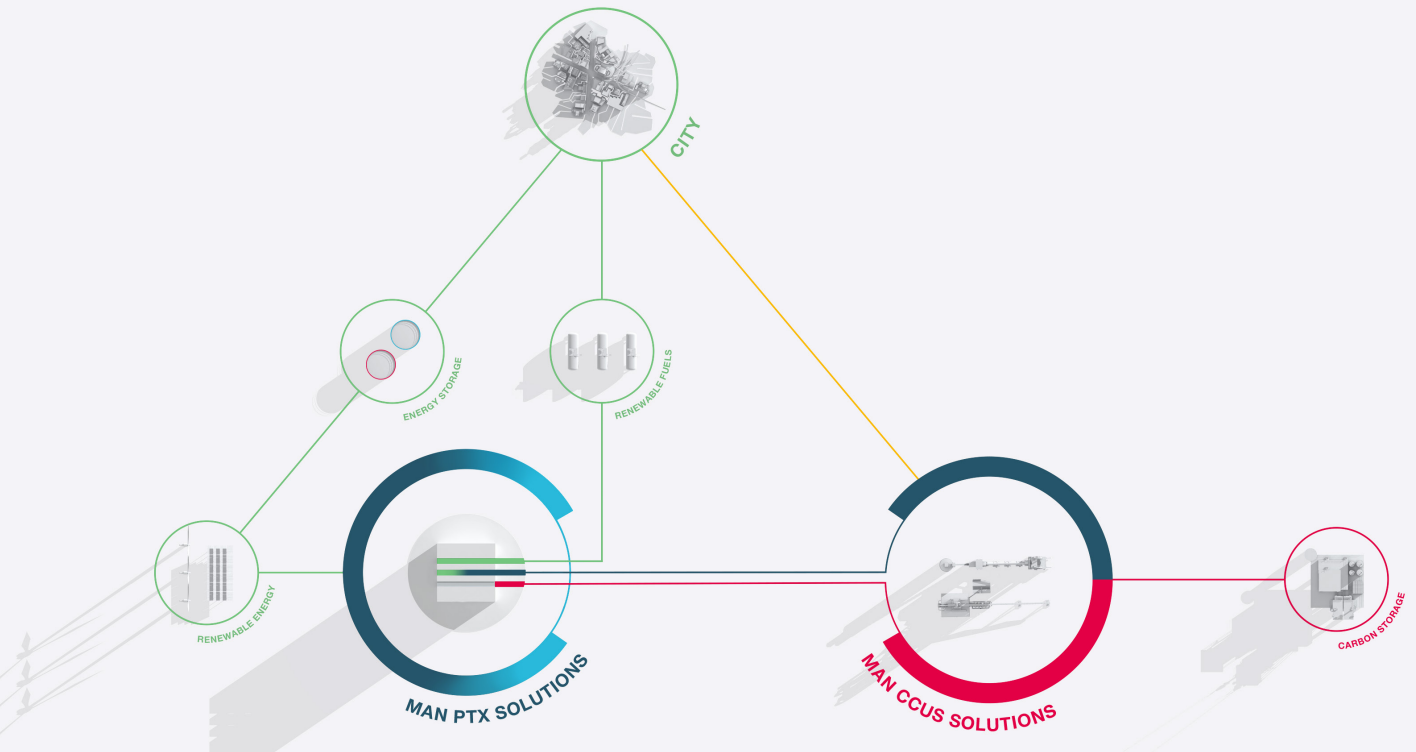
## Carbon capture, utilization, and storage

How carbon capture works. CCUS starts with carbon capture, removing emissions directly from the air or, more usually, before they're released into the atmosphere in the first place. The captured gas is then compressed as a liquid or solid and either stored deep underground or made available for further processing.

For example, the captured carbon can be combined with green hydrogen to create climate-neutral methane fuel or methanol, or it can be transported to industries that need it to produce everything from plastics to fertilizer.

### Benefits at a glance

- Reduction of carbon emissions, especially in hard-to-abate sectors
- CO<sub>2</sub> becomes a commodity
- Industrial plant is integrated into a new energy infrastructure centered on CO<sub>2</sub> utilization and renewable hydrogen
- Industrial plant is connected with other industries and sectors including transport, utilities, municipalities, and renewable energy



# Changing the role of carbon in industry



## Dealing with unavoidable emissions

The energy transition is underway and industry is doing its part to reach net zero by increasing efficiency and replacing fossil fuels. However, there is still the problem of unavoidable emissions caused by industrial processes – these account for around 30 % of all industrial greenhouse gas (GHG) emissions.

As unavoidable emissions move to the forefront of discussions, scientists, politicians, and industry leaders agree — there is no way to achieve climate targets without carbon capture. Avoidance, balancing, and capture are the three main carbon-reduction tactics. But not all three approaches are viable for all industrial producers. Industrial plants emit large amounts of CO<sub>2</sub> in flue gases. This CO<sub>2</sub> can be captured after combustion using methods such as amine treatment and cryogenic capture.

## The technology for carbon capture

MAN Energy Solutions provides the leading compression technology and expertise necessary for CCUS.

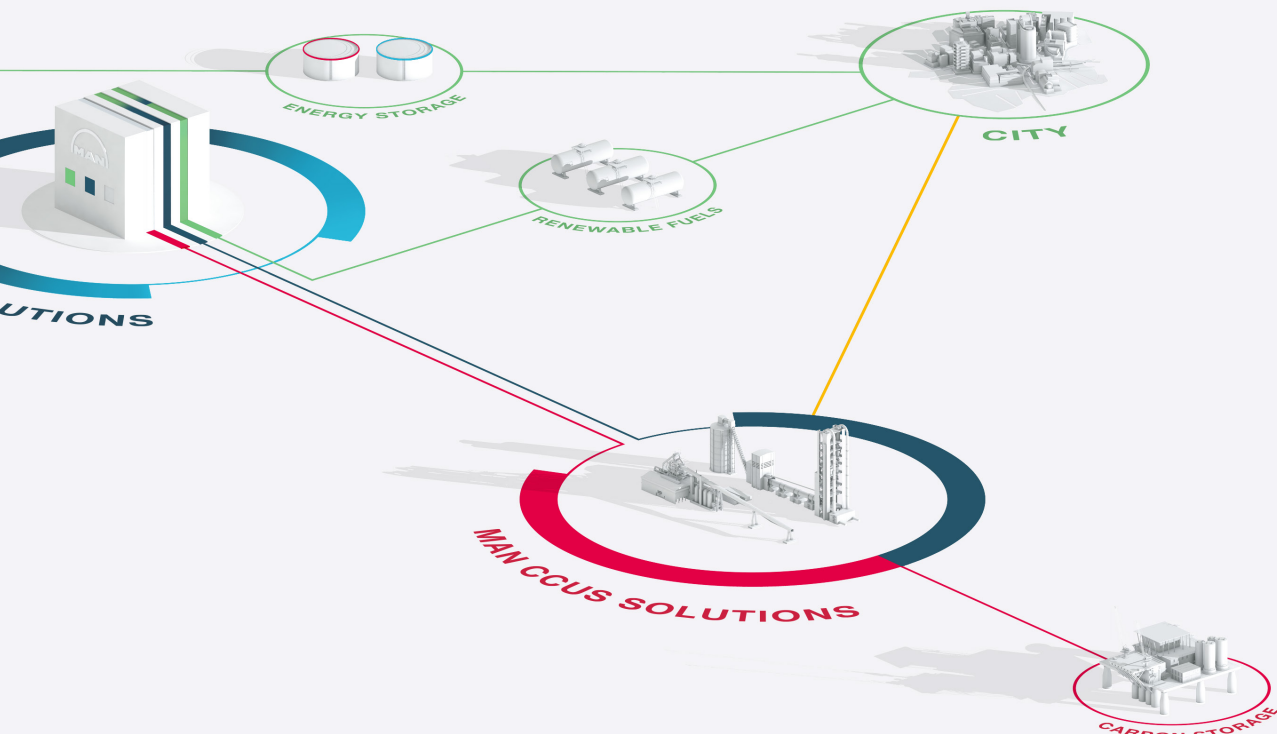
This includes displacement compressors and turbo compressors. MAN oil-free screw-type compressors combine the advantages of turbo and reciprocating compressors, with volume flows of 200 – 20,000 m<sup>3</sup>/h and discharge pressure up to 52 bar. The MAN RG integrally geared compressor has suction flow rates of up to 600,000 m<sup>3</sup>/h and maximum discharge pressure up to 250 bar. With its improved impeller design, optimized pinion speeds and tailored aerodynamics, it guarantees the highest level of efficiency. The multistage design also fully complies with API standards.

Modularity is the key to scaling CCUS as needed. MAN CCUS offers modular compression solutions for all available capture technologies. MAN CCUS solutions are optimized for delivery and erection time thanks to years of experience in compression of dry and wet CO<sub>2</sub> and more than 1,000,000 operating hours in CO<sub>2</sub> compression applications.

## System solution

MAN CCUS is a proven and practical solution for reducing industrial emissions. MAN Energy Solutions provides the compression technology necessary for the various CO<sub>2</sub> gas streams within the capture process (amine, cryogenic, PSA, membrane), including the integration of compression duties for CO<sub>2</sub> liquefaction or delivery to pipelines for transportation.

The MAN CCUS compression systems adapt flexibly to required discharge pressures or side streams and can integrate heat and power recovery systems to make plants more efficient and regenerate some of the required heat and power.



### Selected applications

Installations that traditionally emit large amounts of CO<sub>2</sub> are prime candidates for CCUS technology, either retrofitted or as part of new plant construction.

#### Hard-to-abate sectors include:

- Cement
- Petrochemicals
- Metals
- Refineries
- Midstream and upstream oil & gas
- Blue hydrogen
- Fossil fuel power generation

For these sectors a carbon capture heat recovery (CCHR®) installation is beneficial as it helps reduce the cost of CCUS.

### Key components

- **Carbon capture**  
All capture technologies are supported by MAN CCUS.
- **Storage**  
All CO<sub>2</sub> storage options and transportation methods are supported by MAN CCUS.
- **MAN RG compressors**  
Best-in-class compressor for CO<sub>2</sub> compression.
- **Renewables**  
MAN CCUS is compatible with hydrogen electrolysis (H-TEC SYSTEMS), hydrogen compression, CO<sub>2</sub> batteries, direct air capture (DAC), and e-fuel technologies.
- **Heat and power recovery**  
MAN Energy Solutions can provide efficient solutions to reduce power needs within a plant by recovering expansion energy and using waste heat to produce steam, electricity and hot water.
- **MAN power-to-X (MAN PtX)**  
MAN CCUS offers straightforward integration solutions for PtX or other utilization cases. After capture, purification and compression, carbon dioxide is distributed to industrial producers who use it as raw material. Carbon dioxide can be used as a feedstock for marketable fuels chemicals and then can be processed within MAN DWE® reactors together with hydrogen to produce synthetic methane (power-to-gas = MAN PtG), methanol or kerosene (power-to-liquids = MAN PtL) as well as power-to-chemicals (e.g. methanol to olefins). MAN Energy Solutions is a market-leading provider of PtX technologies.

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