

# The Added Value of Pentair Biogas Upgrading

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# Overview

## What to Expect

### Who is Pentair?

### The Basics

### Added Value

### CO<sub>2</sub> Recovery

### Summary

– System images



# Pentair At A Glance

A Global Leader in Smart, Sustainable Solutions

**~11,250** employees  
serving customers in

**150+** countries

**~\$4.1B<sup>^</sup>** in revenue

<sup>^</sup>2022 full year results

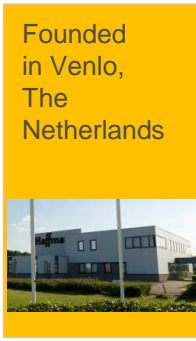
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# Some History

With Over 160 Years of Experience

Haffmans



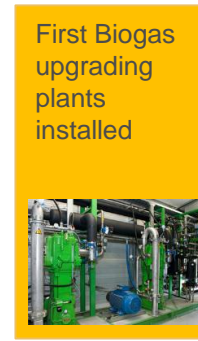
Founded in Venlo, The Netherlands

1948



Started to produce CO<sub>2</sub> recovery systems

1977



First Biogas upgrading plants installed

2010



Haffmans, Südmo, Norit Process Technology and X-Flow acquired by Pentair

2011



1933



Founded in Fredericia, Denmark

1972

First CO<sub>2</sub> plant installed; Coca Cola Acquired by British Oxygen Company



2013

Acquisition of Wittemann, USA  
**WITTEMANN**  
ECO<sub>2</sub>Brew launched



2017

Acquired by Pentair  
CO<sub>2</sub>mpactBrew launched



Combined forces allow us to offer great technologies, components, units and **Service** globally!

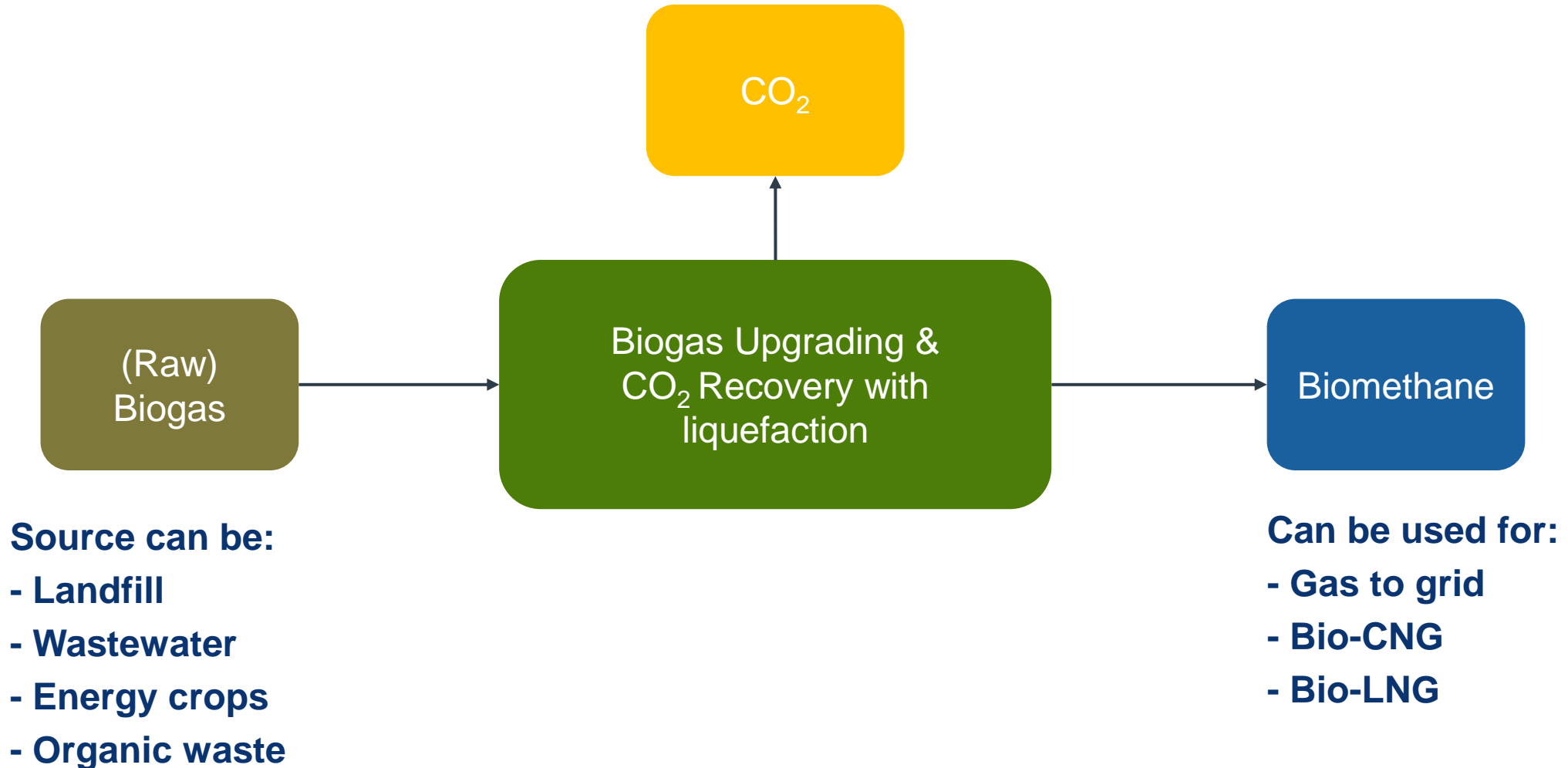
Union Engineering

# Advancing the Positive Impact Of Our Business

Since 2010, Pentair has supplied biogas upgrading solutions with the capacity to produce 1.15 billion normal cubic meters (Nm<sup>3</sup>) of biomethane, a better alternative to natural gas, that avoids emitting 2.1 million Mt of CO<sub>2</sub> from fossil fuels. In 2022, we supplied biogas upgrading solutions with the capacity to produce 194 million Nm<sup>3</sup> of biomethane.

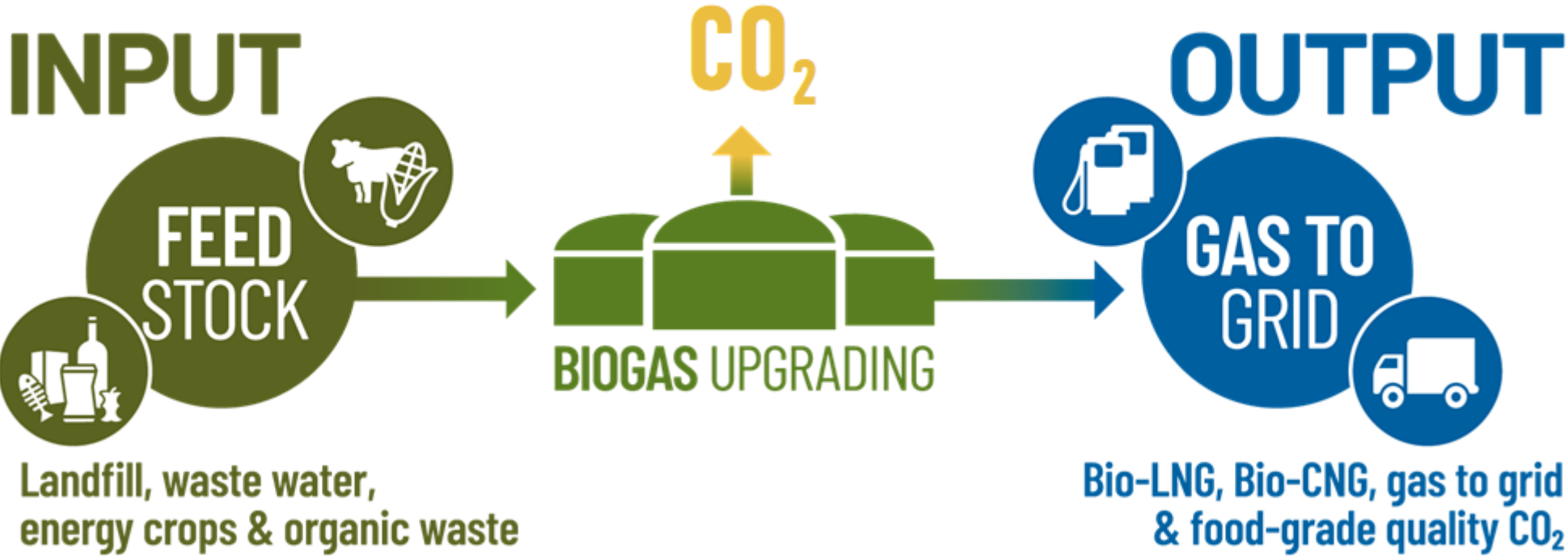
# What We Call Things

Let's Speak the Same Language



# The Value in Biogas-to-Biomethane Upgrading

CO<sub>2</sub> to Free Air



# The Value in Biogas-to-Biomethane Upgrading

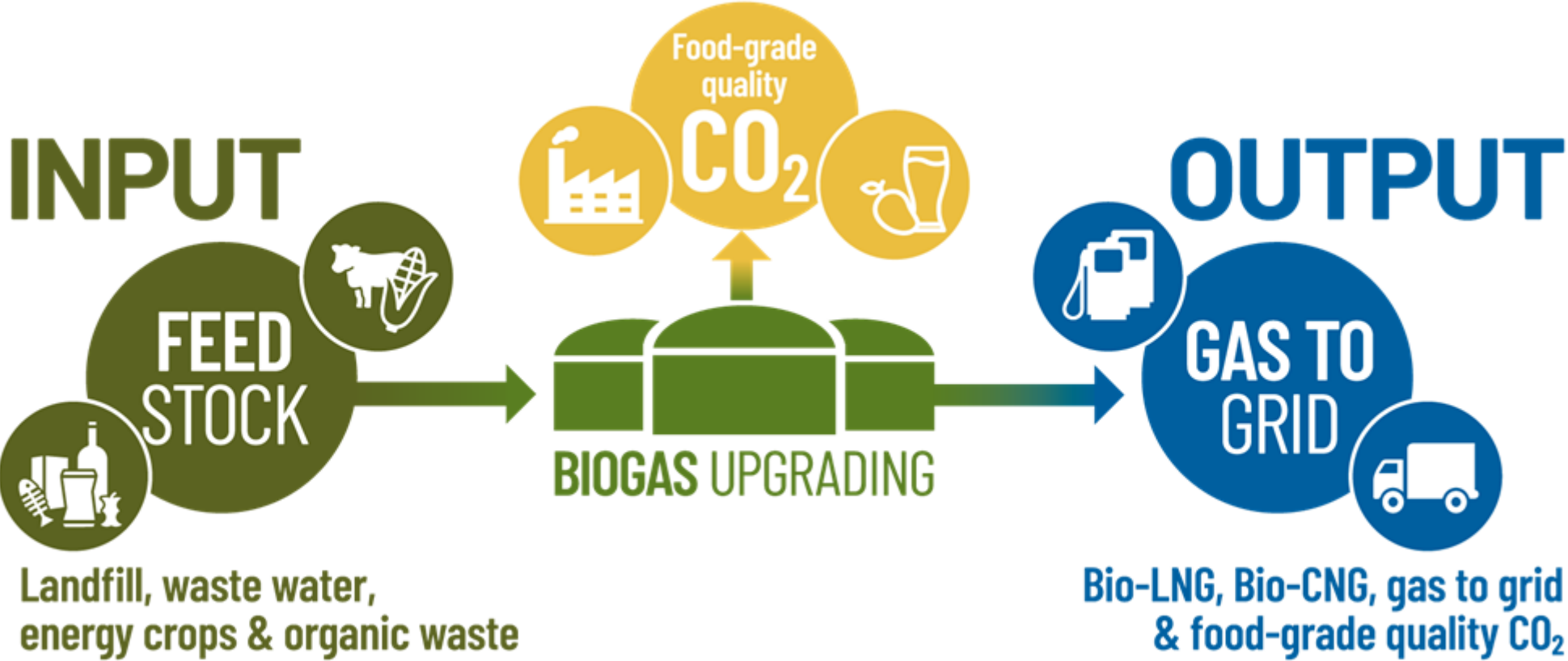
Applications: G2G, CNG & LNG





# The Value in Biogas-to-Biomethane Upgrading

Capture CO<sub>2</sub> and Use it



# Adding Value with CO<sub>2</sub> Recovery

## The Bonus

- Capability to recover food-grade quality CO<sub>2</sub>.
- EIGA (European Industrial Gases Association), ISBT (International Society of Beverage Technologists).
- Possibility to meet specific regulations (experience with EC1935/2004, MOCA).
- Multi-line vessels and pumps facilitating transportation of the product.



# Areas of Application

## From Feedstock to Green CO<sub>2</sub>

### Industry cleaning

- Solvent-free on surfaces

### Welding industry

- Arc stabilization

### Dry ice

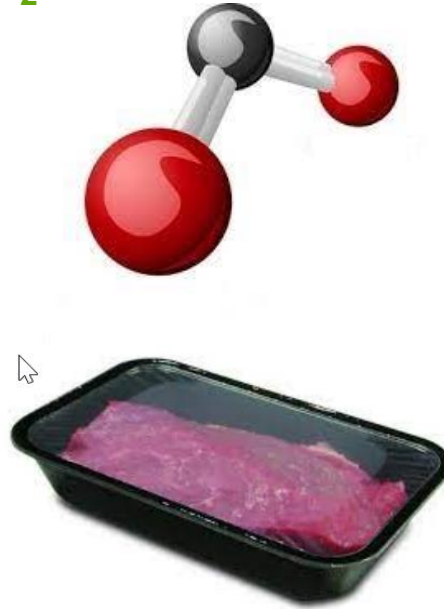
- Non-mech. cooling source

### Power to X

- Methanization out of H<sub>2</sub>

### Working fluid

- Thermodynamic cycles



### Agri production

- Acc. growth in greenhouses

### Beverage

- Carbonation and dispensing

### Food industry

- Food preservation, freezing, packaging

### Refrigerated transport

- Maintain the cold

### pH control

- Water treatment

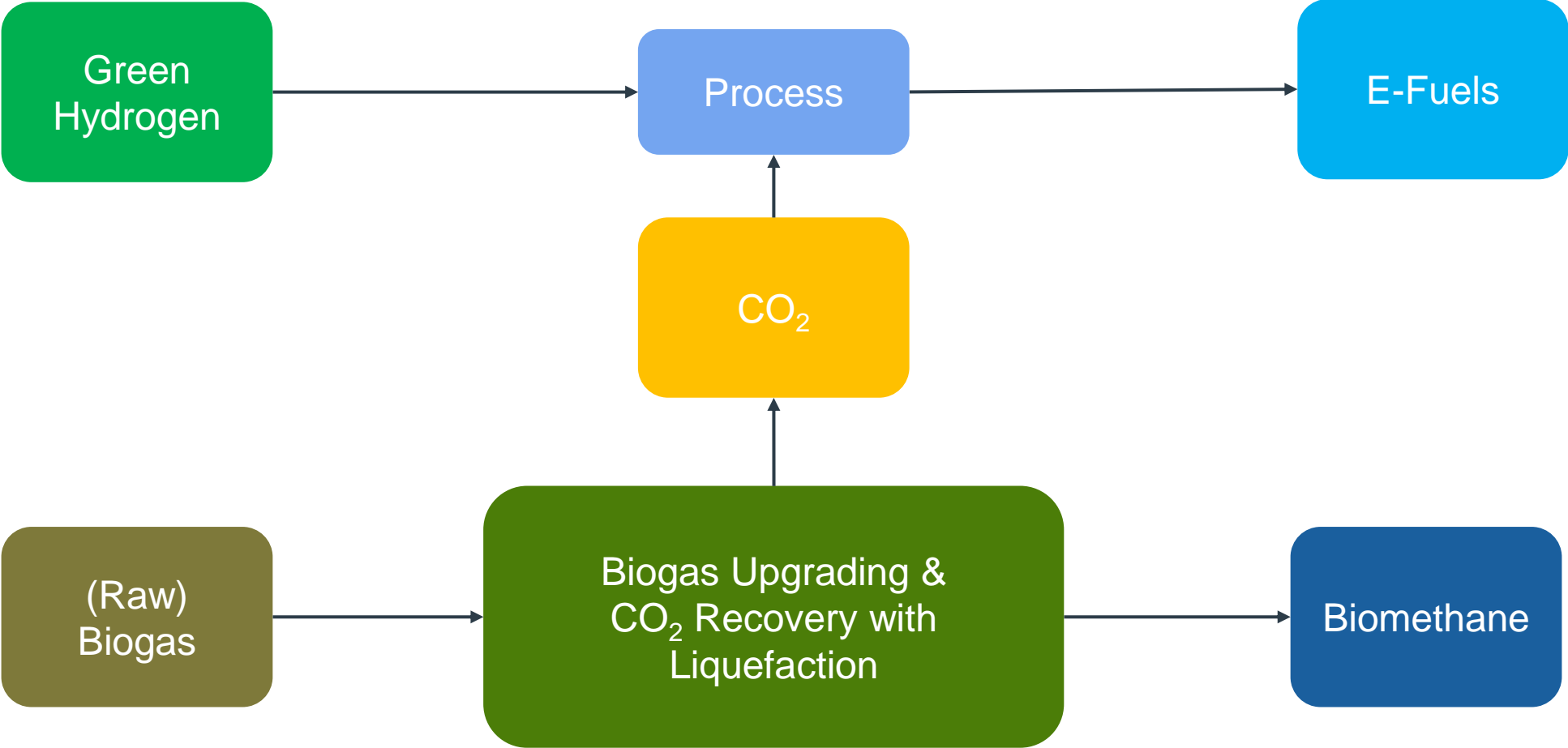
### Chemistry

- Reactive agent



# Area of Application

Focus on Power-to-X



# The Added Value in Biogas-to-Biomethane Upgrading

Applications: G2G, CNG, LNG + E-Fuels



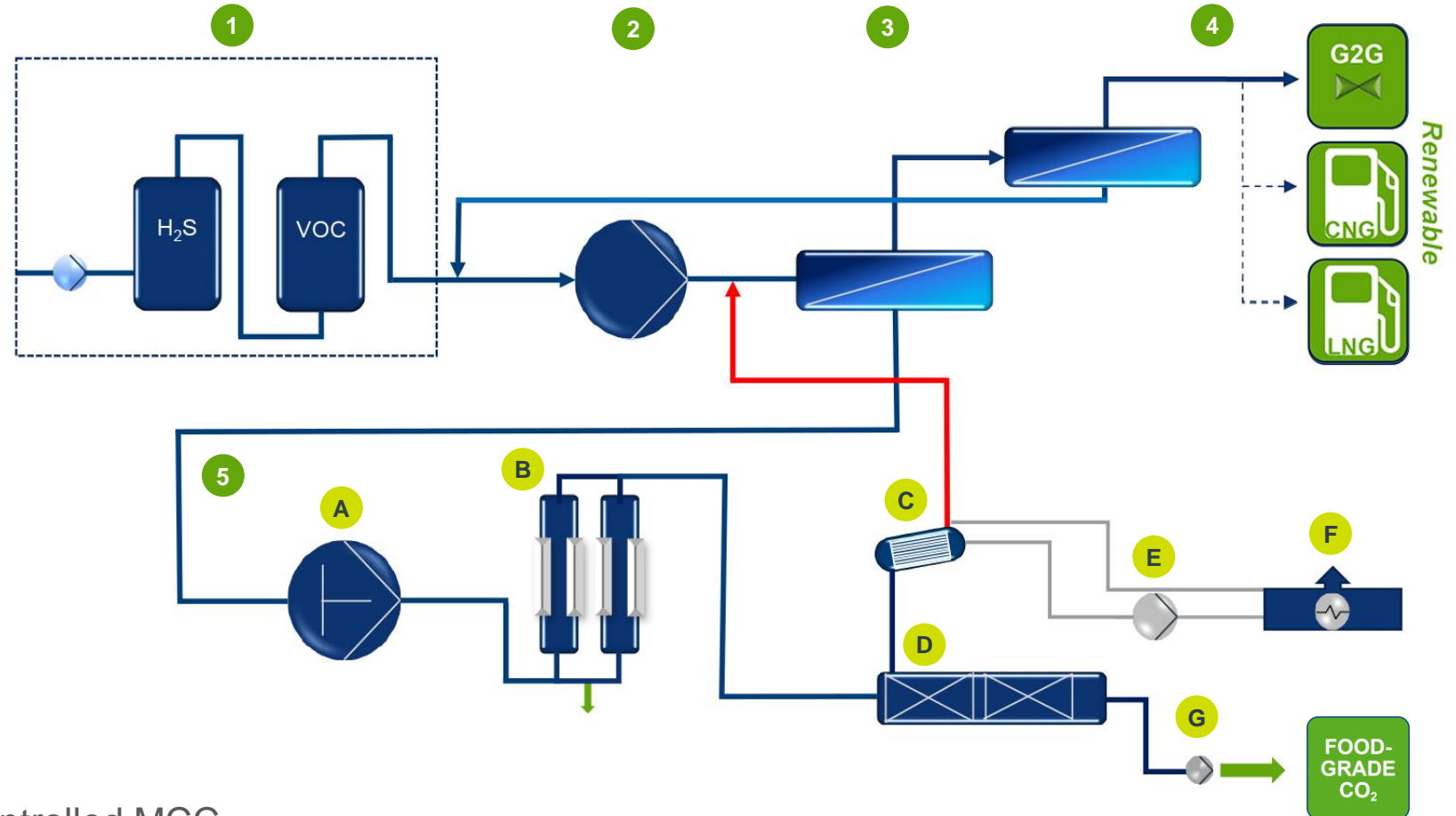
# Biogas-to-Biomethane Upgrading & CO<sub>2</sub> Recovery

## Our Solution

- 1 Pre-treatment biogas
- 2 Biogas compressor
- 3 2-stage membrane unit
- 4 Biogas outlet

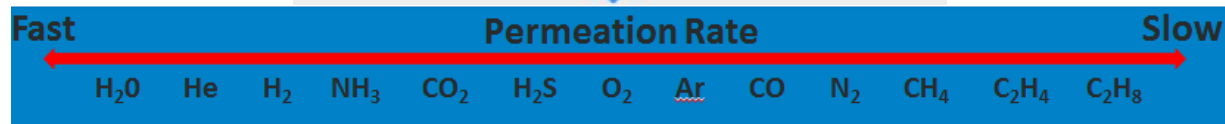
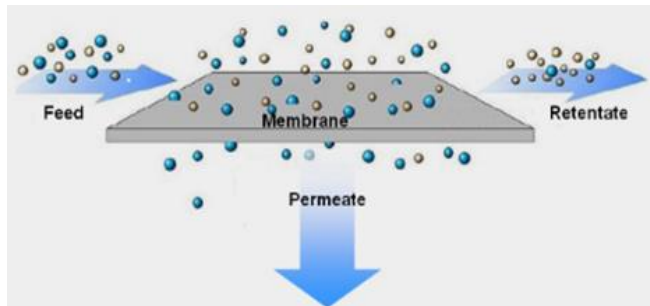
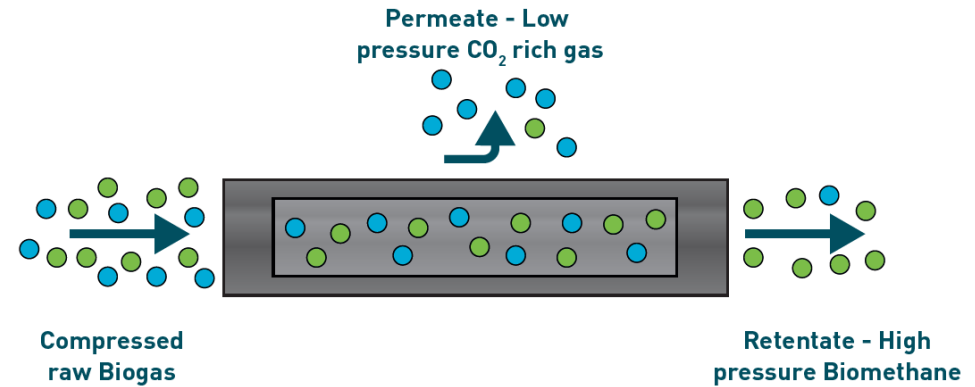
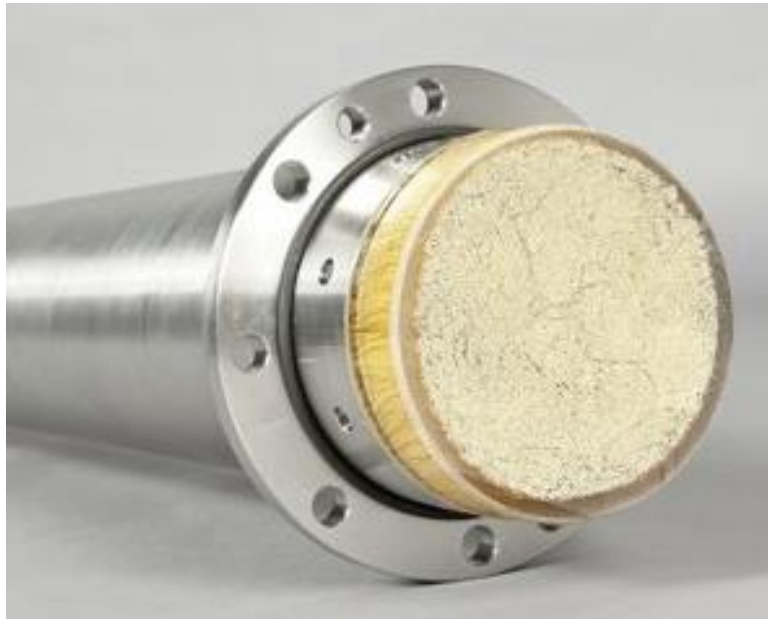
- 5 CO<sub>2</sub> Recovery:
  - A CO<sub>2</sub> compressor
  - B Activated carbon filter/drier
  - C CO<sub>2</sub> condenser
  - D Stripper/reboiler
  - E Cooling compressor
  - F Dry cooler
  - G CO<sub>2</sub> pump

> All parts skid mounted and controlled MCC



# Biogas Upgrading - Membrane Gas Separation

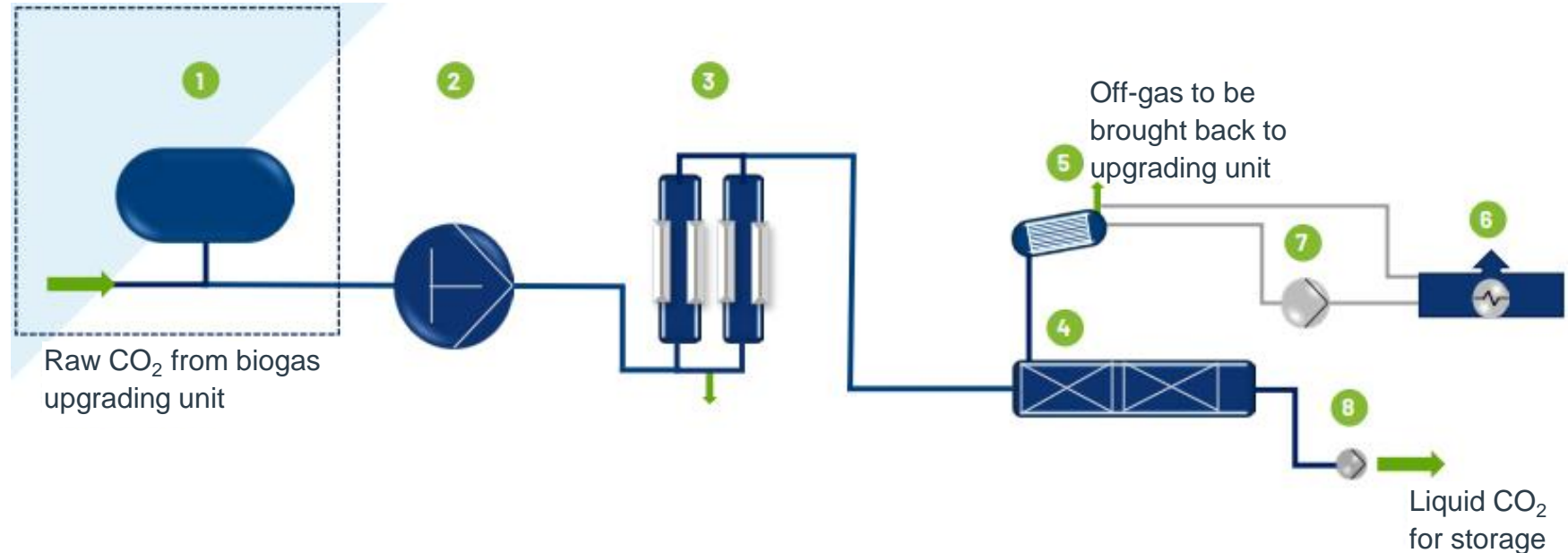
## The Core



# Pentair CO<sub>2</sub> Recovery

## Scope of Supply

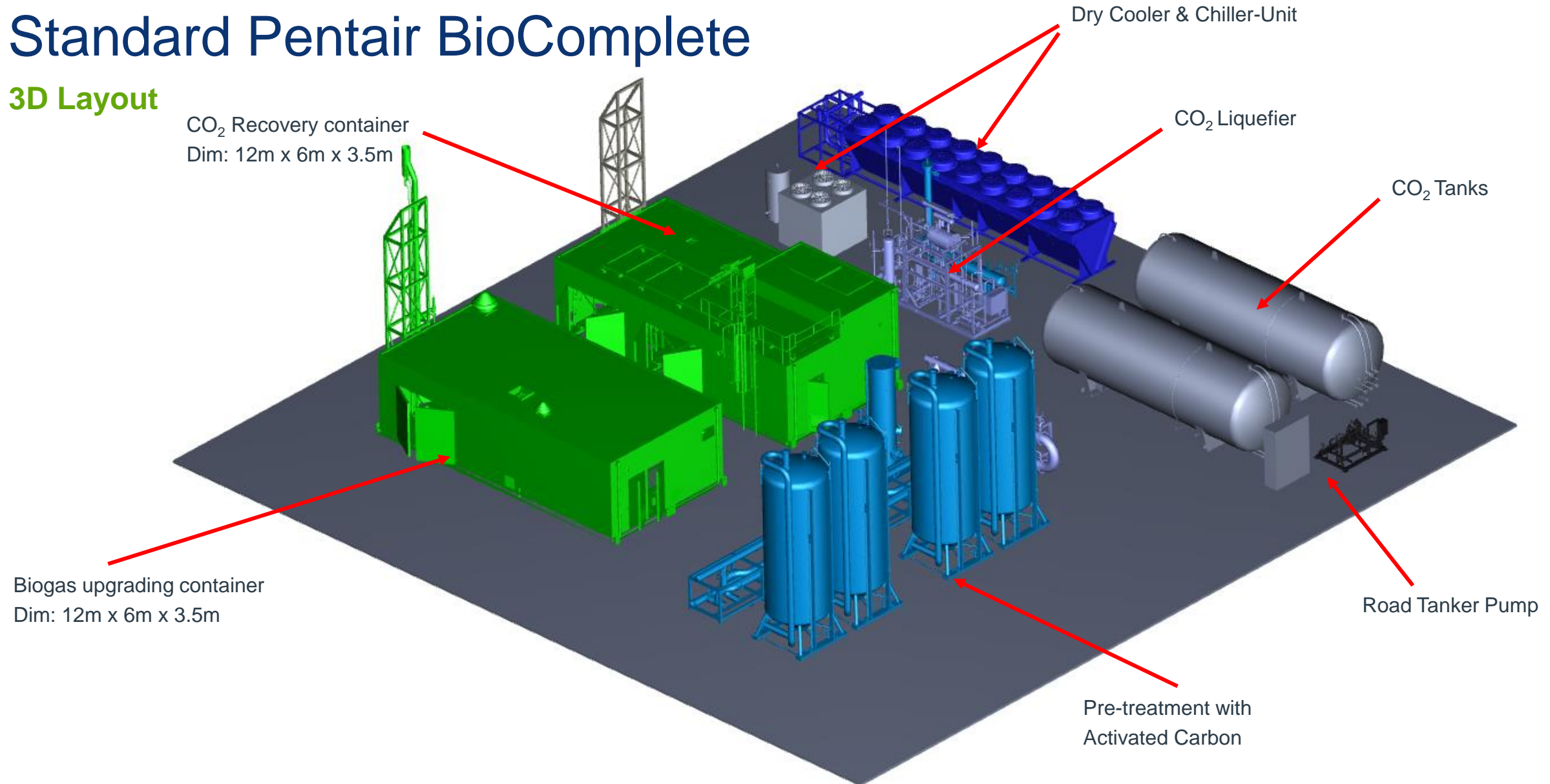
- 1 Gas balloon (optional)
- 2 CO<sub>2</sub> compressor
- 3 Activated carbon filter & drier
- 4 Stripper-reboiler
- 5 Refrigerant cooled CO<sub>2</sub> condenser
- 6 Refrigerant (dry) condenser
- 7 Refrigerant compressor
- 8 Liquid CO<sub>2</sub> pump
- > Main parts skid mounted and controlled MCC





# Standard Pentair BioComplete

## 3D Layout



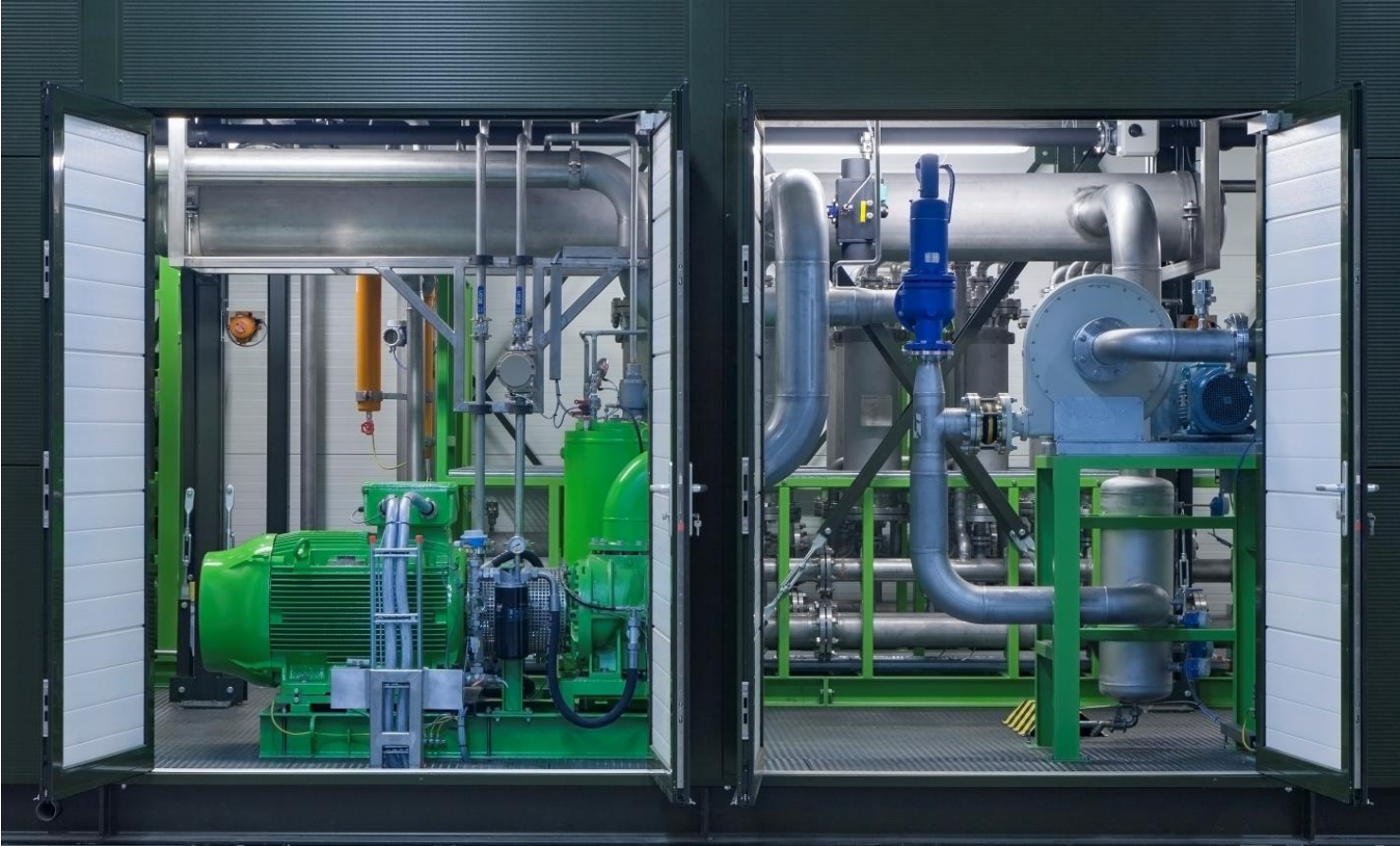
# Integration

## Upgrade Installation in an Existing Biogas Plant



# Compact Enclosed Skid

Efficient Setup



# Compact Enclosed Skid

Efficient Setup



# To Summarize

## Biogas Upgrading Benefits

- Rely on a market leader in membrane technology and 90 years of CO<sub>2</sub> equipment and recovery system expertise.
- Energy and cost-efficient CO<sub>2</sub> & CH<sub>4</sub> separation and CO<sub>2</sub> recovery.
- Low OPEX with low-pressure membrane operation.
- Low Total Cost of Ownership (TCO).
- Flexibility to plug Pentair CO<sub>2</sub> Recovery system onto Pentair or non-Pentair Biogas Upgrading System.
- High system uptime availability
- Flexibility with plug & play installation





Q&A



A photograph of an industrial facility, possibly a water treatment plant, with a semi-transparent wireframe overlay of a tall tower structure. The background shows a landscape with trees and hills under a cloudy sky. The image is partially obscured by a large green and blue diagonal graphic on the right side.

**Thank you for your attention**