

PENTAIR AND CARBON CAPTURE

4th July 2023

Anaerobic Digestion and Bioresources Association

Biogenic CO₂ from Anaerobic digestion

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TECHNOLOGY LEADER – SUSTAINABLE GAS SOLUTIONS

Overview

- **Pentair Sustainable Gas Solutions**
- **Pentair Biogas Upgrading**
- **Increasing Competitiveness of Biogas Units**
 - **Adding value to Carbon Dioxide**
 - **Foodgrade**
 - **CCUS**



Sustainable Gas Solutions



- PRODUCTS
- MARKETS
- APPLICATIONS
- ENGINEERING
- SERVICE
- CONTACT

CARBONATED SOFT DRINKS

In an increasingly competitive marketplace that has seen the consumption of nonalcoholic beverages grow rapidly, producers must find highly flexible and sustainable processes.

[Learn more](#)



BEER AND CIDER

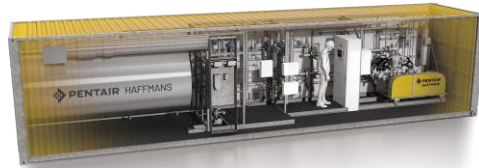
Higher costs for raw materials, water, energy, and logistics in virtually every geographical area force our customers to change their investment philosophy and optimize their economies of scale.



The first biogenic CO₂ dealt with our units

Pentair Sustainable Gas Solutions

Representing decades of experience & excellence



Pentair Haffmans Quality Control Equipment and CO₂ Recovery Solutions, manufactured in Venlo and Enschede, The Netherlands, offers over 75 years of experience in quality control equipment, and micro-filtration, plus carbon dioxide (CO₂) recovery systems for the brewing, soft drink, wine, bioethanol, and biogas industries.



Pentair Union Engineering Carbon Capture Solutions, engineered in Fredericia, Denmark, capture, recover, and purify CO₂ for carbon utilization and storage. With 90 years of expertise, Pentair Union Engineering specializes in project execution encompassing engineering, procurement, construction, and maintenance of individual or modular designed CO₂ plants.

Sustainable Gas Solutions

CO₂ & Methane Purification from Biogas

3 Stage & 2 Stage with CO₂



80+

MEMBRANE
PLANTS

CO₂ Capture from Industrial Plants

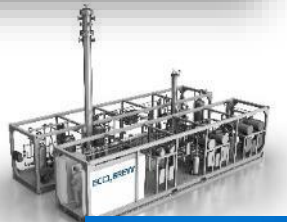
500 lb to 15 ton/hr CO₂ Industrial CO₂
Anaerobic Digestion Biogas Upgrading



300+

AMINE PLANTS

CO₂ Plants for
Breweries &
Soft Drinks



1700+

CO₂ PLANTS

20,000+

MEASUREMENT
DEVICES



CO₂/O₂ in Breweries
BioSENSE

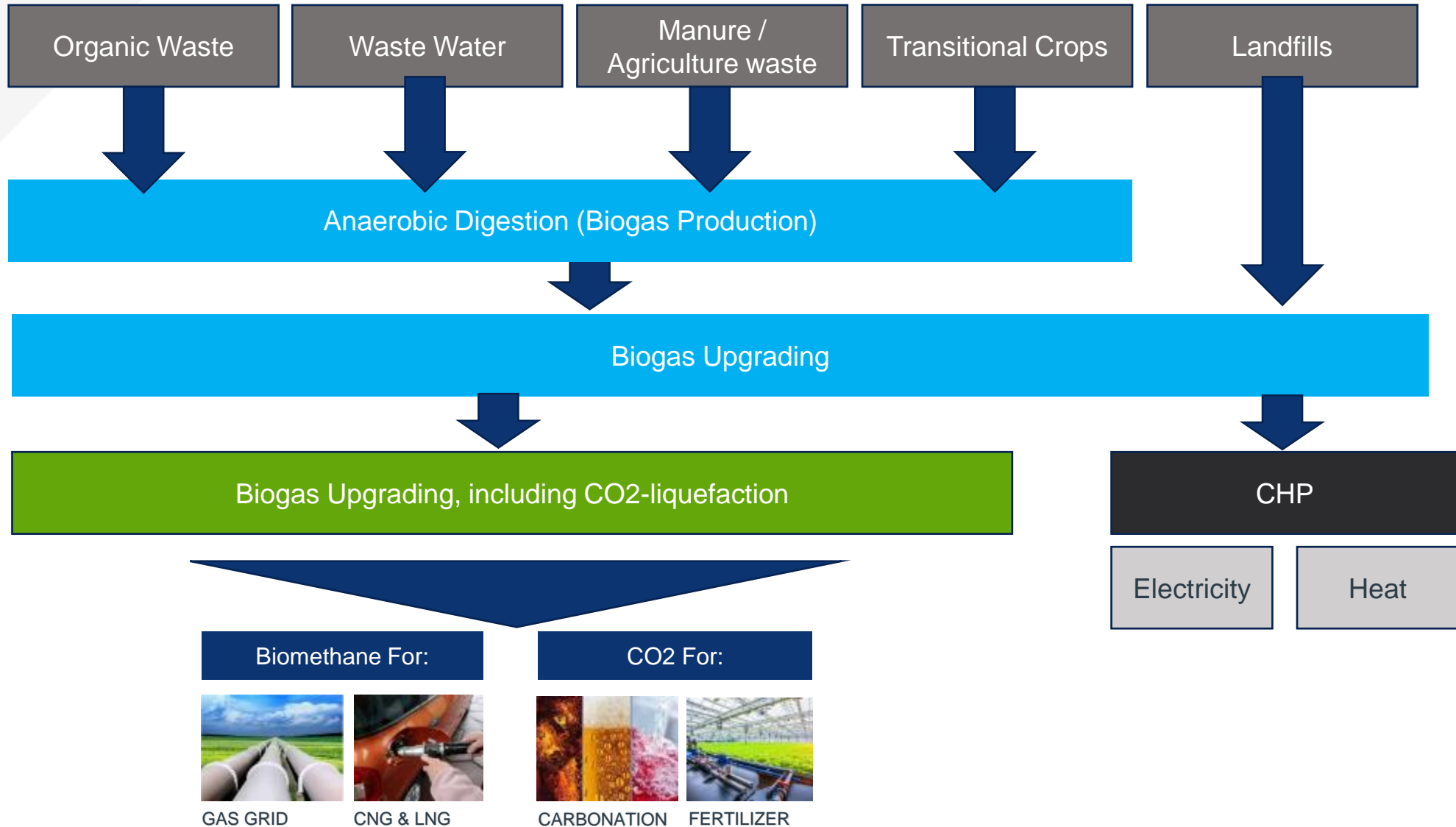


CO₂ Recovery in Breweries/Soft Drinks

Gas Analysis in Breweries/SD/Biogas

Established Provider in CO₂ Recovery and Biogas Solutions

Biogas Upgrading

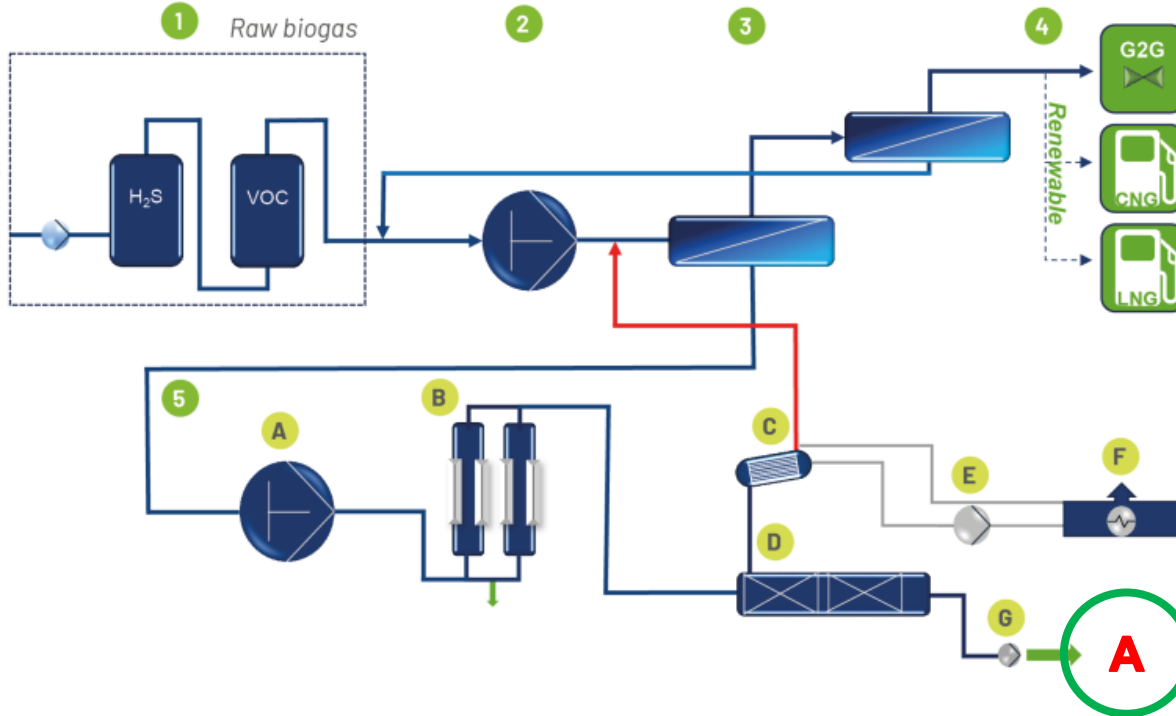


Biogas Upgrading Solutions Pentair

BioComplete

SCOPE OF SUPPLY

- 1 Pre-treatment biogas
- 2 Biogas compressor
- 3 2-stage membrane unit
- 4 Biogas outlet gas to grid or optional CNG or Bio-LNG
- 5 CO₂ Recovery:
 - A CO₂ compressor
 - B Activated carbon filter/drier
 - C CO₂ condenser
 - D Stripper/re-boiler
 - E Cooling compressor
 - F Dry cooler
 - G CO₂ pump
- > All parts skid mounted and controlled MCC

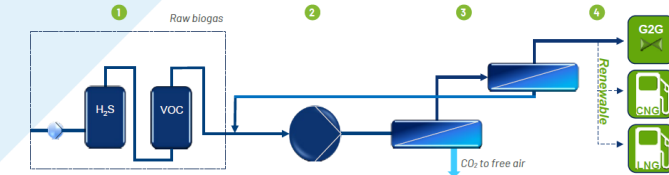


Market evolution towards higher demand of biogenic CO₂
 Origin of CO₂ needs proper assessment to define purification processes

BioCompact

SCOPE OF SUPPLY

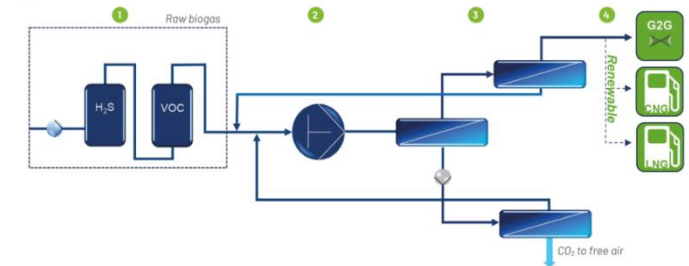
- 1 Pre-treatment biogas (booster with activated carbon filters for H₂S and VOC)
- 2 Biogas compressor
- 3 2-stage membrane unit
- 4 Optional bio-methane outlet to grid, CNG or Bio-LNG
- > Main parts skid mounted and controlled MCC



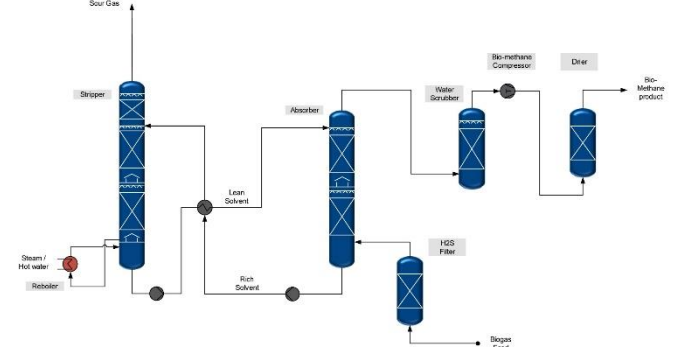
BioPlus

SCOPE OF SUPPLY

- 1 Pre-treatment biogas (booster with activated carbon filters for H₂S and VOC)
- 2 Biogas compressor
- 3 3-stage membrane unit
- 4 Biogas outlet gas to grid or optional CNG or Bio-LNG
- > Main parts skid mounted and controlled MCC



BioAmine



Adding value to CO₂

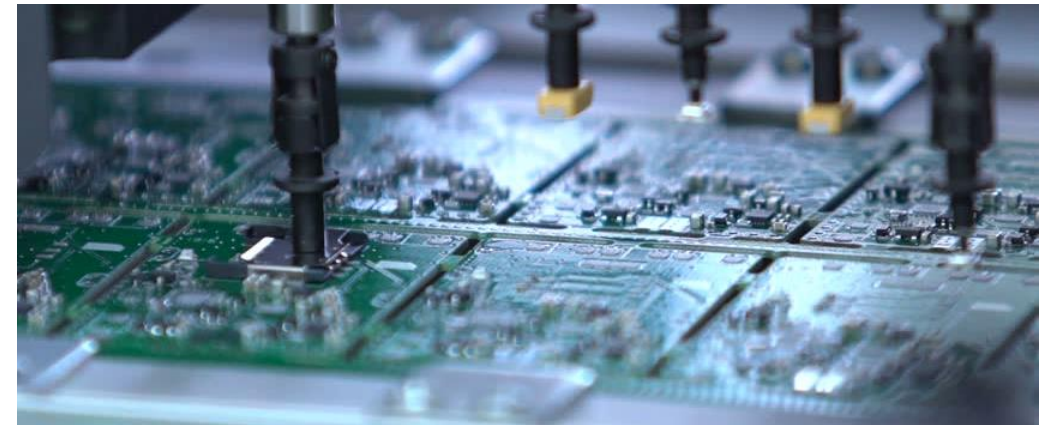
- Capability to provide food-grade quality CO₂.
- EIGA (European Industrial Gases Association), ISBT (International Society of Beverage Technologists).
- Possibility to meet specific regulations (experience with EC1935/2004, MOCA).
- Multi-line vessels and pumps facilitate the transportation of product.



Component	Concentration
Assay	99.9% v/v min.
Moisture	20 ppm v/v max
Ammonia	2.5 ppm v/v max.
Oxygen	30 ppm v/v max.
Oxides of nitrogen (NO/NO2)	2.5 ppm v/v max. each
Non-volatile residue(particulates)	10 ppm w/w max.
Non-volatile organic residue (oil and grease)	5 ppm w/w max.
Phosphine ***	0.3 ppm v/v max
Total volatile hydrocarbons (calculated as methane)	50 ppm v/v max. of which 20 ppm v/v max non-methane hydrocarbons.
Acetaldehyde	0.2 ppm v/v max.
Aromatic hydrocarbon	0.02 ppm v/v max.
Carbon monoxide	10 ppm v/v max.
Methanol	10 ppm v/v max.
Hydrogen cyanide*	0.5 ppm v/v max
Total sulfur (as S) **	0.1 ppm v/v max.
Taste and odour in water	No foreign taste or odour
Appearance in water	No colour or turbidity
Odour and appearance of solid CO2 (snow)	No foreign odour or appearance

Added Value to CO₂

- Contributor to the EBA White Paper
 - Hundreds of references of CO₂ units in the Beverage Industry.
 - Tens of units recovering CO₂ from biogas units.
- Beyond Business-as-Usual Food-Grade quality CO₂
 - Special queries for Electronic Grade CO₂
 - Water content at ppb level.
 - Extra removal of impurities.



Added value to CO₂

Carbon Capture (and Storage)

Carbon sequestration is evolving under new policies and incentives.

Can we reach the gas specifications?

Yes, specific patented technologies enable the removal of VOCs and other chemicals.

Capabilities of current systems:

from 0.5 to 15 tCO₂/h – Industrial Gases.

from 0.5 to 4 tCO₂/h – from Biogas.

Quality specification for liquified CO₂



Component	Concentration, ppm (mol)
Water (H ₂ O)	≤ 30
Oxygen (O ₂)	≤ 10
Sulphur oxides (SO _x)	≤ 10
Nitric oxide/Nitrogen dioxide (NO _x)	≤ 10
Hydrogen sulphide (H ₂ S)	≤ 9
Carbon monoxide (CO)	≤ 100
Amine	≤ 10
Ammonia (NH ₃)	≤ 10
Hydrogen (H ₂)	≤ 50
Formaldehyde	≤ 20
Acetaldehyde	≤ 20
Mercury (Hg)	≤ 0.03
Cadmium (Cd), Thallium, (Tl)	Sum ≤ 0.03

Non-condensable gases are components that, when pure, will be in gaseous form at 15 barg and -26°C. The content of non-condensable gasses will be limited by the actual solubility of the liquid CO₂ in the interim storage tanks at the capture plants.

Source: <https://norlights.com/wp-content/uploads/2021/12/Quality-specification-for-liquified-c02.pdf>

Added value to CO₂

Carbon Capture (and Utilisation)

Partnership with Academia

Supporting development of gas cleaning

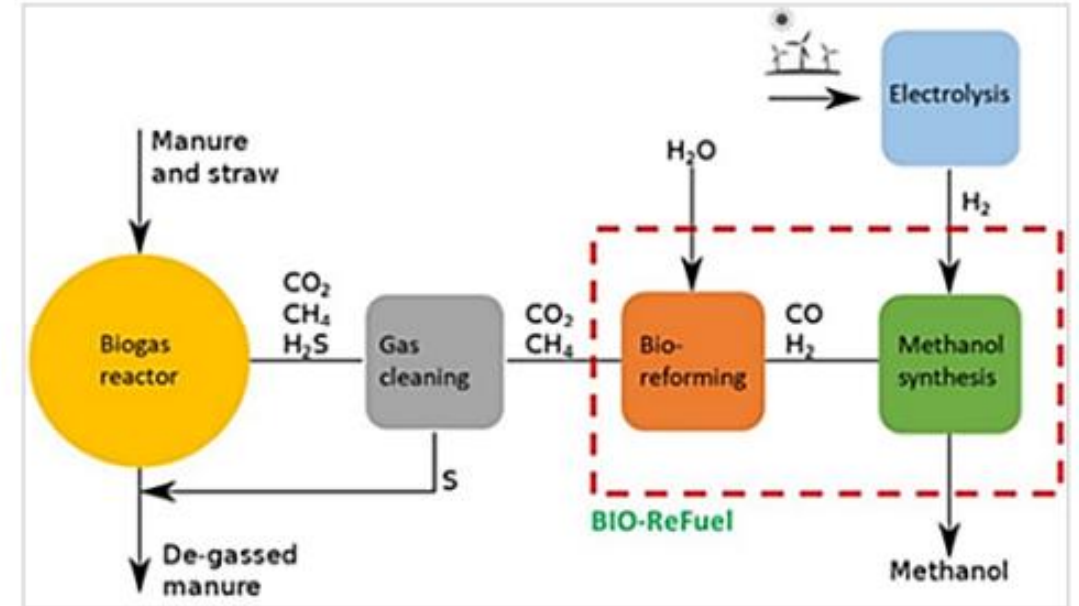
Supporting on CO₂ handling and avoidance of impurities

Use of CO₂ for production of:

Methanol

Synthetic Aviation Fuels

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PENTAIR

THANK YOU