BE-X: Biological Methanation (Power-to-X)

Converting CO_2 into Renewable Methane

The patented Biogasclean BE-X biological methanation process converts CO_2 — or untreated raw biogas without prior sulphur removal — into methane (CH_4) through the addition of hydrogen (H_2).
This process significantly increases methane output, enabling production of up to ~99% CH_4 in the resulting gas stream and maximizing the energy value of existing biogas.

How it works

Hydrogen produced from renewable electricity is injected into the biogas stream or directly into the BE-X reactor. Methanogenic microorganisms convert CO_2 and H_2 into CH_4 under controlled biological conditions. By utilizing existing CO_2 streams and infrastructure, biogas plants can transition from conventional upgrading to integrated Power-to-X facilities.

This enables:

- Conversion of CO_2 into additional methane
- Increased overall plant efficiency
- Production of carbon-neutral electro-methane (e-methane)

As a result, biogas plants can become net-zero or net-positive, while unlocking new revenue streams.

Applications

- Production of biomethane and e-methane for energy storage, transport, or liquefaction
- Carbon Capture and Utilization (CCU) from industrial CO_2 sources, including:
- Waste incineration
- Cement plants
- Industrial facilities
- Direct air capture (DAC) integration
- Agricultural, industrial, landfill, and wastewater-based biogas plants

Key Highlights

- Converts CO_2 and raw biogas directly into methane
- Up to 78% increase in biomethane output from the same feedstock
- Enables net-zero or net-positive plant operation
- Fast ramp-up and ramp-down, supporting flexible operation aligned with power availability
- Low OPEX due to operation at low pressure and moderate temperature
- Compatible with existing biogas infrastructure

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Reference Installation

Shell Plc BE-X site - Glansager, Denmark

- Demonstration of patented biological methanation technology
- Developed in partnership with Shell plc
- Proven performance under real operating conditions

Technology Positioning

BE-X represents a key enabling technology for the transition toward integrated renewable gas systems, combining biogas production with Power-to-X.
Biogas plants evolve from waste treatment facilities into renewable energy hubs, producing carbon-neutral fuels at scale.

Technical Specifications	
Process Tecnique Unit (PTU)	Installed within a skid-mounted unit, contains the equipment necessary for safe, automatic operations. The PTU includes a liquid supply and drain system, a heating and cooling system, a control system and gas detectors and analysers.
BE-X reactors and cleaning (QD)	Reactors comprise one or more insulated tanks manufactured using high quality reinforced fiberglass or stainless-steel materials. Depending on the volume of CO_2, we provide either prefabricated or field erected tanks. Each tank includes a grating, allowing for easy inspection underneath the packing media. They can be filled with water and include the Quick Decompression system (QD).
Packing media (Made of PP)	The Quick Decompression (QD) system can decompress the packing media to prevent clogging and channeling in the filter.
System and data control	The system is automatically controlled by the PLC controller board, reducing the risk of manual errors. It ensures stable conditions for the biological process and allows safe and reliable production. The data is available in the control room and can also be accessed remotely.
Safety The gas blowers and the air cooler are located outside the PTU	No gas pipes are inside the PTU and the potential risk is limited to small unintended gas leakages from liquid pipes. If the gas detectors in the PTU measure above 25% of the Lower Explosive Level (LEL) for CH4 or 20% for H2, the ignition source is removed by automatically cutting the power supply.
Operational pressure	<200 mbar or 2.9 psi.
Operating temperature	<65°C or 149°F.
Approvals	CE marking.

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