

Biological **desulfurization** and **methanation** of biogas and CO₂

Biogasclean A/S
Biogas PowerON 2023



Innovative solutions for efficient
production of biogas and e-fuels

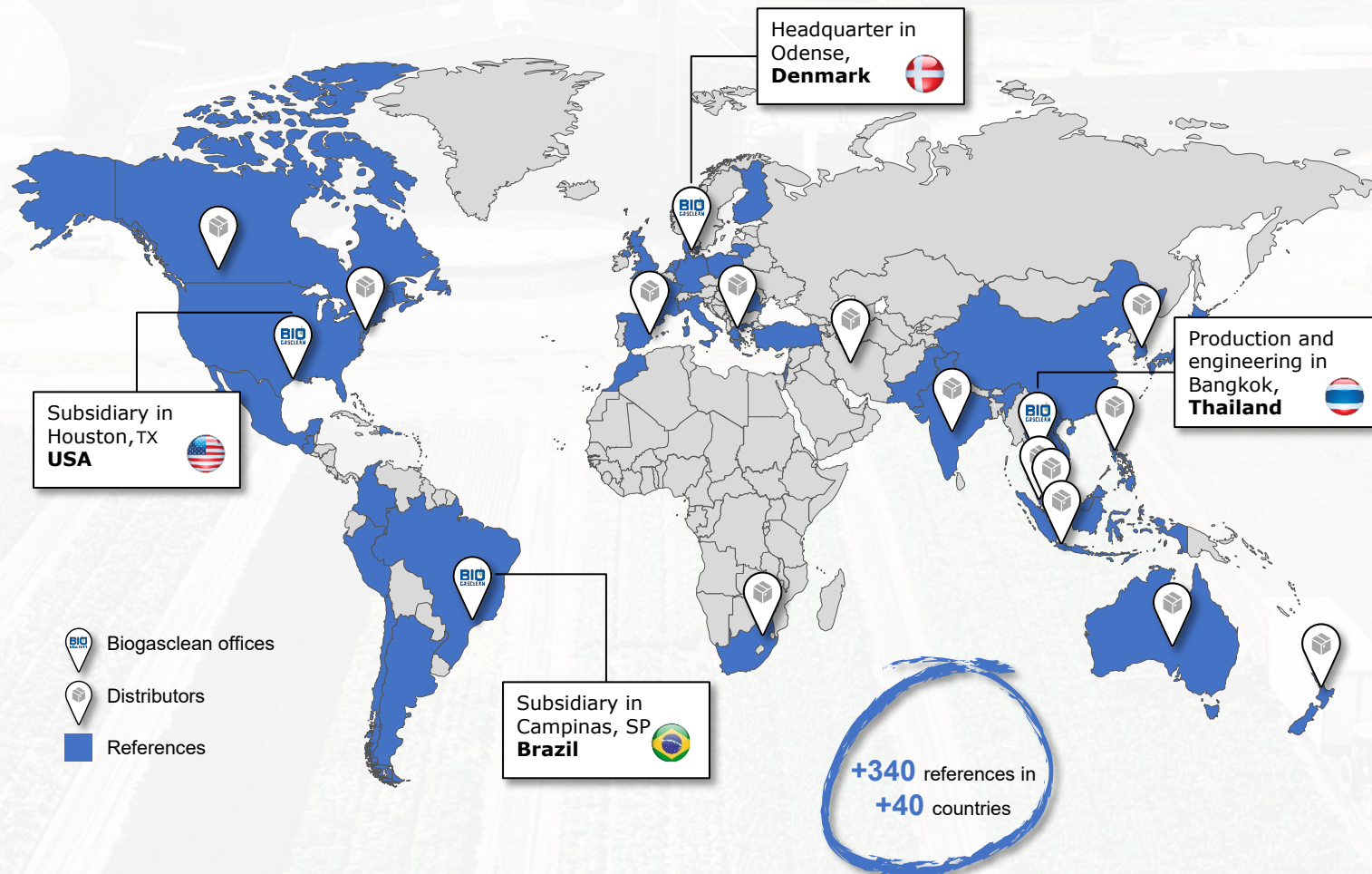
Introduction

- Engineer
- Experience with:
 - Biogas upgrading
 - Carbon capture
 - Gasification
 - Desulphurization
 - Methanation
- CSO - Biogasclean A/S



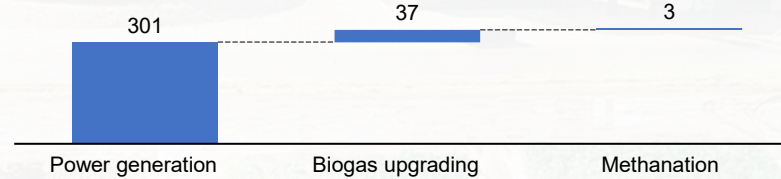
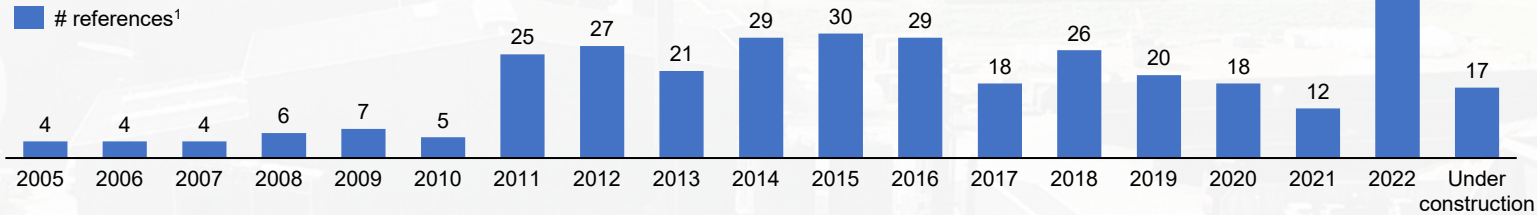
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Global footprint



References

No. of references per year



Power generation

By country	#	By substrate	#
Malaysia	72	Palm oil WW	138
Thailand	63	Codigestion	43
Indonesia	45	Public WWTP	36
Denmark	16	Cassava WW	34
USA	15	Food industry WW	12
India	14	Ethanol molasses	11
<i>Other</i>	76	<i>Other</i>	27
Total	301	Total	301

Biogas upgrading

By country	#	By substrate	#
Denmark	26	Codigestion	36
USA	9	<i>Other</i>	1
<i>Other</i>	2	Total	37
Total	37		

Methanation

By country	#	By substrate	#
Denmark	3	Codigestion	2
Total	3	<i>Other</i>	1
		Total	3

Technologies

Biological desulfurization

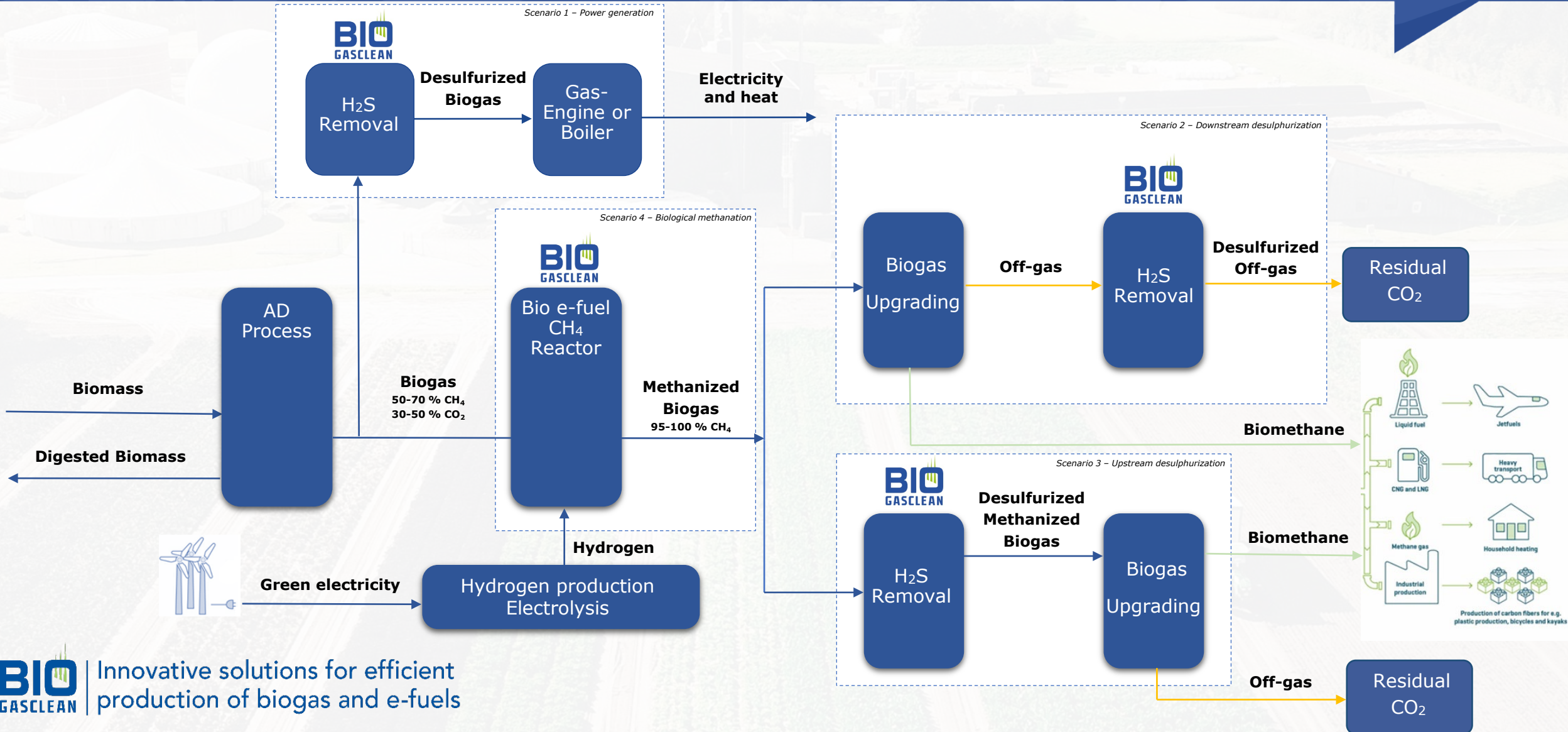
- Biogasclean has developed two different technologies – **BTR (Bio Tricking Reactor)** and **MBR (Moving Bed Reactor)** and offer **three different types** of gas cleaners. The gas cleaners can be designed to handle any flow and H₂S content in the raw biogas or tail gas (CO₂ stream) from biogas upgrading and can be installed at greenfield projects or refurbishment of existing plants.

Biological methanation

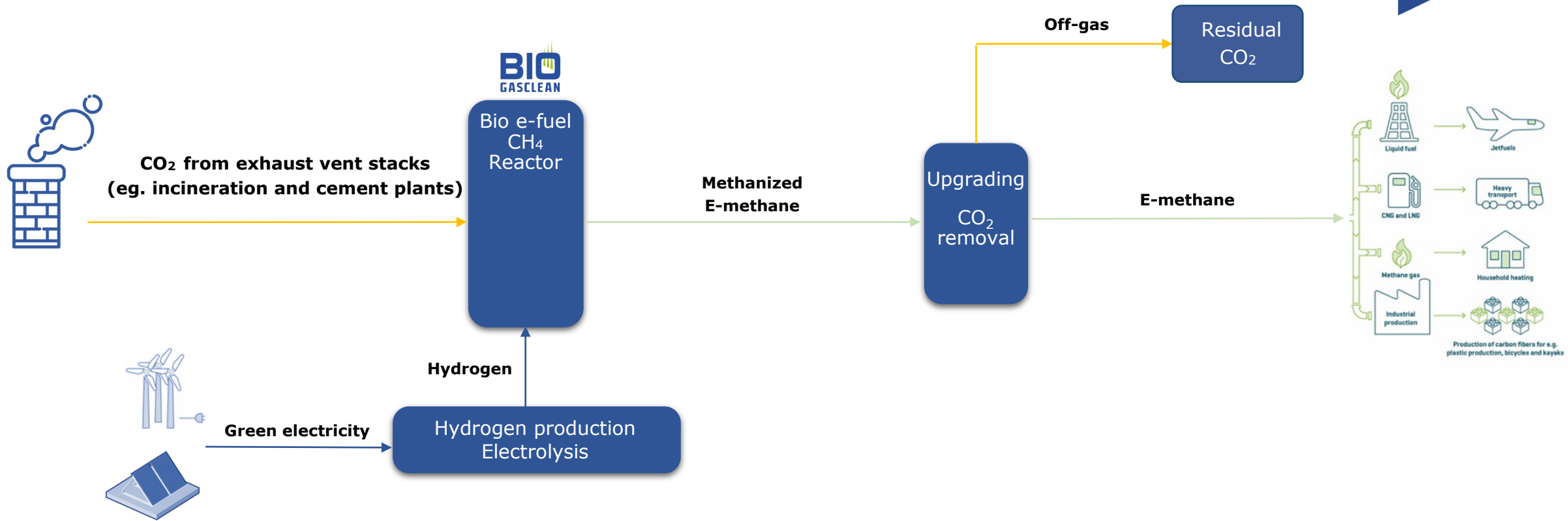
- Biogasclean has developed a biological Power-To-X technology – Bio E-Fuel - which is based on **BTR (Bio Tricking Reactor)**. Bio E-Fuel can be applied on all CO₂ sources. However, the lowest hanging fruit is biogas plants where the biogas typically consists of 55-60% CH₄ and 40-45% CO₂. Bio E-Fuel will enable biogas plants - from the same input of organic waste streams - to raise the concentration of methane in the biogas from 55-60% to +97-98% CH₄. With Bio E-Fuel, the production of renewable green gas will increase by up to 78%!

Technologies

Biogas plants – Methanation & desulfurization



Technologies Carbon Capture & Utilization (CCU) – Methanation



References

Client: E.ON - Greenlab

Application: Grid injection

Location: Skive, Denmark

Year: 2020

Project: 41247

CO₂ flow: 2,250 m³/h

H₂S inlet: 7,400 ppm

H₂S outlet: 50 ppm



References

Client: Roeslein Energy
Enduser: Seaboard Energy
Sector: Grind injection
Location: Sunray, Texas
Year: 2022
Project: 41277

CO₂ flow: 1,190 m³/h
H₂S inlet: 5,000 ppm
H₂S outlet: 1,000 ppm



Biogasclean **desulfurization** key takeaways

- Biogasclean is a leading supplier of **biological desulfurization and methanation** for industrial scale biogas plants with **more than +340 plants** in operation or under construction in **+40 countries**.
- **100% biological.** Why destroy the green image of biogas with chemical desulfurization? Biogasclean can do the job without ferric chloride, caustic soda, iron sponge or activated carbon.
- **Guaranteed performance.** Biogasclean's H₂S removal systems operate efficient and robust and performance guarantees are offered on all projects.
- **High availability.** The uptime of a Biogasclean system exceeds 98%.
- **Low operating costs** gives most economic solution. When considering both CAPEX and OPEX biological H₂S removal is much more cost effective than chemical gas cleaning.

Bio E-Fuel

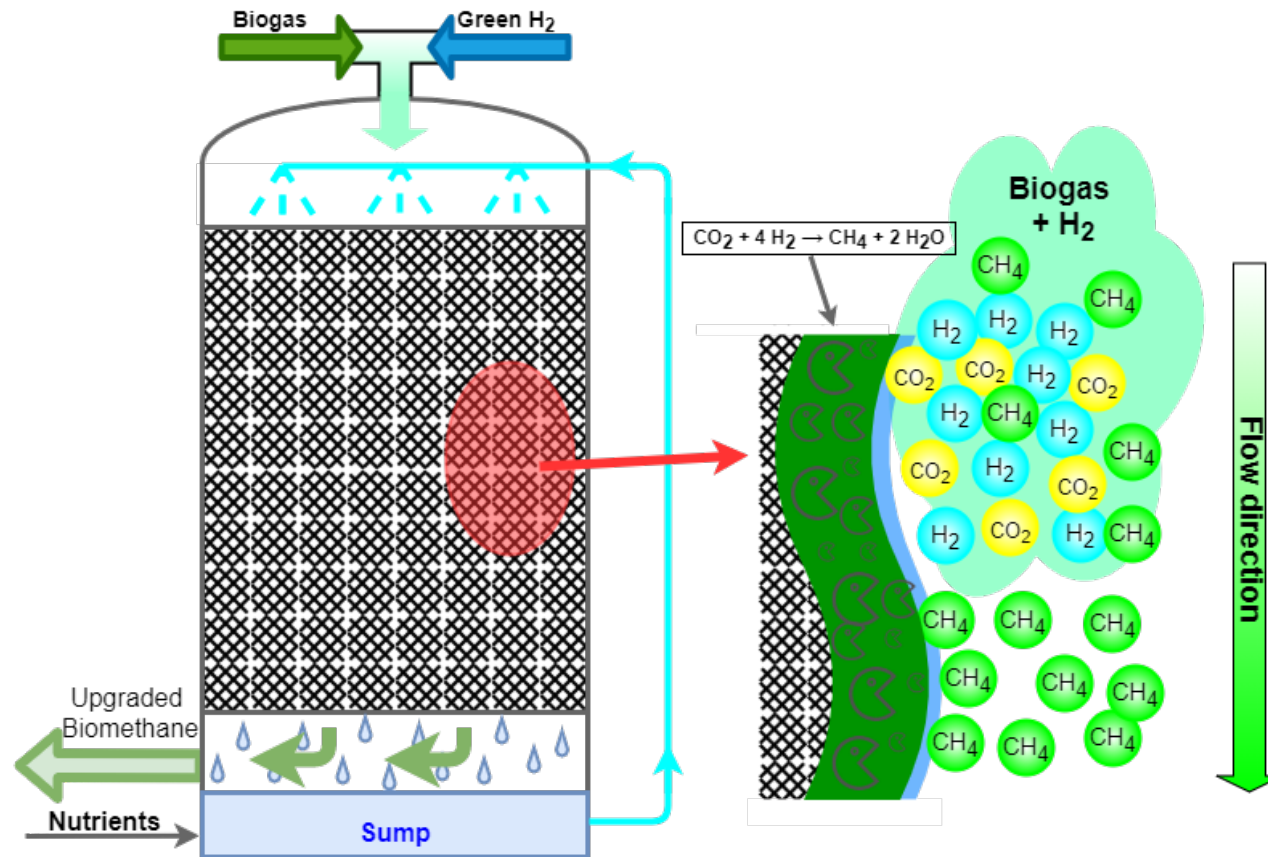
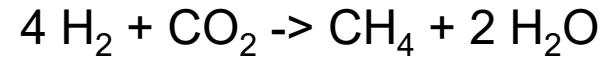
A biological Power-To-X (P2X) technology

- **Bio E-Fuel** is a biological process converting (CO_2) and hydrogen (H_2) to methane (CH_4) in a Bio Trickling Reactor; i.e. biological methanation of CO_2 .
- **Bio E-Fuel** can be applied everywhere where you have a CO_2 source. Biogas typically consists of 55-60% CH_4 and 40-45% CO_2 . With Bio E-Fuel biogas plants can increase the methane content in biogas to +97-98%, i.e. the efficiency of biogas production increases by up to 78%.
- The process is very robust and handles untreated biogas and CO_2 without prior removal of sulfur and other impurities.



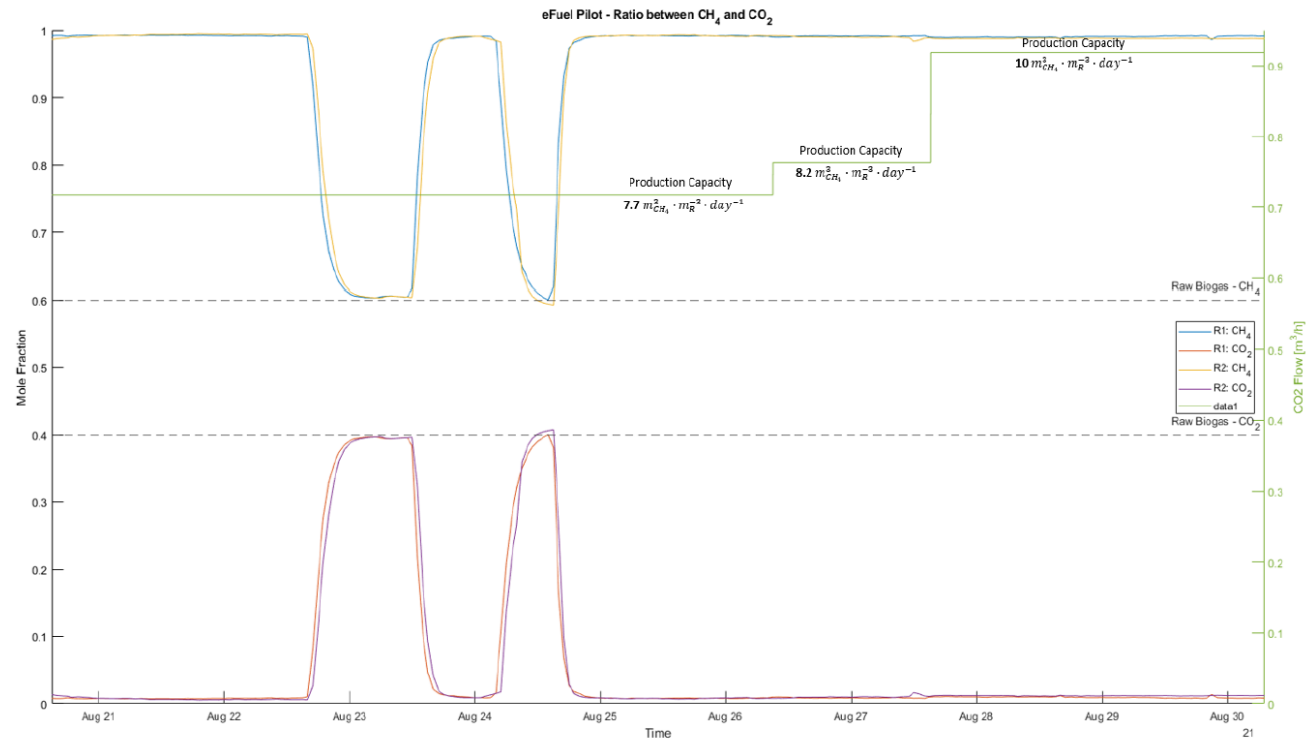
Process in Bio Trickling Reactor

Biological Methanation



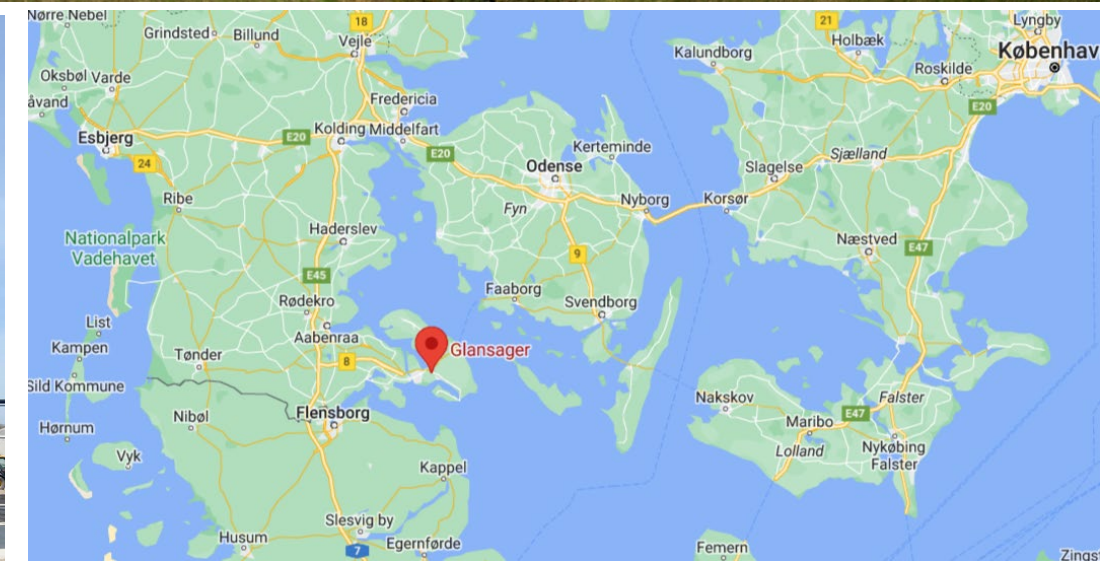
Bio E-Fuel

The product gas is composed of >95% CH₄ and <5% CO₂ and H₂.

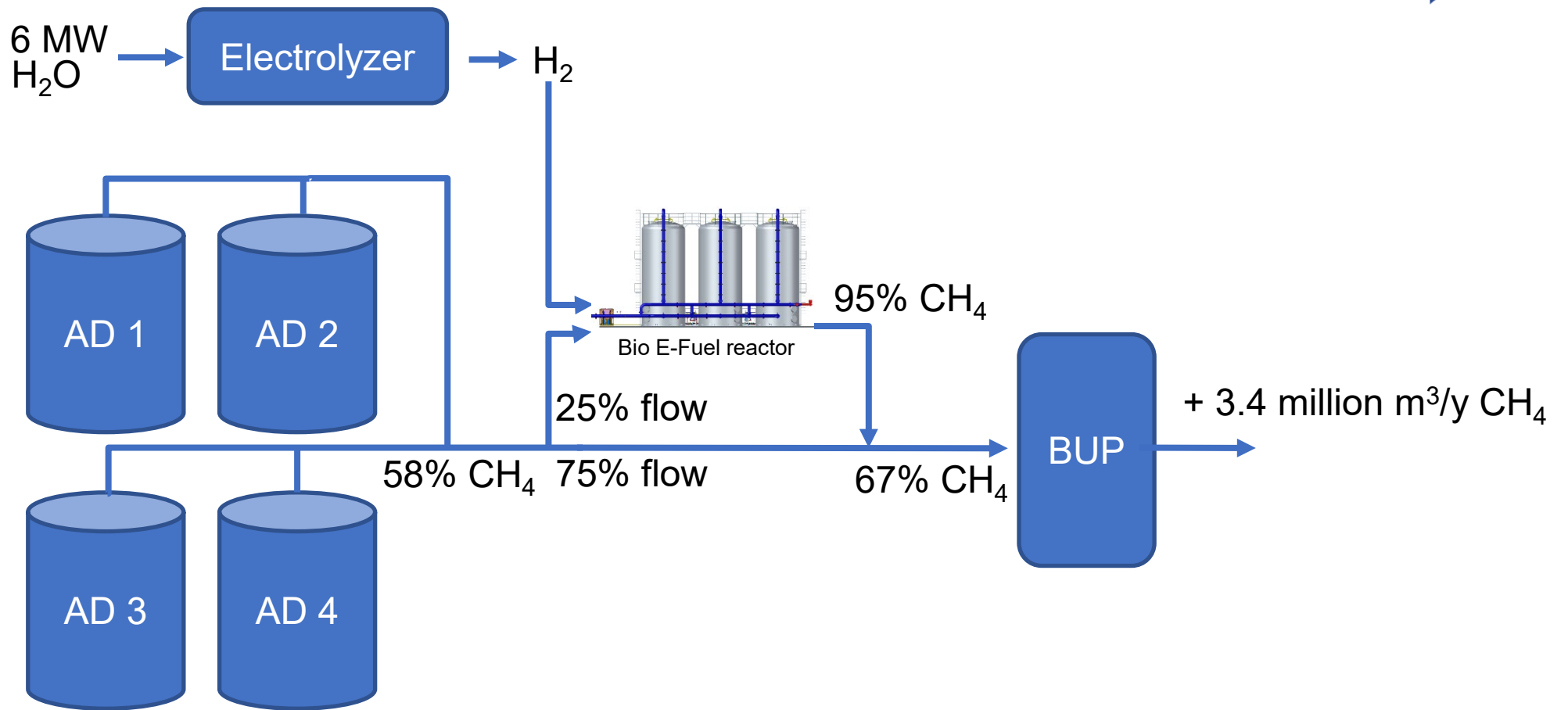


P2G Plant at Nature Energy, Glansager - Overview

- Location in **Sonderborg, Denmark.**
- The first full scale Bio E-Fuel Plant is under installation and will start operation in late **September 2023.**
- Production capacity: **381 Nm³/h E-Methane** or 3,400,000 Nm³/y or 33 GWh/y E-Methane.
- Biogasclean's Bio E-Fuel plants are based on a **scalable and modular design** with one or more tanks in stainless steel or reinforced fiberglass.
- The Bio E-Fuel plant **comprises 3 pcs. insulated tanks** in stainless steel filled with a random packed packing material.



PTX Plant at Nature Energy, Glansager – Flow diagram



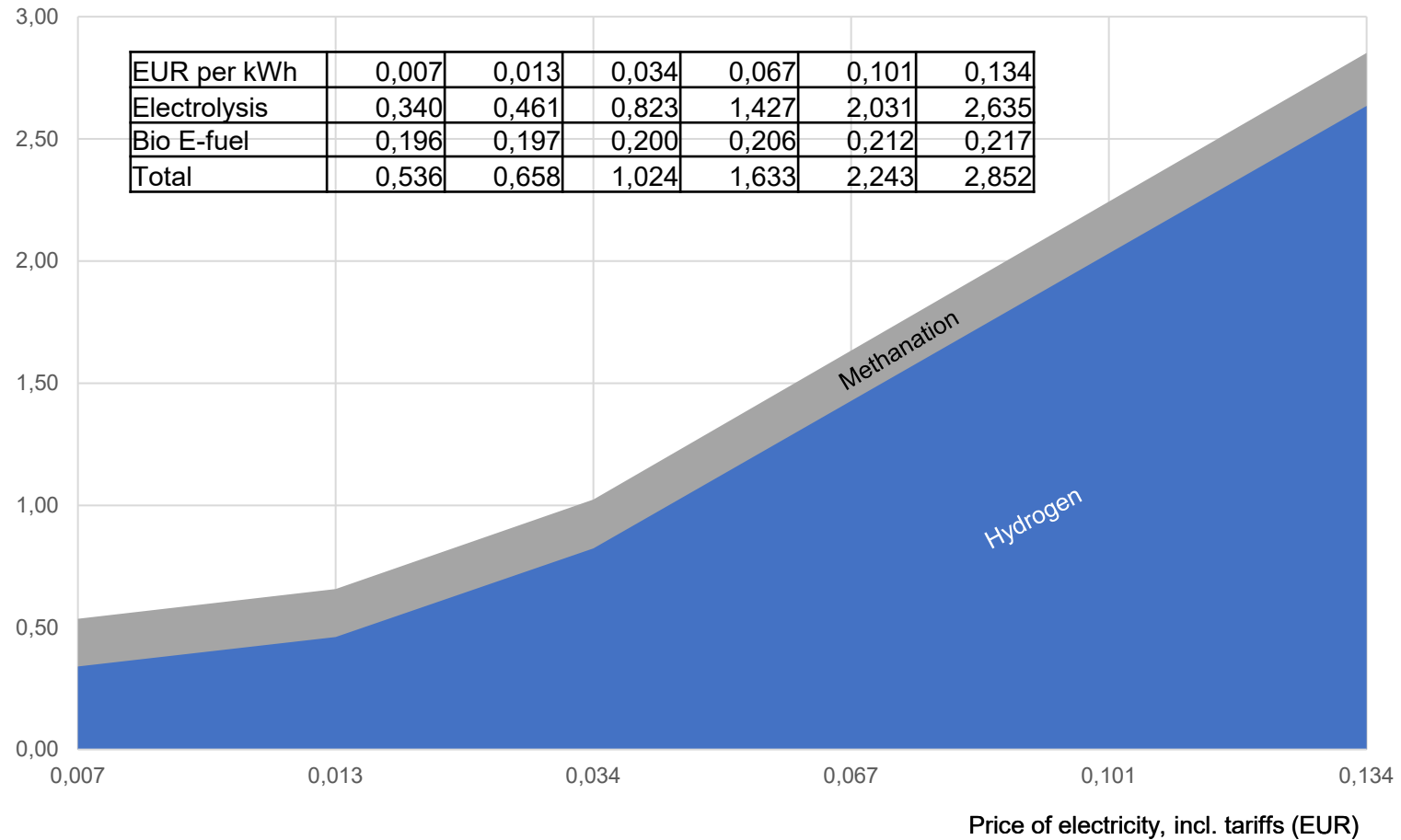
Bio e-fuel



Cost estimation electrolysis and Bio E-Fuel (EUR)

EUR

Cost estimation of 1 Nm³/h E-methane



Biogasclean **methanation** key takeaways

- **Bio E-Fuel can be applied everywhere where you have a CO₂ source**; however, it is a **perfect fit for biogas plants** as the CO₂ and the infrastructure for methane production are already available.
- Biogas consists of 55-60% CH₄, 40-45% CO₂ and 3-5,000 ppm H₂S; **the cheapest source of biogenic CO₂**.
- Bio E-Fuel increases the output on biogas plants from 55-60% to **+97-98% CH₄**; i.e., up to **78% more biomethane produced** from the same amount of organic substrate.
- Bio E-Fuel can process the **raw biogas or CO₂** flow without any prior removal sulfur or other impurities.
- **Operation at low pressure** (<200 mBar) and **low temperature** (<60°C) gives low OPEX.

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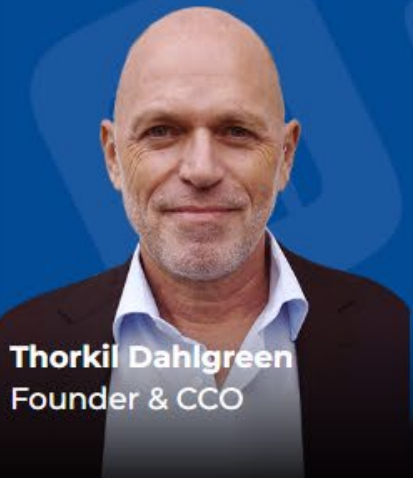
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 **BIO**
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production of biogas and e-fuels



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