## **Biological Methanation for Cost-Effective Biomethane Production: The SEMPRE-BIO Project** SEMPRE-BIO at Baix Llobregat WWTP CETAQUA **EUBCE** 2025 WATER TECHNOLOGY CENTRE

## **SEMPRE-BIO Project...**

SEMPRE-BIO aims to demonstrate novel and cost-effective biomethane production solutions and pathways, deemed essential to achieve the European Green Deal and climate and energy targets for 2030 and the net zero greenhouse gas emissions by 2050, and to increase the market up-take of biomethane related technologies.

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**PILOT SITE:** 

Baix Llobregat WWTP (Barcelona). Managed by: Aigües de Barcelona.

Case study I – Spain 🗣

#### **PROCESS HIGHLIGHTS:**

- Feedstock: WWTP biogas production capacity  $(700-800 \text{ Nm}^3/\text{h}).$
- Technology: Ex-situ biological methanation + PEM electrolysis.
- Pilot site target: 14 Nm<sup>3</sup>/h biomethane for local transport.
- Operating conditions: 4-9 bara, thermophilic temperature.

### **FEED BIOGAS COMPOSITION:**

- CH₄/CO₂: 1.87 (molar ratio).
- Other components: 1.5% N<sub>2</sub>, ~290 ppm H<sub>2</sub>S, trace amounts of siloxanes and VOCs.

#### **PROCESS DESCRIPTION:**

- Reactor modeled as fixed conversion reactor.
- Biomethanation reaction:  $CO_2 + 4H_2 \rightarrow CH_4 + 2H_2O_2$ .
- Biomethane compressed to 250 bar for CNG storage.
- End use: Local public transportation.



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Months

Partners

Countries

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#### **PRELIMINARY RESULTS FROM SIMULATIONS:**

As part of the technology scale-up strategy, laboratory experiments and process simulations were conducted to optimize the biomethanation process.

#### **KEY FINDINGS:**

- ✓ Biomethane Production Rate: 0.588 kg CH₄/kg biogas.
- ✓ Product Composition: >95% CH₄.
- Remove impurities (H<sub>2</sub>S, siloxanes, VOCs).

#### **ENERGY REQUIREMENTS:**

9.9M Funding

Case Studies

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Technologies

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**3** Feedstocks

**CO2** Valorization

- Total Energy Consumption: 14.93 MJ/kg biogas (1.69 MW).
- Cooling Demand: 0.72 MJ/kg biogas.
- Refrigeration Needs: 0.35 MJ/kg biogas.

#### LAB-SCALE VALIDATION:

Reactor configurations tested:

- Trickle Bed Reactor (TBR).
- Continuous Stirred Tank Reactor (CSTR).
- Bubble Column Reactor (BCR).
- Hollow Fibre Membrane Reactor (HFR).

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## Case Study 3: Belgium





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