
Innovative biomethane pathways: The BIOMETHAVERSE Project

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innovations in the
BIOMETHA^{ne}
uni**VERSE**

Demonstrating and Connecting Innovations in the BIOMETHANE universe



54 Months

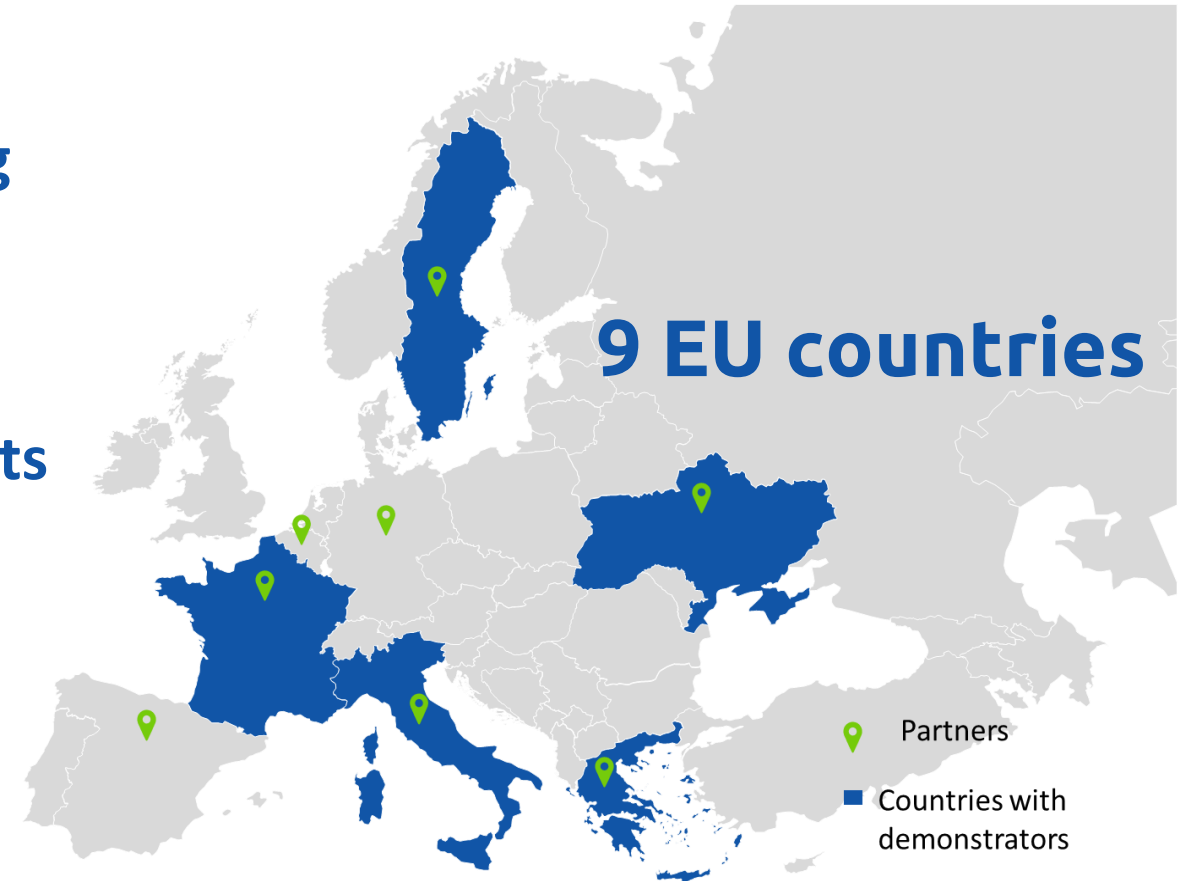


9.87 M€ of EC funding



7 Technological centers
3 Universities
9 Private companies
3 Associations-NPO

22 Project
Participants



➤ 5 case studies-innovative pathways

➤ 5 WORK PAKAGES - EBA leads WP2 & WP4

ISINNOVA
research innovation sustainability

EBA
European Biogas
Association

ENEA
Italian National Agency for New Technologies,
Energy and Sustainable Economic Development

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managing technologies

Ellmann EE Engineering GmbH



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Goals – Objectives

1 + ECONOMICS & + bioCH₄ efficiency by 5 pathways

2 + SUSTAINABILITY and max CO₂ utilization

3 REPLICABILITY and UPSCALING

4 MARKET PENETRATION & POLICY RECOMMENDATION

Technological Diversification for
bioCH₄ production in EU

Cost effectiveness &
Market uptake

Contribute to SET Plan Action 8
(++ performance & ↓ GHG)



5 innovative
pathways –
FR-EL-IT-SE-UA

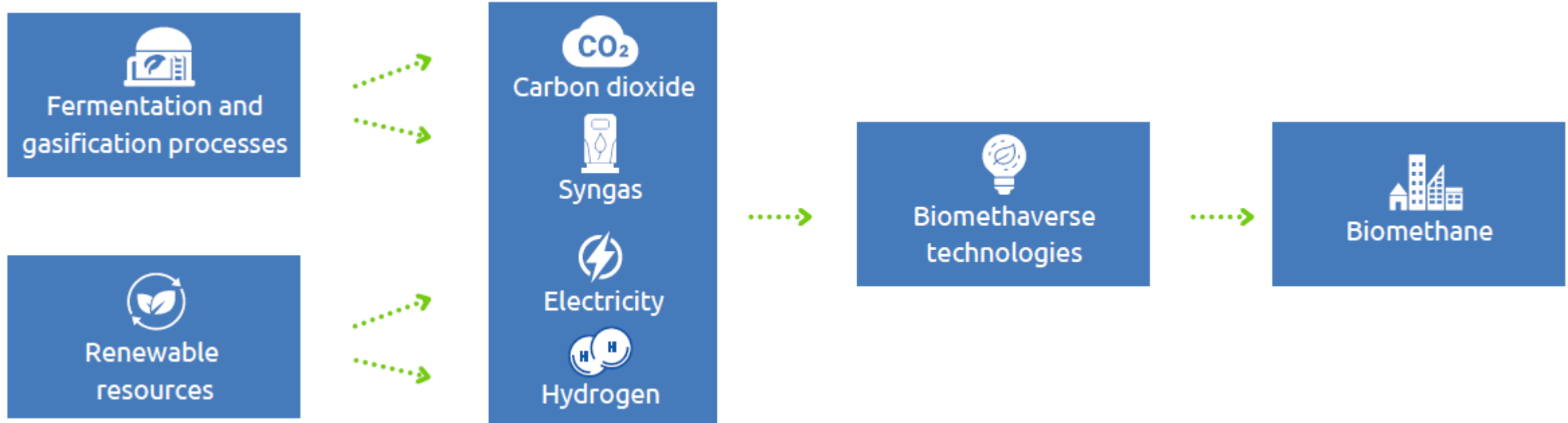


CO₂ effluents from AD or syngas in synergy w/ H₂ or EE
→ increase bioCH₄ yields & address circular system



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Innovative technological concepts in BIOMETHAVERSE



GOAL : establish a scalable and economically viable process to convert biogas, syngas, EE, CO₂, H₂ to bioCH₄ to be used for power, heat, transport



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WORK PACKAGES Breakdown structure

16 Tasks
29 deliverables

WP1 Coordination & Management



WP2 Demonstration of Innovative bioCH4 pathways



WP3 Assessment & Optimization of Innovative bioCH4 pathways



- Evaluation framework and **data collection** strategy
- Demos flow sheeting and TEA
- **Environmental and social sustainability**
- **Evaluation** results and upscaling of demos



WP4 Replicability, Planning Decision, Market Penetration Policy dimension



- **Replicability** analysis
- Assisting future planning decisions
- **Market** uptake
- **Policy** recommendations



WP5 Dissemination & Comm

- website
- leaflets
- poster,
- roll-up,
- newsletters,
- video,
- press, social media publications
- conference, WS..



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5 Innovative bioCH₄ Pathways

FR	In-Situ & Ex-Situ Electromethanogenesis
EL	Ex-Situ Thermochemical/catalytic Methanation
IT	Ex-Situ Biological Methanation
SE	Ex-Situ Syngas Biological Methanation
UA	In-Situ Biological Methanation

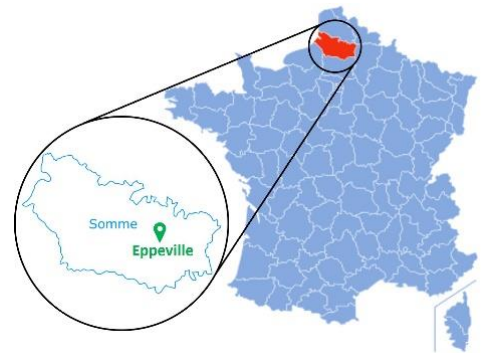
FEEDSTOCKS- WASTE BASED

	Agro-industrial residues			
	Livestock Waste			
	WWTP sewage sludge			
	Wood Chips, Logging Residues, Municipal Yard Trimming			
	Chicken manure & agricultural residues			



In-Situ and Ex-Situ Electro-methanogenesis (EMG) in France

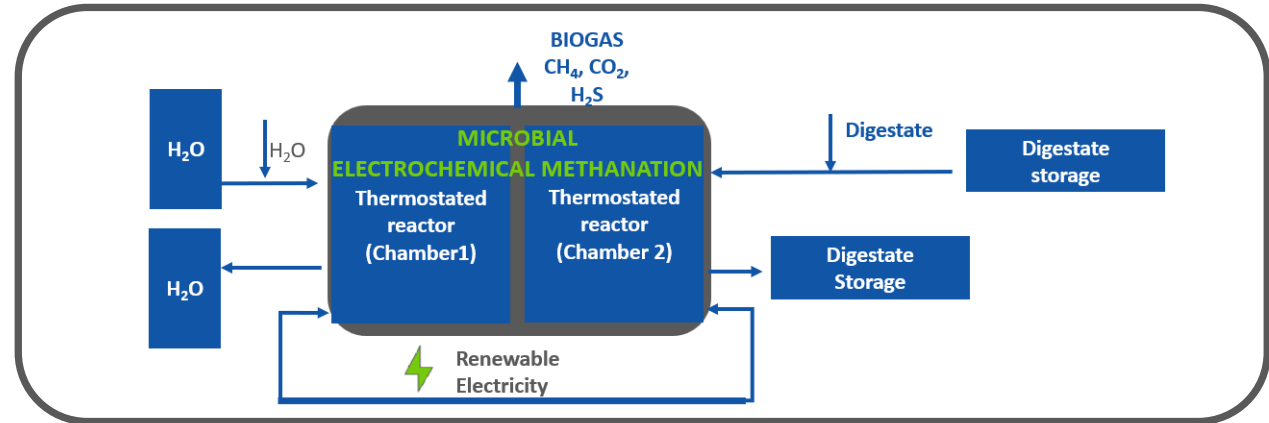
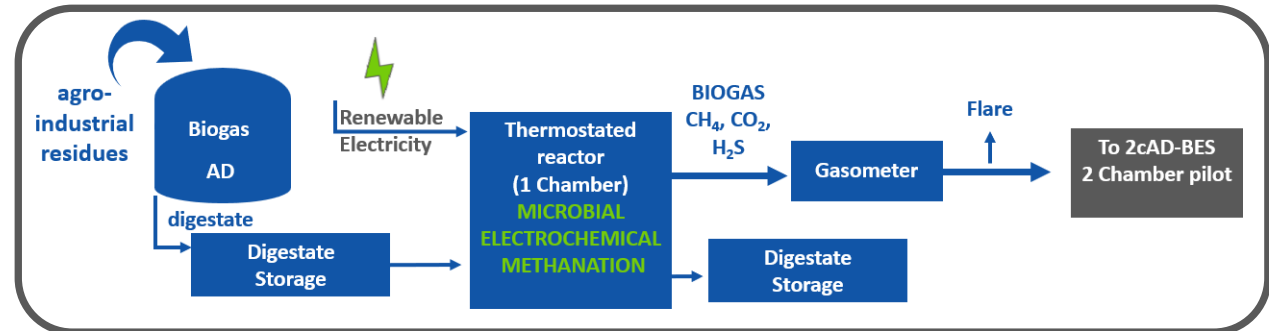
Demonstration site: EPPEVILLE,
HAUT DE FRANCE REGION



Feedstock: 30,000 t/y agro-industrial residues

Main numbers:

- 1,815,000 m³/y bioCH₄
- 250 Nm³/h injected into NG grid
- 6,000 m³ digestion volume (HRT > 50 d)
- Valorization of digestate-land spreading (6,000 ha, 31 farms).



TRL
advance:
4 → 6-7

Technology: bioCH₄ from bioelectrochemical methanation

- 1c-AD-BES: biogas with a bioCH₄ content up to 70-80%
- 2c-AD-BES: biogas upgrading to bioCH₄ (>95%) and P2G applications (bio-electrocatalytically), converting the biogas CO₂ share

Input : CO₂ + electricity + H₂ O

Output: + 91% of biogas, 98% bioCH₄, 0.8 m³/day

Ex-Situ Thermochemical/catalytic Methanation (ETM) in Greece

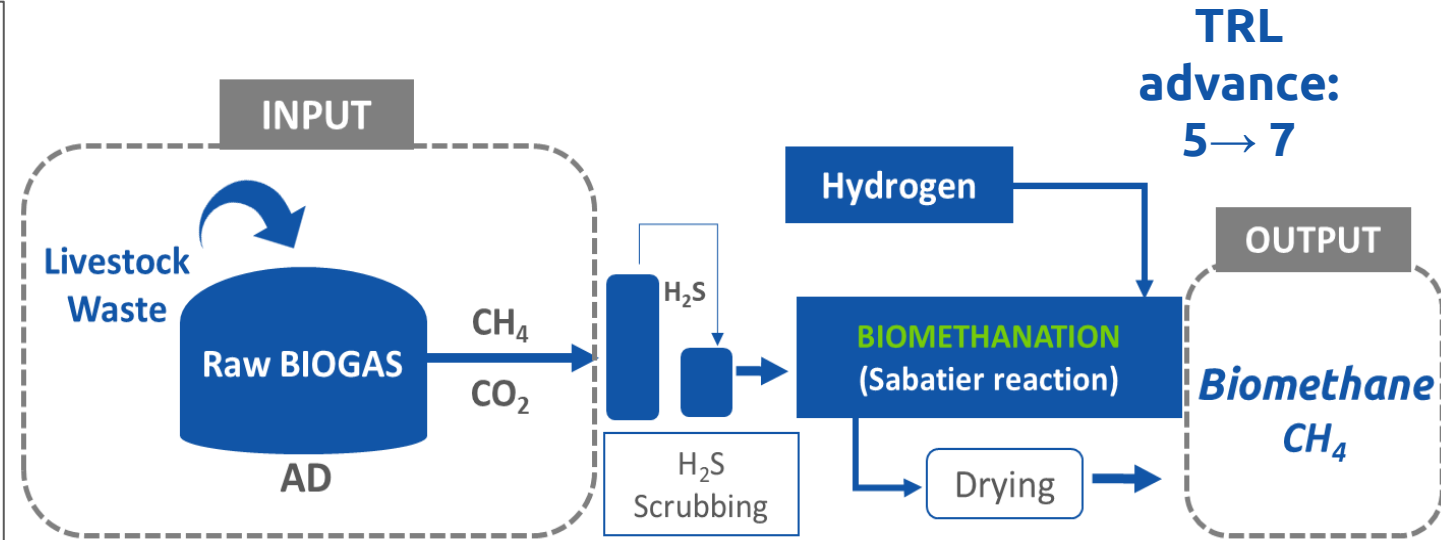
Demonstration site: KOLCHIKO-LAGADAS,
CENTRAL MACEDONIA REGION



Feedstock: 80,000 t/y of livestock waste

Main numbers:

- 8,400 MWh electricity + 75,000 t digestate
- 290 Nm³/h capacity - 1 MW CHP
- 2 fermenters of 4,500 m³ each
- Land-spreading valorizations (5,000 acres).



Technology: Conversion of CO₂ in the biogas to bioCH₄, through its reaction with renewable H₂ in a catalytic reactor

Input: 6 Nm³ /h biogas

Output: 15,000 Nm³ of bioCH₄, @ 96-98 vol%, energy efficiency 61%

Ex-Situ Syngas Biological Methanation (ESB) in Sweden

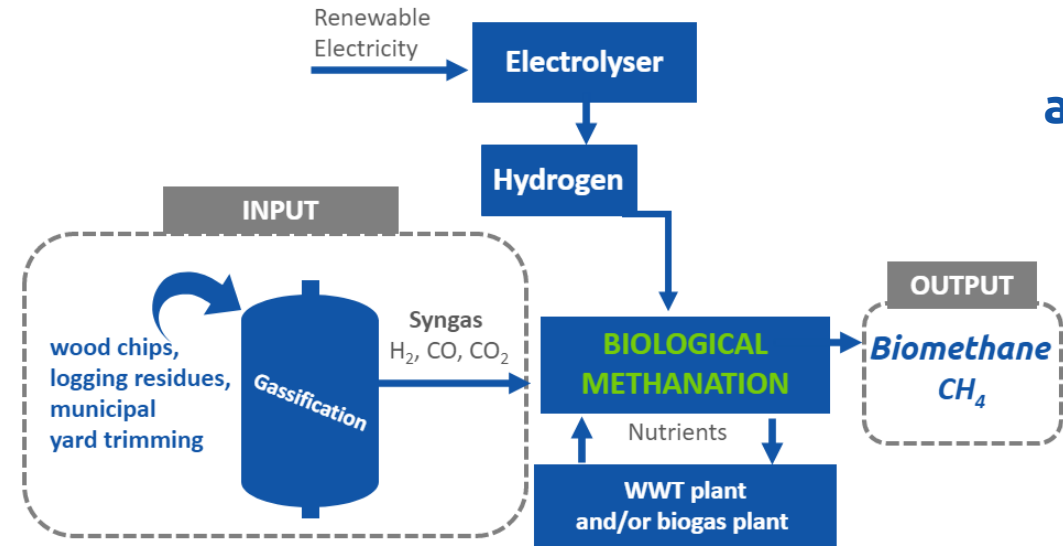
Demonstration site: HÖGANÄS, GÖTALAND REGION



Feedstock: wood chips, logging residues, municipal yard trimming

Main numbers:

- **6 MW** gasification plant owned
- Syngas H₂ (**55%**) CO (**30%**) CO₂ (**14%**) CH₄ (**1%**)



TRL
advance:
4 → 6-7

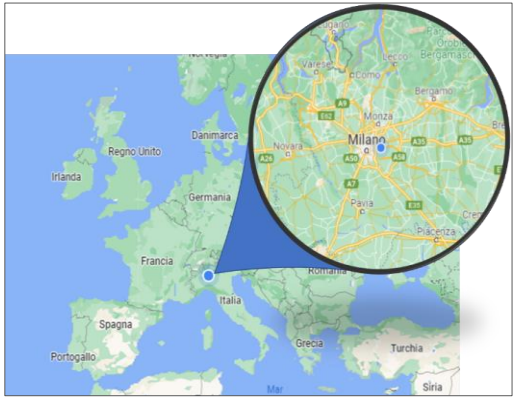
Technology: Demo plant is containerized and fully mobile. Biological methanation of syngas (CO and H₂) and nutrient solution (i.e., digestate or from H₂O after S/L of WWT sludge) with or w/o external electrolyser that provides additional H₂ from RE.

Input : 10 kW syngas (+H₂)

Output: 16 kW bioCH₄

Ex-Situ Biological Methanation (EBM) in Italy

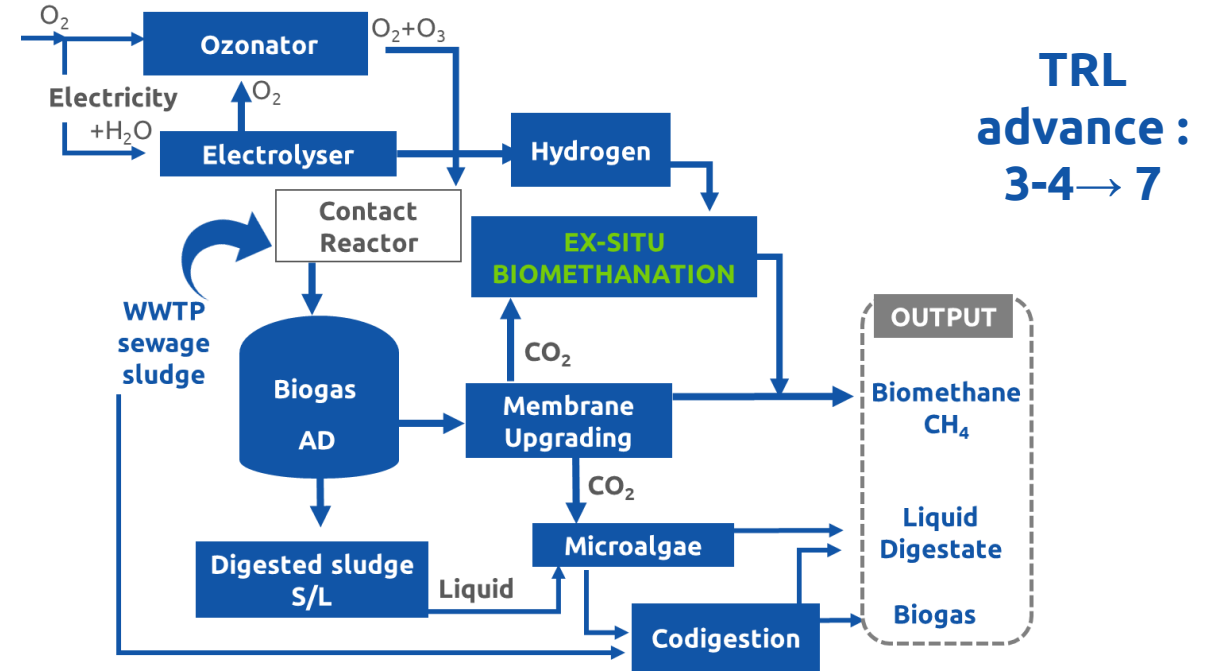
Demonstration site: **BRESSO-NIGUARDA, LOMBARDY REGION**



Feedstock: Urban WWTP with 2 parallel AD lines for sewage sludge valorization to biogas

Main numbers:

90 m³/h or **600,000 m³/y** bioCH₄ injected into grid



Technology: Feedstock pre-treatment via ozonolysis, Pilot-scale Ex-situ biological upgrading (EBM), Pilot-scale microalgae operation, Pilot-scale co-digestion operation

Input : CO₂ + H₂

Output: 160 L/h biomethane, increase of 78% of biomethane production

In-Situ Biological Methanation (IBM) in Ukraine

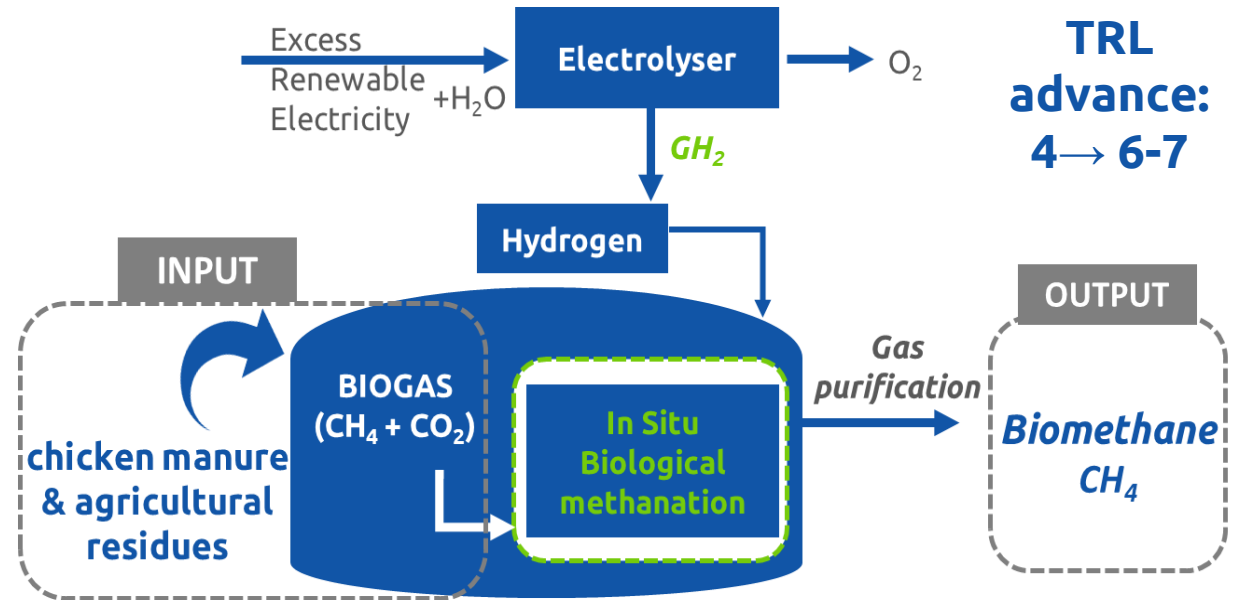
Demonstration site: LADYZHIN, VYNNITSIA REGION



Feedstock: 300 t/d chicken manure and agricultural residues

Main numbers:

- 85 GW electricity + 75,000 t of digestate
- 12 MW capacity
- 12 reactors (9 main fermenters, 3 post-digestors)
- 90,000 m³ each



Technology: Hydrogen-assisted in situ biological biogas upgrading to bioCH₄

Input: 100 Nm³ biogas

Output: 18 Nm³ biomethane, 85% biomethane



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