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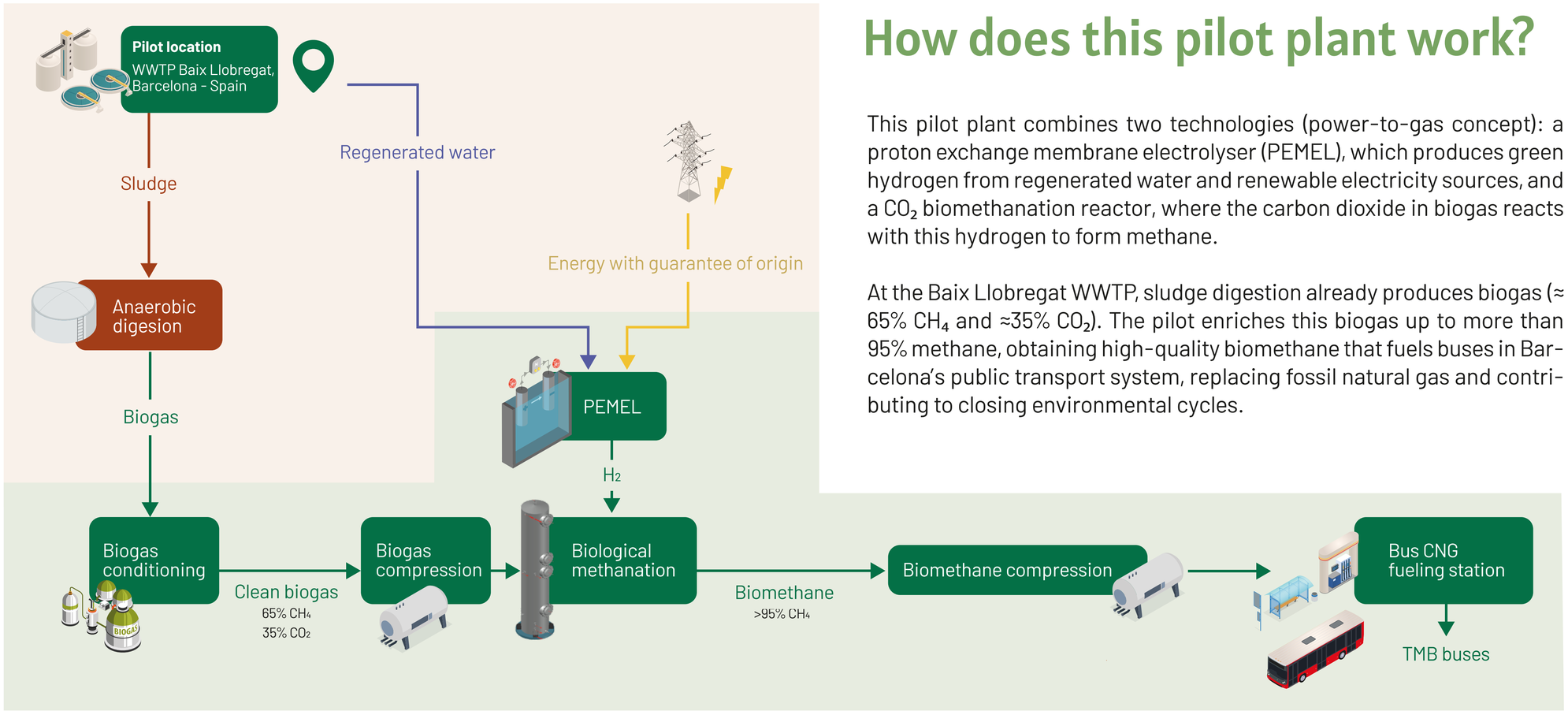
Case Study I: Wastewater to Bus Fuel

Case Study Context

This is the first of the three European Biomethane Innovation Ecosystems within SEMPRE-BIO.

Located at the El Baix Llobregat wastewater treatment plant in Barcelona and led by CETAQUA with partners Aigües de Barcelona, Biothane, Propuls, TMB, DTU, SINTEF, and DBFZ, it demonstrates how a biogas byproduct of wastewater treatment can be upgraded into high-value clean transport fuel.

The result is a local circular economy solution where waste becomes green energy that powers buses in Barcelona's metropolitan area.



How does this pilot plant work?

This pilot plant combines two technologies (power-to-gas concept): a proton exchange membrane electrolyser (PEMEL), which produces green hydrogen from regenerated water and renewable electricity sources, and a CO_2 biomethanation reactor, where the carbon dioxide in biogas reacts with this hydrogen to form methane.

At the Baix Llobregat WWTP, sludge digestion already produces biogas (≈ 65% CH_4 and ≈35% CO_2). The pilot enriches this biogas up to more than 95% methane, obtaining high-quality biomethane that fuels buses in Barcelona's public transport system, replacing fossil natural gas and contributing to closing environmental cycles.

Results

RES1-Biomethanation of biogas from WWTP sludge anaerobic digestion.

RES2-PEM electrolysis with hydraulic compression.

Learn more at sempre-bio.com

Funded by the European Union

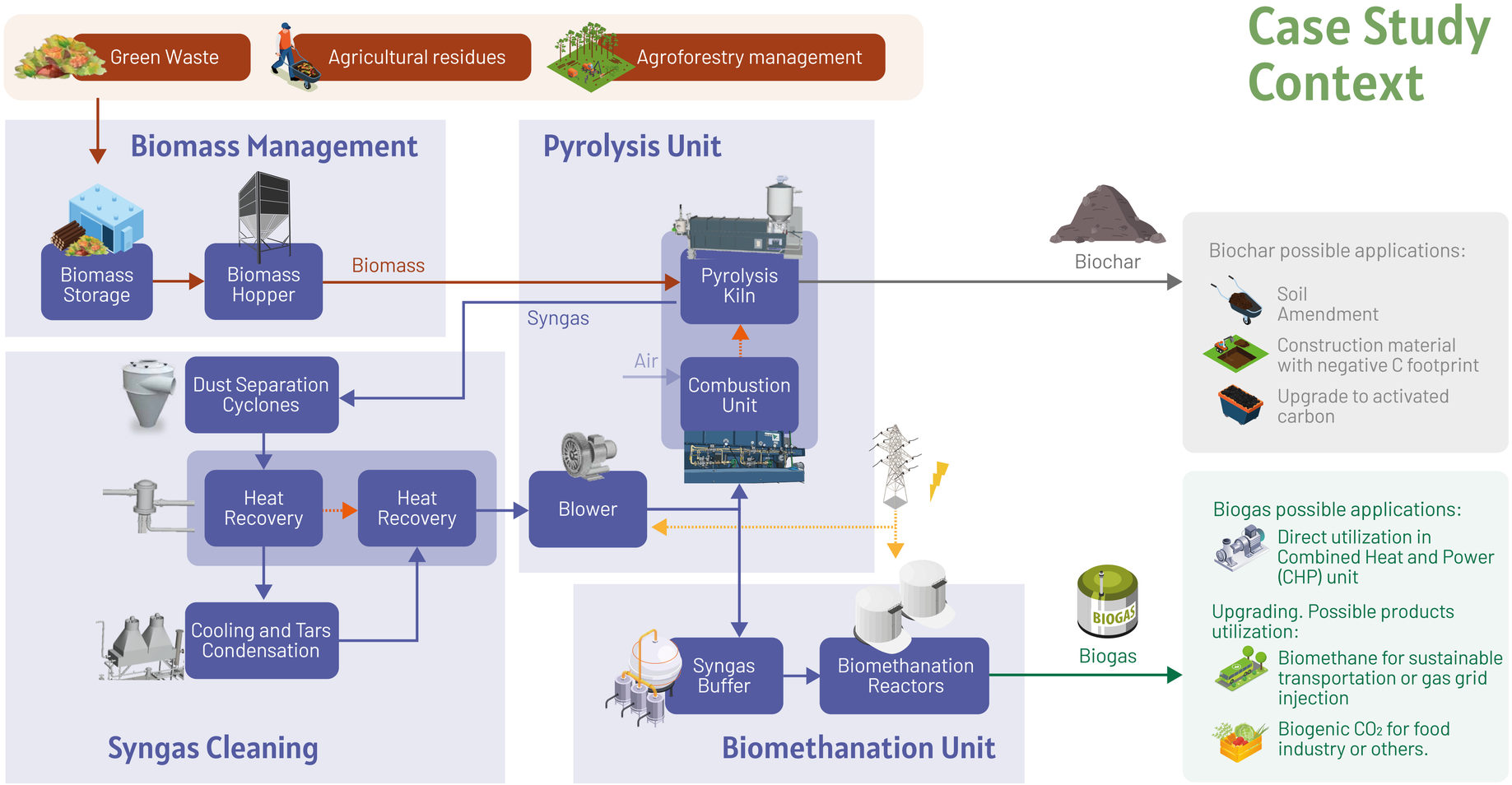
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SEMPRE-BIO partners involved in this Case Study 1

CETAQUA CENTRO TECNOLÓGICO DEL AGUA · Aigües de Barcelona · BIOTHANE · ProPuls · DTU · TMB Transports Metropolitans de Barcelona · DBFZ · SINTEF · Naturgy · inveniam

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Case Study 2: Green Waste to Grid Gas



Case Study Context

Green waste that cannot be treated by conventional anaerobic digestion is the starting point of this European Biomethane Innovation Ecosystem within SEMPRE-BIO. Located at the Marmagne ecopole near Bourges, France, and led by TerraWatt in collaboration with DTU, it turns this woody biomass into renewable gas through a patented two-step process.

Biochar possible applications:

- Soil Amendment
- Construction material with negative C footprint
- Upgrade to activated carbon

Biogas possible applications:

- Direct utilization in Combined Heat and Power (CHP) unit

Upgrading. Possible products utilization:

- Biomethane for sustainable transportation or gas grid injection
- Biogenic CO_2 for food industry or others.

How does this pilot plant work?

The process combines two technologies: pyrolysis and bio-methanation. First, the green waste is shredded and fed into a pyrolysis unit, where high temperatures break it down into a pyrolysis gas, together with bio-oil and biochar as co-products. This gas is cleaned of tars and oils to obtain a syngas, made up of hydrogen, carbon monoxide and carbon dioxide. The syngas is then fed into a bio-methanation reactor, where a consortium of microorganisms converts it into biogas. Finally, this biogas is combined with that of the site's existing anaerobic digestion plant, upgraded into biomethane, and injected into the gas grid.

Learn more at sempre-bio.com

Results

RES3-Pyrolysis of green waste (woody biomass) and gas cleaning to produce clean syngas.

RES4-Biomethanation of syngas.

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SEMPRE-BIO partners involved in this Case Study 2

terrawatt · DTU · Naturgy · DBFZ · SINTEF · inveniam

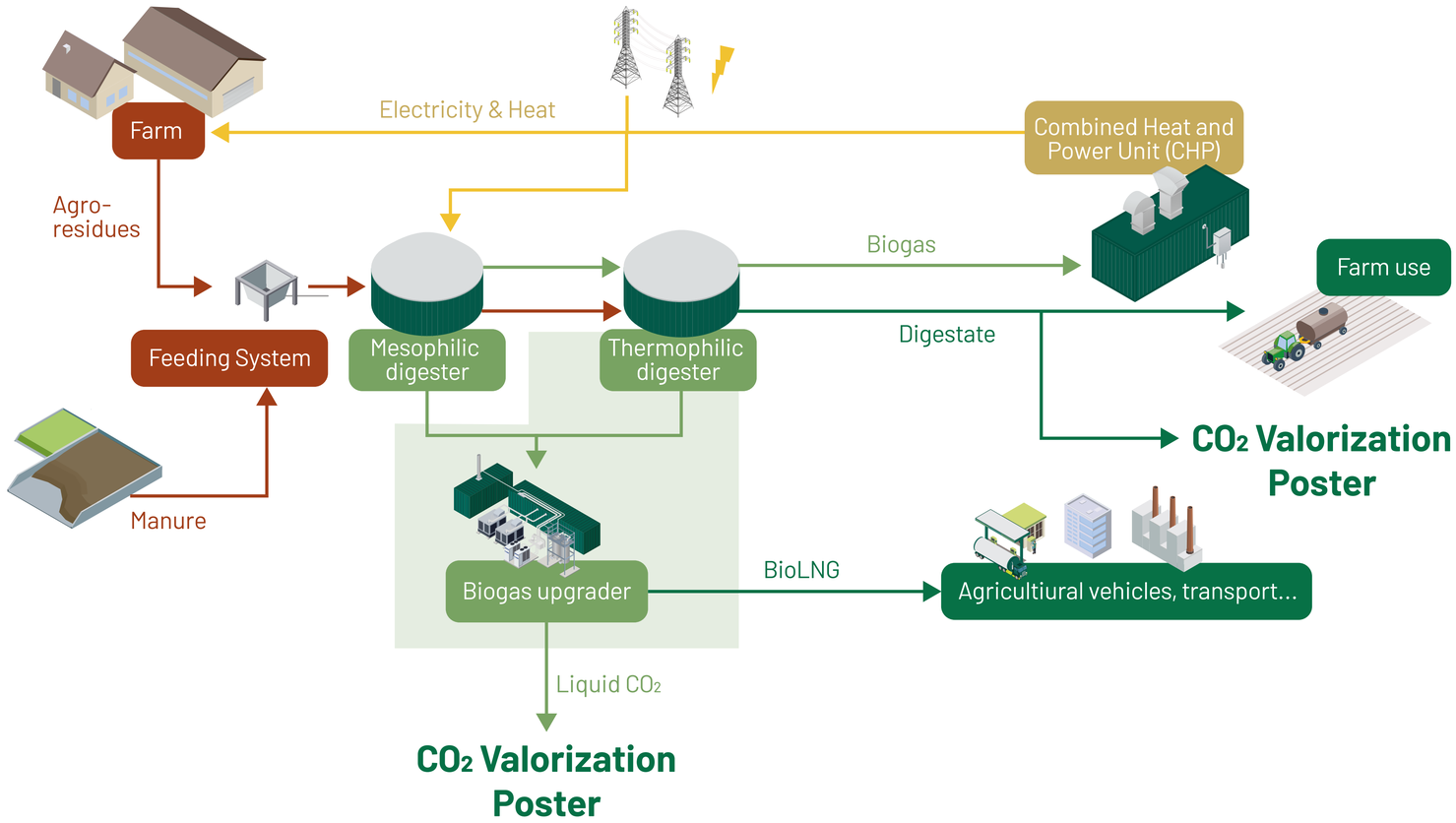
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Case Study 3:
Biogas into Bio-LNG and Liquid CO_2

Case Study Context

At a dairy farm of around 1,500 cows in West Flanders, Belgium, anaerobic digestion already converts manure and agro-residues into biogas. Within SEMPRE-BIO, Cryolnox adds a compact cryogenic unit that upgrades the biogas into two clean products: bio-LNG and food-grade liquid CO_2.

The innovation of this pilot is doing this at farm scale, giving small producers a new way to add value to their biogas. The bio-LNG can even power the farm's own vehicles, and with many producers struggling to stay viable as incentives end and costs rise, that turns a liability into a resource they can use themselves.



How does this pilot plant work?

The demo plant treats the raw biogas from the farm's digester in a single integrated cryogenic unit. Rather than converting the CO_2, it separates it. The biogas is progressively cooled until its components split apart, yielding a stream of biomethane with less than 1% CO_2, which is liquefied to produce bio-LNG, and a separate stream of pure, food-grade liquid CO_2.

Learn more at sempre-bio.com

Results

RES5-Cryogenic cleaning & separation of biogas into liquified biomethane and liquified CO_2

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SEMPRE-BIO partners involved in this Case Study 3

Naturgy · NV De Zwanebloem · Biogas-E · CRYOinox · Innolab · inveniam · DBFZ · Ghent University · SINTEF

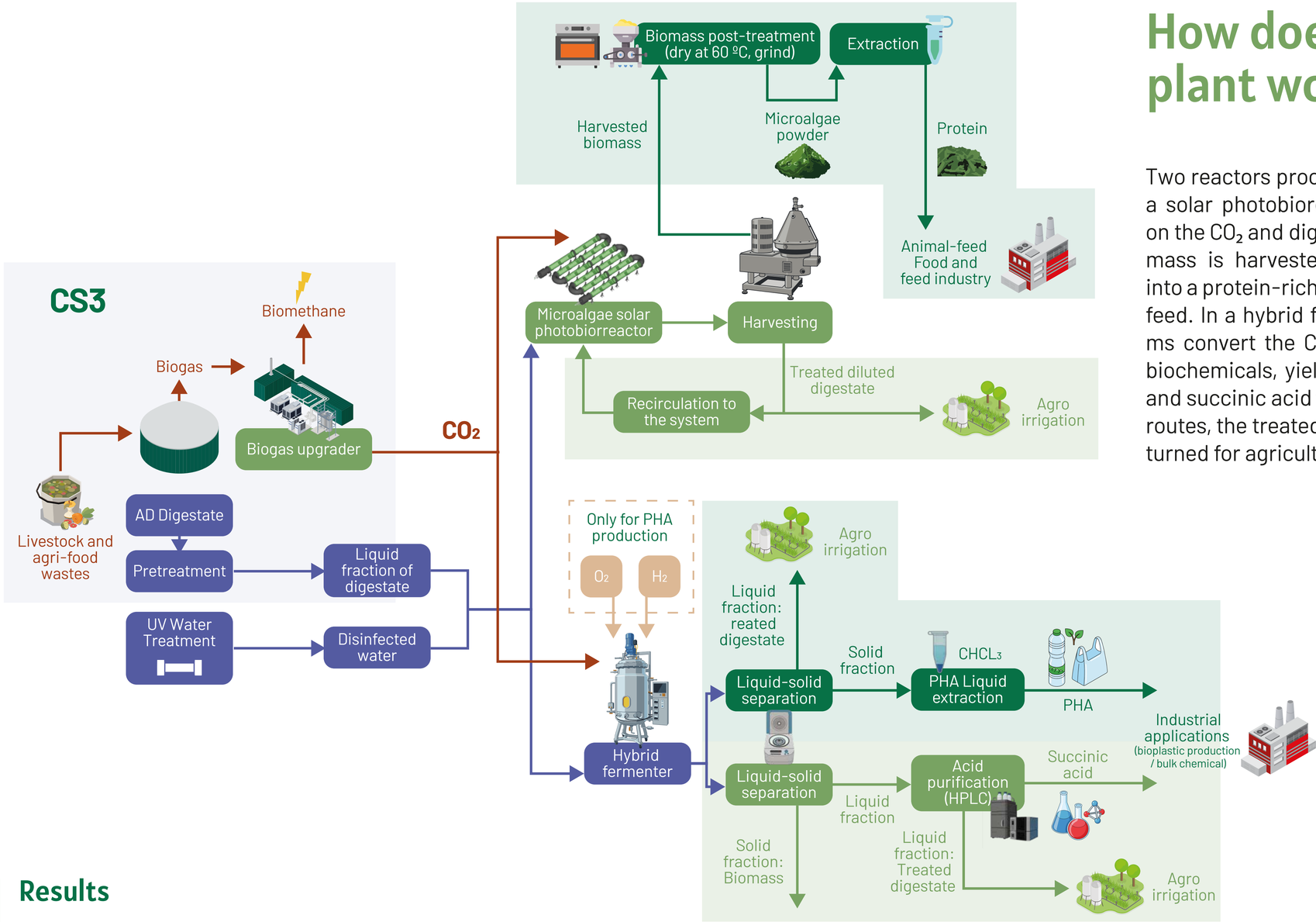
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CO_2 Valorization:
Microalgae cultivation and hybrid fermentation

Case Study Context

The upgrading process in Case Study 3 also yields a secondary stream, CO_2. This opens an opportunity: within SEMPRE-BIO, the BETA Technological Center of the UVic-UCC and UGENT are studying how to valorise that CO_2, using it to grow microalgae as an alternative protein for animal feed and a potential substitute for imported soy. The goal is to prove this biomass is safe for use, building the scientific and technical evidence needed to lift the legal barriers that currently keep by-products such as digestate out of the food chain.

In parallel, a hybrid fermenter is operated to produce biochemicals and biopolymers to valorise CO_2.



How does this pilot plant work?

Two reactors process the CO_2 in parallel. In a solar photobioreactor, microalgae grow on the CO_2 and digestate nutrients; the biomass is harvested, dried and processed into a protein-rich powder for use in animal feed. In a hybrid fermenter, microorganisms convert the CO_2 into biopolymers and biochemicals, yielding PHA for bioplastics and succinic acid for industrial use. In both routes, the treated digestate left over is returned for agricultural irrigation.

Learn more at sempre-bio.com

Results

RES6-Cost-efficient conversion of CO_2 valueadded products

Funded by the European Union

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SEMPRE-BIO partners involved in CO_2 Valorization

Beta UVIC VERSITAT DE VIC VERSITAT CENTRAL DE CATALUNYA · Innolab · Naturgy · GHENT UNIVERSITY · inveniam · DBFZ