Speaker
Andres SALDIVIA - HYSYTECH

INNOVATIONS FOR DECARBONIZATION AND SUSTAINABILITY OF THE INDUSTRIAL SECTOR

HYSYTECH | NIPPON GASES

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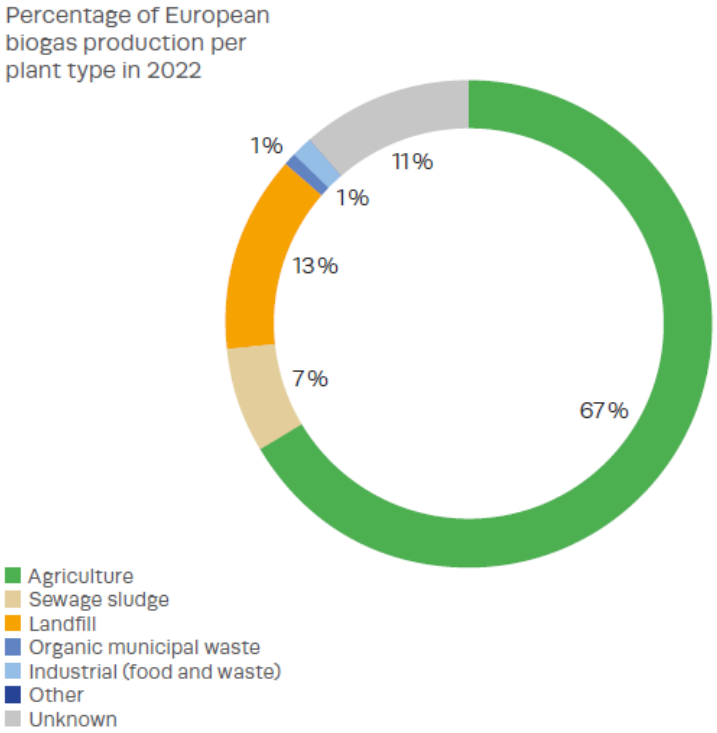
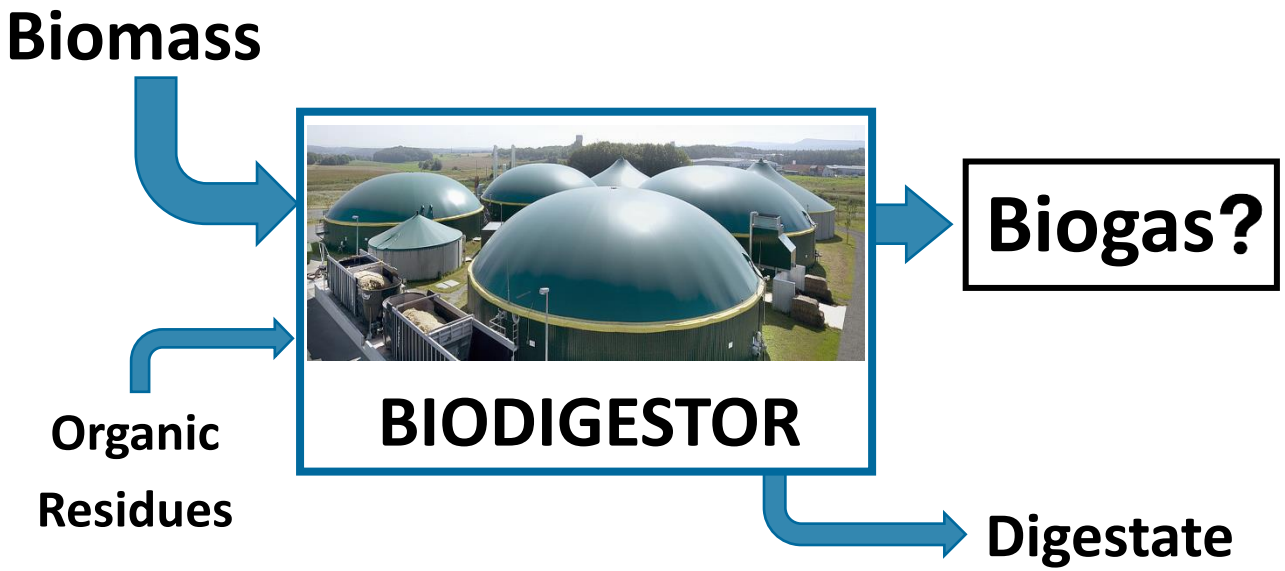
Biogas: Anaerobic Digestion of Biomass





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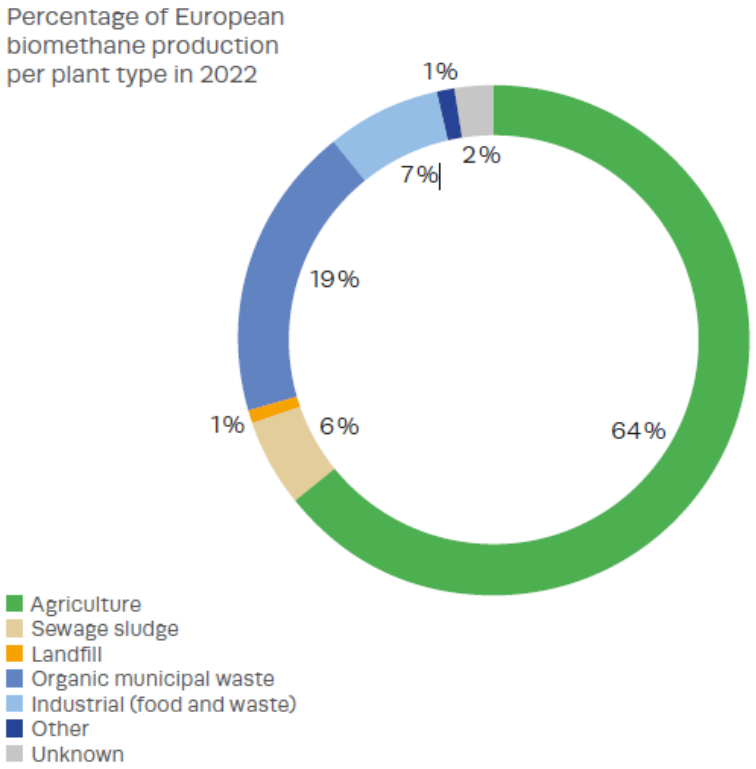
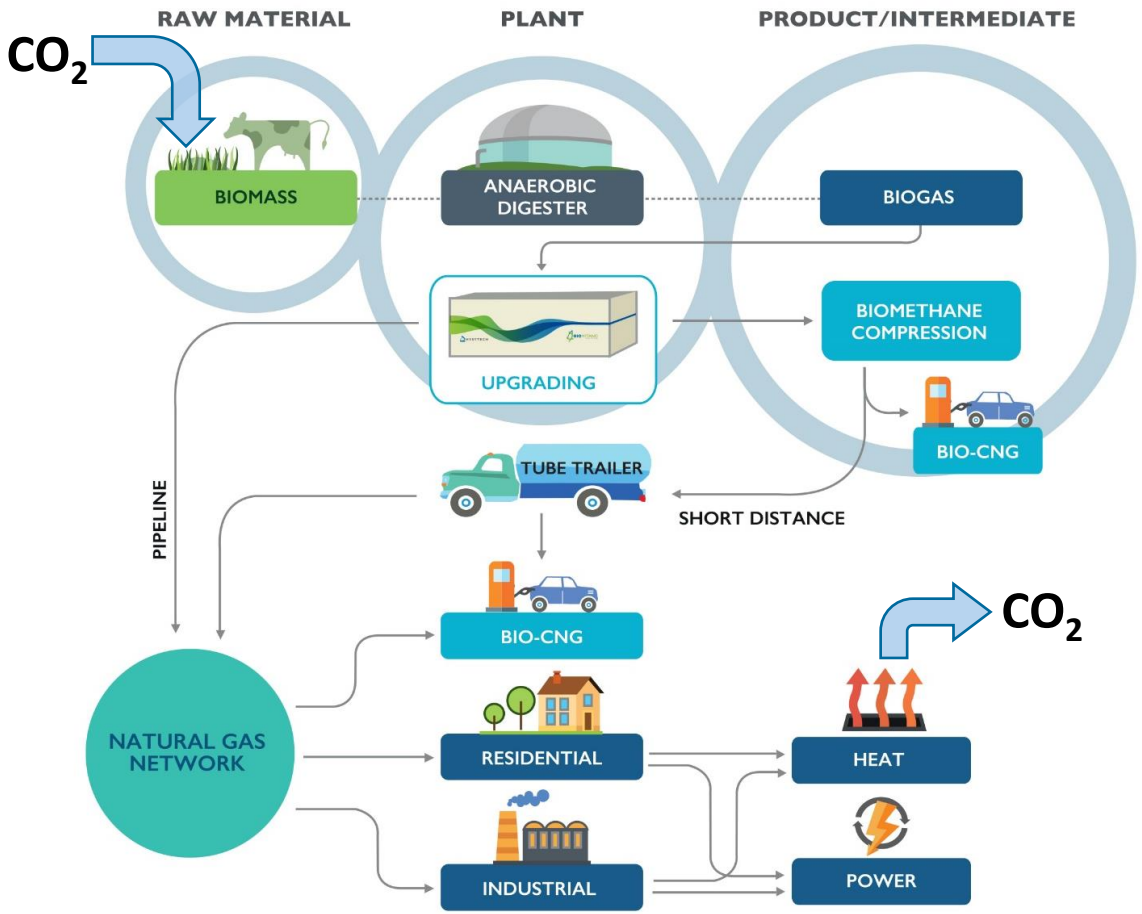
Biomethane Value Chain





Biomethane: Renewable Fuel Compliance

- **Standardized Fuel:** meets specifications set by industry standards or regulatory bodies to ensure:
  - **Consistent Quality**: such as energy content, purity, density and emissions output.
  - **Interchangeability:** can be used across different equipment without compatibility issues (suitable for widespread commercial and industrial use).
  - **Application:** enables use in transportation (gasoline, diesel), aviation (jet fuel), shipping (marine fuels), and other sectors where consistent performance and safety are critical.
  - **Regulatory Compliance:** emissions control, safety and environmental impact. This ensures compliance with environmental laws, health standards and **sustainability**. (92% GHG compared to traditional fuels, even negative)

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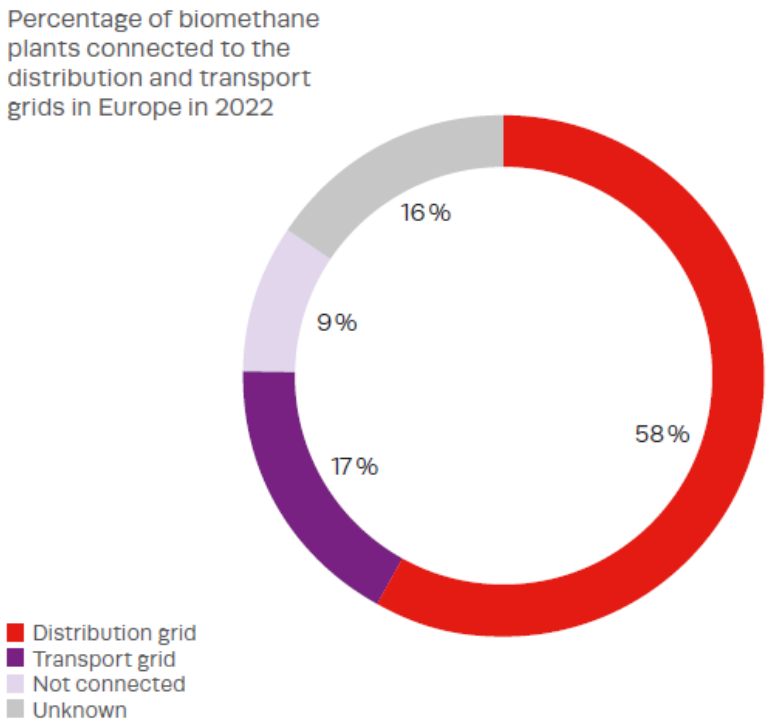
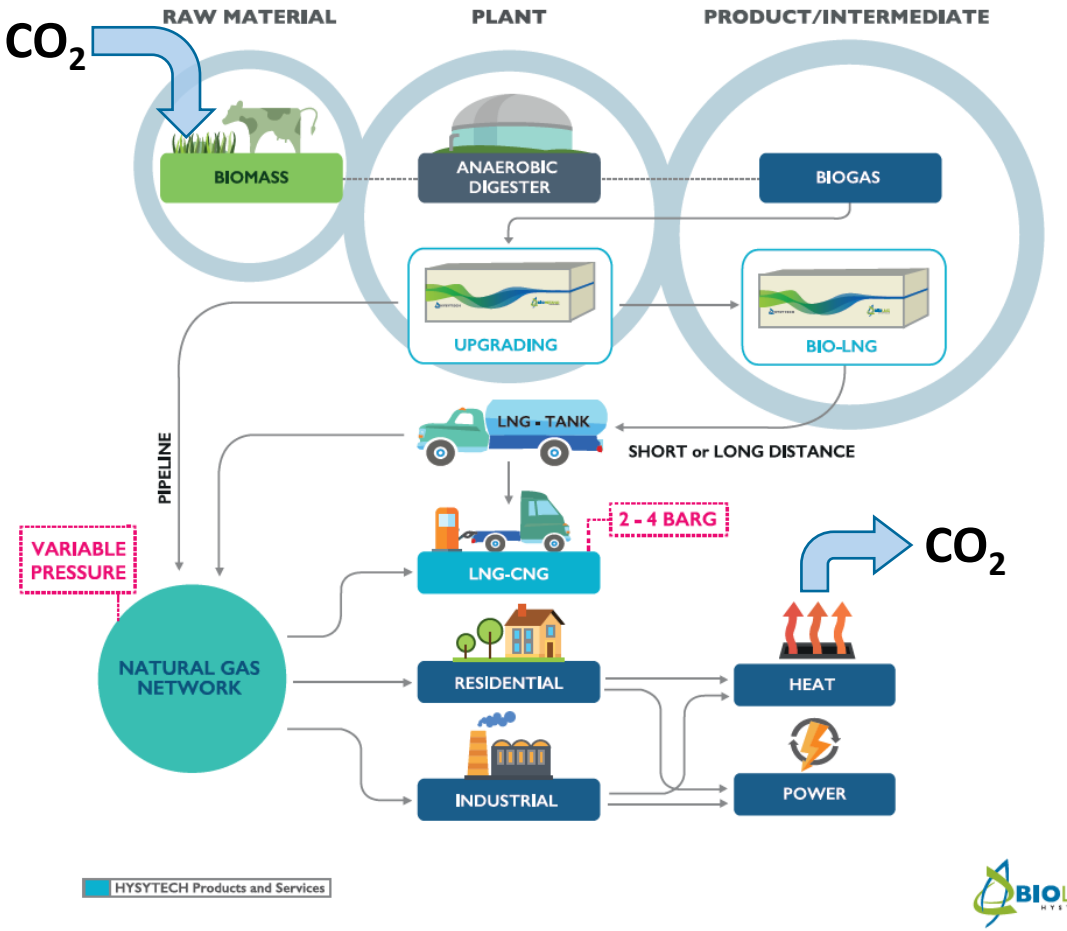
BioLNG Value Chain





Biomethane vs Bio-LNG

Biomethane:

- Uses:
  - complete overlap with Natural Gas,
  - requires grid availability,
  - very limited or unapplicable in Heavy Transportation

- Value (Base+Emissions+Incentives):
  - Base:
    - Today: competes to displace Natural Gas, it is traded based on the same market price
    - Tomorrow: no change
  - Emissions: GoO fully enforceable within ETS
  - Incentives: Depending on single State legislation

Bio-LNG:

- Uses:
  - complete overlap with Natural Gas,
  - Does NOT required grid availability,
  - Tremendous potential in Heavy Transportation (Trucking and Maritime)

- Value (Base+Emissions+Incentives):
  - Base:
    - Today: overlapping with Fossil LNG drives prices to compete with Natural Gas
    - Tomorrow: displace Diesel and Maritime Fuel Oil Higher prices (energy-equivalent basis).
  - Emissions: GoO fully enforceable within ETS
  - Incentives: Depending on single State legislation

References & Sizes

Capacity	Type of plant	Scope	Place	Date of commissioning
660 Nm3/h	Biogas Upgrading	Upgrading, Liquefaction, CO2	Norway	October 2026
4000 Nm3/h	Biogas Upgrading	Upgrading and CO2	Netherlands	October 2025
1200 Nm3/h	Biogas Upgrading	Upgrading	Italy	October 2025
750 Nm3/h	Biogas Upgrading	Upgrading and Liquefaction	Sweden	June 2025
550 Nm3/h	Biogas Upgrading	Upgrading, Liquefaction, CO2	Germany	December 2024
550 Nm3/h	Biogas Upgrading	Upgrading and Liquefaction	Sweden	December 2024
1500 Nm3/h	Biogas Upgrading	Upgrading	Italy	March 2024
550 Nm3/h	Biogas Upgrading	Upgrading and Liquefaction	Italy	December 2022
550 Nm3/h	Biogas Upgrading	Upgrading and Liquefaction	Italy	December 2022
150 Nm3/h	Biogas Upgrading	Upgrading and CNG	Italy	January 2022
600 Nm3/h	Biogas Upgrading	Upgrading	Spain	September 2021
300 Nm3/h	Biogas Upgrading	Upgrading	Italy	January 2021
1500 Nm3/h	Biogas Upgrading	Upgrading	Italy	September 2020
150 Nm3/h	Biogas Upgrading	Upgrading	Italy	October 2015

References & Sizes

>20

Capacity	Type of plant	Scope	Place	Date of commissioning
7 ton/day	bioLNG production	Upgrading, purification & Liquefaction, CO2	Norway	Q4 2026
8 ton/day	bioLNG production	Upgrading, purification & Liquefaction	Sweden	Q2 2025
8 ton/day	bioLNG production	Liquefaction	Italy	Q2 2025
5 ton/day	bioLNG production	Purification & Liquefaction	Spain	Q1 2025
5 ton/day	bioLNG production	Upgrading, purification & Liquefaction, CO2	Germany	Q1 2025
5 ton/day	bioLNG production	Upgrading, purification & Liquefaction	Sweden	Q4 2024
7 ton/day	bioLNG production	Liquefaction	Italy	Q4 2024
6 ton/day	bioLNG production	UpgraPurification & Liquefaction	Germany	October 2024
11 ton/day	bioLNG production	Purification & Liquefaction	Germany	September 2024
7 ton/day	bioLNG production	Liquefaction	Italy	November 2023
7 ton/day	bioLNG production	Liquefaction	Italy	November 2023
5 ton/day	bioLNG production	Liquefaction	Germany	October 2023
8 ton/day	bioLNG production	Liquefaction	Italy	May 2023
9 ton/day	bioLNG production	Liquefaction	Italy	January 2023
6 ton/day	bioLNG production	Upgrading, purification & Liquefaction	Italy	February 2023
6 ton/day	bioLNG production	Upgrading, purification & Liquefaction	Italy	January 2023
5 ton/day	bioLNG production	Purification & Liquefaction	France	October 2022
11 ton/day	bioLNG production	Liquefaction	Italy	September 2022
11 ton/day	bioLNG production	Liquefaction	Italy	May 2022
2 ton/day	bioLNG production	Purification & Liquefaction	Sweden	May 2022
5 ton/day	bioLNG production	Purification & Liquefaction	France	September 2021
1 ton/day	bioLNG production	Purification & Liquefaction	Italy	September 2018

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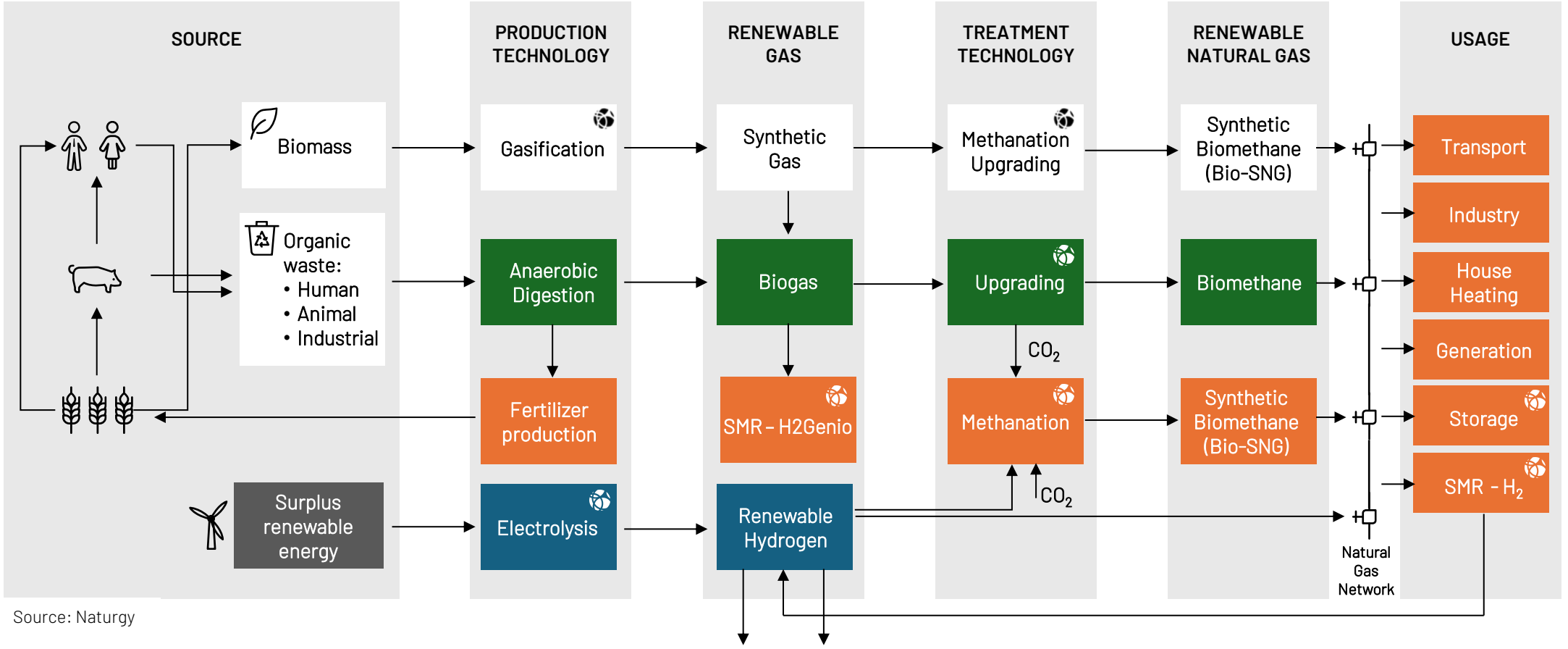
Biomethane and Bio-LNG: Key Takeaways

- **Standardized Fuel, Interchangeability, Regulatory Compliance:**
  - **Adaptation:** Widespread commercial and industrial use already today, no additional equipment or infrastructure
  - **Impact on GHG emissions:** Bio-LNG has -92% GHG compared to traditional fuels, even negative (manure).
  - **Application:** Full overlapping with Natural Gas, enables use in higher-value heavy transportation (diesel), shipping (marine fuels)

- **Sustainability**: Biomass availability, easy adoption and impact on emissions makes one of the most concrete actions towards **Carbon Neutrality**.

- **Opportunity for Industry and Agriculture sector:** Unique opportunity for a new value chain: From Biomass to Fuel

- **Our role:** offer the enabling technology to achieve these target with the highest quality standards, energy efficiency and reliability

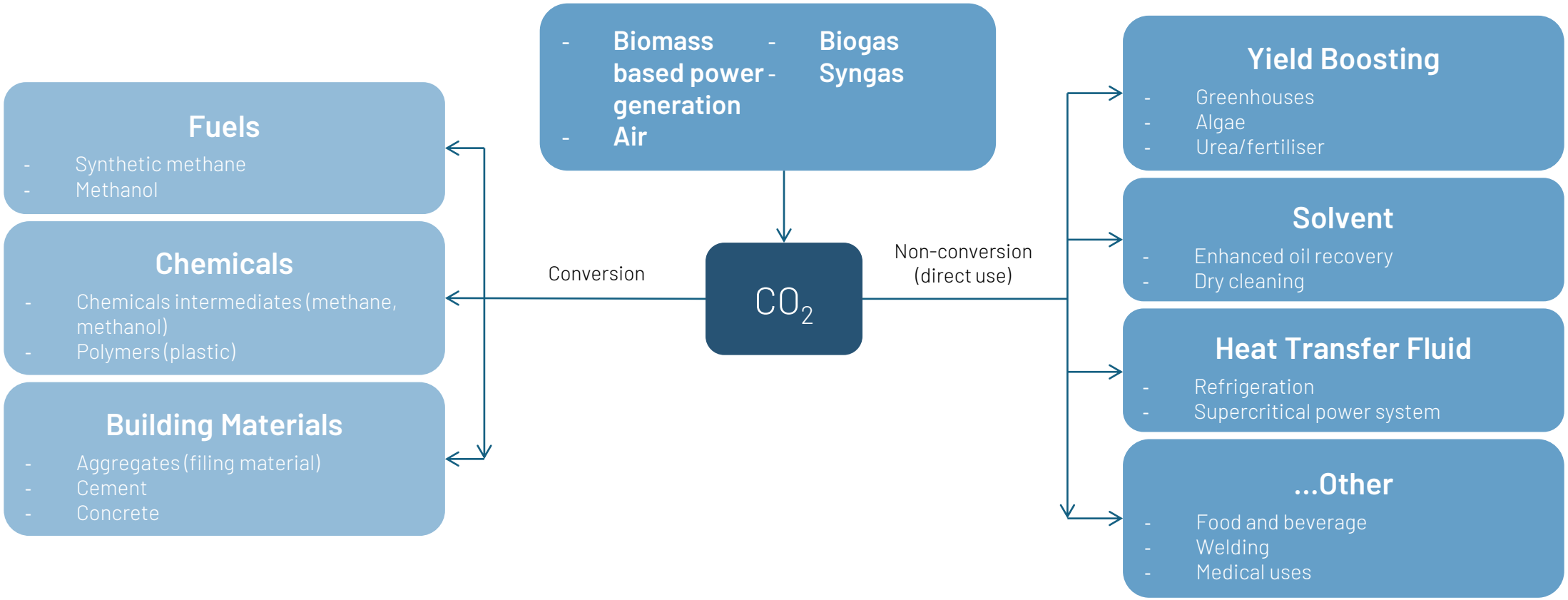


Source: Naturgy

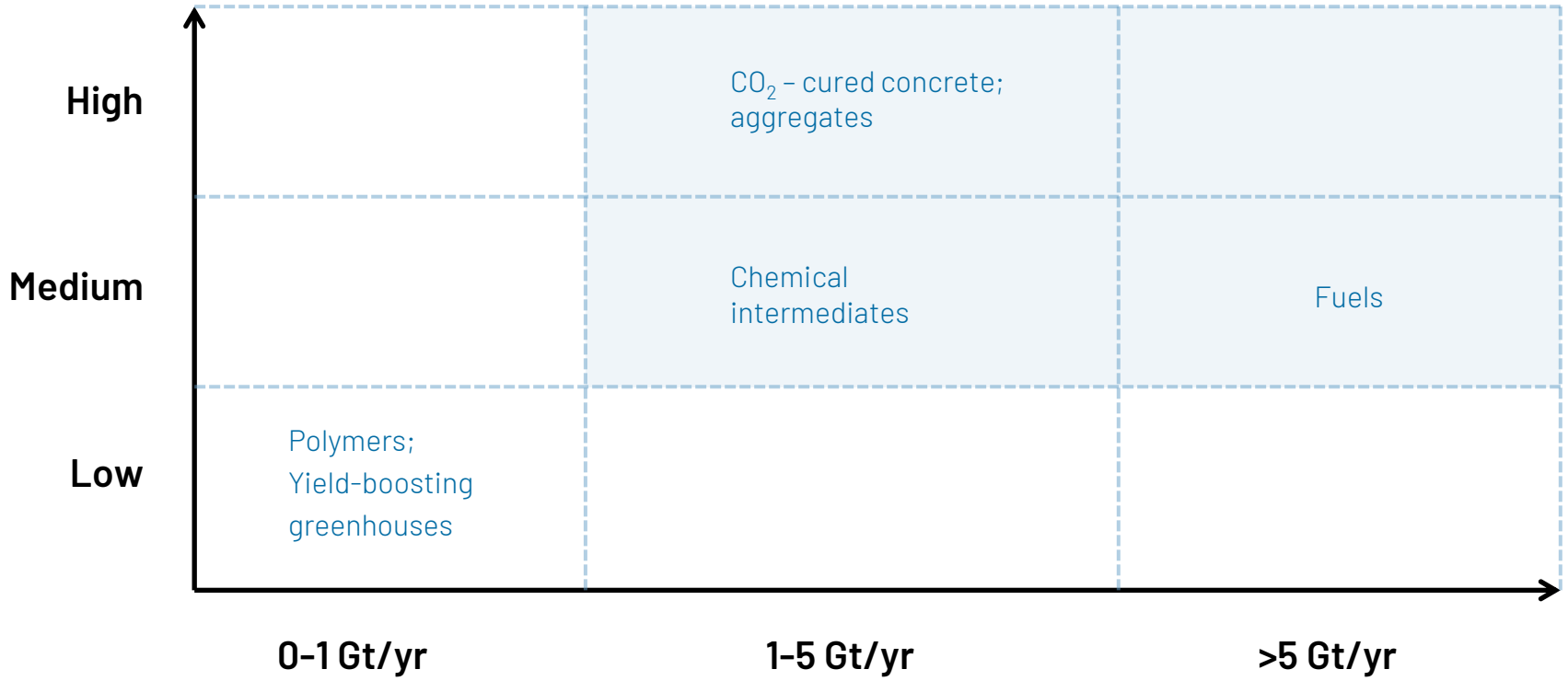
Direct use in transport

- Natural Gas Grid Injection
- Storage

CO_2 Recovery: Future Applications



CO_2 Recovery: Future Applications



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METHAREN

METHAREN 2022-2027 ★
Methanation technology integration within a Waste management plant with an Anaerobic Digestion and upgrading system to increase Methane production and CO_2 conversion

DECADE

DECADE 2020-2024
Distributed Chemicals And fuels production from CO_2 in photoelectrocatalytic Devices

CardioSol

CARDIOSOL 2013-2015
Non conventional process integration with sunlight for CO_2 and biogas valorization into syngas

RECODE

RECODE 2017-2021
Recycling carbon dioxide in the cement industry to produce added-value additives: a step towards a CO2 circular economy

FRESH

FRESH 2022-2025 ★
Formic acid production from CO_2 electroreduction for direct energy production through Direct Formate Fuel Cell

SunChem O_2

SunCoChem 2020-2024
Photoelectrocatalytic device for SUN-driven CO_2 conversion into green Chemicals

elbicon

CELBICON 2016-2019
Electrochemical and biological processes combination for CO_2 conversion into bio plastics, lactic acid and isoprene.

STORE&GO

STORE&GO 2016-2020
CO_2 conversion into Methane and its liquefaction for storage

CATCO$_2$NVERS

CATCO$_2$NVERS 2021-2025 ★
Catalytic CO_2 conversion into added-value products through different technologies (Electro, thermal and biologic CO_2 reduction)

LICROX

LICROX 2020-2023
Light assisted solar fuel production by artificial CO_2 Reduction and water Oxidation

ocean

OCEAN 2017-2021
Oxaclic acid from CO_2 using Elcetrochemistry At demonstration scale

engicoin

ENGICOIN 2018-2022
Engineered microbial factories for CO2 exploitation in an integrated waste treatment platform

CCU – STORE&GO case study – thermocatalysis

The Store&GO EU funded project aimed at demonstrating at TRL 7 the carbon dioxide conversion to methane through a process called CO_2 methanation.

The main inputs to the process are:

- Hydrogen obtained through water electrolysis
- Carbon dioxide from direct air capture/biogas plants
- DSP already present in biogas upgrade plants or Cryogenic liquefaction of methane to LNG

STORE&GO

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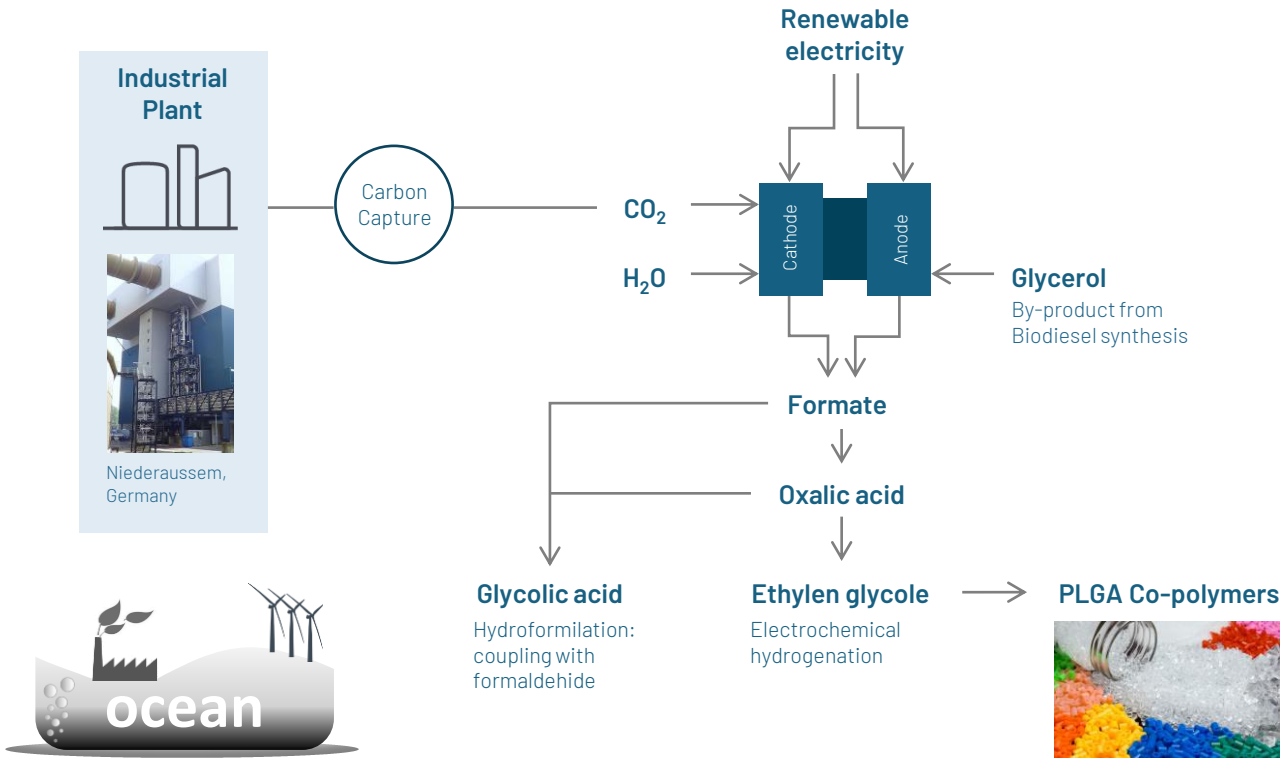
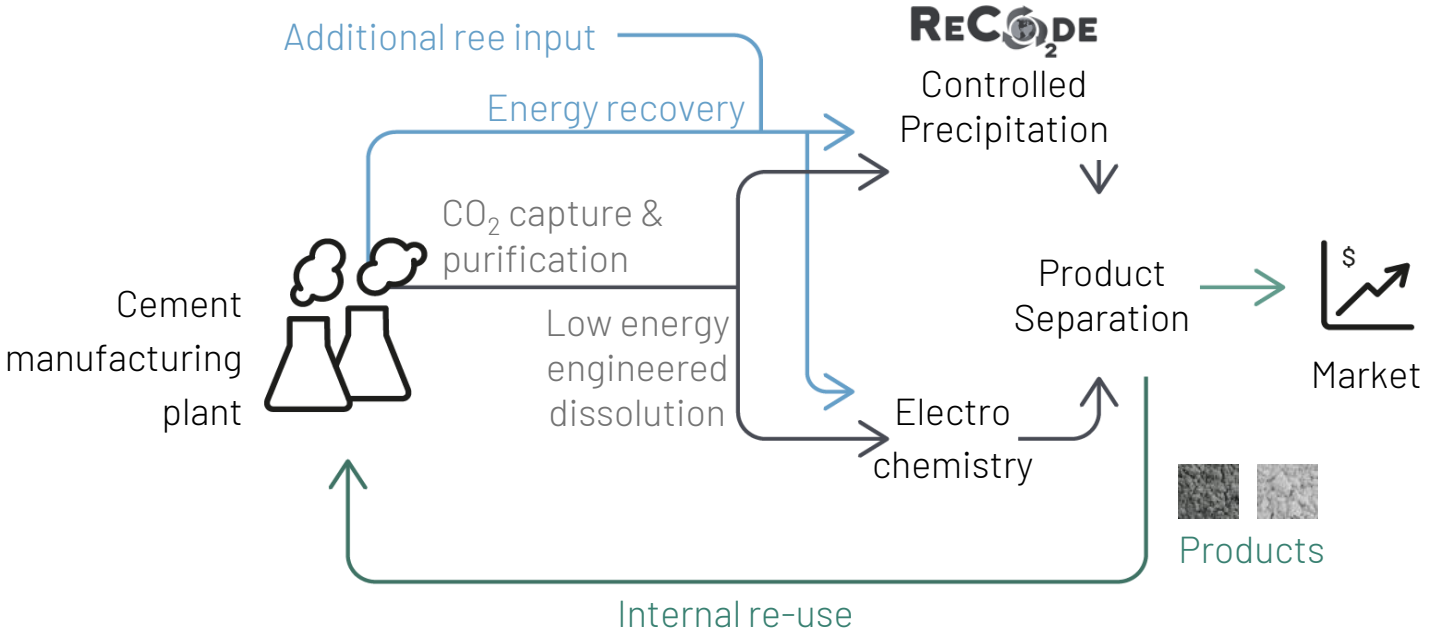
CCU – OCEAN case study – Electrochemistry



- Electrochemical synthesis technologies are promising to produce **specialty and commodity chemicals** from renewable electricity and recycled CO_2
- **Low synthesis temperatures and pressures** in comparison to conventional thermo-chemical synthesis routes
- **Coupling of oxidative and reductive electrosynthesis processes** is the key to improve efficiency while reducing costs, wastes and emissions.

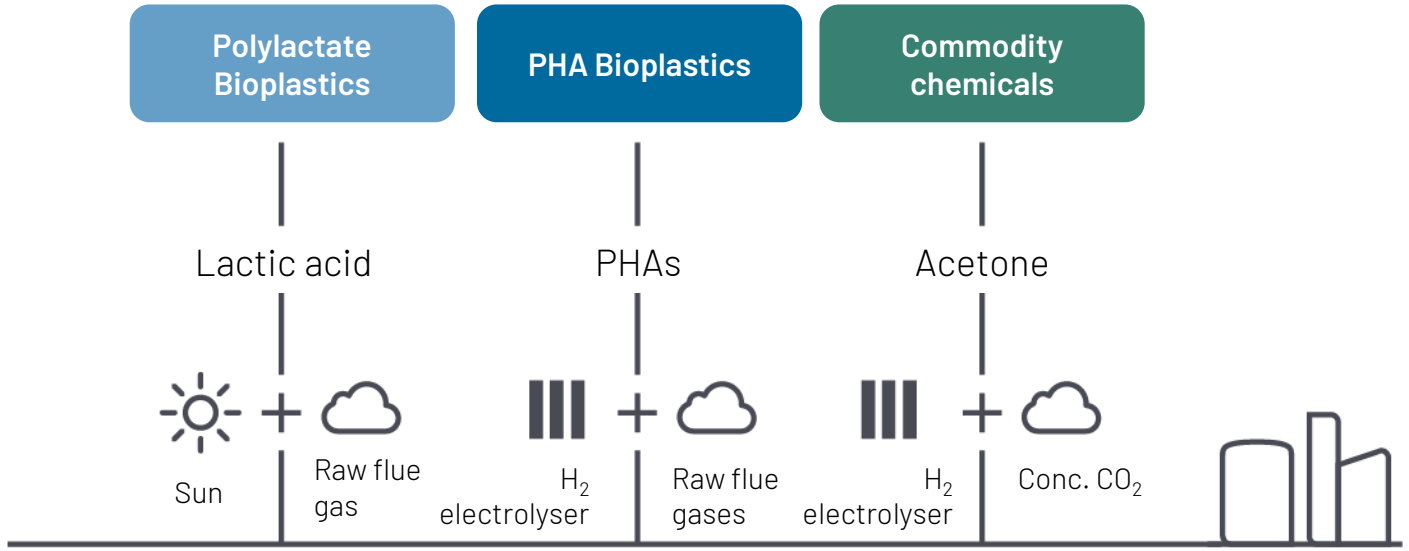
CCU – RECODE case study

Recycling carbon dioxide in the cement industry to produce added-value chemicals & materials to enhance cement quality: a step towards a CO_2 circular economy.



CCU – ENGICOIN case study – biological

The ENGICOIN EU funded project aimed at the development, from TRL3 to TRL5, of three new microbial factories (MFs), integrated in an organic waste anaerobic digestion (AD) platform, based on engineered strains exploiting CO_2 sources and renewable solar radiation or H_2 for the production of value-added chemicals



MF1
CO_2 conversion to lactic acid with Synechocystis.

MF2
Synthesis of PHA from CO_2 + H_2 with Cupriavidus necator

MF3
Synthesis of acetone from CO_2 + H_2 with Acetobacterium woodii.

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FILLING THE GAP

When you're exploring a potential new project, it's easy to underestimate the size of the gap between where you are now and where you want to be.

This feature makes HYSYTECH a flexible and all-around resource, capable to provide high quality custom services.