Beyond Biomethane

The strategic role of Biomethane in energy carrier synthesis

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NIPPON SANSO HOLDINGS

Nippon Gases is part of **Nippon Sanso Holdings Corporation** -the parent company to the **Taiyo Nippon Sanso** industrial gas business in Japan, the US **Matheson Tri-Gas Group**, the European **Nippon Gases**, the Asia/Oceania Regional Group and **Thermos Business Group.** Our group has over 100 years of experience and boasts a major presence in Japan, Southeast Asia, Australia, the United States, Canada and in Europe.

Established 30th Oct **1910**

Head office In Tokyo **Japan**

With more than **19K** employees

Operations in more than **30** countries

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Our presence in Europe positions us as a leading company:

Over **3.5K** employees in Europe | **29.7%** of them are women | **14** European countries today

Belgium, Denmark, France, Germany, Luxembourg, Ireland, Italy, The Netherlands, Norway, Poland, Portugal, Spain, Sweden and the United Kingdom.

serving more than **150K** customers **390K** patients

achieving revenues above **2B€** in FYE2025

Nippon Gases, the European company of **Nippon Sanso Holdings**

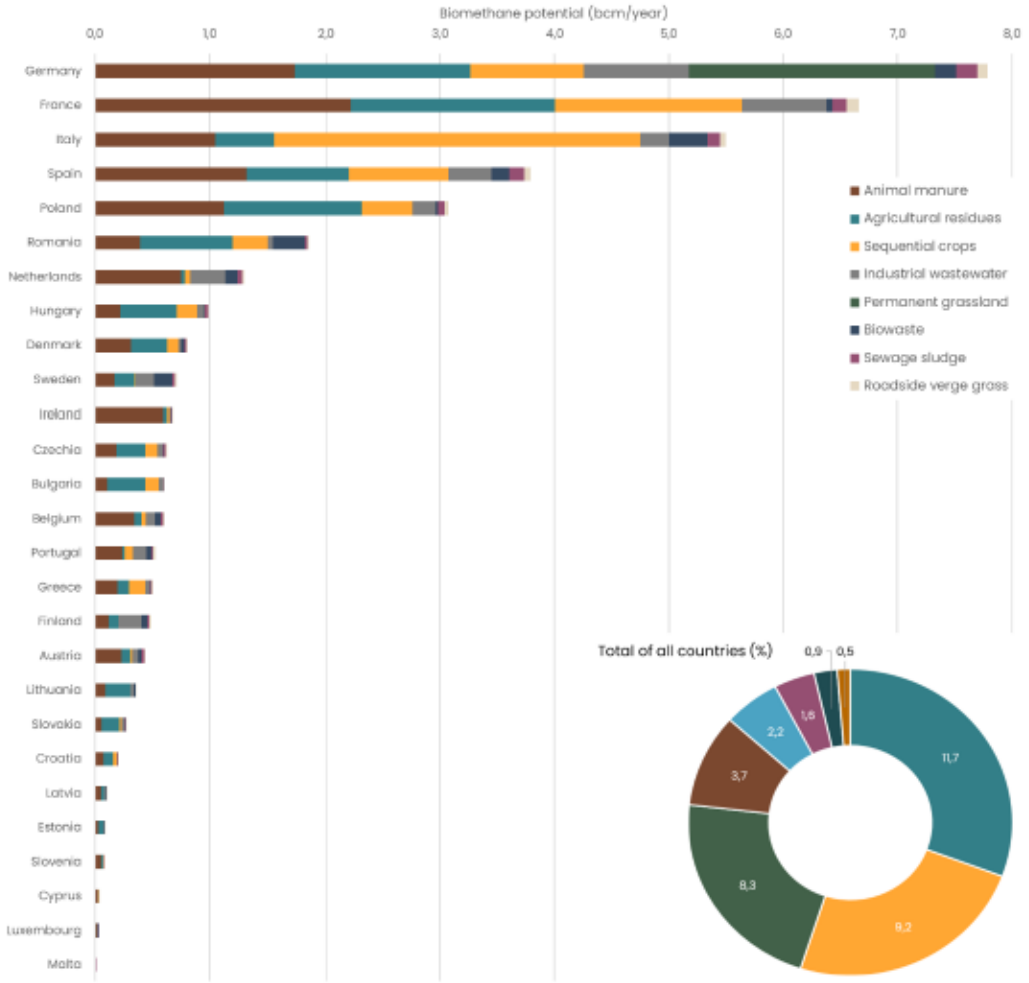
Hysytech

HYSYTECH is an engineering company founded in 2003, specialized in the design, development and industrial implementation of **new turn-key process technologies and equipment.**

Our skills start from the know-how in chemical and process engineering, up to commissioning, monitoring and maintenance.

We operate mainly in the field of **generation, treatment and recovery of industrial gases, organic liquids and energy**, according to the best engineering practices, also through the implementation of our technologies.

$BioCH_4$ pillars



Security of supply

UE 2030 Target: 35 bcm biomethane potentials (20% of imported Russian gas). Domestic and stable supply.

Cost-Competitive

Most affordable and rapidly scalable renewable gas currently available. Large-scale production is already competitive with fossil natural gas.

Rapid climate action

High GHG savings, especially for hard-to-abate energy demand sectors. Supporting a low-emission, cost-efficient energy system (electricity, industrial and building heat, fuel for transport).

Sustainable agricolture

Improve local employment, circular agriculture and soil health with digestate.

Technology and infrastructure ready

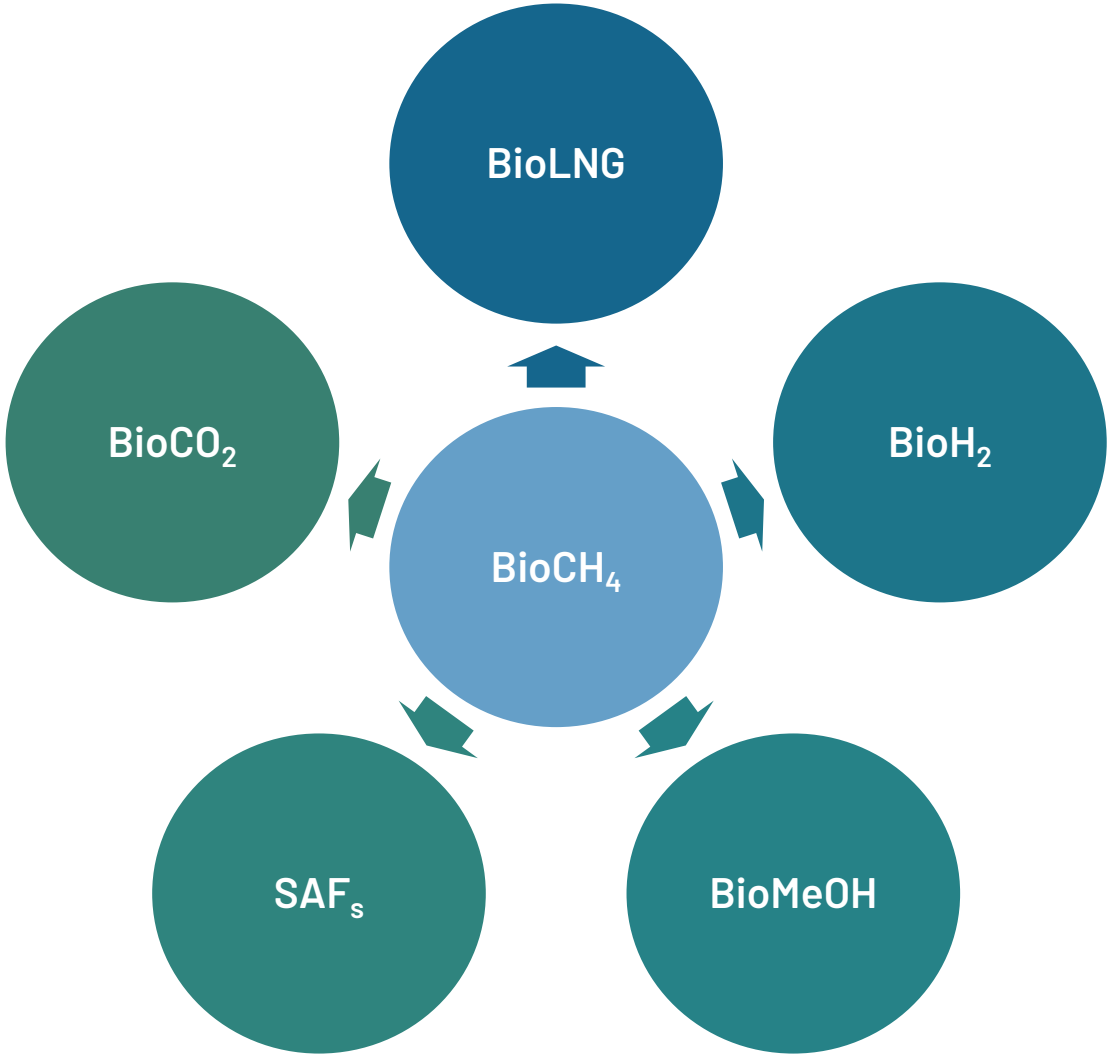
Consolidated technologies for $BioCH_4$ production. It can also be transported, stored and distributed through existing gas grids.

Opportunities

$BioCH_4$ could be consider as raw material for other renewable energy vector. Use captured CO_2 for renewable energy generation or sequestration (negative emissions).

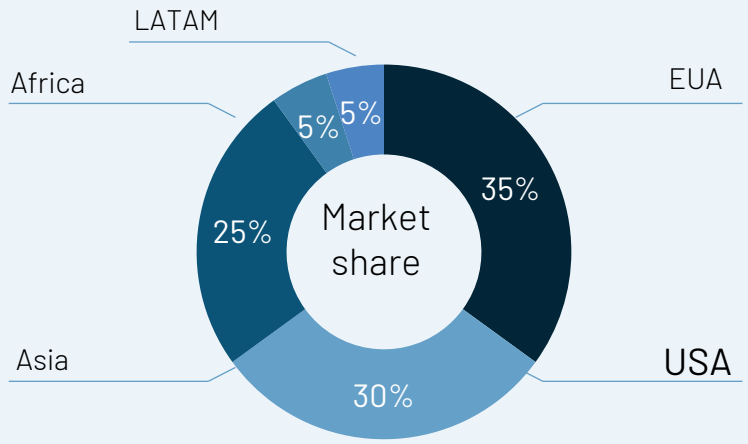
Breakdown of biomethane potentials based on available sustainable biomass feedstock for anaerobic digestion based production installations.
Source: Gas for Climate 2022

Opportunities



BioLNG

Global Market Share Scenario 2023÷2050



Sweden: +400 BioLNG Fuel Station

Global market value:

In 2024	Within 2033	Within 2050
12÷15B USD	20÷25B USD	35÷40B USD

CAGR ≤ 5%

European goals:

REPowerEU targets the production of 35 bcm of Biomethane by 2030 and achieving carbon neutrality by 2050

Transport: 25% of CO_2 emission in UE

Today:
46,7 gCO_2/tons_km

2050
<5 gCO_2/tons_km

Est.ed 2030÷2050
Transport (Road)
40÷45%

Est.ed 2030÷2050
Transport:Maritime
30÷35%

Est.ed 2030÷2050
Industry
20÷25%

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SOURCES:
- *EBA Statistical Report 2023*
- *BP Energy Outlook 2025*
- *IEA Global Energy Review 2025*

Ostersund plant

Upgrading and liquefaction plant in Ostersund, Sweden for production of 8 TPD.

The BioLNG will be produced from OFMSW collected in the city of Ostersund and seven other municipalities in the Swedish country of Jamtland (population 130,000).

BioH_2 Market

Market Size	USD **53÷81M (2024)** → **95÷146M (2030–2034)**, **CAGR 6÷7.4%**.
Growth Drivers	Technological innovation (fermentation, gasification, photolysis), renewable feedstocks (biomass, waste, algae), and strong EU policy support.
Market	Mainly EU. Leaders: Germany, Netherlands, Denmark. Italy shows high potential but remains in early development.
Key Customers	Heavy transport and shipping companies, energy producers, chemical and refining industries, and utilities seeking green gas integration.
Challenges	High production costs, limited scalability, and need for clearer regulation.
Outlook	Strong potential for decarbonization and circular bioeconomy with continued innovation and investment.

SOURCES:

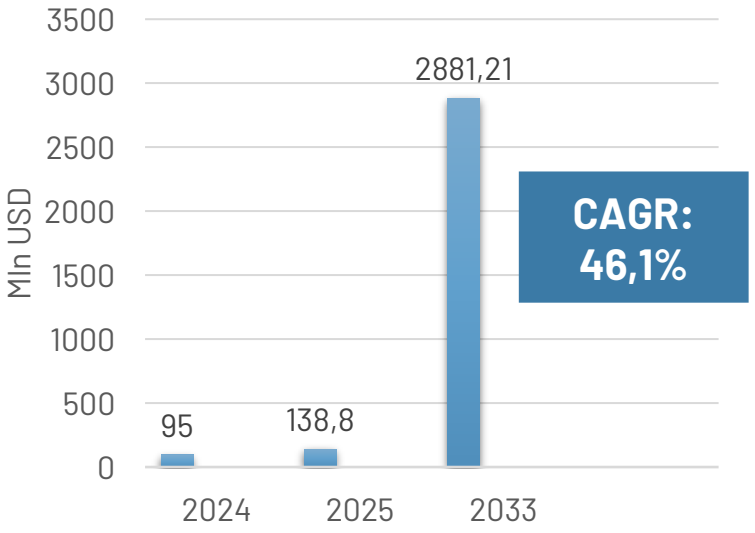
- *Infobuildenergia – Il potenziale del bioidrogeno prodotto da biomassa o biogas*
- *USDA Analytics – Biohydrogen Market Size, Share, Trends, Growth Outlook*
- *Coherent Market Insights – Bio Hydrogen Market Size, Share and Analysis, 2025-2032*
- *Research and Markets – Biohydrogen Market Size, Competitors & Forecast to 2030*
- *Credence Research – Bio Hydrogen Market Size, Share and Growth Report 2032*
- *Cervicorn Consulting – Biohydrogen Market Size to Hit USD 135.05 Million by 2034*
- *Transparency Market Research – Biohydrogen Market Size, Share, Growth Report 2034*

BioMeOH: Trends, sources and market

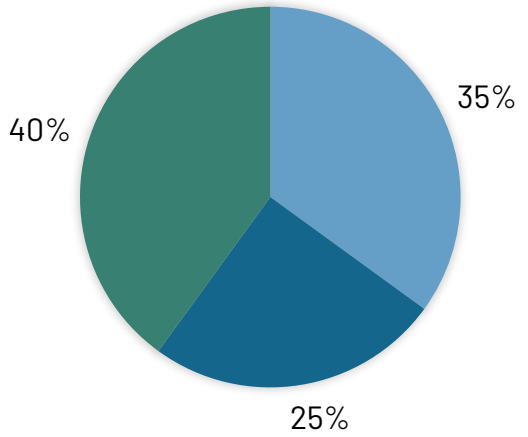
BioMeOH can contribute to a 45% reduction emission compared to fossil-based methanol.

The shift to BioMeOH can cut **carbon intensity by over 65%**, with increasing use in **maritime transport**.

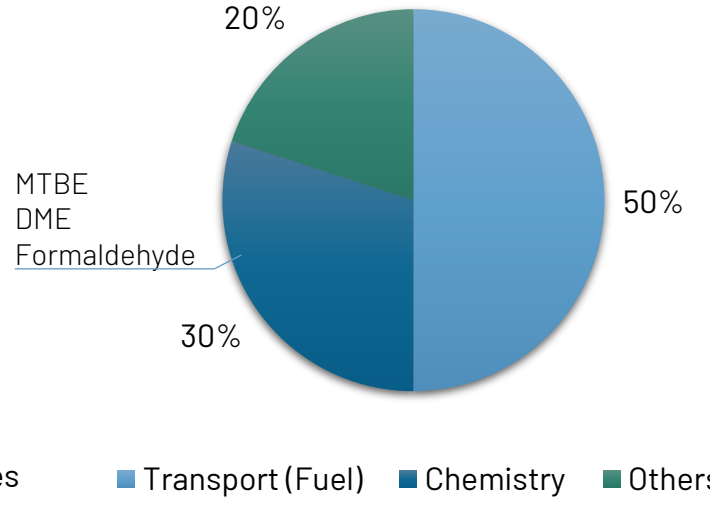
Market size



Type of sources



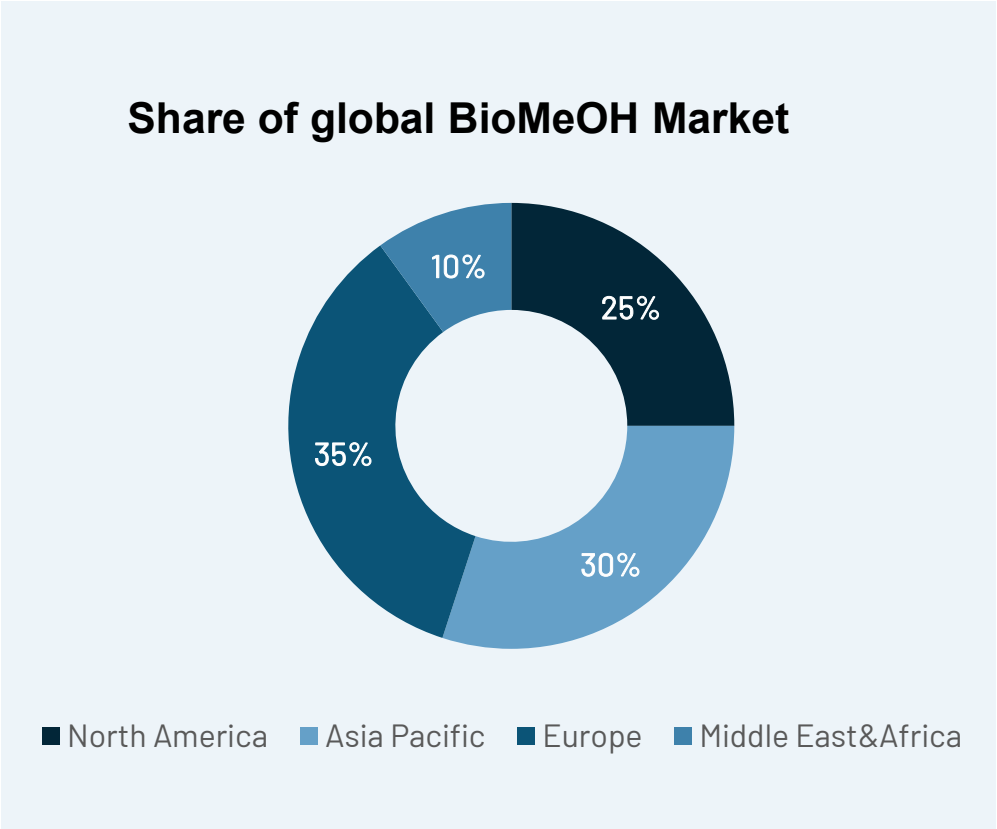
Application



SOURCES:

- Bio Methanol Market Insights & Forecast to 2033
- 24ChemicalResearch, Green Bio-Methanol Market: Trends, Growth, and Forecast (2025-2032)
- Methanol Institute Global Project Pipeline
- IRENA Innovation Outlook,
- IEA Bioenergy Task 36

BioMeOH Global Market



EUROPE

More than 50% of demand comes from bio-based sources (mainly in the Netherlands, Sweden, and Germany). Around 60% of maritime shipping is shifting to methanol fuels, while EU biofuel mandates drive over 45% of production capacity investments.

ASIA

Around 50% of China's DME comes from bio methanol, while Japan's biofuel blending policies boosted imports by 20%. Over 35% of planned expansions focus on converting municipal and agricultural waste into methanol.

AFRICA

GCC governments include bio methanol in over 30% of energy transition plans, while South Africa contributes nearly 5%, using forestry and agricultural biomass. Bio methanol-based MTBE blends adoption in the region rose 25% last year.

AMERICA

Over 40% of U.S. producers use landfill and industrial waste, while Canada (≈8% of the regional share) relies more on forestry by-products. Waste-to-energy initiatives are supporting the growth of decentralized bio methanol plants.

SAF$_s$

In Italy, ENAC created the National SAF Observatory to coordinate ministries, airlines, airports, and industry. With support from the Politecnico di Torino, a national roadmap was developed, assessing policy options through stakeholder consultation.

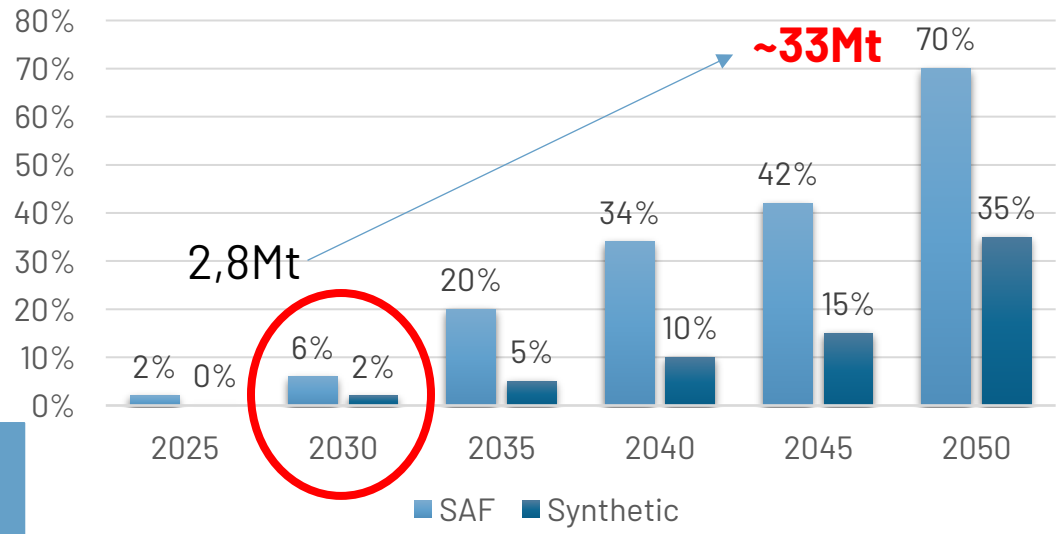
In Europe, aviation emissions making up about 13% of transport-related emissions.

Article 3(7) of ReFuelEU Aviation Regulation (EU 2023/2405) and Renewable Energy Directive (RED) define SAF as:

- Synthetic aviation fuels from renewable hydrogen and captured carbon → RFNBOs
- Advanced biofuels from waste and residues
- Biofuels produced from oils and fats
- Recycled carbon aviation fuels

ReFuelEU mandate at 2030:
- Fuel required: 46 Mt → SAF: 2,8 Mt (6%)
  - Synthetic: 0,8 Mt (~2%)
  - Other SAF$_s$: 2 Mt (~4%)

SAF & Synthetic Fuels Market Shares by ReFuelEU Aviation



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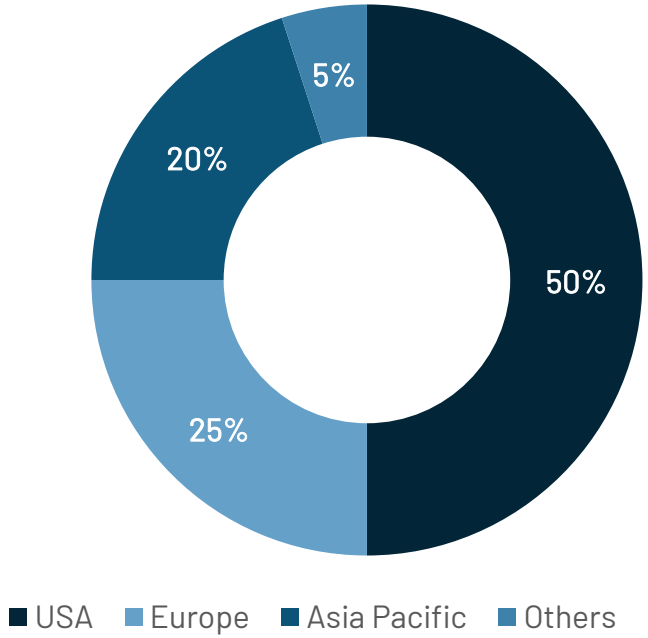
SOURCES:
- ENAC Roadmap 2023
- Decarbonising Aviation in the IEA's Net Zero Emissions by 2050 Scenario, By Praveen Bains, Hyeji Kim and Jacob Teter (International Energy Agency – IEA)
- https://www.cena-hessen.de/en
- https://www.iea.org/reports/global-hydrogen-review-2024/progress-summary-dashboard

SAF$_s$

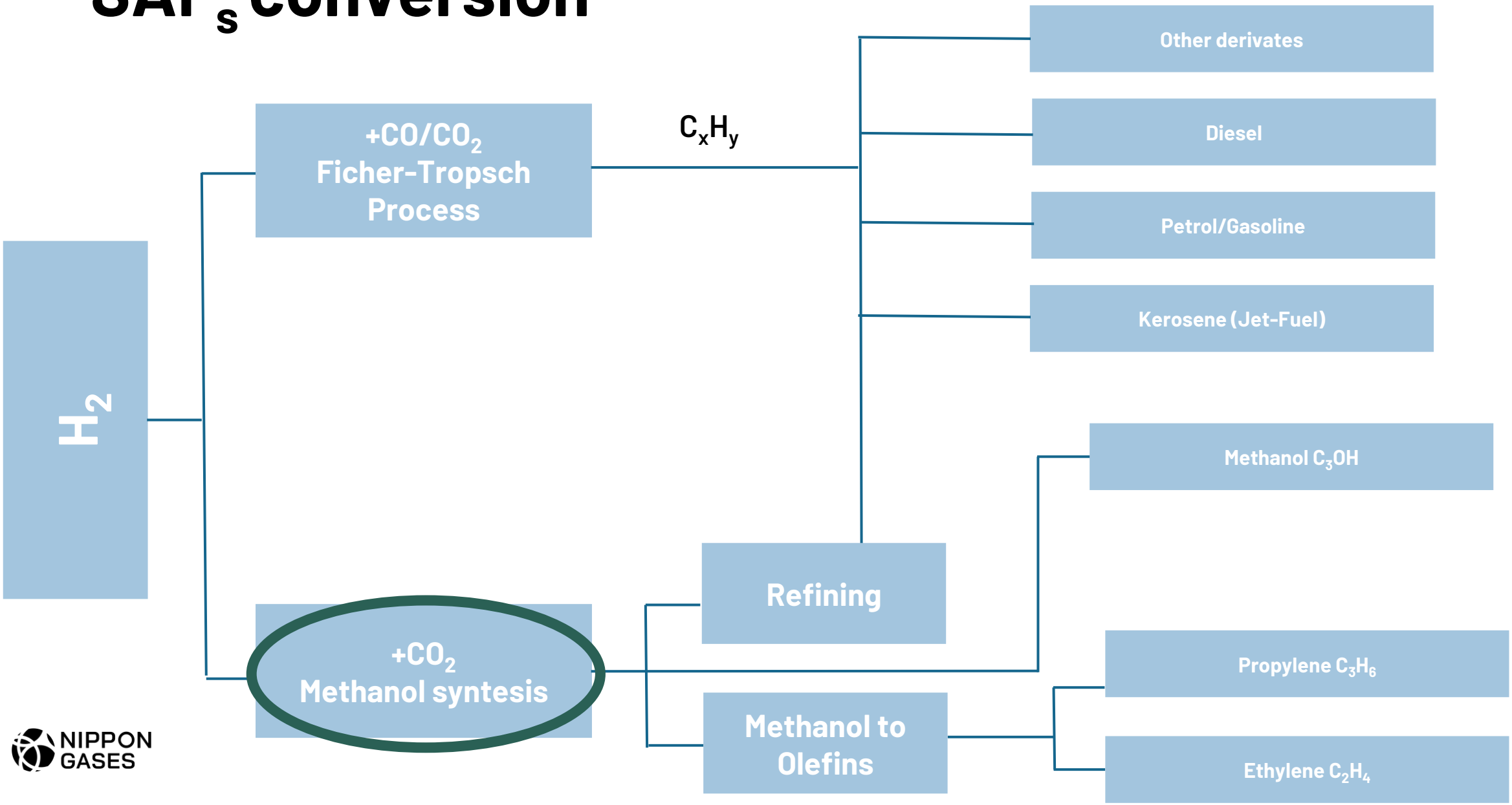
Market size

Timeframe	Mld (USD)
2025	1,4-2,3
2034-2035	60-140
2050	>250-300 (with mandatory blending + e-fuels)

Share of global SAF$_s$ Market Projection to 2030



SAF_s conversion



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$BioCO_2$

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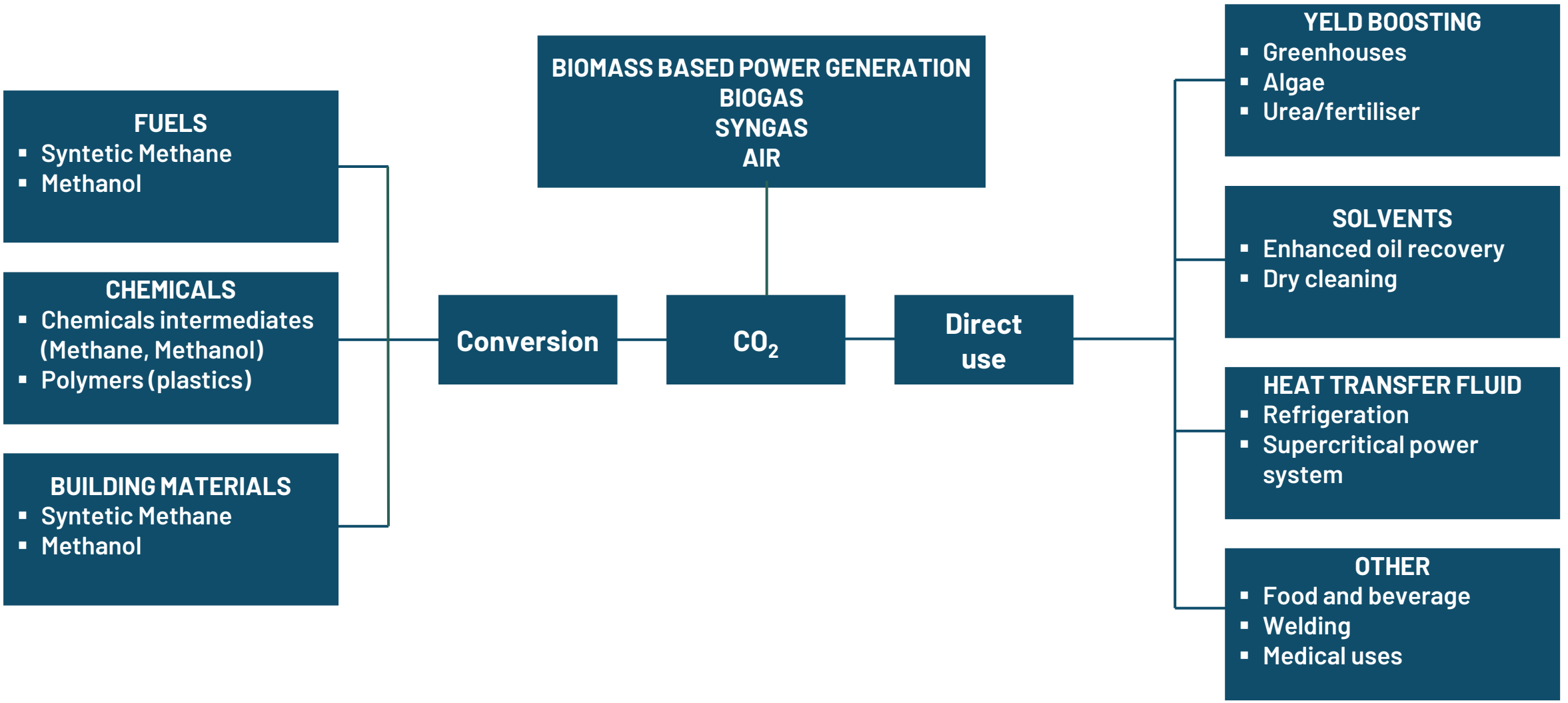

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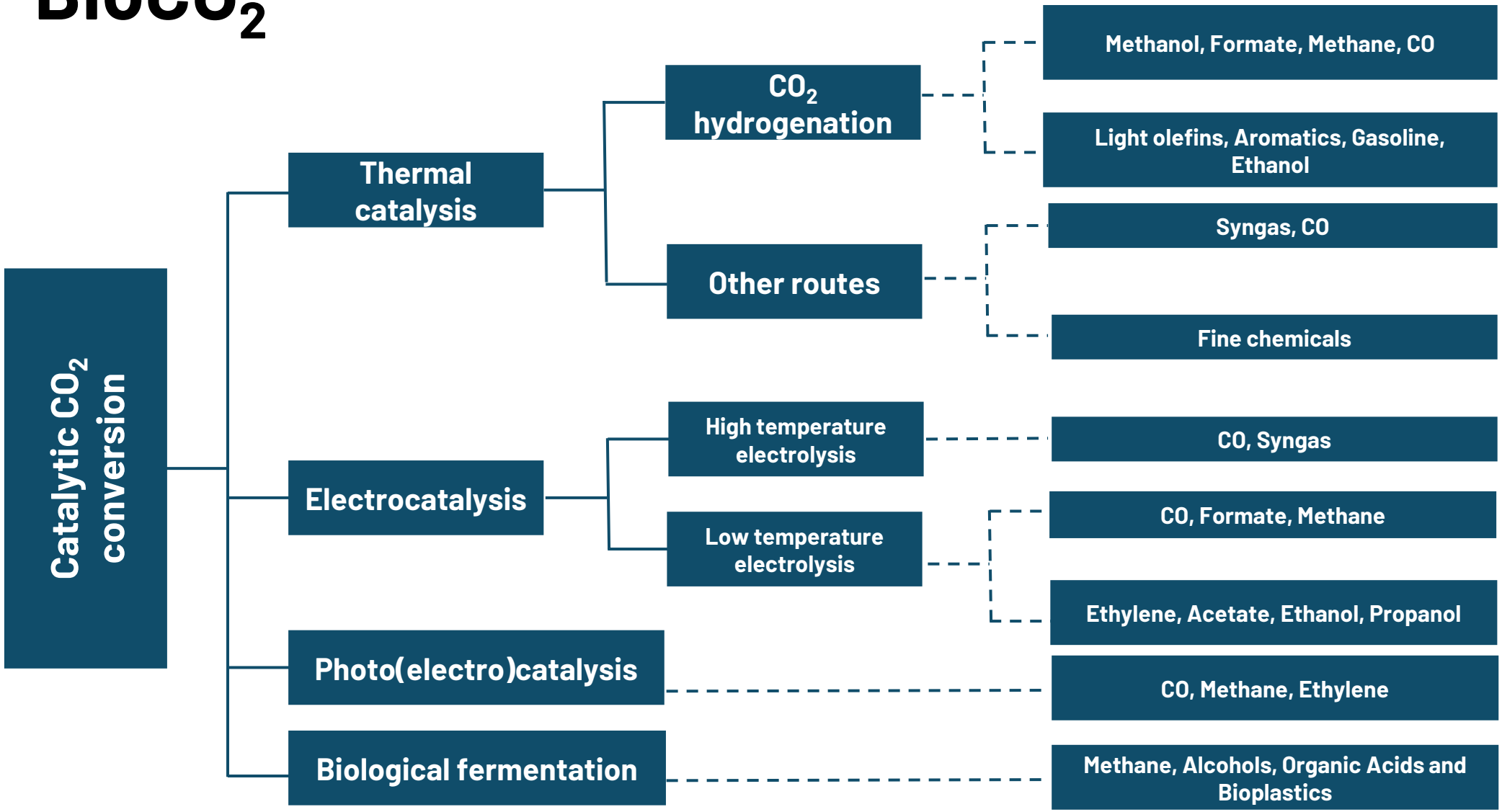
BioCO$_2$


Catalytic CO2 conversion
Thermal catalysis
CO2 hydrogenation
Methanol, Formate, Methane, CO
Light olefins, Aromatics, Gasoline, Ethanol
Other routes
Syngas, CO
Fine chemicals
Electrocatalysis
High temperature electrolysis
CO, Syngas
Low temperature electrolysis
CO, Formate, Methane
Ethylene, Acetate, Ethanol, Propanol
Photo(electro)catalysis
CO, Methane, Ethylene
Biological fermentation
Methane, Alcohols, Organic Acids and Bioplastics

CCU – related projects

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.

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

CATCO2NVERS 2021-2025
Catalytic CO_2 conversion into added-value products through different technologies (Electro, thermal and biologic CO_2 reduction).

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

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

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

CARDIOSOL 2013-2015
Non conventional process integration with sunlight for CO_2 and Biogas valorization into Syngas.

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

OCEAN 2017-2021
Oxaclic acid from CO_2 using Electrochemistry at demonstration scale.

RECODE 2017-2021
Recycling carbon dioxide in the cement industry to produce added-value additives: a step towards a CO_2 circular economy.

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

ENGICOIN 2018-2022
Engineered microbial factories for CO_2 exploitation in an integrated waste treatment platform.

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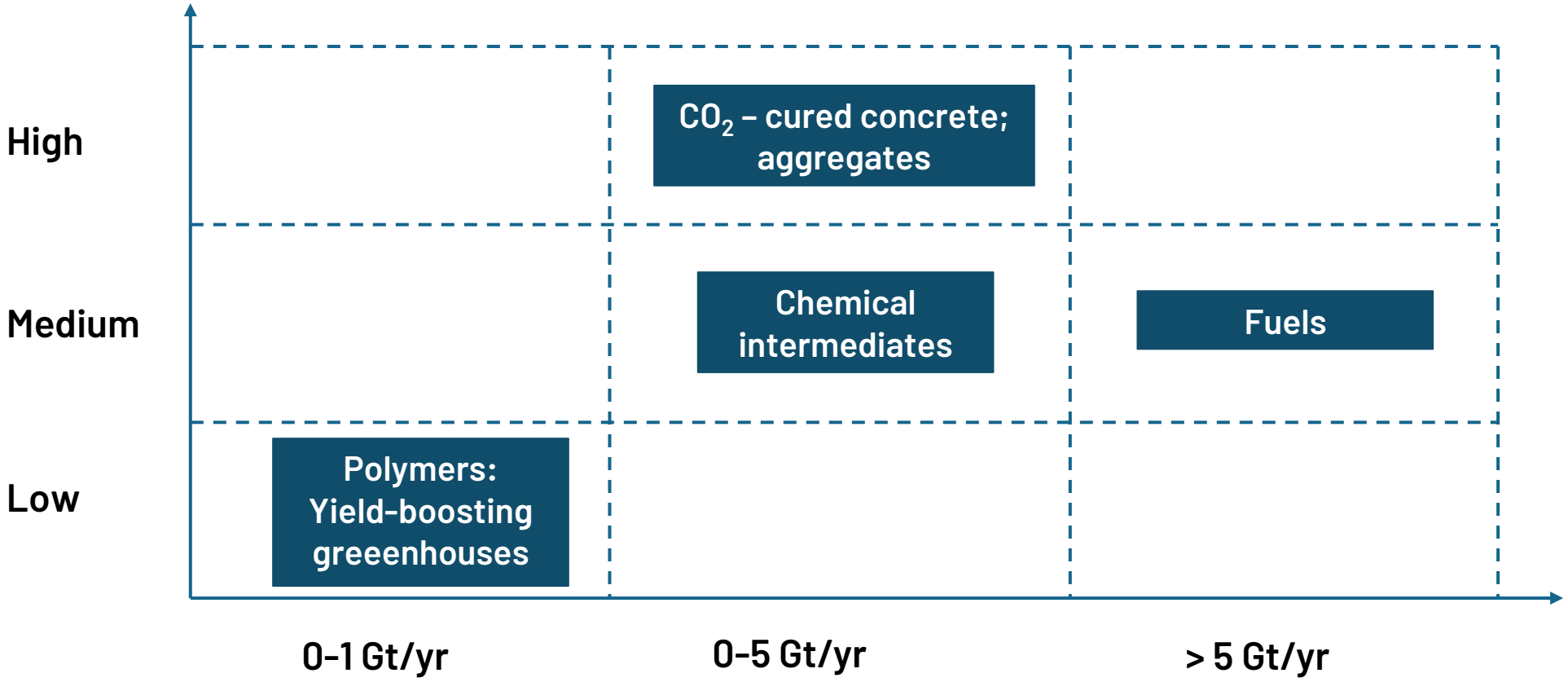
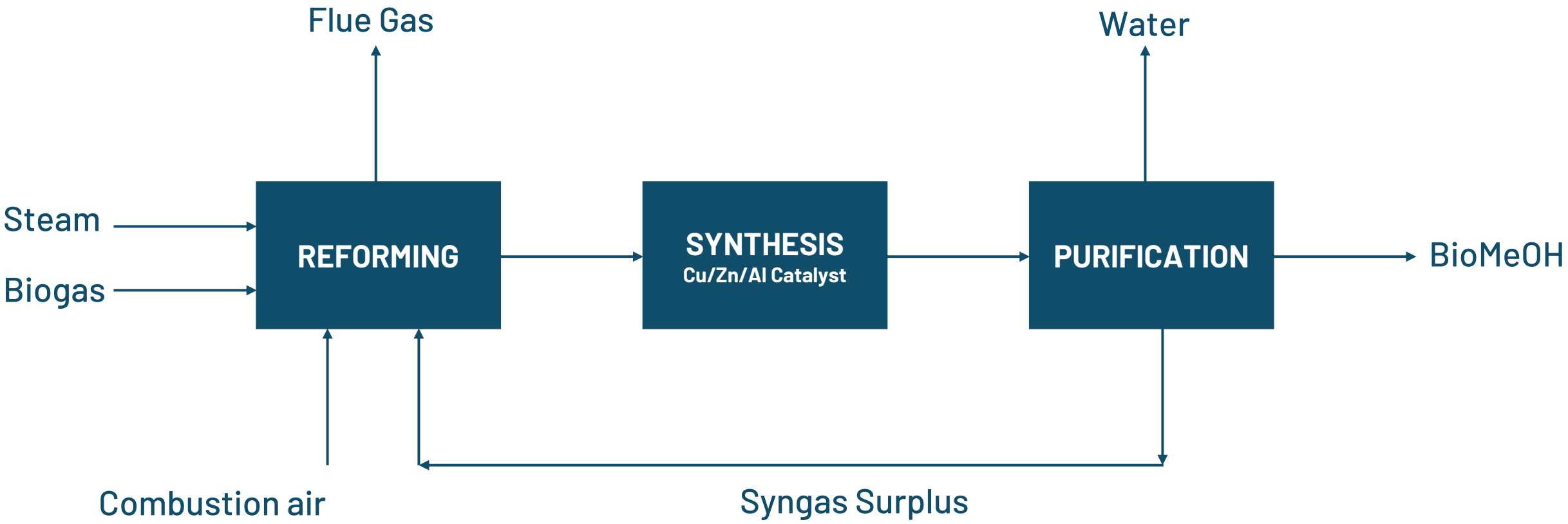
BioCO_2 relative climate benefits



BioMeOH


Flue Gas
Water
Steam
Biogas
REFORMING
SYNTHESIS
Cu/Zn/Al Catalyst
PURIFICATION
BioMeOH
Combustion air
Syngas Surplus