



Sustainable Peri-Urban framework
for Climate Neutral development

SOLUTIONS PROVIDER

**CCU - Synthetic Methanol
production from catalytic
hydrogenation of captured CO₂**



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General Information

Solution Name

CCU - Synthetic Methanol production from catalytic hydrogenation of captured CO₂

Solution Type

Technical Hardware

Solution Owner

National Technical University of Athens (NTUA)

TRL Level

6 - 7

Challenge solved

Target Pain Point

CCU synthetic methanol production addresses a major challenge for industrial decarbonisation by unlocking economically viable pathways to using captured CO₂ and turning it into valuable products. Many industries are equipped with CO₂ capture technologies; however, they struggle with identifying ways to use or add value to it economically, so they often rely on costly storage or transport. By converting captured CO₂ and renewable H₂ into synthetic methanol, a valuable low-carbon fuel and chemical feedstock is produced.

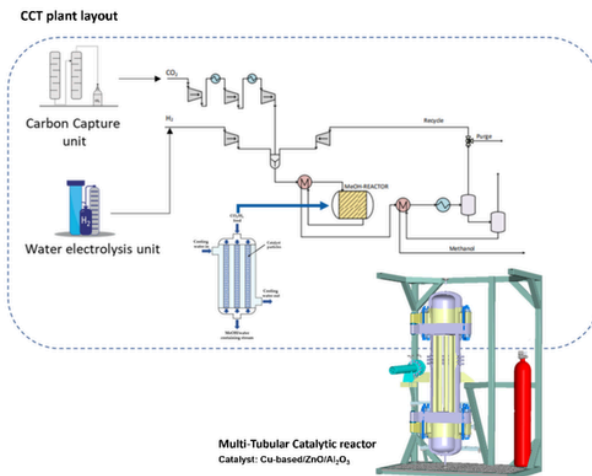
The Innovation

Core Functionality

- **Versatile e-Methanol product:** Converts captured CO₂ and renewable H₂ into synthetic methanol through catalytic hydrogenation.
- **Containerized modular system:** Compact and scalable unit that can be integrated into existing industrial facilities.
- **High-efficiency catalytic process:** Uses Cu/Zn/Al₂O₃ catalyst and flue gas stream recycling to maximize CO₂ conversion and produce high-purity methanol (~99.85%).
- **Low-carbon fuel production:** Enables the conversion of emissions into a valuable product while significantly reducing GHG emissions compared to conventional methanol production.

Beyond State of the Art

- **CO₂-to-fuel valorisation:** Direct conversion of captured CO₂ to synthetic methanol, turning emissions into value, supporting circular carbon use and industrial CCU deployment. Literature identifies CO₂ hydrogenation with renewable H₂ as one of the most promising routes for renewable methanol production.
- **Containerized modular unit:** A small-scale, scalable unit that can be deployed on-site versus larger, centralised methanol plants.
- **Integrated CCU approach:** Combines carbon capture, renewable hydrogen electrolysis and methanol synthesis in one system.
- **It targets hard-to-abate sectors:** E-methanol is increasingly seen as a relevant low-carbon fuel for sectors such as maritime transport and energy-intensive industry, where direct electrification is difficult. Recent commercial projects in Europe show growing market interest in e-methanol from renewable hydrogen and captured CO₂.



User value - Benefits

01

GHG emissions reduction: Helps industries significantly lower their carbon footprint and meet climate targets

02

Scalable deployment: Containerized, modular design allows easy deployment and integration into existing facilities

03

Compliance with climate regulations: Supports companies in meeting EU climate targets, emissions reduction requirements, and sustainability commitments.

04

New revenue streams: Enables the production of synthetic methanol that can be sold as a fuel or chemical feedstock.

05

Versatile product: It can be used in internal combustion engines, and in hybrid and fuel cell vehicles and vessels, cookstoves, and boilers. It is a liquid at ambient temperature and pressures and so is straightforward to store, transport and distribute. It is compatible with existing distribution infrastructure and can be blended with conventional fuels.

Implementation and validation

Living Lab

Living Lab 1: Thessaloniki, Greece (Thessaloniki municipality, Regional Development Fund of Central Macedonia, Athenian brewery)

Replication Potential

Replicator 1: Stara Zagora, Bulgaria



SPURUP

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National
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University
of Athens



pwc



cesie
the world is only one country



IUE
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for Urban
Excellence



SIMAVI
Software Imagination & Vision



University of
BRISTOL



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OF ENGLAND
MAYORAL
COMBINED
AUTHORITY



FGS



prometech



DITENCO
ocean efficient engineering



MG sustainable



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TECHNOLOGIES



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Suite5
We Deliver Intelligence



Teletia
Technologies



UNIQ CUBE



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ΖΥΘΟΠΟΙΑ



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Kommune



CITY OF
THESSALONIKI



ZAGORKA



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UV DISINFECTION SYSTEMS



Fulcea



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