

Consortium



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15 Partners
7 Countries
48 Months

7,491,637.71
Mln € total budget

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COUPLED

CO₂ Utilisation Process
via Looping tEchnology
Demostration



coupled-horizoneurope.eu

Accelerating Europe's Path to Climate Neutrality

Achieving net-zero emissions requires a deep transformation of the entire energy system. Carbon Capture, Utilization and Storage (CCUS) will be a cornerstone of this transition, delivering nearly 20% of the global emissions reductions needed by 2050. In Europe, the Industrial Carbon Management Strategy foresees the capture of more than 450 million tonnes of CO₂ per year, with almost half reused to produce low-carbon fuels and materials. To meet ambitious climate targets, innovative CO₂ capture and utilization technologies must be validated under real industrial conditions to identify the most efficient and scalable solutions.

The COUPLED Solution

COUPLED addresses this challenge by demonstrating, at TRL7, a fully integrated and modular process for the production of cost-effective renewable fuels. The process combines green hydrogen, biogas, recycled CO₂ and low-quality industrial waste gases, enabling circular carbon use across multiple industrial sectors. Building on over a decade of research in chemical looping, membrane separation and process intensification, COUPLED showcases three complementary technologies covering the entire value chain, from biogenic and non-biogenic CO₂ to sustainable liquid fuels

Project Objectives

The core objective of COUPLED is to design, scale up and demonstrate a modular chemical looping process that converts hydrogen or biogas with recycled CO₂ into sustainable, cost-competitive syngas. This syngas is subsequently converted into carbon-neutral liquid fuels, such as Sustainable Aviation Fuel (SAF), via Fischer–Tropsch synthesis or methanol pathways.

The process integrates unmixed combustion of industrial off-gases with a CO₂-selective membrane, enabling efficient CO₂ recovery and internal reuse. Two process configurations are demonstrated:

- GREEN COUPLED: syngas production using green hydrogen via chemical looping reverse water–gas shift (CL-RWGS)
- BIO COUPLED: syngas production from biogas and CO₂ via chemical looping dry reforming (CL-DR)

The project focuses on TRL7 validation, detailed techno-economic assessment, and life-cycle and societal sustainability analysis across applications in renewable fuels, hydrogen, chemicals, and iron & steel industries. To accelerate market uptake, COUPLED will deliver robust business models and exploitation strategies tailored to each industrial scenario.

