DefiCO2 2026-2030 :

Research activities within DefiCO2 are structured around three closely interconnected Work Packages, providing an integrated approach to the complexity of CO_2 management and utilization. Chemistry, biology, process engineering, environmental sciences, economics, and social science**s** are brought together to connect the characteristics of CO_2 sources, available technologies, and the real-world conditions for their deployment.

WP1. CO_2 sources, transport and local utilization

How can geographically dispersed CO_2 sources be effectively managed, and when should CO_2 be transported rather than utilized locally? This WP brings together chemistry, biology, energy research, and territorial and sociotechnical analysis to explore different options according to the origin, location, and characteristics of CO_2 sources.

Methanation will serve as a key case study to investigate the utilization of decentralized CO_2 sources and their conversion into valuable products. Particular attention will also be paid to the availability of renewable hydrogen, a critical resource for several CO_2 conversion pathways, and to its integration into decentralized energy systems.

Beyond technological performance, the analysis will consider existing infrastructure, energy requirements, transport costs, potential markets, and territorial specificities. The objective is to determine under which conditions local utilization, transport to centralized facilities, or alternative CO_2 management strategies should be favored.

WP2. Conversion technologies adapted to real CO_2 sources

How do the composition and variability of real CO_2 sources affect conversion technologies, and under which conditions is purification actually necessary? CO_2 conversion technologies are generally developed and evaluated using pure CO_2, whereas real-world CO_2 streams vary widely in composition and may contain numerous impurities. This WP aims to understand how the origin and composition of CO_2 streams affect process performance, selectivity, stability, and long-term robustness.

To address this question, DefiCO2 brings together a range of chemical, electrochemical, photochemical, and biological conversion approaches, as well as mineralization processes. We will investigate their performance using gas mixtures representative of real-world conditions to identify problematic species, tolerance thresholds, and situations where separation or purification is required or could potentially be avoided.

This experimental approach is closely integrated with life-cycle assessment (LCA). The objective is to determine which solutions are genuinely relevant when efficiency, robustness, purification requirements, energy consumption, and environmental impacts are considered together.

WP3. Understanding the conditions for deploying CO_2 management solutions

Under which conditions can different CO2 management solutions move from technological feasibility to deployment in real-world settings? A solution that is technically efficient and environmentally relevant can only be deployed if it is also economically viable, compatible with regulatory frameworks, adapted to territorial contexts, and socially acceptable. This third WP therefore investigates how these different dimensions can enable or, conversely, constrain the deployment of different CO_2 management pathways.

It combines techno-economic analysis, economics, regulatory studies, social sciences, and the analysis of industrial and territorial strategies. Research will notably address business models associated with CO_2 from different sources, evolving regulatory frameworks, societal perceptions and acceptance of different CO_2 management pathways, and the conditions required for their integration into decarbonization strategies.

By combining these analyses with the knowledge of CO_2 sources and territorial contexts developed in WP1, and the technological and environmental performance assessed in WP2, WP3 will enable the development and comparison of realistic deployment scenarios, rather than evaluating technologies independently of the contexts in which they would ultimately be implemented.