

Carbon Capture, Utilisation and Storage:
Opportunities, challenges and pathways to Net Zero
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MADE4CO₂ Lab: A research infrastructure for advanced CO₂ capture materials, from design to performance

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In the framework of the European ECCSEL-ERIC network and the Italian ECCSELLENT project, the Institute of Sciences and Technologies for Sustainable Energy and Mobility (CNR-STEMS) has established the research infrastructure MADE4CO₂ Lab (Materials Development for CO₂ Capture Laboratory) [1] dedicated to the synthesis, physicochemical characterization and performance assessment at laboratory scale (TRL4) of advanced solid sorbents for carbon capture applications. MADE4CO₂ Lab supports the development of innovative materials, including carbon-based sorbents, metal-organic frameworks (MOFs), nanocomposites, polymers and hybrid materials, and their evaluation under operating conditions representative of industrial CO₂ capture processes.

This contribution will present the facility's experimental capabilities and ongoing research activities focused on understanding structure-property-performance relationships governing CO₂ adsorption and separation processes. A specific focus will be placed on the description of how the competences available at MADE4CO₂ Lab contribute to the design of sustainable and cost-effective sorbents, including materials derived from waste valorisation and circular-economy approaches, as well as to the interpretation of the results of different and complementary characterization methodologies employed to assess adsorption behaviour, selectivity, stability and regeneration performance.

The presentation will highlight how advanced materials research can contribute to overcoming key technological barriers in CCUS deployment, supporting the development of efficient capture technologies for industrial decarbonisation and low-carbon energy systems. Through selected examples and recent research outcomes, MADE4CO₂ Lab will be presented as a state-of-art research infrastructure in Southern Italy for materials innovation in carbon capture and storage applications.

Keywords: *CO₂ capture, advanced sorbent materials, performance evaluation, research infrastructure*

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References

[1] <https://www.eccsel.eu> – last accessed: September 2026.

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