

Project Newsletter

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Dissemination level -Public

European Innovation Council

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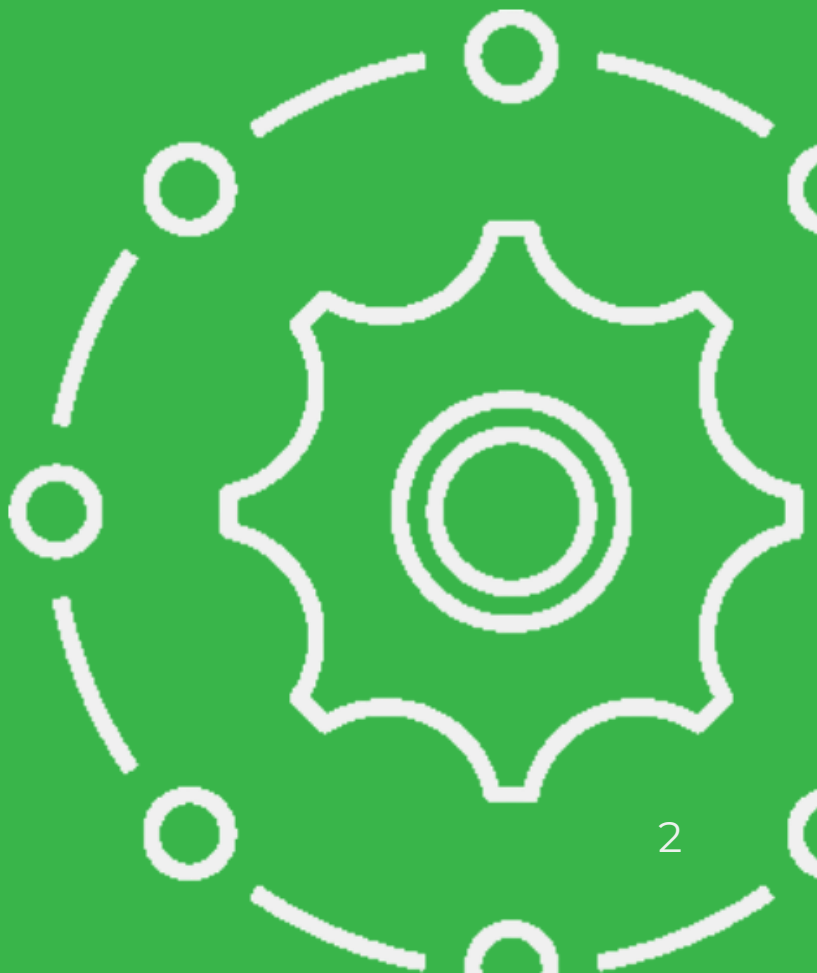
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MOJITO starts: addressing the challenge of low-carbon lime production

MOJITO has officially started its three-year research journey to explore a new route for decarbonised lime production.

Funded under the European Innovation Council Pathfinder programme, the project addresses one of the **key challenges of industrial decarbonisation: reducing emissions from lime calcination** while maintaining process performance, material quality and future industrial relevance.

Lime is an essential material for several industrial value chains, including construction, environmental applications and manufacturing processes. However, its production is highly energy-intensive and generates process-related CO_2 emissions during calcination. For this reason, developing innovative technologies able to reduce energy demand and collect CO_2 at the source is becoming increasingly important.

MOJITO aims to validate a laboratory-scale system for producing decarbonised lime through an electrified rotary kiln integrating hybrid microwave and electric heating. The project combines experimental research, materials analysis, process engineering and computational modelling to better understand how calcination can be performed under innovative operating conditions.

The project is also part of the *European Innovation Council Pathfinder Portfolio "Towards cement and concrete as a carbon sink"*, contributing to a wider European effort to rethink carbon-intensive mineral processes and support the transition towards low-carbon materials.

The official Kick-Off Meeting was held on 15 October 2025 at the Environment, Energy and Sea Research Centre, Marina di Ravenna site of the Ravenna Technopole, bringing together the two project partners: the University of Bologna and Fraunhofer UMSICHT.

The meeting marked the beginning of the project's technical and organisational activities, setting the basis for the first experimental and modelling steps.

In its first year, MOJITO will focus on defining the experimental framework, analysing input materials, preparing data collection protocols and setting the technical specifications for the hybrid rotary kiln.

EIC Cement and Concrete PORTFOLIO

Visit the new website:
https://eic-carbonsink.eu



The Mojito Approach

Hybrid electrified calcination, microwave heating and CO_2 collection

The MOJITO concept is based on the development of an electrified rotary kiln designed to support lime calcination through two complementary heating modes: conventional electric heating and microwave-assisted heating.

In conventional lime production, heat is transferred from the outside to the material and the process usually requires high operating temperatures. MOJITO investigates a different approach, where microwave energy can penetrate limestone particles and contribute to heating the material more directly.

This may enable calcination under improved process conditions and support a reduction in the overall energy demand.

A key element of the project is the use of carbonaceous additives, including waste-derived carbon materials, to enhance electromagnetic energy absorption. These additives are expected to improve the conversion of microwave energy into heat and support a more efficient calcination process.

The MOJITO rotary kiln will be designed to operate with electric and microwave heating either independently or in combined mode. The system will work in an airtight environment and will include dedicated provisions for the collection and analysis of process gases. The CO_2 released during calcination will be collected in an external vessel, opening possible future pathways for carbon capture, utilisation or storage.

Alongside the experimental work, MOJITO will develop computational modelling activities to investigate the calcination process at the atomic scale. These simulations will help clarify the mechanisms of $CaCO_3$ calcination and support the optimisation of the process



Alessia Alcantarini - FIP-WE@UNIBO with rotatory kiln TT10

MOJITO Rotatory kiln will be the evolution of the actual kiln located in the Environment, Energy and Sea Research Centre, Marina di Ravenna site of the Ravenna Technopole (picture above).



The Project Roadmap

Six Work Packages connecting materials, process engineering, modelling and exploitation

MOJITO is structured around six interconnected Work Packages, designed to guide the project from coordination and experimental preparation to technology validation, modelling, exploitation and portfolio cooperation.

The project starts with a strong management and coordination framework, ensuring alignment between scientific objectives, technical activities, administrative requirements and risk management. This structure supports the work of the consortium throughout the three-year project duration.

The first technical step focuses on the analysis of input materials a nd products. MOJITO will study carbonate and carbonaceous materials, prepare mixtures for calcination tests and collect relevant process data. This phase will provide the knowledge base needed to understand how different materials behave under hybrid electric and microwave heating.

A central part of the project is the development and operation of the MOJITO rotary kiln. The system will be designed to process up to 5 kg/h of material and to operate within a temperature range of 500–1100 °C. It will include electric and microwave heating systems, gas management solutions and data acquisition tools to support experimental campaigns.

In parallel, computational science activities will investigate the calcination reaction from first principles. Atomistic simulations will help analyse the behaviour of $CaCO_3$ under realistic process conditions and provide insights into the mechanisms involved in microwave-assisted calcination.

Communication, dissemination and exploitation activities will ensure that project results are shared with relevant technical and industrial stakeholders, including researchers, companies, clusters and innovation actors. These activities will also support the future uptake and valorisation of MOJITO outcomes.

Finally, MOJITO will contribute to the EIC Pathfinder Portfolio by exploring synergies with other projects working on cement, concrete and carbon sink pathways. This portfolio dimension will help connect MOJITO to a broader European innovation ecosystem



WP1
Management, coordination and risk management



WP2
Analysis of input materials, products and gathering of relevant process data



WP3
Pilotplantpurchase, commissioning and operation



WP4
Computational science



WP5
Exploitation, communication and dissemination



WP6
Portfolio management

MOJITO People

Maria Clelia Righi
Professor
University of Bologna



SHORT BIO

Maria Clelia Righi is Full Professor at the Department of Physics and Astronomy “Augusto Righi” of the University of Bologna. Her research focuses on computational materials science, with particular attention to surfaces, interfaces and atomistic simulations.

In MOJITO, she leads WP4, dedicated to computational activities. Her work contributes to understanding the mechanisms of $CaCO_3$ calcination and the role of biochar and microwaves in supporting the conversion of calcium carbonate into lime.

Interview

Main research expertise	*Development and application of computational tools for the study of materials, in particular surface and interface phenomena*
Role in MOJITO	*WP leader*
Which WP or task are you involved in?	*WP4, devoted to computational activities*
What is the main scientific or technical challenge you are working on?	*The main scientific challenge of WP4 is to capture the real-time conversion of calcium carbonate into lime through atomistic simulations. These simulations will elucidate how biochar promotes this transformation, providing a mechanistic understanding of the core innovation underpinning the MOJITO project*
Why is MOJITO relevant for your research area?	*This project is highly relevant to my research, as it allows us to investigate microwave–matter interactions and catalytic processes that have been underexplored and poorly understood. The insights we aim to gain through atomistic simulations will help advance both practical applications in lime production and our understanding of fundamental mechanisms relevant to catalysis and, indirectly, geophysics. Calcium carbonate is abundant in rocks, and calcination processes have also been observed in connection with earthquake nucleation.* *This makes the project particularly stimulating: it combines applications with significant implications for energy, the environment, and the economy with fundamental scientific questions.*

The quote on the project

“MOJITO will make lime production more sustainable.
Through atomistic simulations, we aim to better understa how biochar and microwaves promote this transformation, opening new perspectives on both industrial applications and the underlying physics and chemistry.”





Contact us for further inquiries

mojito-project.eu/

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Fraunhofer
UMSICHT

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