

# PYROCO<sub>2</sub>



Demonstrating sustainable value creation from industrial CO<sub>2</sub> by its thermophilic microbial conversion into acetone

## Results towards the demonstration of sustainable value creation from industrial CO<sub>2</sub>

The PYROCO<sub>2</sub> project goes on and it is celebrating the first 18 months of its implementation!

Read the third project newsletter to discover how PYROCO<sub>2</sub> is progressing towards demonstrating the scalability and economic viability of carbon capture and utilization (CCU) to produce climate-positive acetone out of industrial CO<sub>2</sub> and green hydrogen, as a platform for sustainable manufacturing of chemicals and materials.

Remember to visit the [PYROCO<sub>2</sub> website](#) and to follow the project on [LinkedIn](#) and [Twitter](#) to be always updated on the latest news!

## FROM FEEDSTOCK TO ACETONE: BIOPROCESS DEVELOPMENT & OPTIMIZATION

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From a biological perspective, intensive efforts have been made by project partners [SecondCircle](#), [DTU](#), [SINTEF](#), and [NORCE](#) to improve the robustness of the microbial biocatalysts used in each fermentation step and their cultivations. By mimicking nature through evolution and combining it with novel strain engineering approaches, the bacteria we use convert our substrates into products more rapidly and more favourably. The fermentation process is now ready for further scale up in the next months!

## FROM ACETONE TO MARKETABLE PRODUCTS: CHEM-CAT DEVELOPMENT & OPTIMISATION

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The key objective for project partner [Ranido](#) within first 18 months of the PYROCO<sub>2</sub> project was to assemble and commission a pilot reactor for the chemo-catalytic upgrading of acetone. This task was successfully executed, and currently the reactor is fully operational at Ranido's site in Czech Republic. The first pilot-scale conversion campaign is expected to start at end of 2023, depending on the availability of the bio-based acetone from the bioprocess. Moreover, Ranido contributed to other tasks related to the development of chemo-catalytic transformations by providing materials, expertise, and support in catalysis and process optimization to other project partners. The close collaboration with other PYROCO<sub>2</sub> partners is ongoing and current research results already inspire confidence for the successful demonstration of the chemical valorization value chain.

[CNRS](#) alongside [Arkema](#) has performed a thorough literature survey and published a review article on the dehydration catalysis of isopropanol. The article is titled "[Catalytic Dehydration of Isopropanol to Propylene](#)". Furthermore, CNRS has mainly focused on the characterization of the catalysts provided by our different partners: [Johnson Matthey](#), [Ranido](#), and [Arkema](#). CNRS employed gas adsorption microcalorimetry to investigate in detail the acidic and basic properties of the catalysts. The catalysts, presenting a large panel of acidic/basic properties, are now identified, and classified based on the number and strength distribution of the active sites. Finally, the stability of the solids towards water/steam has been studied by treating the solids in boiling water (100°C) and in steam (400°C). It was observed that the surface reconstruction in the presence of steam can induce catalyst deactivation.

## PROCESS INTEGRATION AND SUSTAINABILITY ASSESSMENT

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Project partner [Karlsruhe Institute of Technology](#) oversees the close follow-up of the PYROCO<sub>2</sub> process design development. First sets of process data were collected to build up a process model and start with a process ecosystem model. Collected data are derived mainly from progress in the technical work of the project in preparation to construct the PYROCO<sub>2</sub> demonstrator plant. As design base of the demonstration plant, the preliminary data enabled a first integrated process simulation with mass-, component-, and energy balance. The operation of the PYROCO<sub>2</sub> demonstrator will provide more refined and verified experimental results in industrial relevant scale by which a full sustainability assessment on ecological, economic, and social dimensions towards the end of the project. For the utilization of the CO<sub>2</sub>-derived acetone as intermediate for chemo-catalytic syntheses to chemicals, fuels, and polymers, different process concepts and variations are in development. Thus, a deep understanding of the core PYROCO<sub>2</sub> process steps to provide CO<sub>2</sub>-derived acetone is achieved, enabling preliminary assessments on individual process steps and the full value chain. A preliminary cradle-to-gate LCA was done to determine the environmental impact of the PYROCO<sub>2</sub> process and to identify its environmental hotspots.

## EXPLOITATION, REPLICATION, COMMUNICATION AND DISSEMINATION OF THE PROJECT RESULTS

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[CiaoTech – PNO Group](#) has supported the development of an in-depth stakeholder analysis concerning the bio-based carbon dioxide utilization (CCU) value chain. This analysis allowed the identification of 299 European stakeholders, including key innovation players in the field, beyond the main innovation trends, thus accounting the related patent and publicly funded projects. Moreover, potential end-user for the PYROCO<sub>2</sub> technologies and products have been also spotted. Furthermore, CiaoTech is also coordinating and monitoring all the dissemination and communication activities performed in the frame of PYROCO<sub>2</sub>.

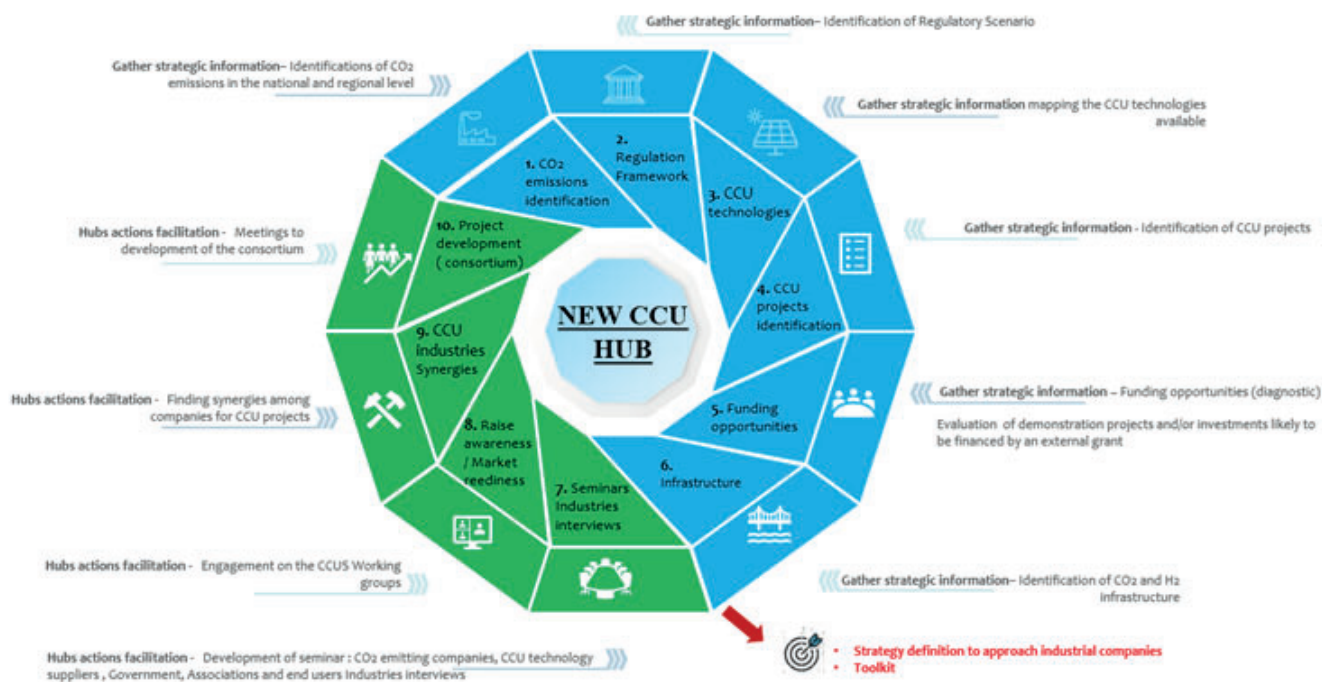
In addition, project partner [Axelera](#) is working on several axes to de-risk and to develop market readiness in Auvergne Rhône-Alpes region. Every 3 months, Axelera shares with the Consortium members and the main regional industrial companies the strategic intelligence bulletin. The bulletins are published with the aim of helping the partners of the PYROCO<sub>2</sub> consortium to make strategic decisions and to support the emergence of the CCU market also via broader dissemination, to engage companies on the emergence of new CCU projects.

For the development of CCU hubs, Axelera is working on several topics as:

- Mapping of CO<sub>2</sub> emission of the regional industrial companies,
- Market study to get the information needed from industrial companies,
- Toolkit which presents the CCU technologies, the regulations, and the funding opportunities.

Axelera has also interviewed the CO<sub>2</sub> emitting companies and developed the high-level seminars with the CCU value chain. As a result of these tasks, several CCU projects are under discussion. The first deliverable of the project on this topic will be ready in March 2023 and consists in the replication strategy methodology for facilitating the emergence of local CCU hubs in other regions in Europe.

## STEPS FOR CCU HUB DEVELOPMENT



Complete list of steps to be performed for the development of CCU hub.  
This information will be part of a first deliverable on this topic.

Want to learn more about PYROCO<sub>2</sub>?  
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and the official [LinkedIn](#) and [Twitter](#) accounts.

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## PYROCO2 Partners



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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101037009.