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PYROCO$_2$

Demonstrating sustainable value creation from industrial CO_2 by its thermophilic microbial conversion into acetone

THE PROJECT

Achieving climate neutrality by 2050 requires a rapid paradigm shift towards the implementations of new, climate positive solutions that can boost the European market. Emerging new solutions for carbon capture, utilization, and storage (CCUS) have great potential to decarbonize production in the chemical industry, while allowing value creation from parts of its own carbon emissions.

In this context, the PYROCO₂ project will demonstrate the scalability and economic viability of carbon capture and utilization (CCU) to make climate-positive acetone out of industrial CO_2 and renewable electricity derived hydrogen. **Core of the technology is an energy-efficient thermophilic microbial bioprocess that is projected towards a reduction of 17 Mt CO_{2eq} by 2050.** The acetone produced by the PYROCO₂ process will be demonstrated as an ideal platform for the catalytic synthesis of a range of chemicals, synthetic fuels, and recyclable polymer materials from CO_2, generating a portfolio of viable business cases and pre-developed processes for replication and commercialization.

The PYROCO₂ demonstrator plant will be able to produce up to 400 tonnes acetone annually from 910 tonnes of industrial CO_2 and green hydrogen. It will be located at **SINTEF's piloting area at Tiller**, near Trondheim, Norway, while the industrial cluster of **Herøya Industrial Park** in southern Norway will serve as a primary scenario location for a future full-scale PYROCO₂ production site withguaranteed access to industrial CO_2 feedstock and green energy at a competitive price and connects several carbon-intensive industries with chemical production through industrial symbiosis.

From here, the PYROCO₂ project will represent a key driver for the emergence of CCU Hubs across Europe. Besides the large-scale demonstration and full financial, regulatory, and environmental assessment of the PYROCO₂ technology, the project will explore the sphere of public acceptance and market exploitation to further encourage the emergence of the CCU market.

OBJECTIVES

The PYROCO₂ project will demonstrate the scalability and economic viability of carbon capture and utilization (CCU) to make climate-positive acetone, a platform chemical for many other chemicals, fuel additives, and materials. This will be realized by achieving the following specific objectives:

- To design and build a demonstrator-scale chemical production plant based on industrial symbiosis that clearly shows new options for European carbon-intensive industries to create value from CO_2 while reducing emissions.
- To demonstrate large-scale industrial feasibility of thermophilic microbial gas fermentation to produce up to 4,000 t/a acetone from CO_2 and renewable electricity as a platform for its further chemo-catalytic upgrading into a range of other commodity chemicals and materials.
- To establish and promote the new chemical production platform as a more sustainable and economically viable alternative to existing fossil-feedstock based production of acetone and derivable products.
- To create synergies with a wide spectrum of existing and future projects and initiatives of relevance for the Green Transition in Europe, including existing efforts for the emergence of CCUS hubs, related CCUS solutions, renewable energy, and hydrogen.
- To become a key driver for the emergence of CCU Hubs across Europe so that the European chemical industry can lead the ongoing low-carbon and circular economy transitions and ensure that investment and policy needs are met to jointly build a greener and prosperous future in Europe.

IMPACT

The key outcomes of the PYROCO₂ project and the impacts beyond the end of the project include:

- Establishment of an industrial scale demonstrator operational by the end of 2026 based on industrial symbiosis that will interconnect multiple sectors, such as medical and technical gas, fertilizer, cement, metallurgy, hydrogen, chemicals, polymers/materials sectors, and synthetic fuels.
- Providing significant reduction of industrial CO_2 emissions through a highly efficient acetone production process, which is expected to reduce CO_2eq emissions by about the 50% compared to conventional acetone production.
- Contribution to accelerate the transition of the EU chemical industry towards climate neutrality by providing an innovative, affordable, and clean process for producing platform chemicals, as well as a portfolio of commodity products.
- Demonstration of the industrial feasibility and cost effectiveness of the production of acetone via the PYROCO₂ process that will pave the way for the economically sound replication and further upscaling of the PYROCO₂ process elsewhere in Europe.
- Contribution to the strategy adopted by EU for mitigating the excess of air pollution and therefore preserving the health of EU citizens.