PYROCO$_2$

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

Towards large-scale demonstration of the PYROCO$_2$ process

The main aim of the PYROCO$_2$ project is to demonstrate the scalability and economic viability of carbon capture and utilization (CCU) using the innovative PYROCO$_2$ bioprocess that produces climate-friendly acetone out of industrial CO_2 and renewable electricity derived hydrogen. The acetone thereby serves as a platform for sustainable manufacturing of a wide range of chemicals, materials, and fuel ingredients.

As the project is nearing the end of its fourth year, increasing efforts by project partners SINTEF, HIP, DTU, KIT, NEXTCHEM, and BPT during the past two years have been on accomplishing the project's main physical deliverable, the establishment of a large-scale test facility for the PYROCO$_2$ process to be used for the at-scale demonstration of CO_2-based acetone production.

RISK MANAGEMENT FOR DEMONSTRATOR ESTABLISHMENT AT HERØYA INDUSTRIAL PARK

After securing access to a suitable patch of land of totally 5000 m² within Herøya Industrial Park (HIP) in Porsgrunn, Norway, engineering of the demonstrator entered the phase of basic engineering of the facility and its incorporation in the industrial area and existing infrastructure. During this process, several issues became apparent and had to be addressed by the project's risk management.

In response to unforeseen hikes in material and energy prices for process equipment and hydrogen feedstock, respectively, linked to the changing geopolitical situation and its severe implication on European societies and economies, it became clear that the originally envisioned size of the demonstrator with a capacity of 4000 tonnes acetone per year could not be realized, leading to a downscaling by a factor of approximately 10. This was found to be accomplishable without compromising the project's purpose of demonstration of the process at a scale that is meaningful with respect to future final process scale-up to commercial scale and replication.

In addition, establishing the process building for hosting the downscaled PYROCO$_2$ process, and linking it to all utilities at site turned out to be more complex and projected to be more time consuming and costly than previously envisioned, thus exceeding the project's frames for budget and time. Attempts to mitigate the risks by considering alternative locations at Herøya could somewhat reduce the risks, but ultimately it was concluded that establishing the demonstrator at Herøya was not feasible within the frame of a responsible financial and temporal risk picture.

To ensure the accomplishment of the project's goals, the PYROCO$_2$ consortium searched for alternative Norwegian sites that could balance risks with the original purposes of the demonstrator. In that process a possibly suitable option arose in SINTEF's test area at Tiller, near Trondheim, Norway. In close dialog with the project's funders (EC-HaDEA), at the end of 2024 the consortium decided not to pursue establishing the demonstrator at Herøya due to too high financial and time risks and evaluate in detail the possibility to establish the PYROCO$_2$ demonstrator at Tiller.

A VIABLE ALTERNATIVE AT SINTEF'S SUSTAINABLE PROCESS LAB AT TILLER

Coordinator SINTEF's Tiller piloting area offers unique opportunities with heavy expertise and infrastructure that has supported industry needs for research-based piloting and scaling for over 40 years. The vision "Tiller Sustainable Processes Lab" covers the entire value chain for green technologies, from CO_2 capture to the production of chemicals, materials, and fuels. Of high significance for CCUS value chains and industrial piloting are SINTEF's CO_2Lab, including a full-scale CO_2 capture test rig, the flexible Process lab for piloting diverse processes, and the extensive multi-phase test facilities that today have relevance for establishing safe and permanent CO2 underground storage. In addition, one of the two PYROCO2 chemo-catalytic process modules for product diversification were from the get-go planned to be established at SINTEF Tiller within the CO_2Lab building.

SINTEF has already planned an expansion at Tiller to address a growing market for piloting new sustainable industrial processes. A new piloting building close to the CO_2Lab would increase space capacity and meet market growth. This and the need of the PYROCO$_2$ project for a financially viable solution for the demonstrator facility has triggered the concretization of plans for a new piloting building at Tiller (Figure 1).

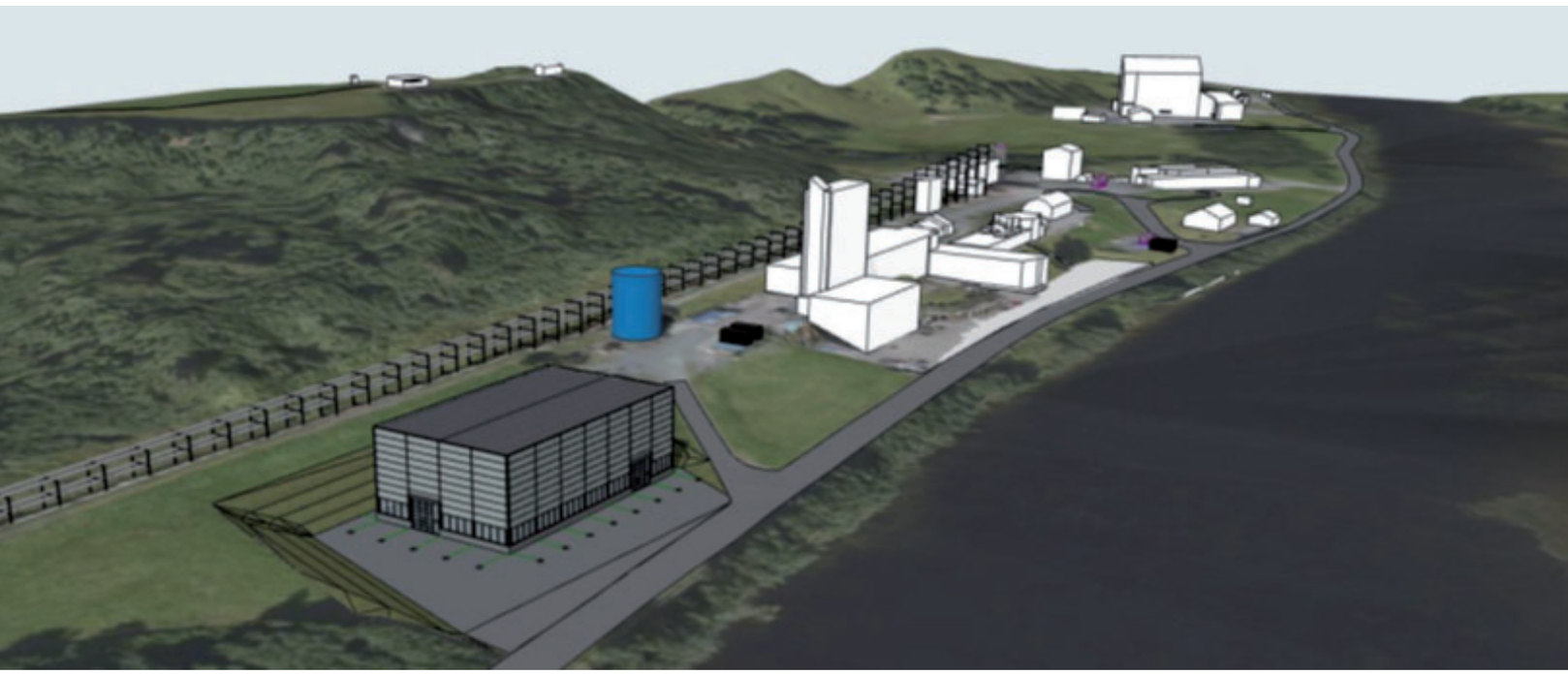

Figure 1. Schematic of the new SINTEF piloting building (in grey, bottom left) at the Sustainable Process Lab area at Tiller on the shores of river Nidelva that the PYROCO$_2$ project will use for establishing the project's demonstration process in 2026. The new building will be direct neighbour to the large multiphase flow loop (above-left) and SINTEF's CO_2Lab for demo-scale CO2 capture process development (white high building behind-right), also hosting one of the project's two chemo-catalytic product diversification modules. The industrial pilot area serves all utility needs of PYROCO$_2$ with respect to water, gases, and electricity, as well as staff experienced in scale-up and piloting.

In March 2025 the SINTEF board approved an investment of up to 35 million NOK into a new 1000 m² building to enable research-based piloting and scaling for faster testing and validation of new green processes at Tiller. The new piloting building is planned to be ready in spring 2026, which is in line with the project's timeline. Based on an updated cost estimate and positive projections for a successful demonstrator establishment within the project's financial and temporal constraints, the PYROCO₂ General Assembly in April 2025 decided to move forward with coordinator SINTEF's proposal to establish the project's demonstrator process in the new piloting building at Tiller.

The decision for Tiller was further supported by the recently concluded tendering process for PYROCO₂ process equipment in which suitable suppliers were found for all major process units within the available budget frame of project partner DTU. Immediately after the GA vote on Tiller as the new demonstrator facility location, contracts with vendors were signed, with delivery and commissioning targets in the period April to July 2026, aligning well with the timelines for construction.

Engineering of the SINTEF piloting building has been progressing well since the beginning of 2025 in close interplay with PYROCO₂ project staff to align the layout of a generic piloting building with the special needs and features of the PYROCO2 process. While detailed engineering and planning on both sides will continue until the end of the year, groundbreaking is scheduled for August 2025.

PYROCO₂ PROCESS SCALE-UP AND PRODUCT DIVERSIFICATION MODULES

While the demonstrator construction process progresses, preparations for performing demonstration of the PYROCO₂ process at Tiller have already intensified. A crucial part is the process scale-up to intermediate scale performed by partner NORCE at their facilities in Risavika, near Stavanger, Norway. The pilot-scale system of the process is fully installed and ready to produce crucial data for later demonstrator operation at Tiller. Data generation and production of small batches of acetone from CO2 is currently ongoing and will continue until key parts from the system are transferred and integrated in the demonstrator process at Tiller in the beginning of 2026.

By that time, also the product diversification module by SINTEF will be fully operational at Tiller, while plans will be made to include the second module currently operated at partner RANIDO in Czech Republic on site at Tiller. With all units in one place at Tiller and despite of all hurdles the project had to take during the past three years, prospects are today positive for the project to demonstrate acetone production and product diversification from industrial CO2 and renewable electricity-derived hydrogen in a similar way as it was planned for Herøya from conceptualization of the project.

BUT WHAT ABOUT PYROCO$_2$ AND HERØYA INDUSTRIAL PARK?

Although the project's demonstration facility will not be established at Herøya, the project is still considering the possibility of a future for the PYROCO$_2$ process at Herøya Industrial Park. With the recent plans by Eramet and Lanzatech to establish full-scale biotech-based CCUS at Herøya, the prospects for industrial CO_2 utilization and value creation from local emitters are brighter than ever. The PYROCO$_2$ project has acknowledged this recent development by prioritizing Herøya Industrial Park in its assessment of a future full-scale scenario, positioning it as a cornerstone for upscaling and replicating the project's innovative technology across Europe.




Want to learn more about PYROCO$_2$?
Visit the project website
and the official LinkedIn and Twitter accounts.

Subscribe to the newsletter to be always updated on the latest news!

PYROCO$_2$ Partners

SINTEF · again · DTU · ARKEMA

cnrs · KIT Karlsruhe Institute of Technology · PNO INNOVATION · axelera

Firmenich for good, naturally · NORCE · HERØYA INDUSTRIPARK · CHALMERS UNIVERSITY OF TECHNOLOGY

BIOPROCESS TECHNOLOGY · norner The Polymer Explorers · SCGC · JM Johnson Matthey Inspiring science, enhancing life

Ranido · ecoinnovazione spin off ENEA · Vestfold and Telemark COUNTY COUNCIL

GET IN TOUCH WITH US

www.pyroco2.eu

info@pyroco2.eu

#PyroCO2

/company/pyroco2

Dr. Alexander Wentzel
SINTEF Industry, Department of Biotechnology and Nanomedicine

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