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## REPAIR project annual consortium partners meeting, and midterm review meeting

The REPAIR project is funded by part of Horizon Europe and has its goal to develop techniques for lowering the release and removing methane and possibly  $N_2O$  from the atmosphere with the agricultural sector being the first mover of technologies.

The project focuses on emissions from the dairy sector, but ultimately, there may be multiple areas where the technique may be applied. As we conclude the year 2024 we look back on our first two years and mid-term EU review of the project with satisfaction, a lot of progress has been made and several key steps have been taken toward the project goal. This is what we summarized at our annual consortium meeting that was held in June in beautiful Utrecht.

In the project REPAIR, we will develop the proof-of-concept for technologies to remove non- $CO_2$  greenhouse gases from atmosphere, and evaluate the technical, economic, environmental, social and policy compatibility by including stakeholder feedback in the early stages of technology development. REPAIR is a European Commission funded project within the Horizon Europe framework.

## Material screening for removal of methane

We are happy to share that Kian Karimi, PhD candidate in Matteo Gazzani's group at Utrecht University presented his research project at CHISA conference in Prague (25-29 August 2024).

In the poster presentation, he discussed the most recent research findings, focusing on material screening to capture methane from diluted sources (<1%) by cyclic adsorption process, and how equilibrium cycle models can support this. On top of the scientific discussions, the conference provided a great opportunity to connect with passionate scientists from all over the world and share the progress of the REPAIR project.



Image: Kian Karimi, PhD candidate Utrecht University

## Mitigation of methane from low concentration sources using transition metal based oxidation catalysts

Nardana Bazybek, a PhD candidate at KTH Royal Institute of Technology presented her research on mitigation at two conferences: the Greenhouse Gas Control Technologies (GHGT-17) conference in Calgary (20-24 October) and the AIChE Annual Meeting 2024 in San Diego (27-31 October).

At the GHGT-17 conference, Nardana shared her research on mitigating methane emissions from agricultural sources through thermal and photocatalytic methods. Her work involved experiments conducted under conditions that closely replicate barn environments, with methane concentrations ranging from 10 to 10,000 ppm, along with the presence of CO<sub>2</sub> and humidity. The study revealed that the thermal catalyst cobalt oxide (Co<sub>3</sub>O<sub>4</sub>) achieved a 90% conversion rate at 380°C for methane concentrations of 10 ppm. While the catalyst's performance remained stable in the presence of CO<sub>2</sub>, it was slightly reduced under humid conditions. Additionally, titanium dioxide (TiO<sub>2</sub>) was investigated as a photocatalyst in collaboration with InPhoCat, showcasing its potential for photolytic methane conversion.

At the AIChE Annual Meeting, she presented her findings on methane oxidation using transition metal-based catalysts. This research focused on binary metal oxides, including cobalt, manganese, barium, and nickel, to identify catalysts that are both active and stable for low-temperature methane combustion. Through advanced characterization methods, the study provided insights into the reaction mechanisms of transition metal oxide (TMO) catalysts. Notably, Co<sub>3</sub>O<sub>4</sub>-MnxOy catalysts demonstrated a 90% methane conversion rate at 330°C, with manganese additions significantly enhancing catalytic efficiency by facilitating methane activation.

Given methane's significantly higher global warming potential compared to CO<sub>2</sub>, converting methane into CO<sub>2</sub> presents a valuable strategy for reducing CO<sub>2</sub>-equivalent emissions in the atmosphere. This research as part of the REPAIR project contributes to the development of effective technologies for mitigating non-CO<sub>2</sub> greenhouse gas emissions, particularly from the agricultural sectors, thereby supporting global efforts to combat climate change.

In addition to the scientific discussions, the conferences offered an excellent platform to engage with research from around the globe. Nardana also had the opportunity to highlight the ongoing advancements of the REPAIR project, contributing to the exchange of knowledge and ideas within the international research community.

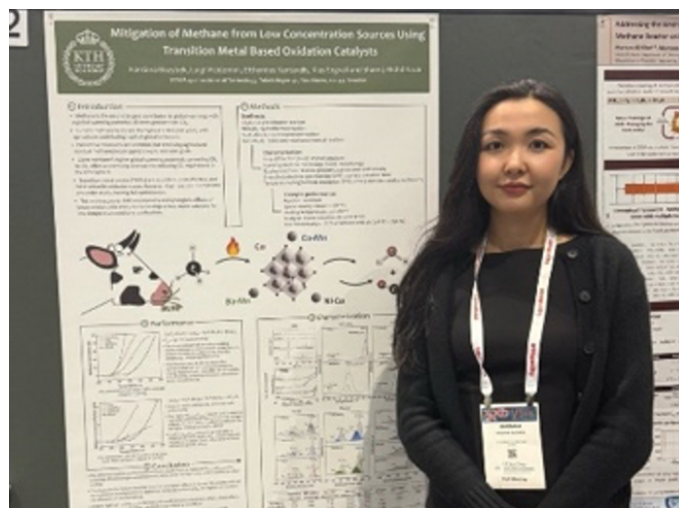


Image: Nardana Bazybek, PhD candidate at KTH

## Webinar Horizon Europe VISIONARY & REPAIR

Strategies from the dairy primary sector to match decarbonization targets. On June 4, 2024, a webinar with 150 participants, titled "Horizon Europe VISIONARY & REPAIR" convened stakeholders from across the European dairy sector to discuss strategies and technologies for reducing greenhouse gas emissions. Hosted in collaboration with COPA COGECA and the DG Climate of the European Commission.

The event aimed to address the agri-food sector's environmental impact, with a particular focus on dairy's role in emissions reduction. The event highlighted ambitious goals for the European dairy industry to achieve lower emissions by 2030 and 2050, presenting actionable steps and fostering international collaboration.

The mission of the Horizon Europe VISIONARY & REPAIR webinar was to address the growing environmental challenge posed by greenhouse gas emissions within the dairy sector and explore sustainable solutions that would not compromise economic viability. Emphasizing both technological innovation and cooperative strategies, the event sought to unite diverse stakeholders — from cooperatives to government bodies — in a shared commitment to decarbonize the dairy value chain effectively and equitably.

The webinar centred on the Decarbonization Strategies of Dairy Cooperatives. Moderated by ICOS, this segment examined how cooperatives could guide farmers through emission-reduction initiatives while balancing their roles as competitive market players. The cooperatives emphasized the need for gradual, knowledge-based transitions to maintain both market access and "brand prestige," as these changes increasingly influence consumer trust and channel access.

The event concluded with a summary by Cooperativas Agro-Alimentarias de Espana, highlighting the multifaceted approach necessary for successful decarbonization. Key takeaways included the importance of technological innovation, cooperative support for farmers, and the growing influence of ESG commitments on the market dynamics.

The Horizon Europe VISIONARY & REPAIR webinar underscored that while the path to decarbonization is complex, the European dairy sector is proactively engaging in sustainable strategies and partnerships. With continued support from research initiatives, cooperatives, and international collaboration, the sector is poised to make meaningful progress toward a more sustainable future.

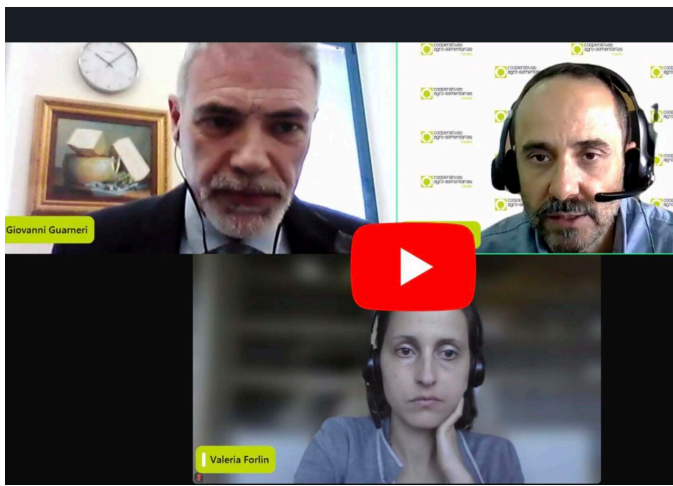


Image: Giovanni Guarmeri, Juan Sagarna and Valeria Forlin

Representatives from the European Commission's DG Agri, Giovanni Guarmeri presented on pivotal research spotlighting; VISIONARY Project: This project is dedicated to connecting farmers' sustainability efforts with consumers, creating transparency in how sustainable practices at the farm level contribute to broader environmental objectives.

REPAIR Project: Aimed at methane capture technology in dairy barns, the REPAIR project is focused on developing effective technologies to reduce methane emissions, one of the primary greenhouse gases associated with dairy farming. These projects demonstrated the EU's commitment to not only reduce emissions but also provide concrete technological solutions fostering a sustainable dairy industry.

The final segment discussed the industry's role in fulfilling environmental, social and governance (ESG) commitments through Scope 3 emissions, which encompass indirect emissions across the supply chain.

## Key Participants

The webinar featured influential participants from various organizations and sectors: COPA COGECA and DG Climate of the European Commission: Opened the webinar, framing the urgency and relevance of decarbonizing the dairy sector in Europe.

ICOS: Moderated the cooperative discussion, facilitating an exchange of insights among key dairy cooperatives from Finland, Spain, Ireland, France, and Denmark.

Agri Zero NZ: Represented New Zealand collaboration between government and private agri-food companies

European Commission's DG Agri: Presented insights on European projects (VISIONARY and REPAIR) that contribute to sustainable innovations in dairy farming.

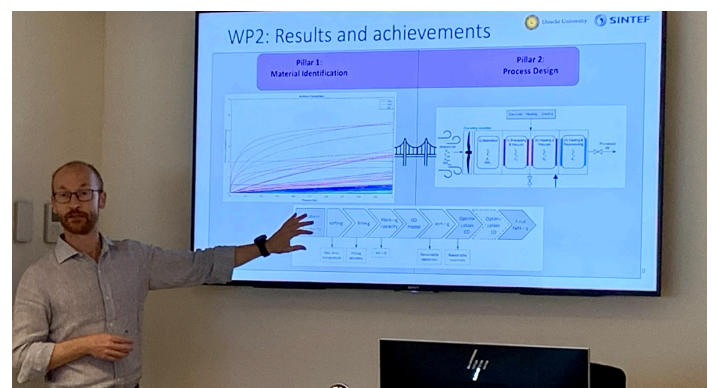
MilkBE: Shared industry-specific efforts toward emission reduction in Flanders, underscoring the role of regional partnerships in achieving climate targets.

Cooperativas Agro-alimentarias de España: Juan Sagarna provided concluding remarks, summarizing the critical takeaways and future implications for the industry.

## Partner Utrecht University

Within the Copernicus Institute of Sustainable Development, the Energy & Resources group at Utrecht University has been working on process and energy system modelling and optimization for a few decades, providing important knowledge for the transition to a climate-positive society. The group has been building a unique critical knowledge mass around technologies and processes for the energy transition, including fundamental separation sciences, process and system optimization, and economic and environmental assessment.

More recently, under the lead of Dr. Gazzani and Prof. Kramer, the group started working on GHG removal from very diluted gases, especially CO<sub>2</sub> and CH<sub>4</sub> removal from the atmosphere. Recent work on DAC has attracted significant interest from academia, industry and the media.



Matteo Gazzani, hosting annual partners meeting  
Image: Utrecht University 27.06.2024

Overall, key expertise for REPAIR that the team possesses includes, but is not limited to (i) design and mathematical optimization of gas separation processes, especially ab- and ad-sorption based, (ii) mathematical optimization of energy systems via linear/non-linear programming, (iii) chain and environmental analysis, (iii) techno-economic assessment of (new) technologies.

Especially, within REPAIR, UU will lead WP2, which brings together the technical modelling of the project, reconciling experiments in WP1 with techno-economic and integrated assessments in WP3. UU will oversee process and system modelling for designing REPAIR technologies when deployed at scale in WP4, in addition to contributing to communication activities in WP5.

## Reducing emissions must involve the entire life cycle of milk.

Last 18th and 19th of November, Cooperativas Agro-Alimentarias de España, as part of the European project VISIONARY, organized in Galicia, the community with the highest milk production in Spain, a meeting to address the sustainable future of the dairy sector.

This brought together experts, cooperatives and international entities with a common objective: to discuss strategies for the decarbonization of the sector. The objectives set by the large supermarket and industrial companies, and the pressure from consumers and institutions mark the future steps of the dairy sector to reduce its emissions. Still, without a consensus on the objectives set, the dairy sector and the cooperatives are analyzing possible alternatives to meet the demands, always with a view to Scope 3, which implies that reductions must cover the entire life cycle of the milk. That is, from the farm to its distribution.

The most promising is the formulation of feed with raw materials with a low carbon footprint, the use of additives that reduce emissions, and the improvement of production efficiency through genetic advances and optimal farm management. During the visit, attendees visited the CLUN cooperative to learn about its innovative production model, which has given rise to the first "ZERO emissions" milk on the market: ÚNICLA.



From the care in the feeding of its cows, which reduces the carbon footprint by 20% compared to conventional milk, to its packaging process with carbon-neutral materials made from recycled materials and forest residues, ÚNICLA represents a model of integral sustainability.

In addition, the benefits of its special diet not only impact the environment but also the quality of the product, increasing its Omega 3 content and other nutrients. To close the cycle, the cooperative offsets the remaining emissions by reforesting burned forests in Galicia through the ARUME association. Regarding the barn, it has side openings to improve ventilation in the hot months. Also, it is supported by fans to mitigate high temperatures. Even though in this area of Spain they do not suffer so much from high temperatures, they have high rainfall throughout the year. That is why the manure ponds have a roof. Also, it has photovoltaic panels for maintaining the temperature at which the milk is stored.

## Summary

The REPAIR project aims to develop a cost-efficient method for the confinement systems that would allow the capturing or catalytic transformation of methane. We have made great progress this year in implementing real-world conditions from farms and agriculture into technology development.

## Follow the project



[www.repair-eu.com](http://www.repair-eu.com)

## Partners



The work is part of the project "Removing non-CO2 greenhouse gas emissions to support ambitious climate transitions (REPAIR)" (Project number: 101069905) funded by the European Commission via the European Climate, Infrastructure and Environment Executive Agency (CINEA) within the Horizon Europe framework.