REPAIR Newsletter

Annual edition Jan 2024

Funded by the European Union

Nardana Bazybek, Newsha Bashirian, Joanna Macyk, Finn Eriksson, Jakko Luoma, Shareq Mohd Nazir, Robert Harmoinen, Laura Aleluia Reis Simon Roussanaly, Matteo Gazzani, Daniel Vare, Sai Gokul Subraveti, Kian Karimi. Photo: KTH University Stockholm 28.11.2023

Removal of non CO_2 greenhouse gases, methane and nitrous oxide

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 2023 we look back on our first year 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 November in a frozen Stockholm.

Although the progress of all parts of the project was summarized the focus of the meeting was on discussions about the next years and how we together can get the best synergistic effects from the project parts and involved teams and on constructive discussions for the upcoming stages, incorporating stakeholder feedback in technology development, a collaboration between experimental and modelling activities, and to maximize the effect of the dissemination and exploitation efforts.

Early adopters

One of the projects foreseen early adopters and a project partner is Valio, a dairy company that is owned by its 3500 dairy producers through their farmer co-operatives.

Valio actively participates as a key stakeholder in the project, contributing to its development and ensuring continuous integration of real-world conditions and insights. Valio is a forerunner in Finnish dairy production with a target to have a carbon-neutral milk value chain by 2035.

Over time the Finnish dairy production has taken big steps towards more nature-friendly production. Long-term efforts to improve productivity in milk production have resulted in a 37% CH_4 emission reduction per energy-corrected litre of milk. Improved milk production efficiency is mainly a result of animal breeding, better feeding, and management practices. Finnish milk production is now one of the world´s most climate efficient as the carbon footprint is approximately 1.3kg CO_2e/ECM. The feeding of ruminants is based mainly on grass and supplementary feed is based on agricultural by-products and no soy is used.

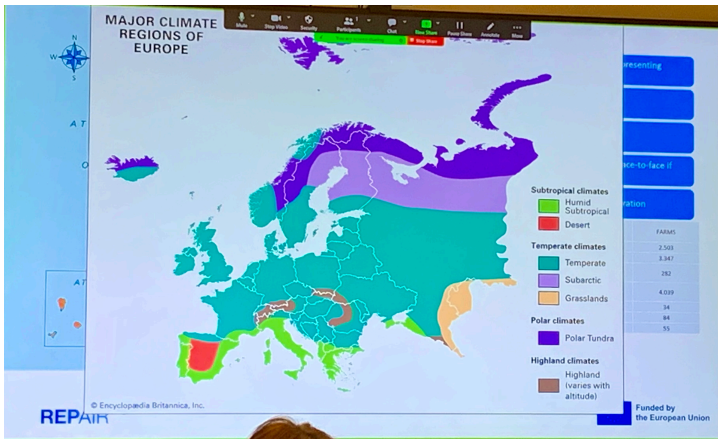
The carbon footprint of Finnish milk includes emissions from soil and consists of CH_4 emissions (40%) N_2O emissions (29%) and CO_2 emissions (31%). The outcome of the REPAIR project may become a key step in removing the remaining emissions.

Modern dairy cow barn in Finland, Image by Valio

Farm and barn conditions

Ensuring the technology development of the project remains in tune with reality involves consideration of varying conditions in different geographical areas.

Therefore, the REPAIR project also has Cooperativas Agromentarias de España, as partner in the project. They have during the year for example interviewed staff from the technical departments of total of 7 dairy cooperatives 3 of them located in oceanic climate zone (80% of Spanish milk production), 2 in continental climate (10% of Spanish milk production) and 2 in



Major climate regions of Europe

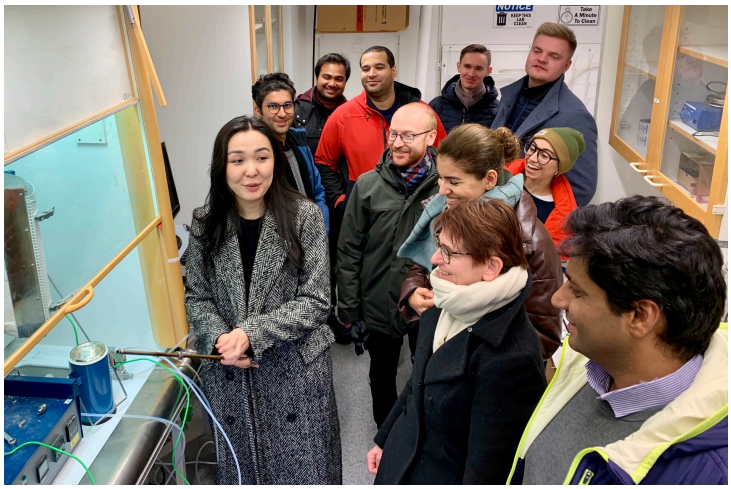
Mediterranean climate (remaining 10% of Spanish milk production) with precise knowledge of the farms in the surrounding areas. The analysis of the information gathered in this process has yielded several conclusions that can be compared to the northern Europe farms and be used in the project technology development process.

In the image, Juan Sagarna and Susana Rivera.
Spanish dairy cooperatives surveyed by Cooperativas Agro-alimentarias de España team.

Methane capture and conversion

The focus in the first year of REPAIR regarding the methane capture and conversion aspects of the project has been to identify suitable materials that can aid an efficient capture or oxidation of methane at very low concentrations (<1%-vol).

In this context, the research team at KTH has provided knowledge about photocatalysts and the team at TU Eindhoven has focused on identifying suitable sorbent materials for methane separation.



Lab visit at KTH

A recent study by the KTH team indicated that lowering the temperature in the thermal catalytic conversion route will significantly lower the energy demand. (Ref: Sirigina, D.S.S.S., A. Goel, and S.M. Nazir, Process concepts and analysis for co-removing methane and carbon dioxide from the atmosphere. Scientific Reports, 2023. 13(1): p. 17290.), and thereby the costs.

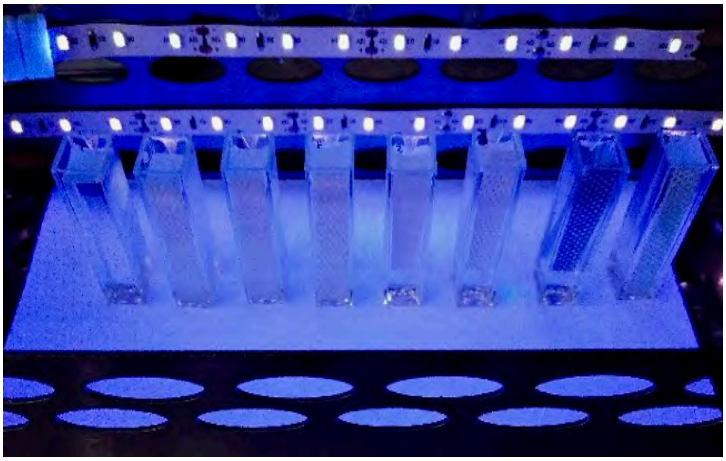
Simultaneously, the teams at Utrecht University and SINTEF Energy Research have been developing process models for methane capture using various sources of published thermodynamic data. The potential of these technologies at a system level will then be identified by CMCC. Valio and Cooperativas Agro Alimentarias de España have provided a great amount of input to start envisioning the technologies in the context of mitigating methane emissions, either through capture or conversion, from the agricultural sector.

IPhotocatalytic testing module developed by InPhoCat team (Joanna Macyk, Marta Macyk, Paweł Wyżga, Karolina Zając and Wojciech Macyk)

One of the important components of our technology is the photocatalytic module, intensively developed by the InPhoCat team from Kraków. The heart of the system is the photocatalytic cartridge, which consists of an appropriately selected light source and a photoactive filter with a carefully applied photocatalytic coating deposited on various supporting materials (e.g., fibre polymers, metal, glass wool) pre-treated using the corona discharge.

Our idea is to create a uniform system that can be installed and operated in various ventilation ducts and reactor systems. The exchangeable photocatalytic filter and the light source can be easily replaced to ensure the highest air purification efficiency. During the last year, the InPhoCat team developed effective procedures for depositing photocatalysts on various supports.

Currently, the technology is intensively tested and optimized, including the operation of photocatalytic filters and coatings in different environments. These efforts are focused on refining the system for use in barns when the technique eventually will be deployed for removing greenhouse gases.



Testing photocatalytic activity

Meet the REPAIR team

We will among others, participate in the following conference where we welcome you to meet up with us if you wish to discuss the project in person.

- The 3rd International Conference on Negative CO_2 Emissions, 18-21 June 2024, University of Oxford, UK.
- The Greenhouse Gas Control Technologies (GHGT) Conference, 20-24 October 2024, Calgary, Alberta, Canada.

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

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.

Funded by the European Union