

LIFE CLINMED-FARM

Towards a Mediterranean Climate Neutral Farm Model



The first two years of the project

LIFE CLINMED-FARM project started in September 2021 intending to **mitigate greenhouse gas** (GHG: methane, CH₄, and nitrous oxide, N₂O) and **ammonia (NH₃) emissions** which were produced in the **main stages of manure management of swine and cow farms**; that is, generation in the animals' building, external storage, and land application. **Simple and innovative techniques** are implemented at the farm level based on good practices and **best available techniques** (BAT) according to **circular economy** principles for existing and new facilities. These techniques consist of **frequent remotion** of slurry from the barns, **recovering the biogas** produced in external storage for using the energy on the farm, utilising the excess heat from biogas purification to obtain biomethane as a **renewable energy** source for nearby industries, and reducing the consumption of mineral fertilisers by optimising the management of the liquid fraction of the digestate as an **organic fertiliser** in double-cropping systems.

One of the most important purposes of the project is to **develop and validate robust methodologies for environmental** (GHG and NH₃ emissions and efficiency in biogas energy valorisation processes) and **agronomic** (nutrient use efficiency) measurement and monitoring to obtain objective and comparable data. These methodologies are used to **evaluate** the mitigation potential of the **implemented techniques** both separately and integrally at the farm level compared to traditional manure management practices.

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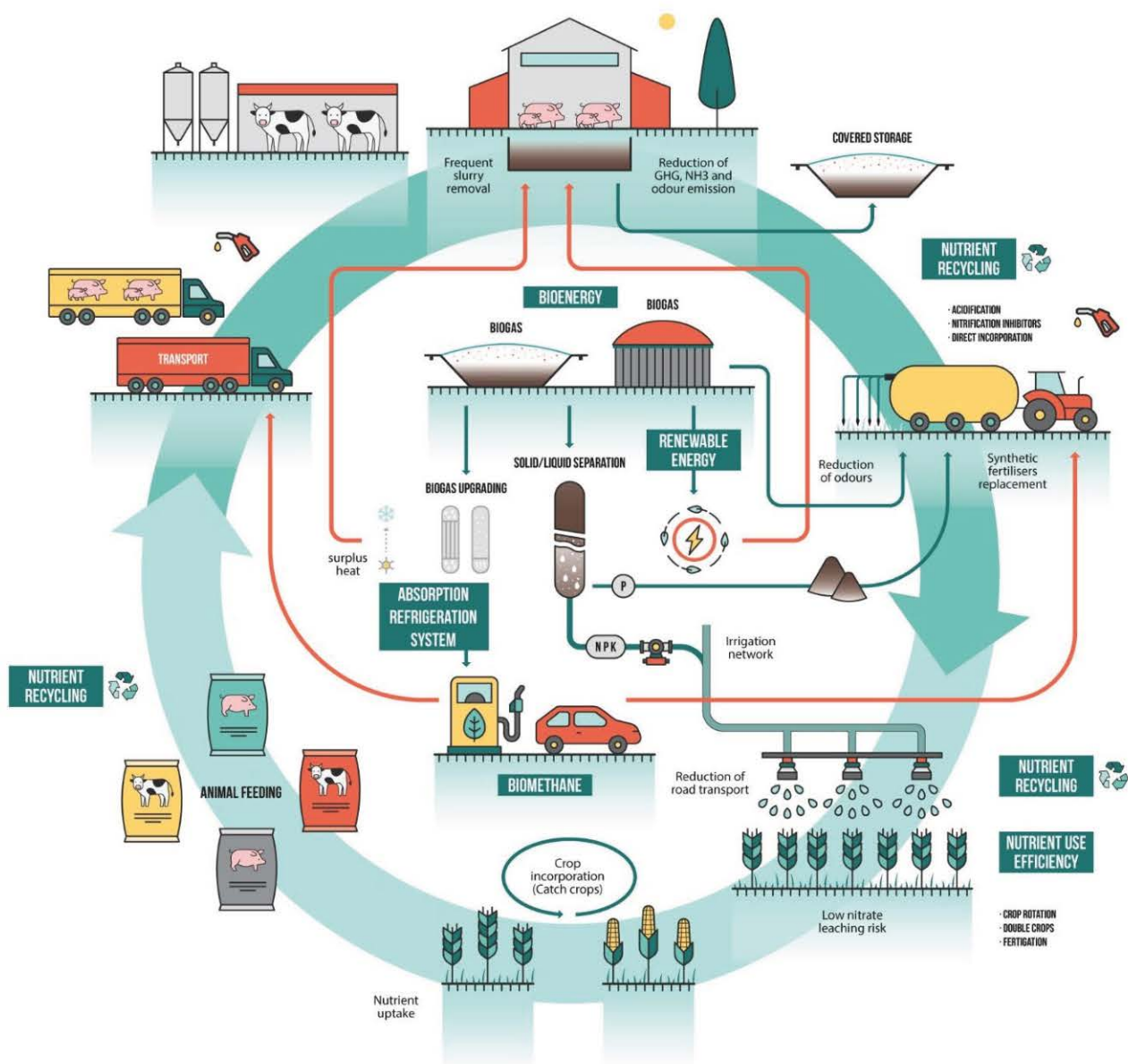
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The project conducts a comparative evaluation using a **case-control strategy**, assessing the emissions produced by applying the proposed mitigation techniques at the farm scale (*case* or demonstration scenario) against those obtained using traditional practices (*control* or reference scenario).

The emission reduction techniques are implemented in **two study cases (CS)**: a **sow farm in Aragón** (Spain, ES) and a **dairy farm in Piedmont** (Italy, IT). To learn more about the Italian study case, keep reading the following sections. The study case of Aragón will be explained in detail in the next Newsletter, so don't miss it!

Italian context of emissions

Italy is one of the leading countries in livestock production in Europe. In this country, **dairy cattle farming** is the most extensive livestock activity, representing the **main source of GHG emissions** (ISPRA, 2020), especially due to CH₄ produced in **enteric fermentation** and **manure storage** (accounting for more than 20% of national emissions) and N₂O emitted following **organic fertilisation** with slurry (more than 10% of emissions in Italy). The management of slurry and manure is also responsible for **75% of total NH₃ emissions** (Romano *et al.*, 2014), an indirect source of N₂O emissions. It is therefore necessary to adopt measures to reduce GHG and NH₃ emissions to mitigate climate change (IPPC, 2007) and move towards the environmental sustainability of agricultural and livestock activities.

Italian SC in figures



Cooperativa Speranza



Candiolo (TO), Piemonte (IT)



1.200 dairy cows & 500 beef cattle



4 anaerobic digestion plants



2 Italian partners:



University of Turin

<https://www.disafa.unito.it/>

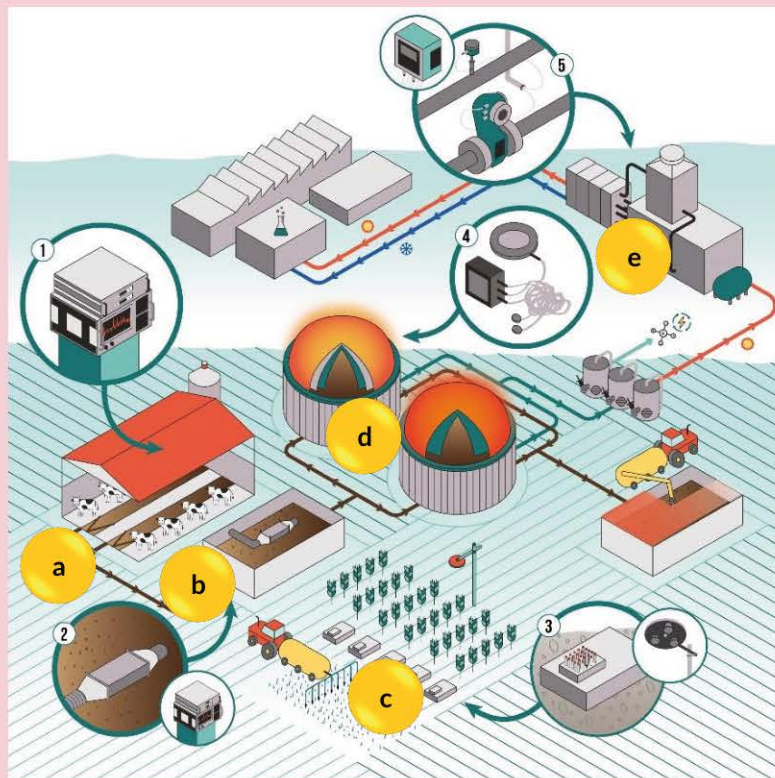


Micropower S.r.l. Unipersonale

<http://micro-power.it/>

Italian SC

The Italian study case is developed in a farm holding managed by **Cooperativa Speranza**. It comprises **mixed farms** combining **cereal and forage crops** for **milk production**, and it owns **three anaerobic digestion plants** fed with agricultural **by-products, manure, and energy crops**. The project activities are also extended to a typical **beef cattle farm (Societa' Agricola Cavaglià)** based on **permanent grassland**, which also manages an **anaerobic digestion installation**.



The LIFE CLINMED-FARM project implements the **following techniques** to mitigate GHG and NH₃ emissions in each stage above-mentioned:

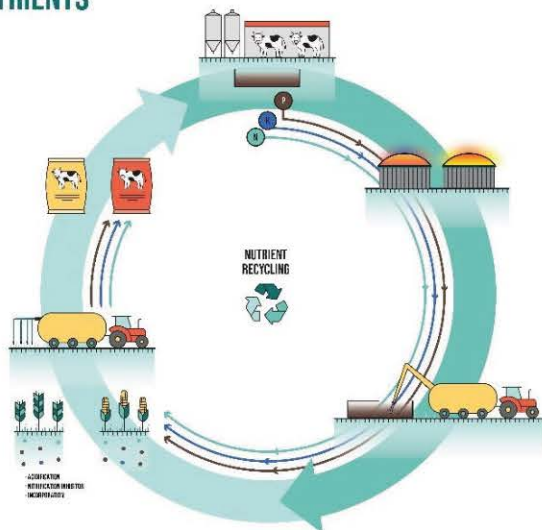
- a. **Animal housing:** **frequent slurry** and manure removal practices (increased frequency from 4 up to 12 times a day). Use of **additives** in feed, straw bedding and heaps to decrease emissions from solid manure.
- b. **Storage:** **coverage** of the external slurry tank with **natural crust** and a **fixed cover**.
- c. **Agricultural fertilisation:** use of different **fertilising strategies with digestate** in double-crop systems and permanent grassland (H₂SO₄ acidification prototype, application of the nitrification inhibitor Instinct® - Nitrapyrin 30%w/w-, coupled with band spreading and/or direct injection).
- d. **Energy use:** installation of an **energetically efficient gasometric coverage system** (Cupola M3 Heat Shield®) to reduce heat losses.
- e. **Absorption refrigeration system:** **use of the surplus heat** obtained in the biomethane upgrading process to produce cold in a nearby industry.



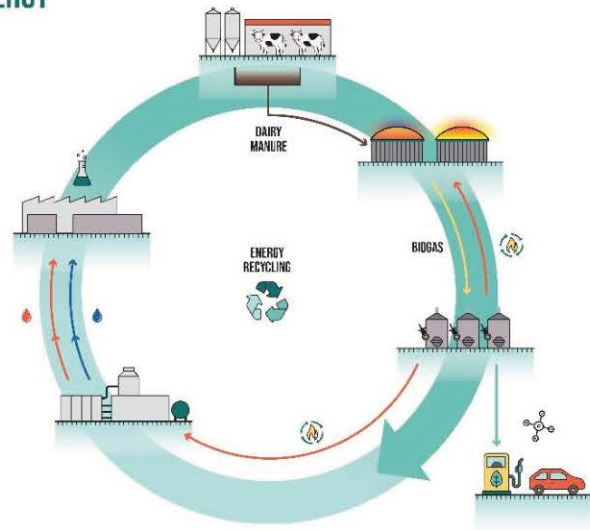
Italian SC circularity

The principles of the **circular economy** are **fundamental pillars** of the LIFE CLINMED-FARM project, and this is highlighted in the **circularity of nutrients and energy**, as illustrated in the following flow diagrams:

STUDY CASE 2 NUTRIENTS



STUDY CASE 2 ENERGY



The **nutrients generated in the barns** are **at crop disposition** after agricultural application (diagram on the left). These crops can then serve as a nutrient source for livestock if used as feed. The fertilisation **strategies** proposed in the project across all stages of slurry management lead to better **utilisation of these nutrients by reducing their losses to the environment** through NH_3 volatilisation and N_2O emission.

The efficiency of **energy valorisation of livestock excrement through the recovery and utilisation of CH_4 in anaerobic digestion processes** (diagram on the right) can be **optimised** by installing **digester covers (membranes for gas holders)** that minimise heat losses. Additionally, efficiency is further enhanced by the **production of biomethane**, a renewable energy source. This process requires **purifying the biomethane** for subsequent use as fuel, **generating excess thermal energy** which is utilised to **meet the heating needs** of industries near the livestock farm through an absorption refrigeration system.

Environmental monitoring

Environmental monitoring at various stages of livestock waste management and in both reference and demonstrative scenarios allows us to evaluate the effectiveness of proposed emission reduction techniques.

- › Buildings: using a photoacoustic spectrometer (QEPAS), we monitor carbon dioxide (CO_2), NH_3 , CH_4 , H_2O , N_2O , temperature, and wind speed to calculate emission flows by CO_2 mass balance.
- › Lagoon storage: using a wind tunnel and the photoacoustic spectrometer, we monitor NH_3 , CH_4 , and N_2O to calculate emission flows through a micrometeorological method.
- › Energy generation: monitoring the thermal flow through the covers of digesters to assess energy losses.
- › Field application: monitoring NH_3 with ALPHA[®] passive samplers and calculating emissions with the inverse Lagrangian stochastic dispersion model. Monitoring CH_4 and N_2O with closed static chambers and calculating emissions through linear regression.



Knowing our partner Department of Agricultural, Forest and Food Sciences (DISAFA) from University of Turin (UNITO)



The **University of Turin (UNITO)** is one of the most important universities in Italy, renowned for its **high-quality teaching and research and having an international reputation**. UNITO has 70,000 students, 4,000 administrative, academic, and technical staff, 1,800 postgraduate and postdoctoral students, and 120 buildings in key locations across Piedmont. UNITO is **active internationally** through the participation of its researchers in projects with foreign partners, the signing of collaboration agreements with institutions worldwide, and the offering of joint degrees and international doctoral programmes.



Its **Department of Agricultural, Forest and Food Sciences (DISAFA)**, through research, innovation, and education, aims for **environmental preservation**, the continuous and more **sustainable improvement of agriculture and forest management** to ensure **food security and resource availability**, all in favour of **economic and social progress** and the fight **against climate change**. To achieve this, the approach is **multidisciplinary**, considering biological, ecological, and productive aspects that add value to its scientific and technological role.

Thus, the LIFE CLINMED-FARM project fits perfectly with the vision and objectives of the Department.

You can find more on [Facebook](#), [YouTube](#), [Instagram](#).

Project dissemination

The project has already been **presented at several technical seminars** aimed at the sector and the public, as well as in the **scientific-technical field**, showcasing the work carried out and the initial results obtained:

- September 2023. Cambridge (UK). 18th International RAMIRAN Conference: "Recycling of Agricultural, Municipal and Industrial Residues in Agriculture Network".
- February 2024. Candiolo (IT). Meeting Regionale Frisona.
- March 2024. Amberes (BE). 6th International conference on manure management and valorization (ManuREsource).
- March 2024. Santiago de Compostela (ES). Technical meeting at l'Asociación Galega de Cooperativas Agroalimentarias (AGACA).


Also in media:



Did you miss the first
Newsletter...?
Just click here:

LIFE CLINMED-FARM

Hacia un modelo de granja mediterránea climáticamente neutra



El proyecto

El proyecto LIFE CLINMED-FARM busca integrar técnicas simples e innovadoras en las tres etapas clave de la gestión del purín (producción en las naves, almacenamiento y fertilización agrícola) con el fin de mitigar las emisiones de gases de efecto invernadero (metano - CH₄ y óxido nítrico - N₂O) y de amoníaco (NH₃). Dichas técnicas van dirigidas a extraer de forma rápida el purín del interior de las naves, recuperar el metano generado durante el almacenamiento, optimizar el aprovechamiento energético del biogás generado, valorizar el calor excedente de los procesos de producción de biometano como fuente de energía renovable para las actividades de las granjas y/o industrias adyacentes y reducir el consumo de fertilizantes minerales optimizando la gestión del digerido como fertilizante orgánico, todo ello de acuerdo con los principios de economía circular. Estos modelos se analizan desde un punto de vista medioambiental y socioeconómico desarrollando metodologías de medición de emisiones y seguimiento medioambiental y agronómico que proporcionan datos objetivos para poder ser comparados.

El proyecto monitoriza, supervisa y evalúa la eficacia y la sostenibilidad socioeconómica y medioambiental de estas técnicas, así como los posibles impactos derivados de su implementación en etapas de gestión posteriores. La evaluación centra sus esfuerzos en el desarrollo de técnicas fiables de medición de emisiones de gases y en el potencial de mitigación individual y en conjunto de cada técnica o práctica de mitigación en comparación con los sistemas de gestión tradicional.

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And in the following Newsletter...
the study case of Aragón!



Find out about upcoming
events and the evolution
of the project on our
social networks!!



@lifeclinmed



Highlighting...

- The third annual meeting of the project and the second visit by the project's external monitor took place in Turin on the 6th and 7th of September 2023.
- The first meeting of the Spanish local platform was held in Zaragoza on the 26th of September 2023. You can see the detailed news on our website: <https://lifeclinmed.eu/en/1a-reunion-de-la-plataforma-local-espanola/>
- The visit to [Hacienda Iber](#), carried out on the 25th of January 2024, was a transfer activity within the Project: <https://lifeclinmed.eu/en/actividades-de-transferencia-dentro-del-life-clinmed-farm/>

