



RES4LIVE

ENERGY SMART LIVESTOCK FARMING
TOWARDS ZERO FOSSIL FUEL CONSUMPTION

Report on co-design process

Deliverable 6.3

WP6. Clustering through stakeholder's engagement

Project title

RES4LIVE - Energy Smart Livestock Farming towards Zero Fossil Fuel Consumption

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Prepared by: EAAP

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DELIVERABLE FACTSHEET

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Approvals/ Document history

	Company/ Institution
Author/s	EAAP
Task Leader	EAAP
WP Leader	EAAP

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PARTNERS SHORT NAMES

AUA - AGRICULTURAL UNIVERSITY OF ATHENS

UNIBO – UNIVERSITY OF BOLOGNA

ATB - LEIBNIZ INSTITUTE FOR AGRICULTURAL ENGINEERING AND BIOECONOMY

EV ILVO - RESEARCH INSTITUTE FOR AGRICULTURE, FISHERIES AND FOOD

UGENT - GHENT UNIVERSITY

CERTH - CENTRE FOR RESEARCH AND TECHNOLOGY-HELLAS

AU - AARHUS UNIVERSITY

LVAT - LEHR- UND VERSUCHSANSTALT FÜR TIERZUCHT UND TIERHALTUNG GROß KREUTZ E.V.

PSYCTOTHERM - G. LIGEROS & SIA OE

PLEGMA LABS- PLEGMA LABS TECHNOLOGIKES LYSEIS ANONYMOS ETAIRIA

CRMT SAS - CENTRE DE RECHERCHES EN MACHINES THERMIQUES

TERRA - TERRA ENERGY


MG SUSTAINABLE - MG SUSTAINABLE ENGINEERING AB

CETRI - CENTER FOR TECHNOLOGY RESEARCH & INNOVATION LTD

GOLINELLI - GOLINELLI GIULIO

EAAP - FEDERAZIONE EUROPEA PER LA ZOOTECNICA

EUREC - EUREC EESV

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PUBLISHABLE SUMMARY

Deliverable D6.3 entails the creation of a common methodology, based on the OPERA, needed for the organization of a series of workshops aimed at interacting stakeholders such as local farmers, associations, technology providers (e.g. of PVs, biomass boilers) and presenting them the technologies developed within RES4LIVE. The workshops were organized in Greece, Italy, Germany and Belgium. This activity was iterated every year (3 workshops per country), in order to make sure that the activities were aligned with stakeholders' inputs.




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1. RES4LIVE – OPERA GUIDELINES FOR LOCAL WORKSHOPS

1.1 Introduction

The aim of task 6.2 “Co-design process towards energy smart agriculture” is to develop and adapt solutions that are needed by a wide range of farmers and exactly address their needs, without interfering with their everyday practices. User-friendliness is a crucial aspect, as well as maintenance needs, which can play a vital role in their investment decision. To include their needs and recommendations in the development process, frequent contact with different stakeholders will be initiated early in the project. RES4LIVE will organize dedicated workshops in Greece, Italy, Germany and Belgium with the active participation of local farmers, associations, and technology providers (e.g. PVs, biomass boilers) and present them with the proposed solutions. Their feedback will be processed, in order to be included in the development process. This activity will be iterated every year (3 in total), to make sure that the activities are aligned with the farmers’ needs.

1.2 Teams involved

The teams involved members from:


- EAAP (Taks Leader)
- AUA & CERTH (Greece)
- GOLINELLI & UNIBO (Italy)
- EV ILVO & UGENT (Belgium)
- LVAT & ATB (Germany)

1.3 Background

The approach for organizing the local workshops was discussed during two ad-hoc meetings held on 10 September and 15 December 2021 respectively.

During the meetings, it was agreed on the following:

- Creation of a common methodology and structure (duration, format, agenda, targeted stakeholders, etc.) for the local workshops;
- To use as methodology an adapted version of OPERA;
- To be adapted to the chosen topics and local environment in each of the 4 pilot countries;
- The feedback received during the workshops will be processed and included in the technology development carried out within RES4LIVE.

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1.4 Agenda

The agenda (see the draft in Annex 1) of each workshop can be flexible to be adapted to the local situations, however, it should:

- Include a common set of presentations;
- To be focused on main objectives and results;
- Comprise a presentation of the chosen technologies;
- Comprise a customized part adapted to the needs of each country;
- Include time for discussions;
- Aim at gathering valuable feedback through a questionnaire.

1.5 Audience

There is no optimal number of participants, however, during the meetings, it was agreed to have from 10 to 15 participants to facilitate interactions among stakeholders and to break them out into small groups. Moreover, it was also agreed, if possible, to keep the same participants in the three rounds of workshops.

1.6 Duration

There is no optimal duration of the workshop, but it was agreed to keep the workshops as short as possible, from half a day to one day, taking into consideration that stakeholders are busy with their daily activities.

1.7 Facilitators

The key feature to successfully implementing OPERA methodology is the facilitator, who guides the passage from one phase to another, keeps the time, gives the word, ensures the rhythm of work and respects the deliveries and operational methods foreseen for each phase. It is also advisable to appoint co-facilitators, chosen within the organizing teams, once stakeholders are broken out into small groups.

1.8 Workshops language

Each workshop will be implemented in the local language rather than using English, which may not be familiar to every participant.

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1.9 Translation of documents

The common methodology will be drafted in English, if needed it will be translated into local languages by the national teams. All technical documents, including the agenda to be used during the workshops, will be translated into local languages by the national teams. The table 1 below summarizes the features related to each national team:

	Greece	Germany	Belgium	Italy
Partners	AUA	ATB/LVAT	ILVO/UGent	UNIBO/GOLINELLI
Date of the 1st Workshops	Late September/early October 2022	Early 2023	Late 2022	Late 2022
Duration	Half day	Half day	Half day	1 day
Location	To be identified	LVAT	ILVO demo farm or meeting rooms	University of Bologna (Distal) or farming exhibition (e.g. Cremona International Livestock Exhibitions)
Facilitators	D. Manolakos M. Goliomytis	To be identified	ILVO & UGent RES4LIVE team, To be further identified	UNIBO RES4LIVE team, Golinelli and Corrado Fantuzzi
Technologies	Heat pumps, PVs, LEDs, and smart control to be installed in each farm	Biomethane upgrading; PV/T; Smart control and monitoring; Optional: other parallel initiatives at LVAT	Integrated system PVT – heat pump - smart control for pig barn; possibly align with other projects like cool pigs	Integrated system PVT - geothermal storage – heat pump for pig barn
Audience	10-15 (ideally the same ones will be involved in the three workshops)	10-15	10-15 (ideally the same ones will be involved in the three workshops)	10

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Stakeholders	Producers (pullets, eggs, meat chickens); Suppliers, and poultry equipment installers; Institutional bodies (from both livestock and energy sectors); AUA students, teaching and research staff	Tech safety authorities, Policymakers	Farmers' associations; Farm advisors; Consultants; Installers; Farmers; researchers	COLDIRETTI; TerraViva (farmers' association); Italian Agronomists; Association of manufacturers of RES systems: ANIE RINNOVABILI (ANIE - CONFINDUSTRIA); Builders specialized in livestock barns; Regional or national Government, Department of Agriculture or Environmental policies, European Association of Agricultural Engineering
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1.10 OPERA

The acronym **OPERA** identifies a five-step process. After having identified a crucial question to be considered, participants are invited to:

- O.** reflect individually (**Own suggestion**);
- P.** compare, discuss and write ideas in groups (**Pair suggestions**);
- E.** explain from three to five statements for each group to all participants at the session (**Explanation**);
- R.** ranking the suggested ideas from the most important to the least important;
- A.** **arrange** statements in a cluster of connected ideas.

1.11 Why OPERA?

OPERA is a sort of guided focus group aimed at facilitating individual reflection and collective confrontation on a theme or issue defined and shared with/among participants. It is more

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than a problem-solving method, it helps people gather in temporary groups, organizations or small community meetings to work on given subjects.

With this tool:

- Each person is able to make personal contributions (individual contributions are the trigger for a reasoned comparison with other people);
- Exchanges of ideas are facilitated, so that the reflective/elaborative process is enriched by a moment of inter-subjective deepening;
- A (written) production is requested, which is visualized, reconsidered and reassembled according to criteria shared by the group;
- A climate of equal, open and structured interaction is encouraged;
- The productions in terms of ideas and proposals constitute a collective heritage that is made available for further elaboration;
- Activities are carried out in a participatory but not dispersive manner; the management and respect for deadlines ensure results that are generally more than appreciable, sometimes excellent;
- The material produced, which can be elaborated in subsequent drafts, is quite rich: it is possible to store what has been achieved in individual work, what has emerged in small groups, what has been generated by the plenary discussion, when - in the end - the work was carried out in the plenary session.

1.12 Strong points

The main features using OPERA are:

- The itinerary goes from individual engagement to re-aggregated statements.
- The technique helps to express many ideas, refine them, present and ponder them, and reorganise ideas in a specific cluster.
- From different voices and ideas, it is possible to reach a common point of view.
- OPERA is a technique to enhance writing in groups and produce a draft that can then be rewritten and refined.
- Consensus-driven decision-making is an output of step-by-step writing involving systematic reconstruction.
- Guidance is fundamental to define the question to consider and to achieve results.


Within RES4LIVE, the methodology will be applied in the following six steps:

Phase	Objectives	Methodology	Duration	Outcomes
1. Introductory discussion	To present workshop objectives	The facilitator chairs an introductory discussion to ensure that the	5-10 min	Objectives understood



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		participants have the objectives clear		
2. Silent reflection	To reflect on the positive and negative aspects concerning the proposed technologies	The facilitator gives a few minutes to participants to think about the proposed technologies. The facilitator asks participants to write down – on a notepad – comments, challenges, issues, etc. of the proposed technologies	5-10 min (Own time)	Feedback from everyone provided
3. Think-sharing (divided in groups)	To share ideas within the groups before moving into a discussion phase	Participants discuss within the group their responses. The facilitator/co-facilitator invites groups to write about the challenges found. The facilitator gathers challenges	20-30 min	Information/ Experiences from individuals shared in the groups
4. Ranking	To classify each group's contributions	Under the supervision of the facilitator/co-facilitator, participants rank the contributions of the group. The facilitator/co-facilitator supports the group in achieving consensus in this phase.	10-15 min	Each group's contributions classified
5. Wrap up	To identify the top-ranked outcomes recorded	The facilitator collects in a (PowerPoint) template the top-ranked outcomes, information, and experiences.	10-15 min	The top-ranked concepts, information, and experiences collected
6. Plenary discussion	To present and discuss the outcomes of the group's activity	A rapporteur selected within the group presents activity outcomes. Further comments, opinions, examples and possible solutions will come out managed by the facilitator within the participants.	30-40 min	To agree on conclusions as final outcomes of this interaction.

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1.13 Instructions for Workshop Facilitators

0. Prior to the meeting

- The Leading Facilitator (LF) ensures that all participants have been provided with a list of the selected technologies;
- The LF, in coordination with the CFs, takes care to create groups of five persons of the least homogeneity (education, profession, gender, age).
- The Leading Facilitator appoints a Co-Facilitator (CF), chosen within the organizing teams, in each Group;

1. Phase 1 (Introductory discussion)

- Ensure that the participants assigned to the Group have the objectives clear;
- Ensure that the participants understand that the discussion is exclusively oriented to the objectives;
- Ensure that the participants fully comprehend the procedure and the importance of keeping strictly with the timetables drawn.

2. Phase 2 (Silent reflection)


- Ensure that each participant is equipped with all necessary tools to prepare, write down and publish his/her opinion on the selected technologies.

3. Phase 3 (Think – Group of 5 sharing)

- Ensure the technical ability to use separate “discussion rooms” for each group of five persons;
- The CF of each group should keep the discussion organized, ensure that every single one of the participants has full opportunity to express his/her ideas or opinions and work towards the formation of a general text (to be included in a template), trying to ensure:
 - i. The greater consensus possible
 - ii. The shortest length of text possible
 - iii. The clearest written expression of the results is possible.

4. Phase 4 (Ranking)

- The discussion is directed by the LF;
- All participants are encouraged to speak and argue on all texts presented;
- LF, supported by CFs, makes efforts to reach a consensus among the participants by rephrasing, reorganizing and homogenizing priorities.

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5. Phase 5 (Wrap up)

- LF, supported by CFs, excludes priorities not selected in full consensus during Phase 4 and prepares the PowerPoint file of prioritization of selected technologies agreed.

6. Phase 6 (Plenary discussion)

- The LF encourages participants to solidify the final text with examples explaining the importance of each issue and with ideas on solving each of them.

1.14 Communication guidelines

Before the workshop:

A day or two before the workshop, each country can, if they wish, make a communication mentioning the workshop. To this end, facilitators can send a message in English to Riccardo (riccardo@eaap.org) and Marlene (marlene@eaap.org) with the text to be posted within the RES4LIVE social accounts.

During the workshop:

Each facilitator is asked to:

- Take picture of participants (see Annex 3), if the event will be held in presence;
- Take one or two screenshots (see Annex 3) of the meeting if online. For this, you ask people to turn on their webcams, at least for the photo; make sure to collect the participants' information (Number of people attending, etc.).

After the workshop:

- Send the picture/screenshots and a short text (in English or your language) about the workshop to Riccardo & Marlene, who can tweet/post on project social accounts about it.

2. NATIONAL WORKSHOPS' IMPLEMENTATION

2.1 First Round of Workshops

The first round of national workshops was completed as follows:

- National Workshop in Greece organized on 28 September 2022 in Athens
- National Workshop in Italy organized on 22 October 2022 in Montichiari
- National Workshop in Belgium organized on 25 January 2023 and 1 February 2023 in Beveren and Sint-Niklaas
- National Workshop in Germany organized on 23 April 2024 in LVAT Gross Kreuz


2.1.1 Greece – 1st Round



The first Greek national workshop, focusing on egg-laying hens, took place on Wednesday 28 September 2022 (see the agenda [here](#)), on the premises of the Agricultural University of Athens (AUA). Among the participants (28 in total) were producers with a significant percentage of the national turnover of the Greek egg industry, manufacturers, policymakers, and researchers:

- VLACHAKIS SA
- ZOURAS FARM SA
- Ioannina Agricultural Poultry Cooperative PINDOS
- MEGAFARM SA
- Tetoros Machinery SA
- ANITEC LP
- V. Karabinas SA
- National Interprofessional Poultry Organization
- Department of Poultry, Pig, Breeding & Fur Breeding of the Greek Ministry of Rural Development and Food
- Centre for Renewable Energy Sources and Saving (CRES)

Dimitrios Tyris (AUA - Project Manager) and Prof. Michael Goliomytis (AUA - Poultry House Supervisor) facilitated the session, welcoming the attendees. Dimitrios Tyris initiated the proceedings with an overview of the workshop's scope and objectives, followed by a comprehensive update on the RES4LIVE activities across all areas, with a special focus on the planned interventions at the four pilot farms. Prof. Michael Goliomytis then provided a detailed presentation on the experimental laying hens facility at AUA. Subsequently, Panteleimon Bakalis (PSYCTO – Heat Pumps), Stelios Kalogridis (PLEGMA – Smart Control), Dimitrios Tyris (AUA – Photovoltaic System), and Michael Goliomytis (AUA – LED System) elaborated on the technologies that are being or will be installed at the AUA pilot farm, laying the groundwork for the upcoming discussion.

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After a brief coffee break, the goal of the next phase was to assess these technological interventions in the poultry farm, based on the presentations and the attendees' overall expertise.



Participants identified both positive aspects and potential drawbacks, which were then prioritized. The discussion then shifted towards suggestions for improvement, alternative approaches, and broader

actions that could address the identified challenges. For this part, participants were divided into groups, allowing for more in-depth discussion and collaborative problem-solving. The project team actively participated, answering as many questions as possible. Closing this first Greek Workshop, the RES4LIVE partners expressed their gratitude to the participants for their time and input and extended an invitation to attend the two upcoming workshops.


2.1.2 Italy – 1st Round

The first Italian national workshop, focused on the integration of Renewable Energy systems within livestock farms, took place on Saturday 22 October 2022 at the Exhibition Centre of Montichiari (BS), within the framework of the national Agricultural and Livestock Exhibition. The participants (10 in total) included representatives of the main national farmers' associations, members of the Agricultural Commission of the Italian Parliament, technicians involved in the design of livestock buildings, and managers of livestock farms.



RES4LIVE was presented by the teams of UNIBO and Golinelli farm, with particular reference to the technologies developed for pig barns, that were under installation in the Italian pilot farm of the project.

In particular, the innovative solution of an integrated system with a Photovoltaic-Thermal panel, Geothermal Storage boreholes and modular Heat Pump was analyzed. The discussion focused on the potential of these technologies in terms of savings in the energy budget of farms and reduction of the carbon footprint of animal production.

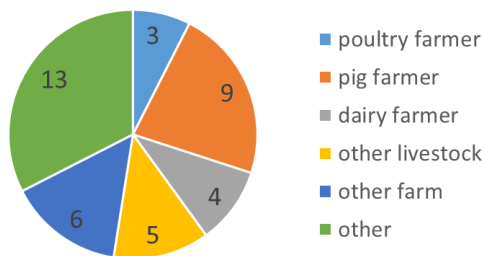
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The participants identified the main obstacle that can limit the widespread adoption of these technologies, i.e. the economic impact of the initial investment. Therefore, various proposals were formulated in terms of possible policies to support farmers in reducing the economic uncertainties of investments in Renewable Energies, as well as enhancing livestock productions carried out with sustainable low-carbon approaches. The agenda and participants list are available [here](#).

2.1.3 Belgium – 1st Round

The first Belgian national workshop, focused on appropriate renewable energy sources (RES) technology selection concerning livestock farming took place and was delivered to livestock farmers in two info session moments organized in collaboration with INTERWAAS. The sessions took place on 25 January and 1 February 2023 in the city hall of Beveren and Sint-Niklaas, respectively. The RES4LIVE project was introduced to the local livestock farmers in Belgium, with 40 participants in total.




The workshop lasted one hour and consisted of three parts:

- Introduction on RES4LIVE and available renewable energy sources in livestock farms (15 min)

State of the art on RES technologies with a special focus on the integration of photovoltaic thermal panels and modular heat pumps – the installation in the Belgian pilot farm – were presented. Individual and group discussions were held among the participants on the challenges and opportunities of selecting appropriate RES technologies for livestock farming.

- Example case: simulation results of economic and ecologic impacts of various scenarios applied to the Varkenscampus (15 min)

The interactive digital tool – developed by EV-ILVO and UGent – for informed RES technology selection was brought to the participants' attention for tryouts and feedback. With this tool, the participants had a chance to select various RES technology combinations appropriate for their farm. Then, the tool interactively provided them an insight into the investment cost and the environmental impact of the selected RES technology or technologies. Moreover, during the workshops, a running online survey for

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studying the energy consumption pattern and RES penetration at different livestock farms was promoted.

- Workshop: Hurdles, Needs, and Opportunities for Renewable Energy in Livestock Farming (30 mins)

A Mentimeter was used to gain insights into the participants' opinions. Even though the workshop was held in different cities, they belong to the same region so the results are put together.

First, we asked whether the farmers agreed (“akkoord”) or not (“nit akkoord”) with these statements.




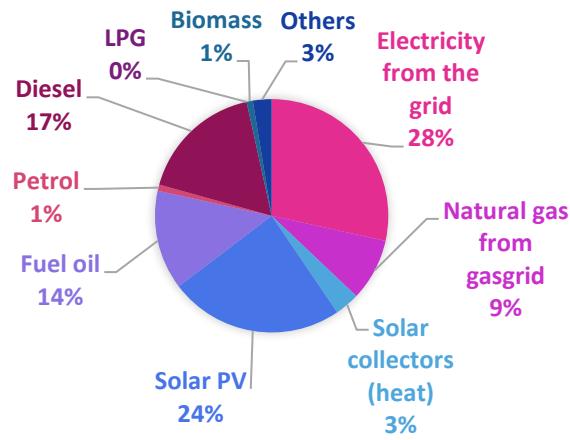
In order of occurrence, these are translated as:

1. The energy transition is necessary for livestock
2. It is financially beneficial to create my own energy
3. The installation of RES is too expensive
4. Fossil fuels are more reliable
5. The total energy use should first be reduced
6. I want renewable energy sources in my barn

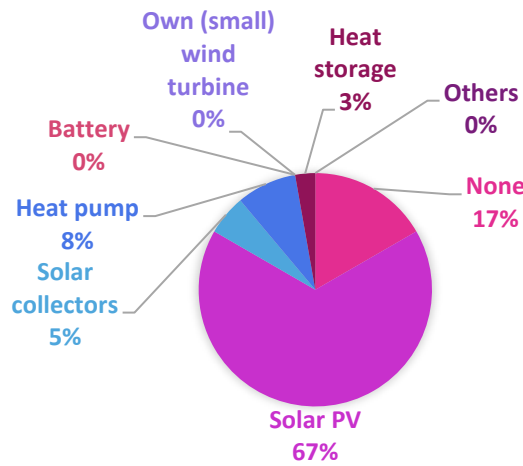
Second, we asked if the participants were interested in the interactive selection tool designed by UGent and ILVO for WP2. 54 % responded “yes”, 43 % “maybe” and one person responded “no”, showing that such a selection tool (then still in its early stages) would benefit farmers.

Third, we asked for their current energy sources (a), which renewable energy sources they have (b) and which options they are still considering (c).

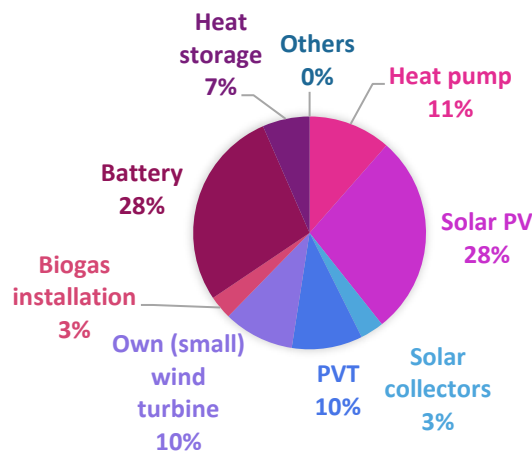
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(a)




(b)

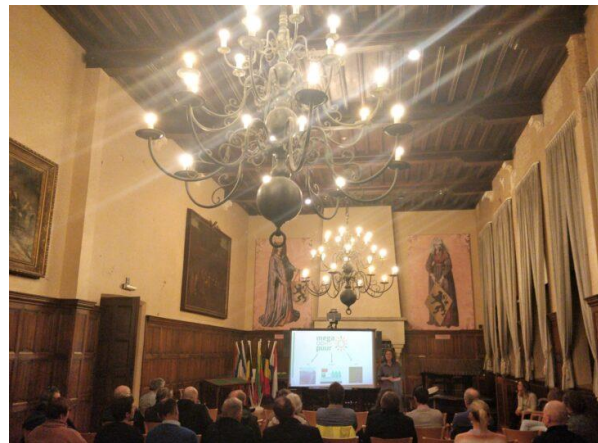
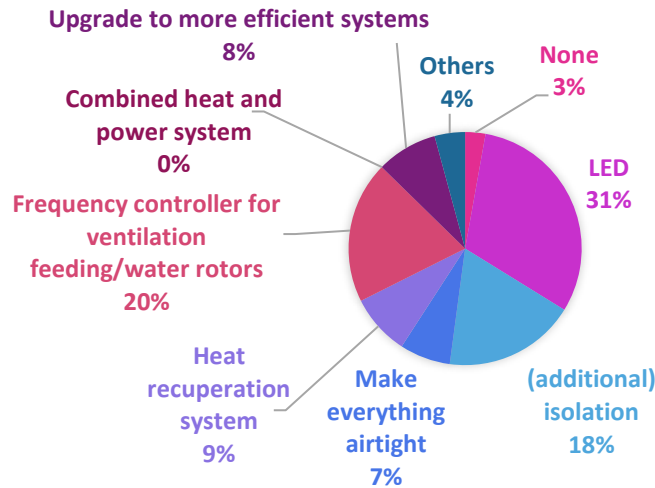


(c)

Fourth, we asked the participants to sum benefits or disadvantages of renewable energy compared to fossil fuels. Some advantages include an improved image, cost reduction in the long run, benefits for the climate and independence from energy providers.

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Disadvantages were high initial cost, not always available, long permit time, disagreement between power production and demand and higher maintenance. Finally, we asked what measures they already take to reduce their energy use.



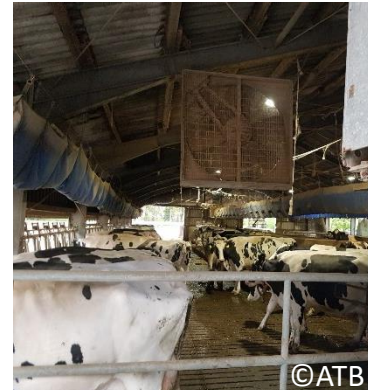
The agenda is available [here](#).

2.1.4 Germany – 1st Round

The INNORIND & RES4LIVE expert meeting on heat stress mitigation and adaptation in cattle at the LVAT tube system for barn ventilation and supply air cooling took place on 23 April 2024, marking the first RES4LIVE national workshop. The air-cooling system was demonstrated to 29 leading experts from research, consulting, and industry in Germany. The aim of the tube ventilation and cooling system is to reduce or mitigate heat stress in dairy cows by injecting pre-cooled air into the barn via a tube ventilation system, aiming at barn temperature reductions of up to 5 K. Discussions ranged from overall technical feasibility over the impact on the animals in the barn to questions of economic viability.

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Initially, the basic challenges were addressed, like having the cooling pads in the environment of a barn that will always have to deal with dust of some kind, and planning the dimensions and parameters for the tube ventilation and cooling system in a way that provides the desired effect.



The participants agreed on the need for ways to measure and assess the benefit of the system compared to alternative cooling systems, like spray cooling and conventional fan ventilation systems. The main criteria here should be the welfare and performance of the animals, as well as the energy consumption. The increased use of sensor data of different kinds in this context could allow setting up a digital twin, which could be used for optimizing the system's use, as in providing a barn climate that is beneficial for the animals at the lowest possible energy cost. The potential inclusion of feedback from the animals via sensor-based monitoring of animal welfare criteria was considered an interesting option for the future.


A positive effect of the energy consumption of the tube ventilation and cooling system is the seasonality of the application. Heat stress mitigation is directly linked to warm or hot climate conditions during the summer half-year, where non-fossil energy from e.g. photovoltaic arrays usually is available in abundance.

Overall the tube ventilation and cooling system installed in the LVAT welfare barn can be seen as a proof of concept. In-depth, long-term feasibility studies on animal health and welfare through hybrid ventilation and cooling systems are required, especially as prerequisites for further economic assessment.

2.2 Second Round of Workshops

The second round of national workshops was completed as follows:

- National Workshop in Greece organized on 14 December 2023 in Athens
- National Workshop in Italy organized on 21 February 2024 in Bologna
- National Workshop in Belgium organized on 11 June 2024 in Brussels
- National Workshop in Germany organized on 30 April 2024 in ATB Potsdam, LVAT Groß Kreuz

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2.2.1 Greece – 2nd Round


The 2nd RES4LIVE Workshop, focusing on egg-laying hens, took place on Thursday, December 14, 2023, at the Agricultural University of Athens (AUA) (see agenda [here](#)). Participants included producers representing a significant portion of the national turnover in the Greek egg industry, alongside manufacturers, policymakers, and researchers.



Dimitris Manolakos (AUA), the Project Coordinator, welcomed attendees and introduced the project's goals to those unfamiliar with its activities. Dimitrios Tyrís (AUA) followed with a detailed presentation outlining the progress made over the year since the first workshop, with an in-depth overview of the ongoing installation of RES systems at the three other pilot farms in Germany, Belgium, and Italy.

After a brief coffee break, Prof. Michael Goliomytis (AUA) and Dimitrios Tyrís further elaborated on the advancements in installing and testing the RES systems at the experimental egg-laying hens facility on the AUA campus. They presented the initial positive outcomes as well as the challenges encountered. Shortly after, participants visited the poultry house for an on-site inspection, where they evaluated the interventions and suggested improvements based on their expertise.

The insights, comments, and suggestions gathered during this interaction were combined with those from the first workshop, creating a stronger foundation for discussions about the future needs of EU agri-food sector policies.

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2.2.2 Italy – 2nd Round

On the 21st of February 2024, at the premises of Bologna’s Department of Agricultural and Food Sciences (DISTAL), a workshop titled “The Energy Transition in Livestock Farming: Problems and Perspectives Co-design meeting among stakeholders” took place. The meeting was open to stakeholders, technicians, entrepreneurs and operators in the agricultural sector and bodies and organizations involved in the energy transition process of the agro-livestock supply chain.

The meeting was coordinated by Stefano Benni, Associate Professor of Rural Construction at the University of Bologna, who gave an overview of the RES4LIVE project. The presentation is available [here](#).

Sarah Magrini, Head of Environment and Territory Area Coldiretti Emilia Romagna presented the point of view of Coldiretti, which brings together 1.5 million associated Italian farmers: Farms in the energy transition: concerns and requests. The presentation is available [here](#).

Dr. Marco Alberghini, representing Terra Viva Association of Free Agricultural Producers, articulated the perspectives of farmers, drawing from several experiences and opinions. The presentation is available [here](#).


Corrado Fantuzzi of STET-Agri followed, delving into the nuances of livestock building design and the evolving challenges faced by technicians and companies in the field. The presentation is available [here](#).

Guglielmo Golinelli, a member of the Agriculture Commission of the Chamber of Deputies and a breeder, shed light on the legislative landscape, providing a panoramic view of national policies. The presentation is available [here](#).

Dr. Davide Montagnini then presented the case study of his own agricultural company, a farm of 500 dairy cows, located in the Bologna plain, with a 200kW photovoltaic system which is scheduled to double, a 300 kW biogas plant powered with 30,000 t/year of wastewater, with the possibility of doubling and preparing the connection to the methane pipeline network for a possible upgrade to biomethane.

The Rural Construction Research Group at DISTAL, University of Bologna, discussed the implementation of a pilot project on renewable energy technologies in livestock farming, focusing on RES4LIVE and the Golinelli Agricultural Company.

Finally, during the round table and discussion (presentation is available [here](#)), participants began with a presentation on climate-changing emissions linked to various human activities, including agriculture. They engaged in dialogue, emphasizing the significance of proposed ideas and interventions. Specifically, they stressed the need for guidelines, policies, and regulations to boost agri-food production while facilitating the integration of renewable energy sources compatible with agricultural practices. Additionally, incentives for enhancing energy efficiency in agricultural and livestock buildings were highlighted. Professor Daniele Torreggiani emphasized the importance of integrating these topics into the education and training of young agronomists at all academic levels.

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The program is available [here](#).

2.2.3 Belgium – 2nd Round

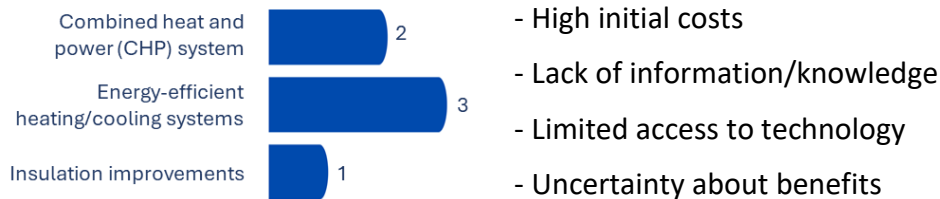


On the 11th of June 2024, during the first day of the European Sustainable Energy Week in Brussels, ILVO hosted its second national workshop, engaging conference participants, including stakeholders, policymakers, and energy experts. We had the honour of sharing a booth with EUREC and launched a survey for attendees to gather valuable insights.


4 participants filled in the survey: a dairy farmer, an agricultural consultant, an

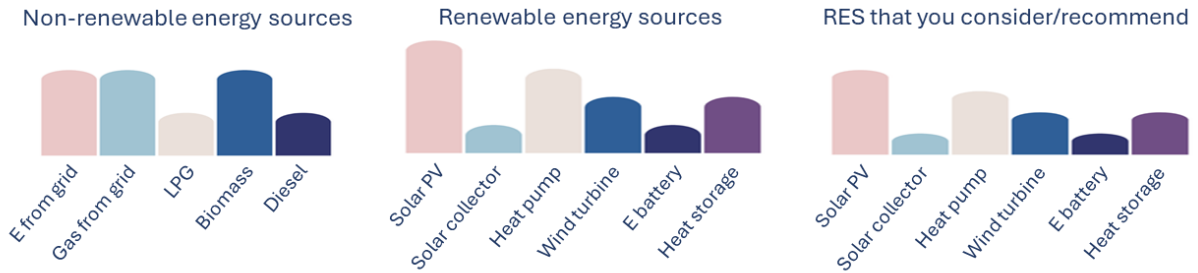
academic researcher and someone from regional government.

First, we asked what the most effective energy-reducing practices in livestock could be and the potential barriers a farmer would encounter.



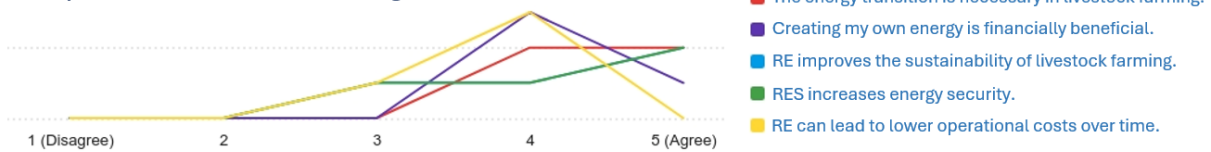
Second, we asked which sources (the participants think) livestock farmers mainly use.

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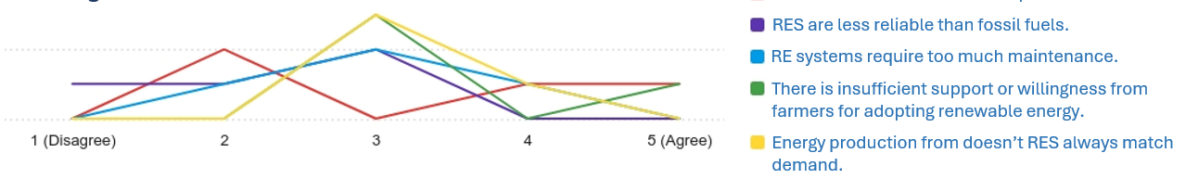


Finally, whether they agree or not with the following statements.

Perceptions of RES in livestock farming



Challenges of RE in the Livestock Sector




2.2.4 Germany – 2nd Round

On Tuesday, 30 April 2024, the 2nd RES4LIVE national workshop in Germany took place on the premises of the ATB and LVAT. This significant event drew 40 participants from diverse sectors including researchers, consultants, industry representatives, policymakers, and business figures focused on alternative fuels. The workshop centred on the technical and economic facets of the BioCNG refuelling station and explored the potential of compressed natural gas (CNG) to achieve self-sufficiency and fossil-free agriculture. Discussions also covered the market availability of CNG and biogas tractors, costs associated with refitting diesel engines, and the existing barriers hindering market development.

The event successfully highlighted the resolution of several synergy problems, demonstrating that both tractors and fueling stations are now available on the market, affirming the technical and economic feasibility of the innovations. However, it also pointed out that approval procedures remain a significant obstacle. Simplification of micro fueling stations and standardization of approval procedures were identified as crucial steps forward.

During the workshop, participants were provided with an overview of relevant economic and technical key figures, drawn from the practical operation of the BioCNG soft filling station and a series of tractors converted to CNG.

Additionally, experiences from official approval practices were shared, providing valuable insights into the regulatory landscape.

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The BioCNG fueling station, a pivotal element of the RES4LIVE research project, was showcased as a demonstration of the technical possibilities for achieving fossil-free agriculture. The project underscores the substantial bioeconomic potential of upgrading farm




biogas to biomethane or bio-CNG, which can effectively replace fossil fuels such as diesel or natural gas in agricultural operations. As part of the EU-funded RES4LIVE project, a pilot plant has been designed to upgrade biogas to biomethane/CNG and refuel series tractors equipped with methane engines. This innovation enables decentralized and self-sufficient fuel production on farms, using biogas generated from the farm's organic

residues and manure. Consequently, the fuel supply becomes independent, and greenhouse gas emissions can be significantly reduced. This breakthrough has garnered recognition and is now featured as an exemplary innovation on the European Commission's Innovation Radar Platform, marking a significant step towards sustainable and environmentally friendly agricultural practices. The program is available [here](#).

2.3 Third Round of Workshops

The third round of national workshops was completed as follows:

- National Workshop in Greece organized on 12 September 2024 online
- National Workshop in Italy organized on 9 September 2024 in Bologna
- National Workshop in Belgium organized on 18 June 2024 in ILVO Merelbeke
- National Workshop in Germany organized on 5-6 June 2024 in ATB Potsdam, LVAT Groß Kreutz and BAuA Berlin

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2.3.1 Greece – 3rd Round

The 3rd and final Greek national Workshop, on the same subject was held online via the MS Teams platform on Thursday, September 12, 2024 (see agenda [here](#)). Participants included attendees from the previous in-person workshop, as well as AUA postgraduate students specializing in renewable energy (RES) technologies and livestock farming.




Progress across all pilot farms, with a special focus on the AUA poultry house, was briefly introduced by Prof. Michael Goliomytis (AUA) and Dimitrios Tyris (AUA), particularly for the benefit of the postgraduate students unfamiliar with the RES4LIVE activities. Key achievements, such as effective temperature control and reduced mortality rates in the flock, were highlighted. Challenges were also addressed, including the dust concentration issue - previously discussed during the second national workshop - and the higher-than-expected energy consumption.

Dimitrios Tyris then presented the first concrete techno-economic results. Focusing on the heat pump and photovoltaic (PV) system, Dr. Vasileios Anestis, a post-doctoral researcher at AUA, provided a detailed overview of the environmental footprint of the egg production facility and the RES technologies implemented. A recurring observation by all presenters was that minor misconceptions during the initial design phase, along with space limitations, led to a suboptimal final design for the integrated system. Additionally, the higher energy consumption observed was partly attributed to the necessary experimentation with the newly designed innovative system.

2.3.2 Italy – 3rd Round

The 3rd workshop titled “The Contribution of Livestock Farms to Energy Independency and De-fossilization”, took place in Bologna on September 9, 2024, during a co-design meeting among stakeholders. Professor Benni introduced the workshop and the objectives of the RES4LIVE

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project, which focuses on renewable energy in livestock farming. The presentation is available [here](#).



Sarah Magrini from Coldiretti emphasized that agriculture can overcome the challenges posed by climate change only by acknowledging the primary importance of agricultural production. She also highlighted the opportunities that farm multifunctionality offers. The presentation is available [here](#).

Dr. Marco Alberghini presented opportunities for funding and public support for the installation of renewable energy systems on farms, noting that decarbonizing farm activities is often a priority in grant applications. The presentation is available [here](#).


Maurizio Gallo, Director of ANAS (National Swine Farmers' Association), gave an overview of the current state of the Italian swine sector and stressed the need to update farming practices to improve animal welfare, reduce environmental impact, and ensure energy efficiency for sustainability and competitiveness. The presentation is available [here](#).

The Rural Construction Research Group of the DISTAL of the University of Bologna proceeded to illustrate the Technologies for the use of renewable energy in livestock farming: implementation of a pilot project, with specific reference to the RES4LIVE project and the Golinelli Agricultural Company. The results of one-year tests and data analyses were described. The presentation is available [here](#).

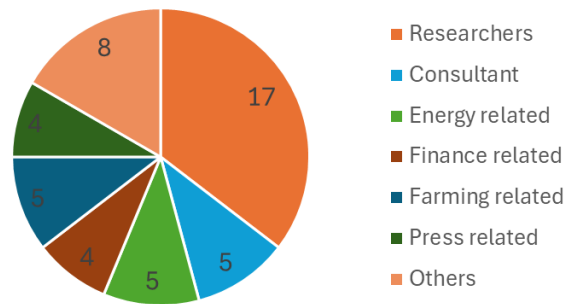
During the discussion, participants addressed difficulties in obtaining permits for building new pig farms, the need for national criteria to validate technological innovations, and the challenges farmers face in preparing applications for funding. Additionally, they discussed the lack of coordination between agricultural, energy, and urban planning policies. The program is available [here](#).

2.3.3 Belgium – 3rd Round

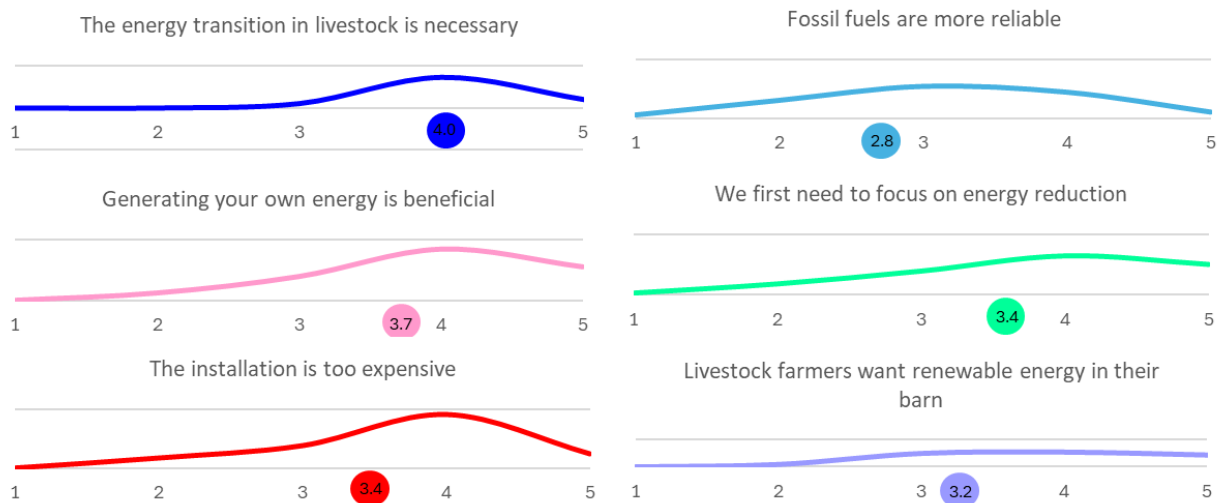
On the 18th of June 2024, the 3rd and final Belgian workshop “Cool Energy” took place at ILVO in collaboration with the Agritechdag 2024. About 130 people registered, including researchers, policymakers, financiers, contractors, and farmers.

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The workshop lasted 45 minutes. First, the results from the market study (D2.1) about available energy-efficient and renewable energy source technologies were provided (20 min). The participants were informed on how to heat and cool livestock farms in a sustainable and/or renewable way. Second, the simulation work (D2.2) and the RES4LIVE case studies were explained (10 min).



Third, the results and performances of the RES4LIVE installation at the Varkenscampus were explained in more detail (5 min). During the final 5 minutes, we asked about the participants' opinions on the same statements as our first national workshop.



Participants also cited some positives and negatives, with the main disadvantages being high investment costs, difficulties in obtaining permits, and insufficient knowledge of the technologies. The ability to connect to the electricity grid was also mentioned, as some farms lie in remote areas where the grid isn't maintained well and are unable to handle new PV or wind turbine installations. The main advantage was found to be cost-beneficial after overcoming the initial investment cost.

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During noon, a technology market was organized in which the contractors explained their services. In the afternoon, participants had the opportunity to visit the RES4LIVE installation in the Varkenscampus.




The program and further information on the event are available [here](#).

2.3.4 Germany – 3rd Round



The 3rd RES4LIVE national workshop in Germany took place in cooperation with the EmiMod project meeting on 5 and 6 June at ATB Potsdam, LVAT Groß Kreutz, and BAuA Berlin. Among the 37 participants were members of main research facilities & universities, industry, and consulting in livestock with a focus on emission mitigation. Therefore, the subject emissions were also taken up as a topic to further look into. The relevant interventions for this at the LVAT farm are the


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BioCNG upgrade plant and filling station and the tube ventilation and cooling system.

The possibility of defossilisation of a farm tractor and vehicle fleet was widely acknowledged by the participants. Economic aspects were quickly recognized when results of data analyses showed that one CNG tractor of medium power level only utilizes the BioCNG plant to about 15 %, indicating again that farms willing to invest in such a plant need to have a concept for usage of at least 75 % of the time to make the plant feasible. Investment in the BioCNG upgrade plan should come with a business plan that also includes potential users external to the farm. Future emission-related studies should also include the composition change of the biogas due to the off-gas that is reverted to the biogas plant. This might have an impact on the efficiency of the engine in the combined heat and power plant. More in-depth life cycle and economic analyses are required to assess the overall environmental impact and also social acceptance.



The main emission-related question about the tube ventilation and cooling system was if this actually could also contribute to emission mitigation in peak times due to cooling down the air in the barn. Specifically, ammonia emissions are known to depend on temperature, and this could be another topic to investigate. The synergy of improving barn climate while using solar energy at relevant peak times was also noted.

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3. CONCLUSIONS

3.1 Outcomes from the Greek Workshops

The first two workshops attracted a significant number of producers and equipment manufacturers. Several farmers had prior experience with renewable energy systems, particularly photovoltaics, which appears to be the most commonly used option. Many participants shared similar opinions and reactions. The third workshop drew only a small number of producers, primarily researchers.

Overall, the three workshops indicated that Greek livestock farmers are keen to integrate renewable energy solutions and energy efficiency measures into their operations. Their objectives include reducing the overall energy consumption of their facilities and achieving energy self-sufficiency. The motivations for adopting renewable energy sources include long-term financial benefits, increased independence from the grid and energy suppliers, and an improved overall reputation. Additionally, the potential for enhanced animal welfare - leading to increased productivity through the use of renewable technologies - also garnered attention.

Despite this interest, participants identified insufficient knowledge about available technologies as a barrier, along with the relatively high investment costs. Furthermore, challenges in obtaining permits and the absence of structured government guidance were noted as significant obstacles.


These findings highlight the importance of the RES4LIVE initiative, which aims to educate farmers on energy-efficient practices and the integration of renewable energy sources. The policy recommendations from RES4LIVE can assist policymakers in addressing challenges such as obtaining permits and managing substantial investment costs.

The stakeholders' feedback, gathered throughout the three Greek National Workshops, is summarized in Annex 4.

3.2 Outcomes from the Italian Workshops

The stakeholders who participated in the three Italian Workshops focused on the importance of developing guidelines, establishing agricultural and energy policies and issuing regulations that enhance agri-food production, and at the same time allow the creation of energy production plants from renewable sources that are compatible with farming and land cultivation. The participants also underlined the regulatory and bureaucratic difficulties for the installation of RES technologies in farms and therefore highlighted the need for a simplification of the procedures, declarations and authorizations. Moreover, the importance of incentives for the energy efficiency of agricultural and livestock buildings was highlighted.

The stakeholders agreed on the following conclusions:

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- A combination of state aid and contributions to support the annual costs of RES in farms must be activated, to accumulate at least 90% of the overall cost of the investment;
- A brand similar to organic would be appropriate for zero-carbon farming;
- There is a need to have criteria regulated at least at a national level, to objectively validate the technological innovations proposed by the various companies operating in the livestock sector;
- There is a lack of coordination between community agricultural policies, energy policies and land-use planning policies, which should instead be integrated.
- Teaching and lifelong learning of technicians in the animal production sector should focus on RES integration in livestock farms from a scientific and technical point of view, as well as the relevant administrative procedures.
-

3.3 Outcomes from the Belgian Workshops

The first workshop was part of an information session on “Renewable Energy for Farmers.” About 50 % of the audience were livestock farmers with a general interest in energy. Most of their views and responses were aligned. The audience appeared quite progressive, with 67 % already having solar PV installed and 8 % using heat pumps.


The second and third workshops attracted fewer livestock farmers and more policymakers, stakeholders, consultants, and researchers. These participants shared their opinions and perspectives on livestock farmers.

From the three workshops, we concluded that Flemish livestock farmers are willing to install renewable energy but would first like to reduce their overall energy use. The main hurdles include insufficient knowledge about available and effective technologies, difficulties in obtaining permits, and high investment costs. The drivers for installing renewable sources include long-term cost benefits, independence from the grid and energy providers, and an improved overall image. Other participants, who weren’t livestock farmers, had similar opinions although their replies and perspectives were more varied.

These findings back up the importance of the RES4LIVE project which aims to inform farmers about the possibilities of energy-efficient measures and the integration of renewable energy. RES4LIVE’s policy recommendations can help address some of the hurdles to the policymakers, such as permit acquisition and high investment costs.

3.4 Outcomes from the German Workshops

Talks and exchanges with experts and practitioners during the three workshops about the RES interventions at the LVAT experimental dairy farm have shown that the different technologies are in various stages of development. The tube ventilation and cooling system looks promising, but several open questions were raised in the discussions that yet have to be answered and likely require monitoring and analyses beyond the scope of RES4LIVE.

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The PVT system as well as the BioCNG upgrade plant are logical and straightforward advancements of already existing technologies that just require an adequate adaption to the relevant conditions on a farm. Within these boundaries, they were considered ready for the market by the participants. Both were deemed suitable solutions for the defossilization of livestock farms when implemented following the best practices.

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ANNEXES

Annex 1 – Workshops’ agenda template

Time	Duration	Session	Aims	Materials who does what
	5'	Introduction	Welcome Presentation of the session Rules of the sessions	PPT slides
	30'	Engagement procedure Round Table	Presentation of the project and the role of the participants 1) Be sure that both the project and aims of the workshops are clear for everyone 2) Highlight there are benefits for them and the projects 3) Explain it will be a participatory process, a co-design Know and understand each other. Learn more about the participants (jobs, background, vision and needs related to the topic...) Start building the trust Make sure everyone speaks	PPT slides Representative of the project (National Facilitator)
	15'	Break		
	1h	Presentation of selected technologies		PPT slides and To be identified
	2h	Implementation of the methodology	Work together on selected technologies The facilitator must: 1) Foster exchanges between participants 2) Make sure everyone speaks and is involved, heard, can explain points of view	OPERA Guidelines National Facilitator

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	15'	Conclusion	Evaluation of the workshop (collect the feedback of the participants regarding the session organization, and methods...)	PPT slides
	To be defined	Field tour (optional)		

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Annex 2 - Workshop invitation letter template

PROJECT HEADED PAPER

Invitation to attend RES4LIVE xxx [country] Workshop

Dear xxx,

RES4LIVE (<https://res4live.eu>) is an EU H2020-funded project that started on 1st October 2020 and will last for 4 years. The main aim of RES4LIVE is to develop and bring into the market integrated, cost-effective and case-sensitive RES technologies in energy-intensive livestock farming (swine, dairy and poultry) in order to achieve fossil-free livestock farming. Dedicated solutions will be proposed, demonstrated in 4 pilot farms (in Belgium, Greece, Italy and Germany) and evaluated technically, economically, environmentally, and socially.

This multi-partner project is led by AUA in Greece, with 17 partners from 8 countries. A multi-actor approach will be used to engage with stakeholders more widely. In this way, we will build on existing experience to develop a better understanding of expectations in terms of innovative technologies and provide adapted solutions to livestock farming. The success of the project very much relies on the support and involvement of stakeholders.

The (country) Workshop is organized [as a virtual event] to meet relevant stakeholders and gather views on the proposed technologies to be implemented in [your country], and to consider how this new project might best be able to address the relevant issues.


We would be delighted if you would participate in this Workshop on the [date] from [start time] to [finish time]. Your views will be greatly valued. Please contact [LF of the country] to confirm whether or not you are able to attend.

Full joining instructions will be provided in advance of the workshop. To help facilitate discussions, we will provide you in advance with the selected technologies for [your country], as identified by our colleagues.

I am looking forward to hearing from you,

Best regards,

Xxx (LF of the country)

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Annex 3 - Workshop disclaimer

xxxx WORKSHOP

DISCLAIMER

By signing the workshop registration and attending the workshop,

I agree that:

- the findings from this workshop may be used within the project activities and reports to the European Commission
- photographs and/or videos may be taken and used for dissemination purposes and/or within the reports to the European Commission

I am aware that:

All information will be treated as confidential and no quotes, comments or findings within the reports will at any stage be made attributable directly to my identity or that of any other workshop participant.

I confirm that:

I understand the purpose of this Workshop, and that, at any time, I can withdraw during the activities, and ask for my information to be deleted.

Name :

Place :Date : .../.../2022

Signature :

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Annex 4 – More feedback from the Greek national workshops

HEAT PUMPS	i.	Equipment financing/subsidy policies	Initial cost (installation)
	ii.	Tax exemptions/ Low interest rate for the first period	
	iii.	Financing through energy saving	Performance/ Depreciation
	iv.	Combination with Photovoltaics (PV), Thermal Photovoltaics (PVT) and heat recovery systems	
	v.	Need for combination with Building Management Systems (avoid wasting energy)	
	vi.	Promotion of geothermal heat pumps	Information campaign
	vii.	Information for a proper study and selection of a suitable system on a case-by-case basis	
	viii.	Public information policies	Certification
	ix.	Certification of agricultural facilities utilizing RES	


SMART CONTROL SYSTEM	i.	Addition to "Subsidized Technologies"	Initial cost (installation)
	ii.	More economical sensors	Depreciation
	iii.	Sale to data analytics companies	Installation's Performance
	iv.	Correct installation technology assessment	Complexity
	v.	Secondary system for dealing with power outages	
	vi.	Training personnel on how to operate	

LEDs	i.	Subsidizing equipment	Initial cost (installation)
	ii.	Incentives to reduce the overall energy footprint	Depreciation
	iii.	Efficient fee for recycling	Installation's Performance
	iv.	Use of voltage stabilizers	Animal Welfare
	v.	Mirrors for better diffusion of light	
	vi.	Selection of high frequency lamps	

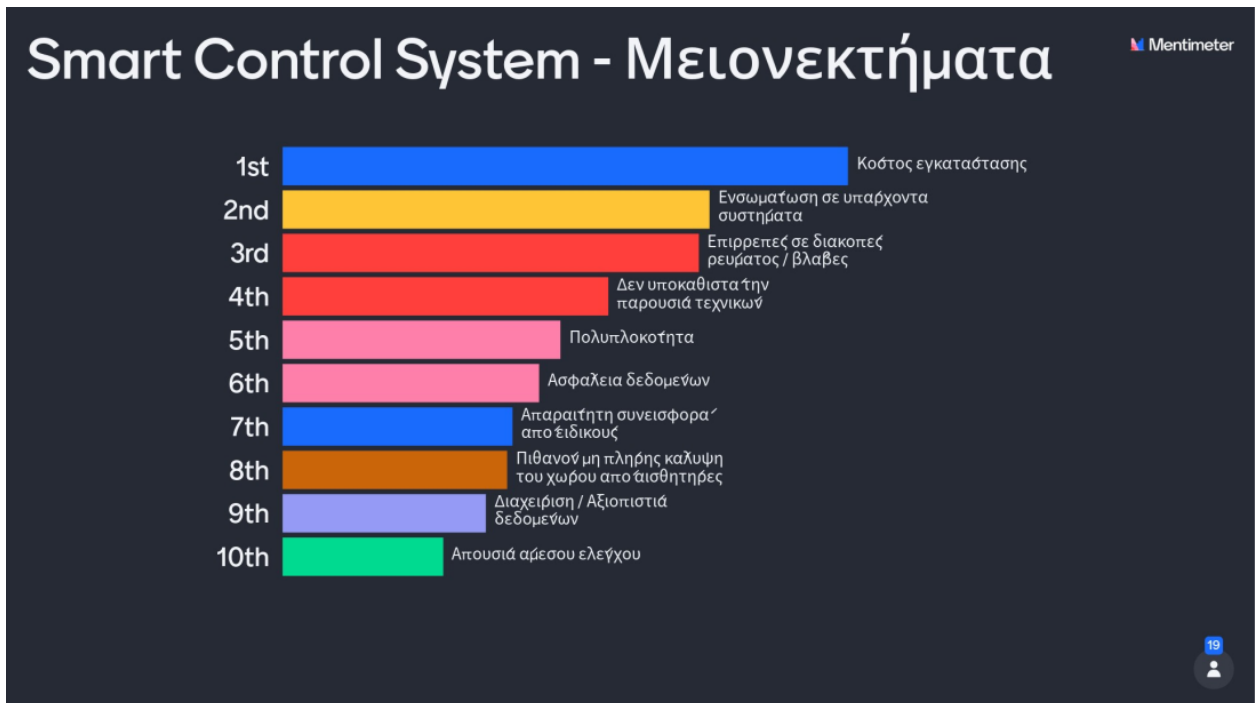
PHOTOVOLTAIC PANELS	i.	Equipment subsidy and funding - Stable policy framework	Initial cost (installation)
	ii.	No subsidy for installations on productive land (exploitation of available areas of building units)	
	iii.	Facilitation of licensing / connection to the network (avoiding the installation of batteries)	
	iv.	Virtual net metering for agricultural/ livestock units	Depreciation
	v.	Policies prioritising licensing - Stable policy framework	Authorisation
	vi.	Priority licensing in farms/ buildings for self-production (instead of cultivated areas)	
	viii.	Certification of installations using Renewable Energy Sources (RES)	Certification
	ix.	Recognition and special labelling of products using RES	Information campaign
	vii.	Funding a campaign to promote consumer awareness	

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Overall, based on your experience, how would poultry farmers view the project's interventions? Would they consider investing? Are they concerned about the issues raised?		
1	Given the escalating energy costs, leading to increased production expenses, consumers will inevitably shoulder the burden of these rising costs over time.	Socio-economic
2	The level of receptivity towards project interventions varies among poultry producers; while younger individuals tend to be more open to them, the older average age of producers correlates with lower interest levels.	Social
3	Many experienced farmers had hoped that the younger generation would drive further advancements, but unfortunately, this hasn't materialized yet, as economic concerns remain paramount for everyone.	Socio-economic
4	Expensive technologies inherently pose challenges. From a legislative perspective, farmer compliance could drive adoption, potentially spurred on by Development Programs setting the agenda.	Economic/ Legal
5	Photovoltaic (PV) panels represent the most widely adopted renewable energy source (RES) technology, largely due to supportive regulatory frameworks.	Legal
6	While heating remains relatively uncommon, there's an emerging trend of integrating PV and heat pump technologies.	Technical
7	Even traditional technologies, such as exhaust fans, have evolved to become more energy-efficient. However, precise data on energy consumption and investment costs are essential to incentivize producers to embrace RES technologies.	Techno-economic
8	Maintaining precise temperature control within farms is crucial to ensuring animal welfare and productivity.	Technical (animal welfare)
9	Integration of the ventilation system within innovative setups is essential, as standalone operation does not seem feasible.	Technical (animal welfare)

	Document:	D6.3 Report on co-design process		
	Author:	EAAP	Version:	1
	Reference:	D6.3 RES4LIVE ID GA 101000785	Date:	27/09/2024

Pros and Cons identified during the three Workshops:



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	Author:	EAAP	Version:	1
	Reference:	D6.3 RES4LIVE ID GA 101000785	Date:	27/09/2024

Αντλίες Θερμότητας - Πλεονεκτήματα

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Αντλίες Θερμότητας - Μειονεκτήματα


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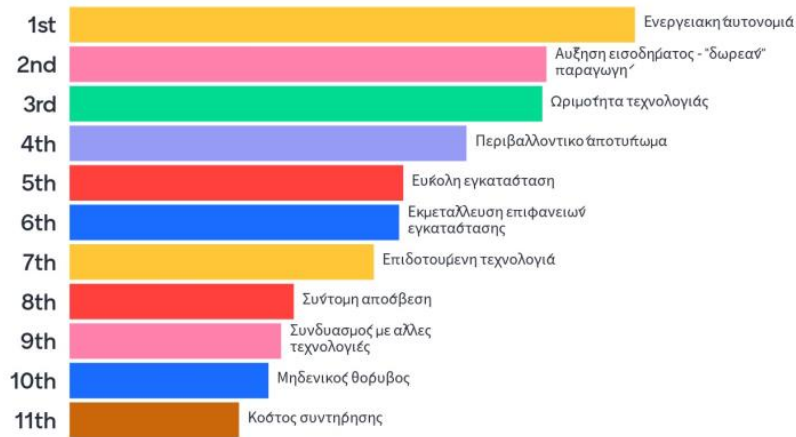
	Document:	D6.3 Report on co-design process		
	Author:	EAAP	Version:	1
	Reference:	D6.3 RES4LIVE ID GA 101000785	Date:	27/09/2024



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Φωτοβολταϊκά πάνελ - Πλεονεκτήματα

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Φωτοβολταϊκά πάνελ - Μειονεκτήματα

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