RES4LIVE

ENERGY SMART LIVESTOCK FARMING
TOWARDS ZERO FOSSIL FUEL CONSUMPTION

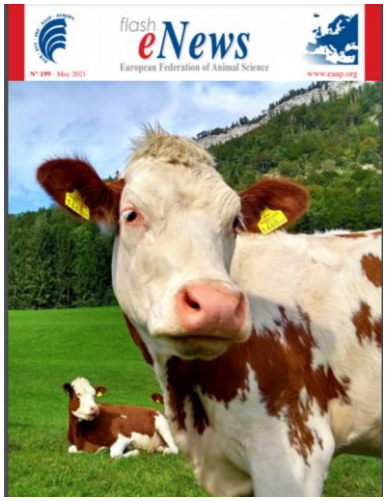
Newsletter - Issue 2

July 2021

The RES4LIVE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement N°101000785.

SUMMARY

H2020 project RES4LIVE 2nd Consortium Meeting



Cover page of the issue no. 199 of the EAAP e-newsletter where the article appeared on 11th May 2021

The RES4LIVE consortium met again, after its first semester, from 15th to 16th of April 2021. The 2nd Consortium Meeting was organised by our Italian colleagues in UNIBO and was held via teleconference, to comply with the current COVID-19 restrictions. Stefano Benni (UNIBO, Italy) opened and moderated the meeting, while over 45 participants from the 17 RES4LIVE partners, from industry and research, have been able to share preliminary results and to set the basis of the upcoming work steps. Project coordinator Dimitris Manolakos (AUA, Greece) presented the current stage of RES4LIVE. The participants from all the participating organizations introduced themselves and the newly formed Advisory Board - composed of notable professionals and academics - gave a brief presentation of their position and expertise. The major achievements within the eight Work Packages (WP) were presented to the consortium and next steps were discussed and decided. During the first day, the work done in the framework of the first three WPs was analyzed. The progress of adapting innovative Renewable Energy Sources (RES) technologies in livestock farm's needs (WP1) was examined, and the preparatory work of identifying market available RES and energy efficiency solutions, machinery, and practices for livestock farms (WP2) was presented. The preliminary data gathered for the energy flows assessment, smart control, and simulation purposes (WP3), indicated that more excessive work in this context would be of great interest. The second day started with the discussion abouts the preparation of pilot farms for the implementation and testing of the RES4LIVE proposed solutions (WP4), a challenging task that will act as reference point for the whole project. The preparatory work regarding the needs of technical, socio-economic, and environmental assessment of the interventions in the pilot farms (WP5), showed that a proactive approach for the data acquisition should be followed. In the field of clustering, communication, and dissemination activities (WP6, WP7), our first Cluster formation, as well as the established presence in social media, were introduced. Also, an overview of the work done from the managerial perspective (WP8) and the necessary actions to be taken for the efficient continuance of the project, was given by the project coordination team. The 2nd RES4LIVE Consortium Meeting was concluded with the hope to meet again next October, this time - conditions permitting - in person. The RES4LIVE project: "Energy Smart Livestock Farming Towards Zero Fossil Fuel Consumption" receives funding from the European Union's Horizon 2020 Research and Innovation Programme, under Grant Agreement No. 101000785. To find out more, visit RES4LIVE official website, as well as our social media accounts (LinkedIn, Twitter and Facebook), or contact Project Coordinator Prof. Dimitris Manolakos (dman@aua.gr), and Assistant Project Manager Dimitrios Tyris (dtyris@aua.gr).

Adaptation of innovative technologies for livestock farming

As we are currently in the tenth month of RES4LIVE, the works of Work Package 1 (WP1) are on full development. WP1 focuses on the adaptation of innovative technologies so that to perfectly fit the condition and environment entailed by livestock farming. Promising Renewable Energy Sources (RES) technologies capable to greatly serve the vision of de-fossilising livestock farming are the:

1. On farm production and upgrading of biogas to biomethane, by ATB
2. Adaptation of a farm tractor for biomethane use, by CRMT
3. Adaptation and testing of the flexible heat pump, by PSYCTOTHERM
4. Development of PVT (Photovoltaic thermal collectors) system designs towards standardisation, by MG Sustainable

Up to now, the initial designs have been finalized, the expected performance and cost-related parameters have been confirmed.

1. <u>On farm production and upgrading of biogas to biomethane</u>

ATB has undertaken the task of upgrading a biogas plant to produce biomethane, utilizing the membrane separation technique. Through this, the biogas would be initially purified from H_2S and then compressed to a higher pressure to allow its separation from CO_2. Then, a clever sequence of separation stages combined with CO_2 recovery will allow the 100% separation of methane. The recovery of CO_2 facilitates the 100% CH_4 separation from biogas and subsequently provides food safe CO_2 that is produced with further compressing of the part containing CO_2 after going through the membrane separation. The CO_2 is subsequently liquefied, while non-condensable gases are separated within a downstream separator and conveyed again to the membrane unit. A schematic overview of the initial design for the biogas upgrading unit in LVAT pilot farm, is provided in Figure 1.

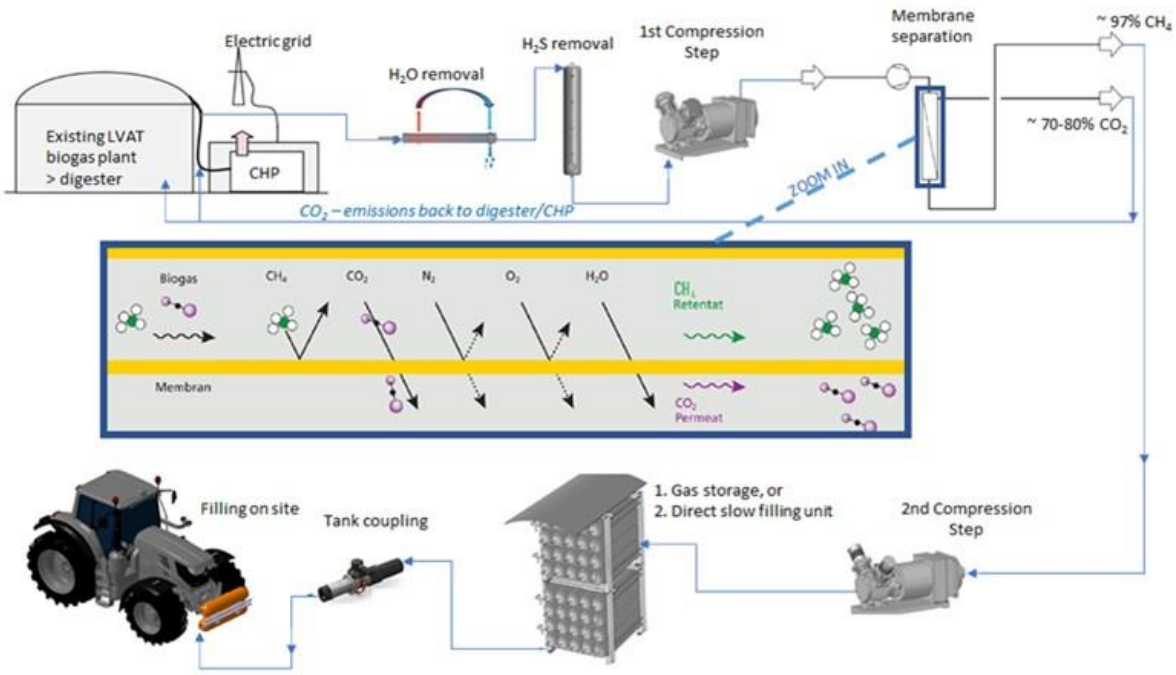


Figure 1. Schematic overview of biogas upgrading unit (*source: Apex AG/ Final Report Blue Bonsai/ Swiss Confederation, parts of images and text (modified by Wannasek, L.)*

The plant layout and an indicative positioning of measurement equipment is presented in Figure 2.

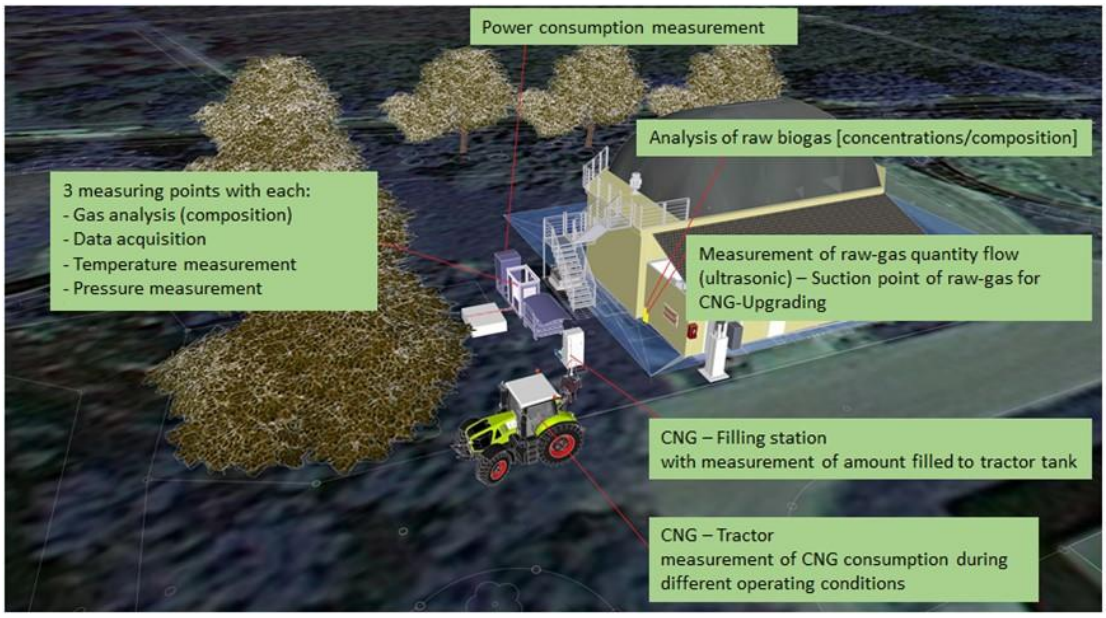


Figure 2. Plant layout and equipment positioning.

The main performance parameters of the biogas upgrading unit can be summarized as follows:

Biomethane production flow rates:

Raw gas: 10-12 m^3/h

Product gas: 4-6 m^3/h

CH4 contents:

Raw gas: ~52%

Product-gas: ~95-98%

Recycle-gas: ~15-25% (to CHP or digester)

Gas compression:

Raw gas: up to 14-18 bar

Product gas: up to 250 bar

Power supply:

10-13W

2. Adaptation of a farm tractor for biomethane use

The RES4LIVE concept includes the conversion of a diesel agricultural tractor to be fueled by biomethane, which is an alternative energy solution to small diesel tractor owners. The retrofit conversion process concerns two aspects: the engine and the vehicle transformation. The competitive advantages of the CRMT kit are that: (i) uses its own complete all-in-one ECU (open platform), (ii) is suitable for CNG, LNG and biomethane, (iii) has full control system (CRMT 5+), which is a flexible and open system capable of being adapted to different vehicles and fuels, and (iv) greatly reduces emissions (targeting Euro VII emissions standard). The tractor's capabilities will be the following:

Table 1. Farm tractor required capabilities.

Operation	365	days/year
	2-5	hours/day
Diesel consumption	10-20	lit/day
	350-600	lit/month
	6000	lit/year
Speed in the field	10-25	km/h
Speed on the road	10-35	km/h

The conversion concerns the design of the following parts:

1. Piston
2. Cylinder Head
3. Air Inlet Line
4. Ignition and management system
5. Biogas storage
6. Gas regulation system
7. Exhaust Line

To get an idea, the gas regulation system, and the positions of biogas storage system are presented in Figures 3 and 4 respectively.

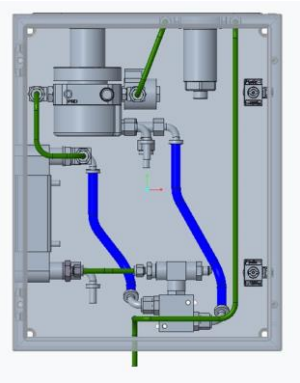


Figure 3. Gas regulation system.

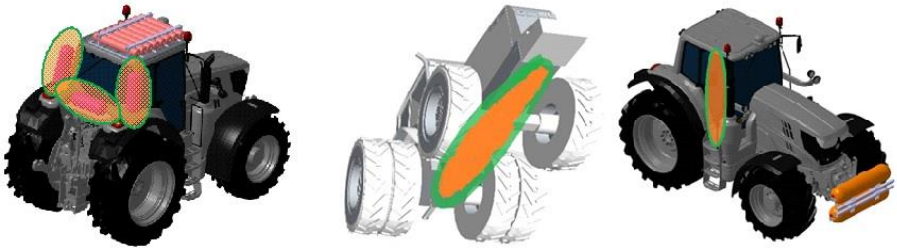
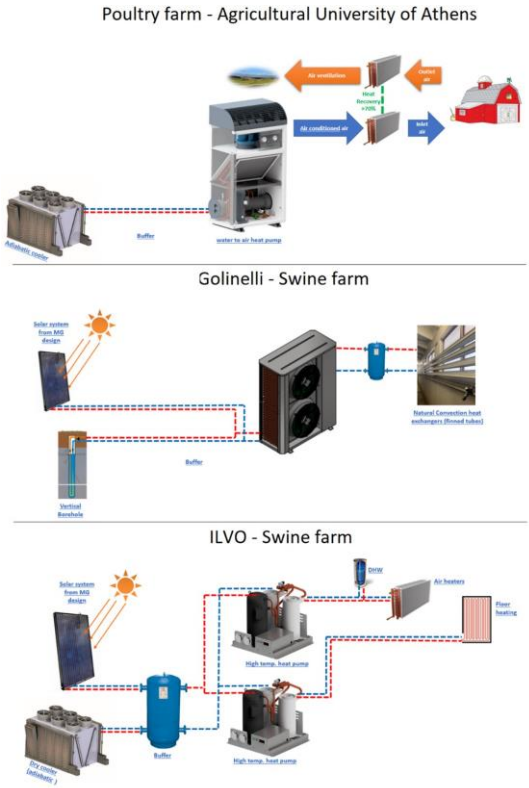


Figure 4. Positions of the biogas storage system.

3. <u>Adaptation and testing of the flexible heat pump</u>



A modular heat pump unit will be advanced based on the relevant expertise of PSYCTOTHERM, and its heat recovery options, relying on its expertise of heat pump designing and manufacturing for domestic and industrial buildings. This heat pump will provide heating, cooling, and dehumidification to the livestock buildings, for maintaining a proper indoor thermal environment and air quality, which is crucial for the health conditions and welfare of the animals. It operates with a much lower energy demand ensuring its cost-effectiveness (i.e., 1 kWh of electricity produces about 4 kWh of heating), and with a lower environmental impact than diesel oil, LPG or gas boilers (i.e., 50% less CO2-eq. emissions compared to gas). The different heat pump arrangements to be installed in the three of four pilot farms are presented in Figure 5.

Figure 5. Adapted heat pumps for the pilot farms.

4. Development of PVT system designs towards standardisation

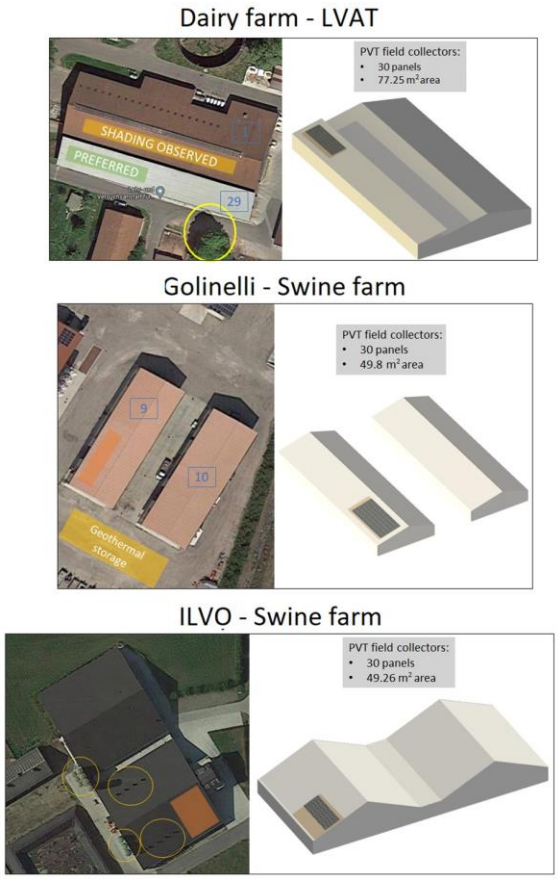


Figure 6. PVT panel positions in the pilot farms

PVT systems are an excellent choice for livestock farming as they combine the simultaneous generation of heat and electricity, which is usually aligned with the energy needs of most livestock farms. MG Sustainable Engineering will develop dedicated PVT system designs for 3 of the 4 pilot farms according to the farms' energy needs based on standardised procedures with the aim to reduce system cost for an easy and fail-proof system installation in livestock farms, while increasing the capacity factor to exploit all energy produced by the sun in a daily basis.

Apart from addressing the individual energy demands and existing systems, the designs will be realised to best integrate the solar system with other RES technologies to be implemented in the farms, such as heat pumps and geothermal energy.

A standardised design of the solar thermal circuit (solar station) will be researched and designed to be implemented in all 3 pilot farms despite different use of heat and heat storage requirements. Preliminary plans for the PVT panels position are presented in Figure 6.

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In the coming months, some changes and improvements in technical level are expected, as each technology will be further adapted depending on the needs of each pilot farm. With the adaptation of RES technologies to developing smoothly, we feel confident about the high final impact of the RES4LIVE intervention.

RES4LIVE Clustering activities with other projects

RES4LIVE is already in a cluster with other projects funded under FNR-06 A&B and LC-SC3-ES-3-2018/2020. Through this cluster we aim to support the agricultural community and the rural areas in their transition to a sustainable energy future with using Renewable energy sources (RES). Our target is to create a centre of excellence for RES adapted to the agricultural community with creating a repository of policy, technology and financial knowledge on renewable energy. This cluster is willing to promote the widespread adoption and sustainable use of all form of RES. Our mission is to seek out, establish and develop new synergies, facilitate dialogue, share best practices, build capacity and foster co-operation and funds at the global, regional and national levels. Our cluster community includes the following projects that all earmark to develop and implement an energy decarbonisation solution.

AgroFossilFree: Strategies and technologies to achieve a European Fossil-energy-free agriculture project aims to create a framework under which critical stakeholders will cooperate to evaluate and promote currently available FEFTS in EU agriculture to diminish in the short term and eliminate in the long run fossil fuels use in any farming process from cradle to farm gate, while maintaining yield and quality of the end-product.

HyperFarm: Hydrogen and Photovoltaic Electrification on Farm is an Innovation Action (IA) project, which aims to demonstrate combined agrovoltaic systems, with dual land use for crop production and simultaneous power production. HyperFarm joins multiple types of actors with the objective to optimize viable agrovoltaic business models as well as test the marketability of the products, via inclusion of new innovative photovoltaic technologies, radically new crop production systems, stakeholder innovation workshops, and citizen-consumer acceptance,

public perception analysis and farmer adoption studies. HyPErFarm also develops and demonstrates new ways of utilizing and distributing the energy-produced on-farm.

The Greefa: Thermochemical fluids in greenhouse farming project is aimed at a new technology for heating, cooling, air humidity control and water recovery in greenhouses as well as for drying of agricultural goods using thermo-chemical conversion principles based on the use of salt solutions (thermochemical fluids).

RENAISSANCE: Renewable Integration and Sustainability in energy communities project is an Innovation Action (IA) whose aim is to deliver a community-driven scalable and replicable approach, to implement new business models and technologies supporting clean production and shared distribution of energy in local communities.

All cluster members have a strong presence in social media. We encourage everyone that is interested in RES for the agricultural sector to have a look at their webpages and check the progress of their projects. Please share our vision for a more sustainable energy solution through social media and help us to grow our RES community. Lastly, we are still looking for a cluster name. Any ideas? ☺

RES4LIVE video

RES4LIVE video presentation is now available on our YouTube channel! Enjoy the video and discover more about RES4LIVE project!

Partners team: CRMT, MG, PSYCTO

Centre de Recherche en Machines Thermiques (CRMT)

CRMT is a French R&D company that designs, develops and markets solutions, systems and engines running on alternative fuels (natural gas and hydrogen). CRMT has almost 45 years of experience on providing customized solutions for cleaner mobility through its 3 core fields of expertise : 1) Engine and fuel-cell testing, 2) Alternative fuel vehicle engineering & 3) Pollutant emissions measurement on running vehicles. The company's role on RES4LIVE Project is to convert an agricultural tractor from Diesel to Bio Natural Gas. We are delighted to be part of this ambitious project! Enjoy the video presentation of the work of our team!

MG Sustainable Engineering AB (MG)

João Gomes
Founder

Alexander Loris
Project Manager
& Solar Thermal Engineer

Manali Kulkarni
Project Manager & Electrical Engineer

Gunnar Lennermo
Solar Thermal Advisor

Sahand Hosouli
Solar Thermal Engineer

Khalid Othman
Solar Thermal Engineer

Yannis Poursanidis
Electrical Engineer

MG Sustainable Engineering AB started in 2014. Based in Uppsala, Sweden MG specializes in the field of Renewable Energy, mainly solar thermal and photovoltaic energy. The MG team has significant expertise in the fields of: Solar Systems Design and Installation, Solar PVT Collector Design and Construction, solar irradiation, solar data analysis, solar system optimization. MG also conducts and collaborates in academic research on novel PVT designs with many scientific publications around improving the thermal and electrical efficiency of PVT collectors, as well as lowering the production and operation costs of PVT systems. Since 2014, MG has been participating or leading several European Energy projects within H2020, as coordinator and as solar energy expert. The MG team has significant expertise in project management, grant applications, dissemination, and communication within research projects.

Flat plate PVT and Concentrating collectors

Role in the RES4LIVE project:

MG has expertise to build innovative solar systems such as PVT (Electricity and Heat), Solar thermal panel, CPV, CPVT. In this project MG will have a significant role in envisioning and re-designing a PVT system to be installed on rooftops without occupying agricultural land. A standardised solution for livestock farming will be reached by focusing on collector mounting, piping, and installation. PVT systems will be demonstrated in the pilot farms in Belgium, Italy, and Germany.

Within this project, MG is mainly responsible to develop and bring into the market integrated, cost-effective, and case-sensitive PVT systems to cater to the thermal and electrical needs of the farms, contributing towards achieving fossil-free livestock farming. PVT collectors combine the features of PV panels and solar thermal collectors, producing both heat and electricity. When applied in the right system design, PVT provides about 30% higher energy yields per m^2 than having separate PV and solar thermal collectors with the same surface area.

Within RES4LIVE, MG is focusing on the following aspects:

- **Standardising the system design** - Considering the energy demands and specific temperature needs of every pilot farm and designing a system with use of low-cost, but reliable components for piping connections, mounting and electrical equipment, integrating with other renewable energy sources.
- **Energy matching** - The design of the solar field and its control will be optimised, so that the heating production matches the specifications of the heating loads during summer. Adjustments in temperature level and flow rate will be automatic to ensure the highest possible seasonal availability.
- **Design and development of a novel standardised solar station** - A PVT and solar thermal circuit need additional components to work. It determines the flow, temperature, and pressure of the heat transfer fluid in the system. A solar station is a unit that is preassembled with most of these components. The purpose is to have a complete system to reduce the installation and maintenance work on site. The thermal circuit carries solar heat from the PVTs or solar collectors to a heat store or directly to a heat user. Depending on the system design the necessary components can vary a lot. It is usually a combination of valves, sensors and pump, along with other components that regulate the desired output of the solar system.
- **Reducing the PVT system installation cost and simplifying the installation process**

PSYCTOTHERM (PSYCTO)

Pantelis Bakalis
Head of R&D Department

Apostolos Gkountas
R&D Engineer

PSYCTOTHERM is an Original Equipment Manufacturer (OEM) company, specialized in the development, manufacturing and marketing of integrated and cost-effective solutions in the marine and industrial refrigeration. In this context, PSYCTO develops high-efficiency heat pump systems, providing custom solutions, standalone or combined with RES technologies, such as solar energy and geothermal energy technologies. Moreover, the company's R&D and production departments design and manufacture innovative systems, providing waste heat recovery solutions that improve energy efficiency and carbon intensity, such as Organic Rankine Cycles (ORC). PSYCTO moves forward designing new products based on four main axes: Innovation, Energy Efficiency, Eco-Friendliness and Cost-Effectiveness. The company's production facilities of a total 1300 m^2 aim to this end, by increasing the production capacity, improving the quality, and minimizing the delivery time.

The role of PSYCTO in RES4LIVE project is to develop and optimize the design of the air to air or water to air modular heat pumps for the demanding environment of livestock buildings for three pilot farms. For each building case, the thermal load can be covered by adding heat pump units in parallel that are capable to operate in complementary modes (e.g. sensible cooling-dehumidification), so to guarantee the optimal indoor conditions. Its design will consider the optional use of ground heat, solar heat from PVT collectors, and/or available thermal storage tanks. The final goal of the project is to develop a commercial product that can be exploited in the agricultural field.

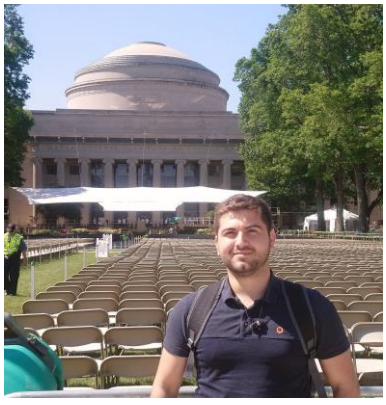
New people in RES4LIVE project: Sepehr Foroushani, Dimitrios Fakis, Giovanni Pollicino

Sepehr Foroushani (ATB Research Scientist)

Sepehr Foroushani joined the Leibniz Institute for Agricultural Engineering and Bioeconomy in Potsdam (ATB) in May 2021. Sepehr is a mechanical engineer with extensive experience in heat transfer, computational fluid dynamics, building energy modeling and sustainable energy systems. His doctoral work at the University of Waterloo in Canada was on an extension of the Newton law of cooling. Prior to joining ATB, Sepehr worked at the City of Richmond and Simon Fraser University in British Columbia, Canada.

Dimitrios Fakis (CERTH Research associate)

Dimitrios Fakis is a graduate of the Department of Electrical and Computer Engineering of the Aristotle University of Thessaloniki and a PhD candidate with the Mechanical and Aerospace Engineering Department of Brunel University in London. He has been employed as a research associate at CERTH/CPERI since early 2021. His research activities are focused on modelling electrical systems, on high voltage/high current/microwave subsystems and also on the utilisation and characterisation of advanced materials, including composite metamaterials. At CERTH he has been predominantly involved in research projects about Hydrogen technologies and renewable energy applications.



Giovanni Pollicino (UNIBO Adjunct Professor)

Giovanni Pollicino is a technician and an adjunct professor at the Department of Agricultural and Food Sciences of the University of Bologna. He gives an administrative and an organizational support to the Biosystems Engineering research group in retrieving and purchasing materials and instruments; he also helps the group in its various research activities: analysis and design of agricultural and agro-industrial buildings, monitoring systems for the agricultural sector (wineries, greenhouses and dairy barns). Regarding the RES4LIVE project, he is involved in the implementation of RES solutions in the Italian pilot farm and in clustering activities and co-creation with stakeholders. https://www.unibo.it/sitoweb/giovanni.pollicino/en

Coming events

List of the upcoming events with RES4LIVE project partners attendance.

EVENT	DATE	LOCATION	PARTNERS INVOLVED
ISES Solar World Congress	25-29 October 2021	Online	MG Sustainable Engeneering

Project Coordinator:
Dimitris Manolakos (Agricultural University of Athens). E-mail: **dman@aua.gr**

Project Contact person:
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For more information visit our website:

www.res4live.eu

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