Brokerage event

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Type: Report, Deliverable Title: Report from the brokerage event

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement ID 101000496

Document Summary

Deliverable Title: **Report from the brokerage event**

Version: **1.0**

Deliverable Lead: **European Conservation Agriculture Federation (ECAF)**

Related Work Package: **WP3**

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Contributor(s):

Communication level: **Public**

Project Number: **101000496**

Grant Agreement Number: **101000496**

Programme: **AgroFossilFree**

Start date of Project: **October 1st, 2020**

Duration: **36 months**

Project coordinator: **Thanos Balafoutis - CERTH**

Abstract

This report highlights the main aspects presented at the brokerage event held in Brussels (Belgium) on the 22nd June 2023, which was developed through different presentations covering all the main aspects worked on during the project. This report develops the thematic presentations, which focused on the role of agriculture in energy production through the production of biogas, as well as the experiences carried out where, through the use of different renewable energies, it is possible to create a zero-emission farm. On the other hand, it presents some of the main milestones achieved by the project, such as the AgEnergy Platform, where an inventory of around 2000 technologies has been created and made available to users. It also shows the policy recommendations in terms of energy use and emission reductions for policies in line with the needs identified. Finally, it highlights the key points developed by 5 experts in a panel discussion on how to achieve fossil-free agriculture in Europe.

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1. Introduction

According to the grant agreement commitments, one of the activities to be developed in the framework of the AgroFossilFree project was the preparation and realisation of a brokerage event. The main objective of this event was to bring together different stakeholders (farmers, energy systems producers, machinery manufacturers, advisors, innovation brokers, venture capitalists, etc.), to promote and raise awareness on how the use of Fossil-Energy-Free Technologies and Strategies (FEFTS) contributes to achieving a more sustainable agriculture in the EU. The event also aimed to highlight the results obtained during the development of the event and to create a dialogue to incorporate the progress made in future EU policies.
This report aims to showcase the issues addressed at the event, as well as the most important conclusions drawn from it.

2. General issues

2.1 Date and Venue

The event was conducted on 22nd of June 2023 in Brussels (Belgium), to facilitate the attendance of all stakeholders, due to the good connection to the city, as well as members of the European institutions and organisations whose headquarters are located in the Belgian capital. The venue for the Brokerage Event was the conference room "Artemis" located in the "Mundo Madou" building. This space located at Avenue des Arts 7-8, 1210 Saint-Josse-Ten-Noode (Brussels) is an eco-designed and eco-managed office and meeting centre dedicated to associations, NGOs and social enterprises. Mundo-Madou offers private professional workspaces, meeting rooms and various services that facilitate the daily management of its member organisations and it was selected in order to also invite in the event these organisations and make it easier to participate.

2.2 Attendees

The brokerage event was developed in a hybrid way in order to facilitate the participation of all those interested people in attending the event. 46 attendees from 11 different countries were present at the venue (Figure 1).

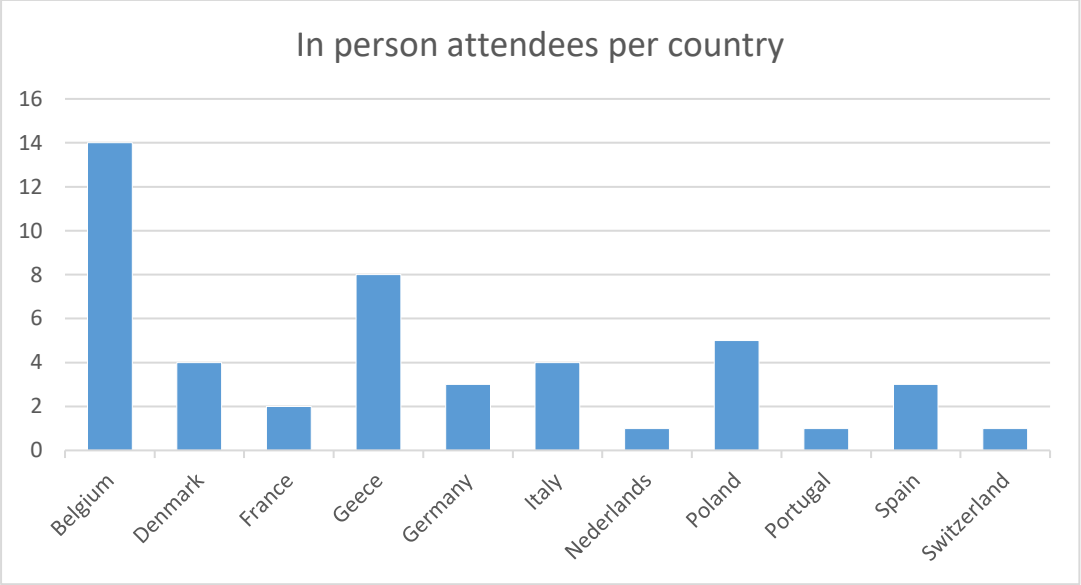

Figure 1 Number of attendees per country at the room conference.

During the event, online attendance was available through the Zoom platform, where an average of 15 people remained connected to the event.

Figure 2 Attendees at the brokerage event.

3. Brokerage Event Sessions

The event consisted of several sessions in which the relevant topics of the project were addressed through two presentations, as well as a presentation of the most relevant aspects carried out in the project. Finally, a panel discussion was held with experts from the different categories of FEFTS described above. The agenda of the event is presented in ANNEX I.

The event began with an introduction and welcome by the project coordinator, Dr. Thanos Balafoutis. Dr. Balafoutis began by thanking all the participants for attending the event and informing them of how the event would unfold. Dr Balafoutis then gave a short presentation on the project, explaining that the AgroFossilFree project was born in response to a concern in the European Commission about the need to find answers to achieve defossilisation in European agriculture. The presentation started with a general description of the project: consortium, budget, etc.

Figure 3 Opening session by Dr Thanos Balafoutis

He then discussed the current situation of energy use in European agriculture and the challenges that need to be addressed to minimise dependence on fossil fuels for energy use in agriculture.

In this sense, Dr. Balafoutis explained that the project does not have a pure research character, as it Is a CSA project, but aims to identify and provide easier access to FEFTS to carry out this transition and to act as a bridge to increase knowledge on these strategic

issues in the European Union. He also showed how these FEFTS have been divided into three categories (on-site renewable energy production; energy efficiency and rational use of energy in agriculture; and soil carbon sequestration practices). Finally, he informed about the creation of an ICT platform where these FEFTS are available to find and the creation of a multi-stakeholder network, in which different regional and transnational workshops have been held in the 8 countries (innovation hubs) involved in the project, to identify solutions and initiatives to generate policy recommendations to promote a greater use of these tools and technologies.

3.1 SESSION 1. GUEST PRESENTATIONS

3.1.1 Defossilisation of EU Agriculture: State of Play & Future Trends

This session was developed around the presentation entitled: "On-farm biogas: a tool to achieve circular a regenerative and fossil-free agriculture ", given by Lucile Sever, the Policy Officer in charge of following the Circular Economy dossiers at the European Biogas Association (EBA).

Figure 4 Ms. Lucile Sever during the presentation

Ms. Sever began by explaining what the EBA is. EBA is an association of 46 national associations, more than 200 companies and research centres representing more than 8,000 stakeholders. The main objective of EBA is to promote and develop the production and use of biogas in Europe.

After introducing the association, Ms. Sever explained the economic model they have developed based on a circular economy. This model focuses on the use of products coming directly from the field, such as plant or animal waste, in the digester to produce renewable energy (biofuel, biomethane, electricity and heat), as well as the use of digester residues that can be applied directly to the field as fertilisers.

She then analysed the evolution of biogas and biomethane production in Europe, highlighting that it increased by more than 20% between 2011 and 2021, taking into account that 64% of biogas and biomethane produced in Europe comes from crops. Concerning the increase in biomethane production, it should be noted that it is accompanied by a technological development in which the newly installed plants are mainly fuelled by agricultural waste and manure. This analysis of the evolution of installations and energy production makes it possible to predict that 41 bcm (400 TWh) of biomethane could be produced in Europe in 2030 thanks to anaerobic digestion and gasification. It is worth noting that agriculture plays an important role in these figures, as 24% of the biomethane produced comes from agricultural waste, making it the second most important input after animal manure, which is also coming from the agricultural sector.

Ms Sever then discussed how biogas can contribute to circular, regenerative and fossil-free agriculture. She presented an infographic (see Figure 5) showing how the implementation of biogas plants in the field is an effective tool to achieve multiple benefits at the field level (improving soil health, pest control, reducing nitrate leaching, etc.) that allow the creation of a circular and regenerative economy in the field and in the community.

Figure 5. Infographic shown during Ms. Sever's presentation

Finally, she highlighted the importance of using this technology to produce a type of organic fertiliser as an alternative to the synthetic fertilisers already on the market. In addition, this alternative makes it possible to reduce greenhouse gas emissions, achieving a reduction of 1.1 million tonnes of CO_2 equivalent in 2021 by replacing the use of chemical fertilisers with digestate.

3.1.2 Successful Case Study of Fossil-Energy-Free Technologies and Strategies (FEFTS) applied in farming.

The second session of the brokerage event, entitled "Upscale case studies of Fossil Energy-Technologies and Strategies (FEFTS) applied in farming", was conducted by Mr Wouter Merckx, who works at the University of Leuven and coordinates the Hyperfarm project (sister project of AgroFossilFree in AREA ZERO Cluster), and is also the director of the Transfarm project, which facilitates scientific research on a pilot scale in the broad research areas of sustainable bio-economy and translational biomedical research.

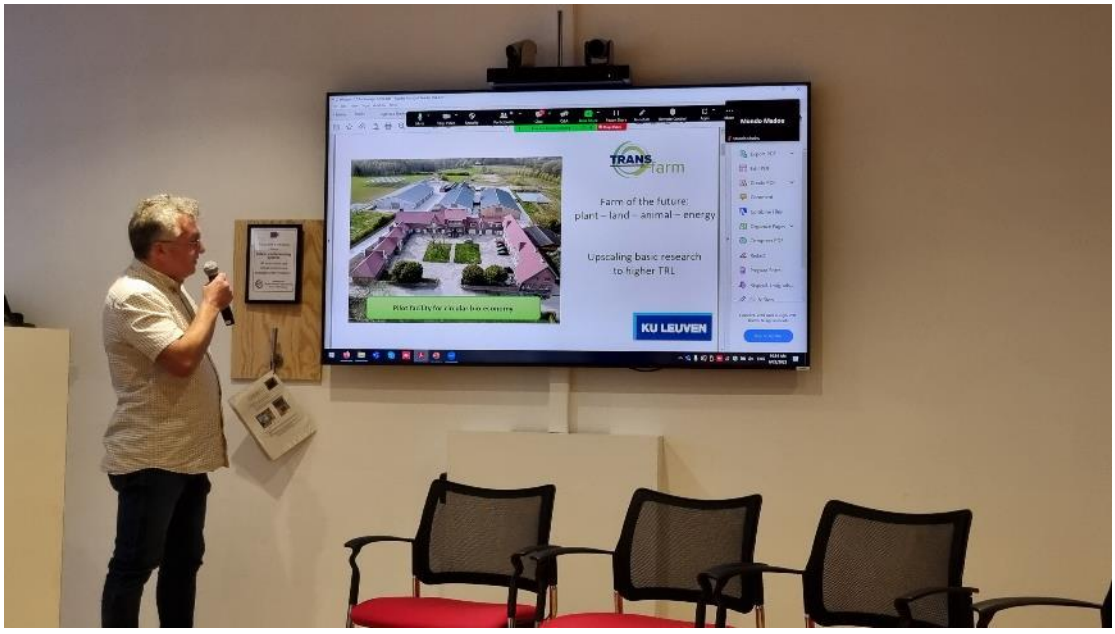

Figure 6. Mr Wouter Merckx during the presentation

In this presentation, Mr Merck talked about the work they are doing in a pilot plant at the University of Leuven to achieve a circular bioeconomy. This pilot plant aims to apply existing technologies to achieve a fossil-free farm.

First, Mr Merckx presented the Hyperfarm project (Hydrogen and Photovoltaic electrification on farms), which aims to demonstrate the effective decarbonisation of farms through agrivoltaics while maintaining crop yields. To this end, they are working on 3 pilot farms: in Belgium, Germany and Denmark, based on 4 lines of innovation:

1. Agrivoltaics energy production systems to ensure crop production.
2. Implementation of on-farm hydrogen production and use.
3. Use of digitalisation to achieve total electrification of the farm (robots, electric controls, climate control).
4. Demonstrating the feasibility of these technologies to gain acceptance.

With regard to Innovation Line 1, Mr Merckx explained how the agrivoltaic systems were implemented in each of the pilot farms. He emphasised that the system built in Belgium is more research-oriented, with many sensors and many applications, whereas in Germany it is an application for farmers. Regarding the production of agrovoltaic energy, Mr Merckx explained that it is easy to calculate, but the problem is to see how it affects production, as there are many factors to take into account. To this end, they have developed a web application that makes it possible to calculate the feasibility of introducing agrivoltaics depending on the location and type of crop.

The second line of innovation is the implementation of panels to produce hydrogen from the humidity of the environment, which he said that it is not yet widely implemented, but which he believes will bring great benefits in terms of energy.

The third line of innovation focuses on the use of the energy produced, showing how it can be used to control climatic conditions in livestock farming (chickens, pigs, etc.), to use electrical machines to power farm buildings and infrastructure, or to produce biochar.

The fourth and final line of innovation relates to social acceptance of the use of agrivoltaics in agriculture. Mr Merckx explained that although the ideas are good, wider communication is necessary for the adoption of the technologies developed, so it is necessary to try to understand what people think. To this end, they have developed a tool called "PERSONAS" (https://hyperfarm.eu/personas/), which shows types of people to understand how stakeholders think about agrivoltaics. Each user can be reflected in the persona types created in the application and, through a survey, understand what the barriers to the adoption of these technologies are. Another tool is the creation of a web-based calculator (https://agrivoltaics.one/HyPErFarm/tool.html) that can give a first impression to a farmer or a related stakeholder on the capabilities of agrivoltaics. On the other hand, they are

developing a series of inspirational journeys involving different stakeholders to raise awareness and promote the adoption of Agrivoltaics.

3.1.3 Questions and Answers (Q&A)

The presentations were followed by a Q&A session.

Firstly, Mr Merckx was asked if the panels used in Agrovoltaic systems were semi-transparent. Mr Merckx said that not all, but 80% of the panels used are semi-transparent and that in horizontal systems they have energy harvesting panels on both sides, as some of the energy reflected from the ground and the crop can be captured. He also reported that as these panels are 5m high, the orientation and tilt angle of the panels is more important than whether they are semi-transparent or not.

One of the participants then asked Mr Merckx whether the software developed for the simulation of agrovoltaic plants would be updated and whether it would continue to be updated after the end of the Hyperfarm project. Mr Merckx replied that the idea is to make it open-access in order to get more data and make the tool more accurate, as it currently works with pre-calculated data.

The next question, also addressed to Mr Merckx, concerned what the result was and for which surface of the hydrogen panels. Mr Merckx replied that only half a gram of hydrogen per panel per day was harvested, which may not sound like much but is an optimal amount.

A question was then put to Mrs Sever about the quantity of CO_2 produced in the fermenter. Mrs Sever replies that it depends on the plant, but she cannot confirm how much CO_2 is stored, how much is used and how much is emitted into the atmosphere.

The last question to Mrs Sever was what is the EBA's position on small farms where it is not feasible to build a biogas plant. Ms Sever replied that they are being implemented in some small locations, but that there are also groups of farmers who are setting up a plant. However, she advocates the small-scale model to reduce transport emissions.

Finally, Mr Konstantinos Vaiopoulos (AgroFossilFree Project Manager) thanked the speakers for their participation and gave way to the next session where the results of the project was presented.

3.2 SESSION 2. AGROFOSSILFREE HIGHLIGHTS

3.2.1 Current energy use status in EU agriculture

Bas Paris from the Agricultural University of Athens (AUA) presented some results from Work Package 1 of the project, which provides a snapshot of the current state of energy use in the agricultural sector of the EU. The aim of this work was to identify the main uses of energy and the technologies used to show to policymakers the current situation in this area. 3% of the energy used in the EU is related to agricultural processes, not including indirect uses. The presentation showed the percentage of energy consumption for different systems (open-field, livestock and greenhouses). Regarding energy use in open-field agriculture, it shows that there is a high variation in energy use per crop, highlighting the high energy demand for citrus fruits. It should also be noted that cereals are the largest energy consumer in the sector. This energy consumption is due to fertilisation (50%) and the use of diesel (31%) as the most relevant measures in terms of energy consumption.

Figure 7. Mr Bas Paris during the presentation.

In the livestock sector, cattle farms are the most energy-intensive, followed by pig and poultry farms. Energy consumption varies according to the purpose but is mainly concentrated in animal housing and manure management.

Regarding energy use in greenhouses, Mr Paris said that it varies greatly depending on the geographical location of the greenhouse and the type of greenhouse, with high tech greenhouses in the northern European countries being the most energy consuming mainly due to heating, ventilation and air conditioning.

He went on saying that there are many opportunities for the use of FEFTS in terms of direct or indirect energy consumption, cultivation techniques, the use of non-fossil fuel machinery and the various alternatives in terms of animal feed and housing that are more energy efficient.

Finally, Mr Paris suggested several issues to be taken into account in future studies, such as the fragmentation of data according to geographical location, the development of detailed methodologies for calculating energy use in European farms and the relationship between indicators used on farms and agricultural uses.

3.2.2 Adopting (or not) FEFTS: Farmers' and advisors' views

Vasiliki Kanaki from the Agricultural University of Athens (AUA) took the floor to present the findings on why farmers do or do not adopt the FEFTS proposed in the project.

Ms Kanaki explained that one of the main objectives of the project was to identify farmers' needs and their interest in adopting FEFTS. Therefore, firstly, an analysis of the current situation was carried out in two ways: surveys of farmers and interviews with experts/advisors. Secondly, successful cases of FEFTS adoption were identified as best practice examples able to be replicated in terms of their innovation processes that made them to succeed.

Figure 8. Ms. Vasili Kanaki during the presentation.

Concerning the results of the needs assessment, surveys were carried out with both adopters and non-adopters. To this end, 470 farmer surveys and 41 expert interviews were carried out, trying to cover adopters and non-adopters equally. The expert interviews

focused mainly on the current challenges in European agriculture, which is the role of FEFTS in agriculture, and what are the ways or difficulties in overcoming the challenges that brings non adoption.

Regarding the use of renewable energies, it was observed that photovoltaic energy is the most common, with a percentage of use of 76%, followed by 36% of use of biogas and 17% of use of heat pumps. This energy is mainly used for the air-conditioning of farm buildings (72%), followed by lighting (66%) and energy for external consumption (62%).

On the other hand, questions were asked about the efficiency of the technologies or practices for each of the defined categories and the following results were obtained:

For open field, the results show that, according to the respondents, conservation farming practices are the most efficient. For both greenhouses and livestock, the creation of energy-efficient buildings was the most common response, followed by precision farming for greenhouses and the use of energy-efficient tools for livestock.

Ms Kanaki then went on to look at the reasons found for the adoption or non-adoption of FEFTS. In terms of the main reasons for farmers to adopt these technologies, the high energy cost is the main reason for the transition. The reduction of environmental impact, energy sales and financial incentives are also shown to be important reasons for the adoption of FEFTS. As for the reasons for not adopting these technologies, the main one is affordability, as the initial cost of implementing FEFTS is usually high. Other reasons identified were the complicated procedures, lack of time to research and learn about the technologies and small farm size.

With regard to the needs identified, Ms Kanaki said that financial support based on grants and subsidies was the principal need found. Moreover, bureaucratic procedures for adopting FEFTS should be simplified. It was also noted that there is a need for long-term and reliable policies that are adapted to the needs of farmers. This needs to be accompanied by adequate and reliable information and training. The final need identified is the lack of a functioning Agricultural Knowledge Innovation System (AKIS) and a platform for innovation in renewable energy systems, technologies and practices.

Finally, she presented the 10 successful FEFTS implementation case studies that have been developed and are available on the project's YouTube channel (https://www.youtube.com/@agrofossilfree/featured). The published case studies are:

- Spain: Conservation agriculture.
- Germany: New Holland T6 methane tractor.
- Denmark: Green protein from clover grass.

- Greece: Brite Solar's semi-transparent Agrivoltaics.
- The Netherlands: Sustainable storage barn.
- Italy: Tenuta di Bagnoli farm biogas plant, PV and Agrivoltaics.
- Ireland: BHSL poultry waste to energy.
- Poland: GB Hybrid strip-till and subsoiler
- Bierbeek (Belgium): Agrivoltaics over orchard for energy production.
- Bocholt (Belgium): Local biomass provides heat for school campus.

3.2.3 AgEnergy platform: A one-stop shop to find FEFTS

This presentation was given by Mr Mike Kaminaris of AGENSO. Mr Kaminaris presented the platform (https://platform.agrofossilfree.eu/) developed in the framework of the project to create an inventory of FEFTS accessible to all those interested in applying technologies for the efficient use of fossil fuels in agriculture. This platform also allows the evaluation of the different FEFTS using sustainability indicators.

Figure 9. Mr Mike Kaminaris during the presentation.

In order to create the platform, a methodology and standards were developed to evaluate the available FEFTS and classify them into sub-categories. 5 types of FEFTS were collected: scientific papers, research projects, commercial technologies, training materials and

financing mechanisms. All these FEFTS were then collected, and wrong data and duplicates were removed.

Mr Kaminaris reported that there are currently more than 2000 FEFTS in the repository and the platform has more than 2500 users. To facilitate the search for information, there are more than 130 filters related to the information provided and 25 dynamic lists on the platform. He also mentioned that the platform is translated into 8 languages to make the information available to a larger number of people in their national languages (as farmers in many cases do not speak English).

A decision support tool (DST) was also presented that allows the user to rank the best possible solutions to be implemented in a specific farm. This DST was developed though a small questionnaire that was answered by experts and then can be used from the users.

Finally, after the presentation, Mr Kaminaris gave a demonstration of how to access the platform and how it works, so that the participants could familiarise themselves with it and recommend it. He also informed that any user could submit FEFTs to the platform to increase the repository and offer a greater number of solutions to other users.

3.2.4 Results of multi-stakeholder approaches and networking activities

This presentation, given by Michael Norremark from the University of Aarhus (AU), aimed to show some of the results of the project's networking activities. During 2021 and 2022, 24 regional innovation workshops (3 in each of the 8 hubs) were organised in the framework of the project, involving 1058 stakeholders. In addition, 3 transnational innovation workshops were held in Greece, Poland and Denmark with 140 participants. Each of the 3 workshops, either at transnational or national level, dealt with one of the project themes: livestock, greenhouses and open fields.

Mr Norremark reported that also three online workshops were held to open the project to other stakeholders. The first, with 70 participants, was used to present the project and highlight the needs of farmers in terms of energy use, innovation and companies using FEFTS. The second, with 69 participants, served to present and promote the use of the AgEnergy platform. The third, with 45 participants, presented the success stories studied in the project and the main outcomes of the project up to then.

Figure 10. Mr Michael Norremark during the presentation.

Mr Norremark returned to explain the objectives of the regional and transnational workshops. The main objective was to provide stakeholders with information on the following aspects related to energy use in the EU:

- Conditions (problems, what to solve, needs)
- Current status of energy consumption for livestock, open-field and greenhouses
- Main and current European industry solutions and policies promoting FEFTS.
- Identification of research directions, collaboration schemes, cross border and educational efforts

After that, he summarized the results obtained in the transnational and regional workshops according to theme, highlighting the following aspects:

<u>Open field</u>

- The 3 most energy-wasteful parameters in open-field agriculture are fertilization, tillage and irrigation.
- Cover crops and legumes, adoption of conservation agriculture practices were suggested as well as more resilient varieties of crop plants.
- Agrivoltaics could be a business game changer for large arable landowners.
- Policy proposals were focused on energy efficiency and carbon storage.
- Suggesting biomethane produced from the conversion of biomass as an alternative to fossil fuelled engines.
- To familiarize with FEFTS is important to invest in training / education / knowledge / innovation broker programs for advisors, create pilot platforms and farms where events

and demonstrations can take place, and establish subsidy schemes that would attract the attention of farmers.

- Regulations should not complicate the FEFTS implementation/installation and this regulation will be focused on:
    - Reduction of taxes on energy when energy use is provided from a RES, policies for self-sufficiency of biofuel, biofertilizer and electricity.
    - Carbon credit schemes promote any effort of carbon capture (sequestration), cover crop practices, and zero emission open field agriculture approach.
    - Incentives for self-sufficiency of feed protein from sustainable protein crop cultivation on an EU level.
    - New policies should be result/measurable based on subsidy financing of FEFTS, and associate/link the subsidies to the output and not to the specific technology.
- Research and innovation were devoted to precision agriculture and conservation agriculture.

Livestock

- The 3 most energy-wasteful parameters in livestock production were (1) feed production/efficiency independent of livestock production type, (2) transport and (3) energy used by buildings (milking, heating, cooling, ventilation, etc.)
- The status quo of the market development of livestock production and higher energy costs are not at all a driver for investments.
- Biogas plants were considered must-haves for livestock farmers shortly.
- Heat pumps, ventilation systems, building envelope, and converting livestock buildings to more energy-efficient facilities were suggested.
- Need for practical as well as online training and demonstrations on pilot platforms and farms with FEFTS implemented.
- Incentives focusing on benefits for farmers adopting FEFTS and associated economics.
- Proposed policies should concern result/measurable-based subsidy financing of FEFTS.
- Multidisciplinary involvement in research and innovation with a focus on gathering FEFTS knowledge and disseminating it to all EU countries.

Greenhouses

- The 3 most energy-wasteful parameters for greenhouses were (1) Thermal regulation of greenhouses environment, (2) Greenhouse design and (3) Lightning.

- The speed of transition to energy efficiency technologies and practices is claimed to be dependent on the prices of fossil fuels, on technological developments, and on common efficiency improvement goals on the EU partnership level.
- Suggested incentives with the potential to stimulate FEFTS adoption should include policies (focus on supporting returns of investments), subsidies and effective communication strategies, and knowledge sharing, training and education.
- Clear information and orientation on research with the involvement of different stakeholders, as well as effective dissemination strategies/knowledge sharing.

This presentation was followed by a 20-minute coffee break for participants to exchange views. Participants were also able to visit the exhibition village to learn more about the projects of the Area Zero cluster members. Videos of the successful case studies presented earlier in the day were also shown on the screens in the conference room.

3.2.5 AgroFossilFree Guidelines: From the Field to Policy

After the coffee break, the event continued with a presentation by Mr Dirk Vansintjan from RESCoop.eu. In this presentation, Mr Vansitjan briefly summarised the recommendations and policy briefs developed during the project. He explained that 19 policy briefs had been produced and that they were available for download via a QR code placed around the room. Each of the policy briefs is divided into three sections: (1) What is the Challenge?, (2) Policy Recommendations and (3) Expected Impact (the policy briefs will be available in D3.7).

Figure 11. Mr Dirk Vansintjan during the presentation.

The 19 policy briefs are divided into 3 horizontal policy recommendations, 6 specifics to open-field farming, 7 specific to farm structures (greenhouses and livestock buildings) and 3 general policy recommendations.

Mr Vansitjan then briefly outlined the policy briefs developed, highlighting some of the recommendations and indicating whether they were at the EU or national level. Mr Vansitjan then went through the recommendations, focusing on the main points. More specifically:

Policy Brief 1: Enabling the creation and growth of energy communities in rural areas

- Align both definitions of energy communities (REC/CEC) with each other and make sure that they guarantee citizen participation and special support to citizen-driven initiatives.
- Assessment of barriers and potential for the development of energy communities should be used for the design of a complete enabling framework for them to be able to participate in the market without discrimination compared to other market actors. - Tailored community building support, legal, financial, and technical advice for energy communities make up an essential element of the enabling framework.
- Ambitious community energy sub-target within the renewable energy target
- Specific allocation and targeting of development programs and EU public funds (Recovery and Resilience Funds, Cohesion & Regional Development Funds, Modernisation Fund) for energy communities

Policy Brief 2: Farm Energy Audits

- Promote the advantages of conducting farm energy audits on a national level towards minimization of energy consumption combined with farm operational cost reductions.
- Create a uniform methodology for conducting energy audits across the EU.
- Create a platform where farmers and their advisors can easily customize to their needs and do the energy audit with minimum effort.
- Ensure that the existing energy audit processes for commercial, industrial, and residential buildings are adapted and followed for farms of all types. Initially, keep the audit procedure optional and then move to a mandatory certificate of completion for farms to be able to operate (as for urban buildings).
- Farmers who have done an energy audit on their farm could be eligible for financing aid.

Policy Brief 3: European Low Energy/Carbon Label of Agricultural Products

- The official certification scheme for direct and indirect energy use reduction should have clear rules and be transparent.
- Label based on the energy use reduction level and the emissions reductions/removal methodologies approved by an official of the EU.
- The certified energy use reduction and GHG emission reductions/removals should be registered in an official registry.
- The certification framework set initially by the EU's responsible authority should also follow a bottom-up approach.
- Third-party auditors could be verification and certification bodies.
- Labelling of agricultural products should be of low cost for farmers and the products should receive higher prices in the market and specific CAP support.
- Extension services and advisors should inform farmers about such frameworks and support them during the application process.

Policy Brief 4: Agrivoltaics for open field agriculture

- Set specific standards on what qualifies as an APV system.
- Targeted financial support of APV for a period of time.
- Streamlining regulatory processes.
- Addressing access to grid issues.
- Promote APV innovation.
- Awareness.

Policy Brief 5: Alternative Fuels for Agricultural Machinery

- Create awareness that ICE (internal combustion engine) remains a necessary technology for farmers to deliver on GHG reduction.
- Recognise agriculture as a key sector for drop-in replacement fuels.
- Regulatory EU and national framework for investment of scale up and uptake of alternative fuels.
- Immediate and long-term EU and national strategies on promoting alternative fuels (taxation/incentives) proportionate with the specific fuels' capability to reduce GHG emissions without compromising food security.
- Promote Circular Agriculture models, towards more sustainable and resilient farms.
- Well-to-crop in focus rather than tailpipe CO_2 emissions (holistic lifecycle approach).

Policy Brief 6: Precision Agriculture as Energy Consumption Reduction Strategy

- Subsidies and incentives should be given to farmers to acquire PA technologies that allow precision input application. If PA technologies are affordable for farmers, their widespread adoption will be accelerated.
- The concept of joint ownership or purchase by a group of farmers or agricultural associations should promoted and simplified, in case of very expensive equipment.
- Raise agricultural communities' awareness, supporting farmers in gaining knowledge on how to implement certain methods and what outcomes they should expect. Common standard training programmes are necessary.
- Farmers should be urged to record their inputs (annually) and join a program developed by the state to provide their data for monitoring/assessment purposes. If they also provide information about the respective yield, then a ratio could be formatted. Based on this ratio, farmers' footprint can easily be identified. Such a framework could be integrated into an energy audit system, providing either multiple rewards (for successful cases) or recommendations to improve.
- Farmers providing their production data and energy audit information their capacity for improvement of the direct and indirect energy consumption through PA application could be prioritized for respective incentives provision to replace/upgrade the existing conventional agricultural equipment.
- Extension services should be trained adequately to provide recommendations & technical support to farmers applying for PA.

Policy Brief 7: Carbon Farming for Carbon Removals

- Accelerate the development of tailored certification for the different types of carbon removal activities.
- Support the work of the Carbon Removal Expert Group on the voluntary certification of carbon removals.
- Continue to develop the standardisation of monitoring, reporting and verification methodologies.
- Continue to promote carbon farming through CAP (e.g., good agricultural environmental conditions, eco-schemes, etc.).
- Supporting tools that allow farmers to get paid for adopting climate-friendly carbon farming practices.

- Develop a range of financial incentives on a national and EU level that support the adoption of and transition for farmers to agricultural techniques that support carbon farming including conservation agriculture practices, permaculture, regenerative agriculture and agroforestry. Farmers must be supported in the first years of their transition.
- Continue to support R&D processes (like EJP SOIL) that attempt to accurately measure the impacts of the life cycle of various carbon sequestration techniques.
- Develop education and extension processes that provide information to farmers on the long-term environmental and economic benefits of using various carbon farming techniques.

Policy Brief 8: Conservation Agriculture to enhance soil carbon stock and reduce GHG emissions in European Agriculture

- Promote carbon farming practices based on Conservation Agriculture through the CAP and other EU policies.
- Promote R&D policies to adapt the technique to all crops, especially horticultural crops.
- Promote direct payments to farmers who store carbon and reduce their carbon footprint by integrating no-tillage, strip-tillage, groundcover in woody crops and cover/catch crops.
- Promote efficient communication to the EU citizens to give knowledge and raise awareness.
- Analyse data from carbon farming pilots and assess if a functional EU carbon farming tool can be developed.

Policy Brief 9: Alternative crop nutrient providers (Green Fertilisers/biofertilisers, biostimulants/ Biochar)

- Promote R&D processes that support the replacement of fossil fuels with RES in the production of chemical fertilisers.
- Promote demonstration projects and pilots that showcase to farmers how to use alternative crop nutrients.
- Support industries (subsidies) to produce green fertilisers.
- Promote the use of biomethane and green hydrogen in the Haber-Bosch process.
- Develop farmers' education and extension processes to use alternative crop nutrients.

- Through market incentives, ensure the long-term cost and price competitiveness of green fertilisers.
- Promote alternative crop nutrient providers through the CAP and other EU policies.
- Support products that improve the quality of soils and support carbon sequestration (e.g., biochar).
- Support the development of local networks that prioritize local biofertilizers sourced from local feedstocks.
- Provide a financial incentive to the industry that uses pyrolysis and gasification technologies of agricultural biomass to produce biofuels or electricity and biochar as a by-product.

Policy Brief 10: Building Management Systems (BMS) for Agricultural Constructions

- A clear view of energy consumption in the current status assists in fast and precise energy audits.
- Incentives for integrating existing control systems into a holistic BMS.
- Offer financial incentives (e.g., grants, subsidies, or tax benefits) for the required initial BMS investment.
- Raise awareness through training programs and campaigns that educate livestock facility owners about the benefits of BMS.
- Develop and enforce regulations mandating the implementation of BMS in new livestock facility constructions or major renovations.
- Finance R&D for optimisation of existing BMSs for other uses to cover the needs of agricultural buildings and R&D for cheap sensors.
- Provision of free governmental technical assistance and guidance for planning, installation, and operation phases of BMS through training workshops, consulting services, and access to expert advice to address any technical challenges or concerns.
- Foster partnerships between government agencies, industry associations, technology providers, and financial institutions to create a supportive ecosystem for BMS adoption, as a common workplace for BMS implementation in agricultural constructions.

Policy Brief 11: Heat pumps for HVAC of agricultural constructions (RES4LIVE)

- Assess the potential of HP in different types of agricultural facilities to determine optimal systems for each location.

- Implement monitoring and evaluation systems to track performance and energy efficiency.
- Encourage the integration of heat pumps with other RES, such as solar or geothermal power, to elevate the COP, further reducing GHG emissions and energy costs.
- Design heat pump technologies specifically tailored for the agricultural sector, considering the unique challenges of high humidity in greenhouses and high humidity and corrosive environments in livestock buildings.
- Foster partnerships and collaborations between heat pump manufacturers, agricultural stakeholders, and research institutions to drive innovation and knowledge transfer.
- Establish guidelines and standards for the design, installation, and operation of heat pumps to ensure safety, reliability, and efficiency.
- Provide financial incentives and explore innovative financing models to offset initial investment costs.
- Develop training programs and materials for farmers and technicians on the installation, operation, and maintenance.

Policy Brief 12: Photovoltaics (PV) and Photovoltaic Thermal (PVT) Collectors and Systems for Agricultural Constructions Rooftops

- PV systems should be expanded to all agricultural building rooftops in a net metering format to reduce bills.
- Better recognise PVT technology as a viable and efficient solution for renewable electricity and heat.
- Facilitate support and subsidies for PVT technology and solar thermal just like is being done for PV technology.
- Impose stricter carbon tax on fossil fuel usage to disincentivise their use and purchasing.
- Establish a short long-term EU-wide strategy for the adoption of renewable and low-carbon fuels in agriculture, including feasible targets and specific taxation and incentives based on life cycle assessment processes.
- Treat the transformation to zero CO2 emissions as an investment with proper assignment of value.
- Incentivise SMEs working on the conversation and implementation of PV/PVT deployment and innovation.
- Promote R&D that offers comprehensive reviews and studies on optimised PVT systems up to market scale.

- Support the renovation and purchase of PVT technology.
- Awareness raising of state-of-the-art PVT through demo farms and flagship eco-schemes.
- Promote and support local businesses developing and manufacturing PV/PVT products to keep them within the EU.

Policy Brief 13: Biogas production from innovative feedstock / Biomethane upgrading.

- Ensure transparency in the process and that no energy provider abuses the financial aid.
- Transition from conventional biogas production to using multi-feeding mode.
- Provide farmers financing aid for the installation of new biogas plants.
- Encourage smallholders to create associations/energy communities, which will build a common biogas plant or sell feedstock to a nearby biogas production facility.
- Provide financing incentives, such as tax deductions, to farmers who install anaerobic digesters on their farms and incorporate new methodologies.
- Promote training activities for farmers and advisors at national and regional levels, demonstrating the benefits of adopting new feedstocks.
- Encourage farmers to shift to mixed farms so that both manure and crop residues can be used for biogas production.
- Promote the direct in-farm use of biogas and biomethane on the farms themselves, especially for their machines.
- Include biogas production and use in the overall political strategies as one important contributor.

Policy Brief 14: Facilitating the development of energy-independent farming in Livestock.

- Promote through farmers' organizations energy independent farming, including advisory services.
- Enable farmers, through subsidy programs, to invest in biomethane emission capture solutions.
- Providesupportbypromotinganykiloofbiomethaneusedforagriculturalmachineryorfortransportationandreplacingfossilfueldiesel.
- Promote demonstration activities at farm level as key examples of supporting strategies, facilitating the adoption and uptake of Innovative biogas production equipment.
- Promote tools that allow farmer experiences to be shared, as well as the exchange of information about training courses and, above all, to improve and harmonize the training courses provided.

- Enable small scale producers to group into clusters to connect to the electricity grid or gas supply chain.
- Promote how farms can support CO_2 emission reduction when becoming carbon negative.

Policy Brief 15: Livestock building energy upgrading/renovation.

- Create a database/category of the many options for building envelope constructions and insulation materials.
- Certification of producing animal products through sustainable energy use practices and promoting animal welfare.
- Develop the building code or guidance for farmers regarding the design of livestock building envelope.
- Establish short-and long-term renovation schemes for upgrading livestock building envelopes.
- Implementation of an energy audit system to reward the farmers' investments.
- Attract livestock farmers to follow pilot/demo examples.
- Promote training activities for farmers and advisors at national and regional levels.
- Funding and subsidy programs to acquire low-energy livestock buildings while establishing new livestock production sites.

Policy Brief 16:The use of thermochemical fluids for energy saving and storage in agriculture (The GreefaProject)

- The EC has recommended ten points for EU Member States to maximize energy storage to its full potential. Member States should develop new market products. A lower carbon cap needs to be mandated in the capacity market.
- The double role of the "consumer-producer" of storage should be considered by applying the EU electricity regulatory framework and by removing barriers, including avoiding double taxation and facilitating permitting procedures.
- Joint EASE/EERA recommendations for a European Energy Storage Technology include the need to develop and implement thermal energy storage systems that are coupled to power-to-heat technologies.
- Consider the specific characteristics of energy storage when designing network charges and tariff schemes.

- Boost sustainable consumption and production practices through education, awareness, and economic incentives.
- As part of the Policy and Valuation Track of the Energy Storage Grand Challenge Draft Roadmap, provide tools, analyses, and recommendations that maximize the value of energy storage to electric and thermal energy systems.

Policy Brief 17:Financial Support to Fossil Energy Free Technologies and Strategies (FEFTS)

- Well-structured financial incentives (e.g., the eco-scheme of the current CAP -25% of the direct payments).
- Concrete targets (e.g., RED II) can provide better direction, combined with Agri-environmental indicators.
- Member States need to align their policies with their geographical and socioeconomic conditions.
- Framework for supporting pioneering entrepreneurs.
- Financing needs of smaller farms.
- Streamline subsidy policies and ensure that they are compatible with each other.
- Provide long-term certainty and stability to investors and farmers by setting clear targets for emissions reduction and sustainable agricultural practices.
- Create new food/clean energy business models.
- Create specific economic provisions within the Energy Communities framework.
- Fund training and knowledge transfer programs that promote FEFTS.

Policy Brief 18: Regulatory amendments to support Fossil Energy-Free Technologies and Strategies (FEFTS)

- Streamline and digitize procedures with "one-stop-shop" schemes.
- Harmonize policies by different ministries.
- Specify food/energy policies, considering combined food and energy production.
- Assist farmers to produce and use directly renewable fuels.
- Promote sustainable food labelling.
- Integrate agriculture in energy planning including spatial analysis of rural areas.
- Implement circular economy policies.
- Develop agriculture-focused electricity flexibility schemes.
- Promote FEFTS related certification schemes.
- Address the needs of small farms.

- Promote energy audits.
- Improve policy communication.

Policy Brief 19: Technology, Knowledge Transfer, and Awareness Building provisions to support FEFTS diffusion

- Enforce Agricultural Knowledge and Innovation Systems (AKIS)(Research, Extension, Industry, Farmers).
- Establish "FEFTS innovation brokers“.
- Promote localized standardized technical solutions.
- Support FEFTS demonstration projects.
- Encourage flexibility schemes and energy storage.
- Promote data sharing.
- Implement the "Train the Trainers" program.
- Organize targeted workshops for farmers.
- Create transfer centres in rural areas.
- Include more engineering disciplines in advisory/extension services.
- “Train the Farmer” programs.
- Highlight success stories of energy communities adopting FEFTS.

3.3 SESSION 3. PANEL DISCUSSION

The panel, chaired by Dr Thanos Balafoutis, consisted of 5 experts from different sectors related to the issues addressed in the project. Dr. Balafoutis first asked the panellists to introduce themselves.

- Mr Thomas Garabetian: Research Innovation Manager of Solar Power Europe, the organisation representing the PV industry in Europe.
- Mr Jean-Marc Jossart: Secretary General of Bioenergy Europe, which represents the bioenergy sector, including biomass processing into heat, electricity and transport fuel.
- Mr Peter Pickel: Manager of External Relations at John Deere and is now working on Intelligence Solutions.
- Mr Gilles Mayer: CNH Group, New Holland Industrial and is responsible for product management for alternative fuels.

- Mr Gottlieb Basch: Professor at the University of Evora, Portugal, and chairman of the European Conservation Agriculture Federation.

Figure 12. Experts at the panel discussion session

After the brief presentation, Dr Balafoutis said that with these panellists, all the pillars of the project were covered. He then started the panel discussion with the first question to Mr Mayer, asking why New Holland had developed a methane tractor and not another alternative fuel. Mr Mayer explained that there is currently another alternative to powering an internal combustion engine. He said that since agriculture is responsible for about 10% of global CO_2 emissions, developing a technology that does not emit CO_2 is a good reason to choose methane as a fuel. In addition, after more than 20 years of research, it is worth noting that producing 1 kg of methane requires 60 times less electricity than producing 1 kg of hydrogen, as well as more space to store the hydrogen, which does not favour the design of the tractor. Finally, he reported that the energy produced by methane is 4 times higher than that of hydrogen. It was for these reasons, among others, that methane was chosen as the fuel of choice.

Based on this answer, Dr Balafoutis asked whether it could be used on all farms or only for livestock. Mr Mayer replied that methane is produced in livestock farming, so the short-term aim is to introduce this tractor on livestock farms, also helping to reduce and stabilise costs.

Dr Balafoutis then asks Mr Pickel if there is an alternative. Mr Pickel replies that there is, but the main problem is space to store the energy in the tractors. He explains that John Deere is committed to bringing electric tractors to market with small batteries and sufficient power. As with CNH, Mr Pickel stresses that the principle of reducing energy consumption should be

the guiding principle, encouraging that if energy is produced on the farm, it should be used there. He also mentioned the path towards biofuels as a complementary fuel. Dr Balafoutis asked about the use of multi-fuel tractors. Mr Pickel explained that solutions were being developed to adapt the engine to the type of fuel in the tank.

Following this discussion, Dr Balafoutis asked Mr Jossart for his opinion and that of Bioenergy Europe. Mr Jossart explains that there are indeed several solutions, depending on the different factors that determine the characteristics of the farm or livestock farm.

For Mr Jossart, the aim is not to make the farm self-sufficient but to provide energy for other uses in the vicinity. The role of agriculture must therefore be recognised.

Dr Balafoutis then asked about the contribution of bioenergy to achieving the 42.5% renewable energy target in Europe, particularly in agriculture. Mr Jossart explained that 60% of renewable energy currently comes from bioenergy, which will continue to make an important contribution to the sector. However, he stressed the importance of European policy understanding and supporting the multiple roles of agriculture.

Continuing the discussion, Dr Balafoutis asked Mr Garabetian about the role of PV in agricultural installations. Mr Garabetian said that several factors influence the type of installation, but that they are getting very good results from the implementation of this technology, including maintaining productivity. However, it is necessary to have appropriate business models and incentives that are in line with current needs.

Dr Balafoutis then asked Mr Basch about the role of conservation agriculture in storing carbon in the soil. Mr Basch replied that the potential of conservation agriculture in these matters has two approaches, one in terms of reducing energy demand and the other in terms of storing carbon in the soil by avoiding soil disturbance, which mineralises CO_2 from the atmosphere. He stresses that the conservation of crop residues should not be considered waste, as they serve as food for the soil and the organisms that live in it.

Dr Balafoutis then asked if it is true that conservation agriculture reduces production. Mr Basch replied that it depends on the initial situation; if the soil is very degraded it is very difficult to start, but if the soil is improved, production can be maintained or even increased.

After this first round of questions, Dr Balafoutis asked whether conservation agriculture conflicted with machinery. Mr Mayer replied emphatically in the negative, as machinery adapts to all conditions and works in different scenarios, and the objective is the same, both in terms of reducing energy and maintaining the health and quality of the soil. Mr Pickel took the floor to confirm what his colleague on the panel had said, and he believed that technology was being developed to help achieving these objectives. Mr Jossart took the

floor to say that the introduction of conservation agriculture was complicated. Mr Jossart then stated that he believe that the mineralisation of organic matter was not a permanent solution for residual carbon and asked Mr Basch for his opinion on the addition of biochar. Mr Basch replied that it is true that biochar is a form of carbon with a longer life span than fresh biomass, but that what guarantees the permanence of carbon in the soil is the non-disturbance of the soil, hence the introduction of conservation agriculture.

Mr Basch said that in other areas, such as South America, there is a 70% adoption rate of conservation agriculture, and why is this not the case in Europe? In response, Mr Mayer said that controlled traffic is very common in South America and that controlled traffic is not included as a fourth principle of conservation agriculture. Mr Basch explained that this is the case in Australia, for example, but to introduce it as a fourth principle in Europe would require larger fields. However, he stated that although it is complex in some situations, controlled traffic is a very good solution to avoid soil compaction.

In this context, Dr Balafoutis points out that Conservation Agriculture and Precision Farming are linked and can greatly reduce energy consumption in agriculture.

After this discussion, Dr Balafoutis takes up the conversation with Mr Garabetian and asks if there are any technical challenges for PV to work on farms or aspects that need to be combined. Firstly, and in response to the previous discussion on the importance of soil, Mr Garabetian explains that they have had good results in terms of soil moisture conservation after implementing Agrovoltaics. They are developing several applications, especially in greenhouses, to ensure that the installations allow the whole system to function well.

Figure 13. Instant of the panel discussion session

After the discussion, Dr Balafoutis opened the floor to the audience to ask questions of the panellists.

One of the participants asked whether conservation agriculture could be carried out with electric tractors, where the power would be around 100 horsepower. Mr Basch explained that the operation that requires more power from the tractor is ploughing, and by eliminating this there is no problem in using such tractors. The participant then asked if a 100% electric farm can exist under the principles of conservation agriculture. Mr Basch replied that it depends on the length of the direct seeder; if it is 4m it is sufficient, but for a 12m direct seeder it may not be enough. Mr Mayer pointed out that it all depends on the size of the farm and where the electricity comes from, for which farmer it is economically viable.

Later, another attendee asked about using biogas to generate electricity. Mr Jossart replied that it is complex because if the technology exists to use biogas as heat energy, it is not cost effective to change the machinery, but that there are many sources of biogas electricity and the challenge is to reach 39 billion cubic metres by 2030, which will open more options for using biogas. The panel then discussed the need to share biodigesters and produce biogas together to increase the feasibility of building biodigesters. It was also stressed that biogas production should not increase production costs.

The panellists were then asked about the future of the AgroFossilFree project, given the need to ensure food security and the climate change scenario we are facing. In response to this question, the panellists approached the importance of the solutions provided by the project from different angles and concluded that the solutions are multiple and need to be adapted to each of the scenarios. Therefore, the project addresses climate change mitigation and adaptation solutions without compromising food security. However, the real challenge is how to get these technologies to farmers, and the most important thing is that they reach them now.

Finally, Dr Balafoutis asked the panellists about the future of agriculture in the "farm to fork" strategy and how they would like to see it. Mr Basch said that he would like to see the principles of conservation agriculture fully adopted, but that this would require a change in EU support policies. Mr Mayer replied that in order to have a viable economy, all farms must be involved in the change. This means making the best use of energy and developing machine technology to meet these challenges. Mr Pickel believes that political conditions are currently the biggest obstacle, but he is confident that an energy-neutral farm concept

will be developed that will make it easier to meet the energy challenges facing agriculture. Mr Jossart is confident that zero-emission agriculture will be achieved by 2050 but believes that farmers need to be integrated into the system, which is an opportunity for real solutions. Mr Garabetian believes that PV systems are integrated, but that policy needs to be more supportive. The big challenge is also to achieve production that is positive in terms of food security and the environment, but also positive in terms of farmers' incomes.

Finally, Dr Balafoutis concluded the event by stating that it is very complex to find a single solution and invited the audience to read the policy briefs developed to provide comments that could enrich the policy recommendations to be forwarded to the European Commission. Dr Balafoutis closed the event by thanking everyone for their participation.

4. ANNEX I

Brokerage Event Agenda

June 22th, 2023, Mundo-Madou, Brussels

THE TIME SCHEDULE IS BASED ON CET ZONE

08:30 - 09:00 – Reception of attendees

09:00 - 09:20 – Welcome & Opening *Thanos Balafoutis (Project Coordinator)*

09:20 - 09:40 – On-farm biogas: a tool to achieve a circular, regenerative and fossil-free agriculture *Lucile Sever (Policy Officer)*

09:20 - 09:40 – Upscale case studies of Fossil-Energy-Free Technologies and Strategies (FEFTS) applied in farming *Wouter Merckx (HyPErFarm's Project Coordinator)*

09:40 - 10:40 – AgroFossilFree Highlights *Moderator: Konstantinos Vaiopoulos (Project Manager)*

- *Bas Paris (AUA) – "Current energy use status in EU Agriculture"*
- *Alexandros Koutsouris and Vasiliki Kanaki (AUA) - "Adopting (or not) FEFTS: Farmers' and advisors' views"*
- *Mike Kaminiaris (AGENSO) - "AgEnergy platform: A one-stop shop to find FEFTS"*
- *Michael Norremark (AU) - "Results of multi-stakeholder approaches and networking activities"*

10:40 - 11:20 – Coffee break at AgroFossilFree Exhibition Village

11:20 - 11:45 – AgroFossilFree Guidelines: from the Field to Policy *Dirk Vansintjan (RESCoop.eu)*

11:45 - 13:00 – Panel discussion and Q&A *Moderator: Thanos Balafoutis (Project Coordinator)*

- Gilles Mayer (CNH Group)
- Peter Pickel (John Deere)
- Jean-Marc Jossart (Bioenergy Europe)
- Thomas Garabetian (Solar Power Europe)
- Gottlieb Basch (European Conservation Agriculture Federation)

13:00 - 13:10 – Closing remarks *Thanos Balafoutis (Project Coordinator)*

13:10 - 14:30 – Light Lunch

The Exhibition Village will be an informal, networking forum with audiovisual materials, posters, dissemination materials and representatives from AgroFossilFree and AREA ZERO Cluster (RES4LIVE, TheGreefa, HyPErFarm).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 101000496