



# Second batch of Practice Abstracts

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## Document Summary

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Project coordinator: **Ethniko Kentro Erevnas Kai Technologikis Anaptyxis (CERTH)**

## Abstract

This deliverable contains the resume and contents of 38 practice abstracts developed under the project's activity. In M18, a total of 21 were already prepared for the first batch (D5.7). By the end of the project, AgroFossilFree will deliver 59 practice abstracts, nine more than expected.

## Abbreviations

AGROFOSSILFREE: Strategies and technologies to achieve a European Fossil-energy-free agriculture

EIP-AGRI: European Innovation Partnership for Agricultural productivity and Sustainability

EU: European Union

FEFTS: Fossil Energy Free Technologies and Strategies

H2020: Horizon 2020

PA: Practice Abstract

## Partners' short names

CERTH: Ethniko Kentro Erevnas Kai Technologikis Anaptyxis

AU: Aarhus Universitet

AUA: Geponiko Panepistimion Athinon

IUNG-PIB: Instytut Uprawy Nawożenia i Gleboznawstwa, Państwowy Instytut Badawczy

CEMA: Comité Européen Des Groupements De Constructeurs Du Machinisme Agricole

ECAF: European Conservation Agriculture Federation

RECOOP.EU ASBL: Rescoop EU ASBL

ICOEL: Innovationscenter for Økologisk Landbrug

CONFAGRICOLTURA: Confederazione Generale Dell Agricoltura Italiana

LODR: Lubelski Osrodek Doradztwa Rolniczego W Konskowoli

AGENSO: Agricultural & Environmental Solutions

DELPHY: Delphy BV

TEAGASC: TEAGASC – Agriculture and Food Development Authority

WIP: Wirtschaft Und Infrastruktur GmbH & Co Planungs KG

INI: Iniciativas Innovadoras SAL

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## 1 Introduction

The European Innovation Partnership for Agricultural productivity and Sustainability (EIP-AGRI) was launched by the European Commission (EC) in 2012. This initiative aimed to help all EU countries to provide their citizens with a more competitive economy, better jobs, and life standards, fostering a competitive and sustainable agriculture and forestry sector that "achieves more from less".

The EIP-AGRI adheres to the "interactive innovation model", which brings together specific actors (e.g., farmers, advisors, researchers, businesses, etc.) to work in multi-actor projects to find a solution for a specific issue or develop a concrete opportunity. In this sense, communicating about projects activities and results is much easier by a common format (see Figure 1) which facilitates the knowledge flow and enables contacting farmers, researchers and all the other actors involved in innovation projects. The EIP common format consists of a set of basic elements characterising the project, including practice abstracts (PAs). The format is developed with the aim to enable contact with partners, incentivise efficient knowledge exchange and disseminate the results of the project in a concise and easily understandable way to practitioners.

All the PAs generated during the life cycle of AGROFOSSILFREE project will be periodically uploaded to the EIP-AGRI, where the information is shared at EU level, via the EIP-AGRI project database, a unique repository which supports the dissemination of results of all interactive innovation projects. In addition, these PAs will be a useful dissemination tool to share the updates and outcomes of AGROFOSSILFREE with the EIP-AGRI subgroup of innovation.

This document presents 38 Practice Abstracts that have been mainly developed based on the policy briefs, the outcomes of the deliverables and the study cases identified during the project life, or particularly interesting FEFTS collected for presentation on the AgEnergy Platform. By the end of the project, there will be a total of 59 Practice Abstracts produced, which is nine more than set in the project objectives.

## 2 Methodology

PAs are short summaries of around 1000 - 1500 characters (word count – no spaces) that describe the main information/recommendations and serve end users in their daily practice.

All PAs have been prepared following the guidance and Common Format of EIP-AGRI (see Figure 1) in the shape of an Excel template. In addition to the PAs, the Excel template contains general information about the project, including keywords, list of partners and contacts, website and audio-visual material. Every PA must be accompanied by a short title of no more than 150 characters.

This deliverable presents the practice abstract with another design that has been prepared in order to publish them on the project website. However, this design contains the main information as required in the EIP-AGRI format (see Figure 2):

- Main results/outcomes of the activity (expected or final).
- Main practical recommendations such as the main added value/benefit/opportunities to the end user.

Both the summary and the title have been provided in the native language of the coordinator or one of the partners. However, an English version of PAs is available.

Please note that the following practice abstracts have not yet been validated by EIP-AGRI.

 EUROPEAN COMMISSION  
DIRECTORATE-GENERAL FOR AGRICULTURE AND RURAL DEVELOPMENT  
Directorate H. Sustainability and Quality of Agriculture and Rural Development  
H.5. Research and Innovation

### EIP-AGRI Common format for interactive innovation projects

The interactive innovation approach under the European Innovation Partnership Agricultural Productivity and Sustainability (EIP-AGRI)<sup>[1]</sup> fosters the development of demand-driven innovation, turning creative new ideas into practical applications thanks to interactions between partners, the sharing of knowledge and effective intermediation and dissemination.

The EIP common format consists of a set of basic elements characterising the project and includes one (or more) "practice abstract"(s). The format was developed with two main objectives:

- (1) to enable contacting partners and incentivise efficient knowledge exchange, and
- (2) to disseminate the results of the project in a concise and easy understandable way to practitioners.

The common format allows providing information all along the life-cycle of the project. The content of the common format can be updated at any moment when useful, for instance in an intermediate phase of the project. Project information should at least be available at the beginning (describing the situation at the start of the project, including project title and objectives) and at the end of the project (describing the results/recommendations resulting from the project, including a final project report and one or more practice abstracts).

[◀](#) [▶](#) **EIP-AGRI Common format** INSTRUCTIONS PROJECT INFORMATION PARTNERS KEYWORDS AUD

Figure 1. EIP-AGRI Common format.

A	B	C	D	E	G	H	I		
Practice "abstract" 1:	Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.								
Short summary for practitioners in <u>english</u> on the <u>final or expected outcomes</u> (1000-1500 characters, word count – no spaces).	This summary should at least contain the following information: - Main results/outcomes of the activity (expected or final) - The main practical recommendation(s), what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results?  This summary should be as interesting as possible for farmers/end-users, using a <u>direct and easy understandable language</u> and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.		Recommended 0 character(s) / 1500						
Short summary for practitioners in <u>native language</u> .		Mandatory 0 character(s) / 1500							
▶	<a href="#">EIP-AGRI Common format</a>	<a href="#">INSTRUCTIONS</a>	<a href="#">PROJECT INFORMATION</a>	<a href="#">PARTNERS</a>	<a href="#">KEYWORDS</a>	<a href="#">AUDIOVISUAL MATERIAL</a>	<a href="#">WEBSITES</a>	<a href="#">PA1</a>	<a href="#">PA2</a>

Figure 2. EIP-AGRI template for PA.

### 3 Practice Abstracts

Nº	Title of the Practice Abstract	Partner	Language
1	Enabling the creation and growth of energy communities in rural areas	RESCOOP	English / Dutch
2	Farm Energy Audits	CERTH	English / Greek
3	European Low Energy/Carbon Label of Agricultural Products	CERTH	English
4	Agrivoltaics for open-field agriculture	HYPERFARM	English
5	Alternative Fuels for Agricultural Machinery	CEMA	English
6	Precision Agriculture as energy consumption reduction strategy	CERTH	English / Greek
7	Carbon Farming for Carbon Removals	AUA	English
8	Conservation Agriculture to enhance soil carbon stock and reduce GHG emissions in European Agriculture	ECAF	English / Spanish
9	Alternative crop nutrient providers (Green Fertilisers / Biofertilisers, biostimulants / Biochar)	AUA	English
10	Building Management Systems (BMS) for Agricultural Constructions	RES4LIVE	English / Greek
11	Heat pumps for HVAC of agricultural constructions	RES4LIVE	English / Greek
12	Photovoltaics (PV) and Photovoltaic Thermal (PVT) Collectors and Systems for agricultural constructions rooftops	RES4LIVE	English / Greek
13	Biogas production from agricultural waste and other innovative feedstock / Biomethane upgrading for local consumption or grid injection	CERTH	English / Greek
14	Facilitating the development of energy independent farming in Livestock	CEMA	English
15	Livestock building energy upgrading/renovation	AU	English / Danish
16	The use of thermochemical fluids for energy saving and storage in agriculture	THEGREEFA	English
17	Financial Support to Fossil Energy Free Technologies and Strategies (FEFTS)	CERTH	English
18	Regulatory support to Fossil Energy Free Technologies and Strategies (FEFTS)	CERTH	English
19	Technology, Knowledge Transfer, and Awareness Building provisions to support Fossil Energy Free Technologies and Strategies (FEFTS) diffusion	CERTH	English
20	Brite Solar: A nanotechnology company developing materials for solar glass applications in agriculture.	AUA	English / Greek
21	GB Hybrid- strip-till and subsoiler	LODR	English / Polish
22	Successful experiences in Conservation Agriculture	ECAF	English / Spanish

<b>23</b>	Landschapsenergie cv, Bocholt/Belgium	RESCOOP	English / Dutch
<b>24</b>	Solet - Solar panels and systems for private and business	AU	English / Danish
<b>25</b>	SkyClean - Stiesdal Fuel Technologies	AU	English / Danish
<b>26</b>	Madsen Bioenergi – Biogas Plant	AU	English / Danish
<b>27</b>	FarmDroid field robot	AU	English / Danish
<b>28</b>	Green protein to replace in feed	AU	English / Danish
<b>29</b>	Development of green protein refinery from clover grass to replace soya in feed to monogastric animals in Denmark	ICOEL	English / Danish
<b>30</b>	Tenuta di Bagnoli	CONFAGRICOLTURA	English / Italian
<b>31</b>	JMP Flowers greenhouse complex	LODR + IUNG	English / Polish
<b>32</b>	Pustelnia Fish Farm	LODR + IUNG	English / Polish
<b>33</b>	Decision Support Tool	AGENSO	English / Greek
<b>34</b>	Sustainable storage barn	DELPHY + AUA	English / Dutch
<b>35</b>	BHSL Waste to Energy Case Study	TEAGASC	English
<b>36</b>	Novel seaweed-based crop biostimulant	TEAGASC	English
<b>37</b>	The AgroFossilFree Project links with the European Biomass Conference & Exhibition	WIP	English / German
<b>38</b>	The AgroFossilFree Project Intersects with the European Photovoltaic Solar Energy Conference & Exhibition	WIP	English / German

# Enabling the creation and growth of energy communities in rural areas

## Main results / outcomes

With a well-designed enabling framework, the [community energy sector can grow substantially](#) as the examples of Scotland with its [CARES scheme](#) and the Netherlands with the [Post Code Rose mechanism](#) illustrate. In the Netherlands the number of citizen-led initiatives grew from about 70 to 700 in 7 years. Ownership of wind and solar farms boosts the [local economy](#) and [social acceptance](#). It gives young people opportunities to stay in their rural area.

## Practical recommendations

Each Member State should do an assessment of barriers and potential for the development of energy communities at the national level and the findings of such an assessment 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. An ambitious community energy sub-target within the renewable energy target (like in [Scotland](#), the [Netherlands](#) and [Wallonia](#)) should be set by all Member States. Tailored community building support, legal, financial, and technical advice for energy communities make up an essential element of the enabling framework. There should be a holistic strategy to provide financing and advice across different levels of project development. Specific allocation and targeting of development programs and [EU public funds](#) (Recovery and Resilience Funds, Cohesion & Regional Development Funds, Modernisation Fund) for energy communities in a national, regional, and local level is required.



Ecopower coop members visit building site wind turbine (Schelle, BE, 2023)



Glasgow, Tuesday 19 September 2023

## Further information

- Report on enabling frameworks: <https://www.rescoop.eu/toolbox/enabling-frameworks-for-renewable-energy-communities-report-on-good-practices>
- YouGov study: [European citizens want ownership of wind and solar projects in their neighborhood - REScoop](#)

## About this abstract

**Author:** Dirk Vansintjan, REScoop.eu asbl (BE)

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

# De opstart en groei van energiegemeenschappen in landelijke gebieden mogelijk maken

## Belangrijkste resultaten/uitkomsten

Met een goed ontworpen ondersteunend kader kan de [burgerenergiesector aanzienlijk groeien](#), zoals de voorbeelden van Schotland met zijn [CARES-regeling](#) en Nederland met het [Post Code Roos-mechanisme](#) illustreren. In Nederland groeide het aantal burgerinitiatieven in 7 jaar tijd van ongeveer 70 naar 700. Eigendom van wind- en zonneparken stimuleert de [lokale economie](#) en [sociale acceptatie](#). Het geeft jonge mensen kansen om in hun landelijke gebied te blijven.

## Praktische aanbevelingen

Elke lidstaat moet een beoordeling maken van de belemmeringen en het potentieel voor de ontwikkeling van energiegemeenschappen op nationaal niveau en de bevindingen van een dergelijke beoordeling moeten worden gebruikt voor het ontwerpen van een volledig kader dat hen in staat stelt aan de markt deel te nemen zonder discriminatie ten opzichte van andere marktspelers. Alle lidstaten moeten een ambitieus subdoel voor burgerenergie vaststellen binnen de doelstelling voor hernieuwbare energie (zoals in [Schotland](#), [Nederland](#) en [Wallonië](#)). Op maat gemaakte steun voor het opbouwen van gemeenschappen, juridisch, financieel en technisch advies voor energiegemeenschappen vormen een essentieel onderdeel van het ondersteunende kader. Er moet een holistische strategie zijn om financiering en advies te verstrekken op verschillende niveaus van projectontwikkeling. Op nationaal, regionaal en lokaal niveau moeten ontwikkelingsprogramma's en [publieke EU-fondsen](#) (herstel- en veerkrachtfondsen, cohesie- en regionale ontwikkelingsfondsen, moderniseringsfonds) specifiek worden toegewezen aan en gericht op energiegemeenschappen.



Ecopower coöperanten bezoeken de bouwplaats van een windturbine (Schelle, BE, 2023)



Glasgow, dinsdag 19 September 2023

## Meer informatie

- Rapport over ondersteunende kaders: <https://www.rescoop.eu/toolbox/enabling-frameworks-for-renewable-energy-communities-report-on-good-practices>
- YouGov studie: [European citizens want ownership of wind and solar projects in their neighborhood - REScoop](#)

## Over deze samenvatting

**Auteur:** Dirk Vansintjan, REScoop.eu vzw (BE)

**AgroFossilFree** is een H2020 multi-actor project dat de huidige status in de EU-landbouw met betrekking tot energiegebruik evalueert en de bestaande behoeften beoordeelt, zodat boeren hun landbouwproductie kunnen optimaliseren door efficiënter energiegebruik en minder uitstoot van broeikasgassen, wat resultert in economische, agronomische en milieuvoordelen. AgroFossilFree creëert een kader waarbinnen cruciale belanghebbenden samenwerken om de momenteel beschikbare technologieën en strategieën zonder fossiele brandstoffen (FEFTS) in de landbouw van de EU te evalueren en te promoten. Het project loopt van oktober 2020 tot september 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

**CERTH**

CENTRE FOR

RESEARCH &amp; TECHNOLOGY

HELLAS

# Farm Energy Audits

## Main results / outcomes

The majority of EU farms do not conduct energy audits as farmers are not familiar with the procedure and the profits gained from it. Whereas, energy audits are mandatory for residential and commercial buildings so as to determine their energy efficiency. The advantages of doing Farm Energy Audits are:

- **Reduction of energy consumption and related emissions in agriculture** through changes to be applied by farmers for the energy optimization of their farms
- Increased farm profitability, as **costs related to energy use will be significantly reduced** while maintaining the same incomes per production, favouring rural population maintenance or increase.
- **Possibility for the conduction of targeted research** in areas required since the results of all farm energy audits will be gathered to create a unified database.
- Acquisition of the knowledge regarding the EU farms energy status through **a registry that will provide to policy makes the information to focus their policies** for energy consumption reduction.

## Practical recommendations

### EU Level:

- **Promote the advantages of conducting farm energy audits** on national level towards minimization of energy consumption combined with farm operational cost reductions.
- **Create a uniform methodology** to be followed for conducting energy audits across EU.

### Member States Level:

- Create a platform where the energy audits could be done effortlessly. Ensure that the existing energy audit processes are adapted and followed for farms of all types.
- **Keep the audit procedure optional and then move to mandatory certificate of completion.**
- Farmers who have done an energy audit could be **eligible for financing aid programs** for upgrading their equipment and their **products could be promoted as eco-friendly and greener** while increasing the price.

## Further information

AgroFossilFree D3.7: Report on identified policy gaps and policy guidelines  
[\(<https://www.agrofossilfree.eu/deliverables/#1606215127215-a809e42c-7525>\)](https://www.agrofossilfree.eu/deliverables/#1606215127215-a809e42c-7525)

## About this abstract

**Authors:** Foteini Vandorou (IBO - CERTH)

**Date:** July 2023

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

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# Γεωργικοί Ενεργειακοί Έλεγχοι

## Κύρια αποτελέσματα

Η πλειονότητα των εκμεταλλεύσεων της ΕΕ δεν διενεργεί ενεργειακούς ελέγχους, καθώς οι αγρότες δεν είναι εξοικειωμένοι με τη διαδικασία και τα κέρδη που αποκομίζονται από αυτήν. Ενώ, οι ενεργειακοί έλεγχοι είναι υποχρεωτικοί για κτίρια κατοικιών και εμπορικών χώρων ώστε να προσδιορίζεται η ενεργειακή τους απόδοση. Τα πλεονεκτήματα των γεωργικών ενεργειακών ελέγχων είναι:

- **Μείωση της κατανάλωσης ενέργειας και σχετικών εκπομπών στη γεωργία** μέσω αλλαγών που θα εφαρμοστούν για την ενεργειακή βελτιστοποίηση των αγρών
- **Αυξημένη κερδοφορία των εκμεταλλεύσεων**, μέσω μείωσης της χρήσης ενέργειας, διατηρώντας τα ίδια εισοδήματα, ευνοώντας τη διατήρηση ή αύξηση του αγροτικού πληθυσμού.
- **Δυνατότητα διεξαγωγής στοχευμένης έρευνας** σε τομείς που απαιτείται με την συγκέντρωση των αποτελεσμάτων όλων των ενεργειακών ελέγχων σε μια ενιαία βάση δεδομένων.
- Γνώση του ενεργειακού καθεστώτος των αγρών της ΕΕ μέσω ενός **μητρώου που θα παρέχει στους φορείς χάραξης πολιτικής πληροφορίες για εστίαση των πολιτικών** τους για μείωση της κατανάλωσης ενέργειας.

## Πρακτικές Συστάσεις

### Επίπεδο ΕΕ:

- Προώθηση των πλεονεκτημάτων διενέργειας γεωργικών ενεργειακών ελέγχων για την μείωση της κατανάλωσης ενέργειας και του λειτουργικού κόστους της εκμετάλλευσης.
- Δημιουργία ενιαίας μεθοδολογίας για τη διενέργεια ενεργειακών επιθεωρήσεων.

### Επίπεδο Κρατών Μελών:

- Δημιουργία πλατφόρμας για τις ενεργειακές επιθεωρήσεις. Οι υπάρχουσες διαδικασίες θα προσαρμόζονται για όλους τους αγρούς.
- Διατήρηση τη διαδικασίας προαιρετική και έπειτα μετάβαση σε υποχρεωτικό πιστοποιητικό ολοκλήρωσης.
- Αγρότες που έχουν κάνει ενεργειακό έλεγχο θα είναι επιλέξιμοι για λήψη χρηματοδότησης και τα προϊόντα τους θα προωθούνται ως φιλικά προς το περιβάλλον αυξάνοντας την τιμή.

## Περισσότερες Πληροφορίες

AgroFossilFree Π3.7: Report on identified policy gaps and policy guidelines  
(<https://www.agrofossilfree.eu/deliverables/#1606215127215-a809e42c-7525>)

## Σχετικά με την περίληψη

**Συγγραφέας:** Φωτεινή Βανδώρου (IBO - EKETA)

**Ημερομηνία:** Ιούλιος 2023

Το AgroFossilFree είναι ένα πολυυσμμετοχικό H2020 πρόγραμμα, το οποίο θα αξιολογήσει την παρούσα κατάσταση και τις υπάρχουσες ανάγκες όσον αφορά στη χρήση ενέργειας στην ευρωπαϊκή γεωργία, επιτρέποντας στους γεωργούς να βελτιστοποιήσουν την παραγωγή τους μέσω πιο αποδοτικής χρήσης ενέργειας και μειωμένων εκπομπών αερίων του Θερμοκηπίου, έχοντας ως αποτέλεσμα οικονομικά, αγρονομικά και περιβαλλοντικά οφέλη. Το AgroFossilFree θα δημιουργήσει ένα πλαίσιο κάτω από το οποίο σημαντικοί εμπλεκόμενοι φορείς θα συνεργαστούν για την αξιολόγηση και την προώθηση των διαθέσιμων στην παρούσα φάση τεχνολογιών και στρατηγικών για ενέργεια που δεν προέρχεται από ορυκτά καύσιμα (FEFTS) στη γεωργία της ΕΕ. Το έργο έχει διάρκεια από τον Οκτώβριο του 2020 έως τον Σεπτέμβριο του 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

# European Low Energy / Carbon Label of Agricultural Products

## Main results / outcomes

- The idea of labelling agricultural products for the benefit of the final consumer (e.g., organic logo) has produced distinctive labels that make it easier for consumers to identify them and help farmers to market them with potential better prices and economic aid.
- Such labelling can only be used on products that have been certified by an authorised control body, using a certain methodology to check the fulfilment of strict conditions in the production system.
- An EU defossilisation labelling system for agricultural products could act as an official certification scheme for foodstuffs produced with sustainable direct and indirect energy use practices that end up to GHG reductions.



## Practical recommendations

- Clear and transparent official certification scheme** for direct and indirect energy use reduction by introducing a framework for monitoring, reporting and verification of the energy use reduction level and the GHG emissions reductions **approved by an official authority of the EU** and **registered in an official registry** to prevent double-counting and avoid green-washing.
- The certification framework should be initially set from the EU's responsible authority (top-down) but should also **allow externals to propose certification** of specific products (bottom-up) that after reviewing by a specialised committee could be a part of the official certification scheme.
- Labelling low or zero fossil energy agricultural products should be of **low cost for farmers** and the products should receive **higher market prices** and **CAP support** to attract farmers into sustainable energy use and efficiency.
- Extension services, private advisors and innovation brokers should inform farmers about such schemes and provide **services to receive this label** and promote these products to consumers.

## Further information

AgroFossilFree D3.7: Report on identified policy gaps and policy guidelines  
<https://www.agrofossilfree.eu/deliverables/#1606215127215-a809e42c-7525>

## About this abstract

**Authors:** Thanos Balafoutis (IBO - CERTH)

**Date:** July 2023

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

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# Agrivoltaics for open-field agriculture

## Main results / outcomes

Agrivoltaics (APV), the integration of agriculture with solar PVs, emerges as a potential remedy, allowing dual land utilization by combining solar energy generation with crop cultivation. This promises a more sustainable approach to land use, ensuring food production is not compromised for energy needs. Based on research from the HyPERFarm H2020 project, the total EU's potential capacity for APV systems is estimated at 51 TW, potentially producing around 71,500 TWh of electricity each year.

## Practical recommendations

Setting standards for what counts as an APV system is essential. Europe doesn't have a single definition for Agri-PV, so using ideas from German, French, and Italian rules could help set clear standards. For real APV systems, they need financial help for a while, similar to past support for new green technologies. APV requires a different setup, which means higher starting costs; so it's really important for public groups to help out. The rules need to be made faster, so we don't slow down APV projects, maybe by giving out ready-to-use designs and fixing issues with connecting to the electricity grid. Since APV works in a spread-out way, we need other options for expanding the grid and backing groups of users. Boosting APV work at the EU level, from research money to making things locally, is a must. Even though the Horizon Europe program doesn't focus much on APV, money for testing new setups is key for making rules and learning more. Getting the word out, from farmers to stores and customers, helps connect tech with what people want to buy. Stores can use ads to push APV items, teaching shoppers to look for green APV goods.



Figure 1: HyPERFarm Agrivoltaics Installations. Left) Krinner, Germany; center) Transfarm KUL, Belgium; right) Aarhus University, Denmark.

## Further information

- [HyPERFarm Scientific publications](#)
- [HyPERFarm Practice Abstracts](#)
- [AgriPV Tool](#)

## About this abstract

**Authors:** Alan Gonzalez Morales (PNO Innovation BE – Clustering activities leaders)

**Date:** August 2023

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

# Alternative Fuels for Agricultural Machinery

## Main results / outcomes

Electrification with batteries and fuel cells seems as a logical step forward for AG machinery, however issues of weight, energy density, and fast refueling of energy storage on-board for a effective and efficient operating range must be considered. Therefore, full electrification seems feasible for small-sized agricultural machines, while for mid- and large-sized and for high power applications there is no alternative to internal combustion engine.

## Practical recommendations

Renewable and low-carbon fuels (biomass fuels, hydrogen and e-fuels) will grow in importance as combustion engines remain a necessary key energy converter for agricultural machinery in the short, mid and long-term due to its specific type of use. Agriculture must be recognized as key sector for use of e-fuels and Hydrotreated Vegetable Oil (HVO i.e. renewable diesel) as drop-in replacement fuels. Biomass fuels may have co-benefits as organic fertilizer and alternative protein source, and in the case of biomethane it contributes to a circular economy model for livestock sector and solves the ammonia/methane emission problem.



1. Methane combustion engine



2. Tractor fueling from Livestock Fugitive Methane

## Further information

GHG emissions from burning fossil fuel in AG machinery counts for 10% of total AG emissions or ca. 1% of total EU-27 GHG emissions ([https://di.unfccc.int/detailed\\_data\\_by\\_party](https://di.unfccc.int/detailed_data_by_party)).

## About this abstract

**Authors:** (Gilles Mayer, New Holland; Ivo Hostens, CEMA aisbl; Vanja Biševac, CEMA aisbl)

**Date:** July 2023

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

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# Precision Agriculture as energy consumption reduction strategy

## Main results / outcomes

Adopting Precision Agriculture (PA) technologies can have a positive impact on farm productivity and economics, providing higher or equal yields with lower production cost than conventional practices. The farming community can save a lot of cost and prevent further GHG emissions by applying PA techniques (i.e., guidance, recording, decision-making and reacting) that suggest optimal routes for less fuel consumption by agricultural vehicles (path planning) and reduction of agricultural inputs through site-specific application (target inputs to spatial and temporal needs of the field). PA can be applied to almost every category of greenhouse and open-field crop production (i.e., arable, orchards, vineyards, vegetables). Certain high-tech equipment most times is necessary.

## Practical recommendations

In order for PA to be promoted as an energy consumption reduction strategy, subsidies and incentives should be given to farmers to acquire technologies that allow precision input application. In case of expensive equipment, the concept of joint ownership/purchase by a group of farmers or associations should be promoted and simplified. Alongside, activities to raise agricultural communities' awareness on PA are needed, supporting farmers on gaining knowledge on how to implement certain methods and what are the outcomes they should expect and participating in training programmes (under common EU standards). In addition, farmers could record their inputs (annually) in order to facilitate any EU state to either provide multiple rewards (for the successful cases) or recommendations from advisory services for further improvement. Extension services should be trained adequately to provide recommendations and technical support to farmers applying PA practices.



Figure 1: Variable rate input application

## Further information

The new Common Agricultural Policy (CAP) of the European Union (EU) has put PA on the list of eco-schemes practices eligible for funding and a total of 270 billion euros will be spent on EU farms until 2027 (<https://www.arc2020.eu/cap-beyond-the-eu-precision-agriculture/>)

## About this abstract

**Authors:** Konstantinos Vaiopoulos, Centre for Research and Technology Hellas (CERTH)

**Date:** July 2023

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

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# Η γεωργία ακριβείας ως στρατηγική μείωσης της ενεργειακής κατανάλωσης

## Κύρια αποτελέσματα

Η υιοθέτηση τεχνολογιών Γεωργίας Ακριβείας (ΓΑ) μπορεί να έχει θετικό αντίκτυπο στην παραγωγικότητα και τα οικονομικά των αγροκτημάτων, παρέχοντας υψηλότερες ή ίσες αποδόσεις με χαμηλότερο κόστος παραγωγής από τις συμβατικές πρακτικές, εξοικονόμηση κόστους και μείωση εκπομπών ΑτΘ. Η ΓΑ προτείνει βέλτιστες διαδρομές για λιγότερη κατανάλωση καυσίμου από γεωργικά οχήματα και μείωση των γεωργικών εισροών μέσω εφαρμογής ανάλογα με την τοποθεσία (στοχευμένες εισροές για χωρικές/χρονικές ανάγκες του χωραφιού). Τεχνικές ΓΑ μπορούν να εφαρμοστούν σε κάθε κατηγορία υπαίθριας και θερμοκηπιακής καλλιέργειας (αροτραίες, οπωρώνες, αμπελώνες, λαχανικά) με χρήση εξοπλισμού υψηλής τεχνολογίας.

## Πρακτικές συστάσεις

Προκειμένου η ΓΑ να πρωθηθεί ως στρατηγική μείωσης κατανάλωσης ενέργειας, θα πρέπει να δοθούν επιδοτήσεις και κίνητρα στους αγρότες για την απόκτηση τεχνολογιών για ακριβή εφαρμογή εισροών. Σε περίπτωση ακριβού εξοπλισμού, θα πρέπει να πρωθηθεί και να απλοποιηθεί η δυνατότητα συνιδιοκτησίας/αγοράς από ομάδες αγροτών ή ενώσεις. Παράλληλα, απαιτούνται δραστηριότητες για την ευαισθητοποίηση των αγροτικών κοινοτήτων σχετικά με την ΓΑ, ώστε οι αγρότες να αποκτήσουν γνώσεις σχετικά με τον τρόπο εφαρμογής ορισμένων μεθόδων και τα αναμενόμενα αποτελέσματα και να συμμετέχουν σε προγράμματα κατάρτισης (με κοινά ευρωπαϊκά πρότυπα). Επιπλέον, οι αγρότες θα μπορούσαν να καταγράφουν τις εισροές τους (ετησίως) προκειμένου να διευκολύνουν την πολιτεία είτε να παρέχει ανταμοιβές στις επιτυχημένες περιπτώσεις, είτε συστάσεις από συμβουλευτικές υπηρεσίες για βελτιώσεις. Οι υπηρεσίες γεωργικών εφαρμογών θα πρέπει να εκπαιδεύονται επαρκώς για να παρέχουν συστάσεις και τεχνική υποστήριξη στους αγρότες που εφαρμόζουν πρακτικές ΓΑ.



Εικόνα 1: Εφαρμογή εισροών μεταβλητού ρυθμού

## Περισσότερες Πληροφορίες

Η νέα Κοινή Αγροτική Πολιτική (ΚΑΠ) της ΕΕ έχει συμπεριλάβει την ΓΑ στον κατάλογο πρακτικών οικολογικών προγραμμάτων που είναι επιλέξιμες για χρηματοδότηση και συνολικά 270 δισεκατομμύρια ευρώ θα δαπανηθούν σε αγροκτήματα της ΕΕ έως το 2027 (<https://www.arc2020.eu/cap-beyond-the-eu-precision-agriculture/>)

## Σχετικά με την περίληψη

**Συγγραφέας:** Κωνσταντίνος Βαϊόπουλος, Εθνικό Κέντρο Έρευνας και Τεχνολογικής Ανάπτυξης (ΕΚΕΤΑ)

**Ημερομηνία:** Ιούλιος 2023

Το AgroFossilFree είναι ένα πολυσυμμετοχικό H2020 πρόγραμμα, το οποίο θα αξιολογήσει την παρούσα κατάσταση και τις υπάρχουσες ανάγκες όσον αφορά στη χρήση ενέργειας στην ευρωπαϊκή γεωργία, επιτρέποντας στους γεωργούς να βελτιστοποιήσουν την παραγωγή τους μέσω πιο αποδοτικής χρήσης ενέργειας και μειωμένων εκπομπών αερίων του Θερμοκηπίου, έχοντας ως αποτέλεσμα οικονομικά, αγρονομικά και περιβαλλοντικά οφέλη. Το AgroFossilFree θα δημιουργήσει ένα πλαίσιο κάτω από το οποίο σημαντικοί εμπλεκόμενοι φορείς θα συνεργαστούν για την αξιολόγηση και την προώθηση των διαθέσιμων στην παρούσα φάση τεχνολογιών και στρατηγικών για ενέργεια που δεν προέρχεται από ορυκτά καύσιμα (FEFTS) στη γεωργία της ΕΕ. Το έργο έχει διάρκεια από τον Οκτώβριο του 2020 έως τον Σεπτέμβριο του 2023.

**Ιστοσελίδα:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

# Policy Brief: Carbon Farming for Carbon Removals

## Main results / outcomes

Carbon farming aims to optimise carbon capture from the atmosphere to plant material and soil. Many farming techniques that support carbon farming (such as conservation agriculture) exist but are not practiced on a large scale. It is necessary to create incentives for the adoption of climate-friendly practices through carbon farming, as currently, there is not yet a targeted policy tool (under development ) to significantly incentivise the increase and protection of carbon sinks.

## Practical Recommendations

- Accelerate the development of certification methodologies based on the QU.A.L.I.TY criteria set out in Carbon Removal Certification Framework, CRCF)
- Support the work of the Carbon Removal Expert Group on the voluntary certification of carbon removals and request an assessment of whether a functional EU carbon farming tool can be developed
- Continue to develop the standardisation of monitoring, reporting and verification methodologies to provide a framework for carbon farming
- Continue to promote carbon farming practices through the CAP
- Depending on the recommendations of Carbon Removal Expert Group on the voluntary certification of carbon removals support the development of an EU-wide carbon farming system
- Develop a range of incentives that support the adoption of carbon farming practices
- Support R&D processes that attempt to measure the impacts and life cycle of carbon sequestration techniques
- Develop education and extension processes on the environmental and economic benefits of carbon farming techniques



**Figure 1.** Image that shows carbon farming. Copyright: FREEPIK

## Expected Impacts

The expected impacts of the policy recommendations include improved farm incomes, enhanced resilience to climate change, increased carbon sequestration, enhanced biodiversity and soil health, positive environmental externalities

## About this abstract

**Authors:** Bas Paris, Agricultural University of Athens

**Date:** July 2023

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

# Adoption of Conservation Agriculture to enhance soil carbon stock and reduce GHG emissions in European Agriculture

## Main results / outcomes

Creating policies that facilitate making a transition in European agriculture towards more sustainable land-use production systems based on the three principles of Conservation Agriculture (Minimum Mechanical Soil Disturbance; Permanent soil organic cover; Species diversification) will increase the carbon stock in the soil, reduce dependence on fossil fuels in agriculture and contribute to the adaptation and mitigation of climate change.

## Practical recommendations

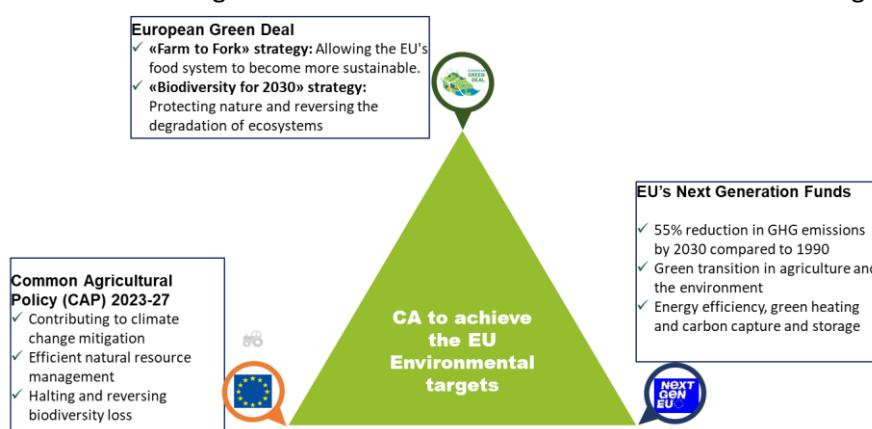
Conservation Agriculture adoption is proven as one of the most suitable agricultural systems to achieve the European climate targets. However, to reach these goals some policy recommendations are needed at the European and National level.

### EU Level

- Promote carbon farming practices based on the principles of Conservation Agriculture (No-tillage and/or strip-till in arable crops and groundcover in woody crops) through the CAP and other EU policies and facilitate access to the information to make the transition from conventional to Conservation Agriculture.
- Creation of a harmonized European Label that certifies the farm contributes to mitigating Climate change by soil carbon sequestration and minimising emissions.
- Promote direct payments to farmers who store carbon and reduce their carbon footprint by reducing direct and indirect fossil energy consumption.

### National Level

- Facilitate farmers and agricultural service providers, through subsidy programmes, to acquire direct seeders, which is needed to establish No-till in the farmland and encourage cooperation between farmers.
- Promote training activities for farmers and advisors at national and regional levels.



**Figure 1:** Conservation Agriculture contributions to the European environmental policies.

## Further information

[Project website](#)

[Conservation Agriculture Climate Change Report](#)

[Conservation Agriculture for boosting Green Deal in Europe](#)

## About this abstract

**Authors:** Julio Román-Vázquez (European Conservation Agriculture Federation)

**Date:** July 2023

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# Agricultura de Conservación para mejorar el contenido de carbono del suelo y reducir las emisiones de GEI

## Principales resultados

Elaborar políticas que faciliten la transición de la agricultura europea hacia sistemas de producción de uso de la tierra más sostenibles basados en los tres principios de la Agricultura de Conservación (mínima alteración mecánica del Suelo; Cobertura permanente del suelo; diversificación de especies) aumentará el contenido de carbono en el suelo, reducirá la dependencia de los combustibles fósiles en la agricultura y contribuirá a la adaptación y mitigación del cambio climático.

## Recomendaciones prácticas

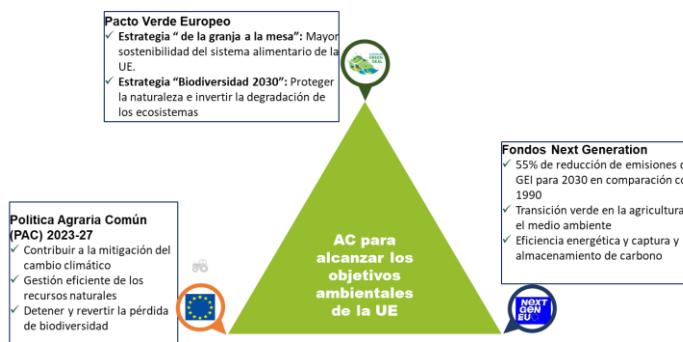
La Agricultura de Conservación ha demostrado ser uno de los sistemas agrícolas más adecuados para alcanzar los objetivos climáticos europeos. Sin embargo, para alcanzar estos objetivos se necesitan algunas recomendaciones políticas a nivel europeo y nacional.

### A nivel europeo

- Promover prácticas de agricultura de carbono basadas en los principios de la Agricultura de Conservación (Siembra directa y/o laboreo en bandas para cultivos extensivos y cubiertas vegetales en cultivos leñosos) a través de la PAC y facilitar el acceso a la información para hacer la transición desde la agricultura convencional a la Agricultura de Conservación.
- Creación de una etiqueta europea que certifique que se realiza una agricultura que contribuye a mitigar el cambio climático mediante el secuestro de carbono en el suelo y minimización las emisiones de GEI.
- Promover pagos directos a los agricultores que almacenan carbono en el suelo y reducen su huella de carbono mediante la disminución del consumo, directo e indirecto, de energía fósil.

### A nivel nacional

- Facilitar a los agricultores y proveedores de servicios agrícolas, a través de subvenciones, la adquisición de sembradoras directas, lo cual es necesario para realizar no laboreo y fomentar la cooperación entre los agricultores.
- Promover actividades de formación para agricultores y asesores a nivel nacional y regional.



**Figura 1:** Contribución de la Agricultura de Conservación a las políticas medioambientales europeas

## Más Información

[Página web del proyecto](#)

[informe sobre Agricultura de Conservación y Cambio Climático](#)

[Agricultura de conservación para impulsar el Pacto Verde en Europa](#)

## Detalles sobre este resumen

**Autor:** Julio Román-Vázquez (European Conservation Agriculture Federation)

**Fecha:** Julio 2023

**AgroFossilFree** es un proyecto H2020 multiactor que evaluará la situación actual de la agricultura de la UE en cuanto al uso de la energía y valorará las necesidades existentes, lo que permitirá a los agricultores optimizar la producción agrícola mediante un uso más eficiente de la energía y la reducción de las emisiones de gases de efecto invernadero, con los consiguientes beneficios económicos, agronómicos y medioambientales. AgroFossilFree creará un marco bajo el cual las partes interesadas críticas cooperarán para evaluar y promover las Tecnologías y Estrategias Libres de Energía Fósil (FEFTS) actualmente disponibles en la agricultura de la UE. El proyecto se desarrolla entre octubre de 2020 y septiembre de 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

# Policy Brief Alternative crop nutrient providers (Green Fertilisers / Biofertilisers, biostimulants / Biochar)

## Main results / outcomes

Around 50% of all energy used in EU agriculture is associated with the production and consumption of chemical fertilisers. The production of these fertilisers is based on fossil fuels, often natural gas. For the EU agricultural sector to move towards sustainable production systems a significant transformation is required in the production of fertilisers. Such products are green fertilisers, biofertilisers/biostimulants and biochar.

## Practical recommendations

- Promote R&D processes that support the replacement of fossil fuels
- Support industries that produce and/or shift their production processes to green fertilisers
- Promote the use of biomethane and green hydrogen as a substitute of natural gas
- Through market incentives, ensure price competitiveness of green fertilisers
- Develop education and extension processes on the benefits of alternative crop nutrient providers
- Support the development of products that improve the quality of soils and support carbon sequestration
- Promote further the use of alternative crop nutrient providers through the Common Agricultural Policy
- Support local networks that prioritize the production of local biofertilizers
- Promote R&D processes on the long-term potential of biochar to improve soil fertility
- Promote demonstration projects and pilots that showcase alternative crop nutrient providers
- Provide a financial incentive to industry that uses pyrolysis and gasification technologies of agricultural biomass to produce biofuels or electricity and biochar as a by-product.



Fig 1: Image showing biofertilisers. Copyright: FREEPIK

## Expected Impacts

The expected impacts of the policy recommendations include reduced greenhouse gas emissions, enhanced biodiversity and soil health, positive environmental externalities, improved public health, increased rural

## About this abstract

**Authors:** Bas Paris, Agricultural University of Athens

**Date:** July 2023

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

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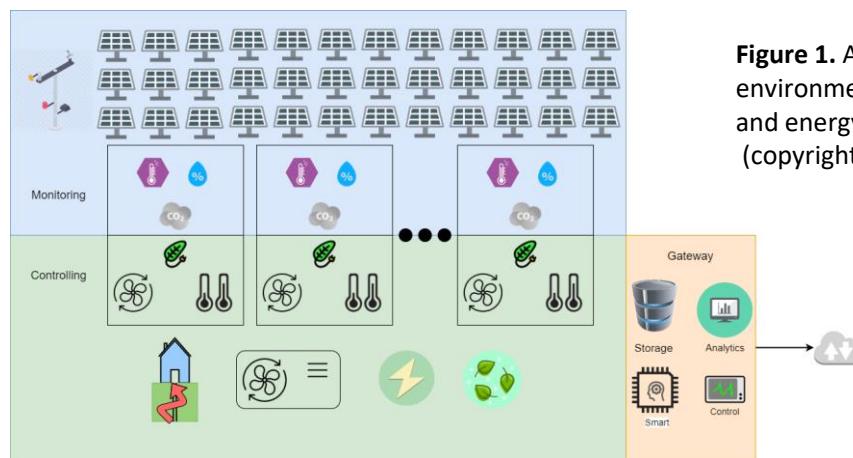
# Building Management Systems (BMS) for Agricultural Constructions

## Main results / outcomes

Agricultural facilities encounter significant challenges, such as inefficient energy usage, suboptimal environmental conditions, and inadequate waste management. Smart Agriculture/ Agriculture 4.0 integrates inexpensive sensors and actuators with cloud computing and artificial intelligence (AI) to attain its objectives, enhancing farmers' decision-making capabilities and simultaneously diminishing their ecological impact

## Practical recommendations

To promote BMS implementation, financial incentives in the form of grants, subsidies, and tax benefits can assist agricultural facility owners in overcoming initial investment barriers. Raising awareness through training programs and campaigns can educate about energy savings, improved animal welfare and productivity, and reduced environmental impact associated with BMS adoption. Regulations mandating BMS implementation in new constructions or major renovations can be enforced, establishing energy efficiency and environmental performance standards. Allocating funding for R&D initiatives focused on BMS technologies will facilitate innovation and address technical challenges. Providing free governmental technical assistance and expert advice can support agricultural facility owners in planning, installing, and operating BMS. Fostered partnerships between government agencies, industry associations, technology providers, and financial institutions can create a supportive ecosystem, allowing the sharing of best practices and success stories to encourage BMS adoption. The anticipated impacts of BMS adoption are substantial towards optimization of energy consumption and resource allocation, improved livestock and crop productivity and sustainability, reduced mortality rates, minimization of greenhouse gas emissions, through data-driven decision-making.



**Figure 1.** Arrangement for precise indoor environmental control of agricultural buildings and energy smart control.  
(copyrights Plegma Labs).

## Further information

For further information visit [www.res4live.eu](http://www.res4live.eu), and the relevant Practice Abstract about "[Precise indoor environmental control of agricultural buildings and energy smart control](#)".

## About this abstract

**Authors:** Stelios Kalogridis, Plegma Labs [RES4LIVE]

**Date:** July 2023

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

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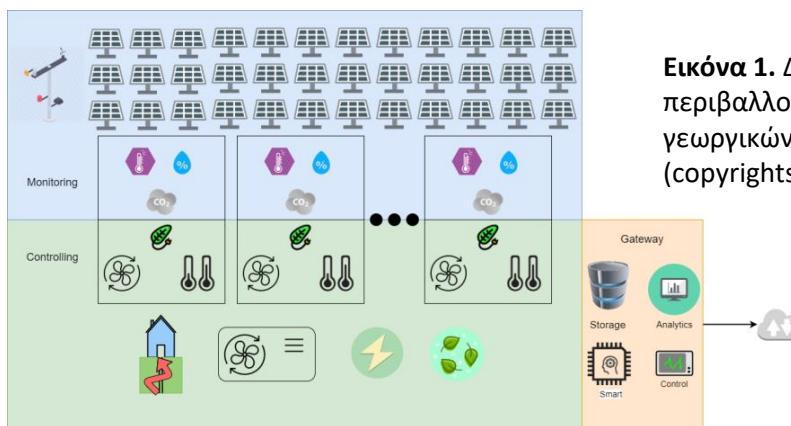
## Συστήματα Διαχείρισης Κτιρίων (BMS) για Γεωργικές Κατασκευές

### Κυριότερα αποτελέσματα

Οι γεωργικές εγκαταστάσεις αντιμετωπίζουν σημαντικές προκλήσεις, όπως η αναποτελεσματική χρήση ενέργειας, οι μη βέλτιστες περιβαλλοντικές συνθήκες και η ανεπαρκής διαχείριση αποβλήτων. Η Ευφύής Γεωργία (Smart Agriculture/Agriculture 4.0) ενσωματώνει φθηνούς αισθητήρες και επενεργητές με το υπολογιστικό νέφος (cloud computing) και την τεχνητή νοημοσύνη (AI) για την επίτευξη των στόχων του, ενισχύοντας τις ικανότητες λήψης αποφάσεων των αγροτών και μειώνοντας ταυτόχρονα τον οικολογικό τους αποτύπωμα.

### Πρακτικές συστάσεις

Για την προώθηση BMS εφαρμογών, τα οικονομικά κίνητρα με τη μορφή επιχορηγήσεων, επιδοτήσεων και φορολογικών πλεονεκτημάτων μπορούν να βοηθήσουν τους ιδιοκτήτες γεωργικών εγκαταστάσεων να ξεπεράσουν τα αρχικά επενδυτικά εμπόδια. Η ευαισθητοποίηση μέσω εκπαιδευτικών προγραμμάτων και εκστρατειών μπορεί να ενημερώσει σχετικά με την εξοικονόμηση ενέργειας, τη βελτίωση ευζωίας και παραγωγικότητα, και τη μείωση των περιβαλλοντικών επιπτώσεων που σχετίζονται με την υιοθέτηση του BMS. Οι κανονισμοί που επιβάλλουν την εφαρμογή BMS σε νέες κατασκευές ή ανακαινίσεις μεγάλης κλίμακας μπορούν να επιβληθούν, θεσπίζοντας πρότυπα ενεργειακής απόδοσης και περιβαλλοντικών επιδόσεων. Η διάθεση χρηματοδότησης για πρωτοβουλίες Έρευνας και Ανάπτυξης που επικεντρώνονται στις τεχνολογίες BMS θα διευκολύνει την καινοτομία και θα αντιμετωπίσει τις τεχνικές προκλήσεις. Η παροχή δωρεάν κυβερνητικής τεχνικής βοήθειας και συμβουλών εμπειρογνωμόνων μπορεί να υποστηρίξει τους ιδιοκτήτες γεωργικών εγκαταστάσεων στο σχεδιασμό, την εγκατάσταση και τη λειτουργία του BMS. Οι πρωθημένες συνεργασίες μεταξύ κυβερνητικών υπηρεσιών, βιομηχανικών ενώσεων, παρόχων τεχνολογίας και χρηματοπιστωτικών ιδρυμάτων μπορούν να δημιουργήσουν ένα υποστηρικτικό οικοσύστημα, επιτρέποντας την ανταλλαγή βέλτιστων πρακτικών και ιστοριών επιτυχίας για την ενθάρρυνση της υιοθέτησης του BMS. Οι αναμενόμενες επιπτώσεις της υιοθέτησης του BMS είναι σημαντικές για τη βελτιστοποίηση της κατανάλωσης ενέργειας και της κατανομής των πόρων, τη βελτίωση της παραγωγικότητας καλλιεργειών, της βιωσιμότητας του ζωικού κεφαλαίου και της μείωση των ποσοστών θνησιμότητας, την ελαχιστοποίηση των εκπομπών αερίων του θερμοκηπίου, μέσω της λήψης αποφάσεων βάσει δεδομένων.



**Εικόνα 1.** Διάταξη για ακριβή εσωτερικό περιβαλλοντικό και ενεργειακό έλεγχο γεωργικών κτιρίων.  
 (copyrights Plegma Labs).

### Περισσότερες πληροφορίες

Για περισσότερες πληροφορίες επισκεφθείτε το [www.res4live.eu](http://www.res4live.eu), και το σχετικό Practice Abstract: "[Precise indoor environmental control of agricultural buildings and energy smart control](#)".

### About this abstract

**Authors:** Stelios Kalogridis, Plegma Labs [RES4LIVE]

**Date:** July 2023

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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



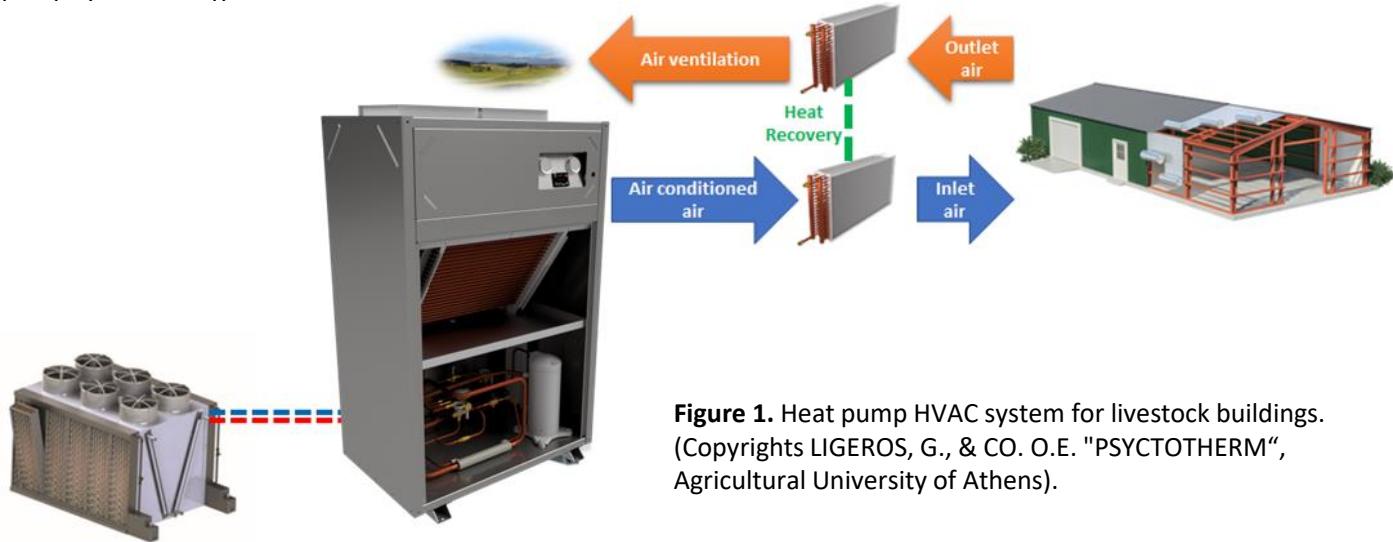
# Heat pumps for HVAC (Heating, Ventilation, and Air Conditioning) of agricultural constructions

## Main results / outcomes

Agricultural construction requires precise control of air temperature and humidity for optimal welfare and productivity. Based on the experience gained by research activities funded by the EC, heat pumps are one of the few technologies that can ensure such conditions, since they are designed to provide heating, cooling, and dehumidifying in a space using electricity.

## Practical recommendations

To maximize heat pump potential in agricultural facilities, we can conduct feasibility studies and pilot projects to evaluate efficiency and cost-effectiveness. By identifying applications where heat pumps yield energy savings, we can optimize systems for each location. Implementing monitoring and evaluation systems with smart technologies will enable real-time performance tracking and data analysis for energy-saving measures. Encouraging their integration with renewables, such as solar or geothermal power, reduces emissions and costs through hybrid, modular systems. Supporting R&D for agricultural-specific heat pump technologies includes funding research for harsh conditions and enhancing durability with innovative materials. Partnerships through forums and workshops can facilitate knowledge-sharing among manufacturers, stakeholders, and research institutions, as well as the development of guidelines and standards for design, installation, and operation, considering system sizing, noise levels, and environmental impact. Training programs for farmers and technicians, along with accessible educational material, will ensure successful implementation. Providing incentives and exploring financing models will offset costs and incentivize adoption of heat pump systems in agriculture.



**Figure 1.** Heat pump HVAC system for livestock buildings.  
 (Copyrights LIGEROS, G., & CO. O.E. "PSYCTOTHERM", Agricultural University of Athens).

## Further information

For further information visit [www.res4live.eu](http://www.res4live.eu), and the relevant Practice Abstract about "[Heat pumps for climate control of livestock buildings](#)".

## About this abstract

**Authors:** Dimitrios Tyris, Agricultural University of Athens [RES4LIVE].

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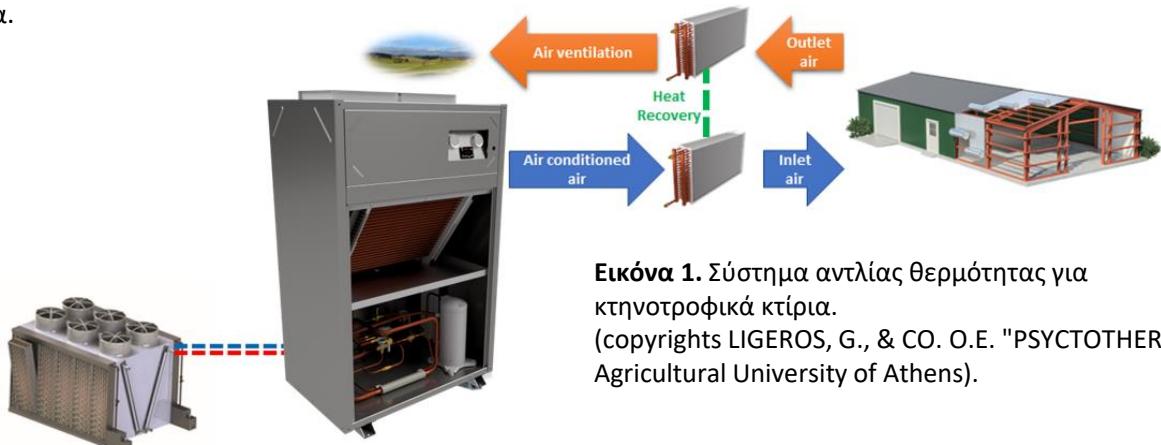
# Αντλίες Θερμότητας για Θέρμανση, Εξαερισμό και Κλιματισμό (HVAC) αγροτικών κατασκευών

## Κυριότερα αποτελέσματα

Οι σύγχρονες γεωργικές εγκαταστάσεις απαιτούν ακριβή έλεγχο της θερμοκρασίας και της υγρασίας του αέρα για βελτιστηρία ευζωίας και παραγωγικότητα. Βάσει της εμπειρίας που έχει αποκτηθεί πλέον από ερευνητικές δραστηριότητες χρηματοδοτούμενες από την Ευρωπαϊκή Επιτροπή, οι αντλίες θερμότητας είναι μία από τις λίγες τεχνολογίες που μπορούν να εξασφαλίσουν τέτοιες συνθήκες, δεδομένου ότι έχουν σχεδιαστεί για να παρέχουν θέρμανση, ψύξη και αφύγρανση, καταναλώνοντας ηλεκτρικό ρεύμα.

## Πρακτικές συστάσεις

Για να μεγιστοποιηθεί το δυναμικό αντλιών θερμότητας σε γεωργικές εγκαταστάσεις, μπορούμε να διεξάγουμε μελέτες σκοπιμότητας και πλοτικά έργα για την αξιολόγηση της αποδοτικότητας και της σχέσης κόστους-αποτελεσματικότητας. Εντοπίζοντας εφαρμογές όπου οι αντλίες θερμότητας εξοικονομούν ενέργεια, μπορούμε να βελτιστοποιήσουμε τα συστήματα για διαφορετικές τοποθεσίες. Η εφαρμογή συστημάτων παρακολούθησης και αξιολόγησης με έξυπνες τεχνολογίες θα επιτρέψει την παρακολούθηση της απόδοσης σε πραγματικό χρόνο και την ανάλυση δεδομένων για την εξοικονόμησης ενέργειας. Η ενθάρρυνση της ενσωμάτωσής τους σε συστήματα ανανεώσιμων πηγών ενέργειας, όπως η ηλιακή ή η γεωθερμική ενέργεια, μπορεί να μειώσει τις εκπομπές και το κόστος μέσω υβριδικών, αρθρωτών συστημάτων. Η υποστήριξη της Έρευνας και Ανάπτυξης για ειδικές εφαρμογές στη γεωργία θα περιλαμβάνει τη χρηματοδότηση έρευνας για λειτουργία σε διαβρωτικά περιβάλλοντα, και την ενίσχυση της ανθεκτικότητας μέσω καινοτόμων υλικών. Η προώθηση συνεργασιών μέσω δημοσίων συζητήσεων και ομάδων εργασίας μπορεί να διευκολύνει της ανταλλαγή γνώσης μεταξύ κατασκευαστών, ερευνητικών ιδρυμάτων και διαφόρων ενδιαφερόμενων μερών, όπως επίσης και η ανάπτυξη κατευθυντήριων γραμμών και προτύπων σχεδιασμού για εγκατάσταση και λειτουργία, λαμβάνοντας υπόψη το μέγεθος του συστήματος, τα επίπεδα θορύβου και τις περιβαλλοντικές επιπτώσεις. Τα εκπαιδευτικά προγράμματα για αγρότες και τεχνικούς, συνοδευόμενα από προσβάσιμο εκπαιδευτικό υλικό, θα εξασφαλίσουν την επιτυχή υλοποίησή τους. Η παροχή κινήτρων και η διερεύνηση μοντέλων χρηματοδότησης μπορούν να αντισταθμίσουν το κόστος και θα δώσουν περαιτέρω κίνητρα για την υιοθέτηση συστημάτων αντλιών θερμότητας στη γεωργία.



**Εικόνα 1.** Σύστημα αντλίας θερμότητας για κτηνοτροφικά κτίρια.  
(copyrights LIGEROS, G., & CO. O.E. "PSYCTOTHERM", Agricultural University of Athens).

## Περισσότερες πληροφορίες

Για περισσότερες πληροφορίες επισκεφθείτε το [www.res4live.eu](http://www.res4live.eu), και το σχετικό Practice Abstract: "[Heat pumps for climate control of livestock buildings](#)".

## About this abstract

**Authors:** (Dimitrios Tyris, Agricultural University of Athens [RES4LIVE])

**Date:** July 2023

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**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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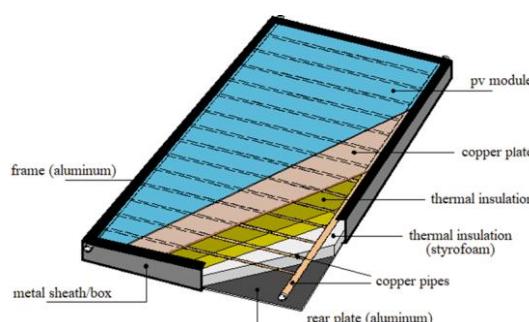
# Photovoltaics (PV) and Photovoltaic Thermal (PVT) Collectors and Systems for agricultural constructions rooftops

## Main results / outcomes

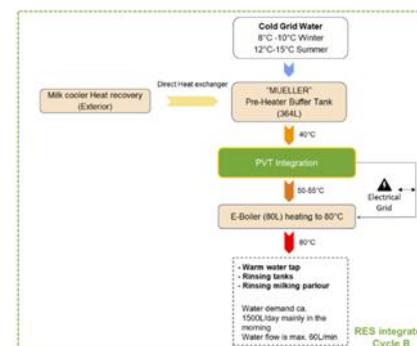
From numerous scientific studies, it can be appreciated that agriculture has high energy demands for heat and electricity. Globally, heat consists of 50% of the total energy consumption, while electricity, 20%. The costs of the energy consumption in greenhouses are up to 50% of the production costs and account for the second largest operating cost. Solar thermal technology can easily cover at least 60% of the hot water energy demand of agriculture. There is little renewable energy penetration in agriculture, and as fossil fuel costs are likely to rise in the future and as complete electrification would overwhelm the grid, a renewable heating solution like solar thermal or PVT technology is a must in the renewable energy mix future.

## Practical recommendations

Solar thermal must be better recognised as a viable and cost-effective renewable heating solution. Although PV technology is on the rise and costs are lowering due to policy incentives, there is very few incentives on solar thermal and none for PVT. Support and subsidies for PVT technology and solar thermal must be facilitated just like PV technology, along with favourable investment plans for those that wish to invest in a new system. Imposing stricter carbon tax to fossil fuel usage will disincentivise its use. Building capacity within the agricultural industry around the opportunities of solar thermal and PVTs and share such research and innovation findings with key actors in the industry will support technology uptake. Local businesses developing and manufacturing PV and PVT products should be supported to ensure the supply chain is kept within the EU at a maximum.



**Figure 1.** Description of PVT Collector



Copyrights MG Sustainable, RES4LIVE H2020 project.

**Figure 2.** Possible integration of PVTs with a heat recovery system in a dairy farm

## Further information

For further information visit [www.res4live.eu](http://www.res4live.eu), and the relevant Practice Abstract about "["Photovoltaic – Thermal collectors for electrical and thermal demands in livestock farms"](#)".

## About this abstract

**Authors:** Alexander Loris, MG Sustainable [RES4LIVE]

**Date:** July 2023

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# Φωτοβολταϊκοί (PV) και Φωτοβολταϊκοί Θερμικοί (PVT) Συλλέκτες και Συστήματα για Στέγες Αγροτικών Κατασκευών

## Κυριότερα αποτελέσματα

Από πολυάριθμες επιστημονικές μελέτες, αναγνωρίζεται ότι η γεωργία έχει υψηλές ενεργειακές απαιτήσεις σε θερμότητα και ηλεκτρική ενέργεια. Σε παγκόσμιο επίπεδο, η θερμότητα αποτελεί το 50% της συνολικής κατανάλωσης ενέργειας, ενώ η ηλεκτρική ενέργεια, το 20%. Το κόστος της κατανάλωσης ενέργειας στα θερμοκήπια ανέρχεται στο 50% του κόστους παραγωγής και αντιπροσωπεύει το δεύτερο μεγαλύτερο λειτουργικό κόστος. Η ηλιοθερμική τεχνολογία μπορεί εύκολα να καλύψει τουλάχιστον το 60% της ενεργειακής ζήτησης ζεστού νερού χρήσης της γεωργίας. Υπάρχει μικρή διείσδυση ανανεώσιμων πηγών ενέργειας στη γεωργία και καθώς το κόστος των ορυκτών καυσίμων είναι πιθανό να αυξηθεί στο μέλλον, και ο πλήρης εξηλεκτρισμός να υπερφορτώσει το δίκτυο, μια λύση ανανεώσιμης θέρμανσης όπως οι ηλιοθερμικές τεχνολογίες ή η τεχνολογία PVT είναι απαραίτητη για το μέλλον του μείγματος ανανεώσιμων πηγών ενέργειας.

## Πρακτικές συστάσεις

Η ηλιοθερμική ενέργεια πρέπει πλέον να αναγνωριστεί ως βιώσιμη και οικονομικά αποδοτική λύση θέρμανσης από ανανεώσιμες πηγές ενέργειας. Παρόλο που τα φωτοβολταϊκά είναι σε άνοδο, και το κόστος τους μειώνεται λόγω των διαφόρων κινήτρων, υπάρχουν πολύ λίγα κίνητρα για την ηλιοθερμική ενέργεια και κανένα για τα PVT. Η στήριξη και οι επιδοτήσεις για την τεχνολογία PVT και την ηλιοθερμική ενέργεια πρέπει να διευκολυνθούν, ακριβώς όπως στη περίπτωση των φωτοβολταϊκών, μαζί με ευνοϊκά επενδυτικά σχέδια για όσους επιθυμούν να επενδύσουν σε ένα νέο σύστημα. Η επιβολή αυστηρότερου φόρου άνθρακα θα αποθαρρύνει επίσης τη χρήση ορυκτών καυσίμων. Η ανάπτυξη των ικανοτήτων του γεωργικού κλάδου γύρω από τις ευκαιρίες της ηλιοθερμικής ενέργειας και των PVT, και η επικοινωνία πορισμάτων έρευνας και καινοτομίας με βασικούς παράγοντες του κλάδου θα στηρίξουν την υιοθέτηση της τεχνολογίας. Οι τοπικές επιχειρήσεις που αναπτύσσουν και κατασκευάζουν φωτοβολταϊκά και PVT προϊόντα θα πρέπει να υποστηριχθούν ώστε να διασφαλιστεί στο μέγιστο ότι η αλυσίδα εφοδιασμού θα διατηρηθεί εντός της ΕΕ.

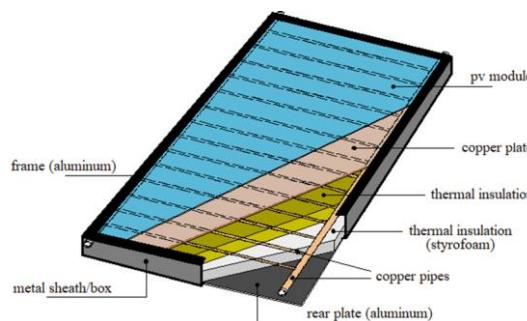


Figure 1. Συλλέκτης PVT

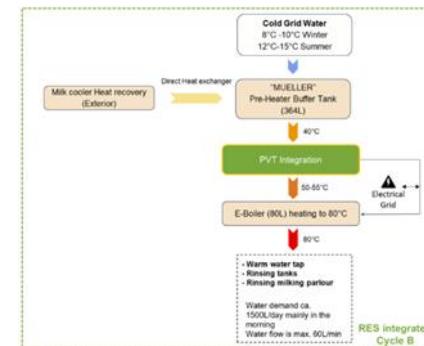


Figure 2. Πιθανή ενσωμάτωση PVT με σύστημα ανάκτησης θερμότητας σε φάρμα γαλακτοπαραγωγής

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## Περισσότερες πληροφορίες

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## About this abstract

**Authors:** (Alexander Loris, MG Sustainable [RES4LIVE])

**Date:** July 2023

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# Biogas production from agricultural waste and other innovative feedstock / Biomethane upgrading for local consumption or grid injection

## Main results / outcomes

Biogas production from livestock waste is a common practice, but numerous livestock farms have not yet integrated such systems for technoeconomic and social reasons as farmers are sceptical towards new methodologies. However, by incorporating such methodologies the numerous outcomes can be expected, such as:

- **Climate change mitigation** through the use of greener/alternative methodologies to produce biogas and biomethane, which will substitute fossil natural gas.
- More **energy independence** at farm and national levels.
- Increased **farm profitability**, as the residues produced on farm are fully self utilized.
- Significant **maintenance cost reductions** of the multi-feeding mode anaerobic digesters and increased life-expectancy.
- Creation of new synergies among farmers and energy providers.
- Local awareness of citizens in renewable energy.
- Accelerated market uptake of the technology through subsidies, technical support, and financial schemes.

## Practical recommendations

- Promote R&D policies to **research and adapt new feedstocks** for biogas production.
- Facilitate access for farmers/energy providers to make the **transition from conventional biogas production to multi-feeding mode**.
- Provide farmers **financing aid and incentives** for the installation of new biogas plants
- Encourage smallholders to **create energy communities** for **common biogas plants or for selling feedstock to a biogas facility**.
- Promote **training activities for farmers and advisors**, demonstrating **in situ** the benefits of adopting new feedstocks for biogas production.
- **Encourage farmers to shift to mixed farms** so that manure and crop residues are used for biogas production and self consumption

## Further information

[AgroFossilFree D3.7: Report on identified policy gaps and policy guidelines](#)

## About this abstract

**Authors:** Foteini Vandorou (IBO-CERTH)

**Date:** July 2023

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# Παραγωγή βιοαερίου από γεωργικά απόβλητα και άλλες καινοτόμες πρώτες ύλες / αναβάθμιση βιομεθανίου για τοπική κατανάλωση ή έγχυση στο δίκτυο

## Κύρια αποτελέσματα

Η παραγωγή βιοαερίου από κτηνοτροφικά απόβλητα είναι κοινή πρακτική, αλλά πολλές κτηνοτροφικές εκμεταλλεύσεις δεν την έχουν ενσωματώσει ακόμη για τεχνοοικονομικούς και κοινωνικούς λόγους. Οι αγρότες είναι δύσπιστοι απέναντι σε νέες μεθοδολογίες. Ωστόσο, με την ενσωμάτωση τέτοιων μεθοδολογιών αναμένονται σημαντικά αποτελέσματα:

- **Μετριασμός της κλιματικής αλλαγής** μέσω χρήσης πιο πράσινων μεθοδολογιών για την παραγωγή βιοαερίου και βιομεθανίου, υποκαθιστώντας το ορυκτό φυσικό αέριο.
- **Περισσότερη ενεργειακή ανεξαρτησία** σε αγροτικό και εθνικό επίπεδο.
- **Αυξημένη κερδοφορία** των αγρών, με την πλήρη αξιοποίηση των υπολειμμάτων που παράγονται.
- **Σημαντικές μειώσεις** του κόστους συντήρησης των αναερόβιων χωνευτών πολλαπλής τροφοδοσίας και αυξημένο προσδόκιμο ζωής.
- **Δημιουργία** νέων συνεργειών μεταξύ αγροτών και παρόχων ενέργειας.
- **Ευαισθητοποίηση** των πολιτών στις ανανεώσιμες πηγές ενέργειας.
- **Επιτάχυνση** της υιοθέτησης της τεχνολογίας μέσω επιδοτήσεων και χρηματοδοτικών προγραμμάτων.

## Πρακτικές Συστάσεις

- Προώθηση πολιτικών Ε&Α για την **έρευνα** νέων πρώτων υλών για την παραγωγή βιοαερίου.
- Διευκόλυνση των αγροτών/παρόχων ενέργειας για τη **μετάβαση** από τη συμβατική παραγωγή βιοαερίου στη λειτουργία πολλαπλής τροφοδοσίας.
- Παροχή **χρηματοδότησης** και κινήτρων για την εγκατάσταση νέων μονάδων βιοαερίου
- Ενθάρρυνση των μικροϊδιοκτητών να **δημιουργήσουν** ενεργειακές κοινότητες για **κοινές** μονάδες βιοαερίου ή για την πώληση πρώτης ύλης σε τρίτες εγκαταστάσεις
- Προώθηση δραστηριοτήτων κατάρτισης επιδεικνύοντας τα οφέλη από την υιοθέτηση νέων πρώτων υλών για την παραγωγή βιοαερίου.
- Ενθάρρυνση των αγροτών για μικτές εκμεταλλεύσεις, ώστε τα υπολείμματα των καλλιεργειών να χρησιμοποιούνται για την παραγωγή βιοαερίου και αυτοκατανάλωση

## Περισσότερες πληροφορίες

[AgroFossilFree Π3.7: Report on identified policy gaps and policy guidelines](#)

## Σχετικά με την περίληψη

**Συγγραφέας:** Φωτεινή Βανδώρου (IBO-ΕΚΕΤΑ)

**Ημερομηνία:** Ιούλιος 2023

Το AgroFossilFree είναι ένα πολυσυμμετοχικό H2020 πρόγραμμα, το οποίο θα αξιολογήσει την παρούσα κατάσταση και τις υπάρχουσες ανάγκες όσον αφορά στη χρήση ενέργειας στην ευρωπαϊκή γεωργία, επιτρέποντας στους γεωργούς να βελτιστοποιήσουν την παραγωγή τους μέσω πιο αποδοτικής χρήσης ενέργειας και μειωμένων εκπομπών αερίων του θερμοκηπίου, έχοντας ως αποτέλεσμα οικονομικά, αγρονομικά και περιβαλλοντικά οφέλη. Το AgroFossilFree θα δημιουργήσει ένα πλαίσιο κάτω από το οποίο σημαντικοί εμπλεκόμενοι φορείς θα συνεργαστούν για την αξιολόγηση και την προώθηση των διαθέσιμων στην παρούσα φάση τεχνολογιών και στρατηγικών για ενέργεια που δεν προέρχεται από ορυκτά καύσιμα (FEFTS) στη γεωργία της ΕΕ. Το έργο έχει διάρκεια από τον Οκτώβριο του 2020 έως τον Σεπτέμβριο του 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

# Facilitating the development of energy independent farming in Livestock

## Main results / outcomes

Making Methane from ruminant animals become an energy asset.

Available solutions to capture methane from manure for small & medium livestock farms will support many farmers into producing and consuming their own energy on site and run agricultural machines and transport vehicles on biomethane produced from livestock manure. This would consequently lead to establish carbon negative farms and would significantly reduce the use of chemical fertilizers. Digested material is an excellent natural fertilizer to restore organic matter in the soil. Even small and medium farmers will lower and stabilize their operational costs. Livestock farms reducing chemical fertilizer and producing energy for surrounding communities will be more accepted by the population.

## Practical recommendations

The challenge is to make most of the livestock farmers capture the fugitive methane and transform it into energy on site, cutting most logistics costs for material purchased and external energy consumption. Therefore, such solutions should be promoted through farmers associations and advisory services. Policy makers should enable farmers, through subsidy programs, to invest in biomethane capture solutions, and biomethane usage for machinery and energy production. Demonstration activities, knowledge sharing and peer to peer learning are necessary to facilitate the quick adoption of innovative biomethane equipment.



**Figure 1.** Methane capturing system on 100 dairy cow farm powering a New Holland T6 180 methane tractor (copyrights New Holland).

## Further information

GHG emissions from burning fossil fuel in agricultural machinery during the normal course of operation is around 10% of the GHG emissions of agriculture in comparison, or ca. 1% of total EU-27 GHG emissions ([https://di.unfccc.int/detailed\\_data\\_by\\_party](https://di.unfccc.int/detailed_data_by_party)).

## About this abstract

**Authors:** Gilles Mayer, New Holland; Vanja Biševac, CEMA aisbl

**Date:** July 2023

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

# Livestock building energy upgrading/renovation

## Main results / outcomes

Livestock production buildings should provide an indoor temperature range in which animals have to use a minimal amount of energy to keep their body temperature constant and to maximize production and animal welfare, especially to avoid heat and cold stress. When focusing separately on the building design, the most important problem is related to the cost of heating and cooling. Heating is the largest direct energy consuming activity for confined livestock buildings, accounting for around 90% of the total consumption, followed by ventilation and lighting. On average 17% of the energy consumption per kg of pig meat was allotted to fossil fuel for heating, which is proportionally equal to broiler production [1]. One of the most wasteful direct energy parameters is heating and/or cooling of livestock buildings, which is a fact derived from the interaction with more than 1000 stakeholders in 8 European countries during the AgroFossilFree project. The reason is related to obsolete conditions of ventilation systems, building envelopes, heating systems and lack of automatic climate control installations.

## Practical recommendations

Heat stress is envisaged to occur more frequently and severely throughout Europe, leading to serious economic losses, hence there is a need to adapt livestock buildings to the climate change. Livestock stakeholders recommends for regions where the weather conditions are extremely variable and the buildings heating/cooling needs are demanding, that upgrading/renovating livestock buildings is a rational choice for an energy efficiency improvement investment. It is also crucial to start analysing the energy consumption in every supply chain and operation on livestock farms.



**Figure 1:** Ceiling insulation of old pig stable using polyisocyanurate (PIR) (source: Recticel Insulation)

## Further information

[1] Paris, B.; Vandorou, F.; Tyris, D.; Balafoutis, A.T.; Vaiopoulos, K.; Kyriakarakos, G.; Manolakos, D.; Papadakis, G. (2022) Energy Use in the EU Livestock Sector: A Review Recommending Energy Efficiency Measures and Renewable Energy Sources Adoption. *Applied Sciences*, 12, 2142.

## About this abstract

**Authors:** Michael Nørremark, Senior Researcher, Aarhus University

**Date:** July 2023

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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# Renovering/opgradering af stalde for energioptimering

## Hovedresultater

Bygninger for husdyrproduktions bør have et indendørs temperaturområde, hvor dyr skal bruge en minimal mængde energi for at holde deres kropstemperatur konstant og for at maksimere produktion og dyrevelfærd, især for at undgå varme- og kuldestress. Når man fokuserer separat på bygningsdesign, er det vigtigste problem relateret til omkostningerne til opvarmning og køling. Opvarmning er den største direkte energiforbrugende aktivitet for lukkede staldbygninger, der tegner sig for omkring 90 % af det samlede forbrug, efterfulgt af ventilation og belysning. I gennemsnit udgjorde fossilt brændsel til opvarmning 17 % af energiforbruget pr. kg svinekød, hvilket er forholds-mæssigt lig med niveauet for slagtekyllingeproduktion [1]. En parameter med størst direkte energispild er opvarmning og/eller afkøling af bygninger til husdyrproduktion, hvilket er en kendsgerning, der stammer fra interaktionen med mere end 1000 interesserter i 8 europæiske lande under AgroFossilFree-projektet. Årsagen er relateret til forældede teknologier for ventilationsanlæg, klimaskærme, varmeanlæg og mangl på automatiske klimaanlæg.

## Praktiske anbefalinger

Varmestress forventes at forekomme hyppigere og mere alvorligt i hele Europa, hvilket fører til alvorlige økonomiske tab, og derfor er der behov for at tilpasse bygninger for husdyrproduktion til klimændringerne. Interesserter indenfor husdyrproduktion anbefaler for regioner, hvor vejrforholdene er ekstremt varierende, og bygningernes opvarmnings-/afkølingsbehov er krævende, at opgradering/renovering af staldbygninger er et rationelt valg for en investering i energieffektiviseringsforbedringer. Det er også afgørende at begynde at analysere energiforbruget i hver forsyningskæde og drift på husdyrbrug.



**Figur 1:** Loftsisolering af gammel svinestald ved hjælp af polyisocyanurat (PIR) (kilde: Recticel Insulation)

## Yderligere information

[1] Paris, B.; Vandorou, F.; Tyris, D.; Balafoutis, A.T.; Vaiopoulos, K.; Kyriakarakos, G.; Manolakos, D.; Papadakis, G. (2022) Energy Use in the EU Livestock Sector: A Review Recommending Energy Efficiency Measures and Renewable Energy Sources Adoption. Applied Sciences, 12, 2142.

## Baggrund for dette 'practice abstract'

**Forfatter:** Michael Nørremark, Seniorrådgiver, Aarhus Universitet

**Dato:** Juli 2023

AgroFossilFree er et H2020 projekt med mange aktører, der vil evaluere den nuværende status i EU's landbrug med hensyn til energiforbrug og vurdere eksisterende behov, hvilket giver landmænd mulighed for at optimere landbrugsproduktionen gennem mere effektiv energianvendelse og reducerede drivhusgasemissioner, hvilket resulterer i økonomiske, agronomiske og miljømæssige fordele. AgroFossilFree vil skabe en ramme, hvorunder relevant interesserter vil samarbejde om at evaluere og fremme de aktuelt tilgængelige Fossil-Energy-Free Technologies og Strategier (FEFTS) i EU's landbrug. Projektet løber fra oktober 2020 til september 2023.

**Web:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

# The use of thermochemical fluids

## Main results / outcomes

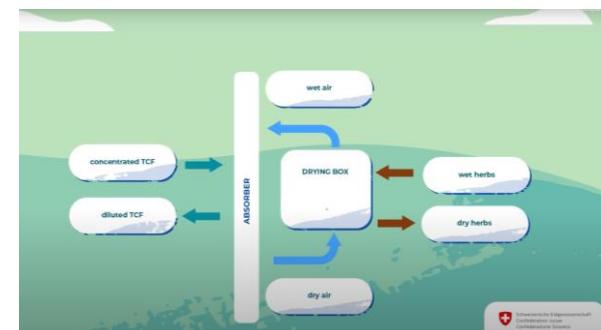
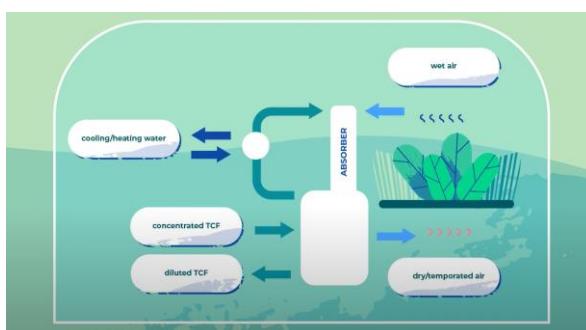
TheGreefa project investigated the use of the salt solution, called thermochemical fluids (TCFs) in agriculture in energy transfer and storage. Multiple processes are required to convert thermal energy to chemical energy and vice versa, and it is essential to increase the efficiency of the TCF systems. The salt solutions have the potential to replace the most common current technologies, like thermal storage based on warm/hot water or phase change material which has high thermal losses and a lower energy density.

## Practical recommendations

There is a need to strengthen and expand the EU's commitments to combat climate change and ensure their effective implementation by member states by setting more ambitious targets and promoting the transition to a low-carbon economy through the wide implementation of renewable energy sources. The new policies should support energy efficiency across sectors, also innovations, R&D activities and testing of new technologies. The development of new products, particularly for peak shaving, curtailment prevention, and congestion management, to secure predictable revenue streams for storage, both utility-scale and behind-the-meter should be required.

When planning the energy strategy, EU member states should facilitate and promote the implementation of new efficient solutions. The dual role of the 'consumer-producer' of storage should be considered by applying the EU regulatory framework for energy and removing barriers, including avoiding double taxation and facilitating permitting procedures.

In terms of the agricultural sector, it is needed to encourage the adoption of sustainable agriculture techniques, such as organic farming, pesticide and fertilizer reduction, to encourage to use energy from renewable sources including thermal storage and the application of circular economy principles in the food production and distribution chain.



**Figure 1 and 2:** Caption of TheGreefa promotional video

## Further information

[TheGreefa promotional video](#)

## About this abstract

**Authors:** Begoña Benito, Serena Danesi, Jakub Pluta

**Date:** July 2023

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

# Financial Support to Fossil Energy Free Technologies and Strategies

## Main results / outcomes

There's a notable absence of clearly defined financial incentives for FEFTS, leading to hurdles for innovation-driven entrepreneurs working in the agricultural sector. Government subsidy policies vary widely, sometimes conflict, and rarely specify support for FEFTS. Investments in FEFTS are often deterred due to multifaceted uncertainties around technology maturity and economic feasibility..

## Practical recommendations

- Optimal harmonization among the different policies and directives should be ensured, especially at the National level.
- Financial incentives should clearly support FEFTS and in the future, CAP can foresee more compulsory measures in this direction
- Concrete targets like the ones present in the RED II directive can provide better direction.
- Member States need to employ measures to support FEFTS that are in alignment with their geographical and socioeconomic conditions, the rest of their policies and their implemented instruments.
- A Framework for supporting pioneering entrepreneurs can increase the adoption of FEFTS.
- Intuitive tools like the EC's "De-risking Energy Efficiency Platform" (DEEP) need to be deployed.
- There is a need for specific support for smaller farms.
- Streamlining of the different subsidy policies is required.
- Encourage farmers to diversify their income streams by promoting the production and sale of energy-related products.
- Create specific provisions within the Energy Communities framework to support agricultural projects.



**Fig 1:** Image representing financial support.

Copyright: FREEPIK

## Further information

Various innovative financing mechanisms are presented in the [AgEnergy Platform](#) of the AgroFossilFree project.

## About this abstract

**Authors:** George Kyriakarakos, CERTH / Athanasios Balafoutis, CERTH

**Date:** July 2023

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

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# Regulatory Amendments to Support Fossil Energy Free Technologies and Strategies

## Main results / outcomes

Streamlining procedures and clarifying policies can boost FEFTS use, reducing emissions. Better communication engages farmers in defossilisation. Tailored policies can improve agricultural energy efficiency. Promoting sustainable food labels and circular policies advances supply chain sustainability. Including agriculture in energy planning optimizes resources. Addressing small farms' needs fosters their role. Regular energy audits enhance savings/resource management..

## Practical recommendations

- **Streamline and digitize procedures:** Implement "one-stop-shop" schemes to minimize effort/ time for implementing FEFTS investments
- **Harmonize policies**
- **Specify food/energy policies:** Detailing of general energy policies for the specifics of the agriculture sector is crucial, considering combined food and energy production
- **Allow farmers to produce and use directly renewable fuels**
- **Promote sustainable food labelling**
- **Integrate agriculture in energy planning**
- **Implement circular economy policies:**  
develop synergies between agriculture and industry in a circular and symbiotic process
- **Develop agriculture-focused electricity flexibility schemes**
- **Promote FEFTS related certification schemes**
- **Address the needs of small farms**
- **Promote energy audits:** A comparable framework for energy audits in farms is needed
- **Improve policy communication:** Enhance communication activities to reduce misconceptions and ensure that farmers understand the goals and benefits of policies

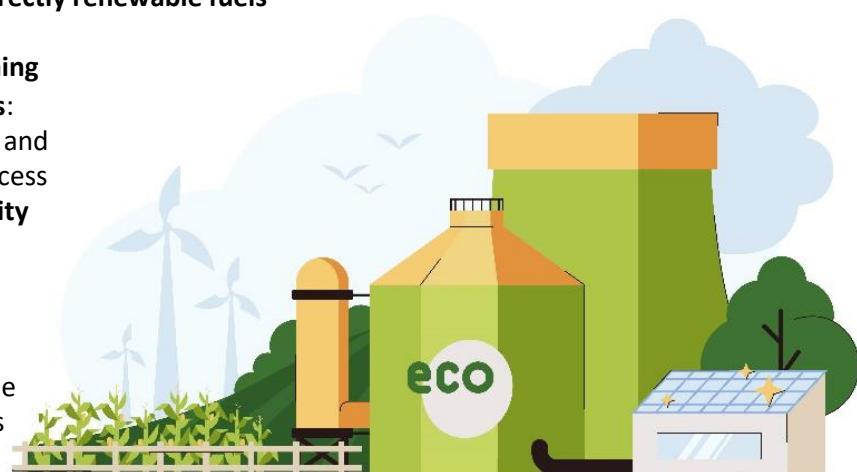


Fig 1: Image representing a sustainable farm.  
Copyright: FREEPIK

## Further information

The website of the AgroFossilFree project provides many resources concerning policy issues relevant to the defossilization of the European agriculture. [www.agrofossilfree.eu](http://www.agrofossilfree.eu)

## About this abstract

**Authors:** George Kyriakarakos, CERTH / Athanasios Balafoutis, CERTH

**Date:** July 2023

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# Technology, Knowledge Transfer, and Awareness Building Provisions to support Fossil Energy Free Technologies and Strategies Diffusion

## Main results / outcomes

The wide range of FEFTS presents a challenge for farmers in deciding the best fit. Regional discrepancies in the comprehension and acceptance of these technologies exist. Limited real-world demonstrations hinder adoption. Crowded rural electricity grids can obstruct clean energy production. Misunderstanding about energy costs, like overlooking indirect inputs like fertilizers, is common. Awareness about FEFTS is generally low, from farmers to policymakers. Extension services often lack FEFTS technical expertise. Communication gaps persist at different levels.

## Practical recommendations

- Enforce **AKIS** players to participate in FEFTS promotion to the farming processes.
- Establish "**FEFTS innovation brokers**"
- Promote localized standardized technical solutions
- Support **FEFTS demonstration projects**
- Encourage flexibility schemes and energy storage
- Promote data sharing: Encourage the sharing of standardized, anonymized data on farm energy balance for policy development and farmer training.
- Implement "Train the trainers" programs
- Organize targeted workshops for farmers
- Create **transfer centres** in all rural areas to provide close advisory to increase FEFTS diffusion.
- Include more engineering disciplines in advisory/extension services to support Agronomists in technical issues.
- "Train the Farmer" programs
- Utilize digital tools: Use AI and social media for efficient knowledge transfer and communication.
- Highlight success stories



**Fig 1:** Image representing the advisor's support to the farmer.  
 Copyright: FREEPIK

## Further information

The website of the AgroFossilFree project provides many resources concerning technology, knowledge transfer, and awareness building issues relevant to the defossilization of the European agriculture.

[www.agrofossilfree.eu](http://www.agrofossilfree.eu)

## About this abstract

**Authors:** George Kyriakarakos, CERTH / Athanasios Balafoutis, CERTH

**Date:** July 2023

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

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# Brite Solar: A nanotechnology company developing materials for solar glass applications in agriculture

## Main results / outcomes

Brite Solar is a Greek nanotechnology company developing semi-transparent solar panels specifically designed for horticulture applications. Brite's Solar Glass Panel can be used either in greenhouse or in crop protective structures for open field farming (Agri-PV), offering a practical approach for dual use of land (agricultural and energy production at the same time)

## Practical recommendations

Brite Solar provides a custom-made product. Panel's transparency can be adapted to the light requirements of the crop under the glass, but also, to the dimension of each greenhouse.

Another technological advantage is that care has been taken to optimize the transparency of the glass in the wavelengths that are critical to photosynthesis. The key technology of this product are nanostructured coatings which convert UV light into strong visible light. These coatings absorb UV light, which is useless for both plants and solar cells and retransmit it into the red (600-650nm) or blue (400-450 nm) region of the spectrum which is useful for both plants and solar cells. This provides an increase in the primary photosynthetic regions of the plants i.e. the amount of light energy the plants receive in order to photosynthesize, is increased.

A Panel consists of a glass coated with Brite's nanostructured materials and on this glass, solar cells are placed. The arrangement of solar cells depends on the transparency required for the crop under the glass.

Brite's Solar Glass allows the greenhouse to offset or eliminate the need for external electricity for greenhouse operations. In open field agriculture, is used to generate electricity while providing protection from extreme weather conditions (wind, hail, excessive heat etc.) for the crop under the glass.



**Figure 1:** Glass covered with Brite's nanostructured coatings, illuminated with low-power UV light.



**Figure 2:** Vineyard cultivation in greenhouse, Tsantali vineyards, Thessaloniki, Greece.

## Further information

<https://www.youtube.com/watch?v=agxrNrUnomw> (video Agrofossilfree project)

<https://www.youtube.com/watch?v=GJ6CDqldJww>

<https://www.youtube.com/watch?v=1zBO2-ZNquE>

## About this abstract

**Authors:** Vasiliki Kanaki/Agricultural University of Athens)

**Date:** May 2022

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

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## Brite Solar: Μία ελληνική εταιρεία νανοτεχνολογίας που αναπτύσσει ημιδιαφανή φωτοβολταϊκά πάνελ για χρήση στην γεωργία

### Main results / outcomes

Η Brite Solar είναι μία ελληνική εταιρεία νανοτεχνολογίας που κατασκευάζει ημιδιαφανή φωτοβολταϊκά πάνελ ειδικά σχεδιασμένα για χρήση στη γεωργία. Το ημιδιαφανές φωτοβολταϊκό της Brite μπορεί να χρησιμοποιηθεί είτε σε θερμοκήπια, είτε σε υπαίθριες καλλιέργειες, ως σκέπαστρο για την προστασία της καλλιέργειας (αγροφωτοβολταϊκά). Προσφέρει τη δυνατότητα διπλής χρήσης γης, δηλαδή, την ταυτόχρονη παραγωγή ενέργειας και γεωργικής παραγωγής.

### Practical recommendations

Το ημιδιαφανές φωτοβολταϊκό της Brite σχεδιάζεται κατά παραγγελία για να καλύψει τις ανάγκες του εκάστοτε χρήστη. Η διαφάνεια του πάνελ μπορεί να προσαρμοστεί στις ανάγκες των φυτών κάτω από το γυαλί (ανάλογα με τις απαιτήσεις σε φωτισμό) αλλά και στις διαστάσεις του κάθε θερμοκηπίου. Ένα ακόμα τεχνολογικό πλεονέκτημα της Brite είναι η βελτιστοποίηση της διαφάνειας του πάνελ στα μήκη κύματος που είναι κρίσιμα για την φωτοσύνθεση. Η τεχνολογία αιχμής είναι η επίστρωση του γυαλιού με νανοδομημένα υλικά που μετατρέπουν την υπεριώδη ακτινοβολία UV σε δυνατό ηλιακό φως. Οι επιστρώσεις αυτές απορροφούν την UV ακτινοβολία, η οποία δεν είναι χρήσιμη ούτε για τα ηλιακά κύτταρα αλλά ούτε για τα φυτά, και την μεταδίδουν στην περιοχή του μπλέ (400-450) και του κόκκινου χρώματος (600-650nm), στις περιοχές δηλαδή του φάσματος όπου τα φυτά φωτοσυνθέτουν. Με άλλα λόγια, η ενέργεια του ηλιακού φωτός που δέχονται τα φυτά για να φωτοσυνθέσουν, αυξάνεται. Το πάνελ αποτελείται από ένα γυαλί επιστρωμένο με τα νανοδομημένα υλικά της Brite. Πάνω σε αυτό το γυαλί, τοποθετούνται τα ηλιακά κύτταρα. Η διάταξη των ηλιακών κυττάρων εξαρτάται από την διαφάνεια που απαιτείται για την καλλιέργεια κάτω από το γυαλί. Το θερμοκήπιο μπορεί να παράγει μόνο του την ενέργεια που απαιτείται για να καλύψει τις ανάγκες του. Στην περίπτωση των αγροφωτοβολταϊκών, έχουμε παραγωγή ενέργειας με ταυτόχρονη προστασία της καλλιέργειας από ακραίες καιρικές συνθήκες (χαλάζι, άνεμος, καύσωνας κτλ.)



**Εικόνα 1:** Επικάλυψη γυαλιού με τα νανοδομημένα υλικά της Brite, σε φωτισμό με λάμπα UV χαμηλής ισχύος.



**Εικόνα 2:** Καλλιέργεια αμπελιού σε θερμοκήπιο. Αμπελώνες Τσάνταλη, Θεσσαλονίκη, Ελλάδα.

### Further information

<https://www.youtube.com/watch?v=agxrNrUnomw> (video Agrofossilfree project)

<https://www.youtube.com/watch?v=GJ6CDqldJww>

<https://www.youtube.com/watch?v=1zBO2-ZNquE>

### About this abstract

**Authors:** Βασιλική Κανάκη/Γεωπονικό Πανεπιστήμιο Αθηνών

**Date:** Μάιος 2022

**AgroFossilFree.** Το AgroFossilFree είναι ένα πολυσυμμετοχικό H2020 πρόγραμμα, το οποίο θα αξιολογήσει την παρούσα κατάσταση και τις υπάρχουσες ανάγκες όσον αφορά στη χρήση ενέργειας στην ευρωπαϊκή γεωργία, επιτρέποντας στους γεωργούς να βελτιστοποιήσουν την παραγωγή τους μέσω πιο αποδοτικής χρήσης ενέργειας και μειωμένων εκπομπών αερίων του θερμοκηπίου, έχοντας ως αποτέλεσμα την ύπαρξη οικονομικών, αγρονομικών και περιβαλλοντικών οφελών. Το AgroFossilFree θα δημιουργήσει ένα πλαίσιο κάτω από το οποίο σημαντικοί εμπλεκόμενοι φορείς θα συνεργαστούν για την αξιολόγηση και την προώθηση των διαθέσιμων στην παρούσα φάση τεχνολογιών και στρατηγικών για ενέργεια χωρίς ορυκτά καύσιμα (FEFTS) στη γεωργία της ΕΕ. Το έργο έχει διάρκεια από τον Οκτώβριο του 2020 έως τον Σεπτέμβριο του 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

# GB Hybrid- strip-till and subsoiler

## Main results / outcomes

Today, many farms are struggling with the problem of drought and nutrient deficiencies, which are especially harmful in critical periods of the crop growth. Additional problematic aspect constitute the requirements imposed on farmers resulting from the implementation of the European Green Deal. The answer to these challenges and problems may be zero tillage in combination with deep fertilization using the GB Hybrid machine developed by Marcin Gryn in collaboration with the GB Agro company.

## Practical recommendations

Soil cultivation performed with the GB Hybrid machine allows to prepare soil for the growing season in a no-till system. It is a perfect choice for cultivation of cereals or rapeseed. Experiments are being conducted on its use for growing potato and other crops as well. Besides the deep soil loosening, the machine offers a possibility of deep application of fertilizers, which motivates the plant to better develop its root system. This technique allows for precise fertilization, significantly reduces the costs and improves the efficiency of the crop cultivation.

Advantages of using the machine in combination with zero tillage:

- Possibility of starting work on the field earlier in spring;
- Reduced fertilizer consumption, reduced traffic on the field (number of required tractor passes with the agricultural equipment), better use of nutrients by plants allowing for their steady growth;
- Overall lower energy consumption in the crop production, reduced emissions to the atmosphere
- Significant improvement of soil fertility in the long run, reduced soil resistance during cultivation, reduced energy intensity of cultivation



Figure 1: GB Hybrid at work



Figure 2: GB Hybrid- Strip-till and subsoiler

## Further information

- <https://www.facebook.com/profile.php?id=100070266183907>  
<https://www.youtube.com/watch?v=7sleUM03oBo>  
<https://www.agrofossilfree.eu/2023/03/06/case-studies-poland/>

## About this abstract

**Authors:** Martyna Próchniak/ LODR, Końskowola, Magdalena Borzęcka/IUNG-PIB Puławy

**Date:** March 2022

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

# GB Hybrid- połączenie głębosza i strip-till

## Główne rezultaty

W dzisiejszych czasach wiele gospodarstw boryka się z problemem suszy, oraz z niedoborami składników pokarmowych, zwłaszcza w newralgicznych okresach uprawy. Dodatkowym aspektem jest spełnienie wymogów prawnych nakładanych na rolników w związku z realizacją założeń Europejskiego Zielonego Ładu. Odpowiadają na te wyzwania i problemy może okazać się uprawa bezorkowa połączona z wgłębnym nawożeniem za pomocą urządzenia GB Hybrid, skonstruowanego przez Marcina Gryna i spółkę GB Agro.

## Praktyczne zalecenia

Uprawa gleby za pomocą urządzenia GB Hybrid pozwala na odpowiednie przygotowanie pola w systemie bezorkowym. Doskonale sprawdza się w uprawie zbóż czy rzepaku. Prowadzone są także doświadczenia nad wykorzystaniem jej w uprawie ziemniaków i innych uprawy. Maszyna poza głębokim spulchnianiem gleby również dogłębnie dawkuje nawozy. Motywuje to rośliny do rozwoju systemu korzeniowego i pozwala na precyzyjne nawożenie, co znacznie obniża koszty uprawy i poprawia wydajność plantacji.

Korzyści z wykorzystania urządzenia i uprawy bezorkowej:

- Możliwy wcześniejszy wjazd w pole wiosną i rozpoczęcie uprawy
- Mniejsze zużycie nawozów, ograniczenie przejazdów ciągnika ze sprzętem, lepsze wykorzystanie składników pokarmowych przez rośliny i ich równomierny wzrost
- Sumarycznie mniejsze zużycie energii w ciągu technologicznym, mniejsza ilość emisji do atmosfery
- Długoterminowo znaczna poprawa żywotności gleby, mniejsze opory podczas uprawy, spadek energochłonności



Figure 1: Gb Hybrid podczas pracy



Figure 2: GH Hybrid- hybryda strip-till i głębosza

## Więcej informacji

- <https://www.facebook.com/profile.php?id=100070266183907>  
<https://www.youtube.com/watch?v=7sleUM03oBo>  
<https://www.agrofossilfree.eu/2023/03/06/case-studies-poland/>

## Szczegóły dotyczące streszczenia

**Autorzy:** (Martyna Próchniak/ LODR, Końskowola, Magdalena Borzęcka/IUNG-PIB Puławy

**Data:** March 2022

**AgroFossilFree** to wielopodmiotowy projekt badawczy H2020, którego celem jest ocena obecnego stanu rolnictwa UE w zakresie zużycia energii oraz istniejących potrzeb, aby umożliwić rolnikom optymalizację produkcji rolnej poprzez bardziej efektywne wykorzystanie energii i zmniejszenie emisji gazów cieplarnianych, co przyniesie korzyści ekonomiczne, agronomiczne i środowiskowe. AgroFossilFree stworzy ramy do współpracy kluczowych interesariuszy w celu oceny i promowania obecnie dostępnych technologii i strategii wolnych od paliw kopalnych (FEFTS) w rolnictwie UE. Projekt trwa od października 2020 do września 2023.

**Strona internetowa:** <https://www.agrofossilfree.eu/pl/home-polski/>



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

# Case Study in Spain: Successful experiences in Conservation Agriculture

## Main results / outcomes

Around 60 -70% of European soils are degraded due to inadequate soil management. This degradation causes a decrease in the organic carbon content of soils, with the Mediterranean regions having the lowest soil carbon content, largely due to intensive tillage of agricultural soils. Moreover, agriculture in Europe is the fourth largest sector in terms of GHG emissions, with more than 10%; in Spain, this value rises to 14%. The introduction of practices based on Conservation Agriculture principles leads to a decrease in GHG emissions produced by the use of fossil fuels, as well as an increase in carbon sequestration in the soil.

## Practical recommendations

In Spain farmers like Mr. Pedro Maestre and Mr. Antonio Conde have been managing their farms under the principles of conservation agriculture for more than 20 years and 5 years respectively.



**Figure 1:** Pedro Maestre, farmer and agricultural engineer manages more than 750 ha of extensive crops in Conservation Agriculture in Alcalá de Guadaira (Seville)



**Figure 2:** Antonio Conde, farmer and agricultural engineer manages a family farm of 5 hectares of olive groves with groundcover in Castillo de Locubín (Jaén)

Both farmers started with Conservation Agriculture due to their concern about soil loss and degradation by water erosion. After several years of attending training and getting knowledge, they joined the farm Network of the LIFE Agromitiga project. This LIFE project monitors some fields and provides data on the evolution of carbon content in the soil. Thanks to this collaboration, these farmers have been able to verify that during the last two years, they have sequestered around 5 tons of Organic Carbon per ha in the case of D. Pedro Maestre and up to 8 tn/ha on the farm of D. Antonio Conde. These figures, together with a reduction in the use of fossil fuel of around 40%, due to the absence of tillage, clearly show that the introduction of the principles of Conservation Agriculture is postulated as one of the most important management systems for carbon sequestration in agricultural soils and reduce emissions on farms.

## Further information

[Case study Video](#)

## About this abstract

**Authors:** Julio Román-Vázquez (European Conservation Agriculture Federation)

**Date:** July 2023

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

# Caso de Estudio en España: Experiencias exitosas de implantación de Agricultura de Conservación

## Principales resultados

Entre el 60 y 70% de los suelos europeos se encuentran degradados, debido principalmente un manejo inadecuado de los mismos. Esta degradación conlleva disminución del contenido de Carbono orgánico de los mismos, siendo las regiones Mediterráneas las que tienen un menor contenido de Carbono en el suelo, ocasionado en gran medida por un laboreo intensivo de los suelos agrícolas. Asimismo, la agricultura en Europa es el cuarto sector en términos de emisiones de GEI, con más de un 10%, y en España ese valor se eleva hasta un 14%. La introducción de las prácticas basadas en los principios de la Agricultura de Conservación conlleva una disminución en las emisiones de GEI producidas por el uso de combustibles fósiles, así como un incremento de secuestro de carbono en el suelo.

## Recomendaciones prácticas

En España agricultores como D. Pedro Maestre y D. Antonio Conde manejan sus fincas bajo los principios de la agricultura de conservación desde hace más de 20 años y 5 años respectivamente.



**Figura 1:** Pedro Maestre, agricultor e ingeniero agrónomo gestiona más de 750 ha de cultivos extensivos en Agricultura de conservación en Alcalá de Guadaira (Sevilla)



**Figura 2:** Antonio Conde, agricultor e ingeniero agrónomo, que gestiona una finca familiar de 5 ha de olivar con cubierta vegetal Castillo de Locubín (Jaén)

Estos agricultores comenzaron a introducirse en estas técnicas por la preocupación que tenían ante la degradación y pérdida de suelos por erosión hídrica. Tras varios años de formación, se integraron en la red de fincas del proyecto LIFE Agromitiga, que les ha servido para monitorear los contenidos de carbono en el suelo, y comprobar que durante los dos últimos años han conseguido secuestrar alrededor de 5 tn de Carbono Orgánico por ha en el caso de D. Pedro Maestre y hasta 8 tn /ha en la finca de D. Antonio Conde. Estos resultados unidos a una reducción del uso de combustible fósil en torno al 40% de media, debido a la ausencia del laboreo, demuestra que la introducción de los principios de la Agricultura de Conservación se postula como uno de los sistemas de gestión más importantes para el secuestro de carbono en los suelos agrícolas y reducir emisiones.

## Más información

[Video del caso de éxito](#)

## Detalles sobre este resumen

**Autor:** Julio Román-Vázquez (European Conservation Agriculture Federation)

**Fecha:** Julio 2023

**AgroFossilFree** es un proyecto H2020 multiactor que evaluará la situación actual de la agricultura de la UE en cuanto al uso de la energía y valorará las necesidades existentes, lo que permitirá a los agricultores optimizar la producción agrícola mediante un uso más eficiente de la energía y la reducción de las emisiones de gases de efecto invernadero, con los consiguientes beneficios económicos, agronómicos y medioambientales. AgroFossilFree creará un marco bajo el cual las partes interesadas críticas cooperarán para evaluar y promover las Tecnologías y Estrategias Libres de Energía Fósil (FEFTS) actualmente disponibles en la agricultura de la UE. El proyecto se desarrolla entre octubre de 2020 y septiembre de 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

# Landschapsenergie cv, Bocholt/Belgium

## Main results / outcomes

A collaboration of local farmers and the energy cooperative ‘Landschapsenergie’ provides renewable heat for a number of schools and a parish hall in Bocholt, Belgium. The project tries to find a balance between nature conservation and agriculture and turns out to be an opportunity for both farmers and for the local community.

## Practical recommendations

Local farmers in Bocholt, a small municipality in Belgium, harvest the wood in the wood edges of their meadows and fields with adapted machines, and this according to a jointly drawn up plan. This harvesting is done according to the coppice principle: relatively thin trunks are cut above the ground, after which branches grow again from the remaining stumps, which can be harvested again about 15 years later.

The harvested wood is processed by the farmers into high-quality wood chips so that it can be used in medium-sized wood chip heating installations (+/- 250 kW). The chips are sold to the ‘Landscape Energy cooperative’.

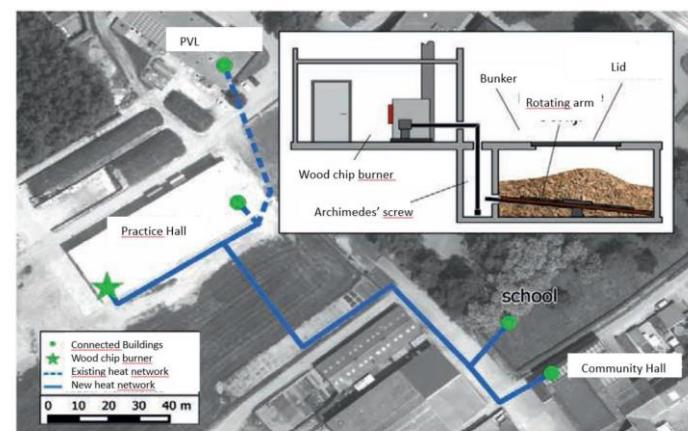
The ‘Landscape Energy cooperative’ operates a heating installation that produces heat for the buildings of the PVL-Biotechnicum school campus, the kindergarten and primary school De Driehoek and the parish hall.

In addition to producing wood chips, this coppice management is also a form of maintenance of the wood edges along the roads and also a measure with positive effects on biodiversity. The method of harvesting is therefore geared to this.

Dit gebouw wordt verwarmd met biomassa uit Bochtse houtkanten, geoogst door plaatselijke landbouwers.



**Figure 1:** Overview of the different partners involved in the project © Landschapsenergie



**Figure 2:** Site map heat network Bocholt

## Further information

<https://youtu.be/XFZTWKQMSnM> (video AgroFossilFree project)  
<https://youtu.be/u7Png9Nfeyo> (video Interreg NWE ECCO project)  
<https://www.landschapsenergycvba.be/meer-weten>

## About this abstract

**Authors:** Dirk Vansintjan, REScoop.eu (based on texts on the website: <https://www.landschapsenergycvba.be/> )

**Date:** March 2022

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

# Landschapsenergie cv, Bocholt/Belgium

## Belangrijkste resultaten

Een samenwerking van lokale boeren en de energiecoöperatie 'Landschapsenergie' levert hernieuwbare warmte voor een aantal schoolgebouwen en een parochiecentrum in Bocholt, België. Het project probeert een evenwicht te vinden tussen natuurbehoud en landbouw en blijkt een kans voor zowel de boeren als de lokale gemeenschap.

## Praktisch

Lokale landbouwers oogsten met aangepaste machines het hout in de houtkanten, en dit volgens een gezamenlijk opgemaakt plan. Dit oogsten gebeurt volgens het hakhout principe: relatief dunne stammen worden boven de grond afgeknapt, waarna uit de overblijvende stronken opnieuw takken groeien, die een 15-tal jaar later opnieuw geoogst kunnen worden.

Het geoogste hout wordt door de landbouwers verwerkt tot kwaliteitsvolle houtsnippers (snipperformaat, vochtgehalte, stofgehalte, ...) zodat dit gebruikt kan worden in middelgrote houtsnipperverwarmingsinstallaties (+/- 250 kW). De snippers worden verkocht aan de coöperatie Landschapsenergie.

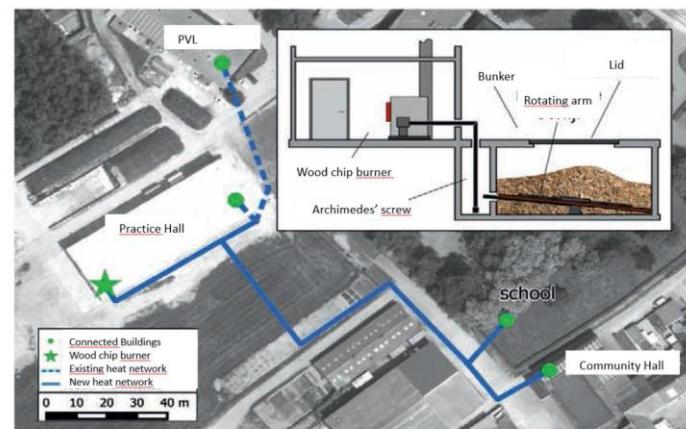
De coöperatie Landschapsenergie baat een verwarmingsinstallaties uit die warmte produceert voor de gebouwen van de scholencampus PVL-Biotechnicum, de kleuter- en lagere school De Driehoek en het parochiecentrum.

Dit hakhoutbeheer is naast het produceren van houtsnippers ook een vorm van onderhoud van de houtkanten langsheel de wegen en bovendien een maatregel met positieve effecten op biodiversiteit. De wijze van oogsten is daar dan ook op afgestemd.

Dit gebouw wordt verwarmd met biomassa uit Bocholse houtkanten, geoogst door plaatselijke landbouwers.



Figuur 1: Overzicht van de verschillende partners betrokken bij het project © Landschapsenergie



Figuur 2: kaart warmtenet Bocholt

## Meer informatie

- <https://youtu.be/XFZTWKQMSnM> (video AgroFossilFree project)
- <https://youtu.be/u7Png9Nfeyo> (video Interreg NWE ECCO project)
- <https://www.landschapsenergycvba.be/meer-weten>

## Over deze fiche

Auteur: Dirk Vansintjan, REScoop.eu (gebaseerd op teksten op de website: <https://www.landschapsenergycvba.be/>)

Datum: Maart 2022

**AgroFossilFree** is een H2020-project met meerdere actoren dat de huidige stand van zaken in de EU-landbouw met betrekking tot energiegebruik zal evalueren en de bestaande behoeften zal beoordelen, zodat landbouwers hun landbouwproductie kunnen optimaliseren door efficiënter energiegebruik en minder uitstoot van broeikasgassen, wat economische, agronomische en milieuvoordelen oplevert. AgroFossilFree zal een kader creëren waarbinnen cruciale belanghebbenden zullen samenwerken om de momenteel beschikbare technologieën en strategieën zonder fossiele brandstoffen (FEFTS) in de landbouw van de EU te evalueren en te bevorderen. Het project loopt van oktober 2020 tot september 2023.

Website: [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

# Solet: Solar panels and systems for private and business

## Main results / outcomes

When the sun shines during the day, Solet system with battery produces green electricity that is used to cover the farm or household's own consumption. When the system produces more power than the household can use - the Solax battery storage is fully charged. Excess power after a fully charged battery is sold to the grid. For the rest of the day and evening, the charged battery is used to supply the household with green electricity. If the battery is empty, the electricity consumption is automatically supplemented with electricity from the grid.

## Practical recommendations

By choosing solar cells, you are helping to contribute to the green transition, where in Denmark in 2050 we must be 100% supplied with renewable energy. Solar panels require a relatively large surface with plenty of space if enough solar panels are to be set up to supply even a single household with electricity. In addition, they can only produce electricity when the sun shines. In the case of stand-alone plants, there is therefore a need to store the energy. In Denmark, for an average family with two adults and two children, a typical electricity consumption is approximately 4,500 kWh per year. Here, a 60 m<sup>2</sup> plant on annual basis can deliver a surplus that can be sold to the grid.



**Figure 1:** Solet solar panel system set up on a roof

Solar panel area, m <sup>2</sup>	60
Slope, °	45
Direction	south
PV efficiency, %	15
Production per m <sup>2</sup> , kWh	148
<b>Production per year, kWh</b>	<b>8,851</b>

**Table 1:** Example of electricity production for a 60 m<sup>2</sup> plant in Denmark.

## Further information

<https://solet.dk/>  
<https://platform.agrofossilfree.eu/en/view/feft/1984>

## About this abstract

**Authors:** Erik Fløjgaard Kristensen & Henrik Mortensen, Aarhus University

**Date:** March 2022

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

# Solet: Solcelle paneler og anlæg til private og erhverv

## Resultater

Når solen skinner i løbet af dagen, producerer Solet-anlæg med batteri grøn strøm, der bruges til at dække gården eller husstandens eget forbrug. Når systemet producerer mere strøm, end husstanden kan bruge - er Solax batterilageret fuldt opladet. Overskydende strøm efter et fuldt opladet batteri er solgt til nettet. Resten af dagen og aftenen bruges det opladede batteri til at forsyne husstanden med grøn strøm. Hvis batteriet er tomt, suppleres elforbruget automatisk med strøm fra el-nettet.

## Praksis og anbefalinger

Ved at vælge solceller er du med til at bidrage til den grønne omstilling, hvor vi i Danmark i 2050 skal være 100 % forsynet med vedvarende energi. Solpaneler kræver en forholdsvis stor overflade med god plads, hvis der skal opsættes nok solpaneler til at forsyne selv en enkelt husstand med strøm. Derudover kan de kun producere strøm, når solen skinner. Ved stand-alone anlæg er der derfor behov for at lagre energien.

For en gennemsnitsfamilie med to voksne og to børn er et almindeligt typisk elforbrug ca. 4.500 kWh om året. Her kan et 60 m<sup>2</sup> anlæg på årsbasis levere et overskud, der kan sælges til nettet.



**Figur 1:** Solet anlæg opstillet på tag.

Solpanel areal, m <sup>2</sup>	60
Hældning, °	45
Retning	syd
PV-nyttevirkning, %	15
Produktion pr m <sup>2</sup> , kWh	148
<b>Produktion pr år, kWh</b>	<b>8851</b>

**Tabel 1:** Eksempel på el-production fra et 60m<sup>2</sup> anlæg i Danmark.

## Yderlig information

<https://solet.dk/>

<https://platform.agrofossilfree.eu/en/view/feft/1984>

## Om dette abstrakt

**Forfattere:** Erik Fløjgaard Kristensen & Henrik Mortensen, Aarhus Universitet, Institut for Elektro- og Computerteknologi

**Dato:** March 2022

**AgroFossilFree** er et EU Horizon 2020 projekt, der skal evaluere den nuværende status i EU's landbrug med hensyn til energiforbrug og vurdere eksisterende behov, således at landmændene får mulighed for at optimere landbrugsproduktionen gennem mere effektiv energianvendelse og reducerede drivhusgasemissioner. Dette vil resulterer i økonomiske, agronomiske og miljømæssige fordele. AgroFossilFree vil skabe en ramme, hvorunder centrale interesser kan samarbejde om at evaluere og fremme de aktuelt tilgængelige fossil-frie energiteknologier og -strategier (FEFTS) indenfor EU's landbrug. Projektet løber fra oktober 2020 til september 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

# SkyClean: Stiesdal Fuel Technologies

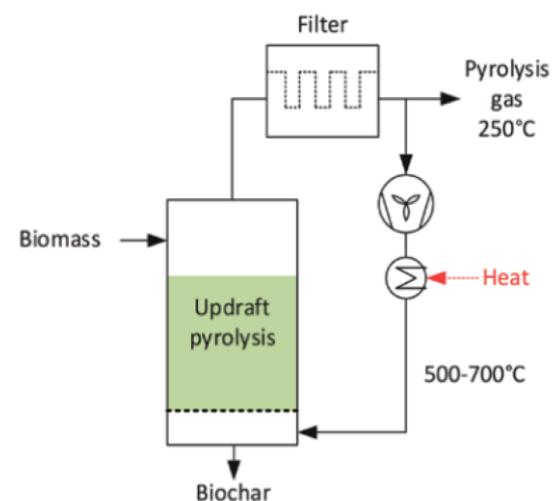
## Main results / outcomes

SkyClean is a high impact, carbon-negative technology developed by Stiesdal Fuel Technologies. It combines biofuel production and carbon capture and storage. The core of SkyClean is a pyrolysis process in which straw and other organic waste from agriculture and forestry is converted into biochar, gas, and oil by heating to a high temperature without the presence of oxygen. In the pyrolysis process, half of the carbon in the material is converted to biochar, while the other half becomes oil and gas. Biochar is a stable material that only decomposes very slowly, and in the SkyCleans carbon cycle, half of the carbon is effectively removed from the atmosphere, providing significant carbon storage.

## Practical recommendations

In order to minimize climate emissions from agriculture, it is central to sequester the carbon in the soil. Calculations show that the SkyClean pyrolysis technology can deliver a very large CO<sub>2</sub> greenhouse gas reduction at a socio-economic cost that is lower than other climate alternatives and thus be a mean for farmers to meet future requirements.

Dry plant material typically contains approximately 50% carbon that plants have extracted from the atmosphere in the form of CO<sub>2</sub>. In the SkyClean process, half of the carbon content of the biomass is converted to biochar, and once stored in the soil, biochar is stable carbon.



**Figure 1:** Fully automated 2 MW plant located in GreenLab near Skive, Denmark (Photo, Stiesdal)

## Further information

<https://platform.agrofossilfree.eu/en/view/feft/421>

<https://www.stiesdal.com/fuels/skyclean-is-a-game-changing-technology-for-agriculture/>

## About this abstract

**Authors:** Erik Fløjgaard Kristensen & Henrik Mortensen, Aarhus University

**Date:** March 2022

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

# SkyClean: Stiesdal Fuel Technologies

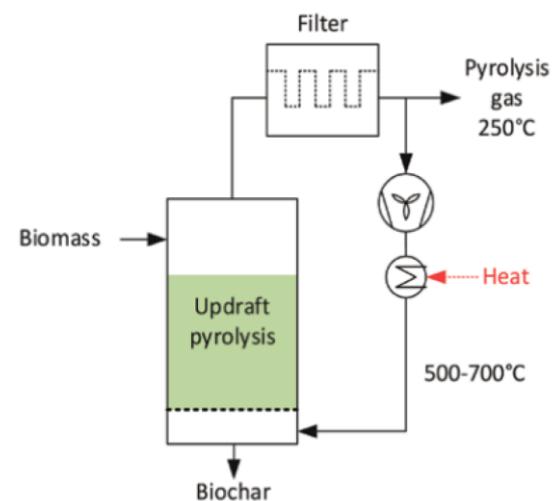
## Resultater

SkyClean er en CO<sub>2</sub>-negativ teknologi udviklet af firmaet Stiesdal Fuel Technologies. Metoden kombinerer produktion af biobrændstof og kulstofopsamling og -lagring. Kernen i SkyClean er en pyrolyseproces, hvor halm og anden organisk affald fra landbrug og skovbrug omdannes til biokul, gas og olie ved opvarmning til høj temperatur uden tilstedeværelse af ilt. I pyrolyseprocessen omdannes halvdelen af kulstoffet i til biokul, mens den anden halvdel bliver til energi i form af olie og gas. Biokul er et stabilt materiale, der kun nedbrydes meget langsomt, og i SkyCleans kulstofkredsløbet fjernes halvdelen af kulstoffet effektivt fra atmosfæren, hvilket giver en betydelig kulstoflagring.

## Praksis og anbefalinger

For at minimere klimaaftynket fra landbruget er det centralt at binde kulstoffet i jorden. Beregninger viser, at SkyClean-pyrolyseteknologien kan levere en meget stor CO<sub>2</sub>-drivhusgasreduktion til en samfundsøkonomisk omkostning, der er lavere end andre klimaalternativer. Metoden kan dermed være et middel for landmændene til at opfylde krav om reduceret klimapåvirkning.

Tørt plantemateriale indeholder typisk cirka 50 % kulstof, som planterne har udvundet fra atmosfæren i form af CO<sub>2</sub>. I SkyClean-processen omdannes halvdelen af kulstofet i biomassen til biokul, og når biokul først er lagret i jorden, er det stabilt og friges/omsættes kun meget langsomt.



**Figur 1:** SkyClean 2MW halm pyrolyseanlæg ved GreenLab nord for Skive, Denmark (Foto, Stiesdal)

## Yderlig information

<https://platform.agrofossilfree.eu/en/view/feft/421>

<https://www.stiesdal.com/fuels/skyclean-is-a-game-changing-technology-for-agriculture>

## Om dette abstrakt

**Forfattere:** Erik Fløjgaard Kristensen & Henrik Mortensen, Aarhus Universitet, Institut for Elektro- og Computerteknologi  
**Dato:** March 2022

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# Madsen Bioenergi – Biogas Plant

## Main results / outcomes

The biogas plant is a farm plant that processes manure from the region's farmers. The biogas plant is designed to mainly process livestock manure - including deep litter. The plant is also fed with energy crops such as maize and grass and residual products from industry. Madsen Bioenergi is one of the first biogas plants in Denmark which upgrades the biogas to bio-natural gas and deliver it into the Danish natural gas grid. The production currently stands at almost 5 million Nm<sup>3</sup> natural gas per year.

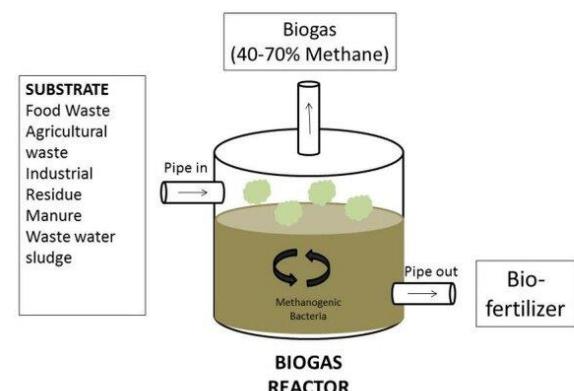
The upgrading plant is supplied by the company Ammongas. The heart of the process is the absorber column. In this column, the raw gas is washed with a water-amine mixture, and the amine absorbs CO<sub>2</sub> and H<sub>2</sub>S.

## Practical recommendations

Biogas can be used instead of fossil fuels such as oil, coal and natural gas. For agriculture's "climate accounting", biogas is of great importance, as the emission of greenhouse gases can be significantly limited by treating livestock manure in a biogas plant. The biogas process also makes the nutrients in manure more readily available to plants. Factors such as transport, consumption of process energy and the methane emissions from the plant must be in focus to ensure maximal environmental benefits.



**Figure 1:** Madsen Bioenergi.



**Figure 2.** Biogas production process (Lara Anne Hale)

## Further information

<https://madsenbioenergi.dk/>  
<https://bce.au.dk/en/research/facilities/biogas-plant>

## About this abstract

**Authors:** Erik Fløjgaard Kristensen & Henrik Mortensen, Aarhus University

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# Madsen Bioenergi, - Biogasanlæg

## Resultater

Madsen Bioenergi ejes af 3 brødre: Kim Madsen, Boe Madsen og Per Madsen. Tilsammen driver brødrene 450 ha. agerbrug. I biogasanlægget behandles gylle fra områdets landmænd. Biogasanlægget er designet til hovedsageligt at behandle husdyrgødning - herunder dybstrøelse. Der anvendes også energiafgrøder som majs og græs samt restprodukter fra industrien. Madsen Bioenergi er et af de første biogasanlæg i Danmark, som opgraderer biogassen til bio-naturgas og leverer den til det danske naturgasnet. Produktionen ligger i dag på næsten 5 millioner Nm<sup>3</sup> naturgas om året. Opgraderingsanlægget er leveret af firmaet Ammongas. Hjertet i processen er absorberkolonnen. I denne kolonne vaskes rå-gassen med en vand-amin-blanding, og aminen optager CO<sub>2</sub> og H<sub>2</sub>S.

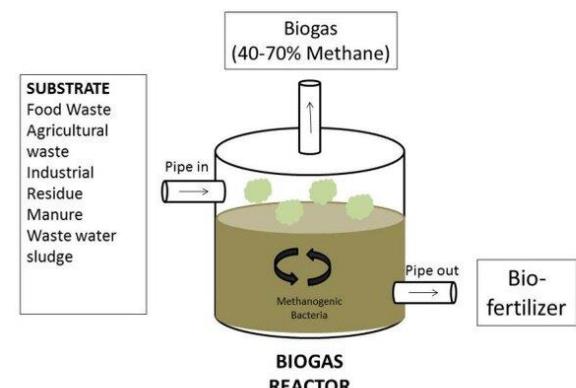
## Praksis og anbefalinger

Biogas kan bruges i stedet for fossile brændstoffer som olie, kul og naturgas. For landbrugets "klimaregnskab" har biogas stor betydning, da udledningen af drivhusgasser kan begrænses væsentligt ved at behandle husdyrgødning i et biogasanlæg.

Biogasprocessen gør også næringsstofferne i gylle lettere tilgængelige for planterne. Faktorer som transport, forbrug af procesenergi og metan udledningen (tab på grund af utæthed mm.) fra anlægget skal være i fokus for at sikre maksimal miljøgevinst.



**Figur 1:** Madsen Bioenergi.



**Figur 2:** Biogas processen (Lara Anne Hale)

## Yderlig information

<https://madsenbioenergi.dk/>  
<https://bce.au.dk/en/research/facilities/biogas-plant>

## Om dette abstrakt

**Forfattere:** Erik Fløjgaard Kristensen & Henrik Mortensen, Aarhus Universitet, Institut for Elektro- og Computerteknologi  
**Dato:** March 2022

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# FarmDroid field robot

## Main results / outcomes

FarmDroid FD20 is an electric (solar panel) driven field robot that helps farmers and growers reduce costs of sowing and weeding crops while also doing it in a CO<sub>2</sub> neutral and ecological way. The "droid" is an automatic light weight field robot that automates sowing and weed removal on farmland. GPS technology is used to know the position of every individual sowed seed and therefore, FD20 does not depend on a camera for crop or weed recognition. The seed is placed very precisely, and the robot remembers where the seed is located, and when weed control is performed, it weeds precisely around the budding plant.

## Practical recommendations

Areas for organic farming are growing year by year, and at the same time the focus on reducing pesticides within conventional agriculture is increasing. There is therefore an increasing focus on the need for mechanical weed control in agriculture. FarmDroid sows the crops and knows the position of each seed, and therefore knows exactly where it must clean - and more importantly where it must not!. It operates fully automatically and does not need to be monitored. FarmDroid FD20 stops itself and sends the farmer an e-mail in case of any stops or deviations.



**Figure 1 and 2:** FarmDroid electrically powered field robot with solar panels  
(Photo: FarmDroid)

## Further information

<https://farmdroid.dk/en/welcome/>

<https://www.bing.com/videos/riverview/relatedvideo?q=farmdroid&mid=E818BA9E064D4564EEE0E818BA9E064D4564EEE0>

## About this abstract

**Authors:** Erik Fløjgaard Kristensen & Henrik Mortensen, Aarhus University

**Date:** March 2022

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

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# FarmDroid elektrisk markrobot med solpaneler

## Resultater

FarmDroid FD20 er en elektrisk (solpanel) drevet markrobot, der hjælper landmænd ogavlere med at reducere omkostninger til at så og luge afgrøder, samtidig med at det gøres på en CO<sub>2</sub>-neutral måde. "Droiden" er en letvægts-markrobot, der automatiserer såning og fjernelse af ukrudt på landbrugsjord. GPS-teknologi bruges til at kende positionen af hvert enkelt sået frø, og derfor er FD20 ikke afhængig af et kamera til afgrøde- eller ukrudtsgenkendelse. Frøet placeres meget præcist, og robotten husker, hvor frøet er placeret, og når der udføres ukrudtsbekämpelse, luger den præcist omkring den spirende plante.

## Praksis og anbefalinger

Arealer til økologisk landbrug vækster år for år, og samtidig øges fokus på reducering af sprøjtemidler indenfor konventionelt landbrug. Der er derfor et stadig større fokus på behovet for mekanisk ukrudtsbekämpelse i landbruget. FarmDroid såer afgrøderne og kender positionen på hvert frø, og ved derfor ved præcis hvor den må rengøre – og endnu vigtigere hvor den ikke må!. Den opererer fuldautomatisk, og skal ikke overvåges. FarmDroid FD20 stopper selv, og sender landmanden en e-mail ved eventuelle stop eller afvigelser.



**Figur 1 og 2:** FarmDroid elektrisk drevet markrobot med solpaneler  
(Foto: FarmDroid)

## Yderlig information

<https://www.bing.com/videos/riverview/relatedvideo?q=farmdroid&mid=E818BA9E064D4564EEE0E818BA9E064D4564EEE0info@farmdroid.dk>

## Om dette abstrakt

**Forfattere:** Erik Fløjgaard Kristensen & Henrik Mortensen, Aarhus Universitet, Institut for Elektro- og Computerteknologi

**Dato:** March 2022

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# Green protein to replace soy in feed

## Main results / outcomes

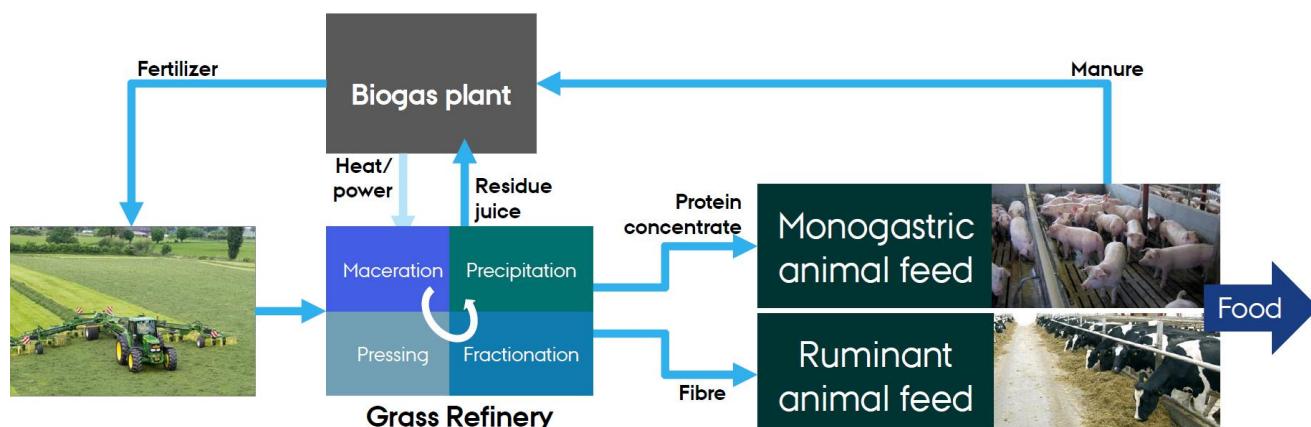
Full-scale biorefining plant on the Danish farm Ausumgaard produces green protein, which is used to replace soy in feed for monogastric animals such as pigs and poultry. Green protein is a protein extracted from clover grass by biorefining with the aim of using it as a feed ingredient. The green protein has an amino acid composition that makes it particularly suitable for one-stomached animals, and it can therefore be used instead of imported soy. Feed trials with grass protein for organic pigs have shown that grass protein concentrate can have the same feed value as soy cake.

## Practical recommendations

Raw material production, harvesting and logistics account for a significant share of the economy for green biorefining. This part should have great focus.

If the quality of processed grass is not optimal, the yields of the protein concentrate will be too low. The fiber fraction can be used for cattle feed or be used for biogas.

During autumn 2022, grass protein from Ausumgaard was used in feed mixtures for pigs, and the pigs liked it.



**Figure 1:** The green protein concept (Morten Amby-Jensen)

## Further information

<https://www.agrofossilfree.eu/2023/03/09/green-protein-extracted-from-clover-grass-case-study-in-denmark/>  
<https://biorefine.dk/p/produktion>  
<https://ausumgaard.dk/>

## About this abstract

**Authors:** Erik Fløjgaard Kristensen & Henrik Mortensen, Aarhus University

**Date:** March 2022

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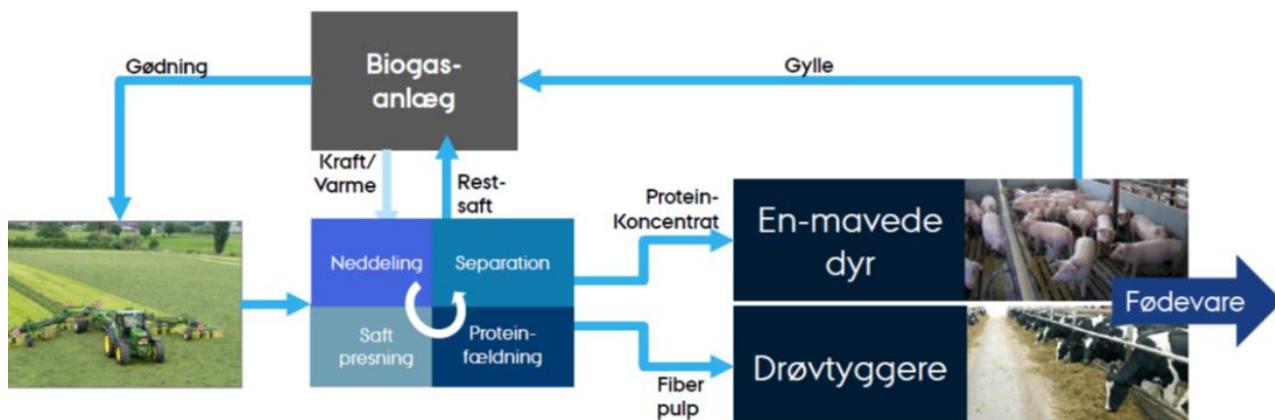
# Grøn protein til erstatning af soja i foder

## Resultater

Fuldkala bioraffineringsanlæg på den danske gård Ausumgaard producerer grønt protein, der bruges til at erstatte soja i foder til en-mavede dyr som svin og fjerkær. Grønt protein er et protein udvundet af kløvergræs ved bioraffinering med det formål, at bruge det som foderingrediens. Det grønne protein har en aminosyresammensætning, der gør det særligt velegnet til en-mavede dyr, og det kan derfor bruges i stedet for importeret soja. Foderforsøg med græsprotein til økologiske grise har vist, at græsproteinkoncentrat kan have samme foderværdi som sojakage.

## Praksis og anbefalinger

Råvareproduktion, høst og logistik udgør en væsentlig del af økonomien for grøn bioraffinering. Denne del skal have stor fokus. Hvis kvaliteten af græs ikke er optimal, vil udbyttet af proteinkoncentratet blive for lavt. Fiberfraktionen kan bruges til kvægfoder eller bruges til biogas. I løbet af efteråret 2022 er græsprotein fra Ausumgaard blevet anvendt i foderblandinger til grise, og grisene kunne lide det.



**Figur 1:** Grøn protein koncept (Morten Amby-Jensen)

## Yderlig information

<https://www.agrofossilfree.eu/2023/03/09/green-protein-extracted-from-clover-grass-case-study-in-denmark/>  
<https://biorefine.dk/p/produktion>  
<https://ausumgaard.dk/>

## Om dette abstrakt

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**Dato:** March 2022

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## Case study in Italy: Tenuta di Bagnoli

### Main results / outcomes

This practice abstract regards the Italian case study, Tenuta di Bagnoli srl. The farm produces prosecco grapes, energy crops and fattening cattle; it has builded and implemented, over the years, two biogas plants, a photovoltaic plant and an agrivoltaics one, and takes advantage of agriculture 4.0 instruments and procedures.

### Practical recommendations

In Italian agriculture, the lack of funding and the long burocratic procedures lead farmers away from innovation. The owner of Tenuta di Bagnoli wanted to invest in the company's future and innovation, both to improve the quality of countryside management and to make those improvements required by climate change prevention policies. For this reasons, he went to collect the good practices of foreign companies that had already known and developed virtuous technologies in their realities for some time, and he defined, with the help of Confagricoltura, what could be the best investment strategy for his company. The example of those successful implementations of fossil-free technologies convinced the owner to partake in this change, and the company aims to present its case to newcomers, hoping that they'll be less doubtful and more resilient in pursuing the change.



**Figure 1:** Tenuta di Bagnoli, vista aerea

### Further information

[Study case video](#)

<https://www.tenutadibagnoli.it/>

### About this abstract

**Authors:** Elisa Tomassi/Confagricoltura

**Date:** March 2022

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# Un caso di studio in Italia: Tenuta di Bagnoli

## Principali risultati / esiti

Questo practice abstract riguarda il case study italiano, Tenuta di Bagnoli srl. L'azienda produce uva da prosecco, colture energetiche e bovini da ingrasso; ha costruito e realizzato, negli anni, due impianti di biogas, un impianto fotovoltaico e uno agrivoltaico, e si avvale degli strumenti e delle procedure dell'agricoltura 4.0.

## Raccomandazioni pratiche

Nell'agricoltura italiana, la mancanza di fondi e le lunghe procedure burocratiche allontanano gli agricoltori dall'innovazione. Il titolare della Tenuta di Bagnoli ha voluto investire nel futuro e nell'innovazione dell'azienda, sia per migliorare la qualità della gestione delle campagne sia per apportare quei miglioramenti richiesti dalle politiche di prevenzione del cambiamento climatico. Per questo è andato a raccogliere le buone pratiche di aziende estere che già da tempo conoscevano e sviluppavano tecnologie virtuose nelle loro realtà, e ha definito, con l'aiuto di Confagricoltura, quale potesse essere la migliore strategia di investimento per la sua azienda. L'esempio di quelle implementazioni di successo di tecnologie prive di fossili ha convinto il proprietario a partecipare a questo cambiamento e l'azienda intende presentare il proprio caso ai nuovi arrivati, sperando che siano meno dubbiosi e più resilienti nel perseguire il cambiamento.



**Figure 1:** Tenuta di Bagnoli, vista aerea

## Ulteriori informazioni

[Study case video](#)

<https://www.tenutadibagnoli.it/>

## Informazioni su questo abstract

**Authors:** Elisa Tomassi/Confagricoltura

**Date:** March 2022

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## JMP Flowers greenhouse complex

### About the company

JMP Flowers is a Polish family business based in Stężyca and the biggest producer of *Phalaenopsis* orchid in Central and Eastern Europe. The company has a wide offer comprising over 600 varieties of orchids cultivated on an area of 11 ha, 50 varieties of roses cultivated on an area of 6 ha, and 40 varieties of anthuriums on an area of 0.7 ha. JMP Flowers also manages Poland's largest, own wholesale retail chain with a total of 15 representative branches, supplying Polish florists with fresh flowers. Each of the branches is equipped with vans that deliver flowers within a radius of up to 50 km. JMP Flowers offers a stable and safe workplace for 240 employees from 9 countries, attracting young, talented people from all over the world.



**Greenhouse complex in Stężyca, Poland**

Source: <https://www.jmpflowers.pl/>

### Innovative solutions

The construction of Europe's largest greenhouse for *Phalaenopsis*, providing a cultivation area of over 10 ha, was completed in 2017. Its innovative character results from the fact that during the production cycle of every orchid, which lasts 11 months, the plant undergoes a number of climate stages which differ in terms of moisture, temperature and watering intensity, in order to accurately reflect the sub-tropical climate which the orchid comes from. Moreover, the facility is equipped with robots sorting out fully grown plants, which identify the budding life-cycle, number and size of buds and the plant height, using specially designed cameras.



**Phalenopsis cultivation in a greenhouse (left) and LED lighting in a greenhouse at night (right);** Source: <https://www.jmpflowers.pl/>

The glass construction, encompassing 17 ha, has also a well-developed technical infrastructure which makes the production process self-sufficient in terms of electricity (lighting) and heating consumption. The company has its own co-generation system. Three units installed in JMP Flowers facilities are equipped with the CodiNOx system, with all engines being connected to the greenhouse light intensity steering system. The applied solutions are eco-friendly, as the exhaust fumes produced in power plants are cleaned by the CodiNOx system removing trace quantities of heavy metals and carbon monoxide. Once treated, the exhaust fumes (with pure CO<sub>2</sub>) are transported to plants grown in the greenhouses, which transform them into oxygen.

**Further information:** Visit the [official JMP Flowers company website](#)

### About this abstract

**Authors:** Magdalena Borzęcka/IUNG-PIB, Małgorzata Wydra/IUNG-PIB, Katarzyna Kozak/LODR

**Date:** June 2023

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# Kompleks szklarniowy JMP Flowers

## O firmie

JMP Flowers to polska rodzinna firma z siedzibą w Stężycy, będąca największym producentem storczyków odmiany Phalaenopsis w Europie Środkowo-Wschodniej. Firma posiada bogatą ofertę obejmującą aż 600 odmian storczyków uprawianych na powierzchni 11 ha, 50 odmian róż uprawianych na powierzchni 6 ha oraz 40 odmian anturium na powierzchni 0,7 ha. JMP Flowers zarządza również największą w Polsce, własną siecią hurtowni detalicznych, posiadającą łącznie 15 reprezentatywnych oddziałów, zaopatrującą polskie kwaciarnie w świeże kwiaty. Każdy z oddziałów wyposażony jest w samochody dostawcze, które dostarczają kwiaty w promieniu do 50 km. JMP Flowers to stabilne i bezpieczne miejsce pracy dla 240 pracowników aż z 9 krajów, przyciągając do pracy młodych, utalentowanych ludzi z całego świata.



**Kompleks szklarni w Stężycy, Polska,**  
Źródło: <https://www.jmpflowers.pl/>

## Innowacyjne rozwiązania

W 2017 roku powstała największa w Europie szklarnia dla Phalaenopsis, zapewniająca ponad 10 ha powierzchni uprawy. Jej innowacyjność polega na odwzorowaniu naturalnych warunków do wzrostu storczyka, trwającego 11 miesięcy, podczas których roślina przechodzi szereg etapów różniących się wilgotnością, temperaturą i intensywnością podlewanego - tak aby jak najdokładniej oddać subtropikalny klimat, z którego pochodzi storczyk. Ponadto obiekt jest wyposażony w roboty sortujące w pełni rozwinięte rośliny, identyfikujące cykl rozwojowy pąków, ich liczbę i wielkość oraz wysokość roślin za pomocą specjalnie zaprojektowanych kamer.



**Szklarnia z uprawą storczyków (po lewej) i z oświetleniem LED nocą (po prawej),** Źródło: <https://www.jmpflowers.pl/>

Cała konstrukcja o powierzchni 17 ha posiada również dobrze rozwiniętą infrastrukturę techniczną, która sprawia, że proces produkcyjny jest samowystarczalny pod względem zużycia energii elektrycznej (oświetlenia) i ciepła. Spółka JMP posiada własny system kogeneracji. Trzy jednostki zainstalowane w obiektach JMP Flowers są wyposażone w system CodiNOx, a silniki są podłączone do systemu sterowania natężeniem światła w szklarni. Zastosowane rozwiązania są przyjazne dla środowiska, ponieważ spaliny powstające w elektrowniach oczyszczane są przez system CodiNOX (usuwanie śladowych ilości metali ciężkich i tlenku węgla), a oczyszczone spaliny (zawierające czysty CO<sub>2</sub>) są transportowane do wszystkich roślin uprawianych w szklarniach, które przekształcają je w tlen.

**Więcej na stronie internetowej [JMP Flowers](https://jmpflowers.pl/)**

## Szczegóły dotyczące streszczenia

**Autorzy:** Magdalena Borzęcka/IUNG-PIB, Małgorzata Wydra/IUNG-PIB, Katarzyna Kozak/LODR

**Data:** czerwiec 2023

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**Strona internetowa projektu:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

## PUSTELNIA fish farm

### About the company

Pustelnia is a family business producing fish (mainly carp and rainbow trout) in naturally preserved fishponds covering nearly 400 ha. The fish are fed with plankton (naturally occurring in the pond), sustainably produced cereals and high-quality fodder based only on natural ingredients, to provide optimal conditions closest to their natural diet. Pustelnia takes into account fish welfare which can be proved by the Fish Welfare Certificate, as well as annual audits for the certificate of the Code of Good Fishing Practices.



Fish ponds and farm buildings in Wola Rudzka (left) and a fisherman at work (right), Source: <https://rybypustelnia.pl/>

### Innovative solutions

The main aim of the company is production of a high-quality product and its local sale. All fish waste is frozen and then collected. Investment in a biogas plant has been considered, but there is too little waste production that could be used for this purpose. A biogas plant would enable the use of heat, for example, in the production of such fish species as sturgeon and catfish. However, the fish farm invested in a photovoltaic installation on farm buildings, which was financially supported from the European Maritime and Fisheries Fund. It is expected to allow for savings on energy cost thanks to production of renewable energy and reduce the environmental impact of the farm itself. The owners are constantly looking for new solutions and improvements, also of their offer for consumers. At the time of the Covid pandemic in 2020, the entire team was reorganized and engaged in the production of processed fish that could be sold outside – online and using fish trucks.



Products offered in the fish farm shops – both stationary and online – comprise carp ham and sausage (left), marinated fish and pate (right); Source: <https://rybypustelnia.pl/>

One of the components of Green Deal is the Farm to Fork strategy. The main scope of actions in Pustelnia Farm - to produce and consume locally - fits perfectly into that strategy. „We care about the fish welfare, get trained and introduce technical innovations to improve fish welfare in the farm as well as during transport and slaughter. At the same time we introduce new technology to use less water and reuse materials (e.g. for packaging) in all aspects of our work. Our fish farm goes towards circular economy, its production being based to the possibly highest extent on reusable and locally provided materials. The idea is to disseminate our activities among the consumers to raise awareness and allow them to choose good quality products.” – say the owners.

**Further information:** Visit the official website: <https://rybypustelnia.pl/en/main-site/>

### About this abstract

**Authors:** Magdalena Borzęcka/IUNG-PIB, Małgorzata Wydra/IUNG-PIB, Katarzyna Kozak/LODR

**Date:** June 2023

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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# Gospodarstwo Rybackie PUSTELNIA Sp. z o.o.

## O firmie

Pustelnia to rodzinna firma produkująca ryby (głównie karpie i pstrągi tęczowe) w naturalnie zachowanych stawach rybnych o powierzchni blisko 400 ha. Ryby żywią się planktonem (występującym w stawie), zbożami produkowanymi w sposób zrównoważony oraz wysokiej jakości paszami opartymi wyłącznie na naturalnych składnikach, co zapewnia im optymalne warunki zbliżone do ich naturalnej diety. Pustelnia dba o dobrostan ryb, którego potwierdzeniem może być Świadectwo Dobrostanu Ryb, a także coroczne audyty w ramach certyfikatu Kodeksu Dobréj Praktyki Rybackiej.



Stawy rybne i budynki gospodarstwa rybackiego w Woli Rudzkiej (po lewej); rybak podczas połówu (po prawej) Źródło: <https://rybypustelnia.pl/>

## Innowacyjne rozwiązania

Główym celem firmy jest wytwarzanie produktu wysokiej jakości oraz jego lokalna sprzedaż. Wszystkie odpady rybne są zamrażane i zbierane. Rozważano inwestycję w biogazownię, która dałaby możliwość wykorzystania ciepła np. do produkcji takich gatunków ryb jak jesiotr czy sum, ale produkowanych odpadów jest zbyt mało, by wykorzystać je w tym celu. Gospodarstwo zainwestowało więc w instalację fotowoltaiczną na budynkach gospodarczych, założoną dzięki dofinansowaniu z Europejskiego Funduszu Morskiego i Rybackiego. Oczekuje się, że produkcja energii odnawialnej pozwoli nie tylko na zmniejszenie kosztów, ale też wpływu działalności gospodarstwa na środowisko. Firma stale poszukuje nowych, ciekawych rozwiązań, także w ramach oferty gastronomicznej. W czasie pandemii Covid w 2020 roku zespół został zreorganizowany i rozpoczął produkcję przetworzonych ryb, które można sprzedawać na zewnątrz – online i przy użyciu fishtrucków.



Produkty oferowane w sklepach Pustelni (stacjonarnie i online) obejmują m.in. szynkę i kiełbasę z karpia (po lewej) oraz marynowane ryby i pasty rybne (po prawej); Źródło: <https://rybypustelnia.pl/>

Jednym z elementów Zielonego Ładu jest strategia „od pola do stołu”. Główne działania promowane w Pustelni – lokalna produkcja i konsumpcja – doskonale wpisują się w tę strategię. „Dbamy o dobrostan ryb, szkolimy się i wprowadzamy rozwiązania poprawiające dobrostan ryb w hodowli, transporcie i uboju. Jednocześnie wprowadzamy nowe technologie, aby zużywać mniej wody, staramy się odzyskiwać i ponownie wykorzystywać materiały (np. opakowania) we wszystkich aspektach naszej pracy. Nasze gospodarstwo rybne rozwija się w kierunku gospodarki o obiegu zamkniętym, a jego produkcja opiera się w możliwie największym stopniu na materiałach wielokrotnego użytku i pozyskiwanych lokalnie. Staramy się też rozpowszechniać nasze działania, aby zwiększać świadomość konsumentów i umożliwić im wybór dobrej jakości produktów.” – mówią właściciele.

Więcej na stronie internetowej: <https://rybypustelnia.pl/>

## Szczegóły dotyczące streszczenia

**Autorzy:** Magdalena Borzęcka/IUNG-PIB, Małgorzata Wydra/IUNG-PIB, Katarzyna Kozak/LODR

**Data:** czerwiec 2023

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**Strona internetowa projektu:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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# The AgroFossilFree Decision Support Toolkit (DST)

## Main results / outcomes

AgroFossilFree project developed a freely accessible online ICT Decision Support Toolkit (DST) that is available in <https://dst.agrofossilfree.eu/>. User is able to select the type of farm (open-field, livestock, and greenhouse) and after replying to six short questions by a drop-down menu, the tool ranks and suggests appropriate Fossil Energy Free Technologies and Strategies (FEFTS) categories based on the user's input using a Fuzzy Cognitive Maps (FCM) approach. The presented categories contain commercial technologies, training material and financing mechanisms. The tool also provides links that redirect to the corresponding content in the AgroFossilFree platform.

## Practical recommendations

The DST is seamlessly integrated within the AgroFossilFree platform (<https://platform.agrofossilfree.eu/>). This way, users can be supported in the process of selecting FEFTS for their custom needs according to the specific characteristics of their farm. Thus, the process of identifying and providing the first insights on which FEFTS to adopt is enhanced and facilitated. The possibility of selecting the non-optimum FEFTS is minimized. Essentially, the DST mimics the consultation process of a number of experts if these experts were in the same room evaluating the input data provided by the end-user to propose the most effective action.

**Figure 1:** Homepage of the DST

**Figure 2:** Results provided by the DST for a specific query

## Further information

The AgroFossilFree DST is available in the link <https://dst.agrofossilfree.eu/>, while more details are available in <https://www.sciencedirect.com/science/article/pii/S2772375522001332>.

## About this abstract

**Authors:** Mike Kaminiaris and Zisis Tsiropoulos, Agricultural & Environmental Solutions (AGENSO)

**Date:** April 2023

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**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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# Το εργαλείο υποστήριξης λήψεως αποφάσεων (DST) του AgroFossilFree

## Main results / outcomes

Το έργο AgroFossilFree ανέπτυξε ένα δωρεάν προσβάσιμο διαδικτυακό ICT εργαλείο υποστήριξης λήψεως αποφάσεων (DST) που είναι ελεύθερα διαθέσιμο στη διεύθυνση <https://dst.agrofossilfree.eu/>. Ο χρήστης μπορεί να επιλέξει τον τύπο της παραγωγικής μονάδας (υπαίθρια καλλιέργεια, κτηνοτροφική μονάδα, και θερμοκηπιακή καλλιέργεια) και αφού απαντήσει σε έξι σύντομες ερωτήσεις από ένα drop-down μενού, το εργαλείο κατατάσσει και προτείνει κατάλληλες κατηγορίες Τεχνολογιών και Στρατηγικών για τη μείωση της χρήσης ορυκτών καυσίμων στην πρωτογενή παραγωγή (FEFTS) χρησιμοποιώντας μια προσέγγιση Fuzzy Cognitive Maps (FCM). Οι παρουσιαζόμενες κατηγορίες περιέχουν εμπορικές τεχνολογίες, εκπαιδευτικό υλικό και μηχανισμούς χρηματοδότησης. Το εργαλείο παρέχει επίσης συνδέσμους που ανακατευθύνουν στο αντίστοιχο περιεχόμενο στην πλατφόρμα AgroFossilFree.

## Practical recommendations

Το DST ενσωματώνεται απρόσκοπτα στην πλατφόρμα AgroFossilFree (<https://platform.agrofossilfree.eu/>). Με αυτόν τον τρόπο, οι χρήστες μπορούν να λάβουν υποστήριξη στη διαδικασία επιλογής FEFTS για τις προσαρμοσμένες ανάγκες τους σύμφωνα με τα ειδικά χαρακτηριστικά της παραγωγικής μονάδας τους. Έτσι, ενισχύεται και διευκολύνεται η διαδικασία υιοθέτησης του FEFTS και η πιθανότητα επιλογής των μη βέλτιστων FEFTS ελαχιστοποιείται. Ουσιαστικά, το DST μιμείται τη διαδικασία διαβούλευσης με έναν αριθμό ειδικών συμβούλων, εάν αυτοί οι ειδικοί βρίσκονταν στο ίδιο δωμάτιο και αξιολογούσαν τα δεδομένα εισόδου που παρέχονται από τον τελικό χρήστη για να προτείνουν την πιο αποτελεσματική ενέργεια.

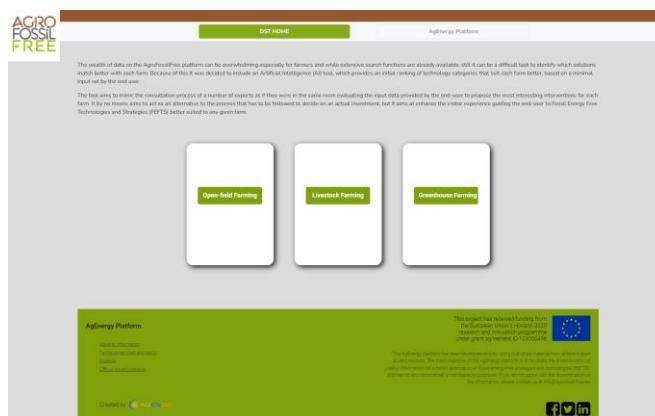


Figure 1: Αρχική σελίδα του DST

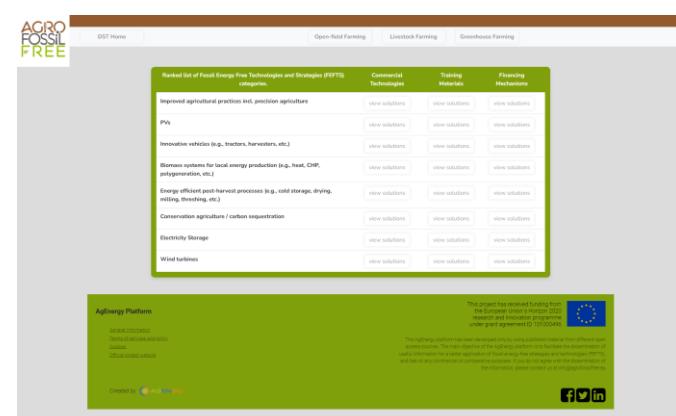


Figure 2: Αποτελέσματα από το εργαλείο για ένα συγκεκριμένο ερώτημα

## Further information

Το διαδικτυακό εργαλείο υποστήριξης λήψεως αποφάσεων του AgroFossilFree είναι διαθέσιμο στο σύνδεσμο <https://dst.agrofossilfree.eu/>, ενώ περισσότερες λεπτομέρειες είναι διαθέσιμες στο σύνδεσμο <https://www.sciencedirect.com/science/article/pii/S2772375522001332>.

## About this abstract

**Authors:** Mike Kaminiaris and Zisis Tsiropoulos, Agricultural & Environmental Solutions (AGENSO)

**Date:** April 2023

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**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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# Sustainable storage barn 'Bewaarschuur van de toekomst'

## Main results / outcomes

In 2014, Tonnie van Peperstraten from the Van Peperstraten Group, had the idea of creating and building an innovative storage barn on his arable farm with the ambition to become independent of fossil fuels in his agricultural operations.

## Practical recommendations

Van Peperstraten Group is a family farm of 250 hectares of arable land, on which potatoes, onions, wheat, sugar beets, carrots and peas are cultivated in a conventional way. The barn was created in collaboration with Altez Construction Group, a company specialised in agricultural and industrial construction works, and Omnidivent, a company specialized in industrial cooling/heating and ventilation systems.

The concept of the 'Bewaarschuur van de Toekomst' is based on eliminating fossil fuels from arable farming in the Netherlands. Energy is generated with 5000 solar panels which produce around 1,8 MW per year. Rainfall water is harvested and stored in a 6000 cubic meters water storage. An energy management system determines whether the produced energy is used in the facility itself or sold to the common energy grid. The collected water is used to moisten the agricultural produce, produce hydrogen, wash agricultural machinery, for spraying operations and as drinking water or demi-water. The ventilation and climate installations in the facility are designed to achieve the highest energy use efficiency as possible.

In the Netherlands, this is a pioneer project. Until now, there are no other plans to construct other storage barns with a similar sustainable building concept. However, all three stakeholders involved in this project, all pointed out that they are open to and interested to assist other farmers with similar ideas with the knowledge developed in this construction project.



**Figure 1:** Layout of the 'Bewaarschuur van de Toekomst' with Dutch explanation of some key features

## Further information

<https://www.youtube.com/watch?v=MYk0JKrfWs8>  
[https://www.youtube.com/watch?v=ls\\_C6VKJIPe](https://www.youtube.com/watch?v=ls_C6VKJIPe)

## About this abstract

**Authors:** Vasiliki Kanaki/Agricultural University of Athens

**Date:** July 2023

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# Duurzame opslagschuur 'Bewaarschuur van de toekomst'

## Belangrijkste resultaten/uitkomsten

In 2014 had Tonnie van Peperstraten van de Van Peperstraten Groep het idee om een innovatieve bewaarschuur te ontwerpen en te bouwen op zijn akkerbouwbedrijf met de ambitie om niet meer afhankelijk te zijn van fossiele brandstoffen in zijn bedrijfsvoering.

## Aanbevelingen

Van Peperstraten Groep is een familiebedrijf met 250 hectare akkerbouwgrond, waarop op gangbare wijze aardappelen, uien, tarwe, suikerbieten, wortelen en erwten worden geteeld. De schuur is tot stand gekomen in samenwerking met Altez Construction Group, een bedrijf gespecialiseerd in de agrarische en industriële bouw, en Omnivent, een bedrijf gespecialiseerd in industriële koel-/verwarmings- en ventilatiesystemen. Het concept van de Bewaarschuur van de Toekomst is gebaseerd op het overbodig maken van fossiele brandstoffen in de akkerbouw in Nederland. Er wordt energie opgewekt met 5000 zonnepanelen die ongeveer 1,8 MW per jaar produceren. Regenwater wordt opgevangen en opgeslagen in een wateropslag van 6000 kubieke meter. Een energiebeheersysteem bepaalt of de geproduceerde energie wordt gebruikt in de faciliteit zelf of wordt verkocht aan het energienet. Het opgevangen water wordt gebruikt om de producten in de akkers te beregenen, om waterstof te produceren, om landbouwmachines te wassen en als drinkwater of demi-water. De ventilatie- en klimaatinstallaties in de voorziening zijn ontworpen om een zo hoog mogelijke energie-efficiëntie te bereiken. In Nederland is dit een pioniersproject. Tot nu toe zijn er geen verdere plannen voor de bouw van andere bewaarschuren met een vergelijkbaar duurzaam bouwconcept. Alle drie de betrokkenen bij dit project hebben echter aangegeven dat ze openstaan voor en geïnteresseerd zijn in het helpen van andere boeren met soortgelijke ideeën met de kennis die is ontwikkeld in dit bouwproject.



**Figuur 1:** Plattegrond van de "Bewaarschuur van de Toekomst"

## Informatie

- Filmweergave en interview met Tonnie van Peperstraten: <https://www.youtube.com/watch?v=MYk0JkrWs8>  
[https://www.youtube.com/watch?v=ls\\_C6VKJIPE](https://www.youtube.com/watch?v=ls_C6VKJIPE)
- Website RVO Netherlands: <https://www.rvo.nl/subsidies-regelingen/projecten/bewaarschuur-van-de-toekomst>

## Over deze samenvatting

**Auteur:** Delphy B.V.

**Datum:** Juli 2022

**AgroFossilFree** is een H2020-project met meerdere betrokken partijen dat de huidige stand van zaken in de EU-landbouw met betrekking tot energiegebruik zal evalueren en bestaande behoeften zal beoordelen, zodat boeren hun landbouwproductie kunnen optimaliseren door efficiënter energiegebruik en minder uitstoot van broeikasgassen, wat zal leiden tot economische, agronomische en milieuvoordelen. AgroFossilFree zal een kader creëren waarbinnen cruciale belanghebbenden zullen samenwerken om de momenteel beschikbare technologieën en strategieën zonder fossiele brandstoffen (FEFTS) in de landbouw van de EU te evalueren en te promoten. Het project loopt van oktober 2020 tot september 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

# BHSL Waste to Energy Case Study

## Main results / outcomes

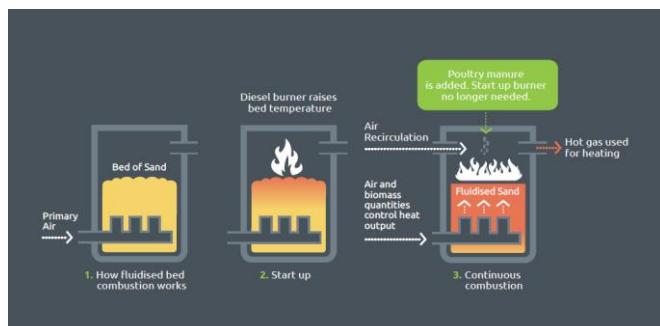
This case study tells the story of the sequential development of an innovative fossil energy-free technology for the poultry production sector in west Limerick, in the south-west of Ireland. In the early 2000's, an initial pilot on a local poultry farm, successfully demonstrated the feasibility of this waste-to-energy concept.

## Practical recommendations

The technology was developed to deal with the abundance of poultry manure produced by farmers in the area. Enactment of European legislation meant that the spreading of poultry manure on local lands could not continue due to its high nutrient levels and associated environmental risks.

In response, the local poultry producers association actively looked for solutions. In collaboration with local producers and the University of Limerick and with support from Government agencies and EU partners , Jack O'Connor, now Head of BHSL Research and Development, led the development and assessment of a pilot to examine the potential of on-site fluidized bed combustion on his and a neighbouring farm locally in west Limerick. The outcome was a win-win situation in terms of "poultry, profits and the planet".

The case study explains the subsequent development of the technology along a set timeline, the challenges that were encountered and addressed and the major benefits that can now be derived from this fossil-energy free technology. It also describes the set-up and expansion of BHSL, now a highly successful Irish agri-tech company and the roll out of this on-farm energy production system which is highly automated, encompassing remote management that allows 27/7 monitoring of multiple production units.



**Figure 1:** Fluidized bed combustion process maximizes poultry manure combustion efficiency and minimizes emissions

**Figure 2:** Combustion Chamber

## Further information

<https://www.bhsl.com>  
<https://www.youtube.com/watch?v=gbLuYkYTak>

## About this abstract

**Authors:** Tom Houlihan/Teagasc

**Date:** June 2023

**AgroFossilFree** is a H2020 multi-actor project that will evaluate the current status in EU agriculture regarding energy use and assess existing needs, allowing farmers to optimize agricultural production through more efficient energy use and reduced GHG emissions, resulting in economic, agronomic and environmental benefits. AgroFossilFree will create a framework under which critical stakeholders will cooperate to evaluate and promote the currently available Fossil-Energy-Free Technologies and Strategies (FEFTS) in EU agriculture. The project is running from October 2020 to September 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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

# Novel seaweed-based crop biostimulant

## Main results / outcomes

An Irish based biotech company Brandon Bioscience has developed a novel seaweed based biostimulant which could hold the key to reduce nitrogen use in agriculture. For over 23 years the company has been producing crop biostimulant products extracted from the common brown seaweed *Ascophyllum nosodum*. The company has perfected the process of identifying, isolating, extracting and concentrating specific bio-compounds from seaweed to create a range of highly effective biostimulant products with targeted properties. One of these products called PSI362, allows for more efficient use of nitrogen by crops, allowing for a 20% reduction in nitrogen rates without affecting crop yields.

## Practical recommendations

This product can have a significant role in delivering the EU target of 20% reduction in nitrogen use in agriculture

- It works by activating select nitrogen transport and assimilation genes in crops to enhance the uptake, transport and assimilation of the nutrient.
- Research work published in the journal *Frontiers in Plant Science* found the Nitrogen Use Efficiency (NUE) was increased by between 29.85 – 60.26% in barley crops with nitrogen rates of just 75% when treated with PSI362.
- When PSI362 was incorporated as a coating to the granular nitrogen fertiliser calcium ammonium nitrate (CAN) and applied to barley crops, nitrate uptake levels in the barley crop were considerably higher 22 days after application.
- Work is still ongoing into the mode of action at a basic plant science level to understand the optimal conditions for efficacy in various crop types and conditions but PSI362 is sure to play an important role in crop nutrition well into the future.



## Further information

- <https://brandongbioscience.com/>
- <https://www.youtube.com/watch?v=aiYuPU48iVk>
- <https://www.youtube.com/watch?v=450vTfnZx1o>

## About this abstract

**Authors:** Barry Caslin/ Teagasc, Energy and Rural Development Specialist, Tom Houlihan/Teagasc, Forestry Specialist

**Date:** June 2023

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# The AgroFossilFree Project links with the European Biomass Conference & Exhibition

## Main results / outcomes

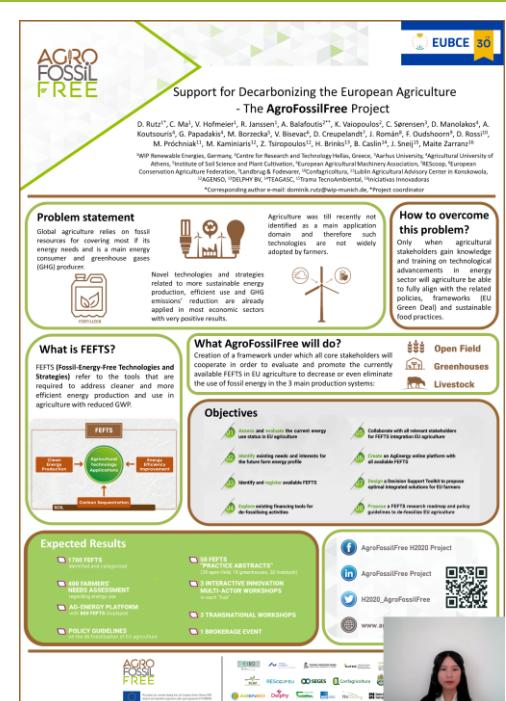
The European Biomass Conference & Exhibition (EUBCE) is the world's largest series of biomass gathering, promoting research and global biomass use. It brings together over 2,000 experts to share innovative ideas and technologies related to biomass sourcing, production, and use. The AgroFossilFree project aligns with the conference's objectives by focusing on the decarbonization of the agricultural sector. Proudly showcased at EUBCE in 2021, 2022, and 2023, the project established a vital connection between the energy and agricultural sectors. During these presentations, individuals from diverse backgrounds intensively discussed to advance the cause of achieving a fossil-free agricultural system. The project has also elaborated papers on the presentations which are available at the conference proceedings.

## Practical recommendations

Participation in the EUBCE can offer a range of benefits to different stakeholders, including farmers. For example, knowledge sharing and learning: this includes groundbreaking ideas, technologies, applications, and solutions for the sourcing, production, and utility of biomass. The event provides a platform for attendees to connect and network with the leading minds in the field of biomass from around the world, including experts from academia, industry, and policy. The scientific programme for the conference covers a wide range of topics related to biomass, including resources, sustainability, bio-based products, biomass conversions, policies, and more. The conference also includes parallel events that provide a deep insight into specific topics. By attending the EUBCE, participants can keep up to date with the latest developments in the bioeconomy and get updated on the achievements and current efforts for using biomass to achieve a fossil-free agriculture.



**Figure 1:** AgroFossilFree presented at EUBCE 2023



**Figure 2:** AgroFossilFree poster at EUBCE 2022

## Further information

EUBCE: <https://www.eubce.com/>

AgroFossilFree Paper DOI (EUBCE 2022): 10.5071/30thEUBCE2022-2BV.7.10

## About this abstract

**Authors:** Chuan Ma, Dominik Rutz (WIP Renewable Energies)

**Date:** June 2023

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

# Das AgroFossilFree-Projekt ist mit der Europäischen Biomasse-Konferenz und -Ausstellung verbunden

## Wichtigste Ergebnisse / Resultate

Die Europäische Biomasse-Konferenz und -Messe (European Biomass Conference & Exhibition - EUBCE) ist eine der weltweit größten Veranstaltungen zu den Themen Biomasse, Bioenergie und Bioökonomie. Sie bringt über 2.000 Experten zusammen, die sich über Innovationen und Entwicklungen im Bereich der Biomasseproduktion und Nutzung auszutauschen. Da ein Großteil der Biomasseproduktion durch die Landwirtschaft bereitgestellt wird, ist die Konferenz eine sehr wichtige Plattform für das Projekt AgroFossilFree. Es verbindet den Energie- mit dem Agrarsektor. Das Projekt wurde deshalb auf der EUBCE in den Jahren 2021, 2022 und 2023 vorgestellt. Dabei diskutierten die Experten untereinander, um das Ziel einer fossilfreien Landwirtschaft voranzutreiben. Das Projekt hat auch Veröffentlichungen zu den Präsentationen erarbeitet, die in den Konferenzunterlagen zu finden sind.

## Praktische Empfehlungen

Die Teilnahme an der EUBCE ermöglicht es verschiedenen Interessengruppen Wissen, Erfahrungen und Entwicklungen zu tauschen. Die Veranstaltung bietet den Teilnehmern eine Plattform, um mit Gleichgesinnten aus der ganzen Welt, darunter Experten aus Wissenschaft, Industrie und Politik, in Kontakt zu treten und sich zu vernetzen. Das wissenschaftliche Programm der Konferenz deckt ein breites Spektrum an Themen im Zusammenhang mit Biomasse ab, darunter Ressourcen, Nachhaltigkeit, biobasierte Produkte, Umwandlung von Biomasse, Politik und mehr. Die Konferenz umfasst auch Parallelveranstaltungen, die einen tieferen Einblick in spezifische Themen bieten. Durch die Teilnahme an der EUBCE können sich die Teilnehmer über die neuesten Entwicklungen in der Bioökonomie auf dem Laufenden halten und sich über die Errungenschaften und aktuellen Bemühungen zur Nutzung von Biomasse auf dem Weg zu einer fossilfreien Landwirtschaft informieren.



Abbildung 1: AgroFossilFree präsentiert auf der EUBCE 2023

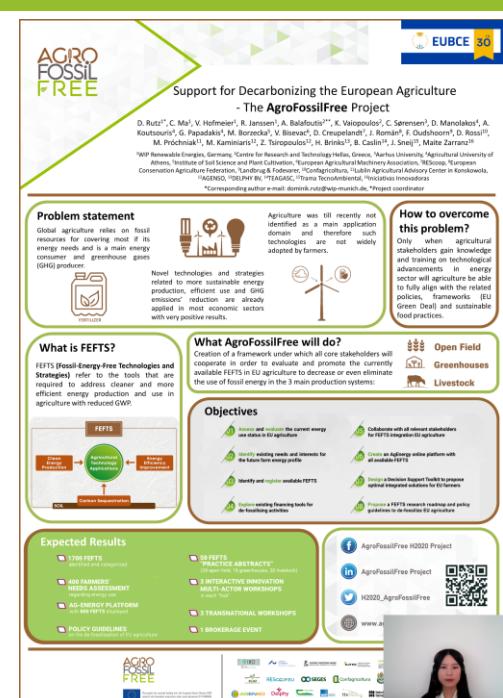


Abbildung 2: AgroFossilFree-Poster auf der EUBCE 2022

## Weitere Informationen

EUBCE: <https://www.eubce.com/>

AgroFossilFree Paper DOI (EUBCE 2022): 10.5071/30thEUBCE2022-2BV.7.10

## Über diese Zusammenfassung

**Autoren:** Chuan Ma, Dominik Rutz (WIP Renewable Energies)

**Datum:** Juni 2023

**AgroFossilFree** ist ein H2020-Multi-Akteur-Projekt, das den aktuellen Stand der Energienutzung in der EU-Landwirtschaft bewerten und den bestehenden Bedarf einschätzen wird, damit Landwirte die landwirtschaftliche Produktion durch effizientere Energienutzung und geringere Treibhausgasemissionen optimieren können, was zu wirtschaftlichen, agronomischen und ökologischen Vorteilen führt. AgroFossilFree wird einen Rahmen schaffen, in dem wichtige Interessengruppen zusammenarbeiten werden, um die derzeit verfügbaren fossil-freien Technologien und Strategien (FEFTS) in der EU-Landwirtschaft zu bewerten und zu fördern. Das Projekt läuft von Oktober 2020 bis September 2023.

**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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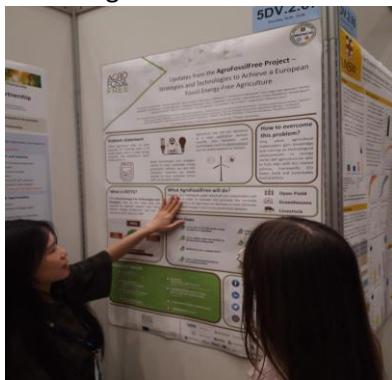
# The AgroFossilFree Project Intersects with the European Photovoltaic Solar Energy Conference & Exhibition

## Main results / outcomes

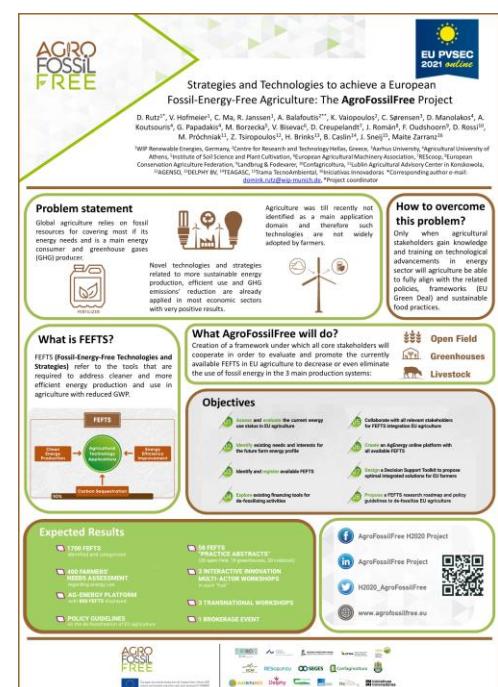
The European Photovoltaic Solar Energy Conference & Exhibition (EUPVSEC) is the world's leading international conference focused on photovoltaic (PV) research, technologies, and applications. Each year, the event brings together global PV experts to present and discuss the latest developments in PV, to network, and to conduct business. The AgroFossilFree project aligns with the EUPVSEC's objectives by focusing on the decarbonization of the agricultural sector and the use of solar energy in this endeavor. The project was proudly presented at EUPVSEC in 2021 and 2022, and is set to continue its presence in 2023, thereby forging a crucial connection between renewable energy and the agricultural sectors. These presentations encouraged intense discussions among various stakeholders to push for a fossil-free agricultural system. Detailed papers based on these presentations are available in the conference proceedings.

## Practical recommendations

Participation in the EUPVSEC offers multiple benefits to different stakeholders, including representatives from the agricultural sector. For instance, it provides an excellent opportunity for knowledge sharing and learning about the latest PV technologies, applications, and market trends. The conference acts as a platform for attendees to connect and network with leading minds in the PV sector worldwide, including experts from academia, industry, finance, and politics. The scientific program covers a broad range of topics related to PV, such as silicon cells, thin films, PV systems engineering, and applications like BIPV, agri-PV, and floating PV. In addition, the conference includes parallel events that provide a deep insight into specific topics. By attending the EUPVSEC, participants can stay updated with the latest developments in the renewable energy sector and learn about the current efforts to achieve a fossil-free agriculture using PV technologies.



**Figure 1:**  
AgroFossilFree  
presented at  
EUPVSEC 2022



**Figure 2:** AgroFossilFree poster at EUPVSEC 2021

## Further information

EUPVSEC: <https://www.eupvsec.org>

AgroFossilFree Paper DOI (EUPVSEC 2022): 10.4229/WCPEC-82022-5DV.2.67

## About this abstract

**Authors:** Chuan Ma, Dominik Rutz (WIP Renewable Energies)

**Date:** June 2023

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**Website:** [www.agrofossilfree.eu](http://www.agrofossilfree.eu)



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# Das AgroFossilFree-Projekt überschneidet sich mit die European Photovoltaic Solar Energy Conference & Exhibition

## Wichtigste Ergebnisse / Resultate

Die Europäische Photovoltaikkonferenz und Messe (EUPVSEC) ist die weltweit führende internationale Konferenz für Photovoltaik-Forschung, Technologien und Anwendungen. Jedes Jahr bringt die Veranstaltung globale Photovoltaik-Experten zusammen, um die neuesten Entwicklungen in der Photovoltaik zu präsentieren und zu diskutieren, Netzwerke zu knüpfen und Geschäfte zu tätigen. Das AgroFossilFree-Projekt steht im Einklang mit den Zielen der EUPVSEC, da es die Dekarbonisierung des Agrarsektors und die Nutzung von Solarenergie in diesem Bereich behandelt. Das Projekt wurde auf der EUPVSEC in den Jahren 2021 und 2022 vorgestellt und soll auch im Jahr 2023 präsentiert werden, um eine wichtige Verbindung zwischen erneuerbaren Energien und dem Agrarsektor herzustellen. Diese Präsentationen regten intensive Diskussionen zwischen verschiedenen Interessengruppen an, um ein fossilfreies Agrarsystem voranzutreiben. Ausführliche Veröffentlichungen, die auf diesen Präsentationen basieren, sind in den Konferenzunterlagen enthalten.

## Praktische Empfehlungen

Die Teilnahme an der EUPVSEC bietet verschiedenen Interessengruppen, darunter auch Vertretern der Landwirtschaft, zahlreiche Vorteile. So bietet sie beispielsweise eine hervorragende Gelegenheit zum Wissensaustausch und zum Lernen über die neuesten PV-Technologien, Anwendungen und Markttrends. Die Konferenz dient den Teilnehmern als Plattform, um mit führenden Köpfen der PV-Branche weltweit in Kontakt zu treten und sich zu vernetzen, darunter mit Experten aus Wissenschaft, Industrie, Finanzwesen und Politik. Das wissenschaftliche Programm deckt ein breites Spektrum an PV-Themen ab, wie Siliziumzellen, Dünnschichten, PV-Systemtechnik und Anwendungen wie Gebäudeintegrierte PV, Agri-PV und schwimmende PV. Darüber hinaus umfasst die Konferenz parallele Veranstaltungen, die einen tieferen Einblick in spezifische Themen bieten. Durch die Teilnahme an der EUPVSEC können sich die Teilnehmer über die neuesten Entwicklungen im Bereich der erneuerbaren Energien auf dem Laufenden halten und sich über die aktuellen Bemühungen informieren, um mit Hilfe von PV-Technologien eine fossilfreie Landwirtschaft zu erreichen.



Bild 1:  
AgroFossilFree  
Präsentation:  
EUPVSEC 2022

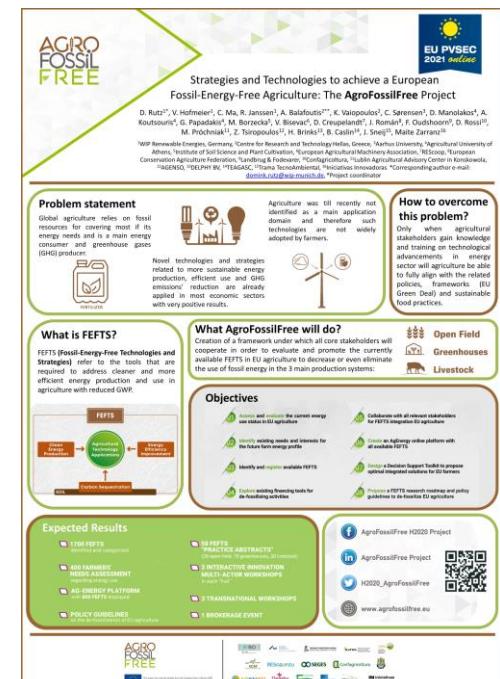


Bild 2: AgroFossilFree Poster: EUPVSEC 2021

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**Autoren:** Chuan Ma, Dominik Rutz (WIP Renewable Energies)

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