Promoting the penetration of agrobiomass in European rural areas

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D2.4 The AgroBioHeat innovative initiatives on disrupting agrobiomass heating

Lead Beneficiary: CIRCE

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Abbreviations

Abbreviation	Explanation
CATI	Computer Assisted Telephone Interview

Project consortium

#	Full name	Acronym
1	Ethniko Kentro Erevnas kai Technologikis Anaptyxis	CERTH
2	Fundación Centro de Investigación de Recursos y Consumos Energéticos	CIRCE
3	Asociación Española de la Valorización Energética de la Biomasa	AVEBIOM
4	BIOS BIOENERGIESYSTEME GmbH	BIOS
5	Food & Bio Cluster Denmark	FBCD
6	Bioenergy Europe	B.E.
7	Zelena energetska zadruga za usluge	ZEZ
8	Asociatia Green Energy	GEA
9	Institouto Agrotikis kai Synetairistikis Oikonomias INASO-PASEGES	INASO-PASEGES
10	Bioenergy Association of Ukraine	UABIO
11	White Research Sprl	W.R.
12	Agronergy	AGRONERGY
13	Association d'Initiatives Locales pour l'Energie et l'Environnement	AILE

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Executive Summary

This document presents the initiatives that have been accompanied throughout the project. Specifically, the countries involved in the project are Croatia, Greece, Romania, Spain and Ukraine. Within each of these countries, in one of the previous tasks of the project, a process of identification and selection of the initiatives has been carried out, which finally have resulted in the selection of the initiatives here presented:

- Croatia / J.T. Energy – production of agropellets from olive pomace and olive tree prunings
- France / Ecole des Roches – use of alternative woody biomass at an existing biomass boiler
- Greece / VAENI Agricultural Cooperative & Naoussa Municipality – use of vineyard prunings for heating of municipal swimming pool
- Romania / Bretcu Commune – use of various agrobiomass fractions for heating municipal buildings through district heating
- Romania / Solfarm Ltd – use of various agrobiomass fractions for heating the installations of an agro-industry
- Spain / Sudanell – use of fruit tree prunings for heating households and agro-industries
- Spain / EVE & Rioja Alavesa – use of vineyard prunings and vinestocks for heating a winery
- Spain / Athisa Biogeneration & Ribera del Duero – use of vineyard prunings as an alternative fuel in an existing biomass district heating system
- Spain / CITA – development of a new agrobiomass boiler testing facility
- Ukraine / Kherson – production of new agrobiomass fuels from reed management
- Ukraine / Odessa – use of sunflower husk pellets for heating of municipal schools

These initiatives are briefly described in the present document, focusing on a global overview so that the reader can get a general idea of which are the initiatives that have been promoted thanks to the AgroBioHeat project, how the supported actions have helped the initiatives to mature, which are the targeted agrobiomasses in each initiative, and what are the innovations or relevance of the initiative.

Finally, for each one of the initiatives the next steps that should be taken into account and the conclusions / final remarks that have been acquired during the accompaniments are presented.

Introduction

The AgroBioHeat project consortium would like to introduce the innovative initiatives that have been accompanied during the development of the project. These initiatives have been identified and selected through a democratic and fair procedure implemented in a previous stage of the project. A key selection criterion was the possibility of the initiative coming to fruition, and thus generating a greater potential for replicability, and consequently being able to promote the use of agrobiomass in the heating and thermal sector.

The selected initiatives try to cover a wide spectrum of innovations, and consist of different innovations and support actions, such as installation of boilers, development of logistic and supply chains, building of facilities or processing operations.

The task is organized in three subtasks, in order to provide the best quality accompaniments possible. The first subtask was the preparation of the accompaniment – by preparing some examples of accompaniment plans, guidelines, and the performance of the Computer Assisted Telephone Interview (CATI) surveys in order to know better the local reality. The second stage consisted in the definition and agreement of the actions plans with the local partners. Finally, the third stage includes the effective accompaniment of the initiatives. In this document, the result of the accompaniments in all the selected initiatives is presented.

1. Croatia / J.T. Energy

1.1. Summary of the accompaniment

The icebreaker initiative is located in Istrian County, near the city of Pula. Its goal is to build an **olive oil by-product press** thus minimizing the management problem of these by-products. This solution also allows to **produce agrobiopellets**. Their final product, HDPS – Hydraulic Drying Press System – can be used as a main resource for sustainable energy production. The company started the **construction of the site** in September 2021. The realization of the **pellet plant** is planned for the end of June 2022.

Figure 1. Istrian county location in Croatia

During the construction, and since the techno-financial plan is already developed by the company, ZEZ is helping initiative via **social and promotional support** such as promoting the project (fairs, TV shows, interviews, promo materials, promotion video, etc.), help engaging and identifying potential new end-users and new financial schemes.

Table 1. Summary of the pellet production in Croatia

Agrobiomass producer of agropellets in Croatia	
Application	The pellet production plant of agropellets on olive pomace and vineyard prunings residues for residential and commercial heating
Technology (developed by them)	HDPS (Hydraulic Drying Press System)
Pellet plant capacity	2,000 t/year with increase to 7,000 t/y
Targeted biomass boiler capacity	500 kW – 1000 kW
Agrobiomass fuel	Olive pomace, olive tree prunings
Agrobiomass fuel consumption	~ 280 t/y
Investement (their own capital + green credit loan)	~ 1,000,000 €

1.2. Main innovations and relevance of the initiative

The main innovations provided by the initiative are the following:

- First producer of agropellets from olive pomace and olive tree residues in Croatia. Technology dries materials with a high moisture content in a short time.
- Have developed their own technology HDPS (hydraulic drying press system), which can be modified to different types of agrobiomass.

- The ash residuals after incineration are around 2%.
- Creating local economy by collaborating with 14 olive mills which provide initiative with the agrobiomass.

1.3. Type of agrobiomass targeted by the initiative

City of Vodnjan, located in the south of Istria County as well as other cities in the region have a strong tradition of wine growing, olive growing and tourism. Agricultural production results in a significant number of **olive pomace** and **vineyard pruning by-products**, thus becoming an energy potential as a raw material in the production process. J.T. Energy d.o.o. discovered an opportunity here and developed HDPS technology which today produces agropellets from olive pomace and pruning residues for heating.

1.4. Main expected benefits

- Raw material sufficiency is secured for the next 9 years via signed contracts with local oil mills, thus creating a waste management income
- The company has already established an Italian distributor for finished products
- Biowaste management
- Residues used as a raw material in another production process (LCA)
- The initiative started as an idea to develop a technology which can be used to reuse locally available waste and make a product out of it for heating
- Green jobs created
- Rural development

1.5. AgroBioHeat support actions

The actions in which the project has supported the initiative are the following:

- Two consultation workshops – one at the beginning to identify obstacles and prepare a plan for promotion and dissemination of the icebreaker initiative. The second one was to assess previous plans and plan future support activities which could further present the initiative to a wider audience. Such as preparing promo materials, interviews, identifying and connecting with potential end-users, site-visit assessment for production of video, etc.
- Prepared and disseminated Icebreaker factsheet
- Conducted CATI survey in Istria region
- Mapp and identify potential end-new users
- Conducted meetings with relevant stakeholders in the area

1.6. Next steps and replication

Due to COVID-19, construction of the pellet plant has been delayed for a couple of months and it is anticipated to be done during the last month of the project, June 2022 (M42). However, as their

technology is already developed, it could be sold and/or further modified to **produce pellets from other agricultural crops** by-products, depending on the region and agrobiomass type. For example, facilities like in the Slavonia region in Croatia could make pellets from rapeseed pomace if the HDPS technology is modified.

Besides pellets, **HDPS can produce other products**: briquettes, animal feed, biomass and muck. Also, the technology isn't limited to olive pomace and can use **more types of the by-products**, such as grape pomace and beer production by-products.

1.7. Conclusions & final remarks

Since the main identified barriers in the area of the icebreaker initiative were lack of transparency and available information as well as the lack of technical know-how, **the strategy of the action plan has been focused on providing all available information to interested parties** (end-users, local authorities and energy institutes in the surrounding area). Additionally, to prevent another important barrier, plausible political complications, **ZEZ has also communicated with the local government**. Lack of residents' involvement in the decision-making process will try to be resolved by presenting the initiative to the local community, and probable skepticism of the community will be resolved by further education and promotion of the initiative in collaboration with initiative and local authorities.

2. France / Ecole de Roches

2.1. Summary of the accompaniment

The accompaniment action was to demonstrate the actual possibilities for realistic penetration that agrobiomass could achieve in small and medium scale heating applications. We gathered key stakeholders in order to show them a real-life example of agrobiomass usage in an existing facility.

2.2. Main innovations and relevance of the initiative

This project can influence its area by **demonstrating the usage of alternative biomass in an existing facility**. The Ecole des Roches site is used on a daily basis by more than 600 students, and includes a swimming pools and several housing buildings.

2.3. Type of agrobiomass targeted by the initiative

The agrobiomass used is a mix of **pruning wood**, **stump wood** and **local forestry woodchips**. It is relevant because it is locally produced, within 20 km from the facility.

2.4. Main expected benefits

Benefits obtained by the project beneficiaries by the use of the agrobiomass are:

- Economic savings due to the moderate cost of biomass, as well as the stability of the energy source, uncorrelated with fossil fuels
- Avoided CO2 emissions thanks to a mix of more than 80% renewable sources
- Social benefits, thanks to raising the awareness o the students about the use of alternative fuels

2.5. AgroBioHeat support actions

A workshop was conducted that involved more than 20 local stakeholders, coming from the neighboring Britany and Normandy regions. The participants included political decision makers, forestry and roadside hedging managers, heating providers, and general heating technicians that wanted to see the results of the project.

2.6. Next steps and replication

We expect that a number of the stakeholders that visited the project will develop similar projects in the future, since the agrobiomass resource is wildly available, and the technical solutions have proven to be working well.

2.7. Conclusions & final remarks

Technical solution is the first step but is not sufficient. Good communication is the second step to deploy a virtuous, positive solution.

3. Greece / VAENI Cooperative & Naoussa Municipality

3.1. Summary of the accompaniment

The initiative supported in Greece links two local actors in the **Naoussa wine growing area of Northern Greece**: the local municipal authorities and the VAENI agricultural cooperative. The core concept revolves around the **valorisation of a locally produced agricultural residue** – vineyard prunings – and its **transformation from a "waste"** that the farmers want to dispose quickly **to a valuable renewable energy resource**.

Figure 2. Naoussa situation in Greece

Initial investigations about the bioenergy potential of vineyard prunings in the Naoussa were implemented together with VAENI[1] in a previous EU funded project – uP_running[2]. Through the actions of AgroBioHeat, the Greek partners CERTH and INASO-PASEGES aimed to **support the development of a bioenergy value chain** based on **vineyard prunings** and aiming to cover the heating demands of major local consumer: the Municipal Swimming Pool. With the conclusion of the project, specific proposals and recommendations for implementing the project were brought to the attention of the local stakeholders which, if implemented, can provide concrete economic and environmental benefits, while also serving as a pioneering example for imitation regarding agrobiomass valorisation in Greece and abroad.

Table 2: Overview of the supported initiative in Naoussa, Greece

Supported initiative: Agrobiomass heating at Naoussa Municipal Swimming Pool	
Application	Heating of municipal swimming pool (1 Olympic-sized pool + 1 training pool for children)
Current heating system	2 heating oil boilers (~ 1,700 kW total)
Current fossil fuel consumption	> 115,000 lt/y heating oil
Targeted biomass boiler capacity	500 kW (downsized to match heat demand profile)
Targeted agrobiomass fuel	Vineyard prunings (chips), sourced from local farmers
Expected agrobiomass fuel consumption	~ 280 t/y
Expected CO_2 savings	> 303 t/y

[1] https://www.youtube.com/watch?v=LiK9uJ9k7sc & https://www.vaeni-naoussa.com/blog/109-epideiktiki-drasi-diacheirisis-kladematon-apo-kalliergeies-ampelion
[2] https://www.up-running.eu/

3.2. Main innovations and relevance of the initiative

The valorisation of vineyard prunings for heat production on the local heat level has been implemented in several projects in Europe. A fairly well-known example is that of the municipality of **Vilafranca del Penedès**[3] in Spain which – through the assistance of the LIFE project Vineyards4heat[4] – implemented a new value chain for the prunings of the local vineyard and their use in a local district heating system that serves several municipal buildings. However, such initiatives remain very few in number in comparison with the biomass potential from the vineyard prunings in Europe.

Agricultural prunings from vineyards, olive groves and fruit orchards represent a significant biomass potential in Greece. However, there are almost no existing success cases for their use for energy production.

In this sense, the initiative of the Municipality of Naoussa and the VAENI Cooperative has the potential to evolve into a real "icebreaker" for the Greek agrobiomass sector: by replicating an existing model that has proven to work in Europe, it covers local energy demands with local, renewable energy sources and can demonstrate that the agrobiomass heating concept can also be applied to Greek conditions.

3.3. Type of agrobiomass targeted by the initiative

The targeted agrobiomass for the Greek initiative is **vineyard prunings** in the form of chips.

Previous studies indicate the the vineyards are quite **vigorous**. In particular, **up to 1,200 tons of vineyard prunings** are generated annually out of the around 550 hectares of vineyards in cultivation. This volume of material is enough to supply a number of local heating applications.

After cutting, vineyard prunings can be left by the farmers on the side of the field to dry naturally. It is then fairly easy to process them on the field site with mobile chippers, producing a solid biofuel with high calorific value and with a granulometry that allows its direct use in appropriate biomass heating systems.

3.4. Main expected benefits

The installation of an agrobiomass boiler fuelled by vineyard prunings at the Municipal Swimming Pool of Naoussa is expected to yield several benefits, both economic and environmental.

The **economic benefits** are clear and immediate: the swimming pool is currently consuming an excess of 100,000 litres of heating oil per year. The annual heating costs are significant and are only expected to increase with rising fossil fuel prices. Provided that a biomass supply using locally sourced vineyard pruning

[3] https://agrobioheat.eu/vilafranca-del-penedes-visit/
[4] https://vineyards4heat.eu/

chips is established, the **annual heating costs are expected to be reduced by more than 80 %,** leading to a very quick payback time for the investment in a new biomass boiler.

On the **environmental side**, the substitution of heating oil with a renewable biomass fuel is expected to lead to a decrease of around 280 tons of CO_2 per year. In addition, the controlled combustion of prunings in a modern biomass boiler equipped with suitable antipollution control measures and devices can lead to a decrease of air pollution in comparison with the uncontrolled combustion of agricultural residues in open fires.

3.5. AgroBioHeat support actions

The AgroBioHeat partners from Greece, INASO-PASEGES and CERTH, supported the emerging initiative in the Naoussa area through the following actions:

- Organizing a visit at the existing success of at Vilafranca del Penedès[5].
- Gauging public awareness and perception of the benefits offered by agrobiomass heating through a local telephone.
- Implementing a short supply chain demonstration, through the collection and chipping of around 500 kg of dried prunings from local vineyards.
- Validating the compatibility of the vineyard pruning chips in a modern biomass boiler system.

Figure 4: Demonstration of vineyard pruning chipping in Naoussa. Source: AgroBioHeat project

3.6. Next steps and replication

The AgroBioHeat support has allowed this initiative to mature till a very advanced stage. As of June 2022, a new (agro)biomass boiler has not yet been implemented since one critical aspect remains to be solved: **funding**. Switching to agrobiomass heating totally makes economic sense for the swimming pool, since the heating costs are very high throughout the year. However, it is also true that the capital cost for the investment in a new agrobiomass boiler can be quite high and this can be a bottleneck for municipalities in Greece and elsewhere. If own funds are not available, there are other possible ways for support this investment: **suitable public support schemes** for renewable energy investments, which can partially

[5] https://agrobioheat.eu/vilafranca-del-penedes-visit/

subsidize the investment cost, or implementation through the **ESCO (Energy Service Company) model**, through which a specialized company implements the investment and undertakes all aspects of boiler operation (e.g. fuel supply, maintenance, etc.) while the end-user reaps only the benefits in terms of a reduced heating bill. The AgroBioHeat partners have briefed the local actors on these options, and it is up to the municipal authorities to make the best decision using the data made available through AgroBioHeat.

The AgroBioHeat partners see an **excellent potential for replicating aspects of this initiative in other wine growing areas** of Greece, Europe or the wider world. Greece has a very dynamic wine sector with several PDO areas. Sustainability in the agro-food sector is growing in importance. On the other hand, rising costs of fossil fuels are prompting local energy consumers to find low-cost alternatives. The concept of using local agrobiomass resources to cover local energy demands is expected to grow in importance. Already, the Greek AgroBioHeat partners, have been in contact with agricultural cooperatives, wineries and other actors, offering some first support and suggestions for using vineyard prunings as a heating fuel.

3.7. Conclusions & final remarks

The initiative supported by the AgroBioHeat project in Naoussa, Greece is a prime example of the benefits as well as the challenges associated with the implementation of agrobiomass heating projects. It is a case that makes both economic and environmental sense and one that connects a local energy resource with a local energy demand. However, the organization aspects and the creation of a vision require significant time and efforts. Moreover, the higher upfront investments in a modern and efficient biomass boiler system may be a limiting factor, especially for end-users that have limited financial means at their disposal. This naturally leads to two specific recommendations: **enhance the dissemination / knowledge transfer** of existing success cases and positive results so that the seeds for more similar initiatives are planted and **provide suitable funding instruments or business models** for facilitating the planned investments to materialize.

As an additional final note, it is very interesting to note that **sport facilities with swimming pools are excellent choices for the implementation of biomass heating systems**. Swimming pools have large and quite constant heat demands throughout the year, meaning that a quick payback time for the investments in biomass boilers can be achieved.

4. Romania / Bretcu Commune

4.1. Summary of the accompaniment

Bretcu Commune is a commune in Covasna County in Romania close the Carpathian Mountain region. The commune has submitted a project proposal for investment in POIM 6.1 public call, aiming the establishment of local agrobiomass supply value chain and construction of 2 agrobiomass based heating plants in Bretcu.

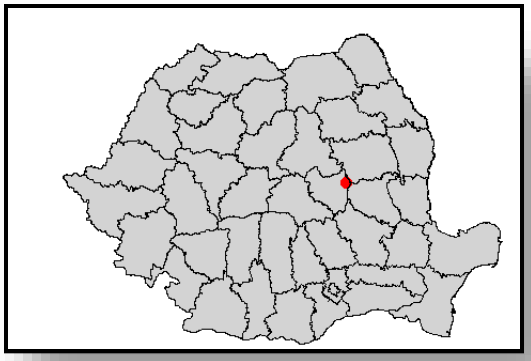

Figure 5. Bretcu commune location in Romania

In the accompanying actions the icebreaker entity was involved in several actions, such as meeting with technology providers, agrobiomass producers but also with policy makers in order to develop a well-analysed and mature project for agrobiomass to energy. The municipality expressed its willingness to participate and be mentored in this path while many times new information and aspects were discovered which could be later on barrier or issue in the implementation phase.

Table 3. Overview of the supported initiative in Bretcu, Romania

Agrobiomass heating at Public Buildings in Bretcu Municipality	
Application	1. Comenius School, Sports Hall, Kindergarten 2. Mayoralty, Kindergarten, Cultural Center
Current heating system	1. 4 natural gas boilers (520 kW total) 2. 3 natural gas boilers and 1 firewood boiler (460 kW total)
Current fossil fuel consumption	> 1,476 MWh/y natural gas
Targeted biomass boiler capacity	1x500 kW (5% lower demand) 1x500 kW (8% over the present demand)
Agrobiomass fuel	Energy Willow and Mountain Pasture Cleaning (chips)
Agrobiomass fuel consumption	~ 500 t/y
CO_2 savings	> 540 t/y

4.2. Main innovations and relevance of the initiative

The main innovation aspect can be identified in role of **social innovations for transitions in the energy field.** The new energy policy approach initiated by the Municipality of Bretcu, namely to turn from centralized energy supply and based on national natural gas distribution system to d**ecentralized energy supply** need multiple social involvement on local level. The bioenergy innovations, by its technology innovation are **helping to provide rural areas with sustainable, renewable energy and alternatives to fossil energy sources.**

4.3. Type of agrobiomass targeted by the initiative

The agrobiomass that in Bretcu Commune will use the **residues from the cleaning of mountain pastures** as well as **chips of energy willow and agrobiomass.**

4.4. Main expected benefits

Benefits obtained by the project beneficiaries by the use of the agrobiomass:

- Economic savings up to 65% in case of Bretcu Municipality compared to natural gas based heating solution (considering the energy prices from 2021).
- Avoided CO_2 emissions up to 404 t CO_2 eq/yr at Bretcu Municipality.
- 2000 MWh_{th}/yr fossil fuel quantity substitution at Bretcu Municipality .

4.5. AgroBioHeat support actions

Different activities took place during the accompaniment of the project. CATI surveys, consultation workshops with relevant decision makers met and discussed about technical, economic, environmental, energy management or other aspects. Meetings were held, where different technical issues were discussed. All these actions are gathered in Table 4.

Table 4. AgroBioHeat support actions in Bretcu initiative

Action at Bretcu Municipality	Expected outcome at Bretcu Municipality
CATI survey	Discover the state-of-the-art of social perception
Consultation workshop	Engagement among the involvement stakeholders
Site visits / technical meetings	1 -2 Visits were organized in Bretcu Commune.
Value-chain analysis/techno-economic analysis, technical assessment	Cost-Benefit Assessment on harvestable agrobiomass residuals
Mapping of potential stakeholders/ end-users/ markets	Identification and engagement of relevant stakeholders, consultancy company for project development, technology providers
Mobilization of suppliers and/or technology providers	Identification and engagement of relevant stakeholders, involvement of 2 technology providers
Stakeholder involvement for local agrobiomass value chain establishment	Support on stakeholder involvement the business model creation,
Lobby and advocacy actions with local policy actors	Involvement of local mayor and policy maker, advocacy activity

4.6. Next steps and replication

The main challenge in replication process is to explain and penetrate the concept of energy self-sufficiency by valorisation of local or regional biomass and agrobiomass residuals for local decision makers. This activity, in some cases are slowed down because the local decision makers and key stakeholders are changing after the elections in each 4 years. In order to be more attractive and **understandable, the rural municipality Bretcu should organize site visits by invitation of the most** relevant stakeholders and organize site visits to make the **concepts transparent and easy to understand** as well as to highlight key facts and figures in order to **raise awareness and interest** of local and regional authorities and policy makers.

The **agrobiomass potential is high** at rural settlements, only in the Carpathian Mountain region there are over 500 rural municipalities with extended mountain pasture lands, as Bretcu has. Over 750 municipalities have **significant orchard and vineyard plantation**s in Romania, while over 1500 rural municipalities have at least 5000 ha agriculture lands with **over 1000 cubic meter agrobiomass by-products**.

4.7. Conclusions & final remarks

In Romania, we still experiencing a general **lack of information on biomass** and more specifically about **agrobiomass resources to energy**. Since the agrobiomass technologies are not well-penetrated on local level, in many cases the **engagement process is also slower**. In certain regions or micro-regions of Romania, even if the agrobiomass availability is significant, the valorisation of these materials is missing or is not efficiently developed.

In the previous Romanian Rural Development Strategy for 2014-2020, there was no chapter on the valorisation of agricultural residuals with circular economy principles. There was no financial support for waste-to-energy projects in agriculture. All in all, in the last decade, Rom**ania experienced major investments** in modernization of agricultural technologies and infrastructure aiming the development of production capacities and performance. In next period, Romania needs to launch **supportive measures for the development of agrobiomass to energy value chains** and encourage the rural stakeholders to become energy self-sufficient by establishment of local energy communities, agrobiomass value chains, and agrobiomass to energy capacities.

In Romania, there are specific regions where agrobiomass is available. In these regions a **real penetration is possible** if we have lighthouse cases/icebreakers. In between the game is changing, the energy costs dramatically increased, therefore the **private sector is strongly focusing on alternative ways to cover their energy and power demand**. The last significant aspect was before the decision that this agrobiomass could be used in a biomass boiler without technical issues, ash production, emission constrains, etc.

5. Romania / Solfarm Ltd

5.1. Summary of the accompaniment

Solfarm Ltd is a private company dealing with production of potato, grain, corn and rapeseed. The company is located about 20 km to the north from Brasov and about 10 km from Sfantu Gheorghe town in Brasov Depression. The company owns a storage and packaging industrial hall up to 1000 sqm, where space heating is needed.

The company intends to invest in an agrobiomass heating system by own financial capital. The local biomass supply chain must be settled up. The company has its own agricultural residues, but it must procure machines for biomass chipping. Until the own supply chain will be developed, other local biomass sources will be used such as biomass from SRCs as biomass fuel.

Figure 6. Brasov location in Romania

Table 5. Overview of the Solfarm supported initiative in Romania

Agrobiomass heating at Public Buildings in Solfarm	
Application	Industrial Hall over 1000 sqm
Former heating system	New investment
Current fossil fuel consumption	-
Targeted biomass boiler capacity	1x200 kW
Agrobiomass fuel	Orchard Pruning and agriculture residuals
Agrobiomass fuel consumption	~ 100 t/y
CO_2 savings	> 100 t/y

5.2. Main innovations and relevance of the initiative

In Romanian agriculture sector the residuals are considered as waste or organic materials for humus production on the fields. The present project aimed to explore the **opportunities for energy generation** through biomass resources and support the icebreakers towards **investments to become energy self-sufficient**. The main innovations are focusing on **technology innovations**, by presentation of non-conventional equipment for farmers and local stakeholders, **energy production technologies**, **agricultural**

resource management approaches for energy production, and **sustainable business models** and which led its communities to explore the possibilities for innovative agriculture initiatives.

5.3. Type of agrobiomass targeted by the initiative

The agrobiomass that Solfarm used as the main input material for energy production are **orchard prunings**, **straw** and **corn stalks** in chipped form.

5.4. Main expected benefits

Benefits obtained by the project beneficiaries using the agrobiomass:

- economic savings up to 60% in case of Solfarm compared to natural gas-based heating solution (considering the energy prices from 2021),
- avoided CO_2 emissions up to 80 t CO_2 eq/yr at Solfarm company,
- 400 MWh_{th}/yr fossil fuel quantity substitution at Solfarm company,

5.5. AgroBioHeat support actions

Different activities took place during the accompaniment of the project. CATI surveys, consultation workshops with relevant decision makers met and discussed about technical, economic, environmental, energy management or other aspects. Meetings were held, where different technical issues were discussed. All these actions are gathered in Table 6

Table 6. AgroBioHeat support actions in Solfarm initiative

Actions at Solfarm	Expected outcome at Solfarm
CATI survey	Discover the state-of-the-art of social perception
Consultation workshop	Engagement among the involvement stakeholders
Site visits / technical meetings	1 -2 Visits were organized in Bretcu Commune.
Value-chain analysis/techno-economic analysis, technical assessment	Cost-Benefit Assessment on harvestable agrobiomass residuals
Mapping of potential stakeholders/ end-users/ markets	Identification and engagement of relevant stakeholders, consultancy company for project development, technology providers
Mobilization of suppliers and/or technology providers	Identification and engagement of relevant stakeholders, involvement of 2 technology providers
Development of business models	Support on stakeholder involvement the business model creation,
Lobby and advocacy actions with local policy actors	Involvement of local mayor and policy maker, advocacy activity

5.6. Next steps and replication

The main challenge in replication process is to **explain and penetrate the concept of circular economy** by valorisation of local agrobiomass residuals. In order to be more attractive and understandable, for the farms and companies in rural Romania the Solfarm company should pay more attention of its green

marketing by showing their **green energy supply** by highlighting of key facts and figures from AgroBioHeat to energy investment.

The **agrobiomass potential is high** at medium and big size farms. Not only farms but also agri-food industry is characterized by high energy demand in technology. Due to the present energy crisis, the rural SMEs are strongly focusing on how to mitigate their energy expenses. In this term, the **actual shock on energy market** will provide **major benefits for renewable energy technologies**.

5.7. Conclusions & final remarks

In the near future we are expecting a more open mind attitude from the companies and other entities who were involved into the AgroBioHeat project activities to **identify financial sources** and **technical solutions** for **agrobiomass to energy projects**. The best way to attract stakeholders from rural areas, agriculture and agri-food sectors is to **provide best practice examples with highlighting economic benefits and long-term solutions for own energy supply.**

Figure 7. Solfarm initiative meeting with AgroBioHeat Romanian partners

6. Spain / Sudanell

6.1. Summary of the accompaniment

Sudanell is a locality in the province of Lerida, in Spain. One of their economic drivers is the agriculture, particularly **fruit tree crops**. Consequently, the amount of some agricultural by-products, such as agrarian pruning and plantation removal, are produced in great amounts after each season. A local pioneer (an agricultural service company of a self-employed person), who had to face this issue, aimed **to valorise this by-product to energy**. This was the starting point of this icebreaker initiative.

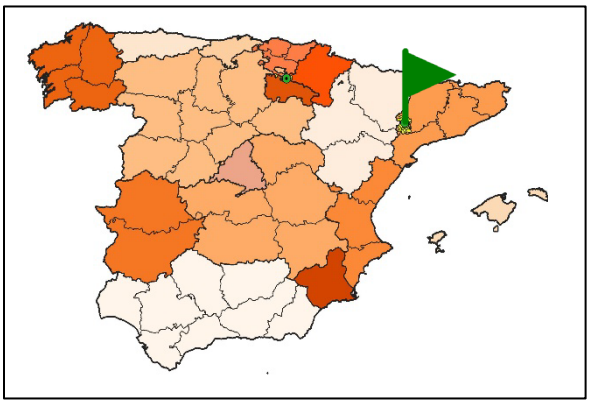

Figure 8. Sudanell location in Spain

An agreement was reached between the local pioneer, a boiler manufacturer, an installer and a machinery manufacturer, after Expobiomasa Fair in Spain (September 2019) and meeting and conversations with AgroBioHeat to install a pilot boiler (75 kW) at the pioneer household.

This is the very first installation of this type in Spain. **The boiler was installed at the beginning of 2020 and it is already in operation.**

Table 7. Overview of the Sudanell supported initiative in Spain

Agrobiomass heating at Sudanell, Lérida, Spain	
Application	Household heating – Local agroindustries heating (in the future)
Current heating system	1 heating oil boiler
Current fossil fuel consumption	~ 10. 000 lt/y heating oil
Targeted biomass boiler capacity	90 kW
Agrobiomass fuel	Fruit tree prunings (hogfuel)
Agrobiomass fuel consumption	~ 25 ton biomass / y
CO_2 savings	~30 t/y

6.2. Main innovations and relevance of the initiative

This project responds to a problematic in a traditionally agricultural area: the management of the by-products and residues of the prunings and tree removals. The **huge potential of this agrobiomass** available can support the **creation of short value and supply chains** to produce heat in a local, sustainable and environmentally friendly way.
The main innovation is the use of fruit tree prunings and removals to **produce heat in a commercial boiler**, with good emission values. It can be really relevant thanks to the availability of this biomass in the area. The **management of these resources** is also innovative, untrailed in order to avoid the introduction of exogenous materials to the boiler, thus improving the heat production and decreasing the ash generation.

6.3. Type of agrobiomass targeted by the initiative

The boiler is currently being fed with **fruit tree prunings and tree removals**, available from the pioneer crops and orchards. This agrobiomass is **chipped *in-situ* and stored** until its fed to the boiler. The huge availability of this biomass in the area is the main reason for its selection for the project.

6.4. Main expected benefits

From an economical point of view, **cheap fuels and independency** of the global market are achieved. The installation of one of these boilers can provide a return of the interest of about 6-7 years, even lower with current fossil fuel prices.

From an environmental point of view, almost **30 tons of CO_2 emissions are avoided**, resulting on a huge impact. If the initiative can be replicated in the area, even in bigger scales, the avoided CO_2 emissions will be much higher. These sustainable management and circular approach will also **avoid the field burnings**, that pose fire hazards for the environment as well.

In a social perspective, a successful initiative can **help the sector with well identified problems**, such as wrong perspectives about its suitability and beneficial effects. It can also serve as **a lever for other similar projects**, providing a new **success story** and encouraging other actors to carry out their initiatives.

6.5. AgroBioHeat support actions

The AgroBioHeat Spanish partners supported the initiative through the following actions:

- Performing a CATI survey, obtaining the perspectives of the general public in the area.
- Organizing a workshop and a field demo, in order to obtain the perspectives of the local actors, contrasting the data with that of the CATI survey, and showing them that these types of projects are feasible.
- Preparing a video to show the initiative in a short, simple, modern and effective way.
- Performing technical consultancy tasks, such as fuel analysis or drying and storage solutions.
- Carrying out fundraising and replication opportunities.

6.6. Next steps and replication

This project has **huge replication potential**, as it has been commented in previous lines, there is a very **high availability of this type of fuels in the area**. The region is a traditional fruit tree harvesting area, so the potential amounts to be disposed in similar type of projects is very promising. The next steps to take in order to achieve a wide replication and uptake of these fuels would be to **promote the initiative** even more, by taking part in events and fairs, **spreading out the produced video** and by word-of-mouth, which is really effective in these sectors. Setting up a successful deployment of a value chain can pose a positive example and a lighthouse to follow in the case of larger agro-industries, municipalities, etc.

6.7. Conclusions & final remarks

The Sudanell accompanied initiative, one of the four supported by the AgroBioHeat project in Spain, is a **great example of the benefits associated to the use and disposal of locally produced agrobiomass**. The organization aspects were clear from the point of view of the pioneer but needed specifical technical consultancy in certain activities such as characterization of the agrobiomass or drying and storage of it. The main problem he faced was the financing opportunities, so help was also provided in this sense.

The recommendations that arise from this accompaniment can be summarized in two basic lines: enhance the **dissemination and visibility of the initiative**, in order to provoke the replication of it; **and obtain suitable funding** to purchase certain processing equipment that can help stablish a more efficient supply chain.

As a final note, it is very relevant to try to achieve the **involvement of municipalities and public institutions**, so that can also lever the uptake of agrobiomass as a heating fuel, especially in rural areas.

7. Spain / EVE & Rioja Alavesa

7.1. Summary of the accompaniment

The Basque Land Energy Agency (EVE) is a **public energy agency promoting a new pilot facility** in Rioja Alavesa winemaking area (more than 13,500 ha of vineyards) which belongs to the Rioja PDO. EVE has performed steps on the **study of feasibility and awareness raising** already since 2018. Through AgroBioHeat the efforts have been placed to support technically EVE when **establishing the pilot**, initially for a district heating initiative, and finally at a winery to provide renewable heating. AgroBioHeat has assisted EVE and interacted with local actors especially in the issues related to logistics.

Figure 9. Situation of Rioja Alavesa in Spain

Table 8. Overview of the EVE/Rioja Alavesa supported initiative in Spain

	Agrobiomass heating at Rioja Alavesa Winery
Application	Hot water and heating for the facilities and processes at a winery
Current heating system	1 heating oil boiler
Current fossil fuel consumption	> 55,000 lt/y heating oil
Targeted biomass boiler capacity	500 kW (oversized; could supply heat for activating cooling system)
Agrobiomass fuel	Vineyard pruning and vinestock (hogfuel)
Agrobiomass fuel consumption	~ 120 t/y
CO_2 savings	> 115 t/y

7.2. Main innovations and relevance of the initiative

The initiative is about to trigger the **first case of vineyard pruning and uprooted vine stock use for bioenergy** in a winery in the area. The consumption will be based only in **part of the annual amount of residues produced**. Therefore, once established the initial logistics **other local potential users could decide to switch to agrobiomass**. Furthermore, the **replication potential** in La Rioja PDO (40.000 ha) and rest of Spanish and EU vineyards **is huge**, as it would provide another key example on how to make real use.

7.3. Type of agrobiomass targeted by the initiative

The intent is to solve the **vineyard woody field** residues issue. This material is usually burnt on the open air, or mulched. However, the official advisors and multiple wineries and farmers understand the incorporation to soil is a potential threat as it is a vector for expanding fungal diseases.

7.4. Main expected benefits

The principal benefit for the whole area is the **reduction of pollutants**, the **improvement in air quality** and the **branding of the best practice**. Winery sited at *el Campillar* is very interested to account the CO_2 reductions involved and brand the good practice. In economic terms the facility started with a payback time of 10 years, though after the changes in fuel and energy prices during 2021 and 2022 the conditions are more favorable to shorten the payback.

The summary data for the initiative is presented in Table 8. There, it is summarized the **fossil fuel consumption avoided** as well as the **eq. tons of CO_2 saved**. The reduction of pollutants is as well a benefit for the area as the combustion of pruning and vine stock is being carried under controlled conditions, which benefits for reduced amount of emission of pollutants.

Another benefit is the **saving at agronomics** as the winery is not anymore involved in the management of permits to execute the fire to dispose the pruning, and the release of the work to perform and control the fires in the scattered fields in the area.

7.5. AgroBioHeat support actions

EVE has been the organization in charge of promoting the icebreaker initiative, and align the interests of all actors involved. AgroBioHeat accompanied the initiative through EVE, when required to cover gaps of knowledge or to provide insights. The actions performed in the accompaniment are as next:

- Understanding of the options and support in review logistics options and costs
- Invited to the Visit – Show Case at Vilafranca el Penedés
- CATI survey to detect population perceptions, barriers and drivers
- Visiting to discuss the supply systems and economics for the case of pruning supply to the heating system in the winery. Preparation of a summary report
- Support to include the facility into the scheme for Carbon Fund for a Sustainable Economy
- Technical assistance on vine stock supply: alternatives to provide it with sufficient quality
- Review cost for the alternative supply from uprooted vine stocks
- Support for organizing the sampling of the material once shredded

As result of the accompaniment the process to **trigger a pilot in the area has been reinforced**.

Figure 10. Images from the EVE initiative

7.6. Next steps and replication

After AgroBioHeat finishes, the **boiler is to be installed and commissioned.** Then it will be object of **advertising as a local lighthouse**. The intent is to **expand the use of pruning and vine stock wood** in other wineries, local district heating, farms and agroindustry's, following the results of this lighthouse. The lighthouse can be replicated in the Rioja DPO, but it has as well a high potential for replication in other Spanish and European winemaking areas.

7.7. Conclusions & final remarks

The main lessons learnt from the accompaniment are:

- The technology to be utilized to feed inhomogeneous shredded vine stock and pruning wood as fuel require complex systems in the discharge, feeding and in the combustion system. The selection and robustness are crucial.
- The investment is high, and payback is not too short, given the fact that the boiler and civil works are expensive.
- Local users tend to understand the vine stock (and sometimes also pruning wood) is like forestry wood and can be utilized in the conventional woodchip boilers. They do not realise the increased amount of inorganics and stones, and the inhomogeneous particle size of the hog fuel in respect woodchips. This can lead and has led in the past, to unsuccessful initiatives.
- It is necessary for the winery or farmer to contribute by paying a fee to the final logistic operator to make the logistics feasible in terms of economics.
- The usual providers of services to wineries are a very appropriate actor to undertake the role of pruning collection or vine stock management. The pre-existing relation of confidence facilitates the agreement for the new practice.
- The lack of lighthouses is a barrier for replication. Starting a first lighthouse requires important efforts in the dialogue, alignment and decision making in the supply scheme, costs, money transfer and contracts.

8. Spain / Athisa Biogeneración & Ribera del Duero

8.1. Summary of the accompaniment

The accompaniment started already in 2019 with first contacts and the possibility to **trigger new value chains** of agricultural woody biomass in different areas of Spain. The objective has therefore been to bring support to Athisa Biogeneración, the main actor in this ice-breaker initiative, to **create confidence** and to **engage actors**, specially towards wineries in Rioja and Ribera del Duero PDO.

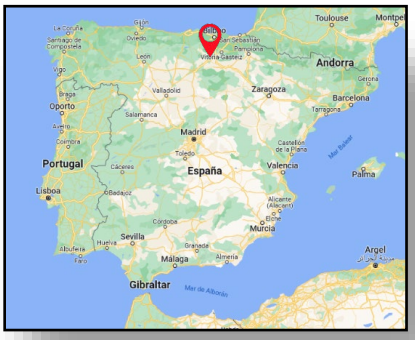

Figure 11. Location of Ribera del Duero in Spain

Table 9. Overview of the Athisa/Ribera del Duero supported initiative in Spain

Agrobiomass for district heating at Ribera del Duero	
Application	District heating
Current heating system	5.2 MW (winter) and 0.7MW (summer)
Current fuel consumption	2500 t woodchips
Agrobiomass fuel	Vineyard pruning (hogfuel)
Agrobiomass fuel consumption	Intended to reach 500 to 1000 t/yr (to be mixed with woodchips in order to ensure appropriate operation of the feeding systems)
CO_2 savings	320 – 640 t/yr (compared to Natural gas)

8.2. Main innovations and relevance of the initiative

Athisa Biogeneración has developed an innovation consisting in a **patented portable system** which perform a **cleaning of shredded wood** (pruning, uproots, stumps). The system **washes the shredded wood** and obtains a **material without stones** and **with low amount of inorganics** (about 3%). Athisa biogeneración provides services to biomass suppliers and power plants to clean their woody material on-site, thus reducing the costs.

This system applied in winemaking areas can open the opportunity to make **more suitable the use of vineyard pruning wood** (which after being hauled outside the field incorporates important amount of soil and stones, as high as 20%, which is not compatible with small and medium scale boilers).

8.3. Type of agrobiomass targeted by the initiative

The biomass to be utilized is **vineyard pruning**. The objective is twofold. On the one hand **avoid the open burning in open areas**, and on the second hand, to **decarbonize the winemaking sector** through bioenergy and bioeconomy based on pruning wood.

8.4. Main expected benefits

A straightforward benefit for wineries is a **reduction in the costs for managing the pruning**: they avoid the costs and time to obtain permits and manage the open fires to dispose it. They pay a small fee per hectare to an external company to gather the small piles. The idea is to valorize in already existing applications in the area, therefore contributing to savings in fossil fuels emissions. The pilot aims to trigger a new value chain, which could lead to important **reduction of CO_2 and local pollutants** and be a precursor for further promoting emissions savings in the Ribera del Duero PDO.

Another benefit for wineries is to **avoid the pruning integration into the soil** as it is a vector for fungal diseases dangerous for the vine health. As for the territory, the **air quality is improved** by **reducing the emission of pollutants** to the air. And as well it helps **diversifying the fuel supply** from forestry biomass, which is expanding in the region.

8.5. AgroBioHeat support actions

Athisa Biogeneración has carried an intense effort in developing their woody biomass cleaning system, and to find actors and market niches to their system in the last years. AgroBioHeat accompanied this pioneer in its intend to trigger new value chains on vineyard pruning and/or uproots, with a series of support actions:

- Invited to the Visit – Show Case at Vilafranca el Penedés
- Accompaniment to discussions with an acknowledged winery
- Preparation of estimations on CO2 footprint saving per hectare and per wine bottle
- Accompaniment as speaker in a workshop in La Rioja to promote interest of wineries to start new management on pruning biomass, attended by the targeted wineries of Ribera del Duero
- Connection during end 2021 and start 2022 with wineries, biomass providers, service companies and potential final consumers for pruning wood in Ribera del Duero PDO
- Visualization at Expobiomasa fair in the “Agrobiomass corner”
- Online meeting with compromised wineries to discuss logistics and costs
- Technical assistance on biomass quality to fulfill quality needed by final user and definition according to updated standard ISO 17225-4, as well as counsel for lab analysis
- Technical assistance on the capacity to obtain shredded pruning wood adequate to final user needs by using large shredders without sieve.
- Visualization in AgroBioHeat stand at AgroEXPO fair.

- Invitation to the AgroBioHeat final meeting and matchmaking among key actors in the region to further expand contacts.

As result of the accompaniment Athisa Biogeneración is in good position to make successful the 500t pilot organized during 2022. The connections facilitated, and further developed by Athisa Biogeneración, have led to raise the interest of several wineries, and to engage several key actors.


Figure 12. Images from the Ribera del Duero initiative

8.6. Next steps and replication

Short trials executed. **Next step mobilizing as pilot 500 t during 2022**. Under good performance for all actors, it is expected to **expand in second and third season to 1.000 – 3.000 t/year**. Necessary to **engage more wineries**, which will be easier with the results of the pilot. As well a pilot in other PDOs have been already discussed. They could trigger new supply to other district heating. As well expected, to **develop other added value uses for pruning at wineries**. A research project is being prepared among the actors to develop new bioeconomy alternatives for the use of pruning.

8.7. Conclusions & final remarks

Principal lessons learnt for replication are presented next (note that Athisa Biogeneración contributed to (d) and (e) directly).

- Crucial to have an end user ready. Otherwise the economics of the new pruning management are uneconomic
- Wineries very ready to mobilise when they consider that integration to soil is not good agronomic practice. Alternatives for pruning management are then more easily adopted
- Important to connect with local companies “usual providers” of agricultural services to wineries in order to participate in the logistics (gathering pruning from fields). The pre-existing relation of confidence facilitates the agreement for the new practice.
- Necessary a dynamiser to align several wineries, service providers and final users.
- Crucial an expert with experience in the pruning use, shredding and mobilisation

9. Spain / CITA

9.1. Summary of the accompaniment

CITA is a research center for agri-food research, located in the central region of Teruel. Teruel is a quite unpopulated area with a quite high availability for agrobiomass. The accompaniment actions that have taken place with this initiative are related to the **installation of a boiler** that can supply heat and DHW to all the building, but with an additional added value: it is intended to be used as a **test facility for the use of new local biomass and agrobiomass**. So, the AgroBioHeat project have supported this initiative by providing technical support in the design of the boiler system, while promoting and giving visibility to the initiative in order to arouse interest and try to attract local stakeholders that may be interested in testing their local agrobiomass.

Figure 13. Teruel situation in Spain

Table 10. Overview of the CITA supported initiative in Spain

Agrobiomass for district heating at Ribera del Duero	
Application	Local agrobiomass boiler – to be used as a heating and new biomass testing facility
Current heating system	Not existing (electricity for hot water)
Current fuel consumption	Electricity for hot water
Agrobiomass fuel	Agro and forestry local residues
Agrobiomass fuel consumption	40 t/y hog fuel*
CO_2 savings	45 t/y*

9.2. Main innovations and relevance of the initiative

The main innovation of the initiative is to create a **first facility working on agrobiomass in the area** of Teruel. Moreover, the fact that can also work as a **test bench** for innovative or local available agrobiomass also represents an innovation which can pose a **huge relevance in the area**, where farmers and agrobiomass owners can turn to **determine the feasibility of their resources**.

9.3. Type of agrobiomass targeted by the initiative

The first intention with which the project was devised is to install a flexible boiler that can **be able to run with different fuels** with good efficiencies, low emissions and low noise and smell generation. Consequently, the type of agrobiomass selected is not defined, because the main goal is to test local resources. So, the type of agrobiomass used would be **locally available agrobiomass.**

9.4. Main expected benefits

The main benefits generated thanks to the installation of this facility would be the **CO_2 savings** (around 45t/y), **provide heat and DHW in a sustainable way with local resources**, and serve as a **lighthouse in the area**, not only as a success case of agrobiomass use, but also to attract farmers and biomass owners to test their resources and lever new initiatives.

9.5. AgroBioHeat support actions

The AgroBioHeat project has supported this initiative in several ways. Due to the fact that is somehow a "*smaller*" accompaniment, the support actions that have taken place are the following:

- Review of installation project and proposal of changes
- Support to access FES CO2 funds (CLIMA - AVEBIOM projects)
- Advice to adapt the installation to laboratory tests.
- Support in events to promote new initiatives in the area.

9.6. Next steps and replication

The next steps after all the advising process, would be to finally **approve the budget** of the installation of the boiler and sign the contract, in order to start with the **installation and commissioning**. Consequently, the boiler will be ideally able to **start operating during 2023** and start not only providing heat and DHW but also testing these locally available agrobiomass.

9.7. Conclusions & final remarks

The initiative accompaniment and support actions has proven to **be key for the decision-making** and the **installation of a boiler** in the CITA center in Teruel. It has been decisive to install an **icebreaking facility** that will be able to **support the use of agrobiomass in the area** and **promote new initiatives**, in private but also in public buildings. Multiple key actors got aware during the workshop and are **expecting the start-up and result of this facility**, thus demonstrating that there is an interest in the area where agrobiomass initiatives might be replicated.

10. Ukraine / Kherson

10.1. Summary of the accompaniment

Figure 14. Kherson situation in Ukraine

The icebreaking initiative of Dobrobud Ltd consists in the **installation of biomass boilers with a total capacity of 500 kW** for the heating of office buildings and warehouses in Kherson with **local agrobiomass** (reed, prunings and husks). Kherson region is located on the Northern Black Sea Coast where the reed is concentrated on a total area of about 80 thousand hectares. The economic energy potential of the reed is 58 ktoe in the region[6]. Dobrobud Ltd has more than 7 years of experience in the production of briquettes, mainly from reed, sunflower husks, and woody biomass, including prunings. The company uses its machines for **reed harvesting and biomass chipper**s. However, they don't have the possibility of full operation due to the lack of permission for reed harvesting and need support to promote reed harvesting in the region. The main results of this icebreaking initiative accompaniment are providing a CATI survey for the understanding of the local perception of agrobiomass and enhancing the competitiveness position of the agrobiomass heating solutions; consultation workshop for sharing the experience of agrobiomass for heat projects; finding out rational technical and organizational solutions for the value-chain; mobilization of local stakeholders, suppliers, technology provider; development of business models; lobby and advocacy actions with local policy actors and promotional activities.

Table 11. Overview of the Kherson supported initiative in Ukraine

Agrobiomass heating at offices and warehouses in Kherson	
Application	Business consumers (2 office buildings, 5 warehouses)
Current heating system	1 heating solid fuel boiler (~ 100 kW), several small natural gas boilers
Current fuel consumption	> 40 t of biomass (wood chips)
Targeted biomass boiler capacity	200 kW + 300 kW
Agrobiomass fuel	Chopped reed, prunings, husks
Agrobiomass fuel consumption	~ 180 t/y

[6] https://rea.org.ua/wp-content/uploads/2019/12/usaid-potential-kherson.pdf

CO_2 savings	> 110 t/y

10.2. Main innovations and relevance of the initiative

The icebreaker is going to harvest more than 100 thousand t of reed for the production of **70 thousand ton of reed panels** and **30 thousand ton of briquettes**. The reed waste will be used as **fuel for boilers**, which is cheaper than quality reed in bundles. It is proposed to **harvest reed** in shredded form, and to **process it at a modular plant** on a floating platform. Now Dobrobud Ltd is harvesting reeds in sheaves, which take up 40% more volume than crushed reeds. The new technology will inc**rease the productivity of reed harvesters and reduce logistics costs**. The floating platform will ensure that the biomass processing is closer to the reed areas.

10.3. Type of agrobiomass targeted by the initiative

Dobrobud Ltd has machines for reed harvesting (Figure 15), shredding and briquetting. The main biomass will **be reed waste and additional biomass is local prunings and husks**. About 180 tons of biomass are required to meet the needs of the new boiler plant in the winter period.

Figure 15. Seiga Tortoise Reed Harvester of Dobrobud Ltd

10.4. Main expected benefits

For locally sourced reed, **annual fuel cost savings of over 60 % can be achieved**, which provides a reasonable payback time. The icebreaking initiative can provide **more than 110 tons of CO_2 savings**.

Key enabling factors are: **reduction of heating costs** compared to natural gas; **seasonal jobs** for biomass management; **reducing Fire Hazard** in reed areas; improving **waste management**; pioneering project in Kherson region, and the case is important for follower initiatives.

10.5. AgroBioHeat support actions

In the Kherson region, a **CATI survey** took place, which contributed to the **understanding of the local perception** of agrobiomass and **enhanced the competitive position** of the agrobiomass heating solutions. The icebreaker concluded with the perception of the initiative by society and the need for further actions.

The UABIO experts developed a report on "**Justification of the resource-logistics reed harvesting value chain for energy use**" for the icebreaker. The results of finding out rational technical and organizational solutions were used for the development of the project for the production of reed panels and briquettes.

The icebreaker received from the AgroBioHeat project the nec**essary information about suppliers and technology providers** for agrobiomass harvesting and use for heat production. The UABIO experts provided Dobrobud team with **contact information and facilitated 7 online meetings**. Potential suppliers of boiler equipment were identified. The initiative was **presented to international stakeholders**, who have experience in reed to energy projects, at the Workshop on "**Paludi-biomass for energy**". Further, the icebreaker will use these groundworks in reaching the goals of the project.

10.6. Next steps and replication

The proposed icebreaking initiative of heat production from reed has a good replication potential in other regions with high potential of reed, including the Southern regions of Ukraine (Odesa, Mykolaiv, Zaporizhia, etc). Sustainable reed harvesting will help to reduce fire hazards and can supply the boilers plants with cheap local agrobiomass. The necessary machinery, boilers and other equipment are available on the market. In addition, the icebreaker has practical experience that can be spread to other stakeholders. However, due to the occupation of Kherson by Russia, the initiative was suspended, which also affects its replication.

10.7. Conclusions & final remarks

The key challenge for the initiative is to **unlock large-scale harvesting of reeds** in Kherson region and obtain permits for reed harvesting. The local authorities, ecologists and society are afraid that the reed harvesting will not be sustainable. Until recently, harvesting has been allowed on small private ponds. However, now the icebreaker with other stakeholders explained the importance of **harvesting reeds as a fire prevention measure**. Large-scale harvesting of reeds will allow launching the production of goods with high added value such as reed panels and briquettes. The reed waste will be used as a **very cheap biomass for heat production**. Rational technical solutions of biomass boiler and additional equipment for heat production are determined with the support of AgroBioHeat. Thus, **the basis is created** for the use of reeds in regions with large potential. In addition, the project will allow the use of other types of local agrobiomass.

11. Ukraine / Odesa

11.1. Summary of the accompaniment

Table 12. Odesa situation in Ukraine

Bioterm-teplo Ltd supplies **heat to two municipal hospitals** and has a **proposition to heat 7 schools** in Odesa. These schools have decentralized boiler houses with old coal-fired boilers. The company is going to **install modern biomass boilers there**. The planned agrobiomass is **sunflower husk pellets**. The proposed icebreaking initiative is the installation of a biomass boiler with a capacity of 500 kW in Odesa school #11. The icebreaker ne**eded a solution to provide effective combustion** of sunflower husk pellets and **necessary emission cleaning.** The identified rational solutions for agrobiomass heating **will be replicated in other schools**.
The main results of the icebreaking initiative Bioterm-teplo accompaniment are providing a CATI survey for the understanding of the local perception of agrobiomass and enhancing the competitiveness position of the agrobiomass heating solutions; consultation workshop for sharing the experience of agrobiomass for heat projects; finding out rational technical and organizational solutions for the value-chain; issues of biomass quality, efficiency, air quality, ash; engineering (automation of the boiler, emission cleaning system); mobilization of local stakeholders, suppliers, technology provider; lobby and advocacy actions with local policy actors and promotional activities.

Table 13. Overview of the Odesa supported initiative in Ukraine

Agrobiomass heating at Odesa school	
Application	Municipal school
Current heating system	2 heating coal boilers (~ 700 kW total)
Current fossil fuel consumption	> 125 t/y of coal
Targeted biomass boiler capacity	500 kW (downsized to match heat demand profile)
Agrobiomass fuel	Sunflower husk pellets
Agrobiomass fuel consumption	~ 200 t/y
CO_2 savings	> 320 t/y

11.2. Main innovations and relevance of the initiative

The key challenge for the initiative is to create understanding in the society that the use of agrobiomass heating in urban areas with dense multi-storey buildings is **efficient and ecologically safe**. The important

input was a **test run of an agrobiomass boiler on sunflower husk pellets** with a capacity of 500 kW in Dnipro provided by the AgroBioHeat project. The icebreaker realized that to ensure acceptable emissions, it was necessary to install a **modern biomass boiler with a moving grate**, automatic ash removal and fuel supply, a good automation/control system and an efficient flue gas cleaning system.

Miscanthus cultivation is also being considered to ensure a stable supply of biomass. The UABIO experts proposed to the icebreaker to establish his miscanthus plantation. Based on the existing average daily coal consumption of 700 kg, about 155 tons of miscanthus pellets per year will be required for the Odesa School #11. The UABIO experts found out the stakeholder, who sold the miscanthus plantation near Odesa. His offer is 8 hectares of Miscanthus Giganteus for rhizomes, which were planted in 2015-2017. According to the owner estimations, there are 5 million rhizomes that can be used for the plantation of 250 ha. The approximate biomass yield of the miscanthus here is 15 t/ha. Thus, for the Odesa School #11, up to 15 hectares are needed.

11.3. Type of agrobiomass targeted by the initiative

The main agrobiomass is **sunflower husk pellets** (Figure 16) as there are several sunflower husk pellets mills near Odessa. The Bioterm-teplo buys sunflower pellets from different biomass suppliers on the market for the existing boiler plants. Local transport companies transport the pellets to the boiler plant on demand. According to the new business strategy, the Bioterm-teplo is going to **expand the business into miscanthus plantations.** Various options for cooperation with local farmers and service companies that provide services for agricultural work with equipment are being considered. For the use in Bioterm-teplo`s boilers, **miscanthus must be processed into pellets**. To do this, the initiator must buy pellets production equipment or cooperate with the existing pellet mills.

Figure 16. Sunflower husk pellets

11.4. Main expected benefits

The icebreaking initiative can provide more than **320 tons of CO_2 savings**. Key enabling factors are: reduction of heating costs compared with coal; reduction of emissions compared to the existing coal-fired boiler; better temperature conditions in the school; follower initiatives in other Odesa schools and other regions.

11.5. AgroBioHeat support actions

In the Odesa region, a **CATI survey** took place, which contributed to the understanding of the **local perception of agrobiomass** and **enhanced the competitive position of the agrobiomass** heating solutions.

The identified rational solutions for agrobiomass heating will be replicated in other schools. A company that is ready to **make full automation of the boiler plant** has been found. UABIO experts collected

information about biomass boilers on the market and organized a consultation workshop. They prepared a report on "**Analysis of flue gas cleaning systems for the use in boiler houses of schools in Odesa, which are planned to be converted to agrobiomass**" for the icebreaker.

The icebreaker with UABIO raised trust among stakeholders in agrobiomass heating solutions in Odesa. There are **modern efficient biomass boilers for the combustion of agrobiomass on Ukrainian market**. As compared to the use of natural gas and coal, the estimated **cost saving on heating is 30 to 60%** depending on the cost of agrobiomass and the prices of fossil fuels.

11.6. Next steps and replication

The proposed icebreaking initiative of heat production from sunflower husk pellets has a **good replication potential in Odesa** and other regions. The complexity of the icebreaking initiative is associated with the installation of biomass boilers in urban areas with dense multi-storey buildings, which were built later than the boiler plants. In the case of the reconstruction of old boiler plants, it is necessary to go through a very complicated procedure for the project agreement and obtain support from residents who are very worried about possible emissions. With the support of AgroBioHeat, the icebreaker has developed the **algorithm for the implementation of such projects** and is **ready to replicate them i**n other schools in Odesa. Unfortunately, due to the current difficult situation in Ukraine, the project cannot be implemented this year.

11.7. Conclusions & final remarks

The proposed icebreaking initiative of the biomass boiler installation with a capacity of 500 kW instead of the old coal-fired boiler in Odesa school #11 has quite **a high maturity status**. The local community is generally **supportive of replacing the coal-fired boiler** with a modern biomass boiler as it reduces emissions. Also, the school management expects that **in winter the temperature conditions in the rooms will be better**. Bioterm-teplo has found the technology provider that has experience in such projects and will **install an automation/control system** to achieve high efficiency of the biomass boiler operation. The icebreaker is ready for the project implementation when the regulation of natural gas prices for budgetary organizations will be cancelled. According to the legislation, the price of heat from biomass is set at the price of natural gas. The **price of sunflower pellets has dropped significantly**, while the price of heat for the budget organizations, including schools, has remained almost unchanged. In addition, the icebreaker is considering the option of growing miscanthus and processing it into pellets to provide his boiler plants with biomass at least partially.