UNLOCKING THE COMMUNITY BIOENERGY POTENTIAL

D5.4 Application of the BECoop Replication Handbook to follower cases

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Legal Notice

About

Over the last years, the EU has witnessed some remarkable steps in Renewable Energy (RE) deployment. However, at the same time, we see an increasingly uneven penetration of RE across the different energy sectors, with the heating and cooling sector lagging behind. Community bioenergy schemes can play a catalytic role in the market uptake of bioenergy heating technologies and can strongly support the increase of renewables penetration in the heating and cooling sector, contributing to the EU target for increasing renewable heat within this next decade. However, compared to other RES, bioenergy has a remarkably slower development pace in the decentralised energy production which is a model that is set to play a crucial role in the future of the energy transition in the EU.

The ambition of the EU-funded BECoop project is **to provide the necessary conditions and technical as well as business support tools for unlocking the underlying market potential of community bioenergy.** The project's goal is to make community bioenergy projects more appealing to potential interested actors and to foster new links and partnerships among the international bioenergy community.

The project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 952930.

Project partners

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Abbreviations

BECoop	Bioenergy Cooperative
CAPEX	Capital expenditures
CHP	Combined Heat and Power
DH	District Heating
EC	Energy Community
EU	European Union
KWh	Kilowatt hours
MWhth	Megawatt hours of heat
NPV	Net present value
OPEX	Operating Expenses
RECs	Renewable Energy Communities
RED	Renewable Energy Directive
RES	Renewable Energy Sources
RE	Renewable Energy
RESCoop	Citizen or Renewable Energy Communities

Executive Summary

The BECoop project aims at its core to facilitate the extensive development of community bioenergy heating projects throughout Europe. **This report outlines a comprehensive analysis of eight (8) distinct follower cases and the corresponding support services offered by the BECoop partners on stakeholder mapping, technical and business aspects**. These services aimed to facilitate the development of action plans and roadmaps for the implementation of a community bioenergy project within each case. The eight selected cases were guided to explore their regional potential, identify the local energy needs, biomass supply and most suitable technology to be deployed, whether by initiating bioenergy projects from scratch or enhancing existing engagement within the community energy sector. **These cases were thoughtfully chosen to span diverse geographic regions, socio-economic contexts, and varying energy demands**, effectively creating a representative cross-section of possible scenarios for the realisation of community bioenergy projects.

After conducting a comprehensive analysis, several important aspects emerged when replicating the BECoop concept, utilising project-introduced tools and methodologies, and developing community bioenergy projects. The BECoop tools were effectively employed to assess and address case-specific obstacles, as well as to explore and visualise potential solutions. The *BECoop self-assessment* tool facilitated the evaluation of each initiative's current status, while the *BECoop toolkit* aided in identifying local biomass resources. Additionally, the *BECoop Replication Handbook*'s step-by-step guidance, along with the templates it provided (e.g., for establishing an energy community roadmap), and the valuable insights drawn from successful cases previously studied by the project, played a central role in guiding follower cases in addressing their challenges.

The deliverable is structured as follows:

- **Chapter 1:** This is where the main objectives of the project's replication activities are highlighted.
- **Chapter 2:** This chapter introduces the **BECoop replication handbook** (D5.3) and provides clarifications on its pivotal role in the BECoop knowledge transfer and replication process.
- **Chapter 3:** This section presents the methodology employed for **identifying the eight follower cases** spread across Europe. It sheds light on the **promotional campaign** that was strategically employed to ensure the identification of follower cases, along with **the applied criteria for shortlisting and selecting cases among the available candidates.**
- **Chapter 4:** This part consists of distinct sections, with each one centering on a particular follower case. These subsections cover various elements, including the case's profile, a thorough outline of the support services offered, an **understanding of the community's core idea**, and a **clear roadmap** that lays out the path toward building, each time, a regional bioenergy community project.
- **Chapter 5:** The report wraps up by summarising the **main challenges** that emerged throughout the process, highlighting the fundamental insights that were acquired, and putting forward essential suggestions implemented to **finetune the project assets.** These improvements aim to offer a more **easily adoptable replication package** applicable to different local contexts and further enhance the facilitation of bioenergy community projects.

Finally, a copy of the profiling template filled out by the follower cases, together with the BECoop experts (Annex I), the templates for the letter of acceptance (Annex II) and the internal identification criteria (Annex III) can be found at the Annex section, together with the available self-assessment results of the follower cases before and after the support provision (Annex IV).

1 Introduction

BECoop's primary ambition is to foster the widespread adoption of bioenergy heating technologies across Europe by providing the necessary conditions and support tools to unlock the community bioenergy potential. The project offers an array of tools, including the BECoop self-assessment tool, BECoop toolkit, BECoop technical and business catalogues, and a Knowledge Exchange Platform. These resources aim to support new initiatives and streamline the establishment of bioenergy heating projects throughout Europe.

To demonstrate and validate the effectiveness of the BECoop approach, the project implemented actions in **four complementary pilot cases across the EU**. The valuable knowledge and evidence generated during the research and piloting activities were then compiled into a comprehensive step-by-step guidebook, the "BECoop Replication Handbook".

In addition to the Replication Handbook, BECoop has been actively engaged in transferring its concept, tools, and services to eight follower cases across Europe. Within the framework of BECoop Task 5.2, these cases were carefully selected and supported by our expert consortium partners towards the utilisation of project tools and methodologies and implementation of the BECoop Replication Handbook.

The main objectives of our replication activities have been as follows:

- Demonstrating the replicability of the project's results and the successful implementation of the Replication Handbook.
- Enhancing the results of our established BECoop RESCoops by incorporating additional cases with diverse characteristics and varying levels of maturity.
- Showcasing the successful utilisation of the developed BECoop tools among additional cases across Europe, indicating their effectiveness and adaptability.
- Identifying common challenges faced by the cases to fine-tune our future strategies, ensuring better outcomes for similar initiatives.
- Inspiring other European projects with comparable characteristics to establish relevant bioenergy initiatives.
- Raising awareness about the importance of bioenergy communities in local areas and contributing to the alleviation of energy poverty.
- Providing policy makers with real-life evidence and insights from new projects to inform their decision-making process.

This report presents the eight BECoop follower cases, outlining the strategy used for their identification and selection, as well as the support-provision and replication-empowering program that has been put in place.

The nature of offered support varied across our 8 follower cases. Our expert partners, after thorough communication with the representatives of each identified initiative, adjusted the services provision process to the unique needs and maturity level of each follower case. This tailored approach ensured that the cases received optimal assistance in adopting and implementing the most suitable BECoop tools and methodologies, empowering them, in turn, to overcome their current challenges.

2 The BECoop Replication Handbook

The BECoop Replication Handbook builds upon the project's experience and pilot implementation results. It offers **a step-by-step approach for developing or expanding community bioenergy heating initiatives.** Whether an interested actor is starting from scratch or enhancing an existing project, the handbook supports them to replicate the successful BECoop concept, tools, and services.

This comprehensive guide goes beyond theory, providing practical recommendations, real-life examples, and accessible solutions. It serves as a valuable resource, facilitating the adoption and replicability of the BECoop tools and services by RESCoops, communities, authorities, and policymakers throughout Europe.

The handbook is one of the main assets of the project which will ensure the exploitation and sustainability of the BECoop methodologies after its completion. It was a dedicated deliverable published in M30, and remains accessible through the project website, and other platforms (see below).

Figure 1. The BECoop Replication Handbook cover

To ensure widespread distribution of the handbook and stakeholders' engagement around the project's mission, a comprehensive dissemination strategy was implemented across Europe.

- Consistent posts on the handbook's insights were shared on the project's and partners' social media platforms and website.
- Information about the handbook was directly communicated to the project's Network of Interest, and the Advisory Board members.
- The handbook was shared with RESCoop.eu, and actively promoted among its networks.
- Collaboration was established with a network of bioenergy-focused Horizon EU projects, who also supported and promoted the dissemination of the handbook.
- An infographic detailing the step-by-step process of developing a bioenergy community was created to effectively engage with interested stakeholders.
- The Handbook was uploaded to Zenodo platform, as well as the Energy Community Platform and Energy Communities Repository.

Figure 2. Infographic on the stepwise approach of the BECoop replication handbook

The BECoop Replication Handbook serves as a vehicle for empowering the project-identified follower cases to replicate the BECoop concept and ambition in their territories.

3 Methodology for Identifying & Supporting 8 Follower Cases across Europe

3.1 Selection Criteria and promotional campaign

Defining the selection criteria to identify the most suitable follower cases

The project consortium placed great significance to the identification of suitable cases for replicating the methodology, tools, and ambitions of BECoop. The partners aspired to **select cases with diverse replication potential, distinct needs, and varying levels of maturity.** This approach aimed to showcase the project's ability to be easily replicated and ensure its widespread impact and applicability across diverse European contexts. To achieve this objective, the consortium engaged in internal meetings where the task leader and expert partners defined a set of selection criteria. These criteria were selected to evaluate the identified cases and ultimately choose the ones that best aligned with the consortium's objectives.

Table 1. Follower cases selection criteria

Criteria	Description
1. Local resources availability	Assessing the extent of available or potential resources within the local region, such as prunings, municipal residuals, etc.
2. Potential to meet local needs	Evaluating the extent to which the initiative adequately addresses localized needs and challenges, such as energy poverty, high heating demands, etc.
3. Current status of stakeholders' engagement	Examining the involvement of key actors, including public authorities and SMEs, who have already been mobilized and can influence the local community, among others.
4. Main types of stakeholders already engaged	Identifying the categories of stakeholders who are already involved in the initiative, such as citizens, local authorities, farmers, vulnerable groups, etc.
5. Type of stakeholder serving as case initiator	Identifying the primary stakeholder that will support the initiative, such as an existing RESCoop, local authority, citizens, etc.
6. Level of support by the local community	Assessing the extent to which the local community has embraced the initiative and is willing to support a local bioenergy community project.
7. Initiative's maturity levels	Determining the level of readiness and development of the initiative to effectively adopt and implement BECoop tools and methodologies.
8. Social innovation at the local level	Evaluating whether the initiative introduces a novel cooperative concept or if similar cases have already been established at the regional level.
9. Replicability	Assessing the potential of the case to serve as an inspirational example, not only at the local level but also at the European level - demonstrating its replicability and broader impact.

Channels exploited for the identification of follower cases.

Two channels were utilised to facilitate a broad search for follower cases, with the aim of attracting candidates from various locations across Europe:

Personal networks: After circulating an internal template, all consortium and especially pilot partners, were requested to leverage their personal networks to identify potential candidates for the follower cases. Through an internal selection process involving pilot and expert partners, the potential candidates were assessed based on the established criteria and a list of the most promising cases was compiled. Finally, these selected cases were contacted to ensure their participation in the project's activities.

Pan – European open call: Complementary to the internal search for participants, WR, with the support of the dissemination manager, designed and launched a pan-European open call in order to attract participants from all over the continent. Following the collection of a list of interested participants, the project reached out to them to secure their involvement in the project's activities.

Figure 3. Pan - European open call

A series of well-planned and regular dissemination actions took place in order to ensure that the open call will be distributed all over Europe and reach out to interested stakeholders. Below can be found the list of the dissemination activities:

- Regular posts were made on the project's social media and website.
- Information was sent to the BECoop Network of Interest, Advisory Board members, list of contacts from the BECoop's letter of support during the proposal stage.
- The call was circulated to RESCoop.eu[1] and was promoted through their social media accounts.
- The call was uploaded to the DG Ener Energy Communities Repository[2].
- An ad hoc Newsletter was drafted and circulated to the project's subscribers.
- Sister projects were invited to support the dissemination.
- The network and social media accounts of the partners were utilized to invite participants from other relevant projects.
- The open call was promoted through the BECoop webinars.
- Communication was initiated with Bioenergy Europe to include the call in their Newsletter.
- Contacted stakeholders engaged in previous project activities (e.g., the interviewees under T1.1) to promote the open call.

[1] REScoop.eu is the European federation of renewable energy cooperatives, https://www.rescoop.eu/
[2] The Energy Communities Repository is an initiative on behalf of the European Commission to assist local actors with setting up and advancing clean energy projects driven by energy communities in urban areas across Europe, https://energy-communities-repository.ec.europa.eu/

- A press release was drafted and shared with 70 journalists at the EU level, as well as with journalists from some Member States outside our four pilots.
- Dedicated e-mails were sent to municipalities and energy communities.

3.2 Identifying the most suitable cases

After careful evaluation, the consortium partners have chosen eight follower cases from seven different countries, namely Spain, Italy, Greece, Poland, Bulgaria, Belgium, and Romania. This selection aims to cover a diverse range of geographical areas and address various needs within the context of the project. Each of these cases brings unique perspectives and challenges, contributing to the overall replicability of the project's outcomes.

A brief overview of the selected cases, along with some key remarks highlighting their significance, can be found below:

Figure 4. BECoop follower cases

Table 2. Overview of the BECoop-selected follower cases across EU

Case Name (Country)	Remarks
1. Sakana (Spain)	Highly motivated stakeholders that have **participated in previous BECoop activities** (T3.2 training workshops). In addition, they embrace a **decentralized approach to biomass availability**, placing ownership in the hands of the citizens. Finally, **local institutions** are willing to push forward projects involving local resources in nearby rural areas.
2. Minoan Energy Community (Greece)	Minoa, an **established energy community** since 2019, exhibits high potential in utilising local residual biomass streams. It actively engages **vulnerable groups** and is prepared to employ BECoop tools and methodologies. Abundant resources, including olive oil cultivations and agricultural residues, offer significant bioheat opportunities. With a **wide range of stakeholders** involved, including public authorities, SMEs, and citizens, Minoa stands as one of Greece's largest energy communities. The community's maturity is evident through **existing photovoltaic parks** while they intend to perform a new activity regarding the **exploitation of residual biomass** in order to cover the thermal and energy demands of the community.
3. Strzeszów (Poland)	The **stakeholders' cow farm** grants access to a valuable resource: manure, while local cereal crops serve as a readily available source of straw. Additionally, the nearby staff hotel's demand for electricity and heat aligns with the stakeholder's energy requirements for cow breeding. To maximize efficiency, the **implementation of an advanced biogas plant** will not only generate surplus electricity and heat but also support sustainable energy practices. Furthermore, the presence of other nearby residential buildings provides opportunities for the establishment of a **small-scale heating network and electricity distribution system**. In addition to benefiting the farmers, this collaboration has the potential to **foster sustainable energy solutions for residents and SMEs**.
4. Macugnaga (Italy)	There is a significant amount of **biomass availability at the local level**. This abundant biomass resource provides a strong foundation for the implementation of a sustainable energy project. Second, the **active involvement and support of local stakeholders** have been secured, ensuring a collaborative approach and increasing the likelihood of successful project execution. Lastly, the high cost of alternative fuels, such as methane, further highlights the

Case Name (Country)	Remarks
	economic viability of utilising the readily available **biomass as a cost-effective and sustainable energy source**.
5. Ecopower (Belgium)	**Wood prunings** from nature, landscape, and infrastructure management serve as available biomass resources. Meeting the **high energy demands of the region**, particularly in the **heritage site of buildings** requiring high-temperature heating, presents a challenge due to heritage conservation regulations limiting energy efficiency measures. Recognising the potential, the city administration has designated the Beguinage[3] as a demonstration area for transitioning from natural gas to sustainable heating. Engaging stakeholders such as the city administration, citizens energy communities, and organisations combating energy poverty demonstrates a collaborative effort. This case holds promise due to its potential for replication, as similar heritage sites exist in numerous cities across Flanders, Belgium, and Europe. The project provides insights into **sustainable heating solutions for heritage sites and urban centres**.
6. Energy Agency Plovdiv (Bulgaria)	The primary biomass resource is **wood chips**, with additional **availability of crops and agricultural residues**. The **demand for efficient and renewable energy sources** in the heat and electricity grids is evident, and this initiative aims to address and fulfil those local needs. Introducing a new **cooperative concept for the region**, this project aims to establish a sustainable and collaborative approach to energy deployment.
7. Sustainable Village (Romania)	The commune benefits from two large creeks and a major river, providing a substantial wood biomass resource spanning approximately 150 hectares. This biomass includes vegetation from surrounding willow plants and woody waste contributed by the inhabitants. Additionally, the vineyards and orchards in the region make a valuable contribution to the available wood biomass. However, there is currently a **significant amount of biomass waste due to burning and improper disposal practices**. To address this issue, the **local authority** is actively working on the collection and management of wood biomass, agricultural biomass, and green waste, including manure. They have identified a storage area and are seeking **financial support** for machinery acquisitions to improve waste management. The BECoop opportunity offers an excellent platform for **developing a community roadmap** and justifying future projects, such as the implementation of local power plants.
8. CommonEn (Greece)	Founded in 2021 in Ioannina, CommonEn has mobilised over 4000 citizens, engaging them through public events, workshops, and local media. This **grassroots organisation** has specifically targeted Epirus, a remote and mountainous region known for its **high heating demands and energy poverty levels**. To address these issues, CommonEn has established a **community energy living lab**, fostering democratic design and development of energy projects. With growing interest from national and international media and researchers, this initiative in Epirus has the potential to serve as a **best practice and inspirational example** for similar endeavours all around Europe.

Note: In the early stages of the process, we received considerable interest from the Estonian community, *TÜ Energiaühistu*, to join as a replication case. Following a series of discussions, it was eventually communicated that the case couldn't advance due to lack of personnel resources. Consequently, to uphold our original objective of securing eight follower cases, we made the determination to promptly select a case with substantial potential from the remaining pool of applicants who responded to our open call. Subsequently,

[3] The Flemish béguinages are architectural ensembles composed of houses, churches, ancillary buildings and green spaces, with a layout of either urban or rural origin and built in styles specific to the Flemish cultural region (https://whc.unesco.org/en/list/855/)

the decision was reached to move forward with the Greek case, presented by *CommonEn*, as its attributes closely matched our selection criteria.

3.3 Methodology for supporting the 8 Follower Cases

Through **three targeted online meetings**, held within Spring - Summer of 2023, higher-level consulting services were offered in ***(a) technical aspects***, including available resources, logistics, activities, and technology-related aspects, and ***(b) business aspects***, providing insights on effective business models and funding opportunities. Additionally, guidance on social aspects was further provided, offering tips on ***(c) community engagement***.

3.3.1 BECoop resources used in the support provision

Through interactive discussions and practical examples, valuable insights and advice were offered, enabling communities to make informed decisions and overcome potential challenges by leveraging the showcased BECoop methodologies. The following BECoop resources (tools, reports, templates etc.,) were employed in the support provision process across the eight follower cases.

The **BECoop self-assessment tool** for bioenergy communities was developed aiming to allow interested cases to carry out a preliminary diagnosis of their initiative and provide hints on the future steps required. The tool consists of self-evaluation forms that allow **to assess an initiative's status and identify the process, technical solution and business model that needs to be followed for initiating and taking part in a community bioenergy heating project**. To initiate the assessment process, the user selects among the five biomass resources (agricultural resources, forestry resources, agro-industrial resources, biomass from urban parks/gardens and wet biomass), and the twelve different activities to be implemented. These activities are categorised under four main axis: logistic supply, biomass processing, electricity and heat production, distribution, and consumption. A number of posed questions acts as a compass, helping the user to check if the most relevant aspects or considerations have been taken into account. For each activity, four different types of aspects are examined: key partners, technical aspects, business and financial aspect, and social and environmental aspects. Based on the sequence of all questions posed, a set of indicators is defined, for each questions-category, as follows: **Knowledge regarding the resource, User engagement, Technical solution maturity, Business solution maturity, Social and environmental impact**.

The different answers provided (multiple choice questions/answers) suggest the steps needed to achieve a successful implementation of a new business model, as well as links (if applicable) to current tools and reports that may be useful to get beyond that stage. The rating process assesses the readiness of an initiative for successful implementation, using two levels: i) Questions within each category are weighted to assess their importance, with key questions receiving higher scores (from 0 to 1), ii) Answers provided for each question are also weighted, with well-developed initiatives receiving higher scores, while early-stage initiatives might score lower. Different answers to the same question can have the same rating. The tool's outputs offer:

- a picture of a user's project status,
- highlighting the strengths and weaknesses through a visual way in a spider-net, and

- providing a series of recommendations for further developing the initiative.

The results of the self-assessment tool provide an indicative proxy for the initiative's current status and aim to present a **comparative picture of the case's potential before and after the BECoop recommendations**. As presented indicatively in Figure 5, different self-assessments (surveys) can be presented in the same graph to monitor the progress of an initiative. Its primary utility during the support provision was to **emphasise the impact of the provided support and the case's potential for improvement**, rather than focusing solely on the absolute scores of individual indicators. A more detailed description of an initiative's status visualisation can be found in the dedicated deliverable D2.2.

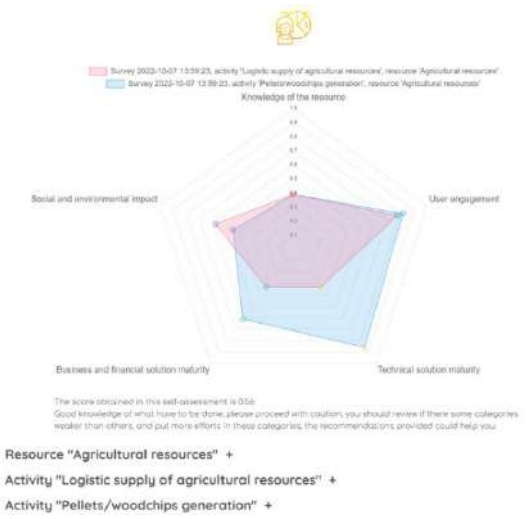


Figure 5. Example of a self-assessment outcome – Scoring results of two different self-assessments in the form of a spider-net

The **BECoop Toolkit**, an online repository of existing open-source tools, developed by other projects or institutions, aimed to complement the support services that are required during the entire community bioenergy project deployment process. The follower cases were guided by the BECoop partners around the different tools and their use. A description of the different tools presented in the Toolkit can be found in the deliverable D2.4 BECoop Toolkit – Final.

The **BECoop e-market environment** was designed to connect biomass related stakeholders in a virtual platform and support the development and operation of community bioenergy heating projects. It further includes an educational vector, visually demonstrating to potential bioenergy RESCoops the various stakeholder interactions and activities that have to take place for setting up an effective and sustainable community bioenergy project. An elaboration of the e-market platform functions can be explored in D2.6 Bioenergy RESCoops e-Market environments – Final. The follower cases were introduced to the e-market environment and explored the needs or offers of other initiatives.

The **BECoop KEP** was developed for enabling exchange of knowledge among bioenergy actors, communities and regions. It acts as a forum to solve any doubts that may arise and as a repository of useful information. It hosts the BECoop developed tools and three other elements: the knowledge repository, the Atlas of bioenergy community cases and the Network of Interest (NoI). It also includes the recorded series of BECoop webinars, which further explores the different aspects of community bioenergy heating projects' development. A detailed description of the KEP can be found in the dedicated deliverable D5.2 BECoop Knowledge Exchange Platform – Final.

The **BECoop technical catalogue** presents in an easy-to-understand manner, the bioenergy heating solutions selected by BECoop, providing to the cases an overview of the technology processes but also the steps that should be followed for their implementation. At the same time, **four factsheets** were developed, aiming to focus on key technical services that can complement the technical solutions compiled in the catalogue for the uptake of community bioenergy heating. An elaborate description of the technical catalogue and key technical factsheets is included in D2.8 BECoop catalogue for the provision of technical support services – Final.

The **Business and financial catalogue** was developed to collect all the necessary information for developing a comprehensive list of business, governance and financial solutions to enable follower cases to easily

navigate among appropriate solutions that are applicable and effective for their case. The cases get exposed to information about the **5 Business Models profiles**, based on the literature classification of RESCoops models, the Sustainable Business Model Canvas methodology, and further developed by the BECoop business experts:

- **Local integrated group of citizens**: a grassroots approach where citizens form a RESCoop to address local needs, often with limited capital sourced from members. They focus on small-scale projects like solar panels and aim for self-sufficiency in energy provision through volunteer efforts.
- **Regional-national RESCoop**: involves regional or national RESCoops that often emerge from citizen groups or external initiatives, aiming to engage in diverse energy projects at a larger scale. They combine volunteer and employee efforts, diversify their funding sources, and establish various partnerships, focusing on multiple energy sources across a region or country.
- **Network of RESCoops**: involves a network of RESCoops, where an incubator invests in new projects and establishes local RESCoops with a proven business model. This approach focuses on replicating successful schemes in various areas, aiming to achieve economies of scale and efficiency, primarily focusing on large-scale solar and wind projects and forming partnerships at local and meso-levels.
- **Multi-stakeholder governance**: involves RESCoops that bring together various stakeholders related to renewable energy provision and consumption through a complex governance structure. This model can be implemented locally or across territories, fostering synergies between public authorities, social enterprises, and local businesses. While it offers potential for scaling up, it also entails governance complexity and relies on regulatory clarity and efficiency, demanding a high level of sophistication and synergy among local and regional entities.
- **Fully integrated RESCoop:** an advanced model that results from a quite long organizational trajectory. The objective here is to function independently on the different dimension of energy provision. These RESCoops function with employees as well as with volunteers.

A detailed description of the different business models can be found in D2.10 BECoop catalogues for the provision of business and financial support services – Final.

The cases also got familiar with our Business Plans, as they have been defined in T4.3 as a result of the business support for the needs of our BECoop RESCoop cases based on their local particularities and their bioenergy heating projects. The **business plans**, elaborated in D4.3 Deployment of the BECoop business and financial support services, were also discussed with the follower cases in order to identify whether any of the existing plans aligns with the follower cases' potential and vision: the **business plan example from Poland** showcasing the development of a pellet production plant and the installation of 830 boilers in public and residential buildings in a rural area, the **business plan example from Greece** outlining the installation of 20 biomass boilers in public buildings and the distribution of solid biofuel to the local market, the **business plan example from Spain** elaborating on the development of a DH plant and network, and the **business plan example from Italy** showcasing the development of a DH and CHP plant in a rural area.
Additionally, the **feasibility studies** conducted for each BECoop RESCoop, presented in detail in D4.2 Deployment of the BECoop technical support services, were showcased to contribute to a better understanding of various aspects, including the local biomass assessment and the primary technology to be used.

Together with the BECoop resources which are all available on the project website, the follower cases were also provided with some dedicated templates, aiming to facilitate the replication process, and better capture the cases' status and vision:

- The **profiling template**, completed by the follower cases in order to provide a summary of the current status of the initiative/project, and their key needs and ambitions.
- The **reporting template**, filled out by the allocated partners, based on the exchanges with the follower cases.
- The **roadmap figure template**, filled out by the allocated partners, based on the exchanges with the follower cases, aiming to present visually the bioenergy community vision within a time horizon.

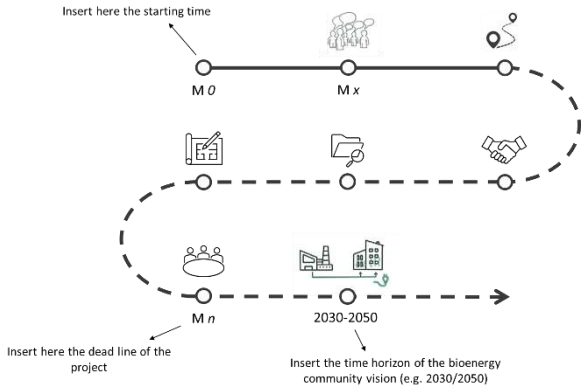


Figure 6. The Roadmap figure template - Cases were guided to design a respective roadmap on how to achieve their goals

Table 3. A summary of the BECoop Resources Utilised for Support Provision across the different cases

BECoop resource	*Why/ How it was used*
Self-assessment tool	To assess the maturity level of the project before and after the supporting services
BECoop Toolkit	To assess the biomass availability, energy demands of the area, or present the construction of value chain, amount of potential greenhouse gas (GHG) emissions from the project
BECoop KEP	To check the BECoop tools and material, explore the Atlas of Bioenergy Community cases and the NoI
Technical catalogues	To choose activity and technology that could be implemented in the follower case
Business catalogues	To choose the various business concepts that are required; to choose financial support schemes and business model
BECoop RESCoops' business plans	To provide guidance on key elements and instructions for developing an efficient business plan for a community bioenergy project
E-market environment	To leverage the experience of others and similar initiatives
D4.2 Deployment of the BECoop technical support services	To learn more about the main technical services employed for the realization of the BECoop RESCoops' action plans
BECoop Webinars	To learn about the use of the BECoop tools, and explore the key information around biomass, and energy communities
Awareness Campaigns Material	To explore examples of existing ARCs in Europe, learn how to build an ARC strategy
Replication Handbook	To explore the step-by-step approach towards the development of a community bioenergy project and read about numerous success cases across EU

3.3.2 Key aspects considered in the support provision process

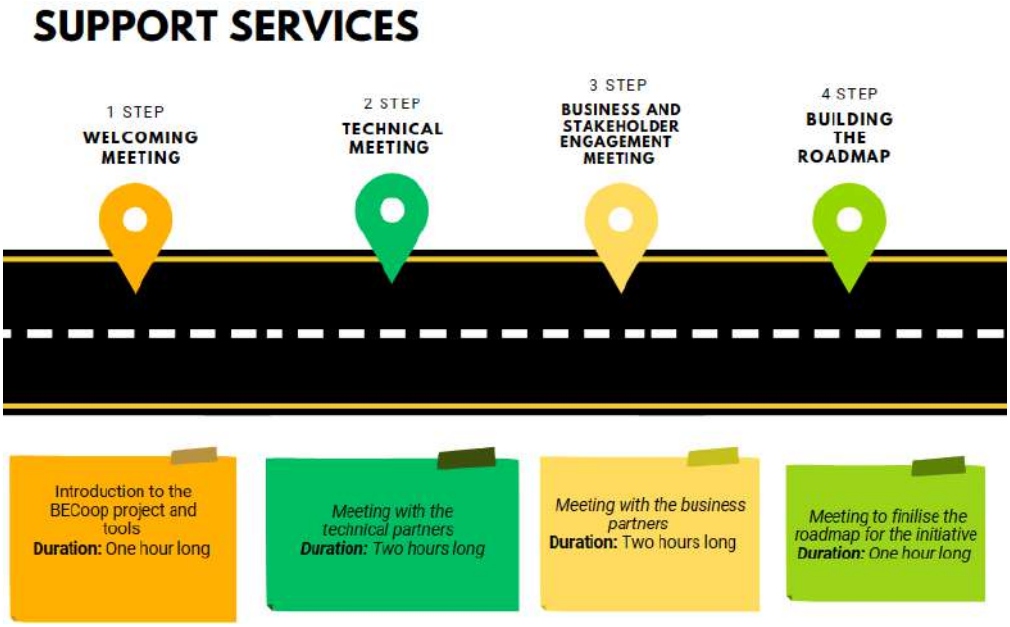


Figure 7. Overview of the support services provided to the BECoop follower cases

Each case was supported by strategically **assigned BECoop expert partners**, as presented below, who accompanied and advised the selected initiatives throughout the entire support-provision process.

Table 4. BECoop experts resource allocation to follower cases support

Follower Case	Welcoming session	Allocated technical expert	Allocated business expert
1. Sakana	All partners	CIRCE	Q-PLAN
2. Strzeszów		WUELS	CBS
3. Macugnaga		CIRCE	CBS
4. Minoan Energy Community		CERTH	Q-PLAN
5. Ecopower		CIRCE	Q-PLAN
6. Energy Agency Plovdiv		CERTH	Q-PLAN
7. Sustainable Village		WUELS	CBS
8. CommonEn		CERTH	CBS

To ensure consistency, a homogeneous approach was followed among all cases, examining the following key actions:

- Evaluating the characteristics of the local area, including biomass availability and heating needs.
- Engaging the local community and identifying the key actors driving the project.
- Providing insights on the technical and business aspects involved.
- Developing an initial concept and roadmap for the community's bioenergy initiative.
- Identifying the challenges and lessons learned throughout the process.

Note: As part of our commitment to enhancing support for selected follower cases, we invited these eight initiatives to the BECoop physical brokerage event held in Athens, Greece. Follower cases' representatives who attended our event had the opportunity to acquaint themselves with each other's work, exchange experiences in the community energy sector, discuss shared enthusiasm and challenges, and explore innovative pathways for community bioenergy project development.

4 BECoop Follower Cases Support Provision

4.1 Sakana (Spain)

Under-exploration initiative in Sakana, Spain:

In Sakana, Spain, a RESCoop in its infancy will be initiated, guided by Goiener (BECoop pilot) in partnership with 15 municipalities in the region. The project's core involves establishing a logistics and pre-treatment center for the collection, drying, chipping, and distribution of biomass from the nearby mountains to support villages in need. The primary goal of this initiative is to establish a collaborative biomass management system that benefits all participating municipalities. As a demonstration of the viability of this initiative, sustainable biomass-fueled boilers will be installed in selected pilot villages.

4.1.1 Background

Sakana Valley, situated in the northwest of the Foral Community of Navarra, lies within the region known as Humid Navarra. Spanning an approximate area of 306 square kilometres and accommodating a **population of over 20,000 residents**, this valley is nestled between the Aralar mountain range and the Urbasa-Andía Natural Park. The Sakana Valley is characterized by the Arakil River and is encompassed by mountains full of beech and oak groves, such as Beriáin-San Donato and Trinidad. Historically, the region comprises three distinct areas: La Burunda, Aranatz, and the Arakil Valley. Noteworthy municipalities and councils within Sakana Valley include Alsasua, Etxarri-Aranatz, Uharte-Arakil, Irurtzun, Bakaiku, Arbizu, and Olazagutía.

Figure 8. The Sakana Valley

One of the workshops conducted as part of the BECoop project, specifically under task 3.2, took place in the Sakana region. During the workshop, several stakeholders expressed a keen interest in utilising biomass in a community-oriented manner. Encouraged by this enthusiasm, **Goiener, was approached by public authorities to provide support in establishing an Energy Community** focused primarily on photovoltaic (PV) systems for self-consumption. As a follower case, **this initiative will enable the citizens of Sakana to consider biomass** as a valuable opportunity for transforming their region into a more sustainable one, particularly as the current thermal energy demand heavily relies on fossil fuels. Furthermore, there are connections to the Aberasturi BECoop RESCoop, as a regional law allows citizens to have access to biomass allotments for personal consumption.

4.1.2 Stakeholder engagement

A workshop was conducted as collaborative effort between the Sakana Garatzen agency and the BECoop project. Sakana Garatzen is a regional development institution with a mission to identify, promote, energize, and manage sustainable development projects in the region. Their focus is on strengthening the collaborative

and community ecosystem of Sakana. During the workshop, **several mayors from villages in Sakana demonstrated keen interest in exploring the potential for developing a Bioenergy community in the region**. Representatives from Nasunvinsa, a public institution in Navarra dedicated to supporting sustainable territorial development, were also present. Nasunvinsa actively works towards building territories through project development, involving public institutions, negotiating agreements, and ensuring the participation of society in fostering a culture of innovation and continuous improvement.

Figure 9. Engagement activities

Both institutions, Sakana Garatzen and Nasunvinsa, are the driving forces behind the initiative to establish an energy community in the Sakana region, with the support of Goiener. The initiative was about to start with the electrical production utilizing PV technology for self-consumption, while to further engage citizens in bioenergy opportunities, **three informational sessions (info days) were organised**. These info days took place in the three main villages of the region with 17 citizens attending in Etxarri, 19 in Irurtzun, and 30 in Altsasu. Additionally, **a video was created** to explain the potential of a Bioenergy community, which was subsequently distributed via local social media channels. **An additional meeting took place involving representatives from Sakana Garatzen, Nasunvinsa and Goiener** for establishing the planning of the activities.

Table 5. Identified Stakeholders willing to support the project in Sakana

Types of Stakeholders	*Role in the project*
Public institution	Initiator of the project
Regional institution	Initiator of the project
Local authorities	Engagement of the citizens, support community, services development. Change public buildings' consumption from fossil fuels to locally produced bioenergy
Existing RESCoop	Supporting energy community development
Citizens and general public	Participating in the bioenergy community
Companies, entrepreneurs, farmers	Promoting local development, study residual heat to be considered or energy consumption to be covered. Take part in the bioenergy community, and offer different services to the community

4.1.3 Technical and Business support

Based on demographic data, the Sakana valley spans approximately 305.5 km^2 or 305,500 hectares. According to the 2010 "Map of crops and land use in Navarre," forestry areas make up approximately 82% of the total community surface. Hence, it can be estimated that around 250,000 hectares of the Sakana valley are covered by forestry biomass. The dominant tree species in these forests include beech, oak, pine, and chestnut. These figures highlight the **substantial potential for biomass availability**, and local allotments enabled by regional legislation allow citizens to utilize these forests. Therefore, the necessary conditions for biomass availability can be met. **However, the willingness to exploit biomass sustainably and the adoption of an appropriate model are still pending**.

At this stage, no decision has been made regarding the specific technology to be deployed, making it difficult to estimate the format and quantity of required biomass. The case is in its early stages, with **efforts focused on disseminating the community energy model throughout the region and engaging as many villages as possible**. Nevertheless, the case remains open to the various possibilities evaluated by the BECoop project, finding the provided catalogues and factsheets useful and interesting.

While the BECoop e-market environment was introduced to facilitate contact with local areas, direct communication has proven easier due to the close relationships between the mayors of these towns. As the activity and technology remain undecided, the energy demand to be addressed has not yet been determined. However, the BECoop toolkit offers tools that can assist in estimating these needs, and CIRCE, as the technical experts and developers of the tools, has extended an invitation to the case for any support required.

In addition, **the business plans that were developed for the BECoop Greek and Italian case** can be used in order to check governance aspects and financial mechanism that our RESCoops used. **The Spanish case can be also used as a guide for the development of the Sakana business model**.

The investment plans of the above 3 RESCoop cases will be very useful for the development of the Sakana initiative. Various information and methodologies can be gathered from the BECoop investment plans developed for the establishment of the project's RESCoops.

4.1.4 Community's concept and roadmap

The objective of the Sakana Agency is to achieve complete decarbonization of the valley. As part of this effort, **a sustainable mobility plan will be developed during 2023-24** to meet legal requirements. Additionally, a cycling path will be constructed to connect all the villages in the valley, promoting alternative transportation methods and reducing car usage.

As for the thermal needs, a finalised plan has not yet been determined. During the meetings, one possibility under discussion was the creation of a unified district heating system that would connect all the involved municipalities. However, considering the current stage of the energy community's development, this option may not be feasible at the moment. Another proposal that received enthusiastic support was the **establishment of a logistic/pre-treatment centre to collect, dry, chip, and distribute biomass from the surrounding mountains to the villages in need**. This proposal aims to create a **shared biomass management system for all the municipalities involved**. Public buildings in selected pilot villages, such as Altsasu and Irurtzun, could install boilers fuelled by sustainable biomass, serving as demonstration cases. Once trust and confidence are gained, the model could be replicated in smaller villages, potentially expanding to individual household boilers. Exploring pellet production within the community may be necessary, as these boilers typically rely on pellets. **Additionally, district heating systems supplying heat to entire villages could be considered as a viable solution**.

The concept of the energy community draws parallels to successful projects like Ecopower in Belgium and the Italian case supported by FIPER. To avoid mistakes and learn from previous experiences, Sakana has been recommended to review the documentation of these projects. Technical catalogues, particularly those related to district heating and solid biofuel production, have been presented as valuable resources for their consideration.

Sakana's roadmap

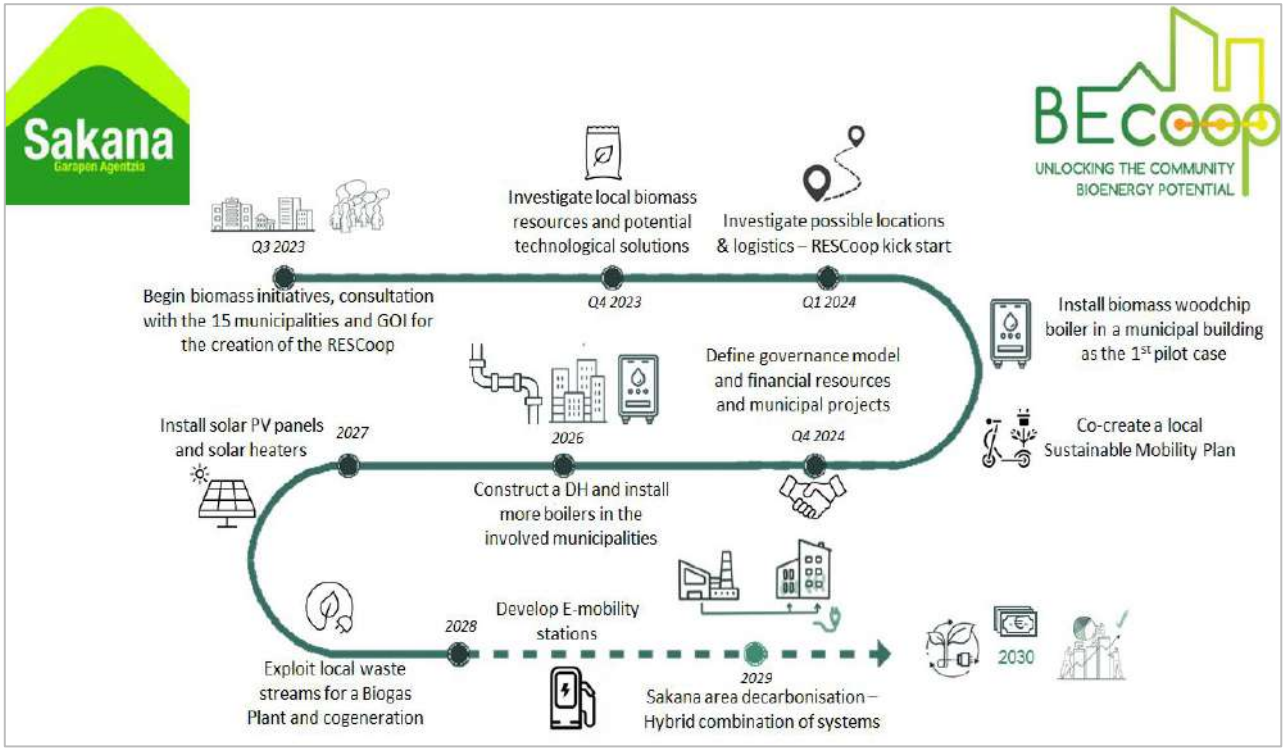


Figure 10. Sakana's Roadmap

A comprehensive scenario to kick-start bioenergy initiatives in the Sakana area has been envisioned by our BECoop consortium members. The following key elements have been identified:

Firstly, discussions **will be initiated with the 15 municipalities** to commence biomass initiatives and co-create the energy community under the guidance of Goiener. This collaborative approach will ensure active participation and involvement from all stakeholders. Secondly, a thorough investigation of local biomass resources will be conducted to **assess their potential for bioenergy**. This step will involve identifying the most suitable technological solutions for each municipality based on their specific requirements.

Next, possible project **locations will be explored**, and a robust **supply chain** for bioenergy projects **will be established**. This includes assessing framework conditions, determining biomass logistics such as collection, distribution, and storage, as well as selecting the appropriate solid biofuels. These preparatory steps are crucial in facilitating the official launch of the energy community. To showcase the viability and effectiveness of biomass innovation in the area, **a prototype biomass woodchip boiler will be installed in a municipal building as a demonstration case**. This initiative aims to raise awareness among the local community about the potential and benefits of bioenergy while encouraging public engagement.

In parallel, a **Sustainable Mobility Plan will be developed** to decarbonize the transport sector in the area. The plan will prioritize promoting cycling, incentivising locals to use bicycles, upgrading public transportation, and implementing e-mobility and biofuel initiatives.

Furthermore, specific projects will be defined for the area, including the **installation of residential biomass boilers and the construction of a District Heating network**. This will involve determining participating

municipalities, outlining governance and financial support requirements, and implementing the necessary infrastructure. The construction of these projects will provide thermal comfort, alleviate energy poverty, and offer sustainable heat to local residents by utilizing the available biomass resources.

Additionally, the **installation of residential solar panels and solar heaters** will allow community members to generate and utilize their own electricity or distribute excess energy to the local grid. Another crucial aspect of the initiative involves **harnessing the combined local waste streams, such as municipal waste, livestock manure, agricultural residues, and forest residues, for biogas production**. This approach offers not only a sustainable waste management solution but also generates renewable energy. **Biogas plants can be used for electricity production** through cogeneration units (CHP engines) and for biomethane upgrade to feed into the natural gas grid. These systems also provide heat energy to meet the thermal demands of nearby structures and **produce valuable fertiliser as a byproduct**, potentially creating a new market for locals.

Looking ahead to 2030, with a sufficient supply of renewable electricity in the local grid from the aforementioned initiatives, the Sakana area can progress by transitioning to electric vehicles and installing charging stations.

Collectively, these projects will enable a significant penetration of renewable heat and electricity in the area, making a substantial contribution to the decarbonization efforts of the Sakana energy community.

4.1.5 Challenges and Mitigation Strategies

On a technical level, several challenges have been identified, primarily stemming from the diversity of villages in the valley. Establishing a single solution to serve all these villages through a unified district heating network proves difficult. Consequently, various alternatives have been proposed:

- Building a logistic center for the storage and processing of the forest biomass under consideration.
- Installing small boilers to provide heat to public buildings.
- Setting up an initial heat network as a demonstration case to inspire other villages to adopt the same approach.

The next crucial steps involve engaging town councils and mayors from the valley in the proposed solutions.

4.1.6 Key outcomes and achievements

To further advance the establishment of the Sakana initiative and drive the development of their bioenergy projects, it is crucial to carefully consider the factors discussed and learn from previous experiences. The development of the roadmap will play a catalytic role in establishing the Sakana energy community, while the provided BECoop material will lead the development of their bioenergy projects. There is a need to improve the maturity of technical solutions, and the utilisation of technical catalogues can serve as a valuable guide in this regard. Despite being in the early stages of development, there is sufficient time and opportunity to accurately define the next steps, adopt effective technical solutions, and establish appropriate business models that involve the community and enhance user engagement within the valley. The case's self-assessment results -in the form of a spider net- conducted after the BECoop interventions can be found in Annex IV Cases' self-assessment results presented in spider-nets (when available)

4.2 Strzeszów (Poland)

Under-exploration initiative in Strzeszów, Poland:

In Strzeszów, Poland, an innovative initiative is currently in the theoretical exploration phase, led by an agricultural entrepreneur. The goal of this initiative is to establish a bioenergy cooperative that leverages the available resources present on a farm owned by the initiative team. The core of the project centres on the development of a Combined Heat and Power (CHP) district heating system. The primary aim is to produce both electricity and heat at the entrepreneur's biogas plant, with the intention of not only self-consumption but also distribution to nearby structures in the nearby area.

4.2.1 Background

The energy community is set to be established in Strzeszów, a commune in Wisznia Mała, Lower Silesia voivodeship, Poland. Led by an agricultural entrepreneur who owns 400 cattle and 500 hectares of farmland, the Bioenergy Cooperative is an innovative initiative aimed at exploiting the potential of available resources on the farm owned by the initiative team. The initiative team recognises the opportunity to utilise bioenergy for heating and electricity production, with the farm's biomass capable of covering an annual energy demand of 200-350 MWhth and 30-95 MWhel. Currently, a small biogas unit on the land produces energy for the owner's personal use but also generates surplus production, sparking the idea of establishing a cooperative.

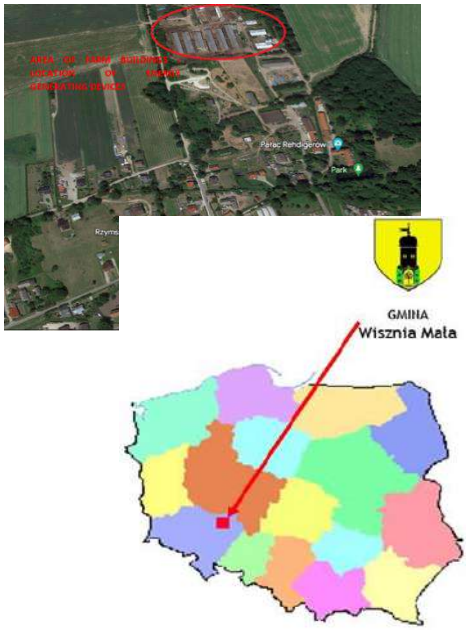


Figure 11. Strzeszów and the area of the farm buildings

The primary objective of the bioenergy cooperative is to leverage the excess energy from the existing biogas unit to meet the heating and power needs of the local community. By pooling resources and expertise with like-minded community members, the initiative team aims to create a sustainable and collaborative approach to energy production. This cooperative model will enable the expansion and optimization of the bioenergy infrastructure, ensuring the efficient utilisation of available resources.

Establishing the bioenergy cooperative serves multiple purposes. Firstly, it **promotes the use of renewable energy sources**, **reducing dependence on non-renewable fossil fuels and contributing to environmental sustainability**. Although the Wisznia Mała commune currently lacks an energy transformation plan, the area has witnessed the development of renewable energy systems, such as photovoltaic installations and biomass boilers. Secondly, **the cooperative aims to stimulate local economic growth by generating job opportunities** in the field of bioenergy production and maintenance. Additionally, the cooperative will **enhance energy security for the community, providing a reliable and self-sufficient heating and power source**. Unfortunately, specific statistical data on the region's current energy poverty was not available.

The bioenergy cooperative aligns with broader sustainable development goals, emphasising the utilisation of locally available resources to meet energy needs. Through collaborative efforts, it aspires to establish a model for decentralised bioenergy production that can be replicated in other communities, facilitating a transition towards cleaner and greener energy alternatives.

4.2.2 Stakeholder engagement

The bioenergy cooperative project was initiated by a local agri-entrepreneur who specialises in cattle breeding and grain cultivation. Word of mouth led representatives from WUELS to establish contact with him, and subsequent on-site meetings were conducted to explore the potential of his energy facilities, which include a container agricultural biogas plant and a biomass boiler for straw bales.

Given the **absence of a successful energy community in the region to serve as a model, the project initiator took the initiative to discuss the establishment of a bioenergy cooperative with neighbouring farmers and local entrepreneurs**. These individuals expressed their approval and willingness to join the cooperative in the future, demonstrating their support for the idea of introducing a renewable energy cooperative within the local community.

To further engage the community, **various awareness and engagement activities were proposed**. This includes organising informative sessions, such as **info days**, to present the facts and benefits of the project to the local community. **In-person meetings** with interested stakeholders were also suggested, aiming to provide a detailed explanation of the energy community concept and its potential advantages. Additionally, the project initiator was introduced to the "How to build your team" section of the BECoop Replication Handbook, which offers valuable guidance on assembling an effective team.

Table 6. Identified Stakeholders willing to support the project in Strzeszów

Types of Stakeholders	*Role in the project*
Agri-entrepreneur Biomass owner and provider, energy producer	RESCoop initiator
Energy consumers	RESCoop members

These efforts highlight the commitment to community involvement and knowledge sharing, with the ultimate goal of fostering a strong and supportive bioenergy cooperative within the local area.

4.2.3 Technical and Business support

In this particular case, the biomass resources available for the project include cattle manure and grain straw, with a significant contribution from approximately 400 cattle and 500 hectares of farmland. **The proposed technology for the community focuses on district heating**, which will be achieved through the **combined use of a biogas plant and a batch boiler for straw bales**. Furthermore, **electricity generation** will be facilitated by the cogeneration engine of the biogas plant.

In terms of energy demands that need to be met, the initiative team can leverage the available biomass resources to cover an annual energy demand that varies between 200-350 MWhth for heat and 30-95 MWhel for electricity, depending on the availability of substrates at any given time.

Based on the self-assessment tool's results (see Annex VI), several insights have been gained regarding the stakeholder's engagement with bioenergy initiatives and the potential for establishing a RESCoop.

It was noted that there is a lack of awareness regarding the potential needs and challenges associated with working with cattle manure. Additionally, the scope of duties as the future initiator of RESCoop, which includes being a producer and distributor of energy, was not fully grasped. To address these gaps, BECoop Deliverable 1.4 was presented, outlining proposed actions to tackle critical needs and challenges identified by stakeholders.

In addition, the initiative team did not consider the relationship between his energy demand and the biogas plant's production capacity when ordering its installation. This resulted in excess production exceeding the farm's consumption. A techno-economic feasibility assessment was recommended, taking into account the primary energy expected from biomass anaerobic digestion, using resources such as "Balancing Biogas Production and Energy Demand - energypedia."

Furthermore, the stakeholder highlighted the high heat demand in his area and was advised to estimate the number of customers required to ensure profitability. However, there are ***limited opportunities for potential partnerships with industries, the primary sector, and regional administrations in the region***, which could provide valuable support.

The initiator was also unaware of the presence of an agricultural cooperative in his area and needed to identify and engage with local farmers who did not utilise their agricultural residues, as these could be potential sources of biomass. Additionally, the stakeholder had not fully considered all the steps of the potential logistic value chain. They were introduced to the BECoop Toolkit and encouraged to familiarise themselves with pruning materials. Moreover, conducting soil morphology analyses on the farm is crucial to gain knowledge about the content of his biomass.

In terms of ecological awareness the initiator was ***unaware of the greenhouse gas emissions*** and had limited knowledge of environmental actions in his area. It was advised to use the Biograce II tool and consult the RESCoop Replication Handbook.

To ensure the successful technical implementation of the project, WUELS has provided substantial support and analytical assistance, particularly in the field of thermal conversion of agricultural substrates. This expertise will play a crucial role in optimizing the utilization of biomass resources and ensuring the efficient operation of the proposed district heating and electricity generation systems.

Based on the interactions with the BECoop business partners, ***the most suitable business model for the case appears to be the local integrated group of citizens***. With the agri-entrepreneur as the project initiator, the goal is to involve the extended family, local enterprises, and local authorities in establishing a Bioenergy Community. This model aligns with their vision of addressing a community need and focuses on small local projects, specifically utilizing biomass resources for district heating and electricity production. By utilising the surplus energy from the existing biogas unit, the cooperative aims to meet the heating and power demands of the local community.

Operating as an integrated group of citizens, the cooperative will function both independently and collaboratively, relying on volunteering efforts and limited employees to achieve its goals.

Given that the Strzeszów project is already underway, accessing national funding through various support programs is not feasible. Therefore, ***alternative funding schemes such as crowdfunding, EU funding, and collaboration with local enterprises are more suitable options***. Crowdfunding, in particular, allows for direct fundraising from the local community. Although convincing potential members may present an initial challenge, a well-structured crowdfunding campaign can mobilise the necessary funds to initiate and expand the project. Additionally, partnering with local enterprises, including local pellet producers, can provide access to additional capital and investment. Exploring EU funding options, such as the ERDF, which can be leveraged at the regional level for such initiatives, can also secure the financial resources needed for project implementation.

4.2.4 Community's concept and roadmap

The project focuses on the **creation of a CHP (Combined Heat and Power) district heating system**. The primary objective is to generate electricity and heat at the entrepreneur's biogas plant, which will be used

for self-consumption and distributed to neighbouring buildings in the area. This approach aims to address several problems that currently exist in the region.

Firstly, there is a significant untapped availability of biomass resources, specifically from cattle manure and straw. Secondly, the region has been experiencing energy poverty due to escalating fossil fuel costs. Thirdly, there is a lack of local awareness regarding the potential of biomass as a clean energy source. Additionally, there is a low level of environmental awareness among residents in rural areas. Furthermore, the absence of successful energy communities in Poland acts as a barrier in terms of having lighthouse cases to guide the project. Regulatory and institutional challenges also hinder the establishment and operation of energy cooperatives in the region. The availability of local biomass is subject to various external factors such as contradictory legal regulations, fluctuations in fertilizer prices, and unstable energy prices. Furthermore, there is still a strong subsidizing scheme for coal purchase, which further complicates the transition to renewable energy sources. Lastly, the cooperative initiative faces the challenge of low trust among potential participants.

To address these issues, the proposed solution involves the development of a CHP district heating system that capitalizes on the untapped biomass resources, including manure and agricultural residues. **The system will generate both electricity and heating, which will be distributed to the local community.** The key goals of this solution include decarbonizing the heating network by utilizing biomass, increasing environmental activity to reduce pollution in the region, and promoting the potential of biomass for clean energy production.

The RESCoop will be structured as a profit cooperative organisation and will offer district heating and electricity as its primary products and services. **The objectives of the RESCoop are twofold: to produce and supply heating and electricity to the citizens and to raise awareness about sustainability matters within the local community.** Additionally, the RESCoop will explore potential opportunities for funding and strive to **foster social integration among the local stakeholders**.

The project definition outlines its **core mission, which is to address energy poverty in the region and facilitate a transition from coal to renewable and clean energy sources.** It aims to be a pioneering initiative in constructing and operating a bioenergy-based RESCoop, marking the first of its kind in Poland. Additionally, the project's success has the potential to positively impact the perception of the commune and enhance the value of land in the area. The initiative aims to provide the local population with more **affordable energy options and greater independence from fluctuating fuel supplies**, which are influenced by global geopolitical factors.

In terms of short-term goals, the project aims to **educate the local community about the benefits of bioenergy and promote its adoption**. It also seeks to generate interest among positive activists who are willing to participate in the development of the energy community. Furthermore, the project plans to establish a biomass pellet production plant and install more than 4,000 biomass boilers in residential and public buildings. The initiative also aims to utilise local agroforestry residues as a biomass source. In the long term, the project aspires to develop a fully functioning energy community in the region.

Strzeszów's roadmap

In October 2020, the vision to start exploiting local biomass began with the initiative team's plan to construct a biomass boiler for straw bales and an agricultural micro biogas plant on the farm. This installation has been successfully completed, and the facilities are currently operational. As part of the BECoop project, in June 2023, representatives from WUELS collaborated with the initiative team to develop a rational roadmap for the establishment of a bioenergy cooperative, which the energy community -to be developed- will manage. His vision includes the transmission of heat to neighbouring buildings through a DH network.

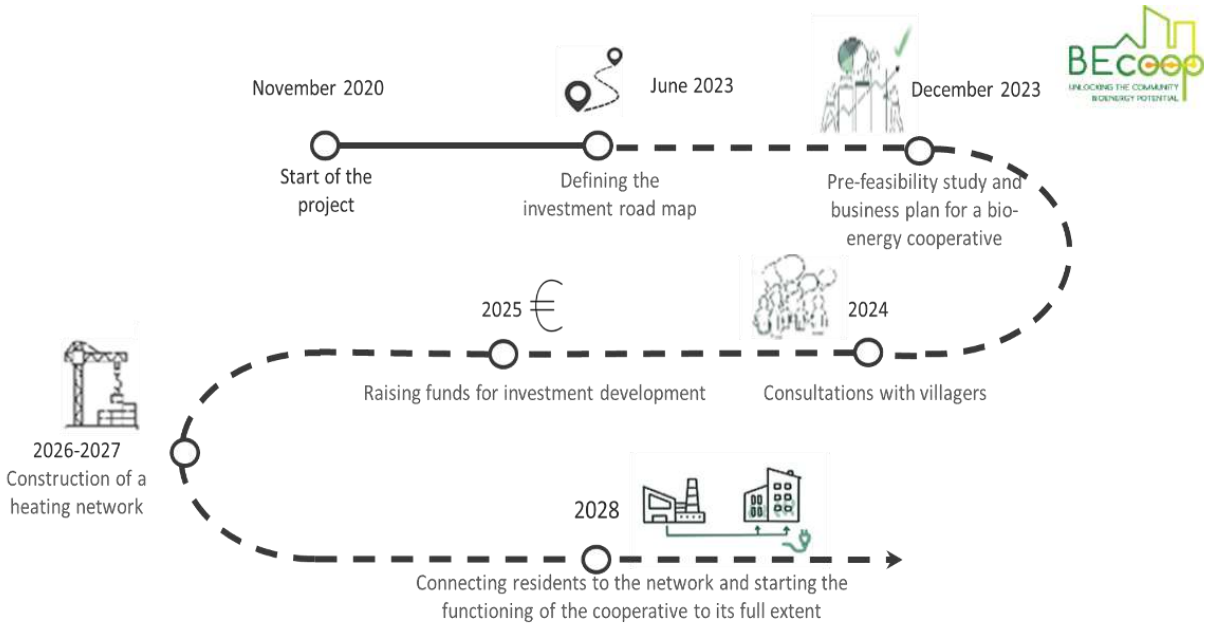


Figure 12. The Roadmap of the Strzeszów case

The roadmap outlines the project's timeline and key milestones. It is anticipated that by December 2023, a pre-feasibility study will be conducted for the investment, along with the preparation of a comprehensive business plan. The following year, 2024, will be dedicated to an information campaign where the stakeholder will introduce the concept of RESCoop to the local community and encourage their participation in the cooperative's structures. In 2025, the stakeholder will focus on raising funds to develop the RESCoop, aiming to secure national or EU funding. Additionally, the stakeholder plans to initiate a crowdfunding campaign to support the implementation of the investment proposed by the BECoop project partners.

If successful in obtaining the necessary funds for the years 2026-2027, the construction of a heating network is scheduled. By 2028, residents will be connected to the heating network, and the bioenergy cooperative will be fully operational, fulfilling its intended objectives.

4.2.5 Challenges and Mitigation Strategies

While working on the Polish follower case, several challenges have been identified. One of these challenges stems from the civic-minded behaviour and memories from the community's past. Another important aspect that plays a crucial role in Eastern European countries is the **negative social perception regarding cooperative structures and centrally planned economies** due to negative memories from the past. As a result, eastern European citizens sometimes show hesitation and scepticism towards the engagement in cooperative projects, which could be explained by the Soviet past of the populations.

Another significant challenge is the **high cost associated with constructing the district heating network**, with preliminary estimates ranging from several hundred to several million euros. Securing funds for this purpose is difficult due to the **absence of appropriate financial support programs** in Poland at present. The **lack of ecological awareness** within the local community and the **complex process of establishing a RESCoop**, which is time-consuming, may also serve as discouraging factors. Additionally, the initiative team's lack of experience in RESCoop operations, coupled with the **scarcity of good practice examples** in the region, further complicates the situation.

These challenges highlight the need for innovative approaches and targeted efforts to overcome misconceptions, secure financial resources, raise ecological awareness, simplify the RESCoop establishment

process, and provide guidance to the initiative team and other stakeholders involved. By addressing these challenges, it is possible to pave the way for the successful implementation of the bioenergy project and the establishment of a thriving energy cooperative in the region.

4.2.6 Key outcomes and achievements

The bioenergy cooperative in Strzeszów has been recognised for its significant development potential. One notable advantage is that the initiative team has been actively learning about the functioning of RESCoop to ensure preparedness for establishing the organisation. Following recommendations, they have enhanced their understanding of the potential logistics chain of the RESCoop and the tasks that lie ahead. The team is eager to share their experience and knowledge, contributing to the growth of the cooperative.

Moreover, the initiative team has made progress in the environmental and social aspects. He now acknowledges the disparity in pollutant emissions between the current fossil fuel-based solution and the RES-based solution. This increased ecological awareness can serve as a driving force in advancing the development of RESCoop and attracting new members. Additionally, the initiative team has complemented his investment profitability analysis by incorporating periodic operating costs, resulting in a comprehensive assessment.

The 2nd self-assessment results revealed notable improvements in the stakeholders' knowledge and understanding across various aspects of the project. Among others, the initiative team now demonstrates an enhanced understanding of the potential needs and challenges associated with working with cattle manure. They have embraced their role as the future initiator of a RESCoop, acknowledging the responsibilities of being a producer and distributor of energy. This progress can be attributed to their exposure to BECoop resources, such as Deliverable 1.4, which provided valuable insights. Although limited partnership opportunities were once more highlighted, the stakeholders acknowledge the high heat demand in the region.

Furthermore, the technical maturity of the solution showcases significant improvement, as the stakeholders conducted a thorough analysis of electricity and thermal energy supply demands. Additionally, they identified interested customers and considered the logistic value chain and the final form of harvested agricultural residue. Moreover, the business and financial solution maturity has improved, as the stakeholders now include operating costs associated with each step of the supply chain in the economic analysis. The knowledge around the "social and environmental impact" has significantly improved as well. They are now aware of the GHG emissions from the bioenergy chain and have discovered pro-environmental campaigns in the area, which can positively influence the development of the bioenergy cooperative. The results of the case's self-assessment both before and after the BECoop interventions are featured in Annex IV Cases' self-assessment results presented in spider-nets (when available)

These advancements demonstrate the initiative team's growing knowledge, environmental consciousness, and financial considerations. With these positive developments, the initiative is well-positioned for further progress and success in its mission of sustainable energy production and community engagement. Through the combined efforts of the community members, and the support of relevant stakeholders, the bioenergy cooperative in Strzeszów can pave the way for a sustainable and prosperous future, contributing to the region's energy transition and fostering local resilience.

4.3 Macugnaga (Italy)

Under-exploration initiative - Macugnaga, Italy:

In the mountainous region of Macugnaga, Italy, a local forest association is in the process of creating a forest-wood energy supply chain from scratch. This endeavour encompasses the revitalisation of currently underutilized forests and harnessing biomass as a fuel source for a biomass district heating plant. The envisioned strategy entails the implementation of a cogeneration system to support a micro-district heating network, specifically designed to supply heat to public buildings.

4.3.1 Background

Macugnaga in Italy is a mountain municipality known for its thriving tourism industry. The region's rich natural resources, including hydroelectric power and abundant forests, present promising opportunities for harnessing local energy sources.

Figure 13: Pictures and the map of the Macugnaga region in Italy

The energy demands in Macugnaga primarily revolve around several key buildings, totalling approximately 785kW of installed power. These buildings, located in the central town area, encompass various establishments such as a swimming pool, a parish house, a tourist residential condominium, a nursery, a conference hall, two residential condominiums, and a hotel. Currently, these structures heavily rely on natural gas boilers for their energy needs.

Similar to the Italian pilot case in the BECoop project, the follower case in Macugnaga aims to **establish a forest-wood energy supply chain from scratch.** However, this case is smaller in scale, as it involves a population of 512 inhabitants residing in the town, along with owners of second homes.

To ensure the success of this initiative, valuable lessons learned from existing BECoop RESCoops can be applied. These lessons include adopting a multisource approach to energy system design, fostering collaborations between the public and private sectors, considering the availability of public subsidies for RE production and RE Certificates, and conducting accurate assessments of the biomass potential in the region. Furthermore, exploring opportunities for EU project funding can provide additional support for the project's development and implementation.

4.3.2 Stakeholder engagement

The **local association AMVA (Associazione Promozione e Sviluppo Macugnaga e Valle Anzasca) plays an active role in forest management initiatives and is keen to explore the potential of using local biomass for energy production**. As the initiator of the project, AMVA will spearhead the efforts in establishing a bioenergy community in Macugnaga.

Continuous communication has been maintained with the initiators of the project and various stakeholders, including representatives from the community, FIPER, POLIMI, and BECoop partners. These interactions have involved meetings, phone calls, and email exchanges. It has been noted that there are currently no existing energy communities in the region, but the local community has shown a favourable attitude towards the establishment of a bioenergy community. However, there is a need to fully capture the attention of the municipality and engage the public administration in the initiative. **To achieve this, on-site initiatives focusing on forest management and renewable resources need to be implemented to raise awareness and garner support from citizens**.

Several ideas for future awareness and engagement activities have been proposed. **These include organising informative info-days, interactive workshops, and events to educate citizens about woodland management and the utilisation of renewable resources**. Furthermore, a local fair was scheduled, providing a valuable platform to inform local people and stakeholders about the initiative. Additionally, conducting a pre-feasibility analysis to estimate the costs and benefits for users/prosumers will be crucial in further engaging the local community and gaining their support for the project.

Table 7. Identified Stakeholders willing to support the project in Macugnaga

Types of Stakeholders	*Role in the project*
Association promoting activities for the conservation and management of forest heritage. It has initiated a biomass-based district heating project.	Initiator
Design offices and companies	Support the technical implementation
National Association of renewable energy producers. It has offered its support, within the BECoop project, for the development of the forest-wood-energy supply chain.	Support the development of the concept

4.3.3 Technical and Business support

In the Macugnaga follower case, technical support services play a crucial role in assessing the availability of local biomass sources and identifying suitable options for energy production. The municipality encompasses a forest area of 770 hectares, with 550 hectares falling within the Special Protection Zone, which may have certain limitations. The estimated reachable and usable surface area for biomass extraction is approximately 250 to 300 hectares. Moreover, there is a significant amount of vegetation present in the outskirts, along access roads, and near water sources that can be cleared and managed to serve as an additional biomass supply.

Regarding the envisioned technology for this case, the focus is on **utilising a biomass boiler or CHP system**, depending on the final size and thermal demand of the connected network. Initial assessments have identified a small area in the heart of Macugnaga as a potential user base for the project. To accommodate this, **plans are underway to establish a micro-district heating network spanning 150 meters**. The selected system is expected to have a thermal power capacity of at least 400/500 kW, and the possibility of cogeneration, producing both heat and power, will be explored using compatible components.

In addition to these technical assessments, the technical support services provided include sharing BECoop catalogues and factsheets. These resources offer valuable insights into available solutions specific to this initiative, aiding in the decision-making process and facilitating informed choices for the project's implementation.

In this given case, the most suitable plan from the business catalogue appears to be the **multi-stakeholder governance model**, which seems highly appropriate given the complexity of the project. This approach would allow for collaboration and input from various stakeholders, ensuring a well-rounded and inclusive decision-making process. However, the most critical challenge lies in determining the right funding.

During the exchanges with the local stakeholders, the lack of competencies in developing a business model emerged together with the necessity to find out suitable funding for the design and realization of the biomass DH system. Therefore, it is imperative to address their issue effectively to move forward. There are potential opportunities for securing funding from various sources, including European, national, or regional funding options, which could provide substantial support for the initiative. Additionally, **exploring crowdfunding opportunities could be a viable option to gather support on a smaller scale, engaging the community and creating a sense of ownership for the project**.

4.3.4 Community's concept and roadmap

The selected concept for Macugnaga revolves around the **establishment of a forest-wood-energy supply chain, which entails revitalising currently neglected forests and utilising biomass as a fuel source for a biomass district heating plant**. The proposed plan involves installing a **cogeneration system to support a micro-district heating network that will supply heat to public buildings**. Currently, there is a suggestion for a cogeneration system with a thermal capacity of 400 kW and an electrical capacity of 100 kW, with an estimated biomass supply of around 2000 tons per year (preliminary information subject to verification).

Figure 14. The concept figure of the Macugnaga case

These public buildings, located in the central area of the town, comprise a swimming pool, a parish house, a tourist residential condominium, a nursery, a conference hall, two residential condominiums, and a hotel. Additional residential users can be connected in subsequent stages. However, a potential challenge arises from the fact that many of these buildings serve as second homes for tourists, resulting in low heat demand throughout the year. Addressing this issue may require tailored approaches to ensure their participation in the biomass district heating system.

Figure 15. Identified challenges and mitigation measures for Macugnaga

Macugnaga's roadmap

Based on the collected information, the following hypothesis outlines the proposed timeline and milestones for the Macugnaga case. In 2023, the initial steps involve defining the project and selecting potential funding sources. Concurrently, a local awareness campaign will be launched to engage with stakeholders in the area. This phase also includes identifying potential beneficiaries and determining the appropriate sizing of the biomass plant. Moving into 2024, the focus shifts towards developing financing strategies and securing the necessary funding. A comprehensive analysis of biomass availability and associated costs will be conducted. Collaboration with regional and European authorities will be sought to establish effective partnerships. Additionally, exploring the possibility of negotiations with the operators of the natural gas network will be explored.

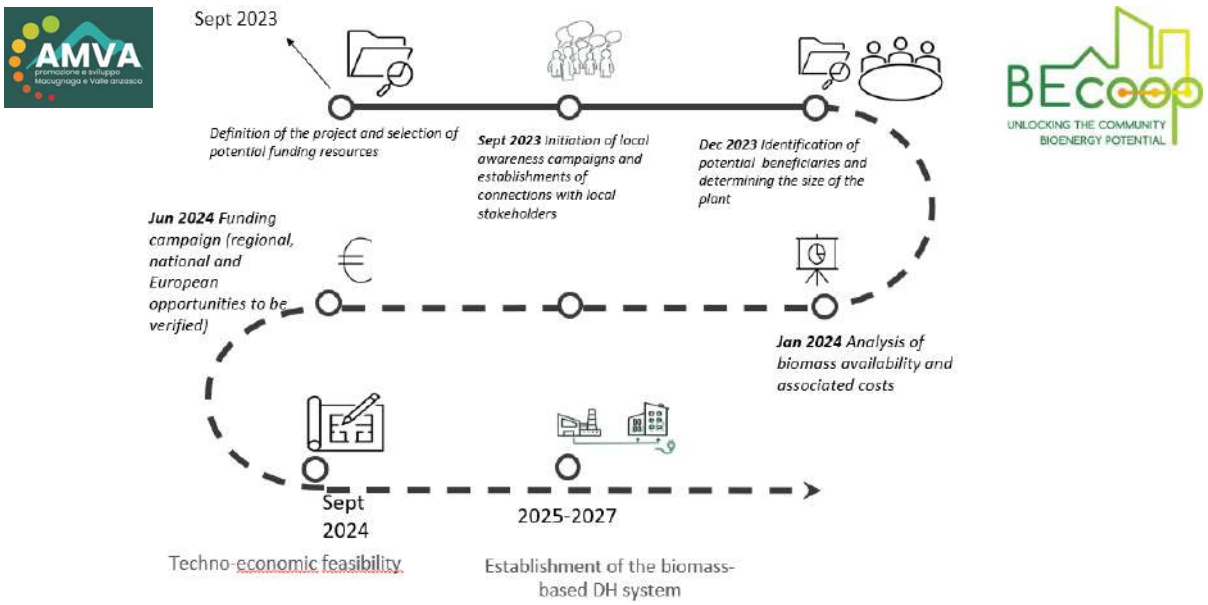


Figure 16. The roadmap for the Macugnaga case

From 2025 to 2027, the project will enter the implementation phase. The biomass-based district heating system will be established, ensuring its efficient operation and management. Continuous monitoring and evaluation of the project's impact on energy sustainability and local communities will be carried out. Ongoing collaboration with stakeholders will be fostered to optimize system performance and address any challenges that may arise.

Table 8. Macugnaga case project schedule and key milestones

Project Schedule, Milestones				
Critical Milestone	**Description**	**Due Date**	**Project Phase**	**Stakeholders Involved**
MS1 Launch of the Project	The willingness of the community to support the project	2023	Project definition and presentation	AMVA; BECoop partners; Local Entities; Citizens; Curia Mayor
MS2 Presentation and Refining of the project	Definition of the roadmap and sharing with local stakeholders. Possible opposition by some of them	2024	Roadmap definition and presentation	AMVA; Local Entities;FIPER Citizens/ Prosumers; Curia Mayor
MS3 Definition of the Biomass Supply	Agreement with owners/ prosumers	2024	Pre-feasibility	AMVA Local Entities Financial Institutions FIPER Citizens/ Prosumers Curia Mayor Designers Companies
MS4 Definition of the Possible Final Users	Agreement and Offer for Local Citizens	2024	Pre-feasibility	
MS5 Techno-Economic Feasibility; Funding and Governance Options	Definition of the actual features of the project, Business Plan	2025	Feasibility	
MS6 Final Implementation	Design, Implementation and Realization of the Project	2026-2027	Design, realization and testing of the system	

4.3.5 Challenges and Mitigation Strategies

The successful implementation and realisation of the case are influenced by several key factors. First and foremost is the level of **support from the local municipality and community**. Their endorsement is crucial for the project's viability and progress. Furthermore, **limited awareness of funding opportunities** can pose a challenge, as accessing the necessary financial resources becomes difficult without knowledge of available funding sources.

When determining the size and type of the energy plant, it is essential to account for the **variability in energy demand**. In this particular area, where many houses serve as holiday premises, fixed consumption patterns are scarce, and seasonal peaks must be considered.

Lastly, the **availability of biomass** is a significant consideration. Different areas may have varying levels of biomass utilisation based on factors such as accessibility and cost-effectiveness. Some regions may have abundant and low-cost biomass sources, while others may face challenges in accessing and utilizing biomass due to limited availability and higher costs. Considering these factors ensures a comprehensive approach to the project's planning and execution.

4.3.6 Key outcomes and achievements

The overall objective of this case remains focused on improving forest management and establishing a forest-wood-energy supply chain. This initiative aims to mitigate the risk of wildfires and hydrogeological instability in the region by promoting sustainable forest practices. Moving forward, the upcoming period will be dedicated to conducting pre-design activities and exploring potential funding solutions. These activities will lay the foundation for the project's development and help pave the way for its successful implementation.

The case's self-assessment results -in the form of a spider net- conducted before the BECoop interventions can be found in Annex IV Cases' self-assessment results presented in spider-nets (when available)

4.4 Minoan Energy Community - MEC (Greece)

Under-exploration initiative - Minoan Energy Community, Greece:

An already active community in Crete and known for its work in photovoltaics, is expanding its horizons into the world of bioenergy. They aim to tap into the potential of residual biomass resources, such as prunings from local olive trees, to produce biofuels. Their first project will be the installation of a 500 kW biomass boiler in a public swimming pool, which will be powered by locally harvested, chipped olive tree prunings.

4.4.1 Background

Located in Crete, Greece, the Minoan Energy Community (MEC) was established in October 2019 in the small town of Arkalochori. Initially founded by 38 members, it has grown to become the largest energy community in Greece, boasting 650 members. Among its members are four municipalities: the Regional Authority of Crete, the Holy Metropolis of Arkalochori, Kasteli, and Viannos, municipal corporations for Irrigation and Water Supply, commercial and agricultural cooperatives, and numerous individuals.

Figure 17. The location of the follower case in Greece and a picture from the local area

MEC's primary objective is to play a regulatory and leading role in implementing energy transition throughout Crete. The community believes that energy transition can pave the way for fair, rational, and sustainable economic and social development for all Cretans. To achieve this, MEC plans to harness various RE sources in Crete, including photovoltaics and solar thermal collectors for electricity and heat production, wind parks and small wind turbines, CHP plants operating with biomass, and DH. They also emphasise implementing energy-saving measures in buildings and other facilities. In their future plans, MEC aims to implement the first large-scale wind park, over 10 MW of photovoltaics, energy-saving initiatives for municipal facilities, and the establishment of pilot cogeneration plants within the next 3–5 years.

When comparing this case to our BECoop RESCoops and pilots, it shares similarities with the Energy Community of Karditsa in Greece. **The MEC's abundant potential lies in utilising the prunings of olive oil trees to meet the thermal demands of the local community**.

4.4.2 Stakeholder engagement

As mentioned earlier, MEC was established in 2019 and has been actively harnessing renewable resources for the energy transition in the region. Currently, they are exploring the expansion of their activities to include the exploitation of untapped biomass for heat and electricity production.

Several meetings were organised with representatives of MEC to discuss their objectives and explore the potential of bioenergy.

Table 9. Identified Stakeholders willing to support the project of Minoan

Types of Stakeholders	*Role in the project*
Existing Energy Community	RESCoop initiator
Biomass Owners and Providers	RESCoop members
Energy consumer	RESCoop member /Supporting implementation
Biomass owner and provider	RESCoop members
Energy consumer	RESCoop members / beneficiaries

In Crete, there are a total of 48 energy communities, but none exist in the region of Heraklion, where MEC operates. Being the largest energy community in Greece with 650 members, it is evident that the local community is favourable towards the expansion of its activities into the exploitation of local biomass and the field of bioenergy.

To increase engagement within the local community, activities for raising awareness and involvement can be conducted. This may include organising information days, workshops, and community events to highlight the advantages of bioenergy and emphasise the role of the community in implementing this expansion towards bioenergy. Additionally, informative materials, videos, and online platforms can be employed to promote greater community participation. Pictures from meetings and community events can be shared through various channels to showcase the progress and success of MEC's involvement in the bioenergy field, further inspiring public support and participation.

4.4.3 Technical and Business support

The follower case area has several untapped biomass sources, such as pruning from olive trees, manure from stock farming (mainly sheep and goats), urban organic wastes, and greenhouse residues. During the bilateral calls with the follower case, the MEC expressed its interest in the **exploitation of olive tree prunings, currently being burned in open fires, towards bioenergy production**. The area has more than 2,350 km2 of olive trees or more than 27,000,000 olive trees. If we assume that 20,000,000 of them are pruned every year and that each tree produces about 20 kg of dry matter, then it is calculated that around 400,000 tn (dry matter) of olive tree prunings (produced mainly during February and March) would be available. It can further be estimated that considering each kg of dry matter from olive tree pruning can produce around 0.5 kg of pellets, approximately 200,000 tn of olive pruning pellets can be produced in theory. Additionally, 50,000 tn of olive kernels are produced from the olive mills (from November to February), and around 1,000,000 tn of manure (of which 50% can be collected throughout the whole year) and 60,000 tn of organic urban waste are roughly estimated to be available throughout the whole year. In brief, only by exploiting the available olive tree prunings in Crete would it produce more than 500,000 MWhth annually.

During the calls with the MEC, CERTH presented several ways to exploit the olive tree prunings along with their pros and cons, such as the installation of biomass boilers in houses and public buildings, biomass District heating systems or biomass Cogeneration units, pellet plants, and biogas facilities. It was suggested by the technical partner that the first step for the exploitation of local olive tree prunings by the MEC would preferably be to start with the installation of a biomass boiler in a public building. **The heating of the municipal, Olympic-size swimming pool in Arkalochori, together with the construction of an enclosure that will upgrade it from an outdoor to an indoor facility, was proposed as a perfect "candidate" as an end-user**

for the locally harvested olive prunings. The current swimming pool centre's annual heating demand is 2,250 MWhth. Thus, the proposed bio-based activity would be the installation of a biomass boiler (500 kW) in a public swimming pool, fuelled by harvested local olive tree prunings (chipped). The technical partners provided the follower case with technical and economic data for such biomass boiler systems that were also used for the performance of the feasibility study of the follower case.

Figure 18. The swimming pool where a biomass boiler can be installed

Further to this information, CERTH based on its past experience in the exploitation of olive tree prunings from previous projects, provided material, information, and results on the logistics (e.g., harvesting, storage, haulage) of olive tree prunings and their end-use (production of pellets, heat, electricity, bio-commodities, etc.). Commercial harvesting machines suitable to be used in the Greek olive farms were presented to the follower case, along with performance indicators and corresponding costs for the whole value chain of olive tree pruning (from field to end-use). Moreover, due to the interest of the follower case in the investment in a CHP plant, CERTH provided information/data on an existing CHP plant (1 MWe) in Italy that is fuelled only by olive tree prunings.

In brief, the technical support services offered to the follower case were the following:

- **Suggestion to use olive tree pruning by-products** as a readily available and untapped resource. Investigation of the possibility of utilizing municipal tree prunings was also suggested by the BECoop partners. For such biomass feedstock, biogas facilities have to be considered.
- **Discussion on biomass conversion technologies** that could be used to exploit available local biomass (biomass boilers, DH/CHP plants, pellet plants, etc.).
- The proposal for the follower case to start with the **installation of a 500-kW biomass boiler (fueled by olive tree prunings) in a public swimming pool**. Technical information (and corresponding costs) was provided regarding the installation and operation of such a system.
- Information on the collection and processing of olive prunings was also provided by CERTH.
- **The immediate energy demands to be covered** are those of a municipal, Olympic-size swimming pool in Arkalochori, along with the construction of an enclosure that will upgrade it from an outdoor to an indoor facility. The current heating load of the facility is 2,250 MWhth.
- The community expressed great **interest in the prospect of developing a CHP plant** in the future. Relevant data on existing CHP plants (fueled by olive tree prunings) was provided by CERTH. However, it was suggested to dismiss this option for now due to the higher cost and potential supply of such feedstock, as the follower case has no experience in managing or handling it yet.
- **Introduction to and provision of BECoop material,** e.g., Replication handbook, technical catalogues, and factsheets, BECoop tools (BECoop toolkit, self-assessment, e-market environment, KEP), deliverables regarding technical support services (D4.2) to the follower case.

The follower case also received robust business support to advance their energy community initiatives. They were provided with specialised business templates, enabling them to craft a comprehensive business plan

tailored to their specific goals. The valuable business plans of ESEK and OBS served as exemplary models, offering insights into successful biomass boiler installations in public buildings and the construction of pellet production plants with residential boiler setups, respectively. **Additionally, a prefeasibility study was conducted, focusing on the follower case's initial idea of installing a 500kW biomass boiler in a public swimming pool**. The results from this analysis provided vital data to guide their future endeavours and can be found below:

Table 10. The results of the prefeasibility study for the Minoan case

CUMULATIVE CASH FLOWS								
Years	CAPEX €	OPEX €	Inflation Rate	Energy Savings €	Cash flow €	Cumulative €	PV €	NPV €
0	470.000	74.983	2,00%	0	-544.983	-544.983	-544.983	-544.983
1		74.983	2,00%	223.872	148.889	-396.094	145.969	-399.014
2		74.983	2,00%	223.872	148.889	-247.205	143.107	-255.906
3		74.983	2,00%	223.872	148.889	-98.317	140.301	-115.605
4		74.983	2,00%	223.872	148.889	50.572	137.550	21.945
5		74.983	2,00%	223.872	148.889	199.461	134.853	156.798
6		74.983	2,00%	223.872	148.889	348.350	132.209	289.007
7		74.983	2,00%	223.872	148.889	497.239	129.617	418.624
8		74.983	2,00%	223.872	148.889	646.127	127.075	545.699
9		74.983	2,00%	223.872	148.889	795.016	124.584	670.283
10		74.983	2,00%	223.872	148.889	943.905	122.141	792.423
11		74.983	2,00%	223.872	148.889	1.092.794	119.746	912.169
12		74.983	2,00%	223.872	148.889	1.241.683	117.398	1.029.567
13		74.983	2,00%	223.872	148.889	1.390.572	115.096	1.144.663
14		74.983	2,00%	223.872	148.889	1.539.460	112.839	1.257.502
15		74.983	2,00%	223.872	148.889	1.688.349	110.627	1.368.129
16		74.983	2,00%	223.872	148.889	1.837.238	108.457	1.476.586
17		74.983	2,00%	223.872	148.889	1.986.127	106.331	1.582.917
18		74.983	2,00%	223.872	148.889	2.135.016	104.246	1.687.163
19		74.983	2,00%	223.872	148.889	2.283.904	102.202	1.789.365
20		74.983	2,00%	223.872	148.889	2.432.793	100.198	**1.889.562**

The breakdown of the costs can be seen below:

CAPEX

- 500 kW biomass woodchip boiler – 320.000 €
- Prunings collector and demolisher – 20.000 €
- System installation and configuration – 130.000 €

OPEX

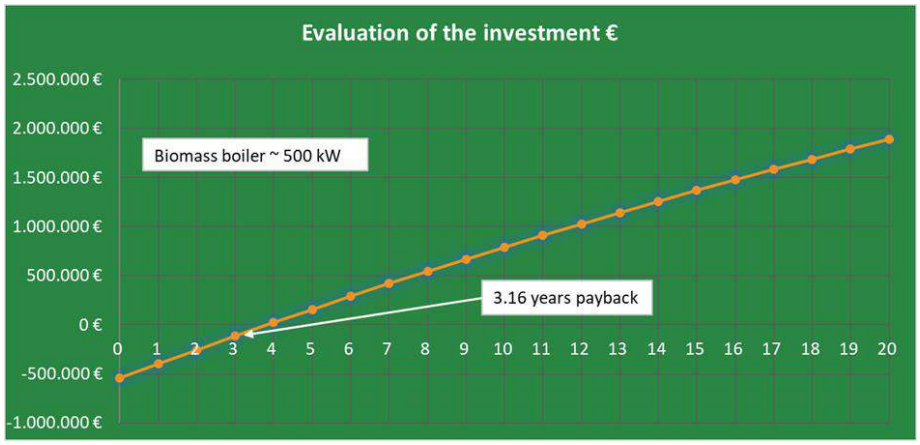
- Biomass logistics (collection, distribution, storage) + labour costs 42 €/tn
- Machinery depreciation 20 €/tn
- Operation & Maintenance of the boiler and the machine 20 €/tn

Energy Savings

- Diesel fuel costs (0.188 €/KWh, th)
- Electricity (0.187 €/KWh, th)
- 1.85 safety factor due to energy crisis and fluctuations

The results of the feasibility along with the calculation of the financial indicators are presented below:

Table 11. Feasibility study results and calculation of the financial indicators for the Minoan case



NPV=	1.889.562 €
ROI =	27.32%
Payback =	3.16 years
IRR =	24.60%

4.4.4 Community's concept and roadmap

The Minoan Energy Community is a well-established and active participant in the local renewable energy landscape, primarily focusing on solar and wind energy. However, the community is now looking to venture into the bioenergy field and incorporate biomass-based innovation into its existing portfolio and projects.

Opening a new chapter in bioenergy presents some challenges for an energy community that has solely dealt with solar and wind energy. These challenges include the **availability of insufficient biomass resources** and **uncertainty about the most effective bioenergy technologies**. Additionally, there are doubts regarding the appropriate biomass technology system that best suits their needs. Furthermore, the **lack of knowledge and experience in exploiting local biomass sources** poses another obstacle, as does the absence of guidance and consultation support for implementing their bioenergy vision.

BECoop, in its current role, aims to address these challenges and provide the necessary support to the MEC in developing and implementing their biomass vision. The upcoming section will present a roadmap that, combined with the mentioned support material, will guide MEC step-by-step towards the successful realization of its bioenergy goals.

Minoan's roadmap

The process began with initial conversations between the follower case, BECoop partners, and local stakeholders who are relevant. These discussions were about incorporating biomass innovation into the energy community's range of activities. As the BECoop project nears its completion, the Minoan energy community plans to thoroughly investigate all potential biomass resources and explore the various technologies that can enhance bioenergy utilization in the local area. The BECoop consortium partners, particularly ESEK, CERTH, and Q-PLAN, will continue to offer their expertise and support to the follower case even after the project concludes, guiding the energy community towards its bioenergy vision.

To gradually develop its bioenergy solutions, Minoan, as a newcomer to the biomass sector, is advised to **initiate a pilot installation of a biomass woodchip boiler in a public building**, preferably a swimming pool. Detailed calculations based on Minoan's data indicate that a 500 kW biomass boiler can adequately cover the specific energy demands of the pool. This prototype boiler installation will introduce biomass and bioenergy heating technologies to the local community, generating a growing interest in local biomass exploitation for heating purposes. It will also serve as proof of the effectiveness of bioenergy technologies, **attracting collaboration from local public authorities and increasing the community's enthusiasm to**

engage in such projects. The business plan of the Greek RESCoop case will play a crucial role in advancing this initiative.

Subsequently, the energy community will investigate potential locations, routes, and logistics for future bioenergy projects, specifically **a pellet production plant** with a capacity of around 3,000 tn/year. **The plant aims to supply the necessary solid biofuel to meet the heating demands of approximately 800 houses in the Arkalochori area**. Residential biomass boilers are seen as an efficient and competitive alternative to conventional fossil fuel options in the region. The Polish business plan will play a pivotal role in the successful implementation of these actions.

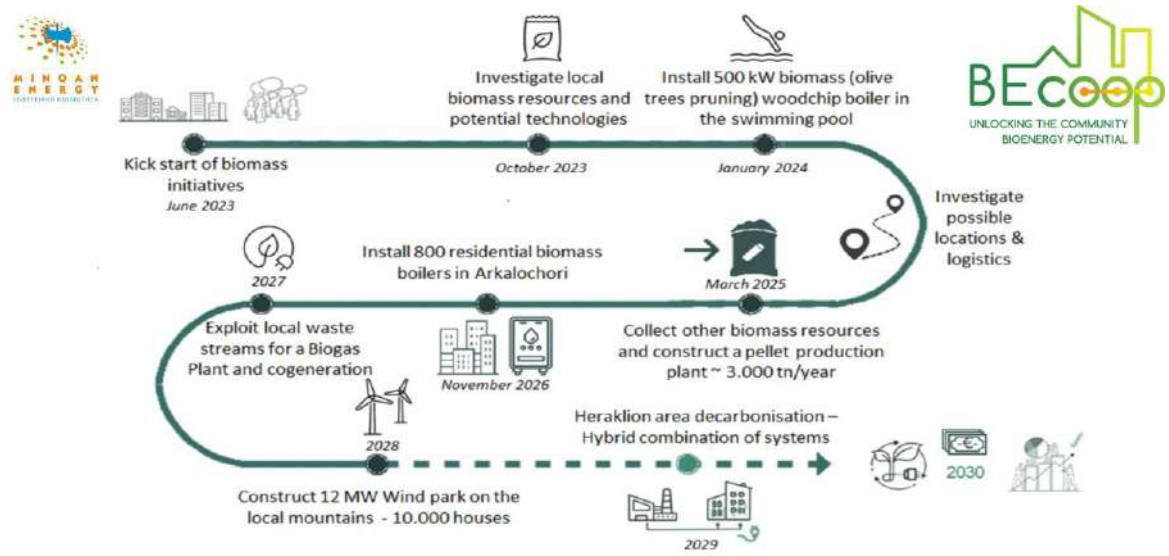


Figure 19. The roadmap for the Minoan case

Moreover, the energy community should explore the potential of other biomass sources, such as waste streams, to produce biogas. **Utilizing municipal waste, livestock farming manure, agricultural residues, industrial waste, and more for biogas production could facilitate cogeneration of electricity, which can then be distributed to the local grid**. Concurrently, Minoan will continue developing other renewable energy projects, including residential PV panels, solar parks, and onshore wind farms, with the goal of achieving a nominal power output of 12 MW, sufficient to cover the energy demands of 10,000 residential houses.

Collectively, these steps will significantly increase the share of renewable energy in the heating and electricity grid, contributing substantially to the decarbonization of the local area. As a pioneer in these endeavours, the Minoan energy community will follow the current roadmap, particularly in the bioenergy field, to guide its actions and achieve its ambitious goals.

4.4.5 Challenges and Mitigation Strategies

Minoa Energy Community (MEC) stands as a well-established energy community, boasting significant achievements. However, amidst its success, certain challenges have come to light. These include uncertainties surrounding the most suitable biomass technology system to meet their specific needs, a lack of expertise and experience in harnessing local biomass sources like olive tree prunings, and limited knowledge about bioenergy projects when not supported by appropriate collaborators. Furthermore, MEC faces the absence of clear guidance and a comprehensive roadmap for implementing bioenergy projects, compounded by a dearth of accessible funding mechanisms. Despite these obstacles, the potential solution lies in implementing the BECoop roadmap, leveraging the existing resources, and capitalizing on MEC's

enthusiastic network. With the right strategy and support, Minoa Energy Community will overcome these challenges, further advancing its mission to drive sustainable energy initiatives in the region.

4.4.6 Key outcomes and achievements

The Minoan Energy Community stands as one of the largest energy communities in Greece, however, their current focus primarily revolves around solar and wind energy projects, leaving their abundant local biomass resources largely untapped. Recognizing the immense potential in local biomass exploitation, the follower case has prioritized delving into this sector in the near future. Nevertheless, they face a significant knowledge gap in effectively handling and exploiting these resources, particularly olive tree prunings.

To bridge this knowledge gap and guide the follower case towards successful biomass-based activities, several productive discussions were organised between the BECoop partners (CERTH, ESEK, QPLAN, CBS) and the follower case. The primary objective was to transfer crucial knowledge from the BECoop activities, specifically relating to the development of biomass-based initiatives within energy communities. The valuable support actions provided by the BECoop partners included sharing BECoop materials and tools developed throughout the project, offering technical insights on local biomass exploitation, assisting in the follower case's feasibility study, and collectively formulating a roadmap and bioenergy vision for their immediate future.

4.5 Ecopower (Belgium)

Under-exploration initiative - Ecopower, Belgium:

As one of the pioneering RESCoops in the European Union, Ecopower has a well-established presence in various renewable energy sources. They're now setting their sights on a comprehensive exploration of the biomass sector and the implementation of district heating solutions in several Belgian towns, with a particular focus on the northern region. At the heart of the project is the efficient and cost-effective production of wood chips, which will play a vital role in the district heating projects.

4.5.1 Background

Ecopower is a Belgian cooperative that was founded in 1991 with a mission to finance renewable energy projects in Flanders. Following the liberalisation of the energy market in Flanders in July 2003, Ecopower transitioned into a supplier of green electricity produced within Belgium. By the end of 2010, they were supplying 1% of Flemish households with green electricity, setting an inspiring example for other energy cooperatives across Europe. Presently, these energy cooperatives control approximately 10% of the market in the region.

Figure 20. Map of Ecopower's existing RE projects

As part of their renewable energy initiatives, Ecopower purchases and constructs renewable electricity units, including wind turbines and water turbines, within Belgium. Noteworthy projects in recent years have included wind turbines in Eeklo, Gistel, and Ghent, as well as hydroelectric turbines in Rotselaar, Hoegaarden, and Overijse. In collaboration with ECoOB (another cooperative), Ecopower launched a solar-energy project in Leuven in 2020, involving the installation of solar panels on 10 public roofs and inviting citizens to become co-owners.

While Ecopower has been actively engaged in various renewable energy sources, they have yet to extensively explore the biomass field. Presently, they operate a single pellet plant with a production capacity of 11,000 tn/year, sufficient to supply solid biofuel to approximately 7,500 households for their heat demands. The cooperative boasts an impressive 50,000 members, with 40% of Ecopower clients having already installed solar panels on their buildings.

Notably, Ecopower is a member of the European group of renewable cooperatives, REScoop.eu, contributing to the broader movement of promoting renewable energy and sustainable practices across the continent.

4.5.2 Stakeholder engagement

There are already numerous stakeholders actively involved in the community actions, as Ecopower has been highly engaged in renewable energy projects for many years. However, to explore and develop bioenergy concepts further, Ecopower needs to engage specific stakeholder groups.

Table 12. Identified Stakeholders willing to support the project of Ecopower

Type of Stakeholders	*Role in the project*
Citizens community	Will be engaged with the roadmap and the overall ECOPOWER concept so to establish energy communities that will lead the bioenergy projects.
Bio-based business and bioeconomy experts	Will collaborate with ECOPOWER for the sound elaboration of their biomass projects and activities with an entrepreneurial approach.
Biotechnology experts	Will assist the design, implementation, operation and maintenance of the bioenergy projects.
Public authorities	Will contribute and assist with various ways into the development of local bioenergy projects, especially in rural areas
Policy makers	In collaboration with the relevant authorities will boost biomass innovations with specific policies at regional, national and EU level.
DH operators and planners	Will bring their knowhow, experience and expertise on the development of the local DH projects.

Investors and financing bodies	Will contribute to the initial capital required and will bring the short profitability and long-term viability of the community bioenergy projects.
Biomass owners	Will play an important role in defining the biomass resources that could be suitable for heating purposes and will contribute on the necessary logistics.

To foster deeper engagement with the local community, awareness and involvement activities can be conducted. These may include organising **information days, workshops, and community events to showcase the benefits of bioenergy** and emphasise the community's vital role in implementing new projects. Additionally, **informative materials, videos, and online platforms can be utilised to encourage greater community participation and understanding**. Sharing images from meetings and community events through various channels can demonstrate the progress and success of Ecopower's bioenergy initiatives, further inspiring public support and active involvement in these important sustainable energy endeavours.

4.5.3 Technical and Business support

Ecopower is an energy community that has been active in Belgium for over 30 years, providing green electricity to its members during their initial years. In 2013, they expanded their operations to include green heat production and delivery and started their own pellet production. Presently, they manufacture pellets from locally sourced biomass collected from within a 150 km radius of the production site, with a maximum capacity of 40,000 t/y, exclusively producing A1 class pellets.

Despite their impressive capacity and adherence to high-quality standards, Ecopower has not been able to reach the plant's maximum production capacity. This is primarily due to insufficient demand among their members to consume the entire production output. As a result, they have considered selling their locally produced pellets in the wholesale market. However, their commitment to maintaining high-quality standards becomes a disadvantage in this case, as larger pellet producing plants offer more cost-competitive options. Consequently, Ecopower has managed to sell only 20,000 t/y, representing 50% of their total installed capacity, in a given year.

To overcome this challenge, Ecopower has devised a two-fold strategy to create more economically viable and accessible heat carriers. Firstly, they have begun designing, developing, and operating district heating stations, especially targeting public buildings. Secondly, they are exploring the production of a less quality-demanding heat carrier: lower quality wood chips. By providing these self-produced wood chips to the district heating stations they help establish, the two aspects of their strategy complement each other.

The project's technical support services have played a crucial role in developing Ecopower's roadmap and operational ideas. The energy community has received valuable technical counselling through technical catalogues and factsheets, particularly focusing on solid biofuel production. With their extensive experience and solid knowledge in technical aspects, societal trends, and business models related to energy production, Ecopower has benefited greatly from these resources.

In terms of energy demands covered by the community's activities, Ecopower's pellet production capacity is 40,000 t/y, producing A1 quality pellets. However, they have never fully utilized this capacity. They currently distribute 2,000 t/y among their members, sell 8,000 t/y to local shops and distributors for the general public, and allocate another 10,000 t/y to the wholesale market. The wholesale market poses a significant challenge as competition from larger and more affordable pellet producers is intense. **Ecopower's solution to install district heating stations in several towns (1-2 MW) and fuel them with lower quality wood chips aligns with their objectives for thermal decarbonization, solid fuel production, and promoting a circular economy**.

Ecopower has also been provided with a range of valuable business tools. These include business templates that offer crucial components and step-by-step guidance for crafting an effective business plan tailored to their community's bioenergy project. Additionally, they've gained valuable insights from the Spanish case business plan. This particular plan focuses on the creation of a compact district heating network within a rural area.

Additionally, Ecopower has access to the Italian case business plan, which serves as a reference for the establishment of a new energy community across three municipalities and the development of a larger scale district heating network for these areas. The Greek case business plan further contributes by providing information on the installation of biomass boilers in public buildings and the distribution of solid biofuel to the local market.

Furthermore, Ecopower takes advantage of the Knowledge Exchange Platform (KEP), which provides them access to a variety of helpful reports and materials from BECoop, such as business guides. Through active participation on the platform, they can connect with other individuals involved in bioenergy through the Network of Interest (NoI). This involvement creates a space for sharing insights, discussing successful methods, and seeking guidance by posting questions and seeking advice on the forum.

4.5.4 Community's concept and roadmap

As explained in the technical section, the primary goal of the community is to supply its members with 100% renewable energy. They initially focused on electricity production and distribution and later added pellet production to provide their members with solid biofuel. However, the demand for these pellets has not met their expectations, prompting them to reevaluate their strategy and capabilities.

While they aim to continue producing and distributing green electricity to their members, their new focus lies in the thermal aspect. **The community has devised a strategy to develop and deploy district heating solutions in various towns across Belgium, particularly in the northern region**. This will be the main area of support and guidance they seek.

Their key idea is to produce wood chips cost-effectively, which will serve as a crucial component in their district heating initiatives. One approach involves a natural drying process, where the wood chips are dried to 20% moisture content, and then used to produce lower quality pellets. Alternatively, they can transport the chips to an industrial drying system, achieving the desired moisture level at a rate of 500 t/h. These self-produced chips or "lower quality" pellets will then be utilised in their district heating plants. This strategic move will not only provide a solution for their over-dimensioned or under-used pellet production facility but also contribute to decarbonising the thermal demand with a local and sustainable source of energy.

By embarking on this thermal-focused path and implementing district heating solutions with wood chips, Ecopower aims to optimise their operations and further their commitment to supplying environmentally friendly energy to their community.

Ecopower's roadmap

Actions began when Ecopower applied for support under T5.2 through the BECoop replication cases. Initially, discussions centered around expanding their business activities in Belgium, with inputs from BECoop members, local stakeholders, and others. The short-term plan involves constructing 1-2 MW district heating (DH) plant networks using lower quality pellets and woodchips. They aim to identify suitable locations for the DH systems, biomass logistics, and boilers as part of their project goals.

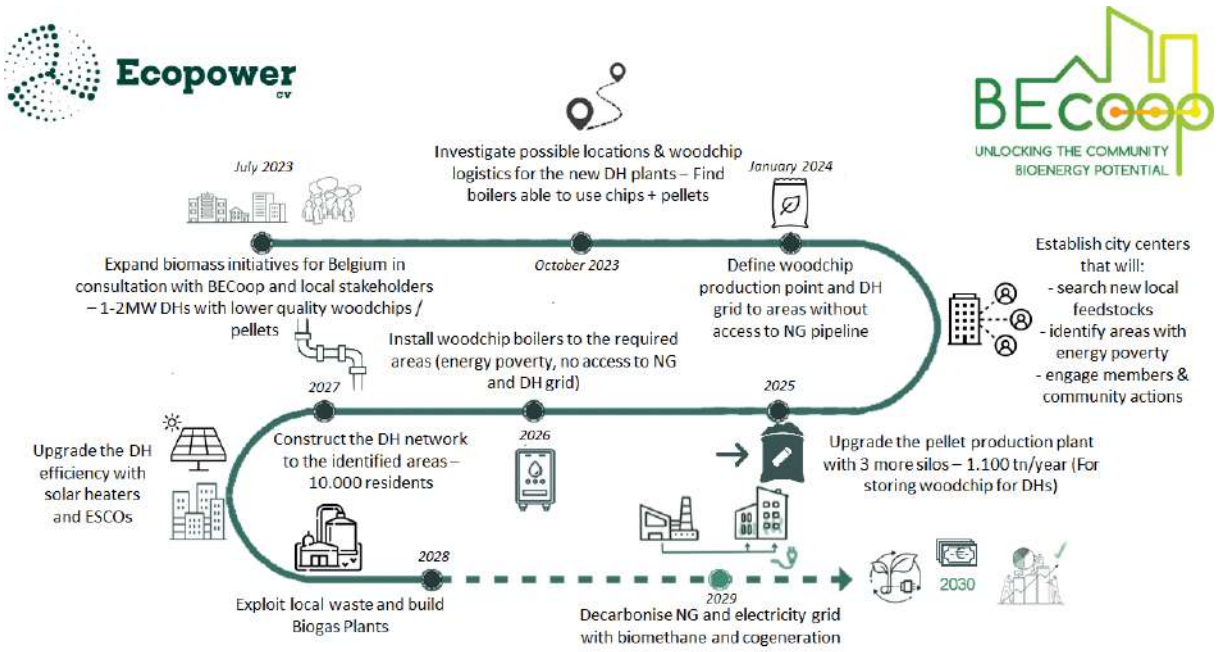


Figure 21. The roadmap of Ecopower

By defining areas without access to the natural gas (NG) grid, Ecopower can focus on developing bioenergy projects in those regions. Considering the biomass availability, they will also determine the optimal spots for producing solid biofuels, such as woodchips and pellets.

A significant step planned for 2024 is the **establishment of city centres** in collaboration with local authorities. These centres will be responsible for exploring local biomass feedstocks, identifying areas with energy poverty, and engaging community members in various actions.

Following this phase, Ecopower plans to **upgrade its existing pellet production plant by adding three more silos**, increasing their solid biofuel capacity by 1,100 tn/year. They will store woodchips for use in the DH plants at this facility. Additionally, they will **install residential biomass boilers in both private and public buildings in areas facing energy poverty**, drawing insights from the BECoop Greek business plan.

By 2026, Ecopower envisions being more mature for implementing its significant concept, which involves constructing DH plants and networks in the identified areas. The BECoop Italian and Spanish business plans will guide this process and offer valuable insights. They will further enhance the system with solar panels to improve thermal efficiency and upgrade the energy performance of buildings in collaboration with local Energy Service Companies (ESCOs).

In their ongoing commitment to decarbonization, Ecopower is advised to embark on a collaborative journey within the biogas sector, working hand in hand with local authorities, biomass owners, farmers, and industrial stakeholders. This collaboration encompasses the creation of biogas projects that tap into a variety of biomass sources, including municipal waste, byproducts from livestock farming, agricultural remnants, and industrial refuse. Ecopower's vision extends to establishing a noteworthy count of biogas plants by 2028. These plants will leverage CHP units for electricity generation, alongside heat production. Furthermore, Ecopower's strategy involves producing biomethane that can be directly integrated into the natural gas pipeline, making a substantial and meaningful contribution to Belgium's decarbonization objectives.

4.5.5 Challenges and Mitigation Strategies

Ecopower is a well-established energy community with a considerable portfolio of projects. However, they may face certain challenges in their bioenergy endeavours. One potential hurdle is the lack of sufficient know-how on bioenergy projects, especially if they do not have proper collaborators or expertise in this field. Additionally, the availability of biomass resources might be limited, posing a potential obstacle to the implementation of bioenergy concepts. Moreover, there could be resistance from citizens and/or local authorities, unwilling to support or participate in the development of bioenergy initiatives.

Nevertheless, Ecopower remains optimistic about overcoming these challenges with the support of BECoop. Drawing upon their extensive experience and network, they believe that their existing knowledge and resources will empower them to tackle any difficulties that may arise. With determination and collaboration, Ecopower is confident in their ability to navigate these potential obstacles and continue making progress in their sustainable energy initiatives.

4.5.6 Key outcomes and achievements

Ecopower is a well-established energy community, but they haven't really delved into using biomass yet. With the help of BECoop, they're working on a plan to gradually bring in biomass innovation to their activities and put bioenergy concepts into practice. BECoop is giving them some really useful support, like existing business plans, technical fact sheets, and ways to engage with others. When coupled with their roadmap, these resources will guide Ecopower in navigating the path toward local decarbonization. Through this collaborative effort, Ecopower seeks to further enhance their renewable energy initiatives and contribute to a more sustainable and greener future.

4.6 Energy Agency of Plovdiv (Bulgaria)

Under-exploration initiative in Plovdiv, Bulgaria:

The Energy Agency of Plovdiv (EAP), in Bulgaria has been actively involved in renewable energy initiatives. Now, they're seeking to expand their efforts, with a strong emphasis on the biomass sector. Their goal is to set up an energy community and a biomass district heating system that will be powered by locally sourced biomass. In essence, their plan revolves around the development of local district heating systems using bio-based resources to supply renewable heat to a range of public and private buildings.

4.6.1 Background

The Energy Agency of Plovdiv (EAP) was established in Bulgaria in 2000 with a focus on promoting efficient and sustainable energy use as well as renewable energy. Providing its services to public administration, businesses, and consumers, the agency conducts feasibility studies, energy and environmental analyses, and modelling. It also identifies, develops, and manages energy and air quality projects. Over the years, EAP has successfully completed more than 50 EU projects.

Although the agency is actively involved in the energy sector and numerous renewable energy projects, it currently does not function as an energy community. However, **EAP aims to integrate a business model that fosters the establishment of energy communities in Bulgaria**. The goal is to empower people to initiate and participate as prosumers in the energy market, enabling them to contribute to and benefit from renewable energy projects.

Figure 22. The logo of the Energy Agency of Plovdiv (EAP)

To achieve this vision, EAP plans to expand its business activities and engage with citizen communities, relevant business entities, key public authorities, and policymakers. District heating operators, planners, investors, and financing bodies are also part of their outreach efforts.

While EAP is already active in renewable energy projects, it seeks to further expand its activities, particularly in the biomass field. Given the abundance of available biomass resources, bioheat presents a feasible solution to address energy poverty and compete with conventional systems. Their overall plan involves seeking support from BECoop and leveraging their high-level expertise and knowledge to develop local district heating systems using biobased raw materials. These systems will provide renewable heat to various public and private buildings, contributing to a more sustainable and eco-friendly energy landscape in Bulgaria.

4.6.2 Stakeholder engagement

The Energy Agency of Plovdiv (EAP) has established a strong presence in the renewable energy sector, actively engaging with numerous stakeholders over the years. However, to further advance their goals in exploring and developing bioenergy concepts, EAP recognises the importance of involving additional key stakeholder groups. These groups play a crucial role in contributing to the success and effectiveness of their bioenergy initiatives.

Table 13. Identified Stakeholders willing to support the project of EAP

Type of Stakeholders	*Role in the project*
Citizens community	Will be engaged with the roadmap and the overall EAP concept to establish energy communities that will lead the bioenergy projects.
Business entities	Will collaborate with the upcoming energy communities and EAP for the sound elaboration of their business activities.
Public authorities	Will contribute and assist with various ways into the creation and the development of local energy communities and their renewable energy projects.
Policy makers	Will help the creation of the energy communities and will guide them in accordance with the BECoop roadmap.
DH operators and planners	Will bring their knowhow, experience and expertise on the development of the local DH projects.
Investors and financing bodies	Will contribute to the initial capital required and will bring the short profitability and long-term viability of the community bioenergy projects.
Biomass owners	Will play an important role in defining the biomass resources that could be suitable for heating purposes and will contribute on the necessary logistics.

4.6.3 Technical and Business support

EAP is located in the Plovdiv region of Bulgaria, characterized by its mountainous terrain, agricultural land, and forests, including several valleys. **This area offers abundant forest biomass, contributing to an already established market for wood pellets**. Despite their interest in establishing a bioenergy community and transitioning to bioenergy for heating, **EAP faces a significant challenge due to the prevalent use of coal and natural gas in the region**, resulting in low costs for electricity and heating. Nonetheless, **EAP envisions replacing fossil fuels with other renewable energy sources, such as biomass-based technologies and solar panels, for heating purposes in the immediate future**.

During their interactions with EAP, various bioenergy-based aspects were discussed, and knowledge transfer from the BECoop results was facilitated. EAP received a summary of the BECoop RESCoops and their activities, drawing similarities with their own case. They were also introduced to the BECoop tools, including the self-assessment, e-market environment, NoI, and BECoop toolkit, providing valuable resources to support their bioenergy community development.

Additionally, the BECoop Handbook served as a guiding document for EAP in developing their bioenergy community. Technical catalogues and factsheets were shared to explore available bio-based technologies suitable for their bioenergy project and gather preliminary data.

Based on the shared material and discussions, EAP intends to focus on biomass-based heat generation, specifically through the development of a biomass district heating system to supply heat to various public and private buildings. **Their goal is to establish a biomass district heating system fuelled by locally available biomass, covering an annual energy demand of 80-100 MWhth**. The types of biomass available locally include forest residues, pruning by-products, and wood-processing residues, sourced from mountainous, agricultural, forest, valley, and sloppy areas. **The envisioned members of their bioenergy community are citizens, public authorities, and SMEs, who will also be their future customers**.

It appears that the follower case possesses sufficient knowledge concerning the social and environmental aspects and user engagement activities related to bioenergy community development. However, there seems to be a lack of knowledge regarding the appropriate feedstock to be utilised by the energy community. Consequently, further support is needed, particularly in the technical and business/financial aspects of bioenergy community development. The case's self-assessment results -in the form of a spider net- conducted before the BECoop interventions can be found in Annex IV.

Overall, the follower case has a solid foundation in certain aspects of bioenergy community development, but targeted support and exposure to **successful bioenergy initiatives in the EU** will undoubtedly strengthen their efforts and contribute to the growth and effectiveness of their bioenergy community in the region.

For the case of EAP, the material developed by BECoop on business models and plans, proves to be valuable for their initial steps in establishing energy communities in Bulgaria. Alongside the roadmap developed in the following section, this material served as a comprehensive guide for the agency's early endeavours and was complemented by other BECoop resources. Specifically, the agency received various business templates providing instructions on developing efficient business plans for community energy projects. Furthermore, they gained insights from the business plans of the different BECoop pilot cases, including the Spanish case focusing on a small local district heating network in a rural area, the Italian case establishing an energy community across three municipalities with a larger scale district heating network, the Polish case initiated by a local municipality with a pellet production plant and residential boiler installations, and the Greek case involving biomass boilers in public buildings and solid biofuel distribution to the local market.

Moreover, EAP benefits from access to the Knowledge Exchange Platform (KEP), which offers a plethora of useful reports and BECoop deliverables like business catalogues and support services. Through the NoI, the agency has the opportunity to engage with other bioenergy actors, exchange ideas, learn from successful

practices, and seek answers to questions in the forum. This comprehensive support from BECoop equips the energy agency with the necessary tools and knowledge to embark on their journey towards establishing successful and sustainable energy communities in Bulgaria.

4.6.4 Community's concept and roadmap

EAP currently does not function as an energy community. To change this, EAP aims to integrate a business model that enables people to initiate and participate as prosumers in the energy market within renewable energy projects. With this goal in mind, the agency seeks to expand its business activities to engage the citizen's community more effectively.

While EAP is already highly active in renewable energy projects, they have a keen interest in further expanding their activities, particularly in the biomass field. The region offers abundant biomass resources, and bioheat stands as a viable solution to address energy poverty and compete with conventional, fossil-based systems. **The follower case's overall concept is to develop local district heating systems using biobased raw materials to supply renewable heat to several public and private buildings**.

In support of this vision, BECoop's current task is to provide high-level support to the follower case, assisting them in developing and implementing their bioenergy initiatives. The roadmap developed in the next section, along with the support materials mentioned above, will serve as a step-by-step guide, leading EAP toward the successful realization of their bioenergy goals.

EAP's roadmap

Actions commenced with consultation activities among EAP members, BECoop partners, and local stakeholders to collaboratively develop the biomass vision. As the project progresses, EAP aims to investigate potential locations and **establish biomass logistics** for the construction of new district heating (DH) projects. By identifying areas without access to the natural gas (NG) grid, the focus will be on developing bioenergy projects in those regions. Additionally, considering biomass availability, EAP will pinpoint optimal spots for the production of solid biofuels, such as woodchips or pellets.

A significant milestone set for 2024 involves the establishment of city centres in cooperation with local authorities, taking responsibility for exploring local biomass feedstocks, optimizing energy usage and technology, identifying areas with energy poverty, creating energy communities, and engaging community members in collective actions.

Subsequently, EAP, in partnership with newly formed energy communities, will install biomass boilers in public buildings and residences within energy poor areas. This crucial step serves as the initial phase of the community bioenergy approach, demonstrating the effective use of biomass for sustainable heat production. As local stakeholders witness the positive outcomes and potential of bioenergy, their engagement in energy communities is expected to increase. BECoop's relevant business plans will guide the overall process during this phase.

After the successful pilot phase, EAP will be better prepared in 2026 to implement its grand concept of constructing DH plants and networks in the identified areas. The insights from BECoop business plans will further enhance the process. Future improvements include incorporating solar panels to boost thermal efficiency and overall energy performance in collaboration with local ESCOs.

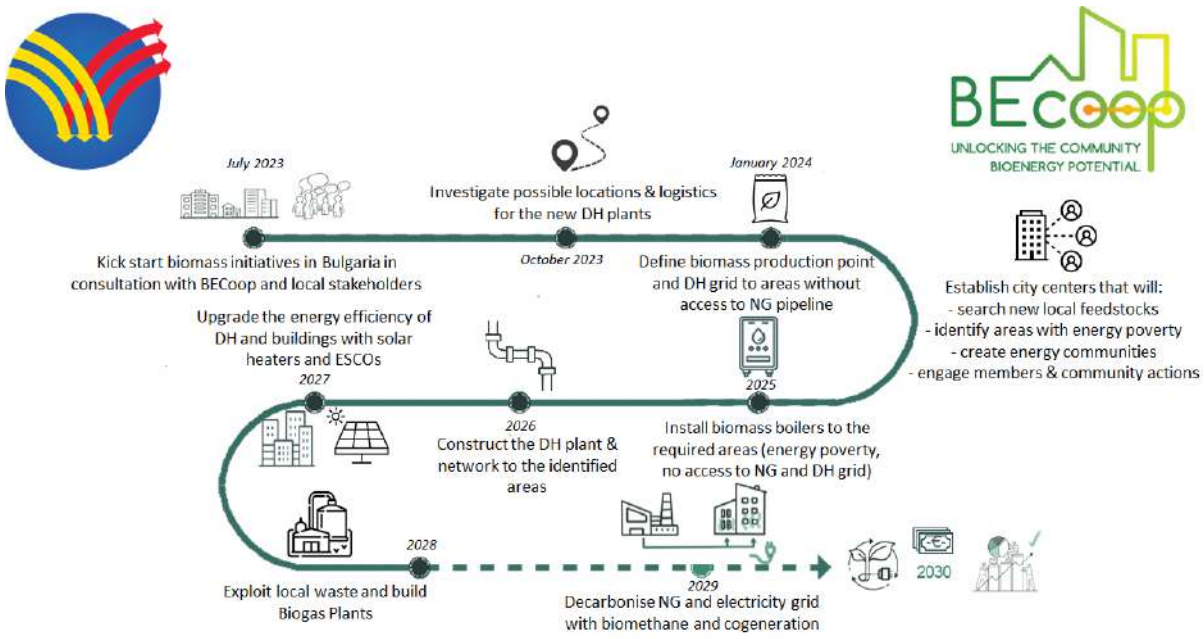


Figure 23. The roadmap of EAP

With untapped biogas potential in Bulgaria, **it is recommended that EAP explores the possibilities for energy communities to develop biogas projects in collaboration with local authorities, biomass owners, farmers, and industrial players**. Biomass sources like municipal waste, livestock farming residues, agricultural by-products, and industrial waste hold promise for such endeavours. By 2028, Bulgaria envisions significant development of biogas plants for electricity generation through CHP units and for heat.

Considering all the above developments and similar initiatives in urban centres, a comprehensive decarbonisation plan will be established. The increased production of biogas, and its potential transformation to biomethane fed directly into the NG pipeline, will play a vital role in achieving the region's decarbonisation goals. The local utilisation of biomass resources, the promotion of energy communities, the adoption of biomass boilers in buildings, the construction of DH infrastructure in NG-inaccessible areas, and the integration of biogas cogeneration and biomethane will significantly contribute to the decarbonisation of the area.

4.6.5 Challenges and Mitigation Strategies

The creation of energy communities to fulfil EAP's vision for decarbonizing the region may face several challenges, including the unwillingness of local authorities to participate, a scarcity of funding resources, public perception favouring fossil fuels for heating, and the low price of fossil fuels. Additionally, the insufficient exploitation of biomass resources due to a lack of knowhow poses a significant hurdle. However, EAP is well-equipped to overcome these challenges through the proper implementation of the BECoop roadmap, leveraging existing materials, and tapping into their extensive experience and network. By combining these strengths, EAP is poised to eliminate and address the above challenges effectively, paving the way for the successful establishment and growth of energy communities in Bulgaria driven by sustainable bioenergy solutions.

4.6.6 Key outcomes and achievements

EAP has a strong willingness to explore the biomass field and utilise this potential for bioenergy heating installation which will bring significant benefits to the local society. The roadmap created by BECoop, along with the helpful materials, can guide the EAP's vision step by step towards becoming a reality. This will involve the newly formed energy communities taking an active and leading role in making it happen.

4.7 Sustainable Village – North East Region, Moldova Association (SVA) (Romania)

Under-exploration initiative - Sustainable Village, Romania:

In the Borlești commune in Romania there's a vision to kickstart a fresh Energy Community, focused on tapping into the abundant biomass resources in the area. The goals of this energy community revolve around gathering and converting previously unused biomass residues from the region to produce and distribute heat to both municipal and residential buildings.

4.7.1 Background

The Borlești commune, located in the mountainous area of Neamț county in Northeast Romania, is currently initiating a project with specific goals in mind. The primary objectives of this project are to secure financial support and acquire necessary processing equipment, such as a shredder, tractor, and trailer. The project aims to establish a dedicated space in the area, encouraging residents to actively contribute to branch collection for biomass utilisation. It aims to establish a pellet production plant and install biomass boilers in public buildings. Notably, since 2021, the Sustainable Village (SVA) has been actively promoting biomass management and usage at the local level, with significant efforts made through the AgroBioHeat Horizon2020 project. This involved organising workshops and site visits to engage stakeholders in the renewable biomass energy sector within Romania's northeast region.

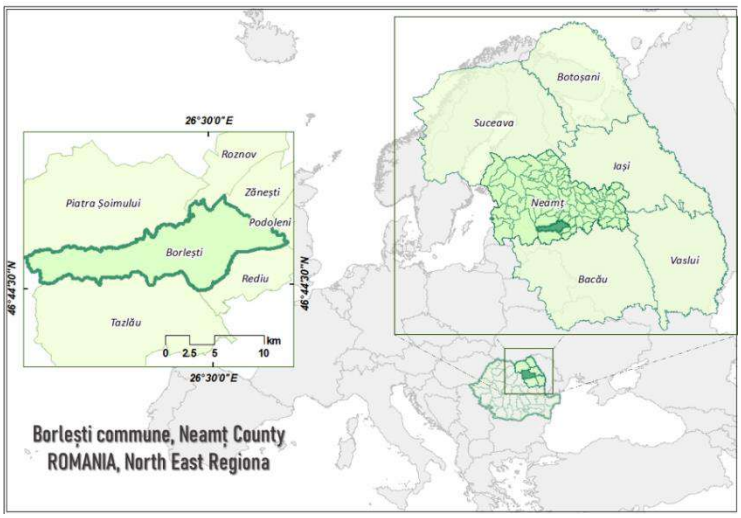


Figure 24. The map of the Borlești commune location

The initiative has the potential to cover an approximate energy demand of 30,000 MWhth/year through biomass exploitation. **The follower case in Borlești exhibits similarities with the Polish and Spanish BECoop cases, particularly in terms of the significant potential for utilising forest residues to fulfil the thermal needs of the local community**.

Regarding the specific scenario that will be examined for this follower case, the focus will be on **building a new Energy Community from scratch**, aiming to harness the abundant biomass resources in the area and promote sustainable energy practices for the benefit of the community.

4.7.2 Stakeholder engagement

The Sustainable Village – Northeast Region, Moldova Association (SVA) will take the lead as the initiator of the project, **collaborating closely with the municipality to address thermal demands by utilising wood residues as an alternative solution**. The identification of the follower case revealed vast, untapped resources of forest biomass in the region, presenting an excellent opportunity for development. Additionally, waste residues from pruning plants in vineyards and orchards were identified as another potential local source of bioenergy. To address critical concerns and engage the local community and authorities in project development, two meetings were organised. The first joint online meeting of BECoop partners (WUELS, CBS) with a representative from SVA was held on June 16. During this meeting, the focus was on finding ways to

engage the local community and authorities effectively. It was noted that the low level of biomass management, as indicated by the representative of SVA, was largely due to the community's limited environmental awareness, with fossil fuels being the predominant energy source. Additionally, there was some reluctance among the local community towards the development of an energy community.

To overcome these challenges and foster community engagement, SVA conducted a survey in 2021 to assess perceptions about biomass as an alternative heating solution among citizens and local businesses. Building on this groundwork, the association has proposed **further awareness and engagement activities, including information days, interactive workshops, and in-person meetings**. These initiatives aim to empower the local community with knowledge about the benefits of a bioenergy community and the sustainable utilisation of biomass resources. During the conversations, the representative of the Romanian follower case mentioned that there are no other similar projects in the region, making it challenging to replicate good practices.

Furthermore, a concept roadmap was created for the development of the RESCoop in the region. The roadmap outlines the steps and strategies for establishing and advancing the Bioenergy community, providing a clear direction for future actions.

The BECoop meetings served as crucial milestones in the journey towards creating a successful and impactful Energy Community focused on sustainable biomass utilisation in the Northeast Region, Moldova. The identified stakeholders are listed in the following table.

Table 14. Identified Stakeholders willing to support the project in Northeast Romania

Types of Stakeholders	*Role in the project*
Environmental NGO	Initiator - Consultant
Local authority, energy consumer	Initiator
Energy consumers	Members of the energy community

4.7.3 Technical and Business support

From the municipality's total surface of 10,765 ha, 43% is forest area (more than 4,600 ha). Another significant source of wood biomass comes from the vineyards and orchards, as more than 70% of households in this region have a surface around their houses with vineyards, and more than 90% have orchards. Each year, especially during the spring season and sometimes in winter and late autumn, the inhabitants clean the vine crops and orchards, resulting in around 10 cubic meters of branches from each household. With Borlești commune having around 3,000 households, this adds up to approximately 30,000 cubic meters of branches from households alone.

As part of their biomass energy management plan, in the near future, **SVA plans to install two boilers with a total capacity of 200 kW in public utility buildings**. It is estimated that RESCoop, by exploiting biomass, could cover approximately 30,000 MWhth/yr.

During the meetings, BECoop partners offered SVA substantive support in the field of thermal conversion of agricultural and forestry substrates and assistance in utilising the BECoop tools. These collaborative efforts aim to make effective use of the abundant biomass resources available and contribute to the establishment of a sustainable and impactful energy community in the Northeast Region, Moldova.

SVA case was aware of the potential surface but lacking knowledge about the availability of forestry biomass. To address this, the use of the **Bioraise tool from the BECoop toolkit** was recommended, along with contacting forest owners and logistic operators to assess their current practices. The case was also encouraged to **consult the BECoop catalogue for fuel characteristics of biomass** for estimating average productivity, although it was emphasised that the specific biomass type can vary significantly depending on

the forest type. Furthermore, they were advised to explore collaboration with local forest cooperatives/associations for securing biomass feedstock. The initiators also demonstrated a high level of understanding of logistic operations related to forest resources and the steps involved in the value chain. However, they lacked information about the morphological features and characteristics of the local forests. It was recommended to consider important factors such as field slopes, accessibility, soil type, and tree spacing in the areas of interest. Furthermore, they had a preliminary idea of the investment costs for logistic operations and operational costs. However, they noted that the local market for pellets or woodchips did not involve forest resources. The recommendation was to assess the types of boilers used by the local users and explore potential strategic partnerships between industries, the primary sector, and local government in the region. The case also showed a good understanding and awareness of bad experiences related to similar initiatives in the local area. It was suggested that they seek out success stories in published reports or handbooks to gain insights and inform the local community about environmental issues. The initiators were well-informed about the environmental impact and sustainability of their logistic activities involving forest resources. The case's self-assessment results -in the form of a spider net- conducted before the BECoop interventions can be found in Annex IV.

The case displayed limited knowledge about potential biomass suppliers in the local area. Consequently, it was strongly encouraged to **leverage the BECoop e-market platform to identify suitable biomass suppliers**. Although there was some awareness of pellet and woodchips manufacturers, there was uncertainty about their compatibility with the available biomass resources. As a result, it was recommended to initiate contact with these manufacturers for further clarification and to identify potential clients who might be interested in purchasing their products. The analysis, conducted by the BECoop partners, revealed that SVA possessed significant expertise in pellet, briquettes, and woodchips plants, yet they had not adequately considered the production capacity of their own facility. To address this oversight, it was suggested that they conduct an assessment of their production capacity, taking into account market share and the availability of resources.

On the business and financial front, the case had a preliminary idea of the investment required for a pellet, briquettes, and woodchips plant. However, it was noted that the local market did not currently integrate their biomass resources effectively. In response, BECoop experts advised evaluating the types of boilers in use by local consumers, exploring potential strategic partnerships, and reviewing the business plan of the Polish BECoop RESCoop, which focuses on establishing a pellet production plant and installing biomass boilers in public and residential premises. GOIENER's business plan was also included in the support package, as it centres around collective harvesting and collection of woody biomass, which aligns with the goals of the Romanian case regarding the voluntary and common contribution of woody waste.

Considering the scale of the project and the objective of involving the local community in utilising residual local biomass, the "Local integrated group of citizens" business model appears to be the most appropriate approach. This model complements the project's aim to mobilise the community and foster the development of local projects, such as wood chip production and biomass boilers.

To secure the necessary financial resources for project implementation, **exploring funding opportunities from national or regional funds, EU funding, and crowdfunding could be beneficial**. By combining these funding sources with the support and business models provided, the Romanian case is well-positioned to achieve its objectives and contribute to the sustainable utilisation of biomass resources in the region.

4.7.4 Community's concept and roadmap

The follower case presents promising opportunities for sustainable residue utilisation, particularly in the significant availability of untapped woody and agricultural biomass. The project aims to **establish a dedicated space on the outskirt of the community, serving as a central collection point for residents to voluntarily contribute branches and other wood waste**. By creating a supply chain and installing biomass boilers, the energy community plans to cover the thermal needs of the local community, replacing fossil fuels with

biomass residues. The initiative also includes **the collection of local biomass for wood chip production, which will be distributed to the community for heating purposes**. Additionally, the project involves the **installation of biomass boilers in both municipal and residential buildings,** with a future plan for expansion to further residential areas. The energy community seeks to offer a sustainable waste management solution for the city and the forest area, decarbonising the heating network through biomass utilisation.

The objectives of the energy community involve the harvesting and processing of untapped biomass residues from the region, as well as the production and supply of heat to municipal and residential buildings. Beyond its immediate goals, the project aims to **raise awareness within the local community about sustainability matters and the potential of biomass as a clean energy source**. It also explores potential opportunities and funding sources, fostering **social integration** among the local stakeholders to create a cohesive and sustainable energy community.

In the long term, the project envisions the **development of a strong energy community in the region**, driven by the responsible use of local biomass resources to meet thermal energy demands. Through education, promotion, and the exploitation of local agroforestry residues, the energy community aims to attract more people to adopt wood chips as an environmentally friendly alternative to fossil fuels.

SVA's roadmap

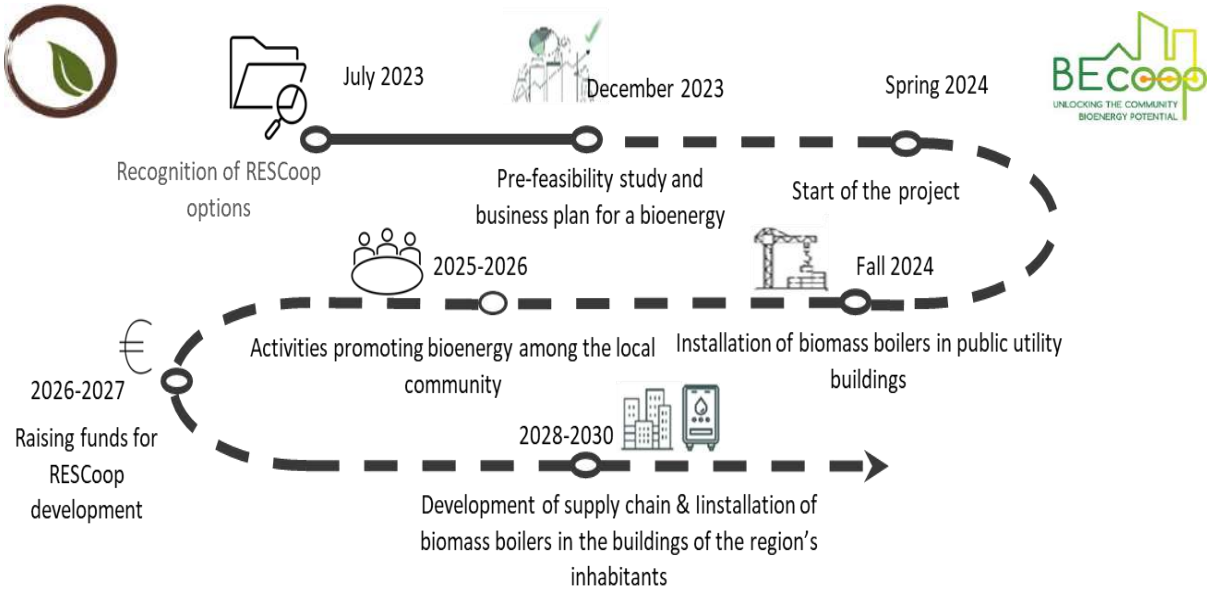


Figure 25. The roadmap of SVA

Following the meetings with BECoop partners, SVA now plans to conduct an accurate assessment of the technical bioenergy potential in the region. With the guidance and collaboration of representatives from WUELS and CBS, a rational roadmap has been developed for the establishment of a bioenergy cooperative, managed by the association. The primary focus is on developing local bioenergy using the region's own raw materials and adopting a direct heating approach, creating an entire supply chain from raw material acquisition to its utilization in the combustion process.

During the meetings, various scenarios for RESCoop operation and methods of financing were thoroughly analysed. The timeline envisions a **pre-feasibility study for the investment** to be carried out by December 2023, followed by the **preparation of a comprehensive business plan**. In 2024, the **first assembly of biomass boilers in public buildings** will take place, with these energy facilities being powered by biofuels produced from local energy resources. The successful implementation of these installations will serve as a compelling example for other inhabitants of the region to join the emerging RESCoop. To promote the concept of

bioenergy among the commune's inhabitants, **an information campaign** is planned for the years 2025-2026. This campaign will include on-site meetings with residents and advertising the idea through various media channels, including the Internet. Subsequently, in 2026 and 2027, the association intends to **apply for national or EU funds** to further develop the supply chain. Additionally, they may consider **initiating a crowdfunding campaign** to gather financial support for the implementation of the proposed investment, as proposed by the partners of the BECoop project. Successful acquisition of funding will enable the development of the supply chain and the installation of biomass boilers in the buildings of the region's inhabitants, solidifying the establishment of the energy community.

4.7.5 Challenges and Mitigation Strategies

During the work on the Romanian follower case, several challenges were identified, including the low environmental awareness of the local population. The lack of proper knowledge regarding the correct combustion of biomass fuels is a significant concern. While the current local government has expressed interest in establishing a value chain to utilize forest residues, there are doubts about its reliability and commitment, possibly due to the lengthy process involved in developing a RESCoop and the current lack of funding. Another challenge lies in the limited human resource capacity to cover various aspects of project implementation, such as legislation and public procurement. Furthermore, the absence of similar projects in the region makes it challenging to implement proven practices and draw on successful models. Overcoming these challenges will be crucial for the successful implementation of the sustainable wood residue utilization project and the establishment of an effective RESCoop in the region.

4.7.6 Key outcomes and achievements

After the end of the BECoop support, there were notable improvements in some aspects of the initiative's concept. The initiator's knowledge of the resource significantly improved, as they familiarised themselves with the physical and chemical properties of the biomass they intend to use. **The support provided by the BECoop project, particularly the solid biomass factsheet for small-scale heating applications, played a crucial role in enhancing their understanding**.

Moreover, the case succeeded in attracting clients interested in the conversion of forest resources into advanced biofuels, such as pellets and briquettes. The initiator's awareness of the need to consider supplementary elements, including resource harvesting and exploitation, machinery selection, operational schedules, transport logistics, storage methods, specific operational costs, and related expenditures, has been significantly enhanced.

In the context of pellet and woodchip generation, user engagement increased due to the initiator's proactive identification and communication with manufacturers of pellet, briquette, and woodchip plants. These manufacturers have shown a strong eagerness to collaborate. This engagement led to an increased maturity level of the technical solution, indicating the initiator's precise assessment of the bioenergetic potential of the region and their comprehensive understanding of their plant's productivity. Notably, dedicated efforts have also resulted in an enhancement in both social and environmental impact, demonstrating a commitment to safeguarding the local community and its environment.

In conclusion, it is evident that empowering the local community to actively participate in the project is of paramount importance in harnessing the potential of residual local biomass for sustainable thermal needs. With continuous improvements and ongoing efforts, the initiative presents promising opportunities for successful implementation and positive impacts on both the environment and the community.

4.8 CommonEn - Ioannina (Greece)

Under-exploration initiative - CommonEn, Greece:

A newly established energy community, already active in solar projects, is now looking to expand into bioenergy projects, primarily focusing on heating and electricity generation. Their plans include the collection of local olive tree prunings and the development of fresh value chains in the biomass sector. Their central objective is to establish a biomass-fuelled CHP plant to meet the local energy demands. As part of their broader strategy, they intend to scale up their biomass operations, increase biomass collection efforts, and eventually install biomass boilers in local households and businesses.

4.8.1 Background

CommonEn is a non-profit energy community located in Ioannina, Greece, established in May 2021 with a core mission of producing and managing clean and affordable energy.

They achieve this mission through a multifaceted approach, including the production of clean energy for self-consumption, implementing energy efficiency solutions, advocating for sustainable mobility, offering expert consulting services, conducting awareness campaigns and educational programs, facilitating knowledge exchange and networking, and engaging in ongoing research activities.

Figure 26.The location of the follower case in Greece

Notably, CommonEn has initiated projects centered around photovoltaic systems (PVs) to harness solar energy, and in partnership with local authorities, they are actively working on an innovative agro-photovoltaic park project, set to be completed by the end of 2024. This pioneering venture combines energy production with the creation of an urban garden, showcasing the dual benefits of sustainable energy and green spaces for the community.

During the meetings, **CommonEn's representatives expressed a keen interest in expanding their activities to include bioenergy**. To begin this transition, the organisation is considering purchasing biomass boilers for their members and partnering with local pellet producers to offer pellets at lower prices. This step will allow them to explore bigger bioenergy projects while providing immediate benefits to their members.

4.8.2 Stakeholder engagement

The project's initiator is CommonEn, which, as already mentioned, is an established energy community. Meetings were held with them, during which they were introduced to the BECoop tools, discussed their vision and potential, and provided guidance to support their entrance into the bioenergy field. While there is another energy community in the local area, it is still in its infancy. Over time, the local community has shown a growing positivity towards the EC, despite initial reservations during its early stages of development. This increased favourability is a result of effectively informing the community about the benefits of such initiatives, leading to greater support and acceptance. The community has a significant number of environmentally conscious individuals.

To further engage the local community, various awareness and engagement activities have been proposed. These activities include **information days, interactive workshops, and in-person meetings**. The aim is to empower the local community with knowledge about the benefits of a Bioenergy community and sustainable biomass utilization. Furthermore, in collaboration with the Onassis Foundation, informative days have been organised to shed light on the concept of energy communities and the benefits they offer to the local community.

Below is a table featuring the main identified stakeholders and their respective roles in the project:

Table 15. Identified Stakeholders willing to support the project of CommonEn.

Types of Stakeholders	*Role in the project*
Energy Community	Initiator and driver of the project
General Public	Beneficiaries and members
Business stakeholder	Beneficiaries Members of the EC
Technical Stakeholders	Producers of pellets
Technical Stakeholders	Biomass Producers and providers
Business Stakeholder	Supporter

4.8.3 Technical and Business support

CommonEn is located in Ioannina city, in the mountainous region of Epirus, northern Greece. The area boasts abundant forest biomass, agricultural resources, and biomass derived from livestock. With a keen interest in transitioning to biomass and developing bioenergy projects for heating and electricity, CommonEn engaged in discussions with the BECoop to explore relevant aspects. During the calls, CommonEn received a summary of the BECoop RESCoops and their activities, identifying similarities with their own aspirations. The BECoop tools, such as self-assessment, e-market environment, NoI and the BECoop toolkit, were presented and shared with the follower case to aid them in their bioenergy community development.

The BECoop Handbook further provided valuable guidelines for the initiative's bioenergy project development. Additionally, technical catalogues and factsheets were shared to introduce available bio-based technologies applicable to their future biomass CHP plant project and gather initial data. Based on the discussions held, **the follower case aims to generate heat and electricity from biomass**. **Their focus is on developing a biomass CHP plant that utilises locally available biomass, specifically olive tree prunings**. For reference and inspiration, the Italian BECoop case was also shared due to its similarities and as a source of further information.

The follower case undertook a self-assessment exercise using the respective BECoop tool, identifying some critical considerations. It was revealed that before advancing with the biomass initiative, the initiators should review the action plan and solidify the next steps in more concrete terms. The self-assessment suggests that the follower case possesses adequate knowledge on social and environmental aspects, as well as user engagement activities related to their bioenergy project. However, they appear to lack knowledge regarding the feedstock selection for the energy community and the technical aspects associated with their chosen bioenergy solution. To address these areas of improvement, the follower case can refer to the resources provided by BECoop, including the Handbook, technical catalogues, and factsheets, which offer valuable insights from similar bioenergy projects. Seeking knowledge transfer and technical support from BECoop

partners and other experts in biomass-based energy generation will also prove beneficial, ensuring the development of a robust and successful biomass CHP plant powered by locally available resources, specifically olive tree prunings. The self-assessment results of the case -in the form of a spider net- conducted before the BECoop interventions can be found in Annex IV.

Regarding the business aspects, in the case of CommonEn, the material developed by BECoop on business models and plans, can be really helpful for taking initial steps towards implementing bioenergy initiatives. In conjunction with the roadmap, this material will guide the energy community's early actions and will be complemented by other BECoop resources. **As CommonEn is an already existing energy community active in other RE, self-financing can be a viable option for upcoming projects focusing on the utilization of local, untapped biomass and the installation of biomass boilers**. Additionally, **crowdfunding** can serve as a plausible alternative financing approach.

4.8.4 Community's concept and roadmap

CommonEn is already an established and active energy community with prior experience in solar power projects. However, they are **now looking to venture into the bioenergy field** and integrate biomass-based innovations into their existing portfolio and projects. Their vision revolves around tapping into the vast potential of **local untapped biomass in the Epirus region**, which includes utilizing agricultural residues like olive tree prunings and vineyard prunings, city prunings, forest residues, and manure.

During discussions, CommonEn expressed a strong interest in harvesting local olive tree prunings and creating new biomass-based value chains. Their primary focus lies in **establishing a biomass-fuelled CHP plant** to meet the local energy demands. As a part of their broader plan, they intend to expand their biomass activities, **collect larger quantities of biomass**, and **eventually install biomass boilers in local households and enterpr**ises.

BECoop's current task is to provide essential high-level support to the follower case, helping them develop and implement their bioenergy vision. Alongside the roadmap that will be developed in the next section, BECoop will offer support materials, guiding CommonEn step-by-step toward the realization of their bioenergy goals.

CommonEn's roadmap

Actions started with consultation activities among CommonEn members, BECoop partners, and local stakeholders in order to co-create the biomass vision. It is suggested that by the end of the project, CommonEn should investigate the local biomass resources available, along with potential technologies. Continuously, CommonEn should also start investigating the possible locations of the biomass CHP plant, together with the required logistics. As long as the locations for the biomass logistics and the CHP plant have been defined, CommonEn should also consider the biomass availability, the optimal spots for the production of solid biofuels, and the type (woodchip, pellet, etc.). Simultaneously, in alignment with CommonEn's agenda, active participation in other renewable energy projects, including those involving agro-voltaics, will be pursued. These projects will not only generate electricity but also enable the retrieval of biomass residues, further enhancing our sustainable energy efforts.

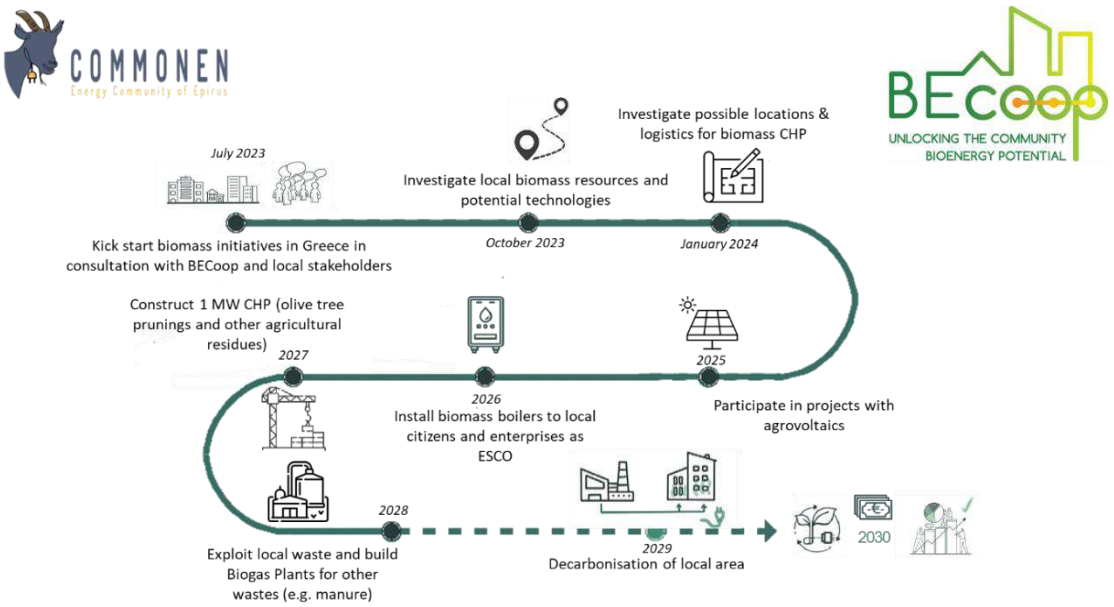


Figure 27. The roadmap of CommonEn

Continuously, CommonEn, in collaboration with boiler manufacturers, **will install biomass boilers in both public buildings and houses in energy-poor areas**, and its members will act as a bioenergy ESCO, selling heat to the members. The installation of biomass boilers in public buildings and houses as part of CommonEn's community bioenergy initiative will be a crucial milestone. This step will serve as the starting point for community-driven bioenergy projects and will exemplify how biomass can effectively produce sustainable heat. By successfully implementing these projects, CommonEn will demonstrate to local stakeholders, including businesses, residents, and institutions, that bioenergy is a viable and environmentally friendly alternative for meeting heating needs. Furthermore, the active engagement of local authorities in community energy actions will foster collaboration and support for bioenergy initiatives. When authorities are involved, they can provide regulatory assistance and facilitate the smooth functioning of such projects. As a result, the local community will be further encouraged to embrace bioenergy and become enthusiastic participants in energy communities. The use of BECoop relevant business plans to guide the entire process ensures that CommonEn's actions are well-informed and strategically executed. These business plans will provide valuable insights into optimising operations, identifying potential risks, and achieving long-term sustainability.

Having successfully navigated through the earlier pilot phase, CommonEn will have gained valuable experience and insights that will significantly mature its capabilities by 2027. This new knowledge will enable CommonEn to proceed on the implementation of its ambitious big concept, **the construction of a CHP plant** with a capacity of 1 Mwe in the pre-identified areas.

The CHP plant will be fuelled solely by local agricultural residues (mainly olive tree prunings and vineyard prunings). The BECoop business plans will guide the overall process and provide valuable insights.

The region holds significant untapped potential for biogas, which can be harnessed effectively following the successful implementation of the aforementioned biobased innovations. To unlock the potential of biogas, CommonEn should engage in productive partnerships with energy communities, local authorities, biomass owners, farmers, industrial players, and other relevant entities. There is plenty of biomass that could be used for such purposes as municipal waste, livestock farming, agricultural residues, urban prunings, industrial waste, etc. Overall, it is proposed that by 2028, the region will start developing more biogas plants, both for the generation of electricity in combination with heat, and/or the upgrading of biogas into bio-methane.

The combination of all the aforementioned projects will have a profound impact on increasing the share of renewable energy in the local heating and electricity grids. To this end, the local exploitation of biomass resources, the creation of bioenergy communities, the installation of biomass boilers in public and private

buildings, and the construction of CHP plants and biogas plants will significantly contribute to the decarbonization of the region.

4.8.5 Challenges and Mitigation Strategies

One of the primary challenges faced by CommonEn is the **uncertainty surrounding the most suitable biomass technology system for their specific needs**. With various options available, selecting the right technology can be daunting and may require expert guidance. Additionally, the **lack of know-how and experience in effectively exploiting local biomass sources**, such as olive tree prunings, forest residues, urban prunings, and manure, presents another significant hurdle. Without the necessary expertise, it becomes challenging to optimize the utilization of these resources to their full potential. Furthermore, the successful execution of bioenergy projects may be impeded by the absence of proper collaborators. Establishing partnerships and collaborating with experts and stakeholders are essential for leveraging expertise and resources to achieve successful outcomes. The underutilization of biomass resources can also be attributed to a lack of know-how in this specific domain. CommonEn may face difficulties in identifying the most effective strategies to maximize biomass utilization without proper guidance and expertise. Lastly, the absence of a comprehensive roadmap with consultation support for implementation poses a challenge. Without clear guidance, it may be difficult to navigate the complexities of energy projects and effectively address potential obstacles.

However, CommonEn has the potential to overcome these challenges. By aligning the existing resources and material with the BECoop roadmap and leveraging its network of willing collaborators, CommonEn can proactively eliminate these hurdles.

4.8.6 Key outcomes and achievements

CommonEn, has a primary objective of producing and managing clean and affordable energy. Although their renewable energy projects have primarily focused on solar energy, they recognize the vast untapped potential of biomass sources in their local area. In the follower case's agenda, the exploitation of local biomass is a top priority for the near future. However, they face challenges due to a lack of knowledge and experience in handling and utilizing these biomass resources effectively. To address this, several calls were conducted between CommonEn and BECoop partners (CERTH, ESEK, QPLAN, and CBS). The purpose of these calls was to provide high-level guidance and transfer knowledge from the BECoop activities related to the development of biomass-based activities within the energy community. The outcome of this collaborative effort was significant support for the follower case. The BECoop partners shared their expertise and provided valuable materials and tools developed within the BECoop project. This assistance played a vital role in developing the biomass-based activities of the follower case, unlocking the potential of local biomass sources. Moreover, **the guidance provided by the BECoop partners enabled the follower case to collectively draw a roadmap and formulate a bioenergy vision for the immediate future**. This strategic planning will help the follower case in effectively managing and utilising biomass resources to produce clean and sustainable energy.

5 Common Challenges and Lessons Learnt

5.1 Unveiling Common Challenges

While providing support to our BECoop followers, a variety of distinct challenges and barriers was identified. The following list outlines the primary challenges for each case, as well as the identification of the most common difficulties shared among our diverse cases.

Table 16. Identified common challenges among BECoop's follower cases

Identified Challenges	Minoan Energy Community	Macugnaga	Sakana	Strzeszów	Energy Agency Plovdiv	CommonEn	Ecopower	Sustainable Village
Lack of knowledge and experience in exploiting local biomass sources	✗				✗	✗	✗	✗
Limited awareness and lack of funding opportunities/financial support programs.		✗		✗	✗			
Limited willingness to join the project (project's acceptance)		✗			✗		✗	
Lack of ecological awareness within the local community				✗				✗
Challenges in biomass collection		✗					✗	
Uncertainty about the most effective bioenergy technologies	✗					✗		
Complex regulatory process of establishing a RESCoop				✗				✗
Variability in energy demand		✗						
Scarcity of best cases examples				✗				✗
High initial costs (construction of DH network)		✗		✗				
Difficulty in installing a comprehensive district heating network to cover the entire region			✗					
Unclear feasibility analysis due to high energy price fluctuations.		✗						
Misconceptions around the “energy community” concept				✗				
Limited human resource capacity to cover project implementation								✗
Local government's unreliable support for long-term projects								✗

Lack of knowledge and experience in exploiting local biomass sources:

Despite having significant sources of untapped local biomass (agricultural residues, forest waste, organic waste, etc.), energy communities may face challenges in effectively utilizing them. The complexity of harvesting procedures, along with difficulties in logistics and technology used for processing the initial biomass, can appear as major challenges for the initiators. However, collaborating with experts, research institutions, and experienced partners can offer valuable insights and guidance in optimizing the exploitation of local biomass resources. By working together, energy communities can find the optimum solution for the available biomass in the region.

The BECoop project has developed a range of tools aimed at supporting the technical decisions of energy community initiators. The BECoop toolkit provides essential tools for assessing the existing biomass resources, while technical catalogues and factsheets offer valuable insights into specific technologies that can be used for biomass utilisation. By leveraging these resources, energy communities can overcome their lack of expertise and gain confidence in exploring the full potential of local biomass sources.

Lack and limited awareness of funding opportunities/financial support programs:

One of the significant obstacles faced by many energy communities is the lack of awareness about available funding opportunities and financial support programs. Securing adequate financial resources is crucial for the effective implementation of renewable energy projects. For instance, the construction of a district heating network can involve substantial initial costs. To address this challenge, energy communities must carefully assess the costs and benefits and explore various financing mechanisms, partnerships, and funding opportunities to manage and mitigate the financial burden.

BECoop has recognised the importance of raising awareness about business and funding aspects by providing dedicated chapters (*STEP 4: Investment Schemes, STEP 5: Make your business plan*) in the BECoop replication Handbook, offering specific recommendations and useful links. Furthermore, the report "BECoop catalogues for the provision of business and financial support services" can provide more precise information about specific funding mechanisms. Learning from existing RESCoops with similar characteristics can also provide valuable insights and accelerate the development of bioenergy projects.

By actively exploring funding options, grants, and subsidies from governmental and private entities, energy communities can initiate their projects and ensure sustainable development. The proper utilization of available resources can significantly enhance the financial viability and success of their bioenergy initiatives.

Limited willingness to join the project (project's acceptance):

Gaining acceptance and participation from community members can indeed be challenging. Misconceptions around the concept of energy communities may create hesitancy among potential participants to join such projects. In order to overcome this challenge, energy communities must actively engage in meaningful dialogues with residents, stakeholders, and local authorities. By addressing concerns and demonstrating the benefits of renewable energy projects, they can foster a deeper understanding for the initiative. Effective communication and community involvement are essential in creating a shared vision and encouraging active participation.

To achieve this aim, our BECoop project has placed special focus on engaging the local community right from the initial stages of the project. The first step (*STEP 1: Build your team*) in our stepwise replication handbook provides examples and links that can help energy communities prepare a comprehensive engagement plan, ensuring the active involvement of the local community and increasing their willingness to join the project. Additionally, by showcasing specific examples of successful engagement activities from our BECoop RESCoop

cases, we aim to inspire and empower energy communities to build strong relationships and secure support from their local community members. Emphasizing the value of community initiatives and collaborative decision-making can pave the way for greater acceptance and successful implementation of community bioenergy projects.

5.2 Identifying best practices for successful replication

5.2.1 Effective Strategies for replicating the BECoop concept

Cultivating strong connections with local key stakeholders

Building strong relationships with local authorities, community leaders, and relevant stakeholders allows for effective communication and collaboration. Establishing partnerships with local organisations, schools, or community centres can help **disseminate information about the bioenergy community project** to a broader audience. It also provides opportunities for educational programs, training sessions, or hands-on activities that engage residents in **learning about and participating in bioenergy initiatives**. By involving various community stakeholders, the project can gain **widespread support within the local population**.

Unravelling misconceptions and spreading awareness through tailored actions

Raising awareness around bioenergy and the energy community concept is vital to dispel any misconceptions or hesitations that might exist within the community. By engaging in personal discussions, initiatives' initiators can better understand the specific needs, challenges, and opportunities in the region, tailoring the bioenergy community concept to suit the local context.

Through targeted educational campaigns, workshops, and information sessions, the actors can inform residents about the benefits and potential of bioenergy as a sustainable and renewable energy source. By highlighting the positive environmental and economic impacts of bioenergy utilisation, the initiative can attract greater interest from the local population. Conducting interviews on local and national TV and radio stations can manage to convey the message to a wider population. Additionally, setting up street billboards presenting information about Bioenergy Communities can familiarise people with the RESCoop concept.

It is important to connect the messages conveyed with daily issues, as people sometimes do not realise the value of biomass when they are not given some context. Practical demonstrations, workshops, and real success stories can effectively showcase the benefits of BE and BECs. For instance, organizing small-scale demonstrations of pellet production, combustion, and pruning harvesting can serve as examples of these activities. Success stories help community members to visualise the impact of sustainable heating solutions on their lives and provide evidence that the proposed solutions work. Visits to successful energy communities can highlight the advantages of participating in such initiatives and showcase the benefits accruing to local communities through their involvement. Improved awareness and understanding of the energy community concept will encourage more people to participate actively and contribute to the success of the project.

Showcasing the implementation of bioenergy technologies through engaging demo activities

Creating a demo project in a municipal building serves as a tangible and visible example of the feasibility of the bioenergy community concept. Selecting a prominent public building to showcase the implementation of bioenergy technologies and practices allows the community to witness firsthand the benefits of this sustainable energy solution. The demo project can demonstrate how biomass boilers and other bioenergy systems work efficiently and contribute to reducing carbon emissions and energy costs. This living demonstration also inspires potential stakeholders, encouraging them to adopt similar technologies in their own residential or commercial buildings.

5.2.2 The use of BECoop resources in the replication process

The use of BECoop tools played a crucial role in supporting the development of bioenergy communities and ensuring the successful implementation of bioenergy initiatives in different regions. The provided resources, such as the BECoop Handbook, technical catalogues, and factsheets, as well as the project's tools offer valuable insights and guidelines for the development of bioenergy projects.

The **BECoop Replication Handbook** is a powerful resource that empowers communities to replicate the bioenergy community concept. Through a clear and structured approach, the handbook provides step-by-step instructions, best practices, and valuable insights from successful case studies, enabling communities to navigate the replication process effectively. By offering customizable templates, tools, and checklists, it simplifies the replication process, allowing communities to save time and effort while building their expertise. Moreover, the handbook fosters learning among communities, creating a network of initiators who can learn from each other's experiences. By addressing challenges, promoting scalability, and aligning with sustainable development goals, the BECoop Replication Handbook acts as a tool for positive change for the local areas.

The actors in the follower cases have further found the provided **catalogues and factsheets** useful and interesting in exploring different possibilities for their bioenergy projects. These resources offered valuable insights into available solutions specific to their initiatives, aiding in the decision-making process and facilitating informed choices for project implementation. Particularly, the Bioraise tool from the **BECoop toolkit** was often recommended to assess the availability of forestry biomass and help them gather information about the biomass resources in their region.

The **e-market environment** platform supported some cases in finding stakeholders that can complement their activities or provide solutions in the aspects that the cases need extra assistance, establishing new contacts and cooperation activities and this way establishing a contact network that can be capable of providing technical, financial, business or community management solutions to the extent necessary.

The **self-assessment tool** helped some cases identify strengths and weaknesses in their bioenergy community development and provided recommendations for improvement. However, it was noted that a number of cases did not complete the self-assessment exercise, possibly due to language barriers, or they found the process not straightforward or time-consuming – challenges we tried to actively address and refine to ensure a more user-friendly experience. Despite this, the cases that utilised the self-assessment tool gained valuable insights into their projects and received support to address their specific needs and challenges. By leveraging the BECoop tools and resources, the bioenergy community initiatives were better equipped to develop their concepts.

Moreover, it was observed that **translating BECoop resources into the local languages** proved to be very useful for the project's follower cases. By circulating the BECoop-generated materials in their native language, the actors were able to better comprehend complex technical concepts and apply the information to their specific contexts. This language adaptation also helped build stronger relationships and trust between the BECoop partners and the local actors, fostering a collaborative and cooperative atmosphere throughout the project's development.

6 Conclusion

A diverse array of cases has been explored across Europe. In Sakana, Spain, a nascent RESCoop collaboration with 15 municipalities aims to establish a collaborative biomass management system, including biomass collection and sustainable biomass-fuelled boiler installations. In Strzeszów, Poland, the initiative led by an agricultural entrepreneur is looking to create a bioenergy cooperative with a combined heat and power (CHP) district heating system. In Macugnaga, Italy, a forest-wood energy supply chain is envisioned from underutilised forests and a biomass district heating plant. In Crete, Greece an existing energy community already operational in the field of solar PVs, plans to expand in bioenergy, with the exploitation of local biomass resources. Ecopower in Belgium, one of the pioneering RESCoops in EU, received support by BECoop to explore their first steps in bioenergy and the efficient wood chip production for district heating. In Plovdiv, Bulgaria's Energy Agency, already active in RES, seeks to establish an energy community and a biomass district heating system. In the Borlești commune in Romania, a new Energy Community aims to convert biomass residues for heat production. CommonEn in Greece, a newly established RESCoop, envisions to expand into bioenergy projects, including a biomass-fuelled CHP plant and biomass boiler installations.

The successful **application of the Replication Handbook to eight (8) complementary cases across the EU, spanning distinct maturity stages and local conditions, involving different types of initiators** (organisations, municipalities, agri-entrepreneurs, etc.,), and resulting in the achievement of KPI 7, has demonstrated the replicability of the BECoop methodology and concept, as well as the practicality of the BECoop tools.

The BECoop replication process accomplished to mobilise communities across the EU to get involved in the community bioenergy field. This process served as a platform for identifying both the strengths and weaknesses of the identified follower cases while designing a meticulous plan and vision. This exchange of insights enabled the creation of a concept note, a well-structured roadmap, and a comprehensive estimation of the community's potential in actualising each desired project.

This report empowers various actors involved in the domain such as municipalities, energy agencies, existing RESCoops active in different fields, to identify success cases, draw inspiration from the replication cases and gain useful insights to develop their community vision. With the new binding renewable energy target for the EU for 2030 of at least 42.5%[4], the BECoop replication process, aiming to establish a replicable and inclusive approach, involved a diverse mix of stakeholders, proving that regardless of the interested actors' level of previous existing knowledge and expertise, everyone can contribute to greening the heating demands and meeting the increased renewable energy target. Interested actors are supported in initiating community-led projects, to cover the basic heating needs, creating the foundations for locals to appreciate the natural resources, fostering strong networks, and encouraging further entrepreneurial activities. This approach ultimately generates additional local socio-economic benefits while alleviating energy poverty. People through their democratic and participatory involvement in bioenergy communities create the conditions for a fair and green transition.

The utilisation of the BECoop replication handbook, along with the insights gained from the implementation process, has proven to be a powerful tool for steering future replication initiatives. This approach not only offers beneficial resources for guiding future projects but also equips actors with the necessary tools for effective implementation. In the long term, the regions involved are better prepared to cultivate an increased awareness of energy communities, address local energy needs, and support vulnerable groups in their efforts to combat energy poverty. Efforts were made to enhance the communication of the replication handbook and ensure its inclusion in the EU Energy Communities Repository, while it is already accessible through

[4] https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-directive_en

Zenodo and the Energy Community Platform. This will help ensure continued accessibility to all interested stakeholders.

Through the exchanges of the BECoop experts with the cases' representatives, each selected follower case managed to map the relevant local stakeholders interested in joining the community bioenergy project. The BECoop experts provided support to the follower cases in order to uncover untapped opportunities and gain deeper insights into regional biomass potential. These ongoing interactions will persist, whenever feasible, to contribute their expertise to promote the adoption of community bioenergy initiatives throughout the EU.

Additionally, the stakeholders engaged in the follower cases will maintain communication amongst themselves. Having had the opportunity to establish connections and exchange insights and personal experiences during the physical BECoop brokerage event to which they were all invited, they will continue to stay in touch.

Ultimately, we envision the BECoop Replication Handbook and our report on the follower cases to extend BECoop's project results beyond our pilot areas and disseminate its message and valuable lessons throughout Europe. By doing so, we aim to equip stakeholders with new tools to secure a green, sustainable, and circular heating production landscape that puts citizens at its heart.

Annex

Annex I Profiling template (gathering input from our follower cases before meetings)

Follower case's characteristics

Region /area /country where the project will be established:	
Initiator of the project:	
Target users:	
Product/service to be offered:	
Are you an already established energy community? If yes, mention the current activity and current energy production capacities of your energy community (if available):	

Is there anything else you would like to state that hasn't been covered about your case or the characteristics of your local area?

Technical information

Price of biomass at the area (specify different available types and prices e.g. pellets, chips, briquettes etc.), €/t	
Price of Natural Gas (NG), €/m^3	
Price of Oil, €/l	
Price of Electricity, €/kWh	
Share of NG, oil, biomass, coal and other sources adopted for heating at local level (if available)	
Heating Degree Days of area involved (HDD)	

Description of local area characteristics (e.g. mountainous, agricultural, forests, valley, sloppy etc.)	
Type of available biomass in the area (e.g. straws, prunings, fruit stones, forest residues etc.)	
Surface of land where the available biomass is produced, ha (estimation)	
Monthly/Seasonal/Annual quantity of biomass available, t (estimation)	
Is there any competitors for using the local biomass feedstock? If yes, what kind of users (e.g. biomass suppliers, industries) and for what purpose (e.g. heating, electricity production, fuel market)?	
Average distance of the resources (biomass) from transformation/treatment facility	
Resource collection: Companies in charge of biomass collection if the service is in place?	
Amount of energy consumption you want to cover (thermal) by exploiting biomass, MWh_{th} annually (estimation)?	

Is there anything else you would like to state that hasn't been covered by the rest of the questions regarding the technical support you are aiming to?

Business information

Available national/local support mechanisms for biomass promotion	
Does the RESCoop have access to external funding sources?	
What are your current and future members?	
Who are your current and future "customers"?	
Who are your competitors (current or future)?	
Which are your strengths and weaknesses?	
What do you need/wish to do but you lack the resources/expertise/skills?	

Is there anything else you would like to state that hasn't been covered by the rest of the questions regarding the business support you are aiming to?

Visual material

Add an image from your local area/ project.

Annex II Letter of Acceptance

Acceptance of Support for [Initiative] from BECoop project

Dear Candidate,

We are pleased to inform you that **your energy community initiative has been selected to receive support from the BECoop project**. Congratulations!

The BECoop project will provide high-level technical and business support to eight energy community initiatives during their initial stages. Our expert partners will offer an extensive introduction on how to apply the BECoop Replication guide, tools, and methodologies, and assist you in preparing a roadmap for your initiative. As shown in the figure below, **the support will be provided through four virtual meetings** scheduled between March and July 2023.

SUPPORT SERVICES

Figure 1. Support services' timeframe

The first meeting, the Welcoming Meeting, will provide you with an overview of the project, our support scheme, and the tools we will be using to support your initiatives. Additionally, you will have the opportunity to meet the expert partners who will be working with you throughout the project. This meeting will be approximately one hour long. Subsequent meetings will focus on technical and business aspects, stakeholder engagement, and the examination of a roadmap for your initiative.

To ensure the presence of all four selected cases during the Welcoming Meeting, we would like to kindly ask you to indicate your availability in this Doodle poll by Thursday (16th of March) EOB. After the poll closes, we will circulate a calendar invitation and the meeting agenda.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement no. 952930.

We are excited to work with you and support your energy community initiative. Please don't hesitate to reach out to us if you have any questions.

Congratulations once again for your selection, and here is more information about the BECoop project:

- Our video
- Our website
- Our brochure in 7 languages
- Our social media: Twitter, LinkedIn, Facebook

Best regards,

BECoop Team

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement no. 952930.

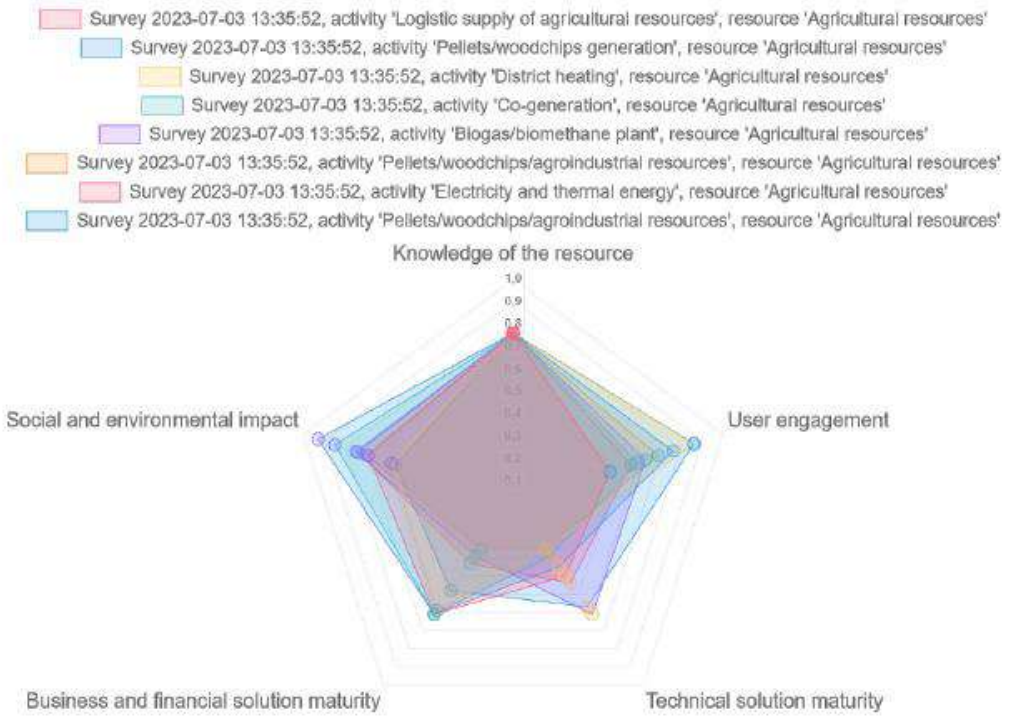
Annex III Internal Identification criteria template

Information						Performacne against criteria										
No	Case name	Country	Name of region	Suggested by:	Identification Means *(T1.1, T3.2 training events, T3.3 awareness campaings, through our network; T5.1 (Not, Forums), AB, Letters of support, other, etc.)*	Local resources availability *(Please rate the availability/potential of resources in the local region e.g. prunings, municipal residuals etc.,)*	Potential to meet local needs *(can the case adequately address and sufficiently cover localised needs, such as energy poverty, high heating demands etc.,)*	Current status of stakeholders' engagement *(are key actors - including public authorities, SMEs, that can influence the local community etc.- already mobilised?)*	Main types of stakeholders already engaged (e.g citizines, local authorities, farmers, vulnerable groups etc.). Which type of stakeholders are already engaged?	Type of stakeholder serving as case initiator (e.g an existing RESCoop, local authority, citizens etc.) Who is the main stakeholder that will support the initiative?	Level of support by the local community *(e.g. has the local community embraced such an initative, are they already willing to support a local bioenergy community project?)*	Initative's maturity levels *(e.g. mature enough to employ and take up BECoop tools and methodologies)*	Sodal innovation at the local level (does this endeavour introduce a new cooperative concept or have there already been similar cases established at the regional level?)	Replicability *(does the case have the potential to serve as an inspirational example not only at the local level but also at the EU level?)*	Additional/Special features *(any characteristics which would make this case to stand out)*	Comments/notes

Annex IV Cases' self-assessment results presented in spider-nets (when available)

The results of the final self-assessment of the Sakana case (after the support):

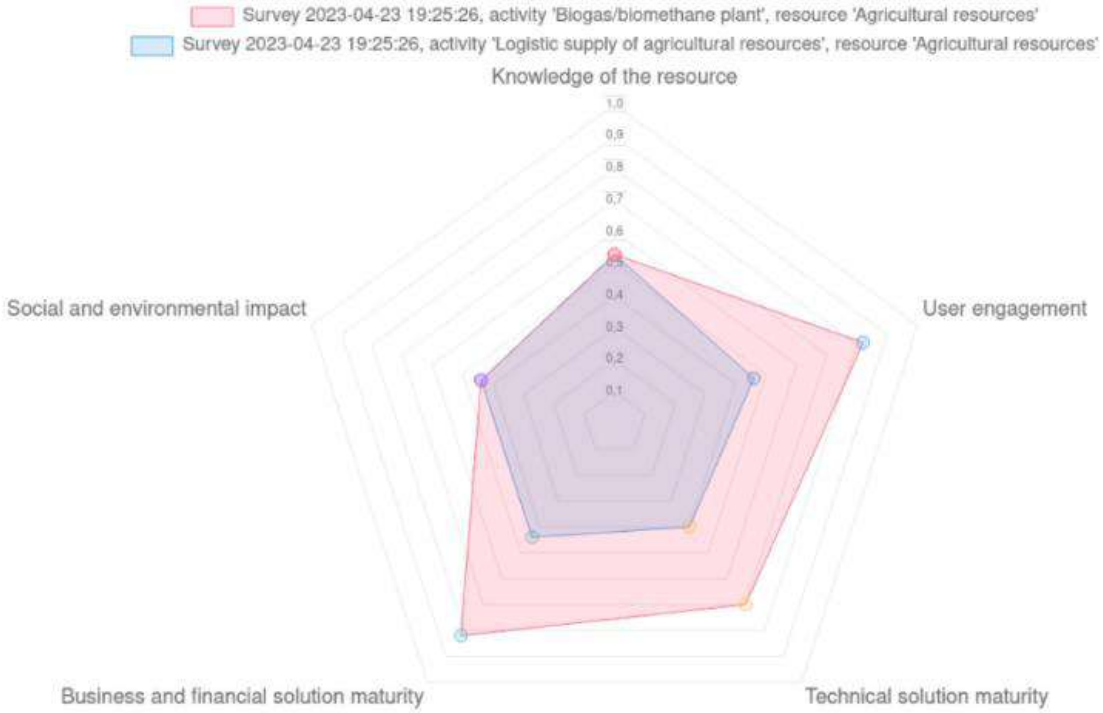
The following graph is the result of the final self-assessment of Sakana in a visual spider-net. The case has been assessed toward multiple activities, and thus there is a graph with overlapping spider-nets from the different surveys/assessments, to generate a comparative overview.



The score obtained in this self-assessment is 0.54:
Good knowledge of what have to be done, please proceed with caution, you should review if there some categories weaker than others, and put more efforts in these categories, the recommendations provided could help you.

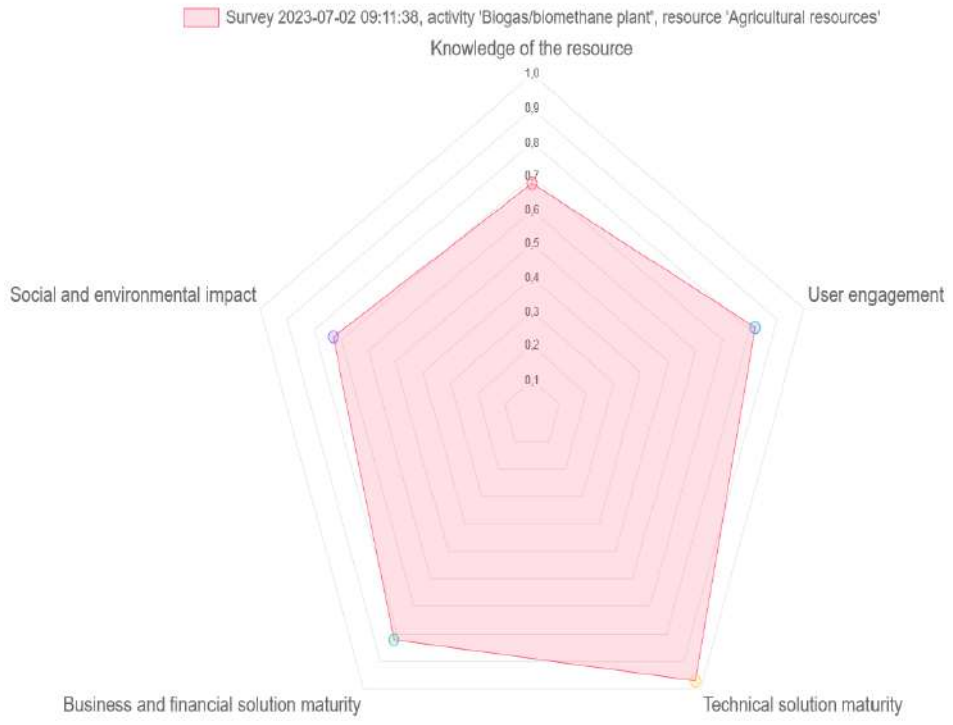
The results of the 1st self – assessment of the Strzeszów case (before the support):

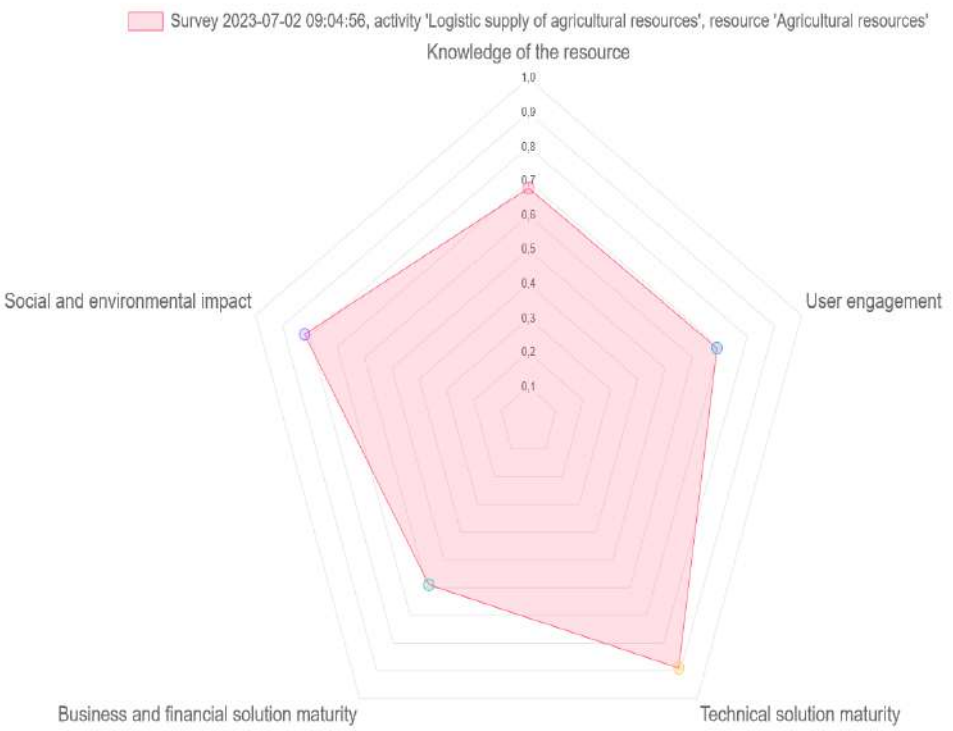
The following graph is the result of the first self-assessment of Strzeszów in a visual spider-net. The case has been assessed toward two activities (Biogas/biomethane plant and Logistic supply of agricultural resources), and thus there is a graph with overlapping spider-nets from the two surveys/assessments, to generate a comparative overview.



The results of the 2nd self-assessment exercise of the Strzeszów case (after the support):

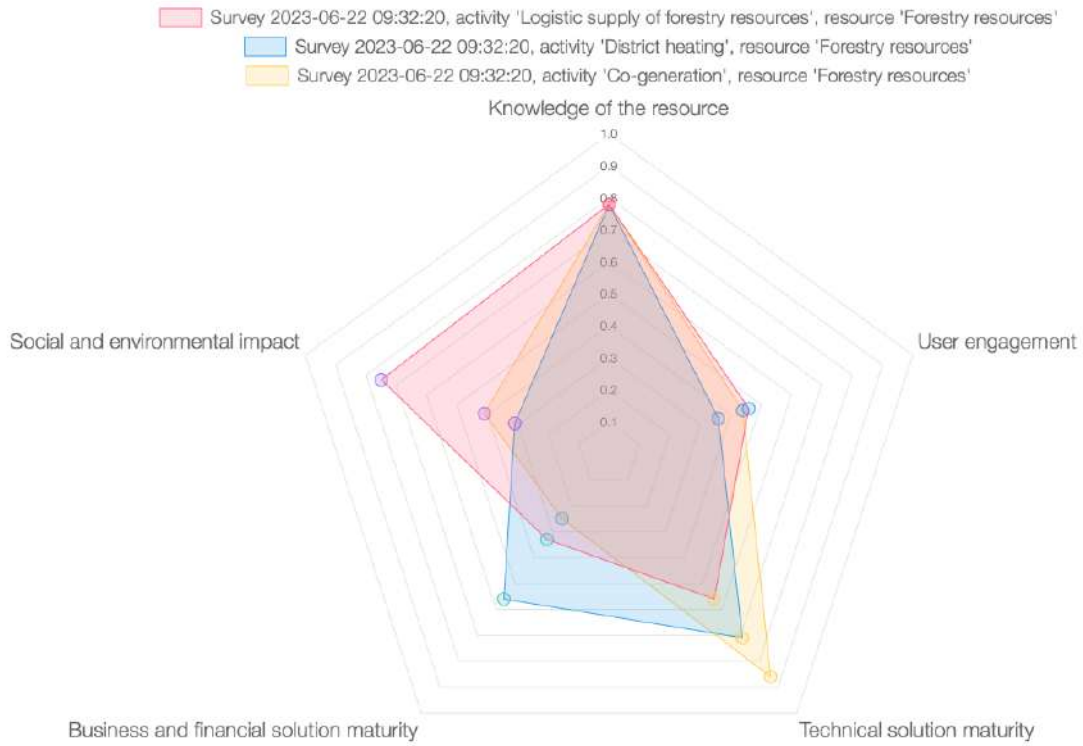
The following graphs are the result of the final self-assessment of Strzeszów in visual spider-nets. The case has been again assessed toward the same two activities (Biogas/biomethane plant and Logistic supply of agricultural resources), but the surveys/assessments are presented in two separate graphs, instead of one as before.





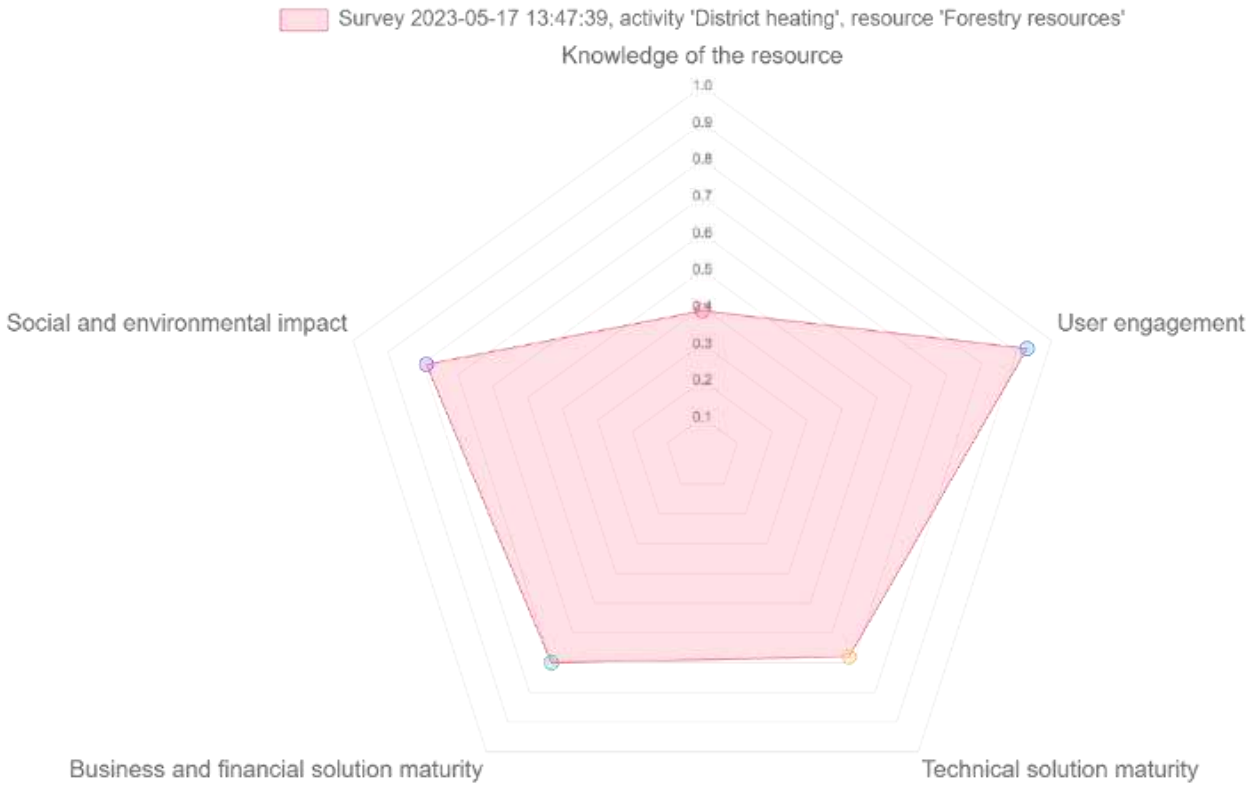
The results of the 1st self – assessment of the Macugnaga case (before the support)

The following graph is the result of the first self-assessment of Macugnaga in a visual spider-net. The case has been assessed toward three activities (Logistic supply of forestry resources, DH, Co-generation), and thus there is a graph with three overlapping spider-nets from the three surveys/assessments, to generate a comparative overview.



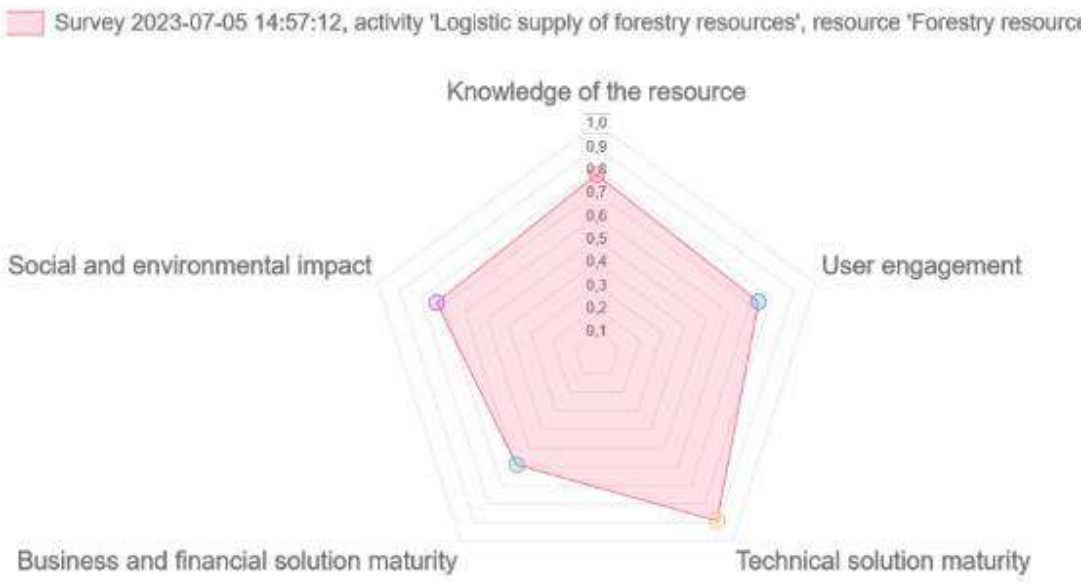
The results of the 1st self – assessment of the EAP case (before the support)

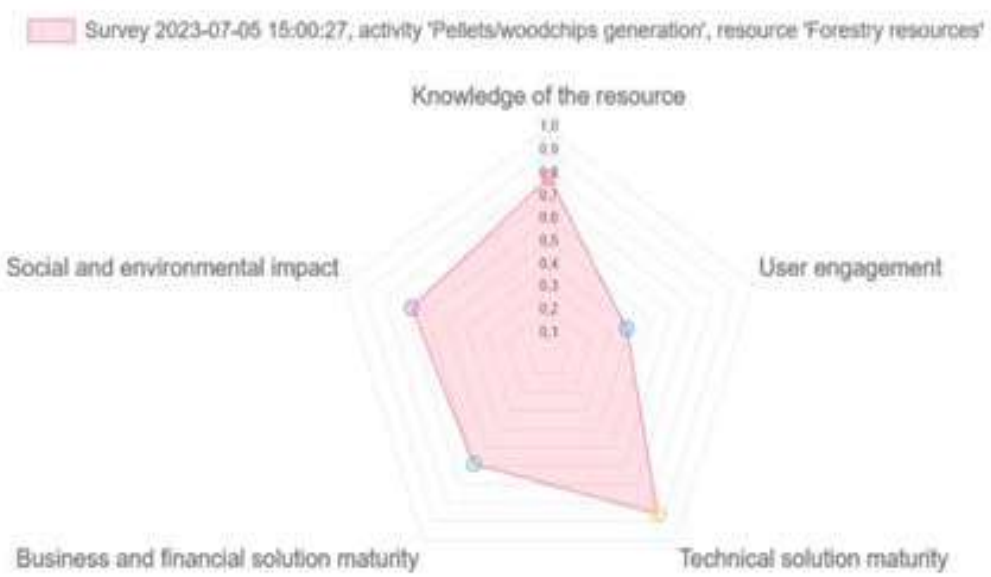
The following graph is the result of the first self-assessment of EAP in a visual spider-net. The case has been assessed toward one activity (DH).



The results of the 1st self – assessment of the SVA case (before the support)

The following graph is the result of the first self-assessment of SVA in a visual spider-net. The case has been assessed toward two activities (Logistic supply of forestry resources and Pellets/woodchips generation).





The results of the 1st self – assessment of CommonEn (before the support)

The following graph is the result of the first self-assessment of CommonEn in a visual spider-net. The case has been assessed toward one activity (Co-generation).