D6.7

Roadmap 2030 per lighthouse city

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List of acronyms

Acronym	Description
ACR+	Association of Cities and Regions for sustainable Resource Management
AD	Anaeorobic digestion
AWM	Abfallwirtschaftsbetriebe Münster
BC	Biowaste Club
BCM	Biowaste Club Meeting
B2B	Business to business
CE	Circular Economy
CEWEP	Confederation of European Waste to Energy Plants
CluBE	Cluster of Bioeconomy and Environment of Western Macedonia
CSCP	Collaborating Centre on Sustainable Consumption and Production
DIADYMA	Waste Management of Western Macedonia
ECN	European Compost Network
HoReCa	Hotel/Restaurant/Catering
H2020	Horizon 2020
ICLEI	International Council for Local Environmental Initiatives
ISWA	International Solid Waste Association
LHs	Lighthouse Cities and Regions
MMSW	Mixed municipal solid waste
MSW	Municipal Solid Waste
MWE	Municipal Waste Europe

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NGO	Non-Governmental Organisation
PAYT	Pay as you throw
PDA	Project Development Assistance
RAYT	Reward as you throw
SAYT	Save as you throw
RMC	Raw Materials Collective
UCO	Used cooking oils
VKU	Verband Kommunaler Unternehmen

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1. Executive summary

The HOOP Project helps to unlock bio-based investments and adopt local bio economies in Europe through a systemic and cross-cutting approach. It offers Project Development Assistance (PDA) at the 8 Lighthouse Cities and Regions - to shape the technical, economic, financial, and legal expertise needed to develop concrete investments for the valorisation of the OFMSW (Organic Fraction of Municipal Solid Waste) or UWWS (Urban Wastewater Sludge) with the aim of obtaining safe and sustainable bio-based products.

With the eight Lighthouse cities and regions being the core of the HOOP project, it is important to analyze what was achieved and the road ahead for them in the urban circular bioeconomy. This deliverable, D6.7 “Roadmap 2030 per lighthouse city”, provides an overview of the manifold achievements carried out by each of the eight lighthouse cities and regions. This stretches beyond the achievements in terms of engaging key stakeholders and looks to not only list the progress made in the project but also offer connections between the different achievements. In addition, and importantly, the deliverable describes roadmaps ahead and beyond the project lifetime on the basis of what has already been achieved. By providing key milestones and achievable results in the road ahead, D6.7 manages to outline concrete goals and ways to achieve those goals. At the same time, the deliverable also shows where the focus areas lie, as not every aspect of the HOOP project will continue in the lighthouses beyond the project lifetime.

The deliverable analyses the lighthouse progress in the following categories:

- *Biowaste Club Framework*
- *Citizen Science*
- *Pilot Actions on Stakeholder Engagement*
- *Biowaste Recycling / Bioeconomy as core topic of the lighthouse organisation*
- *Biowaste Recycling / Bioeconomy as core topic of the lighthouse city/region*
- *Biowaste stream(s) in the lighthouse*
- *Regional/national replication*
- *European cooperation*
- *Others*

Most of the lighthouses worked on all these topics and D6.7 manages to illustrate, in which of these areas longer-lasting focus points will be found in each lighthouse by describing both upcoming milestones as well as concrete actions to get there. Thus, the roadmaps are formed on a case-by-case basis allowing readers to understand how the HOOP journey will continue. Overall, the project manged to achieve many results including technical progress, the engagement of citizens or building connection on national and international level to further collaborate with interested stakeholders.

In conclusion, the deliverable shows that even though the challenges and concrete settings in each of the eight lighthouses differs, there are similarities in the road ahead. In terms of implementing new technologies to valorize biowaste, many lighthouses have made vast progress which in some cases

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even lead to the implementation of new pilot technologies. In other cases, the groundwork has been carried out. When it comes to engaging stakeholders, the approaches vary a lot and the provided methodologies such as the Biowaste Club Framework have proven to be the right tool to bring stakeholders together. Looking ahead, getting new and additional funding sources and projects will also be of relevance as these provide concrete opportunities for further work on the many topics from engaging the stakeholders to implementing novel technical solutions in the circular value-chains in the lighthouses. Most of these actions have a short to medium timeline in mind for the upcoming years after the end of the HOOP-project and thus will manage to keep the momentum of the project going.

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2. Introduction

From late 2021 and early 2022, each of the eight HOOP Lighthouse Cities and Regions (LH) has set up its own local or regional Biowaste Club and carried out its first stakeholder engagement activities through Biowaste Club meetings. In order to meet each Lighthouse's target groups and goals for engagement, each Biowaste Club's set-up, format and size vary. While some are built upon existing local initiatives, others bring stakeholders together for the first time. For a documentation of the Biowaste Clubs' stakeholder engagement activities that have taken place from October 2020 through to September 2023 or that were still expected to take place next, please refer to deliverable D6.3. In six Lighthouse Cities and Regions, Biowaste Clubs are accompanied by citizen science interventions, which were documented in deliverable D6.4, and citizen engagement pilot actions, which were documented in deliverable D6.5. Deliverable D6.6, conversely, assessed the impact of multi-stakeholder engagement activities carried out during the HOOP project.

With the end of the project approaching in less than a quarter year, it is time to reflect on the progress made in the project while also looking ahead on what is next after the project. From motivating citizens to participate in the urban circular bioeconomy to implementing new technologies to valorize biowaste, the eight lighthouse cities and regions have been actively using the HOOP project in various ways producing diverse results. Since these results are not pursued for their own sake but rather based on an impact driven approach to advance the sustainable transformation in the cities and regions as well as beyond, it is important to look ahead and create roadmaps to further foster impact. This deliverable aims to do just that by taking a holistic look at the achievements that each lighthouse has produced and also offering an accessible roadmap framework for the road ahead.

For this purpose, chapter 2 continues explaining the setting and the core concepts of the HOOP project relevant for this roadmap while also showcasing the methodology of this deliverable. Chapter 3 lays out the roadmap per lighthouse in detail while connecting to the different types of work and results achieved by the project. Chapter 4 concludes these findings while giving a consolidated outlook ahead.

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2.1. Concepts

In order to understand the roadmaps characterized in this deliverable, the descriptions feed on core concepts relevant in the HOOP project. These concepts are described below in detail in order to better understand how the work was carried out and what the roadmaps ahead are laying out going forward.

Biobased products

Biobased products are those wholly or partly made from materials of biological origin, excluding materials embedded in geological formations and/or fossilised. As they are derived from renewable raw-materials such as plants and organic waste, biobased products can help reduce CO_2 emissions and offer other advantages such as novel product characteristics (e.g., biodegradable plastic materials).

Bioeconomy

All economic sectors and systems that rely on biological resources (animals, plants, micro-organisms and derived biomass, including organic waste), their functions and principles can be considered part of the Bioeconomy. It includes and interlinks: land and marine ecosystems and the services they provide; all primary production sectors that use and produce biological resources; and all economic and industrial sectors that use biological resources and processes to produce food, feed, biobased products, energy and services. (European Commission's Knowledge Centre for Bioeconomy, 2020).

Biowaste Clubs (BC)

Biowaste Clubs are the main dialogue platform for stakeholder engagement in the HOOP lighthouse cities and regions. They are made up of key local stakeholders, such as representatives of the municipality, of waste collectors or of citizens' initiatives. Biowaste Clubs aim to foster local commitment and engagement for a more circular biowaste value chain. Specific goals of the Biowaste Clubs may be to:

- Increase consumer awareness and acceptance of urban biowaste-derived products.
- Change behaviour towards better recycling rates, in order to increase quality and quantity of the bio-waste collected.
- Implement best practices in biowaste collection, transport, sorting, pre-treatment and characterization.
- Promote new, circular business models and foster social innovation.
- Initiate new local and national policies and initiatives.
- Set milestones for national action manuals.
- Collaborate with Local HOOP Committees in tracking financial and non-financial leverage of HOOP in each Lighthouse.

In the HOOP project, the Biowaste Club members meet at least twice per year per lighthouse but the concept is open to be continuously used beyond the project lifetime as a manifestation of the stakeholder engagement. The BCM set-ups, compositions and formats may vary depending on the topics relevant in each lighthouse at a given time.

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Citizen Science

Citizen Science (CS) refers to public participation in scientific research, and is based on the recognition that, in the wake of socio-environmental challenges calling for local action, science and technology can be enriched with more perspectives than those of just scientists. CS seeks to involve citizens in a research process in different ways, from defining the research question(s) to collecting and analysing data, and co-creating actions with engaged stakeholders. The intensity of involvement depends on the objective of the research. In the HOOP project, a citizen science app was developed in six out of the eight lighthouses to directly engage the citizens and conduct data from them. This data and the existing app are open for further use.

HOOP mother projects

HOOP is the consolidation of the predecessor projects called SCALIBUR, VALUEWASTE and WaysTUP. A number of HOOP partners including several lighthouses already participated in these project that then turned into HOOP. Work carried out by the respective lighthouses that already participated in these projects has in many cases been continued in the HOOP project.

Stakeholder engagement

Stakeholder engagement is a guided process in which relevant actors are included in frequent exchange and join forces to achieve a common goal. Stakeholder engagement is an ongoing, inclusive dialogue among all actors that can contribute directly or indirectly to a given goal. It is a process of agenda-setting and collective implementation of activities that are shaped according to the stakeholders' needs and expectations.

Lighthouse Cities & Regions (LHs)

HOOP partners provide Project Development Assistance (PDA) to eight pioneering lighthouse cities & regions that are committed to developing large-scale urban circular bioeconomy initiatives. The eight cities and regions are: Kuopio (Finland), Bergen (Norway), Almere (The Netherlands), Albano-Laziale (Italy), Greater Porto (Portugal), Western Macedonia (Greece), Murcia (Spain) and Münster (Germany).

Pilot Action

HOOP promotes sustainable waste management and bio-based products through citizen science and pilot actions in the identified lighthouse cities. There are two streams of pilot actions: education and awareness raising on the one hand, and the promotion of bio-based products on the other. The education stream encompasses trainings for the HoReCa sector, workshops for educators to integrate sustainable waste management in curricula, and online teaching materials. The bio-based products stream involves community events and exhibitions. Insights from pilot actions will single out best practices for broader dissemination, and the end goal is for lighthouse cities to scale these actions beyond the HOOP project.

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2.2. Scope and purpose of the deliverable

The roadmaps, even though produced in WP6 (stakeholder engagement), take a broader scope than just the engagement. Focused around the entirety of work carried out by the lighthouses, the deliverable assesses and describes the key results from the project and also the road ahead. Thus, it is possible to gain a better understanding about the key focus points in each lighthouse and to break out of the typical WP structure provided by projects such as HOOP. This is paired with a goal-oriented approach based on tangible results that will live on beyond the project lifetime. This way it is possible to derive engagement strategies for the future, lay out further implementation strategies and to cover both the technical and the exchange-centered topics within the project in a connected way.

The purpose of this deliverable is thus to summarize the main actions that took place in each of the lighthouses. At the same time, by drafting this deliverable, reflections were sparked within the lighthouses by co-creating the core inputs and thus making the lighthouses themselves think about the road ahead in a holistic framework (see chapter 2.3). At the same time, the deliverable aims at giving the reader an idea of what HOOP managed to achieve and how those results could turn into long-lasting impact in each of the lighthouses and beyond.

2.3. Methodology

The methodology of the deliverable bases on the empirical evidence provided by the overall HOOP project progress in which the eight lighthouses have been cross-cutting implementation cases for both the technical PDAs developed in the project as well as the engagement and replication focused work contributions from the project. Table 1 was developed for this purpose and filled by the lighthouses based on over 3,5 years of project work at the time of submission (including in some cases even predecessor projects such as Scalibur taking place). The vertical rows in the table focus on different key focus areas of the project, starting with the engagement-centered themes (Biowaste Club framework, Citizen Science, Pilot Actions on stakeholder engagement), before moving to the more technical side of the biowaste-recycling streams and the valorization both in the respective city and region but also within the organization of the lighthouse representatives (Biowaste-recycling as a core topic in the organization & in the city/region, bio-waste streams in the lighthouse). With regional and/or national replication and the European outreach, topics and actions that go beyond the lighthouse but are rightfully also a vital part of the project can be found in the last columns.

The horizontal columns can be read as a timeline from left to right in each of the thematical rows described above. Starting with the situation before the HOOP project, the baseline in each of the categories is being set. Moving on to the main achievements within the project, readers get a clear understanding on the progress and the impact already achieved. By understanding both the original situation and the progress made, the remaining columns, can be considered the key basis for the roadmap as both required milestones as well as action items and timelines are described. Due to the different focus points in each lighthouse, not every row and column is filled completely but nevertheless, the lighthouses give insights in the achievements and the road ahead. Where table cells are empty, it is either because the concerned lighthouse only limited its activities to the HOOP project, or because, while they have a clear objective, the specific milestones and actions still need to be further defined. In some

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cases, rows have been deleted entirely due to the lack of content. **In the Lighthouse chapters, all sections pertaining to the roadmaps and upcoming activities and steps will be bolded.** The tables get accompanied by additional text descriptions of the situation at hand in each lighthouse chapter that are based on the insights, previous deliverables and the HOOP tales, a short description of the lighthouse's main achievements and focus points, that can be found in the annex and are referenced throughout the chapters.

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Table 1. The roadmap template

	"Lighthouse Name"					
	Status Quo before HOOP	**Achievements in HOOP**	**Next Milestone**	**Action items and Timeline =** HOW this "next goal" will be achieved/ how the activity will continue/ be up-scaled/ replicated etc		
				Action 1	**Action 2**	**Action 3**
	Before HOOP, in our lighthouse there was…	**In the project life-time, we managed to…**	**Our next milestone will be to …**	**We will achieve this milestone by firstly … until …**	**Secondly, until … we will ...**	**Finally, until … we will …**
Biowaste Club framework						
Citizen science						
Pilot actions on Stakeholder En-gagement						
Bio-waste recy-cling/ bio-economy as core topic of our organisation						
Bio-waste recy-cling/ bio-economy						

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as core topic of our city/ region	
Bio-waste stream(s) in our lighthouse	
Regional/national replication	
European coopera-tion	
Other?	

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3. Roadmap 2030 per Lighthouse City

3.1. Albano Laziale

Albano Laziale, the Italian lighthouse in the HOOP project, has certainly benefitted vastly from the role as a lighthouse by facilitating numerous activities and achieving various results as shown in table 2. These results are rooted in the lighthouse's participation in one of the HOOP mother projects, SCALIBUR, during which not only technical groundwork was carried out but also formats such as the Biowaste Clubs could already be established to foster stakeholder engagement. The improvements to the waste management system have been of significant value already during the project lifetime. The region managed for example to reach several important milestones such as getting a 600-ton electromechanical composter into the system and running. In terms of waste management, the lighthouse has managed to further improve the organic waste management in the region. Other milestones include that used cooking oils (UCO) have been implemented as a separate fraction of the recycling system and hence improving the overall system by adding another high-value waste stream to it (for details see annex). First efforts during the project in this regard really focused on getting insights and earning recognition as a best practice while already finding another municipality to replicate the efforts. The economic viability of the efforts has also been increased by finding the partners that pay for the cooking oils and have helped in increasing the number of collection points. **Going ahead, Albano Laziale aims to further upscale these technologies and the connected needed activities, for example by optimizing the collection but also through collaborating with key stakeholders outside of the region.**

In terms of biowaste recycling, Albano Laziale seeks to improve the capacity of relevant stakeholders in the region, creating strategies for stakeholder involvement. Clear goals such as broader participation of stakeholders and closer collaboration with these are already laid out. Enhancing existing initiatives is one of the possibilities to do so and while these goals are linked to some specific topics like the UCOs, these improvements and overall awareness raising activities will help Albano Laziale move forward with most of its efforts related to its urban circular bioeconomy.

When it comes to engaging citizens, there have been several successful examples: The HOOP trainers app for citizen science has been a success in Albano Laziale in terms of reaching out to citizens, especially younger generations. Several learnings already took place in this data-driven process, especially when it comes to fostering a sustainable local environment. **Taking this data-centered approach is also a theme going forward as Albano Laziale. By connecting further citizen science initiatives with the HOOP efforts, as well as replicating some of the learnings to create open data solutions in the future, the lighthouse aims to scale up this methodology.**

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The engagement and involvement of the community takes many shapes and forms in Albano Laziale, beyond the aforementioned systemic changes in the recycling system or the data-driven approach of the citizen science. **Efforts to enhance public awareness, education and partnerships will be strengthened by clear guidelines and best practice sharing initiatives involving the relevant actors. Broader collaboration with concrete events will also support these objectives.**

The forward thinking of the region in Albano Laziale is showcased not only by already providing clear paths ahead but also through already thinking about replicating and further financing the results produced in the project. **In terms of replication, Albano Laziale plans to cooperate with national bodies on several topics such as the UCOs, but also to more directly cooperate, with European partners from the HOOP project and beyond. For this, visions are translated into clear actions: workshops for collaboration, consolidated efforts to implement a bioeconomic strategy, and corresponding advocacy work in the region and on a political level. In terms of funding, one clear lever for Albano Laziale will be the participation in further projects. With HOOP being such a clear success in kickstarting and advancing multiple parallel efforts on the community level and in the biowaste recycling system in the region, this successful practice will continue to be used and leveraged. This way, a broad scale up of proven practices in the region and beyond will be legitimized and enabled.** All in all, Albano Laziale is an example of how to continuously use projects and cooperation with key stakeholders to bring impactful change in more than one sector in order to work towards sustainable transformations in the region.

Figure 1. Biowaste Club Meeting Albano Laziale

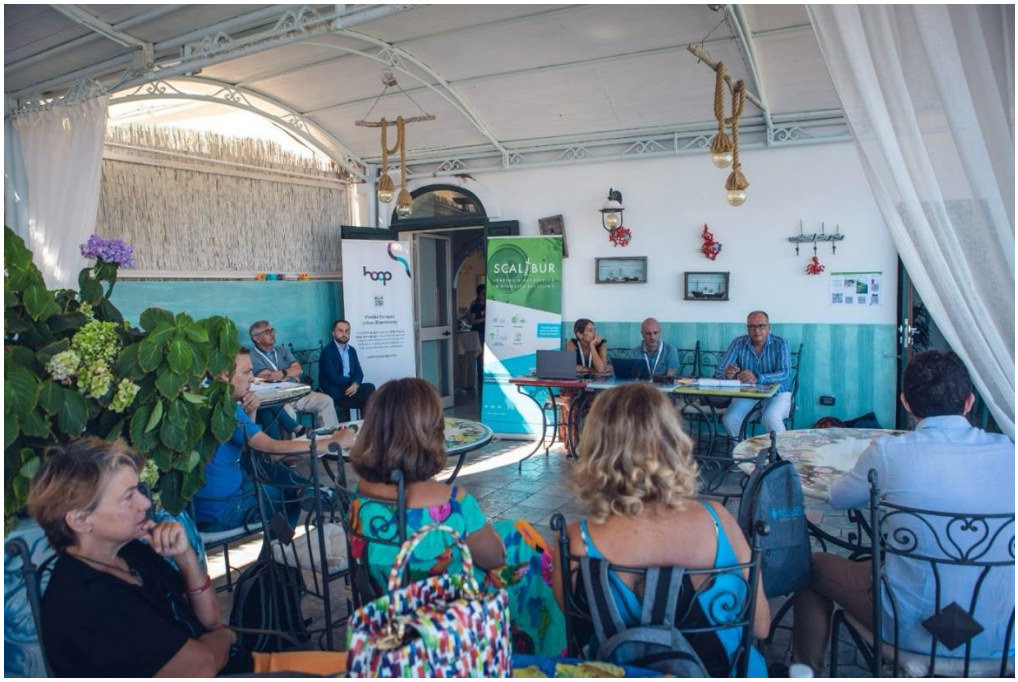

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Table 2. Roadmap for Albano Laziale

	Albano Laziale					
	Status quo before HOOP	**Achievements in HOOP**	**Next Milestone**	**Action Items and Timeline**		
				Action 1	**Action 2**	**Action 3**
Biowaste Club Framework	Lack of consistent engagement among stakeholders on the main HOOP issues.	Establishment and effective operation of the biowaste club, which met semi- annually.	Enhanced stakeholder engagement on core HOOP topics based on the ongoing experience starting from the 600-ton municipal composting plant	Next Meeting with Stakeholders until end 202so 4	Mid/ end 2025 clear shared decision of all stakeholders on municipal composting plant development	Apply for funding with the support of ANCI Lazio, i.e., within the ERDF Funds or ESIF Funding by end 2025
Citizen Science	None	HOOP trainers app experience: Citizens, and in particular young people, reached through awareness campaigns, festivals, and educational events. Learnings from the process: Enhanced community engagement and increased	With the support of ANCI Lazio, Albano Laziale's work in HOOP is influencing the Lazio region to prioritize biotechnology applications in organic waste management. This initiative aims to create greater financing op-	Thanks to Volsca Ambiente e Servizi, Albano Laziale is the only municipality that offers complete online data with details on separate waste collection and adequate communication to citizens with a citizen science	We expect the replicability (mid/ end 2025) of other municipalities to make waste collection and management data increasingly OPEN in order to create greater awareness also on the opportunities for valorising organic waste	Until 2025 Albano Laziale with the support of ANCI Lazio will search for funding to encourage the development of open data solutions applied to waste to increase awareness and the citizen science approach

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		understanding of bio-waste management among the youth, fostering a more sustainable local environment.	portunities for innovative and sustainable waste solutions, enhancing the quality of organic yield through applied biotechnologies.	approach can be applied before the closure of HOOP		
Pilot actions on Stakeholder engagement	Awareness campaigns produced by the Municipality of Albano Laziale and by Volsca Ambiente e Servizi responsible for municipal waste collection and management.	In the project lifetime, we managed to pilot actions on stakeholder engagement, effectively implementing initiatives that fostered active participation and collaboration among community members, local businesses, and governmental bodies. These efforts have been instrumental in shaping sustainable practices and enhancing awareness about bio-waste recycling and the bioeconomy also in Lazio region	As a next step, we aim to consolidate the pilot action by leveraging our knowledge to advocate for policy changes that support applications of biotechnology in organic waste management.	The next step, until 2024 will be a creation of a national event aimed to create specific strategies for different groups of stakeholders reached so far on the topic of biowaste (UCOs, coffee grounds, cosmetics, organic waste...), taking into account their needs, interests and preferred methods of participation.	Secondly, until mid 2025, we will continue to refine these strategies through ongoing dialogue and feedback sessions with stakeholders. This process will ensure that our approaches remain responsive to evolving needs and effectively support sustainable practices across all sectors of biowaste management.	Finally, until 2025, we will consolidate our achievements by integrating the lessons learned into comprehensive guidelines and best practices. This will ensure sustained community engagement and continuous improvement in biowaste management, fostering a lasting impact on environmental sustainability.

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Bio-waste recycling/ bio-economy as core topic of our organisation	At Albano Laziale, separate collection of bio-waste began around 2014	The bioeconomy significantly accelerated and strengthened through the HOOP project, which has played a pivotal role in enhancing our capabilities and expanding community engagement in sustainable waste management practices, especially for the waste vegetable oil fraction.	Next milestone will be to further enhance community participation and expand outreach initiatives in bio-waste recycling and the bioeconomy, building upon the foundation established through the HOOP project. This includes implementing fostering partnerships with local businesses and institutions, and advocating for policy changes that promote sustainable practices and environmental stewardship.	Taking the good practice realised under HOOP about the improved collection of UCOs in Albano Laziale, the next step by ANCI Lazio will be to further extend and improve the used vegetable oil collection program, including more municipalities in the Lazio region.	Secondly, until 2024, we will focus on refining our stakeholder engagement strategies to ensure broader participation and collaboration. This will involve conducting targeted outreach efforts and hosting workshops in the Lazio region to enhance the scalability and sustainability of our initiatives. Our goal is to achieve long-term impact in biowaste management and promote the bioeconomy effectively through the HOOP approach.	Finally, until mid 2025, we will consolidate our efforts by integrating lessons learned and best practices into our ongoing initiatives. This includes enhancing public awareness through educational campaigns, fostering strategic partnerships across sectors, and advocating for policies that support sustainable biowaste management and the advancement of the bio-economy
Bio-waste recycling/ bio-economy as core topic of our city/ region	the collection of used oils in Albano Laziale at the beginning of the HOOP project were only in 4 collection points and without any significant	Thanks to the support and coordination of ANCI Lazio, companies accredited on the white list in Lazio and the national body for waste oils	Our next milestone will be to expand the bio-waste recycling program to include activities at a recycling center within the municipality.	We will achieve this milestone by 2024 firstly enhancing public awareness through educational campaigns and com-	Secondly, until 2025, we will focus on optimizing collection processes and improving logistics at the municipality's recy-	Finally, until 2026, we will consolidate our efforts by leveraging insights from successful HOOP practices observed

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	added value not even the company that handled the collection was registered on the White List (list established at each Prefecture which have the aim of make anti-mafia controls more effective) and finally the transport took place from outside the region.	(CONOE) have been identified. Albano Laziale conducted a market survey and selected a company that significantly improved the service by increasing collection points from 4 to 24, and providing the Municipality with 40 cents per kg for the used oil collected annually.		munity outreach initiatives. Until [specific timeframe], we will collaborate with local stakeholders to establish the infrastructure and operational framework for the bio-waste recycling activities at the municipality's recycling center.	cling center. This includes streamlining waste sorting procedures, implementing efficient transportation routes, and enhancing monitoring systems to ensure effective management of bio-waste recycling activities. Additionally, we will engage in continuous stakeholder consultation to address feedback and adapt our strategies for maximum effectiveness.	in LIPOR and Munster. We will refine and implement a robust composting strategy in Albano Laziale, focusing on maximizing organic waste diversion and promoting sustainable practices. This includes evaluating the effectiveness of our composting initiatives, fostering community participation, and establishing partnerships to ensure the long-term viability and expansion of our composting programs.
Bio-waste stream(s) in our lighthouse	In the Lazio region, including Albano Laziale, a significant challenge concerns the export of organic waste. Logistical and regulatory complexity often limits options for sustainable	In Albano Laziale, our lighthouse status has focused on optimizing organic waste flows, implementing innovative organic waste management solutions, and promoting community	Next milestone will be to expand the experience about the efficiency of our electromechanical composter in Albano Laziale also through the support of AIC (Italian Composting	The next meeting with stakeholders is scheduled to occur by the end of 2024. This meeting aims to review progress, gather feedback, and collaboratively strategize on enhancing bio-waste	Secondly, until mid 2025, we will intensify our efforts to engage the community through targeted outreach campaigns. This includes fostering a deeper understanding of bio-waste management	Finally, until 2025, we will continue to monitor and evaluate the effectiveness of these initiatives, aiming for continuous improvement and sustainability in our bio-waste manage-

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	organic waste disposal, impacting overall waste management and the local environment.	engagement to promote sustainable practices. A significant milestone includes the operation of the municipality's 600-tonne electromechanical composter, which enhances local capacity for sustainable organic waste management.	Association). This includes optimizing operational processes, increasing organic waste processing capabilities, and enhancing the quality of compost produced.	management initiatives in Albano Laziale.	practices, encouraging participation in recycling programs, and promoting sustainable behaviors among residents of Albano Laziale e oltre, nel Lazio.	ment efforts and environmental stewardship within the community. Drawing from the good practices learned in HOOP, such as those from Munster and Lipor, we will refine our strategies to enhance organic waste recycling and promote environmentally responsible practices effectively.
Regional/ national replication	Albano Laziale has received several awards over time for its high level of separate waste collection, beginning with the recognition as a 'Recycling Municipality' awarded by Legambiente	Thanks to Albano Laziale's initiative under the HOOP project, the city successfully implemented a program for collecting used cooking oils (UCO), earning recognition and demonstrating effectiveness in sustainable waste management. This best practice garnered attention from other	Expand organic waste management initiatives with the support of ANCI Lazio and CONOE aimed to further optimize our UCO (Used Cooking Oil) collection program, leveraging best practices learned from successful implementations across the region/national level	Leveraging the experience and support of ANCI Lazio and CONOE, we aim to significantly enhance regional and national efforts towards more effective and sustainable organic waste management practices in municipalities.	Within 2024 we will expand our partnership with ANCI Lazio and CONOE to strengthen organic waste management initiatives together with the AIC (Italian composters association) identifying opportunities for the development of guidelines for sustainable practices.	Finally, until 2025, we will consolidate our achievements by scaling up our organic waste management programs with the continued support of ANCI Lazio, CONOE and AIC. This includes expanding our UCO (Used Cooking Oil) collection network, optimizing composting facilities, and promoting the use of

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		municipalities, including Ciampino, which replicated the model to enhance UCO collection and recycling within their local context.				recycled organic materials in local agriculture and landscaping.
European cooperation	Albano Laziale, thanks to the support of ANCI Lazio, has actively collaborated with various European initiatives such as SCALIBUR, international organizations to promote sustainable practices and innovative waste management.	Thanks to HOOP project, Albano Laziale continued to consolidate and expand its organic waste management initiatives, using the knowledge gained and best practices developed during the project. This included strengthening composting infrastructure and continuing advanced recycling programs, such as the collection of used vegetable oils (UCO) and other organic waste. Furthermore, the city has maintained an active commitment to European cooperation,	thanks to ANCI Lazio Albano Laziale intend to operate in the direction of the bioeconomy by promoting the adoption of sustainable organic waste management practices and the recycling of organic resources. This includes strengthening composting infrastructure, implementing advanced separate collection programs such as for used vegetable oils (UCO), and collaborating with other European bodies to develop policies that foster innovation and	ANCI Lazio and Albano Laziale are actively engaged in policy advocacy at the regional level to support initiatives that promote innovation and sustainability in bioeconomic practices. Their participation in European projects further enhances their efforts to foster these practices not only within Albano Laziale but also across broader contexts.	Secondly, until 2024, we will enhance our outreach efforts and community engagement initiatives, drawing from EU best practices. This includes organizing workshops to raise awareness about bioeconomic practices and the benefits of sustainable waste management.	Finally, until 2025, we will consolidate our efforts by implementing a bioeconomic strategy and advocating for supportive policies at regional and national levels to promote sustainability and innovation in bioeconomic practices. This approach aims to ensure lasting environmental benefits for Albano Laziale and beyond.

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		participating in transnational networks and projects (HOOP Network) to share experiences and adopt new innovative solutions in the field of sustainable waste management.	energy-based economic growth and bio-sustainable solutions.			
Other: Maintenance/ replicability of the PDA approach in Albano	With the support of ANCI Lazio Albano Laziale participated in SCALIBUR project (Horizon2020) developing approaches for optimization and innovation for organic waste collection	through the PDA HOOP Albano Laziale, ANCI Lazio and the stakeholders have gained specific experience on the topic of biotechnology applied to the valorization of waste vegetable oils and for organic waste valorization. 2 new projects were presented by ANCI Lazio. They have not been funded but more experience has been gained in this regard.	Continue to identify opportunities and funds to implement scalable pilot projects that demonstrate the feasibility of these biotechnological processes, thus promoting a circular economy and creating sustainable value chains in the Lazio region.	Firstly, ANCI Lazio will conduct continuous monitoring of funding opportunities (some orientation has already been received from RdA, a partner in HOOP) in order to implement feasibility studies and secure necessary funding, until the possibility of having biorefinery pilot projects.	Second, we will continue constructive dialogue with CONOE and potential investors, as well as patent owners identified during HOOP, until another call opportunity arises in 2025 to implement initiatives related to biotechnology applied to organic waste.	Finally, until the next funding call in 2025, we will prepare detailed project proposals, strengthen our partnerships to ensure swiftly move forward with the implementation of biotechnology initiatives for organic waste valorization.

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3.2. Almere

Almere, the Dutch HOOP lighthouse, is a young municipality with an innovative spirit. This was already manifested before the HOOP project, especially with the so-called Raw Material Collective (RMC) (for details see the annex). The RMC is an organization that brings together a variety of stakeholders in order to create sustainable innovation and to provide space for innovators. This setting was already comparable to the Biowaste Clubs provided by the project and without surprise, the transition within the project worked smoothly with the added advantage that Almere managed to also bring the topics of biobased products as a steadier part into the RMC. One advantage here is that Almere has always managed to connect these concepts to concrete examples of biowaste-based products. **Almere is currently working on specific cases like green concrete, and it will continue to do moving forward with the collaborative approach provided by the Biowaste Club Meetings within the Raw Materials Collective.**

Besides working on innovation in terms of products, the supply side of biobased materials has seen shifts in the lighthouse of Almere. Namely the biowaste collection has changed drastically. The system for residents living in so called low-rise buildings, the ones only hosting a few households at best, has been changed to a system of mono-containers which hold advantages in terms of contamination over the previous duo-containers. In addition to these changes in the provided infrastructure, all citizens have received so-called starter packs, and new bin controls for data collection on impurities have been launched. The first results are already promising, and improvements in the quantity and quality due to the systemic changes could be recorded. **Going forward, replication in different urban contexts such as high-rise buildings is a vital next step.** Technically, household biowaste is mostly intended to end up in anerobic digestion and composting, while Almere has also managed to process other bio-resources like invasive giant hogweed or other fiber plants into composite materials. This has already been achieved in parts previous to the HOOP project and was continued further during the project, also with some of the stakeholder engagement activities focusing on fiber plants. **Going forward, exploring and implementing possible biowaste streams for torrefaction such as leaf waste will be implemented, once again underlining the innovative spirit of Almere.**

While the experimenting and piloting of the many innovations is highly relevant, upscaling remains a challenge: bundling competences and resources is one way to further leverage these existing solutions in the future. For example, by professionalizing the experiments with some of the natural fiber solutions for green concrete, a case could be built in helping to get the binding and buy-in of other municipalities. This approach of collaboration is underlined also by the efforts to continuously join existing initiatives such as a bio-alliance as another achievement in HOOP which will be further pursued after the project lifetime. Almere represents an innovative mindset that will continue to be at the center of the efforts in the municipality and also in the strategic alliances with its peers. Going forward both the biowaste-system and the valorization will continue to thrive on the innovative grounds provided within the municipality and further yields of innovative products will most likely be the result of these developments.

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Figure 2. Example of green concrete in Almere

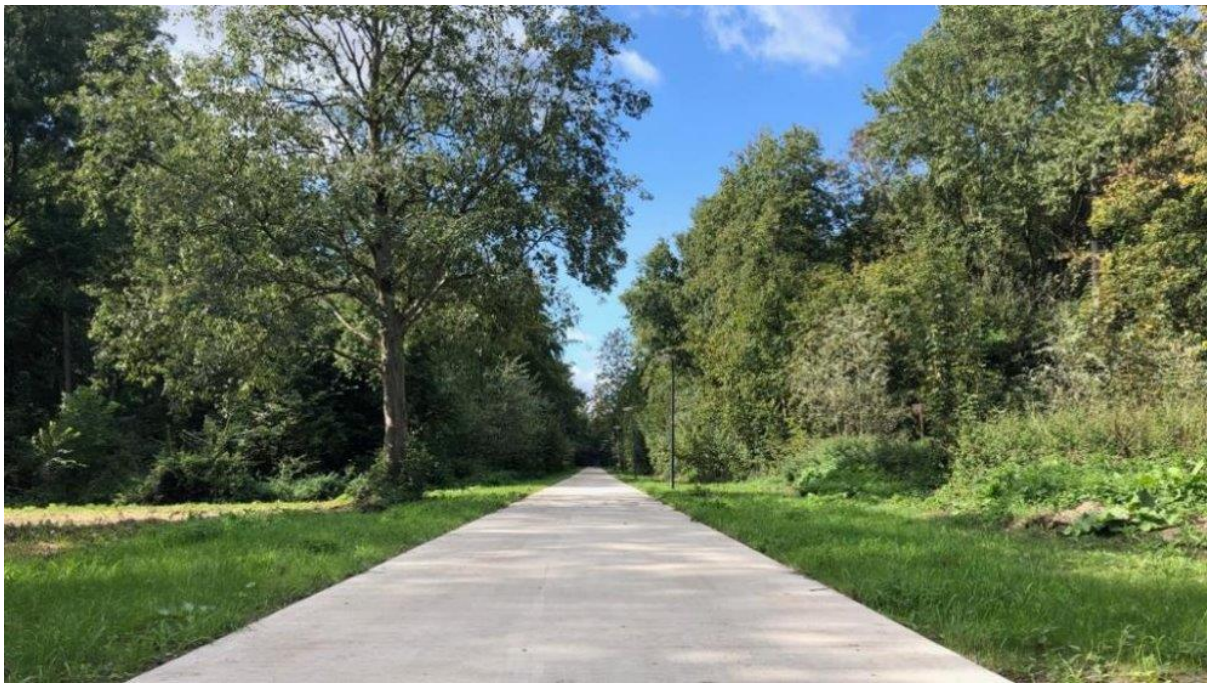

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Table 3. Roadmap for Almere

	Almere					
	Status quo before HOOP	**Achievements in HOOP**	**Next milestone**	**Action items and timeline**		
				Action 1	**Action 2**	**Action 3**
Biowaste Club framework	A Raw Material Collective (RMC) There already was already a "biowaste club" of stakeholders coming together to work on creating value from waste. Their scope is/was wider than biowaste.	Making the "biobased and biowaste based" a steady part of the RMC	Continue having biowaste on the table in the RMC, preferably by working on green concrete a/o torrefaction	2024 + 2025: Every 6 - 8 weeks a RMC meeting, working on professionalizing the green concrete proposition	2025: Creating a bigger project where green concrete is implemented	Continue having a RMC with biowaste on the agenda
				help municipalities to prioritize to invest in waste-to-material solutions	get different municipalities and provinces in a buy-in and get funding	
Bio-waste recycling/ bio-economy as core topic of our organisation	For household biowaste in low-rise buildings: everywhere separate collection using duo-	Complete change of biowaste collection: - all residents in low-rise buildings get a mono-container;	Continuing the actions regarding data and bin controls. Thereby continuing the good results in			

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	containers (containers with two compartments, one for biowaste another for residual waste). Relative low yield and high rate of contamination; For household biowaste in high-rise buildings: in some places separate collection using collective biowaste containers. Low yield and high rate of contamination, biowaste not treated towards compost; Circular solutions for niche biowaste-into-material (e.g., natural fiber for green concrete) only in experimental form	- all residents receive a biowaste sorting starter package - communication campaign - intensive data monitoring - bin controls and waste coaches With that we achieved a big increase in yield and the quality is absolutely perfect Not achieve to scale up these solutions	low-rise buildings and also achieve high quality in high-rise buildings professionalize the proposition in order to 'bind' several municipalities / provinces to buy-in for several green concrete applications
Bio-Waste Recycling/Bio-economy as Core Topic of our City/ Region	same as above	same as above	same as above

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Bio-waste Stream(s) in our Lighthouse	household biowaste (for AD & compost) giant hogweed (for composites) hemp wood (for composites) aquatic plants (for composites)	household biowaste (for AD & compost) giant hogweed (for composites) hemp wood (for composites) aquatic plants (for composites) horticulture stems (for composites)	possible biowaste streams for torrefaction; leaf waste, pruning and garden waste
Regional/ National replication	Almere joins meetings of NVRD & RWS VANG HHA & ISA	Becoming part of bio-alliance (bio-alliantie) and bio-waste-academy (GFT-academie)	continuing

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3.3. Bergen

The HOOP lighthouse region in Bergen, situated on the western coast of Norway, has from start to finish followed a clear pathway and plan in the HOOP project. Embedded deeply into the Fjord landscape of western Norway and in the middle of the Norwegian aquaculture industry, Bergen has connected HOOP to these unique geographical preconditions. Given this situation which comes with a lack of economically feasible options for biowaste valorization methods such as composting in the region, Bergen focuses on what is available and possible with new biobased products. This includes unique biowaste streams such as insects and micro algae as novel options under development. The lighthouse has continuously supported start-ups working in this field in the project and beyond, for example as possible feedstock for the aquacultural industry in the region. **Additional ambitions to build an anaerobic digestion plant showcase further that there is a clear way forward for Bergen in advancing the urban circular bioeconomy. Details about these plans can be found in the annex. These technological building blocks of the road ahead are accompanied by the advancements of building a "biopark" in the collaborating city of Voss in the region. The lighthouse partner, BIR, who is representing the Bergen region in HOOP, has a clear and important plan moving forward with the biopark. Table 4 describes in detail how these goals are interlinked in new waste streams through the means of funding and scaling these initiatives not only on the technical level but also on an engagement level**. By organizing a yearly biopark conference to discuss with peers from all over Norway, BIR managed to engage the right stakeholders not only to learn for themselves but also to tell the story of the biopark. **With two successful iterations of this conference already happening during the project lifetime, it is not surprising that going forward, the successful format of the conference will remain as a focal point.**

Outside of these clear technology-driven focus points in the project, Bergen also showcased many advancements in engaging and involving stakeholders including citizens. **Both on the citizen science and the pilot action level, Bergen plans to build on achievements that were implemented during the project such as incentives towards increasing the food waste collection or building on a successful format, the so-called reuse week.** The reuse week is a yearly event organized by several city stakeholders with the goal of bringing sustainable consumption as a topic to the attention of Bergen's citizens. During this week, different initiatives and actions can showcase themselves under the banner of the reuse week to interact with citizens directly in informative, playful and engaging ways. This long-lasting successful practice has been coupled also with HOOP related topics during the project lifetime and now. It can serve as a best practice for other cities and regions to follow suit.

Additionally, BIR is really invested into cooperating both nationally and internationally. Not only with the formats such as the reuse week or the biopark conference, but also on a strategic level, BIR is looking forward for ways to collaborate. The connection to associations and umbrella organizations such as Waste Norway, Euro Cities and Municipal Waste Europe emphasizes the approach of learning from and with others. Strategically, BIR seeks inspiration from other frontrunners in urban circularity topics within and outside of the HOOP scope.

Looking ahead, BIR on behalf of the lighthouse region Bergen, continues to build on the work already carried out before and during the HOOP project. They are adopting an approach tailored

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to the unique geographical and economic situation while also prioritizing to share knowledge and learn with others. Addressing challenges of funding and scaling will be vital to remain a frontrunner and to create opportunities for and with stakeholders in the region and beyond and to prove that successful ideas can be scaled beyond the pilot stage.

Figure 3. Algae-Based Products in Bergen

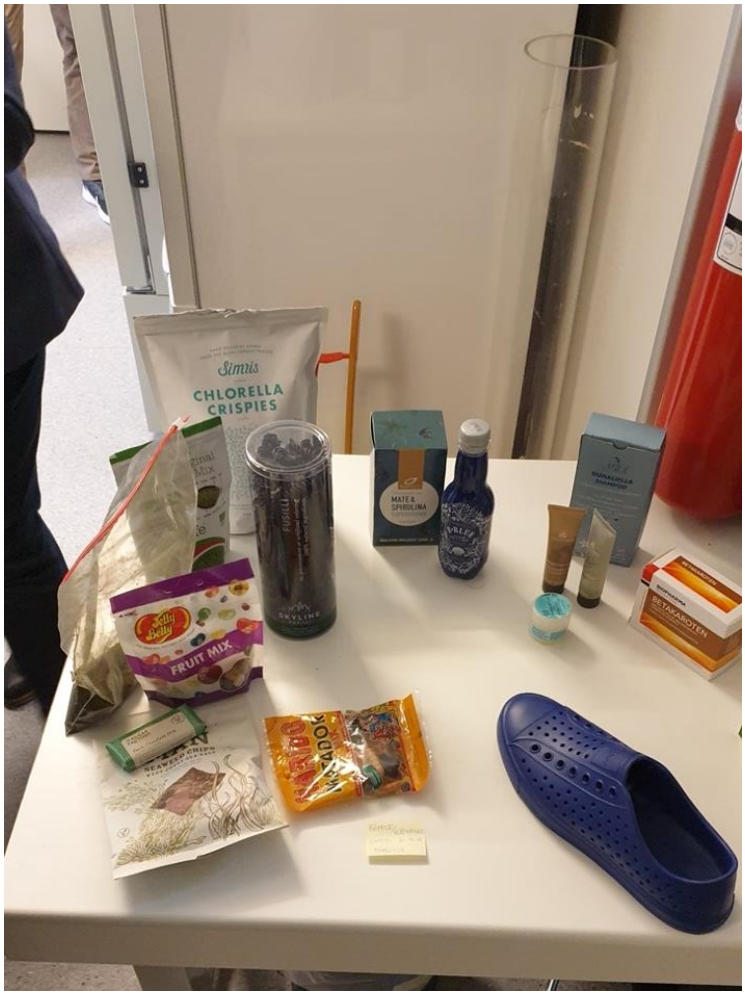

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Table 4. Roadmap for Bergen

	Bergen					
	Status Quo before HOOP	**Achievements in HOOP**	**Next Milestone**	**Action Items and Timeline**		
				Action 1	**Action 2**	**Action 3**
Biowaste Club framework	Some contact, no regular interaction between stakeholders on the core HOOP topics	set-up and successful running	Regular but fewer meetings in the future, a yearly conference on biopark			
Citizen Science	Some research on nudging and PAYT	Incentives to increase food waste collection	Testing and validating incentives to increase food waste collection			
Pilot Actions on Stakeholder Engagement	Stands at local events	Lending out insect farms to schools and kindergartens. Lecture for 9th graders. Introducing biowaste to the yearly reuse week. Presenting Local champions	Continue and developing the actions achieved in HOOP	Possible replication of Reuse week in other Norwegian cities		

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Bio-waste Recycling/ bio-economy as Core Topic of our Organisation	New BIR strategy in 2019 focusing on circular economy and bioeconomy;	Moved from theory to practical action: stakeholders, starting collecting food waste, planning a biopark, start building an AD plant, supporting startups (micro algae, insects etc.);	Developing the biopark and running an AD plant. Develop circular bio value chains.	Complete building the AD plant and best possible utilization of the digestate. Invertapro (start-up) upscaling in the biopark.
	Collection of biowaste streams from household and industry for years, except for household food waste;	Collecting food waste from households. BIR Bedrift (daughter company of BIR) upcycling food waste to feed;	Upscaling collection and feed production.	
Bio-waste Recycling/ bio-economy as Core Topic of our City/ Region	Not a big topic before 2019	Vestland county has developed a vision, Green region Vestland, including several BioHubs/Bioparks. Municipality of Bergen, Vestland County and BIR have included bioeconomy in their strategies.		

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Bio-waste Stream(s) in our Lighthouse	Only compost	AD plant	Develop biopark	Get funding. Stakeholder engagement
		Insects	Upscaling	get funding
		Micro algae pilot	Upscaling	get funding
Regional/ National Replication	BIR active in Waste Norway, Euro Cities and MWE.	biopark Conference (National replication workshop). BIR active in Waste Norway, Euro Cities and MWE.	BIR active in Waste Norway, Euro Cities and MWE.	
European cooperation	Study tour around Europe to get insight on handling biowaste	Exchanging ideas and experiences in the HOOP network	Study tour around Europe to get insight on handling biowaste and on circular economy strategy	

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3.4. Kuopio

For Kuopio, the Finnish HOOP lighthouse, the project and the timeframe of the project have been a launchpad for many initiatives in the urban circular bioeconomy. One trend that shows is that Savonia, the HOOP partner representing Kuopio, a technical university, uses their position as a university to connect HOOP to its students and the university structure. One example is organizing several Biowaste Club meetings directly with students already during the project lifetime with goals to continue working directly also with teachers and to integrate the HOOP topics in the curriculum at the university. **In the longer run the goal will be to assess further, how to best integrate the topics of biowaste valorization and also the legislation in the activities of the university and couple it with adequate resources for further manifestation. To achieve these goals, Savonia plans to build on the increased knowledge, for example within their own staff, and to further manifest the topics related to biowaste recycling and new value chains through new projects.** Besides these overarching topics and goals, Savonia also managed to leverage the citizen science app developed in the HOOP project together with students, as they were among the key users and5 target groups of the app. **Further implementations are planned in order to analyze the use of the application as well as to scale the use of the app, for example by mainstreaming it.** In many of these topics, the analytical approach of Savonia shows. **Many of the upcoming actions and activities will be based on further analysis that help in understanding the situation and the needs better. Through running surveys with the target groups like the staff, data will be collected to focus upcoming project proposals on the needs within the organization, for example in terms of required knowledge to work on urban circular bioeconomy topics.**

On the technical level, the main focus in Kuopio can be found with the biochar reactor that was established in the lighthouse. This process is explained in detail in the annex and represents a pilot action with which test samples of biochar have already been produced in the project lifetime. **The goal is to use those test samples and to convince stakeholders to use the pyrolysis technology for research purposes. These include for example soil improvements, medical use or water filtering as viable options that Savonia wants to test going forward. In this context it is again about analyzing and further understanding the needs and possibilities with the new technology and by already having the pilot reactor available, one of the key steps to bring the technology to the region has been undertaken which will also help in terms of increasing the acceptance amongst stakeholders.**

Engaging stakeholders as a whole is on the radar of Savonia also in other regards and the project has already helped in that sense by fostering the exchange with public authorities, training and education organizations and private companies, including the non-profit waste management company in the region, Jätekukko Ltd. **Going forward the cooperation with these key stakeholders will remain key and is one of the clear goals for Savonia in order to boost the bioeconomy in the region both on the operational and the administrative-legislative level. To foster new partnerships, contribute to the work of these stakeholders or to help on the implementation of legislation will be the milestones going forward.**

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On the technical side, new biowaste streams in the lighthouse will become relevant based on first developments in the HOOP project. This goes along the entire value chain and will include the biowaste sorting which will become mandatory in urban areas later in 2024, by-streams of the food industry or agricultural fertilizers and energy crops are possible options. The ways forward for these streams are manyfold. Collaboration with relevant projects, monitoring solutions or once again engaging the relevant stakeholders, table 5 gives a detailed overview of all these ways forward. The same is also true in terms of replicating the vast knowledge, methodologies and insights generated in Kuopio. For this, additional projects will be sought in order to create further impact with relevant partners in the right funding streams.

Kuopio has been an active lighthouse that managed to use the HOOP project to kick-start many topics at the same time and already set timelines and milestones to be achieved ahead. This wide orientation of topics showcases the involvement and motivation of Savonia and the entire city of Kuopio in terms of advancing the urban circular bioeconomy.

Figure 4. Biowaste Club Meeting in Kuopio

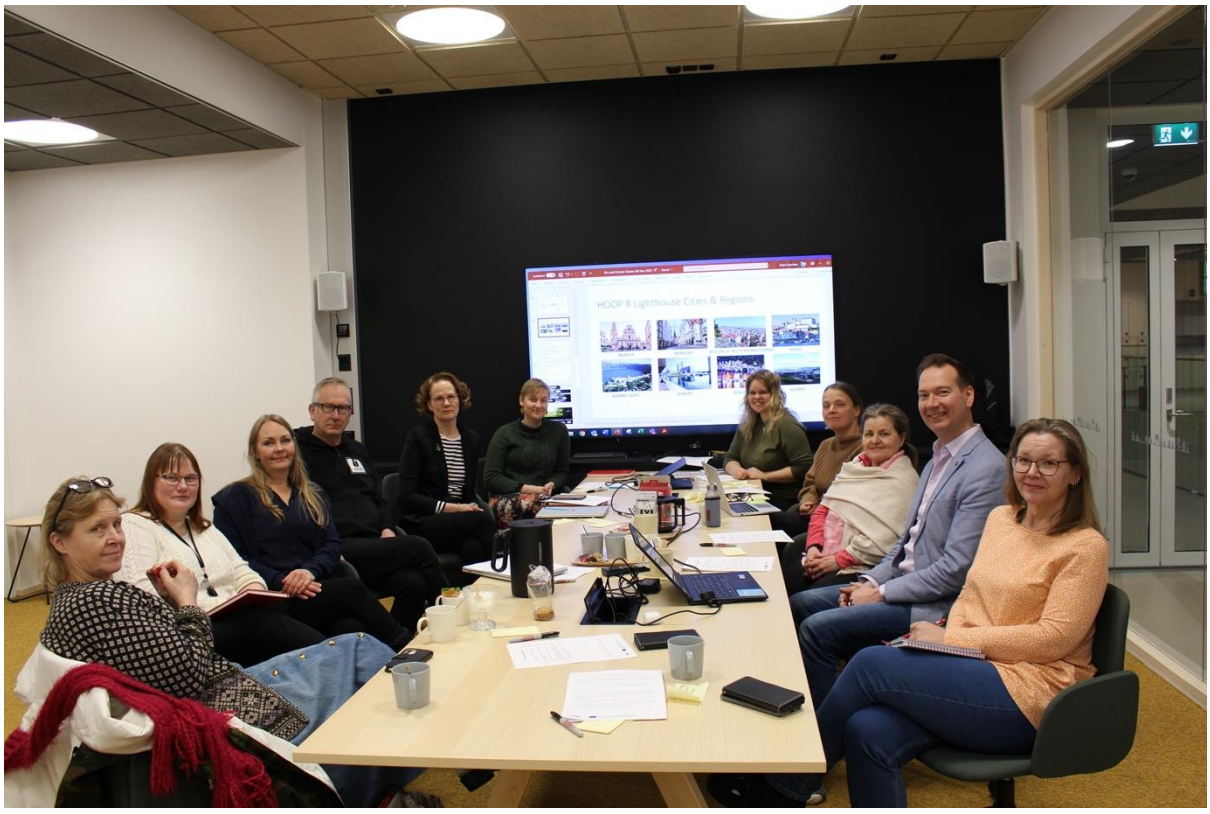

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Table 5. Roadmap for Kuopio.

Kuopio						
	Status quo before HOOP	**Achievements in HOOP**	**Next milestone**	**Action items and Timeline**		
				Action 1	**Action 2**	**Action 3**
Biowaste Club framework	-	organize two biowaste clubs to students: shared information on biowaste valorization and legislation update: need to 1) Composting 2) Separate Collection/Videos and applications enriched the events	integrate into curriculum and teaching	organize an event to teachers to gather info about needs in education/Sept. -24	identify the study fields most suitable to pilot and carry out training/Oct-Nov. -24	Assess and decide on the upcoming activities (e.g. disciplinaries, resource needs, contents, methods, curricula development, new projects)/Dec. -24
Citizen Science	-	biowaste sorting application "Haihuli" introduced to students	analyze how to further promote the use of the application	need to improve the technological solution/Aug -24	analyze the methods to mainstream the use of the application/Sept.-Oct. -24	Gather feedback on the user experiences, Nov.-Sept. -24
Bio-waste recycling/ bio-economy as core topic	-	increase knowledge among staff and	A follow-up project focusing on teaching and curricula development	Organize events with stakeholders	Conduct a survey to the staff about circular economy/Nov. -24	Identify the core topics/needs based on

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of our organisation		students through pilots, events/workshops and trainings		on BioWaste Week/Sept. -24		the information collected; project proposal focusing on circular economy and integration of RDI and teaching/Dec. -24
Bio-waste recycling/ bio-economy as core topic of our city/ region	Kuopio Resource Wisdom Programme, which was approved by city council in 2017; FISU-network (Finnish Sustainable Communities); Circwaste	Collaborate with various stakeholders (public authories, training and education organizations and private companies) in the region; cooperate with Jätekukko Ltd. that is a non-profit waste management company owned by the municipalities, which provides all services related to waste management	Foster co-operation with key stakeholders and identify new operators in bio-economy area of work.	Contribute to the public authorities´work and engage potential companies and NGOs in bio-economy through workshops, trainings, projects and initiatives/Aug-Dec.-24	Follow-up legislation implementation; work with relevant stakeholders (e.g. Jätekukko, respective organizations in other regions to benchmark best practices)/Oct.-Dec.-24)	Organize/participate in seminar focusing on legislative development/ brainstorming event on legislative needs and/or identify concrete solutions to further improvement and replication/Dec. 24
Bio-waste stream(s) in our lighthouse		biowaste sorting mandatory in larger urban areas/legislation update Sept.2024	amount of household waste in the Kuopio region will decrease and the recycling rate will increase to 65 % by 2030; promotion of Biokimppa	Work with stakeholders on monitoring the impact of legislation update/Aug-Dec.-24	Collect information on how new practices work, e.g. Biokimppa/Oct.-Dec. -24	Participate in new initiatives on technological solutions to valorize bio-waste

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		in Replication Workshop for Finnish municipalities environmental specialists; a joint biowaste container			streams (Aug.-Dec. -24)
	by-streams of the food industry	Biowaste sorting has increased; knowledge is increased among citizens, students, staff; Utilize in biogas production	work with other projects, e.g. FoodLoops, SISU and food producers/June-Dec. -24	Engaging food producers, schools, public authorities, companies and NGOs/June-Dec. -24)	Working on concrete solutions; e.g. food waste monitoring applications, food education to students, parents, involve teachers/June-Dec. -24
	agricultural fertilizers and energy crops	Collaboration with stakeholders to increase in biogas production	Work with stakeholders, e.g. the Central Union of Agricultural Producers and Forest Owners/Aug-Dec. -24	Identify (new) collaboration ways: knowledge sharing, networks, digitizing needs, resource needs/Aug-Dec. -24	Promote integrating modern technology into agricultural practices and tracking fertilizing process through digital platforms

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	Biochar Pilot Reactor; With Biochar Pilot Reactor we have been able to produce test samples	Stakeholders to use pyrolysis technology for generating biochar for research purposes; Needs improvement to capture liquids and other fractions	The coals of the pilot plant will be analyzed/Aug. -24	Improvement for soil improvement/Aug-Sept.-24	Improvement for medical use/Sept.-Oct. -24	Improvement for water filtering purposes (Sept-Oct.-24)
Regional/ national replication		National replication workshop: webinar The Finnish Bioeconomy Strategy 22.02.2024	to identify the most update/useful/interesting topics and follow-up (+ reach out to new target/client groups)	Thematic events: presentations in workshops/Aug.-Dec. -24)	Identify other region's practices for drafting project proposal/ Aug-Dec. -24	Organize a webinar/seminar focusing on concrete solutions; co-operation with private companies/Nov. -24
European cooperation		Horizon2020 partners; Circular Cities and Regions Initiative	Strengthening collaboration and sharing HOOP project results with the experts in the area and beyond	HOOP-Hub promotion and collaboration/Aug.-Dec. -24	Identifying follow-up project possibilities with partners/Aug.-Dec.-24	Apply for funding/timeline dependent on calls for proposals

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3.5. Münster

The lighthouse Münster (Germany) has been a frontrunner in biowaste recycling not only in Germany but in Europe for decades. The awm, the lighthouse partner in Münster, is the municipal waste company of the city and has over twenty years of experience in the separate collection of biowaste as well as in valorizing the biowaste through a combination of anaerobic digestion and composting as well as green waste composting. Instead of only focusing on these well established and operating systems, the innovative nature of awm and Münster lead to the participation in the HOOP project to evaluate new ways forward. In the HOOP journey, as explained in the annex in great detail, this led to the focus shifting towards new technologies, namely the pyrolysis technology with the aim of producing biochar as a novel biobased product. For awm this topic has been at the forefront of HOOP and will continue to play a role as the goal is to build a pyrolysis plant which fits the preconditions such as the available input material like the existing sieving overflows from the various composting systems. But besides the technical aspects of the plant, for Münster the focus really is on assessing and following a holistic approach which includes many challenges such as the funding and the business case, finding and engaging the right stakeholders within the city and beyond to answer vital questions. For this purpose, first Biowaste Club Meetings have been organized and will also continue to serve as a format to discuss the arising challenges of all stakeholders in the city. The BCMs also serve as a way of receiving expert inputs for example on use cases for the biochar as the product created in the pyrolysis process. Models such as the Stockholm system in which the biochar is used as a carbon sink and addition to water retention in urban greenings or the use as a building material in bicycle paths are being discussed and will further be assessed on the use side for biochar. **In addition, there are also efforts going ahead in terms of legal feasibility as well as in connecting the topic to the overall picture in Münster by connecting to other stakeholders from the city. From technology to the use case and the business model, Münster has a clear road ahead with the goal of implementing the pyrolysis.**

Whereas the creation of biochar is the main target area for the road ahead, awm has other goals in terms of urban circular bioeconomy. With the composting and anaerobic digestion already working on a high level in terms of reliability and quality while also being economically viable for awm, there is still room for improvements such as the separate collection of biowaste which is mostly relevant for the waste producers, the citizens of Münster. To engage citizens, the HOOP project produced relevant insights and data. **Despite ongoing efforts to inform and educate the citizens, there is room for improvement in order to improve biowaste quality and quantity, which in turn means that going forward this will remain a relevant topic.**

By actively supporting and participating in conferences, exhibitions and other networking events, collaboration and knowledge sharing from the local to the international level take place. The latter is a big focus point, as not only knowledge sharing exchanges with other HOOP lighthouses, such as Albano Laziale, Bergen and Almere, are taking place; concrete and tangible advancements outside of the HOOP scope are also being taken up. **With a partner city in the Netherlands, Enschede, joint biochar projects will be added on top of already existing cooperations on biowaste recycling that outdate the start of the HOOP project. Through these collaborative efforts, awm manages to stay innovative and to bundle up competencies, resources and efforts in new and old focus areas.**

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All in all, Münster successfully participated in numerous activities together with citizens and stakeholders and will continue to focus on the continuation of several formats such as the Biowaste Club Meetings to keep bringing stakeholders together. **While aspects regarding the business model, technical details and other characteristics will play a crucial role in implementing new technologies, convincing and involving the right stakeholders will be another key for awm.**

Figure 5. Biowaste Campaign Münster

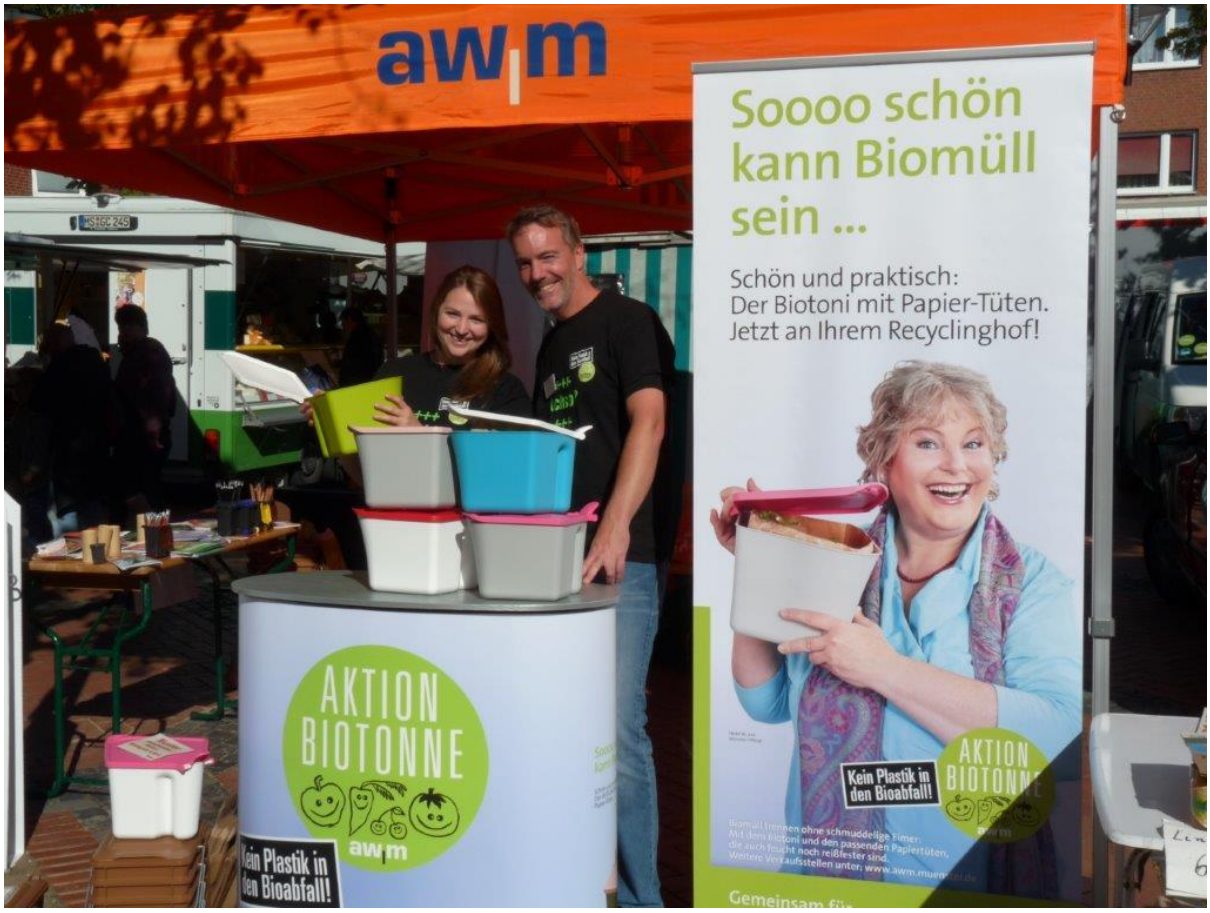

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Table 6. Roadmap for Münster

	Münster					
	Status Quo before HOOP	**Achievements in HOOP**	**Next milestone**	**Action Items and Timeline**		
				Action 1	**Action 2**	**Action 3**
Biowaste Club framework	No regular interaction between stakeholders on the core HOOP topics	Successful set-up and running	Continued institutionalization	Next meeting with stakeholders by the end of 2024	Mid/ End of 2025: clear shared decision of all stakeholders on municipal biochar development	Application for funding (e.g., for Stockholm system/ Sponge City System) by end 2025
Citizen Science		Citizens were reached by awareness campaigns regarding separation issues of bioplastics, but citizens still throw these bags in the biowaste bin				
Pilot Actions on Stakeholder Engagement	Conference and exhibition visits. Focus was rather on knowledge building.	Conference visits/ exhibitions/Compost festival/ Kon-Tiki-	Continuation of hands-on workshops for awareness raising (potential cooperation with Enschede)			

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		Hands-On-Workshop, etc. Bigger focus on networking and awareness raising for the bioeconomy	
Bio-Waste Recycling/Bioeconomy as Core Topic of Our Organization	Separate collection already for 20+ years.	Improved collection	Connect topic to other relevant stakeholders in the city (e.g. climate change departments)
	Topic addressed mainly by management and communication teams	Designated staff set-up to advance this topic.	Increase/maintain human resources for bioeconomy.
	Composting and anaerobic digestion of biowaste for 20 + years.	New approaches and technologies to optimize the sustainability of our biowaste recycling processes have been achieved.	Final Decision on the Feasibility of Pyrolysis Implementation.
	No company-wide GHG-Balancing	Initiate project to develop a robust GHG	Awarding contract to consulting firm for

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		balance for quantifying environmental impacts	support in the development of a GHG balance			
Bio-Waste Recycling/Bio-economy as Core Topic of Our City/ Region	Limited city- wide co-operation	Increased exchange.				
Bio-waste stream(s)	"Only" compost and biogas	Next steps for bio-char (Describe steps already taken)	Produce Bio-char in Münster	Get city Administration's Buy-in	Get Funding	Build Plant
		Biochar in asphalt application	Cooperation Between Enschede (NL)+Münster	Pilot Project in Münster: building a Pathway from Biochar	Explore if it is interesting for the city to scale-up. If yes, inquire into how much the city would be willing to pay for the bio-char and whether this is sufficient for awm (or awm should go for higher use-cases)	Business case for awm to produce bio-char for asphalt production/ does business case work without selling the CO2 certificates (so to keep them for awm itself)
		Kohlenstoffsenken-Inventar (Carbon sink-inventory) for both cities		Discuss with ITACA Institute how to do it / kick-off meeting	Do pilot calculation for Enschede+Münster	Establish a city-wide data exchange and

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				June 2024 in Enschede	publish for public access (and include in CO2 reporting)
		Stockholm System	See above		
Regional/ National Replication	awm active in VKU (German Association of Municipal waste companies) and MWE (Municiapl Waste Europe)	Interaction with VKU- and MWE-members (both associations)and beyond focused on bio-economy.	awm to be more active (leader?) on national level on bio-economy?		
			More direct interaction with other forerunners, e.g., Metabolon…?		
European cooperation	Twence cooperation Incineration of Münsters sieving overflow from residual waste processing by Twence. Composting of green-/biowaste coming from Twence.	Exchance with Albano Laziale regarding Composting technologies. Ongoing Exchange with Almere with regard to Improvement of Biowaste quality (focus on AI utilization in biowaste collection). Close cooperation in pyrolysis/biochar	Joint biochar project with Enschede (NL).		

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	topics with Enschede (NL), Joint projects are currently being considered.				
	Membership in other EU projects with a focus on bioeconomy (EU Life Biobest, Bin2Bean).	Provide further data sets on relevant topics and best practices			
			Other		
	Examples of next actions: CSR reporting according to CSRD regulations/ work across awm team and departments to gather information, ease cross-team cooperation/ introduce new sustainability processes.	"Stabstelle Nachhaltigkeit" (Department Sustainability) at awm	Get internal support and momentum	Set-up team and its tasks	Establish department long-term/ set-up 5 year plan

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3.6. Murcia

Situated in the south of Spain, the lighthouse city Murcia is a frontrunner in leveraging projects such as HOOP to push the agenda in sustainable urban transformation. Before HOOP, Murcia leveraged one of the HOOP mother projects, VALUEWASTE as well as another Horizon2020 project, CityLoops, to create impact in the city. In HOOP, this notion was continued and added the layer of the Biowaste Club framework on top. Murcia successfully proved how the framework could be adopted to many causes by organizing workshops dedicated to different topics and target groups. Workshops focusing on elderly citizens, citizen science related activities, interactive and playful events for entire families or big fairs were organized in order to bring citizens and other stakeholders together and push circular economy topics in a joint manner. With the support of other HOOP partners such as CETENMA or Science for change, these events got filled with dedicated inputs and further expertise to increase the capacity of HOOP project in the city. One example for this can be found in workshop on the results of the HOOP trainers app as rolled out in the project. **Besides the already existing successful results with the citizens, Murcia plans to manifest the format by continuing to organize Biowaste Club meetings even beyond the project lifetime with the clear goal to obtain a high quality and quantity of biowaste. This not only aligns with the HOOP objectives; it also shows the efficiency and success of the format.**

Murcia also plans to manifest change due to technical advancements. Annex 1 explains the detailed journey on a technical level based on the previous projects with goals in terms of new valorization options for the biowaste captured in Murcia. This includes for example the expansion of the composting system, which will be coupled with efforts to extend biowaste collection to the entire city. In this regard, it will of course also be important to get the citizens convinced and on board of the initiative but overall, the plan to look for further funding should be able to provide a holistic approach also on the technical side. With the learnings from previous projects, through organizing a number of target activities in collaboration with other project partners and key local initiatives, Murcia has laid the groundwork and has a clear road ahead in terms of urban circular bioeconomy.

Figure 6. HOOP workshop with elderly citizens in Murcia

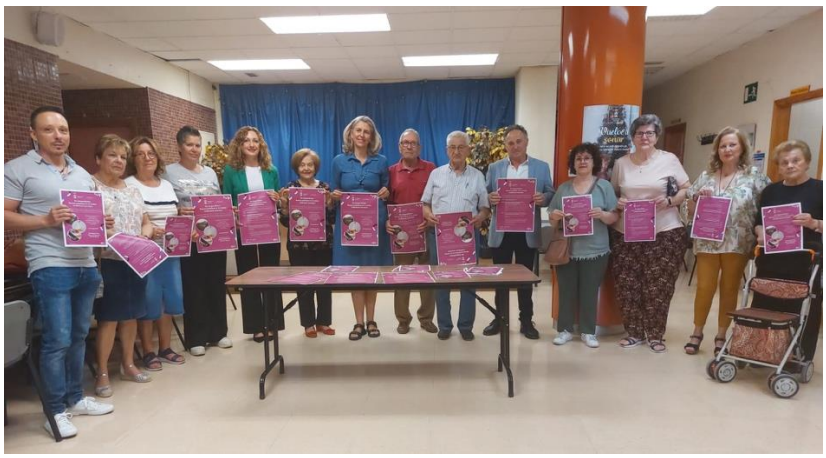

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Table 7. Roadmap for Murcia

	Murcia					
	Status quo before HOOP	**Achievements in HOOP**	**Next Milestone**	**Action items and timeline**		
				Action 1	**Action 2**	**Action 3**
Biowaste Club framework	No	Understand the perception of organic waste among citizens and raise awareness about the whole process of revalorization	Two more Biowaste club in 2024 and turn them into our portfolio of municipal workshops	The end 2024 in the framework of HOOP project	Until 2026 we will organize two biowaste per year with municipal budget	Until we obtain a high quality and quantity of organic waste (expected in 2027) we will keep on organizing biowaste club
Citizen science	No	We have organized several workshops and we have applied citizen science to other project: for example birds sight	We would like to implement citizen science in the citizen engagement process	No	No	No
Pilot actions on stakeholder engagement	Valuewaste project and CityLoops project (H2020)	Circular Economy Fair (LOOP) and Circular Entrepreneurship Contest	Keep on organizing Circular Economy	No	No	No

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			Fair and Circular Entrepreneurship Contest	
Bio-waste recycling/ bio-economy as core topic of our city/ region	Valuewaste project we started to collect biowaste	We applied to several calls for the implementation of biowaste collection in the whole city	Implementation of the biowaste collection in the whole city. Works in the waste treatment plant to extend compost plant	At the end of 2024 with Next Generation Fund (12 million euro)
Bio-waste stream(s) in our lighthouse	Compost and biogas	Compost and biogas	Compost and biogas	At the en of 2024 with Next Generation Fund (12 million euro)
Regional/ national replication	No			
European cooperation				Next Generation Funds

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3.7. Porto Region

In the Porto region (Portugal), LIPOR is the regional waste management company responsible for the HOOP project. LIPOR takes an innovation-driven approach in the region and works in a variety of innovation fields within and beyond the project. On the technical level, in terms of biowaste recycling, Porto has a history spanning over 40 years, with Bioeconomy being one core topic in the organization.

On the technical level, there are several stories to tell, especially connected to large investments that will take place going forward for innovative biobased products in Porto. With the plans of introducing an anaerobic digestion plant, it is clear that a well-established technology will become part of the portfolio offered by LIPOR to its customers in the region. For these plans the HOOP project played a vital role in better understanding the required details for such a plant in the region. The annex explains the details of these plans. **Going forward, launching a tender and then building and operating the plant are key future plans for LIPOR.** A second technology is under exploration in Porto, the biochar production. **The HOOP project opened the door on the subject and going forward further assessments of the situation including market potentials, economic feasibility and overall studies to improve the knowledge on the subject are planned to take an informed decision around 2026 or 2027**. To round off the technological advancements, LIPOR has made use of the project in order to establish expert working groups on the biowaste-recycling but also strategic alliances for new products for agricultural use.

Whereas the valorization of the biowaste in Porto is one key aspect that was further developed within the HOOP project, the collection side wasn't neglected either, with a wide array of solutions proving useful. Bottom-Up initiatives like the community composting have been gaining traction in the project lifetime. At the same time, systematic changes such as pay-as-you-throw systems have been brought to the forefront, to name just one example. Additionally, technical solutions such as prediction tools for expected biowaste have also been added to the portfolio.

Some of these technical topics are connected to solutions developed both with and for citizens. **One prime example is the goal of implementing so called "community champions" which will help with the waste-management systems, for example biowaste-disposal.** Efforts to work towards a Lifestyle strategy by LIPOR perfectly fit the theme of developing citizen-oriented solutions for LIPOR, just like several informative and engaging biobased exhibitions do. **With guided visits and citizen science activities, more citizen related activities are of relevance in the overall HOOP scope.** By taking such a wide-spanning approach, LIPOR manages to engage citizens both directly through participation in events but also indirectly through community-based actions close to the target group. **In line with this is also the fact that LIPOR has managed to accelerate the use of the Biowaste Club format and plans to engage stakeholders continuously through this. By setting out a clear roadmap in terms of meeting dates and number of meetings, it is clear that a continuation is seen as beneficial and will provide further solutions together with and for citizens but also other stakeholders.**

In many topics provided by the HOOP project, LIPOR managed to make clear advancements, but there are also some in which LIPOR has not had a need to internally develop further capacity but rather to

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continue with a business-as-usual approach based on vast previous experiences and structures existing in the lighthouse. This holds true for regional and national replication as well as cooperation outside of the country, two topics in which LIPOR already had vast experience and **plans to continue acting like they've done this far, for example in terms of participating in innovation projects or developing dedicated strategies.**

LIPOR brings innovation and change to the Porto region, and in doing so it helps present the region as a true frontrunner in the urban circular bioeconomy. **By advancing on the technological level along the value chain in parallel with vast and impactful community-oriented solutions, LIPOR has concrete plans on the way forward.**

Figure 7. Biobased Products exhibition in Porto Region

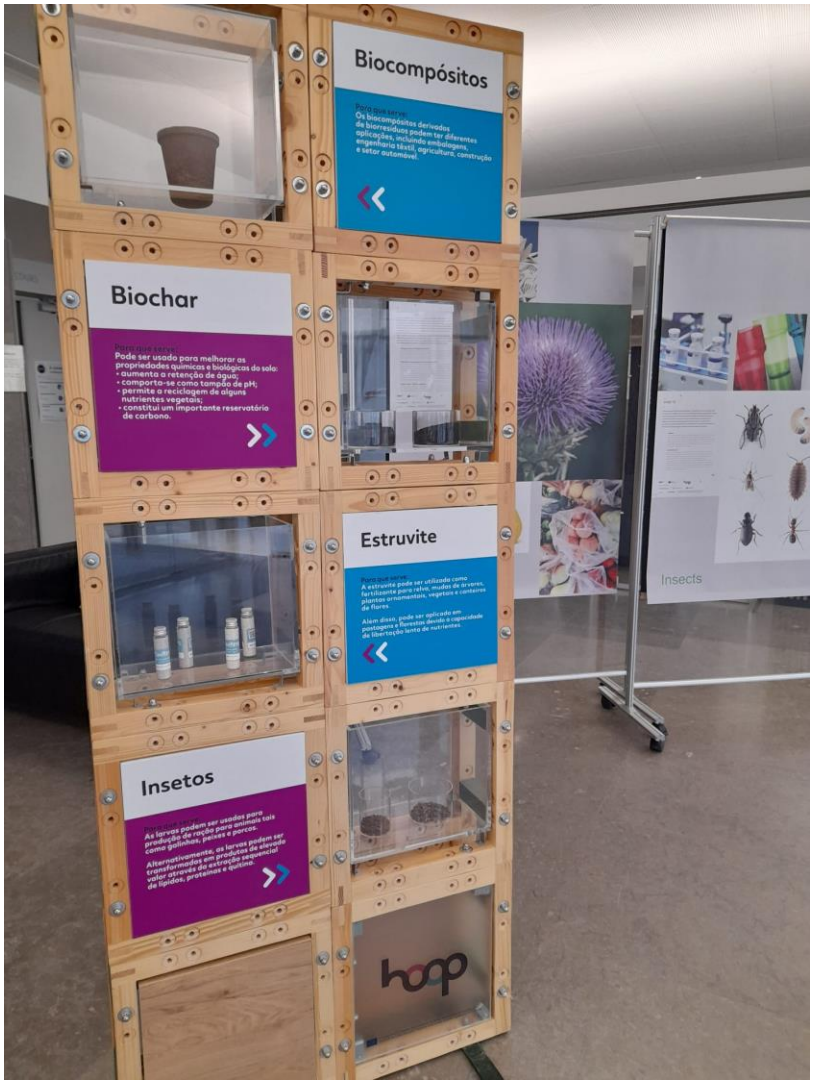

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Table 8. Roadmap for Porto Region

		Porto Region					
		Status quo before HOOP	**Achievements in HOOP**	**Next milestone**	**Action items and timeline**		
					Action 1	**Action 2**	**Action 3**
Biowaste framework	**Club**	discussions were taking place, but not organized under the umbrella of a "biowaste club"	setup and successfully run several biowaste club meetings	carry on using the tool on a regular basis	defining a calendar of sessions for next year until the end of 2024	run at least 2 sessions in 2025, for different stakeholder groups	keep the concept running until 2030, when we expect to have implemented the AD plant for 65kt/yr of food waste
Citizen science			Biobased products exhibition. Implementation of 3 new guided visits related to biowaste in specific: Imitate nature, worm composting and growing oxygen. Citizen science activities in community events in partnership with different stakeholders	keep promoting the concept, taking the exhibition to different places as relevant			

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Pilot actions on stakeholder engagement	Lipor has a long history on stakeholder engagement. Best quality compost from our composting plant (since 2004); separate collection, low presence of contaminants… Lobbying strategy. Development of several projects, aimed at different stakeholders, like the HoReCa sector, home and community composting, organic farming, food waste prevention.	Extend the communication focus to talk and raise awareness to new treatment solutions and new bioproducts; boost community composting through sharing of information and discussion topics in biowaste clubs; promote internal discussions on PAYT/SAYT/RAYT; implementation of predictive tool for food waste reduction in the HoReCa sector; development of a checklist criteria for circular public procurement	Implentation of the iniciative "community champions" (will include biowaste and other topics). Implementation of an incentives' model for the citizen.	Carry on Lipor's purpose of "Every day we build a better world."

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Bio-waste recycling/ bio-economy as core topic of our organisation; **bio-waste recycling/ bio-economy as core topic of our city/ region**	Lipor started, in 1982, with biowaste recycling. We developed a strategy for biowaste prevention and local treatment. Bioeconomy is core as our mission is "To transform waste into new resources through the implementation of innovative, circular practices, generating and sharing value."	HOOP helped leverage discussions about pyrolysis and nutrient recovery from AD. Development of Lipor LIFESTYLE	Implementation of Lipor's PAPERSU (Action Plan for the Implementation of the National Strategic Plan for Municipal Waste PERSU2030); continue R&D&I as usual, with new products Foster LIPOR's strategy towards sustainability and circular economy as a Lifestyle. Implementation of the municipalities' PAPERSU (Action Plan for the Implementation of the National Strategic Plan for Municipal Waste PERSU2030)			
Bio-waste stream(s) in our lighthouse	compost; growth media; pilot study in algae production; small-scale decentralised AD; green composting park; creation of ADERIR -	explore biochar production potential Anaerobic digestion plant	open a new internal study, to improve knowledge on this subject Submit the environmental impact study	reunite all information and draft an action plan by 2025 Launch the tender for conception, con-	market potential and economic feasibility by 2026 build the AD plant and start operation by 2029	decision on next steps (implement pyrolysis or not) by 2026/2027

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	integrated approach program for biowaste (to include prevention, local treatment, collection, recovery and valorization)	PROA - strategic initiative for the development of new products for agriculture Work group of experts in biowaste, within Lipor team, to collaborate with ADERIR	in 2024 to have planning permission as soon as possible. follow relevant projects and initiatives and monitor impact in Lipor's new products' strategy	struction and operation of an AD plant for 65kt of food waste by 2025
Regional/ national replication	Representation in several national associations Participation and organization of conferences, seminars, focus groups…	training session on circular economy with Lipor Academy	business as usual	
European cooperation	member of the ECN, ISWA, ACR+, ICLEI, CEWEP. Participation in several calls from Horizon, Life, EY. Conference participation, strategy development	acquire knowledge and know-how to boost new opportunities	business as usual	

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3.8. Western Macedonia

Western Macedonia, the Greek lighthouse region of HOOP, has started many efforts in the HOOP mother project SCALIBUR already. Amongst those previous efforts is the establishment of the stakeholder engagement format, the Biowaste Clubs. In HOOP this format was used to improve the biowaste collection system, by successfully adding a new fraction, the spent coffee grounds from the HoReCa sector (Hotels, Restaurants & Catering). What sounds simple was mainly achieved through efforts of bringing the relevant stakeholders to the same table in the Biowaste Club of Western Macedonia. This way, the concerns the needs and the road ahead could be discussed in order to successfully implement the first collection schemes. Besides the spent coffee grounds, Western Macedonia also collects kitchen and green wastes and used cooking oils (UCOs). The UCOs have been already part of the collection scheme before HOOP and was enhanced throughout the project (See annex). **Nevertheless, the lighthouse is in search for ways to valorize these two waste fractions better. Looking ahead it will be about upscaling in order to have a widespread collection scheme in place accompanied by the improvement of valorization systems with the local stakeholders active in the region.**

Whereas the technical improvements of the entire biowaste-based value chain are of pivotal importance, the engagement of citizens has been another key focus area in Western Macedonia. By implementing the HOOP citizen science app and by organizing dedicated activities before and throughout the project, Western Macedonia has managed to reach its citizens throughout. The so called “Climate Neutral Week” has been the flagship organized in the scope of both the SCALIBUR and HOOP projects. During this action week over a span of seven days, hundreds of citizens, including many children, were engaged. This helped raise awareness in the region, and it was expanded within the HOOP project with further activities such as school visits or product exhibitions. **Looking ahead, more activities including the publishing of a zero-waste cook book are in the pipeline and will be assessed and implemented to continuously create impact for and with citizens.**

Beyond those concrete points, actions aiming at replicating the most important learnings as well finding further funding opportunities for the key topics in the lighthouse region are foreseen. With both clear concepts and goals for the urban circular bioeconomy system and the involvement of stakeholders including citizens, Western Macedonia is in a good position to continue being a frontrunner and lighthouse in Europe.

Figure 8. Climate Neutral week in Western Macedonia

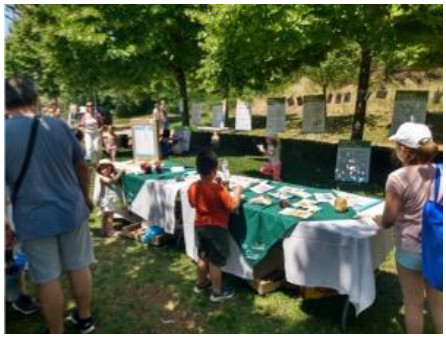

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Table 9. Roadmap for Western Macedonia

Western Macedonia						
	Status quo before HOOP	**Achievements in HOOP**	**Next Milestone**	**Action Items and Timeline**		
				Action 1	**Action 2**	**Action 3**
Biowaste Club framework	similar events gathering all the relevant stakeholders from the SCALIBUR Project discussing circular economy topics (biowaste collection) relevant to the Region of Western Macedonia. UCOs concerning the collection from the ATM machines there were some events between CluBE, DIADYMA and the Municipalities of the Region	start the pilot collection of the spent coffee grounds from the HoReCa sector in the Region of Western Macedonia after several Biowaste Club meetings with their Representatives.	keep having frequent meetings in order to successfully implement the collection of the spent coffee grounds and the Used cooking oils.	next meeting with HoReCa sector until end of the year	until 2025 CluBE and DIADYMA to design the most comprehensive collection scheme	the end of next year, all the spent coffee grounds

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Citizen Science		the use of the app had a great success in the Region of Western Macedonia with more that 400 users.	
Pilot Actions on stakeholder engagement	Biowaste Clubs through the SCALIBUR Project, Climate Neutral Week which was a 7days event that the citizens of Kozani had the opportunity to get familiar with the circular economy and 2 days were dedicate to children with games based in the circular economy and recycling and upcycling. Finally, we participated in the celebration of world environment days	make school visits, many actions such as biobased products exhibitions to schools and central points in the cities of Western Macedonia	Continue all the actions that we run already and to publish a book with zero waste recipes.

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Bio-waste recycling/ bio-economy as core topic of our organization	awareness raising and behavioral change of the citizens and the relevant stakeholders	advanced awareness raising and behavioral change of the citizens and the relevant stakeholders	find new ways to approach children and other ages as separate age groups in order to achieve awareness raising
Bio-waste recycling/ bio-economy as core topic of our city/ region	separate collection already for 15 years. Biowaste separate collection since 2016 starting as pilot in Kozani and increasing	searching ways to valorize the biowaste and more specific the spent coffee grounds and used cooking oils and searching for funding	the full-scale collection of the spent coffee grounds and the used cooking oils
Bio-waste stream(s) in our lighthouse	food wastes, green wastes and used cooking oils	Pilot collection of spent coffee grounds and further collection of used cooking oils	full scale collection of spent coffee grounds and used cooking oils
Regional/ national replication		in collaboration with the Greek association of Municipalities which is a member of CluBE	in collaboration with the Greek association of Municipalities which is a member of CluBE

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European cooperation	Through our Partners of the SCALIBUR Project	Further exchange with our partners of the HOOP Project	to be part of other EU Projects and exchange further knowledge

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4. Conclusions & outlook

The HOOP project was set up in a way that it covers a variety of socio-economic, historic and geographically different lighthouse cities and regions from all over Europe. This approach allows a broad representation of cases relevant for others to find themselves in the varying contexts represented by HOOP. This selection based on differences is also reflected in the roadmaps showcased in chapter 3 which shows how different the urban circular bioeconomy can be approached in each of the cases (i.e. the lighthouses). There are several trends that can be identified in the roadmaps. New technologies implemented by the project have been successfully launched in some lighthouses, while in others, the necessary groundwork has been rolled out to define a clear path forward that will allow new technologies in the biobased value chains to take place. In addition, it is clear for practically all lighthouses that the upscaling will play a vital role. One means to achieve this is by participating in new funding schemes such as projects focusing on specific topics of the HOOP scope. This collaborative approach can be seen as a testament to the impact that projects such as HOOP have in the cities and regions and also for the needs each of the lighthouses have going forward.

There are many roads ahead and one-size-fits-all solutions are not the observation to make in the findings. It is much clearer that the different ways ahead will be achieved through different means (technical advancements & changes to the bio-waste recycling system, new and enhanced existing cooperations, etc.) different financing schemes (new projects, implementation in existing topics/agendas with existing financing, collaboration with others) and obviously in greatly varying contexts. Nevertheless, one trend and success factor is clear. Engaging stakeholders and focusing especially on citizens, will remain crucial in all lighthouses. With stakeholders bringing expertise, their own agendas and resources and vital roles in the value chains, it only makes sense for the lighthouses to keep following this path in their roads ahead. Additionally, engaging stakeholders helps in understanding the own context and cultural aspects from different perspectives, making intervention more meaningful and feasible. Citizens, as both key producers of biowastes but also in different roles like consumers of biobased products and deeply rooted in many initiatives in the lighthouse cities and regions are key and the lighthouses have identified many ways ahead. Taking all of this into account and respectfully working on changing the behavior can thus be crucial for further change for and with citizens and stakeholders.

Lastly, the roadmaps per lighthouse also show that sharing the results and being active beyond the own boarders is key for each lighthouse. By fostering alliances, sharing the results and also showing hunger to learn from others, the lighthouse cities and regions are set for collaboration in the future both for internal goals but also for overarching sustainable transformation in other regions. From these replication focused activities laid out in the roadmaps, and also the clear pathways for change and implementation in the lighthouses itself, it is clear that the HOOP legacy will live on both in the lighthouses and beyond. Additionally, it is evident that more initiatives such as HOOP will be required as the project has enabled cities and regions to act more sustainably and use organic resources full of value more efficiently.

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6. Annex. The HOOP Tales

Albano Laziale: Golden Biowaste for Local Benefit

The municipality of Albano Laziale (Italy), represented in HOOP by the association of municipalities ANCI Lazio, is part of the Region of Lazio and has broad ex- perience in the participation in EU projects, notably in the SCALIBUR project. The HOOP urban metabolism analysis and baseline studies showed that Albano has very high rates of biowaste collection (93.8%) with very high quality (98.5%). The bio- waste quality is better from households than from the HoReCa sector. Despite its high quality, the biowaste was not valorized within the Albano municipality or the surrounding area, which meant that Albano could not benefit from this great separate collection performance. Therefore, as a first action, Albano constructed a composting facility to valorize 13% of its biowaste with an investment of €600,000. In parallel, Albano continued with pilot actions to improve the biowaste quality from the HoReCa sector with the use of the HOOP citizen science app, and invested €300,000 for the purchase of the land dedicated to a 'reuse island' and €200,000 for the creation of a system of computerized islands (for paper, glass, oil, plastic collections).

The baseline study showed a low diversity of locally available bioproducts. This meant that innovative technologies could open new opportunities for Albano's high-quality biowaste. From the HOOP State- of-the- Art portfolio of technologies, Albano discovered the valorisation of used cooking oils (UCO) into bio-plastic poly-3-hydroxybutyrate (P3HB), patented by Nafigate Corporation. The technology was deemed of high interest and potential key stakeholders were engaged through the Biowaste Clubs promoted by ANCI Lazio with the help of HOOP. These discussions and meet- ings helped to build a tailored business model, which identified the waste oil management companies as key stakeholders. The strong cosmetic sector in Lazio region was identified as a potential circular buyer of the P3HB produced from UCO. Demand could be driven by the need to replace microplastics and TiO2, in line with the future ban on micro-plastics, the potential of the biodegradable P3HB in cosmetic

formulations, as well as future limitations for biodiesel, which currently absorbs almost all UCOs avail- able on the market. In parallel, pilot actions to increase the acceptance of bioproducts and dissemina- tion of the HOOP portfolio of technologies for valorisation of biowaste were performed.

The UCO from Albano were tested and found to comply with the requirements for its application in the technology. The techno-economic feasibility study provided by the HOOP PDA showed that a significant production capacity is required to achieve profitability. The increased size of the potential plant entailed the expansion of the scope of the project to a broader area in the region of Lazio, and brought the required investment up to €17 million. Although this ticket was too high for the initial promoter, thanks to the intense communication activities by ANCI Lazio through HOOP, the project raised the interest of the National Consortium of Waste Oils in Italy. Local Biowaste Club and other meetings at national level, promoted by ANCI Lazio and HOOP, took place in the process of discussions for promoters to

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step in. Furthermore, HOOP organised a study visit to Prague for the potential promoters to gain more detailed information on the technology, to better assess the creation of this novel value chain in the Lazio Region and at national level. Although the project is currently in standby, the awareness and interest created about this technology mean that it might launch at any moment. Furthermore, UCO separate collection has been extended in Albano and started in neighbouring Ciampino, with a total investment of €162,000.

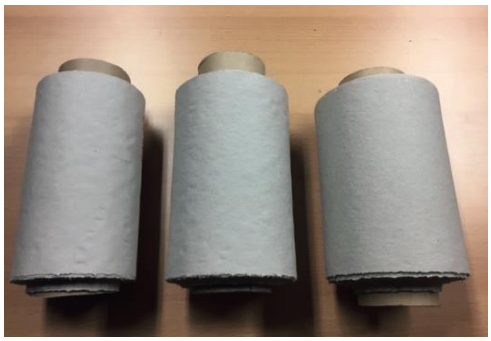
Albano has used all the elements of the HOOP PDA to build a project proposal from scratch, with special focus on the stakeholder engagement as tool to build a business model, investing €81,000 so far. Moreover, Albano has stepped up their circular valorisation with €900,000 additional investment. The momentum cre- ated about the valorisation of UCOs at the national level has been extremely high.

Almere: Cluster the Innovation to build up

The City of Almere (The Netherlands) has broad experience in circular economy and the promotion of entrepreneurial initiatives. An especially remark- able initiative is the Raw Materials Collective, which focuses on the development of raw materials from waste and coordinates circular projects. Their main focus is the valorisation of green waste from many sources, such as invasive plants, aquatic plants, wood waste from agriculture. The HOOP urban metabolism analysis and baseline study found that a high amount of bioproducts are being produced, suggesting very high levels of innovation, but at small scale and far from the market.

Almere is the fastest growing city in the Netherlands and has a very active construction sector. There- fore, the city aims to build upon all this innovation to foster solutions able to respond to the demand for construction materials. This criterion influenced the selection of urban circular bioeconomy projects such as i) the production of biocomposites for traffic signs and urban furniture with fibres from invasive plants, ii) the use of fibres from wood waste as additive to circular concrete and iii) torrefaction of green waste. Despite their interest, the atomisation and small scale of the projects has been a challenge both from the supply chain and from the market demand side, compromising their feasibility. HOOP has tried to increase the marketability of the bioproducts by characterising the properties of biocomposites and evaluating their applicability to packaging in a process of product development.

Figure 9. The HOOP Tales: Fibre-based products



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After realising that most of the projects did not have enough entity or maturity by their own to be up-scaled, a completely different business model was proposed in the framework of HOOP PDA. This new model is a multipurpose fibrebank, which provides a business-to-business approach and buffers the fluctuations both from the supply (seasonality of feedstock) and the demand side (marketability of products). Biowaste Clubs have been instrumental to develop this new concept where the products are fibres as intermediates. The project is currently in search of a promoter to further develop this concept. The multi-purpose fibrebank has clustered with other projects in Almere to be part of a potential circular systemic solution where part of the green waste is sent to anaerobic digestion, another part to torrefaction and a third part to the isolation of fibres. Several actions have been taken in terms of acceptance of bioproducts in order to increase the marketability of circular fibres. However, regulatory issues have been detected by HOOP PDA, which is in the process of providing evidence of the higher sustainability of Almere's approach for the treatment of invasive species. Moreover, the torrefaction part has faced regulatory barriers, which means that the project is currently in stand-by.

Besides the highly innovative entrepreneurship environment, the HOOP urban metabolism analysis and baseline showed that the levels of separate collection (52%) were not the best in the Netherlands and the quality neither (85%). Therefore, actions had to be taken to improve these values. The first was a total change in the separate collection system, followed by activities to raise awareness and educate citizens on how to properly sort the biowaste. Some of these actions were inspired by the experiences of Murcia and Münster. The total investment for this change is €4.46 million.

Almere has taken advantage of the sharing of good practices within HOOP to bring about a change in the biowaste separate collection system. Moreover, the atomised projects from the Raw Materials Collective have clustered and got a new business model thanks to the PDA.

Bergen: Start up the Symbiosis

The region of Bergen (Norway) is represented by the waste management company BIR AS, which was awarded as the Circular Company of Year in Norway in 2021. Despite having run biowaste separate collection in HoReCa for more than 40 years, separate collection in households was not implemented. This separate collection has been implemented during the HOOP project, with an investment of €3.76 million. Education and awareness raising campaigns were launched to show citizens how to properly sort biowaste. Acceptance of bioproducts has been promoted through actions such as showing mealworm in schools.

Considering the limited market for compost at the beginning of the project, the target of BIR AS for the use of biowaste was not compost production, but rather its use for circular applications in symbiosis with the local economy. BIR AS participates directly as shareholder in two circular start-ups in the Bergen region, both using food waste as feedstock. One of them is Invertapro, producing yellow mealworm, and the other is Greentech Innovators, producing microalgae. In both cases the target was to produce feed for the local aquaculture sector, following an industrial symbiosis approach and increasing the use of local resources. However, regulatory assistance from HOOP PDA in the framework of the ROOTS initiative showed the limitations for the use of food waste depending on the final application of the bioproduct.

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The projects for the expansion of the capacity of both start-ups have been self-promoted. Knowledge about EU Taxonomy from the PDA inspired the development of life cycle assessments (LCA) for both processes so that both the mealworm- and microalgae-derived products could demonstrate their substantial positive effects on the environment, especially in terms of cli- mate change. The maturity shown by the projects and confirmed by the HOOP tools made them suitable for pitches to attract investors in several events, including the HOOP Circular Investors Board meetings and the HOOP Circular Investor Day held in Brussels in May 2023. The application of the HOOP financial model proved the profitability of both projects in order to further increase their appeal to investors. HOOP LCA results were used by Invertapro in a crowdfunding campaign, which succeeded to get the targeted €1.3 million. In the case of Greentech Innovators, HOOP PDA provided a proof-of-concept test, confirming the technical feasibility of the project and opening the possibility of a new business model based on hydrolysate as growth media for biotechnology. The start-up has obtained €1.75 million up to now.

The outcomes from the ROOTS regulatory assessment clearly showed that the production of feed is not the only solution for Bergen's biowaste from households. Therefore, BIR AS established collaboration with nearby municipalities in the Indre Hordaland region and expanded there the area of operation. This has resulted in the creation of a Biopark for bioeconomy in Voss, where an anaerobic digestion plant for the treatment of both the biowaste from Bergen region and the manure from the farms in the surrounding area will be installed in 2025, with an investment of €30 million. The outcoming liquid digestate will be employed in nearby lands. However, the use of the solid fraction is not determined yet, and BIR AS, fol- lowing HOOP PDA guidelines, has launched an open market consultation to find alternatives for the valorisation of the solid fraction of the future digestate, promoting the circular bioeconomy in the area. The full-scale Invertapro plant is planned to be built at the same location, is which will mean an investment of €10 million. The concept of the Biopark has been worked through the Biowaste Clubs and awareness about the idea has been extended to other areas of Norway through the National Replication Workshop.

Bergen has experienced a large evolution during the HOOP project, starting with no separate collection to the creation of an industrial symbiosis park, with an investment of €43.76 million, including innovative technologies and using open market consultation. Start-ups have succeeded to get €3.05 million up to now, taking advantage of HOOP PDA.

Kuopio: Do not waste, learn

Kuopio (Finland), represented in HOOP by Savo- nia University of Applied Sciences, has separately collected biowaste from households since 2003, treating it together with urban wastewater sludge in a private anaerobic digestion facility providing heat and electricity to the city. Results from the HOOP urban metabolism analysis showed that the levels of production of urban biowaste are very low (96 kg per person yearly), which can be explained by the high degree of implementation of home composting (48% of households). However, the separate collection rate for the remaining half of biowaste was still medium (50.6%), one of the causes being the fact that those sectors that cannot take advantage of the home composting, like HoReCa, become large producers. Therefore, education actions and awareness raising campaigns have targeted these groups, including through the use of the citizen science app.

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At the beginning of the project, the main project in Kuopio was the upscaling of the nutrient recovery pilot from digestate at Kuopio's anaerobic digestion facility, but this plan was unfortunately affected by international tensions leading to rising component and energy prices. Besides that project, HOOP proposed to Kuopio the possibility to explore other technologies for the valorisation of biowaste from the HOOP state- of-the-art portfolio as Best Available Technologies.

Figure 10. The HOOP Tales: The city of Kuopio

Among these technologies, pyrolysis was one of the most promising ones, with the possibility to establish a symbiosis with the forestry sector identified in the baseline studies. Savonia University of Applied Sciences started the plans for the construction of a pyrolysis pilot to provide assistance to different local industries to treat their by-products, with the aim of obtaining biochar for agriculture or other diverse applications, such us feed additives or replacement of coke from coal in steel production. The pilot obtained funding for €830,000. The tests were supported by HOOP PDA to evaluate the actual use of biochar in field tests and their potential for certification. The business model is not based on the sales of biochar, but on providing services to local and regional industries using the pilot in the university in order to promote the development of larger scale solutions. From this perspective, the future impact is expected to be high. The pilot started operation in late 2023 and it is ready to expand the knowledge about pyrolysis.

Kuopio has set the basis to become a regional reference for pyrolysis, providing assistance to the regional stakeholders in order to open new business models.

Münster: Bioexcellence and Circular Carbon

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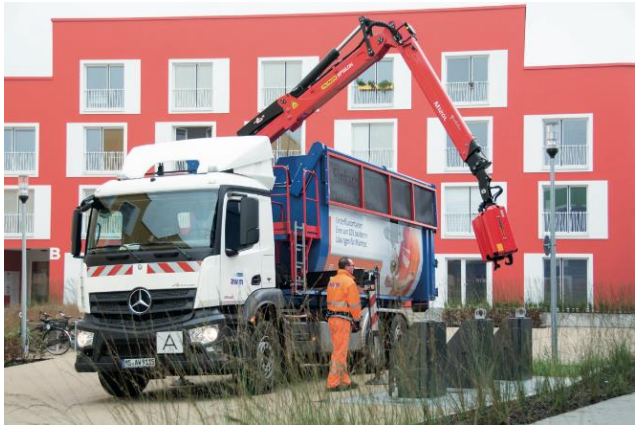
Münster (Germany), represented in HOOP by the waste management company AWM, is one of the reference cities in Europe in terms of separate collection of urban biowaste and its treatment by anaerobic digestion, which is being performed since mid-1990s. Besides this, AWM established a trans-border symbiotic model with the region of Twente (Netherlands), so that sort- ing residues from the residual waste treatment plant from Münster goes to energy recovery in Twente and Twente's biowaste is utilized for composting in Münster. This extensive experience and the work accumulated during decades has led AWM to biowaste separation rates as high as 87% with excellent quality (96.5%). The years of experience have allowed the learning on the good practices such as the door-to-door collec- tion, the avoidance in use of bags for biowaste and the specific campaigns for raising awareness. AWM identified blocks of buildings as the most challenging spots for ensuring high collection rate and high quality. For these spots, good practices were promoted, while initiatives from the citizens were disseminated by HOOP Local Champions.

The HOOP baseline analysis showed that the actual material recovery of biowaste was 75.8%, being the unrecovered 11.2% the important amount of sieving overflow, constituting the refuse from the composting of green waste and digestate (mainly lignocellulosic material). This sieving overflow is sent to energy recovery outside Münster boundaries. Therefore, the focus of HOOP for Münster is to increase the circularity processing this overflow within the municipality and promoting innovative solutions. Two different approaches were followed: i) the increase of the yield of biogas by hydrolysis of the wooden parts of garden waste and ii) the production of biochar from refuse together with digestate (that is being produced in very high quantities and can't be composted it all with garden waste) by pyrolysis. Moreover, thanks to the awareness gained through HOOP PDA on quality, AWM has invested 210 k€ on pilot AI technologies to upgrade the purity of incoming biowaste flows, to pave the way to future higher added-value valorization routes.

The particular characteristics of the sieving overflow are a challenge and the technical feasibility both of the hydrolysis and the pyrolysis had to be proved. In the case of pyrolysis, proof-of-concept tests have been required, showing the high potential of overflow as source of biochar of good quality.

Figure 11. The HOOP Tales: Separate waste collection in Münster



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During this process, the Biowaste Clubs have been the platforms for the engagement of potential customers, spreading the knowledge about pyrolysis, especially on the poten- tial customers in agriculture. The initiative and commitment of AWM with pyrolysis has even promoted replicability actions and clustering with other cities and regions from the HOOP Network with interest in biochar. Biochar acceptance actions were organised, creating a high awareness around Münster. However, regulatory barriers have been found in the pyrolysis project, especially connected with the national regula- tory framework in Germany, which might be satisfied by a redesign avoiding digestate. Moreover, HOOP PDA is promoting actions on policy to overcome some of these barriers. In any case, the project will need a tender due to the public nature of AWM.

In the case of hydrolysis, the technical PDA tests have confirmed the feasibility of the enzymatic hydrolysis as pretreatment to increase biogas yield, but requiring some intermediate conditioning steps which are now under economic evaluation. Moreover, the good results of the pilot tests have led to the search of alternatives in the production of bacterial biostimulants, with very promising results on laboratory scale.

Murcia: Prepare the Land

Murcia (Spain) has an important background in circular bioeconomy due to the experience in EU projects such as VALUEWASTE, where several innovative technologies were developed on a pilot scale based on urban biowaste. The main focus of Murcia in HOOP has been the urban wastewater value chain, having as key stakeholder EMUASA in some of the projects. The HOOP urban metabolism analysis and baseline studies showcased the best water circularity indicators of all the Lighthouses, with a complete circular management of the sludge (which is mainly land applied), but with low level of innovation. Therefore, projects related with water were selected, namely the valorisation of sludge into volatile fatty acids (VFA) following a biorefinery approach. Having a clear objective from the outset made this project advance very fast in providing the technical PDA. The techno-economic feasibility study showed promising turnover results, but exposing the negative profit due to the low capacity of a plant processing available sludges.

Moreover, HOOP PDA identified as Best Available Technology the production of black soldier fly larvae, foreseeing the possibility to upscale the VALUEWASTE pilot. However, the regulatory assessment performed in the framework of the ROOTS initiative revealed important barriers for the use of insects for the treatment of biowaste, shifting the business model to the treatment of agri-food by-products from the surrounding area. The promotor was a technology provider, who finally found an investor, but relocated the project to another area of Spain. In any case, the need to provide a circular treatment for the future full-scale urban biowaste has led HOOP to provide technical assessments of possible scenarios for urban biowaste management.

After the cancellation of the first two projects, a new project for the wastewater sludge value-chain was selected, recovering nutrients (ammonia) from effluent in digestate of sludge in the municipal wastewater treatment plant. The bioproducts are strategic for their application in the strong agriculture sector in Murcia. The PDA proved its technical feasibility and now the project is expanding to increase the amount of streams valorized, with special focus on water recovery. The water management company will launch an open market consultation to define better the conditions for the future precommercial

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procurement, which has raised high interest in Murcia thanks to HOOP PDA, with a National Replication Workshop dedicated to innovation public procurement.

Regarding the biowaste value-chain, the HOOP urban metabolism analysis showed a low separate collection rate (9.4%) as it was only implemented on pilot scale. The full implementation of the separate collection in Murcia, involving an investment of €6.79 million up to now, sets challenges in different areas, with citizen awareness being one of the most important. In this sense, several campaigns have been run in order to promote separate collection and circular bioeconomy. The Biowaste Club conducted in the Circular Economy Fair LOOP (organised by the municipality) was a perfect example of the attempt to create consciousness and co-create to prepare and engage the citizenship for the full-scale separate collection. These actions involve also the promotion of bioproducts and the education actions in schools using as support material the citizen science app. Moreover, the entrepreneurial ecosystem in Murcia was involved in Biowaste Clubs meetings, especially through the association AEMA-RM, with the aim to scan innovative solutions already available and promote actions to develop new circular ideas and bioproducts. In this sense, separate collection of used cooking oils has been implemented, with an investment of €550,000.

Murcia is preparing the ground for upcoming feed- stock valorisation (urban biowaste from households) and improving the value from the sludge through innovative solutions using the valuable HOOP PDA. Invest-ments need to be taken for implementation, accounting for €7.34 million to this point. HOOP promoted awareness about the use of innovation public procurement, expecting to be a tool for circular bioeconomy development for the future.

Porto: Circular Agriculture

LIPOR is the public waste management company in the region of Greater Porto (Portugal), formed by Porto and 7 other municipalities, and has been the pioneer in composting in the Iberian Peninsula. They hold a broad experience with composting, with special attention to Nutrimais®, made from separately collected biowaste and providing highly satisfactory results for the vineyard crops in the surroundings. LIPOR is highly engaged and has run many campaigns of awareness and promotion of the community composting. Moreover, a Waste Data Observatory has been developed to check the waste generation per municipality.

The HOOP baseline analysis showed a significant level in biowaste production (207 kg/cap year), which explains the campaigns and actions for food waste prevention, especially from the HoReCa sector, promoted by LIPOR. The analysis also showed a rate of biowaste separate collection of 29.5%, because separate collection of food waste from households has not yet been fully implemented. These data are line with those accessible through the Waste Data Observatory.

The expansion in biowaste collection to households also requires an increase in the treatment capacity. This will be done through an anaerobic digestion facility. However, both due to the requirements in wastewater discharge and due to LIPOR's commitment with circularity, the construction of a nutrient recovery facility is planned. HOOP's technical PDA has evaluated the possibilities of recovery of the high amount of ammonia expected in the effluent of digestate, as well as the recovery of phosphorus

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by struvite precipitation, trying to provide a circular solution to the excess of nutrients and the needs of regional agriculture.

Figure 12. The HOOP Tales: Biowaste composting

The PDA has served as guide for the intense work of design, preparation and launch of the open market consultation to assess the possibilities that the market offers to solve this challenge in a circular way, with an event in April 2024 gathering relevant technology providers. The results from the consultation will serve to tailor the solution and shape the tender book for the procurement of the large plant, with a total investment estimated at €53 million. To research on anaerobic digestion LIPOR invested €651,000 in a pilot anaerobic digestion plant.

The aforementioned Nutrimais® is an excellent example of circular economy by a waste treatment company that shifted their mindset to the obtention of a high-quality and marketable product rather than treating the maximum possible amount of waste no matter the final outcome. However, this change in concept means also the generation of a higher amount of composting refuse, mainly of lignocellulosic nature. The pyrolysis of this material to produce biochar was selected as Best Available Technology to increase circularity. This same approach might be also used for invasive plants. However, the particular nature of the compost refuse made necessary intense characterisation and testing in the PDA to prove the technical feasibility. This has been performed also for invasive plants. Despite the fact that the refuse is now used for other purposes, the results from PDA are very promising and have high replicability potential. Despite the challenges, the HOOP financial model showed the profitability of the project.

Unlocking new value chains also requires the need to promote the new bioproducts. This has been the main action in the pilot activities to increase the acceptance of bioproducts (i.e. biochar, struvite) with exhibitions. All the processes run by LIPOR have finally as clear target the circular application to re-

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gional agriculture of all the considered bioproducts: compost, biochar, digestate and recovered nutrients. Besides this, the full implementation of separate collection in households also requires to continue with education campaigns.

HOOP PDA has provided support on the decision-making process to shape the future anaerobic digestion plant by the use of open market consultation and technical studies, integrating circularity in the €53 million investment.

Western Macedonia: Cluster and Circular Playgrounds

Western Macedonia is a region of Greece where lignite mining has been the basis of the economy for decades, as indicated in the baseline analysis. The transition to a new economy is driven by sustainability, with special attention given to Bioeconomy. The regional cluster for bioeconomy and environment, CluBE, formed by the different regional stakeholders, is representing the region in HOOP. In this framework, Western Macedo- nia is the Lighthouse with the highest participation in European research projects.

Biowaste management is performed by the public regional company DIADYMA. The separate collection has been progressively implemented since 2016, starting in the capital Kozani. Data from HOOP urban metab- olism analysis, coming from 2019, still showed a low separate collection rate (3.6%). The implementation of separate collection requires intensive social actions for awareness raising and for education in schools and kindergarten, organised by stakeholder engagement PDA. Another issue identified in the baseline was the low acceptability of bioproducts (namely compost), which implied their promotion with very intensive campaigns in the framework of HOOP to help citizens understand, experience and accept a wide range of bioproducts. These actions were complemented with the extensive use of HOOP citizen science app in the high schools of Western Macedonia.

Regarding the projects, there have been two main areas of focus. One of them is about the management of used cooking oils (UCO) from households, currently collected from automated machine bins. The HOOP state-of-the-art portfolio has been an inspiration to develop a project for the valorisation of UCO into bioplastics with the technology from Nafigate Corporation. This was recommended as Best Available Technology due to the availability of raw materials. HOOP PDA showed that currently there is not enough oil available to build a full-scale economically feasible plant, as the largest amounts from industrial or HoReCa sector are employed for the production of biodiesel. However, DIADYMA is promoting the construction of a pilot plant for UCO valorisation for strategic purposes, considering future constraints for the use of biodiesel. Moreover, an LCA study performed by HOOP PDA demonstrates that valorisation through the production of biopolymers provide GHG savings 8 times higher than through the production of biodiesel. The concept of the pilot in DIADYMA has been identified in the evaluation of business models.

The second project was also inspired by the HOOP state-of-the-art portfolio and uses spent coffee grounds (SCG) as feedstock. The impact of this selection has been so high that the first steps to implement the separate collection of spent coffee grounds were taken in Kozani, using Biowaste Club meetings to engage the HoReCa sector, with an investment of €72,500 until now. In addition to this, DI-

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ADYMA led, guided by HOOP PDA, an application to get Horizon 2020 funding to launch a pre-commercial procurement (PCP) for the valorisation of spent coffee grounds with the participation of Albano Laziale. The application was positively evaluated but due to the limited funds it was placed on the waiting list. In between, the SCG have been characterised and tested for the extraction of oil, polyphenols and for the production of carotenoids. The good results of the tests on HOOP PDA were the starting point for an application for funding (Interreg), clustering to other technology (hair valorisation) due to the small size.

The separate collection and valorisation of SCG are the most important impact of HOOP PDA in Western Macedonia, as a new value-chain is being created. The first steps of collection have been taken with an investment of €72,500 up to now. The next step is exploring their valorisation, with a funding application pending.

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