D7.5 Contribution of HOOP to the circular economy strategies of the cities and regions

Author(s): SAV

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List of acronyms

Acronym	Description
ABP	Animal By-Products
BAT	Best Available Technologies
CCRI	Circular Cities and Regions Initiative
CL	Circularity Level
LCA	Life Cycle Assessment
LH	Lighthouse Cities and Regions
NRW	National Replication Workshops
OFMSW	Organic Fraction Municipal Solid Waste
P3HB	Poly-3-hydroxybutyrate
PDA	Project Development Assistance
PML	Project Maturity Level
SCG	Spent Coffee Grounds
UCBE	Urban Circular Bioeconomy
UCBH	Urban Circular Bioeconomy Hub
UCO	Used Cooking Oils
UWWS	Urban Waste Water Sludge
VFA	Volatile Fatty Acids

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1. Executive summary

The HOOP general objective is to foster urban circular bioeconomy (UCBE) across Europe by unlocking bio-based investments through a systemic and cross-cutting approach. In its lifetime, the project deployed Project Development Assistance (PDA) to a group of 8 Lighthouse Cities and Regions (LHs) and enhanced the replicability to other cities and regions across Europe through the HOOP Urban Circular Bioeconomy Hub (UCBH).

The HOOP project has provided Project Development Assistance (PDA) to 8 Lighthouse Cities and Regions (LHs), offering tailored support in the form of technical studies, business models, and financial guidance. The PDAs to the lighthouse cities demonstrated the potential of circular bioeconomy solutions paving the way for replication across Europe.

This document, Deliverable D7.5, provides a comprehensive overview of the HOOP project's achievements, the lessons learned from the Lighthouse Cities and Regions, and the broader impact of HOOP on the circular bioeconomy landscape in Europe. It outlines the key components, the HOOP PDAs, the Urban Circular Bioeconomy Hub, the HOOP Network of Cities and Regions, the HOOP tools and its impact on the circular economy strategies of the HOOP Lighthouses and the Network of Cities and Regions.

Through this document, readers will gain insights into how HOOP is driving the transition towards a circular bioeconomy, fostering innovation, and creating a collaborative ecosystem for sustainable urban development. The findings and tools presented here are intended to inspire and guide other cities and regions in their journey towards circularity, ultimately contributing to a more sustainable and resilient future.

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2. Introduction

The HOOP Project (Hub of circular cities bOosting Platform to foster investments for the valorisation of urban biowaste and wastewater) is a pioneering initiative funded by the European Union under the Horizon 2020 program. The primary goal of HOOP is to foster the urban circular bioeconomy (UCBE) across Europe by unlocking investments in bio-based solutions through a systemic and cross-cutting approach.

The HOOP project focuses on the valorization of urban biowaste and wastewater, transforming these resources into valuable products such as bioplastics, biochar, fertilizers, and other high-value materials. By doing this, HOOP aims to create sustainable, circular loops where waste is no longer seen as a problem but as a resource that can drive economic growth, environmental sustainability, and social benefits.

At the heart of the HOOP project are eight Lighthouse Cities and Regions (LHs) across Europe, which serve as living labs for testing and implementing innovative circular bioeconomy solutions. These cities and regions include Albano Laziale (Italy), Almere (Netherlands), Bergen (Norway), Kuopio (Finland), Münster (Germany), Murcia (Spain), Porto (Portugal), and Western Macedonia (Greece). Each of these LHs has unique challenges and opportunities, and the HOOP project provides tailored Project Development Assistance (PDA) to help them to develop and scale up circular bioeconomy projects.

The HOOP project also emphasizes replicability, ensuring that the solutions developed in the Lighthouse Cities and Regions can be adapted and implemented in other cities and regions across Europe. To support this, HOOP has developed the Urban Circular Bioeconomy Hub (UCBH), an online platform that provides tools, resources, and knowledge-sharing opportunities for cities, regions, and stakeholders interested in advancing circular bioeconomy initiatives.

Key components of the HOOP project include:

- Innovative Technologies: HOOP promotes the use of Best Available Technologies (BAT) for the valorization of biowaste and wastewater.
- Stakeholder Engagement: Through Biowaste Clubs and other engagement platforms, HOOP fosters collaboration among local authorities, businesses, researchers, and citizens to co-create circular solutions.
- Financial and Technical Support: HOOP provides tailored PDA to help cities and regions develop bankable projects, secure funding, and overcome regulatory and technical barriers.
- Knowledge Sharing: The project emphasizes the importance of sharing lessons learned, both within the HOOP network and beyond, to accelerate the transition to a circular bioeconomy across Europe.

This document, Deliverable D7.5, provides a comprehensive overview of the HOOP project's achievements. The document starts describing the functionalities of the UCBH to explain after the impact of the HOOP project on the circular economy strategies of the HOOP Lighthouses and the Network of Cities and Regions.

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3. The HOOP Urban Circular Bioeconomy Hub

3.1. The UCBH concept

The Urban Circular Bioeconomy Hub (UCBH) was created with the aim of providing a platform for boosting Urban Circular Bioeconomy through a network of cities and regions across Europe. To achieve this goal, the UCBH was created to provide resources relevant to urban biowaste and wastewater valorization and tools for unlocking investments to enhance the development of local bioeconomies. At the same time, the UCBH was developed to exchange good practices and lessons learned from the PDAs of the Lighthouse Cities and Regions during the HOOP project.

The UCBH platform (***Figure 1***) can be accessed on-line through this link: https://www.hoop-hub.eu/

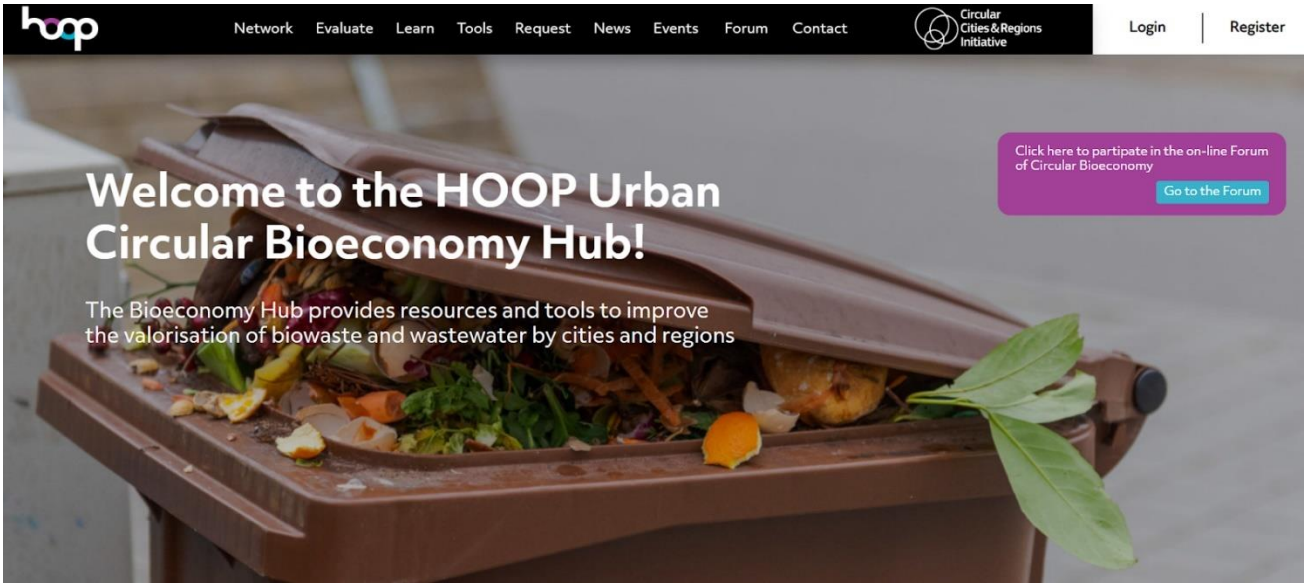

Figure 1. *Screenshot of the HOOP Urban Circular Bioeconomy Hub.*

The platform is divided into 4 main blocks (see **Figure 2**):

- **Network:** with the HOOP Network of Cities and Regions as a forum to exchange lessons learned and ideas for the implementation of bioeconomy projects.

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- **Evaluate:** this section provides HOOP tools to evaluate circular performance and the financial attractiveness and maturity level of bio-circular projects. This includes the Bio-Circularity Label, the Circular Valuation Method and the Project Maturity Level tool.
- **Learn:** with the Virtual Academy to provide resources related to the implementation of Urban Circular Bioeconomy solutions. This includes handbooks, manuals, factsheets and videos on technologies and financial engineering for circular bioeconomy projects.
- **Get support:** this section provides contact for technical, financial and procurement processes support from HOOP partners experts.

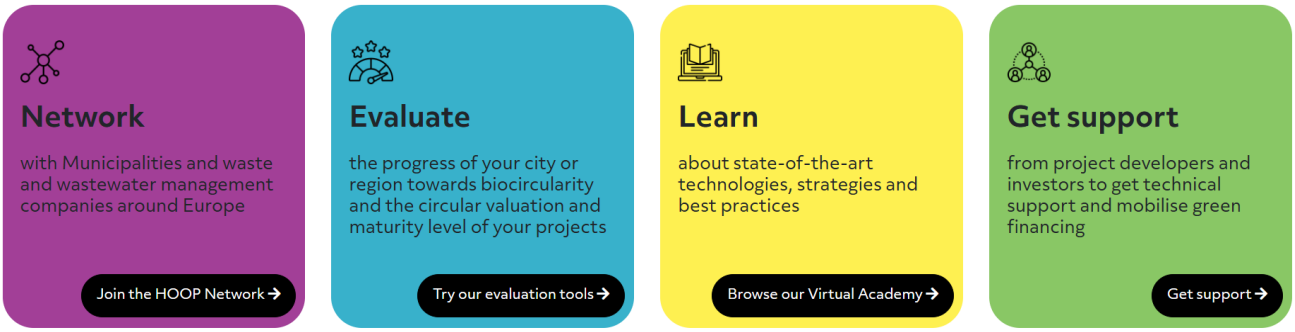

Figure 2. *Four main blocks of the Urban Circular Bioeconomy Hub.*

The list of sections of the UCBH and a description of their content is shown in *¡Error! No se encuentra el origen de la referencia.*.

Table 1. *List of the UCBH sections with description of their content*

Section	Content description
Network	-Member registration form -Map with the locations of the city/region members -Full list of the cities and regions -Information for each city region: company/organization description, link to website, population and key indicators of their bio-circularity performance (when available). -Tool to contact city/region representatives
Evaluate	-HOOP Bio-Circularity Label Tool. This includes submission process to obtain the Bio-Circularity Label (implemented) -Circular Valuation Tool (implemented) -Project Maturity Label Tool (to be implemented in the coming period)

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Section	Content description
Learn	-Virtual Academy with resources related to the implementation of Urban Circular Bioeconomy solutions. This includes currently more than 150 resources including handbooks, manuals, factsheets and videos on technologies and financial engineering for circular bio-economy projects. -Form to send contributions to the Virtual Academy
Tools	-List of tools for investment decisions and implementation of Urban Circular Bioeconomy solutions
Request	-Form for requesting technical support -Form for requesting financial support (matchmaking tool)
News	-News related to the Circular Bioeconomy and HOOP activities
Events	-Events related to the Circular Bioeconomy and HOOP events
Contact	-Form to contact HOOP partners
Login	-Login section to access to the user control panel
Register	-Register form to be user of the platform
Online Forum	-Online Forum to discuss topics related with the Circular Bioeconomy

In the platform, users can **register** and **login** to access more services as messages to cities/regions and an online Forum, see ***Figure 3***. The platform also allows users to access through their LinkedIn account.

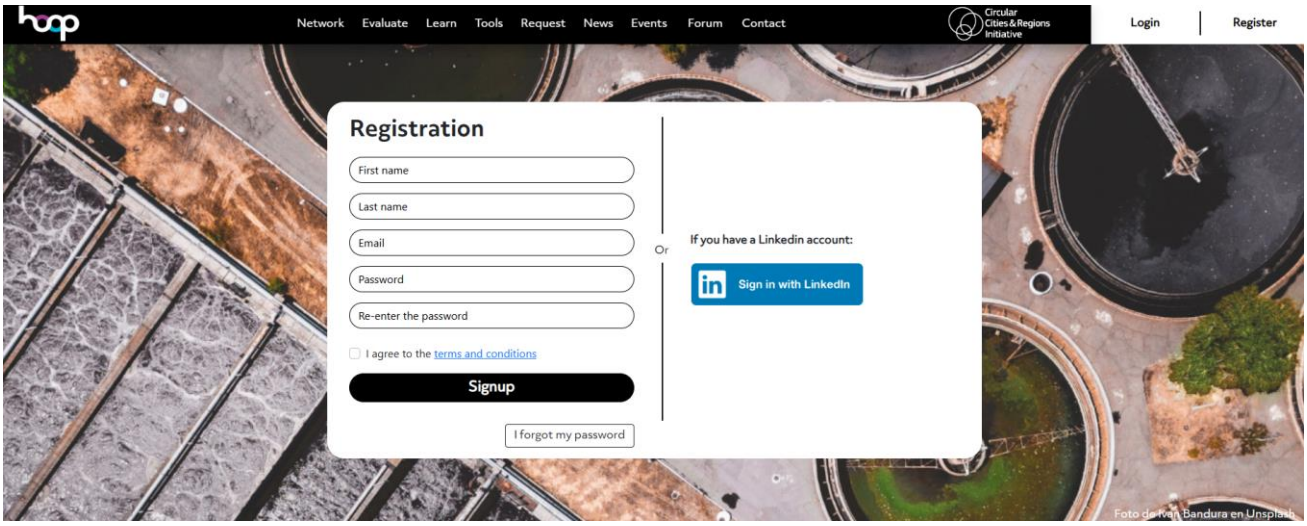

Figure 3. *Screenshot of the register page in the UCBH.*

Any person can register freely to the UCBH as a user of the HUB, but only authorized representatives of cities and regions, or of waste management and wastewater treatment companies can apply to be members of the HOOP Network of Cities and Regions.

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3.2. The HOOP Network of Cities and Regions

The UCBH includes the HOOP Network of Cities and Regions as a forum to exchange lessons learned and ideas for the implementation of bioeconomy projects, see ***Figure 4***. Currently, there are 129 cities/regions registered in the HOOP Network of Cities and Regions.

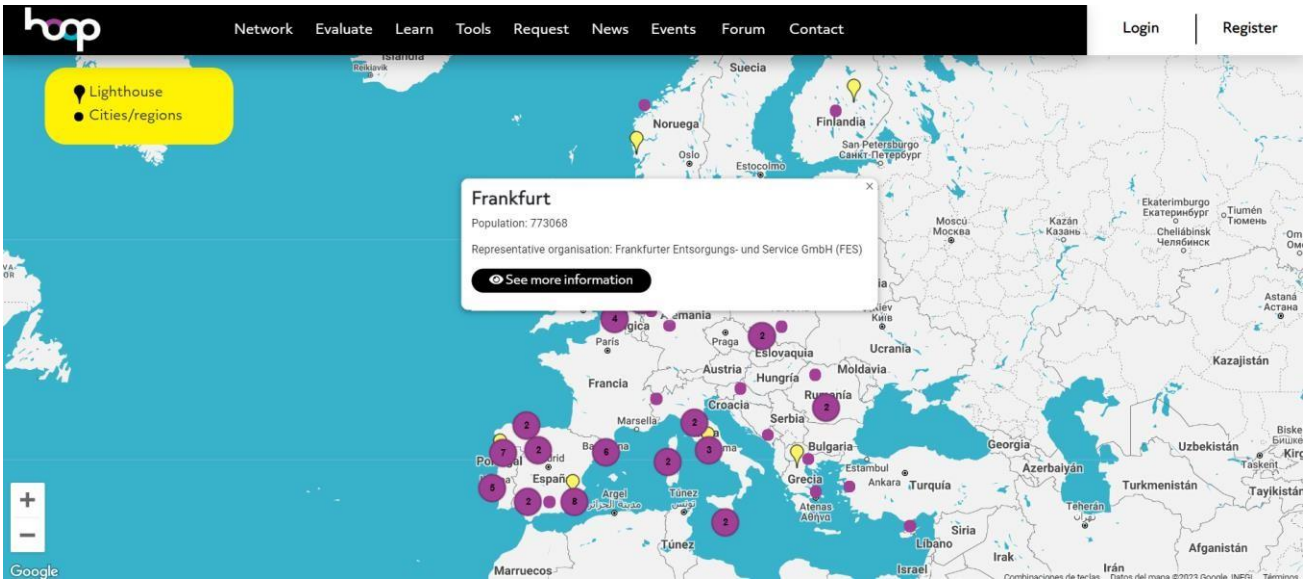

Figure 4*. Screenshot of the UCBH showing the map with the HOOP network of cities and regions*

The platform also provides a table with all the cities and regions with indicators related to their performance in the bio-circularity. By clicking on each of the locations, the platform shows information of the city/region including the company/organization representatives, link to website and population, see ***Figure 5***.

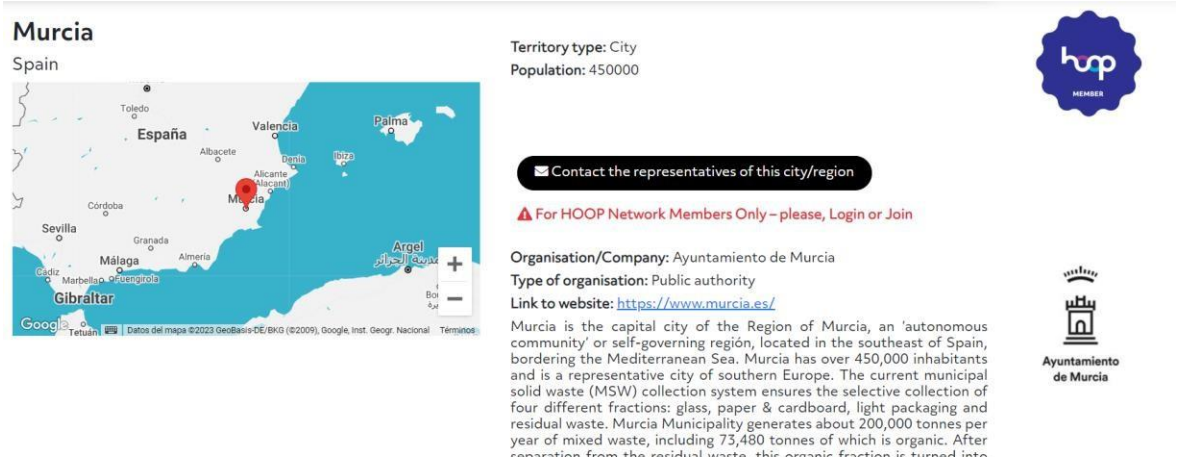

Figure 5. *Screenshot of the UCBH showing information for the city of Murcia*

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The platform also provides a button to directly contact representatives of that city/region. This functionality is only available for registered members of the Network.

By clicking on each city/region, key indicators of their bio-circularity performance are shown when available, see **Figure 6**.

Figure 6. *Key indicators of achievements in circular bioeconomy showed for a city/region.*

When the members are logged in the platform, they have the possibility to select among a list of interests, which helps in tailoring the information that should be sent to them, see ***Figure 7***. Furthermore, users are invited to complete their profile providing basic but key data in terms of their achievements in bioeconomy.

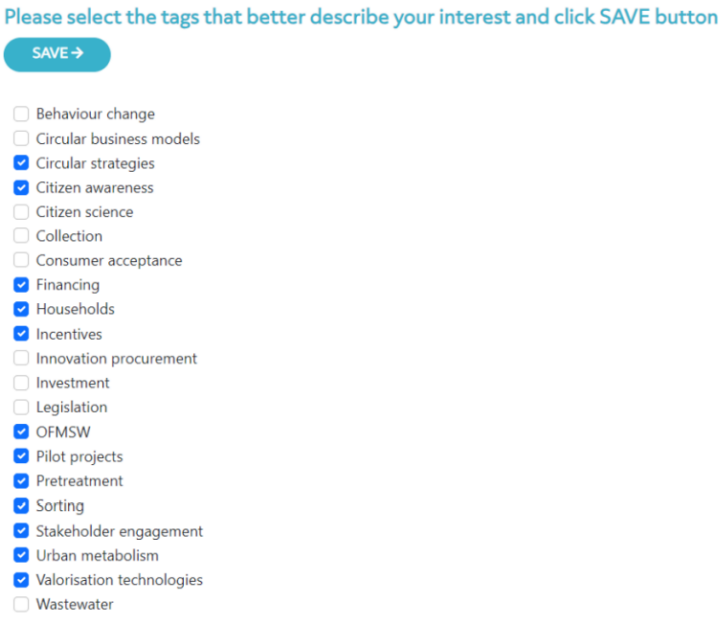

Figure 7. *List of interest for selection by the users*

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As commented above, the HOOP Network reached 129 members. The feature of the Hub to send specific news and events to specific HOOP cities and regions has been assessed several times, see ***Figure 8***, following the guidance and request of other partners. In some cases, when different events or activities needed to be promoted at the same time, ACR+ collected more information in the same news. In this way, a smaller number of communications could be sent to the members.

Citizen science, Financing, Innovation procurement, OFMSW, Valorisation technologies

Put Bioeconomy on your agenda

As we slowly say goodbye to summer and get ready to jump into the last year of the HOOP project, we collected some interesting and key events on bioeconomy. Be sure to save the date and grab all these learning and exchange opportunities.

13 September | The Biocirculacities Trilogy – Episode 3: The journey of the three pilot territories
10:30 – 12:00 | Online
The Biocircularcities project brought together three "pilot territories" aiming to improve a specific value-chain focusing on one key bioresidue. Join this third and final webinar of the Biocircularcities Trilogy to follow the journey of the three pilot territories (the Metropolitan Area of Barcelona, the Metropolitan City of Naples and the Province of Pazardzhik) towards these new value-chains.
More information here: LINK

If you are interested in the experience of these 3 territories, do not miss the opportunity to meet them during the Biocircularcities final event on 28 September in Brussels.
More information here: LINK

28 September | HOOP Lunch Talks Season 3 – Episode I: HOOP Trainers: neighbours shape circular bioeconomy playing and debating
14:00 – 14:30 | Online
The third season of the HOOP Lunch Talks is back with an episode focused on how gamification can help to reflect on circular economy and create bioproducts. HOOP partner Science for Change will unveil the exciting Citizen Science initiatives within HOOP. Join the event to discover how citizens have trained the avatar Dubiop in the art of transforming organic waste into valuable bioproducts and have transformed the data gathered in the game into valuable improvement proposals for optimising the separate collection of OFMSW.

Join the online session here: LINK

Figure 8. *News through the UCBH for the members of the HOOP Network of Cities and Regions.*

Besides the direct messages between members, an online Forum was developed on the Hub in order to boost the communication between members of the HOOP Network. To participate in the Forum, the only requirement is to be registered and logged in the Hub. The users can create topics/questions and reply in order to create conversations related with the Circular Bioeconomy. All the text displayed in the online Forum is previously moderated. This means all texts must be approved by the administrators before to be displayed in the forum, in order to avoid adds and no appropriate texts.

3.3. The UCBH Tools

The UCBH platform provides tools that promote the implementation and investments of UCBE projects. This includes tools that were developed within the project, but also external tools as explained below.

The UCBH tools developed within the project are:

- The HOOP Circularity Label tool.
- The Circular Valuation Method.
- The HOOP Project Maturity Level tool.

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Besides the tools developed within the project, the project also analyzed the state-of-the-art of existing tools to promote the implementation and investments, studying their characteristics, content, and usability. This was reported in Deliverable 7.4. After the analysis, the most appropriate toolset was displayed in this section of the platform (***Figure 9***): https://hoop-hub.eu/tools.html

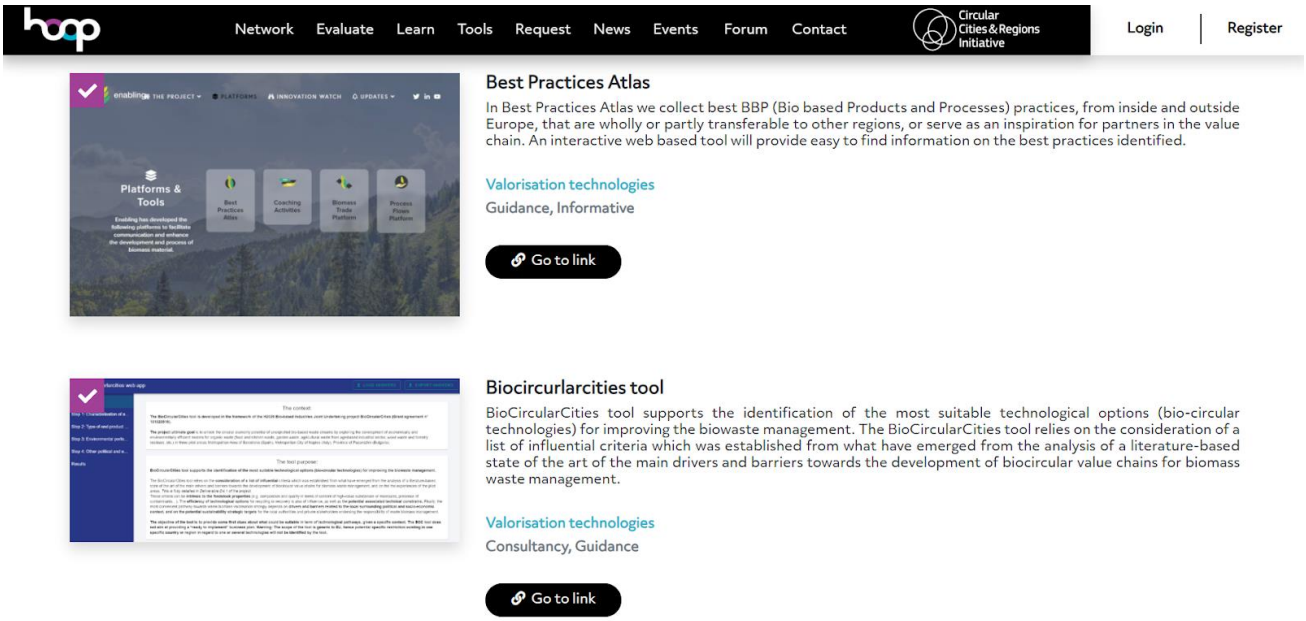

Figure 9. *Tool section in the HOOP platform with a portfolio of tools for investment decisions and implementation of Urban Circular Bioeconomy solutions.*

3.3.1. THE HOOP BIO-CIRCULARITY LABEL TOOL

The HOOP Bio-Circularity Label tool is an instrument to understand the current performance of a city/region regarding the implementation of bio-circular measures. The tool is available on the UCBH platform in this link: https://hoop-hub.eu/circularity_label.html. Anyone can freely use this tool. But only representatives of a city/region in the HOOP Network of Cities and Regions can submit the request to obtain the HOOP Bio-Circularity Label after a process of validation by the HOOP administrators.

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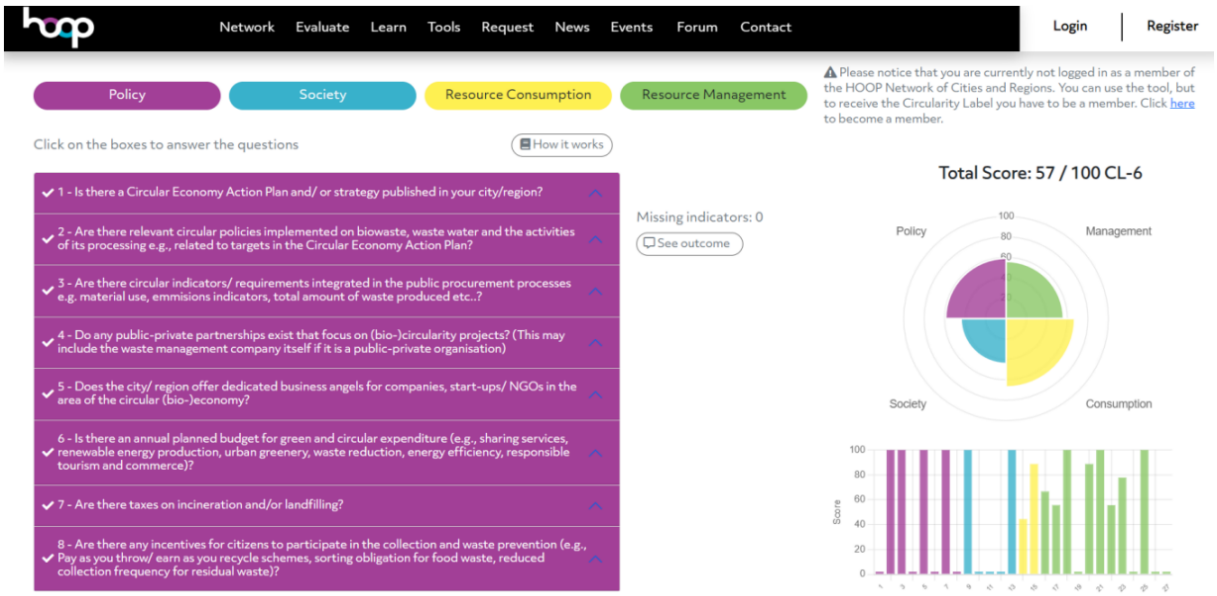

Figure 10. *Interactive tool available on the UCBH to fill the indicators and calculate Bio-Circularity Level.*

The HOOP Bio-Circularity Label tool is based on a set of indicators and thresholds designed to evaluate the current position/performance of a city/region regarding the implementation of bio-circular measures at city level. The development of the tool started with research focusing on existing labels and their indicators. This resulted in the conclusion that a dedicated label for circular maturity of cities and regions is missing. In order to guarantee an optimal Label design, a definition of the goals and requirements of a selection of a realistic set of indicators and reasonable thresholds were created through co-creation sessions with the Lighthouse Cities and Regions as well as the HOOP technology experts. The next phase worked on further detailing the set of indicators, finetuning thresholds by the evaluation and feedback of several European institutions.

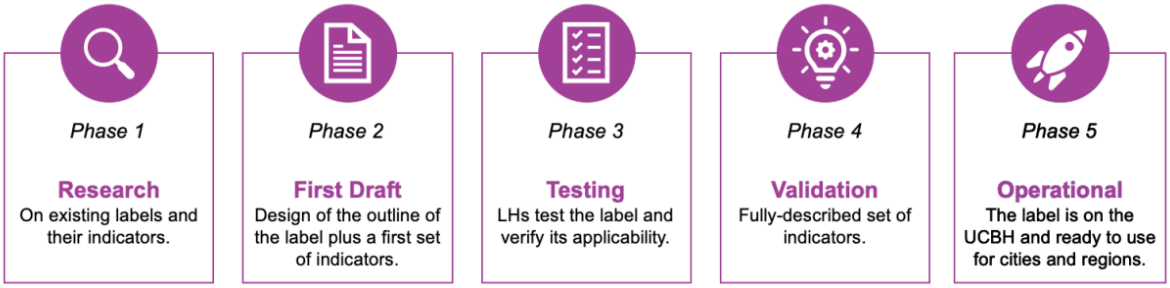

Figure 11. *Overview of the 5 main consecutive phases for the developing the HOOP Bio-Circularity Label.*

The Circularity Level (CL) indicators are related to urban bio-based waste streams including Organic Fraction Municipal Solid Waste (OFMSW) and Urban Waste Water Sludge (UWWS). The assessment covers the political

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ambitions, strategies and implemented policies, participation, awareness and initiatives of the society, consumption, and waste patterns as well as waste treatment.

The indicators are grouped in 4 dimensions that cover the specificities of circular bioeconomy:

- **Policy indicators:** these indicators deal with the strategy and implementation of the circular economy policies for both cities and regions.

- **Society indicators:** these indicators assess the awareness among citizens and their participation in the efforts of the city to reach circularity covering the coordination entity to engage stakeholders, initiative/awareness for campaigns, co-creation of spaces/platforms and the environmental education at schools.

- **Waste generation/Resource consumption indicators:** these indicators assess the total OFMSW produced per capita and the quantity of household water per capita used from public water supply. In this way, low rates score positively as “top waste prevention”.

- **Resource management indicators:** the indicators look at waste prevention, collection, reuse, and recycling, as well as distribution and quality of output materials (including energy).

Figure 12. *The four dimensions of the HOOP Bio-Circularity Label tool.*

The results of the Bio-Circularity Label are determined by the overall score for each dimension. Each indicator has been given a weighing factor, depending on their position in the waste management hierarchy and their overall importance. Based on the results obtained from the indicators, the Circularity Level will be calculated.

The circular performance of cities and regions is assessed on nine CL. Each level indicates the level of maturity, compared to the European average. The higher the CL obtained, the better a city or region is performing, with CL 5 being the European average. The distribution of the CL scoring and the Label design can be seen in ***Figure 13***.

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Figure 13. *Label designs depending on the distribution of the Circularity Levels.*

An interactive web-tool was designed and developed to allow cities and regions to fill the indicators in the UCBH to apply online for the Bio-Circularity Label, see **Figure 10**. The tool in the platform is publicly open in the platform. This means any person can fill the indicators to assess the level of a circularity of a city/region. But only city/region representatives registered in the UCBH can submit the request of the Bio-Circularity Label through the platform. The graphics are interactive in the way that the graphics are updated every time an indicator is filled. The total score is also recalculated automatically every time that an indicator is filled.

Once the indicators are filled and the request is submitted by a representative of a city/region, the HOOP partners review the data submitted to verify and approve the request as well as to provide their feedback. Once the Bio-Circularity Label is granted, the city/regions members receive an automatic email through the platform, see **Figure 14**. In addition, the representatives are able to access the digital label through their platform account.

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Figure 14. *Part of the automatic email sent by the platform once the city is awarded with the label.*

The Label has been promoted to the members of the UCBH through the HOOP newsletters and social media. Besides this, specific episodes on the HOOP Lunch Talks were held for the Label to encourage members of the Network to submit their indicators.

The HOOP project encourages members to request the HOOP Bio-Circularity Label as the tool shows the level of performance regarding the implementation of bio-circular measures compared with the rest of cities/regions in the Network. In addition, the tool provides recommendations of the areas of improvement in the circularity for the city/region based on the filled indicators.

At the moment of writing this deliverable, there were 13 Bio-Circularity Labels issued. ***Table 2*** shows the city/regions awarded with the Bio-Circularity Label including the CL and performance indicators.

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Table 2. List and data of the Bio-Circularity labels issued.

Location	Type	Organisations	Circularity level	Data
Albano Laziale Italy	Group of cities	ANCI Lazio – the Lazio Regional Association of Cities and Municipalities Municipality of Albano Laziale	CL-7	Population: 41000 Recycling rate for biowaste: >80% Recycle/re-use rate of sludge: <10%
Almere Netherlands	City	The Municipality of Almere	CL-8	Population: 215000 Recycling rate for biowaste: 31-40% Recycle/re-use rate of sludge: <10%
Águeda Portugal	City	Águeda Municipality	CL-5	Population: 46119 Density: 138 hab/km^2 Selective collection for food waste: No Selective collection for garden waste: Yes Recycling rate for biowaste: <10% Recycle/re-use rate of sludge: >80%
Bergen Norway	City	BIR Dyrkbart Municipality of Bergen	CL-7	Population: 356000 Recycling rate for biowaste: 10-20% Recycle/re-use rate of sludge: >80%
Kuopio Finland	City	Savonia University of Applied Sciences	CL-8	Population: 120000 Recycling rate for biowaste: 51-60% Recycle/re-use rate of sludge: >80%
Münster Germany	City	Stadt Münster Abfallwirtschaftsbetriebe Münster (AWM)	CL-8	Population: 315000 Density: 1043 hab/km^2 Selective collection for food waste: No Selective collection for garden waste: Yes Recycling rate for biowaste: 71-80% Recycle/re-use rate of sludge: 10-20%
Murcia Spain	City	Ayuntamiento de Murcia	CL-4	Population: 450000 Density: 522 hab/km^2 Selective collection for food waste: No Selective collection for garden waste: No Recycling rate for biowaste: <10% Recycle/re-use rate of sludge: >80%
Niepolomice Poland	City	Municipality of Niepolomice	CL-3	Population: 30103 Recycling rate for biowaste: 10-20% Recycle/re-use rate of sludge: <10%
Oisterwijk Netherlands	City	Municipality of Oisterwijk	CL-7	Population: 32500 Selective collection for food waste: Yes Selective collection for garden waste: Yes Recycling rate for biowaste: >80% Recycle/re-use rate of sludge: >80%
Pays de la Loire France	Region	Pays de la Loire regional Council	CL-7	Population: 3800000 Recycling rate for biowaste: >80% Recycle/re-use rate of sludge: >80%
Porto Portugal	Region	Intermunicipal Waste Management Service of Greater Porto	CL-6	Population: 214000 Recycling rate for biowaste: <10% Recycle/re-use rate of sludge: <10%
Western Macedonia Greece	Region	The Cluster of Bioeconomy and Environment of Western Macedonia (CluBE) DIADYMA SA	CL-6	Population: 280000 Recycling rate for biowaste: >80% Recycle/re-use rate of sludge: <10%

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3.3.2. THE CIRCULAR VALUATION METHOD

To boost investments in bioeconomy projects, the HOOP project developed the Circular Valuation Method. The Circular Valuation method is a clear and simple method for companies and public bodies to assess whether circular projects are financially attractive. With this method circular business cases and investment proposals can be evaluated. The indicators are adapted to the characteristics of circularity and biowaste resulting in a multidimensional assessment method covering domains including financial, circularity, environmental, social, and comparison to the previous situation. The results can be downloaded in a report to show the circular potential of the project.

The number and importance of indicators in each dimension varies, as well as the way they are assessed (quantitative or qualitative). Based on the results obtained from the indicators, the outcome overview is generated.

The financial domain is composed out of a written report. The remaining four domains are awarded a score based on the input and the calculation from the indicators.

A score between 0-100% is given, where the higher the score the better the result. Due to the fact that the indicators are divided into the different domains, the outcome will show whether a project will have a stronger impact on the adoption of circular business models, on the surrounding environment (or from a global point of view), or the people involved in the activities.

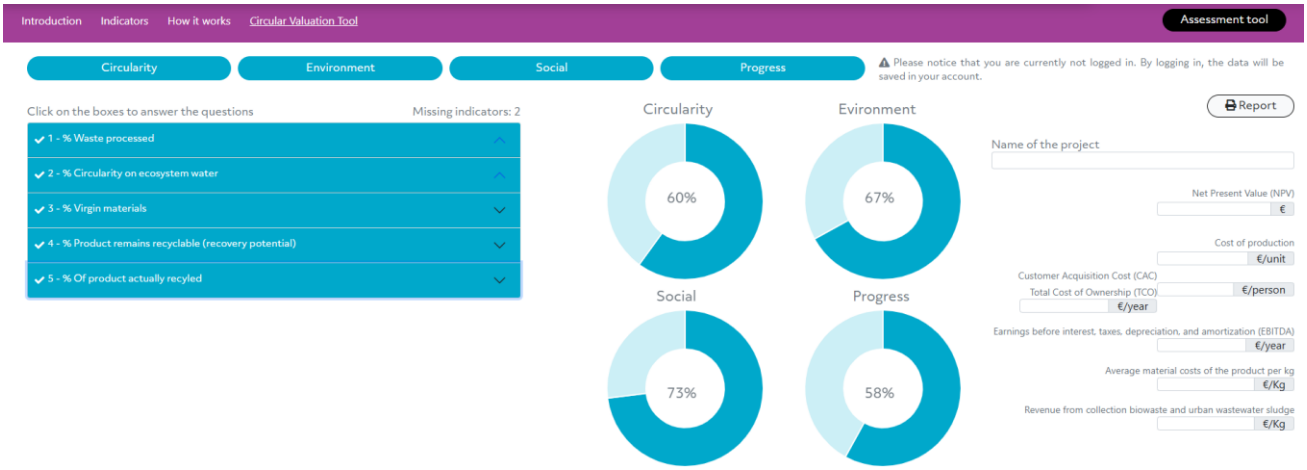

***Figure 15**. Screenshot of the interactive tool for the Circular Valuation Method.*

The Circularity Valuation Method tool is characterized with enhanced flexibility and particularly customizability through its advanced financial modelling tools, which can assess the economic viability of circular projects and identify potential funding sources. Additionally, risk assessment modules might evaluate potential risks and

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provide mitigation strategies for circular projects. Furthermore, networking and collaboration tools can facilitate partnerships between municipalities, investors, and solution providers.

The tool is freely available without registration in this link: https://www.hoop-hub.eu/circular_valuation.html. If the user is registered the data is automatically saved for other times.

3.3.3. THE HOOP PROJECT MATURITY LEVEL TOOL

The HOOP Project Maturity Level (PML) is a standard guidance and ranking tool that evaluates the maturity level of the projects in accordance to several criteria to accomplish and reach, in order to improve their maturity and bankability to mobilize green financing and funding for its realization.

The HOOP Project Maturity Level (PML) approach is aimed to support project developers, promoters, and investors to evaluate which parts of their portfolio are investment-ready and which projects need further development. At the same time, this tool contributes also for the matchmaking between project developers/promoters and investors, contributing to assess and improve the maturity and bankability of Urban Circular Bioeconomy (UCBE) projects.

The Project Maturity Level tool has the potential to enhance flexibility through its progress tracking features, which allows users to monitor the development of their projects over time and identify areas for improvement. Additionally, a resource library provides access to templates, guidelines, and best practices for advancing projects through the maturity levels. Furthermore, mentorship programs connect less experienced project developers with seasoned experts, offering guidance and support.

The purpose of the HOOP PML is:

- to provide project developers, consultants, promoters, public and private entities with a standard tool suitable for guidance, evaluation and ranking of the maturity of UCBE projects;
- to identify the maturity of the circular bioeconomy projects and, thus, facilitating their improvement to increase their bankability for funding and green financing of the projects;
- to match with investors looking for UCBE projects that meet their requirements in PML score;
- to provide investors, funders, and financial institutions with the information necessary to assess the maturity of an investment project in a simple, standard, and fast manner.

The ranking consists of six maturity levels, with specific criteria for each level:

- PML 1 - Potential project identified. Project or technology apparently suitable for intervention.
- PML 2 - Project potential quantified (via audit, study, benchmarking, etc.).
- PML 3 - Project investment estimated, and suitable business models identified.
- PML 4 - Technical project and business case developed.
- PML 5 - Investment-Ready. Business case and tender model confirmed.
- PML 6 - Investment offer or tendering requirements created. Ready to sign or launch the tender.

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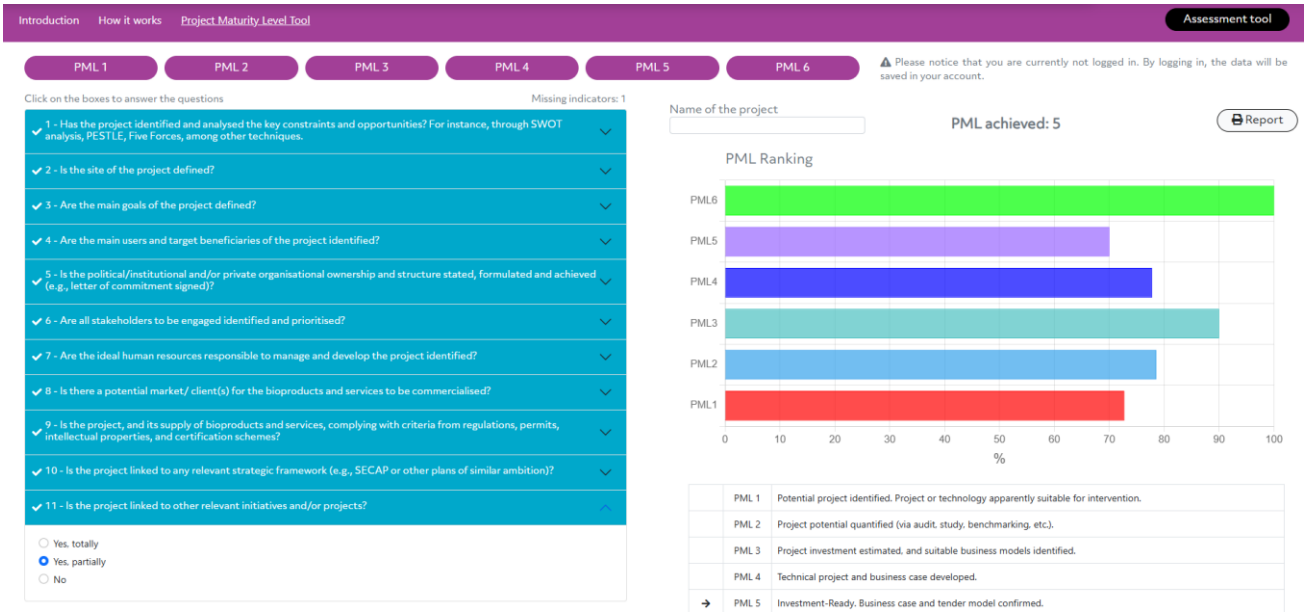

Figure 16. *Screenshot of the interactive tool for the Project Maturity Level.*

The tool is freely available without registration in this link: https://www.hoop-hub.eu/project_maturity_level.html . If the user is registered the data is automatically saved for other times. The tool allows to download a report of the PML.

3.4. The Virtual Academy

The UCBH also includes the Virtual Academy in the “Learn” section to provide resources related to the implementation of Urban Circular Bioeconomy solutions. Currently, there are 156 resources available including handbooks, manuals, factsheets and videos on technologies, financial engineering, stakeholder engagement and evaluation for circular bioeconomy projects.

The metrics of the platform show an average of 105 visits per day for the Virtual Academy section. The average number of PDFs downloaded per day from the Virtual Academy is 11 while the average number of visits per day to webinars at the Virtual Academy is 23.

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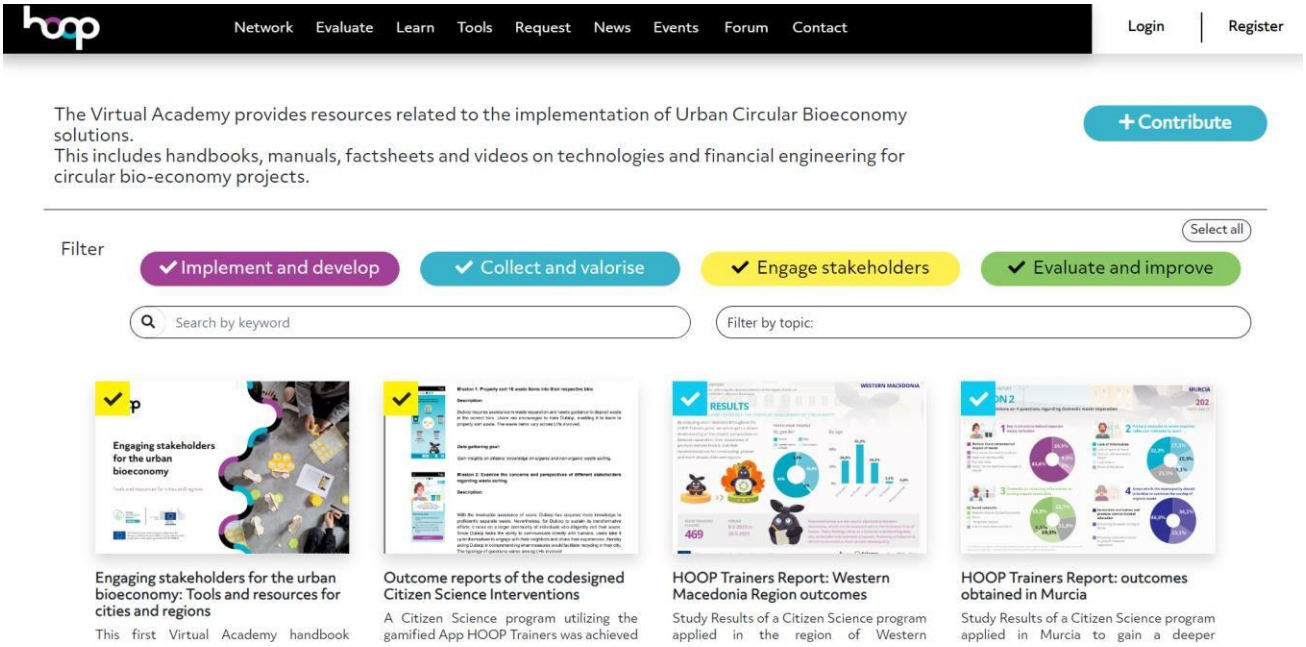

***Figure 17**. Screenshot of the Virtual Academy section*

3.5. Support from HOOP experts

In order to provide support to the city/region members and to encourage other members to join, the Hub includes the "**Request**" section to provide technical, financial and procurement processes support. This functionality was included in the UCBH in order to increase the impact project.

The HOOP members are provided with a targeted service to get one-to-one support from the HOOP technical partners. Cities and regions can fill out a request form to describe the challenge they are facing in their territories and the kind of support they would like to receive from the HOOP partners. The request could be related to a specific bioeconomy technology, collection systems, stakeholders' engagement practices, or even public procurement schemes, etc.

From the financial side, the HOOP matchmaking is a tool for both project developers and investors to get in contact in order to mobilise green financing and funding for the implementation of Urban Circular Bioeconomy projects, also contributing to assess and improve the maturity and bankability of the projects.

Procurement processes support provides support to prepare public procurement processes and instruments for launching tendering processes to trigger the investments in Urban Circular Bioeconomy projects.

At the time of writing this deliverable, there were 2 financial support forms filled and 2 technical support forms filled.

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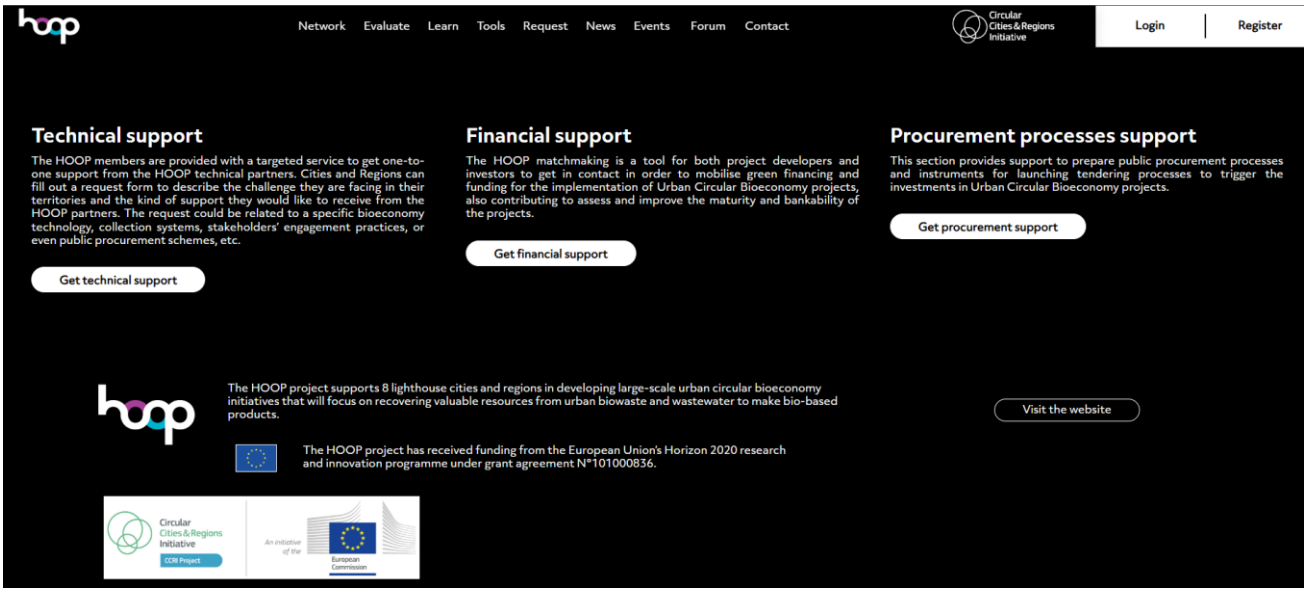

***Figure 18**. Section to provide technical and financial support on the UCBH*

3.6. News and events

The platform also includes a section of news and events that is being updated periodically though the project communication activities.

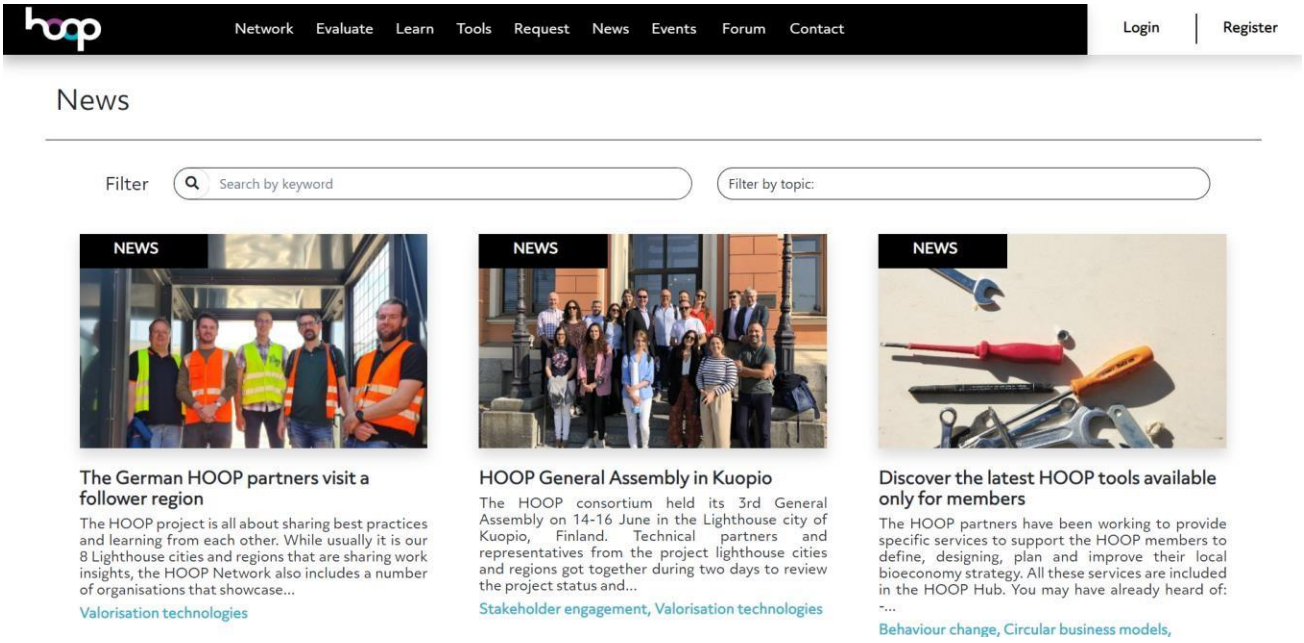

***Figure 19.** News and Evens section on the HOOP Urban Circular Bioeconomy Hub*

3.7. Online forum

With the aim to encourage new users to join to the Hub, the platform also includes an on-line Forum. The on-line Forum allows any registered user to ask and answer questions related with the Circular Bioeconomy, see ***Figure 20¡Error! No se encuentra el origen de la referencia.***.

At the time of writing this deliverable, there were 7 topics open with 14 answers.

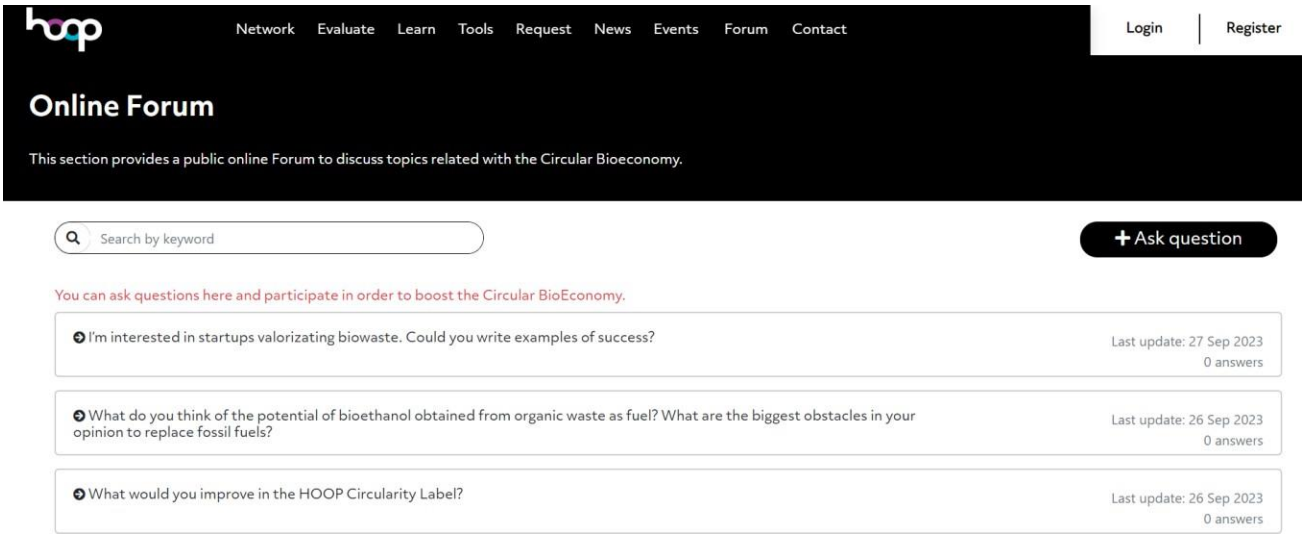

Figure 20. *Online Forum section on the HOOP Urban Circular Bioeconomy Hub*

3.8. The UCBH Metrics

As commented before, there are currently 129 cities/regions registered in the HOOP Network of Cities and Regions and a total of 381 users registered on the Hub.

Data from Google Analytics for the UCBH shows an average of 54 unique users by day with peaks on events that can reach more than 200, see ***Figure 21***. The data also shows that the most active countries visiting the UCBH are USA, Greece, Spain, Netherlands, Finland, Germany and China, see ***Figure 22***.

The sections most visited are listed below with the average number of visits per day:

- Network: 169
- Virtual Academy: 105
- Tools section: 92
- Bio-Circularity Label: 11
- Circular Valuation tool: 4
- Project Maturity Level: 4
- Request support section: 7

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- Technical support: 3
- Financial support: 2
- News: 18
- Events: 11
- Online forum: 6
- Contact section: 10
- Login: 15
- Sign up: 14
- User account: 11

The average number of PDFs downloaded per day from the Virtual Academy is 11 while the average number of visits per day to webinars at the Virtual Academy is 23.

Figure 21. *Data of the visits to the UCBH from Google Analytics*

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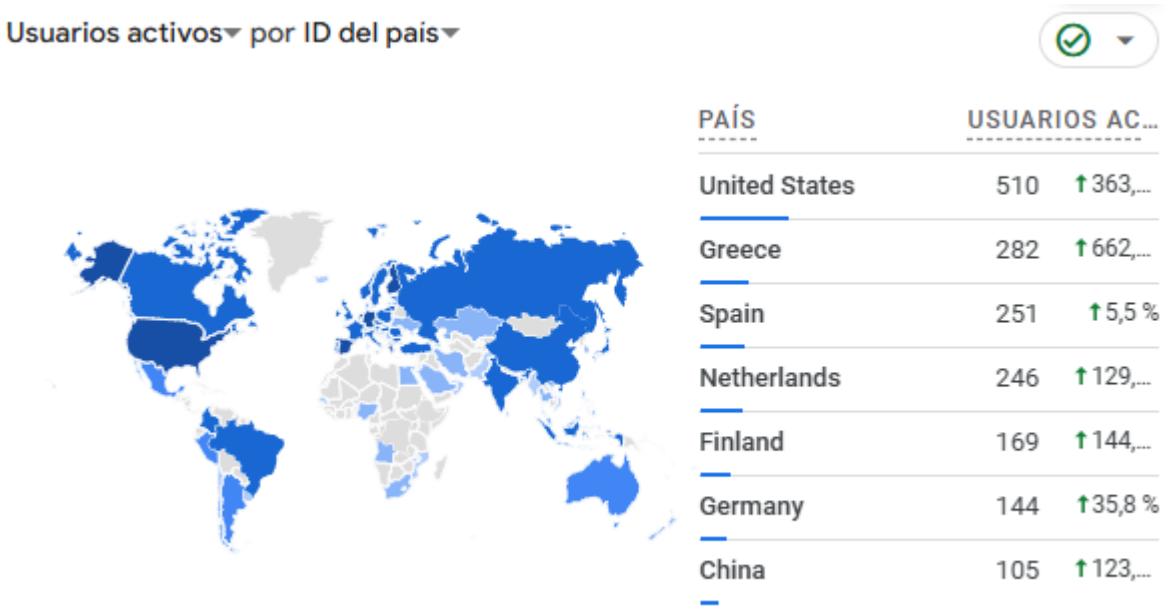

Figure 22. Active users by country from Google analytics.

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4. Impact of the HOOP project to the circular economy strategies of the cities and regions

4.1. Impact on the circular economy strategies of the HOOP Lighthouses

The HOOP project conducted Project Development Assistance (PDA) to the 8 Lighthouses. The PDA started with urban metabolism analysis and the definition of baseline studies required for the PDA for each of the 8 Lighthouses. A summary of the process and impact of the PDA for each of the Lighthouses is described below.

4.1.1. ALBANO LAZIALE

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 experience 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 biowaste quality is better from households than from the HoReCa sector. Despite its high quality, the biowaste was not valorised 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 valorise 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 computerised 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 meetings 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 TiO_2, in line with the future ban on microplastics, the potential of the biodegradable P3HB in cosmetic formulations, as well as future limitations for biodiesel, which currently absorbs almost all UCOs available on the market. In parallel, pilot actions to increase the acceptance of bioproducts and dissemination of the HOOP portfolio of technologies for valorisation of biowaste were performed.

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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 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.

Impact from the HOOP PDA for Albano Laziale:

- Albano has used all the elements of the HOOP PDA to build a project proposal from scratch, with special focus on 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 created about the valorisation of UCOs at the national level has been extremely high.
- Thanks to the HOOP PDA process, Albano Laziale now has 22 collection points for used vegetable oils. This initiative has also been successfully replicated by the Municipality of Ciampino.

4.1.2. ALMERE

The HOOP urban metabolism analysis and baseline study found that a high amount of bioproducts are being produced from biowaste, suggesting very high levels of innovation, but at small scale and far from the market. 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 atomization and small scale of the projects has been a challenge both from the supply chain and from the market demand side, compromising their feasibility.

The HOOP PDA proposed a multipurpose fibrebank business model, 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 has provided evidence of the higher sustainability of Almere's approach for the treatment of invasive

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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.

Impact from the HOOP PDA for Almere:

- Almere has taken advantage of the sharing of good practices within HOOP to bring about a change in the biowaste separate collection system. The quantity of separated biowaste is up and biowaste rejection by treatment were down with about 40%. The total investment for this change is €4.46 million. This change has meant a very significant improvement of the quality up to 98.5% in 2024.
- The atomised projects from the Raw Materials Collective have clustered and got a new business model thanks to the PDA.

4.1.3. BERGEN

The region of Bergen (Norway) is represented by the waste management company BIR AS. 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.

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 climate 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, the HOOP Circular Investor Day held in Brussels in May 2023 or the CCRI Workshop in Brussels in November 2024. 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

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possibility of a new business model based on hydrolysate as growth media for biotechnology. The start-up has obtained €1.75 million.

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 at the end of 2025, with an investment of €30 million. The outcoming liquid digestate will be employed in nearby lands. However, the use of the solid fraction was determined by BIR AS, following HOOP PDA guidelines, after launching 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 fullscale Invertapro plant is planned to be built at the same location.

Impact from the HOOP PDA for Bergen:

- Bergen has experienced a large evolution during the HOOP project, starting with no separate collection to the creation of an industrial symbiosis park, including innovative technologies and using open market consultation.
- Start-ups have succeeded to get €3.05 million, taking advantage of HOOP PDA.
- BIR AS, following HOOP PDA guidelines, launched an open market consultation to find alternatives for the valorisation of the solid fraction of the future digestate.
- 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.

4.1.4. KUOPIO

Kuopio (Finland), represented in HOOP by Savonia 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.

At the beginning of HOOP, 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. 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 has built a pyrolysis pilot to provide assistance to different local industries to treat

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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.

Impact from the HOOP PDA for Kuopio:

- 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.
- The pilot is providing information to companies which could upscale the pilot to an industrial scale.

4.1.5. MÜNSTER

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 the mid-1990s. Besides this, AWM established a trans-border symbiotic model with the region of Twente (Netherlands), so that sorting residues from the residual waste treatment plant from Münster goes to energy recovery in Twente and Twente's biowaste is utilised 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 collection, 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 circular processing of 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 all be composted with garden waste) by pyrolysis. Moreover, thanks to the awareness gained through HOOP PDA on quality, AWM plans to invest in pilot AI technologies to upgrade the purity of incoming biowaste flows, to pave the way for future higher added-value valorisation routes.

The characteristics of the sieving overflow are a challenge and the technical feasibility both of the hydrolysis and the pyrolysis had to be proven. In the case of pyrolysis, proof-of-concept tests were required, showing the high potential of overflow as a source of good quality biochar. During this process, the Biowaste Clubs have been the platforms for the engagement of potential customers, spreading the knowledge about pyrolysis, especially to potential customers in agriculture. The initiative and commitment of AWM with pyrolysis has even

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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 regulatory framework in Germany, which might be satisfied by a redesign avoiding digestate. Moreover, HOOP PDA has promoted 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.

Impact from the HOOP PDA for Münster:

- In the case of hydrolysis, the technical PDA tests have confirmed the feasibility of enzymatic hydrolysis as pretreatment to increase biogas yield, but requiring some intermediate conditioning steps which are not economically feasible. However, the good results of the pilot tests have led to the search of alternatives in the production of bacterial biostimulants, with very interesting results on laboratory scale.
- In the case of the pyrolysis, pilot studies are planned for wastewater filtration by substitution of activated carbon (currently fossil-based) with biochar in wastewater treatment plants, application of biochar in urban tree plantings to increase climate resilience and application of biochar in a climate positive asphalt product (Charcofalt) to create urban C-Sinks.

4.1.6. MURCIA

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 the project has expanded to increase the amount of streams valorised, with special

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focus on water recovery. The water management company launched at the end of 2024 an open market consultation to define better the conditions for the future precommercial 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, 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 HOOP Trainers. Moreover, the entrepreneurial ecosystem in Murcia was involved in Biowaste Clubs meetings, especially through the association AEMARM, 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.

Impact from the HOOP PDA for Murcia:

- Recovering Ammonia from effluent in digestate of sludge in the municipal wastewater treatment plant for agricultural sector: The water management company launched an open market consultation to define better the conditions for the future precommercial procurement, which has raised high interest in Murcia thanks to HOOP PDA, with a National Replication Workshop dedicated to innovation public procurement.
- Murcia is preparing the ground for upcoming feedstock valorisation (urban biowaste from households) and improving the value from the sludge through innovative solutions using the valuable HOOP PDA. Investments 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.

4.1.7. PORTO

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

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collection of food waste from households had not yet been fully implemented. These data are in 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 by struvite precipitation, trying to provide a circular solution to the excess of nutrients and the needs of regional agriculture. 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 have provided key insights and will serve to 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 regional 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.

Impact from the HOOP PDA for Porto:

- 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.
- 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.

4.1.8. WESTERN MACEDONIA

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

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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 Macedonia 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 metabolism 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 demonstrated 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. In addition to this, DIADYMA 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).

<u>Impact from the HOOP PDA for Western Macedonia:</u>

- 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.
- Bigger quantities of UCO's have been achieved through DIADYMA's Project for new collection machines.
- Studies have started for the valorisation of UCO's with sewage sludge for the production of H_2 with DIADYMA.
- Participation on proposals for EU, national and regional funding have been achieved.

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4.2. Framework for upscaling of actions in Lighthouses

The PDAs developed by the HOOP project provided a roadmap for upscaling circular bioeconomy initiatives in Lighthouses. These cities and regions received assistance from the HOOP project to overcome barriers and achieve significant progress in their transition towards a circular bioeconomy.

Besides the impact described in the previous section, the HOOP project has identified the following upscaling of actions in the Lighthouses:

Albano Laziale:

- Continue engaging with the National Consortium of Waste Oils in Italy and other potential investors to secure funding.
- Advocate for supportive policies that facilitate the circular economy model.
- Improvement of strategies for the production of quality compost following the activation of the aerobic composting plant of 600 tons per year.
- Support for writing new research and innovation projects (i.e. dedicated to introduce volumetric sensors and detection of foreign material in the HoReCa sector; or i.e. to test pilot projects that could introduce additional value streams.).
- Expand the separate collection of used cooking oils (UCO) to more municipalities in the Lazio region.
- Share the successes and lessons learned from Albano's circular bioeconomy initiatives with other cities and regions.

Almere:

- Address regulatory barriers related to the treatment of invasive species and torrefaction.
- Continue efforts to improve the separate collection system for biowaste.
- Increase the marketability of bioproducts derived from green waste, such as biocomposites and circular fibres.
- To continue with the biomaterial development towards up-scaling initiatives e.g. green concrete.
- To continue with the search for funding and financing started by HOOP assistance.
- To develop the new business model developed within the HOOP PDA.
- Share the successes and lessons learned from Almere's circular bioeconomy initiatives with other cities and regions.

Bergen:

- Finalize the construction and commissioning of the anaerobic digestion plant in Voss by the end of 2025.
- Scale up the operations of Greentech Innovators within the Biopark, in addition to the upscaling of Invertapro.
- Address regulatory barriers identified to enable broader use of food waste for bioproducts.
- Secure additional funding for the expansion of circular bioeconomy projects in Bergen.

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- Share the successes and lessons learned from Bergen's circular bioeconomy initiatives with other cities and regions.
- Continue education and awareness campaigns to promote proper biowaste sorting and the acceptance of bioproducts.
- Implement a robust monitoring and evaluation framework to track the progress and impact of circular bioeconomy projects.

Kuopio:

- Citizen engagement in order to further increase the separation rate of the biowaste.
- Increase the separate collection rate of biowaste, particularly from sectors like HoReCa (hotel, restaurant, and catering).
- Biochar Pilot Reactor:
    - Capturing the distillates
    - Increase the yield of biochar and optimizing the production parameters
    - Providing information to companies which could upscale the pilot to industrial scale
- Explore diverse uses of biochar, such as in agriculture (as a soil amendment), feed additives, or as a replacement for coke in steel production.
- Provide technical assistance to local and regional industries to help them adopt pyrolysis technology for treating their by-products.
- Strengthen collaboration with regional stakeholders, including industries, local authorities, and research institutions.
- Increase the marketability of biochar and other bioproducts derived from pyrolysis.
- Share the successes and lessons learned from Kuopio's circular bioeconomy initiatives with other cities and regions.

Münster:

- Invest in pilot AI technologies to upgrade the purity of incoming biowaste flows, to pave the way for future higher added-value valorisation routes
- Address regulatory barriers related to the pyrolysis project, particularly those connected with the national regulatory framework in Germany.
- Project Proposal & Funding Support (national or international Grants).
- Engage with potential technology providers and investors to ensure a competitive and successful tender process for the pyrolysis implementation.
- Obtaining the desired Permit according to the Federal Immission Control Act.
- Further develop the production of bacterial biostimulants as an alternative application of the hydrolysis process.
- Share the successes and lessons learned from Münster's circular bioeconomy initiatives with other cities and regions.

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Murcia:

- Launch a pre-commercial procurement, ensuring the project aligns with market needs and technological advancements according to the outcomes of the open market consultation.
- Scale up the nutrient recovery project from the effluent in digestate of sludge at the municipal wastewater treatment plant.
- Fully implement the separate collection of biowaste from households, building on the pilot-scale initiatives.
- Rise awareness about circular bioeconomy from citizen level up to entrepreneurship level.
- Continue education and awareness campaigns to promote proper biowaste sorting among citizens.
- Continue promoting bioproducts and circular economy initiatives in Murcia.
- Leverage innovation public procurement to drive the adoption of circular bioeconomy solutions.
- Share the successes and lessons learned from Murcia's circular bioeconomy initiatives with other cities and regions.

Porto:

- Prepare the tender book for the procurement of the large anaerobic digestion and nutrient recovery plant.
- Scale up the pyrolysis project to produce biochar from composting refuse and invasive plants by using the results from the HOOP PDA to finalize the technical and economic feasibility of the pyrolysis process.
- Secure funding and investment for the scaling up of the pyrolysis project.
- Fully implement separated collection of biowaste from households across the Greater Porto region. Increase biowaste collection rates and improved quality of collected biowaste.
- Share the successes and lessons learned from LIPOR's circular bioeconomy initiatives with other cities and regions.

Western Macedonia:

- Continue the separate collection of spent coffee grounds (SCG).
- Secure funding for the SCG valorization project from EU, National and Regional calls.
- Increase the separate collection rate of biowaste across Western Macedonia.
- Strengthen collaboration with regional stakeholders.
- Encourage circular economy investments by authorities in Greece – regional and national level.
- Increase quantities by expanding the network.
- Mobilise and train the HoReCa sector for the separate collection to improve the quantity and quality.
- Share the successes and lessons learned from Western Macedonia's circular bioeconomy initiatives with other cities and regions.

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4.3. Impact on the HOOP Network of Cities and Regions

The strategy to promote the replicability of the project results in other cities and regions was through workshops, events and study visits. The project was very active in these events to exchange lessons-learnt from the Lighthouses PDAs and the tools developed within the project. These events allowed to create connections within the Network, the HOOP partners and the HOOP Lighthouses while it also allowed the recruitment of new members.

The workshops and study visits inspired innovative solutions that HOOP Network members can adapt and implement in their own territories. They also provided opportunities for HOOP Network Members to meet HOOP Lighthouses and Technical Partners and to receive feedback and exchange lessons learnt and ideas. A summary of these events is shown below:

- 22 episodes of the HOOP Lunch Talks. The talks are available as webinars in the UCBH for the network members.
- 8 study visits: Münster-Almere, Porto (twice), Kuopio, Bergen, Prague, Florence and Murcia.
- 8 National Replication Workshops (NRW) organized by HOOP Lighthouses. The NRW targeted other cities and regions at national level. The NRW aimed to promote the replication of the HOOP project's outcomes and of their achievements. A detailed report of the NRWs is described in Deliverable D8.7.
- Event in Brussels on financing of local circular economy initiatives organised by ACR+ in collaboration with the DECISO project. The event was organised in the framework of the 2nd Circular Investors Day .
- The HOOP Cities and Policy Conference held on 4th – 5th June 2024 in Brussels.
- HOOP Final Event held on 25th March 2025 in Cartagena (Spain).

The National Replication Workshops brought attention from different organizations at regional and national level. The lessons learned by the HOOP partners and especially the Lighthouses highlighted some challenges for replication: the difficulty for local authorities to consider innovative solutions going beyond well-established practices, and the fragility of bio-circular business model making financing challenging. Many National Replication Workshops also allowed Lighthouses to establish strong connections with other players, such as national authorities, fellow municipalities, waste management companies and key players of the circular bioeconomy value-chain. For full details of the outcomes and impact achieved from the NRWs please see Deliverable 8.7.

The HOOP Cities and Policy Conference held on 4th – 5th June 2024 in Brussels was an occasion to gather key information and dialogue about regulatory, economics and policy topics from the perspective of solution providers, EU entities and territories. In the conference, 34 of the 130 people registered were representatives of the members of the HOOP Network of Cities and Regions. In the conference, the Animal By-Products (ABP) Regulation was identified as a significant legal barrier for biowaste valorization while the EU Fertilizer Product Regulation (2019/1009) was noted as a supportive framework for biowaste valorization. Despite various financial instruments, there are still perceived economic and regulatory risks. Innovation Public Procurement was highlighted as a tool to pull innovative solutions, but many public players are unaware of it. For full details of the outcomes of the conference, please see Deliverable D8.6.

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Furthermore, the collaboration with Circular Cities and Regions Initiative (CCRI) and the active participation of the HOOP project in the Thematic Working Group on Bioeconomy resulted in an increase of the Network members.

In order to promote the experiences learnt from the project, the HOOP project created “National action manuals for local uptake and replicability”, Deliverable 8.4. These manuals are guides for users involved in the biowaste value chain of a city and users interested in converting biowaste into high added-value products, transforming linear resource chains into circular loops where biowaste becomes an input in generating a new product. The guide shows to users the process of engaging stakeholders, understand their motivations, bring them together for exchange and discussion, find opportunities for action, and mobilize for change. The guide also introduces the user to how to do a baseline assessment of the urban circular bioeconomy and explains how the assessment can be useful to increase biowaste collection rates and promote the conversion of biowaste into high added-value products. The manual shows also country-specific learnings and experiences as well as on the insights from the respective HOOP Lighthouses.

The HOOP project also created guidelines for local and regional authorities. This was reported in Deliverable 8.5. These guidelines allow local and regional authorities to identify, design, and implement innovative valorization routes for urban biowaste and wastewater sludge. It summarizes key recommendations, as well as relevant resources and tools that can be used to produce high-quality biowaste-based products and materials. The HOOP Guidelines also aims to guide the readers through the different HOOP resources and tools available in the UCBH.

Communication activities within the project encouraged the members of the Network to fill the indicators for requesting the Bio-Circularity Label. As commented above, 13 Bio-Circularity labels were awarded. By filling in the indicators, the HOOP partners were able to provide recommendations to the representatives of the city/region of what to improve in their bio-circularity and local bioeconomy based on the filled indicators.

The Virtual Academy hosted in the UCBH was highly promoted through the events and communication activities. The Virtual Academy provides currently 156 documents including handbooks, manuals, factsheets and videos on resources related to the implementation of Urban Circular Bioeconomy solutions, technologies and financial engineering for circular bioeconomy projects.

The interaction between members was also promoted through direct messages in the Hub and the online Forum (https://www.hoop-hub.eu/forum.html). The connections between members allowed knowledge sharing of their experiences and challenges.

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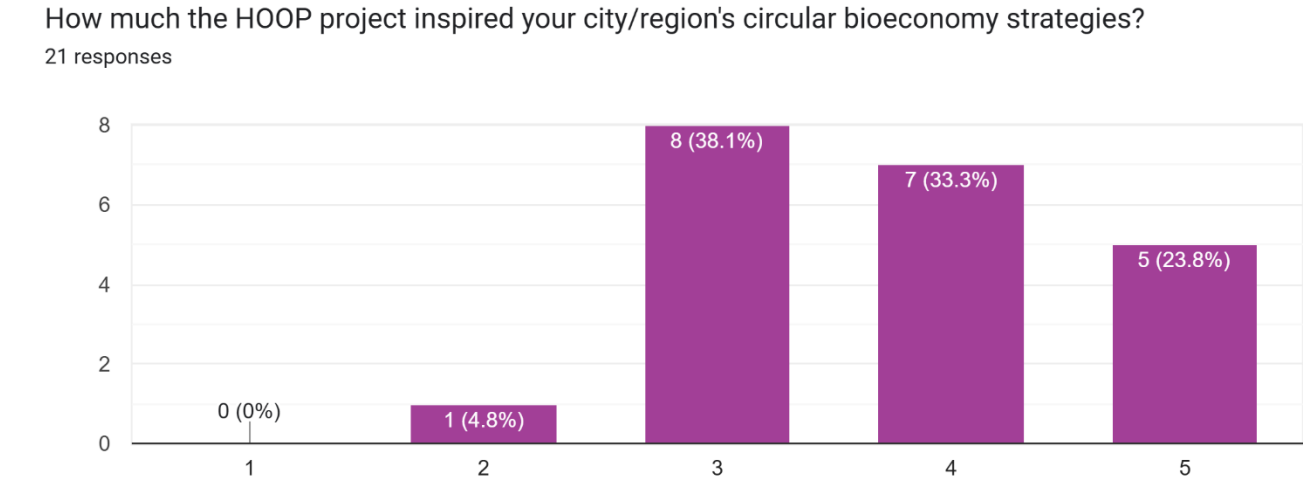
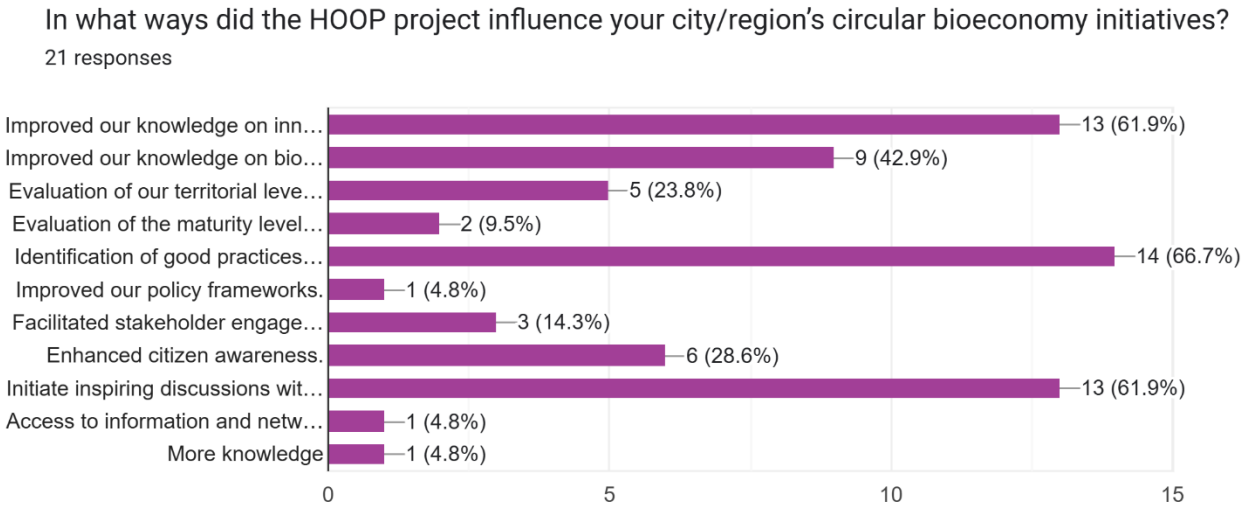
4.4. Feedback from the Network of Cities and Regions

A survey was sent to all members of the Network to receive their feedback regarding the HOOP replicability impact as well as to identify areas of improvement. A total of 21 responses were received. The results of the survey are shown below.



1 Means “No contribution”, while 5 means “Very significant contribution”.



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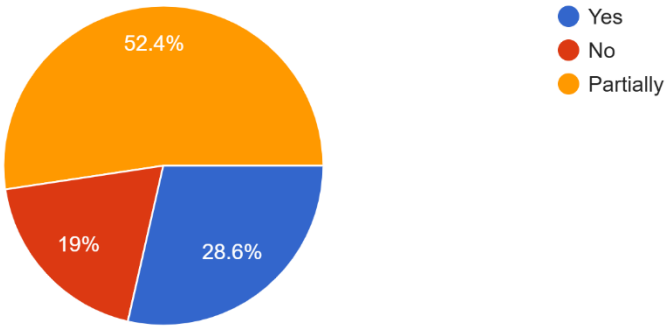
Answers:

- *Improved our knowledge on innovative technologies*
- *Improved our knowledge on biowaste collection*
- *Evaluation of our territorial level of bio-circularity*
- *Evaluation of the maturity level of our circular projects*
- *Identification of good practices to improve our management system*
- *Improved our policy frameworks*
- *Facilitated stakeholder engagement*
- *Enhanced citizen awareness*
- *Initiate inspiring discussions with other cities and experts*
- *Access to information and network for bioeconomy and circular innovation*
- *More knowledge*

Did the HOOP project help you to identify new opportunities for valorizing urban biowaste and wastewater?

21 responses



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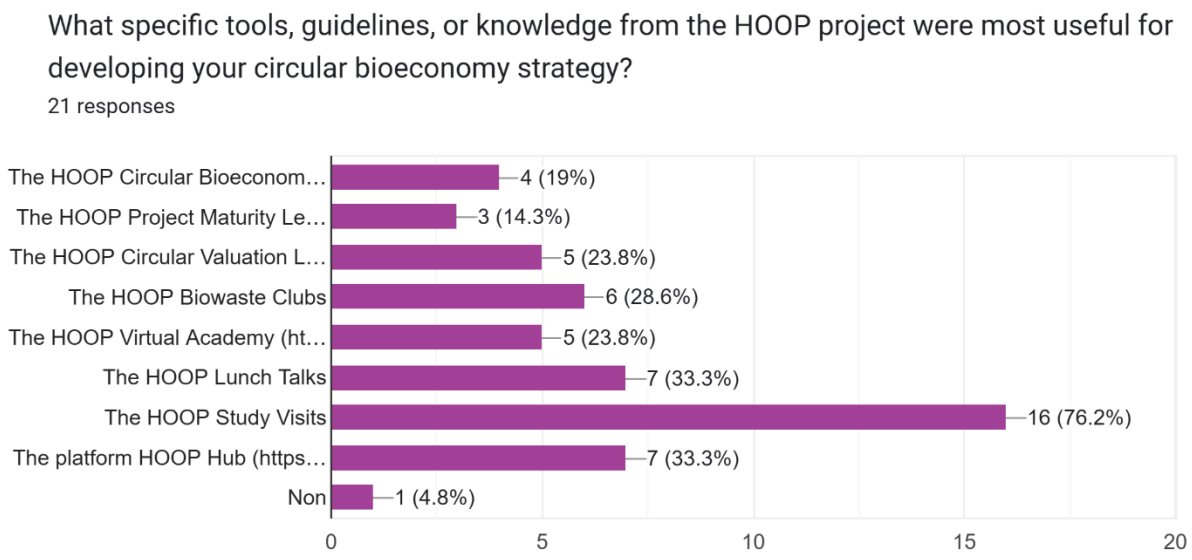

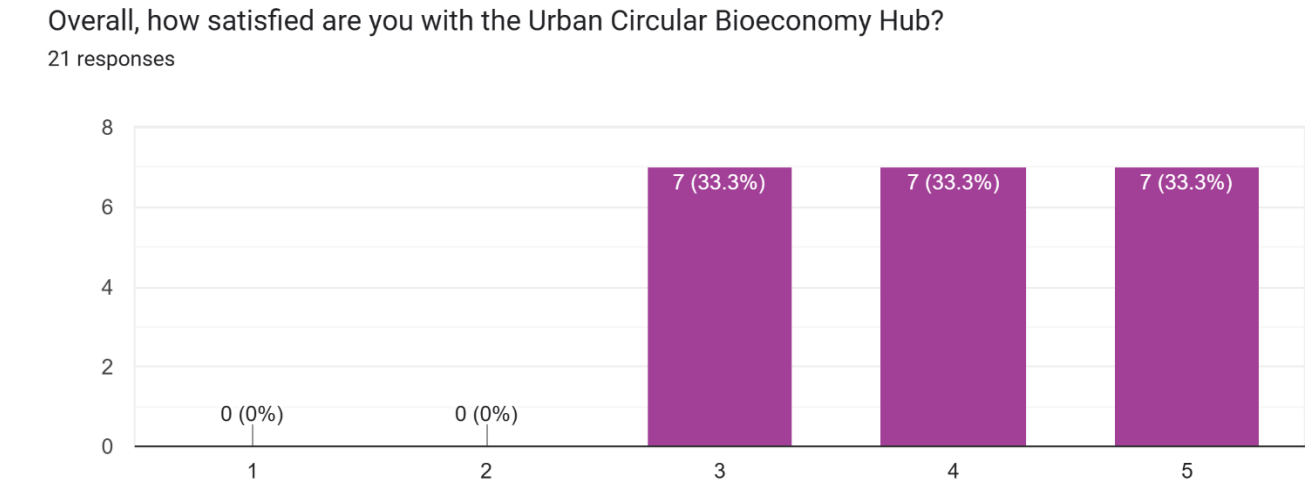

1 means “Very dissatisfied” while 5 means "Very satisfied”.

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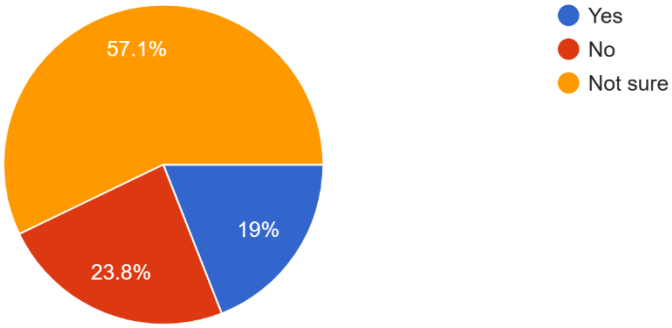
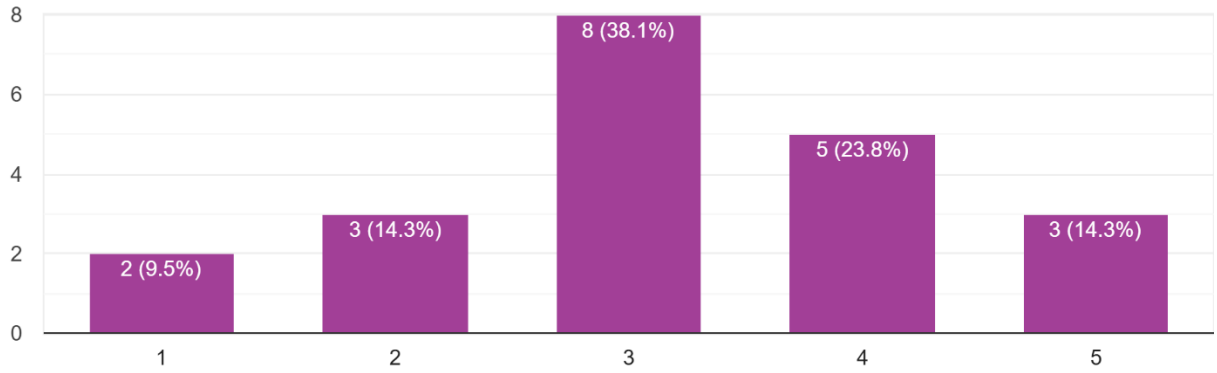
Did the HOOP project help to identify, attract, or secure funding for circular bioeconomy initiatives in your city/region?

21 responses



How likely is it that your city/region will implement new circular bioeconomy projects as a result of insights or frameworks from the HOOP project?

21 responses



1 means “Not likely” while 5 means "Very likely”.

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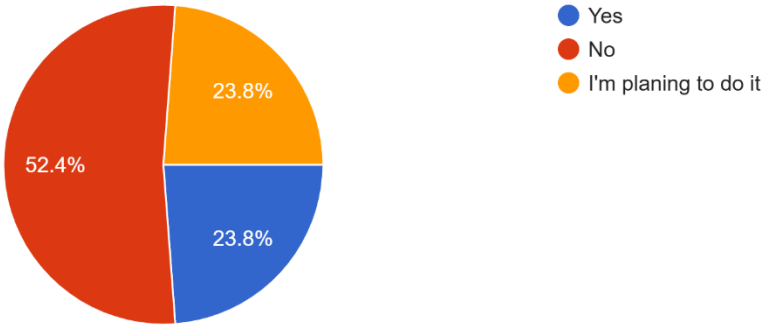
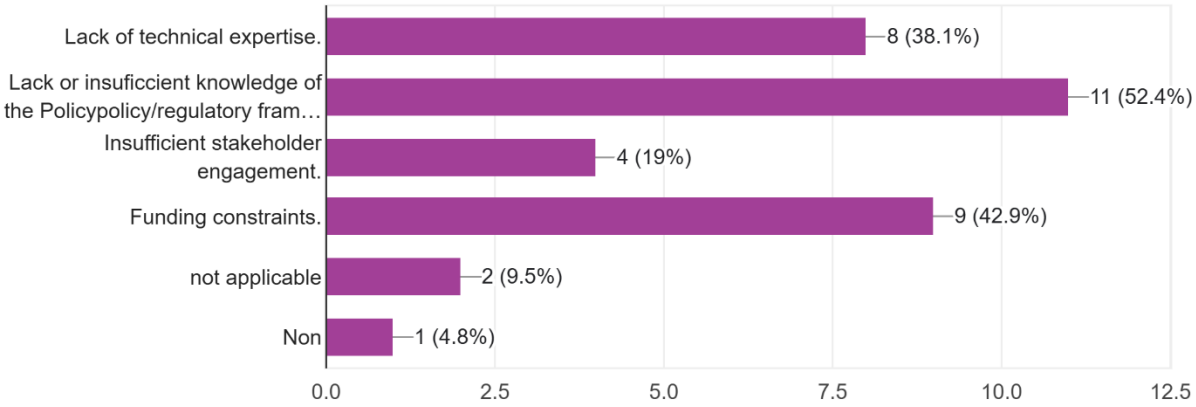
Did you participate/organise a meeting with another member of the Network or a HOOP technical expert following one of the HOOP activities?

21 responses



If HOOP helped you, what were the primary barriers to investment that we helped you to address?

21 responses



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When asking in the survey about what could the HOOP project have done differently to better support your city/region's circular bioeconomy goals, the main aspects were:

- To introduce new products and solutions.
- Some members emphasized on the investments as biggest barriers for the uptake. Then mechanisms and tools to reach investments and funding is a key area to improve and explore in the UCBH.
- Improve knowledge of the policy for the municipalities.
- Access with decision makers.
- Sometimes the experience sharing with members was too technical. Then, a simpler feedback on what other Region/cities are doing would be helpful as some times members did not receive a clear picture on what was done and achieved by other cities and regions.
- To increase the knowledge in funding options.
- Direct support to the municipality in improving existing projects such as biowaste collection.
- Show more sharing experiences to increase the know-how on successful solutions.

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5. Conclusions

The HOOP project has made significant impact in fostering Urban Circular Bioeconomy (UCBE) across Europe by providing tailored Project Development Assistance (PDA) to eight Lighthouse Cities and Regions (LHs) and enhancing the replicability of these efforts through the Network of Cities and Regions and UCBH. The project has developed and implemented tools, resources, and a platform to support cities and regions in their transition towards circular bioeconomy strategies.

The UCBH provides resources, tools, and knowledge related to urban biowaste and wastewater valorization. The platform is divided into four main blocks: Network, Evaluate, Learn, and Get Support, each offering specific functionalities to support the implementation of circular bioeconomy projects. The UCBH has successfully engaged 129 cities and regions, with 381 registered users. The UCBH has facilitated the exchange of good practices and lessons learned among the HOOP Network members.

The HOOP Bio-Circularity Label tool has been instrumental in assessing the circular performance of cities and regions, providing a clear framework for evaluating and improving bio-circularity measures. As of the writing of this document, 13 Bio-Circularity Labels have been issued.

The Circular Valuation Method has provided a clear and simple framework for evaluating the financial attractiveness of circular projects, helping projects to assess the viability of their bioeconomy initiatives.

The HOOP Project Maturity Level (PML) tool has supported project developers and investors in evaluating the maturity and bankability of circular bioeconomy projects, facilitating matchmaking between project promoters and investors.

The PDA provided to the eight Lighthouse Cities and Regions has led to significant advancements in their circular bioeconomy strategies. Each city/region has made progress in areas such as biowaste collection, valorization technologies, and stakeholder engagement. Albano has made strides in biowaste valorization, particularly through the development of a project to convert used cooking oils into bioplastics. Almere developed a multipurpose fibrebank business model to address supply chain challenges while improved biowaste separate collection rates and quality through a new collection system and awareness campaigns. Bergen implemented separate biowaste collection in households, established a Biopark in Voss, featuring an anaerobic digestion plant and plans for a full-scale mealworm production facility while supported circular start-ups. Kuopio has become a regional reference for pyrolysis. Münster has focused on increasing the circular processing of sieving overflow from biowaste through hydrolysis and pyrolysis. Murcia has prioritized the valorization of wastewater sludge and the implementation of separate biowaste collection. Porto focused on nutrient recovery from biowaste for the production of high-quality circular fertilizers and the production of biochar. Western Macedonia focused on valorizing used cooking oils and spent coffee grounds. The project has also supported cities like Münster and Murcia in overcoming regulatory and technical barriers.

The HOOP project has actively promoted the replicability of its outcomes through workshops, study visits, and national replication workshops (NRWs). These events have facilitated knowledge exchange, inspired innovative

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solutions, and strengthened connections within the HOOP Network. The HOOP Cities and Policy Conference and other events have provided platforms for dialogue on regulatory, economic, and policy topics, further enhancing the project's impact. The creation of National Action Manuals and Guidelines for Local and Regional Authorities has provided valuable resources for cities and regions looking to implement circular bioeconomy strategies.

Despite the successes, the project has faced challenges, particularly in securing investments and overcoming regulatory barriers. The survey conducted among Network members highlighted the need for more accessible funding mechanisms, improved policy knowledge, and simpler feedback on successful solutions. The project has also identified the need for more direct support to municipalities in improving existing projects, such as biowaste collection, and for increasing the visibility of successful case studies to inspire further action.

In conclusion, the HOOP project has successfully demonstrated the potential of urban circular bioeconomy to transform waste into valuable resources, driving economic, environmental, and social benefits. The project's legacy will be carried forward through the continued use of the UCBH, the application of HOOP tools, and the ongoing collaboration among the HOOP Network of Cities and Regions. The lessons learned and best practices from the HOOP project will continue to inspire and guide cities and regions across Europe in their efforts to create sustainable, circular, and resilient urban environments.

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