HOOP STUDY VISIT IN PORTO – REPORT

LIPOR & ACR+

The HOOP project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°101000836

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1. Forewords

As part of the HOOP replication strategy, the HOOP Network of Cities and Regions proposes different activities to present the outcomes of the HOOP project and the good practices of HOOP Lighthouses. These activities aim to foster direct exchanges among HOOP Cities and Regions and HOOP partners. The HOOP partners took advantage of the 6-month extension to organise two study visits: a first one in Florence held in November 2024, and a second one in Porto in January 2025.

On 27 and 28 January, the HOOP project organised a study visit in Porto as a joint activity with the Horizon Europe project Fer-Play that aims to promote the use of circular fertilisers. The study visit aimed at presenting the extensive experience of LIPOR, one of the HOOP Lighthouses, when it comes to the production and marketing of compost and growth media. The study visits also addressed some topics on which HOOP Members expressed interest during the HOOP meeting in Bergen in September 2024, such as decentralized bio-waste management or commercial food waste collection in historical centres.

The study visit was coordinated by HOOP replication partner ACR+ and hosted by HOOP Lighthouse LIPOR, the public organisation in charge of municipal waste treatment for 8 municipalities in the Greater Porto area. It also took advantage of the experience of HOOP partners CETENMA and ITENE, and of local players such as Porto Ambiente, the public company in charge of municipal waste collection in the municipality of Porto.

The study visits also aimed to foster interactions among HOOP Members so that they could share their challenges and solutions to improve their local bioeconomy strategies.

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Agenda

DAY 1- Monday 27.01.2025	
Time	Description
12:00-13:00	**Walk in the Adventure Park (old landfill)**
13:00 – 14:00	Lunch
14:00	**Welcome and Registration**
14:15 – 15:25	• Innovation in Coffee and Green Waste Management: Obtaining High-Value Products - ITENE • LIPOR bio-waste strategy • Valorisation of compost refuse into biochar for agriculture uses (CETENMA) • Managing nutrient excess: from troubles to fertilisers through an open market consultation (CETENMA) - Open discussion
15:25 – 15:45	Coffee Break
15:45 – 17:00	Circular fertilisers acceptance • Presentation of the Fer-Play project and guidelines • Roundtable moderated by Telmo Machado (LIPOR*) with Filipa Teixeira (LIPOR), José Martino (consultant), and Beray Cali (ACR+)*
17:00-18:00	Visit to CVO (composting plant)
DAY 2- Tuesday 28.01.2025 - LIPOR, Baguim do Monte	
Time	Description
08:30	**Departure from meeting point**
09:30-10:15	**Visit to Small-scale AD plant**
10:15 – 10:30	**Coffee Break**
10:30- 11:45	**Visit to Green Waste Composting Park**
11:45 – 12:30	**Visit to CEL (LIPOR's Experimentation Centre)**
13:00 – 14:00	Lunch
14:00	Departure
14:30- 15:30	Visit to community composting site
15:30-16:30	Separate collection in the Historic District
16:30	Closing remarks

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2. HOOP/FERPLAY JOINT SESSION

2.1. Introduction of participants

Each participant was invited to provide a short introduction of the organisation she or he represented, along with their main interests when it comes to bio-waste management and local circular bioeconomy. The main topics mentioned by participants are summarised in the table below:

Table 1: participant territories and interests in bio-waste management

Organisation / territory	Country	Key interests
Coimbra Region	PT	Efficient bio-waste management system for rural areas
City of Florence	IT	How to engage inhabitants in bio-waste separation
City of Zagreb	HR	Bio-waste collection was implemented 2 years ago with already good results, but they are looking for inspiration to improve it
Kotor	ME	Improvement in collection and treatment of bio-waste
Alytus Region	LT	Improving their system of collection and treatment
City of Amsterdam	*NL*	*Part of the Bin2Bean project, looking for inspiration for pilot cities and how to support decentralized composting community (also connected to regulation).*
City of Warsaw	*PL*	*They implemented collection of bio-waste and are looking for improvements*
City of Agueda	*PT*	*Interest in forestry bio-waste and how to improve its recovery.*

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Organisation / territory	Country	Key interests
City of Guimaraes	*PT*	*Aiming to implement economic incentives for inhabitants to sort waste. Looking for new project to recycle bio-waste (they already have community farms).*
City of Niepolomice	*PL*	*Improve bio-waste collection, reduce bio-waste management costs (and fees)*
City of Oisterwijk	*NL*	*Improve the quality of collected bio-waste*
Saaremaa Parish	*EE*	*Improve separate collection*
City of Vico Equense	*IT*	*Improve quality*
City of San Lucido	*IT*	*Door to door collection of bio-waste was implemented 10 years ago and they have an agreement of the local company to receive a contribution for the production of energy from bio-waste*
City of Valongo	*PT*	*Learn on bio-waste collection and treatment*
Valorsul (agglomeration of Lisbon)	*PT*	*How to enhance their advanced treatment practices*
City of Ciampino	*IT*	*Awareness raising for inhabitants, improve collection practices*
City of Braga	*PT*	*Challenges linked with the increase of population and increase of immigration, to whom they have to explain how to sort bio-waste. Overall, looking for strategies to reach all part of the population*

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Figure 1: attendees during the afternoon sessions.

2.2. HOOP session: innovative recycling routes for bio-waste

The first session focused on some of the outcomes of the HOOP projects regarding the identification and analysis of innovative recycling routes aiming to produce high added value bioproducts. The sessions included presentations from HOOP partners ITENE, LIPOR, and CETENMA.

2.2.1. ITENE: INNOVATION IN COFFEE AND GREEN WASTE MANAGEMENT: OBTAINING HIGH-VALUE PRODUCTS

ITENE presented different technologies investigated during the project, aiming to treat specific organic waste to produce high-value products:

- **Processing pruning waste from the City of Münster** (Germany) to produce biogas and biostimulants. Pruning waste is considered a challenging material to process, but its hydrolysis allows to enhance biogas production and makes it an excellent raw material to produce microbial biostimulants.
- **Slow pyrolysis applied to invasive plants in Porto**: this process aims to produce biochar that can be then used as a soil improver. The obtained product presented fairly good performances. It is also feasible to pre-extract high value chemicals prior to pyrolysis.
- **Spent coffee grounds recovery** to extract fatty acids and polyphenols. The resultant solid fraction from this process can also be recovered via pyrolysis.

Overall, these different investigated processes all showed promising results. There seems to be a huge potential for the production of high-value products, by targeting very specific bioresidues.

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A short discussion was engaged with the audience. How such technologies could be concretely applied in LIPOR was addressed. Another participant wondered if such processes could only be applied to the very specific fractions mentioned. ITENE replied that, indeed, processes are tailored to specific fractions. However, it is possible to adapt processes to different feedstocks, and many different processes are available to convert any type of waste, offering very diverse solutions.

2.2.2. LIPOR BIO-WASTE STRATEGY

LIPOR presented the different aspects of their bio-waste strategy, with a strong focus both on improving capture rates and ensuring a high quality for sorted fractions. LIPOR works together with 8 municipalities in the Greater Porto area, that all have a margin a flexibility to organise waste collection. Most inhabitants use bring banks to dispose of their waste, but some have access to a door-to-door collection with a frequency up to 3 times per week. For food waste, bring banks are equipped with controlled access, and can only be opened with a resident pass, to preserve the quality. The containers for other fractions (paper/cardboard, light packaging, glass, and residual waste) are “open” and can be used by anyone. About 2,000 restaurants are also collected with higher frequencies (up to 6 days a week), with associated quantities amounting to 10 tonnes per year. LIPOR mentioned the specificity of food waste generated in the Porto area, connected with local consumption patterns: fish, fresh food products, and high humidity for HoReCa waste, that can make its handling more challenging and explains the high collection frequencies. Garden waste has its own collection scheme, depending on the location: door to door, bring banks, or civic amenity sites (collection sites/recycling centres).

The presentation also introduced practices implemented in Maia, one of the most advanced municipalities of the Greater Porto area: door-to-door communication and distribution of new bins equipped with chips to monitor the use in the framework of a new pay-as-you-throw system.

Collection is more challenging due to the impossibility to use compostable plastic bags, that can make storage more comfortable for inhabitants. The compost process is quite short (about 2 weeks) and cannot decompose compostable bags well. There is a difficulty finding the right balance between the resistance of bags to limit leaks and its compostability. Tests are undertaken with paper bags.

Cleaning of individual bins is under the responsibility of users, while bring banks are cleaned by municipalities. New bins with round bottoms are being designed to make cleaning easier.

To promote source separation, LIPOR only charges residual waste treatment, while sorted fractions are processed free of charge. Contamination is not charged, LIPOR prefers to find collaborative solutions together with the municipalities.

LIPOR started composting bio-waste in 2005 and has been operating a composting plant since then. One interesting aspect of their strategy is the product-oriented focus with the creation of the “NUTRIMAIS” brand. The collection strategy is formed with the goal of capturing high quality waste that would result in high quality product; hence the use of plastic bags becomes problematic.

Different products are proposed to fulfil the needs of end-users: different formats (pellet, in bulk, in small or big bags), compost and growth media, compost suitable for organic waste, etc.

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The latest developments of LIPOR's bio-waste strategy are the creation of two new treatment facilities: a small-scale anaerobic digestion plant with a capacity of 1,000 tonnes per year, and a new garden waste composting plant. Both units were created to treat waste collected from less dense municipalities located at the outskirts of the territory, as a way to reduce logistical costs. More information on these units are provided in sections 3.2 and 3.3.

2.2.3. CETENMA: VALORISATION OF COMPOST REFUSE INTO BIOCHAR FOR AGRICULTURE USES, AND MANAGING NUTRIENT EXCESS IN LIQUID DIGESTATE

CETENMA presented some of the aspects of the project development assistance provided to LIPOR, including the essential technical and scientific studies to allow the selection and ensure the viability of the technical solutions. For LIPOR, two challenges were addressed: the recycling of compost refuse, and the high nutrient content in liquid digestate for the upcoming anaerobic digestion plant. This high concentration means that the liquid digestate cannot be sent to the wastewater treatment plant, but that it could on the other hand be recovered as a fertilising product.

As an illustration, the analyses showed that the biochar processed with the pyrolysis of compost refuse at 350-400°C qualified as a fertiliser (and not as a soil improver) according to the Fertilising Product Regulation 2019/1009.

CETENMA also assisted LIPOR to set up an Open Market Consultation for the processing of liquid digestate, since no technical solution could be identified. This process allows to start a discussion with potential solution providers addressing a specific challenge for which no solution is available on the market. This can open the door to a Public Procurement of Innovation, for which different solution providers might even decide to join force to come up with a suitable, innovative solution.

Figure 2: presentations during the HOOP session.

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2.3. FER-PLAY session: engaging end-users

The session opened with a presentation of the Fer-Play project that aimed to promote the uptake of circular fertilisers, meaning fertilisers produced out of bioresidues and sludge. The project has documented many different value chains, presented in a single database, and assessed the potential of seven specific value chain. A key aspect of the project was stakeholder engagement, namely with producers, end-users (farmers), and public administrations aiming to promote their use at local and regional levels. The presentation focused on key recommendations and a selection of good practices to do so that are included in the Fer-Play guideline for Public Administrations.

The presentation was followed by an open discussion moderated by Telmo Machado from the Research, Development and Innovation Department of LIPOR, and brought together Filipa Teixeira (sales manager at LIPOR), José Martino (consultant who supported LIPOR with the development of Nutrimais), and Beray Cayli (ACR+).

The importance of taking the needs and constraints of farmers into consideration was first mentioned. This does not only concern the quality of the end-product, but also more logistical aspect, such as the need to design a 6-month compost storage in the composting plant, considering that compost is only used between October and March.

LIPOR highlighted the need to promote in priority the quality of the product, rather than insist on the circular aspects that are less relevant to end-users. LIPOR is associated with waste management. Therefore, Nutrimais is marketed as a product, not as a waste-derived output. It is also important to present it as a soil improver, and not a fertiliser bringing nutrients. Insisting on the waste aspect might even be counterproductive; other waste-based composts produced through mechanical biological treatment have high presence of plastics, resulting in a general negative perception of biowaste compost. In general, if the added value is clear, and if it is easy to explain to LIPOR's commercial team, it is then easy to market the products. The high quality of Nutrimais products allows LIPOR to sell it at about 60€ per tonne, vs. 10 to 15€ per tonne for others.

Panellists also insisted on the importance to support the promotion of quality composts, such as financing for information campaigns on the benefits of compost, and inclusion of composts in soil protection policies at EU and national levels.

ACR+ explained how Fer-Play worked on stakeholder engagement, by involving already interested parties, and involve different levels of administration connected with the different players (e.g. the farmers). There is a need for promotion of circular fertilisers, since conventional fertilisers are very well-known in comparison, which makes their use much more convenient for farmers. It is essential to highlight the specific benefits of circular fertilisers on soil health, and not only on their equivalence of conventional ones in terms of nutrient content. The role of healthy soils on carbon sink can also be promoted.

To substitute conventional fertilisers, a possibility is to create a formulation including different circular fertilisers, coupled with adapted agricultural practices. Many farmers are already aware of the benefits of C-rich circular fertilisers. Biostimulants could also be added to such formulations, considering their capacity to mobilise N, P, and K in soils to enhance their availability. One of the issues is cost, since biostimulants are more expensive and are hardly competitive with conventional products. One way to overcome this challenge

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is to provide more revenues to farmers via a better distribution of revenues among the different players of the food value chain. Currently, distributors get 70% of the whole revenues from food sales. Giving a bigger share to farmers would allow them to invest more in high quality circular fertilisers. This should be addressed at political level. At their level, both HOOP and Fer-Play bring awareness to different organisations, including public administration, of these difficulties, so that they can design instruments to support farmers adopting more sustainable practices. The use of Carbon Credits acknowledging carbon storage could for instance reduce the costs.

The roundtable ended with several success stories from the use of Nutrimais. LIPOR mentioned its use by multinational companies producing wines, as well as other users who initially switched to products closer to their location but later reverted to Nutrimais upon realising it delivered better results.. Nutrimais also rely on customer service to expand, and trying as much as possible to adapt to their clients' needs (in terms of format adapted to the spreading machines, for instance).

Figure 3: FER-PLAY round table.

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3. Study visits

The HOOP study visits included many different activities to address different topics of interest mentioned by the HOOP Members.

3.1. Visit of LIPOR composting plant (CVO)

Participants could visit the composting facility, with the use of rainwater on the roof to control the process temperature. The visit also included a short introduction of the different Nutrimais products, including pelleted compost, making its use more convenient and micro-organisms readily available for plants. Nutrimais also includes a specific compost for organic farming, produced with batches presenting lower content of heavy metals. Finally, Nutrimais also developed a growing media, that consists of compost mixed with peat and coco fibre to reduce the concentration of nutrients to avoid damaging the plants.

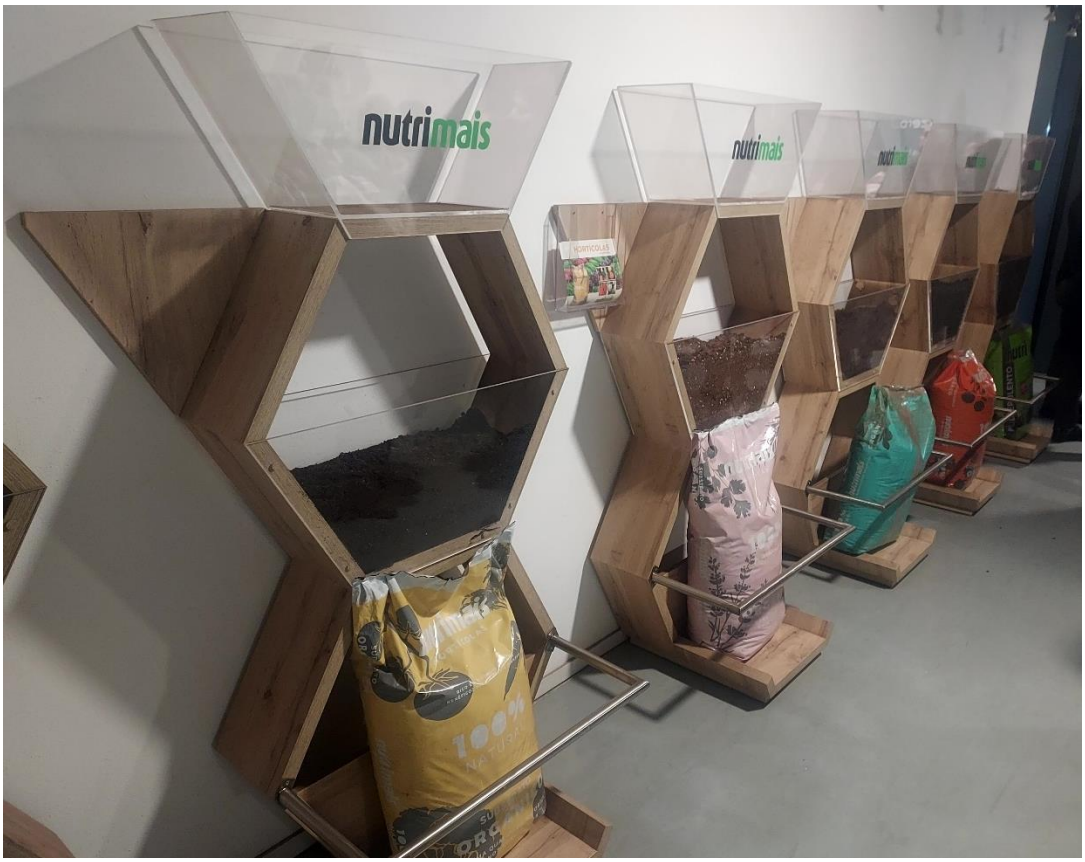

Figure 4: the different NUTRIMAIS products.

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3.2. Transfer station and micro-AD

LIPOR recently implemented a 900 t/yr anaerobic digestion plant in its Póvoa de Varzim transfer station. The transfer station is used to limit the distances made by waste lorries to reach LIPOR facilities the municipality of Póvoa de Varzim). To reduce the distances for bio-waste, and taking advantage of a national call for project, it was decided to set up a small-scale anaerobic digestion plant processing both household and HoReCa food waste, a population of around 18,000 inhabitants.

The unit could benefit from a simplified authorization procedure thanks to its size and the fact that biogas is not pressured, limiting the risks. The fact that the transfer station was already receiving waste also made it quicker to instruct. Overall, the project took three years to be developed: one year and a half of preliminary studies, and one year and a half for the construction and implementation.

Usually, micro anaerobic digestion plants are used as on-site facilities where waste is fed with small buckets, making it easier to spot and remove impurities. Considering that controls are more challenging in the case of household waste collection, a separator including a magnet and a screw press removing the main contaminants (metals, plastics) was implemented. Indeed, small-scale units have a lower tolerance for contamination compared to larger units.

Before entering the digester, food waste is mixed with water to form a pulp, and with a small quantity of digestate to stimulate the digestion at mesophilic conditions. When the pressure of biogas is high enough, it is ejected to a combined heat and power unit, generating heat used for the process, and electricity that is either used by the unit or sent to the electricity grid.

The total capacity is about 2.5 tonnes per day. Currently, only 1.5 tonnes are supplied every day, considering that the food waste collection is still under development. Waste is brought 6 days a week, from one or two of the collection circuits serving Póvoa de Varzim..

The process last about 20 days (respecting the minimum of 15 days set in the regulation), after what the digestate undergoes phase separation. The liquid digestate is hygenised at 70°C for one hour, and the solid digestate is sent to the garden waste composting unit to be composted separately. It is hygenised by the composting process. The possible use of liquid digestate is still being discussed, following the first analyses.

The units costed a bit more than 0.5 million euros.

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Figure 5: the microAD unit: pretreatment unit (left), digesters (centre), and digestate phase separation (right)

3.3. Garden waste composting site

The 8,000 tonnes/year composting unit was opened in November 2024 to locally treat garden waste collected in Póvoa de Varzim and Vila de Conde. Waste is received, shredded, and processed in windrow composting. The composting units is equipped with a concrete slab to ease the operations of the machinery and to collect the (rain) water as requested by the regulation.

The process takes about 3 to 4 months. To optimise the process, probes are put in the compost pile to monitor the temperature: when it goes below 60°C, the pile is mixed with a compost turner and water is added if needed. When the bacterial activity decreases, compost is ready. However, analyses must be conducted with the first batches produced to understand how it will be used. Options include its inclusion to the existing Nutrimais growth media.

3.4. LIPOR's Experimentation Centre

LIPOR established an experimentation centre (CEL) to develop innovative products and solutions. The CEL hosts a production line for Nutrimais growth media, that mixes compost, coco fibre, and peats coming from Germany. Many iterative tests have been performed to produce a consistent product, and tests are still underway. One of the issues is the quality of coco fibres that includes impurities such as stones, damaging the machines. Several tests were conducted with other products, but it was not conclusive.

Other projects were shortly mentioned, such as the wall bins to help households living in small dwelling to store their separated dry recyclable, made out of recovered plastics for which no recycling routes could be identified. Another project is about the recovery of incineration bottom ash as road construction material.

The CEL also includes a laboratory where all necessary tests are performed.

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Figure 6: coconut fibre (left), mixing line to create growth media (centre), wall bin made out of recycled plastic (right) presented in LIPOR's CEL

3.5. Food waste collection in the dense urban centre

A presentation of the food waste collection from restaurants in the municipality of Porto was given by Porto Ambiente, the public waste company operating collection in the municipality. In the municipality of Porto, residents use bring banks for all fractions, and bring banks with controlled access for food waste. The only fraction collected door to door is commercial food waste, due to its properties: commercial food waste is often too liquid to be safely collected with bring banks. Door to door is also applied to a very small part of the municipality (about 200 houses). Overall, it seems that residents prefer bring banks (more flexible), and the presence of narrow streets makes door to door impractical in many different areas. Commercial food waste collection is performed every day, sometimes twice a day, to cope with the important production and the lack of place to store waste in commercial premises. Food waste is collected in bulk, there are some tests for paper liners but only for households.

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Figure 7: collection of restaurant food waste in Porto

Two teams are in contact with the users: an awareness raising team helping them with sorting instructions, and an inspection team controlling non-compliances and contamination, especially the presence of plastic bags in bio-waste.

All households and commercial users pay the waste tax that is collected together with the water tax, and so is disconnected from the actual waste generation and sorting performances. The tax is sufficient to cover the collection costs, which is uncommon in Portugal.

Used cooking oils are collected by private collectors. For household, there are about 90 collection points in the municipality.

In parallel, LIPOR is also engaging with the HORECA sector via two main actions: Dose Certa (“the right dose”), supporting restaurants with the assessment of food waste generation and the implementation of adequate measures to reduce it, and Embrulha (“wrap it up”), providing “doggy bags” made with biodegradable materials to restaurants that can then propose to the clients to take their leftovers home.

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3.6. Community composting in Porto

Figure 8: pictures of the community composter and sorting instructions

In Porto, LIPOR has established community composting sites in the Amial and Paranhos neighbourhoods. Residents close to the composter bring their food waste on to the first bin- a smart bin which they can open with their resident card. The rest of the bins have a padlock, and LIPOR's employees have the key. Once the first bin is full, the waste is transferred to the second bin to start the composting. The temperature of the compost is monitored by LIPOR's employees, and they rotate the heap as needed manually.

The finished product is transferred to the last container which is open for all. Residents can take the finished product to use in their gardens. For residents who do not have gardens on their own, but are participating in the Organic Kitchen Garden (an urban gardening initiative by LIPOR) they are encouraged to use compost.

Residents in the area have given satisfactory feedback to the arrangement and are happy with the quality of the compost.

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4. Conclusion

The HOOP/FER-PLAY study visit in Porto fostered many exchanges between the HOOP Lighthouse LIPOR and HOOP Members, but also among HOOP members. The study visit addressed many different specific challenges and solutions relevant to both dense areas (collection in historical centre) and remote areas (small-scale units, community composting). HOOP Members expressed common expectations when it comes to peer learning, such as the general improvement of bio-waste management, but their expectations also reflected their own specific challenges related to density, remoteness, specific target audiences, or national regulation.

A focus on bio-waste-based, circular fertilisers was made possible thanks to the collaboration with the FER-PLAY project, and highlighted the importance of better aligning the bio-waste management system with the needs of end-users, especially when it comes to quality, but also to consider them less as waste by-products and more as high added value products to allow their marketing and successful collaboration. Testing and improving the characteristics of circular fertilisers, investing in their marketing, and engaging in discussions with the end-users to better understand their needs and constraints are approaches that are worth replicating to move from bio-waste management to local circular bioeconomy.

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