



# Advancing the circular bioeconomy in Murcia

Co-creating improvement proposals in the Biowaste Club of the region through the analysis of HOOP Trainers' outcomes



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**This document is the result of a participatory research using citizen science and co-creation methodologies to identify strategies for optimising the separate collection of the organic and non-organic fraction of waste in the city of Murcia.**

The research goal consisted in the co-creation of improvement proposals based on the challenges identified in the HOOP Trainers game, a gamified citizen science tool with pedagogical purposes. The collected data allowed us to gain valuable insights into the neighborhood's perception of biowaste separation, the acceptance of products derived from it, and collect opinions to develop a greener and more circular city. During two co-creation workshops, participants reflected on the HOOP Trainers outcomes and provided recommendations to enhance citizens' motivation to recycle, overcome barriers that hinder proper waste separation, and implement effective communication actions to raise awareness.

This research has been conducted within the framework of the European project HOOP. It has been possible thanks to 263 HOOP Trainers users and the active participation, motivation and enthusiasm of 51 co-investigators from Murcia, including 39 students aged 14-15 from the highschool Monte Miravete and 12 members of the association [Madres por el Clima](#) (Mothers for Climate), who have been involved in the data analysis process and the conversion of the results into recommendations.

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**Images:** Captured during Biowaste Clubs events.

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# 1. Introduction

## HOOP project: Vitalising Europe's Urban Bioeconomy

Did you know that, on average, Europeans generate approximately 200 kg of organic waste per year, and a staggering 75% of this waste is either landfilled or incinerated? This alarming statistic highlights the urgent need for action. In response to this pressing issue, the [HOOP project](#) is actively supporting 8 European lighthouse (LH) cities and regions in implementing circular bioeconomy solutions to produce innovative and sustainable bio-based products from urban biowaste and wastewater. One crucial aspect of this endeavour involves the creation of [Biowaste Clubs](#) (BC), which serve as **collaborative spaces where stakeholders regularly exchange ideas and foster a shared vision for enhancing circularity within their cities.**

To facilitate these exchanges, Science for Change implemented in 2023 a citizen science program utilizing the gamified App [HOOP Trainers](#), which was adapted to 6 HOOP lighthouse context and needs: Kuopio (Finland), Lazio Region (Italy), Münster (Germany), Murcia (Spain), Porto (Portugal) and Western Macedonia (Greece). **The program's objective was to collaboratively design a highly efficient selective collection system, with a particular emphasis on the Organic Fraction of Municipal Solid Waste (OFMSW), while also actively engaging and raising awareness among citizens in HOOP lighthouses.** The data collected through the App has played a significant role in discussions within the Biowaste Clubs, contributing to the formulation of the co-created recommendations that you'll see below. By analyzing users' decisions during HOOP Trainers missions, a deeper understanding of citizens' perspectives on biowaste separation, acceptance of products derived from biowaste, and their proposals for building a greener and more circular region has been attained.

## HOOP Trainers: Shaping the circular bioeconomy through citizens science and co-creation

In order to create customized versions of HOOP Trainers for each lighthouse, collaborative co-design sessions were conducted with representatives from each city. In Murcia, the co-design sessions were arranged with the Municipality of Murcia. The aim was to align their local circular bioeconomy challenges with the potential of citizen science. These sessions proved valuable in identifying waste selection challenges, determining the necessary data to address them, and devising strategies to involve citizens in the data collection and analysis processes.

While each lighthouse has its own adapted version of the game, they all share a common objective: **training an avatar called Lineop to transform organic waste into useful bioproducts by completing three missions. As Lineop learns the art of giving waste a new purpose, it evolves into Cirklop, a creature capable of constructing a more sustainable city.**

Lineop symbolizes a city that adheres to a linear production and consumption model, where raw materials are extracted to manufacture new products for consumption, only to be disposed of through landfill or incineration once they are no longer useful. Cirklop represents a green and circular city that reduces, recycles, reuses, repairs, and recovers the waste it generates. By doing so, the city breathes new life into its waste, finding diverse ways to reuse it, while minimizing waste-related pollution and emissions, and easing the strain on natural resources.



## HOOP Training missions in Murcia

### MISSION 1: Correct waste sorting

Lineop lacks the knowledge to properly separate waste and needs assistance in depositing items into the appropriate bins. Users are tasked with training Lineop to effectively sort the following **types of rubbish**:



### MISSION 2: Uncover the situation in Western Macedonia

*More details of the questions asked in this mission are shown in the next page.*

To advance Lineop's transformation, more individuals must sort their waste effectively. Thus, in Mission 2, users must actively initiate conversations with their neighbours, exchanging experiences and insights that can aid Lineop in comprehending the most effective measures to promote recycling in Murcia. Of particular emphasis is the sorting of organic waste fractions.

The questions primarily revolve around the **factors that motivate and hinder waste sorting**, as well as the **preferred communication channels for obtaining information**. Additionally, users are asked about their **suggestions for prioritising actions that they believe the municipality should undertake**.

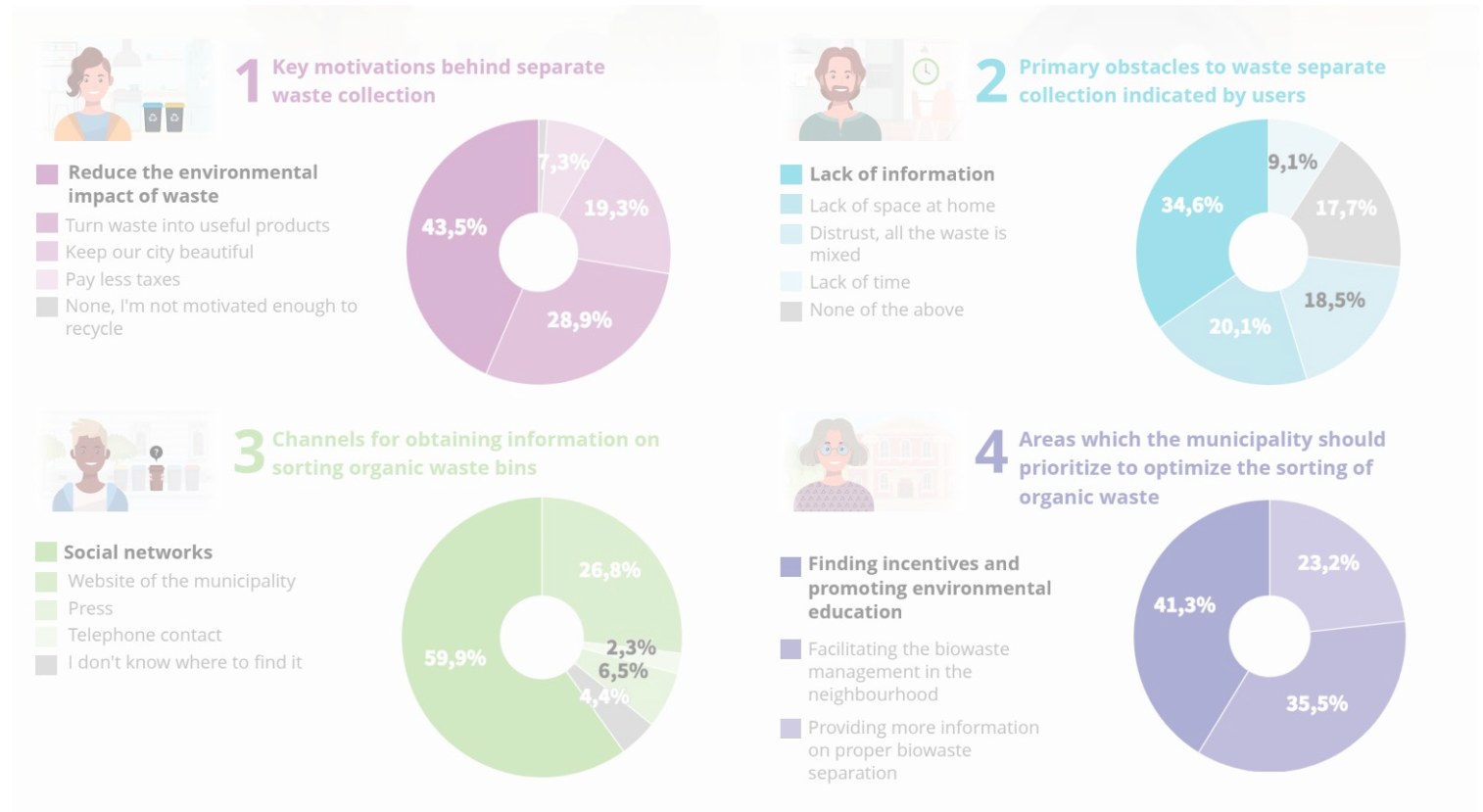
### MISSION 3: Create a Bioproduct

Building upon the success of the previous two missions, users are enthusiastically invited to assist Lineop in choosing and creating one of the following types of bioproducts from the abundant resources at hand:

- Fertilisers
- Nutrients
- Bioplastics
- Green chemicals products

## Specific questions and corresponding answers from Mission 2

Bellown are shown the Mission 2 questions addressed to HOOP Trainers players regarding domestic waste separation, which came from the co-design session done with [CluBe](#) and [DIADYMA SA](#):





## Summary of the quantitative outcomes obtained in each training mission

In Murcia, **263 HOOP Trainers users played the game**. Women comprised the majority of users, constituting approximately 57% of the participants, while men accounted for nearly 36%. The number of non-binary participants was insufficient to draw any statistically significant conclusions. In terms of age distribution, nearly 47% of participants were between 40-59 years old, followed by just about 30% in the 20-39 age group, and almost a 16% in the 40-59 age group. There were also a few users over 60 years old.

During **Mission 1**, the waste items that caused the most uncertainty among participants were **cork** (with approximately 74% of users making mistakes), **diapers** (nearly 39% of users made errors), and **eggshells** (almost 31% of users made errors). In contrast, tetrabricks (only 10,5 % of users made mistakes) and fruit peels (12,3% of users made mistakes) generated fewer doubts among users.

In **Mission 2**, users expressed primary **motivations** for separate waste collection, including **reducing the environmental impact of waste** (nearly 64%), **transforming waste into bioproducts** (around 20%), and **maintaining city aesthetics** (approximately 9%). Paying fewer taxes was a less significant motivation. None relevant differences were found in the motivations highlighted by females and males. **Key obstacles** reported were **limited space at home** (nearly 32%), **lack of information** (around 17%), and **distrust** (nearly 16%). Lack of time was not a significant obstacle (around 9%), while the option "Others" accounted for 25% of responses, reflecting additional obstacles identified during the Biowaste Club meetings held in Murcia to discuss the HOOP Training results. The key obstacles varied slightly between females and males, particularly concerning the lack of information and space at home. Notably, the lack of information appears to be a more significant challenge for males, with 21% citing it as their primary obstacle, while approximately 15% of females reported the same. On the other hand, the limited space at home seems to be a more prevalent concern for females, as nearly 36% of them mentioned it as a main issue compared to around 30% of males. **Social networks** seem to be the most utilized channel for obtaining information on sorting organic waste (close to 35%), followed by the **municipality's website** (approximately 23%), and the press (around 19%). Social networks appear to be more frequently used by females than males, with approximately 41% of females selecting it as their primary option, while nearly 27% of males did the same. In contrast, the press, though chosen by a small number of users overall, has been exclusively preferred by males as their first option. It is noteworthy that almost 22% of citizens from Murcia expressed **uncertainty about where to find information** (an option chosen by nearly 28% of males, in comparison to approximately 19% of females.).

When users were asked about the areas that the municipality should prioritize to optimize the sorting of organic waste, the responses were more fairly distributed. The top priorities identified were **finding incentives and promoting environmental education** (almost the 47%) - the type of incentive and environmental education campaigns were identified in the Biowaste Club meetings -, facilitating waste sorting at home (a 34%), and providing more information on proper biowaste separation (around the 19% of the results). Facilitating waste sorting at home was prioritized as a main action by nearly 38% of females, whereas approximately 30% of males chose the same option.

In **Mission 3**, 33% of users chose to create **bioplastics**, followed by 31% opting for fertilisers, and the remaining users split between creating nutrients (20%) and green chemical products (16%). Some differences can be detected between the bioproducts preferred by females and males. Fertilizers were chosen as the primary option by 45,5% of males, in comparison to almost 22% of females. Conversely, green chemical products were selected as the main option by approximately 20% of females, while only about 8% of males opted for it. Nutrients were also more preferred by females (almost 24%) than by males (around 13%).

The detailed HOOP Trainers outcomes can be shown in the document *HOOP Trainers App game implemented in Murcia: Study results*.

The data collected from the HOOP Trainers in Murcia is a sample that provides a confidence level of 90% with a 5% error, ensuring valuable insights. However, it is essential to be mindful of its limitations when interpreting the findings. Additionally, we must acknowledge the possible presence of common biases, such as sampling bias and social desirability bias (the tendency to answer questions in a manner that will be viewed favourably by others), which could have influenced the outcomes obtained. By recognizing and addressing these biases, we can attain a more comprehensive and nuanced understanding of the data and its constraints. Given that the main objectives of this initiative were the engagement and participation of citizens, the method for sampling and obtaining data was not probabilistic but strategic, and therefore the representativity of the sample over the whole population in Murcia is not assured completely (e.g., the overrepresentation of some age groups). All these factors were thoroughly considered during the Biowaste Club events, which presented a valuable opportunity to integrate the opinions of 263 HOOP Trainers digital users with those 51 citizens from Murcia. The discussions delved into the entirety of the items that appeared in Mission 2 of the game, ensuring a comprehensive analysis beyond just the most voted options.

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## Biowaste Club meetings to transform HOOP Trainers outcomes into improvement proposals

On the 25th of April and the 17th of May of 2023, the outcomes derived from the data analysis of the **HOOP Trainers Mission 2** were examined during two Murcian Biowaste Clubs events. **The first Biowaste Club was tailored for highschool students, while the other catered to members of the association [Madres por el Clima](#) (Mothers for Climate). The purpose of these events was to collaboratively transform the obtained HOOP Trainers outcomes into improvement proposals for optimising waste sorting management in the region<sup>1</sup>.**

The outcomes discussed in the Biowaste Clubs meetings, focused on the **first three questions of Mission 2, which delved into the factors motivating and hindering waste sorting, as well as the preferred communication channels for obtaining information.**

Through the analysis of the HOOP Trainers results, a group of 39 students aged 14-15 from the high school Monte Miravete engaged in insightful discussions during a workshop held at the waste treatment plant [Cañada Hermosa](#). The workshop covered various challenges, such as devising impactful social media campaigns with influencers to reach a wider audience and creating strategies to enhance waste sorting procedures. Among these strategies were installing additional bins near residential areas and introducing automatic sorting systems.

In addition to the students, 12 members of the association [Madres por el Clima](#) also participated in transforming the HOOP Trainers outcomes into recommendations in a second Biowaste Club event held in the [Circular Education Lab of Murcia](#). Their discussions focused on a diverse array of challenges, including systemic issues affecting circularity, rethinking packaging systems, and improving access to more affordable bins that facilitate waste separation in small spaces.

The following synthesis presents the final recommendations co-produced by the participants. These proposals have been drafted based on the recommendations submitted during the co-creation sessions. The proposals are categorized according to the challenges identified in HOOP Trainers and are listed in order of priority based on user feedback from the game.

[1] *Mar Escarrabill and Blanca Guasch conceptualized the sessions. The methodological design of the co-creation sessions was carried out by Blanca Guasch under the Torres Quevedo grant for contracts PTQ2020-011264, financed by the Ministerio de Ciencia e Innovación: MCIN/AEI/10.13039/501100011033 and by the European Union NextGenerationEU/PRTR. Julia de la Cruz and Francisca Fuenzalida designed the materials used in the sessions.*

## 2.1. Enhancing organic and non-organic waste separation in Western Macedonia: Motivations and Recommendations

## How to read these recommendations

In the following pages, you will discover the recommendations put forth by the Biowaste Club participants in response to the challenges identified by the HOOP Trainers players. The outcomes will be distributed as follows:

HOOP

2.1. Enhancing organic and non-organic waste separation in Murcia:  
**Motivations and Recommendations**

**Topic posed to HOOP Trainers** players to collect their perceptions, analyzed by the Biowaste Club participants

### Pay less waste taxes

One of the **potential responses** that players could choose from for the posed topic

*It is the main motivation for **5%** of HOOP Trainers players.*

Percentage of players who chose that particular answer

Profile of the Biowaste Club participants



highschool students



Mothers for Climate

The students did not delve into a detailed discussion of this point as they did not directly question it. However, one group briefly mentioned the topic of **financial penalties** for improper waste separation, rather than focusing on bonuses.

Two contrasting opinions emerged regarding remuneration/financial penalties for waste separation. On one side, "**the polluter pays**" approach was supported, while on the other side, **positive reinforcement** was proposed as an alternative to financial penalties, along with concrete suggestions to promote behavior change.

Areas of agreement were identified regarding the **need for more information on waste management costs and the necessity to impose taxes on large organizations** (such as companies or consumer products) that have a significant negative impact on the environment.

**Recommendations proposed** by the Biowaste Club participants

## Reduce the environmental impact of waste

*It is the main motivation for 63,63% of HOOP Trainers players.*



**Encourage the reduction of plastic consumption by discouraging the use of single-use items.** This can be achieved by eliminating plastic bags, promoting the use of cloth bags, reducing the reliance on plastic bottles, and encouraging the use of reusable containers.

Increase support and resources for **research centres** dedicated to studying and implementing waste reduction strategies.

madres  
por  
el  
clima *RM*

**Engage businesses** in promoting the use of reusable packaging, encouraging bulk purchases, and incentivizing responsible practices by providing positive ratings to eco-conscious businesses.

**Educate and train citizens on making sustainable purchases** and adopting eco-friendly shopping habits.

Launch **raise awareness campaigns** to combat food waste.

Challenge the perception that bottled products offer superior protection and promote a cultural shift towards more sustainable alternatives

## Transform waste into useful products

*It is the main motivation for 20,45% of HOOP Trainers players.*



**Increase the availability and accessibility of properly labeled bins** for separate waste collection, including plastic, cardboard, textiles, and used cooking oil.

**Explore innovative ways to repurpose common waste materials.** For instance, plastic bottles can be transformed into toys or jewelry, used clothing can be upcycled into new garments, and organic matter can be composted.

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el  
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**Implement sustainable practices in the HoReCa sector** by utilizing leftovers to create new food products. A notable example is the production of Murcian limoncello using lemon peels.

Encourage intergenerational knowledge exchange by organizing courses where **older individuals teach younger generations about repurposing food and zero-waste cooking.**

Launch campaigns **promoting the consumption of "ugly" fruits and vegetables** to reduce food waste.

## Keep our city beautiful

*It is the main motivation for 9,54% of HOOP Trainers players.*



**Educate people** about the importance of sorting waste.

Install more bins and **machines where you get money back when you return your plastic or glass bottles** (as already exists in other European cities).

**Strengthen the city's cleanliness regulations and initiate voluntary clean-up projects**, alongside campaigns highlighting the impact of improper waste disposal.

Encourage individuals to implement waste reduction ideas at home, and encourage brands to **design packaging with future reuse in mind**.

Promote **campaigns to highlight the valuable work carried out by waste collection services**, which is often underappreciated by the public despite their immense contribution. Promote **campaigns** immense contributions.

madres  
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el  
clima *RM*

Facilitate knowledge sharing among citizens and cities entities or establishments (such as schools, hairdressers, gyms,...) to **encourage and showcase good practices to foster behavioural change**. The City Council could support this by creating and displaying informative posters in establishments.

Address the barrier of lack of civility by promoting a change in mentality, emphasizing that **public spaces belong to everyone** and should be cared for accordingly.



## Pay less waste taxes

*It is the main motivation for 5% of HOOP Trainers players.*



madres  
por  
el  
clima *RM*

The students did not delve into a detailed discussion of this point as they did not directly question it. However, one group briefly mentioned the topic of **financial penalties** for improper waste separation, rather than focusing on bonuses.

Two contrasting opinions emerged regarding remuneration/financial penalties for waste separation. On one side, “**the polluter pays**” approach was supported, while on the other side, **positive reinforcement** was proposed as an alternative to financial penalties, along with concrete suggestions to promote behavior change.

Areas of agreement were identified regarding the **need for more information on waste management costs and the necessity to impose taxes on large organizations** (such as companies or consumer products) that have a significant negative impact on the environment.

## None, I am not motivated enough to recycle

*It represents the response of only 1,36% of the HOOP Trainers players.*



madres  
por  
el  
clima *RMM*

The students did not delve into a detailed discussion of this point.

**Logistical difficulties**<sup>2</sup>, systemic issues favouring single-use products, and general **environmental apathy** are factors contributing to low motivation to recycle. These challenges should be addressed comprehensively at all ages to encourage widespread recycling efforts.

## 2.2. Enhancing organic and non-organic waste separation in Western Macedonia: Barriers and Recommendations

## Lack of space at home

*It is the main barrier for 32,7% of HOOP Trainers players.*



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clima *RM*

**Promote the use of triple bins (3 in 1)** to save space and reduce costs, as people are reluctant to allocate space and invest in three separate bins at home.

In smaller houses, waste separation becomes challenging due to space limitations and unpleasant odors. Vertical bins that can be stacked vertically instead of horizontally are a space-saving option, but they are often expensive. **Access to more affordable bins that facilitate waste separation in small spaces would be ideal.**

**Improve waste disposal proximity by creating recycling points for various types of waste**, including batteries, in the city center. Additionally, establish urban gardens in central Murcia that incorporate composting facilities.

## Others

*It is the main barrier for 25,45% of HOOP Trainers players.*



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Prevent individuals who do not recycle from influencing others to follow their behavior.

Address the **lack of political accountability by implementing stricter European regulations and setting an example through institutional practices**. For example, sending electoral publicity only to those who request it, and implementing effective codes of good practice such as serving ecological and seasonal meals at institutional events and using reusable containers for water.

Tackle **systemic issues that promote the use of single-use products that citizens must sort themselves after its use**. For instance, ban single-use items like plastic bracelets distributed at specific events or low-quality toys handed out during local festivals.

Implement computer systems in supermarkets that allow customers to use a single bag for heavy fruits and vegetables instead of using separate bags for each item.

Consider changing laws to prohibit single-use bags and trays in supermarkets.

## Lack of information

*It is the main barrier for 17,27% of HOOP Trainers players.*



**Improve visual communication on waste bins** to clearly indicate the appropriate items for disposal. Likewise, product packaging should provide guidance on proper disposal.

**Foster recycling awareness among children** through games, while encouraging people of all generations to learn proper recycling practices.

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**Increase transparency in waste management communication** through visits to waste treatment centers and public talks. Consider breaking down the costs associated with production, packaging, and cleaning on purchase receipts.

**Educate and raise awareness** about the environmental impact of individual actions and design **training programs for teachers in sustainability**.

**Establish reliable sources of information** on recycling to combat the spread of fake news and provide accurate information on the benefits of proper recycling and the environmental impact of specific products. Using **impact equivalences**, such as comparing food waste to wasted water or visualizing the size of microplastics ingested as common plastic objects (e.g., credit cards), can help make the environmental impact more tangible. In parallel, consider implementing indicators that display the environmental impact of products in stores, similar to how calorie information is provided.

## Distrust, all the waste gets mixed

*It is the main barrier for 15,9% of HOOP Trainers players.*



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clima *RM*

**Enhance recycling education in schools**, as the media's portrayal of recycling can sometimes be confusing and lead to mistrust. **Showcasing the operations and processes at waste treatment centers can help build trust and understanding.**

**Distrust encompasses not only the waste treatment process but also the perceived benefits of proper waste separation.** Conducting awareness campaigns to highlight the direct advantages of correct waste separation for individuals and the community would be beneficial.

To address this distrust, **organizing more citizen visits to the Cañada Hermosa waste treatment center could be implemented**, allowing people to **witness firsthand the products that result from recycling**. As an example, distributing free books made from recycled materials to children would serve as a tangible demonstration of the positive outcomes of recycling.

## Lack of time

*It is the main barrier for 9,09% of HOOP Trainers players.*



**Install additional bins near residential areas** and **introduce automatic sorting systems** to facilitate waste disposal in a centralized location.

Encourage people to allocate time for waste separation activities in their agendas. As an incentive, explore the possibility of **providing incentives or financial rewards** to individuals for recycling.

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clima** *RM*

Participants did not identify lack of time as a primary barrier to proper waste separation, attributing it instead to laziness or logistical challenges.



## 2.3. Enhancing organic and non-organic waste separation in Western Macedonia: Communication channels and Recommendations

## Social media

*It is the main channel for 35,45% of HOOP Trainers players.*



Make **videos and awareness campaigns featuring influencers** to promote recycling and inspire individuals. Platforms like **Instagram** or **TikTok** can be utilized to engage influencers like Lola Lolita in advocating for recycling. Additionally, establish a dedicated YouTube channel focusing on recycling and conduct online surveys to gather insights on recycling habits.

Develop **engaging advertisements with catchy songs** to capture children's attention and motivate them to recycle.

Design interactive and educational activities in the form of games for both children and adults.

Implement a campaign that incentivizes recycling by offering monetary rewards for exchanging recyclable waste.

Create a compelling promotional video to encourage participation.

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Establish **specialized YouTube channels** dedicated to providing comprehensive information on recycling.

## Web Murcia Ciudad Sostenible

*It is the main channel for  
22,72% of HOOP Trainers  
players.*



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el  
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Ensure that general websites provide detailed explanations on the importance of recycling and offer comprehensive guidance on how to recycle properly.

The participants did not delve into a detailed discussion of the Web Murcia Ciudad Sostenible. However, they suggested developing a **mobile application that allows users to calculate the carbon footprint of their purchases.**

## Lack of knowledge of where to find information

*It is the main channel for  
21,81% of HOOP Trainers  
players.*



Deliver more **awareness talks in schools and highschools**, empowering teachers to discuss recycling topics and encouraging students to seek additional information through social media and other channels.

Consider establishing a **radio program within schools to further educate about recycling**.

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el  
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Recognize the challenge of information overload and the **need to filter accurate and reliable information to avoid misinformation**.

Address the importance of targeting teenagers through relatable narratives that resonate with their interests and values.

## Press

*It is the main channel for 19,54% of HOOP Trainers players.*



Produce **television spots that educate viewers**, particularly children, on the proper techniques of recycling through **engaging cartoons**.

Raise awareness about environmental issues and the significance of recycling correctly or incorrectly through newspaper articles.

Consider developing a **dedicated newspaper focused on recycling and environmental concerns**, specifically targeting the general public.

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The participants did not delve into a detailed discussion of this point.

## Telephone contact

*It is the main channel for  
0,45% of HOOP Trainers  
players.*



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clima *RM*

Provide a **helpline for individuals who lack internet access** to inquire about proper recycling practices.

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The participants did not delve into a detailed discussion of this point.

## Vitalise Europe's Urban Bioeconomy

The HOOP project supports **8 lighthouse cities and regions** in developing large-scale urban circular bioeconomy initiatives that will focus on making bio-based products from urban biomass and wastewater.



### 3. Next steps

Advancing the circular bioeconomy in Murcia: Co-creating improvement proposals in the Biowaste Club of the region through the analysis of HOOP Trainers' outcomes

July 2023

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## Next steps

The HOOP project is actively supporting 8 European lighthouse (LH) cities and regions in implementing circular bioeconomy solutions to produce innovative and sustainable bio-based products from urban biowaste and wastewater. The participation of citizens in advancing to circularity is crucial to its success. HOOP Trainers program's objective - aligned with the HOOP Biowaste Clubs - has been to collaboratively design a highly efficient selective collection system, with a particular emphasis on the Organic Fraction of Municipal Solid Waste (OFMSW), while also actively engaging and raising awareness among citizens in HOOP lighthouses. The discussion of the data collected through the App have contributed to the formulation of the co-created recommendations shown in this document. **These recommendations will enhance the HOOP circular innovations applied in Western Macedonia and future region interventions aligning them with social needs.**



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