

Roadmap for a Progressive Improvement

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PROJECT BACKGROUND

PPI4Waste aims to achieve resource efficiency, sustainable waste management and sustainable consumption throughout Europe by increasing innovative public procurement through networking, capacity building, and dissemination.

The project covers the complete cycle of preparation activities to implement PPI in municipal waste management.

This document is Deliverable D3.3 “Roadmap for Progressive Improvement”, part of the necessary steps to help decision-making and uptake waste procurement alternatives to progressively improve waste management through improved public procurement processes in order to encourage a quicker market uptake of innovative solutions and improve the quality and efficiency of services provided by public authorities.

The roadmap is focusing on pilot project partners, namely Mancomunidad del Sur, and Zagreb Holding, the current situation of waste management and treatment in their area of influence, and potential actions that pursue the improvement at middle and long term of waste management towards achievement of European targets on waste.

OBJECTIVE OF THE ROADMAP

In Europe there are broad differences between countries, regions and municipalities regarding waste production, collection models and treatment techniques applied as well as regarding the implementation of European Directives on Waste. Although bio-waste, plastic waste and bulky waste management are common challenges ¹throughout Europe, the way to face these challenges strongly depends on local conditions and the starting point of each region and municipality.

In this way while in some regions and municipalities incremental improvements are necessary to address the European targets on waste, other regions and municipalities should make large scale changes in the current waste management model.

On the other hand, Public procurement of innovation represents a clear opportunity to implement innovative solutions, improve quality and efficiency of public services and therefore answer to necessary changes and adaptations to reach the European targets.

In this context, the main aim of this roadmap is to identify potential actions and the future interventions to be uptaken by Zagreb City Holding and Mancomunidad Del Sur, both partners in PPI4Waste project, in order to face their challenges on bio-waste and plastic waste respectively, according to their specific conditions, through market uptake of innovative solutions.

METHODOLOGICAL APPROACH OF THE ROAD MAPPING PROCESS

From the needs analysis work done in WP2 there are expert interviews, TIS snapshots, opportunities summaries in SWOT analysis presented in the D2.3 with many suggestions for change. The

¹ Common needs agreed in the framework of needs assessment developed in WP2 of PPI4Waste Project

suggestions are all based around the common needs in the waste management, some are related to technical issues, some to politics and some more users related. Some examples are insights in trends or changes, some are in the form of advices and others are possible to use directly as actions and could easily be incorporated in a strategy.

In the roadmap the pilot partners analyze their own specific needs identified in the WP2 and present the actions leading to solutions for the needs in a roadmap of targeted and progressive improvements.

The roadmap will allow to:

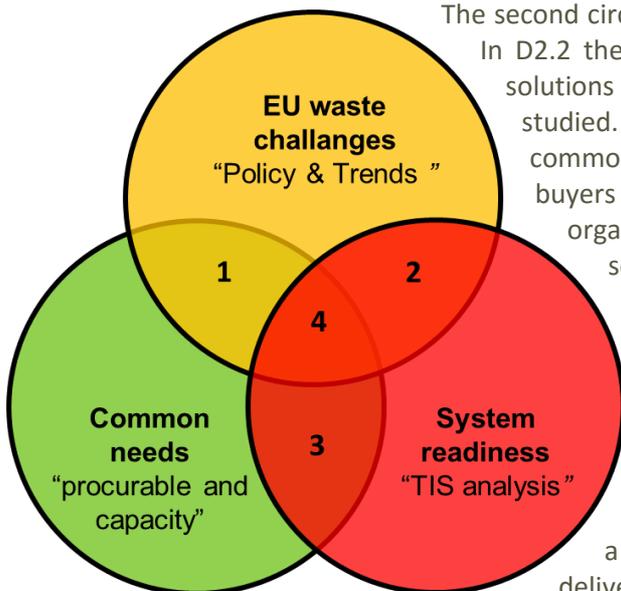
- Define what is important to change in the local waste system.
- Find out the regional, local organizational needs and ability to procure solutions to those needs that overlap with the waste challenges.
- Detail different necessary steps for improvements and associate stakeholders' roles in each of the actions to be conducted.

In the overlap between these areas it is possible to find the targeted improvements that can be realized by PPI actions.

The model (below) has been used as inspiration in finding the targeted improvements developed in WP2 and elaborating the strategy for the roadmap.

The first circle (orange) is illustrating the importance of and focus on the “EU waste challenges”. The circle includes the societal goals and ambitions to reach the goals, the trends that focus for a need. The key players in this circle is the national and regional policy makers enforcing the EU waste challenges, creating incentives and resources for the first customer.

The second circle (green) is the common needs among the project partners. In D2.2 the regional, local organizational needs and ability to procure solutions to those needs in interviews and workshops have been studied. There are several aspects to this capacity to find and procure common needs including “customer readiness” and the leverage of buyers groups. The key player in this circle is the procuring organization with the capacity to act as the first customer to new solutions.



The third circle (red) represents the markets ability to meet the need and the innovations systems ability to deliver future solutions or innovations almost on the market today. The concept of “system readiness” is used as a description of this ability to deliver solutions and especially deliver solutions in response to the challenge and process of a PPI. The key player in this circle is the eco-innovator delivering the solution to the first customer, but the whole system supporting the innovator is of importance.

The model gives four overlapping areas with different characteristics to analyze the targeted improvements. Targeted improvements in the area 4 in this model, drives innovation, makes sure the procuring organization is getting the solution, the innovator and market is getting the first customer for the solution and the society gets a new solution aligned with the waste challenges and a new niche to scale up. The strategies and interventions targeting this area are clearly focusing on realizing the PPI tool in order to meet the needs and challenges targeted in this project.

In order to make a PPI, the procuring organization and the national procurement system must have sufficient procuring capacity.

The procurement capacity or “customer readiness” describes the organizational development towards using PPI efficiently in the procurement system. Considering the gap between the ideal and the current state of waste management as well as the challenges facing Europe on waste management and the new targets stated in the Circular Economy Package and in the future amendment of Waste Directive, PPI implementation can suppose a factor with important impact to reach the targets.

During assessment of needs conducted in WP2 of the project, interviews were conducted with the project’s expert group, external experts on waste management and also with **the potential procurers (also project partners) Zagreb City Holding and Mancomunidad del Sur.**

At this stage, both pilot partners take as basis of the roadmap the outcomes of the analysis previously made to develop and define logical and necessary and most important steps-actions towards progressive improvements in the waste management activities they are supervising.

At this stage, in agreement and coordination with the consortium, two concrete needs have been selected; these specific needs will serve as logical pilot to define roadmap for targeted improvements and common thread to the end of the project to rely assumption on specific pilot cases.

In this deliverable, specific challenges of both Mancomunidad del Sur and Zagreb Holding are described. Once the challenges are described, two challenges common to both of them have been selected, namely biowaste by Zagreb Holding and plastic separation by Mancomunidad del Sur. Both challenges have been prioritized since they represent the major interest and potential to be shared at European level, and explored not only by the two potential procurers of the consortium but also by the members of Interest Communities and Purchasing Community, (both created in the framework of the project), in view to European targets on waste management introduced in Circular Economy Package.

These specific needs will be used as examples to develop subsequent deliverables and use them as pilot cases for performance criteria and for definition of contract models for a real / concrete procurement of innovation.

A separate report (D3.2) based on the targeted improvements of the roadmap will describe desired performance characteristics of the solutions the procurers are willing to purchase.

PILOT MANCOMUNIDAD

I. CHALLENGE DEFINITION MANCOMUNIDAD DEL SUR

A high percentage of the waste generated in Spain is still disposed in landfill sites. In this sense, work is under way to reduce waste generation, encourage re-use, implement separate collection of differentiated waste, and decrease the amount of waste disposed in landfill sites.

Management of household waste is the responsibility of local authorities. In this case Mancomunidad del Sur is a Public Organisation formed by a group of municipalities which is in charge of the domestic waste. The government faces the challenge of implementing efficient and effective management models that ensure compliance with the legal obligations and aims of the entire range of regional, national and community waste legislation.

In this case, Mancomunidad del Sur can be a good pilot to advance in Innovative Public Procurement because of the great need that there is and the challenges that we face. Hereafter, the situation of the public entity will be explained and which aspects are needed to be improved in the short term.

1.1 CURRENT SITUATION

Description of Mancomunidad del Sur

Mancomunidad del Sur was established on January 1 2013 as a result of the implementation of the management model that the Community of Madrid had foreseen in its Waste Strategy 2006 - 2016. Mancomunidad del Sur is a legal entity composed by 71 municipalities of Madrid region and provides services to a total population of 1.850.095 inhabitants (2015).

Although, according to the legal framework of the Community of Madrid, municipalities are responsible of municipal waste management, they usually delegate, well by contract or by other means, the activities to manage municipal waste to other public or private entities.

In this sense, the municipalities that set up Mancomunidad del Sur carry out the collection and transport of waste by their own means or by contracting other entities, while the treatment and final disposal of waste has been delegated by the Mancomunidad del Sur. Specifically Mancomunidad manages from the collection in the transfer station up to the treatment/ final disposal site, the following municipal waste streams:

- Organic + others.
- Light packaging waste.

Likewise Mancomunidad del Sur treats the following types of waste:

- Garden waste.
- Bulky waste.
- Commercial and industrial waste considered inside urban waste category.

The facilities of Mancomunidad del Sur for waste management and treatment are:

- Waste transfer: 4 transfer station located in 4 different municipalities.
- Waste treatment:
 - ✓ 1 Biomethanization Plant for organic fraction of solid wastes
 - ✓ 1 Recycling Plant for separate-collected packaging
 - ✓ 1 Composting Plant for garden waste
 - ✓ Landfill disposal: 1 waste disposal site

The amount of waste managed by Mancomunidad del Sur is showed below:

TOTAL WASTE TRANSFERED (organic waste)	2014	2015
	394.859 ton	399.229 ton
TOTAL SEPARATED-COLLECTED PACKAGING TREATED (transfer station and sorting packaging plant)	2014	2015
	17.461 ton	20.199 ton
TOTAL MIXED URBAN WASTE TREATED in biomethanisation plant	2014	2015
	112.836 ton	79.798 ton
TOTAL MIXED URBAN WASTE DISPOSED AT LANDFILL	2014	2015
	719.911	748.019

Table 1: Total of waste managed by Mancomunidad del Sur in 2014 and 2015

Organisational structure and procurement process

Mancomunidad del Sur has the following governing bodies:

- General Assembly: composed by assembly members/councillors of the 71 municipalities named by their respective municipalities.
- President
- First Vice-President
- Second Vice-President
- Third Vice-President
- Treasurer

On another hand, the administrative bodies of Mancomunidad del Sur are: Secretary and financial controller.

The administrative bodies are responsible for the technical and economic management of waste management, and are supervised by the General Assembly.

The agreement of the Assembly is necessary for the Public procurement decision-making process.

A procurement board is created for each contracting procedure, composed by the secretary, controller, president and Treasurer, including two or three members/councillors who evaluate the technical and economic value of the offers. Approved bids are sent to the Assembly for the decision.

In addition, a technical environmental body, also necessary to address municipalities and monitor activities on the facilities, is involved in the procurement process.

The decision-making process follows the steps described below:

1. Identification of needs: the technical department makes a proposal due to the end of a contract or law modification which entitles changes in the services and/or existing infrastructures.
2. Study of possible technical solutions.
3. Approval of the starting point of the contracting procedure by the Assembly.
4. Start of the procurement procedure: secretary and financial controller.
5. Development of Specifications of tenders: technical: technical department – administrative: secretary.
6. Reception and review of technical and administrative bids. Procurement board.
7. Evaluation of bids: technical department, secretary, and financial controller.
8. Selection of bids: procurement board.
9. Approval: General Assembly.

Waste challenges of Mancomunidad del Sur

Mancomunidad del Sur faces several challenges regarding municipal waste treatment mainly because of the low capacity of its facilities and the poor conditions of some of the same. In this sense, according to their challenges the main areas for improvement of Mancomunidad are:

- Increase the percentage of waste treatment before landfilling.
- Increase the percentage of separate collection of packaging waste
- Increase the percentage of materials recovery.

Although changes in the treatment facilities are necessary and this would improve the general waste management data of Mancomunidad del Sur, these are still considered as isolated actions which will not be enough to cover all necessary improvements to reach the European targets at mid-term and long-term. Therefore, even if Mancomunidad del Sur is only responsible for treatment facilities, other complementing areas of improvement could be addressed by the municipalities that compose Mancomunidad del Sur responsible, in order to achieve complete targeted improvements, such as:

- Reduce the global waste generation rate inside the Mancomunidad.
- Provide access to spaces or containers for different fractions of waste for recycling such as implementation of more green areas.
- Achieve economic savings on the transport waste collection
- Inform the citizens through awareness campaigns about the importance of recycling and their collaboration to adopt a more sustainable pattern in their homes.

According to these challenges, the 10 most important needs that the Mancomunidad is facing are:

- a- Increase the waste treatment rate for bio-waste before its disposal at landfill.
- b- Optimize the biomethanization Plant management.
- c- Improve the pre-treatment system of Biomethan plant.
- d- New systems for bulky waste treatment.
- e- Increase the treatment capacity of bio-waste.
- f- Optimize the sorting plant for packaging waste
- g- Sealing of landfill and gas removal.
- h- Enlargement of landfill.
- i- Implementation of pilot experiences of separate collection of bio-waste targeting important waste producers.
- j- Communication and awareness campaigns to citizens.

Finally, after assessing all the needs and ranking the importance of intervention changes in the treatment phase, it was decided to address the field of plastic packaging, brick and cardboard waste.

Waste packaging challenges

The light packaging facility started working by 1998 by the Community of Madrid. It started with a manual selection process and a treatment capacity of 25,000 tonnes/year. In 2006, the manual operation was replaced by an automatic selection, thereby adjusting to the advances of the optical equipment for the best selection of materials. Currently, it consists of a classification line of light packaging which, after automation, has a nominal capacity to treat 7 tonnes/h. The Pinto sorting facility has a high effectiveness in accordance compared with similar plants (85%) whereas the performance in turn is 57% from total inputs.

To know how quantitatively the facility works, it presents the 2015 data obtained:

Sorting facility of light packaging in Pinto	Review of the year 2015
Inputs	20,198,170 Kg/Year
Requested material (Ecoembes¹) of Inputs. <i>(Film, Colour & natural HDPE , PET, PVC, Remaining plastics, steel & aluminium packagings, beverage cardboard / food)</i>	62.5 %
Material recovered by Ecoembes	11,332,240 Kg/year (56,1 % of inputs)
Materials recovered by other recyclers <i>Steel & aluminum commercial/industrial</i>	3,502,719 Kg/year

<i>packaging, Steel & aluminum no packaging, Celluloses, Commercial packaging p/c with Green Dot, commercial/ industrial film, etc.</i>	
Rejection in landfill	1,796,720 kg/year (8.9 % of inputs)
Overall effectiveness of the plan (Ecoembes + Recyclers of P/C, WEEEs, woods, no plastic packaging, etc.)	89% effectiveness

Table 2: Scenario of the light packaging facility in Pinto of the year 2015

¹ **Ecoembes** is the Integrated Management System (SIG) non-profit organisation responsible for managing plastic containers, cans, bricks (EE.LL), cartons and paper. The purpose of Ecoembes is to run, in collaboration with local and regional governments, systems for selective collection of household lightweight and paper-cardboard packaging waste for subsequent treatment and recovery in order to fulfil the legal recovery and recycling targets in the most environmental and economical efficient way.

Characterization of light packaging plant inputs in 2015. Waste from the municipalities of Mancomunidad del Sur.

	2015		
	Quarter 1	Quarter 2	Quarter 3
Materials	Representative		
Material requested	62,05%	62,10%	63,15%
Film (except single-use bags)	9,04%	9,44%	8,62%
Film single-use bags	8,29%	8,47%	8,35%
Colour HDPE	3,73%	3,38%	2,59%
Natural HDPE	1,20%	0,94%	0,77%
PET	10,80%	10,83%	12,86%
PVC	0,01%	0,01%	0,00%
Remaining plastics	7,11%	6,88%	7,77%
Steel	9,77%	9,39%	8,56%
Aluminium	0,22%	0,25%	0,79%
Beverage cardboard / food	11,20%	11,92%	12,02%
Commercial/Industrial film	0,69%	0,58%	0,82%
Other unsolicited materials	37,95%	37,90%	36,85%
Steel commercial/industrial packaging	0,01%	0,04%	0,05%
Steel no packaging	0,32%	0,32%	0,29%
Aluminium commercial/Industrial packaging	0,00%	0,00%	0,00%
Aluminium no packaging	0,04%	0,01%	0,00%
Celluloses	1,44%	1,47%	1,81%
Commercial packaging p/c with Green Dot	0,10%	0,11%	0,05%
Commercial packaging p/c without Green Dot	1,42%	1,43%	1,12%
Household packaging p/c with	2,42%	1,90%	1,81%

Green Dot			
Household packaging p/c without Green Dot	1,01%	0,75%	0,61%
Film for bine bags	1,01%	1,41%	2,18%
Commercial/Industrial Film	0,37%	0,33%	0,86%
Wood Commercial/Industrial packaging	0,04%	0,02%	0,06%
Wood no packaging	0,45%	0,43%	0,44%
Organic matter	2,01%	2,16%	2,65%
Others (indicate significant)	5,24%	5,26%	5,65%
Printed paper	5,79%	6,05%	4,03%
Plastics Commercial/Industrial packaging (Except Commercial/Industrial film)	0,94%	0,99%	0,67%
Plastics no packaging (Except Film for bin bags)	5,37%	5,52%	4,52%
Pruning	0,72%	0,59%	0,88%
Minor construction waste	0,25%	0,13%	0,48%
Textiles	6,96%	7,24%	6,36%
Glass packaging	2,04%	1,74%	2,33%
Total	100,00%	100,00%	100,00%

Table 3 : Characterization of the light packaging facility in Pinto in 2015

The optimization of the sorting plant for packaging waste has been selected by Mancomunidad del Sur to draw a roadmap for improvement. Although the performance of the sorting plant is adequate it is necessary to address improvements in this area due to the following reasons:

- The facility was opened in 1998, so 18 years of activity are an enough reason to perform a complete overhaul and renovation of equipment, highlighting the obsolescence of certain equipment and mechanical elements in the sorting facility of Pinto; some of them date from the opening of the plant in January 1998.
- Increase the treatment capacity of the plant.
- Optimize the performance of facilities in order to ensure that the current and expected targets regarding packaging recycling can be reached.

1.2 DRIVER FOR IMPROVEMENTS

The current regulatory framework in terms of waste management is becoming increasingly demanding and specific. It is important to note the approval standards concerning waste management of recent years, so that waste policies and potential environmental and economic benefits act as drivers for improvement to boost the different waste separation. In this sense, recently the State -Spanish- Framework **Plan of Waste Management (PEMAR) 2016-2022** has been published.

As reflected in the PEMAR (State –Spanish- Framework Plan of Waste Management) to increase the recycling, it is necessary to launch a series of specific actions to increase separate collection. Thus in

2020 the national objective is to increase the tonnes from separate collections, from 3 million gross tonnes to 9 million, thereby reducing from 17 to 11 million tonnes of mixed waste.

As the European Commission points out in its recommendations, given the existing distribution of powers in these wastes, some of the actions have to be developed by local authorities, but many others must be developed at a national and regional level.

To increase recycling of plastic, metal and bricks, the measures to select must be focused primarily on promoting a better separation in homes and large producers (hotels, public’s administrations, offices, universities, educational and recreational centres, events) as well as to foster the separate collection in the recycling point.

So, in accordance with the estimations included in the PEMAR (mentioned above), at the national level it would be necessary:

- To increase the net recycling of plastic (packaging and non-packaging) in 0.78 million tonnes of plastics packaging.
- To increase the recycling of metals by 0.23 million tonnes.
- To increase the net recycling of bricks to 0.11 million tonnes.

The following table shows the Community of Madrid targets for packaging and packaging waste that must be met since 2008. It is likely that these objectives will be revised upwards by the European Commission.

Current targets for recycling and recovery	
% total recycled	55-80
% total recovery	Min. 60 %
Material → % recycled	
Paper	60
Glass	60
Metals	50
Plastics	25.5
Wood	15

Table 4: Details of the sets of actions to achieve the recycling targets for each material for The Community of Madrid that must be met since 2008 (Look at table 3- requested material of Inputs in 2015)

Following the legal framework, through which the management of packaging waste is regulated, we also find the **Law 11/97 on packaging and contaminated soils**, which sets out the principles of action in minimisation and prevention at source packaging waste. It regulates certain measures to prevent or reduce their impact on the environment, to prevent generation and to promote reuse, recycling or recovery.

It also regulates the regime of Integrated Management Systems (GIS), as is the case with ECOEMBES (1 page 9).

Besides, it sets the target of a reduction of 10% in weight of packaging waste, considering prevention as the first option in waste management.

The **Royal Decree 252/2006** of 3rd of March, revises the recycling and recovery targets set out in the Law 11/1997 of 24th April, on packaging and contaminated soils, and amending Regulation for its development and implementation, approved by Royal Decree 782/1998 of 30th April.

This directive is sought to harmonise the rules on management of packaging and packaging waste from different Member States, in order to prevent or reduce their impact on the environment and prevent barriers between different Member States of the European Union.

The **Royal Decree 1481/2001, of 27th December**, regulates the disposal of waste in landfill. We also have to take into account the rules of the community of Madrid in terms of Waste management, **Law of 5/2003, of 20 March**, Waste of the Community of Madrid.

Finally, based on legislation and national and European difficulties, one of the most important challenges for Spain is to meet the targets applicable to the household waste and similar, applying the principle of hierarchy in waste management, so that the dumping decreases gradually and becomes the minority option. From this end, we must implement a series of actions with a very different nature.

In the same way, Mancomunidad del sur has its specific challenges as to optimise the operation of the light packaging facility in order to get a higher percentage of effectiveness of selected materials and to reduce the loss of recoverable materials in the rejection of the facility which its final destination usually is the landfill.

Reasons why the sorting light packaging should be modified are detailed as follows:

- To improve the performance in terms of reduction of the rejection in landfill, environmental impact and energy efficiency.
- Ensure a possible extension of treatment by modifying the plant and renew equipment. For example to face the chance that the enlargement of the yellow bin to plastics packaging and non-packaging plastics.
- Provide the installation with equipment of a high automation degree to ensure high efficiency in their processes.
- Guarantee a minimum effectiveness of 85% of treatment of the installation.
- Ensure a minimum availability of equipment of 95% of total operating time programmed by the selected operator.
- Remove obstacles that can cause bottlenecks at some point of the installation.
- Comply with the quality specified in the technical specifications for recovered materials (ETMR) for selected waste.
- Adapt the ergonomics and concerned safety and health for workers occupying the various positions of the installation conditions.
- Respect the rules and procedures of quality and environment at the facility.

- Improve the energy efficiency of the plant.
- Introduce the Solid Recovered Fuels (SRF) manufacturing in the treatment process.
- Comply with the obligations under the Framework Cooperation Agreement between the Community of Madrid and Ecoembalajes Spain, S.A., which Mancomunidad del Sur is adhered since 05/14/2014

1.3 DESIRED SITUATION

In the short term, applying the above measures is with an aim to achieve a situation with improved data than 2015. Below, the desired scenario is indicated for 2020.

Sorting facility of light packaging in Pinto	Desired situation 2020
Inputs of EE.LL	21.814,0236 tn/año
Requested material (Ecoembes) of Inputs <i>(Film, Colour & natural HDPE , PET, PVC, Remaining plastics, steel & aluminium packagings, beverage cardboard / food)</i>	63,17%
Overall effectiveness of the plan (Ecoembes + Recyclers of P/C, WEEEs, woods, no plastic packaging, etc.	93% effectiveness
Selected materials by Ecoembes, within the agreement:	
Brick	3.200 t/año
PEAD	935 t/año
PEBD	4.790 t/año
Other plastic	1.930 t/año
PET	3.387 t/año

Table 5: Desired situation of Sorting facility of light packaging in Pinto

II. POTENTIAL FIELDS OF INTERVENTION

2.1 POTENTIAL ACTIONS ON WASTE MANAGEMENT

In the interviews conducted in WP2, some Strengths and Opportunities for innovations in waste management in Spain were described.

Strengths

- Important financial support from the European Union to improve technology
- The universities are working to develop entrepreneurs
- Existing legislation and policies on waste management
- Municipalities are active with information campaigns and offer visits for residents
- The recovery rate is high when it comes to plastic and there is an available market.

- This enables lower taxes for waste recovery in general.

Opportunities

- Existing technology and circular economy are incentives to market formation
- Information campaigns for citizens
- New waste managing facilities create job opportunities

The table lists key potential actions along the waste chain of the waste stream selected that can lead to the desired situation of improvements in Mancomunidad del Sur:

Action	Description
A.1. Determination of the initial state	<p>Municipalities:</p> <ul style="list-style-type: none"> - To develop prevention plans of municipal waste (with planning, specific measures adapted to the reality of the municipality and a proper budget). - To increase and improve the awareness campaigns. - Implement concrete and effective measures for reducing single-use bags as indicated by the European Parliament. - Implement effectively the eco-design and work for the elimination of products with harmful impacts on the environment and health (eg microplastics and oxofragmentables). - Set targets for reuse for beverage packaging, protecting its survival in the HORECA sector (hospitality, restaurant and catering). - Implement deterrents environmental taxes: payment for waste generation. <p>Mancomunidad del Sur</p> <ul style="list-style-type: none"> - Apply stricter deterrent environmental taxation: tax by disposal in landfill or incineration and payment for the waste generation.
A.2. Implementation/adaptation waste collection scheme for appropriate waste management.	<p>Municipalities:</p> <ul style="list-style-type: none"> - To assess the enlargement of the yellow bin to plastics packaging and plastics non packaging. For this situation it would be necessary to prepare the sorting plants. - To improve the selective separation and the quality of the collected materials: analyse and choose the model of collection and separation (door to door, fifth container, wet-dry, mandatory deposit-refund system (SDDR) etc.) most appropriate depending on the circumstances.
A.3. Transportation	<p>Municipalities:</p> <ul style="list-style-type: none"> - Economize the transport: - Changing collection routes. - Modernize the fleet of trucks. - More sustainable driving
A.4. Treatment	<p>Mancomunidad del Sur:</p> <ul style="list-style-type: none"> - Prepare the facility for the possibility of receiving non-packaging plastic waste - To find end markets for recycled plastic of high added value outside the agreement with Ecoembes¹. - To incorporate technological improvements in treatment plants. - To solve the technological limitations of optical separators such as limitations of color, label, metallized surfaces, multi-layer materials or blown errors.

A.5. Recycling	<p>Recyclers or Integrated Management System (Ecoembes):</p> <ul style="list-style-type: none"> - To find e markets for recycled plastic of high added value.
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Table 6: Actions that can lead to the desired situation.

¹ Ecoembes: Integrated Management System of plastic packaging waste.

DEMAND-SIDE INSTRUMENTS

From demand side (procurers), the following measures can be taken to uptake waste procurement alternatives and a progressive improvement of public procurement processes towards PPI:

- Provide access to financing instruments to public entities such as Mancomunidades (association of municipalities with more than 20,000 inhabitants).
- Introduce the concept of innovative public procurement, with the advantages, benefits, drawbacks and risks.
- Update legislation relating to the PPI
- Include a percentage of innovative public procurement in public tenders.
- Improve the procurement process at Mancomunidad del Sur to facilitate innovation with actions such as:
 - Include all stakeholders that innovation or need for innovation come from
 - Analyse outcomes
 - Analyse the main drivers such as: mission or policy articulating demand, market development and opportunities,
 - Early market and/or stakeholder engagement included making sure innovative ideas are included in the procurement process and give attention to new initiatives from the eco-innovators and the market
 - Promote change at organizational level and create a routine to choose PCP/PPI or other process of procurement if suitable.

POTENTIAL BARRIERS

In the interviews in the WP2 some weaknesses and threats to procurement of innovation and the readiness of the innovation system were

Weakness

- Lack of transfer of research results from the universities
- Waste management is only an issue for politicians
- Innovations do not come from the region since there are not many industries at local level
- Small budget for waste management in the municipalities

- Local authorities are not very familiar with the bio waste management
- Lack of knowledge and confidence in waste recovery among citizens

Threat

- Tender-period for waste management for 25 years is slowing down possibilities for innovation and is blocking the development in the region.
- The public sector is in the hands of the biggest private companies and there is a vendor lock-in threat.
- No financial capacity to follow the legislation on waste management.
- A huge resistance to implement new solutions within bio waste management
- Lack of financial resources within the local authorities for these kinds of improvements

The key potential gaps or barriers for the proposed actions and achieving the goals of the roadmap

- Long-terms contracts allocated to waste management organizations (effect of vender lock-in)
- Political conditions different in each municipality which do not favour common agreements on possible innovation in waste management.
- Economic support
- Lack of knowledge on innovative procurement
- Lack knowledge on funding opportunities
- Technological advances unachievable because of its high cost
- Rejection of the population against the construction of new treatment plants

III. STAKEHOLDERS INVOLVEMENT

Identifying and engaging all interested stakeholders is a key element in the success of a roadmap, in terms of both its development and its implementation. A roadmap usually has to engage and align diverse stakeholders that will help to support its implementation.

Therefore it is necessary to identify them, consider and link their involvement and relevance to the actions and measures proposed to achieve the goals of Mancomunidad del Sur.

Actions- Measures/Stakeholders involvement	Municipalities	Citizens	National Government	Mancomunida d	Integrated Management System	Packaging producers
A.1. Determination of the initial state	<ul style="list-style-type: none"> - The local policy makers must develop prevention plans of municipal waste - To increase and improve the awareness campaigns. - Implement concrete and effective measures for reducing single-use bags as indicated by the European Parliament. - Implement 	<ul style="list-style-type: none"> - Teach the younger generation the importance of protecting the environment and to have a sustainable consumption 	<ul style="list-style-type: none"> - To support municipalities and Integrated Management System. -To increase and improve the awareness campaigns. - Implement concrete and effective measures for reducing single-use bags as indicated by the European Parliament. 	<ul style="list-style-type: none"> - To increase and improve the awareness campaigns. 	<ul style="list-style-type: none"> - Implement effectively the eco-design and work for the elimination of products with harmful impacts on the environment and health. 	<ul style="list-style-type: none"> - To create plans against waste generation

	<p>effectively the eco-design and work for the elimination of products with harmful impacts on the environment and health (eg. microplastics and oxofragmentables).</p> <ul style="list-style-type: none"> - Set targets for reuse for beverage packaging, protecting its survival in the HORECA sector (hospitality, restaurant and catering). -Implement stricter deterrents environmental taxes: payment for waste generation. 		<ul style="list-style-type: none"> -Set targets for reuse for beverage packaging, protecting its survival in the HORECA sector (hospitality, restaurant and catering). 			
<p>A.2. Implementation/adaptation waste collection scheme for appropriate waste management.</p>	<ul style="list-style-type: none"> - To assess the enlargement of the yellow bin to plastics packaging and plastics non packaging. - To improve the selective separation and the quality of the collected materials: analyse and choose the model of collection and separation 	<ul style="list-style-type: none"> - Separate waste at home - Deposit each residue in its container 	<ul style="list-style-type: none"> -To support municipalities and associations with financial instruments. 	<ul style="list-style-type: none"> - Apply stricter deterrent environmental taxation: tax by disposal in landfill or incineration and payment for the waste generation. 	<ul style="list-style-type: none"> - Advise municipalities on the means of waste collection. - Advise on the treatment of waste - Get agreements with municipalities and packagers 	

	<i>(door to door, fifth container, wet-dry, mandatory deposit-refund system (SDDR) etc.) most appropriate depending on the circumstances.</i>					
<i>A.3. Transportation</i>	<i>- Economize the transport: ◦Changing collection routes. ◦Modernize the fleet of trucks. ◦More sustainable driving</i>			<i>- Economize the transport from transfer station to treatment facilities</i>		
<i>A.4. Treatment</i>	<i>-Assess the construction of treatment plants on their land. Sometimes it's necessary.</i>		<i>-To support municipalities and associations with financial instruments.</i>	<i>-Prepare the facility for the possibility of receiving non-packaging plastic waste - To find end markets for recycled plastic of high added value outside the agreement with Ecoembes^{1(page 9)} - To incorporate technological improvements in treatment plants. - To solve the technological limitations of</i>	<i>- Work with technology providers on the improvement technological processes</i>	

				optical separators such as limitations of colour, label, metallized surfaces, multi-layer materials or blown errors.		
A.5. Recycling		<ul style="list-style-type: none"> - To prioritize buying items made from recycled materials. - Buy sustainably. - Buy products unpackaged 		<ul style="list-style-type: none"> - To ensure that all selected materials end up in the plants recyclers 	<ul style="list-style-type: none"> - To find e markets for recycled plastic of high added value. 	<ul style="list-style-type: none"> - Industries using recycling materials

PILOT ZAGREB

I. CHALLENGE DEFINITION

Improvement of the current waste management is one of the main challenges for most municipalities in Croatia, mainly due to legal obligations set in different European Union directives regarding waste management, such as reduction of waste generation and landfilling, or increase of separately collected waste and recycling rates. Due to its size, largest obligation is for the City of Zagreb.

Since the present waste management system mainly depends upon landfilling, with the rate of separate waste collection and recycling far from being adequate, it is necessary to introduce a new system which will take into account the current situation in the city as well as the obligations imposed by the European Union. Namely, in the coming years, the Waste Framework and Landfill Directives of the European Union (transposed into national Waste Act) will be a significant driver of change in waste management practices and governance of the City of Zagreb.

At present, the yearly separate waste collection makes somewhat less than 5 kg/cap of various waste fractions, i.e., far below the average value for the capital cities of the EU (28), which is 108 kg/cap. This is possible to achieve only by a better and sustainable planning of future activities and facilities taking care of environmental, economic and social aspect of waste management. This means that the City of Zagreb will not only have to invest in new infrastructure to meet the targets, but will also have to enhance public awareness in diverting this waste at household level.

In this sense, implementation of the circular economy approach to current waste management practice in the City of Zagreb will be necessary in upcoming period.

1.1 CURRENT SITUATION

Description of Zagreb City Holding

As the capital of Croatia, the City of Zagreb is a local self-government unit with a status of regional self-administration. Its area stretches over 641,3 km², and it consists of 17 districts. According to the 2011 census, Zagreb has a population of around 790,000 inhabitants.

The organized municipal waste collection in the city covers around 360,000 service users (data for 2012), out of which 350,000 are residential users (2/3 users live in residential buildings and 1/3 in family houses). There are about 10,000 commercial users.

In the City, the mixed municipal waste from households is mainly collected in containers and bins, and only a small portion in plastic bags.

Zagreb Holding – Čistoća (ZCH) branch was established in 1923 as a communal company responsible for waste collection and disposal and maintenance of cleanliness of public areas for the City of Zagreb. Today it operates as a branch of Zagreb Holding in 100% ownership of the City of Zagreb and it performs the following activities:

- Implementation and development of integrated waste management system for the City

- Separate collection of reusable waste in public traffic areas and recycling yards – paper, metal, glass, plastic and textile plus bulky waste,
- Collection and disposal of municipal waste from households and other beneficiaries,
- Cleaning and washing of public traffic areas (pavements, sidewalks, squares, underpasses, public stairways and passages), setting up and maintenance of waste bins and urban equipment in pedestrian zones,
- Ice and snow removal in winter from public stairways, wheelchair access and pedestrian zone

Organizational structure and procurement process

Zagreb City Holding consists of 16 branches, seven commercial companies and one institution. Mother company is responsible for procurement processes and procurement is centralized and carried in cooperation with the Procurement Office of the City of Zagreb. Central procurement department in Mother company is responsible for managing all the procurement processes in line with Public Procurement Act (Official Gazette 90/2011) and Act amending the Public procurement act (Official Gazette 83/2013).

Management of procurement processes starts with the planning of yearly needs for procurement and ends with realization and monitoring of approved needs/requirements. Once the needs of each branch are identified they are analyzed, selected and for the approved ones the funds on yearly basis are secured. The approval of needs will depend on cost analysis of the needs as well as short term strategy for the business objectives of each Zagreb Holding branch. Once the yearly plans are approved, branches are the ones that set up a requirement for a certain good or service, and they are also in charge to set up technical and economical specifications for the goods and services they are procuring in line with their needs. Central procurement department prepares all the necessary documentation, calculation of expenses, and tenders together with the Procurement Office of the City of Zagreb based on the input that they receive from the branches and then Procurement Office from the City publishes call for tenders. They are in charge to ensure fair and open competition while minimizing risks such as fraud or collusion. The process can be tendering or competitive bidding process. When offers are submitted, the decision-making process begins. Offers are analyzed and evaluated and the report is made regarding those steps. Then the purchasing decision about approving one or more supplier is made, or if no one meets given criteria, they make decision about the annulment of the call for tenders. Criteria for the selection of the supplier/s among submitted offers is that the best possible price is offered when aspects such as quality, quantity, time and location are compared for delivery of goods and services that matches criteria given in the documentation. Also a risk assessment is made and best value assessment before selecting the final suppliers/solution. With the accepted supplier a contract is made and signed from both parties. The branches are in charge for the implementation of the contract. Described steps are used for all the procurement of goods and services that amounts above 200.000 kn (cca €26,000) and for the construction work above 500.000 kn (cca €66,000).

Waste challenges of Zagreb City Holding

Most of the EU legislation concerning waste management has been transposed into national laws, such as: Directive on non-hazardous construction and demolition waste, as well as paper, plastic, glass and metal from households (2008/98/EC), Directive on batteries (2006/66/EC), Directive on end-of-life vehicles (2000/53/EC) (EU, 2000) , etc. Setting the key objectives as defined in the EU legislation is a necessary foundation of the sustainable waste management in the City of Zagreb, as transposed in the Act on Sustainable Waste Management (Official Gazette 94/13). One of its crucial

elements are: need to reduce waste landfilling in order to prevent its damaging influence on the environment, especially the reduction of biodegradable waste. The aim of the above mentioned Waste Management Act is to develop an integral and sustainable waste management system, and also a market for secondary raw materials in the Republic of Croatia and the City of Zagreb, which is still at its beginnings.

ZCH collects municipal solid waste (MSW) from all city districts, which is mostly being landfilled at the landfill Jakuševac-Prudinec. The amount of MSW collected in 2015 was **223.293,31** tons collected through 12,000 different bin volumes (120l, 240l, 1,1m³, etc.).

As for the separate waste collection in the City of Zagreb, paper and cardboard, glass and waste plastics are collected in the bins and containers placed in the public areas. There are 5,155 bins available for source-separated collection of previously mentioned waste fractions.

In addition, paper and cardboard are collected in bundles by special vehicles in the afternoon and evening hours, stopping by the locations where such waste is generated on a daily basis (shops, commercial centres, etc.). All reusable collected waste is handed further to the companies licensed for its further recycling.

In 2015 a total of **11,041.4** tons of reusable waste fractions were collected from the recycling yards and bins of public areas. Furthermore, total of nine recycling yards operate for the separate collection of reusable waste, three more are in the process of opening and recently two mobile recycling yards are operating in the areas of the City that do not have access to the existing recycling yards. Total quantities of certain separately collected waste fractions in 2014 and 2015 are detailed in the table 7.

Year	Paper		Glass		Plastics		Metal		Biowaste Containers and RY (t)
	Contain ers (t)	RY (t)	Contain ers (t)	RY (t)	Contain ers (t)	RY (t)	Contain ers (t)	RY (t)	
2014	1,442.9	435.5	1,053.8	49.9	487,2	0.6	3.2	3.8	5,178.5
2015	1,140.5	328.7	1,181.5	59.8	378,9	20.2	4.3	13	4,673,9

Table 7- Total quantities of separately collected waste fractions through containers and recycling yards organized by the branch Čistoća

According to the above mentioned challenges and the current potential for improvement, the most important needs that the ZCH is facing are:

- Implementation of the sustainable waste management for biodegradable waste,
- Development of integrated solution for biowaste management in the City (e.g. logistics, treatment, etc.)
- Increase the amounts of other source-separated waste fractions (plastics, glass, textile, etc.),
- Develop a solution for a treatment of bulky waste
- Upgrade current biowaste facility in order to treat different fractions (e.g. kitchen waste, industrial waste)
- Implement sorting facility for separately collected plastics,
- Develop different communication and awareness campaigns for citizens.

Finally, focus of this roadmap is to develop sustainable management of biowaste, and emphasizing collection and logistics as a one of the pathway to achieve the legally-binding targets.

Biowaste challenges

Considering the targets for biodegradable municipal waste landfilling set in the above mentioned Waste management act and the call from European Commission to set up separate collections of waste where technically, environmentally and economically practicable and appropriate to meet the necessary quality standards for the relevant recycling sectors, the introduction of improvements in separate collection of biodegradable municipal waste in the City of Zagreb must be set as a priority. Otherwise, the goals and targets at the national level will certainly not be achieved even after 2020, the year set as final deadline.

Namely, in accordance with the obligations related to biodegradable waste that the Republic of Croatia has undertaken, by end 2016 the maximum of **64,274** tonnes of biodegradable municipal waste can be landfilled in the Zagreb region. This means that by the end of 2016 allowed mass of biodegradable waste deposited on the landfill must be reduced from the 2012 level by 81,668 tonnes, or 56% of total landfilled biodegradable waste. For the year 2020 the allowed landfilling of biodegradable waste is even lower and amounts to only **44,992** tonnes, which is a reduction by 100,950 tonnes or as much as 69% of total biodegradable waste in 2012.

Since in 2012 the amount of biodegradable waste landfilled at the Zagreb’s landfill site was as high as 145,942 tonnes, it is evident that these obligations will not be fulfilled and that the separate biodegradable waste collection system is quite underperforming. To put the data into perspective, it results that almost 17% of biodegradable waste out of total waste amounts in Croatia is landfilled in Zagreb. Following image shows current amounts of biowaste and allowed amounts for landfilling.

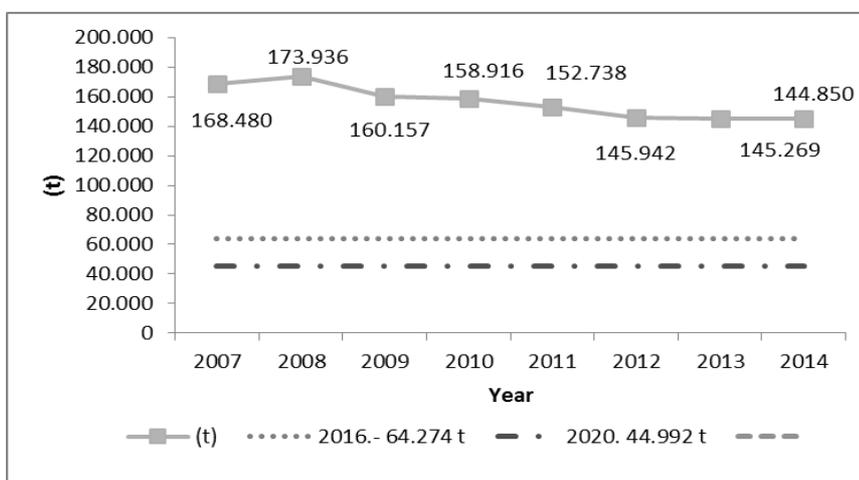


Figure 1. Landfilled biodegradable waste in the City of Zagreb in relation to obligations and quantities allowed to be landfilled

Biowaste, as a fraction with the highest share in total biodegradable municipal waste, represents one of the greatest challenges in establishing a sustainable waste management system. The separate collection of bio-waste where it is generated generally results in better quality of the substrate due to lower content of impurities (such as plastic residues, metal compounds, glass packaging, etc.) when compared to mechanically separated organic waste from mass of municipal waste. Municipal waste mostly consists of organic waste, including kitchen waste, food residues, waste from food industry, grass, wood, paper and cardboard, etc. The “green waste”, as a part of municipal waste,

mainly consists of garden waste and waste generated in the public parks. The collected biowaste is Generally transported to composting units in the city area. The following figures show the composition of MSW in the City of Zagreb, and total annual quantities of treated biowaste (mostly green waste).

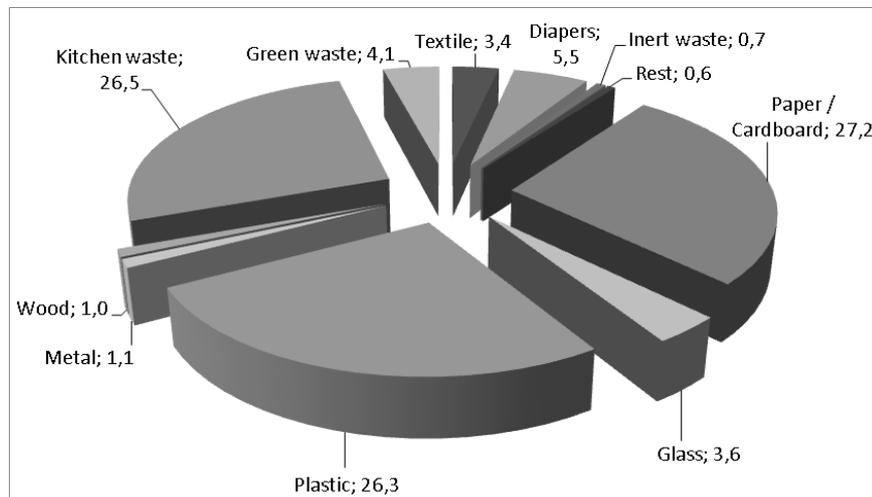


Figure 2. Municipal waste composition in the City of Zagreb

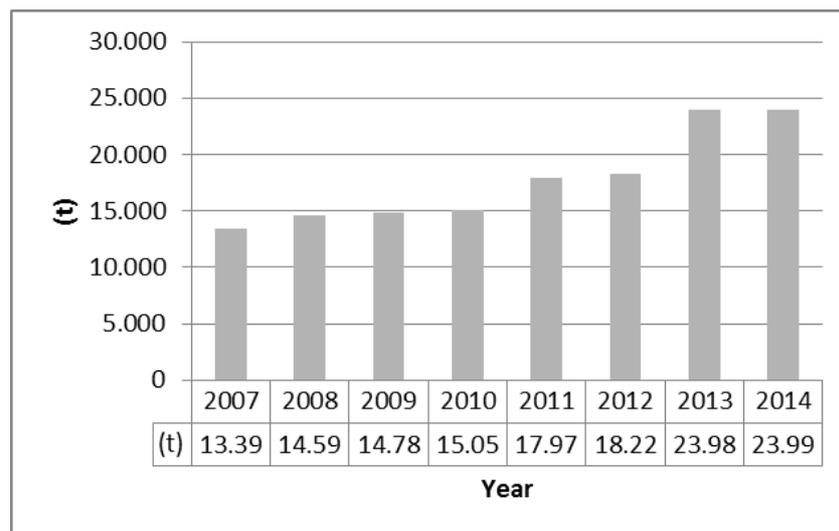


Figure 3. Treated biowaste in the City of Zagreb

The important starting point for developing sustainable biowaste management in the City is to analyse and assess all processes of biowaste management in the City of Zagreb:

- Biowaste producers
- **Collection and transportation**
- Treatment

Special focus is on collection and transportation in order to propose a solution with lowest environmental impact, such as: air quality, noise reduction, optimization of bin and container positioning, etc.

Regarding the separate collection of biowaste in the City of Zagreb, ZCH has developed a system that covers certain districts with households, but also: hotels, restaurants, markets, shopping malls,

florists and other companies (around 3,200 biowaste producers). Separately collected biowaste is disposed at a composting site at Jakuševac area. ZCH has various vehicle fleet for waste collection. In 2015 it disposed of 190 vehicles. It also has 14 vehicles for the collection of special types of waste.

The amounts of biowaste collected (market places, food and beverage industry, households) in 2015 were 4,673.9 tonnes. The increase of collected biowaste amount has been shown in the table xx.

	2012.	2013.	2014.	2015.
Recycling yards	135.9	216.39	397.1	479.5
Households	163.6	1,010.3	1,211.6	948.6
Other (shops, markets, etc.)	2,299.8	2,345.7	3,569.7	3,245.9
TOTAL (tonnes)	2,599.3	3,572.4	5,178.5	4,673.9

Table 8- Total quantities of separate collected biowaste by the branch Čistoća in period 2012-2015

At the moment, all of separately collected biowaste in the City of Zagreb is being composted. Within the City there are three composting plants: Jankomir, Markuševac and Prudinec.

Due to the fact that these composting plants are mainly constructed for the treatment of green waste and wood from green public areas, its usage for kitchen waste is quite limited. This is one of the reasons for the necessity of modern and up-to-date treatment facility for biowaste, where anaerobic digestion and biogas production could represent a possibility for improvement. The main portion of above presented quantities is from marketplaces within the City.

Having in mind the total potential of produced biowaste in the City, these amounts are still not that significant and complete biowaste collection needs improvements. The action of improving that system is underway, where significant improvement is expected in the future. Over the past five years various projects were prepared and actions conducted in Zagreb in which particular attention has been paid to the biowaste collection improvement linked with a previously mentioned legal obligations Croatia has regarding the decrease of biodegradable waste landfilling. Also, over the years ZCH has performed many surveys and inquiries regarding the potential of biowaste in the City from different waste producers. Table xx shows an estimation on possible quantities of biowaste in the City of Zagreb.

Input	Amount, t/year
Biowaste from shopping centers and households	5,000
Biowaste from kitchens and restaurants	10,000
Market biowaste	3,000
Industrial biodegradable waste (brewery, dairy, food processing)	1,500
Expired milk & eggs	500
TOTAL	20,000

Table 9-. Total estimated quantities of biowaste in the City of Zagreb

An estimate provided in the table above can outline the expected potential in the City, combining industrial biodegradable waste, biowaste from restaurants, expired products and biowaste from shopping centres and citizens, which are all included in this project.

Regarding the collection scheme, current biowaste bins for households are being emptied once a week, and from industrial producers it is usually collected on demand. Following tables are presenting the current infrastructure of ZCH regarding the waste management in the City of Zagreb.

Container/tank volume (l)	Number of containers/tanks
1,100	13,335
80	370
120	64,632
240	28,584

Table 10. Number and volume of containers/tanks for collecting of MSW

Container/tank volume (l)	Number of containers/tanks
1,100	158
120	1,769
240	88

Table 11. Number of containers/tanks for biowaste collection in city of Zagreb

Vehicle type	Number of vehicles
Special vehicles for household and industrial waste collection	100
Special vehicles for bulky waste	45
Special vehicles for cleaning and washing	64
Special vehicles for HW transport	2
Pick up and personal vehicles	36
Other	8
Total	255

Table 12. Vehicle fleet in ZCH by vehicle type

Based on all data in the tables above, it is clear that ZCH is operationally prepared for introduction of separate biowaste collection but some improvements will be required, such as: new collection routes for biowaste, network of bins and containers, etc. All of these improvements are core business of waste management companies and its implementation is a good chance to have public procurement where innovative approach and usage of up-to-date technology and solutions will gain benefits to the sector of waste management.

1.2 DRIVERS FOR IMPROVEMENTS

As mentioned before, the EU legislation concerning environmental protection, which has already been implemented in the national laws of the Republic of Croatia, aims at introducing integral and sustainable waste management system. Generally, one of the main reasons for this is an undeveloped system of waste separation and lack of waste treatment (recycling) facilities.

The main driver first obligation of the Republic of Croatia regarding the reduction of municipal waste landfilling refers to the biodegradable waste component. Namely, the goal concerning landfilling in Croatia is regulated by the Act on Sustainable Waste Management (Official Gazette 94/13), which lays down the amounts of maximum allowable biodegradable municipal waste amounts that can be deposited annually in all landfills and non-complaint landfills in the Republic of Croatia, in relation to the 1997 level of mass of biodegradable municipal waste generation. These amounts are:

- 75 % or 567,131 tonnes by 31 December 2013,
- 50 % or 378,088 tonnes by 31 December 2016,
- 35 % or 264,661 tonnes by 31 December 2020.

National waste management plan, as well as the plan for the City of Zagreb has expired in 2015 and at the moment, neither national nor local waste management plans have been adopted.

Finally, particular emphasis has been placed on the diversion of biodegradable municipal waste because the anaerobic degradation of the putrescible fraction of biodegradable waste causes the release of greenhouse gases (GHG), especially methane, if not properly managed. Dealing with biodegradable municipal waste effectively can bring about also an overall reduction in a country's GHG emissions.

The current waste management system in the City of Zagreb needs to be improved in order to make it more resource efficient, as well as to shift the current practice upward on the waste management hierarchy (i.e. to reduce significantly waste disposal, and focus on waste prevention, reuse, recycling and recovery). The improvements must aim at establishing a sustainable waste management and meeting the targets set up by the different EU directives and by the applicable national Law, which should be based on the following priorities: waste prevention and reduction, and the improvement of the present separate collection system by increasing the amount of collected waste. Separately collecting specific fractions from municipal waste not only requires the implementation of an adequate collection system but also the active participation of the citizens. The level of citizens' engagement has a direct impact on the efficiency of a collection system. Good information to citizens about the type and kind of waste that should be placed in separate bins is vital to reduce impurities and obtain a high quality recyclable material. Having in mind the amounts and the composition of municipal waste in the City of Zagreb, sustainable and effective management of biowaste should be one of the priorities for all future activities in this sector.

The separate collection of biowaste and its utilization is one of the most recommendable actions in order to increase total separately collected amounts. This is supported by the relatively high yields of collected biowaste. The system of biowaste collection in Zagreb should be focused firstly towards large biowaste producers, such as food industry with agricultural products processing, i.e., food and beverage industry, green markets and commercial centers, service sector centers and agricultural producers. After that, such system of biowaste separate collection should also involve households, which besides kitchen waste produce large amounts of green waste (branches, grass, leaves, etc.).

The collection of biowaste is logistically organized by use of special separating containers and should be distributed to the households, schools, kindergartens, institutions, small businesses, hotels and restaurants. The biowaste generated at commercial centers and large producers would be collected in large bins and containers. Nevertheless, the increase of biowaste amounts must be followed with the facilities which can efficiently treat such types of waste (e.g. biogas plant with the pretreatment phase). Lack of construction of these facilities could have a negative effect on the whole concept of separate collection. These actions require specially organized collection routes for biowaste, in order to have lowest as possible impact on the environment (fuel consumption, air quality, noise reduction, etc.).

1.3 DESIRED SITUATION

It is considered that sustainable waste management has a huge potential of economic and social development not only of the City of Zagreb but of the whole Croatia as well. There is a need to introduce an integral system for waste management based on the principles of circular economy, which would strictly follow the order of priorities in the waste management – waste prevention, preparation of recycling and recovery, material recovery (recycling) and energy recovery (incineration /co-incineration of waste with an adequate energy use). Given the fact that the present rate of recycling useful components of waste in the City of Zagreb is significantly below the targets set out by the EU, it is necessary to start to improve the current primary recycling system with a view to increasing the rate of waste separation. The upgrade of the existing system of separate collection of paper, plastic, metal, glass, and biowaste would result in considerable reduction of landfilling of all types of waste. The new system must aim at establishing a sustainable waste management and meeting the targets set up by the EU directives and by the applicable Law. It should be based on the following activities:

- Waste prevention and reduction of the amounts of total waste generation, and establishing of system of product reuse
- Improvement of the present separate collection system by increasing the number of the “green islands” and recycling yards and their efficiency,
- **Development of sustainable biowaste collection and transport within the whole City with the lowest environmental impact**
- Introduction of separate collection of bio-waste from large producers, and construction of anaerobic decomposition units for bio methane production,
- Construction of a sorting unit for separately collected waste fractions,
- Construction of automated separation plant for the waste left out of the system of separate collection,

Therefore, the separate collection of biowaste is a prime candidate for significantly increasing total separately collected amounts. This is supported by the relatively high yields of collected biowaste, especially considering that waste collection does not share the long recycling history of more (commercially) valuable materials such as paper and glass. The system of biowaste collection in Zagreb should be focused firstly towards large biowaste producers, such as food industry with agricultural products processing, i.e., food and beverage industry, green markets and commercial centres, service sector centres and agricultural producers. After that, such system of bio-waste separate collection should also involve family houses, which besides kitchen waste produce large amounts of green waste (branches, grass, leaves, etc.).

In residential buildings kitchen waste represents the main collected waste (food scraps, fruits, vegetables, etc.), and that biowaste is partly liquid which makes mandatory to collect it in biodegradable bags. Therefore, collecting bins should be placed in city neighbourhoods for this purpose. The collection of bio-waste is logistically organized by use of special separating containers which would be distributed to the households, or would be placed in special spaces in multi-story buildings.

Having in mind current amounts of landfilled biodegradable waste (133,962 t in 2015), and the legal obligations, City of Zagreb must reduce its landfilling amounts to 48,605 t by the end of 2016, and to 34,023t by the end of 2020. It is more than obvious that the target for 2016 will not be fulfilled.

The containers for bio-waste disposal have volume of 120 and 240 litres and, if required, possibly 1,100 litres. The containers for collecting separate bio-waste should be distributed to the households, schools, kindergartens, institutions, small businesses, hotels and restaurants. The bio-waste generated at commercial centres and large producers would be collected in large bins and containers.

As a possibility, energy use of biowaste collected in this way would be performed through anaerobic digestion and biogas production. Such bio-waste treatment could produce two positive effects: landfilling prevention and production of an important energy source with potentially multiple usage. Main advantage of anaerobic digestion compared with the composting is energy production through the optimal utilisation of biogas from bio-waste, upgraded to natural gas (methane) quality, would be in city public transport, where it would be used as fuel for pressurized natural gas powered buses. So far, within the City of Zagreb has 100 CNG busses that are operating in the public transport, and two CNG filling stations.

It would also be possible to directly connect upgraded biogas to the city gas network. Likewise, there is option of using biogas in cogeneration units, producing electricity and heat, but it presumes the consumption of heat throughout the year. The fact that in the City of Zagreb every year 30% of generated biowaste comes from the municipal waste (Figure 3) is an argument in favour of such utilisation of bio-waste, because this quantity would be sufficient for running a biogas plant of 2MWel of rated capacity. The fermented residue, or bio-waste from anaerobic digestion, has not odour nuisance and, thus, its disposal does not cause this kind of problems for the population in the vicinity of the disposal site. It can also be used as compost for the City's public green surfaces.

By implementing all these activities, the City of Zagreb will certainly make a big step towards introducing a sustainable waste management system and improving useful waste separation. Given the fact that the present recycling rate of the main fractions (paper, plastic, bio-waste) is rather low and the targets appear to be hardly achievable within the given deadline and within the primary recycling system, the fundamental problem to be addressed in the future is how to treat the mixed waste which will continue to be generated in the Zagreb region. Focus should be on source separation of certain waste fractions but also it is necessary to build a plant for automated separation of mixed municipal waste where useful waste streams would be separated (e.g., paper, plastic, glass, metal, bio-waste), and in this way improve the system of primary recycling.

II. POTENTIAL FIELDS OF INTERVENTION

2.1 POTENTIAL ACTIONS ON WASTE MANAGEMENT

In the interviews conducted in WP2, some Strengths and Opportunities for innovations in waste management in Croatia were described as follows:

Strength

- Businesses and actors are present and have knowledge,
- Willingness to change,
- Comparisons with neighbouring regions in other countries (Germany, Italy),
- Resources are present and can be reallocated to change the system;

Opportunity

- Public attitudes / perceptions are changing,

- Waste economy will grow/be developed,
- Opportunity to show political will ,
- School programs available;

The following table is a listing of key potential actions along the waste chain of the selected biowaste stream that can lead to the desired situation.

Action	Description
A.1 Determination of the initial state	<u>Municipality and government</u> <ul style="list-style-type: none"> - Set legal targets for biowaste collection amounts, - Implement different awareness campaigns among citizens and other biowaste producers on separate collection, - Implement effectively the eco-design and work for the elimination of products with harmful impacts on the environment and health - Implement deterrents environmental taxes: payment for waste generation.
A.2. Implementation/adaptation waste collection scheme for appropriate biowaste management	<u>Municipality and ZCH</u> <ul style="list-style-type: none"> - Increase the amount of separate waste collection through the implementation of door-to-door collection, - Develop the infrastructure for the collection of biowaste within the whole City area (bins, containers, vehicles, and other logistic requirements), - Improve selective separation and quality of the collected biowaste (analyse and monitor the quality of separated biowaste), - Introduce sustainable collection of biowaste with low environmental impact - Build biowaste treatment plant for anaerobic digestion in order to utilize the biowaste as an energy source
A.3 Collection and transport	<u>Municipality and ZCH</u> <ul style="list-style-type: none"> - Optimization of the collection routes (bin sizes and position depending on the biowaste producers), - Modernize the vehicle fleet and introduction of dedicated trucks for biowaste collection - Implementation of Eco driving and other fuel-reduction methods, - Monitoring of air quality and noise in the urban areas, - Other actions that will lead to environmental-friendly biowaste collection
A.4 Treatment	<u>Municipality and ZCH</u> <ul style="list-style-type: none"> - Build an up-to-date treatment facility for different biowaste types (kitchen and green waste, different industrial biowaste fractions, etc.) in order to diverse biowaste from landfilling - To incorporate technological improvements in treatment plants in order to produce energy (e.g. purification of biogas in order to produce biofuel)
A.5 Recycling/Energy utilization	<u>Municipality and ZCH</u> <ul style="list-style-type: none"> - Develop a market for biowaste in order to increase its amounts - Implement the scheme for energy utilization of produced biofuel (e.g. CHP, inject in local gas grid, utilize as a transportation fuel), - Create a market for compost (outcome of the AD process)

2.2 DEMAND-SIDE INSTRUMENTS

From demand side (procurers), the following measures can be taken to uptake waste procurement alternatives and a progressive improvement of public procurement processes towards PPI:

- Provide access to financing instruments to public entities

- Introduce the concept of innovative public procurement, with the advantages, benefits, drawbacks and risks.
- Train public administration with knowledge for innovative public procurement.
- Update legislation relating to the PPI
- Include a percentage of innovative public procurement in public tenders.
- Create dialogue among actors and especially institutions responsible for waste management related issues
- Support and initiate market for re-cycled materials

2.3 POTENTIAL BARRIERS

In the interviews in the WP 2 some weaknesses and threats to procurement of innovation and the readiness of the innovation system were described.

Weaknesses

- Waste management plan 2020 - not completed and states that the plan will not be fulfilled until 2030
- No political will
- No LCA in waste plans
- Low understanding of the problem
- No research or university programs
- Export of materials
- Resistance for sorting and recycling from government
- No treatment of waste in the City, only landfill
- Export of material instead of own recycling
- Malfunctioning procurements

Threats

- Increasing costs for waste management in the future (EU fines and other costs)
- Low development of technology
- Fewer jobs
- Lost opportunities for national businesses when waste economy develops

To be able to perform a real PPI in Croatia, the waste management plan 2020 has to be fulfilled by the year of 2020 instead of the year 2030 as stated in the Croatian waste management plan. A clear willingness and leadership from the politicians has to be in place. Resources are present and can be re-allocated for a test of a “PPI”.

In a case like this in Croatia a PPI could probably be performed by scaffolding the procurement capacity and support the eco-innovators for a specific solution to a strong need. This could be done as a project, drawing all the actors, competences and resources together for a mission oriented PPI with support in the local policy and the EU waste challenges.

III. STAKEHOLDERS INVOLVEMENT

Identifying and engaging all interested stakeholders is a key element in the success of a roadmap, in terms of both its development and its implementation. A roadmap usually has to engage and align diverse stakeholders that will help to support its implementation. Therefore it is necessary to identify them, consider and link their involvement and relevance to the actions and measures proposed to achieve the goals of Zagreb Holding.

Actions- Measures/Stakeholder s involvement	Policy makers (national, regional, local)	Waste generators (households, business, etc.)	Services providers (waste management companies)	Technology providers	Industries using recycling materials	Intermediate stakeholders at strategic level (business organizations, research and technology centers, associations of companies, universities...)
A.1 Determination of the initial state	<i>Preparation of waste management strategies and plans</i>	<i>Public participating (e.g. NGO)</i>	<i>Participating in the development of plans and strategies</i>	<i>Participation through its expertise</i>	<i>Participation through its expertise</i>	<i>Participation through its expertise</i>
A.2 Implementation/adaptation of collection scheme for appropriate biowaste management.	<i>Decision making according to current legislation regarding biowaste treatment</i>	<i>Promotional campaign, educational material</i>	<i>Operational implementation</i>	<i>Delivery of possible technology solutions for new biowaste collection scheme</i>	<i>Participation through its expertise</i>	<i>Deliver of their knowledge in the construction of new facilities</i>
A.3 Transportation	<i>Financial support</i>	<i>Active participation in the logistic organisation (e.g. bins and containers positioning)</i>	<i>Organization of biowaste collection and its maintenance</i>	<i>Provide solutions for optimal collection route for different biowaste fractions (e.g. solid/liquid, animal by products, etc.).</i>	<i>Participation through its expertise</i>	<i>Development of the optimized biowaste collection systems through the implementation of up-to-date technological solutions</i>
A.4 Treatment	<i>Financial incentives for desired behavior</i>	<i>Promotional campaign, educational material</i>	<i>Waste treatment according to the plans and strategies</i>	<i>Sharing of knowledge and details regarding the production</i>	<i>Analyze the market for recycle material buyers; Contracts with</i>	<i>Support development of biowaste treatment</i>

				<i>process</i>	<i>companies buying recyclable material</i>		
A.5 Recycling/ utilization	Energy	<i>Financial incentives for desired behavior</i>	<i>Education and raising awareness</i>	<i>Operational implementation of source-separated schemes</i>	<i>Sharing of knowledge and details regarding the production process</i>	<i>Usage of recycling materials</i>	<i>Usage of recycling materials</i>

CONCLUSION

Because of the current situation of Mancomunidad del Sur and the City of Zagreb, where landfill prevailing as one of the main solutions for municipal waste, as well as the policy framework on waste, both municipal waste managers face common challenges in order to reach the current and expected European targets on waste. Within these challenges, improved bio-waste management and plastic separation are two of the main needs that they have in common with municipal waste managers along Europe as is described in the deliverable D2.X.

In order to solve their needs several potential actions have been identified. These actions cover several steps along the chain of waste management and some of them would be implemented by the pilot project partners while others should be implemented by other actors.

In the case of Mancomunidad del Sur several actions aimed at improving packaging separation have been identified. The majority of these actions are in the field of intervention of municipalities while only actions regarding treatment process and taxes are within the responsibilities of Mancomunidad del Sur.

On the other hand, Zagreb City Holding has identified actions aimed at improving bio-waste management along the waste chain. In this case, the majority of actions are within the responsibilities of Zagreb City Holding, from waste collection up to treatment stage.

In both cases, both innovation of their procurement procedures and of products and services in their waste practices currently depend on different factors and barriers that slow down its implementation, such as misalignment of local and municipal strategies with European and national policies, lack of clear strategy on waste management, contracting models developed with routine criteria, lack of awareness on PPI, etc..., and somehow block the necessary conditions to establish PPI as a current practice.

In all cases there is a real potential for improvement for both entities and clear common opportunities and needs expressed could be better met by demand if a stronger dialogue and stimulus from contracting authorities to choose innovation for their procurement procedures would be put in place.

Actions highlighted in the roadmap therefore represent concrete needs for both partners and will be used as application example/case to develop subsequent deliverables of performance characteristics approach and development of feasibility study of a concrete public procurement of innovation.