Roadmap and Action Plan (Task 7.2)

Deliverable 7: Report on the Implementation of High Performing Recycling and Waste Schemes at Local Level

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Directorate-General for Structural Reform Support
REFORM@ec.europa.eu
+32 2 299 11 11 (Commission switchboard)
European Commission
Rue de la Loi 170 / Wetstraat 170
1049 Brussels, Belgium

CONTENTS

1 Introduction

1.1 This report

This report is an output of the DG REFORM commissioned project 'Implementation and Monitoring of the Recovery and Resilience Plan for the Green Transition in Spain' which has the Spanish Ministry for Ecological Transition and Demographic Challenge (MITERD) as beneficiary.

The report is part of the work carried out under Deliverable 7 (on High Performing Recycling and Waste Schemes at Local Level) of the aforementioned project. More specifically this report is the output of Task 7.2 and has to do with the 'Action Plan and Roadmap' for the Implementation of high-performing recycling and waste schemes at local level in Spain.

The aim of the Action Plan and Roadmap (i.e. this report) is to provide a detailed and comprehensive overview of policy options and implementation recommendations aimed at improving the current performance of waste collection systems in Spanish municipalities. The performance metric being considered is the one agreed upon between the Spanish government and the European Commission in their "Operational arrangements between the European Commission and Spain", namely the rate of separate collection of waste, i.e. the ratio (in mass) of separately collected waste / total collected waste.

The scope of this Deliverable is that of municipal waste, i.e. the waste under the responsibility of municipalities under the Spanish law. This includes the commercial waste generated by tertiary activities, but not the construction and demolition waste.

1.2 Method

The consultant team proceeded as follows to draft this report. The team successively performed the following tasks:

1. Short list of high-performing waste collection schemes;
2. Data collection on the selected high-performing waste collection schemes;
3. Review of existing methods to enhance the performance of municipalities in terms of separate collection of waste;
4. Clustering of Spanish municipalities into a "Ladder" of performance levels;
5. Definition of an action plan & roadmap, adapted to each performance level.

1.2.1 Short list of high-performing waste collection schemes

The consultant team selected, within the long list of best practices identified at the end of the Inception phase of the study, those municipalities with either (1) the highest absolute rates of separate collection of waste or (2) a recent history of fast improvement of this rate.

1.2.2 Data collection on the selected high-performing waste collection schemes

Interviews have been carried out with those municipalities in the short list, in Spain and the EU outside of Spain, who accepted our interview request. These interviews aimed at learning from what had worked there and what their challenges have been. Six (6) interviews were carried out with

municipalities in Spain[1], and seven (7) interviews with EU best practices[2]. While developing the cases we were pointed at a Catalan website[3] with good practices which does include Argentona (case we already selected) but does not include Torredembarra (which locally apparently is not considered one of the best cases).

Three interview guides where developed:

1. Questionnaire for cases where waste collection is done by a 'public' operator,
2. Questionnaire for cases where waste collection is done by a 'private' operator
3. Questionnaire for cases where waste collection is public but treatment / recycling is private

The interview guides(questionnaires) were largely the same but each included a couple of specific questions relevant to the situation (public / private / public-private). The following table provides an overview of the questions asked in the interview guide against each of the sections of this report.

Table 1-1 Overview of interview questions feeding into each chapter of this report

Report section	Questions in interview guide
2.1 Waste collection fees	✓ What features of the waste collection fees (e.g. Pay as you throw, Deposit refund) do you believe contributed most to the performance of your waste collection and recycling scheme?
2.2 Waste collection monitoring indicators	✓ The performance of a waste collection and recycling scheme often is being monitored by following specific indicators that enable the assessment of the current situation compared to the targets and to planned trajectories to reach these targets. What features of the monitoring indicators do you believe contributed most to the performance of your waste collection and recycling scheme?
2.3 Operational arrangements	✓ What features of the operational and social arrangements in place in the public (resp. private) waste collection and treatment operator do you believe contributed most to the performance of your waste collection and recycling scheme? ✓ What features of your system for the detection and resolution of conflicts within the public operator, between the public operator (of waste collection) and the private operator(s) (of waste treatment) and between the public and private operators and the public authority, do you believe contributed most to the performance of your waste collection and recycling scheme?
2.4 Tendering characteristics / contractual arrangements	✓ How were the private operators (or the single operator) that manage(s) waste treatment (including recycling) in this municipality / metropolitan area selected? (i.e. what were the selection / award criteria)? Why?

[1] Province of Badajoz, Mancomunidad Sasieta (Basque Country), Hernani (Basque Country), Torredembarra (Catalonia), Argentona (Catalonia), Esporles (Balearic Islands)
[2] Milan (Italy), Parma (Italy), Lublin (Poland), Vienna (Austria), Ghent (Belgium), Salacea (Romania), City of Luxembourg (Luxembourg)
[3] https://www.residusmunicipals.cat/actuacions

Report section	Questions in interview guide
	✓ What are, in your views, the key factors, in the contract between the public authority and the private waste recycling companies or company, leading to this high performance? ✓ What features of the tendering process do you believe contributed most to the performance of your waste collection and recycling scheme? ✓ What features of your system for the control of the public operator, in case of deviation from agreed-upon performance targets, do you believe contributed most to the performance of your waste collection scheme? ✓ A contract between a public authority and a private service provider often includes a rewards and penalty system that provides economic incentives for the private operator to improve its performance beyond the nominal targets of the contract, and to avoid non-compliance with these targets. What features of the rewards and penalties system do you believe contributed most to the performance of your waste recycling scheme? ✓ What features of the contract(s) between the public operator (of waste collection) and the private operator(s) (of waste treatment), e.g. on the quantities and purity levels of the collected waste flows, do you believe contributed most to the performance of your waste collection and recycling scheme? ✓ What features of your system for the detection and resolution of conflicts within the public operator, between the public operator (of waste collection) and the private operator(s) (of waste treatment) and between the public and private operators and the public authority, do you believe contributed most to the performance of your waste collection and recycling scheme?
2.5 Waste prevention	✓ Do you engage in measures aiming at preventing the generation of waste (e.g. via support to repair shops or to shops for exchange / rental of clothes, rental of household equipment, library of toys / games....)? ✓ If so, what are these measures, and how effective have they been in reducing the total amount of waste generated per person? What has been the impact of these measures on the collection and recycling of waste?
2.6 Communication to citizens	✓ What features of the communication to citizens do you believe contributed most to the performance of your waste collection and recycling scheme?
2.7 Challenges, areas for improvement and recommendations	✓ What difficulties have you encountered in your journey towards a high-performance waste collection and recycling scheme (e.g. conflicts due to the changes brought in

Report section	Questions in interview guide
	organisation or in quality or performance requirements)? How have you overcome them? ✓ What recommendations would you give to Spanish municipalities wanting to improve the performance of their waste collection and recycling scheme? ✓ What recommendations would you give to the Spanish Ministry of Ecological Transition and the Demographic Challenge (MITERD) to improve the performance of waste collection and recycling in Spanish municipalities?

In addition, the project team obtained nearly 20 written replies of the interview questionnaire from municipalities in Galicia and Madrid. The questionnaire was circulated by MITERD to all Spanish municipalities asking them to fill it out with their practices. The findings from these replies have been used to populate the "Evidence from other municipalities in Spain" sections below.

1.2.3 Review of existing methods to enhance the performance of municipalities in terms of separate collection of waste

In the course of the interviews, the consultant team was made aware of the existence of methods and guidelines aiming at improving the rate of separate collection of waste, from Spain and from the EU outside Spain. Specifically, the body of work of the two following agencies was reviewed:

- The waste agency of the regional government of Catalonia (Agència de Residus de Catalunya)[4];
- The NGO Zero-Waste Europe, and more specifically its "Zero-Waste cities" programme[5].

Documents by the Catalan waste agency

The documents that we considered were:

- **The "Guide for the installation and management of civic amenity sites" ("*Guia d'implantació i gestió de deixalleries*")** of April 2021[6]. This document is a guide for managers and people in charge of civic amenity sites/household waste recycling centres (HWRCs). The guide is structured in two parts, one focused on the planning, design and construction, and a second part focused on the management of civic amenity sites. The document provides tools in the following areas:
  1. Management system selection
  2. Establishment of new sites or improvement of existing ones
  3. Improvement of accessibility
  4. Increase of citizen participation

- **The "Guide and reference experiences for the implementation of the separate collection of municipal waste" ("*Guía y experiencias de referencia para la implantación de la recogida selectiva de residuos municipales*")** of July 2020[7]. This guide aims to provide relevant information and concepts for the design, implementation and improvement of separate collection systems of municipal waste. It also includes a collection of indicators that describe the evolution and current state of separate collection in Catalonia and presents innovative systems that are gradually being introduced. The guide describes the current legal framework

[4] https://residus.gencat.cat/ca/inici
[5] https://zerowastecities.eu/
[6] https://residus.gencat.cat/web/.content/home/lagencia/publicacions/instalacions/guia_implantacio_gestio_deixalleries.pdf
[7] https://residus.gencat.cat/web/.content/home/lagencia/publicacions/prevencio/guia_experiencies_implantacio_rsrm_es.pdf

for separate waste collection, at the European, Spanish and Catalan levels, and showcases successful experiences in Catalonia and the Basque Country . It contains the following key elements:

1. Aspects to be taken into account when defining the collection system
   - Territorial, economic and demographic characteristics
   - Analysis of the economic feasibility of the new collection system
   - Management of the collection service (i.e., outsourcing, direct management or hybrid approaches)
2. Organic waste, a key fraction when defining the collection system
3. Collection systems and optimization criteria
   - Collection in containers
   - Door-to-door collection
   - Collection of commercial waste
   - Management of the organic fraction at source

- **The "Guide for the implementation of pay-as-you-throw systems for municipal waste" (*"Guia per a la implantació de sistemes de pagament per generació de residus municipals"*)** of November 2010[8]. This guide describes the basic operating principles of pay-as-you-throw (PAYT) systems, the steps to follow for their implementation and the impact they are expected to have both on waste flows and on the operation of the collection service. Experiences in the application of these systems are also described both at Catalan and Spanish levels, as well as in other European countries. Key elements of this document include:
  1. Definition of PAYT systems
  2. Current situation at the national and international levels
  3. Basis and different models of PAYT systems, including minimum requirements and a comparison of the different models
  4. Specificities for PAYT systems for commercial waste
  5. Considerations prior to implementation (i.e., technical, logistical, legal)
  6. Implementation phases (i.e., participatory, communication, pilot, monitoring and control)
  7. Economic aspects associated with implementation
  8. Potential results on waste flows
  9. Fraudulent uses of PAYT systems and proposals for action
  10. Case studies

- **The "Guide for the preparation of local plans for municipal waste prevention" (*"Guia per l'elaboració de plans locals de prevenció de residus municipals"*)** of November 2008[9]. This document comprehensively defines the methodology and the steps that must be carried out to draw up local plans for municipal waste prevention. The guide is structured in four blocks:
  1. An introduction to waste prevention, defined as the reduction of the quantity (weight and volume) and hazardousness of generated municipal waste. It includes the classification of waste prevention measures in four categories:
     - Promoting eco-responsible production;
     - Promoting responsible purchasing;
     - Promoting responsible use of products;
     - Preventing waste that has already been generated from entering collection circuits.
  2. A methodology to develop a diagnosis of waste management in terms of prevention.

[8] https://www.residusmunicipals.cat/uploads/activitats/docs/20170421113935.pdf
[9] https://www.residusmunicipals.cat/uploads/activitats/docs/20170421115139.pdf

3. A methodology to prepare the planning of strategies and all elements that must be included in the plan (i.e., supply, objective, schedule, etc.)
4. A list of explanatory sheets, including examples of development of the diagnosis, actions that can be carried out in the field of prevention, instruments that are applicable in waste prevention actions.

Documents by Zero Waste cities

The documents that we considered were:

- "Creating a methodology for zero waste municipalities" (2020)[10];
- "Starting Scenarios to become a Zero Waste City - Scenario 1: Starting from scratch to quickly improve waste management" (December 2021)[11];
- "Starting Scenarios to become a Zero Waste City - Scenario 2: Stepping-up the existing system to go towards zero waste" (December 2021)[12];
- "Starting Scenarios to become a Zero Waste City - Scenario 3: Going beyond just recycling to total tackle waste generation" (December 2021)[13].

1.2.4 Clustering of Spanish municipalities into a "Ladder" of performance levels

A Waste Management Performance Ladder (WMPL) has been developed establishing a set of "rungs" and performance levels so that each municipality in Spain can self-evaluate and establish their current performance level in relation to the objectives established in the Law 7/2022, of 8 April, on waste and contaminated soils for a circular economy.

1.2.5 Definition of an Action Plan & Roadmap, adapted to each performance level

The Action Plan & Roadmap was designed based on the evidence collected from the high-performing waste collection schemes and from the existing methods.

The first step in this design was to define a table associating to each performance level the features of their waste collection system that the consultant team recommends that Spanish municipalities implement.

The Action Plan & Roadmap was then derived from this table, by developing each of the features listed.

1.3 Reading guide

The reminder of this report covers the following:

- Chapter 2: Lessons learnt from best performing municipalities in the EU and Spain
- Chapter 3: The Waste Management Performance Ladder
- Chapter 4: Roadmap towards the implementation of high-performing recycling schemes

[10] https://zerowastecities.eu/wp-content/uploads/2020/03/zero_waste_europe_creating-a-methodology-for-ZW-municipalities_en.pdf
[11] https://zerowastecities.eu/wp-content/uploads/2021/12/Cities-Scenarios-1-_-Starting-from-scratch-to-improve-waste-management.pdf
[12] https://zerowastecities.eu/wp-content/uploads/2021/12/Cities-Scenarios-2_-Stepping-up-the-existing-system-to-go-towards-zero-waste-1.pdf
[13] https://zerowastecities.eu/wp-content/uploads/2021/12/Cities-Scenarios-3_-Going-beyond-just-recycling-to-tackle-waste-generation.pdf

2 Lessons learnt from best performing municipalities in the EU and Spain

This chapter synthesises the lessons learnt on waste collection fees, waste collection monitoring indicators, operational arrangements, tendering characteristics and contractual arrangements, waste prevention, communication to citizens, and challenges and areas for improvement. For each of these elements we provide lessons learnt from EU best performing examples, lessons learnt from best performing examples in Spain and lessons learnt from other municipalities in Spain. The lessons learnt from both EU and Spanish best performing cases stem from interviews carried out with waste officials. The lessons learnt from other municipalities in Spain stems from evidence received from several municipalities who submitted their 'best practices' to us.

2.1 Waste collection fees

2.1.1 Lessons learnt from EU best performing examples

General pattern

One general feedback obtained in the interviews from the best performing municipalities in the EU is that **waste management fees** should be **high enough** to carry out the many functions to be performed: separate waste collection (including organic waste and hazardous waste), waste treatment (including recycling), measures for waste prevention, provision of information to the public.

Beyond this observation, the feedback obtained from EU best-performing municipalities on waste collection fees focuses on the means to organise (or not) a **Pay as you throw (PAYT)** system. Experience and feedback on this topic differs from municipality to municipality.

In some municipalities, the experience from implementing PAYT systems is that they encourage inappropriate behaviour, such as illegal dumping and under-reporting, and are hence considered as counter-productive. This seems to be particularly prevalent when the circumstances (e.g. multi-apartment buildings) do not enable the exact attribution of responsibility in case of misbehaviour, or in the early stages of the implementation of separate waste collection (when the very legitimacy of such separate waste collection is not yet sufficiently established in society). In other municipalities on the opposite, the PAYT system is considered as the key to very high performance in separate waste collection (up to 82% separate collection rate).

The fee collection systems that were reported are the following:

- Fee based on simple metrics related to the generation of waste:
  - Fee per person in the household;
  - Fee per size of the waste container bin, differentiated per nature of waste being collected in the bin (e.g. more expensive for unsorted residual waste, cheaper for sorted waste for recycling);
- Fee based on the actual generation of waste (strict definition of PAYT systems):
  - Per volume or per weight, with differentiated rates according to the nature of waste being collected (see above);
  - Via pre-paid bags, i.e. the sale of official bags specific to each category of waste to be sorted;

- By using official domestic waste bins, each identified by a passive RFID chip, for the identification of the user and the computation of the number of collections per year.

Bonuses and penalties

Financial **sanctions** can be applied to **citizens** in case of **inappropriate waste sorting**, which can go up to a doubling of the waste collection fee.

Similarly, a means to incentivise people to switch to selective waste sorting, at the very early stage of the introduction of selective waste sorting in a municipality, was to allow people to opt-out from the newly-introduced separate waste collection system – but then at the price of a doubling of the waste collection fee.

Social modulation of fees

In addition, specific **modulations of fees** were implemented by some municipalities for **social** reasons. One example is that of families with infants and young children, who generate considerable amounts of waste diapers. In that case, the municipality allowed a high volume of waste, charged at minimum rates. The same type of arrangements also exists for families that include a person with a handicap.

2.1.2 Lessons learnt from best performing examples in Spain

General pattern

In the interviews held with the best-performing Spanish municipalities, a clear pattern emerged that all ultimately **aim** at a **Pay as you throw (PAYT) system**, but that this is **long journey**.

The first stage for some interviewed municipalities was that of a uniform fee per category of users:

- One single fee for all households;
- One fee per category of commercial users, defined either as ‘small’, ‘medium’ or ‘large’;
- Free usage of separate waste collection bins placed on the street.

Starting from there, municipalities have introduced some degree of modulation per the amount of waste being generated.

One opinion received was that the measurement of the weight of the waste disposal bin upon collection by the lorries is not accurate and reliable enough to warrant equity, so that other metrics for the generation of waste need to be developed and used. Indeed, the most common metric is that of **volume** of waste, measured indirectly via the number of bags needed for the household to pack their waste, these bags being of a specific, mandatory type provided by the municipality / the waste collection company directly (by physical distribution in the door-to-door collection) or indirectly (the bags are sold by the local retailers, with no margin). The adaptation of the fee to the volume of waste being generated then translates into the payment model for these mandatory waste collection bags.

The payment models for these waste collection bags by **households** generally bear the following features:

- The **price** per bag is different according to the **nature of the waste** that the bag contains. In general, bags for residual waste are more expensive, while those containing recyclable material (e.g. packaging) are sold at a lower price (or even provided for free);
- The **first bags**, in numbers dependent on the size of the household, are provided for **free** as part of the fixed waste collection fee. Every **additional bag** above this threshold is being **paid for** at a given unit price.

Regarding **commercial activities**, one means of assessing their generation of waste is simply to consider the total surface of the shop, and to increase the fee as per the surface (proportionally or by setting multiplicators of a basic fee per tranche of surface). In addition, the nature of the activity of the commercial activity (as per their activity code in the Spanish statistical books) can be linked to a generic composition of waste and to a specific multiplier of the waste collection fee. E.g. office activities (insurance, real estate, banks, etc... codes 821 a, 823, etc..) are assumed to generate residual waste and paper / cardboard only, and belong to a category eliciting a multiplier of 1.5, whereas hotels and assimilated activities (codes 681 to 683) generate all categories of waste, and elicit therefore a multiplier of 3.

Rewards and penalties

In addition to the basic fee, the municipalities apply a system of **bonuses** and **penalties** to support a better sorting.

A **reward**, in the form of a reduction in the waste collection fee of 10% can be applied to **households** that participate in the **door-to-door collection**.

Sanctions can be applied to **citizens** that do not sort their waste appropriately. In cases of collective waste disposal bins in the streets, one way of identifying the household responsible is to open the bag and to check for any identifying item (e.g. letters). The practice however is to proceed very progressively: time is given for citizens to learn about the sorting system when it is changed (specifically at the beginning, when waste sorting is introduced for the first time). They are first being informed thoroughly, then information and warning letters are sent in case of non-compliance, if necessary with a possibility of direct contact with a mediator in charge at the municipal / waste management company to solve the problem. It is only after one such warning letter that sanctions are applied.

Rewards, in the form of reductions in the waste collection fees, can be applied to **commercial activities** that have entered in a specific **agreement** with the municipality regarding the **purity** of separate waste collection. Indeed, in this case, the recovered waste is of higher commercial value upon recycling, so that the company generating the waste shares the resulting economic benefits. When the level of impurities is below a threshold, then the waste collection fee is reduced, typically by around 10%.

Rewards can also be applied to the **whole population**, in the form of **general reduction in the waste collection fee**, when the quality of the waste sorting is sufficient to warrant higher prices for the sale of sorted waste to recyclers.

Social modulation of fees

Some form of **indirect social modulation** of **waste collection fees** was observed in one case, in a municipality with a large share of secondary homes. The waste collection fee is applied to all households, independently from whether they are occupied or not at a given moment. Consequently, the owners of secondary homes pay the same fee as the other residents, for a much smaller amount of waste generated, and hence at a higher price per litre of generated waste. Since owners of secondary

homes may[14] be wealthier than the permanent residents of the municipality, this can be seen as an indirect means to have wealthier people contributing more to the waste collection service.

2.1.3 *Evidence from other municipalities in Spain*

One interesting example reduces the fees for households that use efficiently the household waste collection centres ("Clean points" as literally translated from the Spanish), or that take part in self-composting or community composting programmes.

2.1.4 *Conclusions*

The general trend goes in the direction of payment per generation of waste ("Pay as you throw" – PAYT), with however a whole range of intermediate steps:

- Fee independent from the amount of waste generated (flat fee per household, determined only by the nature of commercial activity);
- Fee based on simple metrics related to the generation of waste (per person, per volume of container, per surface of commercial activity);
- Fee based on the actual generation of waste (per weight but most often per volume).

In the cases of payment per volume or per weight, the general rule is that the fee for unsorted waste ("rest" fraction) be much higher (up to 10 times higher) than that for sorted waste.

Economic incentives are often introduced to induce citizens and commercial activities to sort their waste, and to do it properly:

- Sanctions in case of inappropriate sorting (generally with a previous warning and the provision of information / contact details of person in charge to solve problems before the sanction takes place) or for refusing to participate in door-to-door collection;
- Rewards for facilitating high-quality waste sorting (participation in voluntary composting programmes, in agreements for the provision of high-purity waste).

Some consideration is given to the social situation of households, either directly (e.g. in presence of infants / young children) or indirectly (e.g. flat charges for all households, including secondary homes seldom used by richer people).

2.2 Waste collection monitoring indicators

2.2.1 *Lessons learnt from EU best performing examples*

The need for data and quantitative results is becoming more evident across EU countries and new tenders being issued set a higher emphasis on this. Monitoring indicators are the way to obtain such data. Monitoring indicators are seen as useful for continuous evaluation and in turn improvement of separate collection of waste, as well as for the rolling-out of large projects in waste collection, as they allow to test a scheme first in a small area.

Currently, the main indicators municipalities across Europe typically monitor consist of the following:

- **amount of waste collected per waste category (monthly)**
- **amount of waste transferred to recycling (monthly)**
- **the amount of each kind of waste transferred to landfill (monthly)**

[14] This may not be the case for those inheriting a secondary home. In this case permanent residents may be wealthier than the owners.

Auxiliary indicators are '**costs**' and '**number of containers serviced and bags collected**'. The aim of monitoring these indicators is to ensure everything runs smoothly. In general, a full-fledge assessment of the effectiveness of separate collection, littering in the streets, fraction of recyclables that end up among the residual waste among others is carried out every X years.

In order to monitor the above general performance indicators, an interesting set-up Vienna has a '**control centre system**', consisting of approximately 50 control points for which performance is monitored monthly. These control points may be either waste management facilities or products offered to public for instance at events e.g., mobile rest rooms, mobile dishwashers.

2.2.2 Lessons learnt from best performing examples in Spain

Technical monitoring of waste collection services with indicators helps municipalities evaluate the quality of the service provided and design strategies for improvement and higher performance. Such data can also be used in communications towards citizens.

Monitoring indicators vary notably from case to case but in general the tendency is for municipalities to incorporate such indicators more and more in tendering documents or Specifications ("pliego" in Spanish). Indicators cover not only waste data (e.g. collected waste, containers emptied) but also waste infrastructure (e.g. state of containers, efficiency of vehicles, technology used) and HR aspects (e.g. training, employee satisfaction, number of staff).

Overall it seems that incidents and whether collection has gone correctly are monitored daily, while data on quantities of waste collected by fraction may be provided on a daily or otherwise monthly bases. In the cases where collection is managed at a provincial or union of townships ("mancomunidad") level, this data is monitored for each municipality therein.

Below, we provide two simplified examples of indicators used in Spanish municipalities to evaluate quality and efficiency in the waste collection service:

Box -1 Examples of specifications regarding indicators to evaluate quality and efficiency of waste collection

- ✓ **Image Index** (e.g. state / looks of waste collection vehicles including their emissions, state / looks of waste collectors' uniforms)
- ✓ **Pre-collection index** (e.g. state / looks of street garbage containers, sufficient space in street containers for each fraction)
- ✓ **Collection and transport index** (e.g. compliance with collection routes)
- ✓ **Citizen satisfaction index** (e.g. number of complaints received)
- ✓ **Employee satisfaction index** (e.g. number of complaints received)
- ✓ **Performance index of technological tools for management;**
- ✓ **Compliance rate of the percentage of improvement regarding separate collection rates.**

Box 2-2 Examples of specifications regarding annual, monthly and daily indicators to evaluate quality and efficiency of waste collection

Annual

- ✓ Annual staff training plan
- ✓ Annual vacation plan and personnel assigned to the service
- ✓ Annual internal information and awareness plan
- ✓ Monthly monitoring document for vacations and available staff, with list of resignations
- ✓ Collection itineraries on a street map mentioning the start and end points of the service and the streets traveled for each of the fractions.
- ✓ Maintenance plan for vehicles, machinery and containers

Monthly

- ✓ Kg collected - per fraction, per area. For specific fractions i.e. mattresses, specify the number of units collected, per area.
- ✓ Number of emptying of each of the containers - distinguishing between containers used by citizens and containers used by retail
- ✓ Number of containers cleaned - distinguishing as above
- ✓ Monthly inventory of the number and state of conservation of the containers in relation to the containers contemplated for each service
- ✓ Details of container and vehicle maintenance operations carried out.
- ✓ Personnel attached to active service during the monthly period and replacements
- ✓ Result of the monthly inspections of services such as door-to-door collection no later than 72 hours after they have been carried out

Daily

- ✓ Kg collected - per fraction, per area. For specific fractions i.e. mattresses, specify the number of units collected, per area.
- ✓ Communication of the entry to treatment plants and the quality of the material delivered
- ✓ Daily communication of incidents, which must include a description of material collected from outside containers or disposed of incorrectly in the door-to-door area and damage to containers.
- ✓ Quality checks of each fraction and service
- ✓ Daily list of calls to the Citizen Service with explanation of reasons and resolution of complaints

2.2.3 Evidence from other municipalities in Spain

Several municipalities do not have monitoring indicators in place. In those which do, the basic and at the same time most important indicator that municipalities follow Kg/inhabitant/year of waste collected as well as Kg/inhabitant/year collected selectively, that is per fraction. Next to these, some municipalities are intending to expand the indicators they monitor to include for instance indicators on 'number of households who compost' and 'waste by hotels, restaurants, cafes'.

2.2.4 Conclusions

- ➢ Monitoring indicators are necessary to evaluate the quality of the service provided, design strategies for improvement and higher performance and to be able to communicate results to citizens.

- Indicators cover not only waste data (e.g. collected waste, containers emptied) but also waste infrastructure (e.g. state of containers, efficiency of vehicles, technology used) and HR aspects (e.g. training, employee satisfaction, number of staff). Such indicators show that infrastructure and workers are key for the provision of a good service.
- Indicators are monitored either daily, monthly or yearly depending on the indicator. While 'Incidents' (normally regarding collection) are monitored daily, waste data may be monitored daily/monthly and data related to HR (training, personnel assigned to waste collection) are monitored yearly.
- The monitoring of indicators in cities can be done through 'control points' (normally waste management facilities)
- The roll out of schemes with large coverage can start small, being tested in an area before further expansion.

2.3 Operational arrangements

2.3.1 Lessons learnt from EU best performing examples

The main issue being considered is the **compliance** of the (public or private) waste collection operator with its **obligations** regarding e.g. the frequency of waste collection, the availability of waste collection bags, the purity of the sorting, the separate waste collection rate. There are generally three modes of control:

- Periodic comprehensive reviews of performance, based on surveys and analyses of the composition of waste flows (sorted and residual unsorted). Such reviews are performed at long intervals (5 to 6 years);
- Monthly monitoring of key indicators at specific control points;
- Permanent monitoring of complaints by citizens, with a possibility for citizens to address the municipality directly if they are dissatisfied with the private operator's response.

Waste collection operators can in addition be subject to obligations to set up:

- customer relationship infrastructures to enable and monitor the complaints by citizens, and to answer complaints within strict time limits;
- contract managers in charge of the overall quality of service vis-à-vis the municipality;
- monitoring systems on their waste collection lorries (e.g. passive RFID tags).

Independently from these 'hard' control measures, municipalities generally have regular meetings with the waste collection operator to discuss and solve problems at an early stage, before having to impose contractual penalties (which are used as means of last resort).

In addition, social conflicts (e.g. on working conditions) within the waste collection operator are in some cases specifically prevented by the regular meeting (every 3 or 4 months) between management and representatives of workers. To complement this, the management can provide professional training and high-quality working equipment to the operator's personnel to facilitate their work and reduce the reasons for complaining.

2.3.2 Lessons learnt from best performing examples in Spain

Contractual arrangements

Municipalities **monitor** the performance indicators on a monthly or even daily, basis. The latter is made possible when a dedicated IT infrastructure is in place to collect the data: geolocation of lorries, tags on waste collection bins. Thereby, the process is completely automated.

The contracts between the municipality and the operator foresee a set of **financial sanctions** in case of **non-compliance**. This non-compliance can bear on: the **technical performance** of the work (e.g. failure to collect containers, failure to wash containers or to clean around containers) or on the **reporting** (e.g. failure to report indicators on time).

In order to **prevent conflicts** and to address them early on, specific dialogue fora can be set up, either:

- between the municipality and the waste collection operator, or
- with 3 categories of stakeholders (municipality, management of the waste collection operator, workers of the waste collection operator).

These fora have mandatory regular meetings, and the decisions taken can be made mandatory, as amendments to the contract. Some current reflections would include representatives of the citizens to these discussion fora, for a total of 4 categories of stakeholders. In addition, frequent discussions can be held between the municipality and the waste operator, sometimes up to once per day.

In some cases, the contract with the private operator foresees **minimal social conditions of work** (weekly working time, working time on holidays and weekends, annual and exceptional holidays, salaries, bonuses, work-life balance, training plan, gender equality plan). In one case, the consortium of municipalities even initiated a **collective agreement** for the waste collection sector containing elements on salary, holidays, etc. Making the workers in the waste collection operators feeling valued for the importance and relevance of their work is considered as an important factor of service quality.

Waste collection models

The separate waste collection follows a limited number of models:

- Open waste collection bins in the streets;
- Door-to-door collection;
- Intelligent containers, where those for residual waste and organic waste are opened with a chip card. The organic waste container can be opened every day. The residual waste container can be opened 1-2 days/week.

Some additional containers can also be installed: e.g. for textile articles, for sanitary items such as nappies, with an additional permit for some users.

2.3.3 Evidence from other municipalities in Spain

An additional waste collection model is the wet-dry model, whereby waste is collected in four (4) streams: 1) paper & cardboard, 2) glass, 3) organic waste, and 4) residual waste in combination with plastics and metals. This model has to evolve to take into account the EU-wide obligations for separate collection of metals and plastic waste. The recovery of organic waste enables the generation of biogas and of soil fertilisers after an appropriate anaerobic digestion process. In this system, similar to the other systems, additional containers and waste collection points are needed to handle the remaining categories of waste (WEEE, bulky waste, textiles).

Similar to the contractual arrangements identified for the best practices, these other Spanish municipalities also mentioned having economic sanctions when the waste collection operator does not comply with the contractual agreements. Rewards and penalties for the waste treatment plant were also mentioned by one municipality who foresees in their new tender that the treatment of the organic fraction of the waste will have to achieve a pre-established quality. Failure to comply with this quality means that organic waste will be considered as rejection, with consequent (economic) penalties for the waste treatment plant. The same criterion is applied to the material not recovered in the plant and which will therefore end up as rejection. Whether its destination is landfill or transformation into fuel, any of these options will be a less economically advantageous than its recovery at the plant. It is expected that thanks to this system, waste treatment plan operator will play an active part in the awareness and education of the population around separation of waste at work and at home. Rewards are notably lacking. Only one municipality use this compensatory element by transferring the flows of the bonuses received for the quantities of separately collected waste to the company that performs the collection.

2.3.4 Conclusions

The monitoring of the compliance of the waste collection service with the requirements set by the municipality is generally performed along the following methods:

- Thoroughly at long intervals (of several years), using heavy analytical tools such as the composition of the residual waste stream;
- Monthly for standardised indicators, or even daily for the indicators that can be collected with automatic means;
- Via a monitoring of the complaints by citizens. The contract can prescribe the performance of the system in place to handle the complaints by citizens (e.g. in terms of response time) and the appeal mechanism to the municipality in case the citizen is dissatisfied with the answer by the private operator.

Sanctions for non-compliance are financial, either explicitly specified in the contract or in the form of difference in price paid for the waste according to its suitability or not for recycling or fermentation. Sanctions are still often lacking however municipalities recognise that incorporating such in future tenders is desirable.

Conflicts between the municipality and the waste management operator are generally discussed and prevented via periodic meetings. These meeting can be informal, or, on the opposite, strongly formalised, so as to be able to take contractually-binding decisions that amend the initial contract.

In some cases, special care is taken to the working conditions of workers, so as to increase the quality and reliability of the service. Social clauses specifying the required working conditions can hence be included in the contract of the waste collection operator. In addition, representatives of the workers can, in addition to those of the municipality and of the management of the waste collection operator, be members of the formal, periodic, concertation body.

2.4 Tendering characteristics / contractual arrangements

This chapter covers lessons learnt concerning the selection of operators, key contractual agreements and the detention detection and resolution of conflicts between the municipalities and (private) waste operators.

2.4.1 Lessons learnt from EU best performing examples

Private operator selection

Private operator selection is mainly based on high performance, quality offered and price competitiveness. One municipality mentioned some additional non monetary selection criteria which include aspects such as efficiency of trucks that collect waste, the availability of treatment plants in the vicinity (i.e., closeness between collected waste and treatment plants), capability of treatment plants to differentiate and treat as many types of waste as possible, and good working conditions of employees. The awarding system in a municipality would give additional points to bidders committing to higher recycling levels than the statutory ones.

Multiple operators in one city
In Lublin (Poland) the city is divided into seven (7) areas. For household waste collection and treatment each waste operator can apply for a maximum of three (3) parts of the city. In the current contracting period (running until June 2024) three (3) operators cover the work.

Key contractual aspects

Waste collection contracts should be written based on best practices but adapted to the territory. The aspects to be covered in the contract tend to be specified in the Tender Specifications. There is agreement that these Specifications should be stringent with requirements and quality standards.

Some specific characteristics that contracts seem to have in best-performing EU municipalities are as follows:

- **Contract length** – The interviews did not lead to a conclusion on the ideal contract length. A large municipality did mention that servicing at least 100.000 inhabitants for about seven (7) years would be the minimum to obtain a minimum level of efficiency, allowing the private operator to get its return on investment.
- **Territory covered** – There is a minimum number of inhabitants that needs to be covered for waste collection to be efficient. Efficiency requires expanding the area (e.g. number of municipalities) covered by the waste collection service.
- **Step-by-step roll out of the scheme** – incorporated in the tender documents to allow a phased roll out of the waste scheme. The new scheme started as a pilot in one part of the city and other parts of the city were added every few months until the whole city was covered. This acknowledged that city centres are generally very different to suburban / country areas and also provided an opportunity to solve problems and capitalise learnings. Slow development (every part of the city for a few months) so that the problems could be overcome.
- **Requirements on information to the users** – the Tender Specifications require operators to maintain customer service offices, answer calls from residents on a daily basis, and maintain websites with up-to-date collection schedules and contact forms.
- **Reporting requirements** – on waste indicators are typically included in the Tender Specifications in order to control the performance of service providers. One municipality stated to work with yearly targets in this regard.
- **Economic penalties** – are common across EU best cases in the face of non-compliance with the contract or with the quality offered in the contract. For example operators are required to achieve the recycling levels they commit to in their bids or else they will be faced with high penalties (in some cases up to five times the value of state penalties in this regard). These penalties should be high enough to avoid that service providers offer high recycling levels that

they do not intend to achieve just to win the contract (with the intention of just paying the fine). Penalties can also be provided for bad quality of service (e.g. for not delivering dustbin or garbage bags in new location where waste is going to be collected, for not collecting waste according to schedule) or for not delivering monitoring reports on time.

Detection and resolution of conflicts

General practice for detecting and resolving conflicts is **continuous exchange and dialogue** between the public authority and the (private) operator. Some argue that **continuous monitoring** on each step of the waste collection process is the best way to 'prevent' conflicts in the first place.

A municipality said waste collection is evaluated as part of an **internal process management procedure** at the municipality through which processes – like waste collection - are evaluated continuously. Process managers get in contact with heads of departments on a regular basis for exchanges to see whether the operation and processes can be made better, and to tackle any conflicts. In case of failures of operating plants, there is a handbook on how to deal with that.

Another municipality mentioned having a **territorial table** – consisting of municipalities in the area, the operators and contractors, aimed at sitting together to discuss problems and future approaches. Every issue can be treated on time before it becomes a big problem.

For external conflicts (conflicts between operators and residents), a municipality explained to have **municipal supervision and control desk** available to citizens on workdays. When residents feel dissatisfied, they can report their case to the municipal supervision and control desk. If needed, the municipal responsible gets then in contact with the contract coordinator on the operator's side, demanding clarification or consideration of the resident's needs.

2.4.2 Lessons learnt from best performing examples in Spain

Private operator selection

In the cases in which waste collection is not done by a municipal public company, the private operator selection is done through bidding processes for Service Contracts. The award criteria to allow the selection of the service provider are typically based on the extent to which the bidding company meets the **service quality** parameters or criteria, and the attractiveness of its **financial proposal**.

Key contractual aspects

Contract lengths seem to vary between 4-8 years - including extensions – but from the sample consulted we have not been able to conclude on an adequate length.

There is common agreement that very **detailed Technical Specifications** work best, ensuring it is clear to every party how the service should be and little room is left for own interpretation and misinterpretation. For instance aspects such as the need for more containers and collection services during festivities may be specified, or the fact that actual waste containers and bins should be managed by the service provider (to unburden the municipality by avoiding that public authorities have to select, order, maintain bins). These Specifications should include a **monitoring system with indicators** to be assessed. More and more electronic tracking systems are incorporated in service trucks and containers to trace the trucks, what they are collecting and how much of it.

To date, Specifications tend to include penalties, to be applied in the face of non-compliance, including termination. However besides **penalties also rewards** are seen necessary to enhance the

quality of the service provided and to incentivise continuous improvement. One municipality for instance financially reward their service provider in light of increasing yields. This would function as positive pressure for the collection company, helping keep their motivation high for correct management and continuous improvement.

Box 2-3 Example of elements in the Technical Specifications to be covered in an offer by the service provider

Technical Specifications:

- Scope of the services
- Duration of the contract
- Services to be performed
- Description of the collection models (e.g. door-to-door, street containers, bulky, commercial)
- Cleaning and maintenance of containers and street
- Human resources for the service (e.g. profile of staff, training, health and safety)
- Materials and facilities (e.g. vehicles, containers)
- Communication to citizens (e.g. awareness campaigns, advertising, establishment of citizen attention service)
- Supervision of the service
- Quality control of services

Detection and resolution of conflicts

Whether waste collection is done by a private operator or a public operator (i.e. municipal organization), **regular meetings** between the public authorities and the waste operator are common in order to set priorities and solve problems.

In addition a good practice with regards to managing conflicts between the private operator and the municipality seems to be the establishment of a so-called **Contract Monitoring and Control Commission** to deal with any issues and to adapt to the fast changing dynamics in the waste sector. This Commission typically consists of representatives of the city council, representatives of the heads of the company providing the waste services and representatives of day-to-day workers (i.e. managers and technicians). Such a participatory approach has proven productive, serving to put everyone on the same page and to avoid conflicts. The Commission meetings tend to be held at a predefined, regular periodicity and are mandatory to attend by the aforementioned stakeholders.

Conflicts between workers on the other hand are to be dealt with by the contracting company / service provider. Only if there are breaches to the contract, the public administration will intervene.

Tender specifications may require waste collectors to record incidents and inform the municipal responsible accordingly but often citizens reach directly to the municipality. In any case, **rapid resolution of complaints** are key for avoiding conflicts with citizens in the first place.

2.4.3 Evidence from other municipalities in Spain

Private operator selection

The majority of municipalities that submitted best practices (partly) outsource waste collection to a private company. In the places where collection is both public and private, the city council typically manages the collection of the generic container (black bag), while the contract for separate waste collection is tendered for a private operator to do (light packaging, paper/cardboard in containers and paper/cardboard door to door). Municipalities where waste collection is carried out through a

municipal, public company, argue that their choice for this approach is motivated by the belief that the direct provision of services allows for better control of the services.

The private operation operator selection is done through ordinary public procurement open procedures where best value for money is sought for. Financial criteria weighs between 45% and 55% of the tender depending on the municipality.

Key contractual aspects

A municipality explicitly recommended to avoid long contracts (although the specific length was not identified). Another one recommended having a provision that allows the municipality to adjust the objectives if legislation changes as well as ensuring a moment for reflection / assessment on an annual basis to decide if further actions are needed for improvement of the service and increasing the recycling ratios. Although most of the municipalities lack penalties and in particular rewards, the trend observed is towards aiming to include these in future contracts. In municipalities where rewards are already in place, defining clear objectives by which the companies can obtain higher profits seems to have had a positive effect on increasing the performance of private operators.

Detection and resolution of conflicts

Regular communication both ways between the municipality and the private operator in charge of (selective) collection is a good practice across various municipalities. It allows parties to evolve the service and improve separate collection, to tackle Incidents rapidly and to avoid conflicts. Incidents that reach the city council that are responsibility of the operator (full container, unemptied container, etc.) are communicated right away to the operator. Private operators also communicate with the municipality concerning incidents under the domain of the municipality for instance broken containers or badly parked cars.

2.4.4 Conclusions

- The private operator selection is done through bidding processes for Service Contracts. The award criteria consider the extent to which the bidding company meets the service quality parameters or criteria, offers high performance and the attractiveness of its financial proposal.
- Technical specifications may include the scope of the services, duration of the contract, services to be performed, description of the collection models, possibility for a step-by-step roll out of the scheme, cleaning and maintenance of containers and street, human resources for the service, vehicles and containers / bins specifications, communication to citizens, supervision of the service and quality control of services. Very detailed Technical Specifications are key.
- Specifications should include a monitoring system with indicators to be assessed. Digitalisation can facilitate monitoring.
- Penalties are more widely used than rewards currently, but incorporating rewards in the contract is considered very important for keeping up the motivation of service providers high and in turn improving performance.
- Regular meetings between the public authorities and the waste operator (whether public or private) are common in order to set priorities and solve problems.
- Participatory processes such us the establishment of a so-called Contract Monitoring and Control Commission consisting of representatives of the city council, representatives of the heads of the company providing the waste services and representatives of day-to-day workers work well for managing conflicts between the private operator and the municipality.

- Rapid resolution of complaints are key for avoiding conflicts with citizens in the first place. Tender specifications state who is in charge of this.

2.5 Waste prevention

2.5.1 Lessons learnt from EU best performing examples

The first action engaged by municipalities regarding the prevention of the generation of waste takes the form of **communication** to citizens. The **effectiveness** of the measure remains **low** (reduction in waste generation of 8 kg / year.inhabitant is reported).

Beyond this, municipalities set up infrastructures to support the prevention of waste, such as:

- Re-use shops for e.g. clothes, appliances, bicycles, toys, where second-hand products are sold at low price, with important communication around them so that a large share of the population is aware of their existence. The income generated from these re-use shops can be transferred to local charities;
- Recycling centres where a space is arranged where citizens can deposit items that are still functional and that can hence be re-used. These spaces are set at the entrance of the centre, so that citizens can start with depositing the re-usable items there before moving further to places where they dispose of non-reusable items;
- Preparation facility for the re-use and sale of second-hand products in each waste disposal centre or resource centre;
- Deposit refund systems and collection points for plastic bottles;
- Tap water fountains in school canteens to avoid the need for plastic bottles.

A few interviewees also mentioned the provision of free of charge home composting units to the population by municipalities. However it should be noted that according to the WFD as well as, accordingly, to the Spanish Waste Law home composting is considered ‘recycling at source’.

Municipalities also engage in specific actions and processes to prevent the generation of waste, which do not translate into fixed, visible infrastructure. These actions include:

- Collection of unsold food for distribution to charities (prevention of food waste);
- Collection of end-of-use office furniture (desks, chairs) from municipal administration for transfer and re-use in poorer regions or countries;
- Use of washable cutlery and crockery in school canteens instead of single-use material.

2.5.2 Lessons learnt from best performing examples in Spain

The waste prevention measures include communication to citizens, to restaurants or to school pupils, such as:

- The promotion of tap water fountains in restaurants, in order to avoid the generation of waste bottles (this was implemented before this measure was translated into law);
- The promotion of sandwich wrapping instead of aluminium foil.

On top of this, the authority in charge of waste collection organises:

- Periodic (typically: monthly) second-hand markets or exchange markets, with a focus on: clothes, bulky items such as furniture, household appliances;
- The separate collection of specific items, such as toys or clothes, under the condition that they be re-usable;

- The on-demand collection of bulky items, furniture or appliances, some of which can be in working condition;

The prevention of waste is part of several plans for future improvement of the waste management systems, with implementation starting for some in 2023 or 2024.

2.5.3 Evidence from other municipalities in Spain

The experiences reported mainly include repair workshops located in the centres for the collection of domestic waste.

2.5.4 Conclusions

The prevention of the generation of waste is generally considered as difficult to be implemented at municipal level, and seems to yield only modest results. However, this is an area in which municipalities develop actions, as they are aware that it is that where the future progress will happen.

The actions aiming at preventing the generation of waste that were reported include:

- The set up of **infrastructures** dedicated to the **prevention** of the **consumption** of waste-generating goods:
  - installation of tap water fountains in municipal canteens or in private restaurants;
  - replacement of single-use cutlery with washable, re-usable items in municipal canteens;
- The set up of **infrastructures** dedicated to the **preparing for re-use** and **sale** of functional equipment, such as:
  - Specific collection points or processes for re-usable items;
  - Repair shops;
  - Second-hand markets or shops;
- The set up of **processes** dedicated to the transfer of unwanted, but still usable goods to poorer segments of the population within the municipality or beyond it:
  - collection of **unsold food** for distribution to charities;
  - transfer of **public equipment and furniture** to poorer regions in Europe or beyond;
- **Communication** campaigns.

In addition, the set up of infrastructure dedicated to facilitate high-quality recycling such as deposit refund for plastic bottles are considered good practices. While these cannot be considered to 'prevent' waste – as they are basically measures that facilitate recycling– they are important measures to enhance separate collection and posterior treatment of waste.

2.6 Communication to citizens

2.6.1 Lessons learnt from EU best performing examples

Communications – and education and awareness raising - are considered essential for high performance of a waste collection system. In addition, they are also considered key for the success when introducing new collection systems. Communications currently take place through several traditional and more innovative (digital) channels. Recurring best practices in this regard are as follows:

- **Simple, clear and continuous** – There is consensus that communication should be simple (more pictures, less words), clear (messages should be easy to understand) and continuous (repetition is needed).

- **Engaging with both traditional and modern media** – next to more traditional media (local press, flyers, videos). Social media networks (Facebook, Instagram, Youtube) in particular are widely used across successful municipalities in Europe and municipalities remain looking for new, innovative means to reach out to the whole population.
- **Education at school** – Awareness raising that starts in primary schools is considered very useful. Kids learn to make a difference for life and bring it to the families. This is useful specially for children with foreign parents. Immediate improvement has been measured following the campaigns.
- **Public events -** for instance in a form of a 'waste festival' are successful in attracting all kinds of citizens. These events may consist of a combination of information on waste management practices, workshops, games, concerts.
- **Students** – In municipalities with a large (University) student population, a municipality hired students to carry out door-to-door awareness raising activities when a new separate collection waste system was introduced.
- **Good complaint handling systems** – that take the complaints of citizens seriously are mentioned to be key. These should be available throughout (almost) the whole week, easy to reach by citizens and provide citizens with a fast response are key.
  Communications campaigns to prepare citizens for separate collection (to ensure higher purity level in separated waste) and for new collection systems. In a small town in Romania, a comprehensive 4-weeks communication campaign was carried out by all community leaders (the mayor, the priest of the church, the school director) together with the waste collection company. These leaders connect with the local community personally and were ambassadors of the new system helping inform the public at the church, schools, local pubs and at the local cultural center.
- **Provide waste separation tools -** such as bins and bags, as well as printed information materials (flyers, brochures) to guide citizens in complying with (or adapting to the new) system is key. Guides may be in different languages when the population is mixed.
- **Visits to waste landfills and incineration plans** – In Vienna, landfills and incinerations plants are opened to the public (including schools visits) in an attempt to improve their image. At guided visits, citizens would be shown around with the aim of having them experience first hand that these are not per se 'filthy' places and that the city is taking responsibility for doing thigs well. At the incineration plant citizens would learn about how the energy produced in the plant is being used for district heating. At the composting plant citizens were given top-quality compost for free.

2.6.2 Lessons learnt from best performing examples in Spain

There is consensus that communication to citizens is key and an aspect that needs to be considered in waste collection contracts. Communication is important to educate citizens on how to separate their garbage, inform them about how the system works and engage them and obtain their buy-in.

Municipalities deploy several different communication channels in order to **reach all groups** of the population. There is widespread agreement that campaigns have to be **tailored to the local context** (i.e. what works in a specific municipality) and therefore should be locally rolled out.

Channels vary from **traditional media channels** such as local radio, a telephone line open to citizens, bulletin/journal, flyers and street posters with waste collection information (e.g. time, fees) in situ, to more **modern channels** such as mobile apps, information on the web, social media. For web/printed

information, some municipalities offer information in not only Spanish and the local/regional language but also in other **foreign languages** ranging from English and French, to Romanian and Arabic. In addition, **face to face communication** activities are also very diverse. From door to door visits to distribute flyers to households, to technicians who visit retailers to explain them how to go about the disposal of packaging, to workshops with citizens for awareness raising and motivation, hosting exhibitions to show impact. Communication activities may attempt to **make citizens feel proud** of the local efforts to be environmentally-minded and include some goodies that are handed to participants for instance canvas bags with a catchy message.

Continuous communication is essential however there are specific moments when it needs to be intensified for example when introducing a new fraction (e.g. organic waste / compost) or when changes are introduced in the collection system (e.g. new collection days, frequency, time) or when results of waste data are ready to be presented to the citizens to communicate what has been achieved.

2.6.3 Evidence from other municipalities in Spain

Evidence from other municipalities corroborates the above regarding the importance of using diverse communications channels to reach different audiences. Two additional communications channels or means that have proven to be successful are information campaigns specifically directed to hotels / restaurants / cafes in touristic municipalities and campaigns for school children.

2.6.4 Conclusions

- Continuous communication is considered essential in both Spain and other EU countries to inform, educate and engage citizens, including making them feel proud of their efforts;
- Communications are intensified when needed;
- Municipalities aim to reach out to and engage all segments of the population. For this, the use of traditional media as well as modern media, translation of communications materials into foreign languages and face to face events are common practice.

2.7 Challenges, areas for improvement and recommendations

2.7.1 Lessons learnt from EU best performing examples

Challenges and areas of improvement

The main challenges identified are as follows:

- **Language** – in cities and towns where people from different nationalities live, language is a challenge. Websites and other materials have to be developed in several languages.
- **Persuading citizens** – to separate their waste and dispose it correctly. Students and people living in social housing were named as particularly difficult to engage.
- **Quality of separated waste e.g. biowaste** – tends not to be good in densely populated areas.

Biowaste can be inconvenient - when waste collection is not too frequent (e.g., once per week) due to smell. An alternative solution to more frequent collection – if this is not possible – can be to offer residents with a container rinsing service or to allow them to place paper / garden waste at the bottom of the bins to prevent 'dirt'.

Areas for improvement:

- **Bringing communal street containers closer where people live** – to increase convenience. In a couple of cities people feel they have to walk too far to separate waste.

- **Scale up collection to new waste fractions -** Roll out projects to collect biowaste also at apartment complexes (non not only family-homes with gardens) considering that about 40% of waste in residual bins is biowaste. Also the efforts on textiles are currently being scaled up.

Recommendations to other municipalities

- **Think in a systems-perspective** - Door to door collection is only the end of the chain – if you pick up the waste you need to know what to do with that. You can have a perfect collection door to door but that is not useful if you do not have the means to treat such waste.
- **Incentives** – to reward collection. The higher separated waste collected, the higher the pay. This can also work for municipalities where collection is done by a public operator. In this case different consortia (union of companies that recycle a specific type of waste) for each type of the waste (i.e. paper consortium, plastic consortium etc) can pay the city for the waste collected.
- **Adequate fees** – to be paid by citizens are necessary to be able to finance adequate waste management. EU funding tends to be for specific fractions or issues so waste management needs to be able to be sustained by the collection fees.
- **Political lobbying** – Changing political systems hamper long term planning, therefore it is important that the waste management scheme obtains the buy-in of different parties.
- **Innovation** – keep innovating (i.e. finding new ways, new technology) to address consumer behaviour and needs.
- **Learn from others -** Look at best practices in Europe, visit other cities / towns with similar characteristics to yours.
- **Step-**by Step introduction - Citizens can be change-averse or may find difficult to change several behaviors at a time. As such a step-by-step implementation of a better waste collection system is recommended.
- **Communication and awareness raising -** From a very early age (e.g., starting at school), communication and awareness raising on waste collection is essential.

Recommendations to MITERD

- **Legislation** – is considered key to support local governments in increasing their performance by justifying action as well as by helping fund waste management. For instance EU legislation sets the burden more and more on producers
- **Cooperation between Ministry and municipalities** to encourage dialogue around waste collection and to organise national and local educational campaigns in waste management.

2.7.2 Lessons learnt from best performing examples in Spain

Challenges and areas to improve

Several challenges have been raised by the municipalities interviewed, the main ones being the following:

- **Politics** (e.g. in the face of Municipal elections): it is generally unpopular to burden citizens with measures that may decrease their comfort and so politicians avoid these. However timing is everything. The implementation of door-to-door collection for example was well received in places where this was implemented a couple of months before Covid-19 lockdowns.
- **Citizens willingness:** linked to the above, the opposition of the citizens to separate waste at source has been the main hurdle in some of the municipalities who have door-to-door collection in place.
- **Increasing performance (collected %) requires increasingly complex collection** – this means aiming at fractions that are not being separated yet and that may be more difficult-to-recycle

materials. Collecting household 'oil' for instance requires a large effort for small municipalities unless they receive a specific subsidy for this.

- **Rural areas** - Offering quality services to rural areas is challenging due to the ongoing process of rapid depopulation. This means long collection routes to collect the waste from fewer and fewer people, who must therefore pay more and more money for this service.
- **Communal containers and bins** – Voluntary and anonymous collection systems, which depend on good will, have a ceiling (40-45% recycling) and overcoming that is difficult. Street containers tend to attract trash which does not belong in the container. As for as bins, if the size of the opening is too large, some people may throw the garbage bags there, if too small, they leave the bags outside next to the bins.
- **Tourism** – Tourists come from different countries, speak different languages and come and go. In addition, municipalities where people buy a second-home face the challenge of having to inform not only their permanent residents, but also these seasonal incomers.
- **Awareness raising of specific groups** - There is a sector of the population (e.g. people with mental or social difficulties, etc.) who does not care and are not supportive of waste collection.

Areas for improvement mentioned by interviewees are as follows:

- **Retail and shops** – Many municipalities mention that it is necessary to introduce improvements in commercial waste collection so that they do not throw away mixed waste. These typically have large amounts of the same waste and therefore it is a source worth tapping into.
- **Seizing available technology** – Many municipalities agree that new technologies should be used. The implementation of payment for generation and traceability of the discharge could for instance be enhanced by an intelligent container system / smart bins with cards identifying who uses them.
- **Door-to-door** – Several municipalities said to aim to increase the number of door-to-door collection areas.
- **Improve the quality of waste** (e.g. in organic waste) so that it contains fewer improper materials. This is typically an area that municipalities (or provinces) which are more advanced are pursuing. For the non-frontrunners, the first step is to ensure maturity i.e. adequate level of service (in all municipalities);
- **Reduce waste generation**, by working on prevention as well as by implementing 'Pay As You Throw' system in those municipalities who do not have it;
- **Continuously increasing performance (collected %)** – this requires aiming at fractions that are not being separated yet and that may be more difficult-to-recycle materials. Many municipalities are currently working towards the implementation of the so-called "fifth fraction" namely organic waste. Others, who already collect organic waste are making collection attempts for specific fractions like diapers. An additional challenge faced by those collecting organic waste is finding a solution for the current organic bag, which tears off easily (this results in people using two bags each time)
- **Internal communications** – between waste operators and the municipality / town hall / public waste authority have been raised in a case as an area for improvement. In the event of an incident (e.g. some streets have been left uncollected because a truck has broken down or because a worker has failed), the municipality should be immediately informed of the incident and of the solution the provider proposes. That way the municipality can inform citizens accordingly before these turn to the town hall to complain. Currently citizens are often faster, making the municipality reactive rather than proactive.

Recommendations to other municipalities

A general advice for Spanish municipalities is to "know your municipality" well (understand the waste that is produced, how it is being separated, where it is going to) and to tailor the waste collection systems accordingly to the needs and characteristics of the municipality. Next to that, some specific recommendations from frontrunners read as follows:

- **Facilitate separate collection by providing the tools / materials and service needed.** For example, for bio-waste, provide the bins and compostable bags, (electronic) card to open containers and the like. In the cases of door-to-door collection, adjust the frequency in which 'residual' waste is collected to decrease it every time while increasing the collection for waste that is sorted for recycling.
- **Seek separate collection and systems that identify the user** (door to door, cards, etc.) as these obtain better collection rates. It is enhancing to implement door-to-door collection together with payment per generation.
- **Environmental education of the public** at all levels of population is imposed as essential. Start with schools, but do not forget about the elderly (particularly in rural areas where this is the dominant population).
- **Involvement of civil society** (e.g. NGOs, user and consumer organizations, unions) is key as they tend to play an important role in reinforcing communications and environmental education.
- **Communication** – The only way in which municipalities can take generally unpopular measures seems to be by ensuring to keep the public informed and by consulting citizens and businesses (present them with the technical options and ask their opinion on which one to choose) and keep a record of these choices to eventually justify later changes in the system. Consider participatory processes; these have resulted in a decision for door-to-door collection in some municipalities.
- **Establish a good complaint handling system.**
- **Trying to find political consensus** is important for the stability of the waste collection system, as local government may change every four (4) years and this may discontinue the waste collection system in place.
- **Consider** 'Pay As You Throw' systems – which rather aim at "fairness" than at increasing separation. Some municipalities are doing it and others are carrying out pilots with good results.
- **Higher fees -** One municipality argued that municipalities should not be afraid to introduce higher fees. These are necessary for the council to be able to provide an adequate service and in the experience of the municipality, increasing the fee by a few Euros is not significant on an individual level ("we increased the fee from 115 Euros to 117 Euros and nobody noticed it").
- **Fines** – Can be established to penalise those who throw away their trash waste incorrectly;
- **Subsidies** – the municipal responsible should be aware and on top of subsidies that become available.
- **Education within municipality** – For small municipalities, an advice was to ensure the entire council is sensitized and informed about waste collection aspects (not just the mayor and councilor) because inhabitants may reach out to a random worker.

Recommendations to MITERD

The municipalities interviewed also provided advice to MITERD:

- **Be ambitious** – Some felt that MITERD should be more stringent and match new legislation with that of frontrunners (e.g. Legislation in Catalonia is more stringent than Spanish law). A

specific requirement mentioned was to make selective door-to-door collection mandatory by law.

- **Motivation and engagement of local municipalities** – This is key all over Spain but in particular in provinces / municipalities where the waste collection system is (somewhat) obsolete, and where minimum services are being carried out at a subsidized rate.
- **Sanctions** - Councils that do not recycle must be penalised to avoid that municipalities stick to the cheapest waste collection systems (which basically means not recycling). The recycling canon of Catalonia for example has been decisive for the city councils allowing door-to-door collection to be carried out.
- **Urban and rural areas** – Municipalities point at MITERD, as legislator, as responsible for helping overcome the challenges faced in rural areas.
- **Consider facilitating a container-deposit system** - for plastic bottles, cans, glass like it is the case in some north European countries. When returning them, one gets the deposit back (10-25 Euro cents).
- **Reduce administrative burden in grant applications** - One municipality felt that currently the amount of documentation that must be delivered is a burden and that instead, MITERD should require documentation after implementation (rather than in the application process), to prove how the grant has been used.

2.7.3 Evidence from other municipalities in Spain

Challenges and areas to improve

A synthesis of the challenges experienced by municipalities is as follows:

- **Public awareness** - Users are not aware / lack knowledge of how to separate waste at source; the existence of different models confuse the population. Persistence and continuous communication are required in this regard.
- **Acceptance** - Many users are not willing to separate waste and it is very difficult to follow these one by one. In particular biowaste separation seems the most unpopular amongst. It is important for municipalities to take a strong stance and to continue to communicate about the waste collection system and to stress the duty citizens have on this.
- **Packaging separation** –The yellow container i.e. packaging container tends to contain waste that does not belong in it.
- **Inadequate use** – Incorrect waste disposal decreases performance and the quality of the separated waste.
- **Physical barriers** – Waste collection trucks struggle to navigate historic city centers, with very narrow streets and incorrectly parked cars. The solutions were to set a fixed day to empty the containers and intensive surveillance by local police on how cars are parked.

Areas for improvement are:

- **Education and awareness raising, not forgetting adult population** - Almost all awareness raising efforts are focused on children while in the end adults are responsible for household waste. Education of adults, whether done by municipalities or local NGOs is therefore necessary. In addition, information on how the waste collection and treatment model works and the costs of the service should be communicated openly to citizens to address the feeling that many have of paying too many waste taxes.
- **Use of new technologies** - Technology such as sensors and container locks (closure) should be considered to enhance the quality of collected waste.

- **Introducing the separate collection of the organic waste fraction** – including encouragement of home composting in urban and rural areas.
- **Recycling options for specific waste types** – Whether specific facilities where citizens can bring their waste to, or periodic collection, waste types such as WEEE, bulky waste, sanitary waste need to be considered.
- **Recycling workshops** – Recycling workshops should be made available for residents e.g., textiles / clothing.
- **Waste management at festivals** - There is a need for a waste management model for events and parties. Despite the fact that separate containers are provided, there is little control over what goes into these.

Recommendations to other municipalities

- **Continuous learning and involvement** – It is important to consider environmental training for service workers and to involve all relevant stakeholders in management for continuous improvement.
- **Periodic evaluation of results -** By periodically evaluating the amounts collected separately, one can understand whether the system is working as well as where contamination of the fractions may come from.
- **Firm commitment to the separation of bio-waste (or organic fraction)** – Considering the large share of biowaste, tackling this fraction is essential to achieve high recycling targets.
- **Sanctions and penalties** – There is much permissiveness currently when it comes to properly depositing and collecting waste. Sanctions and rewards for both waste operators and citizens are seen as necessary to incentivize a working system.
- **Citizens engagement** – Engaging citizens may be a time and resources consuming process but it leads to greater buy-in.

Recommendations to MITERD

The recommendations provided to MITERD by different municipalities touch upon regulatory, financial organizational (including capacity building) and administrative aspects. More specifically recommendations are as follows:

- Making the approval of regulatory ordinances on waste mandatory in the municipalities. Ban over-packaging of consumer products, make Deposit Return Systems mandatory, promote the use of tap water through encouraging filters instead of bottled water, and penalise the purchase of individual products (for example, a daily yogurt consumer should be economically compensated for buying a 1 litre container instead of 8 containers of 125 ml).
- Remove obstacles to the establishment of municipal composting plants by facilitating administrative procedures and simplifying requirements. This is important in rural areas where farmers are willing to use municipal organic waste to make their own compost.
- Provide financial means for economic audits of the cost of the service, which inform the upgrade of fees.
- Further taking into account of the insular perspective. Waste management in fragmented territories such as the archipelagos – and even so more in the smaller islands - is more costly than on mainland.
- Increased regional involvement – to provide further support and assistance to municipalities as well as to support surveillance of the service in the cases municipalities do not have sufficient resources for this.
- Further individual support to and follow-up of each municipality given each municipality is different and is at a different stage of the waste collection improvement process.

- Facilitate training to qualify personnel.
- Several changes in funding application – Simplifying procedures and requirements for municipalities to request aid, providing more time for application so that municipalities have sufficient time to prepare their proposals, reflecting population and its dispersion in funding provided to municipalities, allowing for more open (less rigid) funding applications for specific waste related projects municipalities may come up with.

2.7.4 Conclusions

- Spanish frontrunner municipalities face similar challenges to municipalities in other EU countries: language, politics, willingness of citizens to separate waste, the quality of separated waste. In addition Spanish municipalities also mentioned challenges such as the difficulties to provide thin-populated, rural areas with adequate service. Help from MITERD in this regard would be welcome.
- Both EU and Spanish frontrunner municipalities consider that continuous improvement in waste collection as well as providing comfort for citizens to facilitate waste separation are important. Seeking separate collection and systems that identify the user such as door-to-door collection and 'Pay As You Throw' systems seem to work well in this regard.
- Both EU and Spanish frontrunner municipalities mentioned the importance of adequate (higher) waste fees for proper waste handling and the importance of environmental education and awareness raising to engage all segments of society.
- A common recommendation to MITERD from both Spanish and EU frontrunners is to ensure legislation is ambitious and conducive to higher performance.

3 The Waste Management Performance Ladder

3.1 Performance ladder

The Action Plan aims to establish clear, measurable, and achievable goals to improve waste management in Spanish municipalities. For this, a Waste Management Performance Ladder (WMPL) has been developed. The aim of this ladder is to establish a set of "rungs" and performance levels so that each municipality in Spain can self-evaluate and establish their current performance level in relation to the objectives established in the EU Waste Framework Directive (WFD), namely by 2020, 50% of municipal waste should be prepared for reuse or recycled, 55% by 2025, 60% by 2030 and 65% by 2035.

Table 1: European Union Waste Framework Directive targets

Target Year	Target preparing for reuse/recycling rate (%)
2020	50%
2025	55%
2030	60%
2035	65%

Taking these targets as a starting point, as well as current rates in municipalities in Spain which are wide ranging, it is necessary to establish a methodology that can be easily applied and that is comparable among the 8,131 municipalities in Spain. The proposed methodology takes into account the wide variation of preparing for reuse and recycling rates currently existing among those municipalities. Based on this, 13 rungs based on performance rates of separate waste collection are proposed. In this regard, it should be noted that the performance in separate waste collection is clearly linked to the achievement of higher rates of preparing for reuse/recycling, especially considering that, from 1 January 2027, the use of biostabilised material in soils will not count as recycling.

Table 2: Waste Management Performance Ladder

Rung	Performance rate (%)	Performance level
1	5-15%	Beginner
2	15-20%	
3	20-25%	
4	25-30%	Intermediate
5	30-35%	
6	35-40%	
7	40-45%	Advanced
8	45-50%	
9	50-55%	
10	55-60%	Expert
11	60-65%	
12	65-70%	
13	>70%	

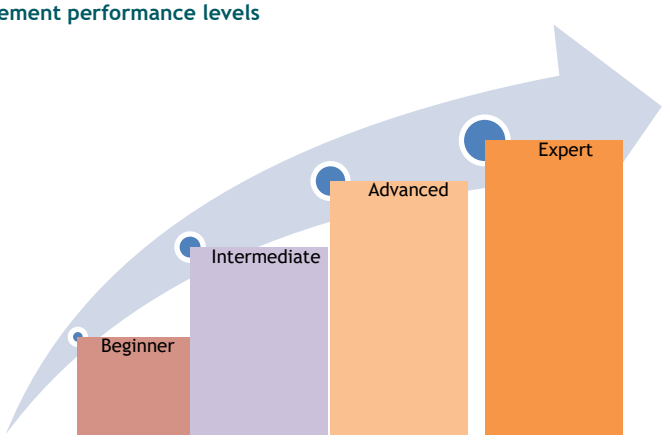
The rungs are established in 5% increments, except for the first rung which groups together municipalities with limited experience in the separate collection of waste, with rates that range from 5 to 15% rates. The idea behind this grouping is to set ambitious yet realistic and achievable goals, so that each municipality is able to climb to the next rung in the ladder**, year by year,** and thus **improve its performance at least 5% yearly**. This objective is in line with commitment no. 188 of the Spanish RRP, to reach a rate of 30% separately collected municipal waste by 2026, from a starting point of 21%[15].

[15] Recovery and Resilience Facility. Operational arrangements between the European Commission and Spain: https://ec.europa.eu/info/sites/default/files/countersigned_es_first_copy_en_01.pdf

For this purpose, the Action Plan will also establish the recommendation of a yearly self-evaluation of waste management performance. In addition to the rungs, four performance levels are established: **Beginner** (5-25%), **Intermediate** (25-40%), **Advanced** (40-55%) and **Expert** (55-65% or more). Each performance level groups 3 or 4 rungs of the ladder.

It is foreseen that, as municipalities achieve higher levels of performance year by year, the lowest rungs will become obsolete and therefore the rungs and levels will need to be reassessed, in a way similar to the reassessment of the EU energy labels[16]. For this reason, our recommendation is that the thresholds of the rungs and levels are re-defined every five years.

Figure 1. Waste management performance levels



In order for municipalities to assess their current performance rung and level, a simple web-based guide and questionnaire will be provided, where they will have to fill in the relevant data relating to separate collection and preparing for re-use rates. To conduct a valid and relevant self-evaluation it is expected that waste management data collection will need to be reinforced, particularly in those municipalities with lower performance levels.

The goal of the Action Plan is to establish the necessary tools and resources needed to bring each Spanish municipality at least one rung higher in the ladder, by sharing a set of best practices and instruments that are relevant and applicable in the context of Spanish municipalities. These will include both data collection and waste management practices. For the Action Plan to be more effective, it will benefit from the WMPT, as it will allow to take into account the starting point of municipalities and provide level-appropriate resources and instruments. In order for the recommendations to remain relevant, we recommend that they recommendations are regularly updated, and a **yearly voluntary self-evaluation should be conducted by the municipalities**.

The following section provides a set of recommendations tailored according to the current performance level, to help local entities move up one or more rungs. Additionally, other measures may be proposed in order to motivate the efforts of local entities to climb rungs. These may involve a combination of measures such as contests, advertising campaigns and other economic incentives.

As for contests, following some experiences that have been conducted, for example in the Autonomous Communities of Cantabria[17] and Murcia[18], contests could be established to promote an improvement in separate collection and recycling rates. Different approaches for this modality could include the following:

- Reduction of total waste collection per inhabitant;

[16] https://ec.europa.eu/commission/presscorner/detail/en/ip_21_818
[17] https://www.cantabria.es/detalle/-/journal_content/56_INSTANCE_DETALLE/16413/13308176
[18] https://www.fmrm.es/index.php/articulos/noticias/389-entrega-de-premios-a-los-municipios-que-mas-reciclan.html

- Increase of waste volume per inhabitant for each waste stream (e.g., increase in the tonnes of waste collected in the blue containers);
- Improvement of separate collection rates achieved by the municipality.

These achievements may result in prizes such as public acknowledgment, economic rewards, campaigns to further promote recycling, etc.:

Public acknowledgement

A municipality earns public recognition for its innovative waste management practices or a noted improvement in results derived from such practices.

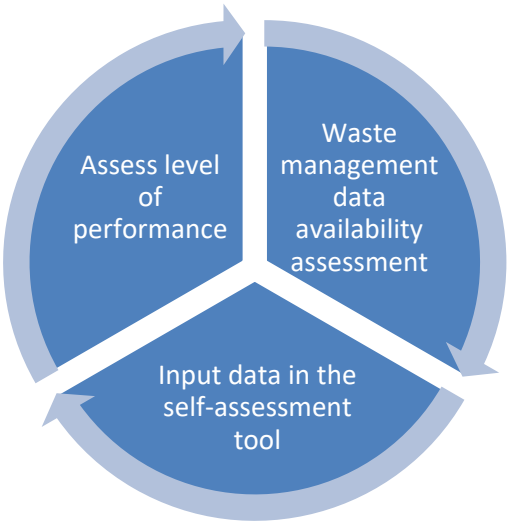
Regarding ***advertising campaigns***, these could consist of providing advertising efforts geared towards educating the citizenship on the reduction of waste at source, separate collection of waste and recycling practices. The goal of these campaigns shall vary depending on the starting point of the municipality.

Lastly, e***conomic incentives*** could include providing economic rewards for municipalities that move up more than one rung in the WMPT.

3.2 Evaluation framework and self-assessment tool

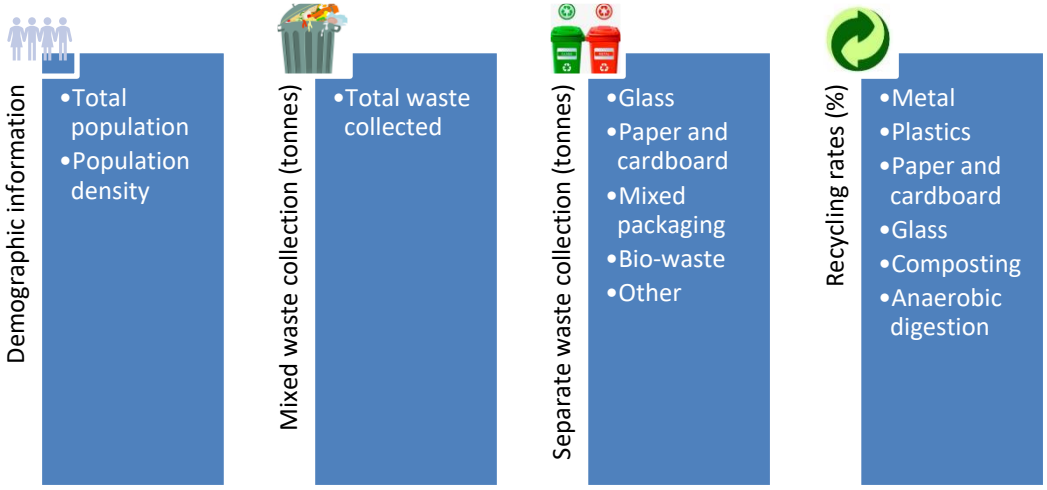
In order for the municipalities to conduct the suggested yearly waste management performance self-assessment, a series of steps need to be taken, starting with the assessment of the available data on waste management for the municipality.

Figure 2. Waste management self-assessment performance cycle (yearly)



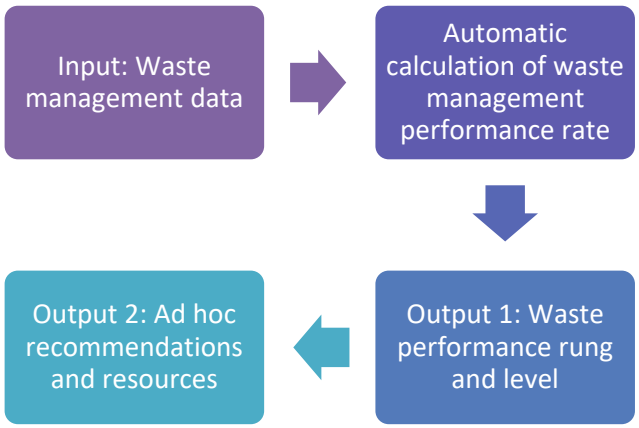
The self-assessment tool will involve an easy-to-use interface, with a step-by-step guide as to which data needs to be collected and input into the tool. Waste management data needed for the assessment includes the following fields:

Figure 3. Self-assessment tool categories and data inputs



Once the data is input into the self-assessment tool, the tool will automatically calculate and return the separate collection rates that will determine the rung and level on which the municipality is currently located, and provide relevant information regarding the EU WFD targets, and suggested instruments and practices in order to reach the next rung/s and level/s, as seen in the figure below.

Figure 4. Self-assessment data inputs and outputs



Data collection best-practices will be provided for those local entities where waste management data is incomplete or insufficient to conduct the self-assessment. Once the local entity has collected the relevant data, the self-assessment can be conducted, and the current performance level is determined. The following section provides relevant recommendations for each performance level.

4 Roadmap towards the implementation of high-performing recycling schemes

4.1 Overview of actions per performance category

The Roadmap is a set of recommendations made to Spanish municipalities and Autonomous Communities. It is meant as a tool for each municipality to discuss democratically with all stakeholders involved, and from which to choose those of greatest relevance and urgency.

This proposed Roadmap is differentiated per category within the Waste Management Performance Ladder described above (§ 3):

1. Beginner;
2. Intermediate;
3. Advanced;
4. Expert.

The Table 4-1 below provides an overview of the features to be added to the waste management system, as the municipality makes progress along that Ladder. The addition of each such feature constitutes an action in the roadmap.

This table should be understood as follows: a municipality at a given rung in the Ladder should:

1. First, implement all features of the table, relevant for their type of municipality, and belonging to the categories it already has achieved;
2. Second, implement the features of the table, relevant for their type of municipality, and that belong to the category it currently is in.

By achieving this, it is expected that it will be able to improve its performance and make progress up the Ladder, to higher rungs and categories – leading it, as it attains a higher category, to implement additional features.

The table is split in three columns:

1. Features common to all areas;
2. Features specific to areas (full municipalities or fractions of municipalities) with single-household buildings (should they be detached or not);
3. Features specific to areas (full municipalities or fractions of municipalities) with multiple-household buildings.

Recommendations to Autonomous Communities are marked with an asterisk*.

The logic presiding the implementation of features is to:

- start with those features that require the least material and financial resources from the municipality, and the least awareness and competence by the population, and to implement progressively those that are more demanding in terms of competencies by the population and of such resources;
- use the collection of commercial waste as a pilot or a boost for the measures meant for households, as these waste generators provide higher volumes of better sorted waste;

- to prepare in one category of rungs the features to be implemented in the next.

It should be clearly reminded that this roadmap only constitutes a **recommendation** for a **progressive** and **incremental** pathway towards higher rates of separate waste collection. Local Entities and Autonomous Communities retain of course full sovereignty on the features that they want to implement (within the framework of the relevant Spanish and regional laws), and on the order in which they want to implement them. In particular, some Local Entities may want to leapfrog stages and target directly the more ambitious features, which require more resources, awareness and competence. This is fully legitimate, and even encouraged for the Local Entities having the resources and the political will necessary for this.

Table 4-1 Overview of actions per category in the Waste Management Performance Ladder

Category in the Waste Management Performance Ladder	Policy objectives to be achieved	Main features to be added to the waste management system		
		Common to all areas	Specific to areas with single-household buildings	Specific to areas with multiple-household buildings
Beginner (separate collection rate ≤20%)	Create awareness of separate collection and of reduction of waste	• Information & Communication to citizens on waste, its collection and its treatment, including visits to the composting pilot plant • Monitoring of landfilling with periodic publication of results • Introduction of the separate collection of waste for five waste streams: (1) glass; (2) paper & cardboard, (3) plastic and metal packaging (4) biowaste, (5) rest • Neighbourhood collective & school composting points • Pilot demonstrators of some collective infrastructures reducing the generation of waste: second-hand shops for clothes, toys, appliances, furniture; repair cafés • Household waste collection centres for bulky / specific waste categories (such as furniture, WEEE, used cooking oil)	*None*	*None*
	Set-up the treatment facilities at pilot scale	• Door to door separate collection of commercial waste of five waste streams: (1) glass, (2) paper & cardboard, (3) metal & plastic packaging, (4) biowaste, (5) rest • Set-up of a pilot plant for the industrial composting or anaerobic digestion of biowaste		

Category in the Waste Management Performance Ladder	Policy objectives to be achieved	Main features to be added to the waste management system		
		Common to all areas	Specific to areas with single-household buildings	Specific to areas with multiple-household buildings
	Prevent conflicts	• Involvement of citizens: forum for concertation with citizens with periodic meetings, surveys of citizens with publication of results • Processes for the anticipation and resolution of conflicts between municipality and operator • Social dialogue and collective agreement with workers of the operator		
	Create incentives for municipalities to diminish the generation of unsorted waste	• Implement the tax for the deposit of waste in landfills, the incineration and the co-incineration of waste established in Law 7/2022 and make it a finalist tax • Set up a plan for preventing unsorted waste being sent to incineration or co-incineration facilities, with an objective to prohibit it by [2040]*		
Intermediate (separate collection rate between 20% and 45%)	Monitoring and control of waste collection	• Monitoring of waste collection (GPS on collection lorries; RFID tags, QR-codes or barcodes on bins) • Monitoring of landfilling, incineration and co-incineration with periodic publication of results • Channel for complaints by citizens and commercial activities with (1) guaranteed response time and (2) monitoring and reporting on the number, gravity and resolution of complaints	*None*	*None*

Category in the Waste Management Performance Ladder	Policy objectives to be achieved	Main features to be added to the waste management system		
		Common to all areas	Specific to areas with single-household buildings	Specific to areas with multiple-household buildings
		• Periodic analysis of the content of the unsorted "rest" containers		
	Introduce door-to-door separate waste collection to the households	• Scale-up of the facilities for the composting or anaerobic digestion of biowaste	Door to door collection in 2 streams: (1) biowaste, (2) rest (the other fractions remain collected in collective containers)	Collective, separate collection in containers in the streets or in multi-apartment buildings, closed with mechanical locks, for (1) biowaste and (2) rest (the other fractions remain in open containers).
	Create an incentive for municipalities to increase the separate collection of waste (incl. biowaste)*	• Implement a tax refund scheme for waste, including biowaste* • Set a mandatory difference in price between that for the treatment of unsorted waste (rest) and that for separately collected waste* • Capacity building for adequate drafting of waste collection contracts*	*None*	*None*

Category in the Waste Management Performance Ladder	Policy objectives to be achieved	Main features to be added to the waste management system		
		Common to all areas	Specific to areas with single-household buildings	Specific to areas with multiple-household buildings
Advanced (separate collection rate between 45% and 65%)	Enhance separate collection of waste with citizens, including with an economic incentive	• Pay as you throw (PAYT) for residual, unsorted waste = 'rest' bin • Set up quality metrics for the purity of separately collected waste (glass, paper & cardboard, metal & plastic packaging, biowaste) • Periodic analysis and reporting on the amounts and the quality of the separately collected waste, as per the metrics	Door to door separate collection with RFID tags on the bins and monitoring system in 5 streams: (1) glass, (2) paper & cardboard, (3) metal & plastic packaging, (4) biowaste, (5) rest	*None*
	Increase the social acceptance of payment per generation of waste	Social modulation of waste collection fees	*None*	*None*
	Reinforce the movement towards the reduction of waste	Generalisation of waste reduction infrastructures (= soft incentives): second-hand shops, centres for the preparing for re-use and repair cafés	*None*	*None*

Category in the Waste Management Performance Ladder	Policy objectives to be achieved	Main features to be added to the waste management system		
		Common to all areas	Specific to areas with single-household buildings	Specific to areas with multiple-household buildings
	Create an incentive for municipalities to increase the quality and purity of the selectively collected waste*	Establish a pricing of treatment for separately collected waste, with fees decreasing as waste quality increases*	*None*	*None*
Expert (separate collection rate >65%)	Reduce overall generation of waste	Pay as you throw (PAYT) for all categories of waste (= harder, economic incentive for the reduction in the generation of waste)	*None*	Collective, separate collection containers in the streets or in multi-apartment buildings, closed with electronic locks (using RFID tags), for all fractions.

Legend: Recommendations to Autonomous Communities are marked with an asterisk*.

These features will be detailed in the following paragraphs, each of which relating to a given category of performance in the separate waste collection. Each paragraph follows the same structure:

- List of policy objectives relevant to that category of performance;
- For each policy objective, the justification of its existence and the tables presenting, in a systematic manner, the features of the waste management system enabling the achievement of that objective.

4.2 Roadmap for municipalities in the 'beginner' category

The policy objectives relevant for municipalities in the 'beginner' category are the following:

- Create awareness of separate collection and of reduction of waste;
- Set-up the treatment facilities at pilot scale;
- Prevent conflicts;
- Create incentives for municipalities to diminish the generation of unsorted waste.

4.2.1 Features enabling the attainment of the policy objective 'Create awareness of separate collection and of reduction of waste'

Justification of the policy objective

Municipalities in the 'beginner' category are at the very start of the process leading them to the separate collection of waste. Their population is generally unaware of the importance and relevance of this separate collection, and of the harm caused to the environment and climate by inadequately processed waste.

It is therefore of great importance, at the start of this process, to gain a broad support for it among the population. It is only if there is a general consensus that a proper management of waste is an objective worth being pursued that the improvement will be possible.

Features of the waste management system enabling the attainment of the policy objective

Table 4-2 Summary of feature "Information & Communication to citizens on waste"

Information & Communication to citizens on waste	
Policy objective	Create awareness of separate collection and of reduction of waste
Justification of the relevance of the feature to reach the objective	The first step to create awareness is to transmit the information and data that people need to build an opinion on the relevance and interest of improving the sorting of waste
Description of feature	• Inform citizens on waste, its collection and its treatment: o the reasons why humans generate waste; o the consequences of littering and of illegal dumping of waste; o the methods for waste disposal (landfilling, incineration), their consequences on the environment and their financial cost for municipalities and citizens; o the renewable and non-renewable resources used to manufacture goods, the origin of these resources, the environmental impact of consumption of new items and of virgin materials; o what is re-use / recycling / incineration with energy recovery? o the environmental and economic benefits of re-use and recycling; o the need for sorting of waste at source; o the categories of waste;

Information & Communication to citizens on waste		
	• Organise visits of citizens and school pupils to the waste collection and treatment facilities (according to what is available): landfill, incineration plant, composting pilot plant.	
Document describing the feature in greater technical detail	• FEMP – Technical Manual of Effective Communication on Waste for Local Entities (*available in Castilian and regional languages of Spain*)[19]; • Alliance of municipalities for sustainability in waste ("*Alianza de Municipios por la Sostenibilidad en los Residuos*") – Ideas of campaigns (available in Castilian, Catalan)[20].	
Implementation period	Short term = 1 to 2 years	
Nature of resources needed	Communication material	
Challenges identified	• Heterogeneity of the population regarding digital media • Need to segment the population accurately	
Risks assessment	***Potential risk***	***Mitigation measure***
	Inadequacy between the nature / the presentation of the message and the target audience	Precise identification *ex ante* of the target audience and of its knowledge level and cognitive capacities
	The population resents being patronised by municipal authorities	Involve local initiatives and NGOs in the communication campaigns at the outset

Table 4-3 Summary of feature "Monitoring of landfilling"

Monitoring of landfilling	
Policy objective	Create awareness of separate collection and of reduction of waste
Justification of the relevance of the feature to reach the objective	Provide the hard data with which citizens can assess the nature and the quantitative importance of the problem created by landfilling, in units that make sense for them
Description of feature	• Monitor periodically (typically: monthly) the amount of waste (in tonnes) being landfilled in the municipality; • Transform this total figure into a figure expressed in kg per inhabitant, and per household, per month, per year and accumulated since the birth dates of citizens of e.g. 20, 30, 50 and 70 years of age; • Compare the figure with the remaining available volume in the landfill site, and compute the remaining duration until the landfill site is full;
Document describing the feature in greater technical detail	*(none identified)*
Implementation period	short term = 1 to 2 years
Nature of resources needed	Communication material IT software development
Challenges identified	• Setting up the data collection system at the landfill site to attribute the load of a given lorry to the source municipality;

[19] http://femp.femp.es/Microsites/Front/PaginasLayout3/Layout3_Personalizables/MS_Maestra_3/_MznynrPoTrXKv5bey-7NcwsmWRvwm_gXqYKvux9hPfYUqkboINUGi_MftU7YSldL
[20] https://sostenibilidadresiduos.es/media/files/Bibliografia/Codigo_28/Catalogo_ideas.pdf
https://residus.gencat.cat/web/.content/home/ambits_dactuacio/recollida_selectiva/eines_recursos/09_Cataleg_idees_campanyes.pdf

Monitoring of landfilling		
	• The estimation of the remaining volume at the landfilling site may be subject to technical uncertainties.	
Risks assessment	***Potential risk***	***Mitigation measure***
	Credibility of the monitoring may be hampered by measurement uncertainties	• Take rigorous methodological steps to ensure reliability of measurements • Test the measurement and monitoring chain before deployment

Table 4-4 Summary of feature "Introduction of the separate collection of waste for (1) glass; (2) paper & cardboard, (3) plastic and metal packaging (4) biowaste, (5) rest

Introduction of the separate collection of waste for (1) glass; (2) paper & cardboard, (3) plastic and metal packaging. (4) biowaste, (5) rest	
Policy objective	1. Create awareness of separate collection and of reduction of waste; 2. Initiate the movement in the municipality towards the separate collection of waste
Justification of the relevance of the feature to reach the objective	• The gradual introduction of the separate collection of new fractions starting in specific areas where implementation is easier (e.g. in less densely populated neighbourhoods) makes it visible to all citizens that a new separate collection of waste has started in the municipality; • The separate collection of biowaste will be mandatory in the EU as of 01 January 2024[21]; • To explain and communicate about their usage, and hence about the different categories of waste to be separately collected, municipalities should display information on the containers , bins or compostators themselves, disseminate information via postal mail and/or engaging directly with citizens on the streets. • There are different systems that can be used for the separate collection of waste: collective open containers in the street, door to door collection, locked containers, community composting for biowaste, etc. The municipality/association of municipalities should choose the system, or combination of systems, that is most appropriate for them according to the type of municipality. Although, it should be taken into account that the more individualised the collection system, the more efficient results will be.
Description of feature	• This measure has to do with implementing the separate collection of five fractions: (1) glass; (2) paper & cardboard, (3) plastic and metal packaging (4) biowaste, (5) rest.However, it should be noted that, according to the previous Waste Law (Law 22/2011, of 27 July on waste and contaminated soils), the separate collection of glass, paper & cardboard and plastic and metal packaging should have been in place since 2015. • Select the most appropriate collection model according to the characteristics of the municipality. In the case where different areas with

[21] As per the revised Directive 2008/98/EC on waste (Waste Framework Directive), Art. 22(1), downloadable at: http://data.europa.eu/eli/dir/2008/98/2018-07-05

Introduction of the separate collection of waste for (1) glass; (2) paper & cardboard, (3) plastic and metal packaging. (4) biowaste, (5) rest	
	different characteristics exist, a combination of models could be selected. If collection by means of collective open containers is to be implemented, it can be envisaged the purchase of open containers that can later be adapted to the introduction of locking systems. • Start with separate collection of biowaste in specific areas where it is easier to implement and, taking into account the lessons learnt in these pilot areas, progressively extend it to all areas of the municipality. • Promote community composting in areas with high production of green waste and where the population can easily participate, avoiding collecting biowaste in those areas. • Consider reducing the frequency of residual fraction collection as separate collection increase, in order to contain costs. • Set-up of the collection and treatment facilities for the waste streams thus separately collected, at the scale relevant for the anticipated rate of selectively collected waste; • Conclusion of contracts with recycling companies for the delivery of sorted waste, in specified quantities and at specified levels of quality and purity. Introduce flexible clauses to allow continuous improvements.
Document describing the feature in greater technical detail	Generalitat de Catalunya "Guide and reference experiences for the implementation of the separate collection of municipal waste" *("Guía y experiencias de referencia para la implantación de la recogida separada de residuos municipales")* of July 2020[22], chapter 3.1 "Collection in container" ("*Recogida en contenedor*").
Implementation period	short term = 1 to 2 years
Nature of resources needed	Communication material Training of personnel Small, diffuse infrastructure Large, concentrated infrastructure Permanent Operational Expenditures
Challenges identified	• The introduction of new separate collections implies significant investment and operational costs. It must hence be carefully prepared, both technically and financially; • Appropriate transmission to the population of the competencies needed for community composting and the separate collection of waste in 5 streams = what item belong to what separate collected fraction (with what level of cleanliness), and what to the "rest" fraction; • Appropriate anticipation of the rate of separate collection of waste (and hence of the volumes to collect and process), of the quality and purity of the separately collected waste, and of their evolution over time (as the population is susceptible to increase over time its competence level regarding the separate collection of waste); • Appropriate adaptation of the residual fraction collection (particularly decreasing frequency) over time, according with the increase of separate collection rate and the consequent reduction of residual fraction.

[22] https://residus.gencat.cat/web/.content/home/lagencia/publicacions/prevencio/guia_experiencies_implantacio_rsrm_es.pdf

Introduction of the separate collection of waste for (1) glass; (2) paper & cardboard, (3) plastic and metal packaging. (4) biowaste, (5) rest		
	• Quality of the separately collected waste - This will be influenced by the selected collection system (for example, public containers where waste is "anonymous" may not always be used correctly by citizens).	
Risks assessment	***Potential risk***	***Mitigation measure***
	Insufficient uptake by the population of the separate collection of waste	Preliminary communication regarding the purpose and benefits of the separate collection of waste
	Insufficient purity or quality of the separately collected waste	• Clear communication on the sorting criteria for the correct placement of waste in each separately collected fraction, and on a (simplified) rationale for these criteria; • Potentially: set-up of proportionate and dissuasive fines for the improper placement of waste, with personnel trained at identifying the household having originated the improper dumping + means to identify it (e.g video supervision of the containers with short-term storage of pictures).
	Insufficient frequency of the collection at the containers, when this model is used, leading to the dumping of (sorted or not) waste along these containers	• Close monitoring of the filling rate of each container; • Fast adaptation of the frequency of collection or of the density of containers to match the actual waste flow.
	Failure to optimise collection frequencies hence increasing the total cost of the separate collection in 5 fractions.	• Coordinate collection frequencies so as to increase collection frequencies where more frequent collection is needed (bio-waste) at the expense of other fractions. Decrease residual collection rates according to the decrease of rest fraction generation.

Table 4-5 Summary of feature "Neighbourhood collective & school composting points""

Neighbourhood collective & school composting points	
Policy objective	1. Create awareness of separate collection and of reduction of waste; 2. Initiate the movement in the municipality towards the separate collection of waste

Neighbourhood collective & school composting points	
Justification of the relevance of the feature to reach the objective	• The presence of composting facilities in the public space (streets, places) and in schools makes visible to all citizens that the separate collection of biowaste has started in the municipality; • These composting facilities constitute an opportunity for the municipality to explain their usage to citizens and to school children (who in turn can educate their parents) and to communicate about the environmental and economic benefits of composting. This communication can be performed on the composting facilities themselves, via direct engagement with citizens and schoolchildren (including via visits to local farms and gardens), or via postal mail; • Composting facilities are the least costly and easiest entry step into the process of separate collection and processing of biowaste, as the collection and the processing of the biowaste occur at the same place with no need for transport to a processing plant, and minimise the disturbance of the habits of households.
Description of feature	• Set-up of collective composting facilities, in public spaces and in schools. Each facility contains several containers: for the collection of biowaste, for the additional cellulosic waste (usually: wood debris) needed to balance the composition of the composting mixture, for the different stages of maturation in the composting process, until the final compost. The facility also contains posters explaining how it should be used; • Set-up of rules on the usage of the composting facility: open to all / reserved to the households having followed a short training; • Set-up of the rules on the attribution of this compost (for free, against payment; unlimited / within a set quota per user category and per period of time), and on who is entitled to receiving it (local farmers / vegetable growers / professional gardeners / general public); • Set-up of the physical distribution processes of the compost.
Document describing the feature in greater technical detail	Generalitat de Catalunya "Guide and reference experiences for the implementation of the separate collection of municipal waste" *("Guía y experiencias de referencia para la implantación de la recogida separada de residuos municipales")* of July 2020[23], chapter 3.4 "Management of the organic fraction at the point of generation" ("Gestion de la fracción orgánica en el punto de la generación").
Implementation period	short term = 1 to 2 years
Nature of resources needed	Communication material Training of personnel Small, diffuse infrastructure
Challenges identified	• The competencies needed to feed and to manage the composting facility require being acquired specifically; • The transfer of the compost from one stage of the process to the next – and hence from one container to the next – and more generally the management of the composting centre requires some periodic and competent manpower;

[23] https://residus.gencat.cat/web/.content/home/lagencia/publicacions/prevencio/guia_experiencies_implantacio_rsrm_es.pdf

Neighbourhood collective & school composting points		
	• The effective usage of the compost depends upon its quality, which is largely determined by the compliance of citizens with the requirements regarding the nature and purity of biowaste to place in the first container of the chain and regarding the addition of woody biomass to balance the mixture.	
Risks assessment	***Potential risk***	***Mitigation measure***
	Insufficient purity of the biowaste being contributed by citizens, or insufficient addition of woody biomass to balance the composting mixture	• Communication to citizens and schoolchildren on these requirements; • Requirement to undergo a specific training before being entitled to use the composting facility.
	Improper management of the composting facility may cause unwanted disturbances	Requirement to undergo a specific training before being entitled to manage the composting facility.

Table 4-6 Summary of feature "Pilot demonstrators of collective infrastructures reducing the generation of waste""

Pilot demonstrators of collective infrastructures reducing the generation of waste	
Policy objective	Create awareness of separate collection and of reduction of waste
Justification of the relevance of the feature to reach the objective	Second-hand shops for clothes, toys, appliances, furniture, and repair cafés serve to inspire citizens about the ways they can contribute to reducing the generation of waste. These shops / cafés make it easy and fun for citizens to hand in something they do not longer want (to give it a second life) and to purchase second hand stuff.
Description of feature	• Set up the pilot demonstrator of at least one collective infrastructure reducing the generation of waste: (1) second-hand shop for clothes, toys, appliances, or furniture or (2) repair café; • "Pilot demonstrator" means: a small unit operating at a scale sufficient to show how the system works (but not necessarily at the scale needed to fulfill all needs), in a place that is visible in the municipality and with sufficient communication about its existence and mode of operation; • The second-hand shop purchases used items that people no longer want or need at a low price (or receive them as donations from household waste management centres) and sells them at a higher price. It can optionally repair or refurbish the items before re-selling them. The proceeds of the sales may be earmarked for a specific cause (support to socially-deprived populations, international solidarity). • Personnel in the municipal repair café have a role of educating the public on repair techniques, of capitalising this knowledge, and of supporting the set-up of independent repair cafés by citizens or local NGOs. • The shops / cafés can hold events / shows (e.g. concerts, drinks night etc) to attract citizens.

Pilot demonstrators of collective infrastructures reducing the generation of waste		
Document describing the feature in greater technical detail	ZeroWasteCities – The Story of Munich[24] on their "Halle 2" recycling shop. Interview with the City of Vienna carried out as part of this project.	
Implementation period	short term = 1 to 2 years	
Nature of resources needed	Communication material Training of personnel Small, diffuse infrastructure Permanent Operational Expenditures	
Challenges identified	• Collecting sufficient numbers of items of sufficient quality in the second-hand for it to be attractive • Training or recruiting the municipal personnel with sufficient qualifications to run a repair café • Finding and paying for a location that is visible enough – and yet at an affordable price	
Risks assessment	***Potential risk***	***Mitigation measure***
	The municipal second-hand shop or repair café is criticised for constituting an unfair competition to existing privately-run organisations	• Only set up the municipal entity if no private initiative of sufficient quality and size is available • As an alternative to entities run by the municipality, consider municipal support to selected private initiatives
	The number of items for sale is too low, or their quality or variety is too low, so that the second-hand shop is not visited	Only start the operations of the second-hand shop if and when a sufficient number of items of sufficient quality and variety has been gathered.

Table 4-7 Summary of feature "Household waste collection centres""

Household waste collection centres	
Policy objective	1. Create awareness of separate collection and of reduction of waste; 2. Initiate the movement in the municipality towards the separate collection of waste
Justification of the relevance of the feature to reach the objective	Bulky and specific waste categories need to be appropriately managed by municipalities. By providing such centres where citizens can bring their bulky / specific waste to, disposal of such waste on the streets or in containers that do not correspond to this waste can be avoided.
Description of feature	• Set up specific centres to collect bulky / specific household waste categories (such as furniture, WEEE, used food oil); • These centres are open to the public including on week-ends, so that people have the opportunity to deposit these categories of waste outside of their working time;

[24] Available at: zwe_case-study_the-story-of-munich_en.pdf (zerowastecities.eu)

<table>
<tr><th colspan="3">Household waste collection centres</th></tr>
<tr><td></td><td colspan="2">• These centres are made of a set of containers, each adapted for the collection of one category of such specific waste, with specific containers and processes for hazardous waste and, conversely, for items to be prepared for re-use. These containers are placed at the entrance of the facility, so that people know immediately what to do with them;
• Personnel of the waste collection body (municipal or contracted private company) is present to provide guidance to the public on where to deposit what category of waste. In addition, posters or panels provide additional written information;</td></tr>
<tr><td>Document describing the feature in greater technical detail</td><td colspan="2">“Guide for the set up and management of household waste collection centres” (“Guia ’’implantació i gestió de deixalleries”) of April 2021 (in Catalan)[25]</td></tr>
<tr><td>Implementation period</td><td colspan="2">medium term = 3 to 5 years</td></tr>
<tr><td>Nature of resources needed</td><td colspan="2">Communication material
Training of personnel
Large, concentrated infrastructure
Permanent Operational Expenditures</td></tr>
<tr><td>Challenges identified</td><td colspan="2">• Keep a high level of cleanliness in the centre (and specifically: avoid the development of unpleasant smells), to encourage the citizens to come;
• Protect some categories of waste from the rain: paper & cardboard, Waste Electric & Electronic Equipment (WEEE), hazardous waste, furniture, all items aimed at being re-used;</td></tr>
<tr><td rowspan="2">Risks assessment</td><td>Potential risk</td><td>Mitigation measure</td></tr>
<tr><td>• The centre is entitled to collect hazardous waste and constitutes therefore a potential health risk for workers, visitors and the neighbourhood
• Citizens not using these centres and instead dumping their waste with their mixed waste (e.g. in the case of small e-waste) or on the streets (e.g. in the case of furniture).</td><td>• Careful attention should be given to the set up and continuous enforcement of safety rules by the workers and visitors
• Promotion of these centres.
• Fines for dumping waste inappropriately.</td></tr>
</table>

4.2.2 Features enabling the attainment of the policy objective ‘Set-up the treatment facilities at pilot scale’

Justification of the policy objective

The separate collection of waste will generate flows of waste that will need to be treated appropriately, in order to fully leverage the benefits of this effort. As per the waste hierarchy, this treatment aims at, in descending order of priority: (1) preparing for re-use; (2) recycling; (3) recovery and (4) disposal.

[25] https://residus.gencat.cat/web/.content/home/lagencia/publicacions/instalacions/guia_implantacio_gestio_deixalleries.pdf

These flows of separately collected waste need to be processed at high levels of quality and at competitive cost for the output of the process (re-usable goods, recycled or recovered materials, waste-based fuel) to be accepted by the market. This requirement stems for the fact that these outputs compete on the market with goods stemming from linear processes (respectively: new goods, virgin materials, fossil fuels or biomass), which are well-suited for their purpose. Considering the quantities to be treated every day, and the quality and cost levels to achieve, the processes applied on separately collected are **industrial** in nature.

Industrial processes generally do not start immediately at full capacity. The machines and equipment need to be adjusted to the specific setting of the processing facility. The workers need to learn the skills needed, at the pace required by the expected throughput. This is why a common practice is to start operations at a smaller scale, in installations that already are fully-featured and are called **'pilot' installations**.

At the 'beginner' performance category, the processes for the treatment of separately collected waste start in 'pilot installations' with **commercial waste**, as defined in the Spanish Waste Law[26] (Art.2(aq)), i.e. waste that is similar in its nature to that from households, but generated by offices, shops, markets, restaurants and hotels. Commercial waste is appropriate to feed pilot installations, because:

- The total amount of commercial waste being generated is generally much below that of households;
- Separately collected commercial waste often is much more pure than that from households, because commercial activities tend to have only one type of activity, and hence to generate only a limited variety of waste. Separately collected commercial waste is hence easier to process.

Features of the waste management system enabling the attainment of the policy objective

Table 5-4 Summary of feature "Door to door separate collection of commercial waste for five waste streams: (1) glass, (2) paper & cardboard, (3) metal & plastic packaging, (4) biowaste, (5) rest"

Door to door separate collection of commercial waste for five waste streams: (1) glass, (2) paper & cardboard, (3) metal & plastic packaging, (4) biowaste, (5) rest	
Policy objective	Set up of treatment facilities at pilot scale
Justification of the relevance of the feature to reach the objective	Once separately collected, waste needs to be treated appropriately, in industrial-grade facilities. On the way to full-scale deployment, it is common good practice to acquire competencies on operations at smaller scale, often referred to as 'pilot' installations. Commercial locations are well suited to feed the waste management facilities at pilot scale as it is anticipated that less, purer and limited variety of waste is being produced in comparison to households.
Description of feature	1. Set up waste treatment centres able to process the collected commercial waste and waste collection vehicles (if not yet available); 2. Set up of a waste collection calendar for the five main waste streams ((1) glass, (2) paper & cardboard, (3) metal & plastic packaging, (4) biowaste, (5) rest)

[26] Ley 7/2022, de 8 de abril, de residuos y suelos contaminados para una economía circular, donwloadable at: https://www.boe.es/eli/es/l/2022/04/08/7/con

	3. Acknowledging it may be challenging to deploy this in one go, the streams of waste to begin with would be (i) biowaste or paper & cardboard, and ii) rest). To this purpose, pre-agreed time and location, which is in a near proximity of each given commercial location and, at the same time, easily accessible by the waste collection vehicles should be defined. Biowaste will be collected separately from companies that generate large quantities of it (restaurants, hotels, food retail), whereas paper & cardboard will be separately collected from all other commercial locations. The waste collection calendar will then be distributed to the commercial locations; 4. The five (or two) streams of commercial waste will be collected and brought to waste treatment centres, which will be further processed there.	
Document describing the feature in greater technical detail	• FEMP – Technical guide. The management of municipal waste.[27] Chapter 5, p.574 "Urban commercial, institutional and industrial wastes" (*Residuos comerciales, institucionales e industriales de ámbito urbano*); • Generalitat de Catalunya "Guide and reference experiences for the implementation of the separate collection of municipal waste" *("Guía y experiencias de referencia para la implantación de la recogida separada de residuos municipales")* of July 2020[28], chapter 3.3 "Commercial collection" ("*Recogida comercial*"). • Recommended to get in touch with municipal door to door associations. In Catalunya for example that is https://www.portaaporta.cat/es/index.php. Such Associations also exist in the automomous community of Valencia.	
Implementation period	medium term = 3 to 5 years	
Nature of resources needed	Communication material Training of personnel Small, diffused infrastructure Permanent Operational Expenditures	
Challenges identified	1. Requires the active participation of all participants, from managers to workers and citizens to handle lots of waste collection bins. The pilot should be appropriately accompanied by awareness-raising campaigns and programmes involving concerned commercial locations more closely for a better outcome. 2. The collection time and location should be convenient for the commercial locations, i.e. nearby the location and outside of their opening hours (as staff might not be available) but during those timeslots when staff is present on location (e.g. shortly after closing hours).	
Risks assessment	***Potential risk***	***Mitigation measure***
	Lack of participation from concerned commercial locations	There is a need for awareness raising campaign among stakeholders, explaining the potential benefits of the pilot. Furthermore, the collection times and location should be convenient for the commercial locations.

[27] Available at: http://femp.femp.es/files/3580-1356-fichero/Guia-Tecnica-Gestion-Residuos-Municipales_Web_Edicion2.pdf
[28] https://residus.gencat.cat/web/.content/home/lagencia/publicacions/prevencio/guia_experiencies_implantacio_rsrm_es.pdf

Table 5-4 Summary of feature "Pilot plant for industrial composting"

Pilot plant for industrial composting or anaerobic digestion of biowaste	
Policy objective	Set up of treatment facilities at pilot sale
Justification of the relevance of the feature to reach the objective	Composting or anaerobic digestion of biowaste is a waste treatment operation deserving specific attention, as it generates a product, compost or digestate, that can be used for the fertilisation of agricultural land, as a valuable substitute for non-renewable, mineral-based fertilisers – provided strict conditions are met regarding the hygiene and sanitary conditions of the process (public health issues) and the purity of the end product (agronomic requirements)[29] It is thus important that the composting or anaerobic digestion process be well mastered at pilot scale before it is generalised to all sources of biowaste. The processing of biowaste is of particular relevance from 2023, as the revised EU Waste Framework Directive[30] places a obligation on Member States to implement the separate collection of biowaste for all households by 31 December 2023.
Description of feature	Set-up of a pilot plant for the industrial composting or anaerobic digestion of biowaste that is collected from commercial activities and, optionally, biowaste collected separately from households. A choice should be made between two options for the processing of biowaste: • **composting** is performed in aerated containers and requires frequent mechanical rotation of the material to ensure that the bacteria receive the oxygen they need. The resulting product is compost, which – under conditions of hygiene (and specifically: of temperature at which the composting takes place) and purity – can be used for the fertilisation of agricultural fields, or of gardens. Good quality compost (i.e. compost accepted by the European Commission under Art.24 of the Regulation on organic farming[31]) is compatible with organic farming. From an environmental point of view, compost has the advantage of feeding the living beings of the soil (and hence increasing soil porosity and water retention capacity); or • **anaerobic digestion** is performed in closed containers that prevent the interaction of the bacteria (of different species from those at work in composting) with the oxygen of air. The resulting products are: (1) biogas, a gaseous fuel containing a mixture of methane and of carbon dioxide and is hence of lesser calorific capacity than methane, but susceptible to be used as such or to be refined (with removal of carbon dioxide) and injected into the gas network as a substitute for fossil

[29] Regulation (EU) 2019/1009 laying down rules on the making available on the market of EU fertilising products, in a consolidated version available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02019R1009-20221003
[30] Directive 2008/98/EC on waste, available in a consolidated version at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02008L0098-20180705
[31] Regulation (EU) 2018/848 on organic production and labelling of organic products, consolidated version available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02018R0848-20230221

<table>
<tr><td></td><td colspan="2">gas; and (2) a sludge-like residue called ‘digestate’, which can be used as a fertiliser under the same conditions of purity and hygiene as above, is compatible with organic farming. Its effects on soils are still the purpose of intense research, with mixed result so far[32]..
Biogas or methane extracted from biogas can be sold on the market and generate an income for the operating entity. Dependent upon market conditions (and specifically: on the market price of mineral-based fertilisers) and on the quality of the product, compost or digestate can be sold as a fertiliser to farmers and gardeners. The income generated by the sale of compost or digestate is likely to increase structurally in parallel with the increasing costs of mineral-based fertilisers.</td></tr>
<tr><td>Documents describing the feature in greater technical detail</td><td colspan="2">• Generalitat de Catalunya “Guide and reference experiences for the implementation of the separate collection of municipal waste” (“Guía y experiencias de referencia para la implantación de la recogida separada de residuos municipales”) of July 2020[33], chapter 3 “Organic matter, a key fraction in the definition of the collection model” (“La materia orgánica, una fracción clave a la hora de definir el modelo de recogida”).
• Generalitat de Catalunya (2016) Guía práctica para el diseño y la explotación de plantas de compostaje[34]
• FEMP – Technical guide. The management of municipal waste.[35] Chapter 4, p. 429 “ Treatment facilities. Composting and bio-methanation” (Plantas de tratamiento. Compostaje y biometanización)
• Zero Waste Europe, case studies of:
o Pontevedra[36] (small municipality);
o Campannori[37] and Newport[38] (medium-sized municipalities);
o Milan[39] and Parma[40] (large municipalities).</td></tr>
<tr><td>Implementation period</td><td colspan="2">medium term = 3 to 5 years</td></tr>
<tr><td>Nature of resources needed</td><td colspan="2">Training of personnel
Large, concentrated infrastructure
Permanent Operational Expenditures, but also potentially permanent income (see above)</td></tr>
<tr><td>Challenges identified</td><td colspan="2">The attainment of the strict hygiene and purity requirements placed on compost or digestates is technically difficult.</td></tr>
<tr><td rowspan="2">Risks assessment</td><td>Potential risk</td><td>Mitigation measure</td></tr>
<tr><td>Failure in meeting the requirements placed for the placement on the market of the resulting compost or digestate as fertiliser</td><td>The purpose of starting at pilot scale is to enable the learning by the plant operators of the process at the right level of quality and rigour. The start of</td></tr>
</table>

[32] See: Karimi, B., Sadet-Bourgeteau, S., Cannavacciuolo, M. et al. Impact of biogas digestates on soil microbiota in agriculture: a review. Environ Chem Lett 20, 3265–3288 (2022). https://doi.org/10.1007/s10311-022-01451-8
[33] https://residus.gencat.cat/web/.content/home/lagencia/publicacions/prevencio/guia_experiencies_implantacio_rsrm_es.pdf
[34] Available at: https://residus.gencat.cat/web/.content/home/lagencia/publicacions/form/GuiaPC_web_ES.pdf
[35] Available at: http://femp.femp.es/files/3580-1356-fichero/Guia-Tecnica-Gestion-Residuos-Municipales_Web_Edicion2.pdf
[36] Available at: https://zerowastecities.eu/wp-content/uploads/2019/09/zero_waste_europe_CS13_pontevedra_en..pdf
[37] Available at: https://zerowastecities.eu/bestpractice/best-practice-the-story-of-capannori/
[38] Available at: https://zerowastecities.eu/bestpractice/the-story-of-newport/
[39] Available at: https://zerowastecities.eu/bestpractice/the-story-of-milan/
[40] Available at: https://zerowastecities.eu/wp-content/uploads/2019/07/zero_waste_europe_cs7_parma_en.pdf

		the pilot plant is preceded by a training of the personnel.

4.2.3 Features enabling the attainment of the policy objective 'Prevent conflicts'

Justification of the policy objective

Conflicts are, considered from a general point of view, a waste of resources and of time, and a source of frustration. Avoiding them is hence beneficial to all parties involved.

In the specific case of waste management in municipalities, the parties susceptible to enter in conflict with one another are:

- The citizens, which are the beneficiaries of the waste management processes, but also are increasingly required to participate actively in them, under a regime of obligation;
- The municipality, which holds the ultimate responsibility for waste management;
- The operator of waste collection and / or of further waste management operations, which can be distinct from the municipality, and has a mandate to at least balance its accounts between (1) the waste collection fees that it receives from the municipality and (2) the capital and operational expenditures needed to perform the processes it is in charge of;
- The workers in the operator of waste collection and / or of further waste management facilities.

The relations between these parties are regulated by explicit or implicit contracts:

- Explicit contracts between the municipality and the operator (public service contract), and between the operator and its employees (employment contracts, collective agreements);
- Implicit or explicit[41] contracts between the municipality and citizens (provision of waste management services against some cooperation in the processes).

Conflicts between these parties have a strongly detrimental effect on the performance of separate waste collection and of waste treatment, as they disrupt the smooth and continuous operation of the waste collection, in the short or even the long term:

- Conflicts between workers and management of the waste collection operator, on wages or on working conditions, can lead to short-term strikes with immediate and very visible detrimental effects, as waste accumulates in the streets. In the longer term, if the conflict is not appropriately solved, the frustration and discontent of the workers results in a deterioration of the quality of separate waste collection, either because of an absence of zeal and goodwill, or because the recruitment is insufficient to cover the quantitative needs for labour;
- Conflicts between the waste collection operator and the municipality generally involve the match between the quality requirements set and the waste collection fee being paid. Whereas a punctual conflict between a private operator and the municipality may be solved by replacing the operator by another one[42], a persistent conflict with successive operators can lead to a structural instability in the delivery of the service and to important quality losses;
- Conflicts between citizens and the municipality or the waste collection operator regarding the quality of the waste collection (which itself can be caused by the labour or contractual conflicts outlined above) or the amount of the waste collection fee. The most problematic

[41] E.g. in the form of municipal ordinances.
[42] E.g. by implementing the clauses in the contract foreseeing its early termination in case one of the parties does not fulfill its obligations.

conflict occurs when citizens are dissatisfied with the quality of the service provided. In this case, citizens are likely to give up their efforts to support separate collection at source, if they feel that the waste collection operator does not deliver at the height of their own commitment. This dis-engagement of citizens can have long-term negative consequences.

A general means to prevent conflicts is to organise structured dialogues between the parties involved, so that they can flag potential sources of conflict as they emerge and jointly devise mutually-agreed solutions to these conflicts before they escalate.

Features of the waste management system enabling the attainment of the policy objective

Table 4-8 Summary of feature "Involvement of citizens in the waste management process"

Involvement of citizens in the waste management process	
Policy objective	Conflict prevention
Justification of the relevance of the feature to reach the objective	An immediate care taken by the waste management operator of the individual issues raised by citizens shows concern for the citizen and avoids frustration, as people can forgive occasional errors, while they resent much more being ignored. Citizen involvement, through the means of participation and education of the importance of the waste management process, is understood to be an important factor in achieving a well-functioning waste management system. This is due to the fact that if citizens properly understand the benefits of proper waste management and are actively participating in the process, this has a positive impact on the desired results. Having citizens actively engaged in the entire process of waste management can be utilised in case of potential issues that citizens might be facing and wished these to be raised.
Description of feature	• Set up a hotline with long service hours, including outside of normal office hours, in the languages relevant for the (permanent or temporary) residents of the municipality, for citizens to flag any individual issue or problem they have with the waste collection service. This hotline has a capacity to mandate a fast intervention by the waste management operator and to report back to the citizen on the way his/her observation has been addressed. • In order to ensure that citizens have the opportunity to actively engage in the waste management process, the municipality is to organise regular meetings with citizens and representatives of the municipality (and potentially the operator). • These meetings should be public and open to all citizens, taking place periodically and outside of working hours, to allow all of those interested to participate. • During these meetings the citizens will be 1) informed on the processes of waste management and next developments, and 2) allowed to actively participate in the process, pose questions and raise issues the citizens are facing. • In addition to these meetings, the municipality will publish a periodic survey among citizens where they are asked to reflect on their satisfaction with the waste management process, provide suggestions for improvement and raise issues to be addressed.

Involvement of citizens in the waste management process		
	• The results of the survey will be made publicly available for citizens to reflect on.	
Document describing the feature in greater technical detail	Izdebska, Olga & Knieling, Jörg. (2020). Citizen involvement in waste management and circular economy in cities: Key elements for planning and implementation. European Spatial Research and Policy. 27. 115-129[43]	
Implementation period	Short term = 1 to 2 years	
Nature of resources needed	Communication material	
Challenges identified	• Lack of participation from citizens.	
Risks assessment	***Potential risk***	***Mitigation measure***
	Limited number of citizens participate in the physical meetings.	To ensure that all citizens are able to participate in the process a written survey will be shared with all of them (via post).

Table 4-9 Summary of feature "Conflict resolution between municipality and waste management operator"

Conflict resolution between municipality and waste management operator	
Policy objective	Conflict prevention
Justification of the relevance of the feature to reach the objective	A pre-agreed method on resolution of potential conflicts between the municipality and the operator of the waste management facilities is a crucial tool for ensuring a smooth cooperation between the two actors. Ensuring there is a functioning conflict prevention method can avoid potential disagreements between the two actors before escalating, which could result in inefficient and/or delayed waste collection and management.
Description of feature	• The Terms of Reference of the call for proposal should describe the work to be performed, the indicators that will be monitored, the requirements set on these monitored indicators, the applicable sanctions in case of non-compliance, the list of possible non-compliances with their associated levels of gravity, in great technical detail, so that the waste management company is informed well in advance of its obligations; • Ahead of signing a contract, the two parties are to develop and agree on a conflict resolution method as part of the contract binding them; • This method can take the form of regular (e.g. monthly) meetings where the municipality and waste management operator representatives come together to discuss any open issues and future approaches. Every meeting should be followed with a brief document summarising the agreements made, for potential future reference; • The legally-binding nature of the agreements that these meetings lead to needs to be specified, according to whether they are simple operational arrangements within the framework of the existing contract or amendments to the contract.
Document describing the feature in greater technical detail	• Technical prescriptions of the waste collection service of Torredembarra , document N°AG13/S119/17/06 ('Plec de prescripcions tècniques particulars que regiran la prestacio del servei de recollida i transport de residus municipals a Torredembarra', in Catalan), § 10.6 (technical equipment for

[43] Available at: http://dx.doi.org/10.18778/1231-1952.27.2.08

Conflict resolution between municipality and waste management operator		
	the control of the service), § 12.2 (coordination of the service = institutionalised discussion between municipality and operator) • Technical specifications of the waste collection service for the South of the province of Badajoz ('*Pliego de prescripciones téccnicas particulares para la contratacion del servicio de recogida y transporte de residuos domésticos, y servicios complementarios, en diversos municipios des la provincia de Badajoz, zona Sur'*), § 4 -Quality of the service ('*Calidad del servicio*') = list of indicators and of their weight in the evaluation • Administrative clauses of the waste collection service of Torredembarra , document N°AG11/G526/17/19 ('Plec de clausules adminstratives particulars que regiran la contratacio del servei de recollida i transport dels residus generats al terme municipal de Torredembarra', in Catalan), Chapter VII – Infractions and penalties ('*Infraccions i penalitats*')	
Implementation period	Short term = 1 to 2 years	
Nature of resources needed	Communication material Training of personnel	
Challenges identified	• The conflict resolution approach might not be agreed in time for the signature of contract, resulting in a non-binding agreement (which in cases of heavy conflicts might not be followed).	
Risks assessment	***Potential risk***	***Mitigation measure***
	In the absence of a binding agreement on conflict resolution method, and hence absence of regular preventative discussions, an issue can escalate, with neither party willing to discuss the issues.	In case of an escalation an independent mediator can be brought in to support the conflict resolution process.

Table 4-10 Summary of feature "Social dialogue within the waste management operator "

Social dialogue within the waste management operator	
Policy objective	Conflict prevention
Justification of the relevance of the feature to reach the objective	Employees of the waste management operators (e.g. those performing waste collection and/or working in the waste treatment facilities) can be faced with unfair working conditions (e.g. unpaid overtime, undeclared work, working without a proper contract), poor health and safety working conditions (as they may be asked to treat hazardous materials without adequate safety equipment or to perform physically-demanding work or to work at unconventional times of the day), or wages considered as unsatisfactory. It can also happen that they are not properly trained for the work they are preforming. Social dialogue, i.e. the structured, periodic meeting between the management of the company and elected representatives of the workers (often, but not always, members of established trade unions), is the standard practice to discuss labour conflicts before they escalate into strikes.
Description of feature	• Facilitate the presence and activity of representative trade unions among the personnel of the waste management operator; • Inform workers of the contents of the applicable collective agreement, if any, upon recruitment and subsequently when it is amended;

<table>
<tr><th colspan="3">Social dialogue within the waste management operator</th></tr>
<tr><td></td><td colspan="2">• Organise the periodic, democratic election of representatives of workers, as per the applicable law or collective agreement;
• Organise periodic (e.g. monthly or quarterly) meetings between the management of the waste collection operator and the elected representatives of the workers, with a shared and freely-determined agenda on any issue relevant for labour and workers: sharing of information and/or grievances, consultation and negotiating arrangements;
• Enable the call of extraordinary meetings at the initiative of either party in the social dialogue;
• The outcomes of the social dialogue can be codified in a collective (bargaining) agreement, under which specify wages,terms and conditions of employment and working conditions.
• The municipality can also prescribe, in the Terms of Reference of the call for proposals, the minimum labour and wage conditions that the operator must provide to its workers.</td></tr>
<tr><td>Document describing the feature in greater technical detail</td><td colspan="2">Technical specifications of the waste collection service for the South of the province of Badajoz (‘Pliego de prescripciones téccnicas particulares para la contratacion del servicio de recogida y transporte de residuos domésticos, y servicios complementarios, en diversos municipios des la provincia de Badajoz, zona Sur’), Annex XXII: Salary table 2020 and minimum reference conditions (‘Tabla salarial 2020 y condiciones minimales de referencia’)</td></tr>
<tr><td>Implementation period</td><td colspan="2">Short term = 1 to 2 years</td></tr>
<tr><td>Nature of resources needed</td><td colspan="2">Communication material
Training of personnel</td></tr>
<tr><td>Challenges identified</td><td colspan="2">• Lack of (willingness of) participation in social dialogue and collective agreements negotiations.
• Inability to come to an agreement between the concerned parties.</td></tr>
<tr><td rowspan="2">Risks assessment</td><td>Potential risk</td><td>Mitigation measure</td></tr>
<tr><td>Culture of mistrust between a management not used to social dialogue and hard-line trade unionists</td><td>• Gestures of goodwill by management towards trade unions in general
• Clear mandate and procedures for the social dialogue sessions
• Show the effectiveness of social dialogue with concrete examples of improvements in working conditions, even if very small or preliminary</td></tr>
</table>

4.2.4 Features enabling the attainment of the policy objective ‘Create incentives for municipalities to diminish the generation of unsorted waste’

Justification of the policy objective

Unsorted waste is generally disposed of in installations that operate at a scale larger than that of the municipality: landfills, or incineration plants or mechanical-biological treatment (MBT) installations.

Consequently, the entities managing these installations, i.e. Autonomous Communities, associations of cities ('*mancomunidades*') or the municipality itself (when it is large enough), have an influence on the costs for municipalities for generating unsorted waste.

Making the generation of unsorted waste more costly or more difficult for municipalities can therefore incentivise their efforts to collect waste separately.

The recommendations of this sub-chapter are addressed to Autonomous Communities.

Features of the waste management system enabling the attainment of the policy objective

Table 4-11 Summary of the feature "Implementation of the tax for the deposit of waste in landfills, the incineration and the co-incineration of waste established in Law 7/2022 and make it a finalist tax"

Implementation of the tax for the deposit of waste in landfills, the incineration and the co-incineration of waste established in Law 7/2022 and make it a finalist tax	
Policy objective	Create incentives for municipalities to diminish the generation of unsorted waste
Justification of the relevance of the feature to reach the objective	Legislation and policies can encourage local authorities to carry out separate collection, while discouraging disposal and incineration of mixed municipal waste by making this more expensive than separate collection. In similar vein, waste treatment fees need to respect the waste hierarchy in order to make landfill and incineration more expensive than recycling. Collected fees and taxes should finance further improvement in waste management that is in line with the waste hierarchy. As established by Law 7/2022, municipal solid waste going to controlled landfill or incinerator incurs a waste tax. When separate collection is carried out, the residual waste going to landfill or incineration is reduced resulting in a cheaper management. Implementing a tax that requires municipalities to pay for waste delivered to landfills incineration and co-incineration plants per tonne incentivises municipalities to engage in actions that enhance the separate collection of waste for subsequent recycling or preparing for re-use. With this tax in place, municipalities which carry out a better separate collection, will pay lower taxes. Besides, if this tax is made a finalist tax and is used to fund actions aimed at improving separate waste collection, there would be more resources to implement high performing schemes for the separate collection of waste.
Description of feature	This feature is for the Autonomous Communities to implement the tax established in chapter II of Title VII of Law 7/2022 and to make use of the Transitory Provision 8 to assume the management of this tax and make it a finalist tax. More specifically it would involve the following: • Implementing the tax for the deposit of waste in landfills, incineration and the co-incineration of waste according to the requirements set in the Waste Law; • Assuming the responsibility for the managements of this tax in the terms established in the transitory provision 8 of the Waste Law; • Setting up the system in the Autonomous Community to allocate part of the funds collected from the levy to actions aimed at improving the separate collection of waste;

Implementation of the tax for the deposit of waste in landfills, the incineration and the co-incineration of waste established in Law 7/2022 and make it a finalist tax		
	• Planning the increase in the tax rate over the following 10 to 15 years (in constant euros), so that increases in tax rates are strong enough to convey a strong message that the long-term prospect is the high quality separate collection of waste (e.g. a doubling in the real tax rate over 5 years, i.e. 15% / year[44]).	
Document describing the feature in greater technical detail	Law 7/2022, of 8 April, on waste and contaminated soils for a circular economy (Title II) Comunidad Autónoma de Cataluña (2008) Law 8/2008, of July 10, on the financing of waste management infrastructures and the fees for the disposal of waste	
Implementation period	short term = 1 to 2 years	
Nature of resources needed	IT software development Large, concentrated infrastructure Permanent Operational Expenditures (for the municipality) and gains (for the Autonomous Community / the local entity)	
Challenges identified	Convincing Autonomous Communities to assume the management of the tax might be challenging.	
Risks assessment	***Potential risk***	***Mitigation measure***
	Political resistance by Autonomous Communities that claim that they lack the resources needed to assume the responsibility for the management of the tax	Taking over the tax and making it finalist will provide local authorities with the necessary resources to undertake reforms in their waste management systems, which will lead to high-performing schemes that will contribute to advance in the fulfilment of the preparing for re-use and recycling targets. Furthermore, if Autonomous Communities assume the responsibility for managing the tax, they could dedicate a percentage of the funds to hiring staff and resources to efficiently manage the funds.

Table 5-4 Summary of feature "Plan for preventing unsorted waste being sent to incineration or co-incineration facilities **"**

Plan for preventing unsorted waste being sent to incineration or co-incineration facilities	
Policy objective	Create incentives for municipalities to diminish the generation of unsorted waste
Justification of the relevance of the	Municipal waste incinerators are large-scale facilities, established by Autonomous Communities or Local Entities that need a permanent flow of incoming waste to feed their combustion chambers. Their set-up is often

[44] In case of inflation, the nominal tax rate should be increased at an even higher rate, so that the real tax rate, when taking into the account the inflation, increases at that target rate of 15% per year.

feature to reach the objective	associated with contracts whereby the municipalities are contractually obliged to deliver a minimum mass of waste per day to the incinerator, including unsorted municipal waste. Consequently, prohibiting the incineration of unsorted municipal waste in incineration or co-incineration facilities would provide an incentive for the implementation of the separate waste collection. . Furthermore, it should be noted that Article 24.4 of Law 7/2022 states that waste which can be prepared for reuse or recycled may not be sent for incineration, with or without energy recovery. Banning the incineration of mixed municipal waste in the long-term paves the way for efforts by municipalities to collect waste separately for subsequent recycling.	
Description of feature	This is a feature to be implemented by the Autonomous Communities. On the one hand, setting up a plan for preventing unsorted municipal waste being sent to all waste incineration or co-incineration facilities, with an objective prohibit it by [2030 to 2040] would involve: • Coming up with the definition of a final, legally-binding date at which the waste incinerator is to be prohibited to incinerate unsorted municipal waste (2040 can be a target of moderate ambition, whereas 2030 is of higher ambition); • a revision of the contract with the operator of the waste incinerator, whereby the minimum amount of unsorted waste that municipalities are obliged to deliver per day to the incinerator starts immediately to diminish over time • an increase in the waste incineration fee, so as to generate the financial resources necessary to pay for the amortisation of the possible loss of profit incurred by the incinerator. On the other hand, in the revision of the contract with the operator of the waste incinerator, provisions should be included to avoid the incineration of waste that can be prepared for reuse or recycling.	
Document describing the feature in greater technical detail		
Implementation period	long term = 6 years and above	
Nature of resources needed	Training of personnel Permanent Operational Expenditures	
Challenges identified	• Resistance by the operator of the incinerator because of loss of profit opportunities.	
Risks assessment	The operator of the incinerator may demand unreasonably high financial compensations for the revision of the contract	The increase in the fees required from municipalities when disposing of unsorted waste at the incinerator will provide additional financial resources to provision for the financial compensation of the losses by the operator (loss of profit opportunities)

4.3 Roadmap for municipalities in the 'intermediate' category

The policy objectives relevant for municipalities in the 'intermediate' category are the following:

- Monitoring and control of waste collection;
- Introduce door to door separate waste collection to the homes of citizens;
- Create an incentive for municipalities to increase the separate collection of waste (incl. biowaste)

4.3.1 Features enabling the attainment of the policy objective 'Monitoring and control of waste collection'

Justification of the policy objective

Waste monitoring is crucial in any waste management strategy. Only what is measured can be improved. It is thus of greatest importance for municipalities, once the basic elements of separate waste collection have been set up as part of the 'Beginner' stage, to gather performance data, both in quasi real-time and over longer periods of time. Primary reasons to monitor data on waste generation, collection and treatment are the following:

- Rationale of collecting real-time data:
  - Detecting and locating operational problems in waste collection and treatment, so as to be able to address them fast;
  - Controlling the compliance of the waste collection operator with its contractual obligations;
  - Controlling the quality and timeliness of the waste collection work by employees;
  - Collecting evidence of non-compliance / of work below the quality requirements, to substantiate discussions with the waste operator / the employee, and also potential sanctions;
  - Assisting with planning and decision-making;
- Rationale of logging long-term data:
  - Identifying waste generation and recycling trends;
  - Anticipating the adaptation of the capacity of the waste collection and treatment systems to these trends (number, capacity and frequency of circuit of waste collection lorries; recycling, composting or anaerobic digestion plants);
  - Setting waste reduction, recycling or diversion, objectives and targets;
  - Planning the nature and the costs of the investments needed to meet these targets;
  - Evaluating economic impacts (current and future) of the municipal waste management system.

Features of the waste management system enabling the attainment of the policy objective

Table 4-12 Summary of feature "Monitoring of waste collection (GPS on collection lorries, RFID tags, QR-codes or bar codes on bins)"

Monitoring of waste collection (GPS on collection lorries, RFID tags, QR-codes or bar codes on bins)	
Policy objective	Monitoring and control of waste collection
Justification of the relevance of the feature to reach the objective	The geographic tracking of waste collection lorries, and the automated verification that the bins have been correctly emptied in the lorry, are the most common technical tools available to: • Detect problems or non-compliance fast; • Correct them fast; and to • Keep track thereof.

<table>
<tr><th colspan="3">Monitoring of waste collection (GPS on collection lorries, RFID tags, QR-codes or bar codes on bins)</th></tr>
<tr><td></td><td colspan="2">They are thus the tools adapted to monitor the waste collection process in real-time.</td></tr>
<tr><td>Description of feature</td><td colspan="2">• Set up in all waste collection lorries an in-vehicle navigation and positioning system (typically based on a satellite positioning constellation like the US-based GPS or the EU-based Galileo), coupled with a periodic radio-based reporting system and / or an on-board recording system. This system computes periodically (e.g. every 5 minutes) the position of the lorry, and reports it via a radio message to a supervision centre (resp. stores it on a tampering-proof on-board recording system).
• Set up a unique identifying RFID tag, QR code or barcode on each waste collection bin, and a corresponding reading system on the waste collection lorry. A typical arrangement can be that the code is set at a specified place on the bin, so that it passes in front of the reader when lifted by the lorry’s crane to be emptied. The reading system is coupled with a clock and the lorry’s radio-based reporting system and / or on-board recording system.
• Set up the supervision centre that:
○ collects the periodic location data from the lorries and the reports on the emptying of bins;
○ comparing this data with the planned routes;
○ generates alerts in case of discrepancies between the planned waste collection route and the actual one. These alerts describe the location where the discrepancy appeared, what was expected and what actually happened;
○ sets up a voice communication between the supervision centre and the lorry subject to the alert to discuss the nature of the problem and of the means to overcome it.
Such integrated monitoring systems for waste collection processes are now available off-the-shelf from dedicated vendors.</td></tr>
<tr><td>Document describing the feature in greater technical detail</td><td colspan="2">• Technical prescriptions of the waste collection service of Torredembarra , document N°AG13/S119/17/06 (‘Plec de prescripcions tècniques particulars que regiran la prestacio del servei de recollida i transport de residus municipals a Torredembarra’, in Catalan), § 10.6 (technical equipment for the control of the service), § 12.1 (Instruments for the technical monitoring of the service)</td></tr>
<tr><td>Implementation period</td><td colspan="2">short term = 1 to 2 years</td></tr>
<tr><td>Nature of resources needed</td><td colspan="2">• Training of personnel
• IT software development
• Small, diffuse infrastructure
• Permanent Operational Expenditures</td></tr>
<tr><td>Challenges identified</td><td colspan="2">Workers of the waste collection operator can resent being monitored in real-time and consider this as intrusive.</td></tr>
<tr><td>Risks assessment</td><td>Potential risk</td><td>Mitigation measure</td></tr>
</table>

Monitoring of waste collection (GPS on collection lorries, RFID tags, QR-codes or bar codes on bins)		
	Reluctance of workers to be closely supervised.	Use the social dialogue institutions set up in the 'beginner' stage above to discuss the concrete implementation of the monitoring, with a clear and honest stance that the purpose is to correct systemic shortcomings, to support and help workers, not to sanction them
	IT infrastructure of the monitoring system does not have a proper level of reliability or quality	• Write a detailed technical specification, based on the experience of front-runners. • Use the services of an independent IT consultancy firm, with no links or arrangements with system vendors, for the detailed specification of the procurement

Table 4-13 Summary of feature "Monitoring of landfilling, incineration and co-incineration with periodic publication of results"

Monitoring of landfilling, , incineration and co-incineration with periodic publication of results	
Policy objective	Monitoring and control of waste collection
Justification of the relevance of the feature to reach the objective	Monitoring landfilling, incineration and co-incineration is a simple means to generate aggregated data on the amount of unsorted waste disposed of by the municipality, and hence, indirectly, on the rate of separate waste collection. Periodically publishing the outcomes and the findings of this monitoring creates awareness among all stakeholders in the municipality of its performance level regarding separate collection of waste, and of the gap to the objectives. They can increase their motivation for a more successful source-separated waste collection system.
Description of feature	• Periodical data reporting should be gathered from the facilities' SCADA (Supervisory Control and Data Acquisition) system of the landfill, the incinerator or the co-incinerator, which was set up by the managing authority (Autonomous Community or Local Entity) upon the implementation of the feature "Implementation of a waste disposal tax" at 'Beginner' stage (described in § 4.2.4). • Publish the data on the amount of waste being landfilled, incinerated or co-incinerated, in total and per capita, on a monthly or quarterly basis, in the communication media of the municipality, with a comparison with the EU, national and regional objectives, with graphs extending over the longest data series available, up to 10 years. Waste type and amounts should be specified in the periodic publications.
Document describing the feature in greater technical detail	NA
Implementation period	Short term = 1 to 2 years,
Nature of resources needed	Communication material
Challenges identified	*None identified: the feature consists in publishing a data that already is available.*

Monitoring of landfilling, , incineration and co-incineration with periodic publication of results		
Risks assessment	***Potential risk***	***Mitigation measure***
	None identified	*None identified*

Table 4-14 Summary of feature "Channel for complaints by citizens and commercial activities with (1) guaranteed response time and (2) monitoring and reporting on the number, gravity and resolution of complaints"

Channel for complaints by citizens and commercial sector with (1) guaranteed response time and (2) monitoring and reporting on the number, gravity and resolution of complaints		
Policy objective	Monitoring and control of waste collection	
Justification of the relevance of the feature to reach the objective	Improving the expertise and efficiency of the operations on separate waste collection at source benefits from a trustable feedback mechanism where citizens and commercial businesses can report issues. Conversely, citizens and commercial businesses expect that waste collection operates smoothly and efficiently and take this for granted. In case of a problem, they require to have a fast fix to their concern, and to have at least an immediate access to a person able to reliably handle their problem. Feeling heard is thus the basis of what citizens and commercial businesses expect in the implicit moral contract between them and the municipality, and constitutes the foundation of their willingness to cooperate in waste collection.	
Description of feature	• A customer service-like department should be formed in the municipality to attend complaints; such department should be easily available / reachable (five to seven days a week, large part of the day); this department would also be in charge of developing statistics around the complaints received; • This service should be available via a varied array of channels (i.e., telephone, SMS, e-mail, messaging, mobile app, website) and in the languages needed by the local permanent or seasonal population (Castillan, regional language, foreign languages used by tourists or by immigrants); • Set up the intervention service able to intervene to solve the problem within a guaranteed response time (e.g. less than 24 hours, in 90+% of cases); • Collect and publish (on a monthly or quarterly basis) the statistical data regarding this channel for the collection and treatment of complaints (i.e., number, gravity, resolution of complaints, response time).	
Document describing the feature in greater technical detail	*None identified*	
Implementation period	short term = 1 to 2 years	
Nature of resources needed	• Communication material • Training of personnel • IT software development • One-off operational expenditures (for setting up the appropriate channels) • Permanent Operational Expenditures	
Challenges identified	Unnecessary claims can occupy the system and cause extra workload for the team responsible for the claims. Recruiting and keeping the persons able to handle complaints in a polite but firm way.	
Risks assessment	***Potential risk***	***Mitigation measure***

Channel for complaints by citizens and commercial sector with (1) guaranteed response time and (2) monitoring and reporting on the number, gravity and resolution of complaints		
	Excessive focus on claims deviating resources from other services that may be more relevant	A filtering method can be used to overcome unnecessary claims, and the dedicated team only focuses on the confirmed claims.
	Strong emotional pressure on the persons in charge of receiving complaints, who may be subject to verbal aggression by unhappy citizens or business owners	• Set up an efficient follow-up system, so that the complaint be treated fast; • Train the person to handle aggressive behaviour in a way that leads to mutual respect; • Inform citizens and business owners that verbal aggression against civil servants will be prosecuted.

Table 4-15 Summary of feature "Periodic analysis of the content of the unsorted "rest" containers"

Periodic analysis of the content of the unsorted "rest" containers	
Policy objective	Monitoring and control of waste collection
Justification of the relevance of the feature to reach the objective	Containers dedicated to unsorted waste are filled by two categories of waste. 1) Waste belonging legitimately to these containers, because it belongs to none of the containers dedicated to the separate collection of waste; 2) waste that should be disposed of in a container dedicated to a specific flow of separately collected waste, but is unduly disposed of there. Analyzing the contents of containers dedicated to unsorted waste is critical for municipalities to characterise the waste unduly disposed of there, to understand the behaviour of people, and to eventually be able to adopt suitable measures aimed at increasing the efficiency of separate waste collection.
Description of feature	• Periodically (e.g. every 1, 2 or 3 years), collect a sample of unsorted "rest" containers, selected at random in various collection points; • Analyse the contents of these containers, and break the total mass down into categories, attached either to the "unsorted" waste stream or to one of the separately collected waste streams; • Interpret results and compare those from different sampling locations and over time; • Municipalities should use the results to implement measures accordingly. For example, if the amount of waste that should be separately collected, and that is nevertheless found in the "rest" container, is high in a certain neighbourhood, citizens / the commercial sector of that neighbourhood should be informed and trained on separate collection of waste. Also, if a particular kind of waste due to be separately collected is observed in the "rest" container, adding a new container for that type of waste should be considered. • Monitoring should continue after measures have been taken to assess their effectiveness.

Periodic analysis of the content of the unsorted "rest" containers		
Document describing the feature in greater technical detail	NA	
Implementation period	short term = 1 to 2 years	
Nature of resources needed	Training of personnel	
Challenges identified	Analysing the content of containers dedicated to unsorted waste causes an additional workload for the team, which is in addition unpleasant and unhealthy.	
Risks assessment	***Potential risk***	***Mitigation measure***
	The workers assigned to the analysis of the content of containers dedicated to unsorted waste refuse to perform the work, as being unpleasant and source of health hazards.	• The implementation of this feature should be discussed well in advance in the social dialogue institution, to inform workers of the rationale for this task and to define precisely the conditions of its performance; • The material conditions for the analysis should be those of a form of laboratory, performed by qualified personnel, under strict hygiene rules.

4.3.2 Features enabling the attainment of the policy objective 'Introduce door to door separate waste collection to the homes of citizens'

Justification of the policy objective

The experience of front-runners in separate waste collection shows that higher performance in the rate of separate collection of waste can only be achieved by some form of door to door collection, adapted to the nature of the buildings in the area considered. Open street containers are not sufficient to reach higher rates of separate collection.

Door-to-door collection has a positive relation with the separate waste collection rate, and with the purity of the separately collected waste streams, as it connects the separately collected waste with a particular household (or group of households) and hence introduces a form of personal responsibility to sort waste appropriately.

Systematic presentation of the features of the waste management system enabling the attainment of the policy objective

Table 4-16 Summary of feature "Scale-up of the facilities for the composting or anaerobic digestion of biowaste"

Scale-up of the facilities for the industrial composting or anaerobic digestion of biowaste	
Policy objective	Introduce door to door separate waste collection to the homes of citizens
Justification of the relevance of the feature to reach the objective	Industrial biowaste management facilities that use composting or anaerobic digestion techniques have been dimensioned at the "beginner" stage to process commercial biowaste only, which is generated in smaller quantities, and in higher levels of purity, than biowaste from households.

Scale-up of the facilities for the industrial composting or anaerobic digestion of biowaste	
	Similarly, the decentralised composting points set up in neighbourhoods and schools were dimensioned to process the biowaste provided by a minority of volunteer citizens. In order to process the biowaste to be collected systematically from households (and no longer on a volunteer basis), and hence larger quantities at lower purity levels, these facilities need to be redesigned and scaled up.
Description of feature	• List the capacity of the existing facilities; • Decide about the respective roles of at-home composting and neighbourhood composting (generally: in lower-density areas) and of centralised treatment of biowaste (generally: in higher-density areas); • Enquire, with other municipalities having implemented the feature previously, about the characteristics (quantities and purity level, over time since implementation of separate collection of biowaste) to be expected of separately collected biowaste from households, and about the costs to be anticipated; • Deduce from these technical data, from the choices on the respective roles of decentralised vs. centralised treatment, from the features of the population of the municipality, and from the experience accumulated on the treatment of biowaste from commercial sources, the technical specifications of the facilities to be set up for the processing of biowaste from households. Aim at compost / digestate that is compatible with the fertilisation of fields for food crops; • Set up a financing plan for the set up of the scaled-up composting or anaerobic digestion facility; • Procure and distribute home composting systems to the target households; • Set up neighourhood composting facilities in the areas where the option is taken of decentralised processing; • Procure the engineering studies, the construction, the commissioning and the operation of the new facilities for the processing of biowaste, scaled-up and adapted to the flow of biowaste from households; • Arrange the distribution of the compost (resp. the digestate) to local farmers, and to private or public gardens, if possible against payment.
Document describing the feature in greater technical detail	• Generalitat de Catalunya “Guide and reference experiences for the implementation of the separate collection of municipal waste” *(“Guía y experiencias de referencia para la implantación de la recogida separada de residuos municipales”)* of July 2020[45], chapter 2 “Organic matter, a key fraction at the moment of definition of the collection model” (“*La materia orgánica, una fracción clave a la hora de definir el modelo de recogida*”). • FEMP – Technical guide. The management of municipal waste.[46] Chapter 4, p. 429 “ Treatment facilities. Composting and bio-methanation” (*Plantas de tratamiento. Compostaje y biometanización*) • Zero Waste Europe, case studies of: ○ Pontevedra[47] (small municipality);

[45] https://residus.gencat.cat/web/.content/home/lagencia/publicacions/prevencio/guia_experiencies_implantacio_rsrm_es.pdf
[46] Available at: http://femp.femp.es/files/3580-1356-fichero/Guia-Tecnica-Gestion-Residuos-Municipales_Web_Edicion2.pdf
[47] Available at: https://zerowastecities.eu/wp-content/uploads/2019/09/zero_waste_europe_CS13_pontevedra_en..pdf

Scale-up of the facilities for the industrial composting or anaerobic digestion of biowaste		
	○ Campannori[48] and Newport[49] (medium-sized municipalities); ○ Milan[50] and Parma[51] (large municipalities).	
Implementation period	long term = 6 years and above	
Nature of resources needed	• Large, concentrated infrastructure • Small, disseminated infrastructure • Permanent Operational Expenditures	
Challenges identified	Planning of the separate collection of the biowaste should be in line with the scaling up of the processing capacity, to avoid any loss in efficiency.	
Risks assessment	***Potential risk***	***Mitigation measure***
	Delays in the complex process of upscaling the centralised and decentralised processing facilities for biowaste	• Implement a rigorous project planning with clear milestones and deliverables. If necessary, use the services of project management assistance consultancies; • Only deploy the separate collection of biowaste when the processing facilities are operational

Table 4-17 Summary of feature "Door to door collection in 2 streams: (1) biowaste, (2) rest, in areas with single-household buildings"

Door to door collection in 2 streams: (1) biowaste, (2) rest, in areas with single-household buildings	
Policy objective	Introduce door to door separate waste collection to households.
Justification of the relevance of the feature to reach the objective	The European Waste Framework Directive requires that Member States shall ensure that biowaste is either separated and recycled at source, or is collected separately and is not mixed with other types of waste by 31 December 2023. Door-to-door collection is a proven system to stimulate separate collection and rapidly achieve high recycling rates. At this 'Intermediate' performance level, the concept is to start with door-to-door separate collection by changing habits progressively, from the situation at the 'Beginner' stage. The change consists only in introducing the door to door collection for two fractions: (1) biowaste and (2) rest, remembering that a separate collection of the other recyclable waste streams (paper & cardboard; glass; plastic & metal packaging) already is implemented usually by open containers in the street.
Description of feature	• Ensure suitable and sufficient waste treatment facilities for the collected biowaste (which is ensured by the feature "Scale-up of the facilities for the composting or anaerobic digestion of biowaste" described above); • Perform thorough information of households regarding the sorting of biowaste, explaining what nature of waste is suitable for the subsequent processing (centralised or decentralised composting, anaerobic digestion) and hence should (or not) be placed in the bin dedicated to biowaste. This

[48] Available at: https://zerowastecities.eu/bestpractice/best-practice-the-story-of-capannori/
[49] Available at: https://zerowastecities.eu/bestpractice/the-story-of-newport/
[50] Available at: https://zerowastecities.eu/bestpractice/the-story-of-milan/
[51] Available at: https://zerowastecities.eu/wp-content/uploads/2019/07/zero_waste_europe_cs7_parma_en.pdf

Door to door collection in 2 streams: (1) biowaste, (2) rest, in areas with single-household buildings	
	information material can be completed by short training sessions of children in schools or of adults. The exact features of what is suitable or not needs to be adapted to the subsequent processing (and hence may vary according to the location in the municipality); • Provide households with waste bins and disposal bags that minimise the nuisance from the fermentation of biowaste: ventilated or perforated waste bins and disposal bags made of compostable material enabling the circulation of oxygen, so that the aerobic fermentation be privileged (vs. anaerobic fermentation causing smells); • Define the frequency with which biowaste will be collected; the advice is to ensure a frequent door-to-door collection at the expenses of the collection of 'rest' (to reduce nuisance from biowaste in households). For residential areas with single-family housing, one (1) to two (2), or two (2) to three (3) collection moments per week are recommended depending on the amount of private space that people in the area have – the bigger the private space private homes have, the less frequent collection can be. Based on the amount of space, waste bins can range from 20-40L. • Define a staged corrective policy in case of inappropriate sorting of biowaste, addressed to the specific household (see the feature on separate collection of commercial waste); • Provide clear information to citizens on frequency and timetable in which waste will be collected (resp. on the decentralised composting facility where the biowaste should be brought), including the customer service number to call in case of incidents (e.g. container does not get emptied). Consider involving citizens in a participatory process at the early stages of designing the system. • Inform citizens on the means to access the compost resulting from the collection of biowaste, and of the suitable usages (gardening, growing of trees, growing of food crops)
Document describing the feature in greater technical detail	• Generalitat de Catalunya "Guide and reference experiences for the implementation of the separate collection of municipal waste*" ("Guía y experiencias de referencia para la implantación de la recogida separada deT residuos municipales")* of July 2020[52], chapter 2 "Organic matter, a key fraction in the definition of the collection model" ("*La materia orgànica, una fracción clave a la hora de definir el modelo de recogida*"). Specifically p. 41 (left pictures) for an illustration of the waste bins and collection bags adapted to the aerobic storage of biowaste (thereby limiting smell). • Recommended to get in touch with municipal door to door associations. In Catalunya for example that is https://www.portaaporta.cat/es/index.php. Such Associations also exist in the automomous community of Valencia.
Implementation period	Short term = 1 to 2 years
Nature of resources needed	• Training of personnel • Small, diffuse infrastructure • Permanent Operational Expenditures

[52] https://residus.gencat.cat/web/.content/home/lagencia/publicacions/prevencio/guia_experiencies_implantacio_rsrm_es.pdf

Door to door collection in 2 streams: (1) biowaste, (2) rest, in areas with single-household buildings		
Challenges identified	• Resource intensive as it doubles the number of waste collection bins. • All households need to be provided with the appropriate information (or even a short training) regarding the sorting of biowaste, and on the procedure in case of inappropriate sorting; • All households affected need to be provided with bins and bags adapted to the home conservation of biowaste – while avoiding smell; • The frequency of collection should be appropriate.	
Risks assessment	***Potential risk***	***Mitigation measure***
	Households refusing / struggling to separate biowaste, particularly because of smell or because the biodegradable collection bags decompose and leak before being collected	• Provide households with waste bins and bags compatible with the avoidance of smell; • Inform households about the usage of these waste bins and bags; • Ensure a collection frequency that is sufficient to ensure the removal of biowaste before the biodegradable collection bags decompose and leak.

Table 4-18 Summary of feature "Collective, separate collection containers with mechanical locks for (1) biowaste and (2) rest, in areas with multi-household buildings"

Collective, separate collection containers with mechanical locks for (1) biowaste and (2) rest, in areas with multi-household buildings	
Policy objective	Introduce separate waste collection to households
Justification of the relevance of the feature to reach the objective	The European Waste Framework Directive requires that Member States shall ensure that biowaste is either separated and recycled at source, or is collected separately and is not mixed with other types of waste by 31 December 2023). At the 'Intermediate' level, in dense areas with multi-household buildings, an important step is to take steps to limit the inappropriate dumping of waste, specifically for biowaste that requires high levels of purity for the resulting compost or digestate to be usable in agriculture or gardening. Waste collection containers with mechanical locks are a good option to contribute to this purity when the containers are located on the street, as it reserves the usage of the containers to the local inhabitants who are made liable in case of inappropriate disposal (and prevents external people from dumping their waste inappropriately). Mechanical locks are not absolutely necessary for collective containers from buildings with several households (because these containers spend most of the time in the private area of the building), but can be helpful to avoid them being inappropriately used during the short but critical time when the containers are placed on the street and waiting for the waste collection lorry.
Description of feature	See description of feature above in box for areas with single-household buildings, with the following specifics: • The separate collection of biowaste and of "rest" waste is performed in collective containers, which are either specific to each multiple-household

<table>
<tr><th colspan="3">Collective, separate collection containers with mechanical locks for (1) biowaste and (2) rest, in areas with multi-household buildings</th></tr>
<tr><td></td><td colspan="2">building (in which case the containers are mobile and stored most of the time in the private space of the building, and moved to the street at the moment planned for the collection to take place), or to a given geographic area containing several buildings in a dense urban area (in which case the containers are fixed and located on the street);
• The collective containers for separate collection of some categories of waste are mechanically locked. The keys to these containers are distributed to the residents of the multiple-household building (in case of containers attached to each building) or to the residents of the area covered by the collective container (in case of containers in the street). The mechanical locks are preferably placed on the collective containers for (1) biowaste and (2) rest, with a priority set on locking the container for biowaste. The usage of the other containers is restricted by leaving only small openings. Thereby, the dumping of inappropriate waste is limited in the key biowaste container, the ‘rest’ container also is protected but still allows for the disposal of large items by authorised users, and the other containers for the separate collection receive a lesser, but still real, protection against the dumping of large items.
• Each multiple-household building (resp. each area covered by a collective container) designates one “contact person for the separate collection of waste” responsible for the interaction with the waste collection operator and for meeting the operator in case of inappropriate sorting.
• The liability payments in case of inappropriate sorting (if this measure of last resort is used) are requested from all households of the multiple-household building (resp. of the area covered by a collective container), under a regime of several liability (“*responsabilidad mancomunada*”), where each household is requested to pay an equal share of the damage (more sophisticated rules can be developed, but are more costly to implement, e.g. per surface of the home).</td></tr>
<tr><td>Document describing the feature in greater technical detail</td><td colspan="2">Generalitat de Catalunya “Guide and reference experiences for the implementation of the separate collection of municipal waste” (“Guía y experiencias de referencia para la implantación de la recogida separada de residuos municipales”) of July 2020[53], Chapter 3.1.8 “Containers with restricted access” (“Contenidor cerrado con acceso restringido”).</td></tr>
<tr><td>Implementation period</td><td colspan="2">short term = 1 to 2 years,</td></tr>
<tr><td>Nature of resources needed</td><td colspan="2">• Training of personnel
• Small, diffuse infrastructure
• Permanent Operational Expenditures</td></tr>
<tr><td>Challenges identified</td><td colspan="2">See description of feature above in box for areas with single-household buildings, with the following specifics:
• A proper process must be put in place to treat the case when a specific household does not sort its biowaste properly and causes the contamination of the collective waste container.</td></tr>
<tr><td>Risks assessment</td><td>Potential risk</td><td>Mitigation measure</td></tr>
</table>

[53] https://residus.gencat.cat/web/.content/home/lagencia/publicacions/prevencio/guia_experiencies_implantacio_rsrm_es.pdf

Collective, separate collection containers with mechanical locks for (1) biowaste and (2) rest, in areas with multi-household buildings		
	See description of feature above in box for areas with single-household buildings	
	Households in a building (resp. in an urban area) do not accept to be liable in case of inappropriate sorting by one or some of their neighbours	Allow the splitting of the group of households into 2 sub-groups, each with its own mechanically-locked biowaste container and its specific key, at the expense of the households not wanting to be liable for the others.

4.3.3 Features enabling the attainment of the policy objective 'Create an incentive for municipalities to increase the separate collection of waste (incl. biowaste)'

Justification of the policy objective

At the 'beginner' level, we proposed that Autonomous Communities put in place an economic incentive for municipalities to reduce the generation of unsorted waste, in the form of a finalist tax for the deposit of waste in landfills, the incineration and the co-incineration of waste. At the 'intermediate' level, we propose that they create a more positive incentive to improve the separate collection rate and the quality of the sorting between the different waste streams.

Presentation of the features of the waste management system enabling the attainment of the policy objective

Table 4-19 Summary of feature "Implement a tax refund scheme for waste including biowaste"

Implement a tax refund scheme for waste including biowaste	
Policy objective	Create an incentive for municipalities to increase the separate collection of waste (incl. biowaste)
Justification of the relevance of the feature to reach the objective	A refund scheme for the tax on the deposit of waste in landfills, the incineration and the co-incineration of waste for municipalities provides a financial incentive for better management of waste. The underlying idea is that separate waste collection and treatment costs must be made cheaper than disposal into landfill or incineration.
Description of feature	• Such a tax refund scheme refunds municipalities depending on the quality of waste per tonne delivered to treatment plants. • As such, this feature is to be implemented by the Autonomous Communities (Article 16 of the Spanish Waste Act allows waste authorities from autonomous communities (regions) to apply economic incentives, to promote waste prevention and separate collection); • Such a tax refund is related to - and is recommended to be implemented as a follow-up of - the feature 'Implement the disposal tax for the deposit of waste in landfills, the incineration and the co-incineration of waste established in Law 7/2022 and make it a finalist tax' presented above. • Autonomous communities need to decide which percentage of the revenue generated by the tax must be allocated to treatment of waste, and which percentage revenue is refunded to local authorities according to their

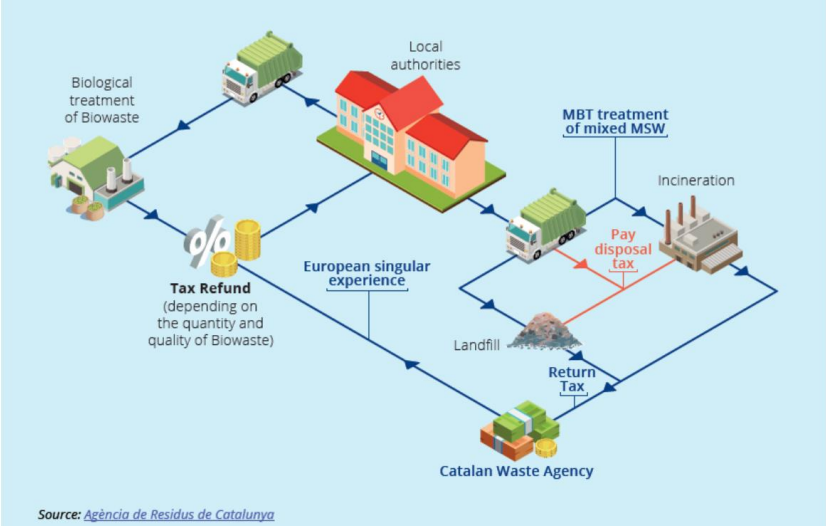
Implement a tax refund scheme for waste including biowaste		
	performance on separate collection of waste. The picture below illustrates the system exchanges in such a refund scheme for biowaste taking the example of Catalonia.  	
Document describing the feature in greater technical detail	Comunidad Autónoma de Cataluña (2008) Law 8/2008, of July 10, on the financing of waste management infrastructures and the fees for the disposal of waste	
Implementation period	Medium term = 3 to 5 years	
Nature of resources needed	Permanent Operational Expenditures	
Challenges identified	Not identified	
Risks assessment	***Potential risk***	***Mitigation measure***
	New scheme, Catalonia pioneer in Europe (not many tested examples to learn from)	Engage with Catalonia to learn from their lessons learnt.

Table 4-20 Summary of feature "Set a mandatory difference in price between that for the treatment of unsorted waste (rest) and that for separately collected waste"

Set a mandatory difference in price between that for the treatment of unsorted waste (rest) and that for separately collected waste	
Policy objective	Create an incentive for municipalities to increase the separate collection of waste (incl. biowaste)
Justification of the relevance of the feature to reach the objective	Treatment of unsorted waste is more costly than treatment of separately collected waste. Also, the scrap value of materials gathered from unsorted waste is generally relatively little while the scrap value of separately collected waste is higher due to the higher material quality and low contamination, generating more income in return. This justifies guiding waste collection practices towards separate collection by for instance setting a higher price for the treatment of unsorted waste.
Description of feature	Perform the following operations periodically, e.g. annually:

Set a mandatory difference in price between that for the treatment of unsorted waste (rest) and that for separately collected waste		

	• Compute the net cost per tonne of the processing of unsorted waste (via Mechanical Biological Treatment (MBT), incineration or landfilling), including the potential income from the selling of the resulting energy;
	• Compute the net cost per tonne of the processing of each stream of separately collected waste, including the potential income from the selling of the resulting materials (scrap paper, scrap metal, glass, plastics, compost, digestate, biogas);
	• Measure the respective masses of each waste stream (unsorted waste, each stream of separately sorted waste) being processed per year by the facilities owned by the Autonomous Community / the Local Entity;
	• Compute updated prices per tonne of sorted and unsorted waste, so as to achieve the following objectives:
	  ○ Set a higher price per tonne for the processing of unsorted waste than for separately collected waste;
	  ○ Maintain a stable income for the facilities owned by the Autonomous Community / the Local Entity – and therefore a stable overall burden for the municipalities (so that the additional costs of some are compensated by the gains of others).	

Document describing the feature in greater technical detail	Generalitat de Catalunya (2018) Guide for the implementation of pay-as-you-throw systems for municipal waste ('Guia per a la implementació de sistemes de pagament per generació de residus municipals') – in Catalan, Castilian and English.[54]	
Implementation period	Medium term = 3 to 5 years	
Nature of resources needed	Not identified	
Challenges identified	Confirmation of the price per generated waste stream that the consumers will pay can be challenging due to the additional work required to control waste streams and amounts.	
Risks assessment	***Potential risk***	***Mitigation measure***
	It can create resistance from the consumers to the significant price difference.	Enlightening the consumers regarding the reasons for this difference can eliminate the resistance.

Table 4-21 Summary of feature "Capacity building for adequate drafting of waste collection contracts"

Capacity building for adequate drafting of waste collection contracts	
Policy objective	Create an incentive for municipalities to increase the separate collection of waste (incl. biowaste)
Justification of the relevance of the	Waste management contracts define the details of the waste collection services including what is to be collected and how often among others. They also specify

[54] Available online at:
- Castilian version: http://residus.gencat.cat/web/.content/home/lagencia/publicacions/centre_catala_del_reciclatge__ccr/guia_pxg_es.pdf
- Catalan version: http://residus.gencat.cat/web/.content/home/lagencia/publicacions/centre_catala_del_reciclatge__ccr/guia_pxg.pdf
- English version: https://residus.gencat.cat/web/.content/home/lagencia/publicacions/centre_catala_del_reciclatge__ccr/guia_pxg_en.pdf

Capacity building for adequate drafting of waste collection contracts		
feature to reach the objective	the period or length of the services to be provided and the area of a municipality that it will cover. However, there are some aspects which our first hand research show are essential to very specifically capture in the contract. These are for example defining who is in charge of maintaining the material infrastructure (i.e. containers) and waste trucks, determining penalties and rewards, specifying how the handling of complaints/issues will be done, requirements on information to the users as well as reporting requirements. Capacity building on the staff of the municipalities to draft 'appropriate' tender specifications will improve the waste management operational quality while protecting the best interest of society.	

Description of feature	• Ensuring the municipality has support staff with legal and administrative background who can help in drafting tender specifications and contracts;
	• Provide training on tender specifications / contract drafting to the staff.
	  ○ Analyzing the past contracts and pointing the critical articles to identify challenging parts
	  ○ Create a draft from lessons learned from the previous contacts and share a guideline with the team for forming a proper contract.
	  ○ Draw from good examples from other municipalities	

Document describing the feature in greater technical detail	• Technical prescriptions for the Torredembarra waste collection service (*'Plec de prescripcions tècniques particulars que regiran la prestacio del servei de recollida i transport de residus municipales a Torredembarra'*) • Specifications for the contracting of the domestic waste collection and transport service, and complementary services, in various municipalities of the province of Badajoz, southern zone (*'Pliego de prescripciones técnicas particulares para la contratación del servicio de recogida y transporte de residuos domésticos, y servicios complementarios, en diversos municipios de la provincia de Badajoz, zona Sur'*) • FEMP – Technical guide. The management of municipal waste.[55] Chapter 6, p.621 "Contractual specficiations" (*Pliegos de condiciones)*	
Implementation period	short term = 1 to 2 years	
Nature of resources needed	Communication material / Training of personnel	
Challenges identified	It could be challenging to change the staff's mindset and approach to the new structure of drafting the contracts.	
Risks assessment	***Potential risk***	***Mitigation measure***
	• Not identified	• NA

4.4 Roadmap for municipalities in the 'advanced' category

The policy objectives relevant for municipalities in the 'advanced' category are the following:

- Enhance separate collection of waste with citizens, including with an economic incentive;
- Increase the social acceptance of payment per generation of waste;
- Reinforce the movement towards the reduction of waste;
- Create an incentive for municipalities to increase the quality and purity of the separately collected waste.

[55] Available at: http://femp.femp.es/files/3580-1356-fichero/Guia-Tecnica-Gestion-Residuos-Municipales_Web_Edicion2.pdf

4.4.1 Features enabling the attainment of the policy objective 'Enhance separate collection of waste with citizens, including with an economic incentive'

Justification of the policy objective

The separate collection of waste has been initiated and developed in the previous 'Beginner' and 'Intermediate' stages, to a level of door-to-door collection of some waste fractions. At the 'Advanced' level, the system is moved to a higher level of performance and also of demands placed on citizens, using the economic incentives generally referred to as 'Pay as you throw' (PAYT). Under these schemes, households pay as per the quantity of unsorted waste that they generate. This creates an individual economic incentive to increase separate waste collection.

Presentation of the features of the waste management system enabling the attainment of the policy objective

Table 4-22 Summary of feature "Pay as you throw (PAYT) for residual, unsorted waste = 'rest' bin"

Pay as you throw (PAYT) for residual, unsorted waste = 'rest' bin	
Policy objective	Enhance separate collection of waste with citizens, including with an economic incentive
Justification of the relevance of the feature to reach the objective	Waste collection fees can create an economic incentive towards the reduction and separation of waste at source, for instance through a Fair Tax that is based on Pay-As You Throw (PAYT) systems. Such systems enable that the users of the waste collection service pay their waste collection fee depending on their generation of unsorted waste. As such these systems make it possible to transfer the "polluter pays" principle to the waste collection fee and reward those citizens and businesses who make an effort to reduce their unsorted waste and participate in separate collection of recyclable or compostable waste. The "pay as you throw" approach is a waste management strategy that aims to encourage responsible waste disposal by tying the fee for waste collection and treatment to the amount of unsorted waste generated by individual households or businesses. In this system, residents are charged based on the volume or mass of their unsorted waste, typically through the use of specialized bags, tags, or containers. The underlying principle of the pay as you throw approach is to create a financial incentive for individuals to reduce their generation of unsorted waste and to increase their separate collection efforts. By directly linking the waste fee to the amount of unsorted waste produced, households have a direct economic motivation to minimize their generation of unsorted waste and to maximize the separate collection of recyclable and compostable waste.
Description of feature	• Define whether the metric to measure the quantity of unsorted waste being generated, and which will constitute the taxation base for the Pay As You Throw (PAYT) system, is based on **mass** or on **volume** of unsorted waste; • Based on this decision, set up the necessary technical tools to support the PAYT system. These tools can be: ○ In the case where volume is the metric being used: Specific bags that are required to dispose of unsorted waste (= waste not placed in these bags is not collected). The purchasing price of the bags is generally much higher than its cost, and includes the tax being

Pay as you throw (PAYT) for residual, unsorted waste = 'rest' bin	
	placed on the collection of unsorted waste. The bags can be sold directly to the municipality, or by local shops under mandate by the municipality; ○ In the case where mass is the metric being used: ▪ mass measurement tools on the waste collection lorries, together with an identification mechanism (QR code or RFID tag) on the unsorted waste collection bin and an adapted reader on the waste collection lorry (as described above in the feature "Monitoring of waste collection (GPS on collection lorries, RFID tags, QR-codes or bar codes on bins)"; ▪ locking the collection bins for unsorted waste, to avoid the illegitimate dumping of unsorted waste from one household to the next, for single-household buildings, on top of what was implemented under the feature "Collective, separate collection containers with mechanical locks for (1) biowaste and (2) rest, in areas with multi-household buildings" described above; • Define the economic model of the PAYT system, with the aim that this PAYT system be economically balanced in the long term. This economic model includes: ○ the reduction in the flat fee for waste collection paid per month by the households; ○ the fee per litre (resp. per kg) of unsorted waste being generated, if the metric for quantities is per volume (resp. per mass), and ○ the payment principles, among options such as: ▪ payment strictly proportional to the quantity of unsorted waste being generated; ▪ free allowance of a limited quantity of unsorted waste, and payment per quantity of unsorted waste above that threshold; ○ the anticipated increase in the quantities of separately collected waste, and hence the increase in the economic value extracted from it sale to recyclers; ○ the anticipated decrease in the quantities of unsorted waste, and hence the decrease in the landfilling, incineration or MBT treatment fee to be paid to the Autonomous Community / the Local Entity[56] or the private waste management operator (considering that this fee per tonne of unsorted waste has previously increased as per the measure "Create incentives for municipalities to diminish the generation of unsorted waste" described above). • Set up technical infrastructure implementing these payment principles, such as:

[56] Local Entities include groups of municipalities ('*mancomunidades*') and single municipalities managing their own facilities for the final treatment of waste.

Pay as you throw (PAYT) for residual, unsorted waste = 'rest' bin	
	○ in the case of a volume-based metric: the distribution network and processes for the taxed bags specific to the collection of unsorted waste, including the free distribution of a limited number of bags per household and per month if relevant (while keeping track of who already received his/her monthly allowance of free bags); ○ in the case of a mass-based metric: the data collection and billing for each household to compute its fee; ○ in both cases, the adaptation of the billing system to the updated flat fees; • Communication about the scheme – Besides a communications campaign, more innovative means may be used such as providing households with an online tool[57] that shows them how their total fee might change under different scenarios, illustrating this way the potential to pay less than before the scheme was introduced, if the household is sufficiently diligent in improving its separate collection of waste; • Pilot testing and evaluation: Consider conducting a pilot program in a specific area or neighbourhood to test the effectiveness and feasibility of the pay as you throw approach. Gather feedback from participants and make necessary adjustments to the key components of the economic model (flat fee, fee per kg or litre of unsorted waste, free allowance, reduction in generation of unsorted waste, increase in the separate collection rates), based on the lessons learned;, • Monitor and enforce compliance: Establish monitoring and enforcement mechanisms such as cameras to avoid the circumvention of the PAYT fees in the form of illegitimate use of public waste bins or of illegal littering or dumping, specifically on high-risk spots (e.g. public waste bins in densely populated areas, public parks and gardens, parking lots); • Continuous evaluation and improvement: Regularly assess the performance of the pay as you throw system through data analysis, feedback from residents, and stakeholder consultations. Identify areas for improvement, such as addressing equity concerns, enhancing public awareness, or refining the pricing structure. Make necessary adjustments and continuously strive to improve the effectiveness and efficiency of the system.
Document describing the feature in greater technical detail	• Cataluña. Departamento de Territorio y Sostenibilidad, Agencia de Residuos de Cataluña "Guide for the implementation for Pay as you Throw", 2020 ("Guía y experiencias de referencia para la implantación de la recogida selectiva de residuos municipales")[58] • REthinkWASTE consortium "PAYT and KAYT Catalogue. Collection of experiences about pay as you throw (PAYT) and know as you throw (KAYT)", 2020[59]]
Implementation period	medium term = 3 to 5 years
Nature of resources needed	Communication material / Training of personnel / IT software development / Small, diffuse infrastructure / Large, concentrated infrastructure

[57] One example of such a tool for a bag-based scheme was developed by the Hague, in the Netherlands
[58] Available at: https://residus.gencat.cat/web/.content/home/lagencia/publicacions/prevencio/guia_experiencies_implantacio_rsrm_es.pdf
[59] Available at: https://rethinkwaste.eu/life-rethinkwaste-projects-catalogue-of-payt-and-kayt-practices-published-by-acr/

Pay as you throw (PAYT) for residual, unsorted waste = 'rest' bin		
Challenges identified	• Initial infrastructure costs • Monitoring and enforcement, specifically regarding the circumvention via dumping in public wastebins or littering; • Equity and social considerations; • Measurement and billing accuracy;	
Risks assessment	***Potential risk***	***Mitigation measure***
	• Illegitimate usage of public wastebins to throw private unsorted waste • Illegal dumping and burying of unsorted waste • Littering of unsorted waste • Counterfeiting of official bags for unsorted waste	• Video monitoring of spots or areas at risk of littering or of illegitimate use of public wastebins • Back-tracking of illegally dumped or buried waste to the originator • Watermarking or other authentication features of official bags for unsorted waste
	Refusal by the population of the PAYT system because of social or equity considerations	*See policy objective "Increase the social acceptance of the payment per generation of waste" below*
	The measurement of the mass of unsorted waste is too inaccurate to be considered as a legitimate basis for waste collection fees	• The low accuracy of the mass measurement system is one of the key weaknesses of this metric compared to volume-based taxation. This point should be verified very early on when making the choice of mass-based taxation; • Calibrate regularly the mass measurement systems on the waste collection lorries and keep a record of that calibration in registers and on the lorry itself.

Table 4-23 Summary of feature "Set up quality metrics for the purity of separately collected waste (glass, paper & cardboard, metal & plastic packaging, biowaste)"

Set up quality metrics for the purity of separately collected waste (glass, paper & cardboard, metal & plastic packaging, biowaste)	
Policy objective	Enhance separate collection of waste with citizens, including with an economic incentive
Justification of the relevance of the feature to reach the objective	When collecting waste separately, there is generally a certain level of impurities that is, waste that does not belong to the material fraction. This makes the recycling of the waste more difficult from a technical point of view and hence more costly, while reducing the quality (and selling price) of the resulting secondary material. Considering high-quality starting materials are needed to manufacture new products, it can be concluded that material purity is essential for efficient and profitable recycling.

<table>
<tr><th colspan="3">Set up quality metrics for the purity of separately collected waste (glass, paper & cardboard, metal & plastic packaging, biowaste)</th></tr>
<tr><td></td><td colspan="2">In order to implement the measures, described below, “Periodic analysis and reporting on the amounts and the quality of the separately collected waste, as per the metrics" and “Establish a pricing for treatment of separately collected waste, with fees decreasing as waste quality increases”, a common reference is needed to assess the quality and purity of the separately collected waste.</td></tr>
<tr><td>Description of feature</td><td colspan="2">Identify the metrics and measurement methods for the quality of separately collected waste to be used among those defined by the following standards:
• Recycled paper standard: EN 643:2014: European list of standard grades of paper and board for recycling[60]
• Recycled plastics standard: EN 15347[61] for the Characterization of plastics waste
• Glass cullet for recycling: Commission Regulation n°1179/2012[62]
• Steel and aluminium scrap:
  ○ Council Regulation n°333/2011[63]
  ○ European Standard EN 13920-8:2003[64] for aluminium-containing shredded material mixed with other metals and non-metallic components (rubber, plastic, glass etc)
  ○ EU-27 Steel Scrap Specification[65] by European Ferrous Recovery and Recycling Federation that determines environmental, health and safety requirements for steel scrap and other metallic minerals such as Copper, Tin, Lead, Chromium, Nickel..etc. to be processed in a safe way for workers and the environment.
• European Compost Network - Quality Assurance Scheme[66] for compost and digestate of biowaste and for the process leading to such products
• Wood residue and post-consumer wood — Classification, Part 1: Vocabulary: ISO 17300-1[67]</td></tr>
<tr><td>Document describing the feature in greater technical detail</td><td colspan="2">None identified</td></tr>
<tr><td>Implementation period</td><td colspan="2">medium term = 3 to 5 years</td></tr>
<tr><td>Nature of resources needed</td><td colspan="2">One-off selection process</td></tr>
<tr><td>Challenges identified</td><td colspan="2">Lack of standardized guidelines for some categories of separately collected waste: biowaste</td></tr>
<tr><td rowspan="2">Risks assessment</td><td>Potential risk</td><td>Mitigation measure</td></tr>
<tr><td>Disagreement among stakeholders in the selection of the relevant metrics, specifically when considering waste</td><td>Ensure an inclusive process</td></tr>
</table>

[60] https://www.en-standard.eu/bs-en-643-2014-paper-and-board-european-list-of-standard-grades-of-paper-and-board-for-recycling/
[61] https://www.en-standard.eu/bs-en-15347-2007-plastics-recycled-plastics-characterization-of-plastics-waste/
[62] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32012R1179
[63] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32011R0333
[64] https://www.en-standard.eu/bs-en-13920-8-2003-aluminium-and-aluminium-alloys-scrap-scrap-consisting-of-non-ferrous-materials-from-shredding-processes-destined-to-aluminium-separation-processes/
[65] https://www.euric-aisbl.eu/facts-figures/standards-specifications#:~:text=EU%2D27%20Steel%20Scrap%20Specification,material%20for%20the%20steel%20industry .
[66] https://www.compostnetwork.info/ecn-qas/
[67] https://www.iso.org/standard/65044.html

Set up quality metrics for the purity of separately collected waste (glass, paper & cardboard, metal & plastic packaging, biowaste)		
	streams whose quality is not standardised yet	

Table 4-24 Summary of feature "Periodic analysis and reporting on the amounts and the quality of the separately collected waste, as per the metrics"

Periodic analysis and reporting on the amounts and the quality of the separately collected waste, as per the metrics	
Policy objective	Enhance separate collection of waste with citizens, including with an economic incentive
Justification of the relevance of the feature to reach the objective	Periodic analysis, in other words monitoring, of the quantity and quality of separately collected waste is necessary to understand if waste collection is working according to the set objectives and to identify issues at an early stage. Reporting on results achieved can be encouraging for the sector and for the citizenry.
Description of feature	• Establish purity thresholds: Define purity thresholds for each waste stream based on industry standards, legal requirements and local waste management goals. These thresholds represent the acceptable levels of contamination or impurities in the collected waste. For instance, you may set a target of 95% purity for glass, meaning that no more than 5% of the collected glass waste should consist of non-glass materials. • Develop sampling protocols: Determine the sampling protocols that will be used to assess the purity of the waste streams. This may involve randomly selecting samples from different collection points or conducting periodic audits of the collected waste. Consider the sample size, frequency, and locations to ensure a representative assessment of the waste purity. • Train and engage personnel: Provide training to waste management personnel or auditors responsible for assessing the purity of the waste streams. Ensure they understand the evaluation criteria, sampling protocols, and impurities identification techniques. Encourage their active involvement and feedback to continuously improve the quality assessment process. • Monitoring and data collection: Establish a system to monitor and collect data on (1) the quantity of separately collected waste in each waste stream and (2) the quality of each waste stream, as per the metrics defined above (measure "Set up quality metrics for the purity of separately collected waste"). Record and track the results of the measurements, noting any trends or recurring issues. This data will help identify areas for improvement of quality and measure the effectiveness of these efforts over time. • Ensure for (1) the monthly assessment of the quantity of separately collected waste and (2) quarterly or semesterly assessment of its quality (against the metrics defined) • Publish periodically (e.g. quarterly or yearly) in the municipal information and communication channels the results of the monitoring of the quantity and quality of separate collection, providing the history over the past

Periodic analysis and reporting on the amounts and the quality of the separately collected waste, as per the metrics	
	sampling periods, the evolution over that period and the comparison to the target for each waste stream and for each quality criterion; • Continuous improvement and feedback loop: Regularly review the quality metrics and evaluation process to identify opportunities for improvement. Seek feedback from stakeholders, waste management personnel, and recycling facilities to understand challenges and implement corrective actions. Continuously strive to enhance the purity of the waste streams through targeted education, awareness campaigns, and process optimization.
Document describing the feature in greater technical detail	Federación Española de Municipios y Provincias (FEMP) (2016) Manual de comunicación efectiva de residuos para técnicos municipales[68]
Implementation period	medium term = 3 to 5 years
Nature of resources needed	Training of personnel Permanent Operational Expenditures
Challenges identified	• Impurities identification and quantification
Risks assessment	***Potential risk*** / ***Mitigation measure***
	Workers in charge of the assessment of the impurity levels in the separately collected waste streams are reluctant to perform the analysis for health & safety reasons / Ensure from the outset good health & safety conditions in the installations in charge of measuring the purity levels of each waste stream

Table 4-25 Summary of feature "Door to door separate collection with RFID tags on the bins and monitoring system in 5 streams: (1) glass, (2) paper & cardboard, (3) metal & plastic packaging, (4) biowaste, (5) rest in areas with single-household buildings"

Door to door separate collection with RFID tags on the bins and monitoring system in 5 streams: (1) glass, (2) paper & cardboard, (3) metal & plastic packaging, (4) biowaste, (5) rest , in areas with single-household buildings	
Policy objective	Enhance separate collection of waste with citizens, including with an economic incentive
Justification of the relevance of the feature to reach the objective	The Door to Door separate collection system in 5 streams, in areas with single-household buildings, increases the separate collection rate, and the purity level of the resulting waste streams, compared to the situation of the 'Intermediate' stage where only 2 streams are collected Door to Door (and the other streams remain collected in collective bins on the street). The separation at source in 5 streams is easier to implement in areas with single-household buildings, because the homes are larger and have more surface available to store the 5 containers. The usage of RFID tags and of a monitoring system enhances the accountability of households in their separation of waste and provides real-time data for the short-term detection and correction of non-compliance and for long-term decision-making.

[68] Available in all official Spanish languages at: http://femp.femp.es/Microsites/Front/PaginasLayout3/Layout3_Personalizables/MS_Maestra_3/_MznynrPoTrXKv5bey-7NcwsmWRvwm_gXqYKvux9hPfYUqkboINUGi_MftU7YSldL

<table>
<tr><th colspan="3">Door to door separate collection with RFID tags on the bins and monitoring system in 5 streams: (1) glass, (2) paper & cardboard, (3) metal & plastic packaging, (4) biowaste, (5) rest , in areas with single-household buildings</th></tr>
<tr><td>Description of feature</td><td colspan="2">Procure RFID tags and equip bins designated for each waste stream with the tags. Assign a unique identification code to each bin and link it to the corresponding waste stream. Ensure proper installation and maintenance of the RFID tags on the bins to ensure accurate identification and tracking;
Adapt to these additional, differentiated RFID tags the monitoring system already set up under the measure “Monitoring of waste collection (GPS on collection lorries, RFID tags, QR-codes or bar codes on bins)" described above in § 5.3.1;
Adapt the capacity of the waste treatment facilities to the anticipated increase in separately collected waste, for each waste stream, and in particular for biowaste (which is ensured by the feature “Scale-up of the facilities for the composting or anaerobic digestion of biowaste” described above);
Define the frequency with which different fractions will be collected.The advice is to ensure a frequent door-to-door collection of biowaste at the expenses of the collection of ‘rest’ (to reduce nuisance from biowaste in households), in one (1) to two (2), or two (2) to three (3) collection moments per week depending on the amount of private space that people in the area have – the bigger the private space private homes have, the less frequent collection can be, with rest fraction collected every week and paper/cardboard, plastic & metal packaging and glass being collected every other week. Based on the amount of space, individual buckets can range from 20-40L to 40-130L.
Adapt the fleet of waste collection lorries, their routes and the personnel to the additional waste collection duties arising from door-to-door collection of 5 streams of separately collected waste;
Inform citizens of the day(s) in the week (and of the week) when they are allowed to place their waste of each separately collected stream on the street for collection;
Consider involving citizens in a participatory process at the early stages of designing the system.</td></tr>
<tr><td>Document describing the feature in greater technical detail</td><td colspan="2">Generalitat de Catalunya “Guide and reference experiences for the implementation of the separate collection of municipal waste” (“Guía y experiencias de referencia para la implantación de la recogida separada de residuos municipales”) of July 2020[69], §3.2 Door to Door collection</td></tr>
<tr><td>Implementation period</td><td colspan="2">medium term = 3 to 5 years,</td></tr>
<tr><td>Nature of resources needed</td><td colspan="2">Communication material / Training of personnel / IT software development / Small, diffuse infrastructure / Large, concentrated infrastructure / Permanent Operational Expenditures</td></tr>
<tr><td>Challenges identified</td><td colspan="2">Cost implications
Public acceptance and behaviour change</td></tr>
<tr><td>Risks assessment</td><td>Potential risk</td><td>Mitigation measure</td></tr>
</table>

[69] https://residus.gencat.cat/web/.content/home/lagencia/publicacions/prevencio/guia_experiencies_implantacio_rsrm_es.pdf

Door to door separate collection with RFID tags on the bins and monitoring system in 5 streams: (1) glass, (2) paper & cardboard, (3) metal & plastic packaging, (4) biowaste, (5) rest , in areas with single-household buildings		
	• Households refusing / struggling to separate waste streams. • Large costs - inefficiencies • Resistance and non-compliance • Enforcement and monitoring challenges • Privacy and data protection	• Provision of information on the importance of separate collection, detailed explanation on separation to overcome any confusion, provision of bins by municipality. • Avoiding excessive frequencies aiming to avoid user complaints. The rest and the glass are fractions that can have very low collection frequencies. • Combining door-to-door with emergency containers for the different fractions in the area which every citizen can use in case of emergency. • Data protection protocols

4.4.2 Features enabling the attainment of the policy objective 'Increase the social acceptance of payment per generation of waste'

Justification of the policy objective

Payment per generation of waste schemes –commonly known as Pay-As-You-Throw (PAYT) schemes are generally driven by the need or desire to contribute to reducing the generation of waste (in particular residual waste), and to increase waste sorting at a household level, by using economic incentives. Social acceptance of such economic incentives tend to vary according to the economic situation of the household involved: poorer households are sensitive to even small changes in the waste collection fee and are likely to reject any system that increases their economic burden, whereas wealthier ones need much stronger economic incentives to change their behaviour. Public acceptance of PAYT systems is however necessary to avoid a rise of illegal disposal of waste or the avoidance of charges by individuals travelling to areas not operating under a PAYT scheme to dispose of waste.

Features of the waste management system enabling the attainment of the policy objective

Table 4-26 Summary of feature "Social modulation of waste collection fees"

Social modulation of waste collection fees	
Policy objective	Increase the social acceptance of payment per generation of waste
Justification of the relevance of the feature to reach the objective	Waste collection fees or taxes are the charges households pay for the collection and treatment of waste. Low-income people may face problems related to the affordability of such waste taxes, and specifically to the economic incentive constituted by a Pay As You Throw (PAYT) system. In addition, some specific situations (presence of infants or of elderly people) may generate high volumes of residual waste (e.g. nappies) and would hence cause the payment of very high PAYT fees.

Social modulation of waste collection fees	
	As such, social tariffs (e.g. based on income) as well as exemptions need to be considered.

Description of feature	• Select an evidence base to be used for the evaluation of the income of each household, using the data available to the municipality. Some possible sources of such evidence base include:
	  ○ The surface of the dwelling and of its dependencies (garden, garage);
	  ○ The price per square metre of real estate in the area, based on the transactions most recently recorded by the local notaries;
	  ○ The cadastral value of the dwelling, which includes the presence of some exterior signs of wealth (e.g. swimming pool, tennis court);
	  ○ (if available to the municipality, e.g. via water consumption) The number of persons living in the household;
	• Decide on the rates to be charged per level of estimated income, with the estimation being based on the evidence base selected. The rates should increase with income (progressive taxation), and should be defined for the two main types of fee:
	  ○ Flat fee per period of time and per household;
	  ○ Fee per unit of mass or of volume (as per the metric chosen) of waste fraction to which the PAYT applies, for the quantity generated above the free allowance (if such free allowance is foreseen);
	• The rates defined above should be computed so that the total of all waste collection fees remains constant compared to a situation where they are not modulated per estimated income level, considering the number of households at each level of income in the municipality;
	• Define the special cases when a given amount of waste subject to PAYT is allowed to pay a lower fee per unit of mass of volume, e.g. for nappies of infants or of elderly people, and the evidence that the household needs to provide to apply for that reduced PAYT fee

Document describing the feature in greater technical detail	None identified
Implementation period	Medium term = 3 to 5 years
Nature of resources needed	Communication material (to inform citizens – in particular low-income households – of their right to apply for a reduction / exemption) Permanent Operational Expenditures (to manage tax reduction / exemption applications)
Challenges identified	Considering social tariffs and exemptions, instead of a fixed tariff for everyone, makes the system more complex. There is no one size fits all. Each municipality in Spain currently sets their waste rates based on different criteria: Single rate (all households pay the same), according to the street / neighborhood the home is in, depending on the size of homes (square meters), based on the cadastral value of the house (determined at intervals), according to water consumption, based on the periodicity of

Social modulation of waste collection fees		
	collection. As such, it is expected that social modulation of fees will also have to be tailor-made to each municipality.	
Risks assessment	***Potential risk***	***Mitigation measure***
	• The introduction of social tariffs can lead to deviations from the environmental (i.e. waste reduction) objectives, complicating the system and hiding the reality of the costs of service to the user.	• Aim for a fairer contribution by each household by making sure waste collection fees include a fixed as well as a variable element (based on income and wealth).

4.4.3 Features enabling the attainment of the policy objective 'Reinforce the movement towards the reduction of waste'

Justification of the policy objective

The European Waste Framework Directive to be applied by EU Member States in waste management, defines a 'hierarchy' in which waste 'prevention', in other words 'reduction', is the preferred option. Moreover, Spain is aiming to transition to a circular economy by 2050. Second-hand consumption is an important circular practice which can lead to lower environmental impacts. As such, thrift shops and repair cafés can play an important role. Moreover, in addition to contributing to a circular economy, thrift shops and repair cafés contribute to the achievement of other social objectives such as building a more inclusive society and poverty reduction by for instance providing employment for people with a distance to the labor market.

Whereas these infrastructures were trialled and set up at pilot scale at the 'Beginner' level, the purpose at 'Advanced' level is to generalise them and to make them available to the whole population.

Features of the waste management system enabling the attainment of the policy objective

Table 4-27 Summary of feature "Generalisation of waste reduction infrastructures (= soft incentives): second-hand shops for clothes, toys, appliances, furniture; repair cafés"

Generalisation of waste reduction infrastructures (= soft incentives): second-hand shops, centres for the preparing for re-use and repair cafés	
Policy objective	Reinforce the movement towards the reduction of waste
Justification of the relevance of the feature to reach the objective	Waste reduction infrastructure such as second-hand shops, centres for the preparing for re-use and repair cafés (for clothes, toys, appliances, furniture among others) allow for several categories of durable goods of daily use to get a second life and be used for longer as opposed to being thrown away when broken or when no longer needed / wanted. This reduces the volume of raw materials and energy needed to make new products, cutting down CO_2 emissions from manufacturing new products or recycling old products. Repair cafés in particular (meeting places aimed at repairing things (together)) allow for small repairs and equally important, play a role in teaching people to repair things themselves, passing this way invaluable skills from person to person. Whereas some second-hand shops, centres for the preparing for re-use and repair cafés can have their own economic viability by themselves when set up in a favourable environment (e.g. densely populated city centres), the municipality can take steps to generalise the concept to the whole municipality, and make them available to all citizens, Including in less favourable settings.

<table>
<tr><th colspan="3">Generalisation of waste reduction infrastructures (= soft incentives): second-hand shops, centres for the preparing for re-use and repair cafés</th></tr>
<tr><td>Description of feature</td><td colspan="2">• Foster the set up of second-hand shops, centres for the preparing for re-use or repair cafés by becoming a sponsor of such an initiative, by providing funds and/or by making available a space owned by the municipality that could be used for this purpose. A space between 40 and 100 square metres in size is considered suitable; in addition, it should be well located that is easy to find and accessible by public transport.
• Facilitate the start and expansion of second-hand shops or markets, centres for the preparing for re-use or repair cafés by providing support to project managers in applying for government funding for such business activity. This government funding could include grants, government loans or tax breaks to help entrepreneurs with aspects such as covering for business development costs, paying for consulting services, purchasing of new or used equipment, product or service development costs, and covering for renovation costs.
• Ensure the municipal government has a dedicated page on their website with information on the time and location of the second-hand market, on help provided to second-hand shops, to participants in second-hand markets, to centres for the preparing for re-use and to repair cafés including useful links to direct entrepreneurs to information on funding (e.g. how to apply, who are eligible, amount of funding one can apply for etc) and to the municipal contact that can help them further (e.g. with applying for a space).</td></tr>
<tr><td>Document describing the feature in greater technical detail</td><td colspan="2">Repair Café international network website: https://www.repaircafe.org/en/</td></tr>
<tr><td>Implementation period</td><td colspan="2">Short term = 1 to 2 years</td></tr>
<tr><td>Nature of resources needed</td><td colspan="2">Operational expenditures
Capital expenditures (for the municipal-owned spaces)</td></tr>
<tr><td>Challenges identified</td><td colspan="2">• Infrastructure planning and coordination
• Regulatory and policy frameworks
• Infrastructure scalability and adaptability
• Financial constraints</td></tr>
<tr><td rowspan="2">Risks assessment</td><td>Potential risk</td><td>Mitigation measure</td></tr>
<tr><td>• Repair specialists feeling the repair café competes with their services</td><td>• Information provision is essential. Repair Cafés focus attention on the possibility of getting things repaired. Visitors are frequently advised to go to the few professionals still around. People who visit Repair Cafés are not usually customers of repair specialists. They are people who would normally throw broken items away. The Repair Café helps spread the mentality that you don’t have to throw things away when broken; there are alternatives.</td></tr>
</table>

4.4.4 Features enabling the attainment of the policy objective 'Create an incentive for municipalities to increase the quality and purity of the separately collected waste'

Justification of the policy objective

The purity of the waste collected is crucial for the subsequent treatment process – the purer the materials, the more efficient and profitable recycling is. The purity rate of waste is understood as the amount of target materials in the total amount of the separately collected waste (%). With recycling and especially with post-consumer recycling (PCR), there is always an issue of contamination. High purity of waste materials is however a prerequisite for the use of waste as a secondary raw material by manufacturing industries. That is why separate collection of recyclable waste streams at source is usually the most favourable method of waste collection.

In order to achieve such high levels of purity, municipalities engage into measures enhancing the separate collection of waste fractions, which were explored earlier in this report. These measures can be costly to the municipal budget.

Entities at a larger scale, such as the Autonomous Communities or the '*mancomunidades*', can support the efforts of municipalities towards higher separate collection rates with higher purity by establishing a pricing for treatment of separately collected waste, with price decreasing as waste quality and purity increase.

Features of the waste management system enabling the attainment of the policy objective

Table 4-28 Summary of feature "Establish a pricing for treatment of separately collected waste, with fees decreasing as waste quality increases"

Establish a pricing for treatment of separately collected waste, with price decreasing as waste quality increases	
Policy objective	Create an incentive for municipalities to increase the quality and purity of the separately collected waste.
Justification of the relevance of the feature to reach the objective	Establishing a pricing system for treatment of separately collected waste, with fees decreasing as quality and purity of waste increases is an economic instrument that can create an environmental incentive for municipalities to pursue further waste reduction and better separation. This measure also helps municipalities in bearing the additional costs of higher-quality and higher-purity waste collection, as they obtain a direct economic advantage from implementing it. This measure is also likely to be made more simple as markets develop, over the next years or decades, for waste per levels of purity, with recyclers actually purchasing waste at prices that increase with the purity level.
Description of feature	This measure, which is to be implemented by Autonomous Communities or Local Entities applies to the fees paid by the municipality to the Autonomous Community, the Local Entity or the company managing the waste treatment facility. • Establish a pricing for treatment of separately collected waste, with fees decreasing as quality and purity of waste increase. The quality level of the waste should be assessed as per the metrics and standards selected in the feature "Set up quality metrics for the purity of separately collected waste" described in § 4.4.1 above. The price may be dependent upon the attainment or not of specific objectives set by the Autonomous Community or the Local Entity regarding the quality or purity of separately collected waste, as per the metrics and standards selected. It may also be related to the market

<table>
<tr><th colspan="3">Establish a pricing for treatment of separately collected waste, with price decreasing as waste quality increases</th></tr>
<tr><td></td><td colspan="2">price for separately collected waste streams, which is likely to increasingly depend, over the next years or decades, upon their quality levels according to the same metrics and standards, as open markets for high-purity sorted waste develop. The fee can even be negative for the higher levels of quality or purity, i.e. the Autonomous Community / the Local Entity pays the municipality to receive its well-sorted waste;
• Agree between the Autonomous Community / the Local Entity and the municipalities on the processes to periodically review the pricing of the treatment for separately collected waste, based on the costs incurred and on the market prices for separately collected waste, per level of quality and purity;
• Agree between the Autonomous Community / the Local Entity and the municipalities on the measurement methods for the quality and purity of separately collected waste delivered by the municipalities, in addition to what is defined for the measure “Periodic analysis and reporting on the amounts and the quality of the separately collected waste, as per the metrics” described in § 4.4.1 above, and bearing on:
o The frequency and method of sampling (or on a systematic measurement for each incoming lorry);
o The dispute resolution mechanism in case of disagreement on the assessment of the quality or purity of the delivered waste;
• Set up, at the level of the pre-recycling facility, the technical infrastructure necessary to:
o assess the quality of the separately collected waste for each stream (which can be systematic or only at specific sampling times, as defined above);
o couple that measurement with that of the quantity of separately collected waste for each stream (as measured by the systems set up for the measure “Periodic analysis and reporting on the amounts and the quality of the separately collected waste, as per the metrics” described in § 4.4.1 above) and for each municipality; bill the municipality as per the fee associated to each level of quality or purity, and per the quantity delivered of separately collected waste of that level of quality or purity.</td></tr>
<tr><td>Document describing the feature in greater technical detail</td><td colspan="2">Not identified</td></tr>
<tr><td>Implementation period</td><td colspan="2">Medium term = 3 to 5 years</td></tr>
<tr><td>Nature of resources needed</td><td colspan="2">IT software development</td></tr>
<tr><td>Challenges identified</td><td colspan="2">The pricing mechanism needs to be defined so as to have an incentivisation effect on the efforts of municipalities to enhance the high-quality and high-purity separate collection of waste, while preserving the economic balance of the waste treatment facility.</td></tr>
<tr><td rowspan="2">Risks assessment</td><td>Potential risk</td><td>Mitigation measure</td></tr>
<tr><td>• Unbalanced price leading to either insufficient efforts by</td><td>• Periodic review of pricing scheme</td></tr>
</table>

Establish a pricing for treatment of separately collected waste, with price decreasing as waste quality increases		
	municipalities or to financial difficulties for the Autonomous Community / the Local Entity /the operator	

4.5 Roadmap for municipalities in the 'expert' category

The policy objective relevant for municipalities in the 'expert' category are the following:

- Reduce overall generation of waste

4.5.1 Features enabling the attainment of the policy objective "Reduce overall generation of waste"

Justification of the policy objective

The policy objectives of reducing overall generation of waste are driven by the need to address environmental, economic, and social challenges. Firstly, it aims to minimize the environmental impact of waste by conserving natural resources, reducing pollution, and mitigating greenhouse gas emissions associated with waste management processes. Secondly, it promotes resource efficiency and sustainability by encouraging the efficient use of materials and minimizing waste throughout the lifecycle of products. This objective also aligns with the principles of a circular economy, fostering the reuse, recycling, and recovery of materials. Additionally, reducing overall waste generation helps reduce the financial burden of waste management on governments and municipalities, allowing resources to be allocated to more sustainable waste management practices. Lastly, it promotes public health and safety by minimizing the potential hazards and risks associated with improper waste disposal. Overall, the policy objective of reducing overall waste generation contributes to a more sustainable future, fostering environmental preservation, resource conservation, and sustainable development.

This objective belongs to the "Expert" category, as the shift of policy is no longer to improve the separate collection of waste and its proper recycling, the amount of waste remaining (as can be the case for the majority of the measures described in the previous levels), in an "end of pipe" approach, but to go beyond this and reduce upstream the quantity of waste being generated, thereby intervening higher in the "Waste Hierarchy" defined in the Waste Framework Directive – Art. 4[70], namely working on stages a) prevention and b) preparing for re-use of that Hierarchy.

Systematic presentation of the features of the waste management system enabling the attainment of the policy objective

Table 4-29 Summary of feature "Pay as you throw (PAYT) for all categories of waste (= harder, economic incentive for the reduction in the generation of waste)"

Pay as you throw (PAYT) for all categories of waste (= harder, economic incentive for the reduction in the generation of waste)	
Policy objective	Reduce overall generation of waste
Justification of the relevance of the feature to reach the objective	The Pay As You Throw (PAYT) policy is a recognised means to provide an economic incentive for citizens to reduce the amount of waste being generated. If the PAYT fees apply to all categories of waste (not only to the "unsorted" category as it is the case in the previous levels), then citizens have an economic

[70] Directive 2008/98/EC on waste, consolidated version available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02008L0098-20180705

Pay as you throw (PAYT) for all categories of waste (= harder, economic incentive for the reduction in the generation of waste)	
	incentive to minimise the generation of all waste, not only that of unsorted waste. For this feature to be effective, it needs to be socially just.
Description of feature	This feature essentially generalises tools already implemented for the PAYT restricted to unsorted waste, and consists essentially in the following steps: 1. Define the fee level for the sorted waste. This fee should remain considerably lower than that of the unsorted waste, in order not to generate a regression in the behaviour of citizens towards less rigorous separate collection of waste. For the sake of simplicity and of readability, and also to avoid citizens deliberately placing their waste in the category subject to the lower fee (and hence jeopardising the purity of waste streams attained previously), the fee should preferably be identical for all categories of sorted waste. A 1:10 ratio between the fee for sorted waste compared to that for unsorted waste seems to be a simple, readable and reasonable value maintaining a sufficient incentive for citizens to continue sorting their waste at source; 2. Procure and commission the tools and the measurement instruments to measure the quantity of waste being generated in each waste stream, generalising to these waste stream those described in the feature "Pay as you throw (PAYT) for residual, unsorted waste = 'rest' bin" described in § 4.4.1; 3. Extend to the PAYT system for sorted waste the social adaptation of waste collection fees already implemented in the feature "Increase the social acceptance of payment per generation of waste" described in § 4.4.2; 4. Reinforce the capacity of the municipal institutions set up to support the prevention of waste generation, described in the feature "Generalisation of waste reduction infrastructures" described in § 4.4.3; 5. Engage with citizens on the features of this upgraded system: inform them about the reasons for implementing it, discuss the details of implementation, communicate the outcomes in a clear plan; 6. Deploy the PAYT system for all categories of waste, starting in some pilot areas to finalise the test and the operational arrangements; 7. Monitor the quantities of waste being generated in each waste stream and adapt the waste treatment capacity accordingly.
Document describing the feature in greater technical detail	• Generalitat de Catalunya (2018) Guide for the implementation pay as you throw systems for municipal waste ('Guia per a la implementació de sistemes de pagament per generació de residus municipals') – in Catalan, Castilian and English.[71]

[71] Available online at:
- Castilian version: http://residus.gencat.cat/web/.content/home/lagencia/publicacions/centre_catala_del_reciclatge__ccr/guia_pxg_es.pdf
- Catalan version: http://residus.gencat.cat/web/.content/home/lagencia/publicacions/centre_catala_del_reciclatge__ccr/guia_pxg.pdf
- English version: https://residus.gencat.cat/web/.content/home/lagencia/publicacions/centre_catala_del_reciclatge__ccr/guia_pxg_en.pdf

Pay as you throw (PAYT) for all categories of waste (= harder, economic incentive for the reduction in the generation of waste)		
	• REthinkWASTE. Project's catalogue of PAYT and KAYT practices[72]	
Implementation period	long term = 6 years and above	
Nature of resources needed	Communication material / Training of personnel / IT software development / Small, diffuse infrastructure	
Challenges identified	Monitoring and enforcement Data management and billing accuracy Equity and social considerations	
Risks assessment	***Potential risk***	***Mitigation measure***
	Illegal dumping in public bins	Coherent and structured enforcement Surveillance of public disposal bins
	Increased recycling contamination because of shift in disposal towards the waste streams with the lower fees	Equal fee for all sorted waste streams

Table 4-30 Summary of feature "Collective, separate collection containers in the streets or in multi-apartment buildings, closed with electronic locks (using RFID tags), for all 5 waste streams, in areas with multiple-household buildings"

Collective, separate collection containers in the streets or in multi-apartment buildings, closed with electronic locks (using RFID tags), for all 5 waste streams, in areas with multiple-household buildings	
Policy objective	Reduce overall generation of waste
Justification of the relevance of the feature to reach the objective	In buildings or in urban areas where the PAYT waste collection fee is computed by using the **volume** as metric, no specific action is needed, as citizens pay for each of their bags, per category of bag (for sorted or unsorted waste). In buildings or in urban areas where the PAYT waste collection fee is computed by using the **mass** as metric (and not the volume), it is necessary to allocate the fee for a given full collective container between the households that have contributed to filling it, as per the generation of each household. The fee for the total mass of waste in the collective container (as measured when that container is emptied in the waste collection lorry) needs be shared between the households as per the waste generated by each of the households. There is hence a need to measure how much waste each household has disposed of in the collective waste container.
Description of feature	Implement electronic locks on the collective waste containers, together with a timer or with limited volume available to dispose waste once opened, and with an identification of the user with RFID card. Such collective containers tend to be semi-buried. Each time a citizen disposes of waste in the collective waste collection container, s/he identifies him/herself with the RFID tag to open the container: this starts a timer or opens a small volume to place waste. The citizen places his/her waste bag in the opening of the collective waste container, closes it and re-starts the process again if needed. The electronic lock records the date-time when the operation took place, the number of times when the collective

[72] Downloadable at: https://rethinkwaste.eu/life-rethinkwaste-projects-catalogue-of-payt-and-kayt-practices-published-by-acr/

<table>
<tr><th colspan="3">Collective, separate collection containers in the streets or in multi-apartment buildings, closed with electronic locks (using RFID tags), for all 5 waste streams, in areas with multiple-household buildings</th></tr>
<tr><td></td><td colspan="2">container was opened, the duration of the opening (if relevant) and the identity of the citizen.
When the waste collection lorry empties the collective waste container, it measures the total mass of waste and the date-time of collection.
The billing system then uses the records of the electronic lock to allocate the mass collected by the lorry at a given date-time (and the corresponding PAYT fee) to the households that have placed waste in the collective waste container between that date-time of emptying and the previous one, as per the data recorded by the electronic lock regarding the date-times and the number of openings, (when relevant) their duration and the RFID tag identifying the household.
The stages in the implementation of this feature are the following:
• Set up the full system in a test area at small scale: containers with electronic locks, RFID tags, data collection on the waste collection lorries, together with the communication to the citizens regarding the operating process of the PAYT system;
• Collect feedback regarding the operations and adjust the system parameters or correct problems accordingly;
• Generalise the system to all areas with buildings containing multiple households.</td></tr>
<tr><td>Document describing the feature in greater technical detail</td><td colspan="2">Generalitat de Catalunya “Guide and reference experiences for the implementation of the separate collection of municipal waste” (“Guía y experiencias de referencia para la implantación de la recogida selectiva de residuos municipales”) of July 2020[73], chapters 3.1.8. to 3.1.11 (closed container with restricted access “contenidor cerrado con accesso restringido”)</td></tr>
<tr><td>Implementation period</td><td colspan="2">medium term = 3 to 5 years,</td></tr>
<tr><td>Nature of resources needed</td><td colspan="2">Communication material / Training of personnel / IT software development / Small, diffuse infrastructure</td></tr>
<tr><td>Challenges identified</td><td colspan="2">Cost of equipment for the semi-buried collective containers and the electronic locks</td></tr>
<tr><td rowspan="2">Risks assessment</td><td>Potential risk</td><td>Mitigation measure</td></tr>
<tr><td></td><td></td></tr>
</table>

[73] https://residus.gencat.cat/web/.content/home/lagencia/publicacions/prevencio/guia_experiencies_implantacio_rsrm_es.pdf

Annex – Interview guides

Public operator

Q1	Is there a **publicly-available document** that summarises the performance of your waste collection and recycling system, based on **quantitative data** (e.g. on separate waste collection, prevention of waste, recycling, composting, preparing for re-use)? Would you be able to send it to us / provide us with the link to that document?
Q2	What features of the **waste collection fees** (e.g. Pay as you throw, Deposit refund) do you believe contributed most to the performance of your waste collection and recycling scheme?
Q3	The performance of a waste collection and recycling scheme often is being **monitored** by following specific **indicators** that enable the assessment of the current situation compared to the targets and to planned trajectories to reach these targets. What features of the **monitoring indicators** do you believe contributed most to the performance of your waste collection and recycling scheme?
Q4	What features of the **operational and social arrangements in place** in the public waste collection and treatment operator do you believe contributed most to the performance of your waste collection and recycling scheme?
Q5	What features of your system for the **control** of the public operator, in case of deviation from agreed-upon performance targets, do you believe contributed most to the performance of your waste collection and recycling scheme?
Q6	What features of your system for the **detection and resolution of conflicts** within the public operator, and between the public operator and the public authority, do you believe contributed most to the performance of your waste collection and recycling scheme?
Q7	What features of the **communication to citizens** do you believe contributed most to the performance of your waste collection and recycling scheme?
Q8	Do you engage in measures aiming at **preventing** the generation of waste (e.g. via support to repair shops or to shops for exchange / rental of clothes, rental of household equipment, library of toys / games....)? If so, what are these measures, and how effective have they been in reducing the total amount of waste generated per person? What has been the impact of these measures on the collection and recycling of waste?
Q9	What **difficulties** have you encountered in your journey towards a high-performance waste collection and recycling scheme (e.g. conflicts due to the changes brought in organisation or in quality or performance requirements)? How have you **overcome** them?
Q10	Any other issues you would like to raise or reasons you would like to highlight (in addition to those discussed above, e.g. regarding the education of the public, the involvement of local NGOs...) in relation to the performance of your waste collection and recycling scheme?
Q11	What recommendations would you give to Spanish municipalities wanting to improve the performance of their waste collection and recycling scheme?
Q12	What recommendations would you give to the Spanish Ministry of Ecological Transition and the Demographic Challenge (MITECO) to improve the performance of waste collection and recycling in Spanish municipalities?

Public-private operator

Q1	Is there a **publicly-available document** that summarises the performance of your waste collection and recycling system, based on **quantitative data** (e.g. on separate waste collection, prevention of waste, recycling, composting, preparing for re-use)? Would you be able to send it to us / provide us with the link to that document?
Q2	**How** were the private operators (or the single operator) that manage(s) waste treatment (including recycling) in this municipality / metropolitan area **selected**? (i.e. what were the selection / award criteria)? **Why**?
Q3	What are, in your views, the **key factors**, in the **contract** between the public authority and the

	private waste recycling companies or company, leading to this high performance?
Q4	What features of the **waste collection fees** (e.g. Pay as you throw, Deposit refund) do you believe contributed most to the performance of your waste collection and recycling scheme?
Q5	The performance of a waste collection and recycling scheme often is being **monitored** by following specific **indicators** that enable the assessment of the current situation compared to the targets and to planned trajectories to reach these targets. What features of the **monitoring indicators** do you believe contributed most to the performance of your waste collection and recycling scheme?
Q6	What features of the **operational and social arrangements in place** in the public waste collection operator do you believe contributed most to the performance of your waste collection and recycling scheme?
Q7	What features of your system for the **control** of the public operator, in case of deviation from agreed-upon performance targets, do you believe contributed most to the performance of your waste collection scheme?
Q8	A contract between a public authority and a private service provider often includes a **rewards and penalty system** that provides economic incentives for the private operator to improve its performance beyond the nominal targets of the contract, and to avoid non-compliance with these targets. What features of the **rewards and penalties system** do you believe contributed most to the performance of your waste recycling scheme?
Q9	What features of the **contract(s)** between the **public operator** (of waste collection) and the **private operator(s)** (of waste treatment), e.g. on the quantities and purity levels of the collected waste flows, do you believe contributed most to the performance of your waste collection and recycling scheme?
Q10	What features of your system for the **detection and resolution of conflicts** within the public operator, between the public operator (of waste collection) and the private operator(s) (of waste treatment) and between the public and private operators and the public authority, do you believe contributed most to the performance of your waste collection and recycling scheme?
Q11	What features of the **communication to citizens** do you believe contributed most to the performance of your waste collection and recycling scheme?
Q12	Do you engage in measures aiming at **preventing** the generation of waste (e.g. via support to repair shops or to shops for exchange / rental of clothes, rental of household equipment, library of toys / games....)? If so, what are these measures, and how effective have they been in reducing the total amount of waste generated per person? What has been the impact of these measures on the collection and recycling of waste?
Q13	What **difficulties** have you encountered in your journey towards a high-performance waste collection and recycling scheme (e.g. conflicts due to the changes brought in organisation or in quality or performance requirements)? How have you **overcome** them?
Q14	Any other issues you would like to raise or reasons you would like to highlight (in addition to those discussed above, e.g. regarding the education of the public, the involvement of local NGOs...) in relation to the performance of your waste collection and recycling scheme?
Q15	What recommendations would you give to Spanish municipalities wanting to improve the performance of their waste collection and recycling scheme?
Q16	What recommendations would you give to the Spanish Ministry of Ecological Transition and the Demographic Challenge (MITECO) to improve the performance of waste collection and recycling in Spanish municipalities?

Private operator

Q1	Is there a **publicly-available document** that summarises the performance of your waste collection and recycling system, based on **quantitative data** (e.g. on separate waste collection, prevention of waste, recycling, composting, preparing for re-use)? Would you be able to send it to us / provide us with the link to that document?
Q2	**How** were the private operators (or the single operator) that manage(s) waste collection and treatment (including recycling)in this municipality / metropolitan area **selected**? (i.e. what were the selection / award criteria)? **Why**?

Q3	What are, in your views, the **key factors,** in the **contract** between the public authority and the private waste collection and treatment companies or company, leading to this high performance?
Q4	What features of the **waste collection fees** (e.g. Pay as you throw, Deposit refund) do you believe contributed most to the performance of your waste collection and recycling scheme?
Q5	What features of the **tendering process** do you believe contributed most to the performance of your waste collection and recycling scheme?
Q6	The performance of a waste collection and recycling scheme often is being **monitored** by following specific **indicators** that enable the assessment of the current situation compared to the targets and to planned trajectories to reach these targets. What features of the **monitoring indicators** do you believe contributed most to the performance of your waste collection and recycling scheme?
Q7	A contract between a public authority and a private service provider often includes a **rewards and penalty system** that provides economic incentives for the private operator to improve its performance beyond the nominal targets of the contract, and to avoid non-compliance with these targets. What features of the **rewards and penalties system** do you believe contributed most to the performance of your waste collection and recycling scheme?
Q8	What features of your system for the **detection and resolution of conflicts** within the private operator(s), and between the private operator(s) and the public authority, do you believe contributed most to the performance of your waste collection and recycling scheme?
Q9	Do you engage in measures aiming at **preventing** the generation of waste (e.g. via support to repair shops or to shops for exchange / rental of clothes, rental of household equipment, library of toys / games....)? If so, what are these measures, and how effective have they been in reducing the total amount of waste generated per person? What has been the impact of these measures on the collection and recycling of waste?
Q10	What features of the **communication to citizens** do you believe contributed most to the performance of your waste collection and recycling scheme?
Q11	What **difficulties** have you encountered in your journey towards a high-performance waste collection and recycling scheme (e.g. conflicts due to the changes brought in organisation or in quality or performance requirements)? How have you overcome them?
Q12	Any other issues you would like to raise or reasons you would like to highlight (in addition to those discussed above, e.g. regarding the education of the public, the involvement of local NGOs...) in relation to the performance of your waste collection and recycling system?
Q13	What recommendations would you give to Spanish municipalities wanting to improve the performance of their waste collection and recycling scheme?
Q14	What recommendations would you give to the Spanish Ministry of Ecological Transition and the Demographic Challenge (MITECO) to improve the performance of waste collection and recycling in Spanish municipalities?

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