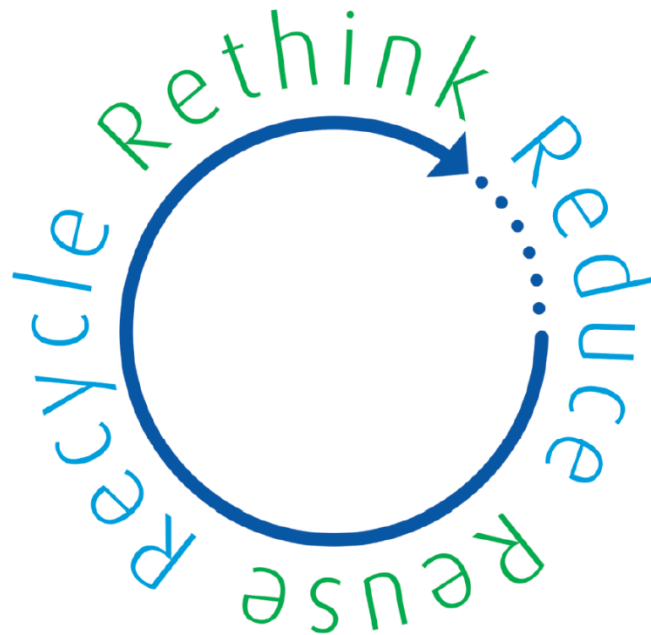




Opportunities for municipalities in glass packaging collection

Final version



March 2021

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Glossary

BB	Brink Bank collection system / Bottle Banks collection system
CAS	Civic amenity site (guarded, fenced-off areas where inhabitants can dispose of and sort out their household waste into receptacles in order to be recycled or otherwise treated)
CSP	Ceramic, Stones, and Porcelain
DE	Germany
DRS	Deposit Return Scheme
DtD	Door to Door collection system
EoW	End of Waste (when waste ceases to be waste and obtain the status of a product)
EPR	Extended Producer Responsibility scheme
ES	Spain
FR	France
GDP	Gross Domestic Product
Hhld	Household
HORECA	Hotel - Restaurant – Catering
IT	Italy
LA	Local authorities (municipalities or groups of municipalities). In some cases, the Municipality delegates the responsibility for the municipal waste management to inter-municipal authorities, association of municipalities, or other form of groups of municipalities. All these categories are described as local authorities.
NGO	Non-governmental organisation
PAYT	Pay-as-you-throw (waste fee model where the users are charged according to their waste production)
PERN	Packaging Export Recovery Note (certificates that provide evidence that waste packaging material has been recycled into a new product after being exported)
PL	Poland
PMC	Plastic - Metal – Drinking Cartons. (Co-mingled waste stream including plastic and metal packaging, and drinking cartons)
PRN	Packaging Recovery Notes (certificates that provide evidence that waste packaging material has been recycled into a new product)
PRO	Producer Responsibility Organisation (organisations managing the EPR schemes)
PT	Portugal
Recycling rate	For data recorded up to 2020, the 'Recycling rate' refers to the purposes of Article 6(1) of Directive 94/62/EC before amendment by Directive (EU) 2018/852.
UK	United Kingdom
WCS	Waste collection system

1 Introduction

1.1 Context

The new Circular Economy Package adopted in 2018 sets out ambitious waste collection and recycling targets for the EU. While the common EU target for recycling of packaging waste is set at 65% by 2025 and 70% by 2030, for some specific packaging materials these targets are higher. For glass packaging, recycling targets of 70% should be achieved by 2025 and 75% by 2030. Moreover – and contrary to previously applied methods – the losses from collection and sorting will need to be deducted and only material effectively recycled can be accounted as such.

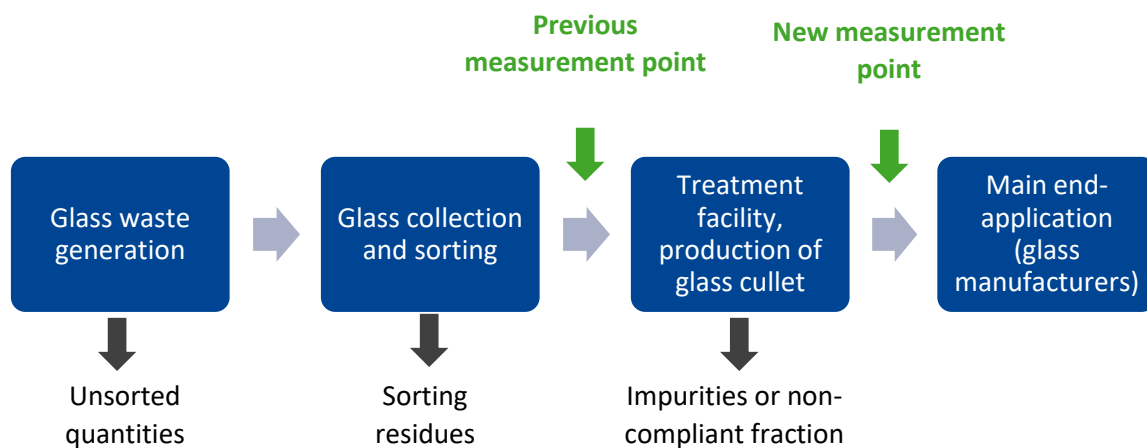


Figure 1: the glass recycling value-chain, losses, as well as previous and new measurement points of the EU recycling target

Today, already over 76% of glass packaging placed on the European market is collected for recycling. However, to ensure the new real recycling target is reached, “collection for recycling” levels need to be at least as high as 85 – 90%.

1.2 The “Close the glass loop” programme

The European glass packaging industry has committed to boost the EU glass collection for recycling rates to 90% by 2030, compared to the actual collection rate of 76%. But the glass packaging industry cannot achieve the targets alone and the efforts of the whole value chain are needed. Taking this into account, the “Close the glass loop” programme has been launched to build a multi-stakeholder partnership and mobilise all relevant actors around the common objective of collecting 90% of all glass packaging placed on the EU market by 2030 focusing on both quantity and quality of the materials collected. The first milestones for shaping of the programme were the presentation of the platform in April 2020 and its official launch in June 2020.

One of the key actors are municipalities at the closest point to the consumer and the moment of disposal. Municipalities have been in charge of managing waste arising on their territories, including the set-up of collection infrastructure and subsequent sorting of collected waste. This situation has changed with the implementation of extended producer responsibility (EPR) policies which require producers (directly or through Producer Responsibility Organisations (PROs)) to bear financial and/ or organisational responsibility for their products ending up as waste. The implementation of EPR schemes significantly changed the organisation of municipal waste management in terms of roles and responsibility, as well as the practical organisation of waste collection. The implementation of EPR policies across the EU – and therefore, the roles and responsibilities of the different actors, including

municipalities – is very diverse in European countries. While it is clear that the situation is not uniform, there appears to be a lack of clear overview of the existing models and a lack of understanding of the implications of each model.

The aim of this study within the context of the “Close the glass loop” programme is to provide an overview of the different existing frameworks for glass collection in seven European countries, to highlight the diversity of approaches when it comes to local waste collection, and to provide first hints regarding the factors for strong involvement of municipalities to reach higher collection targets for glass packaging. The results will serve to inform and engage municipalities in order to reach the objective of 90% collection by 2030.

1.3 Aims and scope

This study provides an overview of the **current framework conditions** and **waste collection organisation for glass packaging** in seven European countries. It also compares the performances and highlights the parameters which are driving high collection and recycling results.

The focus is on municipalities and on separate collection of glass packaging for recycling. The study is to be considered in the context of the “Close the glass loop” programme. Therefore, it has to be seen as the first step of an on-going and long-term project, delivering some first results which would facilitate further exploration and strengthened cooperation in the future along the value chain.

As a first step, the study will therefore have an exploratory focus aiming to establish the factual situation on the basis of which further analysis and shared recommendations can be elaborated later on. The focus is on those European countries which currently present the highest potential for improvement in absolute terms, including the United Kingdom, France, Italy, Spain, Germany, Poland and Portugal. On their own, these seven countries represent more than 80% of the total volumes of non-recycled glass in the EU. According to Eurostat¹, they account for 3.54 million tonnes of non-recycled glass packaging, out of the 4.17 million tonnes of non-recycled glass packaging waste in the EU-28.

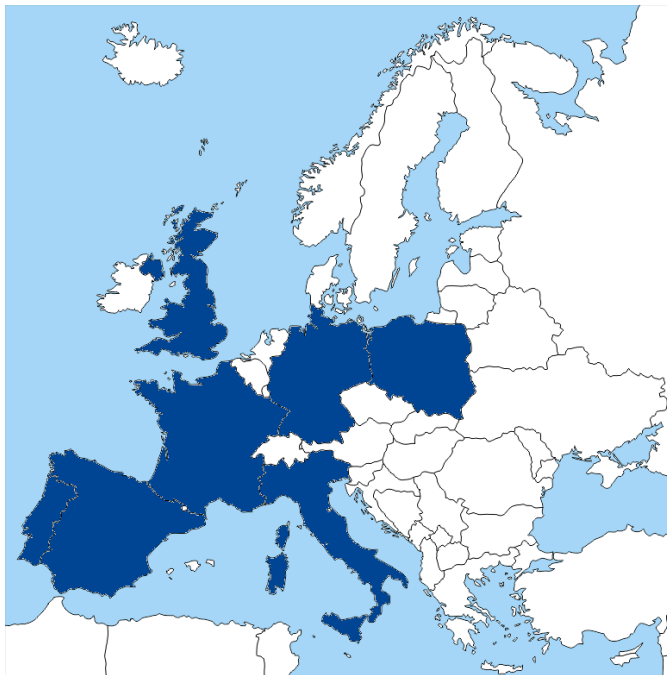


Figure 2: the seven countries covered by the study

¹ Eurostat, Packaging waste by waste management operations and waste flow (2017 data), accessed in September 2020

In the context of the “Close the glass loop” programme and the vision for engagement of the entire value chain, the study will be open to input from relevant stakeholders and after finalisation the results will be publicly available. These will serve as a basis for following steps.

1.4 Approach of the study

The main aim of this study, commissioned by FEVE and FERVER, is to provide a factual overview of the current situation with glass collection in the EU and main models of municipal roles. An important attention has been brought to the quality and relevancy of the collected data.

The study focuses on two aspects:

- A description and comparison of the “**framework conditions**”, e.g., every relevant policies, regulation, and economic instruments set in the seven targeted countries to enable and promote the recycling of glass packaging;
- An overview and comparison of how different **local glass packaging waste collection systems** operate across Europe, to highlight effective instruments as well as to better understand which contextual parameters seem to impact the generation of glass packaging waste and its collection performances.

These two parallel analyses aim to allow a better understanding of the similarities and differences of glass packaging waste management across Europe, and to identify relevant framework conditions and local instruments that could contribute to high performances. By assessing the impact of contextual parameters on local performances, it also aims to define criteria enabling consistent comparisons among local authorities.

1.5 The glass recycling value chain

From the production of glass packaging waste to their integration into new products, there are several steps and different players involved. Depending on the waste collection system and the treatment facilities, glass packaging waste undergoes different routes, a part of it might be recycled into new glass packaging (“closed-loop recycling”), other parts might go to other applications (“open-loop recycling”, where glass cullet can be used to produce e.g., insulation mineral wool, ceramic sanitary ware products, abrasive, among others), while the unsorted fractions and the impurities are sent to specific applications in function of their nature, quality, quantity, and purity: for instance, recycling of metals, recycling of Ceramic, Stones, and Porcelain (CSP) as aggregates, energy recovery of plastic, paper, and cork, disposal of mixed mineral fractions (CSP, heat resistant glass, crystal glass, etc.). The different possible routes of glass packaging are presented below:

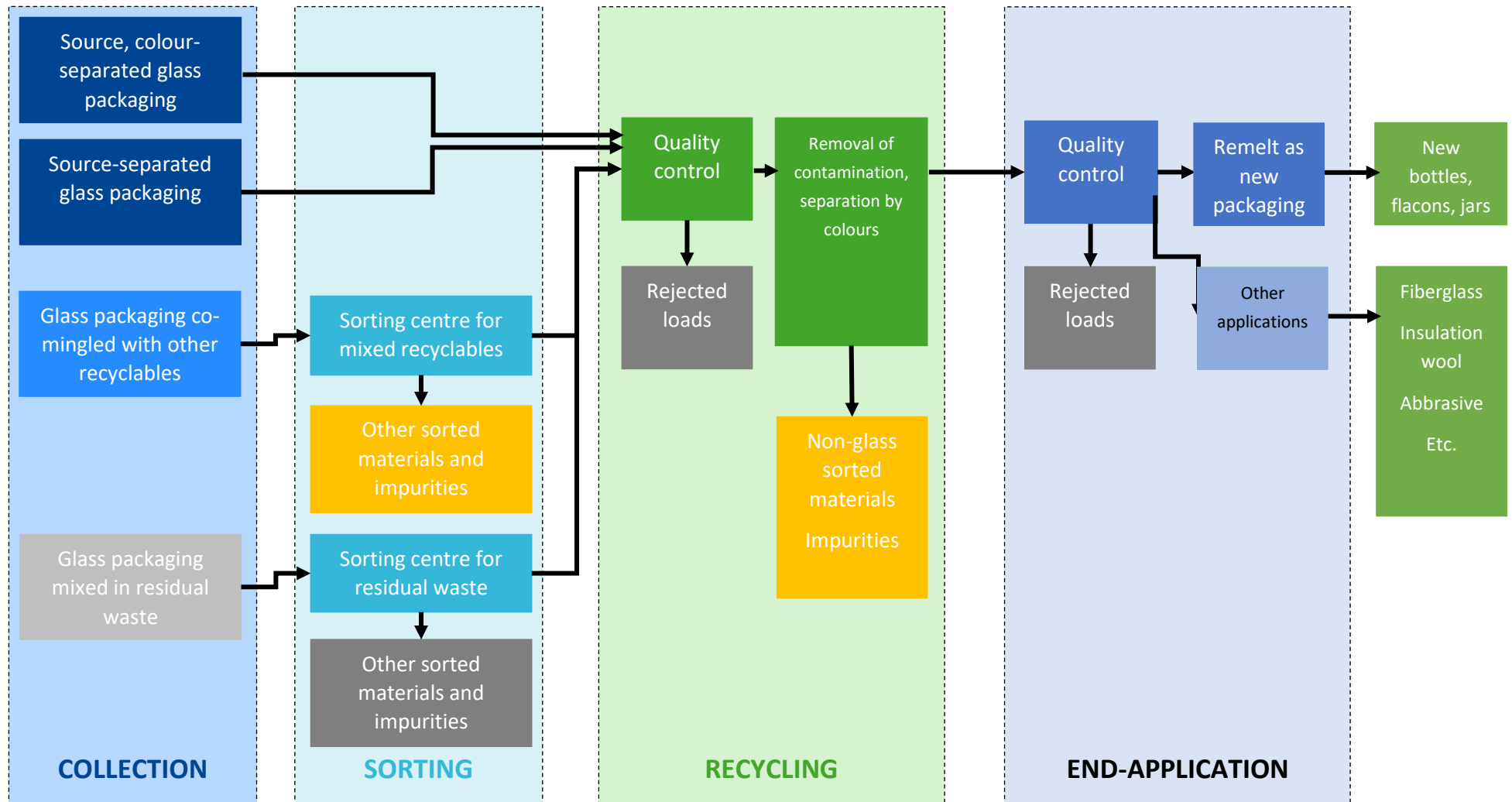


Figure 3: the different routes for glass packaging waste

The main steps are described as follows:

- **Glass packaging waste generation** is when the glass packaging is used and discarded by the inhabitants (or any assimilated waste producer) and sorted in the right container, disposed of in the residual waste bin, or littered;
- **Collection:** depending on the behaviour of the waste generators and the separation system set by the local authority, glass packaging will be either source-separated (possibly according to its colour or all colours mixed together), co-mingled with other recyclable waste (usually other packaging waste such as metal packaging or plastic packaging), or collected with the residual waste. Different options are available for collection: individual waste bins, boxes, or bags collected on the kerbside, bottle banks located on the street or in civic amenity sites, etc.;
- **Sorting:** when collected co-mingled with other recyclable waste, glass packaging waste can either be directly sent to a glass recycling facility, or be sorted in a sorting centres (sometimes referred to as “MRF” for materials recovery facilities), where the different co-mingled fractions are separated from one another and contamination is extracted. In some territories, residual waste undergoes a sorting operation (such as an MBT, mechanical biological treatment, or another sorting process extracting specific waste materials) where glass waste might also be extracted;
- **Treatment/recycling:** this stage consists in turning the glass waste into furnace-ready cullet, by adjusting the particle size, removing the impurities, and sorting the different colours, so that it reaches the quality standards set by the manufacturers;
- **End-application:** there are different manufacturing processes that will use the cullet to make new products, most of which is new packaging in the case of closed-loop recycling. Other applications may include for instance the production of insulation materials or abrasives.

The end-application will be made possible if the different quality standards set by the manufacturers are met. Lower-quality cullet can be directed to other applications, such as granulates in road construction, used as landfill cover, or in asphalt mixtures, but generate little to no revenues.

Over the course of the glass recycling value chain, losses occur at different stages: when glass packaging is incorrectly disposed by waste generators in residual waste, in sorting centres and in glass treatment facilities where some glass packaging can be rejected together with non-glass sorted residues, or loads not meeting the quality requirements can be rejected and sent to disposal.

2 The perspective and roles of local authorities in the glass recycling value chain

Local authorities are in charge of municipal waste management, yet their specific responsibilities and roles can be very different from one territory to another, depending on the national or regional framework and regulation, and on the local strategies and choices.

2.1 The role of local authorities on waste management

Municipal waste management serves different purposes: to provide a service of “removing” waste generated by households and possibly assimilated waste generators, to generate sorted materials to be used as “recycled materials” for manufacturing purposes, as well as to implement communication and education actions to properly orient citizens’ behaviour.



Figure 4: waste collection system in the recycling value chain

2.1.1 Municipal waste collection as a service to citizen

Local authorities have the obligation to provide waste collection to citizens, and in some cases to “assimilated waste generators” such as commercial activities or public entities whose waste quantities and nature are similar to household waste. The exact scope of this obligation differs from one territory to another, according to the national or regional regulation: while the collection and treatment of residual waste commonly fall under the responsibility of local authorities, the organisation of packaging waste management can be under the responsibility of Extended Producer Responsibility Organisations (PRO). Local authorities generally have some flexibility as how to organise the waste collection service in terms of the separation system, type of collection, collection equipment used, or collection frequencies. In some countries or regions, some of these elements might be set by the national/regional authorities or the PRO (e.g., the separation system can be imposed, e.g., source separation of glass packaging can be mandatory), while in other territories, local authorities are entirely free to make their own operational choices.

Regardless of their actual responsibilities when it comes to waste collection, local authorities generally play a significant role regarding the information and awareness raising of citizens concerning the organisation of waste collection and the obligation of waste generators. This also includes all activities implemented to ensure that inhabitants and other waste generators adopt the right behaviours regarding waste separation, respect of collection rules, and do not dispose of their waste illegally: disseminating information in a pro-active way, providing adequate collection equipment and services, setting incentives, controlling the compliance with collection rules, and possibly penalising improper behaviours.

For inhabitants, the intention to sort waste is mostly conditioned by four factors: **information, environmental concern, social norms, and convenience**²:

- **Information** is a prerequisite for the proper sorting behaviours. For citizens, it mostly means the **sorting guidelines**, e.g., clear indications on what must be sorted, and how, and information regarding **the outcome of sorted fractions**.
- **Environmental concern** is an overarching issue for an increasing number of citizens, in link with the general environmental crisis (climate change, biodiversity loss). This makes it relevant to link proper sorting behaviours with a positive impact on more general environmental issues, or to justify any change of the waste collection service to positive environmental outcomes.
- **Social norms**: when the waste collection system is properly implemented and most inhabitants participate, waste sorting actually becomes a part of local life and thus becomes a social norm that citizens are expected to follow.
- **Convenience** is believed to be a strong driver, as waste sorting is regarded as an “extra effort” for many citizens, and only using the mixed residual bin might be regarded as easier (even more so if residual waste collection is easily accessible, with high collection frequencies). Different parameters are especially important regarding convenience, such as the lack of space for pre-collection in vertical housing, or the proximity and accessibility of collection points.

These different parameters might be very context-dependent. Convenience might be considered differently depending on the type of housing, or the mobility of inhabitants. Besides, inhabitants might react differently depending on their background or situation: cultural backgrounds and habits, age, family situation, etc.

Municipalities must also address other concerns and expectations of inhabitants, such as cleanliness, or transparency.

Understanding the perspective of citizens and assimilated waste producer is crucial to ensure their involvement, to identify the information they need and the right messages to convince them. To do so, several practices can be recommended:

- **Conduct surveys** to better understand the level of knowledge of the waste management system, the behaviours of the citizens, and their readiness to comply with collection rules;
- **Focus groups** bringing together representative panels of citizens can contribute to collect more qualitative information on citizens’ perspectives and test the reactions to changes in collection schemes or to specific communication messages;
- **Set feedback-gathering mechanisms**, such as a webpage or a phone number to address complains and collect feedback.

Finally, it is important to note that resident population might not be the sole target of the waste collection system; transient populations (commuters, tourists) can represent a significant share of the waste generators in specific contexts. These “temporary users” require specific collection systems and communication activities.

2.1.2 Production of “secondary raw materials”

Waste collection systems play a significant role for the recycling value chain, by promoting the production of resources e.g., for manufacturing purpose. They are progressively transitioning from a

² COLLECTORS, 2020, *Guidelines for successful implementation*

logic of “waste diversion” (e.g., reducing the quantities of waste sent to disposal) to a “market pull” approach, focusing on their alignment with the needs of recyclers and material end-users³.

Separate collection of glass packaging is mandatory according to the Waste Framework Directive⁴, which is enforced by Member States, mostly through Extended Producer Responsibility systems. EPR systems promote selective collection through various instruments, e.g., take-back schemes for sorted materials that include a price depending on the quantities sorted, along with specific parameters regarding the quality of sorted materials (impurity rates, granulometry, humidity, etc.).

The sorted quantities and associated quality is heavily dependent on the operational choices made by the local authority or by the organisation in charge of waste collection, as well as on how waste generators are involved in waste collection: source separation, the mode of collection, frequent controls of sorted fractions, regular communication activities, or direct contacts with low-performers, all impact the performance of the collection system when it comes to the extraction of recycled materials.

It is worth noting that waste collection systems must find a balance between the “service to citizens” (establishing clear sorting guidelines, setting a convenient collection scheme, securing the participation), the performances of the system in terms of quantities and quality, and the overall cost of the system which will partly be borne by inhabitants.

2.2 The different types of organisation across Europe

The organisation of municipal waste management is very heterogeneous across Europe. In many Member States, the actual organisation of municipal waste management can also be very diverse in terms of competences, operational roles, or organisation of collection. In many cases, many different stakeholders are involved in the design and organisation of municipal waste collection.

2.2.1 Competences for municipal waste collection

As mentioned above, the competences of municipalities regarding municipal waste collection differ from one territory to another. In several Member States (e.g., Germany or Austria), the organisation of packaging waste collection is under the responsibility of Producer Responsibility Organisation, meaning that they directly appoint the waste collectors and finances collection. In other Member States (such as France), the operational responsibility of packaging waste collection falls on municipalities. In some countries (such as Spain), municipalities can decide to entrust PRO with the collection of packaging waste. In other systems, PRO might intervene in setting up the service based on negotiations with the municipalities. Public waste companies can enter tenders run by PRO and then operate the collection as well.

Besides, municipalities can decide to organise waste collection on their own, or to transfer their competence to other organisations, e.g., to municipal companies (owned either independently or jointly with other municipalities), or to a municipal association bringing together several municipalities. Such “grouping” of municipalities allows the mutualisation of resources, and savings on collection and treatment costs, and benefit from the economies of scale. Municipal associations are very common in many Member States such as Spain, Italy, France, Belgium, or the Netherlands.

Intercommunal cooperation can take very diverse administrative forms; in some cases, waste collection is transferred to one municipal association, and waste treatment to another one, leading to several administrative layers between the different public authorities involved in municipal waste management. Such organisations also imply different financing systems, with possible financial

³ COLLECTORS, 2019, *Report on boundary conditions for implementation*

⁴ *Waste Framework Directive 2008/98/EC, amended by Directive 2018/851*

contributions between public authorities in charge of collection and public authorities in charge of treatment.

Other types of organisation also exist: for instance, in Ireland, municipalities plan municipal waste collection, yet they allow private companies to provide the collection service directly to householders.

2.2.2 Scope of action

Municipal waste is defined in the Waste Framework Directive as⁵:

- Mixed waste and separately collected waste from households, including paper and cardboard, glass, metals, plastics, bio-waste, wood, textiles, packaging, waste electrical and electronic equipment, waste batteries and accumulators, and bulky waste, including mattresses and furniture;
- Mixed waste and separately collected waste from other sources, where such waste is similar in nature and composition to waste from households.

At local level, the exact scope of municipal waste can differ from one territory to another:

- **Household waste** is the main component of municipal waste. However, part of household waste might be collected outside of “the municipal waste service”. For instance, deposit-refund system for beverage packaging might run in parallel of “traditional” municipal waste collection schemes.
- **“Assimilated waste”**, defined as waste from non-household sources but similar in nature and composition, is generally included in the scope of municipal waste. This includes commercial waste (e.g., from the HORECA) or waste generated by public institutions. However, the actual scope of “assimilated waste” can be very different from one territory to another, and local authorities might define their own rule for the inclusion of non-household waste (e.g., on the weekly generated quantities), organise specific collection routes, or collect it with household waste. Assimilated, non-household waste generators might also be able to appoint their own collection contractor.

Obtaining clear information on the scope of municipal waste collection is generally challenging, even more so for each waste fraction. While collection rules might clearly explain what can be regarded as “assimilated waste”, data on the actual use of the service by non-household producers and the associated quantities are usually not available.

2.2.3 Operational roles

While the organisation and planning of municipal waste collection is under the responsibility of local authorities and producer responsibility organisation, the actual operation can be conducted by various players:

- Some municipalities own their own collection equipment and directly operate waste collection;
- Some municipalities have set public or semi-public companies, possibly with other municipalities;
- In other cases, collection is contracted to private companies through tenders. Collection contracts with private companies are usually a few year-long (2 to 10 years).

It is also possible to have a combination of systems within the same territory, with different players operating municipal waste collection schemes.

There are very diverse sorts of contracts, including:

⁵ Waste Framework Directive 2008/98/EC, amended by Directive 2018/851

- Public Private Partnership where the assigned organisation has to design, build, finance and operate a public service;
- Concession, where the service provider will be directly paid by the users (e.g., citizens) and benefits from the incomes generated by the service.

These various types of contracts have an impact on the design and decisions regarding the collection systems. In some cases, the local authorities will decide on the main outlines of the service (e.g., collection mode, frequency, etc.), while in other case, the design of the system will be entrusted to the private contractor. This is also true for the ownership of waste, that can be transferred to the contractor.

2.2.4 Waste fees

Waste management entails significant collection and treatment costs, and generate revenues related with the sales of sorted materials or of energy, or from subsidies linked with e.g., EPR systems (financed by the EPR fees paid by companies putting products on the market). The difference between these incomes and the costs are covered by waste fees, paid by the users of the municipal waste collection system (e.g., citizens and assimilated producers).

There is a great diversity of waste fees across Europe. It is possible to define several categories of fees:

- **Absence of “visible” fee:** in some cases, waste management is directly financed by the municipal budget, and no specific waste fee is charged to citizens;
- **Waste tax:** a local tax based on e.g., the value of the property, the water consumption, etc.
- **Waste fee:** a fee based on the characteristic of the household using the service, e.g., the size of the household;
- **Pay-as-you-throw:** a fee (partly) based on the use of the waste service. It usually includes a fixed fee (e.g., based on the size of the household, or the surface of the housing), and a variable fee, usually based on residual waste production. Several PAYT systems exist:
 - **Volume-based systems:** the variable fee is calculated according to the size of the residual waste bin, or the number of waste bags used;
 - **Frequency-based systems:** households are assigned with a specific bin, and are charged according to the number of times that they have their bin collected;
 - **Weight-based:** the waste bin is weighted when collected and the household is charged according to this weight.

Specific fee systems might also be defined for non-household waste using the municipal waste service (e.g., with specific tariffs for the different economic activities).

There might be a legal obligation for the waste fees to cover the waste management costs (as it is the case in Italy), or not. This means that any evolution of the costs of collection and treatment might directly impact the waste fee.

2.2.5 Ownership of sorted waste

Local authorities are given more or less flexibility when it comes to the ownership of sorted waste materials. For some systems (for instance in Germany), the EPR organisations own the materials, decide on their destination, and perceive the associated incomes. In other systems, such as the French one, local authorities own the sorted materials and can either decide to transfer the ownership to other players (e.g., PROs or recycling players), or to set an “individual” contract with a company to take-back its sorted materials. These aspects are detailed in part 3 of this report.

2.3 The perspective of local authorities

2.3.1 Parameters and factors shaping municipal waste management

Even though several parameters can be listed to explain the design of municipal waste management at local level, it is challenging to clearly determine the impact of these different parameters. Municipal waste management systems are the results of the waste management system existing before the introduction of recycling strategies, local political decision, framework conditions (such as regulation, EPR system, national guidelines on municipal waste management, etc.), constraints related to the local context, as well as local expectations or oppositions from the population.

Framework conditions are extremely important; the national regulation and associated obligations and targets are key drivers to implement or improve waste collection. Economic incentives also play a role, such as landfill or incineration taxes and gate fees, which can make separate collection and sorting more financially relevant for local authorities, or low sorting performances not economically sustainable for a waste collection system. Countries that introduced mandatory separate collection also tend to have higher recycling performances⁶. When it comes to packaging waste, the EPR schemes are generally the main parameter when it comes to the design of waste collection, even more so when EPR organisations are in charge of the organisation of waste collection. When local authorities are in charge of waste collection, EPR schemes heavily shape the design of waste collection through its financing system or guidelines.

Context play a significant role on how municipal waste collection is organised. Some contextual parameters will impact waste generation; the presence of non-residents (tourists, secondary residence), population density, or a strong presence of the HORECA sector all seem to lead to higher generation of glass packaging waste⁷. Context can also impact the design of waste collection: high population density might make it more challenging to identify available space for bottle banks, vertical housing might limit the available space for source-separation (either in apartments or in common areas of buildings). These factors can partly explain the use of specific collection modes or the decision to co-mingle recyclable waste.

Other parameters: there are other factors that can impact the design of the collection system, such as the available resources (e.g., lack of resources can limit the use of more expensive technical solutions), local oppositions from the population, or specific political agenda. How the contract for waste collection is designed can also have an impact, for instance if it includes criteria or performance indicators on the quality and quantity of sorted materials. Examples of such parameters are given in part 2.3.4.

2.3.2 Local decision-making processes

The COLLECTORS project addressed the question of multi-criteria decision making (MCDM) and researches were conducted to see how decision-making could be improved through the implementation of MCDM methods. The work was established on the basis of a literature review, as well as the organisation of four working groups bringing together representatives of local authorities in charge of municipal waste management. These working groups tackled the issues of decision-making, important criteria taken into consideration, as well as exercises aiming to map decision-making processes at the level of local authorities⁸. One of the workshops focused on mapping decision-making processes, based on the experience of experts from nine different European cities and regions from across Europe, and focusing on various streams (including paper and packaging

⁶ Bipro (2015), *Assessment of separate collection schemes in the 28 capitals of the EU*

⁷ COLLECTORS, 2020, *Guidelines for successful implementation*

⁸ COLLECTORS (2020), *Report on multiple criteria assessments of the studied waste collection systems and applicability of different methods for decision-support*

waste, WEEE, biowaste, etc.). The examples used by the participants included the re-organisation of waste collection, the discussions regarding the distribution of costs among the different players, or the implementation of new collection sites.

European recycling targets were mentioned as an important driver for improving the performances. Other drivers for changes were mentioned, such as initiatives from other actors, or a raising demand from citizens to improve waste sorting, that could initiate or speed up the processes. The issue of cost is also an important parameter for the process, as well as the question of the distribution of costs among the interested parties.

From the mapping of decision-making described by the different participants from local authorities and waste agencies, the following steps could be highlighted:

- The driver, coming from e.g., a framework condition (e.g., reaching the EU target, or a legal obligation to improve the performances coming from the national authority)
- The definition of the problem, collection of idea, and definition of concept, which is done by the local authority or the public waste company
- A consultation phase (with citizens, NGOs, local players), and a negotiation phase (with the waste operators, the PRO, etc.), leading to a better definition of the action and a prioritisation of the activities;
- A budget discussion and decision, taken by the elected representatives (e.g., the city council)
- The practical implementation by the various actors
- The monitoring and evaluation, which might lead to starting again the process.

Overall, the following conclusions were drawn from these researches:

- Decision-making should be considered as a chain of connected event, and not as a single occasion; decision-making consists in various steps, including the definition of the problem, the generation of idea, the collection of input from the various stakeholders, and eventually reaching a consensus between the interested parties.
- Decision-making is often affected by the lack of data and information, either on the local situation, or on the room for improvement. This reflects also a lack of comparable data among the different waste collection system (WCS), which takes resources to fill.
- The problem definition and data collection stages require the most time and effort, but are essential pre-requisite to a proper decision-making process.

2.3.3 Criteria to support decision-making

The COLLECTORS project also conducted a research on the criteria that can be used for the monitoring of performances of waste collection, for comparisons between collection system, and for the assessment of alternative collection strategies⁹. These criteria were identified through the analysis of data, a literature review, and direct feedback from representatives of local and regional authorities during dedicated working groups. The key criteria identified by the project were sorted in several clusters:

- **Collection for recycling and recycling rates:** while recycling rate was regarded by waste experts as the most suitable performance indicator, **collection for recycling rate** was listed as one of the most used performance indicators by local waste authorities, due to the general lack of data on quality and outcome of sorted fractions which prevents them for assessing their actual recycling rates.
- **Convenience and coverage:** any indicator assessing the proximity of bring points is regarded as valuable, such as the number of points per inhabitant or points' accessibility.

⁹ COLLECTORS (2020), Report on generalized criteria to support decision-making

- **Engagement and participation:** information on citizens' satisfaction obtained through feedback-gathering mechanisms was deemed interesting but difficult to compare between collection schemes.
- **Socio-economic impact:** the evolution of waste fee for citizens was regarded as an important indicator for decision-making. Collection costs for residual waste and the different packaging fractions are also valuable for considering alternative scenarios, even if difficult to assess.

The waste experts also noted the difficulties with data comparisons due to inconsistent calculation methods and scopes.

2.3.4 Drivers behind changes

As mentioned, it is challenging to clearly identify the drivers behind the choices or the changes brought to a waste collection system. While the driver triggering decision-making identified by the COLLECTORS project were mostly described as new legal obligations (e.g., new recycling targets), documented good practices and reports list various elements that influence decision-making, or that kick-started the implementation of more well-performing waste collection systems. Several references were identified, such as the Interreg IVC project "Regions for Recycling"¹⁰, the COLLECTORS project¹¹, or the different case studies documented by Zerowaste Europe¹². Publications focusing on the success factors and drivers behind successful selective collection schemes were also identified^{13 14 15}

2.3.4.1 Availability and cost of landfilling and incineration

One of the factors regarded as a key driver for separate collection is the availability or the cost for landfilling and incineration. Some publication even considers the cost of disposal as the main driving force to implement separation systems, considering that source separation schemes tend to increase the waste fees¹⁶. In many leading regions such as Flanders in Belgium or the Province of Styria in Austria, the first efforts to improve selective collection were driven by a tax or a fee on landfilling, along with subsidies to invest in waste separation equipment.

In many of the case studies documented by Zerowaste Europe, the improvement of waste separation comes from a local challenge linked with the disposal of residual waste: either the saturation of a landfill site or the incineration, the plan to build an incineration plant close to the city... that leads local waste experts to define alternative solutions, or a local opposition that pushes local decision makers to investigate changes of waste management system. These case studies also show that the local mobilisation of inhabitants and stakeholder, or the importance of the topic of waste management in a local election might lead to the identification of potential improvement to boost waste separation (such as the modification of the collection system, the implementation of a pay-as-you-throw, etc.)

2.3.4.2 Economic drivers

The question of cost balance was often mentioned during the COLLECTORS meetings as one important part of decision-making. The issue of the distribution of costs between the different players is one of the key issues; for local decision-makers, the amount paid by inhabitants (usually referred to as the

¹⁰ Regions for Recycling (2014), R4R good practices for selective collection and recycling, available here: <https://www.acrplus.org/en/activities/previous-projects/2-content/1486-r4r-good-practices-for-selective-collection-and-recycling>

¹¹ www.collectors2020.eu

¹² Zerowaste Europe, library: https://zerowasteurope.eu/library/?fwp_paged=8

¹³ Maletz R. (2017) *Success Factors for the Implementation of Separate Collection Systems*

¹⁴ Urbanwins (2017), *Assessment of determinants and effects of waste prevention and management strategies policies and strategies*

¹⁵ Miliute-Plepiene, Jurate & Plepys, Andrius. (2009). *Driving Forces for High Household Waste Recycling. Lessons from Sweden*. Environmental Research, Engineering and Management.

“waste fee”) is an important parameter. Modifications of the waste collection system will meet local opposition if they entail a significant increase of local taxes or fees.

The COLLECTORS project analysed the impact on the cost-benefit balance of different actions leading to the improvement of paper and packaging waste sorting in five different cities: Parma (Italy), Berlin (Germany), Gent (Belgium), Tubbergen (The Netherlands), and Rennes (France)¹⁶. The analyses focused on the evolution of the different technical costs (e.g., collection and treatment costs for residual waste, collection and processing costs for the different paper and packaging streams), as well as the evolution of incomes (linked with EPR subsidies, incomes from material sales, etc), to see whether the cost-benefit balance could be maintained and the impact on the waste fee paid by citizens.

The cross-analysis of the five case studies shows that all territories could improve their sorting performances without increasing the waste fee paid by citizens. However, this was made possible by two main contextual factors:

- The existence of a landfill ban, and/or landfill and incineration costs (taxes and gate fees) that led to savings on the residual treatment costs;
- Sufficient EPR subsidies and incomes from material sales, whose increases could compensate the increasing costs for paper and packaging waste collection, and the decrease of revenues from energy recovery.

Illustration: tax on waste disposal in Catalonia

There is no national landfill tax in Spain, but the regulation allows the waste authorities in autonomous regions to implement their own economic incentives to promote waste prevention and recycling. As an illustration, the Region of Catalonia implemented a tax on landfilling and incineration respectively in 2004 and 2008. These implementations were made in parallel with investment promoting separate collection and waste recovery.

The interesting feature of the Catalonian tax is that it introduced a mechanism to return part of the tax depending on the waste performances. About half of the revenues generated by the tax was used for investment for biowaste recycling facilities, while the other part is given back to the local authorities depending on their performances of bio-waste collection. The tax is set according to the quantities sent to landfills or incineration, with lower rates when a biowaste collection is implemented by the municipality. For instance, in 2016, the landfill tax amounted to €34.10 per tonne, and to €24.50 per tonne if the municipality had implemented a biowaste collection. The amount of the tax has progressively increased (10 €/t in 2008 vs. 30 €/t in 2018 for landfilling).

A “refund system” was also implemented for municipalities, with different criteria, e.g., on the existence of a separated collection with coefficients according to quality, the presence of a civic amenity site in the municipality, the existence of source-separation systems for specific fractions (such paper or hazardous waste), etc. These different refunding criteria have evolved over time to reflect the evolution of waste collection and the decrease of revenues generated by the tax. Local authorities can apply every year for refunding.

The tax on disposal has two main advantages:

- It makes waste incineration and landfilling less financially convenient to local authorities;
- It generates revenues that help local authorities to invest in more efficient waste collection.

This measure had very positive impact on regional recycling performances: selective collection rates rose from 22.6% in 2003 to 39% in 2012, and almost all of the 947 Catalonian local authorities

¹⁶ COLLECTORS (2020), *Assessment of socio economic and financial performance Of 12 selected case studies*

implemented biowaste collection. At first, the disposal tax led to the increase of sorted biowaste with quite high level of contamination. A quality criterion was then introduced to address this issue.

(Sources: ACR+, Circular Europe Network & Urbanwins project, Waste Disposal Tax with Refund Criteria)

2.3.4.3 EPR systems

The 1992 packaging law, followed by the progressive implementation of EPR systems in the different Member States kickstarted selective collection in many European Countries and has led to the increase of selectively collected quantities, with various levels of performances as presented in part 3.

Regardless of the role of the PRO (operational or financial), the EPR system has a great influence on the design of the packaging waste management system.

As indicated previously, the subsidies provided by PRO to local authorities for the organisation of selective collection can considerably contribute to the economic sustainability of waste collection systems. Besides, the technical specifications set within the framework of the take-back systems for sorted materials will impose technical choices in terms of source-separation or collection modes, quality controls, and determine the sorting guidelines set for waste generators.

Besides the operational or financial role of the EPR systems, PRO can propose guidance or launch calls to promote the implementation of new or improved collection systems and instruments. These activities can contribute to guide the choices made by local authorities when it comes to the practical organisation of packaging waste collection.

2.3.4.4 Perception and satisfaction of citizen

As highlighted during the COLLECTORS working groups and in the case studies documented by Zerowaste Europe mentioned above, the contribution and feedback of citizens can be a strong driver for local decision-makers. Local mobilisation can contribute to the identification of potential improvement to sort more waste and reduce disposal; how citizens perceive the waste collection service and react to modifications is also an important parameter for local decision-makers, that might be reluctant in implementing changes that could be perceived as detrimental to the waste service (e.g., reducing collection frequencies), or that could be regarded as unpopular (e.g., PAYT systems). Citizens might also be more sensitive to cleanliness and nuisances (e.g., noise during collection of glass), which also impacts the local decisions.

2.3.5 Testimonies of local authorities

To better understand the drivers behind the design of local collection systems and behind changes of collection, and the involvement of the different players in managing and improving glass packaging waste collection, three interviews were conducted with various organisations to describe different case studies, highlighting different contexts and situations at local level. The outcomes of these interviews are presented below. It is important to note that the following illustrations are based on interviews, and so the presented elements reflect the perspective of the people that were interviewed.

2.3.5.1 The case of Berlin: shifting from door-to-door to bottle banks

Short description of the case study

In Berlin, glass packaging waste has mostly been collected through a door-to-door mode with wheelie bins. Due to quality reasons, the dual systems and the city of Berlin agreed to change the collection mode in most areas of Berlin from door-to-door to bottle banks. With the change of the collection system, the number of bottle banks needs to be increased and inhabitants need to be on board and be properly informed. The change from door-to-door to bottle banks is considered as difficult, since citizens might perceive bottle banks as less convenient.

General facts (2016)

Population: 3,537,100
Area: 892 km²
Density: 3,965 inh/km²

Context

Municipal waste collection is under the responsibility of the local authority. In Berlin, waste collection is organised and carried out by the Berliner Recycling GmbH, a public service company owned by the state of Berlin, which is also in charge of waste treatment. Packaging waste is managed according to the Dual Systems (German Producer responsibility organisations), which appoints waste collectors for this fraction. In Berlin, packaging waste collection is also operated by Berlin Recycling. Due to its size, the city is divided in four parts for the organisation of glass collection.

Organisation of glass collection

Collection modes: collection of glass packaging waste is performed door-to-door or with bottle banks depending on the location. In three of the four contractual areas, door-to-door collection represents about 70% of the collected quantities. In the other one, more than half of the collected quantities are collected by the bottle bank system.

- **Bottle banks:** about 1,600 bottle banks, with three different containers for the different colours (green, amber, flint);
- **Door-to-door:** glass is collected in 2 different wheelie bins: white ones for flint glass, brown ones for green and amber glass. The collection frequency is 2-weekly
- Glass packaging can also be collected in **civic amenity sites**.

Separation system: source separation of glass:

- Glass is separated in three different fractions with bottle banks (green, amber, and flint)
- It is separated in two different fractions when collected door-to-door (flint / green+amber)

Fee system: there is a **pay-as-you-throw system**, where the waste fee is composed of “fixed” part, and a part determined according to the volume of the residual waste bin, as well as an additional charge depending on the distance that the waste collection worker has to take to get to the waste bin. There are five different sizes available for residual waste bins, which can be ordered depending on the amount of household waste arising in a specific household (varying from 60 and 1,100 litres). Glass collection is not charged to citizens.

Performances (2016)

Collected quantities: 17 kg/inh (Average in Germany: 22.5 kg/inh)

Collection modes: in 2016, about 60% of glass packaging was collected door-to-door.

Collection for recycling rate: 57%

Quality: loss rates of 15.5% in Berlin, compared to an average of 9.5% in Germany

Case study: shifting from door-to-door collection to bottle banks to improve quality

Berlin encompasses two main type of organisations for collection of glass: a bottle bank system, and a door-to-door system. The door-to-door system was set up in the early 90s in the eastern side of Berlin, and before the existence of the EPR system; it was implemented in high-rise building and was applied for different types of waste: residual waste, glass packaging, paper, and light packaging waste. Waste are collected in 1,100-l wheelie bins for all waste fractions, whose lid can be opened (meaning that the glass bin has no locked lid with a specific, round opening). This system has led to confusion and sorting mistakes by inhabitants. This, and the fact that glass packaging is collected with compaction trucks led to a very low quality: impurity rates of glass packaging waste in Berlin reached 15.5%, compared to 9.5% in average in Germany. Besides, it impacted the collection for recycling rates, since inhabitants tend to throw their glass packaging in the residual waste bins when the glass bins are full. Furthermore, the door-to-door system does not make waste separation possible for commuters and tourists that are present in the centre part of the city.

In 2013, the Green Dot organisation decided to call for an extension of the bottle bank system in areas where door-to-door collection was implemented. The main reason was the very low quality of collected glass; even if glass recyclers are obliged to take back sorted waste, it became increasingly difficult to find recyclers willing to take back the collected glass.

The Green Dot system had to convince local decision-makers for this change, who were reluctant to do so: door-to-door collection is perceived as more convenient for inhabitants, and they were afraid that the shift to bottle banks would be perceived as a loss of service. Local decision-makers were also not aware of the drawbacks of the current door-to-door system. Besides, the dense character of the city makes it challenging to allocate space for new bottle banks. After several meetings they could be convinced of the relevancy of the change, especially considering the fact that it was increasingly difficult to find recyclers for the glass sorted in Berlin. The support of glass recyclers and glass packaging producers during the discussions allowed to highlight the different perspectives and contributed to convince the local decision-makers. In parallel, interviews and surveys with citizens allowed to explain the reasons behind the changes and identify possible reluctancies. It turned out that inhabitants positively received the change.

The objective is to increase the number of bottle banks from 1,600 to 1,900. This number has not been reached yet. In Germany, the municipalities are in charge of identifying locations for bottle banks. The density of bottle banks has to be more important in dense cities, and the identification of proper location (e.g., where people pass by, or where they can stop and park their car) is difficult. The development of bottle banks is an on-going process; after the implementation of a new bank, it takes about one year to set the proper collection frequency and to assess its interest. Besides, construction works or local complaints can lead to the removal or displacement of bottle banks. Littering can occur around bottle banks, but it seems that it is more frequent when different waste fractions are collected in the same location (e.g., different packaging fractions). The municipality is also interested in underground containers that takes less space and are less visible, but the investment costs are significantly higher. It must be noted that the owner of containers differs from one city to another: it can be either the city or the waste collector.

Overall, the change has had a positive impact on collection: it led to a sharp increase of the quality, and a small increase of sorted quantities.

In Germany, the Green-Dot system is working toward the new recycling target, by addressing the following elements:

- Limit the improper collection practices, such as collection in plastic bags, or co-mingling with other materials;
- A better understanding of sorting mistakes and sorting behaviours: specific studies of unsorted waste packaging and interviews with different categories of inhabitants would allow to better identify the types of glass packaging waste that is insufficiently collected and adapt communication activities. For instance, it seems that non-beverage packaging such as cosmetics bottles and flacons are less likely to be sorted for various reasons: lack of sorting occurring in the bathrooms, misconception of sorting guidelines, etc. Some studies carried out by the Green-Dot system have showed around 5 kg/cap as quantity of unsorted glass in the mixed municipal waste.
- The collection of the HORECA sector is challenging, and quality is rather low. In Germany, HORECA glass waste is included in municipal waste figures, but they generally have a dedicated (and usually paying) service with door-to-door collection, which can lead to the presence of discarded dishes and plates in the glass packaging waste bin.

Municipalities have to be presented with solutions on how to improve and optimise their systems through a collaborative approach and awareness raising, as injunctions from EPR systems do not seem to work. It is also important to keep in mind that municipalities also have to ensure a proper waste collection service (e.g., that waste must be effectively collected in a convenient way for citizens), as well as cleanliness. Besides, costs are still an important driver for municipalities.

This case study was made thanks to the input of Mr. Ulrich Ix, Der Grüner Punkt Deutschland

2.3.5.2 The case of Milan: a well-performing door-to-door system in a dense context

Short description of the case study

AMSA spa manages the separate collection in the City of Milan (1,4 million of inhabitants). It is an example of mono-material, door-to-door collection service considered well managed, in a big city. Besides, the mother company A2A ambiente owns and operates a glass recycling plant, which is located next to a glass packaging manufacturing plant. In the early 2000 they've changed the glass collection, from a commingled one (glass and metals) with bottle banks, to the actual system.

General facts (2016)

Population: 1,366,180
Area: 182 km²
Density: 7,519 inh/km²

Context

Municipal waste collection is under the responsibility of the city, and is organised and operated by AMSA, a waste company partly owned by the municipality, and that manages waste in 12 different municipalities. AMSA also owns and runs a glass recycling plant. Glass packaging waste is source-separated and mostly collected door-to-door.

Organisation of glass collection

Collection modes: collection of glass packaging waste is mostly achieved through door-to-door collection:

- **Door-to-door:** glass is mostly collected in green wheelie bins, once per week.
- **Bottle banks:** bottle banks have been progressively removed in Milan.
- Glass can also be collected in **civic amenity sites**.

Separation system: source separation of glass, all colours mixed together.

Fee system: there is no pay-as-you-throw system. The waste fee is determined according to the size of the housing and the number of people in the household. With regards to business users (e.g., HORECA sector), the waste fee is determined according to surface and business typology. Commercial activities that needs additional collections can contract them with AMSA, against an extra fee. However, separate collection is mandatory, and compliance is controlled by AMSA.

Performances (2019)

Collected quantities: 50 kg/cap (including commercial activities)

Collection for recycling rate: 95%

Quality: the glass treatment facility reports that about 85% of the input materials is recovered, while the rest is landfilled.

Case study: a well-performing door-to-door system in a dense context

AMSA collects almost all glass packaging waste using a door-to-door system, both for household waste and commercial activities, using specific, insulated collection lorries. Bottle banks were used in the past as the main collection system, and then in specific areas (e.g., in parks, and other public areas), but were progressively removed due to poor quality (i.e. high levels of contamination). It seems that beverages in glass packaging are not usually consumed on the street, which means that extra bottle banks are not required to collect waste from e.g., tourists or commuters. The choice of a door-to-door system for glass packaging is explained by several factors:

- Glass packaging represents about 10% of the total municipal waste, which makes it economically and logistically relevant to be collected in a single-stream and door-to-door;
- There is little available space to put bottle banks (narrow streets, competition with other uses such as parking spaces, etc.);
- Door-to-door schemes are widely used in Milan for four other waste streams (paper and cardboard, biowaste, plastic/metal, residual waste), and are considered as very convenient for the inhabitants;
- Door-to-door is regarded by AMSA as better for contamination than bring banks, for all waste fractions. Previous experiences with bring banks were not satisfying when it comes to contamination;
- The typology of the housing in Milan makes door-to-door collection convenient and feasible: apartment blocks usually have sufficient space to store wheelie bins (courtyard, or dedicated pre-collection areas).

Regarding this last point, it is interesting to note that the municipal urban law makes it mandatory to allocate sufficient space for waste storing in new buildings, and building permits cannot be delivered if this demand is not met. For very large building, a dedicated space outside of the building to store the bins before collection is also required.

The collection of glass packaging has always presented good performances, and keeps improving over time, going from 65,000 t in 2015 to over 70,000 t in 2019. This increase is attributed to better sorting performances by inhabitants and commercial activities, but also to an increasing consumption of products packaged in glass (rather than e.g., plastic). It is believed that glass packaging is well sorted by inhabitants because the collection system is consistent across the city and the sorting guidelines are very simple, as only glass bottles and jars are supposed to be put in the glass container. This makes the message for glass separation clear and effective.

Quality is not seen as a major issue for glass packaging compared to other fractions, even though there is occasional contamination with ceramics and plastic bags. These two elements are explicitly forbidden in the sorting guidelines. Contamination is also believed to be low because waste bins are only available for the inhabitants of each building, and that inhabitants try to comply with the collection rules because of the social control and “sense of community”.

One of the reasons identified by AMSA for their high performances (their current recycling rate for municipal waste is above 60%) is the implementation of biowaste collection in 2012, that was preceded by the introduction of a transparent waste bag for residual waste collection, and controls of the content of both residual waste and sorted fractions, with fines for non-compliance. Transparent bags make visual inspection easy for the waste inspectors, who perform regular control. The fact that biowaste separation is mandatory made the residual waste lighter, making it easier for collection crew to identify the presence of denser items such as glass. The fines seem to have a significant impact on sorting behaviours as well. Having clear rules on mandatory separate collection, effectively communicating on these rules, and consistently enforcing them, are believed to be very important to make people comply with them.

Despite the fact that a door-to-door collection might be more expensive than a bottle banks scheme, there is no discussion on a potential shift to bottle banks. When it comes to cost, the fact that glass collection is well implemented means that it was possible to reduce collection costs with the optimisation of collection routes. Besides, it is considered that the advantages of door-to-door collection are worth the extra cost. The previous experiences of AMSA with bring bank schemes was not satisfying in terms of cleanliness (e.g., waste tended to be disposed around the containers, presence of graffiti on the containers, etc.), and their maintenance had an additional cost.

The HORECA sector, and especially restaurants, are regarded as the most challenging waste producers when it comes to waste separation. Several restaurants have very poor performances, or do not respect the collection rules (hours for presenting the waste on the kerbside, use of proper containers, etc.). Besides, they generally complain more about the collection services; this might be due to the fact that they benefit from a specific service that comes with an extra cost. One of the difficulties to engage restaurants is also that it is challenging to monitor the new establishments that open and the ones that close, which makes it more difficult to secure their involvement. This is also more challenging when the owners do not speak Italian.

In 2019, a specific communication action was implemented to target restaurants and bars owned by foreign-speaking people, with a specific focus on the Arab and Chinese communities. It consisted in direct exchanges through special mediators to better understand their perspectives on waste separation. These discussions allowed to identify more specific issues linked with logistical constraints, or lack of knowledge on the sorting rules. As wastes management is positively perceived in Milan as a key environmental topic, it proved to be a good way to engage with specific communities and better understand their perspective.

The good performances for waste collection in Milan are mostly attributed to the new municipal administration that took office in 2011, and for which environmental topics and waste management was high on the political agenda.

This case study was made thanks to the input of Simone Orsi, from the Operational Services Development and Customer Satisfaction at AMSA

2.3.5.3 The case of Cascais: glass collection in a very touristic area

Short description of the case study

Cascais is a very good example of a glass waste collection system in a touristic area. Cascais is a popular touristic destination, with about 1.2 million tourist stays per year. Tourism can have a significant impact on waste collection, with potential variations of waste generation over the year, and a temporary, non-resident population that can be more difficult to reach. Besides, preserving the local environment (e.g., by preventing illegal dumping and littering) is crucial to the local tourism sector.

General facts (2016)

Population: 211,700

Area: 97 km²

Density: 2,174 inh/km²

Context

Cascais is a municipality in the Lisbon District of Portugal, located next to the sea. It is a very touristic location, encompassing a marina and several beaches. Municipal waste management is organised and carried out by Cascais Ambiente, a municipal company also in charge of street cleaning, marine protection, and of the management of green public space.

Organisation of glass collection

Collection mode: bottle banks – both surface (2,500 l) and underground containers (3,500 l). Big producers with a daily production over 1,100 l can have access to a door-to-door scheme, for which wheelie bins are used (also for glass packaging).

Separation system: source separation of glass, all colours mixed together.

Fee system: the current waste fee is not a PAYT system: the price is based on the water bill. However, a pilot test for a new PAYT system was implemented on an area of 2,500 inhabitants, launched within the framework of a Horizon 2020 project, which is still on-going.

Performances (2017)

Collected quantities: 15.2 kg/inh

Collection for recycling rate: 80%

Quality: 14.5% of the contamination, mostly plastics

Case study: glass collection in a very touristic area

Cascais welcomes high number of tourists, as well as new residents from abroad that started to settle in the South of Portugal a few years ago. However, it has not impacted much the seasonal variations of the collected quantities of waste. Two peaks of generation can be observed, one in December, and one in May, when tourists start arriving while the resident population is still here. In July and August, it seems that there is a “transfer” between tourists and the resident population that is going on vacation.

The significant presence of tourists and secondary residence made it important to adapt communication; the key element was to simplify the sorting guidelines and associated communication: indications on containers and bottle banks are in Portuguese and English, and pictograms are generally preferred to text. Considering that the sorting guidelines and colours of bins are different from one country to another, it is important to rely on the pictograms and opening on the containers to make the instructions clear to non-resident population. Otherwise, no specific communication activities are directed to tourists.



Figure 5: underground container during collection (source: Cascais Municipality website)

Communication is regarded as one of the three main pillars to promote sorting behaviours; education on waste sorting is developed in schools, and big producers are directly reached by employees of Cascais Ambiente when delivering the bins.

The second pillar is the convenience and availability of the collection points. About 700 surface containers and 200 underground containers are available for glass collection, and new collection points are supposed to be implemented to comply with the national guidelines set by ERSAR the Water and Waste Services Regulation Authorities that monitors and assesses the performances of local waste operators. These guidelines indicate that bottle banks should be located at maximum 100 m from inhabitants in urban areas. The location of the bottle banks was fine-tuned over time, taking into consideration local requests and the guidelines. For areas where the 100-meter indication is not respected, new locations are considered by taking into consideration the accessibility for collection lorries, the remoteness of housings, as well as economic elements. Cascais Ambiente identified that a dense network of containers (combined with sufficient numbers of street bins) is a key element to prevent littering. Another important element is the maintenance and cleanliness of collection points, as “waste brings more waste”. One strong point of Cascais Ambiente is the fact that they manage both waste collection and cleanliness, which contribute to ensure the proper maintenance of collection points. More underground containers should also be implemented to improve the comfort for inhabitants. Another interesting aspect is the control of the filling-level, which is ensured both by:

- Visual inspection: every time a container is emptied (regardless of the waste fraction), the operator makes a visual inspection of the filling-level of the other containers located next to the collected ones. A “grade” between 1 to 5 is given to each container and indicated in an online database.
- Automatic sensors in specific areas (e.g., in remote areas where visual controls cannot be performed, or in touristic areas where sudden changes can occur).

This allows to optimise the collection routes, which are entirely dynamic: the exact route will depend on the filling level of the containers. It also prevents from bottle banks to be full, which can lead to littering around the containers.

Besides, the quality of collected glass packaging also depends on the availability of collection schemes for other fractions, especially those that are wrongly thrown in glass packaging containers (e.g., light bulbs). A mobile collection point has been implemented to collect different waste

fractions including small hazardous waste, small WEEE, batteries, or re-usable items (e.g., books). This system is available once a week in each of the 6 districts of the municipality.

The third and last pillar is motivational and coercive instruments, and is still under implementation. In 2019, a national regulation provided a framework for the implementation of Pay-As-You-Throw (PAYT) system by local waste authorities. Cascais Ambiente launched a pilot test in an area of 2,500 inhabitants within the framework of a Horizon 2020 project. This consisted in a “collective PAYT” scheme using bring banks whose opening is commanded by individual keycard. When using the containers, inhabitants receive “city points” giving access to municipal services, free bags for biowaste collection, museum tickets, etc. While the pilot focused on biowaste collection, it also improved the overall sorting performances, going from 11% of separation rate to 40%, and leading to a satisfaction rate of 91% for inhabitants.

Moreover, inspections are being implemented in the premises of big producers, as 10 inspectors are in charge of visiting them to check if the sorting obligations are fulfilled. They target the most “problematic” areas where non-conformities are identified (e.g., the touristic areas). The first visits were mainly organised for communication purpose, with little impact. As soon as fines were put, it fostered discussions among the HORECA sectors and it improves the sorting behaviours. However, the inspections are quite recent so it is challenging to assess their impact. Besides, only unsorted waste collection is charged for big producers, and sorted fractions are collected free for charge.

The city experiences a continuous increase of the collected quantities of glass packaging, and the collected quantities increased by 11% last year compared to annual increase of +5 to +8% in the previous years. This is attributed to the improvement of the collection strategy, but also to an increasing interest of the population for environmental issues, such as marine litter of plastics.

Different drivers encouraging the municipality and Cascais Ambiente to move forward with waste collection can be mentioned:

- As mentioned previously, there is a growing interest in environmental issues from the population;
- The evolution of the national regulation (e.g., on PAYT) and the local willingness to be a front-runner in Portugal also drives the improvements;
- Besides, ERSAR, a national authority regulating and monitoring public bodies in charge of waste and water management, makes sure that the regulation is well enforced. This means that Cascais Ambiente has to report annual data on the organisation and performances of waste management and receives an assessment (red, yellow, and green points) to identify strong and weak points. Data includes the availability of containers, costs, air emission, etc. This monitoring is regarded as a strong incentive to comply with the regulation and the recommendations.

Finally, deposit-refund systems might be progressively implemented, depending on an upcoming national law. Ten pilot systems were already implemented in Cascais, collecting glass packaging, PET bottles, and tin cans.

This case study was made thanks to the input of Vera de Sá e Melo, Head of Division for the Future and Decision Support at Cascais Ambiente

These different case studies highlight similar elements when it comes to well-performing collection systems:

- **Convenience** is a key element on which each interviewee insisted. For bottle bank systems, the number of containers, their strategic location, and their proper maintenance (controlled filling level, cleanliness) are essential parameters to ensure their use. All interviews

2. The perspective and roles of local authorities in the glass recycling value chain

highlighted the importance of cleanliness for the engagement of citizens and the support of decision-makers;

- **Collection modes** do not work in a homogenous way, and their performance depend on the local context and the way that they are implemented. Door-to-door collection poorly works in Berlin due e.g., to technical choices (use of compacting trucks), while it led to very high performances in Milan thanks to the quality controls, inspection of residual waste bins, and fines.
- **Incentivising instruments** were mentioned as one of the key solutions to move forward with collection performances in both Cascais and Milan: PAYT, mandatory collection and inspections, fines.

The case studies also reflect the different drivers that lead to change and improvement of glass collection: the lack of outlet for sorted glass in Berlin and the involvement of glass recyclers and manufacturers convinced decision-makers to adapt the collection system. In Cascais, the national monitoring system and willingness to be a front-runner are both mentioned. In Milan, the political commitment is perceived as the elements that led to the new waste management strategy.

3 Framework conditions

As explained previously, the introduction of national drivers is key to shape sustainable models, to help glass organisations to move forward. This part focuses on the framework conditions at national level for seven targeted countries: Germany (DE), Spain (ES), France (FR), Italy (IT), Poland (PL), Portugal (PT) and the United Kingdom (UK).

The objective of this section is to list the relevant pieces of legislation and policies in place, with a focus on economic instruments to drive recycling such as taxes, extended producer responsibility schemes (later referred to as EPR), including their scope of action and the economic incentives for municipalities. Deposit return systems (both for refillable and one-way packaging) are out of the scope of this study, since the main focus is on the systems where municipalities have a direct role to play. However, for the sake of completeness, in several of the targeted countries, there are DRS in place for specific products that have to be taken into account when analysing the whole glass value chain.

The elements presented in this part were selected in consultation with FEVE and FERVER members, during which the most relevant indicators and factors were identified.

3.1 National legislation for glass packaging waste

The EU Directive 2018/852, amending Directive 94/62/EC on packaging and packaging waste, lays down minimum targets for glass packaging waste recycling of 70% (by weight) by 31 December 2025 and 75% (by weight) by 2030. This Directive was to be transposed in each Member States (MS) by 5 July 2020 and it will contribute to harmonize the current national legislations across EU.

The current national targets refer to the consolidated Directive 94/62/EC, which sets the recycling rates (by weight) for packaging between minimum 55% and maximum 80% by 31 December 2008.

In the seven selected countries, the national legislations to date have used different approaches for setting recycling targets. By transposing the EU directives, some countries introduced additional legal requirements setting specific targets on packaging waste, either setting individual targets on the main material fractions (e.g., plastic, glass, etc.), or by targeting the packaging stream as a whole (regardless of the material). Each country also includes legal obligations for glass packaging fillers/distributors to comply with EPR schemes.

3.2 Taxes and bans on disposal

Policies and legislation on incineration and disposal have been proven to effectively support the European waste management hierarchy implementation. Landfill and incineration taxes are meant to increase the cost of disposal and encourage waste producers to consider other options.

3.2.1 Landfill tax

Most of the seven analysed countries do apply landfill taxes (Spain, France, Italy, Portugal, Poland and the United Kingdom). The tax is charged by weight of landfilled waste and it can be modulated according to different criteria, such as measures to reduce the environmental impact of the disposal units (France), sorting targets (Italy) or waste composition (Spain). Portugal and the United Kingdom set the landfill tax without introducing any modulation. The competence of the landfill tax is different from one country to another: it is set at national level in France, Poland, Portugal, and The United Kingdom, and at regional level in Italy and Spain. Regional taxes reflect decentralised approaches regarding the enforcement of the waste regulation, and mean that the incentives might greatly differ from one territory to another.

Countries can also implement bans on disposal to divert specific waste fractions from landfill/incineration to e.g., recycling. Disposal bans are implemented according to different criteria such as calorific power of waste (Germany), nature of waste (France), or organic content (Italy).

3.2.2 Incineration tax

In several of the targeted countries, incineration is also subjected to tax (France, Portugal, and Italy). Incineration taxes are charged with variable rates according to several criteria (environmental protection systems, sorting performances, etc.). The competence can also be at the national or regional level.

3.3 Pay-as-you-throw scheme (PAYT)

Pay-as-you-throw (PAYT) refers to charging systems for waste collection in which at least one part is determined according to the generation of waste by the users. As explained previously, a waste fee based on the PAYT principle is usually composed of a fixed fee (e.g., according to the size of the household), and a variable fee that is usually calculated according to the production of residual waste (there are also systems that take into account other waste fractions). Many different systems exist, charging the inhabitants according to the quantity (either measured by weight or volume) of the collected waste, the frequency of collection, the volume of the residual waste bins, etc.

Pay-as-you-throw (PAYT) is regarded as a very effective instrument to increase recycling rates. By making residual waste more expensive, inhabitants are invited to sort more recyclable waste. Therefore, the use and development of PAYT in the different countries is an indication on the incentivising efforts of local authorities to promote separate collection. In some cases, PAYT entails the risk to reduce the quality of the source separate collected fractions due to the strong incentive to reduce as much as possible the mixed waste (which is in most cases the targeted fraction for PAYT).

Among the seven selected countries, Germany is the only one applying a PAYT system on the whole national territory. In France, Italy, and Spain, there are municipalities or local authorities implementing PAYT schemes in increasing numbers, while in Poland, Portugal and The United Kingdom there are almost no relevant examples (only pilot projects).

3.4 EPR schemes

The EU legislation (Waste Framework Directive 2008/98) sets a global framework for Extended Producer Responsibility (EPR) in Europe, defining principles and general rules, and the Member States are responsible for the actual implementation of EPR schemes. Extended Producer Responsibility (EPR) is a policy approach under which producers are given a significant responsibility – financial and/or operational – for the treatment or disposal of post-consumer products such as packaging. The new EU Directive 852/2018 reinforces the key role of EPR, laying down that all the Member States shall establish such schemes for all packaging by 31 December 2024.

All the seven targeted countries have put in place EPR schemes for glass packaging, differently implemented in each of them.

EPR obligations are implemented by fillers that delegated their obligations to Producer Responsibility Organisations (PROs) the management of the compliance scheme on behalf of the obligated industry. The legal status, scope and functioning, as well as the governance (e.g., in some cases waste companies and recyclers can be also part of PROs) of the PROs vary across countries.

PROs are usually set up to target all packaging materials, but some countries (e.g., Italy and Spain) have established subsidiaries (e.g., glass-specific organisation), to specifically address single material flows. The subsidiaries operate within the packaging national framework.

Another difference is the possibility for competition among PROs, which is available in several countries and not in others. National competition among PROs can also play a role (e.g., Germany and Poland).

PROs commit to different level of responsibility, in terms of financial, operational and communication roles:

- The financial role includes the management of the financial infrastructure undertaken by the compliance system (collecting producers' fees and deploying the budget in such a way to support the recycling glass value chain). The activities covered by the subsidies allocated by PRO to waste collection systems might vary (e.g., depending on the collection performances, communication activities, etc.);
- The operational role refers to the management of the operations along the glass recycling value chain (such as collection, transportation, processing). PROs with operational roles usually do so by tendering and contracting operators (both public and private waste companies) to deliver such activities. The operational role can either focus on one aspect (e.g., appointing glass recyclers to turn collected waste quantities into cullet), or on several steps;
- The communication role deals with putting in place actions to inform the citizens and stakeholders (from producers to consumers) about the requirement and outcomes of the EPR scheme, and with monitoring the activities (possibly also controlling the different operations). PROs centralise messages and figures, to amplify the impact.

PROs operate in agreement with local authorities (LAs), issuing contracts that guide the collection systems of glass packaging waste. In the seven analysed countries there are several types of schemes (even within the same EPR national system), that differ *inter alia* for the stage at which PROs take over for the responsibility in managing the glass packaging waste (e.g., appointing a contractor).

Germany and Spain are the only countries (among the panel of the seven analysed countries) in which PROs play a role thorough the entire glass waste packaging value chain, from collection to manufacturing.

3.4.1 EPR system – operational responsibility

The extent to which operational responsibilities are assumed by PROs is variable among the targeted countries. It depends on the EPR national framework and more broadly on the waste national legislation. Legal obligations for the stakeholders across the waste management value chain and the costs assumed by PROs (covered by producers' fees) play a key role for shaping the EPR model.

Among the targeted countries, there are examples of either full or partial operational responsibility of the PROs. The operational activities analysed by this study are:

- Collection (e.g., Door to Door, bottle banks, civic amenity sites)
- Processing (e.g., co-mingled stream sorting, end-of-Waste furnace-ready cullet production)
- Monitoring (e.g., collection performances, quality of glass entering the process unit, enforcement of penalties/sanctions)

The operational activities under the responsibility of the PROs can refer to different actions: tendering, in house service operation, designing, etc.

3.4.2 EPR system – financial responsibility

The financial responsibility undertaken by the EPR systems in the seven analysed countries varies in terms of target activities and rate of the costs coverage.

The internalisation of the packaging externalities might require the producers to finance a wide range of activities to achieve the EPR objectives: e.g., communication, collection, processing, recycling, litter cleaning-up, monitoring, enforcing penalties/sanctions.

In the case of Germany, the actual cost coverage for the source separated glass packaging waste is 100%, since PROs do pay for the operation (dual system approach). In the case of France, there is a legal obligation fixed by the agreement between CITEO and the State (80% of cost coverage), but how it is implemented and controlled is not clear and cost coverage might be different at local level. In the other analysed countries, PROs declare to support the recycling costs (e.g., covering the additional cost sustained by municipalities to operate source separate collection system for glass packaging), but it is challenging to come up with clear figures on the actual cost coverage. Several factors concur to shape the uncertainty about the cost coverage (e.g., market conditions, availability of plants, et.) and the local conditions can also play a key role.

The figures describing the financial responsibility are challenging to compare, due to different financial schemes, accounting systems and data availability. The models in the analysed countries rely on different approaches. Some schemes mainly reward performances (e.g., France, Italy), sometimes taking into consideration the touristic activity (e.g., in France), while others reward also the means and resources allocated (e.g., Portugal).

3.4.3 EPR system – communication responsibility

Communication responsibilities, such as reporting, monitoring and informing, play a key role in EPR systems. In the seven targeted countries PROs undertake these responsibilities according to obligations laid down by the national framework.

The “communication roles” are rather homogeneous across the different Member States, even if the distribution of roles might slightly differ. All EPR systems cover the communication to citizens with national campaigns or by helping (e.g., co-funding) local communication campaigns.

3.4.4 Technical and quality requirements

EPR schemes introduced technical and quality requirements to effectively achieve the recycling objectives set by the national framework. PROs implement measures to support cost-efficient solutions thorough the value chain. In five out of the seven analysed countries (DE, ES, FR, IT, PT), the PROs for glass packaging introduce different requirements for collection systems (e.g., guidelines to set up a bottle bank system) and cullet processing: impurities (CSP, metals, plastics, textile, organics), granulometry or density, colour contamination (if source separate collection by colour). In PL and UK, the recycling companies can specify their own quality requirements.

The technical and quality requirements are monitored through specific analysis methods that are set by the EPR schemes. In some countries there are parameters defining different quality levels and related prices (e.g., France – two quality levels, Italy – five quality levels), while in other countries thresholds are applied for collection quality to check the conformity or non-conformity of the glass waste (Spain and Portugal). There could be also market conditions that are not clearly stated in the EPR schemes.

In order to receive End-of-Waste status the cullet must meet certain quality specifications as set down on COMMISSION REGULATION (EU) No 1179/2012. In addition, each glass makers have their own technical specifications to meet food contact regulations.

3.5 General organisation of glass collection

3.5.1 Operational schemes

Glass packaging waste collection systems are characterised by different elements:

- **The collection mode:** e.g., bottle bank, door-to-door, civic amenity sites, etc. This is how the waste is collected from household. Bottle bank systems consist in collection points available

to all on the public space where inhabitants must bring and put their waste. In door-to-door systems, inhabitants put their waste in front of their housing (usually on the kerbside), either in bags, bins, or any other containers, that could also be shared with different households living in the same block. Civic amenity sites (also called household waste recycling centres in the UK) are fenced and guarded areas where inhabitants can bring and sort their waste in different containers.

- **The separation system:** glass packaging waste can be collected separately (possibly sorted by colours), or co-mingled together with other materials (e.g., metal cans, or plastic packaging).

Glass packaging collection systems can largely differ within each country, as local authorities have some flexibility to set and organise waste collection. This flexibility generally includes the choice of the collection mode (e.g., bottle bank, door-to-door, civic amenity sites, etc.), and sometimes the choice between source separation (mixed colour or by colour) or co-mingled stream (usually mixed with other dry recyclable materials, such as metal and plastics). Within some territories, different collection systems can be available depending on the area (e.g., specific sorting guidelines in the dense historical centre of a city), the typology of housing (e.g., different systems for single-family housing), or the type of waste producers (e.g., specific door-to-door systems for the HORECA sector). There are also collection schemes based on deposit return system or take back systems other than the ones integrated in the municipal waste collection, that might target specific types of packaging.

Germany is characterized by source separated (in terms of packaging material) bottle bank collection systems, further split by colours: flint, green and amber. In France, there are few local cases of source separation by colour (two colours: flint and coloured), but the vast majority of the French population is served by bottle bank systems collecting glass packaging in a single stream.

In Spain, France, Italy, Poland, Portugal and the United Kingdom, the collection systems do not massively resort to the separation by colour (there could be some local cases, but they do not represent significant share of the glass packaging waste collected). The United Kingdom presents the highest share among the target countries in terms of co-mingled collection (61% of the glass packaging is collected comingled with other dry recyclable materials *via* a door to door system).

In some countries the glass packaging waste can also be collected in civic amenity sites (CAS) that integrate the other systems in place. However, in several cases, glass collection in CAS is addressed to non-packaging glass (e.g., flat glass).

The recycling route entails other steps that follow the collection and the operations vary across the countries.

Bottle bank system and source separation of glass packaging are the main collection models implemented in the analysed countries. However, there are local systems that largely differ within the countries: in Italy for instance, there are local authorities implementing door to door collection systems either source separating or co-mingling glass packaging with other waste packaging fractions (e.g., plastics and metals). This is also the case in the United Kingdom, where glass packaging is commonly collected door to door and co-mingled with other recyclable waste. Bottle bank systems mainly rely on source separation, with the vast majority of the analysed countries collecting glass packaging waste in mixed colours. Germany is the only country, among the seven in the focus of this study, to source separate waste per colours in the whole territory.

The consistency in sorting guidelines (mainly separation system) does help citizens to properly sort, and different separation schemes might confuse inhabitants.

3.5.2 Performances

Several factors concur to achieve the EPR policy objectives and cross analysing the target countries performances may offer the opportunity to identify common enabling factors and blockers.


However, the way the EPR systems are shaped and implemented significantly influences the interpretation of data. The organisational models, as well as monitoring and communication responsibilities undertaken by PROs, play a key role in the availability and accuracy of data.

3.6 Framework conditions in the seven countries

The following parts present country-based descriptions of the framework conditions, based on literature review, completed and validated by interviews with national contact points.

3.6.1 Germany

Germany	
Population (1 st January 2020) ¹⁷	83.12 million
Type of EPR	Financial and operational responsibility
Scope of EPR	Households (one-way in the segments of mineral water, soft drinks and beer, which are covered by DRS) and commercial (e.g., HORECA sector) waste. Reusable packaging is exempted from the EPR scope.
Recycling rate (2017) ¹⁸	84.4%
Glass packaging to recycling operation (2017) ¹⁹	2,440 kt 29.6 kg/inh ²⁰
Number of container glass factories	31



3.6.1.1 National legislation

The New German Packaging Act (VerpackG) as of 01/01/2019 replaced the packaging ordinance of 1991 (4) and transposed the objectives of the new EU packaging directive. It also strengthened the extended producer responsibility principle by introducing new provisions. This act applies to all distributors that put packaging on the German market, including importers and online sellers. The newly introduced “mandatory participation” strengthens the obligation for any company selling packaged good in Germany to participate in the “dual system”, meaning that they have to register the packaging and pay the related participation to cover its collection and processing. The law also introduced a new “Central Agency Packaging Registry” (“Zentrale Stelle”), which organises and controls the legal compliance of obliged companies and PRO, and ensure that take-back and recycling is in place. It will centralise the registration and data, and ensure the transparency of the system.

¹⁷ EUROSTAT database, accessed on 09/10/2020

¹⁸ EUROSTAT database, accessed on 09/10/2020

¹⁹ EUROSTAT database, accessed on 14/02/2020

²⁰ Calculated by dividing the glass packaging to recycling in 2017 (EUROSTAT) by the population in 2017 (EUROSTAT)

The regulation also introduced specific targets for glass recycling: 90% by 2022.

3.6.1.2 Taxes and ban on disposal

There is no landfill or incineration tax. A landfill ban was introduced in 1993 and enforced in 2005 on “untreated waste”, including separately collected waste, but also unsorted waste that can be recovered. The ban especially targets organic content, as there is a limit set for the carbon content of mixed residual waste sent to landfilling: 5% for untreated waste, and 18% for waste that has been pre-treated. Mixed residual waste must be either incinerated or sent to mechanical-biological treatment prior to landfilling.

3.6.1.3 Pay as you throw scheme

PAYT is extensively used in Germany, with nearly 100% of the population being subject to such system. The PAYT schemes are quite diverse across Germany (e.g., volume-based, weight-based, or according to the collection frequency), and they usually include a fixed fee and a variable fee. Even if PAYT is not a legal requirement, it has been widely used because of the introduction of the landfill ban.

3.6.1.4 EPR schemes

The specificity of the German EPR system is that PRO has a full operational responsibility for the collection of packaging waste. The distribution of roles and responsibilities is organised as follows.

Collection: the PRO has full operational responsibility regarding the collection and mostly transfer the processing of glass. There are currently ten for-profit organisations, accredited by the State, are in competition to establish contract with packaging producers and companies putting packaging waste on the German market. Each PRO is then in charge of organising household packaging waste collection in the lots that it is responsible of, i.e., by launching tenders and selecting the operators. The number of districts that are under each PRO responsibility is defined by their market shares, and are awarded by a draw by a third party. Both public waste companies and private companies can compete to these calls. The design of the collection systems is decided by the PRO but in full agreement with the municipality, and should be made in coordination with the existing municipal waste system. Some agreement can be set for mutualizing collection equipment if required. The contract duration for collection is 3 years. If different systems are organised in one given collection area, a common representative will be appointed by the operators for negotiation with the public authority.

In the following table is reported the share of each main collection system in Germany.

Table 1: Inhabitants by collection system

Collection system	Inhabitants	share %
Bottle bank	74.508.200	89,46
Wheely bins 1.100 ltr	4.208.400	5,053
Container park	3.568.700	4,285
Collection of flat and round glass	744.400	0,894
Comingled collection (Glass + metal)	230.700	0,277
Plastic bags	17.800	0,021
Bucket 30l (1 for each colour)	3.700	0,004

Processing: Processing of glass packaging is executed by glass recyclers. PRO owned by waste management companies might use their own facilities. Some glass factories own glass recycling plants as well or cooperate with glass recyclers.

Monitoring and controls: each PRO is responsible for the control and monitoring of the operations under its responsibility. A Clearinghouse (“Zentrale Stelle”) has been set up to ensure the fair

competition between the PROs. It is in charge of monitoring and controlling that they fulfil their obligation in terms of collection and delivering to the glass recycling plant. They also check the data reports and provide access to the tender platform. The methods to assess the market shares and the distribution of responsibilities are also decided by this Central Agency. In case of non-compliance, it will report it to the national authority. It also lists accredited experts and auditors that can be appointed to control the different systems. Data can be made available to regional authorities. If a tender is launched it is organised through an online tendering platform, ensuring its transparency. The Central Agency is under the supervision of the Federal Environment Agency that ensures that it complies with its legal obligation, and can take over the Central Agency's responsibilities in case of non-compliance. Producers have to report their data through an annual declaration above a certain threshold, which is 80 t for glass.

Financing: the financing of the operation is mainly done by the PRO, and the associated costs are shared by PROs according to their market shares. The Central Agency is also funded by the different PROs. The different PROs share the collection costs: the PRO managing the contract will pay at least 50% of the costs, while the rest is shared among the other PRO according to their market shares, which incentivises the PRO in charge of the tender to achieve a good financial outcome. PRO also funds communication activities.

The German EPR scheme takes the full financial (and operational) responsibility, requiring PROs to cover all the costs across the value chain (from collection to recycling). Most of the financial indicators of the German scheme are not publicly available, likely due to competition issues.


In order to get some additional information about the framework conditions in Germany, an interview with a national contact point was carried out. Below are some considerations which came up during the interview with Ulrich Ix from Der Grüne Punkt – Duales System Deutschland on 5 August 2020. The following points reflect the view of the person interviewed.

Considerations about the framework conditions in Germany - Interview with Ulrich Ix from Der Grüne Punkt – Duales System Deutschland on 5 August 2020

- Eco-design plays a key role in order to improve recyclability
- The contract duration for collection is 3 years, which is a relatively short period to return on the investments needed to put in place the service (particularly for small companies). A 5-year contract duration could guarantee a fairer competition
- Quality is key, and more funding should go for communication and education actions to reduce impurities
- High competition among PROs might lead to more and more price reduction, making the introduction of innovation actions challenging
- PAYT might lead in some cases to a quality reduction of the source separated fractions
- There is a risk to reduce quality when setting high collection targets
- The collection system does affect the recyclability of the glass collected e.g., in some cases door-to-door systems may generate higher quantities of fine fractions, which lead to increase the losses across the recycling route.

3.6.2 Spain

Spain	
Population (1 st January 2020) ²¹	47.33 million
Type of EPR	Financial and operational responsibility
Scope of EPR	Households and commercial (e.g., HORECA sector) waste
Recycling rate (2017) ²²	72.2%
Glass packaging to recycling operation (2017) ²³	46,528 kt 23.03 kg/inh ²⁴
Number of container glass factories	14 (belonging to 4 companies)



3.6.2.1 Taxes and ban on disposal

In Spain, the tax is charged by weight of landfilled waste, yet in some Regions there is not any landfill tax on municipal solid waste²⁵. The competence of the landfill tax is at the regional level and it ranges from EUR 7/t to 47.1/t depending on the province. If biowaste is not collected at source, there can be an increased landfill tax, as it is the case in Catalonia. The landfill gate fee ranges from EUR 13/t to EUR 52.50/t. The incineration tax ranges from EUR 5.70 to 16.50/t and it is also defined at a regional level, while the incineration gate fee varies from EUR 35/t to EUR 79/t²⁶. This means that the incentivising character of the tax is very heterogeneous across the different provinces.

3.6.2.2 Pay as you throw scheme

PAYT schemes are applied in about 10 to 20 municipalities, with door-to-door as the main collection system implemented with PAYT.

3.6.2.3 EPR schemes

There are 2 PROs in Spain. ECOEMBES, non-profit and privately owned, is the main one for packaging waste. Regarding glass, ECOVIDRIO is the largest organisation, covering 60% of municipalities. It takes care of household and HORECA packaging waste and has a responsibility for financial and operational aspects (including collection), and for communication.

The fillers pay the EPR fee, which is calculated based on the tonnage and the number of units put on the market. PROs pay municipalities for the extra cost for the source separate collection of the material through the containers.

Collection: municipalities can either decide to operate glass packaging waste collection and get funding from PRO, or leave the operational organisation of glass collection to the PRO. The latter is

²¹ EUROSTAT database, accessed on 09/10/2020

²² EUROSTAT database, accessed on 09/10/2020

²³ EUROSTAT database, accessed on 14/02/2020

²⁴ Calculated by dividing the glass packaging to recycling in 2017 (EUROSTAT) by the population in 2017 (EUROSTAT)

²⁵ <https://www.cewep.eu/wp-content/uploads/2017/12/Landfill-taxes-and-bans-overview.pdf>

²⁶ Use of economic instruments and waste management performances (European Commission [DG ENV–Unit C2], 2012)

the case of ECOVIDRIO, already in charge of all the all the operational activities for collection in 60% of the municipalities, and getting in direct contact with recyclers and glass manufacturers.

As soon as the glass collected is in the warehouse of the PROs (after collection), PROs are in charge of the material. Transportation from the PRO warehouse to the treatment plant is the responsibility of the glass buyer (glass manufacturers or rarely treatment plant managers). PROs can either sell the material to glass manufacturers before or after the treatment processes to remove impurities. There is also a relatively small percentage (about 5%) of material coming from mixed waste treatment plants.

When the collection is organised by the PRO, the privileged approach is bottle banks located on the public space following field studies, and collection is sub-contracted to private companies; this is the case for 60% of the Spanish municipalities. Ecovidrio also developed sorting system to extract glass from residual waste prior to its treatment. Otherwise, Ecovidrio establishes contracts with local authorities defining the conditions for taking back the glass (location of the centre, technical specifications, and tariffs). The main collection system is based on bottle banks, with about 225,000 bottle banks across Spain, representing about one container for 208 inhabitants in average. About 100 municipalities out of more than 8,000 municipalities in Spain use door-to-door (e.g., ECOVIDRIO operates DtD only for HORECA sector).

Processing and recovery: the PRO manages the processing of glass packaging waste into glass cullet, by monitoring the processes and ensuring the traceability. It then commercializes the sorted materials to glass companies through public competition processes. Ecovidrio has agreements with 4 private companies organizing glass treatment in 14 processing plants across Spain.

Monitoring and control: the PROs monitor and control the quantities and the quality of the sorted glass packaging waste, as well as the glass processing. Quality requirements are set in agreement between PRO and the public authority, based for instance on the impurity rate, infusible fraction rate, etc.²⁷. The EPR system is overseen by the Ministry and audits are performed to ensure the compliance with the regulation. Tests are carried out in each treatment plant to ensure the quality of the treatment.

Financing: ECOVIDRIO either takes the cost of collection in charge by directly tendering a company to do so, or cover the additional collection cost for the municipality if it decides to organize it. Set by a 5-year agreement, municipalities choose how they wish to proceed with the PRO and can leave the contract at any time.

Negotiations take place first with the regions, where different parameters are discussed (the system, the cost, the coverage, etc.) and then with municipalities.

The PRO provides funding of EUR 0.06 per habitant per year for communication activities.

In order to get some additional information about the framework conditions in Spain, an interview with a national contact point was carried out. Below there are some considerations come up during the interview with José Manuel Nuñez-Lagos from Ecovidrio on 31 July 2020. The following points reflect the view of the person interviewed.

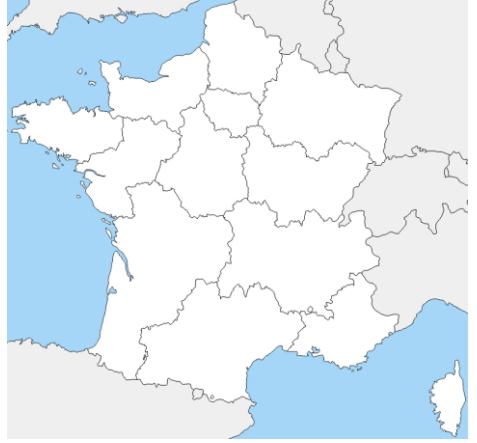
Considerations about the framework conditions in Spain - Interview with José Manuel Nuñez-Lagos from Ecovidrio on 31 July 2020

- Close cooperation between PRO and Municipalities is key
- Additional investments in equipment and technologies are needed to improve source separate collection (both in terms of quality and quantity)
- Inclusion of bonus to increase the quality of the collected material could help to improve recycling performances

²⁷ file:///C:/Users/acrUser/AppData/Local/Temp/2014_6684%20Convenio.pdf

- Cooperation rather than strong competition among PROs might lead to economy of scale and better coordination along the recycling route. Competition exists at the operational level, among glass manufacturers and glass treatment plants.

3.6.3 France

France		
Population (1 st January 2020) ²⁸	67.10 million	
Type of EPR	Financial responsibility	
Scope of EPR	Households waste	
Recycling rate (2017) ²⁹	77.9 %	
Glass packaging to recycling operation (2017) ³⁰	2,128 kt 31.85 kg/inh ³¹	
Number of container glass factories	17	

3.6.3.1 National legislation

In addition to the EU targets, France put a target of 75% of packaging waste recycling for household packaging by 2022.

In November 2019, local authorities (through the Association des Maires de France – Association of French Mayors), and the glass packaging value chain (glass recyclers, and glass producers, EPR schemes, retailers, food & beverage producers) signed the *Charte verre 100% solution* which sets a target of 90% collection in 2025. This is a voluntary pledge.

3.6.3.2 Taxes and ban on disposal

A tax is collected according to the tonnes sent to landfilling, with different tariffs depending on several criteria, such as measures to reduce the environmental impact of the disposal units. Reductions apply for units that are certified with ISO 14000, recovering 75% of the biogas for energy production, reinjecting leachate for reduction the time for stabilisation of cells.

Landfill taxation varies from EUR 16/t to 41 EUR/t (2018), and the incineration taxation goes from EUR 3/t to EUR 15/t (2018)³².

In addition to these calculations, the gate fees for incineration and landfilling play an important role in the full cost picture. According to CITEO estimation, 1 tonne of glass sent to landfill/incineration costs in average EUR 130 more than 1 tonne of glass sent to recycling.

²⁸ EUROSTAT database, accessed on 09/10/2020

²⁹ EUROSTAT database, accessed on 09/10/2020

³⁰ EUROSTAT database, accessed on 14/02/2020

³¹ Calculated by dividing the glass packaging to recycling in 2017 (EUROSTAT) by the population in 2017 (EUROSTAT)

³² <https://www.actu-environnement.com/media/pdf/news-30449-tgap-tableau-2018.pdf>

3.6.3.3 Pay as you throw scheme

PAYT covers 10% of the population and is used in some municipalities³³. To date, the largest city implementing PAYT is Besançon (about 116,000 inh).

3.6.3.4 EPR schemes

In France, CITEO is the PRO responsible for the EPR scheme. ADELPHÉ, a subsidiary of CITEO, is responsible for wine, spirits and medical products of household packaging waste.

Fillers have to pay the EPR fee for glass packaging to comply with the EPR scheme.

The PRO gives support for collection and recycling through reimbursement contracts with local authorities, according to: (modulate) fee per tonne of collected glass and a rewarding mechanism based on the average recycling rates for metal, paper and cardboard, plastic, and glass packaging. It also gives funding for communication activities. It is supposed to cover 80% of the costs of the activities. The “cost coverage” indicator does not necessarily reflect the actual costs coverage by the PRO. In the case of France, this is a legal obligation fixed by the agreement between CITEO and the State, but how it is implemented and controlled is not clear and might be different at local level.

The French scheme sets fixed specific support fees for collection (EUR 7/t of collected glass and additional potential bonuses depending on the performances, reviewed every 6 years), for the material (EUR 24/t in average for collecting the glass complying with the quality standard, this price is revised every year) and communication (EUR 0.15/cap and lump sum of EUR 4,000 for employed “waste ambassador” in charge of direct communication with citizens). The main system is organised around the principle of take-back guarantee, which means that the cost fee is fixed and there is no threshold for the quantity of glass waste collected (to date globally around 2 million tonnes). The municipalities take care of the collection and the sorting of the waste, then they sell the material directly to glass manufacturers who will take care of the transport, treatment and recycling. Municipalities have also the possibility to go for other systems: contracting with recycling federation, or directly contracting with glass manufacturers.

The technical and quality requirements are monitored through specific analysis methods that are set by the EPR schemes. In France, there are parameters defining 2 quality levels and related support unitary fees.

3.6.3.5 Collection schemes

Glass is normally source separated in one stream (about 98% of the population, 2% served with co-mingled collection for glass – e.g., Lille Metropole) and then sorted by colour at industrial treatment level. The vast majority of the French population is served by bottle bank systems (about 80% of the population). About 6% of the municipalities use Door to Door collection. 85% of the total glass packaging waste is collected via BB and 15% via DtD, according to CITEO figures. There are around 200,000 collection points in use.

After collection, glass packaging is either sent to a transfer station, or directly to a treatment unit where impurities are removed. In 2018, the glass federation reported the percentage of glass according to the quality level: good quality (96.6%) average quality (2.8%), bad quality (0.6%)³⁴.

Level of impurities (including CSP) has to be below 2%, which is generally well respected. Bottle Bank system is very efficient to comply with quality requirements. Therefore, losses are limited during the treatment phase (about 3% in total, including the finest glass fraction lost along the treatment process).

³³

https://www.ademe.fr/sites/default/files/assets/documents/dechets_chiffres_cles_essentiel2018_010690.pdf

³⁴ https://bo.citeo.com/sites/default/files/2020-08/G60184-CITEO-Rapport%20activite%202019_07_01_bd.pdf

3. Framework conditions

Quality requirements are described in the PRO's contract for taking back the glass cullet, as well as the control processes and specific recommendations on the design of the storage or the treatment platform on which the glass cullet is stored or treated. The controls are done by glass manufacturers.

Different quality standards (e.g., infusible rate) are set, depending on where it is measured. Considering that the density of the glass is likely to be degraded over time and processes, the quality standards are defined as follows:

- On the local authorities' storage area: if the density is lower than 0.76%, it is regarded as Q1 (top quality). Below, it is discarded
- On a treatment unit, there are different criteria:
 - the material density is checked when the glass is entering the facility. If its density is below 0.76 +6%, it is Q1. If between 0.76+6% and 1+6%, it is Q2. Above 1+6% it is discarded

In order to get some additional information about the framework conditions in France, an interview with a national contact point was carried out. Below there are some considerations come up during the interview with Jacques Bordat, president of the Fédération des Chambres Syndicales des Industries du Verre, on 27 July 2020. The following points reflect the view of the person interviewed.


Considerations about the framework conditions in France - Interview with Jacques Bordat, president of the Fédération des Chambres Syndicales des Industries du Verre, on 27 July 2020

- Close cooperation among all the stakeholders across the glass value chain is key, and the Chartre verre 100% solutions is an outstanding collective pledge.
- In order to improve the performances, the main target should be put on big cities and the HORECA sector. Eg Trilib services³⁵ (implemented by CITEO through pilot actions in big cities, such as Paris).
- Innovative collection systems can play a crucial role (e.g., bottle banks very well designed, clean and well maintained, to encourage people to come and bring glass)
- Competition is open by law, but system with unique PRO is very efficient in France
- In France there has been significant investment in sorting by colour at industrial level

³⁵ <https://www.citeo.com/le-mag/531/>

3.6.4 Italy

Italy	
Population (1 st January 2020) ³⁶	60.25 million
Type of EPR	Financial responsibility
Scope of EPR	Households, commercial (e.g., HORECA sector)
Recycling rate (2017) ³⁷	72.2 %
Glass packaging to recycling operation (2017) ³⁸	1,769 kt 29.20 kg/inh ³⁹
Number of container glass factories	35 (belonging to 17 companies)



3.6.4.1 National legislation

The EU Directive 2018/852, amending Directive 94/62/EC on packaging and packaging waste, lays down minimum recycling targets by weight for glass packaging waste of 70% by 2025 and 75% by 2030. The Decree Law 166/2020 (DECRETO LEGISLATIVO 3 settembre 2020, n. 116) has transposed the EU Directives⁴⁰.

The Italy set up a target on municipal waste sorting for recycling of 65% (by weight) by 2012.

3.6.4.2 Taxes and ban on disposal

Italy applies landfill taxes. The tax is charged by weight of landfilled waste and it can be modulated based on the sorting targets. Average cost for landfilling is EUR 150/t, including the gate fee.

The disposal operations by way of incineration are also subjected to tax in Italy. Incineration taxes go from EUR 5.2/t to 25.82/t and the competence is at the regional level. If there is no energy recovery, the landfill tax rate is applied.

3.6.4.3 Pay as you throw scheme

In Italy, about 8% of the municipalities or local authorities implement PAYT schemes (ISPRA, 2019⁴¹). There are guidelines included in a Law⁴² at national level ruling the PAYT implementation.

3.6.4.4 EPR schemes

Collection: Municipalities are responsible for the collection of the packaging waste. The collection operations can either be performed by a public waste operator owned by the municipalities or sub-

³⁶ EUROSTAT database, accessed on 09/10/2020

³⁷ EUROSTAT database, accessed on 09/10/2020

³⁸ Piano Specifico di Prevenzione 2018, COREVE

³⁹ Calculated by dividing the glass packaging to recycling in 2017 (COREVE) by the population in 2017 (EUROSTAT)

⁴⁰ <https://eur-lex.europa.eu/legal-content/EN/NIM/?uri=celex%3A32018L0851>

⁴¹ Rapporto Rifiuti Urbani, ISPRA, 2019

⁴² https://www.minambiente.it/sites/default/files/archivio/normativa/rifiuti/dim_20_04_2017.pdf

contracted to a private waste management company. The Italian PRO for glass packaging (COREVE) provides some guidelines, promoting source glass separation and referring (COREVE website) to the bring banks system as the most cost-efficient scheme. Concerning the BB system implementation, COREVE suggests also the best maximum distance for the user to get the container (250 m) and the maximum number of people served with one glass packaging bank (250/350).

Some municipalities are using the DtD system and the commingled collection (mainly with metals and in few cases with plastics & metals) is the system for the 20% of the total glass packaging waste collected. After the collection, the glass is first sorted and then treated to make the material complying with glass manufacturer requirement.

In 2019, the 12.1% of the total glass packaging waste collected in Italy was managed outside the COREVE framework (COREVE, 2020⁴³).

The EPR covers the collection of glass from households and commercial. However, hospitals (pharmaceutical packaging), for instance, are not included, since they are obliged to issue contracts with specialised private companies.

Processing: there are two different contract typologies between COREVE and municipalities (or entities acting on behalf of municipalities via proxy). The first one transfers the responsibility from municipality to COREVE right after the collection phase (with or without an additional sorting stage to remove impurities). In this case, COREVE takes over the municipalities before the recycling phase (including transfer operations). The municipality receives revenues from COREVE according to quality criteria laid down in the ANCI (Italian municipalities association) - CONAI (Italian framework organization implementing the packaging EPR policy) framework agreement⁴⁴.

In the second contract typology COREVE takes over the Municipality after the final sorting phase, when the cullet complies with the EoW (End of Waste) criteria and is ready to be sent to the glass factory. In this last case there is a third entity managing the sorting operations.

Monitoring and controls: The penalties/sanctions are laid down in the Glass Technical Annex of the ANCI-CONAI framework agreement. The municipality is responsible to communicate to COREVE the collection area, the collection system and the estimated quantity (according to data of the previous year). The municipality can only deliver to COREVE glass packaging from municipal waste stream. In the Glass Technical Annex there are also included the quality criteria ruling the unitary price for cullet.

Financing: COREVE supports municipalities to improve the collection investing each year EUR 0.5/t of cullet to fund specific initiatives. The EPR fee for glass fillers/distributors in 2019 is EUR 24.00/t. It sharply increased comparing to 2018 when it was equal to EUR 13.30/t, due to significant increase of glass collected reaching out the maximum capacity of treatment plants, so decreasing the cullet price, as well as the significant increasing of rewarding to municipalities.

The reimbursement unitary fee recognized by COREVE to the municipalities ranges according to the quality of the collected packaging glass waste (there are five categories, with a unitary fee ranging from EUR 5.00/t to EUR 45.50/ton in 2019). The PRO contributes to the transport operations (EUR 0.165-0.088/t/km) for transferring the collected glass from the local authority to the process unit. Furthermore, there is a specific budget line allocated by PROs to improve collections systems (EUR 0.5/t of the total glass which is yearly collected).

In order to comply with the EPR framework, Importers pay directly to CONAI (organisation managing the EPR scheme for packaging in Italy), while the fillers pay the EPR fee to CONAI through the invoices issued by glass manufacturers (producing and selling the packaging items).

⁴³ <https://coreve.it/wp-content/uploads/2020/07/Psp-Coreve-maggio-2020-dati-2019-29-maggio-2020.pdf>

⁴⁴ <http://www.anciconaiformazione.it/images/AccordoQuadro/Allegato-tecnico-vetro.pdf>


In order to get some additional information about the framework conditions in Italy, an interview with a national contact point was carried out. Below there are some considerations come up during the interview with Massimiliano Avella, responsible for collection and recycling development at COREVE, on 4 August 2020. The following points reflect the view of the person interviewed.

Considerations about the framework conditions in Italy - Interview with Massimiliano Avella, responsible for collection and recycling development at COREVE (PRO for glass packaging), on 4 August 2020

- Quality of the material collected is key and reducing the losses during the recycling process is a first priority
- DtD system in Italy often leads to reduced performances in terms of quality, both for users' habits (e.g., use of plastic bags) and logistic optimisation to increase cost-efficiency (producing significant percentages of fine fractions affecting the further recycling steps)
- PAYT has normally positive effects in terms of increasing source separate collection rate (so decreasing residual waste), but negative effects with regards to quality performances
- If BB collection system is implemented, the revenues from glass recognized by PRO to municipalities might be (even if there are several variables according to local conditions to make general statements) sufficient to cover the full cost for the source separate collection management of the glass packaging waste , while with regards to DtD, the cost is much higher and unlikely the current revenues can cover the full cost held by municipalities
- High competition among PROs might be challenging to cover remote areas with low population density
- The recycling performances currently reported by COREVE do not consider the losses along the recycling routes (losses are deducted from the calculation).

3.6.5 Poland

Poland	
Population (1 st January 2020) ⁴⁵	37.96 million
Type of EPR	Financial responsibility
Scope of EPR	Households and commercial (e.g., HORECA sector) waste
Recycling rate (2017) ⁴⁶	63%
Glass packaging to recycling operation (2017) ⁴⁷	749 kt 19.71 kg/inh ⁴⁸
Number of container glass factories	17 (4 main companies covering 90% of the market share)



⁴⁵ EUROSTAT database, accessed on 09/10/2020

⁴⁶ EUROSTAT database, accessed on 09/10/2020

⁴⁷ EUROSTAT database, accessed on 14/02/2020

⁴⁸ Calculated by dividing the glass packaging to recycling in 2017 (EUROSTAT) by the population in 2017 (EUROSTAT)

3.6.5.1 Taxes and ban on disposal

Poland does apply landfill taxes, as a competence of the national government.

As of 2020, the landfill tax amounts to PLN 295.05 (approximately EUR 65.5) per tonne⁴⁹, after increasing for the past few years. In addition, since 1 January 2013, Poland applied a ban on biodegradable waste collected separately. Since 1 January 2016, a ban on combustible waste with > 5 % TOC, >8% LOI*, Calorific value > 6MJ/kg was added.

3.6.5.2 Pay as you throw scheme

In Poland, there are no relevant examples of PAYT.

3.6.5.3 EPR schemes

In 2020, there were 24 PROs in Poland, among which 22 deals with glass packaging waste, the historically largest one is REKOPOL, which is non-for-profit and privately owned. There is no glass specific organisation. Previously, there were less PROs, the number increased recently and they are competing. The PROs cover both household and industrial packaging waste and have a financial, and a partially communicational responsibility. The cost covered by the EPR fee does not cover the full cost for the source separate collection of the glass, but it is still an advantage for municipalities since they can sell the sorted materials and avoid the landfill cost. There is not any clearance system or obligation to report on EPR fees, so there are not publicly available figures about the actual coverage of cost by PROs.

Collection: the municipalities launch public procurements and can decide if glass collection is done via door-to-door (in this case glass packaging is put in a separate plastic bag) or bottle bank systems.

It is difficult to identify which collection system is the most used because it is often the case that both systems are in place in the same collection area. Usually, low population density neighborhoods go for the bottle banks, while dense areas choose door-to-door. Besides, single houses In both cases, the glass is collected separately from the other materials.

Until 2017, municipalities have been free to set their own collection system, which resulted in many inconsistencies. A unified separation mode is currently being implemented⁵⁰, where glass packaging waste has to be source-separated, with no separation by colour, and the vast majority of local collection systems operate this way. Some municipalities also have a separate collection for flint glass packaging waste.

Processing and recovery: local authorities send their sorted waste to accredited recyclers that then issue a recycling certificate called “DPR” (proof of recycling documents). PROs support the activities of glass recycling buying “DPR”. The DPR’s “market” is based on supply and demand, with prices fluctuating depending on whether the PROs (and their clients) are short or in surplus when compared to annual targets.

Monitoring and control: the PRO has to ensure that the recycling operations are well conducted and that data are well reported. Mandatory audits are foreseen for packaging recovery or recycling facilities processing more than 400 t per year, conducted by accredited experts. These audits have to be sent to the Regional Authorities, that have to control their compliance and can conduct inspections. The PRO also has to report data and information to the Regional Authorities.

There are no national quality parameters for collected glass. Recycling companies set their own quality systems and specifications.

⁴⁹ <http://prawo.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WMP20190000866>

⁵⁰ <http://prawo.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20170000019>

Financing: There are several PROs for packaging in Poland. PROs provide municipalities with funding for communication activities. The conditions for getting subsidies are defined by the different PROs (signing a contract with the PRO, providing a recycling certificate issued by a recycler, etc.). PROs also organise communication activities targeting the general public.


In order to get some additional information about the framework conditions in Poland, an interview with a national contact point was carried out. Below there are some considerations come up during the interview with Piotr Kardas from Polish Glass, on 30 July 2020. The following points reflect the view of the person interviewed.

Considerations about the framework conditions in Poland - Interview with Piotr Kardas from Polish Glass, on 30 July 2020

- To improve the recycling system for glass packaging waste, two main challenges have to be addressed: increase both the quantity (collection for recycling rate) and the quality of the glass packaging waste.
- Current issues are not caused by competition in place among PROs but by the lack of regulations.
- There is a general lack of funding for improving source separated collection and recycling. Local waste taxes can hardly be increased to cover the cost of such investment. However, there are positive evolutions as some recyclers have invested (mainly from national and EU funds) in most efficient technologies and R&D in the past years, so improvements should come in the next years.
- DtD collection system generate high level of impurities, also because the glass packaging waste is generally collected with plastic bags.

3.6.6 Portugal

Portugal	
Population (1 st January 2020) ⁵¹	10.30 million
Type of EPR	Financial responsibility
Scope of EPR	Households, commercial incl. HoReCa (< 1,100 l produced per day, above it is classified as industrial and not included in the EPR system)
Recycling rate (2017) ⁵²	49%
Glass packaging to recycling operation (2017) ⁵³	186 kt 18.00 kg/inh ⁵⁴
Number of container glass factories	6 (belonging to 3 companies)



⁵¹ EUROSTAT database, accessed on 09/10/2020

⁵² EUROSTAT database, accessed on 09/10/2020

⁵³ EUROSTAT database, accessed on 14/02/2020

⁵⁴ Calculated by dividing the glass packaging to recycling in 2017 (EUROSTAT) by the population in 2017 (EUROSTAT)

3.6.6.1 National legislation

The EU Directive 2018/852, amending Directive 94/62/EC on packaging and packaging waste, lays down minimum recycling targets by weight for glass packaging waste of 70% by 2025 and 75% by 2030.

The European Waste Framework Directive (WFD) 2008/98/EC of the European Parliament and of the Council of 19 November 2008 is currently applied at the national level through the Decree Laws (“Decreto-Lei”) No 67/2014 of 7 May, and No 165/2014 of 5 November, which amended the Decree Law No 73/2011 of 17 June.

3.6.6.2 Taxes and ban on disposal

Portugal sets the landfill tax of 11€/t without introducing any modulations. The competence of the landfill tax is at the national level.

In Portugal, disposal operations by way of incineration are also subjected to tax. Incineration taxes are charged with variable rates according to several criteria (environmental protection systems, sorting performances, etc.) and the competence can be at the national or regional level.

3.6.6.3 Pay as you throw scheme

PAYT is only used in pilot projects. Currently, in Portugal, waste taxes depend on the water consumption of households. There are neither incentives nor penalties in place.

3.6.6.4 EPR schemes

In Portugal there are three PROs managing glass packaging that own a license (with the same obligations) to operate within SIGRE⁵⁵ (EPR scheme for packaging waste). The fillers choose to which of the three PROs they want to delegate the non-reusable packaging waste management responsibility. Sociedade Sociedade Ponto verde, the historic PRO, owns about 80 % share of the market. Each PRO takes care of the waste which falls into their own share of the market. Then, they issue tenders for the glass manufacturers. The three PROs, although in competition, share the same criteria and work in a similar way.

The municipalities issue contracts within the framework set out by SIGRE.

Collection: the municipalities are responsible for organising the collection of packaging waste. Municipalities can form associations of municipalities, and either operate collection through an intermunicipal company (“intermunicipalities”), or create a concession to do so (“multi-municipalities”).

For glass, bottle bank is the main system in place. Other systems are in place in Portugal, but with lower coverage (e.g., there are door to door collection systems in historical centres, bigger sized HoReCa, and in several pilot projects).

Processing and recovery: the mission of the PROs is to organize and manage the collection and recovery of packaging on behalf of packers/fillers/importers and distributors (against an EPR fee).

Municipalities collect waste and hand over the material to the glass manufacturer tendered by the PRO to take care of the transport and recycling of glass. Each year, the tender is launched for the following year.

The material is not treated by the municipalities before the manufacturers takes the material to the treatment plant. There are only 2 treatment plants in Portugal (one owned by one of the 3 glass manufacturers).

⁵⁵ https://www.pontoverde.pt/en/como_funciona.php

Municipalities inform the PROs about the expected quantities of glass to be collected in the year to come, so the PROs can launch the tenders.

In terms of financial flow, glass manufacturers buy glass to PRO that buy the glass packaging waste from municipalities.

Monitoring and control: the PRO controls the collected quantities and the quality of the sorted materials. The national authority oversees the compliance with the regulation through a national environmental agency (APA - Agência Portuguesa do Ambiente⁵⁶), and audits of the data and financial information are performed on a regular basis.

The HORECA sector is considered as the main source of contamination (high level of ceramics in the collected glass).

Mandatory Technical specifications apply at the national level through the Office Laws (“Despacho”) No 15370/2008. Quality requirements for unprocessed glass packaging waste include a threshold of 2% (by weight) maximum contamination with impurities and other specifications. Specific limits are set for: CSP (size ≤ 40mm) ≤ 0,05% by weight, CSP (size > 40mm) ≤ 0,5% by weight, magnetic metals < 0,75% by weight, Non-magnetic Metals ≤ 0,2% by weight, organic matter ≤ 0,5% by weight⁵⁷.

Financing: functioning as a non-profit organisation PROs fully allocates their annual overall income to cover the additional costs (considering the saving from landfilling) of municipalities in regard to collection and sorting, promotion of communication and environmental education as well as research & development projects. In order to reward or penalize the fulfillment or non-fulfilment of the applicable recovery targets and the quality of the service provided in the previous year, the management entities include in the billing to the SGRU (Sistema de Gestão de Resíduos Urbanos = intermunicipalities) a bonus or penalty, according to performance indicators. There is also a coefficient taking into account the quality of the collection service (e.g., density of collection points, up to 200 m between 2 collection points is perceived as good⁵⁸). The support fee for selective collection and sorting, ranges from EUR 32 to 60/t in mainland. In the Região Autónoma da Madeira (RAM) and Região Autónoma dos Açores (RAA), the support fee is EUR 62/t.

The financial compensation for the glass packaging waste recovered from the municipal mixed waste stream by Mechanical Biological Treatment (MBT) is EUR 71/t in mainland and EUR 48/t in Madeira and Azores Islands. However, the coverage of the MBT treatment is really minimal for glass packaging waste.

In order to get some additional information about the framework conditions in Portugal, an interview with a national contact point was carried out. Below there are some considerations come up during the interview with Beatriz Freitas from AIVE (Association of glass packaging manufacturers), on 30 July 2020. The following points reflect the view of the person interviewed.

Considerations about the framework conditions in Portugal - Interview with Beatriz Freitas from AIVE (Association of glass packaging manufacturers), on 30 July 2020

- SAYT - save as you throw scheme could be an interesting rewarding approach to encourage source separation
- the increase of the landfill tax is currently under discussion
- Strengths of glass recycling in Portugal:
 - Bottle banks in place throughout the country (an approximate average quantity of one bottle bank per 240 inhabitants)
 - The glass collected by the municipalities has been bought by glass packaging manufactures via tender, and so the cullet is only reprocessed into new packaging

⁵⁶ <https://apambiente.pt/index.php?ref=16&subref=84&sub2ref=197&sub3ref=276>


⁵⁷ https://dre.pt/pesquisa/-/search/2516665/details/maximized?p_p_auth=swF79OqX

⁵⁸ Gabinetes dos Secretários de Estado Adjuntoe do Comércio e do Ambiente, Despacho n.º 14202-C/2016

- Significant demand for recycled glass in Portugal
- Weaknesses of glass recycling in Portugal:
 - Mismatch between local glass production and local glass consumption (export-driven cullet market)
 - Significant amount of glass still going to landfill
- Opportunities of glass recycling in Portugal:
 - Improve collection for HORECA sector
 - Development of strong awareness-raising communication campaigns
 - There is the treatment and manufacturing capacity to absorb more cullet in Portugal
 - Assessment of the current fees paid by the waste management systems that do not meet recycling targets, in order to revise the fee system to make it more incentivising
- Threats:
 - The deposit-return scheme on single-use beverage packaging to be introduced after 2022 for glass (also plastic and cans) might negatively impact the current system
 - The new calculation method set by Directive (EU) 2018/852 can reduce the current recycling rate

3.6.7 The United Kingdom

The United Kingdom	
Population (1 st January 2020) ⁵⁹	67.03 million
Type of EPR	Financial responsibility (tradable certificates)
Scope of EPR	Households, commercial (e.g., HORECA sector)
Recycling rate (2017) ⁶⁰	67.6%
Glass packaging to recycling operation (2017) ⁶¹	1.622 kt 24.64 kg/inh ⁶²
Number of container glass factories	9



⁵⁹ EUROSTAT database, accessed on 09/10/2020

⁶⁰ EUROSTAT database, accessed on 09/10/2020

⁶¹ EUROSTAT database, accessed on 14/02/2020

⁶² Calculated by dividing the glass packaging to recycling in 2017 (EUROSTAT) by the population in 2017 (EUROSTAT)

3.6.7.1 National legislation

Packaging recycling obligations for packaging producers are determined by national business targets set by the government. The target for the obligated businesses⁶³ (within the scope of the EPR scheme) is 80% for 2020 (targets for 2025 and 2030 are under consultation)⁶⁴.

3.6.7.2 Taxes and ban on disposal

The UK sets the landfill tax of GBP 96.70/t (April 2021⁶⁵). The competence of the landfill tax is at the national level.

Scotland has introduced a ban on landfill for source-separated waste since 2014 and Northern Ireland has a ban for separately collected food waste since 1st April 2015.

3.6.7.3 Pay as you throw scheme

PAYT is not used in the UK. However, discussions about systems rewarding citizens who recycle well are ongoing.

There is an action implemented in Swansea (South Wales), which set fines (up to GBP 100) that are issued in case of failures in source separation by citizens.

The recycling rate for businesses (e.g., Hospitality businesses) is generally quite poor, especially in England where there is no obligation for businesses to separate recyclables (this is not the case in Scotland and Wales). Commercial waste is collected by companies contracted by businesses (in the same street there could be several companies collecting commercial waste, while household waste is collected by companies contracted by area or zone).

3.6.7.4 EPR schemes

The fillers pay the EPR fees to comply with the EPR scheme. There are several PROs for profit and privately owned companies. Valpak is the UK's largest Packaging Compliance Scheme and purchaser of PRNs / Packaging Export Recovery Notes (PERNs). VALPAK was created in 1997, when the Packaging Waste Regulations first came into force, as a means to outsource legal compliance to a third party. Valpak is the UK administrator of the Green Dot licence on behalf of PRO Europe, the umbrella organisation for packaging schemes throughout Europe, which manages the Green Dot trademark worldwide.

Collection: it is under the responsibility of the local authorities that can choose to operate source separate or co-mingled collections (either via Door to Door or Bottle Bank system). The local authorities (in case of inhouse operations) or waste management companies (depending on the terms of the contract issued by the local authority) collect, sort, and sell the waste packaging to accredited reprocessors or exporters.

Processing and recovery: the sorted waste material is bought by reprocessors or exporters. All companies in the UK performing recycling activities for packaging must become accredited and report all their recycled quantities. When recycling or recovering one tonne of packaging material, reprocessors issue Packaging Recovery Notes (PRN) that are then sold to companies (putting glass packaging on the market) or compliance schemes to which companies are registered to; for exporters, Packaging Export Recovery Note (PERN) are issued.

⁶³ Business that handled and supplied to UK markets over 50 tonnes of packaging and had a turnover in excess of GBP 2 million in their last audited accounts

⁶⁴ DEFRA consultation document (March 2019)

⁶⁵ <https://www.gov.uk/government/publications/excise-notice-lft1-a-general-guide-to-landfill-tax/excise-notice-lft1-a-general-guide-to-landfill-tax>

Monitoring and control: glass PRNs are issued when the cullet is produced and so will exclude any contamination, including caps, closures and corks. Exports also need to account for contamination prior to reporting on NPWD (National Packaging Waste Database). Where the glass is collected separately, a 3% loss is assumed for contamination (primarily caps and closures). It is assumed that glass collected with other materials will be reported with 10% contamination levels⁶⁶. PRNs are regarded as certificates that show a company has met its obligation to fund recycling of packaging. They are either bought by compliance schemes on behalf of their members or by the companies themselves. They are also submitted to the Environmental Agency along with data for proving the compliance.

Financing: PROs support the activities of glass processors by buying Packaging Recovery Notes (PRNs) issued according to the processed quantities. The EPR scheme in the UK uses a system of tradable credits for packaging. When a company, or a group of companies, meets specific criteria (like handling over 50 tonnes of packaging supplied to the UK markets yearly, having a turnover in excess of GBP 2 million), it must buy PRNs according to the quantity of packaging put on the market. All companies in the UK performing recycling activities for packaging must be accredited and report their recycling performances. The PRNs market is based on supply and demand, with prices fluctuating depending on whether the market is short or in surplus when compared to annual targets. There are many factors that feed into this, such as the targets themselves, recycling performance against those targets and world socio-economic events.

In 2019, PRN prices ranged from GBP 20/ton to 30 /ton approximately⁶⁷. About 10% of the costs are covered by PROs. There is debate about increasing the coverage of costs (also including collection, littering) by glass packaging industry.

3.6.7.5 Organisation of collection

The collection systems do not resort to the separation by colour, although it used to be the case (through bottle banks in the 1970s). The UK present a significant share of co-mingled collection (61% of the glass packaging is collected comingled with other dry recyclable materials via a door to door system, according to GlassFlow 2025, WRAP, 2017).

Source separation of glass provides significantly better results in terms of quality and less losses along the recycling route:

- 3% for Source separate collection,
- 10% for commingled collection.

Around 7-8% of the glass is rejected during the cullet-making process whilst removing CSP; however, this is assumed to be recycled (GlassFlow 2025, WRAP, 2017).

In order to get some additional information about the framework conditions in the UK, an interview with a national contact point was carried out. Below there are some considerations come up during the interview with Phil Fenton, Lead Packaging & Recycling Adviser at British Glass, on 29 July 2020. The following points reflect the view of the person interviewed.

Considerations about the framework conditions in the United Kingdom - Interview with Phil Fenton, Lead Packaging & Recycling Adviser at British Glass, on 29 July 2020

- Wales is the best recycling region, so it could be looked as a reference for good practices.
 - The majority of local authorities in Wales follow the Collections Blueprint, achieving an 87.3% glass collection rate at the kerbside in 2015 and likely higher still in 2019 – less than 3% off our goal of 90%.

⁶⁶ (GlassFlow 2025, WRAP, 2017), <https://www.wrap.org.uk/content/glass-flow-2025-%E2%80%93-glass-packaging-flow-data-report>

⁶⁷ <https://www.wrap.org.uk/content/glass-prn-prices>

- There are several challenges the glass supply chain must overcome to achieve a collection rate of 90% by 2030 (*Recycle it right Roadmap*⁶⁸):
 - Inconsistency of source separated collection system across the country, creating confusion among citizens and inefficiency for processors and recyclers
 - Lack of funding: there has been a lack of investment in UK recycling with the total amount of money budgeted by councils to spend on recycling services dropping from £630m in 2013/14 to £569m in 2016/17⁶⁹. Due to the UK Government's austerity agenda, local authorities have had to make decisions based on cost cutting rather than maximising recycling. In addition to public funding, Packaging Waste Recovery Notes (PRN) drive investment into UK recycling, however, they do not currently require producers to pay the full net costs of recovery, only contributing around 10 to 20% of the collection costs to local authorities⁷⁰.
 - Fixing a target on glass going to re-melt would help achieving circularity
 - Business waste should be put in the focus: around a third of glass packaging being consumed within the hospitality sector⁷¹. Whilst there is a legal requirement for businesses in Wales and Scotland to separate their waste for recycling, this is not currently the case in England
 - Colour imbalance: whilst there is a good supply of green cullet in the UK, due to large quantities of green wine and beers bottles being imported into the UK, the UK has a higher demand than supply for clear glass largely due to the production and export of spirits. In the UK, other than spirits, much clear cullet is used in food containers such as sauce bottles, jars and ramekins. Food container glass is recycled less regularly than drinks bottles often due to consumer confusion around recyclability. Communications must be improved to increase recycling of valuable clear glass to increase the supply of clear cullet⁷².
 - There is a need for continued innovation to increase efficiency in the recycling system (from collection, to the material recovery facility, to reprocessing) to keep losses to a minimum and increase yields.
- By 2023, the UK government wishes to introduce a DRS (mostly for plastics and cans), the glass industry highlights some issues about including glass in DRS schemes such as the risk to break glass bottles at reverse vending machine stage, the significant rate (about 15%⁷³) of glass packaging put on the market which is not represented by bottles, e.g., food jars, and so requiring door to door or bottle bank systems for source separate collection, which might affect the overall cost effectiveness of such system.

The elements presented above seem to indicate that low performances can be linked with insufficient regulation and cost coverage by the EPR system. Many interviewees insisted on the importance of cooperation among the different players and highlighted common challenges, such as the need to improve the quality of sorted fraction (by local actions, but also by implementing schemes rewarding quality), and the low performances of glass collection from the HORECA sector.

It is interesting to consider the propositions formulated by the Early Warning Reports that the European Commission addressed to 14 Member States that were identified as at risk of missing the

⁶⁸ <https://www.britglass.org.uk/our-work/recycling/recycle-it-right>

⁶⁹ <https://www.dssmith.com/recycling/insights/recycling-tipping-point>

⁷⁰ <https://www.letsrecycle.com/news/latest-news/councils-benefit-more-prn-system/>

⁷¹ <https://www.biffa.co.uk/-/media/files/download-pdfs/recycling-collection-april-2019.ashx>

⁷² Glass recycling (England and Wales), Toluna Surveys, Feb 2020

⁷³ <https://www.wrap.org.uk/sites/files/wrap/GlassFlow%202025%20Report.pdf>

3. Framework conditions

2020 target for municipal waste recycling. Three of the targeted countries are concerned by these reports: Poland, Portugal, and Spain.

Among the listed recommendations, the following ones can be linked with the observations formulated above:

- The need to improve the EPR schemes and provide better cost coverage for local collection (PL, PT)
- The need to develop more economic incentives for local authorities: binding targets and harmonised taxes on disposal (SP), fines for not reaching the targets (PT, PL), adjustment of funding schemes by the national authorities to ensure sufficient funds for investments (PT)
- The need to provide technical support to improve waste collection and sharing of good practices (mentioned for all three countries)
- The need for better monitoring and assessment of local performances (PL, SP)

4 Local waste collection systems for glass packaging waste

This part focuses on local performances on municipal waste collection systems. Municipalities are key players for the collection of glass packaging, considering that they are in charge of municipal waste management. Many municipalities (or groups of municipalities) coordinate packaging waste collection, either themselves, or by commissioning a public or a private company to do so. Even when packaging waste management is coordinated by producer responsibility organisations, local authorities are closely associated in the design of the waste collection system, and have an important role to promote separate collection through communication or incentives such as pay-as-you-throw schemes.

As explained above, municipal waste collection performances depend on the general framework conditions, but also on the local choices made by local authorities or waste operators when it comes to the dissemination of information, the technical operations, and the instruments implemented to incentivise waste separation by inhabitants.

The previous part presented data regarding the organisation of waste collection and national performances in the seven targeted countries. These data provide an exhaustive overview regarding the general organisation of municipal glass waste collection and average performances; however, it does not allow to have more insight on the discrepancies linked with specific local contexts or with local strategies.

To get more insight on the diversity of local approach and identify trends between local context, local strategies, and performances, a database of waste collection system located in the seven targeted countries was established, based on data collected by the COLLECTORS projects and completed with further researches and checking of data. The territories are either individual municipalities or “municipal associations” to which municipalities transferred their waste competences. This database includes local data focusing on the following information:

- **Contextual data:** information on the context of the territory (e.g., population, density, touristic activity, etc.);
- **Organisation of waste collection for residual waste, glass packaging waste, and other packaging waste:** information on source separation systems, collection modes in use, the number of collection points or the collection frequencies, or the fee system;
- **Performances of the glass packaging waste collection:** information on collected quantities for residual waste and glass packaging, unsorted quantities, collected quantities per collection mode, etc.
- **Other data:** various data on costs, the outcome of sorted fractions, etc.

Documenting individual collection system in a homogeneous manner is a time-consuming process: local data are not necessarily easily available, and data collection also requires the analysis of the waste collection system to ensure that the interpretation of data is correct. Therefore, it is very challenging to come up with a database including systems from different countries, which would also be representative of European waste collection systems.

The panel reflects many different contexts. **Despite the fact that it cannot be presented as a representative view of glass packaging waste collection in Europe, it gives a good overview of the diversity of contexts and of organisation for waste management.** The data and information presented below cannot be regarded as a representative description of the average organisation and performance of glass packaging collection, but rather than an illustration of the diversity of approaches, and a first analysis as why local collection systems perform differently.

4.1 Presentation of the approach

4.1.1 Comparable territories

Municipalities operate in a given framework set by the national regulation and the organisation of the EPR system, yet they also have a range of possibilities to optimise the performance of packaging waste collection, or to adapt the system to local specificities. These local constraints are important to consider when comparing performance, since they might have an impact on waste generation, or on the possibility available for setting the right “sorting framework” for waste generators (e.g., inhabitants).

Good sorting systems generally rely on three guiding principles:

- **Information:** the inhabitants must be aware of what they are supposed to do to sort their waste (what fractions to sort, what fractions are excluded, how, where, and when their waste is collected, etc.).
- **Convenience:** the collection system must be organised so that it is perceived as convenient for the inhabitant. For instance, the number of sorted fractions must be adapted to the space available for pre-collection in housings, the collection frequencies should limit the nuisance of waste storage, and bring points should be easily accessible.
- **Incentives:** inhabitants must be given “a good reason” to do the right thing. This can be achieved through communication actions (e.g., by highlighting the positive impact of waste sorting), or by implementing bonuses or penalties (obligation of sorting with fines for non-compliance, charging the inhabitants according to their production of residual waste, rewarding good sorting behaviours, etc.).

Specific constraints might make the implementation of these principles more challenging: for instance, vertical housing makes it more complicated to directly reach the inhabitants, high density limits the space for pre-collection and collection equipment, newcomers and tourists might be more complicated to inform, etc. It is therefore useful to understand how these constraints impact sorting performances, and to compare territories sharing similar challenges to come up with transferable good practices.

4.1.2 Source and organisation of data

Most of the data used for this analysis were collected by the COLLECTORS consortium. COLLECTORS⁷⁴ is a H2020 project aiming to identify good practices for the collection of paper and packaging, WEEE, and construction and demolition waste. One of the first part of the project was to document a large panel of waste collection system representing various situation across Europe. This resulted in the documentation of 135 waste collection systems for paper and packaging waste, with relatively recent datasets (between 2014 and 2018).

The relevant parameters to document local waste collection systems were discussed and validated with FEVE and FERVER.

For this analysis, the available data on glass packaging of waste collection systems located in the seven targeted countries were extracted, checked, and completed with further research. Specific efforts were devoted to check the quality and comparability of data (verification of the consistency of data with the descriptions of the waste collection systems, distinction between source separated and co-mingled streams, identification of glass quantities among co-mingled fraction, exploitation of available qualitative information, etc.). The database was also completed with several extra waste collection systems for countries where a low share of the national population was covered.

⁷⁴ <https://www.collectors2020.eu>

This resulted in a database of **67 waste collection systems** for which data on glass packaging could be retrieved. An overview of the documented systems is presented in the following part.

Further researches were made to match the parameters agreed on with FEVE and FERVER. However, several parameters could not be properly documented due to a lack of data. Moreover, data about costs (running costs, waste fees, etc.) prove to be hardly comparable and difficult to analyse: definitions and calculation methods are likely to be very different from one waste collection to another (e.g., whether incomes from materials sales or subsidies are included in the costs or not, how the costs are allocated to the different waste fractions for which resources are shared, whether administrative costs are included or not, etc.).

It proved very challenging to identify local data on the quality of sorted fractions. When reaching several local waste experts, it seems that detailed data on impurity rates are not consistently available at municipality level, even though information on the quantities rejected when entering recycling facilities can be available, even more so when EPR fees given by PRO to local authorities for the take-back of sorted materials depends on their quality. Besides, how the data could compare was not clear (e.g., some data seem to refer to the rate of rejected quantities when entering the transfer/treatment facility, while other also include the actual quantities rejected during the recycling process). However, average data were provided by FERVER, based on a survey addressed to their members. These data provide the rate of furnace-ready cullet extracted from glass packaging waste by type of collection mode and source separation. These average data were incorporated in the database according to the available information on the collection modes (bottle banks, door-to-door, collection in plastic bags, etc.) and types of source separation (colour separation, co-mingling with other types of recyclables, etc.). Even if the use of average data includes a share of uncertainties, it allows to assess the actual sorted quantities in a better way than collection rates do. However, it should be noted that there are uncertainties regarding the rates of non-comingled, door-to-door collection, for which little data is available. Data also show an important consistency for the rates associated with bottle bank systems, and quite inconsistent rates for co-mingled, door-to-door collection systems.

Any possible bias linked to inconsistencies among local datasets will be highlighted in the analysis.

4.2 An overview of the documented waste collection system

4.2.1 Geographical coverage

The collected data on paper and packaging waste covers 67 systems in the seven countries targeted by this study, as presented in the list below.

Table 2: Population covered by the waste collection systems (WCS) documented for this study

	Number of documented WCS	Covered population	Share of the countries population covered
France	21	12,280,079	18%
Germany	13	9,261,873	11%
Italy	9	6,233,551	10%
Poland	4	3,170,309	8%
Portugal	4	1,818,796	18%
Spain	8	6,384,090	14%
UK	8	10,959,025	16%

As mentioned earlier, the panel cannot be regarded as completely representative of the European situation as a whole, or of the average situation in each Member States (which was presented in the

previous part of this report). However, they reflect various types of organisation and contexts which makes their cross-analysis interesting.

4.2.2 Typology of territories

The panel of documented WCS include various types of contexts when it comes to the density of population, GDP, and touristic activities. Different categories for these parameters were establish, to ease cross-analysis among the WCS. The distribution of WCS among these different parameters is presented in the tables below:

Table 3: number of documented waste collection systems by categories of population density, GDP per capita, and number of overnight stays per resident population

Population density (in inh./km ²)	Nb of WCS	GDP per capita	Nb of WCS	Number of overnight stays per resident	Nb of WCS
1. 0 - 250	10	1. 10000 - 20000	12	1. 0 - 2.5	7
2. 250 - 500	6	2. 20000 - 25000	12	2. 2.5 - 5	21
3. 500 - 1500	17	3. 25000 - 30000	13	3. 5 - 7.5	16
4. 1500 - 2500	16	4. 30000 - 40000	15	4. 7.5 - 15	8
5. 2500 - 5000	11	5. 40000 - 50000	7	5. 15 - 25	5
6. >5000	6	6. >50000	8	6. >25	4

The database includes a good distribution of big cities and more remote areas (ranging from 5 to 21,000 inh./km²), several high-tourism territories (up to 200 overnight stays per resident), and various profile in terms of GDP (ranging from 10,000 to 80,000 €/inh.). These parameters are known to be correlated with packaging waste generation and collection.

4.2.3 Limits of data collection

Data collection proved difficult for several parameters:

- **Scope of glass collection:** whether commercial glass is included is not always clear. Some WCS organise a specific collection scheme for the HORECA sector (e.g., a door-to-door system in parallel of the bring bank system for households). It is possible that the fact that the majority of WCS use bottle banks makes it challenging to control their use by commercial activities. Besides, local authorities rarely hold specific data on commercial waste quantities.
- **Sorting obligation:** some cities have implemented a legal obligation for packaging collection. For instance, both households and assimilated waste generators have to sort packaging in Brussels, and punctual controls of the presence of packaging waste within the residual bins or bags are performed. However, information on local sorting obligations could not be easily identified. Besides, obligations properly work when it is properly enforced (e.g., with controls), and little data is available on systems controlling the compliance of the sorting obligation.
- **Costs:** few data could be collected on cost of glass packaging. Moreover, and as stated above, the collected data on glass might be quite inconsistent among the documented WCS. In general, obtaining consistent and comparable data on local costs for municipal waste collection is a time and resource-intensive process.
- **Littering and glass packaging escaping the local WCS:** while data can be obtained on the quantities of waste generated by street cleaning, it is uncommon to find local composition analysis of littering. The fact that street cleaning and waste management might be managed by different services at local level also contributes to make data collection complicated. It is also possible that data on unsorted quantities only cover residual waste, and not street bins.
- **Quality and levels of impurity:** the rate of impurities is available only for a few waste collection systems. Whether the information is available or not for local authorities is unclear,

yet it seems that several waste collection systems indicated that there is no information at municipal level.

4.3 Organisation of glass packaging management

4.3.1 Responsibility and scope of collection

The exact scope of municipal waste might not be consistent across Europe. As mentioned above, municipal waste includes household waste, and generally a share of non-household waste similar in quantities and composition, called “similar” or “assimilated waste”. This assimilated waste might be produced by commercial activities or public institution, and it might be collected together with household waste or through specific collection scheme. Municipalities generally set specific rules for the inclusion of commercial waste, e.g., a maximum weekly volume of residual waste above which the waste generators cannot benefit from the municipal waste collection system.

However, it is challenging to clearly identify whether assimilated waste is included in the different data sets. Most of the waste collection systems documented for this study collect both household and assimilated waste, yet the information is not available for each waste fraction and the commercial activities (e.g., HORECA) included is usually not known. Therefore, the exact scope of municipal glass packaging waste collection is usually not available for each local WCS. Besides, there is usually no distinct data for the household and the non-household collected quantities.

Deposit systems are also in use for glass packaging, either with refillable bottles or for recycling, in several member states, e.g., in Germany. These systems are managed separately from the municipal waste collection system, yet they can have an impact on local figures, by making collected quantities per inhabitant comparably lower, or by “reducing” the quantities of unsorted glass packaging remaining in residual waste.

4.3.2 Collection of glass packaging

The data presented below include the 67 waste collection systems.

4.3.2.1 Source separation of glass

The collection systems set for glass packaging are quite diverse, even though some schemes appear to be more widespread. When it comes to the separation system, source separation is the dominating approach.

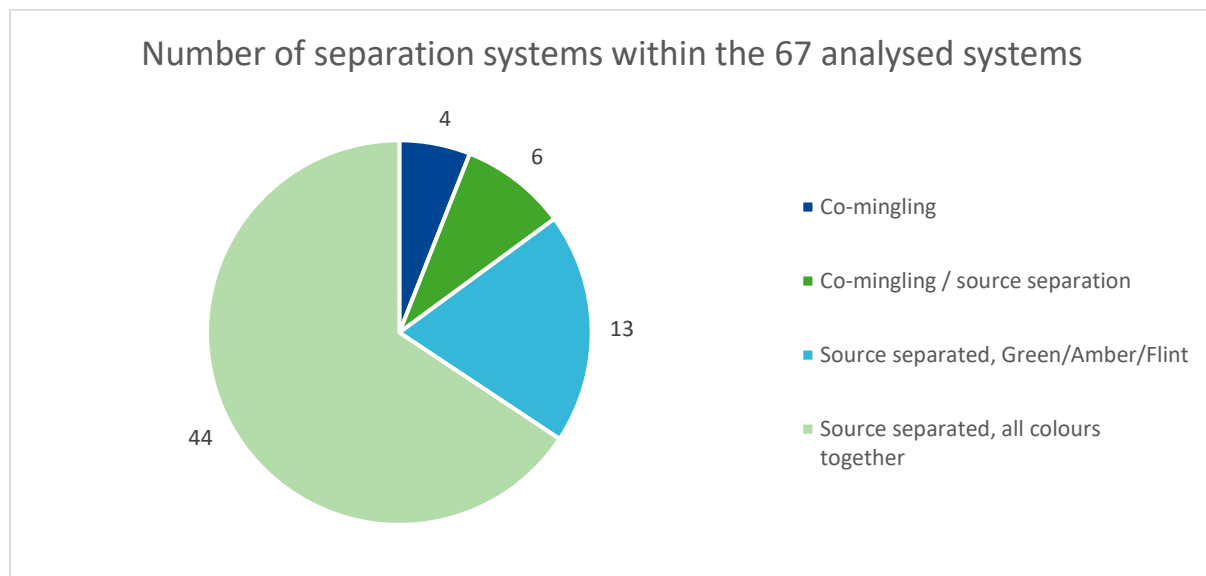


Figure 6: distribution of separation systems for glass packaging within the 67 documented WCS

4. Local waste collection systems for glass packaging waste

All WCS with colour separation are located in Germany, while systems using co-mingling are located in Italy (5), the UK (3), France (1), and Poland (1). The combinations of co-mingling are quite diverse, as presented in the table below:

- 3 of them combine glass packaging with metal packaging. They are all located in Italy.
- 2 of them combine glass packaging with metal and plastic packaging. They are also located in Italy
- For the other systems all dry recyclables are co-mingled, meaning glass, plastic, metal, and composite packaging, with paper and cardboard.

Three of the waste collection systems out of the four using only co-mingled collection for glass packaging present a very high population density. Otherwise, there is no clear contextual element that is commonly found for waste collection systems co-mingling glass with other materials.

4.3.2.2 Collection modes for glass packaging

The collection modes are also quite diverse among the documented waste collection systems. The collection modes covered by the study are the following:

- Door-to-door collection (where the collector picks up the waste from each different housing);
- Bottle bank collection (where waste generators have to dispose of their waste in containers located on the public space such as supermarket parking, street corners, etc.);
- Civic amenity sites: fenced, guarded areas where inhabitants can dispose of various types of waste, generally including bulky waste and recyclable fractions;
- “Other” (re-use centres, collection on demand, punctual collection points, etc.)

The classification between door-to-door and bottle bank collection systems can be challenging. Here, a system resorting to containers located on the public space and not allocated to a very specific group of housing is regarded as a “bring bank” system. A set of containers located within the premises of one given group of vertical housing and dedicated to this group will be regarded as a door-to-door system. Civic amenity sites are guarded, fenced-off areas where inhabitants can dispose of and sort out their household waste into receptacles in order to be recycled or otherwise treated.

Besides, it is important to note that these categories encompass different practices, that might lead to different behaviours or outcomes in terms of quality:

- **Door-to-door** collection can be performed using different equipment: wheelie bins (with locked lids and round opening, or not), plastic bags, crates... Collection in bags adds contamination to the glass fraction that will need to be removed in recycling centres;
- **Door-to-door** collection can be done through containers that are shared by different households in a block of flats. This means that improper behaviours from one inhabitant can contaminate the proper sorting of others, and that it might be more challenging to identify households not sorting properly;
- **Bottle-banks** might also take different forms. For instance, most bottle banks have round opening that limit the type of waste that can be put, yet it is not always the case. This is also true for wheelie bins used for door-to-door collection.

In many territories, different collection modes are used in parallel, either depending on the location, the type of housing, or the type of waste producer (e.g., households have to use a bring bank system while commercial activities are collected door-to-door). The level of precision for the data on collection modes differs from one WCS to another; in some cases, the collected quantities are not available for each collection mode. The collection systems were classified according to the share of collected quantities for each collection methods:

4. Local waste collection systems for glass packaging waste

- If more than 80% of the waste is collected by one type of waste collection method, it is labelled as “mostly door-to-door”, “mostly bottle bank”, etc.
- If more than 60% of the waste is collected by one type of waste collection method, it is labelled as “mainly door-to-door”, “mainly bottle bank”, etc.
- If no collection system falls into these criteria, the collection is labelled as “combined”.

For systems for which no data were available on the share of collected quantities according to the collection methods, the labelling was achieved according to the other information available (usually qualitative information or sorting guidelines).

The distribution of collection modes among the documented waste collection systems is presented on the graph below:

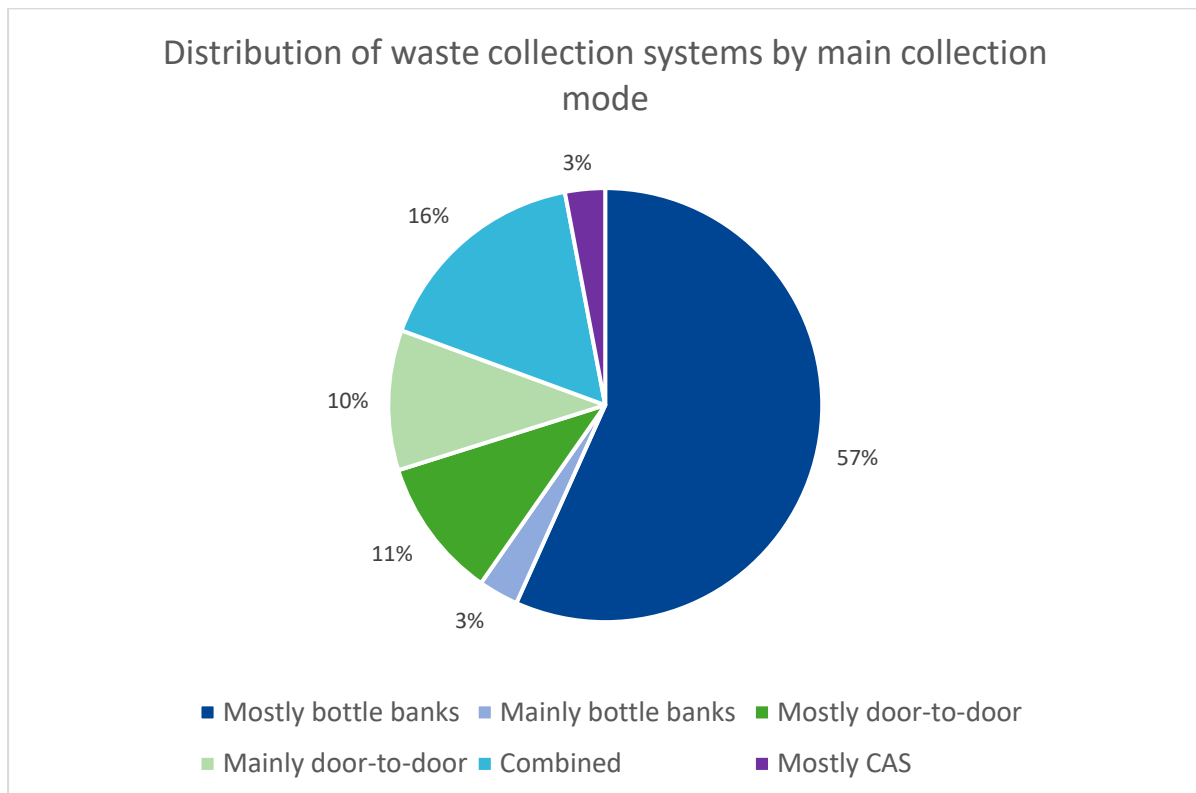


Figure 7: Distribution of collection modes across the 67 documented waste collection systems

Bottle bank is the main collection mode used, being the main collection system in almost 60% of the 67 waste collection systems, and also used in most of the WCS resorting to “combined” collection schemes as well. Around 10% of the 67 WCS use mostly door-to-door collection.

This is confirmed by the following graph, presenting the total collected quantities of glass packaging in WCS for which the distribution of collected quantities among the different collection modes is available:

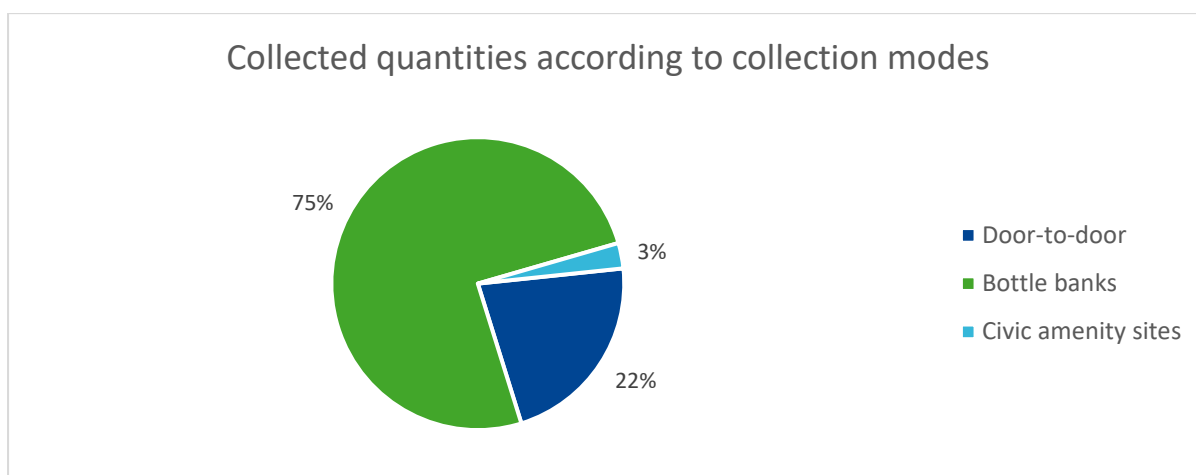


Figure 8: Collected quantities (in tonnes) according to collection modes

There is no clear correlation between the context or the typology of the territory and the collection mode used for glass packaging. WCS resorting mainly to door-to-door collection encompass various types of territories in term of typology, population density, GDP, and tourism activity, and are present in all seven countries. However, it seems that door-to-door systems are more common in more densely-populated territories.

However, it is worth noting that almost all the waste collection systems that predominantly use door-to-door systems for glass packaging also use such collection mode for the other recyclable fractions (paper and cardboard, and plastic, metal packaging, and drinking cartons). For systems using mostly bottle banks for glass packaging, the collection modes for the other recyclable fractions are more diverse.

Besides, the majority of system using co-mingling collection mainly use door-to-door collection systems.

When door-to-door collection is available, collection frequency ranges from once a month (for about 25% of the documented door-to-door systems) to once a week (for about half of the documented door-to-door systems).

The number of bottle banks per 10,000 inhabitants is quite heterogeneous, and ranges between 2 and 65 among the 38 WCS for which data on the number of bottle banks are available. The density of bottle banks ranges from 0.1 bottle bank per km² to about 30. There is no clear correlation between the local context and the number of bottle banks, despite the fact that denser territories tend to have denser networks of bottle banks.

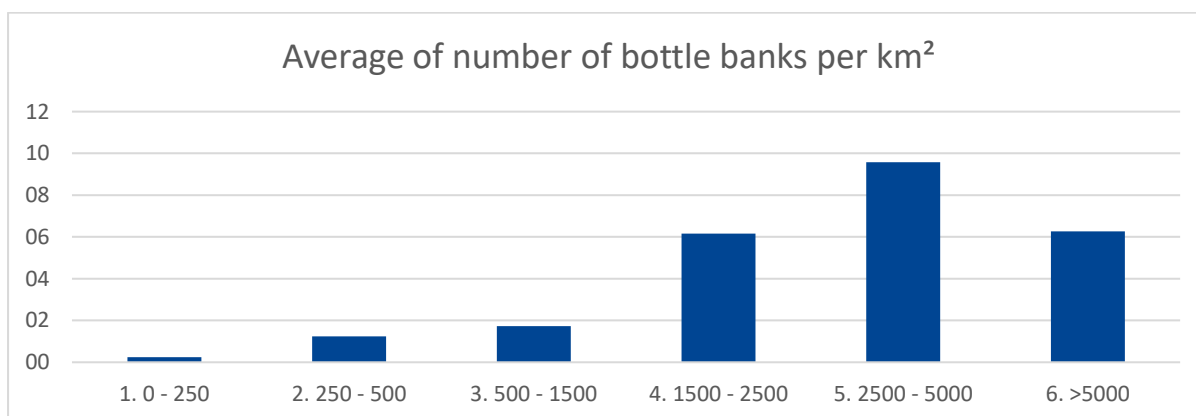


Figure 9: average number of bottle banks per km² according to the category of population density, for systems using mostly bottle banks for glass collection

4.3.3 Fee systems

Information was collected on the fee systems set by local authorities: whether they set a charging system according to the production of waste (usually residual waste) or not, and how the waste fee is calculated.

Only 19 waste collection systems among the total of 67 documented for the study have a pay-as-you-throw (PAYT) system; they are located in Germany and in Italy.

The majority of PAYT systems covered by the panel are based on volume and frequency, meaning that households will be charged either depending on the size of their residual waste bin, the collection frequency of residual waste (or the number of collections of their bin), or a combination of these two parameters. For instance, a household can be assigned a specific residual waste bin and a number of collection rounds per year, and any additional collection is charged an extra fee.

There are many other different PAYT systems across Europe: some are based on the number of residual bags used, or on the weight of residual waste collected. Other systems are only based on the size of the residual bin, or on the number of times the bring banks are used by the household (whose access is controlled by an individual card, which is used in several cities in Belgium and the Netherlands⁷⁵).

Non-PAYT systems documented in this panel consist in various fee systems: tax based on property value (used in France and in the UK), tax based on water consumption (used in Portugal), fee according to the size of the households, or a share of the municipal tax.

In many of the countries covered by the panel, the fee systems are quite homogeneous. In France and the UK, most systems are based on property value, while in Italy or Germany the most common system is based on volume and frequency when PAYT is used. Otherwise, the Italian systems mostly used a combination between the size of the property and the number of inhabitants per household.

The amount of the fee per household significantly varies across the panel, and ranges from 20 to 350 € per household. The average fee is around 115 €/hhld; the average fee of PAYT systems is very close to the average fee of non PAYT systems. However, and as stated above, the amount of the fee might not reflect the actual cost of waste management, since other incomes also cover the management costs (e.g., the EPR fees and incomes from material sales), and the local authorities might also only cover a fraction of the total cost with the fee, and use a part of its municipal budget to cover the rest. In Italy, there is a legal obligation to cover 100% of waste management cost with waste tax/fee.

4.4 Generation of glass packaging

At national level, generation of glass packaging is generally assessed according to the quantities of packaging put on the market. However, this data is not available at local level, and no consistent data is available regarding the consumption of packaging glass. To assess local waste generation at local level, it is common to consider both the sorted quantities, and the quantities remaining in residual waste, which are the two main routes that glass packaging is likely to take. This method does not include glass packaging that is illegally disposed (e.g., littered), yet there is little to no data on littering at local level. In a study⁷⁶ published by the European Commission on littering, an average assessment of 0.3 kg/cap/yr of littered glass packaging is calculated. Even if significant, this quantity is rather limited compared to the sorted and unsorted quantities collected and reported by local authorities. These quantities also include the quantities of non-glass materials improperly put with the glass packaging fraction (e.g., plastic bags, other types of packaging, etc.).

⁷⁵ Example of Amsterdam: <https://www.amsterdam.nl/en/waste-recycling/disposal-card-noord/>

⁷⁶ ICF (2018), *Assessment of measures to reduce marine litter from single use plastics*

4. Local waste collection systems for glass packaging waste

Data on the share of glass collected within the residual waste stream, i.e. unsorted glass, could be collected for 53 waste collection systems out of the 67 documented ones, and many WCS do not have specific figure for the composition of residual waste. The accuracy of data on unsorted waste is uncertain and might vary depending on the method used for the composition analysis of residual waste. If the composition analysis is done properly, it generally gives a good assessment of the unsorted quantities.

Glass generation per capita is very heterogenous among the panel, and ranges from about 20 to 85 kg/cap, with an average of 32.5 kg/cap for the 53 waste collection systems for which generation data are available. The distribution of WCS according to the glass packaging waste generation is presented on the graph below:

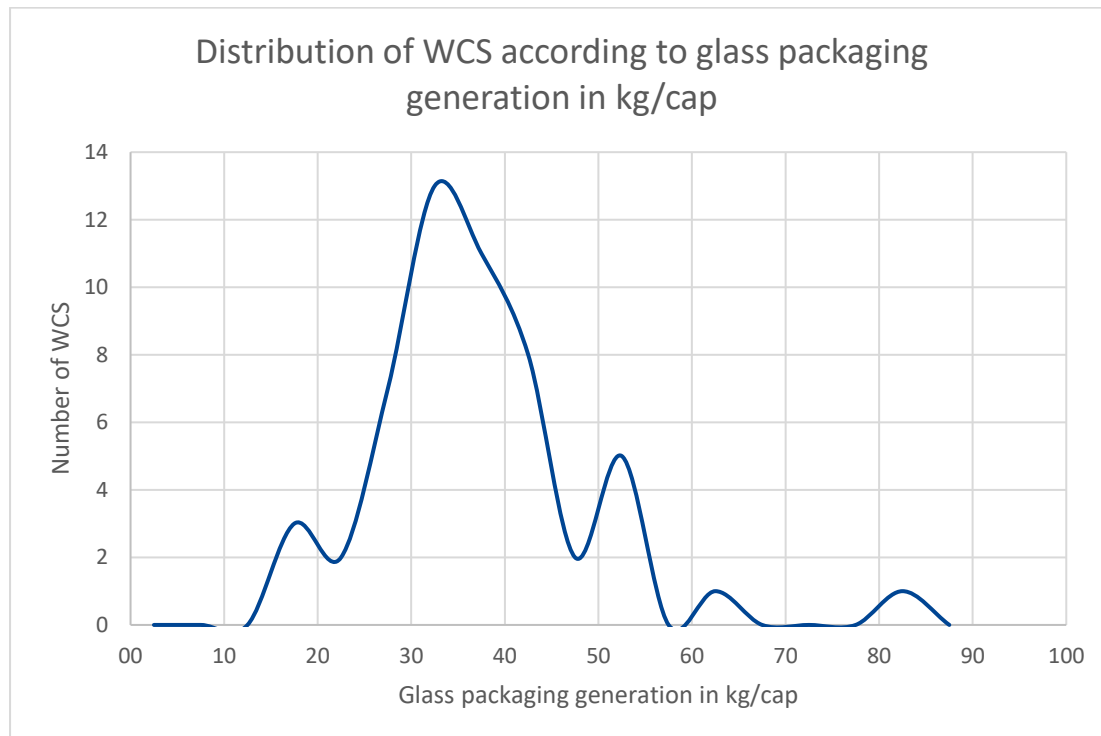


Figure 10: Distribution of WCS according to glass packaging generation in kg/cap

It appears that 75% of the WCS present a glass packaging generation between 25 and 45 kg/cap.

It is interesting to note that the average glass packaging waste generation reported by Eurostat is quite close to the average of the panel studied here (32 kg/cap in 2016).

While the average generated quantities of the documented WCS are usually quite close to the value reported by Eurostat, it is interesting to note that minimum and maximum observed values at local level can be quite different. It shows how data on collected quantities alone, or collection for recycling calculated on the basis of national average or quantity put on the market do not allow to have a clear understanding of the local performance. To properly assess local performances, information on the unsorted quantities should also be retrieved.

For the panel studied, glass packaging represents in average 20% of the total production of paper and packaging in terms of weight. Again, there are significant differences within the panel: glass represents from 10% to 40% of the generated paper and packaging waste at local level.

The reasons behind these differences are likely to be linked with the local context. This will be explored in part 4.6 on the role of the local context on glass packaging waste management.

4.5 Performances of glass packaging collection

To assess the performances of WCS, data on collected and sorted quantities were collected. To do so, both source-separated quantities and co-mingled fractions were taken into account, by assessing the quantity of glass collected within the co-mingled fraction (e.g., by identifying the quantities of glass sorted out of the mechanical sorting centres). Collected quantities varies very much within the panel, ranging from 4.5 to over 60 kg/cap. Glass represents between 5 and 70% of the total collected quantities of paper and packaging waste, with an average of 29%, which is above the share of glass waste in the total PPW generated quantities. This tends to show that the collection for recycling rate of glass tends to be higher than the average PPW collection for recycling rate.

The distribution of WCS according to the collected quantities is shown on the following graph:

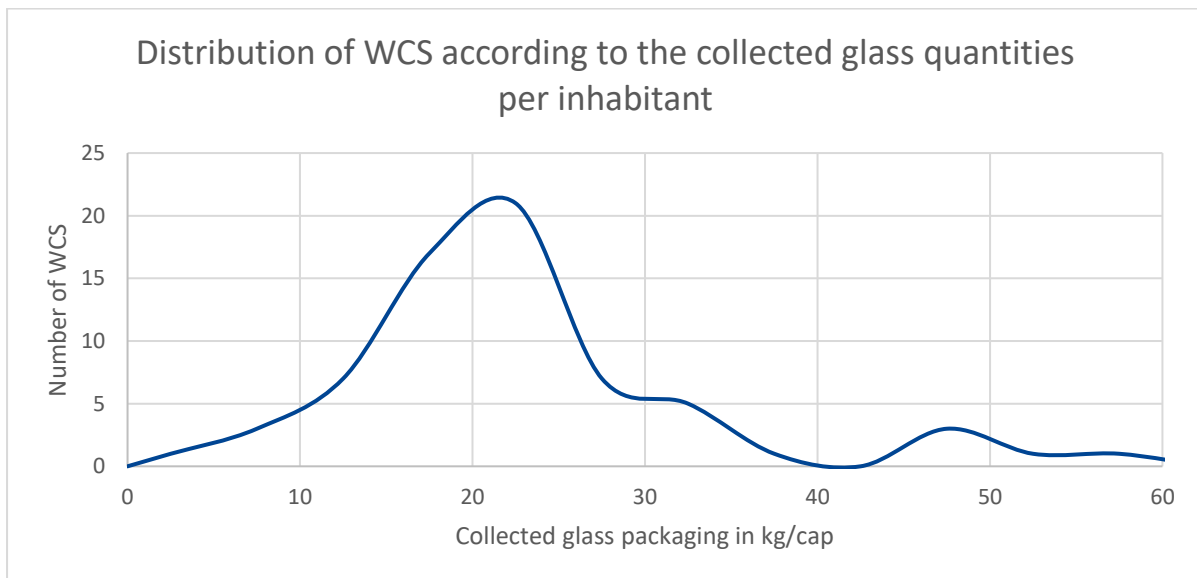


Figure 11: Distribution of WCS according to the collected glass quantities per inhabitant

About 75% of the WCS present collected quantities between 15 and 30 kg/cap.

However, and as shown in the previous part, the generated quantities can greatly vary from one WCS to another, which means that glass collected quantities do not provide a clear information on the actual performance of the system. One way to approach this performance is to compare the collected quantities with the unsorted quantities, by calculating the “collection for recycling rate”. The collection for recycling rate is the division of the separately collected quantities by the total generated quantities (which is here assessed as the sum of the separated and unsorted quantities).

The collection for recycling rate could be calculated for 53 WCS. The collection for recycling rates range from 14 to 95%, which shows that the panel is very diverse in terms of performances. The distribution of collection for recycling rates is presented on the following graph:

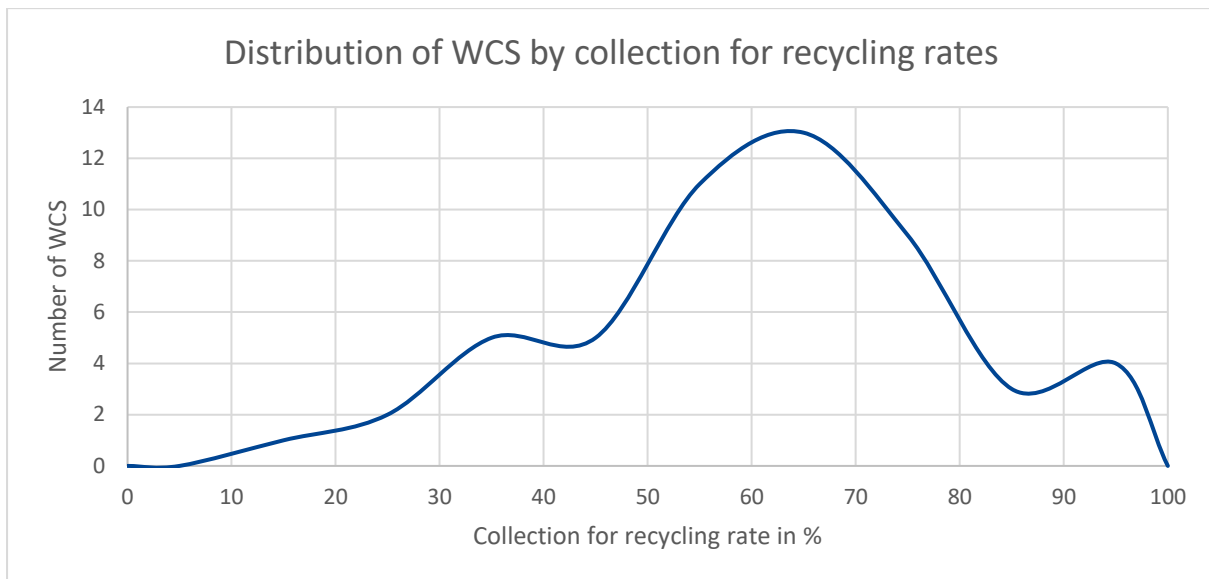


Figure 12: Number of WCS according to the collection for recycling rate

The panel encompasses rather well performing systems, 6 of them capturing more than 80% of the glass packaging. It also includes 14 systems with poor to average collection for recycling rates, less than 50%, and half of the documented WCS are below the average European collection for recycling rate, and the average collection for recycling rate is 60%, which indicates that the panel does include a wide variety of performances.

4.5.1 Performances compared with local instruments

In order to identify good practices, comparisons were done between the different types of organisation and the average collection for recycling rates.

4.5.1.1 Separation system

Few WCS resort to co-mingling of glass packaging with other type of materials. The collection for recycling rates of systems resorting entirely or partially to comingling are available for nine WCS. The values are quite diverse, and range from 33 to 93%, with an average of 67%. Two systems achieve a collection for recycling rate above 80%, both using different commingled streams (glass being commingled with metal packaging in one case, and with plastic and metal packaging in the other case). Little data is available when it comes to the impurity rates of WCS co-mingling glass.

Data on collection for recycling rates for systems using source-separation for glass packaging is available for 41 WCS. The average collection for recycling rates for systems using source-separation is around 60%, and no significant difference can be observed between system having source separation of colours and systems mixing all the colours together. There is a very significant discrepancies among these 41 systems, with collection for recycling rates ranging between 14% and 95%.

When assigning the average recovery rates provided by FERVER to the different types of collection and separation systems, it appears that the quantities of furnace-ready cullet is quite similar for all systems, regardless of the source separation systems, with average “recycling rates” around 50%. However, and as noted previously, FERVER data tend to show that impurity rates can be very different from one co-mingling collection system to another, so these figures have to be taken with caution.

4.5.1.2 Collection mode

As shown in the previous part, an important share of WCS collect glass using bottle bank systems. The average collection for recycling rates of WCS were calculated depending on their main collection modes. As specified previously, the data on collected quantities have been collected by the

4. Local waste collection systems for glass packaging waste

COLLECTORS project and consolidated by ACR+, while the impurity rates are assumed on the basis of the data provided by FERVER. It is important to remind here that the rate used for door-to-door system is based on a small number of systems, and therefore there are uncertainties regarding the average recycling rate presented below.

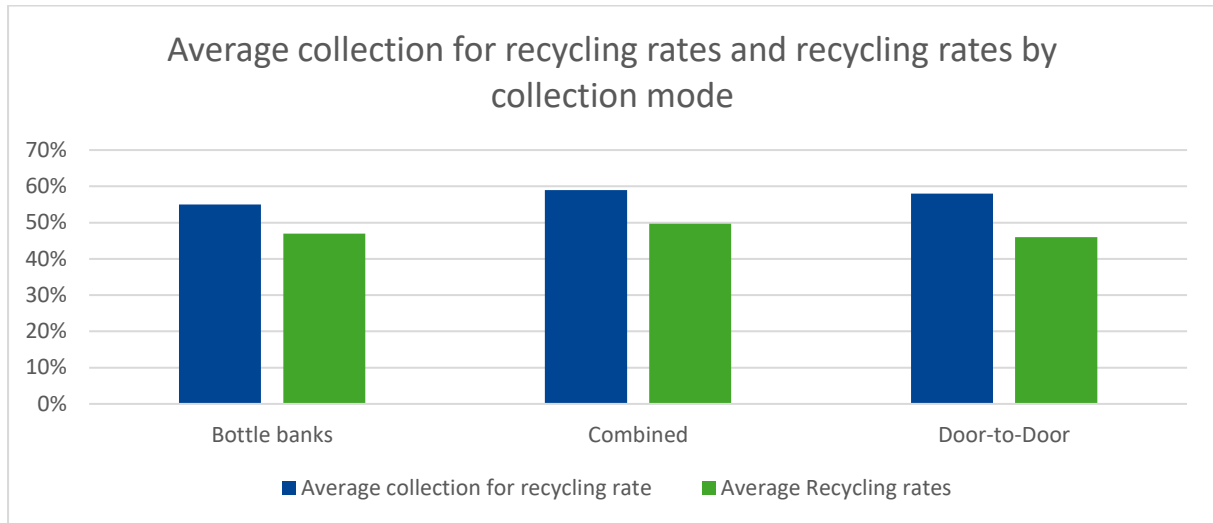


Figure 13: Average collection for recycling rate and recycling rates by collection mode (“combined” systems encompass both door-to-door and bottle banks collection)

The nine documented door-to-door WCS generally presents a slightly higher average collection for recycling rate compared to bottle banks. However, this observation has to be nuanced when also considering the recycling rates by using FERVER’s data on glass processing. It appears that the bottle banks systems and the door-to-door systems included in the panel have quite similar average recycling performances when taking into consideration both the collection for recycling rates and the impurity rates: indeed, door-to-door collection systems seem to lead to the collection of higher quantities, but the lower quality leads to an average recycling rate that is comparable to bottle bank systems in the panel.

Besides, there are significant discrepancies among systems using bottle banks and door-to-door systems: both categories include both systems performing very well and other performing very poorly, as shown on the following graphs:

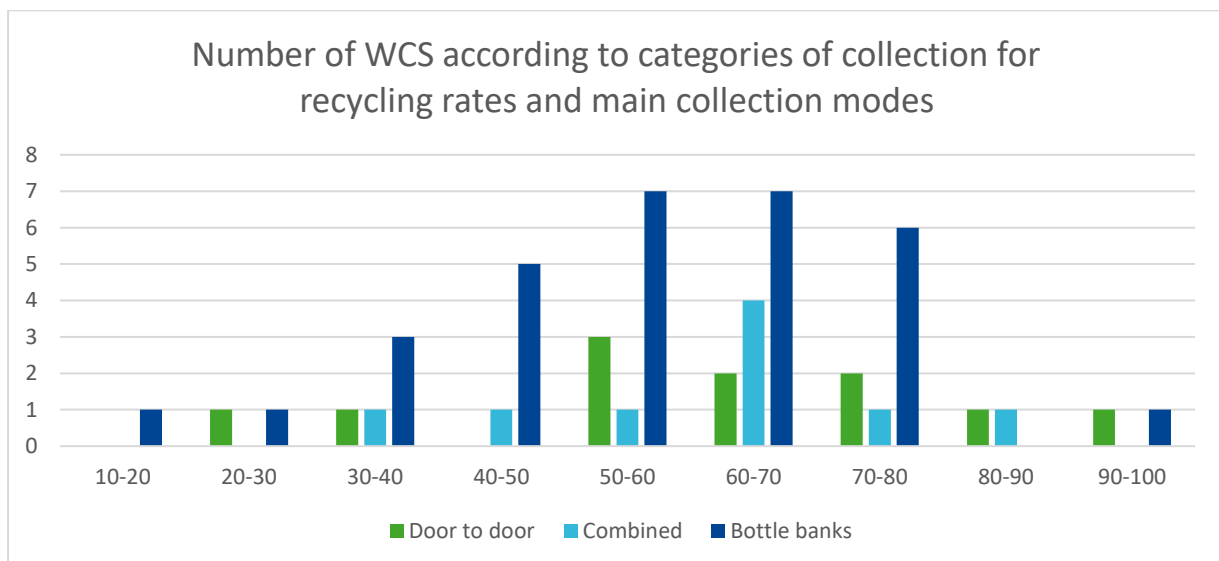


Figure 14: number of documented waste collection systems by categories of collection for recycling rates, and main collection modes

4. Local waste collection systems for glass packaging waste

The graph shows that all types of collection mode seem to allow very high collection for recycling rate, and that some WCS using door-to-door collection also perform poorly. As highlighted by the case studies presented in part 2.3.5, how the collection modes are actually implemented has a strong impact on the performances.

The average collection for recycling rates according to the number of bottle banks per inhabitant, and the density of bottle banks is presented on the graphs below. These data only include systems that mostly resort to bottle banks for glass packaging collection.

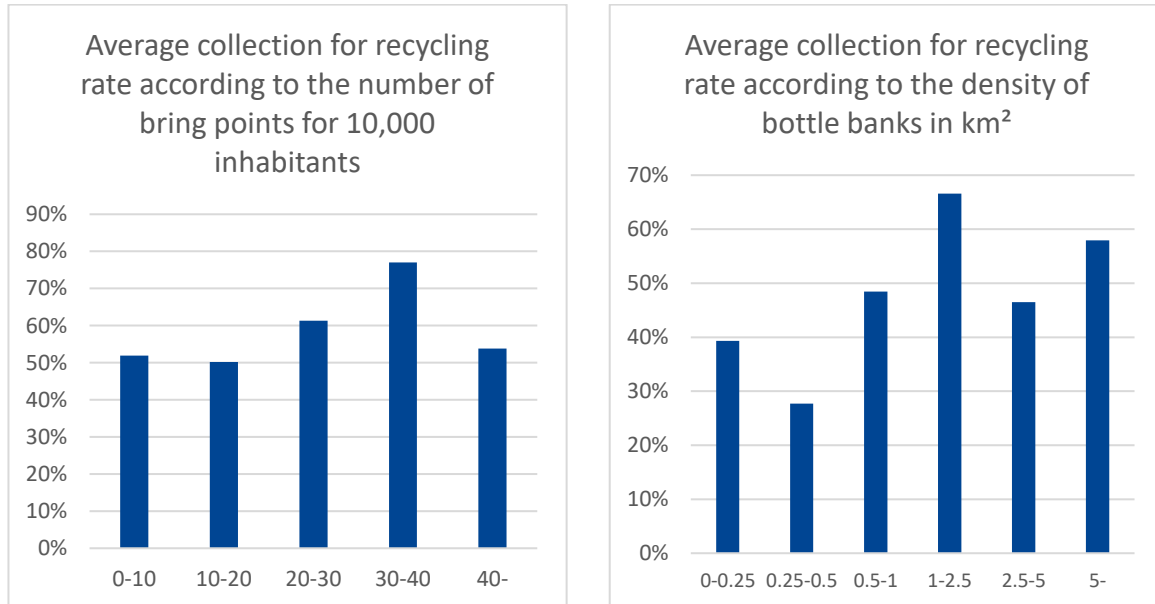


Figure 15: average collection for recycling rates (vertical axis) according to the number of bottle banks per 10,000 inh. and the density of bottle banks (horizontal axis).

It seems that there is a slight correlation between both indicators and the collection for recycling rates, even though the differences are not too significant. This might reflect the fact that both indicators are not sufficient to properly reflect the convenience of the system, or that the accessibility of bottle banks is not a sufficient criterion to lead to a proper collection for recycling rate. These indicators have also to be considered in their own context, and how mobile the populations are. Besides, other factors might be very important for the effectiveness of the bottle banks networks, such as the choice of suitable locations, the cleanliness and the maintenance of the bottle banks, etc. These factors are more challenging to quantify.

Illustration: guidelines on bottle banks collection in France

As an illustration, the French PRO issued several recommendations when it comes to the network of bring points, based on the analysis of their own data⁷⁷:

- Increasing the density of containers alone can lead to a +5% increase of the performances;
- **The “optimal” number of bring point per inhabitant depends on the context:** in rural area, the value of 1 bring point per 250 inhabitants is provided, while in urban areas the number is 1 bring point for every 450 inhabitants. These numbers might be different depending on the context (e.g., in high density areas);
- **The location of the bring points** is an essential factor when it comes to their effectiveness. According to CITEO, placing them in strategic locations (next to public services such as the post office or a civic amenity site, next to schools, or on the parking lots of supermarkets), makes them 62% more effective than the average, making them visible gives a performance

⁷⁷ Eco-Emballages (2014), *Feuille de route verre*

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of +35%, and grouping them with other bring points (if the other waste fractions are also collected this way).

(Source: CITEO)

These elements might show why little correlation could be found between general figures on the number or the density of bring points and the performances. Further information on the availability of bottle points depending on the specific contexts of the area, or on the efforts developed on identifying the best spots for bring points would be required to better understand the reason behind the success of the highest-performing waste collection systems using bottle banks.

When it comes to door-to-door collection, the low number of WCS for which the collection for recycling is known, and the lack of data on collection frequencies does not allow to draw conclusions on the efficiency of lowering residual waste collection frequencies to boost glass sorting. This instrument is known to be effective for biowaste⁷⁸ and for paper and packaging waste in general⁷⁹.

4.5.1.3 Collection mode of other paper and packaging waste fraction

Waste collection systems have to be regarded as a whole; the sorting performances of one single waste stream might not only depend on how its collection is organised, but also how residual and other separated fractions are handled. As explained by the three presented case studies, the introduction of new collection schemes for other waste fractions (e.g., biowaste) can have a positive impact on glass packaging waste collection performances.

The following graph shows the average collection for recycling and recycling rates for waste collection systems using mainly bottle banks for glass packaging, according to the main collection mode used for all paper and packaging waste:

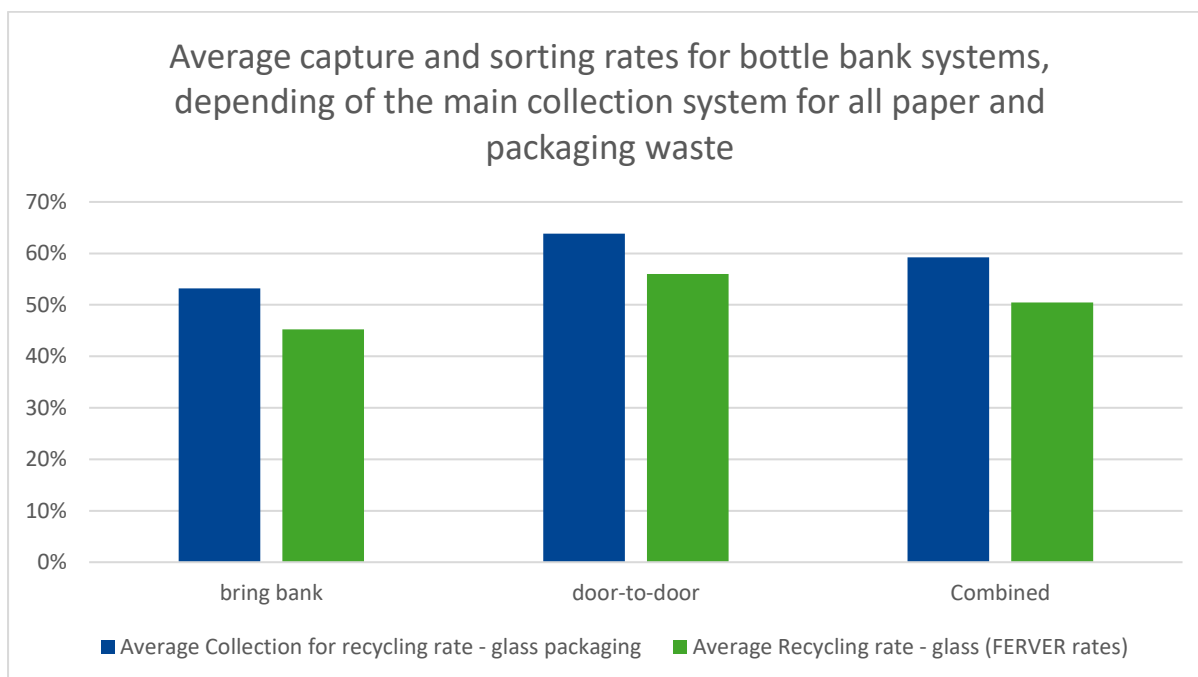


Figure 16: average collection for recycling and recycling rates for bottle banks systems, depending on the main collection mode for all paper and packaging waste

⁷⁸ DECISIVE project (2018), *State-of-the-art of communication materials and incentive methods*

⁷⁹ ACR+ (2019), *Analysis of 135 paper and packaging waste collection systems*

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It appears that bottle banks systems present in general higher collection for recycling and recycling rates when other fractions such as paper and PMC are collected door-to-door. A distinctive system for glass packaging might make sorting guidelines clearer for inhabitants.

4.5.1.4 Pay-as-you-throw

PAYT is known as an effective local instrument to promote sorting behaviours to inhabitants. There is a noticeable difference regarding the average collection for recycling rate of WCS between systems using PAYT and systems not using PAYT, as shown on the following graph. The recycling rates were assessed according to the average values provided by FERVER and assigned according to the organisation of the different WCS (collection modes, type of separation, etc.).

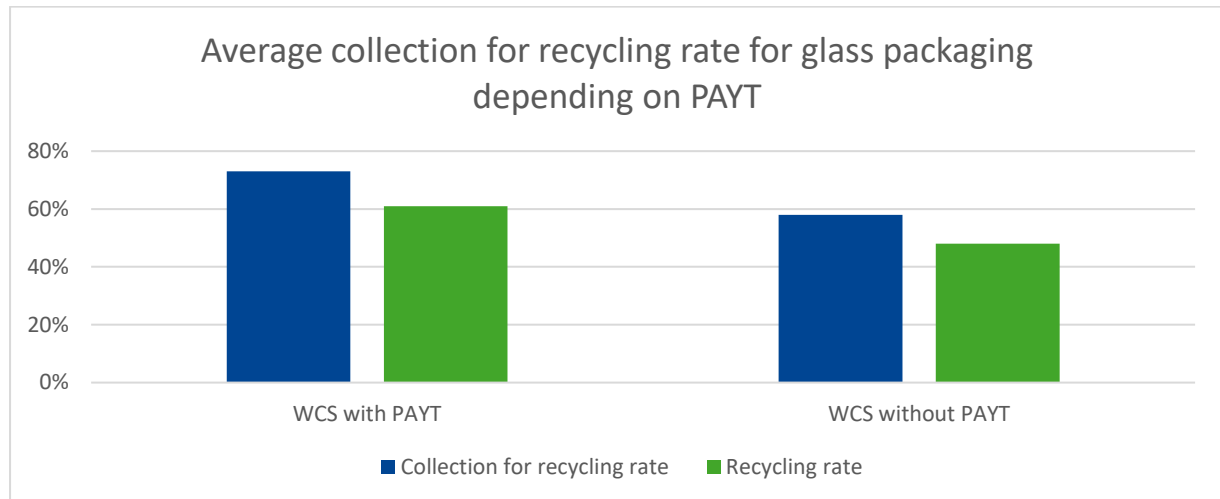


Figure 17: average collection for recycling and recycling rates for systems with and without PAYT

Besides, the five waste collection systems with the highest collection for recycling and recycling rates all have PAYT, or a sorting obligation with controls of the presence of recyclables in residual waste.

It should be noted that there seem to be some exceptions: some very well performing systems could reach high performances without such fee systems, and low-performing systems might have implemented PAYT. Sorting obligations with controls can also give interesting results, as shown with the example of Milan presented before. Another example is provided below.

Illustration: obligation for waste separation enforced with local controls

In 2010, the Brussels Region introduced an obligation for selective collection on paper and packaging waste among other waste fractions. To enforce this obligation, regular controls are implemented by a team of sworn controllers, which consist in the collection of about 500 residual waste bags before the actual collection, on which the address is noted by the controllers. The bags are then opened in a treatment facility and their content is analysed. Fines going from 75 to over 600 euros can be put depending on the content of the bag. Fines are put when the content indicates that the household does not sort waste at all, rather than the presence of few recyclables. Higher fines can be put when specific waste can be found, for instance glass packaging, that can be dangerous for the collection staff. Residual bags are not individual, meaning that the household has to be identified using different methods: presence of mail with the name and address of the person in the residual waste bags, for instance. Otherwise, further investigation might be required, based on the address where the bag was collected. This obligation led to the increase of sorted quantities, and the Brussels Region presents overall good performances considering its dense characteristics.

(Source: COLLECTORS project⁸⁰)

⁸⁰ COLLECTORS, 2020, *Guidelines for successful implementation*

4.5.1.5 Local instruments set by the top-performers

The cross-analyses between the collection for recycling rates and local instruments show that, besides PAYT and enforced sorting obligation, no isolated instrument can be clearly associated with best practices. It seems that waste collection systems can manage to achieve high collection rates with bottle banks and door-to-door systems.

The performances of the five highest performing systems (with collection rates above 75%, up to 97%, and recycling rates above 70%) and the five lowest performing systems (with collection rates below 35%, and recycling rates below 30%) within the 53 WCS for which collection for recycling rates are documented were compared. Both panels include both bring-systems and door-to-door systems, as well as systems using co-mingling. Besides, two systems among the top performers also effectively use civic amenity sites to collect glass packaging.

The main difference is the use of incentivising instruments such as PAYT and sorting obligations, which are used by all the WCS within the top five and not used by any of the bottom five systems. Interestingly, the top-performers also present quite high performances for the other recyclables (paper and packaging waste), which reflects a well-integrated municipal waste management system, while the systems with low performances for glass packaging also present quite low performances for the other types of packaging.

4.5.2 Quality of the collected fraction

As explained above, the data collected on the impurity rates for the difference WCS are scarce and does not allow to conclude on any difference between the different collection modes. The quality of collected glass packaging waste is a key parameter to enable closed-loop recycling. Two parameters are important when it comes to quality:

- The presence of impurities, for instance infusible elements (ceramics, etc), that will reduce the efficiency of the sorting processes in the glass treatment plants, and could jeopardise the manufacturing process;
- The density of the glass: if the particles are too fine, the glass cullet cannot be used for glass packaging re-manufacturing: below certain particle size called as “fines” (e.g., 8 or 4 mm, according to the available technologies⁸¹), it is not possible removing impurities such as infusible fractions from the cullet.

Even though the cullet treatment plants include several sorting steps that allow the removal of impurities, the quality of collected glass brought in these plants heavily influences the quality of the produced cullet, and lower impurity rates will lead to lower losses during the sorting stage. It is therefore important to ensure the quality of the collected glass between the collection and the glass processing. In particular, it is advised to avoid any operation that might compress the glass during its collection, transfer, and transport⁸². Several elements can be listed to ensure the quality of sorted glass:

- Collection⁸³:
 - Avoiding open containers and using lids (with holes of limited diameter e.g., 20 cm by the Italian PRO) to prevent inhabitants from putting waste other than bottles and jars;
 - Avoiding collection trucks with compactors, and using clean equipment
 - Clear information on the accepted glass packaging waste, and on the non-accepted products containing or made of glass (e.g., light bulbs, drinking glasses, etc.)

⁸¹ <https://coreve.it/il-ciclo-del-riciclo/> (COREVE website)

⁸² Eco-Emballages (2014), *Feuille de route verre*

⁸³ Verre Avenir (2012), *Recyclage, Qualité d'abord*

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- Transfer⁸⁴: the design (concrete surface, closed area, clear separation with other materials), training of the staff on quality requirements, equipment (clean and adapted), and operations (limiting the heights of piles, avoiding unnecessary operations) can all impact positively the quality of the glass.

While the collected data could not allow to draw conclusions on the impact of the waste collection systems on glass collection, further observations could be identified in various reports. In particular, a report published by FONDAZIONE DELLO SVILUPPO SOSTENIBILE⁸⁵ in 2016 includes some figures about impurities in relation to different collection modes, based on data provided by COREVE, the Italian glass packaging PRO.

- **Co-mingling of glass with other materials:** while co-mingling can allow to reduce costs and collect more quantities, the low quality of the glass sorted in MRF (material recovery facility) and the associated losses seem to exceed these potential benefits. Various reports point out the incompatibility of co-mingled collection with closed-loop recycling, (also due to the damage of glass during the sorting processes), as well as the contamination of other material fractions^{86 87}. Glass and metal packaging co-mingled collection systems seem to generate significant higher losses rate (8% for bring bank vs. 21% for door to door).
- **Mixed colours:** the COLLECTORS projects determined that mixed coloured glass waste can be effectively sorted by high-end optical sorting equipment while keeping a high quality⁸⁸.
- **Collection mode:** even if no evidence was found within the database regarding the difference of impurity level between door-to-door and bottle bank schemes, several studies seem to indicate that bottle bank systems result in less breaks of load, which entails a lower density and thus less losses⁸⁹. The above-mentioned Italian study reports that bottle bank schemes tend to generate less losses along the recycling route (4% for bring bank vs. 10% for door to door).

These observations are confirmed by the data collected by FERVER from their members, which identified the quantities of the different material fractions after glass processing for different types of input (e.g., source-separated glass in bottle banks, kerbside collection of co-mingled materials, etc.).

When comparing the yield of furnace-ready cullet, it appears that bottle banks systems with colour separation gives the best performances in terms of quality, followed by bottle banks with mixed colours, and kerbside collection. Co-mingling leads to significantly lower yields, even if co-mingling of glass and metal seems to lead to higher quality than other types of co-mingling. Collection with plastic bags also leads to a significant drop of quality.

4.5.3 Costs of glass packaging collection

4.5.3.1 Available data on costs of glass packaging collection

As explained previously, benchmarking on costs figures is a challenging exercise, due to the significant inconsistency of cost reporting by local authorities. Data labelled as collection costs are generally based on various assessment (e.g., calculation methods to allocate the different costs to the different waste fractions) and might encompass different elements (e.g., actual technical costs or cost invoiced by the waste contractor, additional administrative costs, costs related to street cleaning, inclusion of

⁸⁴ Verre Avenir & Eco-Emballages (2016), *Aire de stockage et de transfert du verre brut ménager*

⁸⁵ FONDAZIONE DELLO SVILUPPO SOSTENIBILE (2016), *Il riciclo del vetro e i nuovi obiettivi europei per la circular economy*

⁸⁶ Welsh Government (2014), *Statutory Guidance on the Separate Collection of Waste Paper, Metal, Plastic and Glass*

⁸⁷ Zerowaste Scotland (2012), *Glass Collection & Re-processing Options Appraisal in Scotland*

⁸⁸ COLLECTORS (2019), *Report on boundary conditions for implementation*

⁸⁹ ADEME (2005), *Campagne de mesure de la densité des collectes de verre d'emballage ménager*

treatment costs, inclusion of incomes, etc.). Therefore, benchmarking should be made based on costs reported according to a common method, using the same repartition keys and following the same data matrix. Such data collection usually requires either the access to more detailed data or an extra effort from local authorities to report their costs accordingly. Such initiatives exist at regional or national level (“coût vérité” in Walloon Region, “matrice compta-coût” in France), and therefore some comparable data can be identified when it comes to glass packaging waste collection.

ADEME (the French Agency for Ecologic Transition) published a report based on 2016 data collected from 351 local authorities representing 21 million inhabitants⁹⁰. While the presented data cannot be regarded as representative of other European territories, the comparisons between the different modes of glass collection are interesting to highlight. The report identifies two main parameters to explain differences among the costs of glass packaging waste management:

- **The collection mode:** bottle bank systems present lower overall costs than collection systems using door-to-door systems (partly or fully). This is due to the fact that “technical” collection costs are lower in average (67 €/t for bottle bank systems vs. 111 €/t for the others), and that the incomes from bottle bank systems are on average higher due to higher performances within the considered panel;
- **The collected quantities:** collection services are usually charged by waste collection operators according to the quantities of waste that are collected, meaning that the systems collecting more quantities generally have higher technical costs. However, these costs are compensated by the higher incomes from material sales, making the overall cost balance (e.g., technical cost minus the incomes) similar.

Overall, the main part of the cost borne by local authorities are the collection costs, while the incomes mostly come from the sales of glass.

In a study comparing the waste collection systems implemented by Scottish waste authorities⁹¹, Zerowaste Scotland also identified bring systems as the one having the lowest cost; according to their observation, bottle banks with mixed colours have lower collection costs compared to colour-separated bring collection, but the total cost is offset by processing costs because it needs more efforts to separate the colours and to sort the different type of glass afterwards.

4.5.3.2 Costs and revenues of packaging waste collection systems

The COLLECTORS project conducted in-depth analysis of the cost-benefit balance of five waste collection systems for paper and packaging waste⁹². It consisted in the assessment of the actual costs linked with paper and packaging waste collection and processing, including the unsorted fractions remaining in residual waste, and possibly the management of littered packaging, as well as detailing the different “revenues”, e.g., from EPR schemes, local waste fee, and other existing subsidies. The analysis highlighted very different costs and benefits structures across the different documented case studies. The different distributions of costs and revenues are presented in the graphs below:

⁹⁰ ADEME (2019), *référentiel national des coûts du service public de prévention et de gestion des déchets*

⁹¹ Zerowaste Scotland (2012), *Glass Collection & Re-processing Options Appraisal in Scotland*

⁹² COLLECTORS (2019), *Report on the economic and financial performance of waste collection systems*

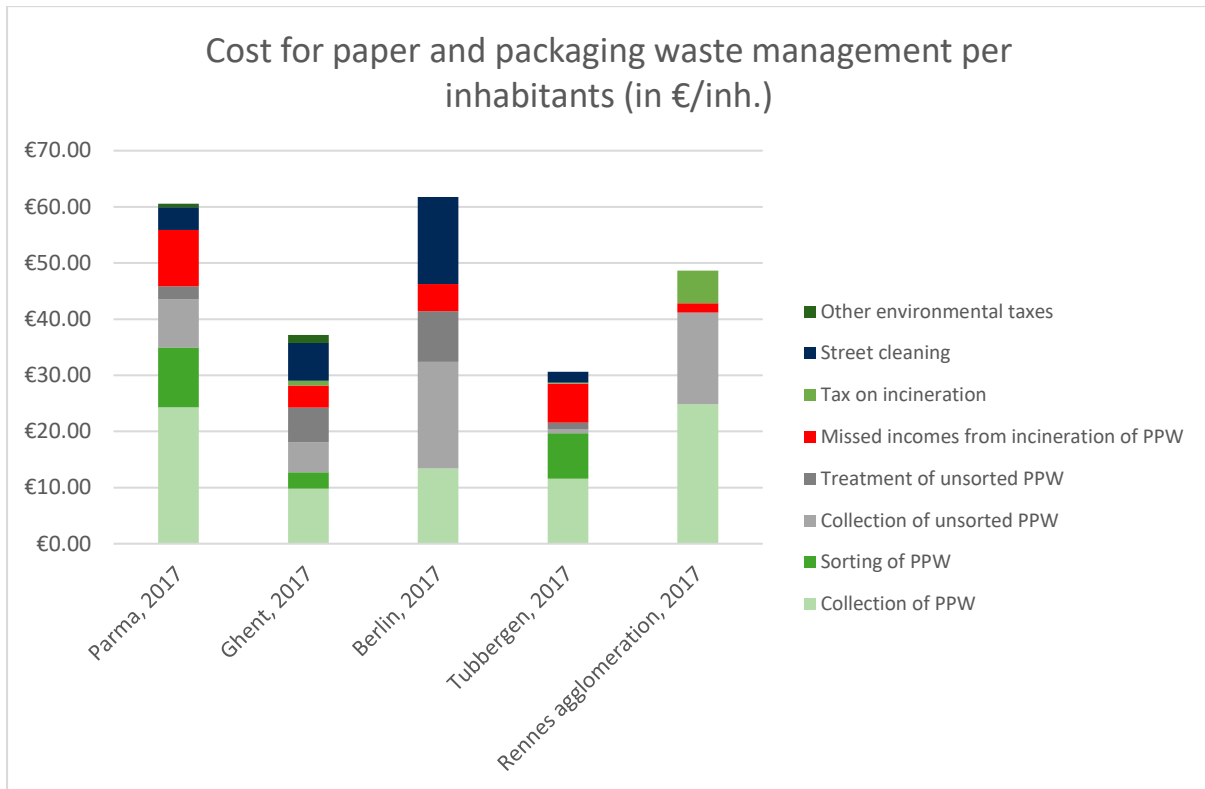


Figure 18: Cost for paper and packaging waste management per inhabitants (source: COLLECTORS project)

The distribution of costs depends on the sorting performances of the paper and packaging waste collection system; it is interesting to note that the management of paper and packaging waste within residual waste and littering can represent very significant costs for waste collection systems, as it is the case in Ghent and Berlin.

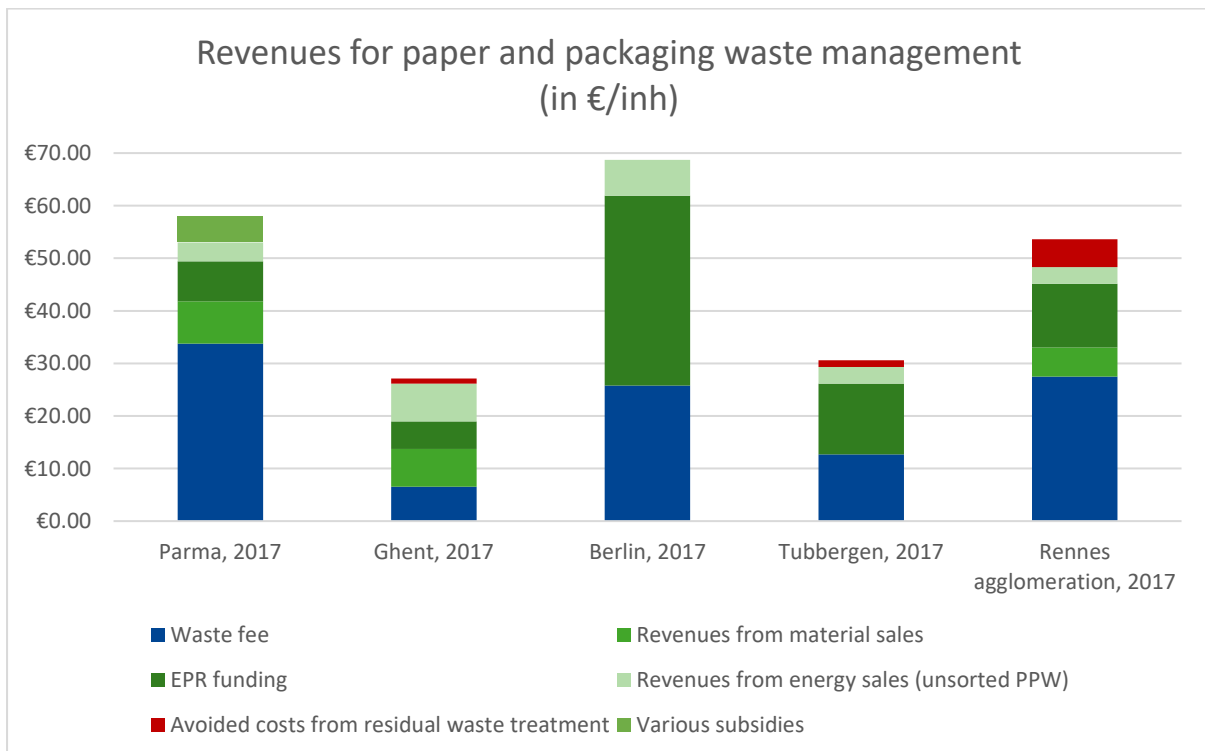


Figure 19: Revenues for paper and packaging waste management (source: COLLECTORS project)

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The distribution of revenues is also very different from one city to another. The contribution of the EPR system and materials sales range from 27% to 52%, while the share of the waste fee paid by inhabitants ranges from 27% to 59%.

The project also highlighted the cost per tonne for the management of the different packaging fractions and residual waste. The cost of glass packaging waste management ranges between 50 and 100 €/t within the five cities, which is below residual waste management costs (ranging from 175 and 300 €/t).

Finally, the COLLECTORS project analysed the evolution of costs for the municipality of Parma, that significantly improve selective collection of paper and packaging over a relatively short period of time, through the modification of its collection system and the introduction of a PAYT. The evolution of costs and revenues is presented on the figure below:

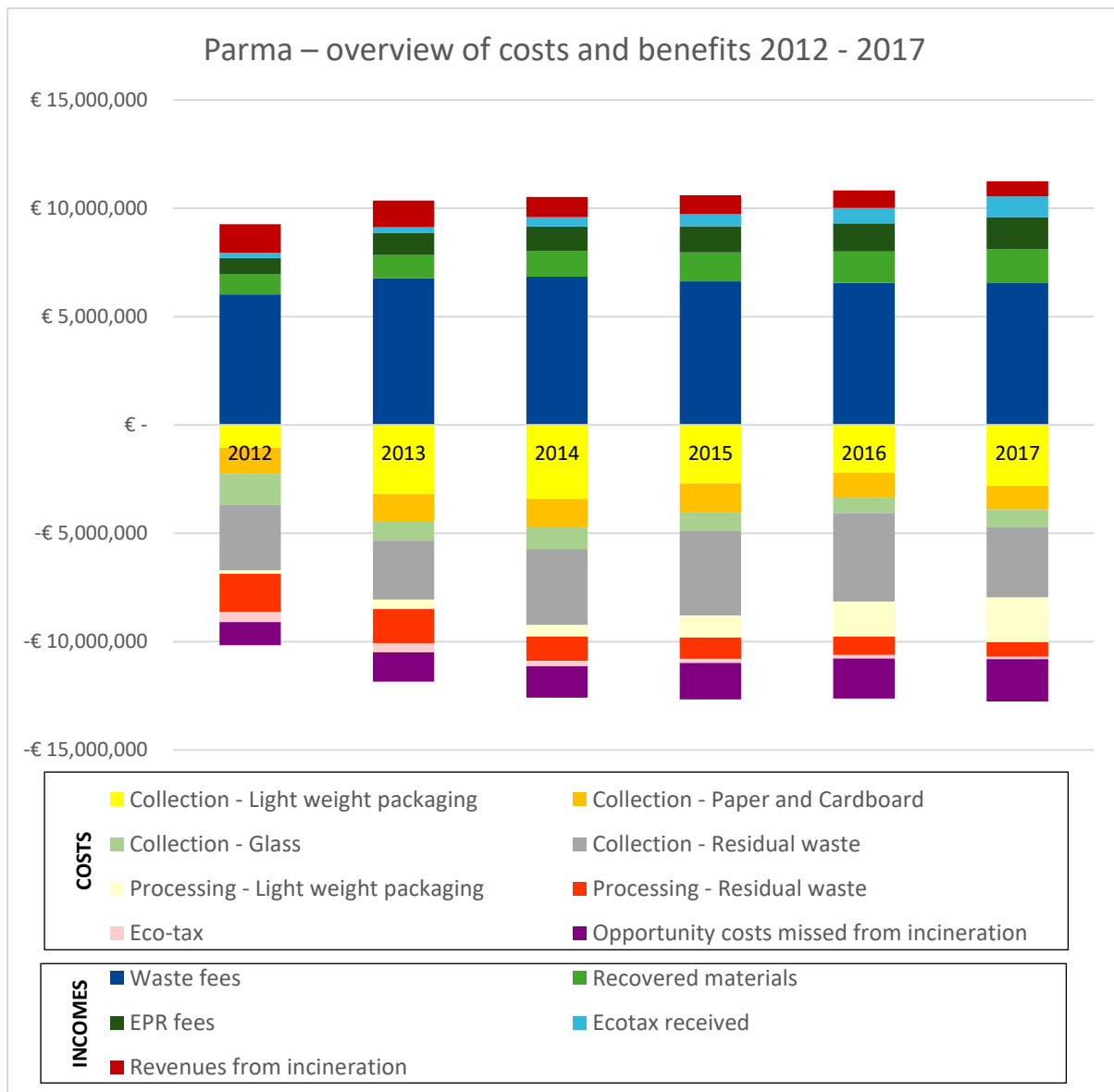


Figure 20: evolution of costs and revenues in Parma between 2012 and 2017 (source: COLLECTORS project)

This evolution shows that improving selective collection led to an increase of collection and processing costs. However, the municipality managed to keep the local waste fee relatively stable. This seems to have been possible thanks to the savings made on residual waste treatment (which is quite expensive partly due to an incineration tax), and the increase of revenues from the EPR systems and recovered

materials. This example highlights the importance of proper framework conditions (EPR system, tax on disposal) to make separate collection economically sustainable for local authorities.

4.6 The impact of local context

Local specificities have a significant impact on the organisation and performances of WCS. For instance, high density generally means a lack of space for inhabitants to store waste, as well as limited space to implement pre-collection and collection equipment. Tourism or commuting might also lead to punctual increase of the population and lead to higher waste generation per capita.

4.6.1 Impact of the local context on glass waste generation

As indicated previously, glass packaging waste generation is assessed as the sum of sorted quantities and the quantities remaining in residual waste, based on data from composition analysis. This approach has some limits, as glass packaging can escape both streams (e.g., be littered, exported out of the territory, collected by other schemes, etc.). However, and as stated above, there are no accurate data on local consumption at municipal level.

Overall, there are two main reasons for which generation per capita varies from the average:

- The generation of glass packaging waste is linked with consumption patterns that might vary at local level, and depends on the scope of the considered data (e.g., the inclusion of commercial glass in municipal waste collection and data);
- The presence of non-resident waste generators (tourists, inhabitants in secondary houses, commercial activities...), which are not accounted in the statistics on the resident population.

As indicated in part 4.4 presenting data on glass packaging waste generation, there are important discrepancies among the panel when it comes to glass generation, with 75% of WCS ranging between 25 and 45 kg/inh. Several sub-categories can be identified:

Tourism appears to have a strong impact on glass packaging waste generation per inhabitant, especially in small areas with low resident population. All of the top “glass producers” are rather small territories with relatively high number of overnight stays. This is confirmed by the following graph, presenting the average glass waste packaging generated quantities per capita:

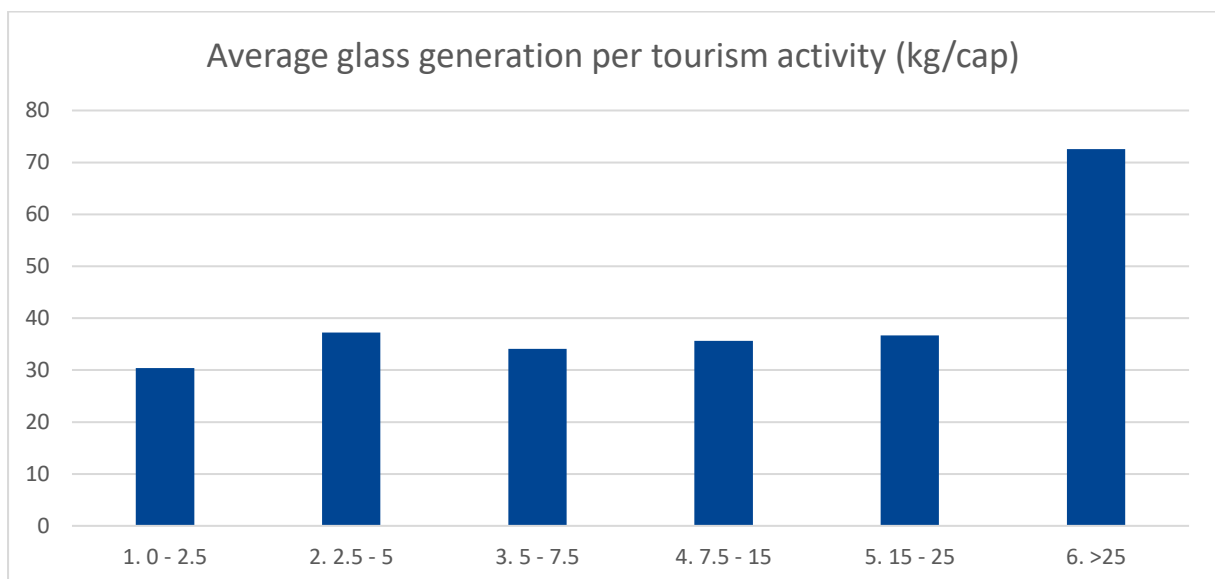


Figure 21: average glass packaging waste generation per tourism activity (in kg/cap)

The COLLECTORS project also identified other parameters for which there are correlations with glass packaging waste generation⁹³: glass packaging waste generation seems to tend to be higher in high-density territories, and lower in low-GDP areas.

4.6.2 Impact of the local context on glass packaging waste collection

The studied panel shows quite contrasted situations when it comes to collection and recycling rates, and local contexts. For the three main parameters considered here (population density, GDP per capita, and number of overnight stays per resident population), no clear correlation could be identified, as very diverse level of performances could be observed for each type of territory.

The COLLECTORS project worked on a larger panel of waste collection panel, and noted that densest cities tended to show lower collection performances than the average. However, this “underperformance” was more noticeable for other material fractions, such as paper and cardboard⁹⁴.

⁹³ COLLECTORS, 2020, *Guidelines for successful implementation*

⁹⁴ COLLECTORS, 2020, *Guidelines for successful implementation*

Illustration: tackling waste separation in flats

In 2017, Resource London launched an initiative to address recycling in flats; studies highlighted the fact that flats services yield 50% less recycling than average low-rise properties, but the reasons behind this were not well-known. This also includes glass packaging recycling, as a collection for recycling rate of 39.3% was recorded during a sampling period, and the contamination rate of the recycling bin was at 30.7%

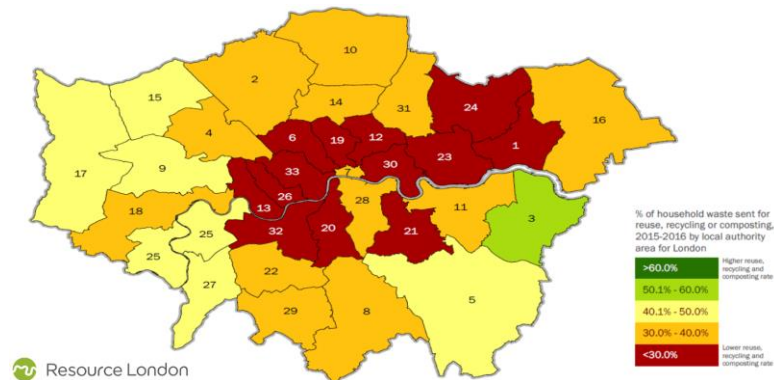


Figure 22: recycling rates of the different London boroughs (source: Resource London)

Several researches were conducted to better understand and then improve sorting performances: review of existing researches, estate inventories, and ethnological researches aiming at better understand actual sorting behaviours. Several reasons were identified to explain low performances:

- Historical context: in many flats, the communal bin areas were often housed away from the main entrances; when recycling was implemented, the focus was more put on the access of bins for the collection service rather than on resident's needs, and housing providers were not involved in the design of the service;
- Socio-demographic reasons: high-rise areas include transient populations, language and cultural barriers, and higher level of deprivation;
- Poor design, maintenance, and management of communal bin areas, with poor, usually ad-hoc signage, problems of over-flowing bins and fly-tipping of bulky waste;
- Individual behaviours: researches show that recycling only occur when resident has the proper motivation, knowledge, and ease to do so. Motivation seems to be inconsistent, especially when recycling behaviours are perceived as anonymous (no feedback from other residents or tenants, no feeling of accountability). Knowledge was insufficient, and residents felt disconnected from the collection service. Finally, the lack of storage inside the flats, and the poorly-managed bins (e.g., overflowing) discourage resident from making an extra effort.

To overcome these shortcomings, a series of actions were implemented in several high-rise buildings: setting, clean, well maintained bins and bins areas, ensuring sufficient volumes, equipping bins with appropriate apertures to limit the size of what can be put, clear signage, and information material (annual leaflets given to residents, posters with recycling messages, etc.). Other interventions included the distribution of pre-collection equipment for inhabitants to store their recycling waste before bringing them to the bins.

Overall, these actions led to an increase of 25% of recycling in several pilot buildings. Among the specific interventions that were tested, providing pre-collection equipment proved to be quite effective.

Source: Resource London⁹⁵

⁹⁵ Resource London (2020), *Making recycling work for people in flats*

4.6.3 Analyses among categories

4.6.3.1 High-density areas

The database used for this study includes six cities with a population density higher than 5,000 inh./km². Their associated collected and unsorted quantities are presented in the graph below:

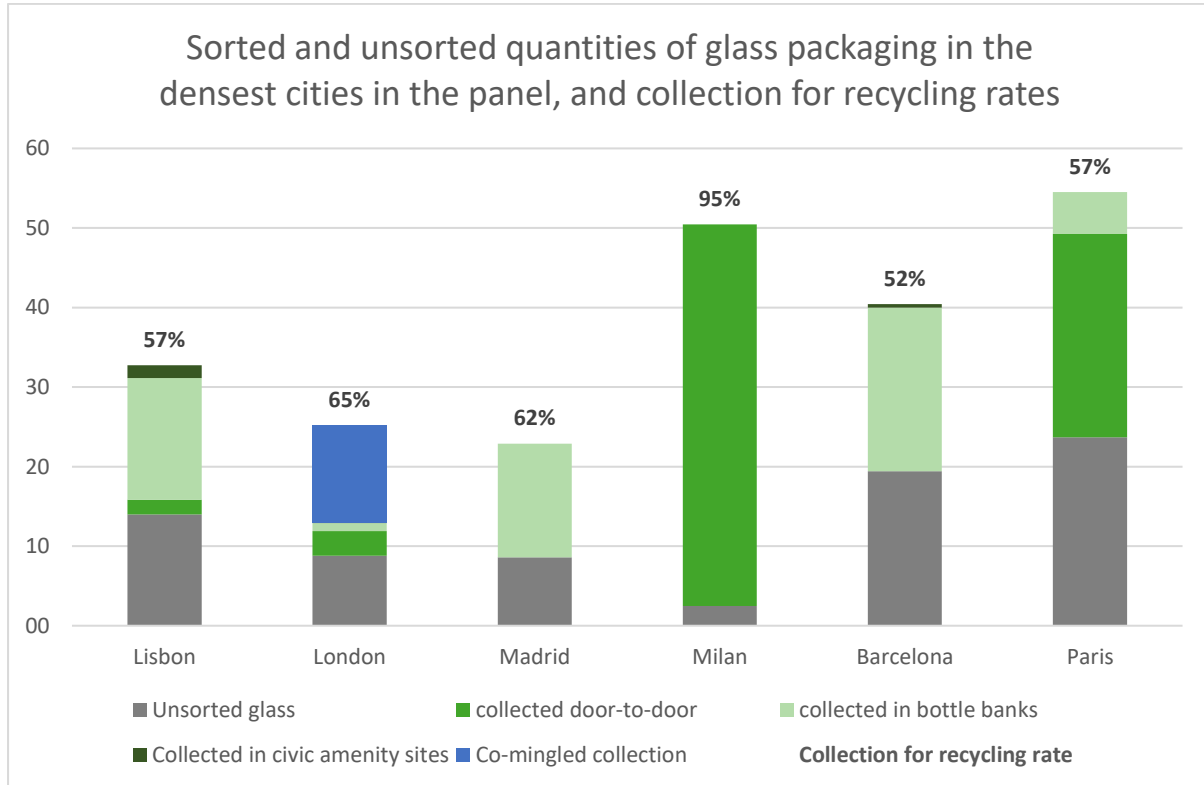


Figure 23: Sorted and unsorted quantities of glass packaging in the densest cities in the panel, and collection for recycling rates

Collection for recycling rates are mostly average, except for Milan (whose case was presented in part 2.3.5.2). Among this panel, Milan is the only city that implemented an incentivising instrument by introducing transparent bags for residual waste collection, allowing to control the sorting behaviours. An interesting element is the diversity of approaches when it comes to glass collection. The number of bottle banks per inhabitant for the three cities resorting to bottle banks (about 18 for 10,000 inh.), which is slightly below the average number for other bottle bank systems; this might reflect the difficulty to identify locations for bottle banks in dense context. The door-to-door systems in Paris and London might face difficulties when it comes to pre-collection in vertical housing; this is not an issue in Milan, where the typology of housing allow to allocate space for the storage of bins.

When it comes to glass packaging waste generation, it is considerably higher for Milan, Barcelona, and Paris, which reflects either the inclusion of glass waste from HORECA (in Milan and in Paris where specific collection routes are organised for the HORCA sector) and a high tourism activity (for Barcelona and Paris).

4.6.3.2 High-tourism areas

High-tourism areas are characterised by a higher generation of glass packaging, and specific challenges linked with the involvement of non-resident population. The glass packaging waste quantities identified in the most touristic cities are presented on the graph below:

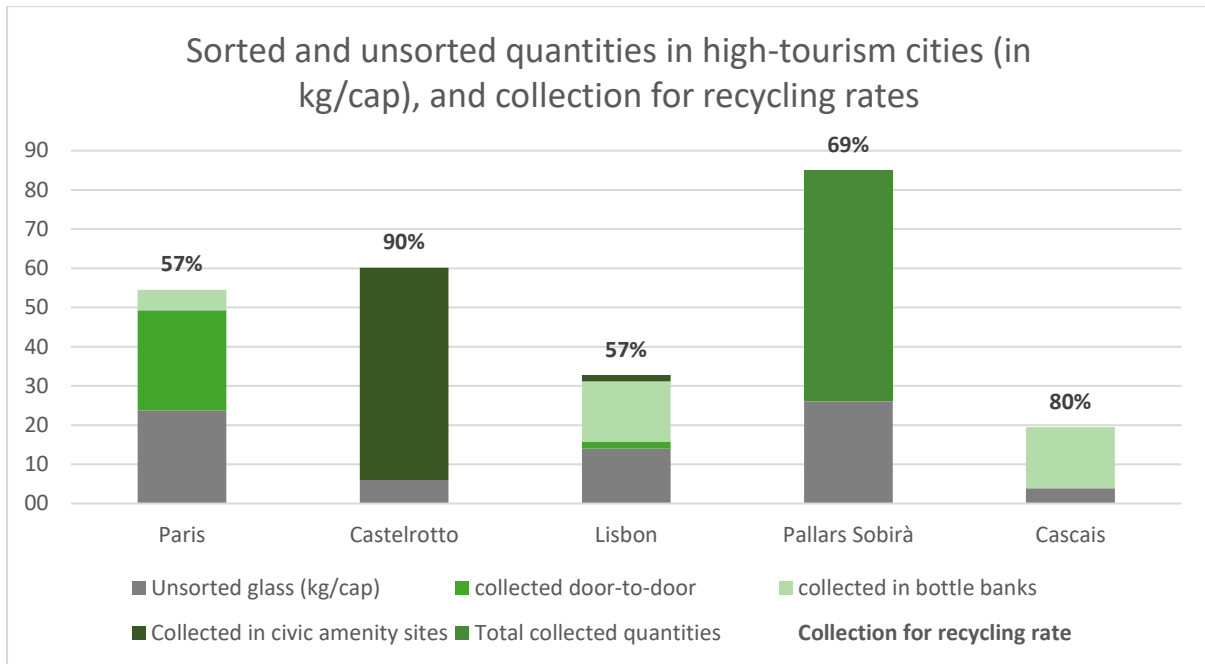


Figure 24: sorted and unsorted quantities of glass packaging waste in high-tourism cities, and collection for recycling rates

It is interesting to note that the total generated quantities are quite high for 3 systems, especially Castelrotto and Pallars Sobira which are both remote, low-populated areas welcoming either many tourists or encompassing many secondary residents. Both cities, as well as Cascais, also present quite higher performances, and rely mostly on bring-systems which might make it easier for non-resident to sort waste. Besides, Castelrotto is the only system that has a PAYT system.

5 Conclusion and outlooks

The study highlighted the very high diversity of local approaches for glass packaging waste collection at city level. This reflects quite different national and regional frameworks, as well as the diversity of types of organisations when it comes to roles and responsibilities among EPR systems, municipalities, and waste collection companies. The organisation of glass collection is a result of historical decisions, of the framework conditions, as well as local decisions, either taken by elected representatives, or by the organisation in charge of the operational aspects. For local authorities, there is a need to find a balance between the recycling requirements (mainly dictated by the EPR systems and the associated financing mechanisms) and the need to provide a proper service to citizens that ensure social acceptance, secure their involvement, and preserve the cleanliness.

The framework conditions play a significant role to support the implementation of effective local waste collection systems. The legal and economic incentives seem to play a very significant role, especially EPR subsidies for sorted fractions, and taxes on disposal. Clear guidelines and guidance directed to local authorities on how to improve collection system are also relevant, as well as homogeneous sorting guidelines for inhabitants. In general, well-performing systems seem to have established a close collaboration between EPR organisations and local authorities.

When it comes to practical organisation, bottle banks and source separation seem to be the main collection system across Europe. Co-mingling is still used in several countries such as the UK and Italy. Door-to-door collection is sometimes used in parallel with bottle banks, or as the main collection mode, especially in urban contexts, and when other packaging waste are also collected door-to-door. Door-to-door collection is generally perceived as effective in terms of source separation and convenient for inhabitants, which might make local decision makers reluctant to abandon.

When it comes to local performances, it is interesting to note that high performances can be reached by both bottle banks and door-to-door systems, yet door-to-door systems appear to be more expensive and may lead to lower quality. As highlighted by the experience of Milan, successful door-to-door systems require a proper pre-collection (e.g., proper communal bin areas in high rise building) and quality controls, and the right collection equipment (e.g., preventing the use of plastic bags). Besides, incentives seem to be essential to reach very high performances: either PAYT systems or sorting obligations enforced by controls are widely used among best-performing territories, and not used in the lower performing territories documented in this study.

The collection system does affect the recycling yields of the glass collected and door-to-door systems may lead to lower quality (e.g., contamination and generation of higher quantities of fine fractions) and a subsequent increase in the losses across the recycling route. As highlighted by the experience of Berlin, the introduction of a door-to-door system must be deeply weighted also because the change (the way back) from door-to-door to bottle banks is considered very difficult, since citizens might perceive bottle banks as less convenient.

Local context plays an important role for glass packaging collection, especially tourism (which leads to significantly higher generation) and density of population, which makes it more challenging to set an extensive network of bottle banks. Both touristic cities and dense areas are relevant typologies for further investigations.

To improve sorting performances or to initiate selective collection systems, the following elements would require further attention:

- Addressing the framework conditions in the low-performing countries is a pre-requisite for improving local performances, especially how EPR systems contribute to local cost coverage and incentivise quality, and taxes on disposal. According to the interviews, investments should be made in collection and sorting equipment to increase recycling performances.

5. Conclusion and outlooks

- Further work on glass collection in dense contexts is needed, either focusing on collection in vertical housing, or on solutions to improve collection points in dense contexts;
- The promotion of incentivising methods such as sorting obligations and PAYT systems has to be extended, as most high-performing collection systems implemented such instruments. These instruments seem extremely important in order to reach collection performances over 90%;
- Interviews of both representatives of case studies and national contact points tended to highlight the need to focus on glass collection from HORECA, for which high quality seems more challenging to reach;
- A better understanding on local costs is needed, to identify solution to optimise the costs, and ensure that the current incentives are sufficient to promote source separation; a further analysis identifying the overall financial balance (costs and revenues) per type of collection system would help decision-makers select the most efficient system in their local situation.
- Better information is also needed for local authorities and waste collection organisations regarding quality requirements and way to improve quality of sorted glass. Including criteria concerning quality for the EPR subsidies to collection is a good way to promote this. Providing data to local authorities regarding the quality of their collected waste, and inviting them to report it along with collected quantities, could also contribute to give more importance to quality.

The analysis and comparison of data tend to show that there is no “ready-to-use” best practice when it comes to glass collection. The involvement of inhabitants can only be secured if they are properly informed, dispose of a convenient collection system, and motivated to sort their waste. The role of communication is essential when it comes to the dissemination of clear sorting guidelines and the promotion of sorting behaviours. Besides, the efficiency of a network of bottle banks not only rely on the number of collection points, but also on their locations so that they fit with the inhabitants sorting habits, which are very linked with the local context. Therefore, the improvement of local performances requires tailored strategies following an analysis of the local system, and a continuous improvement connected with consistent monitoring.

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