Guidance on Separate Collection

The untapped potential and steps forward for separate collection of household food waste for high-quality recycling

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Acknowledgments

The main authors want to thank the participants of the Task Group on Separate Collection that actively contributed to the inception, development, drafting and revision of this paper and provided relevant input also in the form of empirical data, best practices and case studies examples.

Further materials

This paper should be read in parallel with an online map tool developed to collect and store instances of best practice examples in the separate collection of food waste. The tool is available for free online on the website of the European Compost Network at the url https://www.compostnetwork.info/policy/biowaste-in-europe/separate-collection/.

This map has been prepared with the contribution of the Task Group on Separate Collection of the European Compost Network. It is meant for demonstrative purposes and it does not mean to include all existing good practices about separate collection of food waste. Readers that wish to contribute can provide info about new municipalities implementing separate collection of food waste by sending an email with basic data to giacomazzi@compostnetwork.info.

Publication date: 13.02.2022

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Summary

Separate collection is the cornerstone of high-quality recycling. The EU Directive on Waste requires Member States to implement separate collection of bio-waste from 1 January 2024, at the latest. Various separate collection systems, such as kerbside/door-to-door collection, bring or reception systems or other collection systems, exist for bio-waste in the different rural and urban areas across Europe. However, national figures for separate collection of bio-waste are worrying and they are worse for the separate collection of food waste.

In 2017, the EU Member States, including the UK (EU-28), generated 252 million tonnes of municipal solid waste, of which about 45%, or 113 million tonnes, was bio-waste. A recent report from the European Environment Agency (EEA) found that food waste represents 60% of bio-waste, and other studies have confirmed these findings. It is very interesting to note that waste characterisation is becoming a common practice, providing accurate insights into the composition of different waste streams, especially for residual waste and bio-waste.

Bio-waste is the sum of two fractions of biodegradable waste, namely park and garden waste (green waste) and household kitchen waste (food waste). The main output of the recycling of bio-waste is a stabilised and sanitised organic material. Depending on the recycling process, the material can be digestate or compost, which are both excellent soil improvers. By replacing mineral fertilisers with organic soil improvers, it is possible to sustain and even increase current food production, while restoring biodiversity and the good quality of the soil, air and water.

This document outlines the status of the separate collection of bio-waste in Europe. It mentions and further develops previous reports which found that one third of food waste is not sorted correctly, even in countries that introduced separate collection of bio-waste a long time ago.

It is still common to find large amounts of food waste in the residual fraction that is sent to incinerators or landfill sites. Waste characterisation is crucial to study the composition of different waste streams, and the results of it were included in all the studies considered.

Although many countries claim to collect bio-waste, they organise only the separate collection of green waste and do not provide any solution for citizens food waste, other than throwing it in the residual waste bin. It is important to outline the rationale for and provide evidence to policymakers and interested stakeholders for the need to ensure that Member States improve their separate collection of not only green waste but also food waste. Likewise, as a minimum, they should collect accurate figures on the composition of the bio-waste and residual waste fractions, based on waste characterisation.

By collecting the food waste that is currently lost in the residual bin, it is possible to enhance high-quality recycling. Moreover, larger quantities of organic soil improvers of excellent quality will be available, such as compost and digestate, which are essential for restoring the good ecological status of the environment. In the new Circular Economy Action Plan, the European Commission has proposed harmonising separate waste collection systems. This is the right time to get everyone prepared for 2024.

1 Status of separate collection of food waste

Studies and reports on bio-waste find that a large amount of food waste (50 million tonnes) is not collected and ends up in the residual waste bins.

Out of the 60 million tonnes of food waste generated in the EU in one year, 50 million tonnes are not delivered to high-quality recycling.

"Only 43% of municipal bio-waste was collected separately, while 57% of bio-waste ended up in mixed municipal waste and was thus lost for recycling"

Broadly speaking, EU Member States still have a long way to go to successfully design and implement the separate collection of bio-waste, but their time is running out quickly, as the EU Directive on Waste[1] established that they should put in place such a system by no later than 1 January 2024. Moreover, the European Commission announced in the new Circular Economy Action Plan that it intends to adopt a legislative proposal to set up an EU model for separate collection of waste.

Bio-waste represents an important share of municipal solid waste. Bio-waste is the sum of two fractions of biodegradable waste, namely park and garden waste (green waste) and household kitchen waste (food waste). In terms of bio-waste composition, the latter comprises the largest share but most is lost to landfills and incinerators, whereas green waste is the only fraction that is collected for recycling in many countries.

The composition of collected bio-waste is also related to social factors. In regions with single-family single houses, green waste is often the main fraction found in the waste bins – particularly in spring and autumn – whereas in regions with many high-rise apartment buildings, food waste is the main fraction throughout the year.

In 2017, the EU Member States, including the UK, generated 252 million tonnes of municipal solid waste, of which about 45%, or 113 million tonnes, was bio-waste. A recent report by the European Environment Agency (EEA) also found that food waste represents 60% of bio-waste.

[1] Directive EC/2008/98 on Waste

The same report found that only 43% of municipal bio-waste was collected separately, while 57% of bio-waste ended up in mixed municipal waste and was thus lost for recycling. Another report by the Bio-based Industries Consortium and Zero Waste Europe (BIC/ZWE) found comparable figures for generated bio-waste and uncollected food waste in Europe.

A massive amount of food waste that separate collection could deliver to high-quality recycling is instead lost in landfills and incinerators. This is a big loss not only for citizens, who pay taxes, levies and/or tariffs for proper separate collection and recycling and are instead financing the lowest step of the waste hierarchy, but also for the environment and the climate.

According to Eurostat, municipal waste generation totals vary considerably, ranging from 280 kg per capita in Romania to 844 kg per capita in Denmark. The variations reflect differences in consumption patterns and economic wealth and also depend on how municipal waste is collected, managed, monitored and reported.

A report by the German Environmental Agency confirmed the findings of the EEA and BIC/ZWE and provided further insights into several German schemes for the separate collection of bio-waste and residual waste.

Given the environmental and climate challenges we are facing, restoration and protection of good ecological status should play a pivotal role in any policy decisions. In fact, a healthy and safe environment is a prerequisite for a healthy and safe lifestyle. Increasingly, European citizens and undertakings are experiencing – in a direct way – the effects of climate change and environmental pollution; these aspects should be at the heart of decisions, including those on separate collection and waste management.

Table 1 reports figures and estimations for the separate collection of bio-waste and food waste in the EU, plus Norway and the UK, for the years 2017 and 2018.

Table 1: 2017 and 2018 data on bio-waste and food waste generation and on separation and capture rates reported in BIC/ZWE and EEA reports

EU countries	Separate bio-waste collection[a]	Bio-waste		Food waste	
		Amount generated (t)[b]	Separate collection (%)[a,b]	Amount generated (t)[b]	Separate collection (%)[b]
Austria	+++	2,273,206	44%	1,049,986	19%
Belgium	+++	2,745,650	34%	1,212,159	16%
Bulgaria	–	1,390,173	17%	561,368	0%
Croatia	+	915,478	3%	344,151	2%
Cyprus	–	103,728	16%	69,901	5%
Czechia	++	2,472,287	19%	998,355	10%
Denmark	++	1,587,929	83%	600,929	22%
Estonia	+	281,748	8%	148,153	3%
Finland	+++	1,251,314	34%	562,898	15%
France	+	15,982,965	54%	8,199,668	21%
Germany	+++	18,264,534	57%	7,834,000	27%
Greece	–	2,053,670	16%	1,530,315	4%
Hungary	+	2,383,107	11%	1,075,121	5%
Ireland	+++	1,153,415	20%	579,621	8%
Italy	+++	10,636,692	55%	7,707,443	47%
Latvia	–	441,914	10%	206,142	4%
Lithuania	+	701,567	14%	339,217	6%
Luxembourg	+	169,852	29%	72,636	13%
Malta	+++	62,933	19%	55,934	4%
Netherlands	+++	3,605,080	41%	1,932,858	15%
Norway	+++	1,153,451	30%	419,863	45%
Poland	++	9,378,206	11%	4,251,877	5%
Portugal	+	2,510,189	4%	1,307,414	2%
Romania	–	5,263,491	7%	2,477,413	3%
Slovakia	–	1,279,042	17%	460,170	9%
Slovenia	+++	548,644	28%	225,520	13%
Spain	+	8,761,288	10%	6,758,587	3%
Sweden	+++	2,309,392	32%	1,081,360	14%
United Kingdom	+++	14,135,826	35%	7,873,663	13%
Total/average EU-28+NO+UK		**113,816,770**	**32%**	**59,936,725**	**16%**

[a]Source: EEA.

[b]Source: BIC/ZWE.

An example (Figure 1) illustrating that bio-waste is still present in large amounts in residual waste is shown in the figure from the report by the German Environmental Agency, based on a characterisation study performed in 2017 on municipal solid waste from representative regions in Germany.

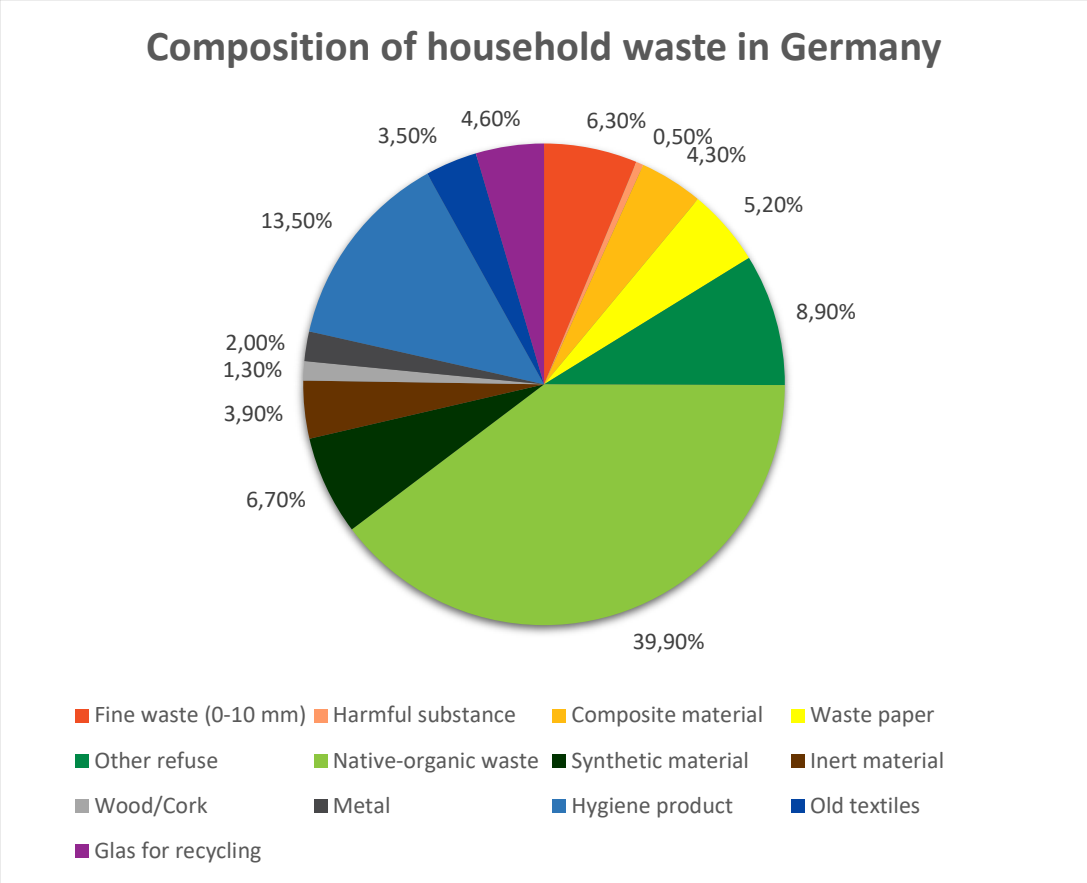

Figure 1:Compostition of Household waste in Germany. Source: Umweltbundesamt, Texte 113/2020

The study very accurately detailed the composition of residual waste and the share of food waste that it contained. Bio-waste accounted for 39% of total residual waste, of which 88% was food waste, including packaged food waste. The report provides an important indicator of the separate collection of food waste, but also of the overall quality of collection.

The findings should be compared with the total amount of residual waste. Overall, 156 kg of residual waste per capita and year of the timeframe was collected, and of this, 53.5 kg per capita and year was food waste.

To obtain good qualitative and quantitative insights into both the amounts of waste and their pathways, waste characterisations are needed for the separated fractions and residual waste.

2 Indicators to measure effectiveness of separate collection

2.1 Bio-waste composition

Bio-waste (m_{BW}) is the sum of two fractions of biodegradable waste, namely park and garden waste (green waste) (m_{GW}) and household kitchen waste (food waste) (m_{FW}):

$$m_{BW} = m_{GW} + m_{FW} \qquad [kg] \tag{1}$$

It is common practice in some Member States to collect only the garden waste fraction of bio-waste. In those countries, citizens usually throw their food waste in the residual waste bin. A very large amount of food waste that could be recycled regularly ends in landfills and incinerators. Figures 2 and 3 show the differences between partial separate collection when food waste is lost and correct separate collection when food waste is collected and recycled.

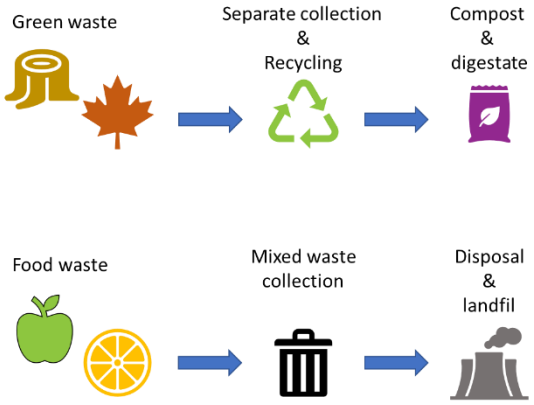

Figure 2: Typical partial separate collection of bio-waste.

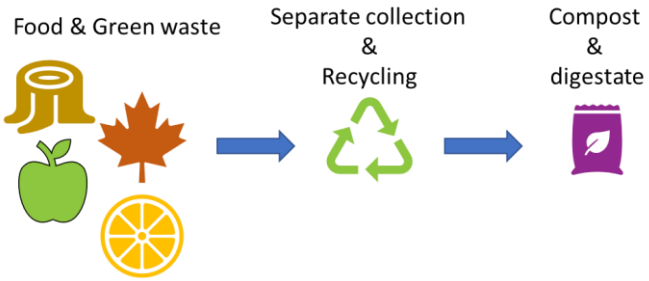

Figure 3: Correct separate collection of bio-waste.

2.1.1 Food waste left in residual waste

The indicator should be given as food waste in residual waste (FW_{RW}) as kilograms per capita and year. If local waste managers decide to monitor this indicator, they must ensure that it is reduced to a minimum.

$$FW_{RW} = \%FW_{RW} * m_{total\ RW} \quad \left[\frac{kg}{capita, year}\right] \tag{2}$$

Even when the separate collection of food waste is implemented regularly for a long time, it is not unusual for certain amounts to be found in the residual waste bins. This can happen for many different reasons, for instance if tourists are not well informed about the separate collection practices, food waste is not collected frequently enough, or households are not instructed or incentivised enough to sort their waste appropriately.

Therefore, it is necessary to conduct waste characterisations at the location of interest to measure the amount of food waste that is thrown in the residual waste bins.

2.1.2 Untapped potential: total food waste generation

This indicator is the sum of all food waste that is produced by households (m_{FWgen}). This figure sums up the waste captured in the municipal collection system (m_{FWsep}), such as separate bio-waste, food waste left in residual waste (m_{FWRW}), and other collection streams such as home-composting ($m_{FW\ home-composting}$). The last need not be calculated only in the extreme case of negligible amounts.

$$m_{FW_{gen}} = m_{FW_{sep}} + m_{FW_{RW}} + m_{FW_{home-composting}} \quad \left[\frac{kg}{capita, year}\right] \tag{3}$$

As shown in equation 3, this indicator is to be calculated as total generation in kg per capita and year.

2.2 Participation in separate collection: effectiveness of total food waste separation

Separation effectiveness is the amount of food waste that is correctly separated as a percentage of the total food waste generated as shown in equation 4. In addition to food waste in separate collection and in home-composting, it is important to know the amount of food waste in residual waste.

$$FW_{sep-eff} = \frac{m_{FW_{sep}} + m_{FW_{home-comp}}}{m_{FW_{sep}} + m_{FW_{home-comp}} + m_{FW_{RW}}} * 100 \quad [\%\ of\ FW\ generated] \tag{4}$$

This indicator shows the capacity of the system to capture food waste in the municipal separate collection, including home composting. It shows the extent of the participation of the population in the separate collection system and the separation effectiveness. The effectiveness of food waste separate collection can be known accurately only if regular characterisations of the residual waste are carried out.

If local waste managers decide to monitor this indicator, they must aim to achieve the highest share. The higher the percentage, the more effective the collection system. **Shares below 30% are highly inefficient**, which sadly is still the case in many European countries, where many cities separate only **around 10–30 kg/capita** of food waste per year. **The best examples collect more than 70 kg/capita.** Food waste generation is usually estimated at between 100 and 120 kg/capita per year.

3 Handbook for separate collection

Individual municipalities are responsible for separate collection but very often they unite to form a single administrative unit with a unified collection system. The governance structures, competences, and how fees and/or levies are defined and collected may vary widely within a country.

Various separate collection systems, for example door-to-door, bring or reception systems or other collection systems, exist for bio-waste in the different rural and urban areas across the EU Member States. Flanking measures, such as communication and awareness-raising campaigns, incentive schemes operating through fees and levies, targets for separate collection, etc., are also required for the successful collection of bio-waste for high-quality recycling.

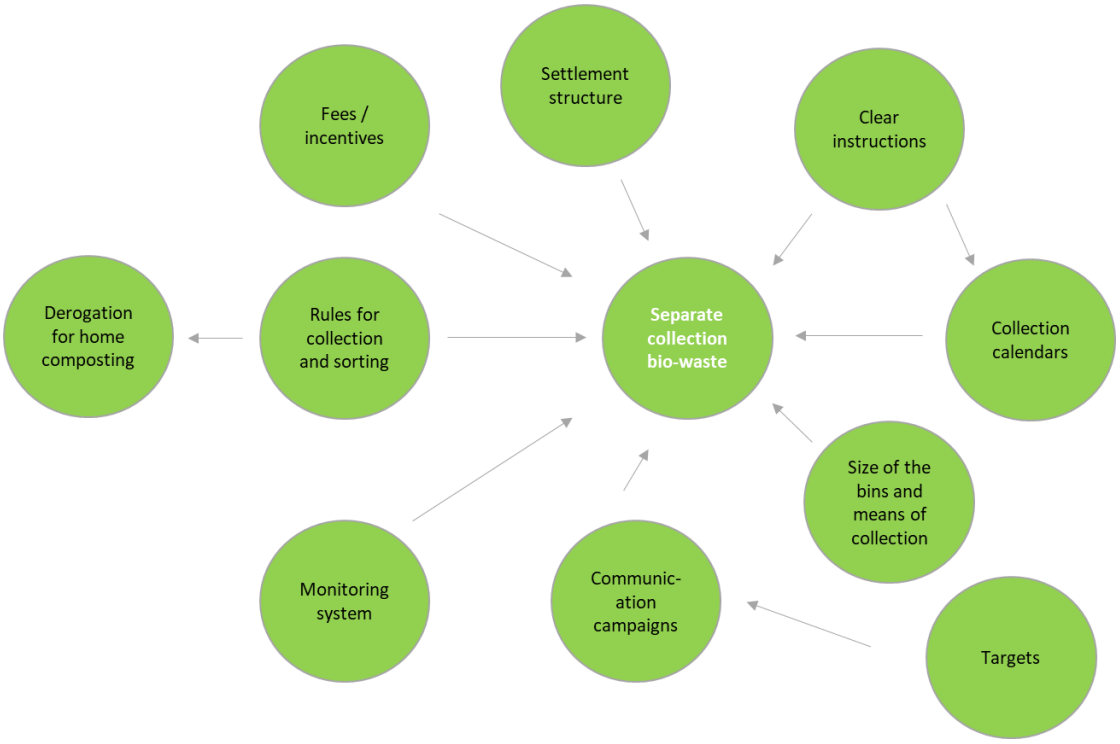

Figure 4: Factors influencing bio-waste collection. Adapted from the German Environmental Agency report, "Comparative analysis of residual municipal waste from representative regions in Germany" (see the references).

It is important to know the impact of each factor on citizens commitment to take part in the system for separate collection of waste. Each of the indicators can be measured to evaluate either a specific detail or the system as a whole, and they all provide useful insights on qualitative and quantitative shortcomings or barriers.

The following section provides a description of the impact factors (Figure 4) together with some examples of both well-established and innovative practices. The factors influencing the means of collection are the collection system logistics, settlement structure, fee system for rewards and penalties (incentives), material flow management, awareness-raising and communication campaigns, and rules.

3.1 Collection system logistics

The most common collection schemes are kerbside/door-to-door, (collective) bring points, community composting and home composting.

Kerbside (door-to-door) collections are common in many countries such as Italy, Germany, Austria, Belgium and some areas of Portugal (Figure 5). Within this general category there are a few differences. In Italy, more than 40 million people are served by door-to-door schemes where food waste is collected in an individual stream by means of compostable bags, usually two to three times a week. Similar schemes operate in Belgium, Malta, some areas of Spain, mainly Catalonia, the UK, France and the city of Copenhagen in Denmark. In Germany, Austria and other countries in central Europe, the collection is carried out using a dedicated bin and preferably without bags. Food waste is collected per building, mixed, or commingled, with an amount of green waste, typically 50% or more. Lower collection frequencies, once per week or every two weeks, are common. In the most intensive kerbside schemes, such as in Italy, a capture rate of 80–100 kg/capita per year of just food waste is commonly achieved, equating to a participation rate of around 80%, with an impurity rate of less than 5%.

Figure 5: Door-to-door collection with different waste streams collected in different days. Source: CC BY-SA 3.0, https://en.wikipedia.org/w/index.php?curid=11163571

(Collective) bring points, i.e. large "proximity bins" or containers accessible 24/7 on the street, dedicated to food waste are used by many municipalities in Italy, France and other countries (Figure 6). These are becoming more popular where, due to the increase in urban areas and the types of buildings, kerbside collection is a less viable option. In many cases, an amount of garden waste is also permitted, with food waste. Recently, public containers have been provided with personalised electronic locker systems. Dedicated electronic keys or cards are provided to users following identification. Such measures are intended to reduce and prevent contamination with other materials. Bio-waste delivery to public bins is usually more anonymous than kerbside collection and it affects the quality of the collected materials. The capture rate with public bins is typically lower than for kerbside collection, around 20–50 kg/capita per year, and impurities are considerably higher, reaching averages of 10–15% in many cases.

Figure 6: Normal roadside container for mixed or separate waste collection. Source: https://it.wikipedia.org/w/index.php?curid=1145420

Community composting is a viable option for rural areas and sparse villages; best practices can be found in the province of Pontevedra in Spain and the city of Besançon in France. These systems work well when "master composters" are hired and take part daily in the collection. They perform the routine control and maintenance tasks in the community composting module. Although the quality is good, the participation rate is rarely more than 50%, because it is not mandatory and instead relies on the engagement and commitment of the municipality and citizens.

Home composting is another option (Figure 7). Member States can account for the amounts of waste that are composted at home as "recycled" even if it is not strictly a collection scheme. Home composting is considered a kind of waste avoidance because the bio-waste generated by the household is used at the place of origin. Again, a strict monitoring protocol should be implemented to ensure that the scheme is used effectively over time. A municipality cannot rely exclusively on home composting, which should remain voluntary. An effective scheme for separate collection of bio-waste should always be established in urban areas.

Figure 7: Home composting. Source: Di Herman at fr.wikipedia – originally at fr.wikipedia, Pubblico dominio, https://commons.wikimedia.org/w/index.php?curid=1647281

Collection frequency often differs even between cities in the same Member State. It is usually higher in Mediterranean countries and it is lower in northern Europe. Where food waste is collected more frequently, both acceptance of the system and participation are usually high, since nuisance odours are avoided and the not in-my-back-yard ('NIMBY') effect is prevented.

Enforcement and controls during collection. In kerbside schemes, public authorities can mandate the waste collection operators to visually inspect the contents of the bins and refuse to collect bio-waste contaminated with glass, metal and plastic. In this case, the collector should leave an explanation for the householder about why the bin was not collected, together with advice to improve future separation. Alternatively, it could collect the contaminated bin but fine the non-compliant householder. Inspections and enforcement controls are easy for single-family houses, but they are very difficult to implement in big buildings comprising multiple flats.

3.2 Settlement structure

The composition, quality and quantity of food waste usually reflects the location of the settlement. Population densities, socioeconomic background, differences between rural and urban areas and season are all important factors affecting citizens' lives and the amounts of waste they generate.

- Settlement structure: the composition of bio-waste is very different between rural and urban areas. In urban areas, food waste is the largest fraction, while in most rural areas green waste is the largest.
- Building structure ranges from single-family houses and multi-family houses to large settlements (one building, from tens to hundreds of households). The differences in the composition of waste observed between the different living areas are usually the same as those observed between the rural and urban areas, i.e. more green waste and fewer impurities are typical where population density is lower.

3.3 Fee system for rewards and penalties (incentives)

The fee system is important to foster participation in the separate collection schemes. A "pay as you throw" (PAYT) fee includes a fixed part covering the costs of collection and a variable part rewarding good separation, and preventing and penalising the generation of badly separated waste. Other flexible fees can be applied through bag purchases (common in Italy) or the purchase of differently sized bins (common in Germany).

Financing bio-waste management with the landfill tax in Catalonia

The incentive scheme that has been in place in Catalonia since 2004, is a striking example of economic instruments promoting separate collection of food waste. The Waste Agency of Catalonia (ARC) manages this scheme, which is based on a progressively increasing tax on landfilling (around €10/t at the beginning, €53.1/t since 1 January 2021 and projected to increase up to €71.6/t by 2024) and a lower tax on incineration (about half the landfill tax).

All the money (96%) is given back, directly or indirectly, to municipalities to improve their separate collection of food-waste, and to composting plants to improve their treatment and compost quality. The amount refunded to municipalities is calculated according to their performance on separate collection of food waste. This includes coefficients to account for the quality of food waste collected; hence, a mandatory set of waste composition analyses are carried out, using part of the funds from the landfill and incineration taxes.

3.4 Material flow management

Single stream or commingled. Although some countries prefer to collect food waste in a single fraction, mixing food (Figure 8) and green (Figure 9) waste is another common practice in other regions. Furthermore, separate collection can also be influenced by the recycling plants that are available for that region and that determine its treatment capacity. Composting and anaerobic digestion processes must always respect certain standards, which are set at European level but configurations may vary. Composting can take place in the open air or in closed tunnels, can be a wet or dry process and can be operated at different temperatures. Similar distinctions can be made for anaerobic digestion. Furthermore, some EU Member States do not allow recycling of certain food waste fractions, i.e. animal-based food waste in all configurations of the plants undertaking biological recycling

Figure 8: Food waste. Source: https://static.gamberorosso.it/adobestock-133146491-1-768x511.jpeg

Figure 9: Garden waste. Source: https://westmount.org/wp-content/uploads/2019/09/residus-jardin-800x445.jpg

Impurities such as glass, metal and plastic occur more often in food waste than in green waste. Certain countries mandatorily require that bio-waste is collected using certified compostable paper and plastic bags. Every effort must be made to avoid all foreign matter at the point of origin as this can only be removed in the recycling process with a high effort and in any case not completely.

3.5 Communication and awareness-raising campaigns

One of the most important tools to achieve or maintain high-quality separate collection are communication campaigns. It is therefore necessary to have knowledge of the effectiveness

of different tools to ensure money is not wasted on programmes that have almost no effect. As an example, just distributing leaflets might not result in improvements, and in certain areas a more intense communication strategy is necessary.

A **social experiment in Lübeck**, Germany, was carried out in cooperation with the local waste management company (Entsorgungsbetriebe Lübeck), two housing associations and the Bioresource Management Group of the Hamburg University of Technology. A new collection system for household food waste was tested in two areas, which both comprised multi-family living units. A bio-waste collection scheme was already in place in both areas. As is usual in Germany, it consisted of a mixed collection of food waste and green waste once per week, or every other week; however, food waste collection from both areas was rather low. Before testing the new system, communication was undertaken to inform households about the new system, explain the importance of good waste-sorting behaviour, and provide them with easy-to-follow instructions. The system set-up consisted of providing individual small bins (5 L capacity), which replaced the old communal one (> 240 L capacity), and increasing the collection frequency to three times per week. During collection, the bins were also exchanged for clean ones.

Collected food waste increased from 7% to 65% and impurities decreased from 5% to less than 0.5% very quickly. Interviewed households explained that they were motivated to improve the sorting of their own food waste. Furthermore, the new system fostered positive competition between those householders who started to discuss their sorting habits.

Aktion Biotonne and #WirfuerBio are initiatives launched by German waste management companies and municipalities to harmonise communications with the population (Figures 10 and 11). Citizens are taught about the different incentive schemes and how to improve sorting of their bio-waste at home, especially with the message “NO PLASTICS IN THE BIN FOR BIO-WASTE” (translated from the poster in Figure 11).

The campaign #WirfuerBio was conceived in 2017 to reduce the contaminants - first and foremost plastic - in bio-waste compost. At that time, there were six municipal operations in Schleswig-Holstein and Hamburg. Today, there are more than sixty municipal waste management companies from twelve federal states.

The idea for the Aktion Biotonne Deutschland campaign originally came from the Hessian Ministry of the Environment and was first implemented in Hesse in 2016 together with cities and a retail company.

Figure 10: Poster for a German communication campaign. Source: https://www.aktion-biotonne-deutschland.de/

Figure 11: Poster for a German communication campaign. Source: https://www.aktion-biotonne-deutschland.de/

The implementation of residential food waste **separate collection in Milan** (Italy) is another example of high citizens engagement. In 2011, Milan had an overall recycling rate of 35%; made of mainly dry recyclables like paper, glass, plastics and metals collected separately at the kerbside. Food waste was only being collected from commercial sources such as restaurants, supermarkets, hotels and schools. The newly elected city government considered this to be unsatisfactory and as a main action decided to introduce the source separation of residential food waste to be sent to an anaerobic digestion and composting facility for biogas and compost production. The scheme was rolled out in 2014 in the whole city based on the delivery of 10 liter ventilated kitchen caddies, a free starter kit of compostable bags (Figure 12) and dedicated bins for each building.

Since the beginning the results were impressive: more than 90 kg/capita/year of food waste were collected separately (most recent data show around 110 kg/capita, of which 30% commercial and 70% residential), corresponding to 80-90% diversion of food waste from disposal with a high level of satisfaction and participation by citizens and a low level of impurities.

Figure 12 - Poster for an Italian communication campaign

One of the key success factors of Milan was the convenience of the scheme, based on door to door collection, building management services taking care of setting out bins on the street twice a week, and the availability of compostable bags in supermarkets as these are the only carrier bags allowed by law in Italy since 2014; as carrier bags, mainly compostable plastic shopping and produce bags reused for collecting organics are used in Italy.

Free paper bags for food waste collection were provided to citizens by the city of Hamburg in Germany. The innovative product, a wax-coated paper bag for the sorting and collection of kitchen food waste, was designed to fit in the food waste collection bucket. The bags were distributed in recycling centres and drug stores. Each year, the municipal company for waste management gives 30 bags to each inhabitant for free.

Compost Goal is a project carried out in southern Italy to teach citizens how to distinguish between compostable and non-compostable plastic bags. Although compostable bags have been mandatory for the collection of bio-waste since 2014, many polyethylene bags are still used – with figures higher than 40%. The project sponsor and its partners rewarded the municipalities that managed to score the best at sorting compostable bags, using waste characterisations to verify the performance of the different municipalities.

REthinkWASTE is a project funded by the LIFE programme of the EU (Figure 13) to test the "know as you throw" (KAYT) scheme and benchmark it against the "pay as you throw" (PAYT) scheme. Citizens are provided with individual and customised feedback to improve their sorting habits. A messaging platform based on WhatsApp, SMS and Telegram was built, linked to individual measurements of bin deliveries and inspections by trained operators. Key messages such as "In your building food waste collection is quite good but you can improve quality", together with suggestions and strategies for improvement, are sent to the participants.

Figure 13 - EU project REthinkWASTE.

5 Conclusion

This paper, along with other studies, confirms that the share of bio-waste in municipal waste is still very high, around 30-40%, even in Member States that perform very well in separate collection and recycling. Food waste is the biggest fraction of bio-waste that EU citizens struggle to sort properly for separate collection and high-quality recycling.

To better assess the effectiveness of bio-waste collection schemes, using the following combined indicators is very important for waste managers and public authorities:

- Monitoring bio-waste composition allows the amount of green waste and food waste collected to be calculated. There is no need to adapt the indicator to different collection systems. It is flexible and it can be easily applied to both single-stream and commingled systems.
- Food waste left in residual waste, measured in kg/capita/year, should be minimised significantly to prevent landfilling or incineration of valuable resources. It can be minimised preliminary through separate collection and recycling (composting/anaerobic digestion), but also by actions to prevent food waste and adapted guidelines on home composting where possible home composting.

The second indicator should be compared with the total food waste generated, estimated from studies, the literature or official statistics, when available, to assess the participation rate of citizens in all these actions. Clearly, for the indicators introduced above, it is necessary to obtain specific knowledge on the amounts, shares and pathways of food waste. To have good qualitative and quantitative insights into local waste management, it is highly recommended that frequent waste characterisation of the separated fractions, either single-stream food waste or commingled with green waste, and the residual waste fraction is carried out. This is crucial if waste managers and municipalities want to capture all food waste that is present in the municipal collection system and measure the impact of the actions undertaken to improve the system.

When carrying out waste characterisations of the residual waste, it is recommended that the presence of food waste, green waste and other compostable waste, such as kitchen napkins and other paper, is also verified.

The European Compost Network highlights the need for municipalities, regulators, citizens, companies and waste managers to cooperate to achieve sorted and collected materials of the highest quality. Impurities in separate collection are expensive and inefficient for the system and bad for the environment. Any means of reducing impurities should be encouraged, including awareness-raising campaigns, control and enforcement measures, and digital and technological innovation. The main guiding principle should always be that, in line with the waste hierarchy, preventing impurities and improving sorting habits upstream is the most sustainable, efficient and environmentally friendly practice.

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About ECN

The European Compost Network is a membership organisation with 68 members from 27 European countries. Members include all European bio-waste organisations and their operating plants, research, policymaking, consultants and authorities. Via the member organisations, the ECN represents more than 4500 experts and plant operators with more than 45 million tonnes of biological waste treatment capacity.