Waste collection strategy

In a nutshell

Summary overview

It is best practice to design and implement a waste collection strategy that considers:

- the main features of the waste management strategy (e.g. number of separately collected waste fractions);
- the targets set in the waste management strategy (e.g. share of separately collected waste out of the total waste collected, impurity rates of the separately collected fractions, revenues from recyclables);
- the characteristics of the collection area (e.g. population density and main housing types);
- the current environmental attitudes and perceptions of residents;
- any other specific condition affecting waste collection (e.g. the relevant presence of tourists/commuters, specific economic activities, climate).

The main goal of a waste collection strategy is to collect, in a timely and economical manner, as much correctly source separated waste as possible, in order to ease the subsequent waste sorting/treatment with the aim to maximise recycling. In many cases, these objectives can be pursued by setting up the following:

- frequent door-to-door separate collection of food waste (e.g. weekly or more often depending on the season and climate);
- less frequent collection of mixed waste (e.g. every two weeks);
- door-to-door collection of recyclables (e.g. paper, cardboard, cans, plastics, glass), individually source separated where public acceptability allows, otherwise co-mingled and sorted at a material recovery facility; glass, followed by paper and cardboard, is more often more effectively collected separately;
- a convenient network of civic amenity sites (see the best practice Civic amenity sites) that accept all waste fractions not collected door-to-door or in street containers from households, including hazardous waste and biowaste.

Waste management area

Cross-cutting	MSW - strategy	MSW - prevention	MSW - collection	MSW - EPR	MSW - treatment	CDW	HCW

Applicability

The prevailing socio-economic status and recycling consciousness within the area from which waste is collected needs to be considered in the definition of the waste collection strategy. More costly strategies, such as door-to-door collection, may prove more cost-effective once fully running, but require initial investment.

Specific environmental performance indicators

In addition to the common environmental performance indicators presented in the best practice Common Environmental Performance indicators, the most appropriate indicators to assess the successful implementation of this best practice are:

- Participation rate, i.e. the share of the population using the waste collection system (%).
- Share of the local area covered with a specific waste collection system (%).
- Customer satisfaction (% of residents satisfied with household waste collection and specifically with the collection of the separately collected fractions).
- Collection of bulky waste on demand (y/n).

Benchmark of excellence

Door-to-door waste collection of at least four waste fractions[1] is implemented in the whole territory administered.

[1] In areas where different waste fractions are collected co-mingled (e.g. metal and plastic waste packaging) the co-mingled fraction is considered as one fraction.

Description

Background

Collection of MSW can be undertaken via door-to-door (or kerbside) collection rounds from households and businesses or at municipal waste collection centres. Collection rounds are typically provided for the most voluminous MSW fractions, with municipal waste collection centres accepting a wider range of waste streams, including electronic and hazardous waste streams. Return schemes and electronic waste are addressed in other BEMPs; here the primary focus is on the following MSW fractions: biowastes[1], glass, paper and card, plastics, metals and mixed waste (where “mixed waste” refers to waste not separated at source and sent for incineration/final disposal).

A key measure of environmental efficiency for any waste collection strategy is the proportion of total waste collected that is *selectively* collected. ACR+ (2014) defined “selective collection” as the separation of waste materials at source with the intention of recycling them, and has benchmarked performance across European cities (Figure 1). The quantities of waste fractions selectively collected are also influenced by the quantities generated, and do not necessarily represent the highest *proportions* of waste being selectively collected.

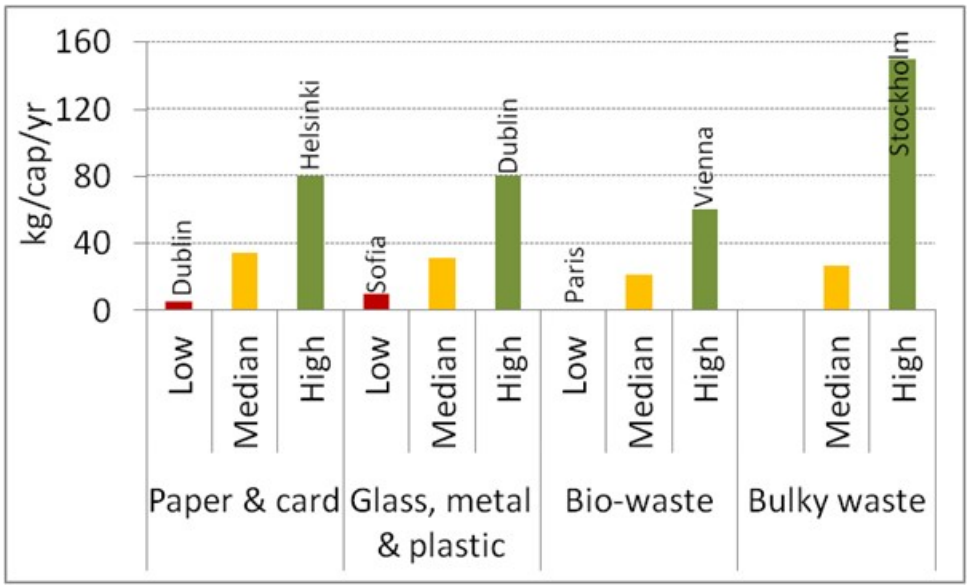


Figure 1. Range of quantities of different waste fractions selectively collected across European cities, according to ACR+ (2014)

Benchmarking, such as that undertaken by ACR+ (2014), can be a powerful driver to improve effectiveness and cost-efficiency (see also best practice on waste monitoring).

Types of selective waste collection

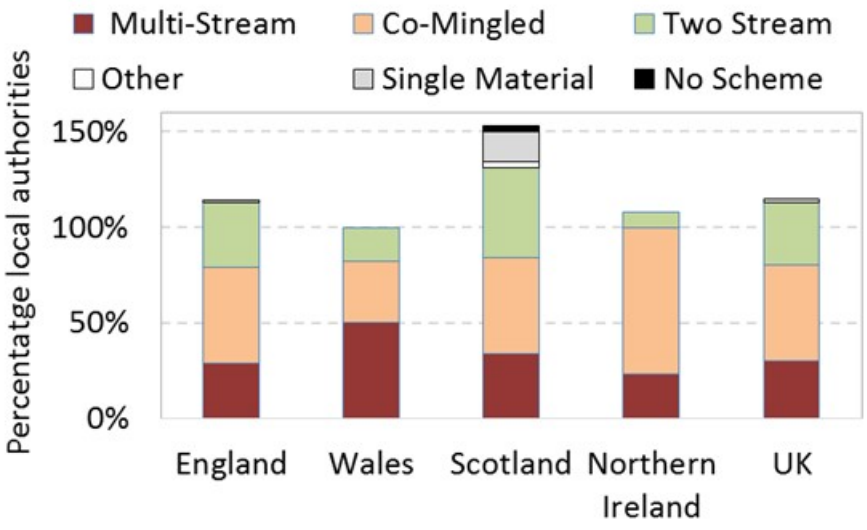
Various models of waste collection exist to deliver separated fractions for recycling, including separate door-to-door collection rounds for individual fractions, co-mingled recyclable material collection rounds with and without kerbside sorting, and community collection centres where citizens deposit waste fractions as required. Strategies for collection of dry recyclables (e.g. paper, card, cans, plastic bottles, mixed plastic, glass, aerosols, batteries, foil and textiles) are particularly varied (Table 1).

Table 1 Main types of waste collection strategies for dry recyclables

Collection type	Explanation
Door-to-door 	Within door-to-door collection systems the bins/sacks can be collected from the doorstep of the inhabitants, but also by kerbside collections. Kerbside collections are provided for flats where residents set out containers for collection from the street. This system can range from one bin for mixed waste collection to up to six separate bins/sacks (including the bin for residual waste) for other targeted waste streams. Most commonly this covers the waste streams paper, plastic, metal, glass, and biowaste. However, it is also possible that several materials are collected together in one bin/sack which is then called co-mingled collection; this is most common for metal and plastic together in one bin. This system can be supplemented by occasional collections by the municipality or other actors such as private operators, e.g. for bulky or hazardous wastes. The collection frequency varies in general, but it is mainly every two weeks for most fractions. Biowaste collection tends to be more frequent, presumably due to the nature of this fraction, while many cities apply more frequent collection during the summer. For some materials (e.g. glass), collection in some cases happens upon demand from the households.

Bring points 	Another system is bring point collection which is applied for the collection of recyclable materials and mixed waste, e.g. commonly for the collection of glass (mostly separate for white and coloured glass). But paper/cardboard, plastics, and metals are also collected at bring points. In addition, another form of bring point collection is the centralised/community composting of biowaste. Residents jointly share and manage a central composting facility. The advantage of this system is mainly that the collection points across the city are reduced substantially compared to door-to-door systems. Bring systems can also be complementary to door-to-door collection and they may target specific materials that are not covered by door-to-door collection.
Civic amenity sites 	**Civic amenity sites** or recycling centres are typically enclosed and sometimes staffed collection sites that are used as additional collection systems, usually accepting the same streams as collected in the door-to-door and bring point collection but also additional streams such as hazardous waste, garden wastes, and WEEE. Often civic amenity sites are operated by the municipalities themselves. Citizens can bring their waste there, which may or may not be free of charge.
Deposit and refund schemes 	**Deposit and refund systems** are typically applied for beverage bottles (cans) made of glass or plastic (metal) and are in most cases systems established at national level, e.g. by an EPR scheme.

Figure 2 shows the frequency of different types of waste collection across the UK.



Source: WRAP (2015).

NB: Values over 100 % owing to multiple collection frequencies across zones with local authorities. Includes textiles in some local authorities but not in others.

Figure 2. Percentage of local authorities operating each dry recycling scheme in 2013/14

The most appropriate collection strategies will depend on the characteristics of the collection zone (e.g. densely populated urban areas versus sparsely populated rural areas) and public acceptability of various strategies. Municipal collection points can be very cost-efficient and cost-effective in areas where citizens are sufficiently motivated to ensure widespread and effective separation (Table 2). Similarly, multi-stream collection systems such as *Optibag* and the *Quattro System* (see Operational data) have achieved very high separation efficiencies in Sweden, leading to 90 % recyclability (Björk, 2015; LAPV, 2012), but again require high levels of citizen engagement.

Waste collection strategy design

WRAP (2009) refers to the following four primary criteria that waste management authorities should consider when deciding on the type of waste collection system to implement or outsource for a particular waste fraction: (i) quality of material, (ii) cost-efficiency, (iii) cost-effectiveness, (iv) public acceptability. In terms of environmental performance, the separation efficiency and the quality of the separated material are the key criteria.

“Quality” is defined as “consistently delivering materials to the market that are effectively separated to meet reprocessor requirements, in the required volumes with security of supply, and at a price that sustains the market” (WRAP, 2009).

“Cost-efficiency” refers to the objective of minimising waste collection costs per household served, but may conflict with “cost-effectiveness”, which ultimately represents the cost per tonne of final waste disposal avoided. From a societal perspective, “cost-effectiveness” represents a maximisation of resource efficiency and minimisation of environmental externalities associated with waste management per euro spent on waste management. From a narrower waste management authority perspective, “cost-effectiveness” can be defined as the economic balance of recyclable waste stream income minus collection costs and landfill charges. Thus, some low-cost collection strategies, such as alternate-week kerbside collection of co-mingled recyclable fractions may lead to a poor overall economic performance owing to reduced revenue for low-quality material streams. Table 2 under Operational data section highlights some of the trade-offs in relation to glass collection.

“Public acceptability” is one of the prerequisites for establishing an effective system for separate collection of recyclables and waste materials. Varying public acceptability and engagement with recycling across Europe is a major reason why different waste collection strategies may be considered “best” across different Member States, and regions within them.

Key factors influencing separation efficiency

A best fit regression model developed in the UK explains 42 % of the variation in kerbside recyclable collection performance (kg/resident/year) across 434 local authorities using variables relating to socio-economic and regional characteristics and kerbside operational factors (WRAP, 2010). The frequency of residual waste collection was found to be an important driving force for the recycling rate. Fortnightly refuse collections were associated with higher dry recycling yields compared with weekly refuse collections, presumably because less frequent residual waste collection means a lower effective weekly capacity for residual waste, and increases citizens' consciousness of the need to reduce residual waste. Meanwhile, the number of recyclable fractions collected, the recyclable fraction containment volume and the frequency of collection were all positively associated with the recycling rate. These results highlight the importance of an integrated waste collection strategy that simultaneously:

- ensures adequate frequency (e.g. weekly) and containment volume for recyclable fractions, including separate collection of biowaste;
- minimises the residual waste collection frequency (climate-dependent, best achieved when the organic fraction is separated out);
- accepts a wide range of dry recyclable fractions.

ACR+ (2014), in its EU Capital Cities Study, notes that European cities with the highest rates of separate waste collection, such as Helsinki, have comprehensive door-to-door collection schemes alongside civic amenity centres which are free at the point of use. Meanwhile, analysis by WYG Environment (2011) showed that the best dry recycling performances in the UK were associated with:

- 100 % co-mingled dry recyclates collected fortnightly in wheeled bins; plus
- refuse collections being made fortnightly from wheeled bins; and
- at least the five main materials being collected for recycling: i.e. paper, card, cans, glass and plastic bottles.

Co-mingled collections were found to yield 30–40 kg more separated recyclable waste streams per household per year compared with kerbside sort collections, across the societal spectrum (WYG Environment, 2011). Although co-mingled collections have been found to be more expensive than kerbside sorting collections in the past, cost comparisons have often ignored the following factors for co-mingled collections: (i) the potential for fortnightly (rather than weekly) collections, (ii) higher recycling yields, (iii) reducing material recovery facility costs (WYG Environment, 2011).

Best practice

Ultimately, performance varies considerably depending on implementation, and there is significant potential to optimise all waste collection strategies in accordance with the principles outlined in the integrated waste management strategies best practice. Each local authority must decide on the most appropriate strategy for their area and residents, and under local conditions.

It is best practice to design and implement a waste collection strategy that considers:

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- the targets set in the waste management strategy (e.g. share of separately collected waste out of the total waste collected, impurity rates of the separately collected fractions, revenues from recyclables);
- the characteristics of the collection area (e.g. population density and main housing types);
- the current environmental attitudes and perceptions of residents;
- any other specific condition affecting waste collection (e.g. the relevant presence of tourists/commuters, specific economic activities, climate).

The main goal of a waste collection strategy is to collect, in a timely and economical manner, as much correctly source separated waste as possible, in order to ease the subsequent waste sorting/treatment with the aim to maximise recycling. In many cases, these objectives can be pursued by setting up the following:

- frequent door-to-door separate collection of food waste (e.g. weekly or more often depending on the season and climate);
- less frequent collection of mixed waste (e.g. every two weeks);
- door-to-door collection of recyclables (e.g. paper, cardboard, cans, plastics, glass), individually source separated where public acceptability allows, otherwise co-mingled and sorted at a material recovery facility; glass, followed by paper and cardboard, is more often more effectively collected separately;
- a convenient network of civic amenity sites (see Civic amenity sites best practice) that accept all waste fractions not collected door-to-door or in street containers from households, including hazardous waste and biowaste.

[1] Biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises, and comparable waste from food processing plants, excluding forestry or agricultural residues, manure, sewage sludge, or other biodegradable waste such as natural textiles, paper or processed wood (EC, 2015).

Environmental benefits

Each kg of material diverted from landfill or incineration to recycling leads to significant resource and environmental savings. For example, sending biowaste for anaerobic digestion leads to avoided fossil fuel combustion and fertiliser production, and avoids significant GHG emission associated with the landfilling of biowaste. Recycling metal and plastic wastes avoids resource extraction and energy-intensive primary processing.

Implementation of an effective waste collection strategy can rapidly increase recycling rates. In Treviso, Italy, Contarina increased the MSW recycling rate from 55 % in 2013 to 85 % in 2014, simultaneously reducing residual waste to 53 kg per

capita per year (Contarina, 2014).

Side effects

There may be a trade-off for waste collection strategies between maximising material recovery and minimising fuel consumption and emissions associated with collection. For PET plastic, for example, Bing et al. (2014) conclude that post-separation of co-mingled dry-recyclable collections is associated with higher costs and a higher environmental impact for the collection and transport stage owing to the limited number of separation centres compared with cross-docking sites for source separation. However, they note that post-separation is associated with a higher separation rate and lower installation costs for waste management organisations and householders, which is likely to result in a better life-cycle environmental performance.

Applicability

The optimum approach to maximise the recycling rate whilst minimising costs will vary considerably depending on local circumstances, including human behaviour which is partly related to socio-economic situation. WRAP (2010) found that the prevailing socio-economic status within local authority areas was an important factor in determining the recycling rate, with lower recycling rates associated with a lower socio-economic status, perhaps reflecting a low prioritisation for waste management in poorer households.

Whilst bring centres can be an effective and cost-efficient strategy for waste collection in countries and regions where recycling is well established in the public psyche, in other areas, including poorer regions, waste collection at bring centres should be restricted to those waste types that really cannot be collected from households, such as bulky objects and hazardous wastes. More costly strategies, such as door-to-door collections (see Italian example in Box 2), may be required to achieve acceptable levels of recycling across the major dry recyclable fractions in such areas.

Less frequent (e.g. fortnightly) residual waste collection may not be practical in warmer climates owing to odour and hygiene issues if it contains biowaste. The separate collection of biowaste is crucial as then other waste fractions can be collected more efficiently (ACR+, 2014). In hot countries, the collection frequency must be higher. In Milan the biowaste collection is twice a week; in Germany it is usually once a week in summer and twice a month in winter.

Economics

Costs for the staff, for the collection fleet and bins, for treatment and for landfill are major determinants of the economics of different waste collection strategies. For example, it is essential for strategy and logistics optimisation to invest in “multi-modal” collection vehicles that are able to empty different kinds and sizes of collection bins (see the example of Vienna waste authority in the best practice on Inter-municipality cooperation among small municipalities). In some cases recyclate revenues are an additional determinant. For example, the price of cullet determines whether colour sorting of glass is economically attractive to waste management authorities (WRAP, 2012).

Bing et al. (2014) compared the GHG emission intensity of different collection strategies for plastics in the Netherlands. Results were highly region- (context-) specific, and in some scenarios separate collection of polyethylene terephthalate (PET) bottles was found to be both cost- and carbon-efficient. Bing et al. (2014) reported that post-collection separation scenarios were found to have the highest costs and environmental impacts owing to the limited number of separation centres compared with abundant cross-docking sites for source separation. However, post-collection separation achieves a higher separation rate and lower installation costs for municipalities and householders.

WYG Environment (2011) suggests that local authorities rarely undertake comprehensive comparisons of costs across waste collection strategies. It is essential that representative (optimised) collection frequencies and economic data on recyclate revenues, material recovery facility costs and landfill costs are accounted for in integrated cost-benefit analyses. Proximity to a material recovery facility can significantly influence the relative costs of co-mingled versus separated collection, and WYG Environment (2011) suggests that co-mingled collection can be a cost-effective collection strategy.

Quattro Select collection vehicles cost GBP 300 000 (EUR 420,000) each, over double the price of conventional single-compartment collection trucks. However, each Quattro Select vehicle has a capacity of 10 tonnes, can replace at least two conventional trucks, and requires less manpower (one person per truck). In Lund, eight Quattro Select vehicles and one truck cover up to 2 400 houses, equivalent to 4 800 bins, with each operator emptying up to 180 bins in one shift (LAPV, 2012). The need for just two separate vehicle collections per household can facilitate logistics optimisation further, whilst

high separation efficiencies greatly improve the overall economic efficiencies of waste management companies by minimising residual waste disposal costs.

Driving forces for implementation

Targets established in the Landfill Directive and the Waste Framework Directive, alongside associated landfill charges and commodity prices (recyclate value), drive collection of separated recyclable fractions. Bans on biowaste and combustible waste being sent to landfill in Sweden helped to drive implementation of the highly effective Optibag and Quattro System collection systems (Björk, 2015). However, high levels of citizen awareness and engagement with waste recycling also played an important role in the efficacy of these systems.

Personnel costs drive optimisation of waste collection strategies in terms of the economic efficiency of collection (e.g. automation, side loaders for one-man-operation). In some cases, recyclate revenues are a driving force too.

Fuel costs drive optimisation of waste collection strategies in terms of the energy efficiency (minimisation of GHG emissions and reduction of air pollution) of collection.

Reference organisations

Box 1. Gwynedd Council waste collection strategy, involving separate biowaste collection and kerbside sorting

The UK has only recently begun to recycle food waste in composting and anaerobic digestion plants; food waste recycling increased from 1 % in 2006 to 12 % in 2012 (Defra, 2014). Gwynedd Council collects food waste separately once a week from the kerb in 22-litre brown containers (left). The following fractions of food waste are collected in small kitchen containers and biodegradable bags provided by the Council (left): any food waste, cooked or raw, including fruit and vegetable peelings, cheese, bread, beans, meat, eggs, plate scraps, food passed its best before date, tea bags, fish, etc., but excluding liquids such as milk or oil. Food waste is sent for anaerobic digestion.

Gwynedd Council collects the following dry mixed recyclable fractions in blue boxes once a week, on the same day as food waste collection, using a kerbside sorting service: paper (newspaper, magazines, office paper, junk mail, shredded paper), food and drink cans, glass bottles and jars, foil, aerosols, plastic bottles, plastic pots, tubs and trays, yoghurt and butter pots, plastic containers for fruit and vegetables and meat trays, food and drink cartons, fruit juice or soup cartons, cardboard.

Green garden waste and residual waste are collected in separate brown and green 240-litre wheelie bins (right) on alternate weeks, coinciding with food waste and mixed recyclable waste collection days.

Source: Gwynedd Council (2015).

Box 2. Example of twice-weekly biowaste collection in Milan

The municipality of Milan covered by Amsa comprises 1.281 million citizens, and first introduced door-to-door collection of household biowaste in November 2012 for one quarter of the city of Milan. The scheme was expanded to the entire city over four stages, and was fully implemented by June 2014. Compostable bags and 120-litre brown bins are used for collection from houses (smaller 35-litre brown bins are available on request). Small 10-litre aerated kitchen baskets, designed with an airy structure to minimise odours and anaerobic decomposition, are used in apartments. Biowaste is collected twice a week.

The waste management organisation coordinated activities with the City of Milan. Census data from the area were used to prepare the service setup. A software model was used to determine logistics requirements, based on factors such as bin weights, vehicle loads, route distances, crew productivity, etc. The model was validated using data from trial runs.

Following implementation of the plan across three quarters of the city, the recycling rate for food waste rose from 35 % in 2011 to 48 % in 2014, equating to 90 kg per capita per year. Composition analysis at the start of the service showed that just 3.8 % of the food waste fraction comprised non-compostable (contaminant) material. This increased to 5.1 % eight months into the campaign, but dropped back down to 3.7 % after the quality awareness campaign.

Source: R4R (2014c).

Box 3. Example of waste collection strategy operated by the county of Aschaffenburg in Germany

The county of Aschaffenburg in Germany collects residual waste in padlocked wheelie bins that contain identifier microchips and are weighed on the back of refuse collection trucks (see pay-as-you-throw BEMP), with rubble collected separately. Paper, plastic and metal cans are collected weekly from the kerbside in yellow sacks in urban areas, and in waste collection centres in villages (80 % of metal is collected in waste collection centres). Glass, garden waste and various other fractions such as batteries are collected in local waste collection centres (see description under Operational data). In small villages, local citizens are employed by the County to operate recycling stations.

Source: County of Aschaffenburg (personal communication).

Box 4. Mobile civic amenity sites in Île-de-France

This innovative solution addresses waste collection at source in an area where the implementation of traditional civic amenity sites is extremely challenging (because of urbanisation, high population density and limited access of citizens to personal vehicles for the transport of bulky waste). Collection containers are temporarily left in public areas such as town squares and marketplaces, and opening hours communicated to citizens by local authorities. The service is provided free of charge to citizens living within the municipality, and accepts construction and demolition wastes, mixed bulky wastes, garden waste, WEEE and textiles, among other fractions. The system is regarded positively by citizens and attracts increasing numbers of users.

Source: R4R (2014a).

Box 5. Initiating door-to-door collection in Lisbon

This example from Lisbon provides an example for municipalities with less developed waste collection strategies on how to rapidly upgrade the service offered, including the introduction of separate biowaste collection.

Selective kerbside collection of paper/ cardboard and packages was introduced gradually to replace bring banks and to complement kerbside collection of residual waste. Separate collection of biowaste was also implemented for small commercial premises such as restaurants, canteens and markets. The collection frequency was also adapted progressively, beginning with alternate collection of residual and recyclable waste fractions. Contact was made with waste producers during collection rounds to disseminate information material and to answer any questions on the new service. A communication campaign was used to generate public awareness of the new system, and local stakeholders were consulted and involved during implementation. The quantity of selectively collected recyclable material has increased significantly under the new system, from 6 % to over 20 % of the total MSW generated.

Source: R4R (2014b).

Box 6. Contarina SPA integrated waste management collection strategy

Contarina is a publically owned waste management compnay serving a region of 1 300 km^2 and a population of 554 000 inhabitants across 50 municipalities in the Veneto region (Italy), with 260 000 users across a range of urban and rural settlements. Contarina employs separate waste collection strategies for less densely populated areas and densely populated and often logically complex (historic) urban centres:

Standard service for less densely populated areas (below)

Service for densely populated urban areas, including small bags for users with limited space (below)

Contarina implements a PAYT approach. Users are charged a 60 % fixed fee based on household numbers, plus a 40 % variable fee based on home composting (-30 %) and number of bin collections. Waste collection costs are less than half the Italian average, at EUR 104 per user. Contarina has successfully increased the recycling rate for MSW in Treviso from 55 % in 2013 to 85 % in 2014, simultaneously reducing residual waste to 53 kg per capita per year.

Source: ZeroWasteEurope (2015).

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