

A hand is shown placing vegetable scraps into a blue biowaste bag. The bag is filled with various food waste items, including an avocado pit, onion skins, carrot peels, and other vegetable scraps. The background is a wooden surface.

Best practices for biowaste management

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Best Practices Collection

Homogeneous bring banks around the country

Best practice factsheet #1

Collection
Characterisation

Transport
Social awareness



Challenge

Size and shape of the containers is really important as no uniformity can later conditionate transport, making it more difficult. Also, when bring banks look the same around the whole city, people tend to recognise them easily and can recycle more. According to the EEA, the collected fraction of bio-waste varies greatly from one EU country to another. In this context, less than 10% of municipal bio-waste is collected in certain countries such as Bosnia-Herzegovina, Cyprus, North Macedonia, Portugal, Spain or Turkey, so there is a great room for improvement regarding this aspect.

Action

Use the same colour in the containers for the selective collection of organic waste in all the region or country.

Implementation

1. Analyse morphology and socio-demography of the municipality.
2. Constant communication activities during the implementation of the system towards every main stakeholder.
3. The containers should be located within a short distance from the entry door of the apartment block so that it is not too inconvenient for users, and it reduces noise issues for the surrounding apartments.
4. Monitoring collection systems and advice on possible improvements.

Results

Bring point collection is applied for the collection of recyclable materials and mixed waste. The advantage of this system is mainly that the collection points across the city are reduced substantially compared to door-to-door systems. Consequently, the homogenization of colours, size, and shape of the containers facilitates recycling while improves the quality of the collected organic fraction. 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 collection¹.

Example

Veneto, Italy²

Within the region of Veneto, the public company Contarina is responsible for the management of waste in Treviso, amongst others. Here they serve 554 000 inhabitants in 50 municipalities and has reached levels of source separation of up to 85% and generates only 53kg of residual waste per inhabitant and year. In contrast, the EU average level is a 42% source separation and a 285 kg per inhabitant and year of residual waste generation. Municipal solid waste is collected in five or six major waste-streams: non-recyclable dry, organics (food scraps), garden waste, paper and cardboard, glass, plastic and tin. They are placed in special colour-coded bins that are readily available throughout the region, free of charge and collected curbside.

Benefits

Better identification of the correct bring bank to recycle the different types of waste.

Higher quality of the organic fraction

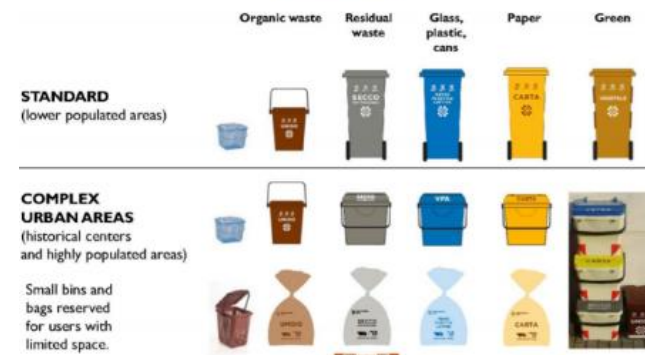
Increased community commitment to the environment

Increase in the recycling rate



Curbside collection

Types of Bins



Further reading

1. <https://ec.europa.eu/environment/emas/pdf/WasteManagementBEMP.pdf>
2. <https://greenexchange.earth/wp-content/uploads/2016/07/CS4-CONTARINA-EN.pdf>

Source: <https://slideplayer.com/slide/9533181/>



Implementation of an underground container system

Best practice factsheet #2

Collection

Characterisation

Transport

Social awareness

SCALIBUR

Challenge

Solid waste collection systems are one of the most important activities in urban management. In 2016, Europe generated 2740 million tonnes of municipal solid waste, which is almost 477 per capita¹. Cities in Europe spend up to 120€/tonne dealing with their waste management system². Unfortunately, and despite their high running costs, systems currently used in modern cities have some weaknesses, for instance in the case of containers, and in often they do not provide a service of sufficient efficiency and quality. In this sense, it is common that in some cases containers are too small, and consequently, they become overcrowded, littering the city and causing odors, visual impact, and reducing the quality of the urban environment.

Action

Implementation of an underground collection system to collect biowaste in order to establish cleaner surroundings and improve the collection efficiency.



Source: <https://www.elkoplast.eu/underground-containers>

Implementation³

1. Conduct a first morphology and socio-demography research on where the containers should be placed. The municipality should bear in mind the walking distance to the container (less than 125m), the safety, the accessibility for the garbage truck, or any obstacles such as trees, cables, pipes...
2. After the investigation, the municipality should submit the proposal on the location of the underground containers. Citizens who live in the neighbourhood should be able to appeal or to propose new locations.
3. The municipality, after reviewing all the responses from citizens, will make a final implementation plan
4. Search for companies specialised in implementing underground container systems and contact them for a quotation. Analyse the catalogue of underground containers available and select the best fitting one.
5. Place the containers in the desired location.
6. After the implementation, constant monitoring on the collection system is recommended to improve possible flaws.

Results

Replacing common waste bins by underground containers with a high capacity for waste implies several direct benefits for the urban environment as mentioned below: 1) this system avoids the visual impact of containers on the street; 2) It dignifies the urban area, which can be used for other purposes. 3) It makes waste disposal more accessible for citizens; 4) and a greater cleanliness is achieved. They are also an interesting solution to overcome difficulties linked with the implementation of separated collection in dense areas and vertical housing.

Implementation of an underground container system

Best practice factsheet #2

Collection

Transport

Characterisation

Social awareness

SCALIBUR

Benefits



A higher collection capacity as the container is underground	<input type="radio"/>	<input type="radio"/>
Collection frequency is reduced, lowering costs, and reducing environmental impacts from traffic	<input type="radio"/>	<input type="radio"/>
As temperature below ground level is lower and more stable, waste decomposition and odours are reduced	<input type="radio"/>	<input type="radio"/>
Waste is stored up to a height of 2.5m, resulting in better compaction by its own weight	<input type="radio"/>	<input type="radio"/>
Public areas are unburdened, and the cities aesthetic is better	<input type="radio"/>	<input type="radio"/>
Vandalism and the possibility of re-collection is reduced	<input type="radio"/>	<input type="radio"/>
Containers take less space therefore more parking space is available	<input type="radio"/>	<input type="radio"/>

Example⁴

In the Portimao area in Portugal introduced underground collection points to the town's collection system in 2010. Amongst the main problems that led this change were hygiene impacts specially during summer months (flies, odours, rodents...), aesthetics, and improvement of both recycling ratios and the flexibility in collection frequency. According to the EMARP (Empresa Municipal de Água e Resíduos de Portimão) the savings offered by the adoption of the system reach up to 18% compared to the old collection scheme. Also, the truck collection crews have been reduced from 3 to 2 persons while an increase of productivity of 10 hours per week per truck-crew is attained.



Source: <https://www.elkoplast.eu/underground-containers>

Further reading

1. https://ec.europa.eu/eurostat/statistics-explained/index.php/Waste_statistics#Waste_treatment
2. "Costs for Municipal Waste Management in the EU Final Report to Directorate General Environment, European Commission." (2002).
3. <https://www.denhaag.nl/nl/afval/huishoudelijk-afval/plaatsen-van-ondergrondse-restafvalcontainers.htm#>
4. https://www.iswa.org/index.php?eID=tx_iswaknowledgebase_download&documentUid=3157

App for on-demand collection from HORECA

Collection
Characterisation

Transport
Social awareness

Best practice factsheet #3

SCALIBUR

Challenge

In the EU over 100 million tonnes of biowaste are thrown away each year – around 200 kg per person. Currently 75% of this goes to landfill or is incinerated, causing major environmental problems: biowaste produces greenhouse gases when it decomposes and contaminates soil and groundwater. Landfilling of biowaste goes against the principle of a circular economy and is a waste of nutrients, energy and resources for bioproducts. It is usual in the HORECA sector that the waste bins are filled before the collection date, avoiding more waste to be collected. When the opposite happens, bins are not completely full, the collection is not optimised.

Action

Implementation of an app that allows the HORECA sector to have on-demand collection when needed.

Implementation

1. Find a company to help create an app for waste collection.
2. Inform the HORECA sector on how they can use and install the app.
3. Train personal on its use.
4. Perform periodic checks to verify proper functioning and periodic maintenance.

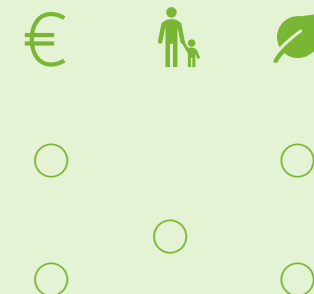
Results

When implementing an app for on-demand collection for the HORECA sector it can have a big impact on the amount of waste collected. It gives restaurants and hotels more flexibility and control and optimised resources for the waste management system. Because biowaste is collected quickly, it significantly reduces the amount of waste sent to landfill. IT can also help with keeping streets free from unsightly discarded materials.



Benefits

- Efficiency of the separate collection service, avoiding "empty" trips because the containers have not yet been filled for various reasons.
- Increased satisfaction of the municipal service and users
- Increase in the quality of composting



Example

Yo-waste¹

Yo-Waste is a tech waste management company that provides waste, recycling and smart city solutions to businesses and governments. As start-up based in Uganda, they connect local waste haulers and recycling businesses to customers who need their services using our mobile app and website. This app allows anyone who owns a truck to sign up as a garbage collector and get access to the variety of customers that need their services.

Recycle Track Systems²

Recycle Track Systems (RTS), a waste and recycling technology company headquartered in New York City, launched their On-Demand Waste & Recycling Pick-Up App in 2015. RTS uses a software platform and a proprietary tracking system to provide hauling services for businesses. The app is an easy and quick way to accurately price and schedule pick-ups for traditional, recyclable materials or bulk waste. Users can select from a drop-down of items or simply take and upload a photo of the items they wish to be removed.

Further reading

1. <https://yowasteapp.com/>
2. <https://www.rts.com/services/waste-management-app/>



Containers with chip to register filling levels

Best practice factsheet #4

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

The current effects of a fast-local population increase, large and dense residential areas, tourist increase and a pressing demand for urban environmental protection create a challenge for waste and resource managers. In many cases, the overflowing of the containers is a problem for the municipality. However, in other cases, containers are in places where the filling occurs slower than in other areas which if not controlled, may result in inefficient collection routes. The information about filling level of containers allows waste resource managers to plan optimized collection routes for waste and recyclables collection.

Action

Implementation of a system to control filling level of containers to monitor collection rates and improve planning procedures.

Implementation

1. Find a company to design and build chips to install in containers to register filling levels and gases like CO₂, CH₄ or H₂S.
2. Filling sensors need to be assembled in the container and wireless connection is needed.
3. Train personnel on how to use it properly.
4. Perform periodic checks to verify proper functioning and periodic maintenance.



Source: <https://smartwastemanagement.wordpress.com/>

Results

Installation of sensors to measure temperature, CH₄, H₂S can be integrated in bins to track the degradation levels of biowaste. When it reaches a certain level, it can notify the company so a truck can collect it. The information about filling levels of containers allow waste resource managers to plan optimised collection routes for waste collection.

Benefits

	€	Person	Leaf
Waste collection emits less CO ₂		<input type="checkbox"/>	
Reduce collection costs by optimising routes and fuel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Real time filling levels of the containers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Improve government-to-citizens communication	<input type="checkbox"/>		<input type="checkbox"/>
Waste collection service settlement gets easier		<input type="checkbox"/>	<input type="checkbox"/>

Containers with chip to register filling levels

Best practice factsheet #4

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Example

SmartBin Technology in Dublin (Ireland)¹

Intelligent remote monitoring solutions allow to optimize logistic resources (reducing of collection costs up to 50%). This technology allows to know the filling level of containers, also reducing problems such as over-filling and complaints from citizens. The municipality of Dublin has included in its Litter Management Plan 2016 2018, many initiatives including smart bin technologies. Currently, smart bin technologies are being tested through two trials. In the South East Area, 52 smart bin units have replaced conventional bins on 2 routes. Suitability and new efficiencies are currently being evaluated. This initiative will also be soon implemented in the North West Area.

Increasing Waste Management Efficiency in Rotterdam (Netherlands)²

Rotterdam has implemented a pilot case for Paper and Cardboard Waste Fractions with an innovative company in smart waste management and its Dutch partner TWS. The extended use of this waste management data analytics and route planning will help further the city's push towards a circular economy. It consists in the implementation of intelligence and cloud-based filling-level monitoring. These sensors continuously monitor the fill level of the containers and are linked to the waste department's project office via cloud servers. Alternatively, smart plans dynamic collection route planning system were operating. Data is collected during the day from all the sensors in the pilot area. Fill levels and fill rates are compared to trend data to predict the future waste collection needs.



Source: <https://www.eltegps.com/our-offer/waste-bin-fill-level-monitoring-system.html>

Further reading

1. SMARTBIN. Smartbin technology in Dublin (Ireland)
2. ENEVO (2016). Increasing Waste Management Efficiency in Rotterdam (Netherlands)

Use of biodegradable and biocompostable bags for collection

Best practice factsheet #5

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

The Austrian compost and biogas association KBVÖ (Kompost- und Biogasverband Österreich) reported that 80-90% of impurities in the organic waste collected from households are conventional, non-biodegradable bags. To tackle this problem and reduce impurities, biodegradable and biocompostable bags can be used to collect biowaste.

Action

Implement the use of biodegradable and biocompostable bags for biowaste collection.

Implementation

1. Design compostable bags with instructions on how to use them.
2. Make sure this information is also in the containers so citizens know they should use them with biowaste.
3. Give away bags during event or to households that want to recycle.

Results

The use of biodegradable bags can reduce the amount of impurities in biowaste collection as conventional, non-biodegradable bags will be reduced. A study in a Spanish municipality showed that approximately 81% of the population were willing to participate in selective collection of biowaste. This percentage would increase until 89% if the Town Council provided specific waste bins and bags, since the main barrier to participate in the new selective collection system is the need to use specific waste bin and bags for the separation of biowaste¹.

Benefits

Contamination in biowaste collection could decrease
Biowaste is easily collected in bags
Citizens find it easier to handle biowaste if it's in bags
Biowaste produces less odours



Example

The Austrian compost and biogas association² (KBVÖ) plans to launch an initiative aiming to only market single-use carrier bags in Austria that are compostable according to the European standard for industrial composting EN 13432. Combined with a consumer information campaign, the compostable bags are intended to be re-use to collect and dispose organic kitchen waste. This way, more bio-waste will be separately collected and diverted from other recycling streams, while, at the same time, the contamination of the collected organic waste with conventional, non-biodegradable plastics will be reduced.



Further reading

1. Bertrán D, Simó A, Bovea MD. Attitude towards the incorporation of the selectinad-Beve collection of biowaste in a municipal solid waste management system. A case study. *Waste Manag.* 2014; 34 (12): 2434-2444. doi:10.1016/j.wasman.2014.08.023
2. <https://www.biosackerl.at/>

Start biowaste collection at schools

Best practice factsheet #6

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

Schools often produce tremendous amounts of waste with instructional materials, used electronics, and food. One estimate is that 24% of school waste is recyclable paper and 50% is food waste and non-recyclable paper that can be composted. But teachers and students can work collaboratively to reduce the amount of waste produced¹. Getting students and teachers involved in recycling at school is good for the environment, educational and can be a lot of fun. Educating our children about the importance of recycling provides the country with a path to a greener future. As children learn about recycling, they will be more likely to carry these habits into their adult years. They also will learn how their personal actions can affect the future

Action

An educational project promoting the collection of biowaste in schools, where they will be a starting point to collect organic waste.

Implementation

1. Contact schools and inform them of the project and its benefits.
2. Set up biowaste recycling bins for each classroom so children and teachers can use them.
3. Make sure they are clearly labelled and placed in obvious places.
4. Brief the teachers about the recycling scheme and hold assemblies to inform the pupils. Make sure that the teachers and staff understand the importance of recycling, and this should filter down to the students.
5. Teachers and children can be involved in making the compost by adding items such as tea bags, coffee granules, fruit and vegetable cuttings from the cafeteria. If your school has a garden, then you can add leaves, plant cuttings and grass trimmings to the compost heap.
6. Organise games and fun activities that help them remember and understand the message without difficulties using simple language.

Results

As any separation at source, the separation of biowaste in the households requires personal efforts in form of awareness and change of habits of the citizens. Therefore, it is important to convey to them the benefits of biowaste collection. Starting collection at schools is a good way to educate students in that way, who tend to bring their experience home and act as multipliers of the information.

Benefits

	€	👤	🌿
Increases social awareness on the importance of recycling	○	○	○
Increase recycling rates in the city	○		○
Increase quantity and quality of biowaste	○		○
Improvement of the citizens' perception about their municipal entities		○	○

Example

Kindergartens and schools in Liberec to recycle biowaste²

A total of 40 composters have been sent free of charge to kindergartens and primary schools in Liberec as the result of cooperation between the town and our subsidiary FCC Liberec. The aim of the joint project is to teach schoolchildren and pre-schoolers to recycle all biowaste.

Uganda schools recycle biowaste³

During Martyrs Day, a weeklong celebration that attracts thousands of visitors from all around Uganda, tons of waste is discarded. But students of St. Kizito have come up with ways to collect it and transform it into useful products. The students turn the biowaste collected into organic fertilizer for the school's garden, where they learn how to grow vegetables and they use dried briquettes made from biowaste as fuel to cook school meals.

Further reading

1. <https://www.reusethisbag.com/articles/guide-to-recycling-at-school/>
2. <https://www.fcc-group.eu/en/czech-republic/news/kindergartens-and-schools-in-liberec-to-recycle-biowaste.html>
3. <http://www.ipsnews.net/2019/08/ugandan-students-turn-waste-wealth/>



Specific collection system adapted to each situation

Best practice factsheet #7

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

In low-density areas great distances have to be covered per amount collected which increases the costs and reduces the overall environmental benefit. In rural areas home composting can often be easily implemented and the recovered nutrients can be used locally¹. A Spanish study² of home composting demonstrated a capture rate of 77% of household organic waste with 126 kg/person composted each year. In highly populated areas, door-to-door collection is more optimal and cost effective. However, living space especially in high-rise buildings, may not allow for storage of several waste streams, inhibiting source separation. That is why a specific collection system needs to be implemented bearing in mind each particular situation.

Action

Selection of the best collection system (door-to-door, mobile collection points, bring banks...) for each zone of the municipality by considering its specific characteristics and needs type of building, density of population, climate, infrastructure...

Implementation

1. Development of an understanding of municipal solid waste management: it is important to understand the features of the municipal solid waste management system, the influencing factors, the main phases and the actors and organisations involved. Local waste authorities and waste management companies should have an overview of all steps/operations that their municipal solid waste management system comprises as well as stakeholders involved, including the roles they play.
2. Prepare the appropriate action plan to define the actions to be implemented. Also provide guidelines on how to go from the planning phase to the implementation phase.
3. Monitoring & review is also important to ensure both that the plan remains relevant to its goals and objectives over time. The simplest and most common monitoring tools are visual observations, general feed-back from the work-force and customer complaints.

Results

Adapting the collection scheme to the territory, in particular regarding the frequency, the type of collection (door-to-door, bring scheme) and the collection vehicle, and testing the scheme at a pilot level before implementing it full scale, by enlarging progressively the territory and promoting biowaste prevention in areas where there is low quantity/potential.



Source: <https://ajuntament.barcelona.cat/ca/>

Specific collection system adapted to each situation

Best practice factsheet #7

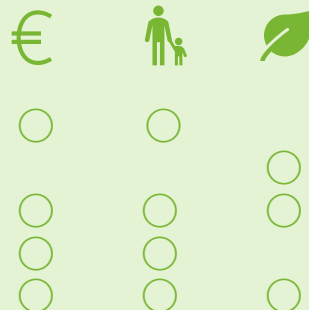
Collection
Characterisation

Transport
Social awareness

SCALIBUR

Benefits

- Lower cost of overall waste management
- Conservation of raw materials
- Better coordination between urban services
- Better cost management and higher recovery cost
- Less environmental pollution



Example: Household waste collection in Barcelona⁴

Barcelona has an extensive municipal service to collect daily household waste according to the characteristics of each urban district. This service is carried out through street containers, door to door bag collection services, pneumatic collection box and bins for collections in shops.

- Brown containers for organic waste: This waste is delivered to ecoparks, where it becomes compost and biogas. All citizens have recycling collection containers located less than 100 meters from their home.
- Manual bag collection service: Door-to-door waste collection of different types of waste and recyclables service in specific zones including the old part of the city, where is especially difficult to place containers or access with vehicles.
- Recycling yards: Used to get rid of municipal waste fractions which can't be thrown into street containers.

Example: Waste management plan 2018 in Copenhagen⁵

The city of Copenhagen established an efficient waste management plan in 2018. The efforts fall under four topics, each with a specific target and several measures and concrete initiatives. Each topic furthermore contains a flagship project.

Under the Topic 2: "Better separation among citizens and business", all citizens in the City of Copenhagen must have access to separation of the most ordinary types of waste near their home, and all institutions of the City will source-separate their waste.

Further reading

1. JRC (2011), Dri et al. (2018)
2. EU project Mini waste that inventories good practices regarding (bio-waste) minimization in Europa (Mini-waste 2012)
3. Vázquez and Soto (2017)
4. AJUNTAMENT DE BARCELONA (2016): Ecology, Urban Planning and Mobility
5. CITY OF COPENHAGEN: Resource and Waste Management Plan 2018



Source: <https://www.residuesrecurs.cat/>



Efficient collection during summer

Best practice factsheet #8

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

Depending on local conditions such as food and drink habits, type of plant growth, seasons and climate, living standard and degree of economic development, bio-waste accounts for 30% to 40% by weight and volume of municipal solid waste. This proportion is much larger (up to 80%) in Mediterranean countries, due to a larger consumption of vegetables and fruits in the daily diet, as well as to the effects of tourism¹. Especially during the summer months odour nuisance is a problem. In order to overcome this problem, the collection intervals are shortened, and the collection bins get washed regularly.

Action

During summer months the organization of the collection must be very effective in order to avoid problems related to odours, flies, etc.

Implementation

1. Development of an understanding of municipal solid waste management: it is important to understand the features of the municipal solid waste management system, the influencing factors, the main phases and the actors and organisations involved. Local waste authorities and waste management companies should have an overview of all steps/operations that their municipal solid waste management system comprises as well as stakeholders involved, including the roles they play.
2. Prepare the appropriate action plan to define the actions to be implemented. Also provide guidelines on how to go from the planning phase to the implementation phase. The decision to have a proactive or reactive strategy for vermin, pests and smells, and whether to initiate local government wide actions or address issues on a house-by-house basis, will depend on factors including community support for the service, as well as the available budget and resources. These decisions should be considered in the early planning stages of a new organics service.
3. Continuous monitoring: To monitor change over time, to conclude on the efficiency of activities and/or measures implemented, it is useful for the monitoring/collection of data becomes a continuous process. That way, seasonal changes can be identified.

Results

As any separation at source, the separation of biowaste in the households requires personal efforts in form of awareness and change of habits of the citizens. Therefore, it is important to convey to them the benefits of biowaste collection. Starting collection at schools is a good way to educate students in that way, who tend to bring their experience home and act as multipliers of the information.



Adaptation from: <https://connect.sprucegrove.org/wastechanges>

Efficient collection during summer

Best practice factsheet #8

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Benefits



Biowaste can be turned into high-quality product	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Biowaste bin cuts residual waste by up to 40%, which saves households money	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Prevents odours and other nuisance factors	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Example: Heidelberg, Germany³

Some councils in Europe have opted for a weekly organics collection in summer and a fortnightly collection in winter. For example, in Heidelberg, Germany, during the winter months has the option of emptying the bins either once a week or on a two-week basis. In the summer months, all biowaste bins are emptied weekly. Has a population density of 1,500/km² and each resident generates 100 kilograms of biowaste and green waste every year. This waste goes to the city's composting centre, where it is transformed into valuable compost.

Further reading

1. https://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=LIFE08%20ENVF000486_Miniwaste_good_practices_inventory1.pdf
2. 2012. *FOOD AND GARDEN ORGANICS Best Practice Collection Manual*. [PDF] Available at: <<https://www.environment.gov.au/system/files/resources/8b73aa44-aebc-4d68-b8c9-c848358958c6/files/collection-manual.pdf>> [Accessed 21 October 2020].
3. <https://www.heidelberg.de/english/Home/City+Hall/biowaste.html>



Source: <https://eligerverde.net/>

Selective collection of biowaste from the Horeca waste

Best practice factsheet #9

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

The collection of biowaste can be carried out by a private waste collector or through the municipality. The service can be offered to households, residential areas, and commercial businesses such as restaurants and hotels. As part of the municipal solid waste (MSW) collection, kitchen waste can be collected from households and/or from small scale commercial premises such as restaurants, hotels, canteens, grocery shops and markets (commonly referred to as HoReCa). In case the commercial premises are already part of the municipal waste collection system, it makes sense to also integrate them into the municipal biowaste collection system. The reason is that such small-scale shops generate kitchen waste comparable in its composition to that of a common household and, therefore, synergies can be realised through combined collection and treatment of the waste from the two sources.

Action

Selective collection of biowaste (i.e., food waste plus green waste) from hotels and restaurants through door-to-door collection or bring banks systems.

Implementation

1. Establish a selective collection service, either provided by the municipality or by a private authorised waste collector, to collect the organic fraction in the Horeca sector.
2. Agreement with the stakeholders to increase the quality of biowaste collection.
3. Provide the HORECA sector with a map that registers all the biowaste bring banks and all the areas served by the door-to-door collection schedule in order to help the accessing the system.
4. Encourage biowaste generators to separate organic waste and comply with the requirements of the collection service such as schedules, correct separation...
5. The hotels and restaurants should appoint a responsible person to coordinate the implementation and assessment of the measure. Training and awareness activities of the kitchen staff should also be implemented.

Results

With the collection of biowaste from hotels and restaurants, compost can be produced. After a quality control, it can be sold to farmers, for example. The selling market price in Europe for agricultural purposes is 6.1€/ton in average². While the composition of household and assimilated kitchen waste is generally comparable, some differences between the two can be noted. Selectively collected biowaste from commerce is generally more uniform in its composition and of higher purity³. It occurs in larger quantities and therefore has the potential to be separated at source more easily and effectively, as it can more easily be traced, and corrective actions taken if needed.



Source: <https://www.logisplan.com/planificacion-y-optimizacion-de-rutas-horeca/>

Selective collection of biowaste from the Horeca waste

Best practice factsheet #9

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Benefits



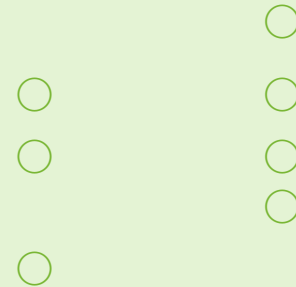
Less waste of resources by operators in the HORECA sector

Increase in the quality of the material to be used for composting

Saving of landfill space

Avoidance of greenhouse gas emissions

Facilitates the separated treatment for production of high-quality compost or biogas.



Example: Barcelona⁴

Barcelona started in Hotels the "Iniciativa del Gremio de Hoteles de Barcelona" to increase the sustainability levels in the city. This agreement was signed by the municipality together with more than 300 hotels to offer them discounts in public tariffs and waste generation taxes. It promotes biowaste reduction and separate collection campaigns, while acting as a framework to support involved hotels in complying with legislation regarding biowaste management and collection. Since then, the percentage of impurities of commercial kitchen waste has been lower than for household kitchen waste. As an example, in 2013 collected kitchen waste from restaurants was estimated to have 8.2% impurities compared to 21.1% from households⁵.

Example: Lisbon⁶

The city of Lisbon started in 2005 to selectively collect kitchen waste from restaurants, hotels and canteens via a door-to-door collection scheme. The biowaste is later sent to an anaerobic digestion plant managed by the company Valorsul. The quantity of collected biowaste annually has increased from 7,000 tons in 2005 to more than 23,000 tons in 2015.



Source: <https://www.traza.net/2021/04/21/reciclaje-y-contenedores-de-basura-en-restaurantes/>

Further reading

1. https://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch10s10-4-7.html
2. J. Barth, F. Amlinger, E. Favoino, S. Siebert, B. Kehres, R. Gottschall, M. Bieker, A. Löbig and W. Bidlingmaier (2008). Compost Production and Use in the EU. Report for the European Commission DG/JRC
3. Arcadi/Eunomia, "Assesment of the options to improve the management of bio-waste in the European Union", p.79, November 2009
4. Guía de hoteles más sostenibles (2010). Ajuntament de Barcelona – Agenda 21 – Publicaciones – Guías de Educación Ambiental
5. http://www.turkeycomposts.org/files/resources/ACR_Biowaste_selective_collection_scheme_s_2016.pdf
6. Câmara Municipal de Lisboa (<http://www.cm-lisboa.pt/en/living-in/urban-cleaning/waste-disposal>); Lisbon: Door-to-door selective collection (Regions For Recycling) (<http://www.regions4recycling.eu/upload/public/Good>)



Collection of biowaste from open markets

Best practice factsheet #10

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

The environmental impact of bio-waste is significant. Because of the energy and resources used to produce, transform and transport food from producer and supplier to the home, and subsequently to landfill, there is a major carbon impact. Moreover, different studies about energy use indicate that food is the second most energy demanding product group after housing. The amount of food thrown away is a waste of resources as energy, water and packaging used for food production, transportation and storage. All this goes to waste when we throw away edible food.

Action

Selective collection of biowaste (i.e., food waste plus green waste) in open markets.

Implementation

1. Establish a selective collection service, either provided by the municipality or by a private authorised waste collector, to collect the organic fraction in Open markets.
2. Agreement with the stakeholders to increase the quality of biowaste collection.
3. Provide Open markets with a map that registers all the biowaste bring banks and all the areas served by the door-to-door collection schedule in order to help the accessing the system.
4. Encourage biowaste generators to separate organic waste and comply with the requirements of the collection service such as schedules, correct separation...
5. Open markets should appoint a responsible person to coordinate the implementation and assessment of the measure. Training and awareness activities of the staff should also be implemented.

Results

With the collection of biowaste from hotels and restaurants, compost can be produced. After a quality control, it can be sold to farmers, for example. The selling market price in Europe for agricultural purposes is in average 6.1€/ton. While the composition of household and assimilated kitchen waste is generally comparable, some differences between the two can be noted. Selectively collected biowaste from commerce is generally more uniform in its composition and of higher purity². It occurs in larger quantities and therefore has the potential to be separated at source more easily and effectively, as it can more easily be traced, and corrective actions taken if needed.

Benefits

	€	People	Leaf
Less waste of resources by operators in open markets			<input type="radio"/>
Increase in the quality of the material to be used for composting	<input type="radio"/>		<input type="radio"/>
Saving of landfill space	<input type="radio"/>		<input type="radio"/>
Avoidance of greenhouse gas emissions			<input type="radio"/>
Less waste of resources by operators in open markets			<input type="radio"/>

Example: Sao Tome and Principe, West Africa³

Two central markets were included: 'Coco-Coco' and 'Mercado Municipal'. These markets posed different challenges compared with local businesses owing to their chaotic nature and high density of vendors, both inside and outside. The strategy implemented with municipal markets was to use 'tutors' as focal points. Tutors are sellers who were trained and motivated for separate biowaste collection. Green 120-L wheelie bins were placed at strategic sites near tutors. A shredding machine was installed in both markets in July 2014 to shred biowaste (banana peels mainly) and reduce the volume. Information about biowaste collection was spread by the tutors as 'word-of-mouth' and through written notices in wall-posters.

Further reading

1. J. Barth, F. Amlinger, E. Favoino, S. Siebert, B. Kehres, R. Gottschall, M. Bieker, A. Löbig and W. Bidlingmaier (2008). Compost Production and Use in the EU. Report for the European Commission DG/JRC
2. Arcadi/Eunomia, "Assesment of the options to improve the management of bio-waste in the European Union", p.79, November 2009
3. Vaz, Joao & Ferreira, José & Dias-Ferreira, Celia. (2015). Biowaste separate collection and composting in a Small Island Developing State: The case study of Sao Tome and Principe, West Africa. Waste Management & Research. 33. 10.1177/0734242X15611737.



User-friendly collection containers

Best practice factsheet #11

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

Recycling should be easy and encouraging for all the population. Thus, the design of the collection infrastructure should be appealing and adapted to all the users. Furthermore, proper maintenance and clean surroundings are also important to boost biowaste recycling as well as the adaptability of the frequency of collection and opening hours of recycling yards to all citizens. Citizens that are disabled or of younger or older age, find it difficult to recycle due to the non-user-friendly containers. This causes a reduced collection rate and a worse quality waste.

Action

Use of containers with ergonomic design adapted to different kind of users such as, children, elderly people or disabled citizens.

Implementation

1. Make an analysis of the containers to know if they are ergonomic by asking the users. If it is not the case, keep it in mind for future container purchases.
2. Check containers regularly (maintenance)
3. Make a cleaning plan for the containers and the surroundings.

Results

Design is important and it should include the maximum part of the population. Making containers user friendly will allow more citizens to use it increasing therefore the amount of waste collected. They will also find it more comfortable and convenient to recycle making the city cleaner. Furthermore, containers and surrounding spaces should be kept clean, accessible, well-lighted and in good condition in general.

Further reading

1. <https://www.municipalwasteeurope.eu/sites/default/files/SI%20Ljubljana%20Capital%20factsheet.pdf>

Example: Ljubljana experience (Slovenia)¹

In 2013, Ljubljana introduced a simpler and more user-friendly method of collecting packaging, which increased the quantities collected. 82% of the total households collected biowaste with bins with a total of 22441t collected in total. Using their own bins/containers outside their buildings, residents collect residual waste, biowaste, packaging and paper. They also collect packaging at collection points or eco-Islands situated in public areas.

Benefits

- Citizens will find it easier to use containers
- More comfort and convenience for the citizens
- Cleaner city
- Prevention of non-biowaste materials in the container
- Increased biowaste collection rates



Source: <https://ecoembesdudasreciclaje.es/contenedores-inteligentes/>



Volunteer collection of biowaste

Best practice factsheet #12

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

Volunteer collection is an initiative that public or private organization (e.g., schools, sports, clubs, charity organizations, etc.) at local level (neighborhoods, sports clubs, etc.) can implement in a municipality by collecting paper and board separately.

Volunteer collection can entail a benefit for the entire community, not only by raising money but also by increasing environmental awareness in people.

Action

Form a network of volunteers to promote environmentally friendly actions and biowaste collections.



Implementation

1. Allow NGOs, schools or clubs to collect waste on them on behalf and by their own means.
2. Give recommendations and information on methods to collect biowaste and how to communicate results to the municipality.
3. Establish an efficient communication channel to allow organisations to communicate with the municipality.
4. Evaluate and monitor the quantity of biowaste collected by the organizations.

Results

Specific campaigns for collection of biowaste by public and municipal centres like schools and sports clubs, which may provide an extra revenue and used for helping to fund their activities and needs. A specific measure adopted for awareness-raising is the establishment of a network of waste advisers. These are employees or volunteers trained in waste prevention and management who support residents in reducing and correctly separating at source the waste generated in households at the very local level down to even individual buildings or households.

Benefits

	€		
Increase of biowaste collection		<input type="radio"/>	<input type="radio"/>
Better quality of the collected material, reducing therefore sorting costs	<input type="radio"/>		
Collect funds for a social cause	<input type="radio"/>	<input type="radio"/>	
Commitment of citizens on biowaste collection at home by financing a social and environmental cause		<input type="radio"/>	<input type="radio"/>

Example: Composter Advisor Scheme¹

A network of Compost Advisors, in partnership with The Conservation Volunteer and funded by the Kent council, was established in 2001. The Compost Advisor Project aims to appoint volunteers, who will advise people on composting issues and help promote the need for waste reduction. Since the project began in 2001, the BTCV has recruited over 200 advisors across Kent, each one receiving free training, a compost bin to get them started, access to the documentation of the BTCV offices and introduction in the Compost Advisors network. As volunteers they can decide how much time they spend being a Compost Advisor and where their particular interest lies. For example, some may prefer to offer telephone support to composters or be able to promote the scheme at local events.

Further reading

1. https://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=LIFE08%20ENVF000486_Miniwaste_good_practices_inventory1.pdf

Anaerobic digestion plant

Collection

Transport

Characterisation

Social awareness

Best practice factsheet #13

SCALIBUR

Challenge

The EU Waste Framework Directive of December 2008 underscores the need to make better use of bio-waste. The Directive prescribes in Article 22 that Member States shall take appropriate measures to encourage the separate collection of bio-waste with a view to their composting and anaerobic digestion. Only high-quality biogenic waste is suitable for composting so impurities must be separated, which necessitates technical efforts or increased personnel input. Biowaste material is a good candidate for the production of energy in urban territories. The presence of undesirable or constituents mixed with the biowaste collected by municipalities makes it difficult to recycle organic matter of sufficient quality for agricultural uses. Methane production is particularly attractive for energy recovery notably because this energy vector can be distributed using the grid already in place for natural gas in many cities.

Action

Build an anaerobic digestion plant to treat biowaste.

Implementation

1. Determine the Municipality goals and needs and perform a feasibility study to implement an anaerobic digestion plant.
2. Interview designers and consultants and select the digester designer. There are several factors to consider when choosing a design company to work with through the process of building an AD system: the type of design, knowing if the company has previously built and how they perform, and guarantees.
3. Obtain proper permits like building permits, land application permits, etc.
4. Start the construction

Results

Per metric ton of bio-waste between 80 and 140 cubic metres (m³) of biogas with a methane content of 50–65 percent is produced which equates to 50–80 m³ of natural gas. In most cases the biogas is converted directly into electricity and heat via a cogeneration plant. As an example, an input of 20,000 metric tons of bio-waste per year suffices to operate a cogeneration plant with a rated electrical capacity of 600 kW, producing enough electricity for 1,000 to 1,500 homes.

The anaerobic digestion of biological waste also consumes energy, requiring between 30 kWh and 60 kWh of electricity per metric ton of input as well as heat for the digestion process. However, by using the emerging biogas to produce electricity and heat, specific energy credits in the order of 200 kWh for both electricity and heat offset this consumption, with the result that the whole process has a clear energy surplus. The most important end products of anaerobic digestion are biogas and a nutrient-rich digestate that can be used in agriculture.



Source: <https://www.bioenergy-news.com/news/anaerobic-digestion-the-digester/>

Anaerobic digestion plant

Collection

Transport

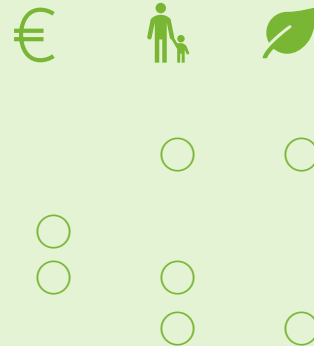
Characterisation

Social awareness

Best practice factsheet #13

SCALIBUR

Benefits



Anaerobic digestion achieves a positive energy and climate balance due to the emerging biogas and the resulting substitution of fossil fuels.

Less greenhouse gas emission

Less biowaste that ends up in landfill

High-value product from biowaste



Source: <https://agfprocesos.com/category/biogas/>

Example: Deisslingen anaerobic digestion plant¹

The anaerobic digestion plant in Deisslingen recycles the separately collected bio-waste from the Schwarzwald-Baar-Heuberg region, which is made up of the districts of Rottweil, Schwarzwald-Baar-Kreis and Tuttlingen. The project is an example of successful cooperation between local authorities. The preferred anaerobic digestion technology was only economically viable based on the wastes from all three districts. The plant was constructed next to the Upper Neckar Joint Wastewater Board sewage treatment works. It is situated conveniently for vehicle access in the middle of the waste management area close to the A 81 motorway to Lake Constance. Anaerobic digestion started in 2005. Each year around 25,000 metric tons of bio-waste are processed. The biogas produced is converted into electricity in a cogeneration plant and fed into the public electricity grid. The surplus heat from the cogeneration plant is used on site to dry municipal sewage sludge. In this way almost the entire energy is used. Wastewater can be discharged the short distance into the neighbouring treatment works. All the materials to be used for anaerobic digestion are pasteurised by heat treatment. The solid digestates are sold as high-grade, quality-controlled fertilisers to farmers in the region.

Further reading

1. <https://pubmed.ncbi.nlm.nih.gov/32050107/>

Containers with an ergonomic design

Best practice factsheet #14

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

Recycling should be easy and encouraging for all the population. Thus, the design of the collection infrastructure should be appealing and adapted to all the users. Furthermore, citizens that are disabled or of younger or older age, find it difficult to recycle due to the non-user-friendly containers. This causes a reduced collection rate and a worse quality waste.

Action

Implement containers with an ergonomic design adapted to different kind of users like elderly or disabled people and children.

Implementation

1. Make an analysis of the containers to know if they are ergonomic by asking the users. If it is not the case, keep it in mind for future container purchases.
2. Check containers regularly (maintenance) so they are clean.
3. It is important for employees to receive continuing education in ergonomics and body biomechanics basics. Workers should understand the importance of maintaining the back in an ergonomically neutral position and be able to recognize the early onset of ergonomic injuries so back injuries can be minimized.
4. Make a cleaning plan for the containers and the surroundings.

Results

Controlling ergonomics hazards in trash collection can present some difficulties. The main problem involves how customers put out their trash for pickup. Repeatedly giving customers information, such as flyers, about employee safety and health may encourage some customers to correctly use and place containers for pickup. Customers will likely improve such behaviour, however, only if the necessary equipment is easily attainable and convenient to use. Improving collection site safety can bolster overall employee health because injuries are cumulative by nature.

Example: Innovative ergonomic litter bin in Alcoy, Spain¹

Alcoy city Council has placed about 100 units of this litter bin model in different places of the city. The peculiarity of this litter bin lies on the fact that it has been designed to be fitted to the existing streetlights. Its main feature is a quick and ergonomic emptying system to make easier its handling by waste collection workers.

Benefits

- Citizens will find it easier to use containers
- More comfort and convenience for the citizens and workers
- The city looks cleaner
- Prevention of non-biowaste materials in the container
- Increased biowaste collection rates

€	Person icon	Leaf icon
○	○	○
	○	○
	○	○
	○	○
○	○	○



Source: <https://www.cervicenvironment.com/en/>

Further reading

1. <https://www.cervicenvironment.com/en/news/projects/alcoy-city-has-placed-an-innovative-ergonomic-litter-bin-developed-by-cervic-environment>



Best practices Transport

Software designed optimised waste collection route

Best practice factsheet #15

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

Collection rounds have to be planned according to anticipated quantities and composition of collected organics (which may fluctuate by season and area). As the segregation of garden and food organics alters quantity and composition of residual waste, existing garbage collection services may also have to be adjusted¹. Even without significant changes to the service, typical savings (of resources and costs) for route optimisation projects in the household waste sector are between 5 and 15 per cent. For these projects, the primary service remains the same—such as the collections offered to households, the vehicles used to make collections, the location of facilities—but how the work is done is optimised. Where more radical changes are incorporated into projects, such as changing shift patterns or the frequency of collections, then savings of up to 45 per cent have been achieved².

Action

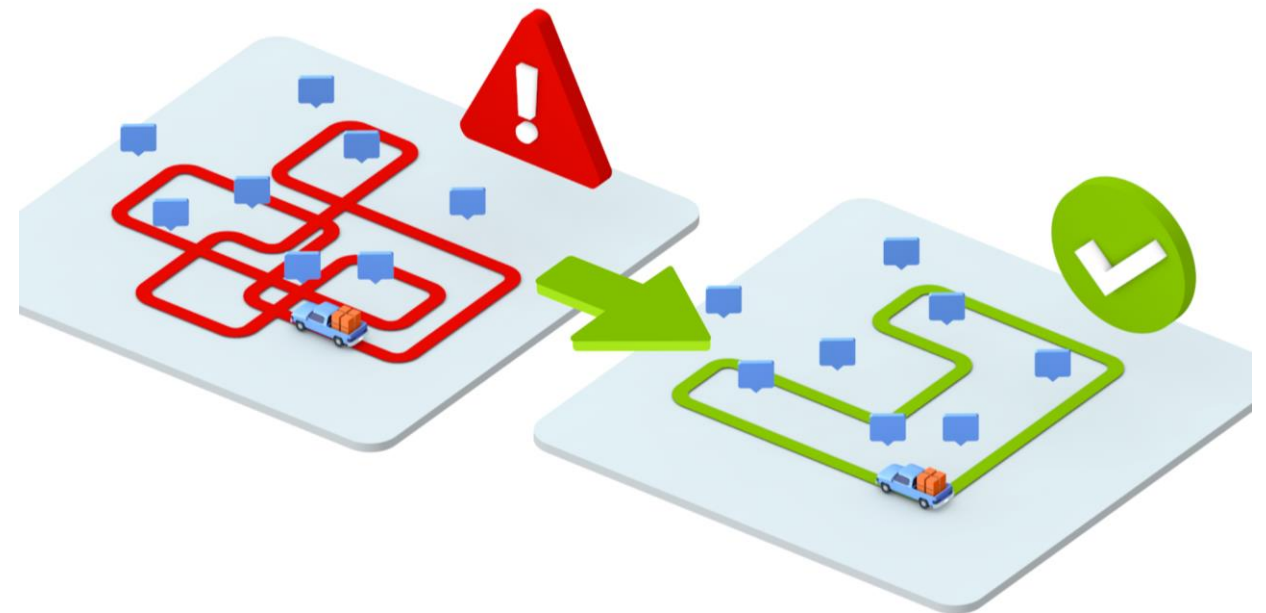
Implementation of an optimisation software which will plan the routes of the collection trucks.

Implementation²

1. Find a company able to design and install the system.
2. Involve drivers and supervisors: Route optimisation software lets people who understand waste collection design better rounds faster, but it doesn't seek to replace the knowledge of the people who operate the service. Their knowledge is vital in understanding the parameters in which the design must operate, and the operational issues associated with different types of collection.
3. Choose Sector-Specific Software as the optimisation of waste collection and street cleansing rounds is different and more complex than routing problems in other industries, such as deliveries or field service.
4. Create a Plan to Maintain Your Routes Going Forward: Where data has been kept up-to-date, it is much easier to re-plan routes as they become inefficient. In this way, solid waste operators can consistently maintain a more efficient set of routes.

Results

Route optimisation allows waste collection and street cleansing operators to identify and then remove inefficiencies. By building a digital model of their service, solid waste operators can compare different options with their current setup to identify more efficient and effective operating routes. In addition to cost savings, this can also mean balanced workloads and happier drivers, better customer service as crews are less likely to run short of capacity, and a safer operating environment since routes have been designed to account for safety issues properly.



Source: <https://support.route4me.com/faq/route-planning-glossary/route-optimization/>

Software designed optimised waste collection route

Best practice factsheet #15

Collection
Characterisation

Transport
Social awareness



Example: Ireland³

AES is a leading provider of waste management and recycling services in Ireland. The collection routes used to be planned by the drivers, resulting in inefficient routes, missed bins and dissatisfied customers. AES decided to contact a route optimisation company that resulted in spectacular cost savings and highly improved customer service. The company handles recyclable, organic, and general waste, keeping the approx. 165 vehicles busy with 400-500 collections per route on average and serving over 70,000 residential homes and 6,000 commercial customers. They reduced approximately 15% in costs per lift and 100% elimination of ad hoc routes for collecting missed bins (most expensive routes). They also improved their customer service, as the number of missed bins were reduced. The existing vehicles have, therefore the ability to take on a more significant number of new costumers .



Source: <https://www.bioenergyconsult.com/effective-waste-management/>

Benefits

	€	Person icon	Leaf icon
Improve efficiency and productivity	<input type="radio"/>		
Minimise the number of vehicles and routes driven	<input type="radio"/>		<input type="radio"/>
Maximising stops and lifts per hour	<input type="radio"/>		
Reduction in total work hours, labour, and overtime costs	<input type="radio"/>	<input type="radio"/>	
Decrease fleet maintenance, fuel consumption costs, and emissions	<input type="radio"/>		<input type="radio"/>
Provide better overall service to customers - less missed bins		<input type="radio"/>	

Further reading

1. <https://www.environment.gov.au/system/files/resources/8b73aa44-aebc-4d68-b8c9-c848358958c6/files/collection-manual.pdf>
2. https://www.webaspx.com/resources/blog/route_optimisation_secrets_of_success/
3. <https://www.amcsrouting.com/success-stories/aes/>



Challenge

Access to appropriate collection vehicles and container systems is a fundamental consideration for organics collection services. The configuration of collection vehicles and services may have a significant impact on the overall efficiency and cost effectiveness of organics collection services¹. Organics have a different bulk density and are more compactable than residual household waste. It is important to ensure the capacity of the collection vehicle is appropriate to the tonnage collected.

Action

Use of a truck equipped with a compactor in order to reduce the volume of waste.

Implementation

1. Define the amount of biowaste that is expected to be collected.
2. Select the best fitting compacting vehicle and determine the number of trucks according to the quantity estimations.
3. Include additional measures to optimise filling of the truck (e.g., redesign routes, collecting calendars, etc.)
4. Monitoring the quantity of organics loaded into the truck is recommended so as to avoid overloading, particularly when the proportion of grass clippings is high, or in high density housing areas where the proportion of food organics is high.

Results

The compaction of the collected material allows increasing amounts of biowaste to be transported per trip. Less space required for the collection of waste. Thus, it is possible to increase the route length being so more effective.

Further reading

1. <https://www.environment.gov.au/system/files/resources/8b73aa44-aebc-4d68-b8c9-c848358958c6/files/collection-manual.pdf>

Example: Compacting truck for paper and board collection

The technical specifications established in the tendering process for MSW collection in 'Urola Erdia' require the use of a 20 m³ compacting truck for the collection of organic, light packaging, PfR and mixed waste. It also specifies that compacting truck should be rear-load and suitable for containers between 80 and 1300L. In addition, the rear-load compactor collection box must be fully installed in the chassis cab. The main benefit of installing compactor in the truck is the volume reduction making transport more efficient.

Benefits

- The compaction of biowaste allows to increase the amount of waste collected.
- Increase efficiency of collection operations
- Less emissions of greenhouse gases
- Savings on operating and fuel costs
- Improve local air quality

€		
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



Waste: <https://www.recycling-magazine.com/2018/02/01/renault-refuse-collection-portfolio/>

Using electric trucks to collect waste

Best practice factsheet #17

Collection
Characterisation

Transport
Social awareness



Challenge

Almost every waste collection round relies on refuse collection vehicles (RCVs) that are powered by diesel-fuelled internal combustion engines. As local authorities become increasingly alert to the dangers of climate change and air pollution, and the urgent need for action, the days of diesel vehicles seem likely to be numbered. While there are several alternative technologies that might replace diesel, one of the best developed is battery-powered electric propulsion, recharged from the electricity grid.

When considering the seven-year lifespan of a waste collection vehicle, it has been discovered that an electric fleet would be more sustainable and cost-effective in the long-term compared to diesel. Moreover, the cost of repowering a vehicle would be recovered during its lifetime. In comparison to a standard diesel waste collection truck, early life cycle cost analysis suggests a saving of roughly £2,000 per month per eRCV.¹

Action

Use electric vehicles to collect biowaste.

Implementation

1. Define the amount of biowaste that is expected to be collected.
2. Select the best fitting electric vehicle and determine the number of trucks according to the quantity estimations.
3. Include additional measures to optimize filling of the truck (e.g., redesign routes, collecting calendars, etc.)
4. Monitoring the quantity of organics loaded into the truck is recommended so as to avoid overloading, particularly when the proportion of grass clippings is high, or in high density housing areas where the proportion of food organics is high.

Result

Electric collection trucks will provide cleaner and healthier air in the cities where they operate. They will not create emissions, which will improve local air quality, and the electricity used to recharge batteries will come from a power generator with an individual emission point and pollution control equipment. Electric vehicles do not idle when stopped or parked, and they make far less noise than diesel engines while on the move. Electric trucks may create opportunities such as new renewable energy from waste generation.

Benefits

- Electricity generation is less emissions intensive than diesel and the air quality emissions occur further away from residential areas, reducing their impact.
- Savings on operating and fuel costs
- Improve local air quality
- Electric engines are also far quieter than diesel equivalents, reducing noise pollution and improving the working environment for collection crews.



Using electric trucks to collect waste

Best practice factsheet #17

Collection

Transport

Characterisation

Social awareness

SCALIBUR

Example: Electric refuse collection vehicles in the UK²

A research done in the UK studied the benefits of electric collection trucks in comparison with diesel-powered vehicles. This research estimates that local authority RCVs emit approximately 330 kilotonnes of carbon dioxide-equivalent per annum (ktCO₂e/yr). Replacement eRCVs would produce only 40 ktCO₂e/yr, a carbon saving equivalent to every person in the UK recycling an extra 250 plastic bottles each year. A cost benefit analysis (CBA) comparing diesel RCVs with eRCVs found that, under quite conservative assumptions, the lower capital costs of a diesel RCV are largely offset by the lower running costs of an eRCV. In the CBA's central scenario, the eRCV's total cost of ownership (TCO) is £29,608 (5.2%) greater than that of the diesel equivalent; if the monetised impact of emissions is included, the eRCV's TCO saving is £12,365 (2.0%).

If we were to look at the air quality damage costs of nitrogen oxides (NO_x), on average it costs £6,199 per tonne of emission. When you consider the fact that converting one waste collection vehicle to fully electric is the equivalent of taking 30 diesel-powered cars off the street, it makes a big difference in air quality.

Further reading

1. <https://cleanstreets.westminster.gov.uk/westminster-city-council-first-electric-refuse-collection-trucks/>
2. Tomes, T. and Williams, L. (2020) Ditching Diesel A Cost-benefit Analysis of Electric Refuse Collection Vehicles. Eonomia. Available at: <https://www.eonomia.co.uk/reports-tools/ditching-diesel-analysis-electric-refuse-collection-vehicles/>



Source: <https://www.urbaser.com/>

Truck traceability

Best practice factsheet #18

Collection
Characterisation

Transport
Social awareness



Challenge

Waste collection is a highly visible municipal service that involves large expenditures and difficult operational problems, plus it is expensive to operate in terms of investment costs (i.e., vehicles fleet), operational costs (i.e., fuel, maintenances) and environmental costs (i.e., emissions, noise and traffic congestions). Modern traceability devices permit to obtain data in real time, which is fundamental to implement an efficient and innovative waste collection routing model. The basic idea is that knowing the real time data of each vehicle and the real time replenishment level at each bin makes it possible to decide, in function of the waste generation pattern, what bin should be emptied and what should not, optimizing different aspects like the total covered distance, the necessary number of vehicles and the environmental impact¹.

Action

Installation of a system of sensors and GPRs to the waste collection truck to trace vehicles.

Implementation

1. Find a company to design and build chips to install in trucks.
2. Filling sensors need to be assembled in the container and wireless connection is needed.
3. Train personnel on how to use it properly.
4. Perform periodic checks to verify proper functioning and periodic maintenance

Results

Vehicle emissions depends on driving behaviour such as acceleration and speed. Monitoring the speed, excessive idling, unnecessary accelerations, and braking will give information that can be used to significantly reduce the fuel consumption. The truck traceability system allows to monitor the speed, acceleration, RPM and engine load. The system allows to detect speeding, high acceleration and braking during a route. Monitoring the speed, RPM and engine load allows to identify interesting events as container emptying and excessive idling.

Reducing the time of use of the power take-off (PTO) in the process of emptying the containers and making the collectors to work at the optimum RPM (i.e., in the optimum power curve and consumption). This will significantly reduce the fuel consumption and cost.

Benefits

Reduction in investment costs for vehicles fleet, thanks to the ability to schedule on-demand pick-ups according to the effective need, with a consequent reduction in the number of vehicles.

Reduction in operational costs (fuel, maintenance, etc.), thanks to the reduction of vehicles, covered distance and stationary load and unload times.

The elimination of unnecessary stops, which means a reduction of engine emissions, produced both by sanitation vehicles and traffic congestion.

The reduction of noise especially in urban areas.



Example: Dubai²

The municipality of Dubai, together with Dubai Technologies, implemented mobile RFID readers that feature GPS, GSM modules and cameras to create a system of traceable bins. A total of 5,000 garbage bins were tagged with durable RFID tags. Each garbage bin's information was recorded to the database with a unique ID and GPS location. Each garbage truck was outfitted with mobile RFID readers. At each pickup, garbage collectors scanned the bin from inside the truck, receiving the data thanks to the RFID tags and readers' long-range performance. Any bin damage observed by collectors was photographed, and the system automatically reported the bin's condition. The main outcome of the project is the management of bin inventory based on reliable information and can therefore optimise the level of spare parts that municipality officials can keep. The monitoring of a live city map with data in real time provides a planning tool for the municipality managers to plan and provide waste collection routes in a more efficient way.

Further reading

1. Faccio, Maurizio & Persona, Alessandro & Zanin, Giorgia. (2011). Waste collection multi objective model with real time traceability data. Waste management (New York, N.Y.). 31. 2391-405. 10.1016/j.wasman.2011.07.005.
2. <https://litumrfid.com/dubai-waste-collection-rfid/>



Eco-driving in waste collection trucks

Collection
Characterisation

Transport
Social awareness

Best practice factsheet #19

SCALIBUR

Challenge

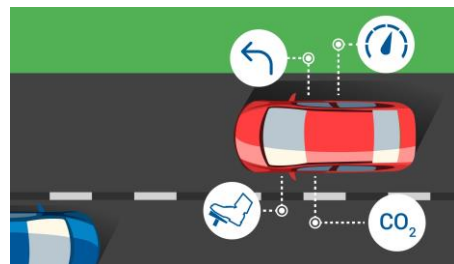
We are living today in a globalized world in which millions of vehicles are emitting harmful gases day after day. Any responsible company is therefore duty bound to look out for the environment. Moreover, eco-friendly companies have been shown to be more highly regarded by their customers. Especially driving with high engine revolutions (high RPM) raises the fuel consumption significantly. Also, avoidable sequences of acceleration and braking will lower fuel efficiency. Following the guideline "Safety First", Eco-driving enables a highly fuel-efficient, smart and relaxed driving style without any loss of time.

Action

Implementation of eco-driving in waste collection trucks.

Implementation

1. Anticipate traffic flow to make use of the vehicles momentum and to let the car roll in neutral.
2. Maintain a steady speed at low RPM using the highest possible gear.
3. Shift up early, approximately at 2000 RPM
4. Check tyre pressures frequently at least once a month and before driving at high speed
5. Consider any extra energy required costs fuel and money such as air conditioning and electrical equipment.



Source: <https://gurtam.com/es/blog/eco-driving-soversenstivuem-stil-vozdenia>

Further reading

1. George Goes, Renata Bandeira, Daniel Gonçalves, Márcio de Almeida D'Agosto & Cíntia Oliveira (2020) The effect of eco-driving initiatives toward sustainable urban waste collection, International Journal of Sustainable Transportation, 14:8, 569-578, DOI: 10.1080/15568318.2019.1584933

Results

Eco-driving is a systematic driving style that cuts fuel consumption and the emission of polluting gases. Onboard units now enable a wide array of vehicle data to be recorded, such as fuel consumption, revs per minute, acceleration, braking, maintenance, etc, while also flagging up technical alarms. All this information can then be combined with complementary data from other systems such as the fleet management system. Drivers are given instant feedback with visual and acoustic cues for correcting their driving style and cutting out inefficient behaviour such as over-braking and excessive idling. This allows drivers to react immediately to correct this driving style and enables performance reports to be drawn up afterwards as the basis for continual driver training, better service planning, vehicle maintenance, etc. Through the implementation of eco-driving, fuel reduction and better maintenance of the vehicle are obtained, extending its life.

Benefits

- Reduces fuel consumption
- Reduces noise pollution as well as local air pollution
- Reduces costs for maintenance and costs for repairing cars after accidents as a result of safer driving
- Enhance municipalities public image



Example

In Rio de Janeiro, Brazil, the company in charge of the urban waste collection applied a range of eco-driving techniques to the collection trucks' fleet¹. Eco-driving training was offered to 22 drivers in a fleet of 11 trucks, which operate in two different scenarios: a stop-and-go cycle and a transfer operation to a single delivery point. As results, eco-driving techniques provide economic returns according to the mileage driven. The practice not only has effects on fuel economy, up to US\$18,507.55 per month for a fleet of 43 vehicles, but also mitigates 7.1% of CO₂-e emissions and local air pollutants.





Best Practices Social Awareness

Clear instructions on the containers and bags

Best practice factsheet #20

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

Confusion about selective collection leads to mistakes and skepticism which causes people to throw tons of waste into the wrong container daily. This confusion may be due, among other reasons, to the lack of clarity in the labels of recycling container. The presence of wrong materials in recycling containers has serious consequences on the economic outcome of recycling. For biowaste, the results might also significantly vary depending on which types of biowaste are collected by the system. There are often misunderstandings on the part of residents on what they are allowed to dispose of as biowaste. As an example, in 2013 collected kitchen waste from households in Barcelona was estimated to have 21.1% impurities¹, that is almost a fifth part of all biowaste collected.

Action

Include an illustrative and brief information about biowaste collection with the recycling instructions.

Implementation

1. Use images and keep it simple and consistent.
2. Keep consistent color coding to help reinforce the connection.
3. Make sure the graphics are in a place where visible.
4. Overcome language barriers.

Results

If the information given to people is appropriate and well presented, the outcome will be a higher commitment to help achieve recycling goals and targets. Consistent and regular information should be provided to citizens through different channels, up to the final separation point. The information is intended to clarify citizens' concerns, increase their understanding of recycling processes, and could include recycling targets as an additional motivation.

Benefits

	€	Person	Leaf
Increase of biowaste collection	○	○	○
Increase citizen participation in recycling activities	○	○	○
Increase social awareness on the importance of recycling	○	○	○

Example: Market single-use carrier bags in Austria²

The Austrian compost and biogas association (KBVÖ) plans to launch an initiative aiming to only market single-use carrier bags in Austria that are compostable according to the European standard for industrial composting EN 13432. Combined with a consumer information campaign, the compostable bags are intended to be re-use to collect and dispose organic kitchen waste. This way, more bio-waste will be separately collected and diverted from other recycling streams, while, at the same time, the contamination of the collected organic waste with conventional, non-biodegradable plastics will be reduced.



Source: <https://www.myjobquote.co.uk/blog/home-recycling-tips>

Further reading

1. Barcelona City Council, «La gestion de déchets dans les centres urbains denses. Le cas de Barcelona» ORDIF conference: Waste Management in dense urban centres, 6 November 2014.
2. <https://www.biosackerl.at/>

Pay-as-you-throw principle for fee calculation

Best practice factsheet #21

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

Pay-as-you-throw schemes create clear incentives to divert bio-waste from residual waste. The basic principle is that those who produce pollution should bear the costs of managing it to prevent damage to human health or the environment.

In the traditional schemes for household waste management in Europe, the services are financed via general taxes or due to a fixed recurring fee in bills of other supply services as electricity, regardless of the produced waste amount. The cost is usually calculated based on living space and the number of household members. This way of financing is unfair for people who produce little waste either because of their recycling-composting efforts or because they don't over-consume. On the contrast, PAYT schemes household pay a variable amount depending on the quantity of waste generated by them and the corresponding service they obtained for its disposal.

Action

Fee calculation based on the principle that the less waste you produce or, the more and better you sort, the less you pay.

Implementation¹

1. Communication campaign: One key aspect to consider in the introduction of a pay-as-you-throw system is its acceptance by the population. Consequently, before the implementation of the system and the communication campaign, a participative process should be completed.
2. A test stage is not essential, but is advisable at least until people have got used to the pay-as-you-throw system. The aim is to help to prepare the population for the change in habits required by the new charge system. It mainly consists in distributing and beginning to use the standard container, but without charges, for a certain amount of time before the new tax system is fully implemented.
3. Monitoring and control stage: once the pay-as-you-throw system has been fully implemented, it is important to maintain a high level of participation by monitoring performance, resolving unforeseen problems and disseminating results.

Benefits

- | | € | Person | Leaf |
|-----------------------------------------------------------------------------------------------------------|---|--------|------|
| Increase of biowaste collection | ○ | ○ | ○ |
| Increase citizen participation in recycling activities | ○ | ○ | ○ |
| Variable pricing promotes equity in user payments by basing cost on the actual volume of waste generation | ○ | ○ | ○ |
| Higher transparency of service and thus promotion of a more reliable public image of waste services. | ○ | ○ | ○ |

Example: Esporles, Majorca

Esporles municipality is situated on the island of Majorca and has a population of 4,600 inhabitants spread over an area of 35.73 km². On 1 January 2009, a pay-as-you-throw system was introduced, called the Taxa de Fems (Waste Charge). Previously, the waste tax was a flat rate. For example, in 2009 each dwelling was expected to be charged €150/year, regardless of waste generation. With the new tax, a family that produces one bag of refuse and one of packaging waste a week will pay a total of €142/year, which is 6% less than they would have paid previously. However, in reality the results show that on average every family throws away a bag of refuse every 2 to 3 weeks. Therefore, the household tax is usually between €100 and €115/year. Results show that the selective waste collection rate rose from 46% in 2008 to 73% in 2009. Refuse production decreased by 61.3% and the overall waste production dropped by 23%.

Further reading

1. http://residus.gencat.cat/web/.content/home/lagencia/publicacions/centre_catala_del_reciclatge_ccr/guia_pxx_en.pdf
2. Ajuntament d'Esporles (2008), Implantació d'una taxa de residus per generació. Una experiència capdavantera en la gestió de residus, Fòrum Ciutadà d'Esporles (Balearic Islands)

Results

It can act as an incentive to recycle and an excellent way to reward households doing it well. Introduce (mandatorily) specific bags for every source separated fraction and charge higher costs for fractions that need to be reduced. Pay for quantity of waste generated (not by m²).

Educational areas in Recycling Yards

Best practice factsheet #22

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

The European Commission has set stricter regulations on waste separation, including biowaste. By the end of 2023, biowaste must be completely separated or recycled at source. In an effort to achieve sustainable development, cities across the globe are pushed to improve the waste management. An important part of household waste comes in the form of biowaste.

Getting citizens, especially children, involved in recycling in Recycling Yards is good for the environment, educational and can be a lot of fun. Educating our children about the importance of recycling provides the country with a path to a greener future. As children learn about recycling, they will be more likely to carry these habits into their adult years. They also will learn how their personal actions can affect the future.

Action

Integrating a reserved area in Recycling yards to teach about how to sort waste and which kind of material can users bring to Recycling Yards.

Implementation

1. Make space in a Recycling yard for the educational activities. Bear in mind to put it far enough from dangerous items like glass, machinery...
2. Decorate the area in an appealing way for children and adults using for example, using recycled materials.
3. Identify the activities you want to perform in this area and design the space so that it is adapted to these activities.
4. Organize information campaign to inform schools and other institutions of the Recycling Yards.
5. Plan open days to visit the installations and promote it on social media.

Results

Fun activities are a great way to learn about the environmental benefits of recycling and how to separate waste correctly. This is especially true for children who have a powerful influence over the recycling habits of households. The population can learn how to separate waste and the places/days to deposit. This increases the amount and quality of waste.

Benefits

- Increases social awareness on the importance of recycling
- Visiting recycling yard can be very impressive for children and the message to communicate could be more easily understood.
- Practical demonstrations can be easily remembered.



Example: La Rioja¹

The urban treatment plant in La Rioja has a visitor's center or environmental classroom where schoolchildren and the general public come to find out what happens to the garbage after it is thrown in the container. The environmental educators of the Ecoparque carry out different activities throughout the year, such as workshops and guided visits, with which they try to raise awareness about the importance of separating the waste we produce in our homes. They also offer the possibility of a guided tour through the whole plant, to understand how they add value to waste and the importance of everyone in this closed loop. The visit involves environmental educators performing different activities such as handmade crafts or games to reinforce the message of how important it is to correctly separate the waste that we produce in our houses.

Further reading

1. <https://www.larioja.org/medio-ambiente/es/publicaciones/material-didactico/contenidos/programa-residuo-responsable>



Source: <https://www.iberdrola.com/medio-ambiente/educacion-ambiental-para-ninos>

Events, roadshows and workshops

Best practice factsheet #23

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

Nowadays, using and throwing is part of our automatic behavior. We use one thing and, when we feel that we have finished with it or that we are tired of it, we throw it away. We must not forget that the awareness campaigns and education on the importance of recycling and on how we should separate our waste are the way to raise awareness among consumers. Above all, these campaigns help consumers to change their habits. These types of activities include attending popular public events, public meetings...

Action

Use workshops, roadshows or events to communicate face-to-face to with residents.

Implementation

1. Analyse the target of the campaign and where to reach them, as it is key to prepare the event around this information (targeting, planning and organization is the key to a successful event).
2. Selection of a good location and timing for the event.
3. Take a display panel, the more engaging your display the better, as it will encourage more people to come and talk. Activities can also be used to entertain or draw people to the stand while engaging with them.
4. Reinforce your communications messages with practical giveaways to help collect biowaste.

Results

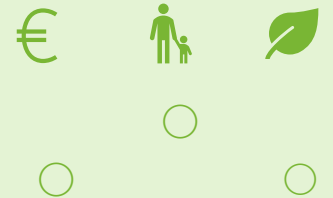
Some of the benefits are increasing citizen engagement and therefore increasing the quantity and quality of biowaste due to the information received and direct feedback about problems to address them directly. Citizen's viewpoint can be very valuable in decision making processes to improve recycling rates.

Further reading

1. <https://www.javea.com/en/ninos-y-mayores-aprenden-a-reciclar-de-manera-ludica-en-el-poble-nou-de-benitatxell/>

Benefits

Increased satisfaction as citizens feel part of the system.
Increased citizen engagement and consequently increase a quantity and quality of biowaste



Source: <https://www.javea.com/en/ninos-y-mayores-aprenden-a-reciclar-de-manera-ludica-en-el-poble-nou-de-benitatxell/>

Example: El Poble Nou de Benitatxell, Spain¹

Raising awareness among neighbors about the importance of caring for and preserving the environment was one of the objectives of Poble Nou de Benitatxell. Through games, dozens of residents of the municipality participated in the raffle of recycling installed in the street market. The game has allowed neighbors to interact and demonstrate what they know about selective collection, while solving doubts and winning awards such as backpacks and pens if they successfully overcome the different levels. During the campaign, free guides and refrigerator magnets are distributed explaining in a very visual way how to separate the containers and where to deposit them so they can be recycled.

Competition rewarding the best performance in biowaste collection

Best practice factsheet #24

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

Bio-waste represents an important share of European municipal waste generation. In 2017, the EU-28 (28 EU Member States) generated 249 million tons of municipal solid waste, of which about 34 %, or 86 million tons, was bio-waste. Impurities such as plastics, glass shards and metals can still be found in biowastes, even where source separation of waste is well established, probably due to the citizens' lack of environmental awareness. The presence of impurities (non-biodegradable materials) in biodegradable waste hinders its recycling by increasing its treatment costs and negatively affecting the quality of the obtained product which, in turn, hinders its commercialization.

Action

Establishment of competitions in order to award the best performances or excellent behavior in biowaste collection

Implementation

1. Design your competition and make it appealing to the target public.
2. The core message should be tempting without forgetting the core message.
3. Message should be clear and illustrative with videos and other visuals.

Results

Competitions can be an excellent way to generate awareness and interest in biowaste collection. They give extra motivation to the people and help to reinforce the messages from the recycling campaigns. Of course, these campaigns should be in line with the messages and the prizes appealing (and ideally incorporate recycled materials or promote the conservation of resources). Furthermore, the competitions can be held at different levels (Municipalities, neighborhoods, small business, schools).



Source: <https://biconsortium.eu/news/biowaste>

Benefits

Competition reinforce the key message at different levels using an attractive and fun method.

People can be easily engaged and improvements in recycling rates can be achieved if the competition is well planned.

People encourage each other to increase the recycling due to the team competition

If it is well designed, the recycling habits will remain a common practice



Example: The Riverina Eastern Region of Councils, Australia¹

The Riverina Eastern Region of Councils (REROC) is a voluntary association of 13 councils in the eastern Riverina region of NSW. It covers a large geographical area of about 43,000 square kilometers but has a small population of approximately 140,000 people. The councils developed an innovative method for engaging residents, managing contamination and monitoring participation at the household level. Each compostable liner bag distributed was numbered to identify individual households, which allowed the councils to run spot audits, measuring contamination levels and promoting a rewards program where householders could win a prize for low or no contamination. Each fortnight a number was selected from each of the four LGAs and the resident received a prize worth \$50.

Further reading

1. <https://www.environment.gov.au/system/files/resources/8b73aa44-aebc-4d68-b8c9-848358958c6/files/collection-manual.pdf>



Schools campaign

Collection
Characterisation

Transport
Social awareness

Best practice factsheet #25

SCALIBUR

Challenge

As any separation at source, the separation of biowaste in the households requires personal efforts in form of awareness and change of habits of the citizens. Therefore, it is important to convey to children the benefits of recycling for the environment. Children are our future; it is therefore important to provide meaningful information on ecological and waste management aspects in good time. By visiting schools and organizing activities children's engagement increases.

Action

Start educational campaigns in different schools to engage children with the recycling in their town.

Implementation

1. Identify a specific campaign goal.
2. Determine the duration of the campaign.
3. Set up biowaste recycling activities that are fun for children that help them remember and understand the message without difficulties using simple language.
4. Encourage participation and gather support for the campaign school-wide.
5. Brief the teachers about the recycling scheme and hold assemblies to inform the pupils. Make sure that the teachers and staff understand the importance of recycling, and this should filter down to the students.
6. Publicize the campaign.

Results

Fun activities are a great way to learn how about the environmental benefits of recycling and how to separate waste correctly. This is especially true for children who in addition have a powerful influence over the recycling habits of a household. The population can learn how to separate waste and the places/days to deposit. This increases the amount and quality of waste.

Benefits

	€	👤	🌿
Increase social awareness on the importance of recycling	○	○	○
Increase recycling rates in the city	○		○
Increase quantity and quality of biowaste	○		○
Improvement of the citizens' perception about their municipal entities		○	○
Practical demonstrations can be easily remembered.		○	○

Example: King county Council¹

Schools across King county, Washington, have raised awareness of the schools use of plastic bottles and encouraging them to recycle them. The campaign encourages alternatives to disposable plastic bottles by promoting reusable drink bottles and recycling of the plastic ones.



Source: <https://kingcounty.gov/~media/depts/dnpr/solid-waste/secondary-school/documents/Plastic-Bottle-Campaign.ashx?la=en>

Further reading

1. <https://kingcounty.gov/~media/depts/dnpr/solid-waste/secondary-school/documents/Plastic-Bottle-Campaign.ashx?la=en>

Publication of positive recycling news as TV advertisement

Best practice factsheet #26

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

Television advertising enables marketers to reach local and national viewing markets. Population should be aware of the actions and possibilities they could take as individuals to have a positive impact (localized actions, undertaken by citizens, should cumulate to have global effects). The publication of these actions and effects can give ideas and serve as inspiration to engage other citizens. News that confirm good information about recycling and positive results help people to become more committed with recycling.

Action

Advertising campaign launched on the local/national TV about environmental, economic and social benefits of recycling in the town/country.

Implementation

1. Collect and analyze information of interest on the waste collection system including contact information for citizens.
2. Design the advertisement in a user-friendly way by organizing and providing information clearly.
3. Promote it on local media.

Results

Advertisement on TV is a fast and direct way to give information to the population about how and why is important to recycle waste. Thus, motivate the people and increase recycling rates.

Example: Recycle Now, UK¹

Recycle Now, the campaign to promote recycling in England, is to run a television campaign to encourage people to recycle garden waste as compost. The ad, created by Team Saatchi, extends the theme of 'the possibilities are endless' used in Recycle Now's first burst of advertising, which focused on recycling cans. They demonstrate how common garden waste, such as leaves, twigs and grass-cuttings, can easily be composted. The campaign has been adapted to run in the national press and gardening magazines. Recycle Now is managed by the Waste and Resources Action Programme, a government-backed non-profit organization.

Benefits

	€	People	Leaf
Promotion of biowaste recycling	○	○	○
Improve the brand image in the case of companies.	○	○	○
Serve as inspiration for new ideas for innovation and research	○	○	○
Increase environmental awareness	○	○	○
Change in the habits of life and consumption of society	○	○	○



Recycle Now Campaign Toolkit
VERSION 1 | JUNE 2018



Source: <https://www.marketingweek.com/recycle-now-runs-tv-campaign/>

Further reading

1. <https://www.marketingweek.com/recycle-now-runs-tv-campaign/>



Include citizens actively in the information loop

Best practice factsheet #27

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

Citizens are not involved in the decisions that municipalities take regarding waste management activities. This means that they are not involved in the activities proposed by municipalities and that the recycling rate is very low. For this reason, cities are challenged to include citizens in decision making so that they feel more involved and are motivated to participate actively.

Action

Establishment of a bi-directional communication among municipalities, waste and resource managers, experts and citizens, in order to get inputs from all stakeholders involved (co-design).



Implementation

1. Identify stakeholders: Perform a demographic, cultural, socioeconomic study in order to implicate representative population groups and define best performing strategies to involve citizens.
2. Explain the current system: Set a dissemination and communication strategy to inform what options there are on decision-making processes and how to participate.
3. Identify current problems: Define the main points to be discussed and the kind of feedback that is expected to be collected.
4. Define possible solutions: Carrying out regular surveys, campaigns, assemblies, apps, web platforms and face-to-face meetings. Citizens can use these interactive platforms to cooperate with new ideas, opinions or to participate in voting processes.
5. Develop actions to implement them.

Results

Thanks to the involvement of citizens in the decisions taken on waste management activities, citizen participation will increase, the quality of the collected material will rise, and the quality of biological waste collected will improve. These positive developments would imply a reduction in waste management costs for cities, which would allow investing this money in activities and facilities for citizens.

Benefits

	€		
Improving organic waste management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Increase the recycling rate	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Citizens involved with the correct functioning of the city		<input type="radio"/>	
Reduction of waste management costs	<input type="radio"/>		
Changing citizens' views on recycling issues		<input type="radio"/>	
Increase citizen participation in recycling activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Incorporating a cleaner collection system		<input type="radio"/>	<input type="radio"/>
Increase the quality of the waste collected	<input type="radio"/>		<input type="radio"/>

Example: The Netherlands^{1 2}

In the Netherlands, the most active and committed citizens in their neighbourhood do not want the government to provide standard solutions for everything, they prefer a tailor-made approach and for the authorities to think along with them. This new way of relating to each other and working together is what is often called a do-ocracy. In addition to being actively involved in collecting waste and keeping the city clean, citizens can also actively participate in making decisions about the municipal budget. In this way, local authorities act with a more supportive role, for example by providing facilities to the neighbourhood.

Further reading

1. <https://www.government.nl/topics/active-citizens/citizen-participation>
2. Verhoeven I (2014). Do-ocracy and the reinvention of government. ECPR. url: <https://ecpr.eu/Events/PaperDetails.aspx?PaperID=16320&EventID=12>

Waste ambassadors

Best practice factsheet #28

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

The use of waste advisers is especially relevant to address specific issues by targeting a specific territory or audience with a poor separate collection rate or high contamination in separately collected fractions in order to deliver an adapted answer, as waste advisers can interact face to face¹.

Action

To design an awareness system based on ambassadors who inform citizens about the collection system established in the municipality.

Implementation

1. Identify current problems
2. Design a process to solve the problems of citizen education.
3. Form a team to manage the Recycling Ambassador Programme.
4. Explain to the waste ambassador the waste management policy and all related topics.
5. Detect citizens' demands and promote activities according to the needs of specific groups
6. Train residents and small businesses on environmental issues related to waste generation and management
7. Create instructional materials and short videos to disseminate information on recycling to carry out educational events
8. Develop a Zero Waste Plan
9. Appropriate signage on each of the containers
10. See the results and improve the process on a periodic basis

Example: California Polytechnic State University²

In 2017, California Polytechnic State University (Cal Poly) launched the Zero Waste Ambassadors (ZWA) program, a program aimed at students to educate them about sustainable waste disposal. The programme continues today, has 7 members, and is supported by 125 volunteers.

Results

Ambassadors can play an interesting role in making communication flow. Their tasks will be developed through visits to neighbours and information points.

Thanks to their tasks, information between citizens and the municipality will be more fluid, because questions will be answered, and barriers faced by households when managing their waste will be identified.

The information gathered will enable decisions to be taken that facilitate waste recycling, as well as achieving greater commitment and behavioural change on the part of the citizen.

Investing in ambassadors can be useful to raise awareness among residents and small businesses about environmental issues and waste generation, provide guidance to determine the possibilities of reducing or better managing waste, solve the problems of the most problematic fractions, carry out participatory actions aimed at specific audiences.

Benefits

Citizens trained in environmental issues related to waste generation and management	€	👤	🌿
Improvement of urban waste management	○	○	○
Increased recycling rate	○		○
Increase citizen participation in recycling activities		○	○
Better communication and feedback between citizens and authorities			

**ZERO
WASTE**

Source:
<https://afd.calpoly.edu/sustainability/student/zero-waste-ambassadors>

Further reading

1. <https://ec.europa.eu/environment/emas/pdf/WasteManagementBEMP.pdf> (p.257)
2. <https://afd.calpoly.edu/sustainability/student/zero-waste-ambassadors>

Website on biowaste and recycling

Best practice factsheet #29

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

Misinformation and false news about waste management lead to poor classification by citizens. In many occasions, the citizen has doubts about where to classify the most complicated materials and it is necessary a tool that can solve the problems instantly.

Action

Website explaining the municipal waste collection system in an easy way and showing the benefits of recycling.

Implementation

1. Collect and analyze information of interest on the waste collection system including contact information for citizens.
2. Design the website in a user-friendly way by organizing and providing information clearly.
3. Explain the importance of recycling to citizens through clear and graphic images
4. Promote the existence of the website by local media.

Results

The website will serve to keep the city informed about the importance of recycling, bio-waste and its management, which will lead to an increase in the recycling rate and greater involvement by citizens. Thanks to this information, citizens will manage their waste correctly.

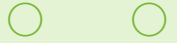
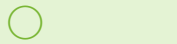
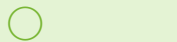
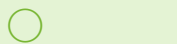
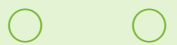
This website will be promoted through all channels used by the municipality like local newspaper, information on bins, leaflets and radio.

Example: Spain¹

In Spain, Ecoembes has developed a website to teach how to recycle well and explain the role of packaging in society. In addition, they have incorporated an Intelligent Recycling Assistant (A.I.R-e) that solves the doubts of the population about where to recycle the different materials.

Benefits

- Increase the knowledge of the citizens about the operation of the system and the benefits of recycling. It is an easy way for people to access information and engage.
- Improve the image of the municipality.
- Provides useful information on biowaste collection system.
- Solve the citizen's doubts quickly



Source: <https://www.ecoembes.com/proyectos-destacados/chatbot-aire/>

Further reading

1. <https://www.ecoembes.com/proyectos-destacados/chatbot-aire/>

Associations of citizens providing direct feedback to municipalities

Best practice factsheet #30

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

The authorities cannot know every real problem that citizens encounter when it comes to recycling. For this reason, it is important that there are citizens' organizations or associations that communicate the problems of the cities and maintain a continuous flow of communication between the cities and the citizens.

Action

Creation of association of citizens who get together to discuss issues about waste collection. Their feedback is afterwards used by the municipality to improve the waste collection system.

Implementation

1. Create an open space discussion or open an online template for consultation.
2. Contact with the associations of the municipality on a regular basis.
3. Evaluate the association's claims.
4. Improve collection system taking into account the association claims

Results

Citizens' associations involved with the problem of recycling in cities will discuss problems related to waste management issues with the people concerned. In this way they will collect the problems that citizens face on a daily basis and convey to the authorities possible improvements that can be made to involve other citizens in recycling problems and possible solutions. In this way, cities will improve their management and increase the interest and collection rate.

Further reading

1. Residents' associations in York (UK)
2. CAG (2016): Citizens association of Georgetown

Benefits

- € Increase the quantity and quality of biowaste collected as well as the environmental awareness.
- Improve the green image of the municipality.
- Improve the citizens' perception about their municipal entities.



Example: City of York¹

Citizens of the city of York can get involved with the council by joining a Residents' Association. These organizations play an essential role in contributing to policy making, building local communities and shaping the delivery of services to residents in the city. They focus on local issues such as community or housing concerns as well as on the local environment.

Example: Georgetown²

This historic neighborhood located in northwest Washington, D.C. involves its residents by a non-profit organization. The Citizen association of Georgetown represents the interests of its residents in local affairs. It also provides an opportunity to build a community and share concerns and ideas to improve the village.



Source: <https://www.yorkpress.co.uk/news/11803986.join-yorks-annual-city-wide-big-clean-up/>



Targeted communication campaigns

Best practice factsheet #31

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

Public awareness campaigns are usually conducted for a general audience, which means that information does not reach certain people and is not recycled or done properly. For this reason, it is necessary to focus the information on specific groups of people, such as tourists in holiday flats, new residents or children motivating their parents to recycle.

Action

Identification of the social group in which waste collection should be improved and develop targeted communication campaigns for them.

Implementation

1. Identify a cultural and social theme recognizable by targeted public. Like for example, when the targeted public is children, it is important to organize games and fun activities that help them remember the message without difficulties.
2. If the text is in other languages, check the accuracy of the translations.
3. Reward the citizen involved with gift packages that motivate the rest of the population to participate and do things correctly.
4. Carry out a study of the population and classify it to ensure that the whole population receives the correct instructions.

Results

These communication campaigns can be used to identify new opportunities to improve the service. With the collaboration of citizens, the most common mistakes among residents will be detected, i.e. direct contact with the population can be used to find out the strengths and weaknesses of the waste management system and improve communication campaigns.

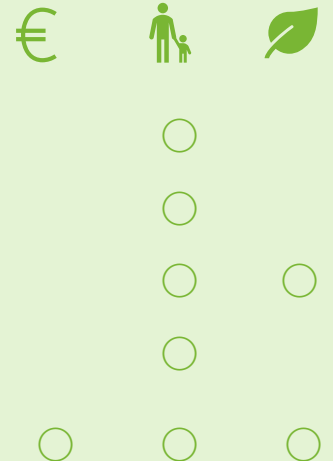
Furthermore, thanks to the personalized attention towards certain interest groups, the collection rate will increase.

Further reading

1. <http://www.thecampaigncompany.co.uk/portfolio/communicating-recycling-young-people/>

Benefits

A reinforcement of the key message at a local level talking directly to the public about local recycling issues.
More engagement of the citizens, since they feel attracted easily by the communication items
People will understand better the message and will encourage recycling habits with their relatives and friends.
Rewards to citizens will encourage other citizens to join in recycling
A small investment in the training of the population will allow an increase in both environmental and economic benefits



Example: Communicating to young people in the UK¹

The Waste and Resources Action Programme is a national charity that works with the government to improve recycling. Its consumer-oriented campaign focuses on using communication to encourage early involvement in recycling, i.e., it targets people between the ages of 8 and 21. The task of this group of Scouts is to recycle paper, plastic, metal and glass. The winner was awarded with gifts. Thanks to this initiative, it is possible for children to motivate parents to recycle more and better.



Source: https://commo.es/portfolio_page/otro-final-es-posible-campana-de-reciclaje/



Dissemination of the environmental and economic benefits of biowaste recycling

Best practice factsheet #32

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

Due to limited capacities of landfill sites new alternatives for certain waste streams need to be found. As biowaste made out more than 1/3 of the total waste landfilled, biowaste is one priority topic. Currently, only around 51% of household biowaste is collected in organic waste containers, which is integrated in the separate collection system. By disseminating the benefits of biowaste recycling, the amount of organic waste can increase and decrease the amount of impurities.

Action

Development and launch of awareness campaigns based on illustrative and clear examples of the biowaste recycling benefits.

Implementation

1. Collect interesting information related to the benefits of recycling biowaste and the disadvantages or problems associated with non-recycling.
2. Use communication channels to disseminate the news allowing the maximum possible number of citizens to be reached.
3. To carry out activities that involve citizens and attract their interest
4. Demonstrate with real economic data the economic benefits of good waste management
5. Explain to citizens the ways in which the collected waste can be recovered.

Results

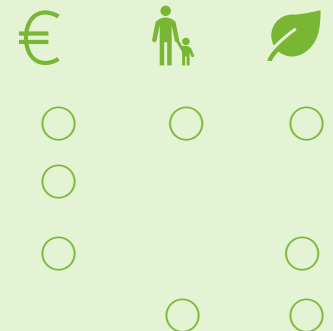
Campaigns to reduce bio-waste promoted by cities will help to reduce the environmental impact of waste by reducing the number of tons of waste going to landfill, while at the same time providing economic benefits from the transformation of this waste into high value-added products such as biogas and compost.

Further reading

1. <http://www.compostplus.org/>
2. Organics recycling in France: how new compost standards & incoming laws will change the landscape (2015): <http://www.organicstream.org/tag/quality-standards/>

Benefits

- Serve as a marketing tool.
- Dissemination of the benefits can serve as educational information for school or other institutions.
- Can increase social knowledge about real benefits of recycling.
- It can promote biowaste recycling and separation.
- You can open a new business channel by obtaining high added value products



Example: Réseau Compost Plus^{1 2}

Réseau Compost Plus is a network of French municipalities that promote the separate collection of bio-waste in France. The association was created in 2011, on the initiative of 6 communities that were pioneers in the selective collection of bio-waste, and today it brings together 9 million citizens. Compostplus launched a campaign called "Ce Serait Absurde" consisting of videos to raise awareness and promote the selective collection of bio-waste. The videos are short, unconventional and accessible to all to generate a broad mobilization. They also published a manual in early 2015 to help sort out biological waste. The network manages a Quality Assurance Scheme for compost (ASQA label) to certify compliance with high standards and organizes local events to promote best practices in separate collection.



Source: <http://www.compostplus.org/>





Best Practices Characterisation

Data collection and monitoring quality parameters

Best practice factsheet #33

Collection
Characterisation

Transport
Social awareness

SCALIBUR

Challenge

Although it is important to focus efforts on getting citizens to recycle, it is even more challenging to get them to do so in the right way. For this reason, the most important parameters must be monitored, and data collected to determine whether communication and awareness raising efforts are having an effect on citizens.

Action

Implementation of sampling procedures to control the quality of biowaste for recycling.

Implementation

1. Describe the guideline for recycling facilities to use as a reference.
2. Develop a programme to collect data from the municipalities and recycling facilities.
3. It is recommended training and education programmes for employees.
4. Perform tests to ensure that the smart sensors are responding correctly



Source: <https://www.sostenibilidadresiduos.es/nuevos-contenedores-de-residuos-con-sensores-inteligentes-en-san-sebastian/>

Results

During waste collection, the main parameters will be measured, such as: material composition, impurities, ashes, moisture and sticky contaminants. Thanks to these results, it will be possible to know how citizens are acting and if they are doing it correctly in addition to recycling. This will influence the quality of the final product. If this is not the case, it will be possible to know where to improve.

Benefits¹

	€	People	Environment
Increasing the efficiency of waste collection	<input type="radio"/>		
Enable managers to analyse the suitability of the location of containers	<input type="radio"/>		
Know the capacity of the containers to avoid taking them away empty	<input type="radio"/>		<input type="radio"/>
Knowing the frequency of use and filling and the time of greatest influx to adjust the time of collection	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Improving the organisation of collection	<input type="radio"/>		
Reduction of CO ₂ emissions associated with transport			<input type="radio"/>
Reduction of noise pollution			<input type="radio"/>

Example: Hispavista Labs and Marsemic²

At the beginning of 2018, Hispavista Labs and Marsemic started a pilot test of 100 waste containers with intelligent sensors to monitor the rest fraction in San Sebastian (Spain). These containers measure, weigh, take the temperature and measure the level of filling. At the end of 2019, they increased the number of sensors installed in the containers to 170.

Example: Hirisens and Garbiker³

Similarly, in 2017, Hirisens and Garbiker started a pilot test with 10 containers in Bizkaia (Spain).

Further reading

1. <https://www.sostenibilidadresiduos.es/nuevos-contenedores-de-residuos-con-sensores-inteligentes-en-san-sebastian/>
2. <https://www.residuosprofesional.com/san-sebastian-sensores-contenedores-2/>
3. <https://www.residuosprofesional.com/bizkaia-contenedores-con-sensores/>



Monitoring and control of the composition of residual waste in other recycling streams

Best practice factsheet #34

Collection

Transport

Characterisation

Social awareness

SCALIBUR

Challenge

The presence of impurities (non-biodegradable materials) in biodegradable waste (biowaste; in this article considered as the separately-collected organic fraction of municipal solid waste) hinders its recycling by increasing its treatment costs and negatively affecting the quality of the obtained product, which, in turn, hinders its commercialization.

Action

Implementation of a methodology to monitor and analyze the composition of residual waste.

Implementation

1. Waste compositional sampling strategy design
2. Development of a suitable and clear list of waste categories.
3. Advice on procurement where local authorities will be obtaining the service of an external waste composition analysis contractor.
4. Include the responsibilities for local authority regarding responsibility for management.
5. Data analysis and reporting.

Results

The results should indicate the waste composition that appears in other recycling streams, i.e., the percentage of material that is poorly recycled. Based on the results of the monitoring, specific measures will be taken to obtain more recyclable and/or recoverable material and to prevent waste from ending up in the other recycling streams. This will result in an improvement of the recovered waste fraction and an increase in quality.

Example: Northumberland County Council¹

Northumberland County Council identified the need for a waste composition analysis to assess the impact during a campaign to increase the recycling rate. The council undertook a monitoring programme which included pollution, waste analysis for monitoring the rate of capture and committed surveys of waste pickers. The analysis of the results was carried out by an external contractor over 5 months in 50 different containers. During the training of the citizens, improvements in the level of pollution were observed, reaching an improvement of more than 2% which was the target set.

Benefits

- It can increase quantities of biowaste which means an increase of income to municipalities.
- Stronger motivation of citizens to participate in a scheme that works.
- Decrease the percentage of improper
- Less environmental pollution
- Better coordination between urban services



Source: Improving the Performance of Waste Diversion Schemes: A Good Practice Guide to Monitoring and Evaluation. Chapter 5. Monitoring scheme usage, participation and uptake.

Further reading

1. Improving the Performance of Waste Diversion Schemes: A Good Practice Guide to Monitoring and Evaluation. Annex 1. Case studies. Material change for a better environment: <https://www.wrap.org.uk/sites/files/wrap/WRAP%20ME%20Guidance%20-%20Annex%201.pdf>