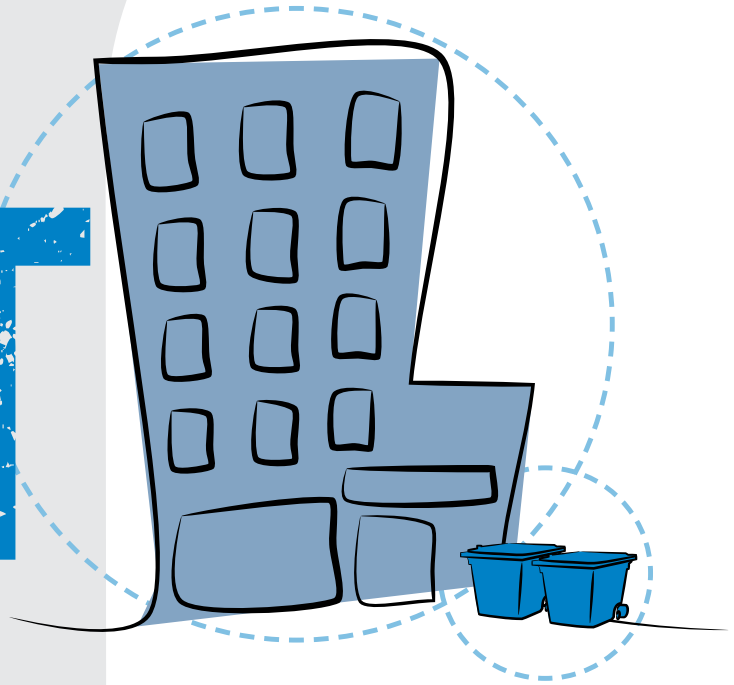
Guide
for the Implementation of
Pay-As-You-Throw Systems
for Municipal Waste

PAYT



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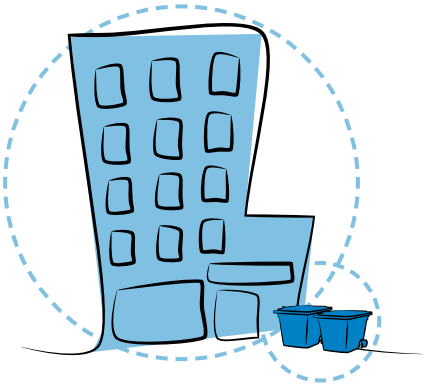


01

Introduction

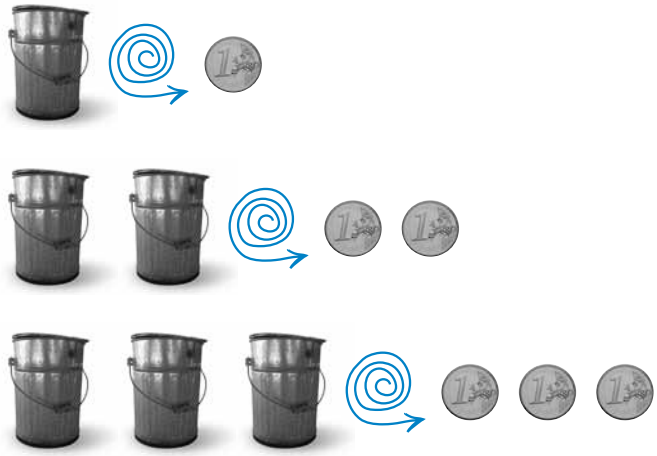
Municipal waste management is one of the key areas of municipal environmental policy and is also the item on which town councils spend most resources. Therefore, a wide range of tools needs to be used, including public investment, local regulations and communication campaigns, to obtain ever improving results in prevention and selective waste collection.

The use of tax instruments in the area of waste management is an increasingly popular option to create incentives that help to achieve better prevention and selective waste collection results, ensure appropriate allocation of waste management charges, and guarantee that tax collection is effective.

At local level, the main economic instrument that is available are waste charges. In the past, waste charges in Catalonia were conceived without incentives in mind. However, in other countries, pay-as-you-throw (PAYT) systems are commonly used. Such systems enable the real production of waste in each home or business to be calculated, and the tax is determined by the amount and type of waste that is thrown away. Thus, pay-as-you-throw systems promote waste prevention and recycling and enable the 'polluter pays' principle to be applied.

The Catalan Municipal Waste Management Programme (PROGREMIC 2007-2012) establishes as a crosscutting action 'fostering the implementation of pay-as-you-throw systems for commercial and household collection'. This is carried out through various measures, including the development of a research line and the provision of advice and training to implement PAYT in commercial and household waste collection. In line with PROGREMIC, this guide has been drawn up to provide local authorities with more information about these systems and to describe the basic steps needed for their implementation at municipal level.

It explains the main principles of PAYT schemes' operation, the steps required to implement them and the impact that they are expected to have on waste streams and on the operation of collection services. The guide also describes cases in which PAYT schemes have been deployed in Catalonia, the rest of Spain and other European countries.



02

What is pay-as-you-throw?

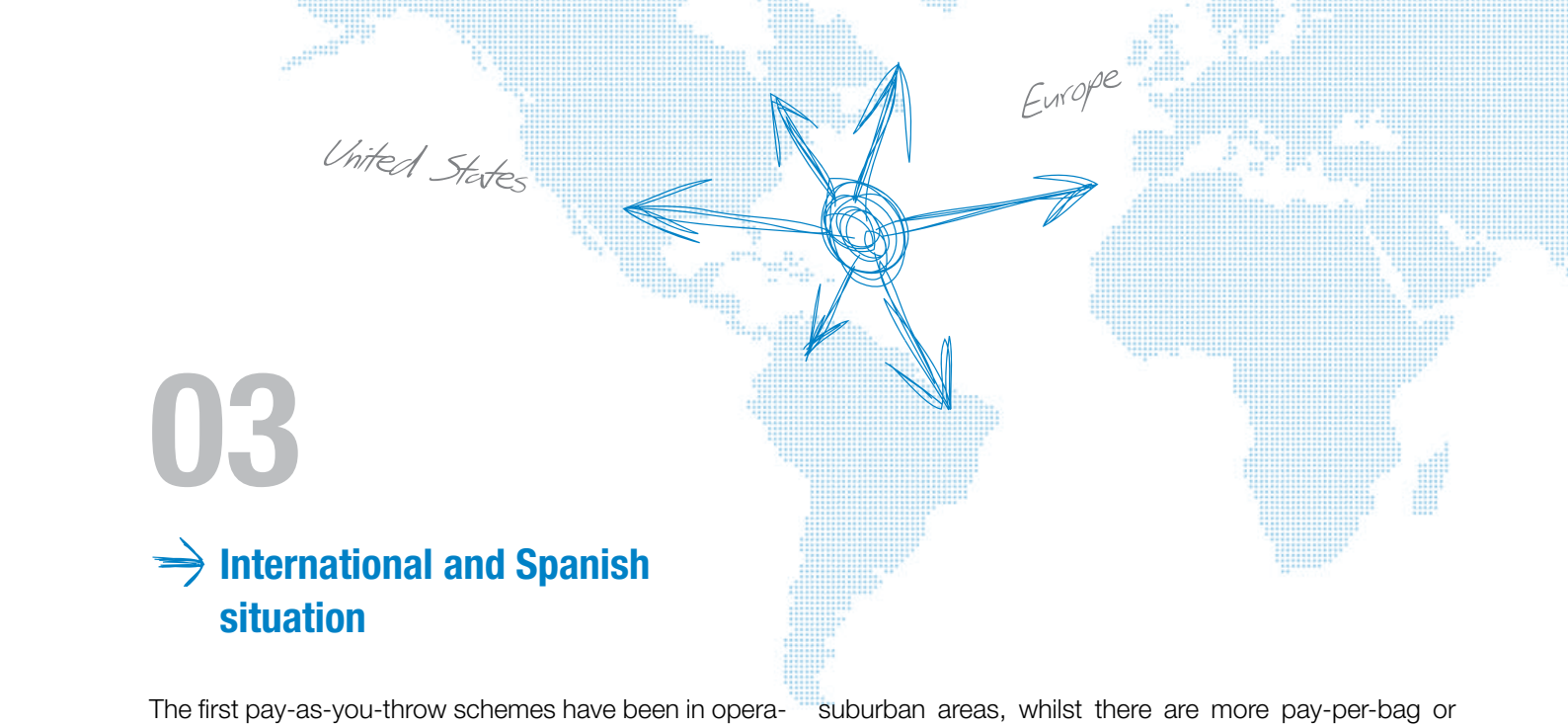
A pay-as-you-throw system is based on the application of a mechanism by which the user of the waste collection service pays a waste charge according to their real waste generation and the waste management service that is used.

Such schemes incorporate the 'polluter pays' principle into the waste charge. Consequently, residents or businesses who make an effort to reduce their waste and separate it correctly are rewarded.

Therefore, pay-as-you-throw systems encourage the participation of residents and businesses to meet waste policy objectives, through the creation of an economic incentive that consists in establishing a link between waste charge payment and the amount and type of waste that is generated.

To a great extent, this incentive is determined by selecting a taxable base, that is, the waste fraction or fractions that will be liable to charge. If a charge is put on refuse, the incentive is both to reduce waste and to participate in selective waste collection. Another option is to lay a charge on both refuse and a recyclable fraction such as packaging waste, which has a high waste reduction potential, as it may change the service user's purchasing habits. In this case, an incentive is also introduced to reduce this fraction.

users of the waste collection service pay the waste charge according to their real amount of waste generated



03

International and Spanish situation

The first pay-as-you-throw schemes have been in operation in the USA since the start of the twentieth century (Aldy et al., 2006). Such schemes became more widespread from the 1970s onwards, particularly in California, Michigan, New York and Washington. Currently, over 7,000 US towns have deployed PAYT schemes, which is almost a quarter of the total number of municipalities and population of the United States. PAYT are used in 30 of the 100 largest municipalities in the country (Skumatz, 2008). The operation of these schemes is particularly notable in large cities such as Seattle (Washington), San José (California) and Vancouver (Canada).

Subsequently, the scheme began to spread to almost all European countries. It is extremely widespread in Switzerland and the northeastern area of Germany (Reichenbach, 2004), as well as in the rest of Germany, the north of Italy, Denmark and the Netherlands. Some examples of European cities that have introduced these schemes are Berlin, Brussels, Munich, Vienna and Dublin. In most cases, PAYT has been implemented in the context of selective door-to-door collection.

In the USA, pay-per-bin with individual tally systems predominate in the largest municipalities and urban and suburban areas, whilst there are more pay-per-bag or pay-per-bin with tag systems in smaller, more rural towns (Skumatz, 2008). In Europe, the most common model is pay-per-bin, although there has been a sharp increase in the use of the chamber system (see Chapter 6.2.3), especially in densely populated areas (Reichenbach, 2008). This scheme is common in German cities, such as Dresden, Heidelberg, Hamburg, Berlin, Freiburg and Düsseldorf.

Pay-by-volume schemes have generally been used to measure the amount of waste produced, although recently pay-by-weight systems have begun to be deployed.

To date, there have only been three cases in which pay-as-you-throw schemes have been implemented for household and commercial waste in Spain: Torrelles de Llobregat (2003, subsequently withdrawn), Esporles in Majorca (2009) and Argentona (2010). There are also a few cases in which the concept of pay-as-you-throw has been applied for commercial waste only (e.g. Canet de Mar, Barcelona and towns in the county of El Pla de l'Estany). With the support of the Catalan Waste Agency, several towns in the region are carrying out feasibility studies with a view to implementation in the future.

04

Bases and types of pay-as-you-throw systems

This section includes a review of existing pay-as-you-throw systems. The schemes are described and compared and there is a preliminary consideration of the minimum requirements for establishing a pay-as-you-throw system and which taxable base is most suitable for creating the desired incentive.

4.1

Minimum requirements for establishing pay-as-you-throw schemes

The application of pay-as-you-throw is based on three main factors:

- The identification of the waste generator
- The measurement of the amount of waste generated and/or the services that are used
- Individual taxation

to measure the amount of waste that is collected, the waste generator must be identified

To measure the amount of waste that is collected, the waste generator must be identified. In door-to-door collection schemes, this can be done by identifying the bin that is used to throw the waste away. When waste is collected by means of road containers, the waste generator should be identified at the time that he/she disposes of the waste. The amount of waste produced can be measured by volume or weight. Once the waste generator has been identified and the amount of waste measured, the individual tax can be calculated.

4.2

Taxable fractions

Taxing refuse is an incentive to reduce waste and to participate in selective waste collections. Consequently, a charge should always be imposed on this fraction. However, if a charge is only put on refuse, which is a relatively small percentage of the waste that is generated, the rate of the charge for the variable part of the waste charge will have to be quite high to collect a significant proportion of the revenue, and this could lead to a high risk of fraud.

Therefore, charges should also be levied on another fraction.

The packaging fraction is that which can be reduced the most by changes in habits. It is one of the most difficult fractions to recycle, so it may be a good idea to impose a charge on it.

Organic fraction is the heaviest. However, if households were charged for this fraction, recycling could be discouraged. In addition, it is difficult to reduce organic waste. However, this is an option that should be considered for large-scale waste generators, as the volume of organic waste that is generated and the properties of its constitu-

ents mean that it has to be collected frequently, which increases the cost of the service provision. Consequently, a charge should only be levied on organic fraction at commercial level.

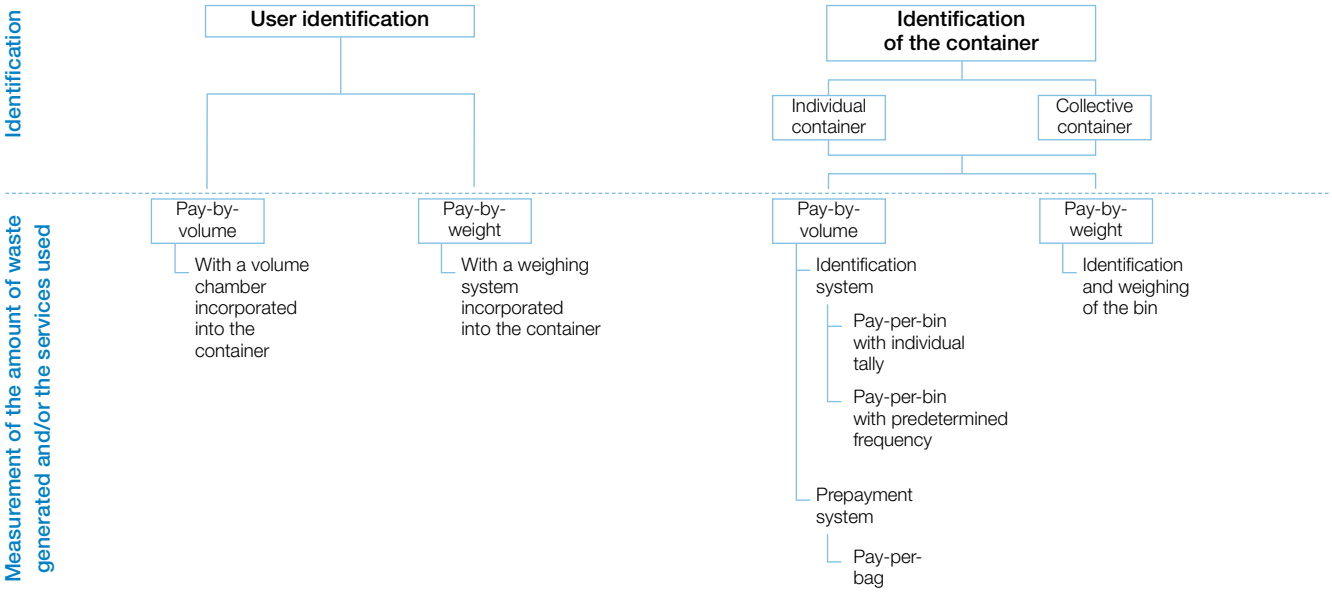
It is not advisable to levy a tax on paper, cardboard or glass, as this could discourage recycling.

4.3

Classification of the models

Taking into account the minimum requirements for establishing pay-as-you-throw schemes as described in Section 4.1, the following figure shows the main options for deploying a pay-as-you-throw system.

Figure 1. Main alternatives for implementing a pay-as-you-throw system



Source: Adapted from Reichenbach (2004).

4.4

Description of the models

Below is a short description of the pay-as-you-throw models presented in the above figure:

→ Pay-as-you-throw systems in which **the user is identified** using a magnetic card (also known as chamber systems):

- **Pay-by-volume with a volume chamber incorporated**: the container has a device that opens to allow a maximum volume of waste to be thrown away on each use, once the user has identified him/herself using a magnetic card.

- **Pay-by-weight with a weighing system incorporated into the container**: this is similar to the above system, but the bin has a weighing system installed. The weight of the waste thrown away by the user is recorded.

→ Pay-as-you-throw systems **with container identification**:

- **Pay-per-bin with individual tally**: each user or group of users is allocated a receptacle of known volume that can be identified by means of a chip or a tag. These electronic devices can be read by the collection service using equipment installed in the garbage truck (or a portable reader carried by the operator). In this system, all of the receptacles that are collected can be recorded and the tax is calculated on the basis of the number of collections. Users can choose the volume of their receptacle.

- **Pay-per-bin with predetermined frequency**: in this case, the allocated bin is collected according to a fixed schedule. Users can choose the volume of the container and/or the frequency of collection from the options offered by the town council. Unlike pay-per-bin with an individual tally, in this system the user has to decide in advance how often he/she wants a bin to be collected.

- **Identification and weighing of the bin**: the tax is determined on the basis of the weight of waste in the delivered receptacle, which has a chip or a tag — an electronic device that is detected by the garbage truck. The container's contents are weighed by a mechanism incorporated in the garbage truck.

- **Pay-per-bag**: in this case, the user pays the tax in advance, by purchasing standardized bags for disposing of waste. The collection service only accepts this kind of bag. Bags are distributed by the town council or by collaborating retailers and tend to vary depending on the waste fraction. Recyclable fractions that are taxed are generally placed in transparent or translucent bags to reduce the presence of impurities.

If we consider the waste collection methods that are currently used in Catalan towns, the most suitable pay-as-you-throw systems for implementation in the near future are those that fit the logistics of door-to-door collection. These include: pay-per-bin with an individual tally or predetermined frequency, pay-per-bag, and bin identification and weighing systems (Puig, 2008). The recent increase in the number of towns that have adopted door-to-door collection systems, which are now in operation in over 90 Catalan towns, provides an excellent opportunity to introduce pay-as-you-throw systems.

In general, when a PAYT system is introduced with door-to-door collection, the maximum number of fractions should be collected on the doorstep, to reduce the number of waste loophole options and to make the system more robust and visible.

Chamber systems are another, more complex alternative that can be used to introduce pay-as-you-throw schemes in situations where there is no door-to-door collection.

4.5

Comparison of the various models

The following table compares various characteristics of the pay-as-you-throw models described in the previous section.

Table 1. Comparison of pay-as-you-throw models

	CONTAINER IDENTIFICATION SYSTEMS				USER IDENTIFICATION SYSTEMS	
	Pay-per-bin with individual tally	Pay-per-bin with predetermined frequency	Pay-per-bag	Identification and weighing of the bin	Pay-by-volume with a volume chamber incorporated	Pay-by-weight with a weighing system incorporated into the bin
Prevention and recycling incentive	Average	Low	High	Very high	High	Very high
Technological complexity	High	Low	Low	Very high	Very high	Very high
Implementation cost	High	Average	Low	Very high	Very high	Very high
Maintenance cost	Average	Low	High	Very high	High	High
Reliability and transparency of tax calculation	High	High	High	High	High	High
Certainty of revenue	High	Very high	Average	High	Average	Average
Fraud risk	Low	Very low	Average	Low	Average	Average
Collection efficiency	High	Low	High	Low	High	High
Correspondence between volume or weight and charge	High	Average	Very high	Very high	High	Very high
Convenience for users	High	High	Average	High	Average	Average

Source: compiled by author.

4.6
The flat rate

Usually, only part of the total charge is calculated according to the amount of waste generated. This is called the variable fee. Generally, there is another part of the tax, which is known as the flat rate[1] and does not depend on waste generation. The flat rate may be the same for all taxpayers or could depend on a variable that is not related to waste. The combination of flat and variable fees guarantees a certain amount of fixed revenue and reduces uncertainty about how much tax will be collected. At the same time, the 'polluter pays' principle is applied and there is an incentive to reduce and recycle waste.

The flat rate is based on the fact that the collection service has some fixed costs. Residents are charged for the opportunity to use the waste collection service, regardless of how much waste they actually generate. Consequently, the flat rate is particularly justified in towns that have a high number of second homes, as the collection service operates regardless of the occupancy of the dwellings.

Past experiences of applying pay-as-you-throw systems and the cost structure of the service indicate the suitability of a tax comprised of a flat rate and a variable fee.

The following options can be used to determine the household flat rate:

→ Number of people: the flat rate depends on the number of people who live in a dwelling. This is calculated based on housing censuses.

→ Characteristics of the home: the flat rate depends on a feature of the home, such as the surface area, the property value, its location or the length of the facade.

→ One fee per home: the flat rate is the same for all dwellings.

Table 2. Comparison of the taxable bases for the flat rate of the household charge

	Number of people	Characteristics of the home	One fee per home
Difficulty in calculating the tax	Average	Average	Low
Cost of maintaining the system	Average	Average	Low
Correlation with the generation of waste fractions that are not included in the variable fee	High	Average-Low	Low

Source: compiled by author.

[1] This can also be called the general rate.

05

Characteristics of commercial pay-as-you-throw systems

According to PROGREMIC 2007-2012, commercial waste makes up 21% of municipal waste. This figure includes waste generated by retailers, wholesalers, hotels, bars, markets, offices and services.[2]

This is a particularly problematic fraction because of its large volume. Therefore, in some cases there is a need for separate commercial and household collection services, and for larger volume containers for collecting certain fractions.

commercial waste makes up 21% of municipal waste

5.1

Legal aspects of commercial waste

Decree 1/2009, of 21 July, approving the revised text of the Law regulating waste establishes in Article 54 that 'the person responsible for an activity that generates commercial waste must manage it, in accordance with the obligations of those who produce or have waste' and that 'they must deliver the waste that they generate or hold to an authorised waste manager for valuation, if this operation is possible, or the treatment of waste. Alternatively, they must make use of the waste collection and management system that the relevant local entity has set up for this kind of waste, including waste collection centre services'. In any case, according to Point 3.c of the same article, the commercial enterprise must 'meet the costs of managing the waste that it has or generates'. In other words, commercial taxes must fully cover the cost of the commercial collection service.

The deregulation of the service makes it easier to introduce selective collection of commercial waste. This can be carried out via a commercial door-to-door system, which is the basic requirement for implementing commercial pay-as-you-throw systems.

The penalty and control scheme for the commercial system must be clearly defined in the municipal ordinances on waste collection, which should deal with commercial waste separately.

[2] The definition was taken from Decree 1/2009, of 21 July, which approved the revised text of the Law regulating waste.

5.2

General aspects of commercial pay-as-you-throw

In areas where there is door-to-door household collection, any commercial pay-as-you-throw scheme can function correctly if it is planned and implemented well, as there are no waste loopholes (containers) on the streets. However, in household collection systems that use containers, it is important to evaluate which model is the most suitable, as not all systems will be as efficient (Álvarez and Puig, 2006) (Section 5.3).

One point of discussion in the commercial model is the flat rate of the commercial tax. This does not have to be the same for all establishments. Instead, it can vary according to some characteristics of the commercial activity, including the established commercial classification or the surface area of the premises. The classification described in the tax ordinance can be used or a new classification can be introduced.

Another key point to be decided in the commercial model is which fractions to use as the taxable base for the variable fee (Section 4.2).

The variable fee for the commercial tax, which is measured in price per litre or volume, should be the same as that used in the chargeable fractions at household level.

5.3

Pay-as-you-throw systems for commercial waste only

A large-scale commercial waste generator of one or more fractions of waste differs from a small or medium-sized waste generator in the amount or volume of waste generated. Household generation of the different fractions is usually taken as a threshold.

In a pay-as-you-throw system for commercial waste only, businesses that are not large-scale waste generators will come under the household collection and taxation system. In contrast, large-scale waste generators will be subject to the pay-as-you-throw system, with door-to-door collection.

The main problem that should be anticipated and addressed is commercial waste being disposed of at household collection points. When household waste is collected from street containers, there may be more waste loopholes than in situations with door-to-door collection systems. In such cases, commercial payment systems should involve the use of containers that are different from those used by households. Pay-per-bin with an individual tally and pay-by-weight systems identify the commercial user, which discourages fraud. Pay-per-bin with predetermined frequency does not create as many incentives to recycle and reduce waste. However, it also discourages fraud as the amount is paid in advance. In contrast, pay-per-bag systems for commercial activities only are more difficult to control and could lead to waste loopholes and illegal waste disposal in household collection containers.

06

Considerations prior to implementation

This chapter analyses technical, logistical and legal considerations for introducing a pay-as-you-throw system for municipal waste.

6.1

Technical aspects

The first step in establishing a pay-as-you-throw system for waste should be to carry out a technical study to analyse the initial situation, assess the implementation options and establish the proposed system's financial and logistical conditions. Some of the aspects that should be addressed are discussed below.

6.1.1

Determination of the pay-as-you-throw system and the measurement container

The choice of a suitable pay-as-you-throw system for a town is not univocal. Below are some guidelines to help local entities to improve their evaluation of the options.

Firstly, the choice of pay-as-you-throw system is closely linked to the choice of measurement container.

The adoption of one model or other is dependent partly on the socio-urban characteristics of each town, and particularly on the distribution of the population within the area. In any case, the basic requirement for implementing a PAYT system is the identification of the waste generator, as discussed in Chapter 4.1. There are two ways of identifying waste generators: by means of a door-to-door collection system in which it is assumed that whatever is deposited outside a dwelling belongs to its residents (identification of the container); or by a collection system using individual or group bins and user identification via a chip or card (user ID).

If the town has a door-to-door collection system, the decision to use a bag or bin is dependent on the following aspects:

the choice of pay-as-you-throw system is closely linked to the choice of measurement container

→ If there is already a specific bin for the fractions that will be taxed, this should continue to be used. An automatic identification system can be added to it.

→ If there is no specific bin, the pay-per-bag system will be the easiest and cheapest to introduce.

These are not strict criteria. If there are no existing bins, but it is considered advisable to invest in and manage a more robust model with user identified bins, this should be considered as a potential option.

In any case, a container with a specific volume should be chosen for each fraction. The volume should be linked to the generation of the particular fraction of waste, taking into account the collection frequency.

If the town has a fairly dense urban structure and the current collection system is not door-to-door, one option would be to use collective containers with user ID (known as the chamber system).

6.1.2

Establishing the fee

The new tax is divided into two main parts: a flat rate and a variable fee. The flat rate is independent of waste generation and may not be the same for all households and businesses. Instead, it could vary according to their specific characteristics. The variable fee takes into account the concept of pay-as-you-throw, as it depends on the amount and type of waste generated by each user.

Broadly speaking, the following aspects should be taken into account to establish the flat and variable fees:

→ **Expected revenue**: the waste collection tax should cover all of the service costs. Nevertheless, the town council may wish to establish a lower amount. However, the total amount of tax collected should not be altered by the new service, as any increase in costs could be erroneously attributed to the pay-as-you-throw system.

→ **Waste generation:** the generation of chargeable fractions should be estimated. The estimate will be based on the total amount of waste generated in the town before the introduction of the new system, its estimated composition and the expected levels of selective waste collection and waste reduction with the new tax system.

If the aim is to increase the total amount of waste tax collected, this change should be made before the pay-as-you-throw system is introduced, otherwise it could lead to false attributions.

If a pay-by-volume system is used, the densities of the different fractions of waste should be taken into account.

→ **Percentage of the flat rate:** the percentage of the revenue that the town council wants to raise via the flat rate of the tax are based on various criteria:

- *Relationship to fixed costs:* the flat rate can be adjusted according to the costs of the collection and treatment system that can be considered structurally fixed. It can be argued that this part must be paid by all of the municipality's inhabitants, as they have the opportunity to use the waste collection service, regardless of how much waste they actually generate.

- *Guaranteed amount of tax collected*: the flat fee that is established should ensure that the costs are covered to a certain extent. The minimum percentage of costs that should be covered with the flat rate is 40-60%.

- *Impact of the tax on selective waste collection and waste reduction:* depending on the required net effect of an increase in selective waste collection and waste reduction, the variable fee should cover a higher or lower percentage of the costs. The minimum percentage of costs that should be covered with the variable rate is 20-30%.

→ **The number and type of fractions that are subject to tax:** to establish a unit price for each of the chargeable fractions, it is essential to determine their relative importance in the achievement of the required selective waste collection and waste reduction levels. Refuse should be subject to the highest charges to discourage generation and to boost the separation of recyclables.

→ **Nappies:** it is important to decide whether these are subject to or exempt from tax. If there is no tax on nappies in door-to-door systems, they should be subtracted from the total estimated amount of trash collected in household waste. If there is no door-to-door collection (with a chamber system), it may be more difficult to separate this waste so that it is exempt from tax.

→ **Waste flows that are not taken into account to establish the fee:** in towns, some waste generated is counted as refuse but in practice is not subject to charges. This includes waste generated by the road cleaning service, trash produced in town council offices, bulky waste collected door-by-door or in containers[3] and some waste that reaches the waste collection centre. All of this waste should be subtracted from the total trash that is collected to calculate the amount.

→ **Recurrent or investment costs:** in pay-per-bag systems, the cost of bags should be included in the total amount of tax to collect. In pay-per-bin systems, the cost of software can be included in the tax as annual amortization or the initial investment can be met by the local authority and not included in the tax.

[3] In cases in which waste was collected in street bins rather than door-to-door prior to the deployment of the PAYT system.

→ **Proportionality between payment and generation:** this is the relationship between the price per litre or kilogram collected as waste generation increases. In the case of pay-per-bag, the only possible relationship is proportional so that each unit collected costs the same as the previous unit. In pay-per-bin systems, the relationship depends on the chargeable fraction. It can be proportional for the refuse, whilst a regressive tax is usually established for the commercial organic fraction[4] and packaging waste. In other words, the price per litre or kilogram collected drops as the volume of the container increases. The aim is to encourage the separation of recyclables and discourage trash generation.

6.2
Logistical aspects

This section explains the logistical requirements to deploy a pay-as-you-throw system. They are described for each of the following models:

- Pay-per-bag model
- Pay-per-bin model
- Chamber system

At the end of this section are some considerations about emergency areas and waste collection centres as complementary elements in these models.

6.2.1
Pay-per-bag model

Below, we discuss the logistical aspects that must be addressed to introduce a pay-per-bag model.

1. Characteristics of standardized bags

Table 3 lists possible characteristics of standardized bags for the various chargeable fractions and for those that are not taxed but need to be differentiated. The table was compiled on the basis of various case studies.

[4] There is usually no charge for organic fraction at household level.

Table 3. Potential characteristics of standardized bags for which there is a charge

Fraction	Recommended volume	Colour	Gauge
Chargeable fractions			
Refuse	10 – 20 litres	Red or grey	70
Commercial refuse	50 – 70 litres	Red or grey	90
Packaging waste	30 – 50 litres	Translucent yellow	70
Commercial packaging waste	90 – 110 litres	Translucent yellow	100
Fractions on which there is no tax			
Household nappies	10 – 20 litres	Translucent white or green	70

Source: compiled by author.

There should be at least two **bags for each chargeable fraction**: a small bag for households and a large bag that can be used by commercial establishments.

Businesses that do not produce high volumes of waste will not need large commercial bags and can use the household bags instead.

The town council's **emblem and/or logo** should be printed in a colour that contrasts with the colour of the bag.

The bags should have 'easy-close' systems.

The bags for recyclables and nappies **must be translucent**, so that their contents can be distinguished. This makes it easy to check that the contents belong to the right fraction and discourages people from including impurities. Refuse bags can also be translucent, although this is not essential.

There should be a low number of bags per packet (e.g. 10 units) for the chargeable fractions, to reduce the amount that the resident or commercial establishment has to

spend on each purchase. The number of units per packet does not need to be so low in the case of bags for the free factions (such as nappies).

Households may not pay a tax on nappies, but commercial establishments should. If nappy waste is free for households, the acquisition of the corresponding standardized bags should be restricted to families that really generate a considerable amount of this fraction: families with infants between 1 and 3 years old and/or adults with incontinence problems. In this case, a bag can be designed specifically for nappies, to differentiate this waste fraction from trash.

There is no tax on household organic, paper, cardboard and glass fractions. Rather than standardized bags, a bin should be used to impose a tax on the commercial organic fraction. This eliminates collection problems caused by the characteristics of this fraction.

The chapter on case studies (11) describes the pay-per-bag systems in Esporles and Argentona.

Bags should be translucent to detect impurities, particularly in the packaging and nappy fractions.

The standardized bag for refuse should be the smallest possible.

A standardized bag should be provided for nappies, to make it easier to collect this waste more frequently.

2. Purchase and storage of standardized bags

Criteria should be established for the purchase of standardized bags, and clearly stated in orders for bags. Some of these criteria are listed in Table 4.

Table 4. Criteria to consider in the purchase of standardized bags

→ 1. The precise characteristics of each type of bag should be specified in the order. These characteristics include the following: • Size (height and width) • Gauge • Made from recycled material • Colour of the bag and of the logo • Translucency • Types of closure • Units per packet or roll
→ 2. The delivery dates, place and time must be specified. If the bags are delivered in installments, the way that the order has been divided and the dates of each delivery should be indicated. A penalty should be established for late delivery.
→ 3. The way that orders are packaged and delivered should be specified: the number of bags per roll, the number of rolls per box, the number of boxes per pallet and the number of pallets. This makes it easy to check the order.
→ 4. All the products that are supplied should be guaranteed for at least one year.

Source: compiled by author.

It may be difficult to order standardized bags for quantities below a minimum number of units (which tends to be around 200,000 units). Consequently, a high number of suppliers should be contacted and there should be some flexibility in the characteristics of bags.

The bag storage area should be as secure as possible. It should either be locked with a key or controlled by one employee during the premises' opening hours.

Aspects to take into account in standardized bag orders: plenty of time should be left to find an appropriate product and the delivery details should be clearly established.

It is essential to check that the delivered product meets all of the specified requirements.

3. Distribution of standardized bags

To facilitate the introduction of the new model, a packet of each of the standardized bags should be delivered free of charge to each home and business during the communication campaign. There should be close monitoring of the free bags that are delivered. This could be carried out by the town council itself or by the Environmental Office.

- **Selection of intermediaries**

Prior to the introduction of the tax system, intermediaries should be sought to help with the distribution of bags, to increase the opening hours and the number of places where bags can be bought. The aim is to make it as easy as possible for people to participate in the scheme. As a result, local authorities will be spared the task of distribution. The most suitable intermediaries are local retailers, with whom collaboration agreements should be made. The main aspects to regulate are listed in Table 5. However, town councils can also take on the task of distributing the standardized bags.

Table 5. Aspects to include in collaboration agreements with local retailers to distribute standardized bags

→ 1. Refer to the tax ordinance for the price of the bags (the price should not be stated directly in the agreement to make it as flexible as possible).
→ 2. Regulation of bag distribution: • One day a month can be established for bag transport and delivery by the local entity. • Alternatively, or as the only method, it should be established that an order can be made at any time and the product collected by the local retailer. The minimum number of days between making an order and delivery should be established.
→ 3. Determination of situations in which the return of bags is accepted: • Defective bags. Instead of providing a refund, packets of defective bags should be exchanged for new packets. • Closing down of the shop or changing hands. The amount of money will be returned or the debt settled. • The lack of planning of certain retailers or the inability or refusal to make a payment. A certain amount of flexibility should be expected in returns from retailers that have not sold the required amounts.
→ 4. Payment by invoice should be made by transferring money into a bank account or by direct debit. The settlement periods are those determined by Act 58/17 December 2003 on General Tax.
→ 5. When there is a change in bag model and/or price, the amount should be refunded or the debt settled at all collaborating local retailers.
→ 6. Collaborating local retailers should be promoted/made visible by means of a tag and/or communication campaigns.

Source: compiled by author.

- **Determining the commission for intermediaries**

Bag distributing retailers should be identified by a distinctive tag and should advertise their involvement. However, there is no need for collaborating local retailers to have a profit margin on the bags. The fact that they sell the standardized bags attracts people to the shop, which acts as compensation.

- **There is no VAT on bag distribution.**

VAT is not applied to the standardized bags, as they are a vehicle for paying taxes. The retailers are only intermediaries in the tax collection; they are not buying or selling the product. If the commercial waste collection service has a public price, then VAT will be applied.

Packets of standardized bags for chargeable fractions should be handed out free of charge during the communication campaign.

Collaborating local retailers should not receive commission for distributing standardized bags.

- **Approval of the agreement**

If the agreement refers to a specific tax ordinance, it cannot be implemented until the ordinance has been approved. In addition, the agreement must be signed by both parties before it can be applied.

- **Receipt for bag purchases**

Finally, some people and/or commercial activities may require a receipt of payment of the variable part of the tax. Therefore, collaborating local retailers should be provided with a model of a bag purchase receipt to be given on request.

6.2.2
Pay-per-bin model

In the pay-per-bin model, the unit of measure is the bin. Bins are fitted with a tag, chip or nothing, depending on whether the chosen model is container identification or predetermined frequency. Table 6 lists the recommended bin sizes for each chargeable fraction as well as some other characteristics.

Table 6. Possible characteristics of standardized bags

Fraction	Volume	Colour	Pedal[1]
Refuse	10, 25, 40, 60, 90, 120, 240 and 660 litres	Light or dark grey	No
Packaging waste	25, 40, 60, 90, 120, 240 and 660 litres	Yellow	No
Organic fraction	10, 25, 40, 90, 120, 240 and 660 litres	Light or dark brown	Yes[1]

[1] Except for the smallest sizes (10 and 25 litres), in which a pedal cannot be incorporated.
Source: compiled by author.

The low volumes are for households, small businesses, or medium-sized waste generators.

No charge is imposed on the paper, cardboard and glass fractions. Chapter 4.2 explains why certain fractions are taxed.

Household nappies should be collected in a standardized bag, as in pay-per-bag schemes (Section 6.2.1).

In pay-by-volume systems, the wider the range of available volumes, the closer the relationship will be between generation and the waste tax. In pay-by-weight systems, the identification and weighing of the container are more important than the correct allocation of bin volume.

For households, the adoption of either a container identification or predetermined frequency system will depend mainly on the type of chargeable fraction. To encourage

in the pay-per-bin model, the measure is the bin, whether it is with a tag, chip or without identification

selective waste collection, a tax should be imposed on the volume of organic waste, rather than the frequency of collection. For the refuse (and the packaging waste, if applicable) the choice of model will depend on:

→ The investment that the council wishes to make. Container identification models require a greater investment.

→ The likelihood of waste loopholes. Systems in which only two fractions (organic and refuse) are collected door-to-door have a greater likelihood of waste loopholes. Container identification models enable greater control of each user's waste generation and lead to less waste loopholes.

→ The closeness of the relationship between payment and generation. Pay-by-weight systems are more accurate than pay-by-volume, and user identification is more precise than predetermined frequency.

Containers can be identified by chips fitted in the bin or by tags (a metal label with barcodes) attached to it. Chips or tags also contain user information. The device for detecting or reading these identifying elements for households and/or businesses can be installed in the garbage truck, with an antenna for reading data at a distance. Alternatively, devices can be hand-held by the operator. To manage and analyse data, all garbage trucks should be fitted with a PC and specific software. Another PC at the base should have the software installed to store and process the data.

A **database** must be created during the communication campaign with the following information for both the predetermined frequency and the container identification systems:

- → Name of the property owner/name of business for tax purposes
- → Tax ID number/company ID number
- → Household address/tax address and real address of the business
- → Bin units and volume for each fraction

If a container identification system needs to be installed, a specialised company should be contacted to do the work. The minimum criteria to be considered in awarding the contract are shown in Table 7.

In a pay-per-bin with predetermined frequency system, the greater the range of volumes, the closer the relationship between payment and generation.

Table 7. Aspects to consider in awarding a contract for the user ID service in a pay-per-bin scheme at household and/or commercial level

→ Regarding **the bins**: • The volume and estimated total number of units must be specified. • The kind of identification (chip or tag) and all the respective accessories should be defined.
→ Regarding **the equipment for the identification service**: • An independent reader must be connected to the on-board computer and an antenna should be incorporated in the bin lift and/or a handheld device provided (the minimum required detection distance between the antenna or handheld device and the bin should be specified). • The addition of a push-button system to facilitate the recording of incidents should be considered. • In addition to complying with regulations, the company should have certification and authorisation.
→ Regarding **software**: • The software must allow data management to generate statistics, plan routes, visualize street plans, etc. • It should be installed in the local authority's and the collection company's offices.
→ Some additional aspects should be defined: • Guarantees of data integrity and security must be obtained. • Staff from the local authority and the collection company must be trained and coordinated. • The deadline for installing the software should be established, as well as the price and the return conditions in the guarantee. • The total amount must include maintenance and resolution of incidents for at least a one-year period. • A test period should be requested in which the company that has won the contract will monitor and control the new collection system. • In the contract, the type of software license acquisition should be specified: purchase or online management.

Source: compiled by author.

the chamber system can be introduced in addition to other pay-as-you-throw systems, to adapt to the characteristics of the urban development

6.2.3
Chamber system

In this model, the user has an ID card or key that he/she uses to access the containers. Once the user has been identified, the bin measures the volume or weight of the waste, depending on the type of system.

A chamber system can be incorporated in self-compactors, pneumatic collection drop-off points or municipal waste collection containers.

The following decisions should be taken:

- Select the chargeable fractions.
- Choose which unit of measure will be used: volume or weight.
- Decide how many chamber units the town needs, according to the current organization of urban development.
- Identify the most suitable place for the units.
- Choose the data transfer method. The two options are:
  - Management software and a PDA to download data.
  - Using a GSM modem that automatically downloads data. This includes a modem for the chamber containers, a modem in the office and the communications management software.

User identification systems only need to be installed in the bins for chargeable fractions. The collection of the other fractions can continue in the same way, but may be a potential point for chargeable waste to escape.

In Europe, various systems have been implemented, but a tax tends to be imposed on trash and organic fraction. Bins for chargeable fractions tend to be placed within clearly marked areas, with uncontrolled access. Commercial establishments are normally not included in these systems.

The chamber system can be introduced in addition to other pay-as-you-throw systems, to adapt to the characteristics of the urban development. For example, this combination could be used when there are large blocks of flats in a town that has a mainly horizontal structure.

Emergency areas may become a waste loophole point. Different solutions should be adopted to reduce this risk.

6.2.4

Emergency areas and waste collection centre

Emergency areas are usually provided in door-to-door collection systems. These are places with containers for all fractions that are designed to deal with occasional situations in which the collection schedule is insufficient. During the implementation of pay-as-you-throw (PAYT) systems, it should be taken into account that emergency areas are potential points for waste loopholes.

→ The best option, but also the most drastic, would be to remove all of the emergency areas so that the waste collection centre is the only place that waste can be deposited outside of the normal collection schedule.

→ Another option would be to reduce the number of emergency areas and make the following changes to remaining ones:

- Remove the containers for the chargeable fractions.
- Install CCTV cameras.
- Fence off the area and introduce a user identification system to control access.

In all cases, the **waste collection centre** will act as a recycling point during its opening hours, which should be as long as possible. Nevertheless, the required steps should be undertaken to accept refuse and organic fraction. Access should be controlled for chargeable fractions, depending on the selected model.

In the case of pay-per-bag, it is important to check that the chargeable fractions are thrown away in the correct standardized bag. In addition, the waste collection centre could be a point of sale for standardized bags. In the case of pay-per-bin, it is essential to introduce a way of collecting payment for chargeable fractions that are brought to the waste collection centre.

6.3

Legal considerations

Waste management is regulated at regional level in Catalonia mainly by Legislative Decree 1/2009, of 21 July, approving the revised text of the Law regulating waste; and at state level by Law 10/98, of 21 April, on waste, which states that 'public administrations in the area of their respective jurisdictions can establish appropriate economic, financial and tax measures for promoting prevention […], reuse and recycling and other forms of waste recovery' (Art. 25).

waste management is regulated at regional level mainly by Legislative Decree 1/2009, of 21 July

At local level, the main economic instrument is clearly the waste charge, which is regulated by tax ordinances. Royal Legislative Decree 2/2004, of 5 March, approving the revised text of the Law regulating local tax offices (Art. 20.4.s) states that a charge can be imposed on waste collection and treatment services. No special characteristics are envisaged that distinguish this from the rest of the charges.

To introduce pay-as-you-throw systems, the tax ordinance regulating waste charges needs to be modified to include the characteristics of the new charge.

In addition, a legal framework is required to regulate the principles of the new system. This can be achieved by adapting (or creating) the ordinance regulating municipal waste. Aspects to be regulated include: the way that households and businesses dispose of waste and the rights and duties of residents, commercial establishments and the local authority. The ordinance should also include a legal framework for sanctions.

The two ordinances should be complementary and consistent.

The schedule needed to process and approve each of them should be taken into account. Normally, at least 4 months are required for final approval of municipal ordinances and 3 months for tax ordinances, although these periods may vary depending on the municipality.

It is extremely important that tax and municipal ordinances on waste are consistent and complementary. The prescribed time limits for their final approval must be taken into account.

07

Stages of implementation of pay-as-you-throw systems

The process of implementing a PAYT system should be based on completing various stages of a technical, participative, logistic and communicative nature, among others. In this chapter, we describe the stages of participation, communication, monitoring and control, and present a schedule for them.

7.1

Participation stage

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.

In this process, consensus should be sought, as far as possible, on the implementation of a pay-as-you-throw system. It should be ensured that the system meets established objectives of waste reduction and selective waste collection. Fears must be assuaged regarding illegal waste disposal and the perception that the introduction of the system will lead to higher taxes, and natural resistance to any kind of change of system should be overcome.

Public participation will enable decision makers to find out more about residents' waste management needs and will provide contributions that help them to design a tax that is acceptable to the users.

Common activities are **participation forums**, which are held to promote discussion and reflection on the new system that will be implemented. Various key groups in the town should be encouraged to play an active role in these forums. The following groups should be represented in the process:

- Political leaders, technicians and municipal associations, among others (the so-called 'working party').
- The town's commercial establishments and activities.
- The residents, who are the target of efforts in the areas of education and recreation.

The participative sessions can be divided into stages (Table 8).

public participation will enable decision makers to find out more about the residents' waste management needs

Table 8. Proposal for a three-stage participation process with the involvement of three key groups from the town

Stage / Group	Working party	Commercial establishments	Residents
STAGE I	Forum - evaluation workshop		Educational and recreational activities on waste
STAGE II	Forum - proposals workshop		File containing reflections and practical exercises
STAGE III	Evaluation and monitoring		

Source: compiled by author on the basis of the participation model used in Argentona.

Stage I: evaluation is aimed purely at providing information about the current waste collection model and gathering opinions—criticisms, positive aspects and shortfalls of the system. This stage could involve a workshop for the working party and the commercial establishments, and recreational activities on waste for the general public.

Stage II: proposals provide information on the new model. Feedback is obtained from the various working groups to redefine some aspects of the model. For the working party and the commercial establishments, this could take the form of workshops-discussions. For the residents, a file could be produced containing reflections on the new model and some practical exercises for calculating the new tax.

Finally, Stage III: 'close of the process' is when the conclusions and proposals for incorporation in the new system are presented.

The participation sessions should be carried out with the support of the experts who designed the system, who understand the technical aspects of the chosen model.

Subsequently, when all of the aspects have been fully defined, a communication campaign should be designed (see the following section).

A physical or telephone information point should be set up during the communication stage and the first few months of monitoring.

7.2
Communication stage

The communication stage is essential to transmit information about the operation of the new waste tax system. This section provides information about the main messages to transmit, the actions to be carried out, and the communication materials that are required. Finally, a budget (in units) is presented for the various items.

7.2.1
Initial aspects and important messages for the communication campaign

Below is a list of issues to take into account before carrying out a communication campaign and some aspects that should be stressed in particular during the campaign.

→ Dialogue with residents should be an interactive process in which there is a flow of information to let people know about the changes brought about by the new system, to respond to questions, and to receive contributions. A permanent physical or telephone information point should be established.

→ Information should be provided on the environmental, economic and social impacts of waste management.

→ Users should not associate the implementation of the pay-as-you-throw system with an increase in charge collection. Therefore, the calculation of the charges must be transparent. In terms of economic activities, the legal requirement of self-financing must be highlighted (see Chapter 5).

→ The reasons why a tax is imposed on some fractions and not on others and the amounts for each fraction should be clearly explained.

→ It should be stressed that the new system is fairer, as it applies the 'polluter pays' principle and residents have the opportunity to reduce the amount of waste charge they pay by making an effort to reduce and recycle.

→ Some pay-as-you-throw systems could be considered an added cost for residents who do not currently pay a tax, like most renters.

→ A distinction should be made between household and commercial waste generators: some communication tasks should be aimed at commercial and industrial activities, particularly those that lead to considerable waste generation.

→ All groups should be involved in waste management: politicians, civil servants, residents, residents with special needs, shopkeepers' associations, local and regional entities and schools, among others.

7.2.2

Steps to follow during the communication stage

The procedure to follow during the campaign will vary depending on the pay-as-you-throw model selected for households and businesses, but the main steps are shown in Table 9.

Table 9. Actions to carry out in a communication campaign for a pay-as-you-throw system

AT A GENERAL LEVEL
→ Announcements should be made in local media.
→ Articles should be published in the local press that describe some aspects of waste management (e.g. service costs, selective waste collection results, etc.).
→ A direct and permanent point of communication (either face-to-face or by telephone) should be established for residents and commercial establishments.
Pay-per-bin model → Households and businesses should be asked what size bin they need for each fraction (if they are given more than one option) and the bins should be delivered.
Pay-per-bag model → Households and businesses should be given a list of the town's points of sale of standardized bags. → All families and businesses should be given a free packet of standardized bags for the chargeable fractions for the reasons discussed in Point 3 of Section 6.2.1.
Chamber system → ID cards or transponders should be distributed to residents and commercial establishments so that they can access the bins.
AT HOUSEHOLD LEVEL
→ Explanatory meetings should be held for households in different areas of the town. It may also be useful to hold some workshops in schools.
→ Information stalls can be set up in key places in the town at the busiest times and on the busiest days (e.g. market day and Saturdays).
→ Mails should be sent with timely, relevant information about the new system.
AT COMMERCIAL LEVEL
→ Meetings should be held with the town's commercial establishments. These could be organized by the trade association, if one exists.
→ Door-to-door visits should be made to all commercial establishments to explain the new waste charge system. If required by the system, the collection container or the ID card can be handed over during this visit.

Source: compiled by author.

7.2.3

Communication materials

The publicity materials should include graphs or other visual means to highlight the information. Normally, this material is divided into two parts: one for general information and one for more specific information, which clearly explains all aspects of the new system, including:

- → The service schedule and information about the collection method.
- → The types of services provided.
- → The charge payment methods.
- → The ways of acquiring the required items (bins, bags and ID cards, among others).
- → Practical examples of how to calculate the charge, with clear explanations of the calculation method so that everyone can apply it to their case.
- → The sanctions that are envisaged for failure to comply.

Additional information can be included, such as advice on how to reduce waste.

Chapter 11 on case studies includes images of the leaflets published for services in Catalonia and the Balearic Islands.

7.2.4

Estimated budget for the communication campaign

The budget for the communication campaign should include the following items:

→ **Campaign coordinating staff**: responsible for leading and reviewing the planned communication activities.

→ **Campaign information providers**: work on the ground, informing the various groups using the methods described in the previous section.

→ **Design, publication and printing of communication materials**: this includes the publication of leaflets, pamphlets, magnets, posters, etc., for dwellings and commercial establishments and may include more visible materials for the streets, such as placards and banners. These materials should have the same design as those produced previously by the town.

→ **Design, publication and printing of materials for monitoring**: the main material for monitoring is the tag used in inspections, which is stuck to bags and/or bins that have been left out incorrectly in door-to-door collections. The tag contains information on why the bag and/or bin contents have not been collected. This material is not required in chamber systems.

Table 10 provides information about the required amounts and the unit costs of each of the above items.

Table 10. Units required and amounts per unit for communication campaign resources and materials

Item	Required units (unit/inhabitant)	Approximate amount per unit (€/unit)
Coordinating staff[1]	0.01 – 0.04 h/inhabitant	35
Information providers[1]	0.06 – 0.18 h/inhabitant	24
Informative leaflets[2]	1.2 units/dwelling[3]	0.14 – 0.60 (2,000 units) 0.12 – 0.40 (5,000 units)
Posters[2]	1.2 units/commercial establishment	0.26 – 2.0 (1,000 - 50 units)
Placards[2]	1 – 3	€60 – 100 (100 x 70 cm poster) €200 – 400 (3.5 x 1.1 m placard)
Inspection tags[2]	3 units/dwelling	0.02 – 0.08 (10,000 – 500 units)

[1] The number of hours needed per inhabitants depends on the size of the town, as economies of scale will apply. The levels given could generally be valid for towns of 500 to 50,000 inhabitants.

[2] The amount depends on various factors: print runs, inks, paper weight, paper type, etc.

[3] It is advisable to print an extra 20% of pamphlets, so that there is a stock available for new residents.
Note: the prices are without VAT.
Source: compiled by author.

7.3
Test stage

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.

The recommended duration of this stage is from two to three months, which is long enough for people to get used to the system, but short enough to not have to carry out another intense communication campaign.

7.4
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.

In the first few weeks of system operation, incidents detected during waste collection should be monitored on a daily basis (for example, waste that is disposed of incorrectly). This process should consist of monitoring the garbage trucks' collection, gathering and dealing with users' complaints, and analysing data (the number of bags and bins collected, the correct and incorrect units, the weight of the different fractions, etc.).

As part of this process, it may be effective to visit commercial establishments and households that are not participating in the model.

If behaviour is detected that is not permitted by the ordinance, the offender should be informed and notified that a penalty will be applied if the infraction is repeated.

In general, a four-month monitoring period is proposed from the time of implementation, whose intensity will decrease progressively. The estimated staff costs for monitoring tasks are detailed in Table 15.

In addition, residents should be periodically informed of the results achieved with the new system. The dissemination of results should stress the benefits of implementing the new system, including a reduction of waste sent to landfill or to the incinerator and an increase in recycling. The monitoring of illegal waste disposal should also be publicised. It is important to highlight ideas and/or methods for reducing waste.

7.5
Implementation schedule

Once the various implementation stages have been described, a timeline needs to be drawn up (Table 11) and justified. A suitable implementation schedule is proposed that coincides with the start of the tax year (January). This is the most common and recommended schedule.

Prior to the implementation of the system, a technical study should be drawn up. Based on an assessment of the characteristics of the town and an analysis of the existing waste management model, the study will propose the most suitable pay-as-you-throw scheme for the town and will describe the technical characteristics. The technical study should be carried out in advance and may take 4-6 months.

Table 11. Timeline for the stages in the implementation of a pay-as-you-throw system for municipal waste

Stage	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April
Participation stage														
Creation and approval of ordinances														
Logistical aspects														
Design and purchase of bags **(pay-per-bag model)**														
Establishment of the bag distribution agreement **(pay-per-bag model)**														
Purchase of bins and/or containers **(pay-per-bin model)**														
Contracting and installation of software for identifying the container/user **(pay-per-bin model or chamber system)**														
Adaptation of emergency areas and waste collection centre														
Communication campaign														
Test stage														
Tax implementation														
Monitoring and control														

Note: hatched areas refer to the test stage, if carried out.
Source: compiled by author.

08

Economic aspects associated with implementation

The following aspects should be taken into account in the proposed stages:

- In the participation stage, technical aspects may end up being modified. Therefore, this stage should be carried out long enough in advance to be able to introduce any subsequent changes.

- The legal procedures to approve the ordinances should be started long enough in advance.

- Most of the logistical aspects should be resolved before the communication campaign begins. However, at the same time, the specification of any remaining aspects should be completed.

- The communication campaign should be started one or two months before implementation, but not any earlier, otherwise its impact will be diminished. It should continue until implementation begins.

- A test stage can help the development of logistical aspects and the progress of the communication campaign. However, it can also interfere with progress in the participation stage.

- The start of implementation should coincide with the beginning of the year (January) for fiscal purposes. Nevertheless, this does not always have to be the case. Tax ordinances will need to be adapted if the start of the tax year and implementation do not coincide.

- The monitoring and control stage directly follows implementation.

This section presents an economic analysis of various items related to the implementation of a pay-as-you-throw system.

The costs are divided into initial and investment costs, and maintenance costs.

- **Initial and investment costs**

The following presents a breakdown of the costs (in units) of each of the pay-as-you-throw schemes (tables 12, 13 and 14 for pay-per-bin, per-bag and chamber systems, respectively).

Also estimated are the amounts and units required for items that are common to all the models, including staff, adaptation of emergency areas and others (Table 15). Although these items are dealt with for all three models together, the requirements vary depending on the model.

The unit amounts for the communication campaign were given in Table 10.

Table 12. Units and approximate prices per unit for implementing a pay-per-bin model

Item	Required units	Approximate price per unit (€/unit)
Bins/containers[1]		
Bin 25 litres	1 unit/inhabitant	18
Bin 40 litres	1 unit/ commercial LG	40
Bin 60 litres	1 unit/commercial LG	46
Bin 90 litres	1 unit/ commercial LG	48
Bin 120 litres	1 unit/ commercial LG	52
Bin 240 litres	1 unit/ commercial LG	61
Container 700 litres	1 unit/ commercial LG	170
Vehicle equipment		
Modem	1 unit/garbage truck	600 - 900
Automatic identification system	1 unit/garbage truck	4,500 - 5,600
On-board computer	1 unit/garbage truck	2,900 - 3,700
Push-button control	1 unit/garbage truck	650
Bin/container equipment[2]		
Chip	1 unit/inhabitant or commercial establishment	3.00 - 3.75
Identifying tag	1 unit/inhabitant or commercial establishment	0.20 - 0.25
Tool for installing chips	1 unit	90 - 110
Office software		
Collection management software	1 unit	6,200 - 7,750
Software license	1 unit	4,600 - 5,800
Equipment installation		
Installation and fine-tuning of machinery[3]	1 unit/garbage truck	480 - 600
Software installation[4]	1 unit	2,500

[1] Commercial establishments will choose a specific container for each chargeable fraction, according to their needs.

[2] This is the model with a chip, rather than the model with a tag (an identifying label with a barcode). The tag is not as robust (it is easier to remove), but it is cheaper.

[3] Includes operator training.

[4] Includes training of specialists and information providers from the town council.
Note: LG = large-scale waste generator.
Note: prices in euros for 2010 without VAT.
Source: compiled by author.

Table 13. Units and approximate prices per unit for implementing a pay-per-bag model

Item	Required units	Approximate price per unit (€/unit)
Standardized bag for household refuse (10-20 litres)[1]	The number of bags required per inhabitant per year will depend on several factors: total waste generation, expected % of selective waste collection, expected waste reduction results. A safety margin should be applied.	0.02 – 0.03[2]
Standardized bag for household packaging waste (30-40 litres)[1]		0.03 – 0.04[2]
Standardized bag for commercial refuse (60-70 litres)[1]		0.05 – 0.06[3]
Standardized bag for commercial packaging waste (90-100 litres)[1]		0.075 – 0.09[3]
Standardized bag for household nappies (10-20 litres)[4]	This depends on the number of homes with infants between 1 and 3 years old and adults with incontinence problems. It also depends on the collection frequency.	0.02 – 0.03[2]

[1] Standardized bags must have an identifying logo and should be easy to close.

[2] These are amounts for a minimum order of 250,000 units.

[3] These are amounts for a minimum order of 200,000 units.
Note: prices in euros for 2010 without VAT.
Source: compiled by author.

Table 14. Units and approximate prices per unit for implementing a chamber system

Item	Required units	Approximate price per unit (€/unit)
Collective container with user identification	1 unit/block or area (100 inhabitants)	3,500 - 4,050[1]
Option 1: PDA for downloading data + software	1 unit	4,170 - 5,050
Option 2: GPS modem	1 unit	5,870
Installation	1 unit	1,600
ID card (*key code transponder*)	1 unit/resident	4 - 4.7

Note: prices in euros for 2010 without VAT.

[1] This is the unit price per bin.
Source: compiled by author.

Table 15. Units and approximate prices per unit for common items in the implementation: staff, emergency areas and others

Item	Required units	Approximate price per unit (€/unit)
STAFF[1]		
Implementation coordinator	0.01 – 0.04 h/inhabitant	49
Technician for the implementation	0.02 – 0.15 h/inhabitant	35
Monitoring and inspection staff	0.06 – 0.3 h/inhabitant	21
EMERGENCY AREAS		
CCTV camera[2]	1 unit/area	2,550
Fence	1 unit/area	3,500
Access control[3]	1 unit/area	3,600
ID card for access control	1 unit/inhabitant	4 – 4.7
SPECIAL CASES		
Bins with keys for multifamily blocks (120 – 240 litres)	1 unit/block	160 – 180

[1] Levels are provided for towns of 500 to 50,000 inhabitants.

[2] A low voltage connection is required on the site.

[3] Includes hours required for the installation.
Note: prices in euros for 2010 without VAT.
Source: compiled by author.

the communication campaign should start one or two months before implementation

09

Potential impact on waste streams

System operating costs

Once the system has been established, the main monitoring and maintenance costs will be associated with staff and the purchase or replacement of materials and resources. The recurrent costs will depend on the pay-as-you-throw scheme that is implemented.

In **pay-per-bag** schemes, the staff costs may be higher than in the other models. Town council staff will be needed to work on the logistics of distributing standardized bags to collaborating local retailers and on closer monitoring of incidents. Another recurrent cost of this scheme will be the purchase of standardized bags.

The specific recurrent costs in the **pay-per-bin** model will be limited to the maintenance and replacement of bins[5] for chargeable fractions with their corresponding chips or tags, as well as software updates. The additional time required to read bin chips or tags is negligible compared to existing door-to-door collection systems.

Finally, in the **chamber system**, there are considerable maintenance costs for containers, user identification software, and data transfer to a central computer.

The use of pay-as-you-throw systems creates incentives for people to reduce and recycle waste.

As the highest tax tends to be put on refuse, the main incentive is to reduce this fraction either by sorting more waste for selective collection or by reducing the total amount of waste that is produced. The imposition of a tax on some of the recyclable fractions also encourages their stabilization and/or reduction.

Table 16 qualitatively shows the general effects of implementing a hypothetical pay-as-you-throw system on waste streams. This system involves selective door-to-door collection, with a tax on refuse and packaging waste at household and commercial level, as well as a tax on the organic fraction at commercial level.

[5] Annual replacement of around 15% of the bins is considered necessary.

charging for some of the recyclable fractions also promotes their stabilization and/or reduction

Table 16. Expected changes in waste streams as a result of implementing a pay-as-you-throw system

Fraction	Expected trend
Refuse collected door-to-door	Tends to diminish
Refuse collected in monitored emergency areas	Tends to disappear if bins for chargeable fractions are removed from emergency areas
Packaging waste collected door-to-door	Tends to diminish
Packaging waste collected in emergency areas	Tends to disappear if bins for chargeable fractions are removed from emergency areas
Percentage of selective waste collection of fractions collected door-to-door	Tends to increase for fractions that are not taxed
Commercial organic fraction collected door-to-door	Tends to increase and contains fewer impurities
Bulky waste collected	Tends to increase
Household composting	Negligible, unless specific tax benefits are provided
Deliveries to the waste collection centre	Tend to increase
Waste collected in emergency areas	Tends to decrease if the number of emergency areas is reduced and containers for chargeable fractions are removed from them
Illegal waste disposal	Tends to increase but depends on the model adopted, the services offered and the implementation of sanctions.

Source: adapted from Reichenbach (2004).

Quantitative estimates of these changes in streams are needed to calculate the waste tax, as they lead to a variation in costs and revenue from waste management. This should be taken into account in assessments of the feasibility of implementing schemes.

From the outset, we can state that a decrease in waste generation and an increase in selective waste collection lead to lower waste treatment costs and lower taxes for landfills and incineration of waste, as well as greater revenue from tax returns, integrated management systems and the sale of collected paper. In contrast, a rise in the collection of organic waste will increase the costs of treating this fraction.

The magnitude of the effects may be highly variable, and will depend on the town's initial situation, the selected model and other aspects.

Door-to-door collection systems obtain levels of selective waste collection of around 65-85%,[6] and pay-as-you-throw systems help to increase these levels slightly. Door-to-door collection systems can also reduce waste generation by 5-20%[7], particularly due to regularization of streams that were collected incorrectly as municipal waste. Pay-as-you-throw systems also reinforce these results and contribute in particular to promoting changes in habits, leading to consumption patterns that generate less waste.

In some cases, there is no existing door-to-door selective waste collection scheme prior to implementation of the new tax system. Consequently, if the new scheme requires door-to-door selective waste collection, both systems can be implemented at the same time, or not. If both systems are implemented at the same time:

→ The population perceives a more abrupt change in habits.

→ Levels of fraud or illegal waste disposal tend to be higher.

→ The message of the new tax system could be hidden by the logistics of the new collection system.

Therefore, although joint implementation leads to savings, it is generally advisable to carry out the implementation in two stages.

As mentioned above, pay-as-you-throw systems can also be implemented using a chamber system, which does not require door-to-door collection. This leads to similar results to those given in Table 16, excluding the emergency areas, which will not exist. There may be more illegal waste disposal in bins for fractions that are not taxed, for which no user ID is needed.

[6] According to door-to-door collection experiences in Catalonia (Puig et al., 2008).

[7] According to results for Catalan towns with door-to-door collection systems.

antisocial and fraudulent behaviour may also appear, including illegal waste disposal in bins and dumping in places that are not permitted

10

Fraudulent uses of the system and proposals for action

The incentive created by the new tax leads to positive changes in the habits of most residents. Nevertheless, antisocial and fraudulent behaviour can also appear. This behaviour includes **illegal waste disposal** in bins and/or places that are not permitted, **waste tourism** (disposal of waste in neighbouring towns) or mixing waste in other fractions (which leads to an **increase in impurities**). All of this behaviour has the same aim: to avoid or reduce payment of the tax.

Potential antisocial behaviour tends to be the main argument against the implementation of a pay-as-you-throw system. Consequently, particular attention should be paid to this area.

The magnitude of these problems varies according to the risk of fraud in the implemented pay-as-you-throw scheme (Table 1). In some cases, measures can be adopted that prevent or partially eliminate the problem:

→ **Household collection of nappies**: if household nappy waste is not taxed, bags of nappies that are collected door-to-door may contain other waste that does not belong to this fraction. To avoid this, white translucent standardized bags should be used so that the content can be identified more easily.

→ **Delivery areas**: the coexistence of roadside containers and pay-as-you-throw systems with separate door-to-door collection is risky, particularly in container identification systems. To reduce illegal waste disposal, various actions are possible:

- Collect as many fractions as possible door-to-door.
- Collect door-to-door in as much of the town as possible.
- In parts of the town that do not have a door-to-door service, locate delivery areas in the most inaccessible places, rather than in busy streets.
- Use locked bins in places where the dwellings are spread out and door-to-door collection is not justified.

→ **Emergency areas**: these will also be a point of waste loopholes in the system. To reduce illegal waste disposal, the options specified in Section 6.2.4 have been proposed.

→ **Second homes**: these can be a source of waste tourism and/or illegal waste disposal if the schedule for door-to-door collection does not enable all the fractions that are collected door-to-door to be taken at the weekend. The only solution is to change the

collection schedule to increase the fractions that are taken at the weekend and/or provide long opening hours at the town waste collection centre.

This problem does not affect chamber systems.

→ **Containers in public roads with uncontrolled access**: in door-to-door collection systems, the most common model involves four fractions. Glass is collected in containers on public roads. These can be potential waste loophole points. If the number of roadside containers is well established, the only action is to install signs indicating that sanctions are applied.
The same situation applies to containers for fractions that are not taxed in the chamber system. These bins would be a waste loophole point that is difficult to eliminate.

→ **Litter bin**: these will remain on the streets and can also become waste loophole points. Signs should state that illegal waste disposal is an infraction. In turn, monitoring should be increased and the number of litter bins reduced.

→ **Waste tourism**: the location of specific containers should be discussed with neighbouring municipalities.

In addition, a series of measures are proposed to prevent these problems in general:

→ **Creation of a suitable legal framework**: prior to the introduction of a pay-as-you-throw system, a municipal ordinance must be approved that makes it easier to take active measures against illegal waste disposal. The types of sanctions should be defined in detail and they should be applied strictly and in an exemplary way.

→ **Rapid clean-up of points with illegal waste disposal**: when an illegal waste disposal site appears, it attracts more illegal dumping. To prevent this, action must be taken quickly after the detection of such sites.

→ **Residents' information**: residents must be provided with information continuously, taking into account the social reality of the town. The publication of results is a useful tool.

In general, it is difficult to quantify precisely illegal waste disposal and waste tourism. However, these problems tend to decrease over time, with the introduction of direct measures that focus on the root of each problem, an increase in residents' awareness, the publication of results, monitoring and sanctions.

11

Case studies

11.1

Esporles waste charge

Esporles municipality is situated on the island of Majorca. It is spread over an area of 35.73 km^2. It has a population of 4,600 inhabitants distributed in the two former town centres of Esporles and S'Esgleieta, as well as two housing developments built in the 1960s called Es Verger and Ses Rogetes.

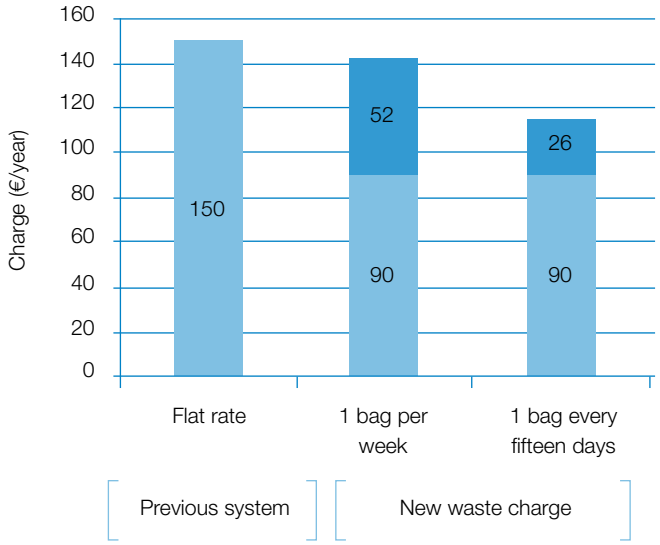
In July 2006, selective door-to-door collection was introduced for two fractions in the two old town centres. In November of the same year, the collection was increased to four fractions (the collection schedule is shown in Figure 2). In May 2008, some of the housing developments (Ses Rogetes, Jardín de Flores and Establidors) joined the door-to-door collection system. In total, 4,000 inhabitants and 1,700 dwellings participate in door-to-door selective waste collection.

On 1 January 2009, a pay-as-you-throw system was introduced, called the *Taxa de Fems* (Waste Charge). This is a pay-per-bag system for refuse collected door-to-door in the area. The tax is divided into two parts: a flat rate (of €90/year for households and according to the commercial category for retailers) that is paid for by bill and a variable fee that is collected through the sale of compulsory standardized bags for trash. The price of these bags includes part of the cost of collecting and treating the waste.

Household bags cost €1/unit and are red with a white logo and an easy-close system. They measure 42 x 47 cm and, according to the Town Council, they hold 10 litres. They are sold in packets or individually by collaborating local retailers in the town, who do not receive any financial compensation for this task. For commercial uses, the Town Council sells larger bags (100 litres) of the same colour and with the same logo. The price is €10/unit, which is proportional to the price for household trash.

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 (Graph 1) (Esporles Town Council, 2008).

Graph 1. Simulation of the final amount of the new waste charge in Esporles (Majorca) for different amounts of waste generation



Source: compiled by the author using data from Esporles Town Council (2008).

The new system also includes a series of discounts to make the tax fairer in social and environmental terms:

→ 100% exemption from the flat rate for reasons of economic capacity.

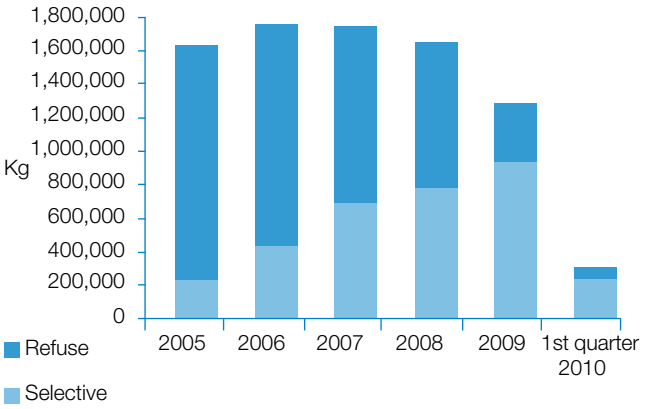
→ A discount for frequent use of the Parc Verd (or the waste collection centre) (30% of the flat rate).

→ A discount for a large family.

- **Outcomes**

The figures 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%. Refuse production in the first quarter of 2008 stood at 248 tonnes. In the same period in 2009 it was 95 tonnes and in 2010 it was 71 tonnes (Graph 2). Total waste generation fell from 1,600 tonnes in 2008 to 1,230 tonnes in 2009. The increase in selective door-to-door collection was particularly noticeable in the packaging and organic fractions. During the first quarter after implementation, 11 and 25 tonnes more packaging and organic waste were collected than in the same period of 2008, which represents an increase of 6% and 12% respectively.

Graph 2. Changes in selective waste collection and refuse collection in Esporles (Majorca)



Source: compiled by the author using data from Esporles Town Council (2010).

the increase in selective door-to-door collection is particularly notable for packaging and organic waste

During the first five/six weeks, between 0.12 and 0.15 standardized bags of refuse on average were collected per dwelling per week. The levels have now stabilised, and around 0.16 bags of refuse are collected per dwelling every Wednesday. As the bag weighs 1.92 kg on average, around 520 kg of household refuse are collected door-to-door each week.

The overall reduction of municipal waste by 23% between 2008 and 2009 could be attributed to a decrease in refuse. However, part of the reduction could also be due to *waste tourism*.

The number of incidents dropped dramatically in the first three weeks. In the first week, 120 bags were thrown away incorrectly, which constitutes 45% of the total bags collected. In the second week, this figure dropped to 60 bags, and in the third week it fell to just 20. Subsequently, the number levelled off at 3 or 4 incorrect bags per week, that is, 1.5% of the collected bags. Since the beginning of the system, only three sanctions have been applied.

- **Main problems, unforeseen events and solutions adopted**

Housing developments: this category includes Es Verger and other scattered centres, in which there is selective waste collection using containers. Initially, there were many problems due to the increase in tax for these dwellings, as the aim was to adjust the amount so that it was closer to the real cost of the service. The following agreement was reached:

→ In Es Verger, a locked hut was constructed for the bins, which can only be used by residents of the housing development.

→ In isolated settlements the drop-off area has been removed. Consequently, residents of these areas have to take their waste to the Parc Verd (or the waste collection centre). In exchange, the tax has been reduced considerably, but the red bags must still be used for refuse.

→ In a third housing development (Ses Rogetes with 165 dwellings) door-to-door collection was introduced in 2008.

Parc Verd: the only emergency area in the system is Parc Verd, which is situated in the centre of the town. At this site, users can deliver waste from the five fractions that are collected door-to-door, including refuse. However, refuse must be delivered in a standardized bag. Parc Verd is open Monday to Saturday.

Litter bins: some illegal waste disposal appeared in and beside public litter bins. In response, these bins were replaced by bins with different coloured compartments and signs describing the penalties associated with illegal waste disposal.

Nappies: to prevent refuse from being thrown away with household nappies, a standardized bag was designed for nappies, which is translucent green. These bags are handed out at the Town Council and the Social Services. They are free for all families with infants under 3 years old or for older people with incontinence problems. They can be left out on the days that OFMSW and refuse are collected (Figure 2).

Collection of commercial trash: in general, the small household refuse bags are used to collect commercial refuse. The red 100-litre bag is rarely used.

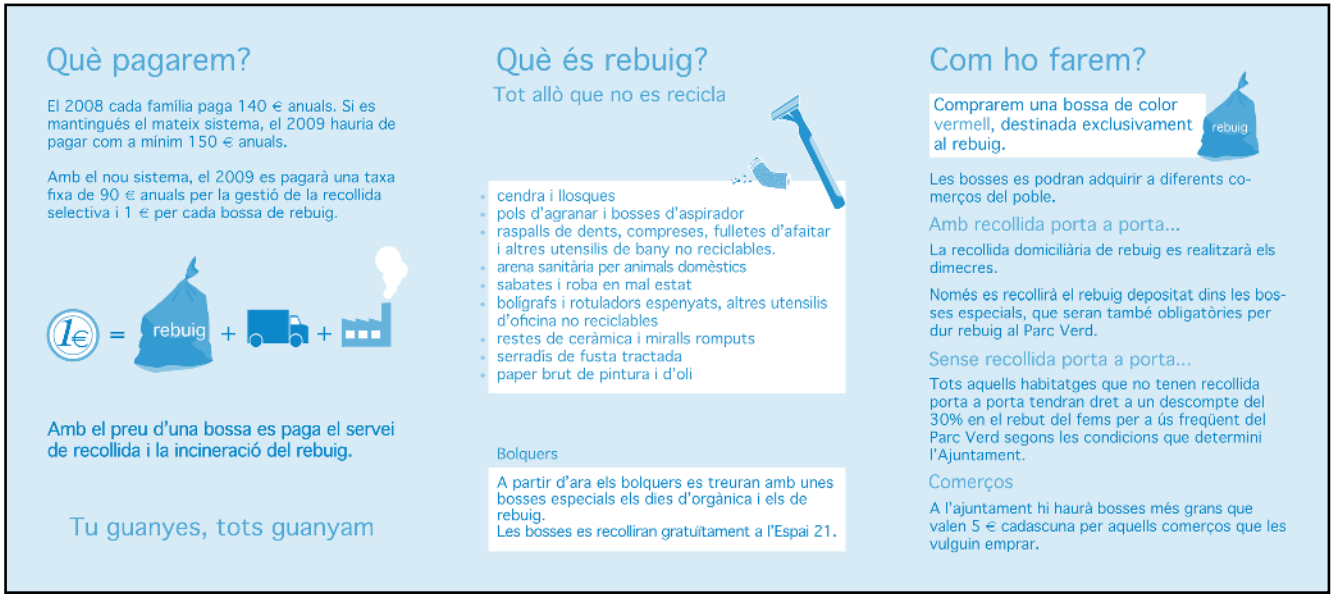
Figure 2. Schedule of door-to-door collection in Esporles (Majorca)

Source: Esporles Town Council (Majorca).

Figure 3. Informative panel on the waste charge in Esporles (Majorca)

Source: Esporles Town Council (Majorca).

Figure 4. Information leaflet on the introduction of a pay-as-you-throw system in Esporles (Majorca)



Source: Esporles Town Council (Majorca).

Figure 5. Image of a bag that has been thrown away incorrectly, waste charge, Esporles (Majorca)

Note: There is a tag stuck on the bag that has been disposed of incorrectly, giving the reason why it has not been collected. In the background is a red bag that is one of the new standardized bags for the waste charge.
Source: Esporles Town Council (Majorca).

Esporles Town Council website: www.ajesporles.net

11.2

The *Taxa Justa* (Fair Charge) of Argentona

Argentona is a town with around 12,000 inhabitants, a total surface area of 25.2 km^2 and an urban surface area of 3.5 km^2. The urban density is 3,363 inhabitant/km^2, which makes it a town with a strongly vertical structure in the town centre and a more horizontal structure in the housing developments and isolated dwellings.

Due to the characteristics of the town centre and the Madà housing development (with around 8,600 inhabitants in total), in 2004 the town council decided that the organic fraction of municipal solid waste (OFMSW) and refuse would be collected door-to-door. In the other housing developments and the Cros neighbourhood (with around 2,900 inhabitants in total), street bins would continue to be used for waste collection.

In December 2008, the yellow and blue bins were removed from the streets in the town centre and Madà and door-to-door collection was started for four fractions (see the schedule in Figure 6).

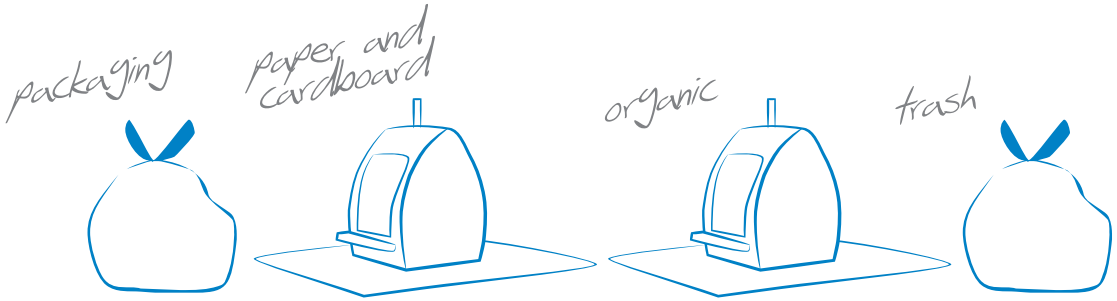


Figure 6. Schedule of door-to-door household collection in Argentona

Note: nappies are collected every day.
Source: Argentona Town Council.

In 2009, over 7,000 t of waste (more than 600 kg/inhabitant/year) was still produced in Argentona, of which 2,500 t was taken to the incinerator. Furthermore, households and commercial establishments that made an effort to recycle and reduce waste were not given any incentives. As a result, Argentona Town Council decided to adopt a pay-as-you-throw system.

On 1 February 2010, a **pay-per-bag system** was introduced for refuse and packaging waste, called the ***Taxa Justa* (Fair Charge)**, after a three-month test period that began on 22 October 2009.

The waste tax is divided into two parts: a flat rate (€95/year for households and according to the commercial classification for businesses) paid by bill; and a variable fee that is collected through the sale of the standardized bags that must be used for household and commercial trash and packaging. These bags are standardized with the Town Council's logo. They have a specific volume and characteristics and a fixed price (see Table 17 and Figure 7) (Argentona Town Hall, February 2010).

Table 17. Characteristics and prices of standardized bags in the Argentona pay-per-bag system

Bag	Characteristics	Volume (l)	Price (€/unit)
Domestic refuse	Translucent red with a black logo	17	0.65
Domestic packaging waste	Translucent yellow with a black logo	35	0.35
Commercial refuse	Translucent red with a black logo	65	2.50
Commercial packaging waste	Translucent yellow with a black logo	100	1.00

Source: Tax ordinance No. 11 Argentona, 2010

Figure 7. Standardized bags used in Argentona

a) Standardized bag for refuse (household size).

b) Standardized bag for packaging waste (commercial size).

Source: compiled by author.

During the test period, residents and commercial establishments had to use standardized bags for refuse and packaging waste, but these could be obtained free of charge from the Environmental Office. From 1 February 2010, no more free bags were provided. Instead, standardized bags have to be bought at one of the town's 12 local retailers that have signed collaboration agreements. Bags can also be purchased from the town's waste collection centre.

There is also a variable fee at commercial level. This fee depends on the volume of the bin selected for the organic fraction (OFMSW). This amount is paid as part of the annual bill (Table 18).

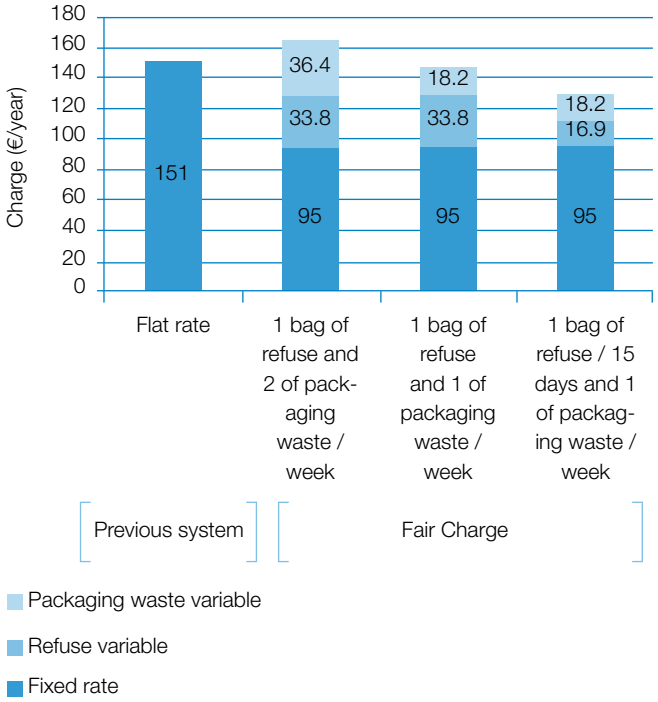
Table 18. Prices for the use of OFMSW bins by large-scale waste generators in Argentona

OFMSW bin volume	Price (€/year)
25 litres	€43/year
35 litres	€54/year
60 litres	€66/year
120 litres	€143/year
240 litres	€203/year

Source: Tax ordinance No. 11, Argentona.

In the past, the household waste charge was a flat rate. For example, in 2010 each family was expected to pay €151/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 €147/year (this and other examples are illustrated in Graph 3).

Graph 3. Simulation of the amount of Argentona's *Taxa Justa* (Fair Charge) for different amounts of waste generation, 2010



Source: compiled by author.

Outcomes

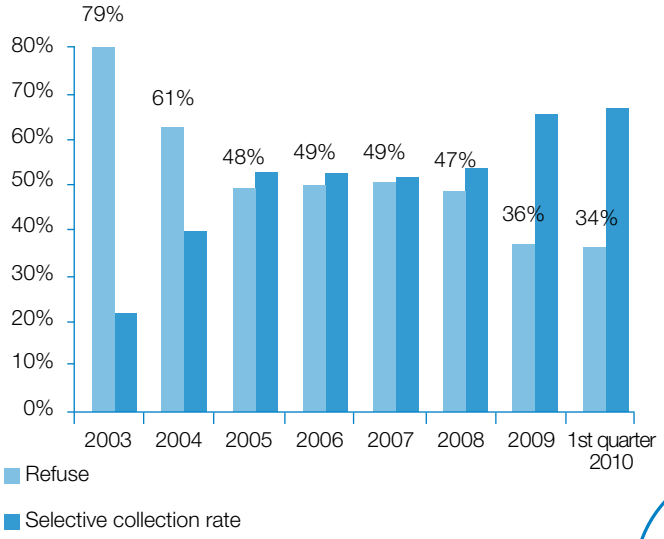
Participation in the tax system is increasing. At the start of the scheme, 30% of bags were used correctly (most of the incorrectly used bags were standardized bags that had been distributed free of charge). A month later, after various monitoring tasks, the number of bags used incorrectly had dropped to 2% for packaging waste and 6% for refuse.

In 2009, there was an increase in recovery: from 52.7% of selective collection in 2008 to 64.4% in 2009. During the test period in October-December 2009, 66.3% of waste was selectively collected. In the first quarter of 2010, the average levels of selective waste collection stood at 66% (Graph 4).

The impact of the tax system can be seen if we compare figures for February and March 2010 with the same months in 2009. The waste recovery rate for the entire town increased from 65% in 2009 to 66.9% in 2010. Specific results for the door-to-door collection area cannot be determined, but it is estimated that they are significantly better.

In the entire town, waste generation was 7% lower during the test period than in January-September 2009. During the period of tax implementation in 2010 (February-April), waste generation values were 6% lower than in the test period.

Graph 4. Changes in the selective waste collection results for Argentona from 2003 to 2010



Source: compiled by author.

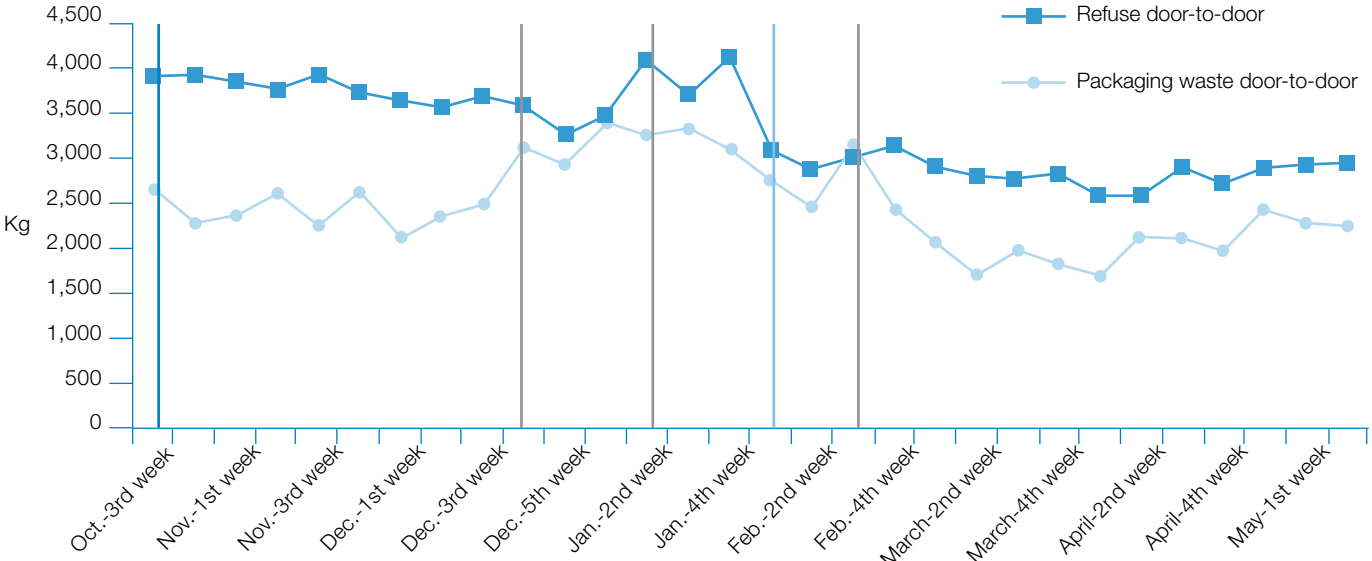
Legend for Graph 5

22 October 2009: start of the pilot test (with free standardized bags)

1 February 2010: start of the tax system (use of standardized bags that need to be purchased). Nevertheless, there was a month of transition in which the inhabitants knew that the test stage bags would be collected.

Removal of emergency areas and bins.

Graph 5. Changes in door-to-door collection of refuse and packaging waste in Argentona

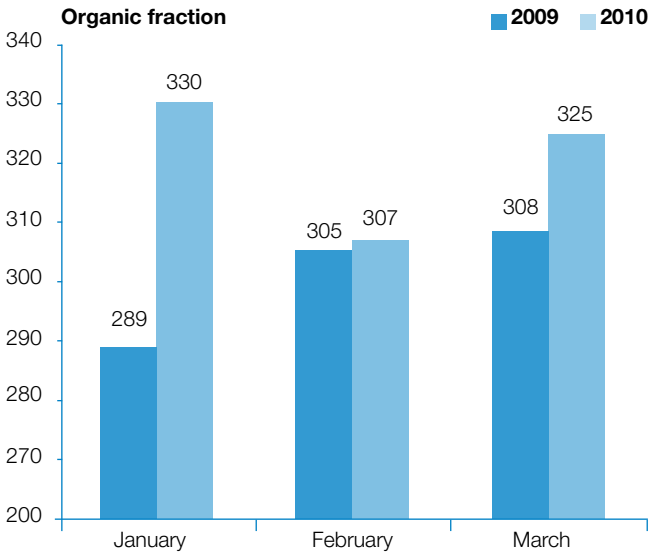


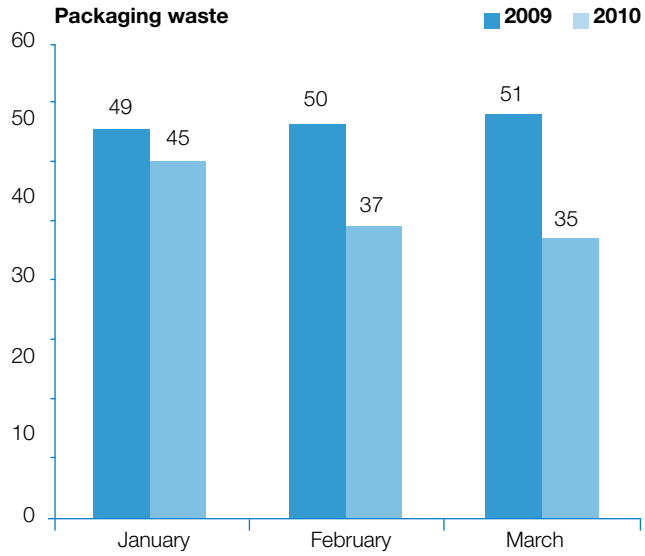
Source: compiled by author.

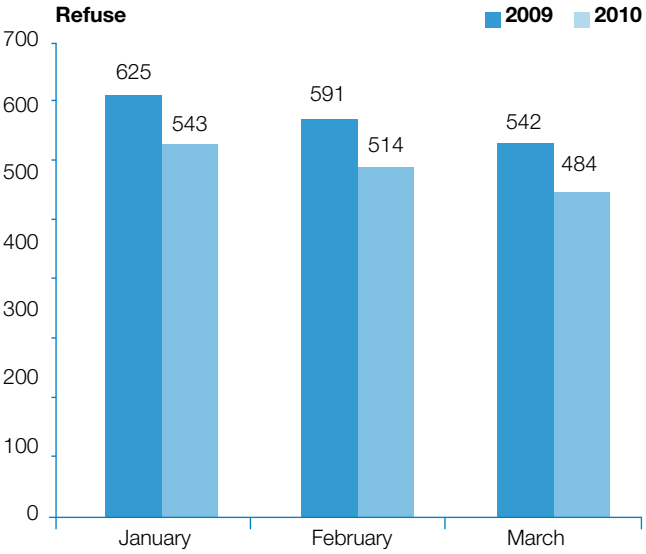
Since the implementation of the system of waste charges (1 February 2010), the amount of chargeable fractions collected door-to-door has been lower than the average during the test period. The amounts dropped by 18.7% for refuse and 23.6% for packaging waste collected door-to-door only. Since the start of April 2010, collection has begun to return to its initial levels (see Graph 5).

A comparison of the generation of organic, packaging waste and refuse fractions in January-March 2009 and 2010 reveals an increase in the recovery of the organic fraction and a reduction in the trash and packaging waste collected (Graph 6).

Graph 6. Comparison of the generation of organic waste, packaging waste and refuse in Argentona from January to March in 2009 and 2010







Note: The values are in grammes per inhabitant per day.
Source: Argentona Town Council, April 2010.

On average, 0.3 bags of refuse and 0.8 bags of packaging waste are collected per household every week. The bags of refuse weigh 1.67 kg and the bags of packaging waste weigh 1.05 kg, on average.

- **The main problems, unforeseen events and solutions adopted**

Emergency areas: Before the start of the system, there were five emergency areas. These would have become potential points for waste loopholes. To reduce illegal waste disposal, the following steps were taken:

→ Four of the emergency areas were removed, leaving just one.

→ The following measures were applied in the remaining area:

- Refuse bins were removed.
- A CCTV camera was installed.
- The area was fenced off and a user identification system introduced to control access.

Waste streams to areas without door-to-door collection: some neighbourhoods in which the system has not yet been implemented still have roadside containers. Waste from the town centre is sometimes deposited in these containers. To address the problem, the containers have been moved to new, more out-of-the-way locations.

Waste collection centre: organic waste can be delivered to the centre. The waste collection centre staff check that packaging waste and refuse are delivered in the correct standardized bags.

Litter bins: There has been some illegal waste disposal next to public litter bins. Consequently, signs were put up to stress that illegal waste disposal in these containers carries a penalty.

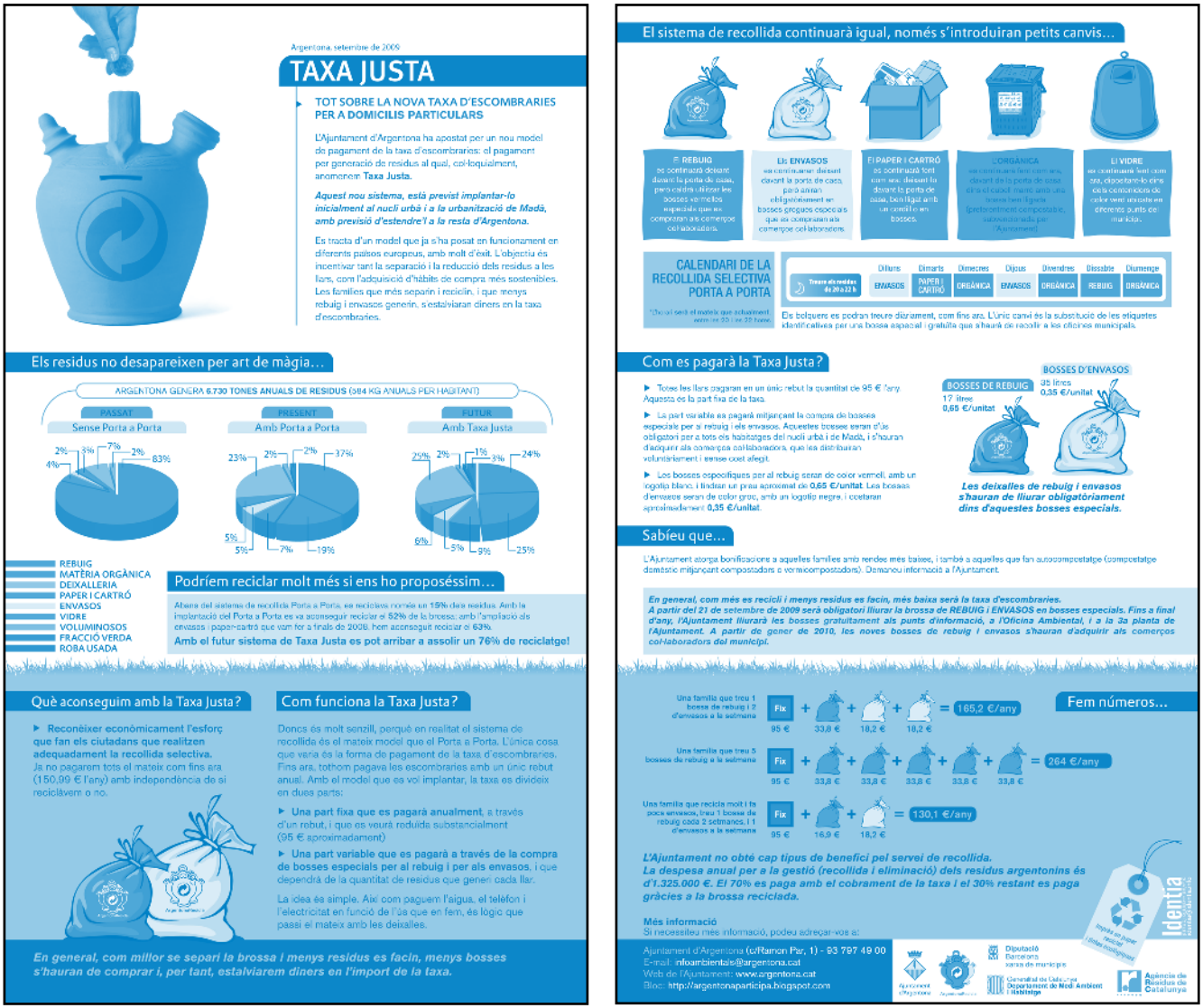
Nappies: to prevent trash from being thrown away with household nappies, a white 15-litre translucent bag was created for nappies, with a red logo. These bags are handed out at the Town Council's Environmental Office. They are free for all families with infants under 3 years old or older people with incontinence problems.

Figure 8. Standardized bag for household nappies in Argentona

Source: compiled by author.

Waste tourism: Cabrera de Mar and Mataró may receive waste from Argentona, particularly in containers that are in convenient situations. Argentona Town Council has discussed with these municipalities the possibility of moving some of the containers to reduce the possibility of waste loopholes.

Figure 9. Household information leaflet for the implementation of the *Taxa Justa* (Fair Charge)



Source: Argentona Town Council.

Figure 10. Sticker used to monitor and control the *Taxa Justa* (Fair Charge)

Note: stickers used from February 2010.
Source: Argentona Town Council.

Argentona Town Council website: www.argentona.cat

11.3

Commercial pay-as-you-throw system in Canet de Mar

Canet de Mar has 13,548 registered inhabitants (on 1 January 2009). The urban density is 7,140 inhabitants/km^2, which is high and indicates that the town is highly compact.

In May 2005, a selective door-to-door collection scheme was introduced in the entire town for domestic and commercial waste. The fractions that are collected door-to-door are refuse, organic (OFMSW), paper and cardboard and packaging waste. Glass is still collected in street bins.

The door-to-door collection has a general schedule that is valid for all households and commercial establishments. In certain cases, commercial establishments can use extra collection services, on request (see the calendar and the leaflet in Figure 11).

Commerce in Canet de Mar is comprised of 700 commercial activities, 100 of which are considered large generators of refuse, organic and packaging waste fractions. This waste has complex characteristics in terms of volume and composition and has a considerable economic impact on the cost of the town's waste collection service.

For this reason, in January 2010, **a pay-per-bin scheme** was introduced, with an individual tally for refuse and packaging waste and a predetermined frequency for organic fraction. **This scheme is for commercial establishments that are large-scale waste generators** in Canet de Mar.

The tax is divided into two parts: a flat rate according to the commercial classification (see Table 19); and a variable fee that depends on the amount of trash, packaging and organic waste that is produced. Both the flat and variable fees are included in an annual bill.

Bins for trash and packaging are identified with a chip. Each emptying of the bin is recorded (Figures 12 and 13). In this case, the variable fee depends on the selected bin volume and the number of times it is emptied every year (Tables 20 and 21). In addition, different fees have been established for extra collections of refuse and a distinction is made between occasional and daily extra collections (Table 20).

A pay-per-bin with predetermined frequency system has been introduced for the organic fraction. As the organic fraction is collected from all businesses 5 days a week, the bill depends entirely on the volume of the selected bin (Table 22). Bins are also fitted with chips to check that the commercial establishments are throwing out their waste correctly (Figures 12 and 13).

Table 19. Variations in the commercial flat rate according to the commercial categories established in Canet de Mar

Category	Description	Basic fee (€)
A	Bars (per m^2)	3.80
B	Restaurants (per m^2)	4.00
C	Hostels, hotels, guesthouses, establishments for public housing and similar (per bed)	10.09
D	Campsites (per place)	10.00
E.1	Garages, workshops, factories (up to 10 workers)	218.42
E.2	Garages, workshops, factories (from 11 to 25 workers)	325.55
E.3	Garages, workshops, factories (from 26 workers)	486.98
F.1	Retailers and food shops (< 150 m^2 and LG of OFMSW, refuse and packaging waste)	70.00
F.2	Retailers and food shops (< 150 m^2, but not LG of OFMSW, refuse and packaging waste)	173.00
F.3	Retailers and food shops (> 150 m^2 and not LG)	200.00
F.4	Retailers and food shops (> 150 m^2 and LG of OFMSW, refuse and packaging waste)	70.00
G	Supermarkets (per m^2)	1.00
H	Cinemas, night clubs, theatres, sports facilities, play centres	165.06
I	Banks and savings banks	300.00
J	Hairdressers, beauty salons and pharmacies	165.93
K	Health centres and vets (LG refuse)	110.00
L	Associations, schools, academies, secondary schools and other teaching centres	
L.1	- Up to 250 m^2	120.44
L.2	- From 251 to 500 m^2	173.78
L.3	- From 501 to 1,000 m^2	211.04
L.4	- More than 1,000 m^2	280.53
M	Homes for the elderly and others, nurseries and hospital	75.00
N	Petrol stations	325.55
O	Houses at more than 500 m from the town centre	174.61
P	Others (offices, medical practices, entities, academies and university)	130.00

* LG: large-scale waste generators. The Town Council indicates which establishments are large-scale waste generators.
Source: Tax ordinance No. 29, Canet de Mar, 2010.

The commercial categories that have been established are very similar to those that were used previously, although the fees have been altered for activities that are subject to pay-as-you-throw.

Businesses that are considered large-scale generators of refuse, packaging waste and organic fractions are mainly bars, restaurants, hotels, campsites, homes for the elderly and others, nurseries and certain retailers.

Table 20. Unit charge for collection of commercial refuse in Canet de Mar

Special fee for refuse	Unit cost (€)	Extra unit cost (€)	Unit cost – day (€)[1]
Price of collecting refuse; 60 l	1.92	2.30	0.38
Price of collecting refuse; 90 l	2.87	3.45	0.57
Price of collecting refuse; 120 l	3.45	4.14	0.69
Price of collecting refuse; 240 l	5.36	6.44	1.07
Price of collecting refuse; 600 l	9.58	11.50	1.92
Price of collecting refuse; 1,100 l	14.05	16.86	2.81

[1] For old people's homes and nurseries, which need almost daily collection of nappies.
Source: Tax ordinance No. 29, Canet de Mar, 2010.

Commercial activities that need extra refuse collection in addition to the day established in the schedule must make a request to the Town Council. The charge for this extra collection is specified in the third column of Table 20 (extra unit cost). Businesses that are large-scale generators of nappy waste do not pay this special fee. For every extra collection of nappies, they are charged the reduced unit price specified in the last column of Table 20.

Table 21. Unit charge for collection of commercial packaging waste in Canet de Mar

Special fee for disposing of packaging	Unit cost (€)
Price for collecting packaging waste: 90 l	0.69
Price for collecting packaging waste: 120 l	0.87
Price for collecting packaging waste: 240 l	1.29
Price for collecting packaging waste: 600 l	2.30
Price for collecting packaging waste: 1,100 l	3.37

Source: Tax ordinance No. 29, Canet de Mar, 2010.

Table 22. Annual charge for collection of commercial organic waste in Canet de Mar

Special fee, according to the type of organic waste bin	Unit cost (€)
40 litres, 5 collections per week	24.64
90 litres, 5 collections per week	49.90
120 litres, 5 collections per week	59.14
240 litres, 5 collections per week	103.49
1,100 litres, 5 collections per week	338.80

Source: Tax ordinance No. 29, Canet de Mar, 2010.

Outcomes

The overall levels of selective waste collection in Canet de Mar have been fairly stable in recent years. They fluctuated from 60% in 2007 to 58% in 2008 and 59% in 2009. In the first quarter of 2010, the rate was 60%.

As we cannot present data on the amounts of waste collected from commercial establishments, here we provide a table with information on the number of bins given to businesses and how often they are used (Table 23).

Table 23. Units of bins and collections carried out for commercial establishments in Canet de Mar from April-May 2010

Type of bin	No. of commercial establishments with bin	No. of collections April and May	No. collections / commercial establishment (April and May)	No. collections / commercial establishment and week[1]
Packaging waste, 90 litres	41	360	8.78	1.03
Packaging waste, 120 litres	19	155	8.16	0.96
Packaging waste, 240 litres	19	267	14.05	1.65
Packaging waste, 660 litres	1	34	34.00	4.00
Packaging waste, 1,100 litres	8	129	16.13	1.90
TOTAL PACKAGING WASTE	88	945	10.74	1.26
Organic, 40 litres[2]	53	-	-	-
Organic, 90 litres	20	268	13.40	1.58
Organic, 120 litres	15	272	18.13	2.13
Organic, 240 litres	11	306	27.82	3.27
Organic, 1,100 litres	1	16	16.00	1.88
TOTAL ORGANIC	100	862	18.34	2.16
Refuse, 60 litres	51	233	4.57	0.54
Refuse, 90 litres	6	23	3.83	0.45
Refuse, 120 litres	1	8	8.00	0.94
Refuse, 240 litres	4	49	12.25	1.44
Refuse, 1,100 litres	8	327	40.88	4.81
TOTAL REFUSE	70	640	9.14	1.08

[1] It is assumed that the months of April and May have 8.5 weeks.
[2] The 40-litre bin for organic fraction cannot have an identifying chip and therefore there are no collection data on this waste.

On the basis of the information gathered, it is estimated that a large-scale commercial waste generator in Canet de Mar generates, on average, approximately 373 litres of packaging waste, 370 litres of organic fraction and 653 litres of refuse every week.

Consequently, the daily waste generation for a large-scale commercial waste generator is 1.9 kg of packaging waste, 29.1 kg of organic fraction and 17 kg of refuse, approximately.

- **Problems**

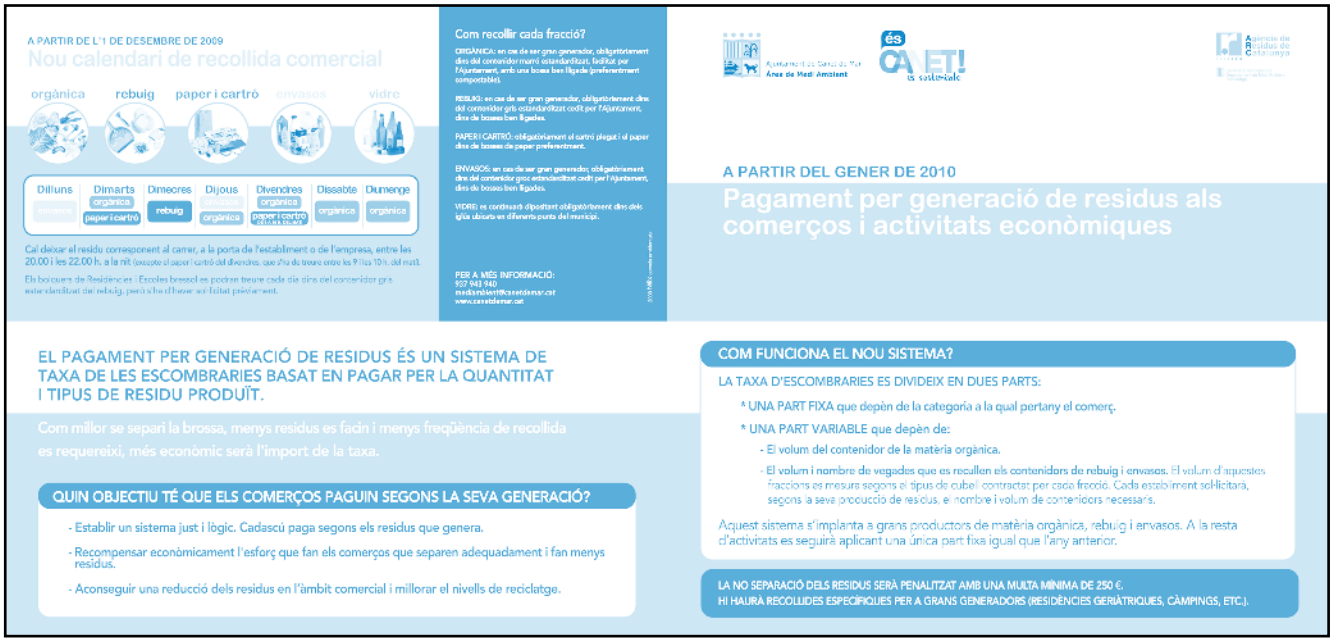
Emergency areas: Door-to-door collection in Canet de Mar is supported by emergency areas, but these are exclusively for household use. Commercial waste is not permitted.

Stabilization of garbage truck readings: to fully implement the system, the garbage truck and businesses needed to be monitored. It was checked whether the devices were turned on in the garbage trucks and the chips in the bins functioned smoothly.

Participation of commercial establishments: once the system had been deployed in the test period, the collections registered by the garbage truck needed to be monitored. The software and user identification were used to detect commercial establishments that did not use the bin for one of the fractions at all. Subsequently, a control procedure was developed that consisted in nocturnal inspections to verify the information from the garbage truck, notifications that were sent to the establishments, and individual visits to better explain the system and respond to doubts, etc. This was carried out in a 3-month period, approximately.

Waste collection centre: managers were reminded of the criteria that no commercial waste from the packaging, organic and refuse fractions could be accepted.

Figure 11. Information leaflet for introducing the commercial pay-as-you-throw scheme in Canet de Mar



Source: Canet de Mar Town Council.

Figure 12. Bins for collecting commercial refuse, packaging waste and organic fractions in Canet de Mar

a) Bin of 60 litres for refuse.

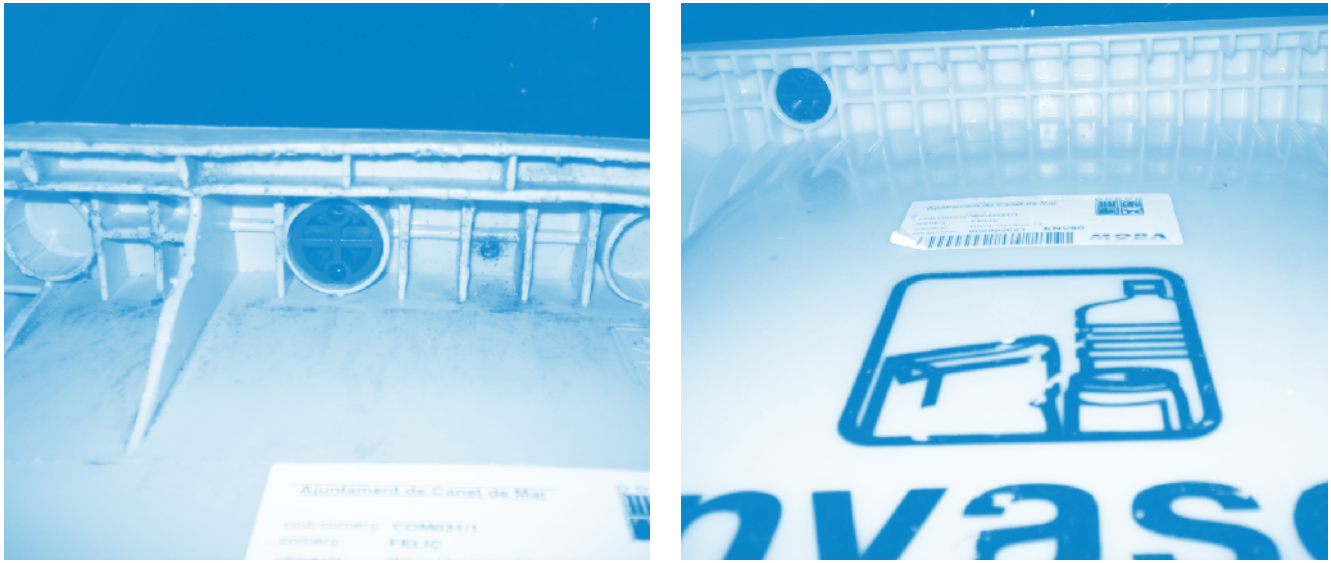
b) Bin of 40 litres for organic fraction.

c) Bin of 120 litres for packaging waste.

d) Bin of 120 litres for organic fraction.

Source: compiled by author.

Figure 13. Detail of the chips installed in organic and packaging waste bins in Canet de Mar



a) ID chip for organic bins.

Source: compiled by author.

Canet de Mar website: www.canetdemar.cat

11.4

Chamber system in two German towns

11.4.1

Chamber system in Lankow, Schwerin (Germany)

The city of Schwerin is the capital of Mecklenburg-Vorpommern. It is situated in the north of Germany and has close to 100,000 inhabitants. Between 1995 and 2000, it implemented various pilot waste collection systems to reduce refuse. One of the pilot projects was the implementation of a chamber system in residential areas of Lankow, which has 1,250 dwellings and a markedly vertical structure (large blocks of flats) (Forschungszentrum Schwerin, 1999 and Stadt Schwerin, 2000). These pilot projects have been consolidated and are now another waste collection system.

The system consisted of equipping refuse containers (of around 1,100 litres) with chips. Access was then controlled so that users could only use the bins with an ID card. The refuse containers have a chamber of a specific volume (15 litres). Each time this chamber is used counts as a collection. A minimum annual volume of 40 litres per household was established.

Figure 14. Refuse containers with controlled access in the town of Schwerin (Germany)

Source: MOBA-ISE Mobile Automation SL.

participation in the chamber system in the two neighbourhoods of the city was around 75%

The refuse containers were still placed besides the bins for other fractions, but they were kept in a closed area with uncontrolled access. A ratio of approximately one containers for each fraction per 100 inhabitants was calculated.

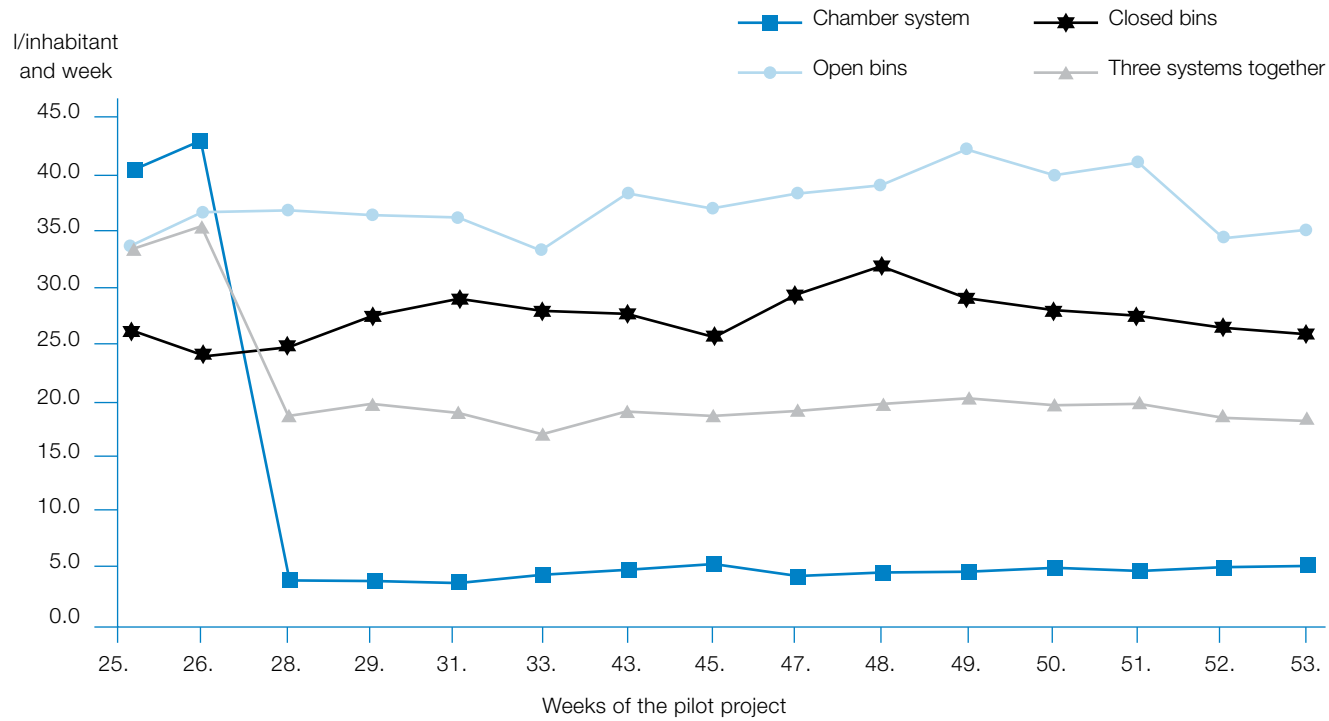
This system was used to introduce an individual billing system. The flat rate was €7.67 per household per month and the variable fee was at least 40 litres of trash per household per year. This was equivalent to an average annual tax of €103.80 (€92 flat rate and €11.80 variable rate).

Outcomes

The chamber system results were compared with systems implemented in other areas of the town, such as a system with closed containers for refuse (with a key to access them) or open bins (Graph 7).

Overall, trash in the Lankow area was reduced by 85% (Stadt Schwerin, 2000).

Graph 7. Changes in the amount of refuse produced per household at the start of the pilot project in Lankow in the three types of waste collection



Source: adaptation of the graph according to Forschungszentrum Schwerin, 1999.

In the area with the chamber system, the refuse was reduced by almost 90%, from 40 to 4 litres per inhabitant per week. The volume available for residents was decreased from 63 litres per inhabitant per week to 11 litres/inhabitant per week. Therefore, the objective of selective waste collection in large residential complexes was met.

In locations with closed bins, 27 litres of refuse were deposited per household per week. There was little fluctuation in this figure. In the area with open bins, the amount of refuse increased from 35 to 40 litres per inhabitant per week after the introduction of the chamber system, due to changes in waste streams.

These refuse reduction results brought about a drop in the environmental and economic costs of waste management. At the same time, the costs of recovery of recyclables increased.

Participation in the chamber system in the two areas of the city was around 75%, although surveys revealed higher participation results of 88%.

Problems

→ Some users considered that the 15-litre volume established for the chamber system was too high. A volume of 5 litres was considered ideal. A combination of measures should be provided.

→ The yellow bin is emptied infrequently, which leads to a lot of waste being left beside it.

→ The organic waste bins are not cleaned enough and are emptied too infrequently.

→ Some impurities were found in bins for recyclable fractions.

→ Some faults occurred in the electronic system. Consequently, it needs to be checked periodically.

→ A continuous effort was needed to increase the awareness of residents. Monitoring and control was also required to gradually increase participation.

11.4.2

Pilot project for a chamber system in two large residential complexes in Heidelberg (Germany)

Heidelberg is a city in the southwest of Germany, with 14 neighbourhoods, a surface area of 109 km^2 and close to 140,000 inhabitants. At the end of 1999, a pilot pay-as-you-throw project using a chamber system was introduced for trash in two large residential complexes. In 2001, the system was fully implemented and is still used today.

The aims of the project were to improve the quality of selective waste collection and significantly reduce the amount of trash.

The characteristics of the two areas and the facilities are as follows (Stadt Heidelberg, 2001):

A. The Philipp-Reis-Strasse study area has 120 dwellings and 6 collection areas for the various fractions that are collected. The 6 refuse containers are equipped with chamber systems.

B. The other test area, Im Weiher, has 33 dwellings and 3 collection areas for the various fractions that are collected. A chamber system was only installed in one of the three refuse containers.

The collection areas for the various fractions were fenced off and suitable signs were put up.

One good decision was to provide various volumes for waste in the refuse containers that were controlled using a chamber system. This meant that the system could be adapted to many households' volume of trash generation.

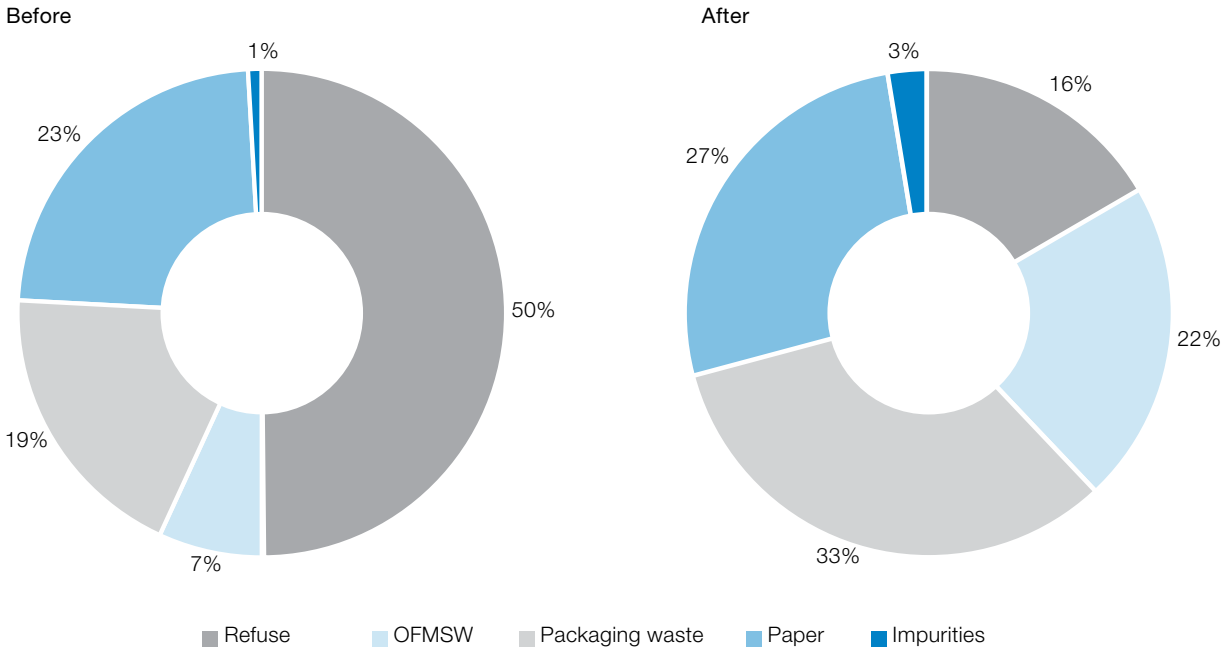
A two-part tax was established, comprised of: a flat rate for all households paid by annual bill; and a variable fee that depended on the use and volume of waste in the refuse container.

An intense communication campaign was carried out before implementation of the system.

Outcomes

Selective waste collection in the two areas increased from 50% to 84%, and there was an average overall reduction in waste of 21%. Impurities detected in bins for recyclables increased from 1 to 3%. The changes in the rest of the fractions are shown in Graph 8.

Graph 8. Comparison of the percentage of waste collected before and after the introduction of the system in Heidelberg (Germany)



Source: data provided by MOBA-ISE Mobile Automation SL.

To record the impact of the project, regular monitoring was carried out during a 6-week period.

The selective waste collection results for Philipp-Reis-Strasse varied according to the collection area. However, in general, an improvement was observed in all cases.

The volume collected in the yellow bin increased. However, impurities were also found from other fractions, and from refuse in particular (nappies, cigarette butts, etc.). It was concluded that this waste came from the non-resident population or from illegal waste disposal by users to reduce part of the tax. The bins with most illegal waste disposal were situated out of sight of the residents. Bins situated inside multifamily blocks received the least amount of impurities.

The selective collection of organic fraction in the Im Weiher area had good results from the outset. The results for the yellow bin were good. In fact, they were better than those for the Philipp-Reis-Strasse area, although some impurities were also found. The project in this area was clearly on a smaller scale. Consequently, it was harder to remain anonymous.

A survey of 47% of the system users was carried out in the Philipp-Reis-Strasse area. Below are some of the main conclusions of this survey:

→ Most of the respondents (57%) used the chamber system every week or every fortnight. Only a small percentage (19%) used the system with less frequency than once a month.

→ Most respondents were generally happy with the operation and appearance of the system.

→ Over 70% of respondents were in agreement with the application of the 'polluter pays' principle. Only 13% rejected this idea and another 13% were undecided.

→ Most respondents understood how to reduce the tax using the chamber system. A fifth of respondents were not sure about this aspect.

→ A total of 38% of households were very satisfied with the Office of Waste Management and Sanitation's information campaign, which was carried out at the start of 2000; 22% were satisfied and 16% were slightly dissatisfied.

Websites of the Heidelberg and Schwerin town councils:

www.heidelberg.de

www.schwerin.de

11.5

Pay-per-bin in the region of Piedmont (Italy)

In Italy, the Ronchi Decree (22/97) transposes the European Community Directives 91/689/EEC and 94/62/EC, and establishes a commitment to obtain 35% of selective collection of municipal waste. In addition, the Decree states that prevention is the first level of waste management.

As a result of the Ronchi Decree, the Piedmont region approved Act 24 of 2002, which established administrative penalties for towns whose selective collection rates in 2004 would be below the 35% that was obligatory at national level. The penalty was €0.30/inhabitant for each site below the obligatory 35% minimum.

In addition, the Piedmont region introduced total waste production as an important parameter in the calculations. As a result, towns that would selectively collect less than 35%, but could reduce their waste production to below the regional average, would not have to pay the penalty.

Consequently, the Piedmont region developed a series of strategies with a range of instruments to increase selective collection and reduce waste production. In this context, various pay-as-you-throw systems emerged.

Dogliani

Dogliani is a city of 4,595 inhabitants and a municipal surface area of 35 km^2.

In 2004, the town began door-to-door collection of all fractions and introduced a pay-as-you-throw scheme for refuse. The same rate was no longer applied to all users.

The waste tax is now comprised of a flat rate calculated according to the surface area of the dwelling and a variable rate based on the number of people in it. For example, a family of 4 in a dwelling of 100 m^2 paid, in 2008, a

flat rate of €55.03/year (including VAT) and a variable fee of €166.16/year (including VAT). This amount includes the collection of all fractions (in free bags) and the supply of fifty 35-litre bags for refuse. Each additional bag required by a household costs €2.

Payment of the annual tax is divided into two bills. In addition, a discount system has been established for various factors: 20% for home composting, 10% for the presence of children between 0 and 3 years old or for families with financial difficulties. There are also exemptions, including old people, hospitals, churches and NGOs. Nappies are collected free of charge in bags with distinctive labels.

Due to the city's urban development, inhabitants of houses outside the main town centre must compost their own organic waste. As a result, their flat rate is reduced by 50% and their variable rate by 70%. Each home has its own bins for paper, tins and packaging waste, whilst glass is collected in roadside containers.

The tax for commercial activities is also broken down into a flat rate (based on surface area and type of activity) and a variable fee (productivity index and type of activity).

An information office was set up in town to assist residents and respond to their doubts about the system. Transparency in the system's costs was considered extremely important, especially as the cost of treating refuse usually increases 20% a year, which has an impact on tax amounts.

The cost of street cleaning is included in the waste fee paid by the inhabitants of this town.

Outcomes

In 2005, the selective waste collection rate was 72%, at the end of two years of implementation. In contrast, in 2003, prior to deployment of the system, the rate was 16%, approximately (Table 24). During 2007, the last year for which data are available, 78% of municipal waste was collected selectively.

There has been approximately a 24% reduction in total annual waste generation since the start of the system.

Table 24. Selective waste collection results for Dogliani on introduction of a door-to-door collection system with pay-as-you-throw for refuse

Year	Total production (kg)	Total selective waste collection	Total refuse
2003[1]	1,830,285	16%	84%
2005[2]	1,352,852	72%	28%
2007[2]	1,380,940	78%	22%

[1] Before implementation of the new charge.

[2] After implementation of the new charge.

Source: data provided by Dogliani and updated using the town's website www.comune.dogliani.cn.it (10 November 2010).

COVAR 14

As a result of Italian waste management regulations, regional units known as ATO (Optimal Regional Areas) have been established, which in turn are divided into smaller units called 'Bacino'. Bacino 14 of the southwest ATO includes COVAR 14 (Consorzio Valorizzazione Rifiuti 14). This consortium brings together 19 municipalities with a total of 243,633 inhabitants. It is responsible for organizing and scheduling waste collection, establishing the tax system, service management and control, etc.

In 2004, COVAR 14 began to implement in these 19 municipalities a door-to-door collection system with four bins (white for paper, brown for organic, blue for glass and grey for refuse) as well as a bag or yellow container for packaging (Figure 15). In addition, a pay-as-you-throw system is applied to refuse. The grey refuse bin is fitted with a microchip containing the user's data. Every time this bin is collected either full or not, the garbage truck records the user's data and the cost is added to the user's bill. The tax that residents pay is divided into two parts: a flat rate and a variable fee.

Legislative Decree 152/2006 still had not been drawn up in 2009. Therefore, tax was calculated according to the provisions established in Decree of the President of the Republic 158/1999, which are the regulations that apply Article 49 of Decree 22/1997:

Flat rate = S x €/m² x Ka

S = surface area of the dwelling

€/m² = fixed costs per m² → €/m² = Fixed costs / surface of a dwelling with *n* people

Ka = surface area adjustment factor: this factor increases as the number (n) of people in the family increases (there are six factors, from 1 to 6 people)

Variable fee = Quv x Kb x Cu

Quv = average amount of waste produced per family → Quv = Amount of waste / number of people in the family

Kb = adjustment factor: this factor increases as the number (n) of people in the family increases (there are six factors, from 1 to 6 people)

Cu = €/kg of waste → Variable costs / kg of refuse

Figure 15. Bins for the five fractions that are selectively collected by COVAR 14 in the town of Carignano (Italy)

Source: image provided by COVAR 14.

the outcome was an increase in selective waste collection

Some of the 19 municipalities require alternative systems for storing bins, due to their vertical structure. Beinasco is a city of 19,828 inhabitants with a municipal surface area of 6.76 km^2, which has predominantly vertical buildings.

There are various ways of storing the bins in the buildings themselves:

1. In the best of cases, an area is adapted for storage of the entire community's bins. One person is responsible for putting out and returning the bins on the days that each fraction is collected.

2. In other cases, the community adapts an area of the property that is next to the street.

3. When neither of the above solutions can be chosen due to lack of space, the city council must be asked for permission to store the bins on the public street. In this case, the community is responsible for the costs of fitting out an area (with signs, fences and greening) and has to pay a tax for using public land.

Outcomes

The results were an increase in selective waste collection from 23% in 2003 to 42% in 2005 and 62% in 2009. In 2009, 3% less waste was generated than in 2003 (Table 25).

Table 25. Selective waste collection results obtained by COVAR 14

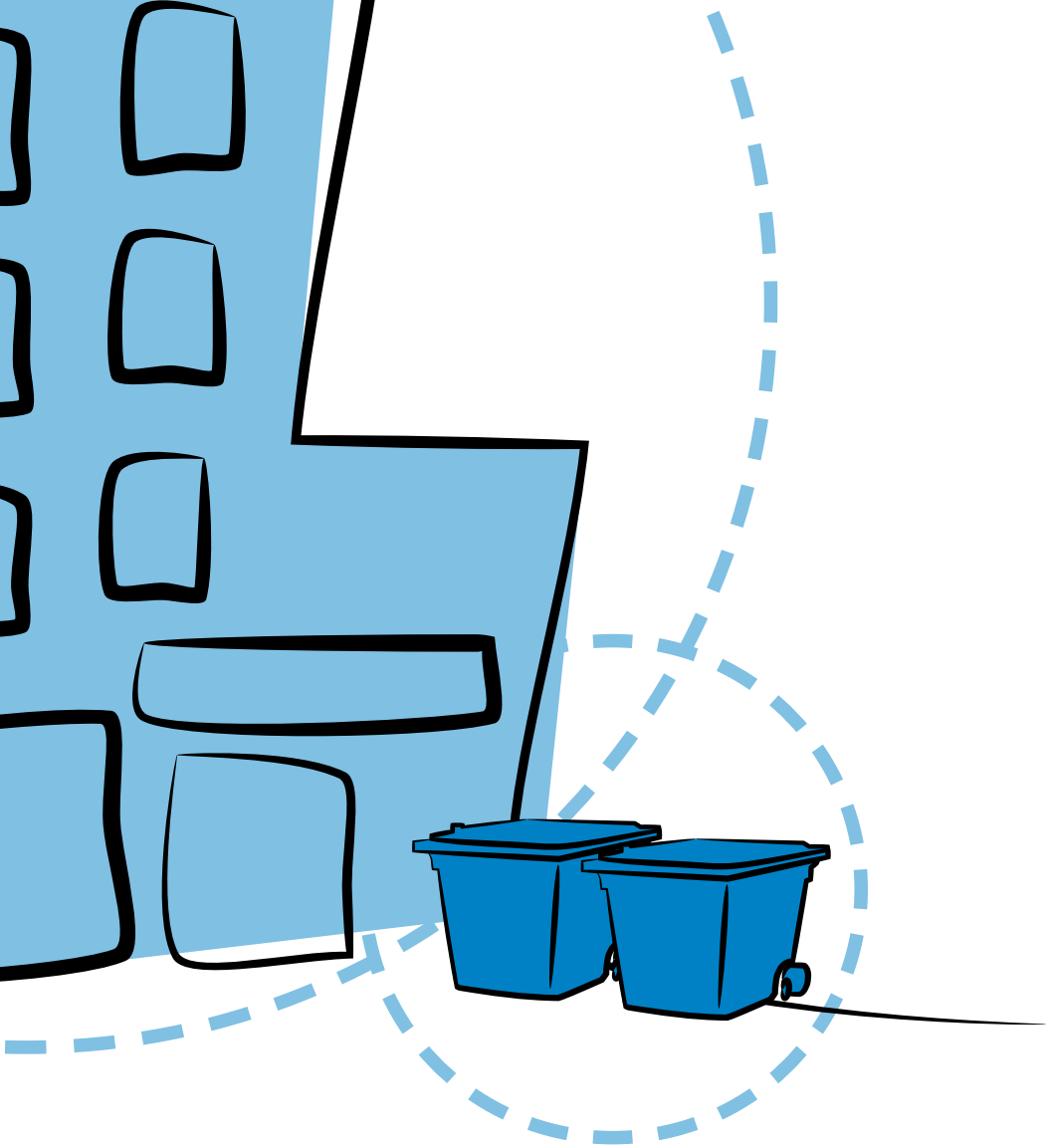
Year	Total production (kg)	Total selective waste collection	Total refuse
2003[1]	114,889,520	23%	77%
2005[2]	109,038,656	42%	58%
2009[2]	111,420,797	62%	38%

[1] Before implementation of the new charge
[2] After implementation of the new charge
Source: Data provided by COVAR 14 and updated from the website: www.covar14.it (22 June 2010).

Websites of COVAR 14 and Dogliani:

www.comune.dogliani.cn.it

www.covar14.it



Glossary

Chamber system: this is a pay-as-you-throw system. Users are identified by a magnetic card that enables them to access the bins for chargeable waste fractions. Once a user has been identified, the container itself measures the volume or weight of the waste, depending on the scheme that is employed.

Flat rate of the waste charge: this is that part of the charge that does not depend on waste generation. It may be the same for all taxpayers or may depend on a non-waste-related variable.

Pay-as-you-throw (PAYT): system for applying a waste charge by which the users of the waste collection service pay according to how much waste they really generate and the service they use to manage the waste.

Standardized bag and/or bin: containers that have specific measurements and characteristics for depositing waste for which there is a charge, as part of the waste charge payment.

Variable fee of the waste charge: this is the part of the charge that is directly related to each service user's real generation of waste. It tends to be a unit amount (by volume or weight of waste produced) that varies according to the fraction of chargeable waste.

Waste tourism: fraudulent behaviour that may appear when pay-as-you-throw systems are introduced. It consists of illegally depositing waste in neighbouring municipalities to avoid paying the waste charge.

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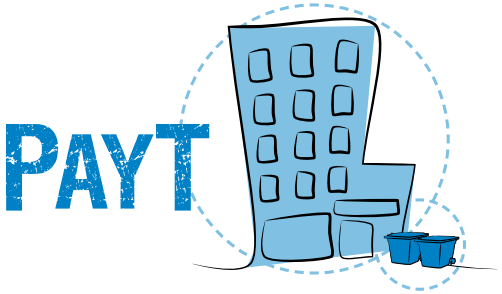
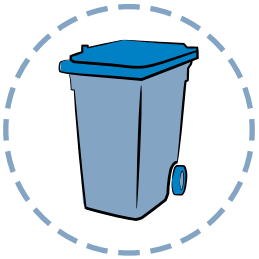

PAYT



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