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Report linked to the Med4Waste Policy Toolkit on Municipal Waste Management

FAIR WASTE CHARGING IN THE MEDITERRANEAN REGION

Key aspects that can support the implementation of efficient waste management solutions



Fair waste charging in the Mediterranean region. Key aspects that can support the implementation of efficient waste management solutions.

This report has been commissioned by BETA Technological Center (University of Vic-Central University of Catalonia) in the framework of the ENI CBC Med Med4Waste project.

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EXECUTIVE SUMMARY

To encourage local authorities to adopt highly efficient collection and treatment options, there are three main factors: social demand (public push for environmentally friendly solutions), the need to comply with sector-specific legislation, and economic costs. When the economic balance is favourable for the municipality, adoption of measures is more likely. However, without considering externalities, lower-tier waste hierarchy options (such as incineration or landfill) tend to be cheaper, which hinders the adoption of more advanced solutions. Thus, incorporating the polluter-pays principle into waste management policy is essential. When externalities are considered and assumed by polluters, environmentally friendly solutions become more competitive.

Aiming to provide guidelines for fair waste taxation, the report delves into various models of waste taxation at national, sub-national and local levels. At national and sub-national levels, the most apparent application of the polluter-pays principle in waste management policies is the adoption of landfill and incineration taxes. Locally, this principle is manifested in pay-as-you-throw (PAYT) schemes as a way to articulate waste charges. Reward schemes like Save-As-You-Throw (SAYT) models may also be an option.

Landfill and incineration taxes are widely applied in the Northern part of the Mediterranean region. Its application for municipal waste is considered relatively straightforward and highly efficient in increasing waste recycling. When these taxes are earmarked to waste management policies, their application is more accepted by taxpayers. Transparency and certainty on the evolution of the tax rates also enhance their results.

At the local level, waste charges can vary significantly, depending on their tax base or structural elements. Common options include flat rates, charges based on dwelling characteristics, number of residents, or water consumption. However, these methods do not incentivize waste reduction, separation, or recycling, as charges are not linked to individual waste management behaviour. To foster such incentives, charges should be based on actual waste generation (measured by weight or volume), by applying

schemes known as pay-as-you-throw (PAYT) or save-as-you-throw (SAYT). In these models, those generating more waste or failing in separation face higher charges, while those reducing generation and separating waste properly pay less.

Implementing PAYT and SAYT schemes requires selecting the tax base (i.e. which fractions of waste are taxed or rewarded) and structuring the charge in two parts: one of them depending on the actual waste generation; the other one being independent, aimed at covering the fixed costs of providing the service. The weight of the two parts has to be decided.

These schemes not only incentivize responsible waste management but also ensure the financial viability of waste management systems and promote a fair cost distribution among citizens. As a result, these systems reduce waste generation, increase separate waste collection and, thus, increase recycling rates. However, challenges in implementing a PAYT or SAYT scheme include economic waste coverage, securing political support, designing waste charging governance to be successful, curbing fraudulent practices (like waste tourism), addressing legal aspects (such as a fiscal ordinance), and adequate data monitoring and personal data protection.

The report presents three scenarios to contextualize these schemes to all ranges of Mediterranean countries, considering factors like existing waste collection systems and national and sub-national legal frameworks. More advanced models (such as door-to-door collection with electronic identification or collection systems based on closed smart containers) enable personalized PAYT and SAYT schemes with data monitoring, while less advanced systems (e.g. open street containers) might only support environmental tax reductions for home composting or for the use of recycling centres, or just introduce a waste charge to ensure sufficient financing for the waste management service. Intermediate situations may allow to implement PAYT schemes without individual data monitoring (e.g. frequency-based door-to-door collection).

PAYT schemes are prevalent in countries such as Italy, but are less common in other European

Mediterranean countries like Spain, France or Greece, for instance, and largely non-existent in countries in the south of the Mediterranean region.

Case studies of PAYT and SAYT from Spain, Italy, France, Croatia and Cyprus highlight the importance of good waste charge design, local context understanding, data protection, continuous monitoring, bidirectional communication with taxpayers, and public awareness campaigns in implementing these schemes.

1

INTRODUCTION

Recent research highlights the worrying environmental effects of current production and consumption patterns in the Mediterranean, which together with growing population and tourism, leads to an increase in the volume of municipal waste.

Waste management is uneven within the Mediterranean region. However, landfilling and incineration are prevalent, while the share of recycling and composting represents less than 10% of the total collected amount, resulting in a loss of resources for the region.

If not properly managed, waste can result in intensified greenhouse gas emissions, environmental degradation, loss of biodiversity, marine and air pollution, as well as pose serious risks to human health.

Continued policy implementation and monitoring is therefore strategic to sustainably manage municipal waste and minimise its consequences on the environment and society.

In spite of the global implications of municipal waste management, implementation of collection and treatment services remains a local issue. To encourage local authorities to adopt highly efficient collection and treatment options, there are three main factors: social demand (public push for environmentally friendly solutions), the need to comply with sector-specific legislation, and economic costs. When the economic balance is favourable for the municipality, adoption of measures is more likely to occur. However, without considering externalities, lower-tier waste hierarchy options (such as incineration or landfill) tend to be cheaper, which hinders the adoption of more advanced solutions. Thus, incorporating the polluter-pays principle into waste management policy is essential. When externalities are considered and assumed by polluters, environmentally friendly solutions become more competitive.

This report delves into waste taxation¹ at national, sub-national and local levels. At national and sub-national levels, the most apparent application of the polluter-pays principle in waste management policies is the adoption of landfill and incineration taxes. Locally, waste charges can guarantee

adequate financing of the collection and treatment services. These charges may adapt to the polluter-pays principle by adopting pay-as-you-throw (PAYT) or Save-As-You-Throw (SAYT) schemes.

This report is structured into three sections: the first one is dedicated to those national and sub-national management policies that can be applied to improve waste management, the second includes a general description of waste charges and PAYT schemes applied at local level and its technical, legal and social implications, and the third section tries to consider the different possibilities around waste charging at the local level depending on the context. Three different contexts, representative of different situations in the Mediterranean, have been presented to discuss the options to improve waste charging and introduce unit pricing in each of them.

This document aims to serve as a guidance, especially for local policymakers, to ensure cost coverage of waste management and adoption of incentives towards waste prevention and recycling in the Mediterranean region.

¹ In this report two types of levies are considered: taxes and charges. Taxes are compulsory and unrequited, while charges (sometimes also referred to as fees) must be required, which means that a direct service is received for the payment.

2

WASTE TAXATION AT SUB-NATIONAL AND NATIONAL LEVELS

As explained in the previous section, economic instruments can have a crucial role in improving waste management. Although this report focuses on waste charges, an overview of economic instruments potentially applicable at national and sub-national level needs to be presented. The two main reasons are: a) economic incentives at national/sub-national level need to be coherent with incentives applied at local level; b) incentives at national/sub-national may significantly affect the costs of waste management and this would thereby affect the revenues that local waste charges may need to raise.

This section focuses on taxes and economic instruments that have a direct effect on local finances, and therefore on waste charges, which are the main focus of the report. These two economic instruments are:

- | Landfill and incineration taxes.
- | Fee-rebate schemes.

Other economic instruments have also some relevance for local finances, but generally less significant, and for this reason are not further developed in this section: e.g. extended producer responsibility (OECD, 2016) –including deposit-refund schemes–, subsidy programmes, landfill allowance trading schemes (Calaf et al., 2014), taxes to specific products (e.g., plastic bag taxes [e.g. Anastasio, Nix, 2016] or VAT reductions [e.g. Oosterhuis et al., 2008]), etc.

2.1 Landfill and incineration taxes

The adoption of highly efficient collection and treatment options by local authorities is normally motivated by social demand (the public pushing for more environmentally friendly solutions) or for the need to comply with obligations and targets

coming from sectorial legislation. However, the cost of advanced collection and treatment solutions is also relevant, and the application of the polluter pays principle is crucial to economically balance the adoption of these improved environmental solutions.

At national and sub-national levels, the most apparent application of the polluter-pays principle in waste management policies is the adoption of landfill and incineration taxes.

Landfill and incineration taxes are widely applied in the Northern part of the Mediterranean region. Most European countries (22 Member States) already have landfill taxes in place for municipal waste. They are sometimes used in combination with bans on the landfilling of certain types of waste. Some countries also have incineration taxes (9 Member States), typically with tax rates lower than those for landfilling (European Environmental Agency, 2023).

Landfilling and incineration are the less preferable options of the waste hierarchy, due to their associated environmental impacts. This is clearly recognised in the European Union, art. 4 of the Waste Framework Directive (Directive 2008/98/EC) in which “Disposal” ranks last in the hierarchy, and “Other recovery, e.g. energy recovery” only comes immediately before. Besides, the Landfill Directive (Council Directive 1999/31/EC), which was revised in 2018, indicates in art. 5.5 that “Member States shall take the necessary measures to ensure that by 2035 the amount of municipal waste landfilled is reduced to 10 % or less of the total amount of municipal waste generated (by weight)”.

Beyond the EU, multilateral institutions, such as the World Bank (World Bank Group - Tokyo Development Learning Center, 2018; World Bank, 2021) or regional institutions, such as MedCities (MedCities, 2003) or ARLEM (ARLEM, 2014) have also advocated for the implementation of the waste hierarchy. The World

Bank Group, for example, explicitly indicates that “Economic instruments in support of the waste hierarchy include landfill taxes that increase the cost of disposal” (World Bank Group 2018: p.10).

Therefore, by applying the polluter pays principle, landfill and incineration taxes increase the cost of these facilities cost compared to alternative treatment options (e.g. composting). In the case of municipal waste, these taxes are generally paid by local authorities, who are also in charge of waste collection. Therefore, they are incentivised to adopt strategies to divert waste from landfills and incinerators, which normally means improving separate collection of biowaste and recyclables and stabilising non-separately collected waste before disposal (e.g., through mechanical-biological treatment –MBT– plants).

These taxes are considered an effective means to divert waste from the taxed facilities. A clear negative correlation has been observed between total cost of landfilling (gate fee plus landfill tax) and the percentage of waste being landfill at a country level (Watkins et al., 2012). Apart from effective, they are also an economically efficient instrument. As typical environmental taxes, they tend to internalise environmental externalities, which increases economic efficiency in the allocation of resources in the market (Field, Field, 2012). As for other environmental taxes, efficiency comes from the fact that the most significant improvements in collection/recycling come from those agents from whom adoption is cheaper. Contrarily, when adoption is more expensive than paying the tax, it does not take place.

According to economic theory, environmental tax rates should reflect the marginal external cost (Pigou, 1920). For this reason, it is common that landfill and incineration taxes differentiate tax rates according to the type of facility (e.g. landfill vs incineration, incinerators with or without energy recovery, etc.) or to the type of waste (e.g. pretreated waste in MBT facilities versus direct landfilling). This increases the economic efficiency of the tax.

Another aspect that can increase the effectiveness and efficiency of landfill or incineration taxes is to

have predictability in the evolution of the tax rates, as taxpayers can have more certainty on the evolution of the disposal costs when they take decisions on long-term investments (e.g., new collection systems or composting facilities). An example is the UK landfill tax escalator, which consisted of a £3/t annual increase of the tax rate between 2005 and 2007, and a subsequent £8/t annual increase between 2008 and 2014, raising the tax rate for municipal waste from £15/t in 2004 to £80/t in 2014 (HM Treasury, 2021).

As it generally happens with environmental taxes, when revenue is dedicated to specific related purposes (‘earmarking’) their application is more accepted by taxpayers (European Environment Agency, 2000). In this case, this refers to dedicating the revenue to promote waste management policies in the upper tiers of the waste hierarchy: investments in composting plants and other treatment facilities, subsidy programmes for local authorities implementing separate collection or waste prevention programmes, awareness raising campaigns, etc.

One example of earmarked landfill and incineration tax occurs in Catalonia. The landfill tax entered into force in 2004 and subsequently was extended to incineration in 2008. Revenues go to a specific fund dedicated to improving separate collection and waste management treatment. Decisions on the destination of these funds are taken by the Catalan Waste Agency and by representatives from local authorities. Typically, most of the revenue is channelled back to municipalities and other local authorities (who are also the taxpayers) according to a set of unitary amounts for different concepts agreed on an annual basis. For example, in 2023, local authorities that justify separate collection of biowaste receive 12 €/t multiplied by two coefficients (one depending on the size of the municipality, and one depending on the percentage of impurities). Besides, they receive 34 €/t for the biological treatment of this biowaste. Several other compensations also apply, e.g. for separate collection of textiles, green waste, recycling centres, home composting, pre-treatment before disposal, etc. (Agència de Residus de Catalunya, 2023).

All in all, landfill and incineration taxes are a cornerstone of sensible waste management policies. However, despite their significant contribution to separate collection and recycling, landfill and incineration taxes do not significantly contribute to moving to the highest tiers in the waste hierarchy: advancing towards prevention and preparing for re-use implies a profound rethinking of the production and distribution strategies by the industry, and the industry is not affected by the incentives created by the landfill and incineration taxes on municipal waste.

Another important question to consider relates to illegal dumping. In some Middle East and North African countries still a significant percentage of municipal waste is managed informally. For example, Kaza et al. (2018) estimated that 53% of all waste is disposed of in open dumps in the region. In such cases, a landfill tax on formal sanitary landfills may have the undesired side effect of diverting waste to informal facilities. In such cases, closing down inadequate dumping sites should precede the adoption of landfill taxes.

2.2. Fee-rebate schemes

Intermunicipal cooperation is frequent in waste management, taking different possible forms, to ensure sufficient scale and efficiency. In particular, is common for municipalities to group themselves to share collection services and, most frequently, treatment facilities (e.g. composting plants). In these associations of municipalities, costs are distributed according to some criteria (e.g. number of inhabitants or amount of waste entered to the shared facilities) which often do not provide sufficient incentives for good practices. In this context, feebate systems can set the incentives right.

Fee-rebate (or feebate) schemes consist of a simultaneous use of fees and rebates to incentivise more environmentally friendly products or activities. In practice, those that are less environmentally friendly compared to the average are charged fees, whereas the most ecological ones receive rebates, making them more economically attractive

compared to the initial situation. The more environmentally harming a product/activity is the greater the fee, and vice versa. Products or activities with the average environmental performance are neither charged nor subsidized. Globally, fees and rebates cancel each other out, and therefore this tool is neutral for the budget of the Administration that sets it up (apart from the administrative costs). This economic instrument can be applied to products and services, but also can be applied in the area of waste management.

So, in the context of distribution of treatment costs among municipalities, a feebate system could reward those municipalities making significant steps towards ecological waste management, whilst penalising the others, using the average values as a reference. Some indicators that could be used to define fees/rebates to stimulate separate collection could be per capita generation collected separately, or per capita generation of biowaste entering composting facilities or percentage of separate collection of biowaste (in all cases, if possible, discounting impurities).

The articulation of this instrument was proposed theoretically (Puig, 2004), and it was suggested that the feebate (fb) was defined for each municipality (i) and for each waste treatment as a linear function of the difference between the per capita waste delivery of waste by the municipality and that of the association of municipalities for each treatment.

A simpler version would be to refer fees and rebates to one treatment, e.g. composting:

$$fb_i = n * \left(\frac{t_i}{pop_i} - \frac{\sum_{i=1}^p t_i}{\sum_{i=1}^p pop_i} \right) * pop_i$$

Where:

- t_i tonnes from the municipality i brought to a composting facility
- pop_i population of municipality i
- p number of municipalities
- n constant defined for composting

If n is defined as a negative value, those municipalities with higher per capita waste collection of biowaste will obtain a rebate, while the others would face a fee.

Another option would be to use as indicator the per capita generation of waste with destination to landfill. In this case, n should take a positive value, so municipalities with generation above the average would have to pay a fee and vice versa.

This instrument, with some variations, was successfully applied in the Metropolitan Area of Barcelona (Puig, 2006), from 2004 to 2017.

3

WASTE CHARGING AT LOCAL LEVEL

In the following sections, several issues related to waste charging and Pay-As-You-Throw schemes are discussed. These all are contextualized at the local level. The section includes an overview of waste charging principles, followed by a detailed examination of the technical, legal and privacy management requirements for the implementation of PAYT and reward-based schemes. Additionally, economic issues necessary for cost coverage as well as the impact on waste flows, potential barriers arising from the introduction of unit pricing schemes and issues about waste charging governance are explained.

3.1. Generalities about waste charging

Local waste management services need a dedicated source of financing. In most countries this is articulated by means of specific waste charge levied by local (often municipal) authorities. Waste charges need to be designed to achieve a certain revenue target. This target depends on the net cost of the service and on the percentage of these costs that the charge needs to cover.

Therefore, the first step is to estimate the cost of the waste management service for the local administration. In this sense, a list of potential costs and revenues to consider is presented in section 3.2.

On the other hand, waste charges can take many different forms, depending on the selection of their tax base or other elements of their structure.

In the case of domestic users, the main options are:

- | Flat rates: application is simple, but inequitable. They have no correlation with income level or waste generation.
- | Waste charges depending on the characteristics of the dwelling: normally square metres or property value. These variables have some positive correlation with income level and waste

generation. Besides, they change little over time, which facilitates the administration and collection of the charge.

- | Waste charges depending on the number of residents: whereas this variable has strong correlation with waste generation, it has no correlation with income level. This variable changes quite significantly over time, which poses an additional difficulty.

- | Waste charges depending on water consumption: including the waste charge in the water bill reduces collection costs and the number of unpaid bills. Besides, there is a correlation between water consumption and waste generation. However, this option lacks transparency and tends to be more contested than others.

A common limitation of these alternatives is that none of them can create an incentive for reduction, separation or recycling, as the amounts being charged do not depend on the individual behaviour related to waste management. To create such an incentive the waste charge needs to be based on actual waste generation (either weight or volume), what is known as pay-as-you-throw (PAYT). Under such models, users that generate more waste and are worse at separation face higher waste charges, while those that reduce and separate their waste properly, pay less.

3.2. Importance of accurate assessment costs

The determination of the net costs and the target of revenue collected with the waste charge are key elements to design the tariffs.

First, the following concepts need to be taken into consideration in the determination of the total cost:

- | Collection costs of the main waste fractions (biowaste, packaging, paper, glass, and refuse),

but also special collection services such as bulky waste, textiles, WEEE, etc., and waste collection centres.

- | Treatment costs for the different fractions.
- | Communication and campaigning costs.
- | Costs related to monitoring users and inspection.
- | Costs of administrative and technical staff of the city council/local authority.
- | Waste Collection Centre costs.
- | Amortization of investments.

Some countries also have specific taxes (e.g. landfill and incineration taxes) or obligations which translate into costs (e.g. maintenance of landfills after closure or need to acquire tradable permits for landfill disposal or emissions).

Additionally, there are sources of revenue that need to be considered:

- | Grants and subsidies received.
- | Revenues from Extended Producer Responsibility schemes (e.g. for packaging, WEEE, etc.).
- | Secondary material or energy sales that report income for the municipality (e.g. from waste incineration facilities or methane recovery from landfills). Often these are already included in the tariffs that municipalities pay for the use of these facilities.
- | All bonuses applied in the configuration of the final tariff must be considered and reduced from the final revenue estimation (no matter if they relate to actual waste generation and disposal or related to socioeconomic circumstances or to other environmental practices).

These net costs should be based upon the last figures available, but then need to be extrapolated for the year for which the waste charge is approved. Thus, a projection will be required.

Then it comes to the decision on which percentage of these net costs are to be covered by the waste charge. The remaining part would be covered by general funds of the Local Authority (e.g. property taxes). However, in some countries full cost coverage is a legal requirement.

3.3. General description of PAYT and of rewarding schemes

Under **pay-as-you-throw schemes**, waste charges are usually structured into a general part and a variable part. The general part is independent of waste generation (it can take any of the forms presented in the previous section) and is where the social discounts can be applied. The variable part is what truly depends on the individual waste generation of each taxpayer and is typically between 20 and 40% of the total charge. The larger the percentage of this part, the stronger the incentive created towards source separation.

An important step in configuring the variable part is to decide the **fractions to be charged**. This will be discussed in the section 3.3.1.

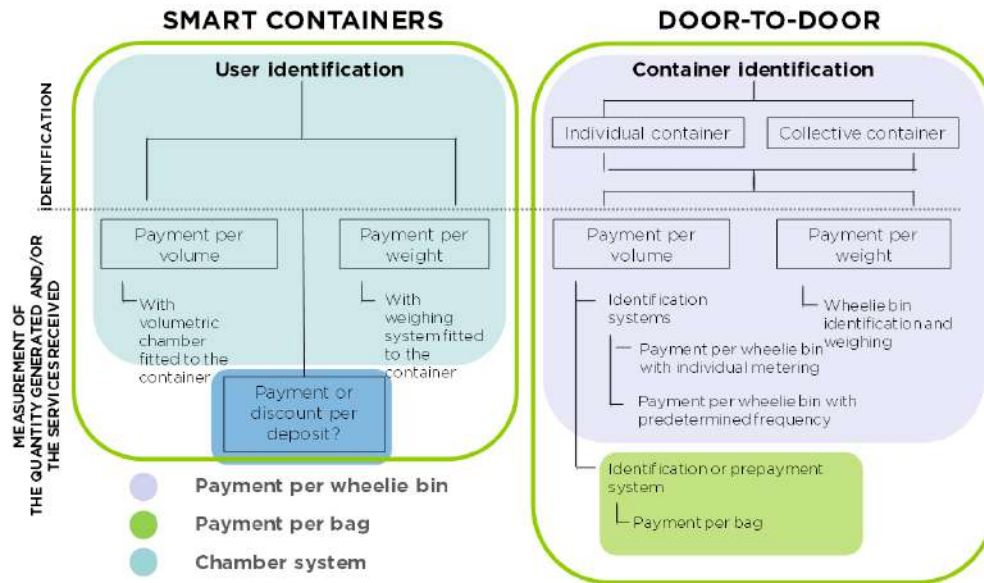
There are many **different variations** of pay-as-you-throw schemes, but they are all based on two pillars (ARC, 2010):

- a) Identification of the waste producer.
- b) Measurement of the quantity of waste generated and/or the services used.

The combination of these two pillars, allows for the final step, which is individual charging.

Figure 1 summarises the most common pay-as-you-throw (PAYT) schemes, according to the main ways of identifying the producer and measuring their generation.

Figure 1. Summary of main pay-as-you-throw (PAYT) schemes



Source: Own elaboration based on Reichenbach et al. (2004)

A variation of PAYT is what is known as **save-as-you-throw (SAYT) (or also Reward-as-you-throw - RAYT)**. In this case, rather than increasing the waste charge according to waste generation, users pay less the more waste they separate at source and hand in separately to the waste collection service. This of course only makes sense for recyclables, and specifically for biowaste, since separate collection of these fractions reduces the amount of residual waste. However, these schemes do not incentivise waste prevention nor efficient waste collection costs. In fact, PAYT and SAYT can be applied in combination, for example, PAYT for residual waste and SAYT for biowaste.

a) Identification of the waste producer

The identification of the user of the waste collection service is the first step to develop a PAYT scheme, as it is the subject to whom the waste charge will be assigned. The material needed to identify and measure the participation of users must be distributed before the approval and roll-out of the waste charge. Furthermore, this material should be

managed and linked to the database that is used to individually calculate the waste charge for each user.

Depending on the waste collection model, different identification systems are recommended and, consequently, different materials need to be distributed:

• **Identification of the individual container (door-to-door collection models).**

In door-to-door collection systems, the act of leaving the bin, wheelie bin or bag on the doorstep implicitly identifies the container's owner. This already allows for some basic forms of PAYT schemes.

o NON-TECHNOLOGICAL SYSTEMS

These systems are based on the use of a standardised bag or a standardised bin with a predefined collection frequency.

In the first case, users of the service pay for each bag when they purchase it, so it is a pre-payment system. The price of the bags varies depending on the fraction and volume. Bags should have a distinctive logo and be translucent, to allow the operatives to verify that the contents correspond to the fraction for which the bag is designated. Biowaste is typically not charged under this model, as the aim is to incentivise separation. The bags should be distributed by the local authority or by intermediary partners, such as retailers with partnership agreements. There might also be bag dispensing machines, with examples in Italy.

In the case of wheelie bin, the payment may depend on the fraction, on the volume required by each taxpayer, and on the predetermined collection frequency. Payment is thus unconnected with actual use. This last option is more secure in cases where applying payment for each delivery may constitute a risk of *waste tourism*,² for example cases of door-to-door commercial collection where there are open communal containers on the street for the domestic use. It is also typically applied to biowaste in combination with PAYT models for residual waste fraction, so as not to discourage separation of the biowaste.



As an additional option, each bin or bag can be equipped with a tag or chip that can be read by the truck or by the collection workers' technology, allowing a digital record of the number of times each user makes use of the collection service (see next point).

o TECHNOLOGICAL SYSTEMS

Technological systems typically function with bins fitted with a chip, tag or some identification element. This identification element carries the information associated with the volume of the bin, the fraction and the taxpayer to whom the bin corresponds.

In all these systems, the information (number of uses, volume, etc.) is gathered for a period (e.g. a year, or a quarter) and the payment takes place afterwards.



• Identification of the user (smart containers)

Systems with user identification can be implemented in areas where communal smart containers are used at least for some fractions. Under this format, the containers for the fractions subject to a charge can only be opened with prior user identification (using a magnetic card or smartphone). These user identification models with locked containers are typically only intended for household users, as the

² *Waste tourism* refers to the phenomenon whereby waste is transported from one place to another in order to take advantage of disposal options, e.g. in the case of PAYT that would mean transporting waste to a nearby municipality (for example with waste collection through open street containers) in order to avoid the payment of the variable part of the waste charge.

recommendation is that large producers should use dedicated door-to-door collection systems.

If locking residual waste containers poses an excessive risk of *waste tourism* or irregular disposal, an option is to lock them but not linking their use to a PAYT scheme, or even only locking biowaste containers and supporting their use with a SAYT scheme.



b) Measurement of the quantity of waste generated and/or the services obtained

The waste charge varies according to the amount of waste deposited for the fractions that are charged. The amount of generated waste of these fractions can be measured by volume, weight, or, less precisely, by the number of deliveries.

In door-to-door systems, it is generally measured by volume. Hence, each taxpayer has standardised buckets or bins with a known volume, which are registered with each use. In the case of using a pre-paid bag system, the price of the bag also varies according to its volume. However, there is also the possibility of measuring weight; in this case, a high-precision weighing system must be incorporated in the truck.

The recommended volumes for domestic bins with typical door-to-door collection cycles would be between 15 and 25 litres for biowaste, between 20 and 25 litres for residual waste, and between 40 and 50 litres for lightweight packaging. Larger volumes may apply in low density dwellings with lower collection frequencies or in cold climates. Also, large volumes apply for commercial activities.

Payment may be by weight or by volume. Payment by volume is predominately used because it is simpler in technological terms, and because it serves to minimise the number of collections, since taxpayers tend to put out their bins or bags only when they are full.

In closed smart containers, a volumetric chamber or drawer system can be installed. These chamber systems mainly consist of a rotating semi-cylindrical drum anchored to the lid of the container, with an opening system linked to user identification. The chamber system or the volumetric drawer has a limited disposal volume (e.g. 20, 30, or 50 litres). These chamber systems may also incorporate a scale that weighs the delivered waste.

In closed smart containers without chamber system, only the number of deposits per user can be measured. This could reduce the accuracy of the charge. This last option might be adequate to monitor regular participation, for example, in biowaste separate collection, to articulate discounts under a SAYT scheme.

3.3.1. Considerations about fractions to be measured

To decide which fractions to measure or include in the design of a PAYT scheme, the following must be considered:

| Taxing **residual waste** represents an incentive both to reduce residual waste and to participate in separate collection. For this reason, this is always a fraction to monitor and charge in a PAYT scheme. However, this makes the system susceptible to *waste tourism* or fly tipping. To prevent these, comprehensive monitoring should be put in place and data should be analysed to

detect possible abnormalities in the number of residual waste disposals by each taxpayer. SAYT schemes are only based on incentivising separate collection of biowaste and recyclables to prevent impurities in these fractions, leaving residual waste unmonitored or at least uncharged.

| The **organic fraction** represents the most important fraction by weight with municipal waste and, therefore, its separate collection should be the main priority.

- o At household level, it is not recommended to charge so as not to discourage correct separation. To achieve a correct separation, at least in smart containers it is recommended to monitor and incentivize it with bonuses (SAYT). In the case of door-to-door collection it is not a requirement, but it may also be a possibility.

- o On the other hand, generation of biowaste should be charged in the case of large commercial waste producers, since commercial generation varies a lot depending on the type of business, and for some of them the volume of generation requires high frequency of collection, thus increasing the cost of the service.

| **Packaging waste** can be significantly reduced through changing habits, and it is one of the most difficult fractions to recycle, so there are reasons to charge it, which some municipalities do. On the contrary, some other municipalities apply incentives for packaging separation, but this may have the unintended consequence of encouraging its generation. When it is charged, the fee should be much lower than that for the residual fraction not to discourage its correct separation.

| **Paper, cardboard, and glass** are fractions that are not usually charged, not to discourage their selective collection. Furthermore, collection of these fractions does not generally represent a significant net cost for the municipality due to the income they can generate through sale of materials and income from producer responsibility organisations, where applicable.

3.3.2. Legal aspects

Implementation of PAYT or other fiscal measures needs to be backed by regulation, not only of the aspects strictly related to charging (local fiscal regulations), but also of the main aspects of the waste collection service (municipal ordinances), for example, which waste fractions need to be separated at source and how these need to be delivered to the collection services.

The regulation of the waste charges in the local fiscal ordinances need to include all the relevant aspects to determine the fee corresponding to each user of the service (taxable event, tax base -if applicable-, charge rates, exemptions, reductions, etc.). Different provisions apply to households and commercial activities. In the case of pay-as-you-throw schemes, the waste charge regulation needs to define which waste fractions are charged, how they are measured (weight/volume) and how much are they charged (cost per kilogram, litre, or use). In the case of other environmental benefits applied to the waste charge, other aspects need to be defined, like the conditions to be accomplished by the user to receive these benefits.

The municipal ordinances must be coherent with the waste charge regulations, and of course they also must be consistent with sub-national and national waste regulations. These ordinances also need to include a section on enforcement and penalties.

Municipal waste charges are due annually, and they need to be approved previously, following the corresponding legal procedure, which usually comprises some period for public consultation. Those periods are conceived to offer transparency and give the opportunity to the users of the service to present their allegations to the waste charge definition. This period is of high importance to guarantee user's rights of participation. The waste charges can be updated subsequently, generally on an annual basis.

3.3.3. Personal data protection

“Personal data” means any information relating to an identified or identifiable natural person (‘data subject’). An identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person.

Waste management systems with individualised collection, and especially those including user identification, require the collection and processing of personal data from waste producers and their habits regarding waste production and participation in the system.

Collected data may include information (1) about the user (waste producer): identity, address, contact details, type of user, household or commercial premises features, etc.; (2) about the waste production and delivery to the collection system: waste quantity or volume, type, quality, delivery frequency, time, location, method of waste collection, etc; and (3) other complementary data: assigned user codes, type and number of incidences, number and type of materials assigned like bags, bins or identification elements, gamification participation, etc.

Data may be used for various purposes, such as monitoring the results and performance, planning, optimising the service and results, or enforcing waste management policies and services. Some of this information may be used to calculate waste management charges, including the establishment of variable part based on waste generation of specific fractions and/or the levels of participation in the system, if applicable.

Regulations on personal data protection vary across countries. For this reason, this section includes two subsections, one for the EU countries and another one with general reflections for non-EU countries.

• *Personal data protection in the EU countries*

In the EU, personal data protection is a fundamental right as per the EU Charter of Fundamental Rights and the Treaty on the Functioning of the European Union.

The right to the protection of personal data is governed by Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of individuals with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC, also known as the General Data Protection Regulation (GDPR)³.

The GDPR applies to the processing of personal data⁴ by private and public entities, both inside and outside the EU, for commercial, administrative, or other purposes.

The GDPR imposes obligations on Data Controllers (in our case, generally, local entities with the competences in waste management)⁵ and Data Processors (in most cases, private companies providing the collection service via public contracts

³ The GDPR is not the only legal instrument that applies to the personal data protection elements in waste management. Depending on the context and the scope of the processing, other relevant laws and regulations may also apply, such as the Data Protection Law Enforcement Directive, the ePrivacy Directive, the Waste Framework Directive, the Environmental Information Directive, or the national laws of the EU Member States.

⁴ Special categories of data” means the types of personal data to which the data protection regulations grant maximum protection. This group includes data related to ethnic or racial origin, political opinions, religion, trade union membership, genetic or biometric data, health data or data related to sexual life or sexual orientation. In relation to these special categories of data, there is a general prohibition of processing, and it is only possible to process them in very specific cases (Article 4 of the GDPR).

⁵ Other managerial contexts can be found with the direct provision of the collection service by the public local entity as well as with a private company signing a private contract with the users to provide the collection service.

with local entities)⁶, such as the principles (Article 5 of the GDPR) defined below:

- **Lawfulness:** Personal data can only be processed if there is at least one legal basis allowing the processing, such as the consent of the data subject, the performance of a contract, the compliance with a legal obligation, the protection of vital interests, the performance of a task in the public interest, or the legitimate interests of the controller or a third party.

In the case of waste collection systems managed by local entities (directly or via a public contract with a private service company), the processing of involved data⁷ is directly legitimated in the performance of a mission of public interest or in the exercise of Public Authority. When waste collection or related billing involves profiling⁸ that has an effect on the person using the service, such as models applying PAYT or SAYT⁹, one of the following is required (ENT Foundation, 2022):

- 1) The consent of the concerned data subject,
- 2) The provision of an EU or Member State law for such profiling, or,
- 3) A contract between the data subject and a Data Controller.

In other situations when the service user has a direct contract with the collection company to receive the service, the applicable legal basis is the performance of a contract. For some additional or complementary data not strictly necessary to develop the service or the related monitoring and billing, the specific and explicit consent of the subject is required.

- **Fairness:** The processing must respect the rights and interests of the data subject, and not cause any undue harm or disadvantage to them.

It is also necessary to assess whether, before putting the waste collection system into operation (before collecting personal data), a data protection impact assessment (DPIA)¹⁰ is required, especially if profiling is applied in the data processing. In the event of modifications to the collection model, data processing protocols or charges, the DPIA

should also be revised accordingly (Agència de Residus de Catalunya, 2023).

If, as a result of the DPIA after defining measures to minimize the detected risks, the Data Controller continues observing a high risk that cannot be mitigated or reduced by reasonable means in accordance with the available technology and its implementation costs, the Control Authority must be consulted before initiating such processing (ENT Foundation, 2022). The Control Authority must provide the Data Controller with some recommendations and may also prohibit that processing.

- **Transparency:** The data subject must be informed about the identity and contact details of the Data Controller and the Processor, the purposes and legal basis of the processing, the categories and sources of the data, the recipients and transfers of the data, the retention period and criteria of the data, the rights and remedies of the data subject,

⁶ When a City Council (Data Controller) uses a company (Data Processor) for the provision of the waste collection service and the company has access to personal data, this relationship must be regulated by a contract or other legal act, such as a collaboration agreement, which must respect the minimum content determined in Article 28.3 of the GDPR. In case Data Processor may entrust certain activities to a sub-processor (such as ICT or communication companies), a contract is required with the same data protection obligations stipulated in the initial contract signed with the Data Controller who additionally must authorize that sub-processor.

⁷ It is important to detail data protection matters and collected data as well as define related managerial tasks (including agents involved) in the corresponding municipal regulations and justify them based on local competences and waste management needs.

⁸ Profiling is the processing of data to evaluate certain personal aspects of an individual; in particular, to analyse or predict aspects of that subject's personal preferences, interests, reliability, behaviour, location, or movements.

⁹ The management of PAYT waste charges can lead to the development of behavioural profiles of people using the collection service as the service user routines, performances or preferences can be established and certain user's behaviour aspects can be evaluated (ENT Foundation, 2022).

¹⁰ The GDPR contains a list of treatments considered high-risk in which the DPIA is required (such as use of profiling, large-scale data treatments, application of new technologies, etc.). The contents of the DPIA include: the description of the processing, such as the life cycle of the data; the purpose or legal basis; the assessment of the necessity and proportionality of the processing; risk assessment and measures to minimize them; etc.

and the existence of any automated decision-making or profiling. The information provided should be concise, transparent and intelligible.

When data is collected from the same data subject, the information must be provided at the time of collection and its contents are defined in Article 13 of the GDPR. When data is obtained from another source (e.g. another administration), the information to be provided is defined in Article 14 of the GDPR.

- Purpose limitation: The data must be collected for specified, explicit, and legitimate purposes, and not further processed in a manner incompatible with those purposes. That is, data collected for a purpose cannot be used for anything else.
- Data minimisation: The data must be adequate, relevant, and limited to what is necessary for the purposes of the processing. In this regard, local entities with competence in waste collection can process the data that is strictly necessary. The selection of the parameters needed according to the specific purposes and waste management activities is key and they should be able to clearly justify it.
- Accuracy: The data must be accurate and, where necessary, kept up to date. Any inaccurate or outdated data must be erased or rectified without delay.

Local entities should introduce mechanisms to facilitate user access to any records, submission of eventual allegations and protocols to revise or correct the charge calculations or other information processed. The technology reliability is essential and mechanisms to prevent possible data record or tracking errors must be considered. Additionally, the algorithm used to establish the amount of the charge should guarantee no gender or social discrimination (Agència de Residus de Catalunya, 2023).

- Storage limitation: The data must be kept in a form that permits identification of the data subjects for no longer than is necessary for the purposes of the processing. After this period, they

can only be kept for research, statistical or archival purposes of public interest.

- Integrity and confidentiality: The data must be processed in a manner that ensures appropriate security, including protection against unauthorized or unlawful processing and against accidental loss, destruction, or damage, using appropriate technical or organisational measures. In relation to this principle, a duty of confidentiality is imposed on all staff as well as mechanisms to restrict and configure the profiles access for certain service personnel should be applied.

The GDPR also requires that adequate measures be taken to ensure data security, according to a previous risk analysis and enumerates security measures such as: minimize data processing, pseudonymization¹¹ or encryption of data, audit the measures applied, data restoring ability, fight against attacks or system errors, protect data servers in the framework of EU territory, etc.

- Principle of proactive responsibility or accountability: The Data Controller must be aware, diligent and proactive in relation to all processing of personal data in order to ensure that law requirements are correctly applied.

In addition, the GDPR includes requirements regarding data protection by design and by default¹², data breach notification, and cooperation with supervisory authorities, among others.

The GDPR also grants the data subjects various rights, such as the right to access, rectify, erase, restrict, or object to the processing of their data, the right to data portability, and the right to lodge a complaint with a supervisory authority. In this

¹¹ Pseudonymization, which is not the same as anonymization, is the process of treating data in such a way that it can no longer be attributed to a person without the use of additional information, which must be stored separately and with very strict security measures.

¹² The local authority must be able to demonstrate that data protection and necessary measures to minimize the risks for the interested parties have been considered when designing a collection model or a unit pricing scheme.

sense, Data Controllers must establish mechanisms to facilitate the exercise of rights and access to the collected data.

• **Personal data protection in the southern Mediterranean countries**

The rules of personal data protection in the southern Mediterranean countries vary depending on the level of alignment and cooperation with the European Union (EU) and its legal framework on data protection, especially the General Data Protection Regulation (GDPR) and the Data Protection Law Enforcement Directive.

Some of the countries in the region, such as Tunisia, Morocco, and Egypt, have adopted national laws on data protection that are inspired by or compatible with the EU standards. Other countries have not yet enacted comprehensive data protection legislation but have some sectorial laws or draft bills that address some aspects of data protection (Council of Europe, 2022a).

The Council of Europe has organised regional conferences and activities to raise awareness of the need and benefits of strong data protection for both individuals and economies in the southern Mediterranean region (Council of Europe, 2022b). The Council of Europe also provides legal and technical consultancy and assistance to the countries in the region to help them harmonise their data protection frameworks with the EU and the Council of Europe standards, and to facilitate their accession to the Convention 108 on data protection of the Council of Europe and its modernised version.

3.4. Waste flow balance

When a PAYT waste charge is implemented, generally the charged fractions such as residual waste or packaging tend to reduce. The rate of separate collection tends to improve, specifically for biowaste, which also improves in quality. Bulky items and textiles tend to increase as well. The magnitude of this, however, always depends on the incentives that are applied.

On the other hand, it must be considered that at the beginning of the implementation some citizens might illegally dump waste.

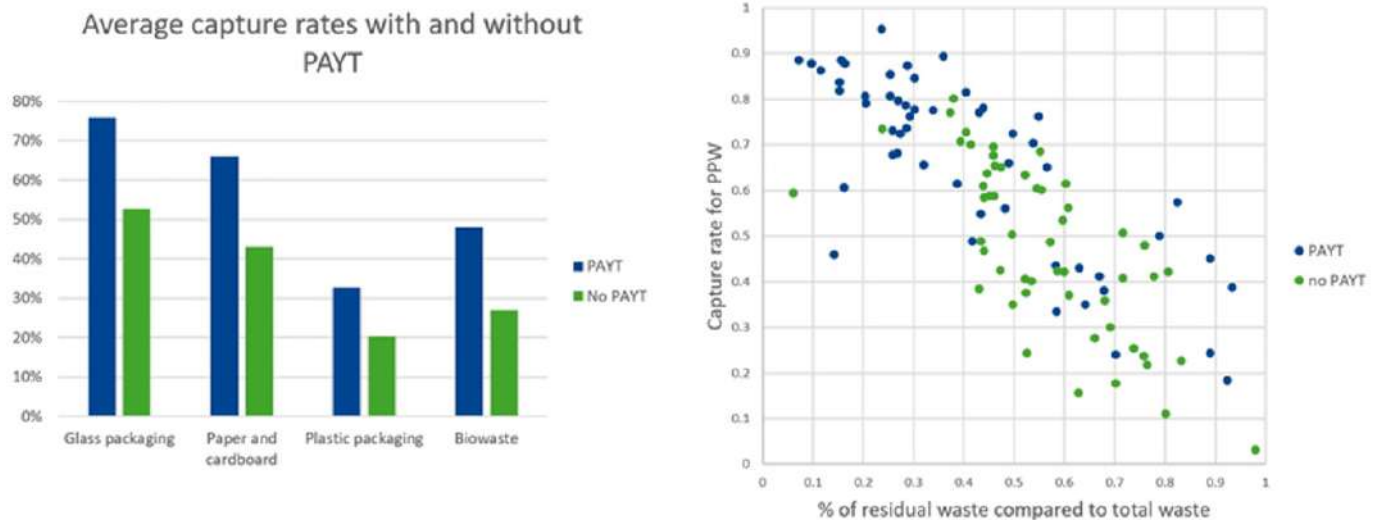
The next table presents a list of the effects observed on waste flows when PAYT waste charges are implemented.

Potential waste flow changes with the introduction of PAYT waste charges

WASTE FRACTION	EXPECTED TREND
Charged fractions (residual waste and packaging where applicable) in door-to-door collections	Tend to reduce
Percentage of separate collection from door-to-door collected waste fractions	Tend to increase for non-charged fractions
Domestic bio-waste fraction (bonused)	Tends to increase
Business' bio-waste fraction from door-to-door collection	Tends to increase and improve its composition
Bulky waste collected	Tends to increase
Textile collected at specific containers	Tends to increase
Waste delivered to Waste Collection Centre	Tends to increase
Irregular dumping	Tends to increase. However, the trend depends on the adopted selective collection model, the services provided and the implementation of monitoring and sanctioning mechanisms.

Figure 2 presents the correlation between the implementation of PAYT schemes and the reduction of the waste generated and the recovery of recyclable materials.

Figure 2. Relation between PAYT schemes implementation, the reduction of residual waste and the percentage in recyclables recovery



Source: ACR+, 2021.

3.5. Overall economic balance

The net cost balance is the difference between gross costs minus income received from recyclable fractions. The list of costs and revenues that should be taken into account has been presented in section 3.2. The percentage of coverage of net costs can be calculated dividing the economic revenue of the waste charge (numerator) by the calculated net costs (denominator).

As introduced in section 3.4 PAYT schemes usually influence waste flows by reducing the production of residual waste and increasing the collection of recyclable materials. This has a direct effect on the net costs because managing recyclables is generally cheaper, due to the potential value these materials have in the market. Nevertheless, the reduction of residual waste not always reports a sufficient reduction of costs to ensure the economic sustainability of the PAYT scheme. Hence, it is relevant to combine PAYT charges with other tools that allow internalizing the environmental impacts of not properly separating waste, for example, extended producer responsibility (EPR) schemes or landfill and incineration taxes (section 0).

3.6. Potential barriers for the correct implementation of variable charging and participation control

When introducing a fair charge there are potential risks of non-payment of the variable part. These risks can exist in both door-to-door and smart containers collection systems, and they are detailed below:

3.6.1. Risks of fraud in door-to-door collection system

In door-to-door collection system, risks of fraud are related to:

- | Illegal dumping in public street bins, communal containers and/or in nearby open spaces. The inclusion of a penalty regime in the municipal ordinance can reduce these situations.
- | Waste tourism in nearby municipalities or in other neighbourhoods that operate with open street containers. In this case, reductions in the charge linked to separate collection (e.g. of bio-waste) can serve as a deterrent.

| Risk of impurities increase of the waste fractions that are not taxed. This risk can be minimised through visual inspections by the operator of the system during collection.

In addition, some other specifications for door-to-door collection systems must be mentioned:

| Diaper collection is a service that must define its users at the local waste regulation ordinance. It is recommended to limit it for homes with babies and/or elderly people with incontinence problems.

| It is recommended that door-to-door collection system is designed at least for 4 fractions (residual waste, biowaste, packaging and paper/cardboard). Likewise, emergency areas or open street containers should be reduced or eliminated to prevent bad practices by the users. Alternatively, an entry price could also be established in those places where emergency areas cannot be eliminated. Furthermore, an emergency service could be established.

| Reduce the size of the mouth of public waste bins to prevent the disposal of waste bags.

3.6.2. Risks of fraud in smart containers waste collection system

In PAYT schemes based on the use of smart containers, risks of fraud are related to:

| Illegal dumping (especially next to containers).

| Malfunctions of the technology and/or errors in the locking systems that can lead to errors when recording the number of uses.

| *Waste tourism*. In this case, the application of bonuses on certain fractions (e.g. bio-waste) can be a dissuasive tool.

| Increase of impurities within fractions not collected via smart containers. To solve that, it is recommended to close as many fractions as possible, as well as reducing the size of the entrance of those containers that are not closed.

| Fraudulent use and impurities in charged waste fractions. The possibility to introduce a bag with QR or alphanumeric code, or tag RFID could permit to control the volume disposed and impurities in charged fractions via subsequent inspections.

In addition, some other specifications for smart containers collection system must be considered:

| In cases where the residual fraction is subject to PAYT schemes, households that dispose of diapers should have an additional number of uses which should not be subject to any additional cost. Alternatively, a specific closed bucket for diaper collection could be placed next to container areas.

| For businesses, it is important to carry out a specific monitoring and to equip the containers with a differentiated lid so as to give the possibility to throw more quantity of the corresponding waste fraction.

| In the case of public waste bins, the risk is like in door-to-door systems. Therefore, bins should be reduced in number. Penalties should be implemented for their misuse.

3.7. Waste charging governance

Developing waste charging schemes at the local level requires a **multi-faceted approach**, involving various players to ensure the system is effective, equitable, and sustainable. At the heart of these efforts are local or municipal administrations, who have the role to design and implement waste charges. To implement

First, waste charges and PAYT schemes require the highest possible **political support** amongst political parties to guarantee its success and durability.

At the technical level, within local administrations, several departments must collaborate closely. The economic department is crucial for estimate the expected revenues from waste charges. The waste management department, on the other hand, brings expertise in operational feasibility, understanding

waste streams, and ensuring that the waste charge scheme enhance waste reduction and source separation. Legal departments are also key, tasked with ensuring that new waste charges comply with national and sub-national regulations and local bylaws, and addressing any legal challenges that may arise.

Beyond the internal departments of local administrations, the success of waste charging schemes heavily relies on the **involvement of external stakeholders**. Companies or agencies responsible for waste collection and management are vital partners, as their operations may be directly affected by any changes in waste charging, especially in the case of PAYT schemes. Their input can provide practical insights into the logistics of waste collection, recycling processes, and the implementation of new systems. Furthermore, engaging with civil society and the public is essential for gaining support and compliance. Public participation initiatives can help in understanding community concerns, expectations, and behaviours towards waste generation and management. Businesses, particularly those producing significant amounts of waste, should also be involved in the process to explore opportunities for waste reduction at the source and to discuss the economic impacts of waste charging on their operations.

When creating a new waste charge or a new PAYT scheme, incorporating **experts** in environmental policy and waste management into the planning and implementation phases can provide valuable knowledge and innovative solutions. These experts can offer evidence-based recommendations, best practices from other regions, and help in tailoring the waste charging schemes to local contexts, especially within the Mediterranean area where environmental, economic, and social conditions can vary widely.

The collaboration between municipal departments, waste management entities, civil society, businesses, and experts creates a comprehensive approach that addresses the multifaceted challenges of waste management. This collaborative effort not only ensures the technical and legal feasibility of waste

charging schemes but also fosters public acceptance and engagement, ultimately contributing to the success and sustainability of waste management initiatives at the local level.

4 VARIABLE WASTE CHARGING IN THREE DIFFERENT MEDITERRANEAN CONTEXTS

This chapter presents three contexts in which to apply waste charging and unit pricing, which could be representative of the different situations of the Mediterranean countries. Factors like the existing waste collection system, the availability of monitoring technology and national and sub-national legal frameworks have been considered to define them:

| Context 1 comprises municipalities with more advanced models, such as door-to-door collection with electronic identification or collection systems based on closed smart containers, which enable personalized PAYT schemes with data monitoring.

| Context 2 refers to municipalities with intermediate waste collection systems which permit PAYT implementation but without individualised data monitoring.

| Context 3 is representative of those municipalities with less advanced systems (e.g. open street containers), for which the waste charge should focus on ensuring adequate revenue. They might also implement some social and environmental charge reductions for composting or recycling centres.

In general, PAYT schemes are widely used throughout North America and European countries such as Germany, the Netherlands and Switzerland.

Major cities around the world that use such PAYT schemes with the door-to-door model include San Francisco, Seattle, Portland (USA), Osaka (Japan), Leipzig, Munich and Dresden (Germany), Toronto, Ottawa and Vancouver (Canada), Seoul (South Korea), Taipei (China), Tallin (Estonia), Ljubljana (Slovenia) or Berna (Switzerland), and hundreds of other towns and villages. In other cities such schemes are present with smart containers such as Hangzhou (China), Bergen (Norway), Innsbruck and Styria (Austria), Schwerin and Heidelberg (Germany),

Twente Milieu and Arnhem (The Netherlands), Linköping (Sweden) and Amberes (Belgium).

As for Mediterranean countries, PAYT schemes are prevalent in countries such as Italy (with both Context 1 models and Context 2 models) but are less common in other countries like Spain, France, Greece or Croatia, and largely non-existent in southern Mediterranean countries.

In Mediterranean countries, cities like Besançon (France), Bergamo (province of Italy), Treviso or Parma (Italy) have unit pricing schemes with the door-to-door model and cities like Imola or Brescia (Italy) have implemented unit pricing with smart containers models of collection.

4.1. Context 1. Municipalities with individualized waste management collection and with data monitoring

When referring to municipalities in Context 1, two main kinds of waste collection models with technological user identification allow for the introduction of unit pricing schemes (see section 3.3):

1) Door-to-door schemes. In door-to-door systems, PAYT schemes have been largely applied and count with many years of experience and good results. However, the incorporation of technology is much more recent; therefore, some precaution must be taken when monitoring and following its results (see the case of Besançon in Box 1, Prelog in Box 3 and Parma in Box 4).

2) Smart containers. PAYT schemes based on these systems are newer, with less experience. Nevertheless, according to recent published data, such schemes have also succeeded and have good results of separate waste collection (see the case of Imola in Box 2).

Technology that can be applied in such models can comprise several possibilities. Section 4.1.1 provides a brief presentation about the available technology for each kind of waste collection system.

Section 4.1.2 includes a brief discussion about the possibilities of configuring the variable part of the waste charge.

Finally, in section 4.1.3, recommendations provide guidance on participatory controls and monitoring technologies.

4.1.1. Technologies for user or container identification

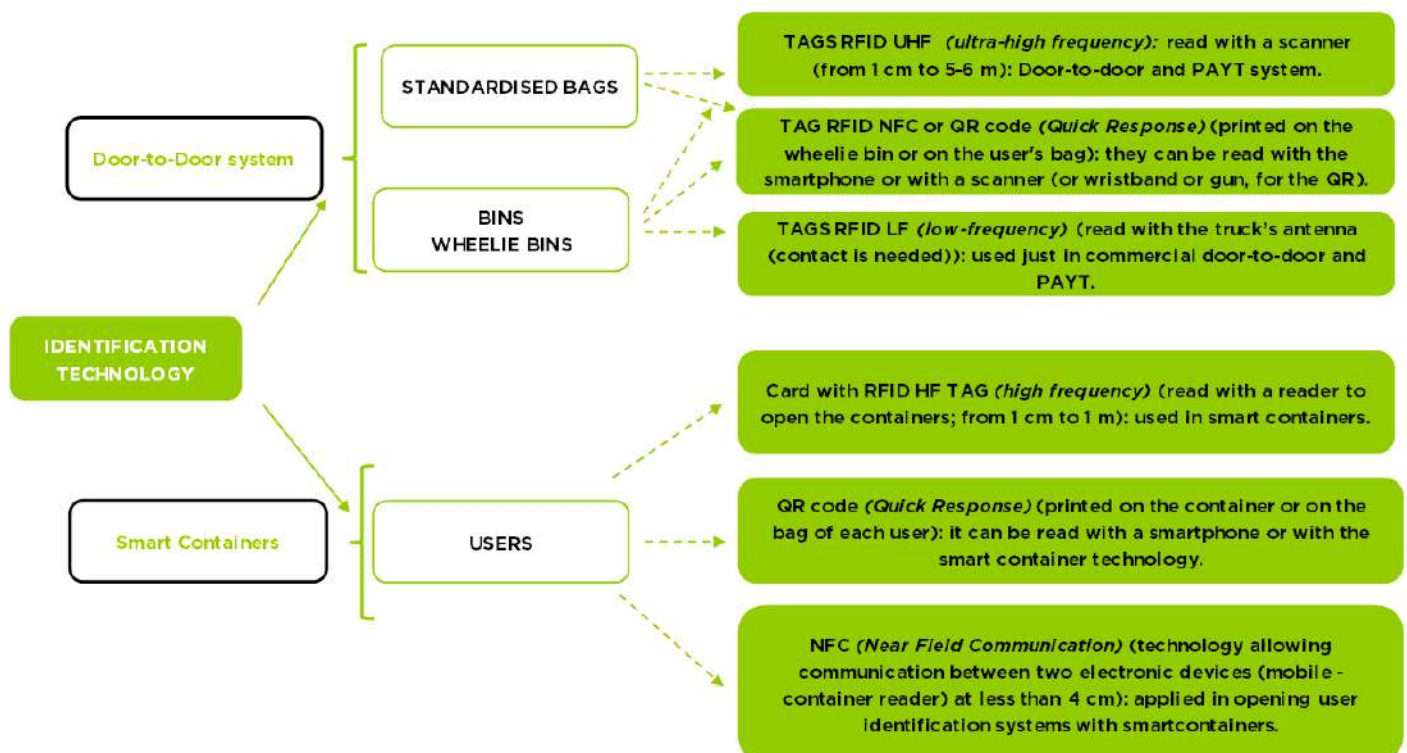
Figure 3 summarises the electronic identification systems of the containers and the users.

There are different identification technologies:

- | Radio-frequency identification (RFID) using electromagnetic cards.
- | Near-Field-Communication (NFC), with smartphones.
- | QR codes placed on containers to be read by smartphones.

This identification can be compulsory or voluntary by the users, depending on the type of technology and systems implemented:

Figure 3. Diagram of the electronic identification systems used in door-to-door collection systems and smart containers



4.1.2. Definition of the variable part of the waste charge

When defining the variable part of the waste charge of PAYT schemes, apart from choosing the waste fractions charged, the mechanism of establishing the tariff of the variable part is also needed. In Context 1 municipalities, the variable part may be structured into two parts:

1. A base fee, which can be charged to all taxpayers (independently of their waste generation). In Context 1, it is also possible to use this minimum part as a penalty for users that do not participate well. For example, users that do not arrive at a minimum of 3-6 annual deliveries for the residual waste fraction can have a variable tariff much higher than those that participate regularly to the system. This can also be applied to other waste fractions such as packaging.
2. A variable part, which depends on each taxpayer individual waste generation. The variable part could represent between the 10-40% of the revenue. The greater the variable part, the greater the incentive on preventing waste generation, but also more uncertainty in the revenue and possible negative side effects. In the case of municipalities in Context 1, PAYT completely proportional to the number of uses may be less robust against possible technological failures. In these cases, establishing a tariff per range of uses/deposits is safer.

SAYT schemes can only be applied in Context 1, with monitoring of recyclable fractions. In addition, establishing the rewards per range is also safer, as just mentioned. Waste fractions to be rewarded can be biowaste and packaging. The last one is recommended to be rewarded when defining a “good-behaviour” tariff, in combination with other waste fractions, but not a bonus per-use. In the case of organic fraction, home composting can also be subject to a specific bonus.

Calculating the net costs of the waste service is the first step in the design of the charge. Then, the behaviour of the users has to be estimated, to evaluate the revenues from the variable part of the charge, and the cost of the reductions (in case of

SAYT). These requires estimating the number of uses of each waste fraction by taxpayers, either in the form of average values or histograms.

Once the taxpayers’ participation has been estimated, unit prices of each variable part of the waste charge can be calculated in order to guarantee the revenue target.

4.1.3. Participation control when monitoring

Once the users are identified, certain actions can be taken to improve their participation and get better results of separate waste collection. If an app for the service is available, it should include information related to the use of the service by each user, kind and quantity of fractions deposited, etc.

However, it is important to onboard those users who participate poorly in the system. Below, several actions are described that can be taken when taxpayers not using the service properly are detected:

- | For domestic users, warning stickers on the doorstep or informative warning letters should be sent, notifying that an incorrect practice has been detected and reminding them the obligation to separate properly. Visits by environmental educators can be also considered.

- | For businesses, visits can be made directly to the establishment during opening hours. In addition, warning letters should be sent in case of recidivism.

In both cases it is important to establish the proper channels to inform about the obligation to participate correctly in the waste selective collection, and the possible penalties for not doing so.

4.1.4. Case studies of PAYT

Box 1. Context 1: The case of Grand Besançon, France

GRAND BESANÇON (FRANCE)

Besançon and its surroundings have a population of around 225,000 people, half of whom live in densely populated areas. In 2007, measures were initiated to enhance waste management in response to addressing the condition of an outdated incineration plant. The political choice was to close the old furnace, requiring both waste prevention and residual waste reduction¹.

Three main measures were progressively taken: the implementation of a PAYT system, the adoption of a waste prevention plan (-15% of residual waste over 5 years) and the development of a decentralised composting system.

The PAYT system consists of two components: a fixed fee based on the size of the residual waste bin and the level of service corresponding to the user's residential area²; and a variable component that depends on the amount of deposits and on the weight of the bin. Each bin contains a chip or a tag that identifies its owner, and the garbage truck is equipped with a reader and a scale that measures its weight before and after emptying.

The implementation of the PAYT scheme has promoted an increase in the separate waste collection rate, contributing to a reduction of the non-recyclable waste from 217 kilograms per inhabitant per year in 2008 to 150 in 2018³. This has resulted in optimized costs for residents, with an annual fee per inhabitant 10€ lower than the national average⁴. The significant reduction in residual waste, driven by the variable waste charge, has successfully prevented the renewal of the incineration plant.



<https://plus.besancon.fr/2023/01/17/gestion-des-dechets-des-couts-maitrises-grace-a-la-redevance-incidentive/>



<https://www.estrepublicain.fr/edition-de-besancon/2018/11/09/de-nouvelles-frequences-de-collecte>

References

¹ https://zerowasteurope.eu/wp-content/uploads/2019/11/zero_waste_europe_cs9_besancon_en.pdf

² <https://www.grandbesancon.fr/infos-pratiques/environnement/la-redevance-incidentive/>

³ <https://zerowastecities.eu/bestpractice/besancon/>

⁴ <https://plus.besancon.fr/2023/01/17/gestion-des-dechets-des-couts-maitrises-grace-a-la-redevance-incidentive/>

Box 2. Context 1: The case of Imola, Italy

IMOLA (ITALY)

In 2016, the municipal administration of Imola, in collaboration with Hera, the waste management utility, initiated a systematic overhaul of waste collection methods. The objective was to enhance both the quality and quantity of separately collected waste for a city with 70,000 inhabitants. The innovative collection system, featuring “ecological islands”, establishes drop-off points with containers for six waste categories: organic, garden, paper/cardboard, plastic/metal, residual waste, and glass. Access to these containers, excluding glass, is regulated by a personal key-card activation system. The personal key-card unlocks the container and records the number of uses. And it can also be used for deliveries to the separate collection centre.

The charge was based on the household’s surface area and the number of residents. A new save-as-you-throw (SAYT) system was implemented by rewarding key-card users for the separate waste they brought to the collection center. Additional discount was provided for domestic composting.

The separate collection centre is located outside the urban area. It accepts recyclable materials such as paper, plastic/cans, glass, vegetables, mineral oils, electric and electronic equipment or batteries. Waste brought to the collection centre are weighed, registered through the key-card system, and credited in the variable part of the fee¹.

Between 2015 and 2019, this transformation led to a more than 50% reduction in residual waste collected, from up to 20,000 tons to less than 10,000. Concurrently, the rate of separate waste collection increased from 55% to 75%, and the municipal Collection Centre’s usage surged from 57,200 uses in 2015 to 79,700 in 2019².

In 2024, the municipal administration has introduced a new PAYT model. Maintaining the previous structure, the innovation adds a variable part calculated based on the annual deposits of residual waste per household. The municipal council sets a price for a minimum number of annual contributions, varying with the number of household residents and the collection type. For instance, a family of four is allocated a minimum of 1,440 liters³, which is equivalent to 72 drop-offs with a 20-liter bin (for containers at the ecological islands), 48 drop-offs with a 30-liter bin (for door-to-door collection in the historic center), and 36 drop-offs with a 40-liter bin (for industries and large families)⁴. Exceeding this minimum incurs an additional fee. This scheme aims to further improve the city’s waste management.



<https://www.ilrestodelcarlino.it/imola/cronaca/rifiuti-tariffa-puntuale-4ff263b2>



<https://www.corriereromagna.it/archivio/imola-cambia-la-raccolta-rifiuti-interessate-oltre-5mila-utenze-JWCR431585>

References

¹ <https://www.ilrestodelcarlino.it/imola/cronaca/stazione-ecologica-b075ab56>

² <https://www.interregeurope.eu/good-practices/basic-ecological-islands-road-waste-collection-in-imola>

³ <https://www.comune.imola.bo.it/argomenti/tutela-sostenibilita-ambientale/gestione-dei-rifiuti/tariffa-corrispettiva-puntuale-tcp/faq-tariffa-corrispettiva-puntuale-tcp>

⁴ <https://www.comune.imola.bo.it/novita/comunicati/2023/12/a-imola-dal-primo-gennaio-2024-arriva-la-tariffa-corrispettiva-puntuale-tcp>

Box 3. Context 1: The case of Prelog, Croatia

PRELOG (CROATIA)

The city of Prelog and neighbouring municipalities in Croatia have successfully improved their recycling rates, achieving a separation collection rate that surged from 22% to 57.5% between 2014 and 2019. This remarkable progress has resulted in only 70 kilograms of residual waste per capita per year, showcasing a notable reduction.

The system implemented by PRE-KOM, the public company for waste management in the city of Prelog and 11 neighbouring municipalities - totalling 40.210 inhabitants - played a pivotal role in this achievement. In 2007, PRE-KOM began separate waste collection in seven municipalities using public containers, later transitioning to door-to-door collection. By 2015, they achieved a 49.5% recyclable rate through the introduction of separate collection of biodegradable waste in brown bins (Kořak, 2020).

The fee follows the 'Pay-as-you-throw' principle, where households generating less residual waste receive lower monthly bills. The pricing is determined by the number of household members and the frequency of emptying the residual waste bin per month. The bin is equipped with a chip or a tag that allows for registration. Different user categories receive discounts, such as a 30% reduction for those not using a brown bin but having their home compost systems for biowaste (Kořak, 2020).

The system not only incorporates door-to-door collection and PAYT but also entails the establishment of local infrastructure. Recognizing the need for a regional waste management centre, the city of Prelog and PRE-KOM took the initiative to construct their own local facilities to efficiently manage waste collected from the 12 municipalities. PRE-KOM built a recycling yard of approximately 2,000 m² size in the city of Prelog. The yard consists of boxes and containers and it can accommodate about 750 m³ of recyclable materials, as well as hosting a sorting plant for such materials, a reuse centre and a composting plant. This comprehensive approach not only led to a decrease in costs for citizens but also proved to be profitable for PRE-KOM through the sale of recyclables.



<https://www.pre-kom.hr>

References

<https://zerowastecities.eu/bestpractice/the-story-of-prelog/>

Box 4. Context 1: The case of Parma, Italy

PARMA (ITALY)

Parma is a city located in Northern Italy with a population of 196,518¹ inhabitants. In November 2012, Parma separately collected 48.5% of its municipal waste, mostly through roadside containers. In 2014, the municipality began to make efforts to achieve zero waste, implementing two key measures: the introduction of a door-to-door (DtD) separate collection system and the implementation of a Pay-As-You-Throw (PAYT) scheme that charges for the generation of residual waste.

Each family or commercial user has a dedicated bin equipped with a transponder for the residual waste (except for residents in the historic area, who are provided with 50-liter bags with a tag).

In households, the fee structure is composed of two main elements: a fixed part based on the square meters of the household, and a variable part that depends on the number of household members. In the case of non-domestic users (commercial activities), the fee structure is also composed of two main tariffs, the fixed part and the variable part, but both linked to the square meters of the activity.

When participating in the **PAYT scheme, the “Tariffazione Puntuale” is added** with new more elements for the waste charge calculation: first, a 29% reduction of the variable part explained for domestic and non-domestic users, and an additional variable fee tied to a minimum number of waste collections (accounted by the number of residual waste deposits). The minimum number of bag/bin collections included in the bill depends on the number of household members and the type of category in the case of commercial activities, and is aimed at covering the fixed costs of managing the system and preventing littering. Additional removals beyond this minimum are charged at 0.73€ for each little bag, 1.45€ for each big bag or bin (45 Liter), and progressively higher fees per different container volumes. Initially, there was a 12% discount applied to the variable part for accredited home composting, which was subsequently increased to 20%². The introduction of this system reduced residual waste collection, with only 25% of inhabitants putting out their bins at each collection in 2018³.

The combination of both systems (DtD and PAYT) led to a significant increase in the percentage of separate collection, helping the city's overall percentage exceed 80% in 2018⁴.



<https://www.comune.parma.it/ambiente/Raccolta-differenziata-2.aspx>

References

- ¹ <https://www.italyreview.com/parma.html>
- ² <https://www.comune.parma.it/ambiente/Tariffazione-puntuale.aspx>
- ³ <https://zerowastecities.eu/bestpractice/best-practice-the-story-of-parma/>
- ⁴ <https://www.residusmunicipals.cat/uploads/activitats/docs/20210304114507.pdf>

4.2. Context 2. Municipalities with individualized waste management collection (without data monitoring)

This context refers to door-to-door **collection models with PAYT schemes** based in non-technological systems, which apply pre-paid standardised bags or buckets with a predetermined frequency. Technological identification is not necessary, since the identification occurs directly when the bag or the bucket is placed in front of the user's household or commercial activity.

In these systems, **SAYT schemes are not possible** since the measurement of user participation (deliveries) in the recycling fractions is not available.

In section 4.2.1 a brief discussion of the possibilities of configuring the variable part are presented, whereas section 4.2.2 includes some recommendations of the kind of participation control that may operate when monitorisation technology is not available.

4.2.1. Definition of the variable part of the waste charge

When defining the variable part of the waste charge of **PAYT schemes**, apart from choosing the waste fractions charged, the definition of the mechanism of establishing the tariff of the variable part is also needed.

In Context 2 municipalities, the variable part of the waste charge could represent between the 10-40% of the revenue. A greater variable part leads to a greater incentive on preventing waste generation but may also lead to some problems in the form of *waste tourism* or fly tipping. In the case of pay-per-bag, the resulting variable tariff is completely proportional to the number of uses. In the case of pay-per-bin with pre-determined frequency, annual fees may be determined according to the size of the bins and contracted collection frequency.

If desired, a minimum tariff can be charged to all taxpayers (independently of their waste generation). In the pay-per-bag model it can be articulated by providing a minimum quantity of bags to all taxpayers.

SAYT schemes can only be applied in Context 1.

Calculating the net costs of the waste service is the first step in the design of the charge. Then, the behaviour of the users has to be estimated, to evaluate the revenues from the variable part of the charge. These requires estimating the number of uses of each waste fraction by taxpayers. In contrast to Context 1, it is more difficult in Context 2, without real data monitored. This estimation must also consider that taxpayers' participation could be increased once unit pricing is applied.

Once the taxpayers' participation has been estimated, unit prices of each variable part of the waste charge can be calculated in order to achieve a certain revenue target.

4.2.2. Participation control when monitorisation is not available

Models without technological identification lack data on the actual participation of users. This is their main weakness compared to more sophisticated models. However, there are also some actions that can be undertaken to ensure user's participation:

- | For domestic users, as these systems are based in door-to-door collection, warning stickers at doorsteps or informative warning letters should be sent when detecting errors with the use of pre-paid bags for example, or when detecting bad separation at source of recyclable fractions. Visits can also be done when recidivism is detected and remind them the obligation to separate properly their waste fractions in the current waste collection system of their municipality.

- | For businesses, visits can be made directly to the establishment during opening hours, to ask about their participation, and check that waste separation facilities (bags, bins, etc.) are in place. There is also the possibility to use stickers to indicate incorrect separation if detected by waste operators during the collection services.

In both cases it is important to establish the proper channels to inform constantly about the obligation to participate correctly in the waste selective

collection, and the possible penalties for not doing so. The use of the municipality website or often campaigns can be suitable.

4.2.3. Case studies of PAYT

Box 5. Context 2: The case of Argentona, Spain

ARGENTONA (SPAIN)

Argentona is a town with around 12,000 inhabitants, a total surface area of 25.2 km² and an urban surface area of 3.5 km². The urban density is 3,363 inhabitant/km², which makes it a town with a strongly vertical structure in the town centre and a more horizontal structure in the housing developments and stand alone dwellings.

Argentona introduced the Door-to-Door (DtD) collection in 2004 for biowaste and residual waste fraction for the central urban area (around 8,000 inhabitants). In 2009 the DtD system was expanded for the lightweight packaging and paper and cardboard fractions in order to implement in 2010 a Pay-As-You-Throw (PAYT) scheme with pre-paid standardized bags for citizens and commercial activities called "Taxa Justa" (Fair Charge). The DtD&PAYT was extended to all suburban areas in 2016.

The PAYT system has been implemented using an initial participation process, information campaign, and pilot period of 3 months. The permanent staff and the information office follow the system operation and the users' performance, which are key tools for the success of the system.

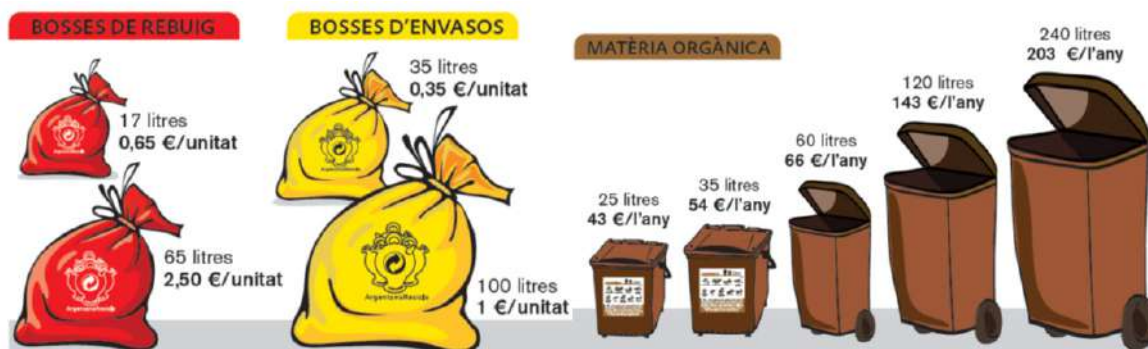
The PAYT scheme relies on the introduction of pre-paid standardized bags (with the Town Council's logo) for residual waste (red) and lightweight packaging (yellow). They were initially introduced for both businesses and households, but later the yellow bags were eliminated for citizens. The PAYT is also applied for the organic fraction produced by businesses.

The household waste charge is divided into two parts: (1) a progressive part modulated depending on the number of residents per household and (2) a variable part as a function of the residual waste bags used. The municipality provides a number of bags included in the fixed part of the charge (10, 20 or 25 bags depending on household members). Additional bags must be purchased at collaborating shops at a cost of 0.65€/17L bag.



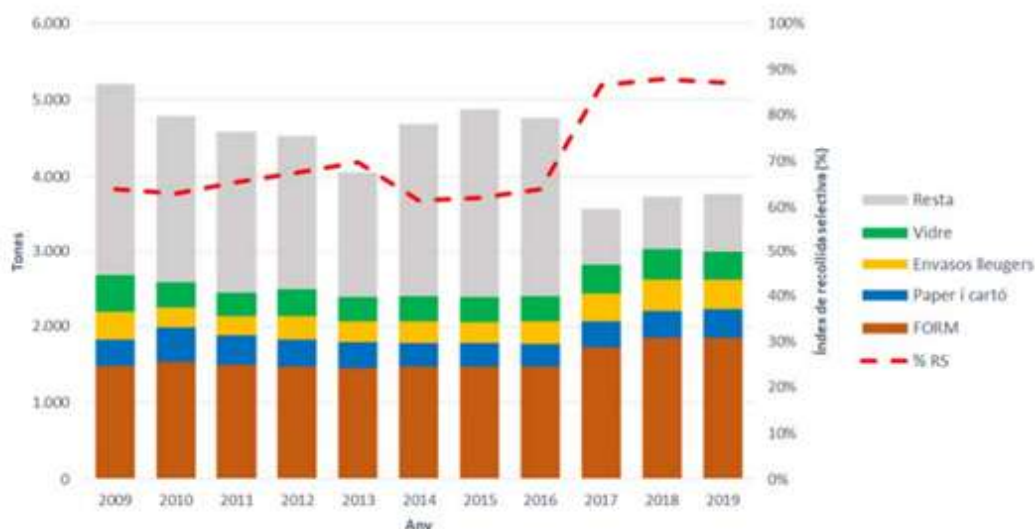
Source: Town Council of Argentona

Businesses pay a part of the charge calculated based on the surface of their premises and the type of activity they carry out; and a variable part based on the number of standardized bags used for residual waste (2.5€/65L bag) and light packaging (1€/100L bag). Additionally, they pay separately for the biowaste bin depending on its volume.



Source: Town Council of Argentona

Between 2008 and 2019, the amount of waste generation/inhab/day decreased by 26% to 1.27 kg. During the same period, the rate of separate waste collection increased from 52.8% to 87.6%. Residual waste dropped by 15% between 2009 and 2013 and packaging waste by 16% (see next Figure).



Source: Town Council of Argentona

The quality of the separately collected waste has remained high. The use of the municipal collection center has increased. The system has been widely accepted by the majority of the population and was the subject of a broad political action.

The monitoring activities to follow the system functioning and the users' performance are key tools for its success. The introduction of the system using an initial participation process, information campaign and initial test period are key elements for its success. The pre-paid standardized bags are very economical elements for the introduction of PAYT systems, as there is no need for the introduction of costly technologies.

The control and sanctioning of the incorrect use of the system and other bad practices like illegal disposal or waste tourism are very important for the proper functioning of the DtD+PAYT scheme.

References

<https://www.interregeurope.eu/good-practices/payt-in-argentona>
Council website: <https://argentona.cat/residus>

Box 6. Context 2: The case of Aglantzia, Cyprus

AGLANTZIA (CYPRUS)

Aglantzia, a small city with 20,783 inhabitants, is at the forefront of municipal waste management on the Mediterranean island of Cyprus. In 2020, inspired by pay-as-you-throw schemes, the municipal administration introduced the “Holistic Waste Management Program of the Municipality - Municipality of Aglantzia (Nicosia)”. This innovative program eliminated the fixed annual waste collection fee. Instead, citizens are now charged based on the volume of residual waste they generate, determined by the special prepaid purple bags they acquire.

These purple bags are available for purchase at specified points of sale in three sizes: 0,40€ for a 10L bag, 1,5€ for a 35L bag, and 2€ for a 56L bag). Their prices reflect the cost by the municipal service for collecting and managing waste. Collection takes place on predetermined days for each area, and the municipality only accepts the prepaid purple bags. Using any other bags may result in fines, and they are not collected. The collection of vegetable fraction of waste is also carried out using special biodegradable paper bags available at 1.50€ per bag. They must be placed on the curb for collection.

Additionally, residents are expected to separate the materials of the stream and to place them outside their house for collection on designated days. The waste collection service for recyclable materials is provided free of charge, but special bags should also be used. For instance, transparent bags for plastic and metal packaging and brown bags for paper, both available at many outlets (local markets, kiosks, etc.) at a cost similar to conventional garbage bags. Furthermore, citizens residing in homes who are interested in home composting can obtain a free home composter from the Municipality.

The implementation of the Holistic Waste Management Program aims to transform waste into valuable raw materials, emphasizing recycling. Citizens can significantly reduce the cost of waste they have been paying for with the implementation of the Limit – Reuse – Recycle – Save philosophy¹.

The pilot initiative in Aglantzia resulted in the first year (2021) in a 30%² reduction in household waste and improved citizen culture in reuse and recycling. This success has prompted the Ministry of Environment to approve the nationwide implementation of the “Pay as you throw” project during the 2021-2027 programming period.



<https://cyprus-mail.com/2021/04/11/cyprus-prepares-for-pay-as-you-throw-scheme/>

References

¹ <https://aglantzia.org.cy/aigli/en/schetika-me-to-programma/>

² <https://www.interregeurope.eu/good-practices/holistic-waste-management-program-hwmp-municipality-of-aglantzia-nicosia>

4.3. Context 3. Municipalities without individualized waste management collection

Context 3 refers to municipalities without individualized management system for waste collection. This includes scenarios where open street containers are used for all waste fractions or solely for mixed refuse waste. It also encompasses door-to-door collection of mixed refuse waste without separate waste collection for the other waste fractions. Additionally, this context may include municipalities with informal waste collection systems.

In such contexts, the existence or absence of a specific waste charging system affects the proposed recommendations:

1) Municipalities with a waste charge:

In situations where a waste charge is implemented, several factors must be considered in its design. These include:

a) Revenue

As revenue from waste charges is dedicated to finance the service, securing sufficient revenue is fundamental to ensure resources to provide a quality service. Raising revenue is the first priority of waste charges, more so when the possibilities to introduce environmental incentives are limited.

b) Fairer distribution of costs

The design of a waste charge can try to establish a fair distribution of costs among residents and commercial activities. Section 3.1 details several criteria that can be used for determining the tax base and structure of waste charges, such as the number of residents, water consumption, etc.

c) Environmental benefits linked to waste charge:

- Incentives for Home or Communal Composting: Promoting the separation of organic waste at the source using designated composters can be encouraged through a bonus. This requires

certification and monitoring of home or communal composting activities. Below is concreted how this could be managed:

- o By visiting those dwelling that have asked for a home composter, with the intention of monitoring the composting activity.
- o By locking the entrance of the communal composting areas and conducting visits to the dwellings participating in the system, validating organic waste separation at source.¹³

- Incentives for Using Recycling Centres: If a facility for disposing of various waste fractions exists¹⁴, bonuses for depositing specific waste types can be implemented. Monitoring methods might include a manual or digital registry (using smart or RFID cards) to track user participation.

A waste collection centre, also called recycling centre¹⁵, is a public facility where municipal waste are separately taken for their subsequent treatments. This is a key facility to achieve the established targets for separate collection, recycling, reuse, and preparation for reuse (PxR).

Establishing economic incentives for using waste collection centres aims at promoting their use. Basically, there are two types of economic incentives for using waste collection centres:

- o Discounts on the waste charge: Different ranks may be defined according to the number of visits or waste items disposed of, and these are translated into different discounts on the local waste charge.

¹³ It could also be automatized by introducing a smart opening system through the use of an electromagnetic card that will register all accesses of the users so as to certify their participation.

¹⁴ Specifically, fractions that are not separately collected in the streets.

¹⁵ Other terms for referring to 'waste collection centres' are 'déchetterie' in French, 'punto limpio' or 'punto verde' in Spanish, 'centro di raccolta' or 'centro di raccolta rifiuti' in Italian, or 'Recyclinghof' in German.

o Accumulated points: By disposing waste to the recycling centres, users get points that may be exchanged for other services or discounts in local shops.

2) Municipalities without a waste charge

In scenarios lacking a waste charging system, sufficient and robust financing for the waste management system is often not secured, which may lead to insufficient quality services. In such cases, creating a new waste charge may be a good option.

In the case of municipalities in this Context 3 with no individualised collection systems, the main aim of the charge should be securing sufficient funding to increase the quality of the service.

When institutional capacity is poor, creating a fully independent waste charge may lead to a high number of unpaid bills, affecting revenue targets. In such cases, integrating the new waste charge with other utility bills, such as water or electricity (as they do in Ecuador, for example), could be a viable solution. These approaches are cheaper, as they make use of existing billing systems and registries, and also deter unpayments, as they are linked to other services.

On the contrary, when institutional capacity is high, the possibility to ensure a specific figure for waste charging that can accomplish all the points described in part 1) must be prioritized.

In any case, when creating a new waste charge, importance should be given to social involvement, offering transparency to the taxpayers about waste management costs and the need to cover them. Therefore, a participatory process is relevant.

4.3.1. Case study of Environmental benefits

Box 7. Context 3. The case of Greece

GREECE

Landfilling remains predominant in Greece, only 21%¹ of municipal waste was recycled in 2021, while 80%² of the non-recycled waste was disposed of in landfills. Since 2019, the Greek government, supported by the EU LIFE program, has been taking significant steps to address this situation³.

Measures to be progressively implemented until 2027 include investments in infrastructure, prevention programs - with a priority on the implementation of Pay-As-You-Throw (PAYT) systems⁴ -, along with new waste management services aimed at reducing, reusing, and recycling. The Municipality of Vari-Voula-Vouliagmeni, with approximately 48,000 inhabitants, will be the first city to fully implement a PAYT system⁵.

Innovative action also took place in 2021 in the Attica region with the launch of a pioneering recycling program named "The Green City"⁶. This program offers a recycling reward system through Mobile Collection Points located throughout the region, where participants can deposit recyclable materials such as paper, plastic, metal, glass, batteries, or clothing. These materials are weighed at the Mobile Collection Points, and participants earn greencoins in return, which can be redeemed at cooperating companies displaying "The Green City" logo. Users can accumulate up to 15€ in greencoins per month⁷.

The program operates through a mobile app, providing users (both individuals and businesses) with information on Mobile Collection Point routes, deposited recyclable weights, accrued points, and eligible exchange locations⁸. In its first year, the program witnessed successful participation, with over 100,000 citizens registering and collecting over 500 tons of clean recyclable municipal solid waste across more than 60 municipalities in Attica⁹. However, these promising results are accompanied by significant financial and environmental costs that should not be underestimated and addressed in the upcoming years.



<https://www.alpha.gr/en/retail/bonus/bonus-news/the-green-city-bonus>

References

- ¹ <https://www.eea.europa.eu/en/analysis/indicators/waste-recycling-in-europe>
- ² https://environment.ec.europa.eu/system/files/2021-10/Greece_0.pdf
- ³ <https://circulargreece.gr/>
- ⁴ <https://doi.org/10.3390/su142215429>
- ⁵ <https://webgate.ec.europa.eu/life/publicWebsite/project/LIFE18-IPE-GR-000013/circular-economy-implementation-in-greece>
- ⁶ <https://thegreencity.gr/en>
- ⁷ <https://www.nbg.gr/en/go4more/green-city>
- ⁸ <https://www.xpatathens.com/living-in-athens/what-s-new/environmental-news/item/8720-what-is-the-green-city-program-how-to-participate>
- ⁹ <https://doi.org/10.3390/inventions8040080>

REFERENCES

- Agència de Residus de Catalunya (2010) Guide for the Implementation of Pay-As-You-Throw Systems. http://www20.gencat.cat/docs/arc/Home/LAgencia/Publicacions/Centre%20catala%20del%20reciclatge%20%28CCR%29/Guia%20PXG_EN.pdf
- Agència de Residus de Catalunya (2023) Guia d'orientació als ens locals sobre l'aplicació del retorn de l'impost cedit de residus assignat al fons de gestió de residus municipals. Exercici 2023. https://residus.gencat.cat/web/.content/home/consultes_i_tramits_-_nou/impost_cedit_residus/canons/guies_balancos/guia_impost_cedit.pdf
- Agència de Residus de Catalunya (2023) Guia de protecció de dades personals en sistemes de recollida de residus amb identificació i en taxes justes. https://residus.gencat.cat/web/.content/home/ambits_dactuacio/recollida_selectiva/eines_recurso/12_Guia_proteccio_dades_personals_recollides.pdf
- Anastasio, M. and Nix, J. (2016) 'Plastic bag levy in Ireland', Institute for European Environmental Policy. <https://ieep.eu/wp-content/uploads/2022/12/IE-Plastic-Bag-Levy-final-1-1.pdf>
- ARLEM - Assemblée Régionale et Locale Euro-Méditerranéenne (2014) Report on waste management at local and regional level in the Mediterranean region. <https://cor.europa.eu/Documents/Migrated/news/rapport-sudev-dechets-2014-en.pdf>
- Calaf-Forn, M., Roca, J., Puig-Ventosa, I. (2014) "Cap and trade schemes on waste management: A case study of the Landfill Allowance Trading Scheme" (LATS) in England. Waste Management 34: 919-928. <https://doi.org/10.1016/j.wasman.2014.02.022>
- Council of Europe (2022a) Data Protection in the South Mediterranean countries, <https://www.coe.int/en/web/data-protection/-/data-protection-in-the-south-mediterranean-countries>
- Council of Europe (2022b) Personal data protection: an opportunity and an imperative for the Southern Mediterranean region, <https://www.coe.int/en/web/data-protection/la-protection-des-donnees-personnelles-une-opportunité-et-un-imperatif-pour-la-region>
- ENT Foundation (2022), Life RethinkWaste Toolkit, Life RethinkWaste Project. <http://www.tutor-rethinkwaste.eu>
- European Environment Agency (2000) Environmental taxes: Recent developments in tools for integration. Environmental issues series No 18. Copenhagen: European Environment Agency. https://www.eea.europa.eu/publications/Environmental_Issues_No_18
- European Environment Agency (2023) Economic instruments and separate collection systems - key strategies to increase recycling. <https://www.eea.europa.eu/publications/economic-instruments-and-separate-collection>
- Field, B.C., Field, M.K (2012) Environmental Economics. The McGraw-Hill.
- HM Treasury (2021). Landfill tax: call for evidence. Ensuring the tax continues to support environmental objectives. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1037307/LfT_review_CfE.pdf
- Kaza, S., Yao, L., Bhada-Tata, P., Van Woerden, F. (2018). What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050. Urban Development Series. Washington, DC: World Bank. [doi:10.1596/978-1-4648-1329-0](https://doi.org/10.1596/978-1-4648-1329-0).
- MedCities (2003) Guidelines for municipal solid waste management in the Mediterranean region. <https://iczmplatform.org/storage/documents/oIHWrPXNe20IJSktwbmH5YDrg3ZuiUHppsvxZrob.pdf>

OECD (2016) Extended Producer Responsibility. Updated Guidance for Efficient Waste Management. Paris: OECD Publishing. <https://www.oecd.org/env/extended-producer-responsibility-9789264256385-en.htm>

Oosterhuis, F.H., Rayment, M., Varma, A., Jantzen, J., Woerd, H. van der, Mudgal, S., Tinetti, B., Gerdes, H., Neubauer, A., Stocker, A., Dodoková, A., Greño, P. (2008) The use of differential VAT rates to promote changes in consumption and innovation. Amsterdam: Institute for Environmental Studies for the European Commission, DG Environment. <https://research.vu.nl/en/publications/the-use-of-differential-vat-rates-to-promote-changes-in-consumpti>

Pigou, A.C. (1920) The Economics of Welfare. Macmillan & Co. London.

Puig Ventosa, I. (2004) "Potential use of feebate systems to foster environmentally sound urban waste management". International Journal of Integrated Waste Management, 24: 3-7. [https://doi.org/10.1016/S0956-053X\(03\)00132-6](https://doi.org/10.1016/S0956-053X(03)00132-6)

Puig Ventosa, I. (2006) "Fee and rebate systems to foster ecologically sound urban waste management" (p.527-534) in Cavaliere, A., Ashiabor, H., Deketelaere, K., Kreiser, L., Milne, J. (Eds.) (2006) Critical Issues in Environmental Taxation: International and Comparative Perspectives. Volume III. Richmond Law & Tax.

Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation), Official Journal of the European Union L 119/1, 4th of May 2016. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32016R0679>

Reichenbach, J. (ed.). (2004) "Handbook on the implementation of Pay-As-You-Throw as a tool for urban waste management". R&D EU project financed by the European Commission (contract EVK4-CT-2000-00021).

Watkins, E., Hogg, D., Mitsios, A., Mudgal, S., Neubauer, A., Reisinger, H., Troeltzsch, J., Van Acoleyen, M. (2012) Use of economic instruments and waste management performances - Final Report. Study prepared for the European Commission, DG Environment. <https://op.europa.eu/en/publication-detail/-/publication/566f28fd-3a94-4fe0-b52d-6e40f8961c7e>

World Bank Group - Tokyo Development Learning Center (2018) MUNICIPAL SOLID WASTE MANAGEMENT. A ROADMAP FOR REFORM FOR POLICY MAKERS. <https://openknowledge.worldbank.org/entities/publication/13444427-3ad4-5a50-81ff-a097fff2ee8d>

World Bank (2021) Bridging the Gap in Solid Waste Management. Governance Requirements for Results. <https://openknowledge.worldbank.org/entities/publication/26eccae3-9850-57f7-a150-cd83573394d0>

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