



# 2. OPERATIONAL COSTS AND POSSIBLE BENEFITS

# 2.1. Costs and income

The waste charge should be designed aiming to collect the net costs (gross costs - income) of the waste management service. Therefore, this section lists the costs and income that must be considered to design a PAYT and KAYT scheme.

The costs to consider are:

- Investment pay-off
- Collection costs, including special collections such as bulky fraction, Textile, WEEE, Oil, etc. Including industrial profit and indirect expenses.
- Treatment costs of the different fractions (Residual fraction, Bio-waste, packaging, etc.).
- Waste taxes can be charged depending on the country, region, or municipality (for example a landfill tax or an incineration tax)
- Initial communication campaign to present the PAYT charge to users, so they are aware of how their performance regarding waste separation might affect their charge amount.
- Communication costs such as monitoring and returning the information received by users.
- Administrative and technical staff of the municipality to do all the processing of the data.
- Waste Collection Centre costs (for non-ordinary fractions).
- Costs for the collection a treatment service inspection.
- Maintenance of landfill in use and after its closure.
- When setting up a PAYT charge, if a bonus is introduced, the final bonus expected to be received by all users must be added as an initial cost so that this does not count as a deficit.

The income to be considered are:

- Financial subsidies received.
- Secondary material sales that report income for the municipality.
- Income from extender producer responsibility.
- Others (depending on the country or region) (for example the return of the landfill tax or incineration tax in Catalonia (Spain)).
  - 2.1.1. Specific costs for the implementation of PAYT schemes in door-to-door collection systems

The PAYT implementation tackles a series of costs associated with the material required. These materials are generally associated with the technology necessary to identify the user of the collection service. The ranges of unit costs that have been estimated for the investment of the implementation of PAYT charges with a door-to-door collection model are presented in Figure 1.





MATERIAL NEEDED FOR THE IMPLEMENTATION OF PAYT IN DOOR-TO-DOOR COLLECTION SYSTEMS	PRICE UNIT (NO VAT)
Domestic bucket with RFID	(4 € (10 L) - 8-9 € (40 L)
Bags with QR code or RFID	0,080 – 0,15 € (20 L-40 L)
Buckets for commercial waste with RFID	40-45 € (120 L), 55-60 € (240 L), 80-90€ (360 L) - 210-230 € (1.100 L)
Adaptation in buildings (see list below)	
Hangers (for 40 litres buckets)	15-20 € (1 hanger - 25-30 € (3 hanger)
Monolith or totems (for 40 litres buckets)	140-150 € (6 hangers) - 220-240 € (12 hangers)
Container Carrier with access control (multi-family blocks)	2.500 - 3.000 €
Smart containers in the street for multi-family blocks	(see the budget for closed containers)
TAG reading technology (see list below)	
Activation service/Project implementation	2.800 - 3.000 €/project
Embarked equipment for TAG reading	5.800 - 6.800 € / vehicle
Embarked equipment installation and maintenance	450 - 500 € / vehicle
Manual reader (bracelet) / wristband	1.200 - 1.500 €/unit
Reading technology maintenance fees (see list below)	
Fee per bracelet	5 - 8 €/month
Fee per vehicle with UHF antenna	35 - 40 €/month
Software fee (not applicable in all cases)	32 - 50 €/month

Figure 1. Unit costs of the material required for PAYT implementation

2.1.2. Specific costs for the implementation of PAYT charges with smart containers

The estimated needed investments for the implementation of PAYT charges with smart containers is presented in Figure 2. The second column indicates the price range of the user identification technology. The third column indicates the price range of the chamber system, which is identification technology with a container with a cylindrical drum to measure the volume of waste delivered.





			User identification systems price range	Chamber system price range
Technology per container		nology per ainer	355 € - 900 €	1,382 € - 1,400 €
Installation per container		allation container	90 € - 100 €	50 €
Hardware maintenance			5 €/container/month	9 €/container/month
RFID Cards or Smartcards		Cards or rtcards	1.35 € - 3.76 €	
s	SmartTag 2.65 €			
v	Volumetric sensor 325 €-390 €			
v	Waste limitation 193 € metallic mesh <sup>*</sup>			
	۷	Software online (manteinance is included)	8 €/container/month 0.25 €/month/smartcard	
ARE	B	Software license	1,950€ - 6,900 €	
SOFTW/		Software installation <sup>b</sup>	1,000 € - 6,000 € (for 3,000 inhabitants)	
		Software and hardware maintenance	150 <sup>°</sup> - 472	t€/month
Project implementation <sup>d</sup>		ect ementation <sup>d</sup>	700 € - 6.500 €	
QR bag		bag	0.098 €	
Alphanumeric bag		hanumeric	0.079 €	

#### Figure 2. Estimated price for the technology needed to lock the containers

a) Consist of a metallic shape grill with square holes for the main purpose of distributing the material homogenously, it also helps to control the material volume the user can introduce in the container.

b) It depends on the number of inhabitants registered.

c) It refers only to software maintenance, for the unidirectional systems.
d) It depends on the number of containers installed.

Note: Price ranges for a minimum of 5 technological manufacturers and suppliers, prices of 2017

Source: User Identification for Municipal Waste Collection in high density contexts (ENT, 2019); https://ent.cat/wpcontent/uploads/2019/07/User-identification-for-municipal-waste-collection\_4.pdf

#### 2.1.3. Specific costs for the implementation of PAYT charges with collection points located in rural or isolated areas

In municipalities with isolated residential areas, closed waste collection areas can be implemented, so that these residents can also participate in the PAYT charge when they are identified to access the collection area. This collection area and user identification system implies different investments that





should be considered. The estimated unit prices associated with those investments are presented in Figure 3.

Figure 3. Material needed for the implementation of PAYT in closed waste collection areas and estimated prices

MATERIAL NEEDED FOR THE IMPLEMENTATION OF PAYT IN ISOLATED RESIDENTIAL AREAS	UNIT PRICE (WITHOUT VAT)
Bucket or containers inside the area (Without locking them and without TAG)	35-45 € (120 L), 50-60 € (240 L), 70-85 € (360 L) - 190- 220 € (1.100 L)
Bucket or lock containers inside the area	(see budget from Figure 2)
Wooden fence of the area	8.000 - 15.000 €/u
Technology to lock the area	2.500 - 5.000 €/u
Electronic Key or card to enter the area	1,75 - 3,5 €/u
Software maintenance and remote assistance	40 - 50 €/month
Video surveillance camera	3.000 - 4-000 €

2.1.4. Material needed in any type of PAYT waste charge implementation

Regardless of the waste charge model implemented, there will always be costs associated with the communication campaign, the software or module that allows for automation of the calculation of the waste charge per user according to deliveries or access to closed containers, and the Citizen App that allows bidirectional communication between the local entity and the taxpayers.

The communication campaign is very relevant to ensure that taxpayers understand how to participate. The costs, however, are very variable depending a lot on the municipality where the implementation takes place and on the complexity of the model.

The costs of the fee calculation software or module and Citizen App are presented in Figure 4.

Figure 4. Software and App costs to calculate and implement PAYT waste charges

OTHER COMMON COSTS TO ALL MODELS OF SELECTIVE COLLECTION, FOR FAIR TAXE IMPLEMENTATION				
1) FAIR TAXE CALCULATION MODULE OR SOFTWARE, BASED ON WASTE DELIVERIES				
Fair Tax module	1.300 - 1.800 €			
Data import from other software / interconnection	1.800 - 2.000 €			
Implementation and staff training	1500 - 1.800 €			
Maintenance	100 €/month			
2) APP FOR CITIZENS AND BUSINESSES				
Bidirectional App	2.000 - 3.500 €			
Maintenance	0,3 €/taxpayer-license/year - 100 €/month			

## 2.2. Waste flow balance and economic benefits

When a PAYT waste charge is implemented, generally the taxed fractions such as the residual fraction or packaging fraction tend to reduce. The rate of selective collection tends to improve, and the generation of bio-waste tends to increase and improve 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. Figure 5 presents a list of the effects observed on waste flows when PAYT waste charges are implemented.

WASTE FRACTION	EXPECTED TREND
Taxed fractions (packaging and remain fractions) in door-to-door collections	Tend to reduce
Fractions collected at monitored waste collection areas	Tend to disappear whether taxed fraction containers are deleted from collection areas
Percentage of selective collection from door-to-door collected waste fractions	Tend to increase at non-taxed 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	Tend to increase
Irregular dumping	Tends to increase. Thus, the trend depends on the adopted selective collection model, the services provided and the implementation of sanctioning mechanisms.

Figure 5. Potential waste flow changes buy the introduction of PAYT waste charges

Changes in waste flows affect the general economic balance. When residual waste is reduced, and the collection of recyclables increases, the cost of waste management decreases because of the income from selling secondary materials or from the extended producer responsibility schemes. Hence, generally, the implementation of the PAYT charge implies a reduction of the net costs (balance) of the waste general service.

As a reference for the implementation of PAYT charges, Figure 6 presents a statistical comparison of the selective collection results analysed between municipalities that operate with open containers without user identification and those that operate with door-to-door collection, with door-to-door collection and PAYT charge, and with smart containers. It shows that the combination of door-to-door collection and PAYT charge is the system that reports the best results, with an average of 85% selective collection. The results of smart containers are still uncertain because most experiences have been based on pilot tests and not across a whole municipality. Nevertheless, the experiences carried out report quite positive results.









### Separate collection results per collection system

Figure 7 presents the correlation between the implementation of PAYT schemes and the reduction of the waste generated and the recovery of recyclable materials (obtained with data from Catalonia (Spain), 2021).

Figure 7. Relation between PAYT schemes implementation, the reduction of residual waste and the percentage in recyclables recovery



Source: ACR+.

#### 2.3. Percentage of net costs covered by tax collected

The net cost balance is the difference between gross costs minus income received from recyclable fractions. The percentage of collection coverage of net costs can be calculated dividing the economic collection of the waste charge (numerator) by the calculated net costs (denominator), as shown in Figure 2.





#### Figure 8. Waste charge net costs coverage

#### Gross costs (€) - Recyclable income (€) = Net costs (€)

# Percentage of collection coverage (%) = $\frac{\text{Waste charge colection (€)}}{\text{Net Costs (€)}}$

Spain has just approved a new waste law that requires municipalities a 100% waste charge coverage of the net costs by 2025. It is important to highlight that the closer you get to the collection goal with the waste charge, the more margin for bonuses and PAYT schemes you have.