

# THE SETTING UP OF A PILOT SCALE PAY-AS-YOU-THROW WASTE TARIFF IN AVEIRO, PORTUGAL

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## ABSTRACT

Over the last 20 years solid waste has become an important issue in municipalities and counties and a problem for societies aspiring to economic, social and environmental sustainability. The new, recently approved Waste Framework Directive and Landfilling Directive have even higher targets related to municipal waste recycling and landfilling, and critical changes need to take place if European targets are to be realistically achieved. Pay-as-you-throw (PAYT) waste tariffs are an instrument that can help achieving recycling targets. PAYT works by linking the payment of a waste-collection tariff with the amount of waste discarded so that the payment increases when more waste is produced: “the more one discards, the more one pays”. This work shows the early stages of PAYT implementation in pilot scale in a municipality in Portugal. The changes carried out in the collection infrastructures are described, as well as other complementary measures that were simultaneously implemented, namely reinforcement of the collection of dry recyclables and promotion of home composting.

*Keywords:* municipal waste, preparing for re-use and recycling, PAYT, separate collections, waste tariffs, closed-access container, collective collection, multi-building.

## 1 INTRODUCTION

The Circular Economy package was published in December 2015, together with legislative proposals to amend the waste framework directive, the landfill directive and the packaging waste directive. As a result, the revised Waste Framework Directive was recently published [1], introducing new targets for municipal waste re-use and recycling: from 50% in 2020 to 65% in 2035. On the same date, the Landfill directive was also amended [2], limiting by 2035 the landfilling of municipal waste to 10% or less.

In Portugal, the rate for “preparing for re-use and recycling” of municipal waste was 38% in 2017 [3]. This is calculated as the percentage of the potentially recyclable waste that enters facilities that prepare waste for re-use and recycling, and includes the valorisation of organic waste through composting and anaerobic digestion. With the new legislation [1], valorisation of organic waste will only count for preparing for re-use and recycling targets if the organic waste comes from separate collection. Since in Portugal the separately collected organic waste is only 2% of total municipal waste, the rate of preparation for reuse and recycling of municipal waste will drop to 13%, rendering Portugal even far behind the European targets.

On the other hand, the separate collection of dry recyclables (e.g. paper, glass, plastic and metal) was widely implemented around the turn of the century in Portugal (1997) becoming widespread in only a few years, rapidly reaching 10% of the total municipal waste generated. Regrettably, more than 20 years later, separate collection rates are persistently low, representing in 2017 16.5% of total municipal waste [3], which is quite a modest value, especially considering the existing recycling infrastructures and the long period that already elapsed since separate collection implementation. The initial expectation that mechanical and biological treatment (MBT) facilities (built in the first decade of the 21<sup>st</sup> century) would allow increasing material recycling was not met: in 2016, out of 1.7



million tonnes of municipal waste entering MBT facilities, only 66 thousand tonnes (circa 3.8%) of materials were recovered. The low grade of recovered materials is an additional problem, since it becomes increasingly difficult to put these materials in the market, and high-quality recycling does not occur. Although this problem is not exclusive to Portugal, as the impact in Europe of the recent ban imposed by China on plastic waste demonstrates, its dimension in Portugal is such that affects the economic sustainability of the recycling sector.

Given the current situation, it is not unexpected that 51% of municipal waste in Portugal is still landfilled [3] which demonstrates the challenge Portugal is facing to reach the newly imposed targets. Table 1 summarises the current situation in Portugal and the new European targets.

Under this framework it becomes evident that critical changes need to take place in the waste management sector in Portugal if European targets are to realistically be achieved. Separate collection is important for high quality recycling, but an on-line survey (n = 217) carried out in Aveiro at the end of 2017 indicated that only 34% of the population source-segregates on a regular base, with the reasons pointed out for not segregating being: not enough room available at home (answer given by 31% of the respondents); drop-off points for recyclables are far away (28%) and the lack of economic advantages (27%), among other minority reasons. Furthermore, the Circular Economy Package mentions the insufficient use in member states of economic instruments, like Pay-as-you-throw (PAYT) schemes, stating that such instruments contribute to high recycling rates, and the new Waste Framework Directive [1] even invites member states to make better use of such instruments.

PAYT tariffs are an incentive to reduce municipal solid waste and increase source segregation, leading to higher separate collection rates and to increased recycling. The incentive works by linking the payment of a waste-collection tariff with the amount of waste discarded, so that the payment increases when more waste is produced: “the more you discard, the more you pay”. PAYT systems are based on the joint application of two of the guiding principles of environmental policy: the polluter pays principle and the shared responsibility concept.

PAYT schemes are already in place in several European countries as well as outside Europe (e.g. USA), in the form of fees according to either the weight of municipal waste, the volume of the waste bin or the frequency of collection. Within Europe, countries using PAYT schemes have generally a better waste management performance in terms of decreased waste generation and increased recycling [4].

Table 1: European targets and current status in Portugal.

	European target 2035 [1], [2]	Situation in Portugal 2017
MSW recycling	At least <b>65%</b> (valorisation of organic waste not separately collected is excluded)	<b>38%</b> <b>13%</b> (excluding the valorisation of organic waste not separately collected)
Fraction of MSW that is landfilled	Max. <b>10%</b>	<b>51%</b>



But even though the PAYT waste tariff is widespread in other parts of the world, this waste charging system has never made its way to Portugal, where waste is charged based on water consumption. To date, in Portugal no Municipality has fully implemented a PAYT system, only pilot projects (e.g. Óbidos, subsequently withdrawn, and the historic centre of Guimarães, with limited reach). One of the reasons is the lack of information regarding the economical and societal impact of PAYT tariffs. Societal structure, processes and personal aspirations are frequently different from northern European countries, making it not so trivial to transpose the knowledge from previous successful initiatives. So, the discussion on PAYT in Portugal is only at the very beginning, and municipalities do not yet regard PAYT tariff as a possible and useful economic instrument.

In the current work, the implementation of a PAYT scheme in pilot scale within a Portuguese municipality is described, showing the earlier stages of the transition from regular tariffs to PAYT tariffs in Portugal.

## 2 PAYT IMPLEMENTATION AT PILOT SCALE IN AVEIRO, PORTUGAL

The implementation of PAYT tariffs at pilot scale in different municipalities in Southern Europe is one of the goals of the LIFE program project “Tool to reduce waste in South Europe (LIFEPAYT)”, (LIFE 15/ENV/PT/000609). In this case, an area within Aveiro City (Portugal) was selected as a demonstration site for PAYT implementation.

### 2.1 Description of the pilot site

Aveiro (Portugal) is a medium sized city (pop. 62,000) with mainly services, tourism, and some industry. The pilot site is a markedly urban neighborhood of 1461 inhabitants, located right at the center of the city of Aveiro (Fig. 1). This site was selected as representative of an urban site, comprising 487 households and some services (namely restaurants, schools, and offices). At the pilot site there is a mixed structure of multi-family buildings (circa 75%) and individual detached and semi-detached houses (25%)

Field waste equipment installed at the study site consists of 26 collective curbside containers of 800 L for mixed waste (Fig. 2(a)) and 10 drop-off containers for dry recyclables (paper/cardboard, plastic and metal and glass), shown in Fig. 2(b). The waste



Figure 1: Study site in Aveiro (PT): Bairro da Forca-Vouga (GPS coordinates: 40.639030, -8.640014).

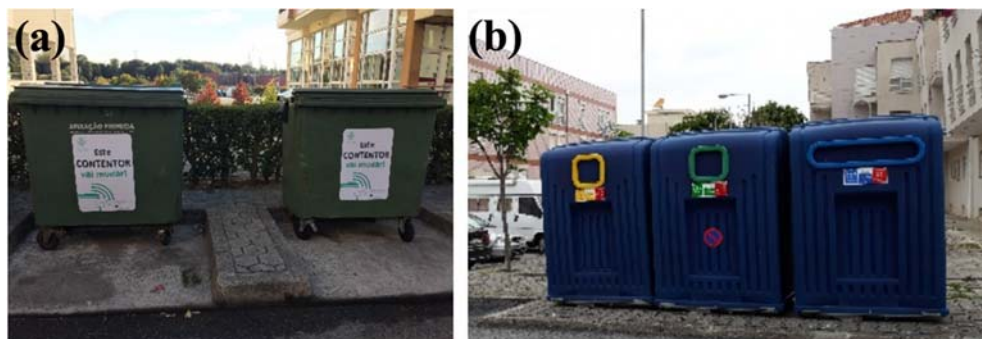


Figure 2: Waste containers at the study site before the start of LIFE PAYT project. (a) Unsorted waste; (b) Dry recyclables.

collection service of unsorted waste is outsourced to a private company and the collection of packaging waste is under the responsibility of a multi-municipal waste management company. Separate collection in the Aveiro administrative region was 7.6% of total waste before the start of PAYT, corresponding to 30.7 kg per inhabitant per year [5]

## 2.2 Waste characterization campaign

Prior to the implementation of the new collection system, it was necessary to build a clear picture of the initial scenario of municipal waste generation in the area. This initial scenario is suitable to be taken as a baseline against which the progress achieved by the project will be evaluated. With this purpose, a characterisation campaign of the municipal waste generated in the area was designed and performed.

The specific objectives of the campaign were to obtain information about the quantity of municipal waste produced and its composition. With this goal, a vehicle collected all the daily residual waste generated in the neighbourhood during four days in June 2017. The waste was weighted, giving an average value of 1080 kg per day, that is 0.74 kg/day *per capita*. This value is clearly lower than the national Portuguese average (1.32 kg/day) [3]. This can be explained because the obtained experimental value consists mainly on purely household waste and does not include waste with commercial or industrial origin nor municipal green waste (which are otherwise included in the national statistics).

After weighing of the loaded vehicle, the collected waste was unloaded, spread on a floor surface and manually sorted by a team of 5 persons who classified all the constituent materials according to the main municipal waste component fractions (Fig. 3). The corresponding result for the composition is shown in Fig. 4.

From the numbers in Fig. 4 it can be concluded that roughly a 22% of the obtained composition corresponds to recyclable materials (paper, cardboard, plastics, glass, composites, metals) which may be suitable for the current source separation and separate collection. This value is lower to that obtained in other characterisations for the region, where these materials make more than 30% of the residual municipal waste. This may perhaps indicate a somewhat better performance of source separation in this particular neighbourhood in comparison with the whole region. Nevertheless, it is concluded that a remarkable room of improvement still exists regarding potential source separation.



Figure 3: Sorting of residual waste components.

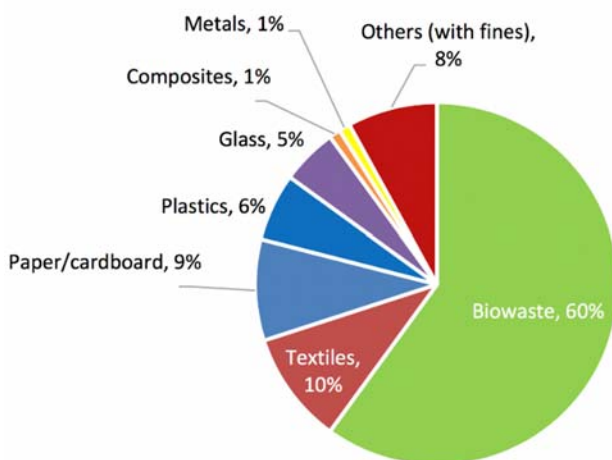


Figure 4: Weight composition of analysed municipal waste.

### 2.3 Conversion of containers for unsorted waste

PAYT schemes require that a correlation is made between the unsorted waste generated and its producer. Therefore, it is necessary to find a way to assess how much unsorted waste each household produces. Different technical options are available to achieve that goal. However, the waste collection equipment initially installed at the site does not allow such a correlation to be made, hence an adjustment was required.

Collective waste bins (800L) were upgraded with an access control system, allowing use of the bin by authorized users only, with access granted through an ID card. The system consists in a rotating chamber inserted into the lid which allows placing 40L waste-volume at a time. An electronic card reader activates the opening of the rotating chamber. Included is also a small battery and a simple storage system to record the number of times each citizen accesses the bin. The information stored in the card reader of the bins is transferred to a central database via GPSR (mobile network) once a day (at 00h:05m). Fig. 5 depicts the new system in place since June 2018. Access cards have been distributed to the

population at the study site through an information stand located at the site, during May 2018 (Fig. 6). Unpicked cards at the stand were sent to the remaining population of the site by regular mail.

#### 2.4 Reinforcement of the collection of packaging waste

The introduction of PAYT means a profound change in the way citizens and other waste producers look at waste. The kerbside waste container will no longer be seen as infinite, and citizens will certainly look for alternatives in an attempt to reduce the waste bill. At the study site it is expected that PAYT implementation will result in a diversion of residual waste from collective bins into the recyclable waste streams (paper, packaging, glass). Therefore, 5 additional drop-off points for recyclables were installed at the study site in June 2018, around the same time as the new waste containers, thus increasing the available number of drop-off points for recyclables from 5 to 10. This means an increased access to drop-offs by the target population. Calculation of the impact of these measures on the amount of recyclable materials collected will be assessed in the future.



Figure 5: New waste containers for unsorted waste installed at the study site allowing for user identification. (a) Outside view; (b) Rotating chamber and card reader system.



Figure 6: Information stand located at the site throughout May 2018, during which the municipality staff handed over to the residents the individual cards allowing the opening of the collective waste bins.





Figure 7: First edition of the home composting course (June 2018).

## 2.5 Promotion of home composting

Home composting is another alternative to residual waste disposal that was made available to the residents at the study site. Home composting is an environmentally sustainable option for dealing with garden waste and uncooked kitchen waste, such as vegetable peelings. Carrying out a home composting program is a strategy followed in other municipalities that successfully applied PAYT tariffs. Such programs significantly raise resident's willingness to accept PAYT tariffs. In Aveiro study site, promoting home composting was even more necessary since there is not a separate collection circuit for bio-waste in place. The results of the waste characterization campaign carried out at the study site in Aveiro immediately before PAYT introduction (Section 2.2), showed that kitchen waste was 55.9% and garden waste was 3.9% of the generated residual waste.

To empower residents on their ability to divert waste from the residual waste into composting, a 4-hour home composting course was developed. The first edition of this course took place in June 2018, with the participation of 17 people (Fig. 7). At the end of the course a home composting kit was distributed to the participants. The composting kit consisted of one caddy (10 L) and one composting bin (290 L), MILKO C290 (from OVO Solutions). The second edition of the course is scheduled for September 2018.

The participant's commitment to home composting is assumed to be voluntary. Follow up actions will take place through monitoring visits to be carried out regularly in the first two years. These will allow estimating how much reduction of residual waste is achieved through home composting. Comparison of residual waste amounts generated from both home composting participants and non-participants will also be carried out in order to help in the development of a fair waste tariff to apply and to properly evaluate the environmental impact of PAYT implementation.

## 3 FUTURE DEVELOPMENT AND PROSPECTS

Most PAYT schemes implemented elsewhere rely on door-to-door collection and on the identification of the waste bin using either the address or an RFID tag opposed to the bin. Using closed collective waste bins which can only be opened by an individual card is one of the few solutions that can be used when collective waste containers are in place and door-to-door collection is not possible. Other PAYT options for similar situations include the use of pre-paid bags (e.g. Switzerland) which are then deposited inside the collective containers. In this scheme the waste is paid when the bag is bought, simplifying the

charging process and avoiding the need for closed containers and electronic hardware (card readers and data storage). Such systems rely on effective inspection of the bags deposited and on the capability to trace the origin of an eventual unauthorized bag (that is a common bag, that has not paid the waste tariff). Given the current waste collection framework such system is not possible to implement in Portugal at present. Effectiveness of the system will rely mostly on the following issues:

- Acceptance by the user: this is the single most relevant parameter. Initial resistance is expected, even with all the complementary measures described (information kiosk, additional drop-off points for recyclables, promotion of home composting). In the months following deployment of the new containers, waste reduction and awareness campaigns will be launched, targeting the residents in the study area. The effectiveness of the campaign (and of the PAYT system under testing) will be measured through waste characterization campaigns, where both the volume and fraction of recyclables present in unsorted waste will be measured and compared to the results obtained in Section 2.2. The number of bags placed outside the container will also be measured systematically, and its evolution will also provide an indicator of acceptance by the population.
- Reliance of the new container and associated electronic components: mechanical issues might hinder the success of the PAYT scheme. Eventual blockage of the rotating drum, problems in opening the lid or in using the electronic card need to be addressed and corrected straight away.
- Economic balance of the PAYT scheme: ultimately, the success of the scheme will be measured by comparing the overall cost of implementation against the additional savings for the municipality due to reduced costs with waste management. A full cost assessment will be carried out along with the feasibility of extending the PAYT scheme to cover all municipality area.

#### 4 CONCLUSION

A pay-as-you-throw waste tariff is currently being implemented in a study site in Aveiro, Portugal. The implementation is framed by a LIFE programme project and driven by the need to increase separate collection rates and decrease waste landfilling, following European legislation. The initial stages of implementation involved a drastic change in the containers: from free, open access kerbside container to a closed container, with limited access and a small opening, where up to 30L of waste can be disposed at a time. Concomitantly, new options were provided to citizens in order to help them divert waste from unsorted waste into other more sustainable solutions. These included home composting and reinforcement of the network of drop-off points for dry recyclables. These are measures complementary to PAYT implementation, but of the utmost importance since they may well dictate the acceptance of the new tariff and the success or failure of the actions leading to PAYT implementation.

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