Pay-as-you-throw

In a nutshell

Summary overview

The aim of pay-as-you-throw (PAYT) is to enact the polluter pays principle in a fair way by charging users of the waste management system according to the amount of waste they generate.

It is best practice to charge waste fees to users based on a fixed plus variable fee component, to reflect the cost structure of waste management and align incentives for users (i.e. lower fee when less waste is produced) and waste collectors (i.e. revenue stability from the fixed fee component).

In practice, the system can be implemented in various forms, typically:

- volume-based schemes (choice of container size);
- sack-based schemes (number of waste sacks used), e.g. with prepaid specific sacks;
- weight-based schemes (the weight of the waste collected in a given container);
- frequency-based schemes (the frequency with which a container is left out for collection – this approach can be combined with volume- and weight-based schemes).

The scheme can be focused on charging for residual waste only or also separated streams, still with the aim of fostering source separation and waste prevention.

The four key elements enabling the implementation of a PAYT scheme are:

- the identification of individual users;
- the measurement of waste streams at the individual user level (e.g. from door-to-door collection, street containers or at civic amenity sites);
- the definition of a unit pricing that effectively drives behavioural change;
- the engagement of residents to ensure a correct understanding of the features of the scheme and their buy-in and commitment (this is important to avoid illegal dumping or the transfer of waste in other territories not served by a PAYT scheme).

Waste management area

Cross-cutting	MSW - strategy	MSW - prevention	MSW - collection	MSW - EPR	MSW - treatment	CDW	HCW

Applicability

While the approach is broadly applicable, existing infrastructure must be adapted (e.g. collection). Door-to-door collection is usually necessary to fully implement PAYT principles.

Precautions must be taken to ensure that enforcement is ensured (e.g. no 'leakage' into the MSW of adjacent local authorities with no PAYT or into litter bins on the streets). This is more feasible when there is already an existing awareness of users regarding source-separation and broader environment and waste issues.

Depending on the implementation (e.g. in case of user identification of individual bins or bags), appropriate measures are needed to deal correctly with data privacy and confidentiality (e.g. secure data storage).

Specific environmental performance indicators

In addition to the indicators presented in the best practice "common environmental performance indicators for municipal waste management", the most appropriate indicators to assess the successful implementation of this best practice are:

- A pay-as-you-throw system is in place (y/n);
- inclusion of waste conferred to civic amenity sites in the PAYT system (y/n);
- share of users with zero waste generation (%).

Benchmarks of excellence

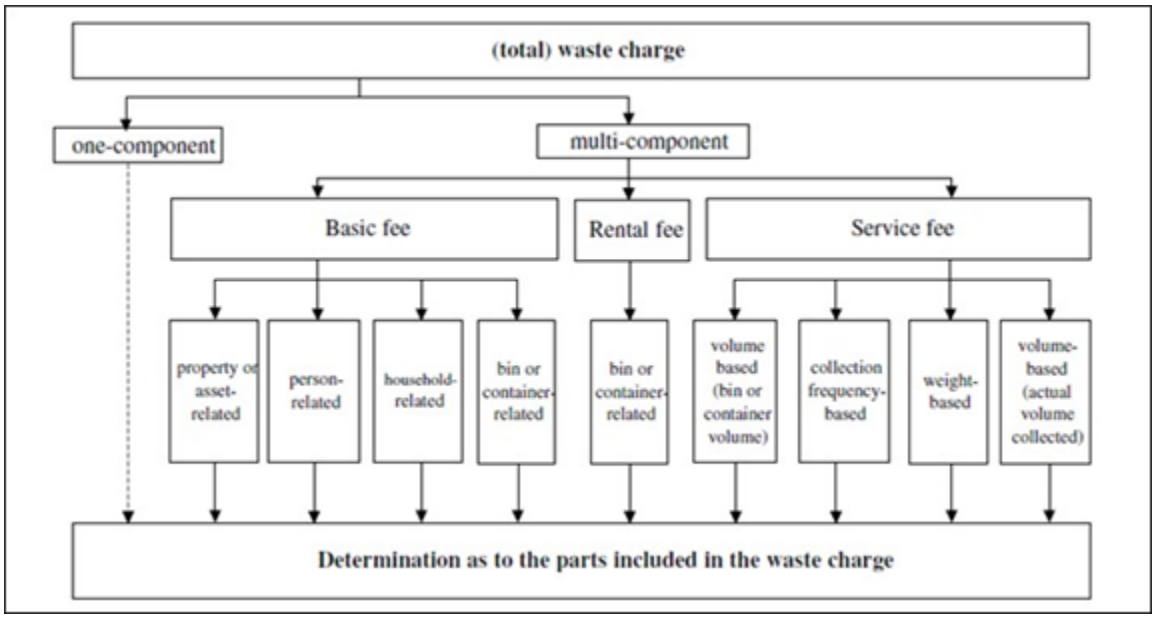
- A pay-as-you-throw system is in place, according to which at least 40 % of the cost is charged to the users depending on the quantity (kg or m^3) of mixed waste collected, the size of the waste collection bins and/or the number of collection rounds.
- The PAYT system also includes the waste conferred to civic amenity sites.

Description

The approach of “pay-as-you-throw” (PAYT) (also known as unit pricing (Dijkgraaf and Gradus, 2009), differential and variable rates (OECD, 2006; van Beukering et al., 2009) and variable fee or charge systems) is to apply the 'polluter pays' principle in a fair way by charging inhabitants according to the amount of waste they generate (Bilitewski et al., 2004).

The experience gained so far has revealed that the waste fee should not only comprise the single component “amount of waste generated” but should ideally consist of fixed and variable (service-based) fees (Bilitewski, 2008). On the one hand, this reflects the cost structure of waste disposal, which consists of fixed and variable costs (Bilitewski et al., 1995), and, on the other hand, the inclusion of a fixed (basic) fee helps to avoid illegal disposal practices, which can increase in the event that the fee is only charged for the variable amount of waste collected (Reichenbach, 2008; Puig-Ventosa, 2008). Waste fees applied to residents should have the right balance between variable and fixed fees. Local authorities aim at revenue stability, thus high fixed fees, but it is the variable fee (unit rate) that leads to behavioural change of residents, driving waste prevention and better waste separation at source. When establishing the waste fees, an economic balance of waste management should also be sought by covering as much as possible residual waste management costs with PAYT revenues.

Figure 1 shows the different possible components of a waste fee.



Source: Bilitewski (2008)

Figure 1. Different suitable components for the design of waste fees

In Figure 1, the service fee represents the service-related part of the fee. Consequently, the PAYT approach means that a substantial part of the overall fee is allocated to the amount of waste generated in order to stimulate waste prevention and recovery.

In this context, PAYT schemes can be implemented in different ways as illustrated in Figure 2.

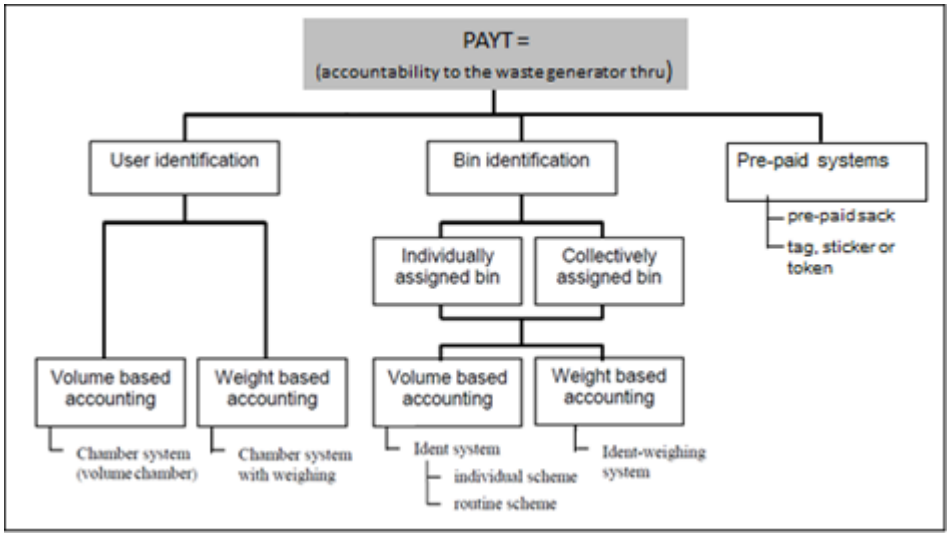


Figure 2. Overview of the different possibilities to implement the PAYT approach (based on Reichenbach, 2008)

The prepaid sack system is also considered to belong to the volume-based systems but here it is presented as an additional system as for solid household waste; the volume of a sack directly correlates with its weight and the fee has to be paid for each sack. Therefore, it is different from common volume-based schemes where citizens pay for the choice of container size. The most important PAYT schemes (Watkins et al., 2012) are:

- volume-based schemes (choice of container size);
- sack-based schemes (number of sacks left out for collection);
- weight-based schemes (the weight of the waste collected in a given container);
- frequency-based schemes (the frequency with which a container is left out for collection – this approach can be combined with volume- and weight-based schemes).

Best practice is that weight-based door-to-door collection is carried out not only for residual waste but also for organic waste and bulky waste. The successful implementation of an efficient PAYT system requires that the waste delivered to civic amenity sites is also covered by the PAYT system; therefore, a well-developed network of civic amenity sites (see the best practice "Civic amenity sites") is key for a well-performing PAYT system in order to offer the citizens a comfortable way to dispose of materials that they no longer need. In addition, awareness-raising is also an important element for PAYT systems; if the citizens are aware, well-informed and supportive of the system, they will contribute to its success.

The experience shows that the best results can be achieved with weight-based schemes but that with prepaid sack schemes good performances are also achieved whereas volume-based systems impart the weakest incentive for waste prevention and recycling (OECD, 2006; Watkins et al., 2012). In contrast, the highest recycling rates and lowest residual waste quantities are achieved with weight-based systems accompanied with well-developed infrastructure and citizens with high awareness. Consequently, a case study is presented in more detail. For such a system, the technical elements of the PAYT scheme are based on the following four pillars:

- the identification of individual users;
- the measurement of waste streams at the individual user level (e.g. from door-to-door collection, street containers or at civic amenity sites);
- the definition of a unit pricing that effectively drives behavioural change;
- the engagement of residents to ensure a correct understanding of the features of the scheme and their buy-in and commitment (this is important to avoid illegal dumping or the transfer of waste in other territories not served by a PAYT scheme).

In other words, the waste producer has to be identified, the amount of waste delivered is recorded by weight, and there is a price per unit of waste which has to be paid in addition to the fixed fee.

Environmental benefits

The amount of residual waste significantly decreases and the amount of recycled waste increases accordingly – if the infrastructure to collect and to process the recyclables is available and efficient and the citizens have adequate awareness and actively support the system. Recycling rates of 70 % and higher (Reichenbach, 2008), up to 86 % in case of weight-based systems (Aschaffenburg, 2013), are achieved. Figure 3 shows the development of the quantities per capita for the total waste, the waste disposed of and the recycled waste from 1991 to 2013 for the county of Aschaffenburg, Germany. The PAYT system with identification and weighing of the waste bins (for residual waste as well as for biowaste), collected door-to-door, was introduced in 1997 and the subsequent increase in recycled waste and the decrease in disposed of waste are obvious. In principle, this example is representative; as the weight-based system is applied, the recycling rates are particularly high.

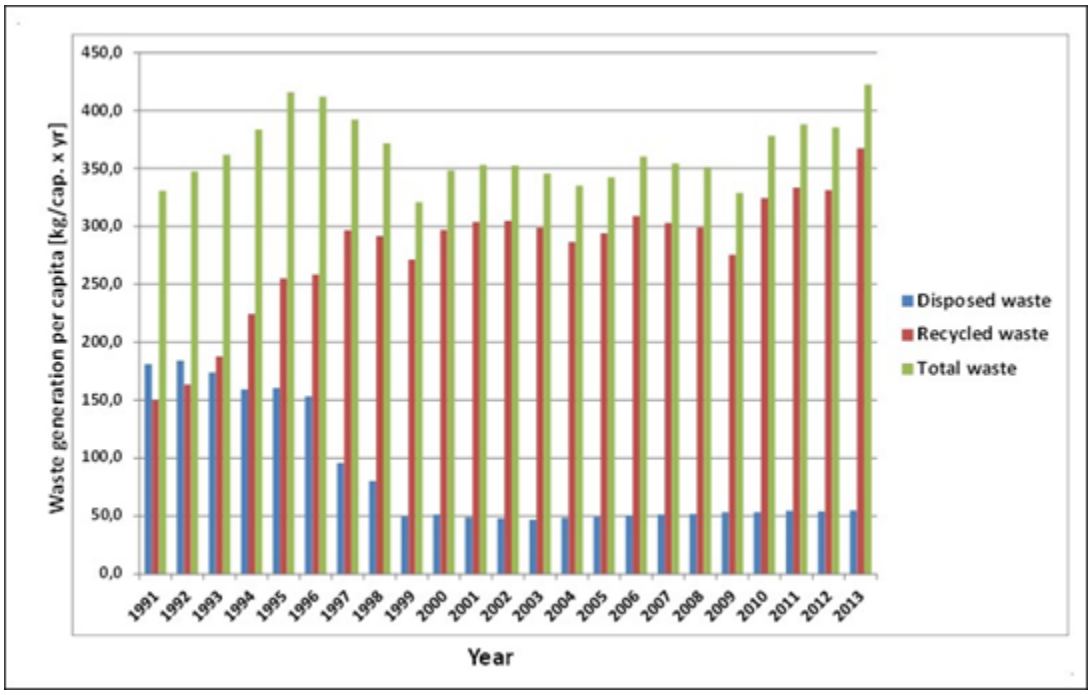


Figure 3. Development of the quantities of total waste, waste disposed of (i.e. mixed waste) and recycled waste from 1991 to 2013 in the county of Aschaffenburg (Germany) (County Aschaffenburg, 2013)

The reported recycling rates for weight-based systems vary significantly due to the different levels of waste collection infrastructure and public awareness. Another example with a very good performance is reported from Italy, where high recycling rates and low residual waste quantities were achieved. In the Treviso region, only 55 kg residual waste per capita were reported for 2015 (Contó, 2015; Contarina, 2015) and in the municipality of Trento in the year 2014 the residual waste quantity was 102 kg/capita per year (see Figure 4).

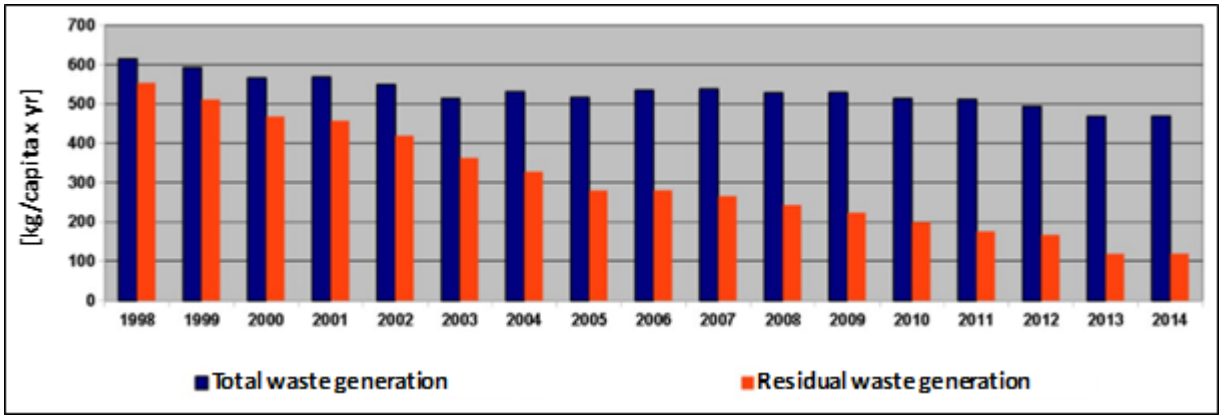


Figure 4. Development of the total and residual waste quantity in the municipality of Trento from 1998 to 2014 (Fedrizzi, 2015)

The same is true for Flanders, a region of Belgium, where first prepaid sacks were used and later weight-based systems. The recycling rate could be significantly reduced and the residual waste quantity reduced down to 149 kg/capita per year (Regions for Recycling, 2014a). The development is indicated in Figure 5.

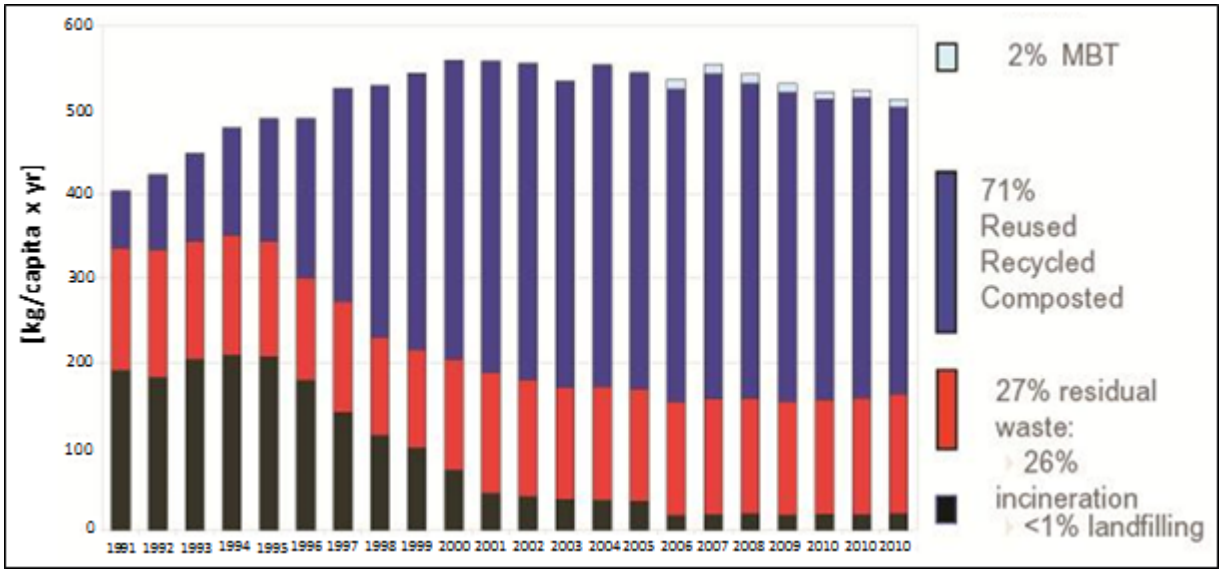


Figure 5. Development of recycled and residual waste as well as incinerated and landfilled waste in Flanders from 1991 to 2012 (Regions for Recycling, 2014a)

The prepaid sack systems also show a significant decrease in the quantity of residual waste but the achievable figures are lower compared to optimum weight-based systems.

- In Switzerland, on average 391 kg/capita per year are recycled which corresponds to 53.5 % of the total waste quantity (Switzerland, 2015).

Side effects

The implementation of PAYT increases the risk of waste leakages from the system (waste going to nearby municipalities without PAYT, illegal dumping, littering, etc.). A well-developed and easy-to-use infrastructure for the collection of waste reduces the risk of waste leakages together with adequate environmental awareness of residents. Local authorities, in addition, can monitor the leaked waste, for instance investigating residents/users with zero waste generation in the PAYT system. This method helps identify those residents disposing of their waste through alternative channels (which could include illegal dumping), so corrective actions can be implemented.

The implementation of PAYT systems may also lead to higher levels of impurities in waste fractions (e.g. recyclables) that can be collected for free or at a lower cost than mixed waste.

Applicability

From a technical point of view, the PAYT system can be implemented in any municipality. The weight-based system requires more technical equipment and staff but can achieve very high performance levels; it requires a detailed inventory of all households and individual bins and containers. Confidentiality aspects can be managed and have not limited the application of the techniques so far; for instance, the privacy fears in the UK could be managed (e.g. Holmes et al., 2014).

At the time of introducing the system, there is a significant workload peak for the municipality, city or county concerned as well as for the service provider (collector of the bins and containers).

Furthermore, as already stressed, a well-established infrastructure for the collection of the different waste fractions is required in order for the citizens to dispose of certain waste fractions in an easy and comfortable way.

The environmental awareness of citizens is also a factor that has to be considered, especially with respect to illegal dumping of waste to save money. If the environmental awareness is low, information campaigns are required. Specifically,

with respect to possible illegal dumping, adequate enforcement must be in place. Meanwhile, as mentioned above, where environmental awareness is already well developed, the introduction of PAYT does not lead to relevant problems with illegal dumping.

Economics

In the county of Aschaffenburg, after implementing the whole current waste management system, the 2013 waste fee was lower compared to the initial situation 16 years before. The PAYT system in Aschaffenburg included: the PAYT scheme with weight-based waste collection of residual waste and biowaste as well as separate collection of paper from all households, the operation of recycling facilities and composting/incineration of green cuttings in all bigger municipalities, the PAYT approach for collection, processing and disposal of bulky waste since 1999, disposal of the residual waste in an incineration plant according to BAT standards, anaerobic digestion of biowaste, subsidies for composting at the household level, for the use of reusable nappies, and for families with incontinent persons).

The calculation of the fee (just before and just after introducing the weight-based system) is publicly available (County of Aschaffenburg, 1995; County of Aschaffenburg, 1997). Despite the manifold additional activities (separate collection of the different fractions, erection of the first facilities to recycle or to recover waste streams), the fee significantly decreased after the change. So, the fear that the weight-based system is more expensive (e.g. Slavik and Pavel, 2013) is not reflected in the case of Aschaffenburg. However, the extent of the cost can vary from case to case. After the change, the disposal cost decreased by 46 %, especially because the residual waste was incinerated and the incineration costs were high at that time (EUR 232/t in 1997) and decreased to EUR 52.80 in 2014. In 1999 and 2000, the fee had to be increased by 20 % to cover all the costs; the fee estimation had been based on a part of the county but the costs in other parts were higher. But, from 2002 to 2013, the fee significantly decreased, by about 23 % (see Table 1), although the county further invested in anaerobic digestion of the biowaste, in collection centres, in weighing the green cuttings, etc.

The same has been observed in Italy. The region of Treviso also has an advanced waste management system (high recycling rates and low quantities of residual waste) and also has low waste fees; the average waste fee is about 27 % lower than the average waste fee in Italy (Contó, 2015; Contarina, 2015). Currently, in Treviso, 60 % of the waste fee for a household is calculated based on the number of people living in the same place and 40 % varies according to the amount of mixed waste collected from the household (Contarina, 2016). Discounts are applied if home composting is implemented, while an increase in the tariff is applied if the household also delivers green cuttings to the waste management system (Contarina, 2016).

Table 1. Development of the waste fees in the county of Aschaffenburg from 1997 (the year the PAYT system for residual waste was implemented) to 2012 for an average four-person household.

Year	Annual basic fee for a 120-l bin	Fee for the weight of the waste	Fee to collect the waste (emptying the bins)	Total annual fee (without a bin for organic waste	Total annual fee (with a bin for organic waste)
	[EUR]	[EUR]	[EUR]	[EUR]	[EUR]
1994-95				171.8 / 245.4[1]	
1996-97				158.0 / 225.50[1]	
After the introduction of the weight-based system in mid-June 2007					
1997	50.31	44.54	21.47	116.33	148.67
1998	50.31	47.92	18.41	116.64	148.97
1999	55.22	53.87	20.25	129.34	165.52
2000	62.58	59.93	21.47	143.99	184.91

2001	62.58	59.30	21.47	143.36	182.05
2002	63.00	46.22	21.60	130.82	162.90
2003	63.00	45.80	21.60	130.40	162.70
2004	63.00	48.50	21.60	133.10	168.33
2005	60.00	40.04	19.60	119.64	147.76
2006	60.00	40.13	19.60	119.73	148.20
2007	60.00	40.66	19.60	120.26	149.49
2008	54.00	37.28	19.60	110.88	138.72
2009	54.00	37.76	19.60	110.36	139.50
2010	54.00	37.20	19.60	110.80	138.65
2011	54.00	38.32	19.60	111.92	140.94
2012	54.00	37.68	19.60	111.28	140.14
2013	54.00	37.60	19.60	111.20	140.38

1Lower figure for a 35-litre bin, higher figure for a 50-litre bin.

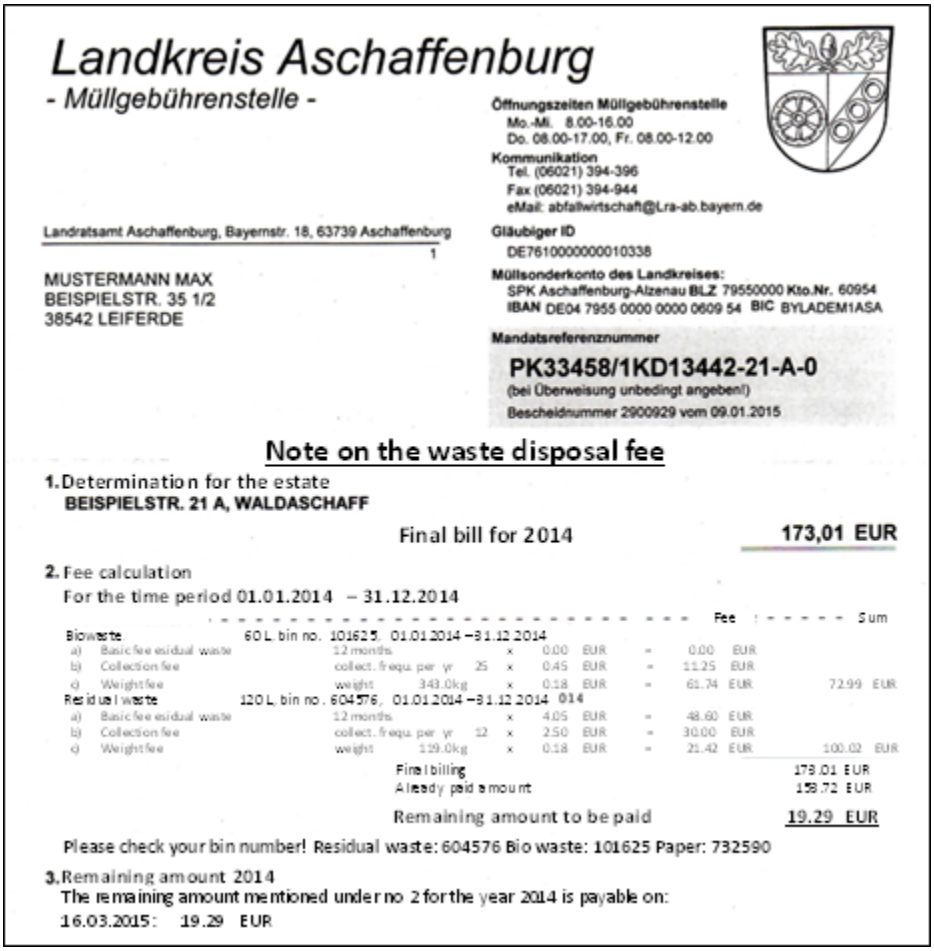
Note to the table: Columns 2-5 provide the figures for the case where the household has no bin for organic waste and column 6 gives the total fee where the household also has a bin for organic waste (County of Aschaffenburg, 2013)

The fee after the introduction of the weight-based system represents an average value as all the bills are individual due to the variable fee for the weight.

The fee in the county of Aschaffenburg consists of the basic fee, the collection fee (to empty the bins) and the weight fee. In 1997 and in 2012, the percentages were as follows (County of Aschaffenburg, 2013):

	1997	**2012**
Basic fee	32 %	47.0 %
Collection fee	17 %	18.5 %
Weight fee	51 %	34.5 %

The percentage for the weight part decreased but is still high enough to motivate waste prevention/recycling. However, the effect on prevention is low. Figure 11 shows an example of the annual bill of the county of Aschaffenburg indicating the basic fee, the service charge to collect the waste (collection fee) with a certain frequency and the weight fee, separately for the biowaste, for which the basic fee is zero, and the residual waste.



Landkreis Aschaffenburg
- Müllgebührenstelle -

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Mandatsreferenznummer
PK33458/1KD13442-21-A-0
(bei Überweisung unbedingt angeben!)
Bescheidnummer 2900929 vom 09.01.2015

Note on the waste disposal fee

1. Determination for the estate
BEISPIELSTR. 21 A, WALDASCHAFF

Final bill for 2014 173,01 EUR

2. Fee calculation
For the time period 01.01.2014 – 31.12.2014

									Fee	Sum
Biowaste	60 L, bin no. 101625, 01.01.2014 – 31.12.2014									
a) Basic fee residual waste	12 months		x	0.00	EUR	=	0.00	EUR		
b) Collection fee	collect. frequ. per yr	25	x	0.45	EUR	=	11.25	EUR		
c) Weight fee	weight	343.0kg	x	0.18	EUR	=	61.74	EUR	72.99	EUR
Residual waste	120 L, bin no. 604576, 01.01.2014 – 31.12.2014 014									
a) Basic fee residual waste	12 months		x	4.05	EUR	=	48.60	EUR		
b) Collection fee	collect. frequ. per yr	12	x	2.50	EUR	=	30.00	EUR		
c) Weight fee	weight	119.0kg	x	0.18	EUR	=	21.42	EUR	100.02	EUR

Final billing 173.01 EUR
Already paid amount 153.72 EUR

Remaining amount to be paid 19.29 EUR

Please check your bin number! Residual waste: 604576 Bio waste: 101625 Paper: 732590

3. Remaining amount 2014
The remaining amount mentioned under no 2 for the year 2014 is payable on:
16.03.2015: 19.29 EUR

Figure 11: County of Aschaffenburg example of the annual bill for the waste fee of a four-person household having separate bins for residual waste (120 l), biowaste (60 l) and paper/cardboard

In a country with a hot climate, the collection frequency for biowaste will be higher, which may be associated with higher collection costs, but the collection frequency for residual waste can be as low as indicated.

Driving forces for implementation

In many cases, waste managers in municipalities were motivated to implement the PAYT approach where landfill capacity was exhausted, where fees were high and/or public environmental awareness called for a change. Furthermore, in some Member States, the landfill of untreated municipal waste was already banned before the EU-wide restrictions came into force[1].

[1] Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste

Reference organisations

Many municipalities in Germany apply the weight-based system (e.g. counties of Aschaffenburg, Schweinfurt, Garmisch-Partenkirchen, Landsberg am Lech) as well as municipalities in the Netherlands (Rijkswaterstaat, 2014), France (city of Besançon) and Ireland (Regions for Recycling, 2014b). It is also practised in the US (Skumatz, 2002, 2008; Hall et al., 2009).

The prepaid sack system is widespread in Switzerland (Bilitewski et al., 2004, Switzerland, 2015) and is applied in Belgium, the Netherlands, Denmark and in a few cases in Italy and Spain (Catalunya, 2010).

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