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Cross-analysis of 'Pay-As-You-Throw' schemes in selected EU municipalities

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EXECUTIVE SUMMARY

Efforts to develop and enhance prevention, prepare for reuse and recycling have improved in the past decade, but still have not managed to stabilise or even reduce waste levels. Increased consumption and accompanying levels of waste have led to an interest in reinforcing policies and strategies addressing the top of the waste hierarchy. One such strategy for household waste is to apply the Polluter Pays Principle through the implementation of a variable fee structure, or Pay-As-You-Throw (PAYT), as studied in this publication. This policy targets household waste at its very source and makes households responsible for the quantity of waste discarded and thus creates an incentive for increased recycling, composting, and ideally a reduction in waste generation.

This report looks at the application of PAYT in the European Union (EU) through several case studies: seven municipalities from seven different countries are examined and compared for their strategies with regard to PAYT. This report aims to clarify the potential benefits and challenges when introducing PAYT. The study focuses on household waste.

Results show that PAYT has the potential to adapt well to local conditions, to encourage (residual) waste reductions, to increase considerable recycling and (home) composting and to be well-received by stakeholders. The report also demonstrates how PAYT systems vary greatly in detail, coverage, objectives, time horizons, targets, indicators, monitoring systems, measures, and policy instruments and results.

KEY FINDINGS

The following key-findings can be drawn from this research:

- A single policy measure can rarely achieve the stated policy goals. Policy measures have the best results when they are applied in a mix. The mix of policy measures should fit other measures. However, there is no one-size-fits- all approach in different countries/ municipalities and for different waste streams. Moreover, PAYT is not a stand-alone policy measure. PAYT should always be incorporated in a mix of environmental policy measures such as prevention/ recycling targets, EPR, bans/ taxes and public information campaigns.

- If backed by sufficient recycling infrastructure PAYT has a strong potential to reduce waste and increase recycling.

- It is often recommended to launch PAYT with Door-to-Door collection schemes to maximise the accessibility of diversion.

- The design of the fee structure, or mix of fixed and variable fees, is critical to fully incentivise changes in waste behaviour.

- The fee structure should correctly reflect the costs of the waste services for the municipality, but also hold the proper balance of fixed and variable parts to encourage reductions. This means the municipalities need to have a solid understanding of the costs involved with their waste collection infrastructure.

- PAYT schemes appear to be most effective when the fees payable by households are at levels high enough to encourage reflection by householders on their waste generation behaviour.

- There are arguments for not making the charges so high in order to avoid providing a strong incentive for illegal dumping.

- Potential barriers to success are viewed as lack of diversion goals, lack of corresponding recycling infrastructure expansions, limited outreach to customers about how to change purchasing habits, and charging of a separate fee for recycling.

- With regards to waste prevention, weight-based systems are most successful, followed by combined volume and frequency-based/sack-based systems, and then volume-based systems (i.e. schemes where households simply choose a specific size of container). Care should be taken for PAYT and producer responsibility schemes to be complementary.

- Additionally, the largest reductions in waste appear to come from the diversion of food waste, meriting adequate attention to this waste stream.

- General waste surveys by the municipalities show satisfaction with the system, and the waste planners reported that users have a perceived high level of acceptance for the waste services and billing system.

- The general advantages for the policy listed by the municipalities are that it is “fair,” offers a strong incentive for waste reductions and increased sorting, and that it delivers high quality waste data.

- During the take-off and acceleration phases, when the policy is first implemented, and users are adjusting to the fee, the municipality can monitor closely, stay in close contact to its citizens through educational materials, and carefully monitor waste outcomes and revenue to adjust the fee accordingly.

ABBREVIATIONS

BB	Bring Banks
C&D	Construction and Demolition (waste)
CO_2	Carbon dioxide
DG	Directorate General for the Environment
EC	European Commission
EEA	European Environment Agency
EEE	Electronic and Electrical Equipment
EI / EIs	Economic Instruments
EPR	Extended Producer Responsibility
EU	European Union
DtD	Door-to-Door (collection)
GDP	Gross Domestic Product
Kg	Kilogram
MBT	Mechanical Biological Treatment Center
MS	Member States
MSW	Municipal Solid Waste
PAYT	Pay-As-You-Throw
PPP	Polluter Pays Principle
RY	Recycling Yard
T	Tonne
UC	Underground Containers
WEEE	Waste Electrical and Electronic Equipment
WFD	Waste Framework Directive

DEFINITIONS

Bimonthly: twice a month.

Bio-waste: biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises and comparable waste from food processing plants (art.3.4 of the WFD 2008/98).

Bring Bank (BB) collection: organising the collection mode in a way where the collection container is made available to the public close to the house.

Bulky waste: voluminous household waste that cannot be deposited in the standard collection bins/ containers. Green waste and rubble are not considered bulky waste.

Collection: the gathering of waste, including the preliminary sorting and preliminary storage of waste for the purposes of transport to a waste treatment facility.

Composting definition: gathering plant material, such as leaves, grass clippings, and vegetable peels, into a pile or bin and letting it decompose as a result of the action of aerobic bacteria, fungi, and other organisms.

Anaerobic digestion: a collection of processes where microorganisms break down biodegradable material in the absence of oxygen producing biogas and digestate.

Door-to-Door (DtD) collection: organisation of the collection mode in a way where waste is collected at the doorstep following a pre-established schedule.

Polluter Pays Principle: a European principle of law according to which the costs of measures carried out to prevent, reduce and control pollution have to be borne by the polluter.

Prevention: measures taken before a substance, material or product has become waste that reduce:
(a) the quantity of waste, including through the re-use of products or the extension of the life span of products;
(b) the adverse impacts of the generated waste on the environment and human health; or
(c) the content of harmful substances in materials and products.

Recyclable materials: scrap metal, paper, cardboard, plastic, wood, textiles, glass, organic waste.

Recycling:	any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.
Recycling yard:	a centralised site authorised by the authorities for the separate collection of household waste with the objective to recycle raw materials.
Residual household waste:	share of mixed household waste collected after separate collection.
Separate collection:	the collection where a waste stream is kept separately by type or nature so as to facilitate a specific treatment.
Waste:	any substance or object which the holder does, intends to, or is required to discard.
Waste holder:	the waste producer or the natural or legal person who is in possession of the waste.
Waste management:	the collection, transport, recovery and disposal of waste, including the supervision of such operations and the after-care of disposal sites. Also includes the actions taken as a dealer or broker.
Waste producer:	anyone whose activities produce waste (original waste producer) or anyone who carries out pre-processing, mixing or other operations resulting in a change in the nature or composition of this waste.

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WHY THIS PUBLICATION?

This PAYT report is the second in a series of ACR+ observatory reports, the first one being the 'EU Capital Cities Waste Management Benchmark (2014)'. The ACR+ observatory activities and reports aim at assisting the local and regional authorities in their endeavour to collect, analyse, and share waste prevention and management data allowing for improved waste prevention and management strategising and planning. The review process covers 7 municipal PAYT cases in 7 different EU Member States presented in two page fact sheets as well as a comprehensive analysis of the different systems.

This report aims to examine how municipalities in selected European countries implement PAYT. It explores how a selection of EU medium-large municipalities/counties adapt PAYT to local conditions, and the role municipalities/regions can play throughout the transition, as well as how the instrument fits into a larger transition towards waste prevention and recycling strategies at the national and EU level.

This publication provides some causal relationships between variables and waste outcomes, but the main aim is rather to explore how municipalities can adapt the policy to local conditions.

The report also emphasises what factors and strategies might impact upon its implementation. It identifies how PAYT can be implemented into an integrated waste management framework, meaning a system of waste management that sorts materials into different streams, and to evaluate the opportunity of this policy instrument for promoting waste reduction and improved recycling. The cases selected are meant to provide contextual examples of the use of PAYT.

The structure of the report is as follows:

- Part 1: Introduction
- Part 2: Factsheets
- Part 3: Cross-analysis PAYT cases

METHODOLOGY

ACR+ analysed data collected from municipal waste planners, public authority reports, and literature reviews. The focus of the research methodology is a collective case study whereby a number of cases are studied in order to investigate some general findings through interviews and document analysis. Theory is used to define the policy drivers that have led to a focus on waste prevention and recycling strategies at the national and EU level. The unit of analysis are municipalities.

A detailed template was developed to guide the information collection process, and to try to ensure that the information gathered was as comparable as possible between the municipalities. The latest headline data on waste management performances per municipality were gathered; most notably on waste generation, selective collection schemes, recycling (and composting) rates and costs.

The sample was selected to cover a variety of municipalities, and semi-structured interviews with open-ended questions were used to collect descriptive contextual data. The questions posed to the waste planners aimed to reveal how municipalities implemented PAYT.

The information gathered was also sent to the municipal waste experts for verification and to help identify additional information sources to address current gaps in the information.

The report should be seen as a presentation of a comprehensive picture of the use of PAYT across 7 municipalities in 7 EU countries showing the most complete analysis possible.

However, information and communication activities were not investigated in depth in this research, and the extent to which differences in the amount of waste were partly due to differences in information policy is unknown.

Finally, a limitation that arose during collecting data was the reality that it was not always possible to access specific information about the PAYT implementation process, since the transition happened a decade ago in some cases.

SUMMARISING OVERVIEW OF THE STUDIED CASES

The cases presented in Table 1 hereunder were identified to build an understanding of the use of PAYT in selected municipalities in Europe.

Table 1: Presentation of the selected case studies

Municipality/ County	Country	Population	PAYT implemented	Urbanisation class (1)	PAYT system
Interza (Zaventem, Kampenhout, Kraainem, Steenokkerzeel en Wezembeek-Oppem)	Belgium (Flanders)	83,000	2004	D	Priced bag (DtD)/ volume (RY)
Maastricht	Netherlands	122,434	2001	B	Priced bag (DtD)/ volume (RY)
Umeå	Sweden	119,613	1991	A	Volume, frequency & weight
Innsbruck	Austria	126,965	1995	A	Volume & weight
Zollernalbkreis	Germany	184,611	1998/ 2001	C	Frequency & weight
Besançon	France	176,339	2012	A	Volume, frequency & weight
Treviso	Italy	83,652	2013	A	Frequency

(1) Urbanisation class:

A: 50 - 100% multi-family houses ,

B: 30 - 49% multi-family houses,

C: 20 – 29% multi-family houses,

D: 8 – 19% multi-family houses,

E: 0 – 7% multi-family houses

PART 1: INTRODUCTION

1.1. Contextualisation of 'Pay-As-You-Throw'

1.1.1. What is Pay-As-You-Throw?

Pay-As-You-Throw (PAYT) is a charging system, offered by local authorities, for solid municipal waste management services. It is based on the polluter pays principle and follows a methodology similar to water and electricity billing. That is to say that the costs paid by a household are related to the amount of waste it produces and therefore intended to provide an incentive to reduce the amount of waste it produces by participating in waste prevention, re-use, recycling and compost activities.

1.1.2. Why PAYT?

PAYT shows potential because it addresses two important environmental challenges for waste management: making individuals responsible for the waste they create, thus fully integrating the Polluter Pays Principle (PPP), and rewarding less-wasteful behaviour, as opposed to concealing it beneath the conventional flat fee. This step of clearly placing responsibility for waste and pollution, and the larger challenge of addressing increasing levels of production and consumption represent one of the critical global trends that affect sustainability. With the rapid growth in consumption witnessed in last decades, waste management goals have not managed to achieve a decoupling of economic growth and waste creation, despite over 30 years since the environment became part of the political agenda. Connecting consumption with environmental impact will make up a critical part of addressing this challenge, and PAYT offers a potential piece of this puzzle by giving citizens an incentive to reduce waste.

The EC supports the use of economic instruments

The Report on the Thematic Strategy on waste prevention and recycling adopted in January 2011[1], demonstrated clear links between the recycling performance of Member States and the use of economic instruments. The conclusions and recommendations of the report included, among other issues: "…optimal combination of economic and legal instruments should be promoted…"

These recommendations were confirmed through the adoption of the "Roadmap on Resource Efficiency"[2] in September 2011, which includes several references to the use of economic instruments.

The study requested by the Commission on the use of economic instruments and their impacts on Member States' waste management performances provides valuable data on the status and impact of various economic instruments in place in the MS, their possible influence on MS performances and the possible impact of an extension of their use in other or all MS.

The Circular Economy package published in December 2015 clearly mentioned the insufficient use of economic instruments like PAYT schemes which contributes to the achievement of high recycling rates and as such invites MS to make better use of them (recital (7) and art 4.3 of the modified WFD proposal).

[1] European Commission (2011): Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the Thematic Strategy on the Prevention and Recycling of Waste. COM (2011)13.

[2] European Commission (2011): Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Roadmap to a Resource Efficient Europe. COM(2011) 571 final.

If backed by sufficient recycling infrastructure PAYT has strong potential to reduce waste and increase recycling. The design of the fee structure, or mix of fixed and weight-based parts, however, is critical to fully incentivise changes in waste behaviour. The fee structure should correctly reflect the costs of the waste services for the municipality, but also hold the proper balance of fixed and variable parts to encourage reductions. This means municipalities need to have a solid understanding of the costs involved with their waste collection infrastructure. The above mentioned sufficient recycling infrastructure is indeed the crucial prerequisite for having a beneficial PAYT scheme in place – beneficial for the residents and beneficial for the municipality at the same time. The residents should be given alternatives and options in order to indeed take advantage of the PAYT scheme, instead of seeing it as yet another financial burden on the household budget. When it comes to the local and regional authorities, sufficient recycling infrastructure should ensure that the residents will not turn to undesirable and environmentally destructive practices, such as illegal dumping, in order to avoid paying a fee foreseen by the PAYT scheme - what overally would do more financial and environmental harm than good to the authorities.

1.1.3. PAYT as 'part of the puzzle' only

PAYT alone will not solve the waste management challenges faced by many European municipalities. Governments (national, regional and local) can influence the impact of society on waste generation and resource use by means of different policy instruments at their disposal. These measures include limiting resource consumption through the introduction of a commodity tax, limiting the release of unwanted material into the environment through landfill taxation, and setting bans on the landfilling of bio-waste or recyclable materials. Generally speaking a set of certain environmentally benign measures can play a big role in closing the gap between waste arising and secondary material production or promoting certain environmental benign measures such as recycling through a special taxation or charging system (e.g. mandatory waste disposal charge) in order to close the loop from the waste arising to secondary material production. A principle of waste management should be that contributions should primarily be coming from those who benefit from the system in order to recover the cost. This is why charges should be levied for availed public services.

The implementation of waste charging by the way of PAYT schemes must be considered as the most suitable option to ensure fairness when paying for waste management services. Moreover, it has proven to be very efficient in promoting the reduction of disposable waste. The polluter pays principle aims to charge citizens in a fair manner in accordance with the actual quantity of waste they generate and the corresponding service obtained for its management.

The implementation of this style of variable waste charging requires:

- The measurement of the generated amount of waste and/or services obtained for it
- A kind of identification for reasons of accountability to the waste generator
- The unit pricing for individual charging according to collected amount or availed services

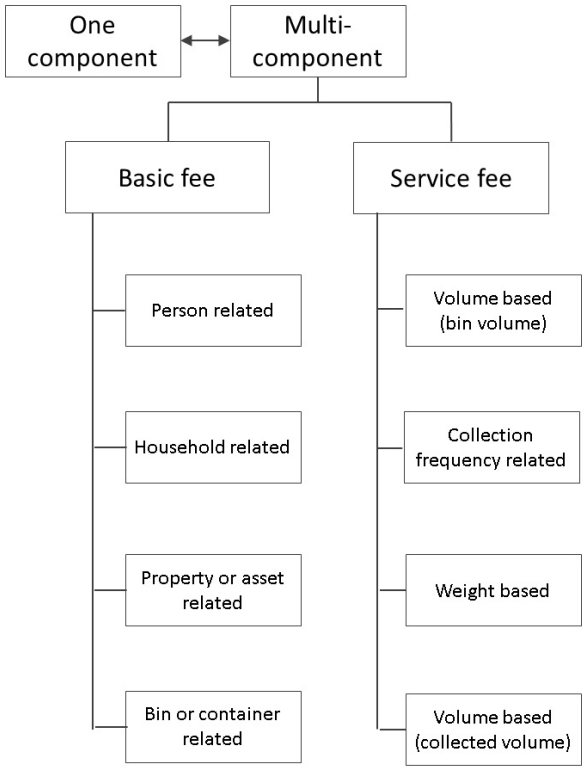
1.1.4. How to set up a PAYT scheme?

Guidance could help to define how to design PAYT schemes so that they enhance the prospects for prevention and recycling, whilst ensuring charging structures recover costs. The infrastructure for recycling should be both comprehensive and convenient for the user. Charging systems should be structured to introduce incentives to reduce, continuously, the quantity of residual waste being generated.

1.1.5. Review of PAYT schemes

Waste charging schemes should consider a splitting of the overall charge into one non-service dependent part, plus another service dependent part, and further differentiated fees for various surplus services. A waste charging scheme should in any case ensure the full coverage of the waste management related costs and the fair allocation of these costs to the population as beneficiaries of the services. Possible components for a waste charging scheme are shown in Figure 1 below.

Figure 1: Suitable components for the design of a waste charge



Two most cited reasons for implementing a PAYT system

1. Fairer costs distribution and therefore meeting the polluter pay principle
2. Stimulating sorting at source and waste prevention

1.1.6. One-component versus multi-component charge system

The one-component charge system represents the simplest charge model. It consists of only one type of fee. The most common is the flat rate scheme. It consists of a fixed fee which is charged independently of the actual amount of generated waste or availed services. This fee is supposed to cover fixed and variable parts of the waste management costs. This system does not provide for any incentive to reduce the amount of generated waste or engage in source separation activities.

The multi-component includes as a basic component a fixed fee from each household. This fee is either unified (e.g. a certain annual amount) or non-unified (according to specific criteria, e.g. a function of the surface of the real estate). Further charged is a variable fee component which is in relation to the collection service actually availed, for instance for each unit of waste set out for collection, and may be combined with other components. Multi-component waste charge models are best suited to apply the polluter pay principle.

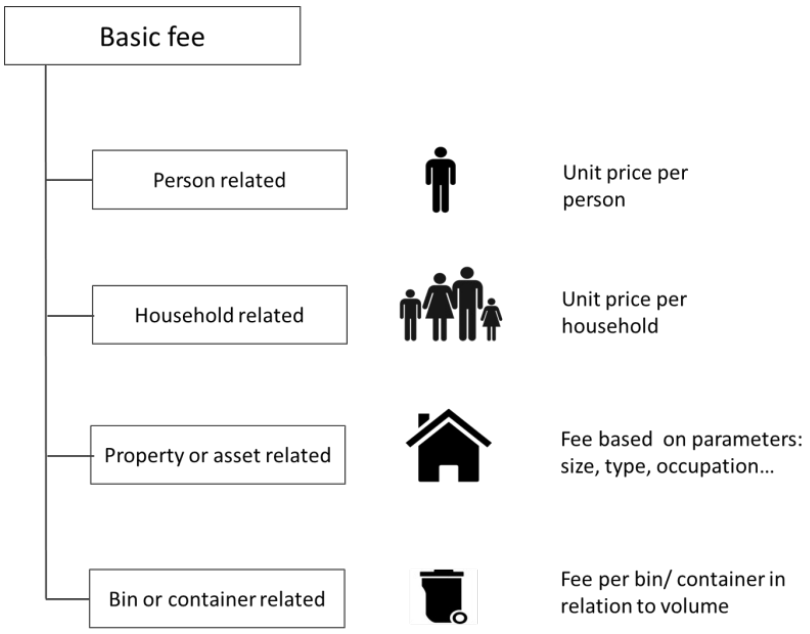
1.1.7. Classification of multi-component charge systems

Basic (fixed) fee(s)

The determination of a fixed basic fee shall reflect that certain expenses already accrue with the installation of a system whether a household is going to use it or not (fixed costs). The fee thus does not serve as a payment for availed services but as a compensation for the provided opportunity to do so. To the eligible costs belong, for example, costs for the accounting and billing, the service routing and the fleet, for the purchase and supply of waste containers, personnel and maintenance costs, rents, capital and depreciation costs. It is recommended to charge the basic fee in the form of a flat rate.

There are various ways to define a basic fee as presented hereunder in Figure 2:

Figure 2: basic fee parameters



A bin or container-related arrangement combines with the need to have the containers registered. This can be achieved through the assignment of the container to the waste generator or a subscription.

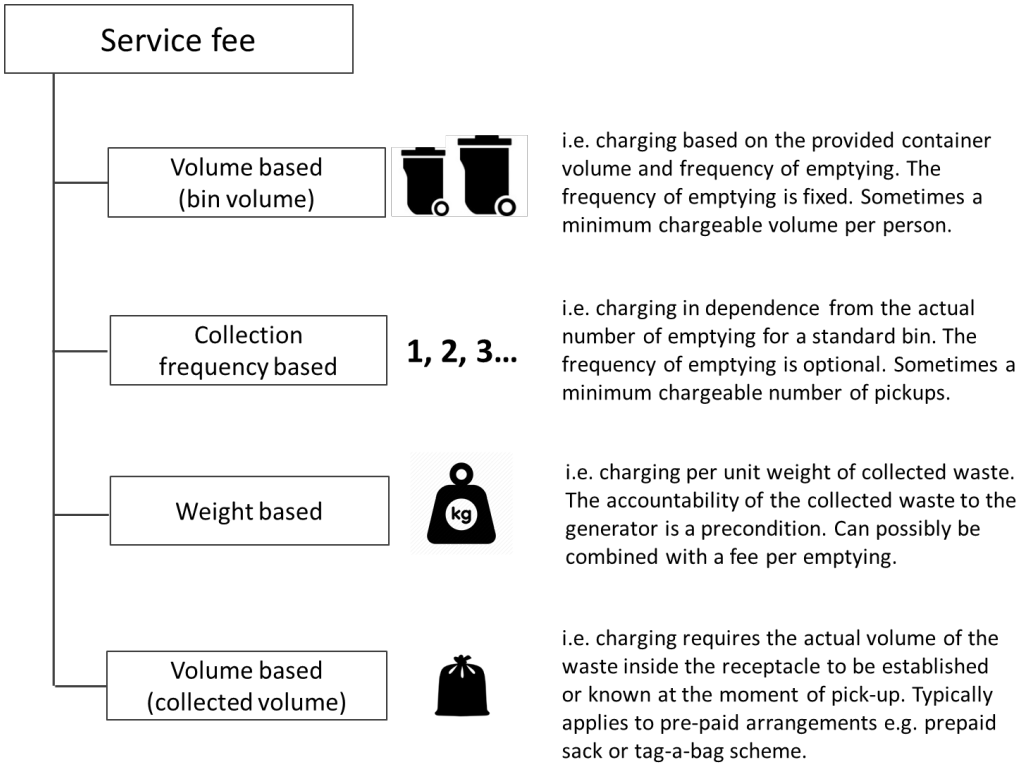
Service-related fee(s) or Pay-as-you-throw

Although a fully variable (service-related fee) waste charging model seems to be possible to realise PAYT, it has to be noted that multi-component waste charge models offer the more suitable solution. Such a model however only considers the indispensable costs for delivering the waste

service in its fixed part whereas a sufficient variable part must be maintained to keep the incentive for waste reduction and diversion. Also a minimum mandatory charge can be included for reasons of additional revenue security.

The most applicable ways of defining service related fees are shown in the following Figure 3. PAYT can thereby not only be applied to Door-to-Door collection but also in Bring Bank systems, provided that they are combined with personal identification.

Figure 3: common options for service-related fee arrangements



Underestimated capacities in the volume-based arrangement are by far the largest problem since the arrangement usually offers the households freedom of choice for the container size used. This is why such arrangements should normally be offered in combination with the determination of a minimum chargeable volume per person.

The prescription of a fixed frequency of emptying does permit the regular pickup of the waste and helps thus to avoid the development of unpleasant odours nuisances and health risks. Such a measure is most suitable for the collection of bio-waste.

Pickup frequency based arrangement can be best realised with the help of bin-identification systems. Identification systems make sure the accountability of the collected waste to the waste generators. This is a precondition for weight-based arrangement as well. As an incentive for households to render containers for emptying only when they are full, an extra fee for each pickup can be charged together with the weight based service fee.

Article 14 of the Waste Framework Directive

In accordance with the polluter-pays principle, the costs of waste management shall be borne by the original waste producer or by the current or previous waste holders.

1.1.8. Pay-As-You-Throw at national level

PAYT has been in place across Europe for more than 25 years already.. The policy now exists in a wide range of European countries in varying forms. Germany, the Netherlands, Belgium, Sweden, Austria and Finland have been experimenting with PAYT for the longest. The integration of the Polluter Pays Principle (PPP), as described in the Waste Framework Directive (2008)[3], into national legislation is seen as one of the main drivers for pilot PAYT projects in Europe. The following table provides country/region PAYT policy information corresponding to the municipalities studied. This will allow for better understanding and comparison of the case studies. It also allows for contextualisation of the studied municipalities.

Table 2: PAYT systems per country/region and characteristics[4]

Country/ Region	PAYT implemented	Diffusion of PAYT	Territorial coverage	System
Belgium (Flanders)		Strong	100%	Volume, sac, frequency & weight
Netherlands		Weak	20% (2000)	Volume (25%), Sac (17%), Frequency (46%), Weight (12%)
Sweden	Early 1990s	Weak	11%	Volume, frequency & weight
Austria		Strong	100%	Volume, & frequency
Germany	as from 1986	Strong	100%	Volume, sac, frequency & weight
France		Weak	11 %[5] (2011)	Volume, frequency & weight
Italy	As from 2000	Weak	3.3 % (2 million inh.	Volume & frequency

A combination of stricter recycling targets from the EU (50% in 2020) and shared positive experiences from countries with PAYT have helped to convince some formally landfill dependent countries to consider implementing PAYT schemes, such as France and Ireland.

[3] DIRECTIVE 2008/98/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 November 2008 on waste and repealing certain Directives

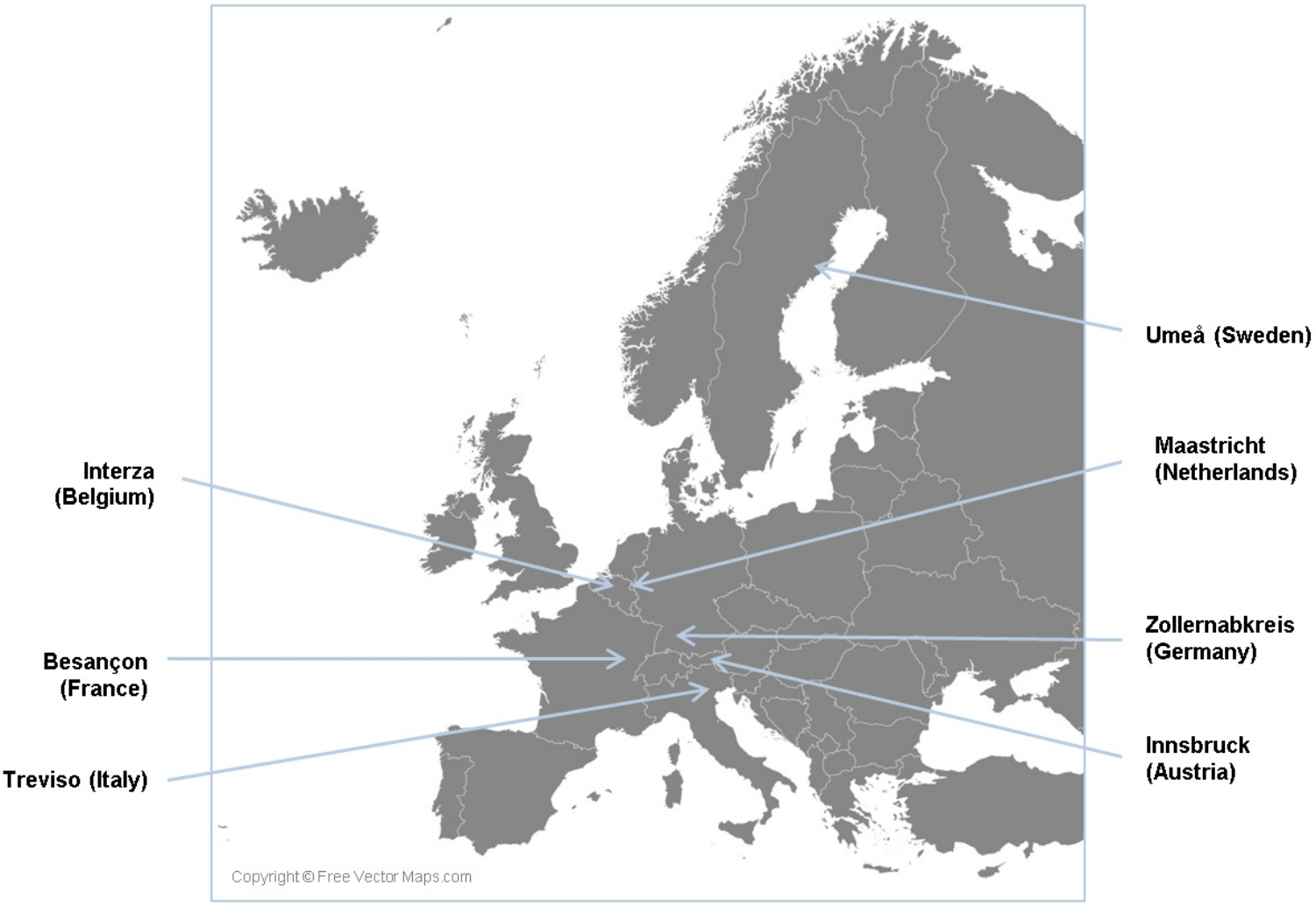
[4] Use of economic instruments & waste management performances – final report', Bio Intelligence Services, April 2012, p. 88-91.

[5] 29 % of municipalities in 2011, covering 11 % of the population. Source: CGDD (2016): La tarification incitative de la gestion des ordures ménagères, p. 6.

PART 2: FACTSHEETS

The report presents factsheets looking at the application of PAYT in the European Union (EU) in seven municipalities from seven countries. The cases studies included are the following:

- Interza (Belgium)
- Maastricht (The Netherlands)
- Umeå (Sweden)
- Innsbruck (Austria)
- Zollernalbkreis (Germany)
- Bensançon (France)
- Treviso (Italy)



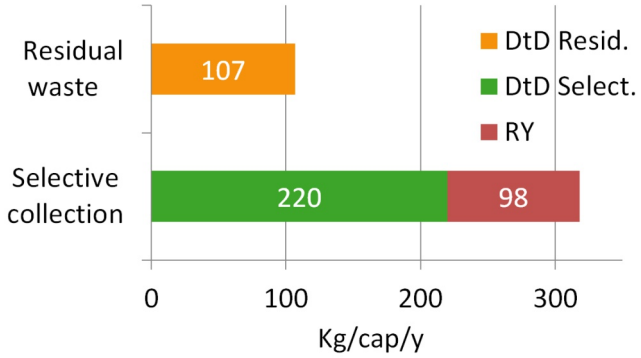
INTERZA

Belgium (Flanders)

General data

Population	82,425
Households	33,235 (2.48/HH)
Surface	98 km²
Density	785 inhabitants/km²
Urbanisation class	D: 8% - 19% multi-family houses
Year of introduction PAYT	2004
PAYT system	Priced bags for residual waste DtD collection Volume based charges at RY

Municipal waste generation and collection (2014)



	Tonnes	Kg/cap/y
Municipal waste	35,039	425
Residual waste	8,831	107
Selectively collected waste	26,208	318
Door-to-Door (DtD)	18,125	220
Recycling yards (RY)	8,083	98
Bring Banks (BB)	–	–

Flanders set quantitative objectives regarding the maximum amount of residual waste to be collected (150 Kg/cap/y by 2015). 23 inter-municipalities (IM) operate in Flanders and serve more than 6 million inhabitants. All IMs put in place separate collection combining door-to-door schemes with recycling yards (voluntary bring). Road containers available for textile collection only. Interza has a separate collection of more than 75% of its municipal waste (incl. C&DW from households only).

Selective collection scheme (2014)

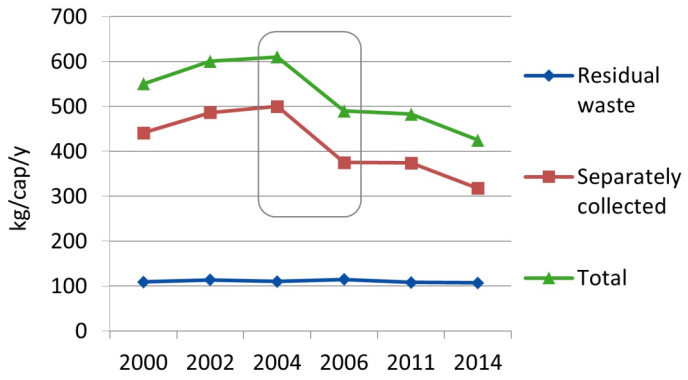
	Container / bag	Recipient	Frequency	Costs	Kg/capita/y
Door-to-Door	Residual waste	60L bag	Weekly	€2/bag (less €1/bag before 2004)	107.14
	Bio-waste	240L bin	Weekly to bimonthly	€30/year (free before 2004)	129.78
	Packaging waste	60L bag	Bimonthly	€0,125/bag	12.74
	Paper / Cardboard	Loose - option: small container	Monthly	Loose: free Container: €50 (once off)	52.19
	Glass	Loose - option: small container	Monthly	Loose: free Container: €50 (once off)	24.34

Selective collection scheme (continued)

	Recycling yard	Recipient	Frequency	Costs	Kg/capita/y
Recycling yard	1 Recycling Yard 22 waste fractions	By car (with trailer)	No limits	Recyclables: €0 for car, €5 for car with trailer <1.5m, €10 if 1.5m - 2.5m Non recyclables: €5 for car, €25 for car with trailer <1.5m, €50 if 1.5m - 2.5m (All free before 2004)	98.07

The fees for separate collection push citizens towards reducing the quantities of residual waste: €2 per 60L residual waste bag vs €0.125 for 60L packaging bag. Recycling yards differentiate between recyclables and non-recyclables as well as between small and larg(er) waste generators. The transition towards PAYT came into force from 2004/2005 and Interza is slowly but steadily increasing the fees for residual waste. No figures are available regarding impurities in the separate collection.

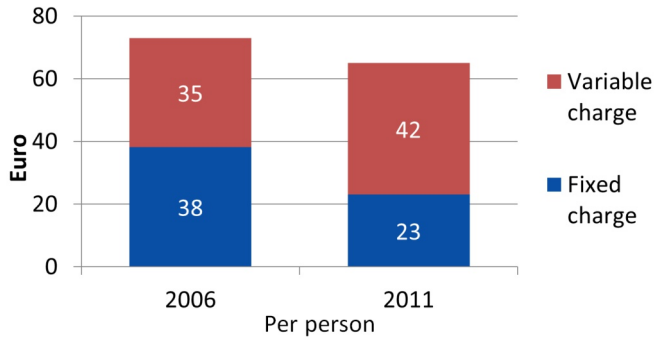
Evolution waste selectively collected



Year	RYs	DtD	DtD Resid.	Total
	Kg / cap / y			
2000	146	295	109	550
2002	194	292	114	600
2004	199	301	109	610
2006	124	250	115	490
2011	147	227	108	482
2014	98	220	107	425

The new PAYT system introduced in 2004 had visible and tangible effects on the total amount of waste collected. The waste streams most affected were bio-waste (yearly fee for DtD collection combined with incentives for home composting including a permanent communication campaign) and a variable fee system for some recyclables (C&DW & bulky waste) and non-recyclables at the recycling yard. Those fractions decreased by nearly 25%. The amount of littering did not increase during the transition period towards the PAYT system.

Costs



The cost and cost recovery mechanism changed throughout the years: overall costs were reduced (nearly 12%) through process efficiency and increased revenues from recyclables sales (2011). The fixed citizens' contribution decreased while the variable part (PAYT), as an average, increased substantially (up to 65% of overall fees to be paid in 2011).

More information: www.interza.be
0032 (0)2 721 07 31 - info@interza.be

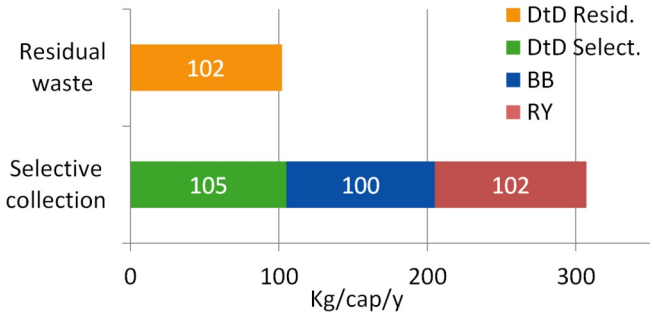
Maastricht Municipality

The Netherlands

General data

Population	122,481
Households	67,281
Surface	60 km²
Density	2,041 inhabitants/km²
Urbanisation class	B: 30%-49% multi-family houses
Year of introduction PAYT	2001
PAYT system	Priced bags for residual waste DtD collection Volume based charges at RY

Municipal waste generation and collection (2014)



	Tonnes	Kg/cap/y
Municipal waste	50,198	410
Residual waste	12,550	102
Selectively collected waste	37,648	307
Door-to-Door (DtD)	12,885	105
Bring Banks (BB)	12,289	100
Recycling yards (RY)	12,474	102

The national waste management plan 2009-2015 set quantitative targets: 55% recycling by 2015. Maastricht introduced an integrated waste management system that combines Door-to-Door collection with Bring Banks (60 parks of 6-10 Underground Containers for recyclables collection) and Recycling Yards receiving up to 22 waste fractions, targeting mainly bulky waste, C&DW and green waste. The city of Maastricht exceeded the set target and in 2014 reached a separate collection of 75% (incl. C&DW from households). Impurities were merely found in the packaging selective collection however not exceeding 5% in 2014 (>50% in 2001).

Selective collection scheme (2014)

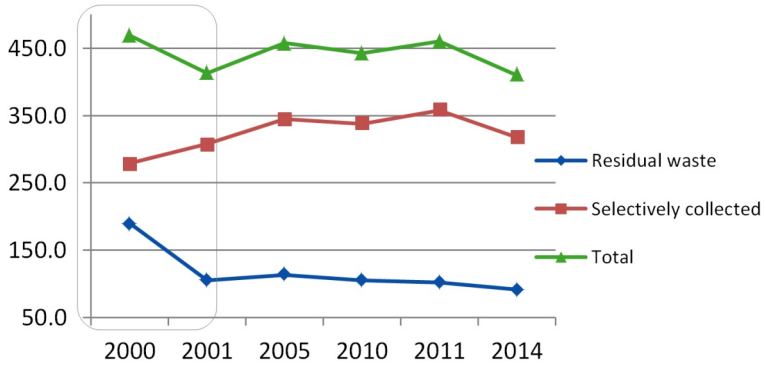
	Container / bag	Recipient	Frequency	Costs	Kg/capita/y
Door-to-Door	Residual waste	50L bag 25L bag	Bimonthly Weekly	€0.71 / 50L bag €0.43 / 25L bag	92
	Bio-waste	140L bin 25L bin	Bimonthly Weekly	–	83
	Paper / Cardboard	Loose	Monthly	–	19
	Textiles, HHV & Bulky waste	–	2 to 4x/year	Bulky waste collection not for free, €20 / collection Max 2m³	3
Bring Bank	Packaging waste, glass, paper & cardboard	Underground Containers (UCs): capacity varying from 3.5m³ to 5m³ and serving 1000 hhld each	Emptying varying per fraction (1 to 7x/ week)	Residual waste: €0.71 / use of Underground Container (max. 50L)	100

Selective collection scheme (continued)

	Recycling yard	Recipient	Frequency	Costs	Kg/capita/y
Recycling yard	4 Recycling Yard 22 waste fractions	By car (with trailer)	Max 2m³/visit Households only	Residual waste €1.5 / 50L bag €3 / 100L bag Bulky waste Till 1/4m³: €5 1/4 m³ - 1/2 m³: €10 1/2 m³ – 1 m³: €20 1 m³ – 1.5 m³: €30 1.5 m³ - 2 m³: €40	112

The variable part of the waste collection is applied to the DtD residual waste collection (priced bags), Bring Banks for residual waste collection (per deposit) and Recycling Yards (volume-based) for residual waste and bulky waste. The fees correspond to the costs of the services rendered. The priced bags (50 litres = €0,71) pays for the production costs of the bag and the processing of +/- 7 kg mixed waste/ bag

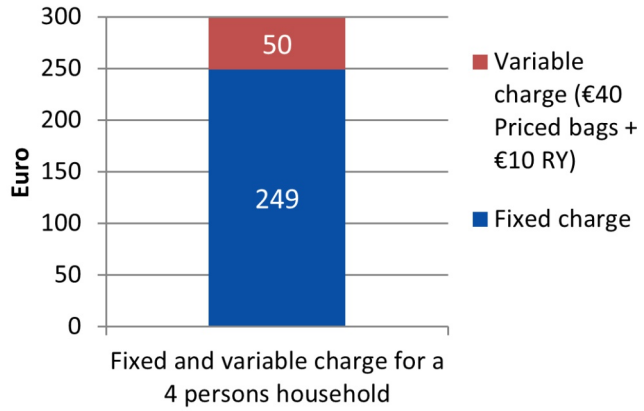
Evolution waste selectively collected (2014)



Year	RYs	DtD+BBs	DtD Resid.	Total
	Kg / cap / y			
2000	161	118	190	469
2001	124	184	105	413
2005	149	196	113	458
2010	132	206	105	443
2011	152	206	102	460
2014	112	206	92	410

The introduction of the PAYT system (DtD + RYs) in 2001 resulted in a decrease of residual waste DtD and RYs collection and an increase in the separate collection of recyclables via DtD and BBs. In 2005 the capacity of underground containers doubled (instead of over-ground level facilities) resulting in a further increase of separately collected recyclables via UCs, the DtD separate recyclabes collection (bio-waste, P&C waste) remaining stable throughout the years. The residual waste DtD collection decreased throughout the years achieving a 50% drop in 2014 as compared to 2001. The decrease of separately collected recyclables is mainly due to the decrease of paper & cardboard separate collection (digitalisation) since 2008. Further improvements can be achieved by focusing on bio-waste separate collection since +/-50% of the residual waste remains bio-waste (food mainly).

Costs



Maastricht applies a fixed and a variable rate per household. The fixed rate pays for organisational costs, regional staffed facilities, collection and treatment. The fixed rate is €249/hhld/y in 2014. The variable charge is estimated (average) at €40 (priced bags at €0.71/bag) and €10 (use of RY). On average a household paid less than €50 per year. The variable rate reflects the real cost of the bag and the processing of its content. In 2001 a priced bag cost €1 and in 2014 €0.71 due to decreased treatment costs for the residual waste (€142 in 2001 and €64 in 2014). The figure presents a simulation of the charges paid for by a family of four.

More information: www.gemeentemaastricht.nl
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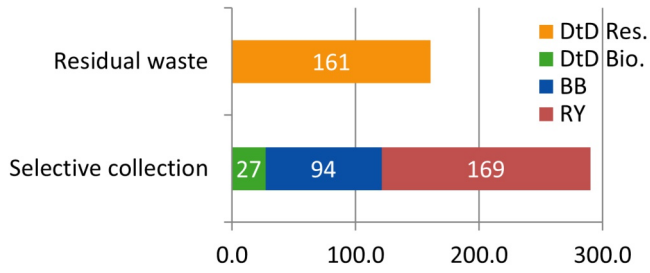
Umeå Municipality

Sweden

General data

Population	119,613
Households	55,943
Surface	2,397.6 km²
Density	50 inhabitants/km²
Urbanisation class	A (>50% multi-family houses)
Year of introduction PAYT	1996
PAYT system	Volume, frequency, weight

Municipal waste generation and collection (2014)



	Tonnes	Kg/cap/y
Municipal waste	53,945	451
Residual waste	19,257	161
Selectively collected waste	34,687	290
Door-to-Door (DtD)	3,229	27
Bring Banks (BB)	11,243	94
Recycling yards (RY)	20,214	169

Umeå has a clear working procedure with objectives, strategies, balanced scorecards and action plans to ensure objectives are met. Umea collects its waste via Door-to-Door, Bring Banks and Recycling yards and has a selective collection rate of 64%. Umea has set the following 2016/2020 objectives/targets: 60% (2016) of residents have access to DtD collection for food waste (100% in 2020) and less than 2% impurities found, 90% of the population has to DtD collection for packaging and small WEEE in 2016, 70% of household waste is source separated in 2020 and finally 50% of all food waste is separated by 2020. Despite a high selective collection rate (64%) only 42% of the municipal waste was recycled and 56% sent to thermal treatment. This is because a large part of the bulky waste and green waste (collected DtD and at RY) is sent for thermal treatment.

Selective collection scheme (2014)

Door-to-Door

Container / bag	Recipient	Frequency	Variable charges in Euro	kg/capita/y
Residual waste	50L bag 25L bag	Bimonthly Weekly	140L: 26.3 190L: 28.4 370L: 63.0 660L: 111.2 + additional charge for towpath < 7m of 10.5 / 10.5 / 13.9 / 17.5 + additional charge for towpath 7.1m - 21m 20.9 / 20.9 / 24.4 / 27.9 + additional charge for towpath > 7m of 31.4 / 31.4 / 41.8 / 52.3 + weight based fee (per kg) – / 0.22 / 0.19 / 0.14 If 1x/week: fees x 2 + 2x towpath fee; if 2x/week: fees x 3.9 + 4x towpath fee; if 3x/week: fees x 6.6 + 6x towpath fee Shared 140 or 190L bins = 50% discount on fixed charge Assimilated waste yearly fee vary from €957/bimonthly pickup of 4m³ to €4,668/ 2x week pick up for 8m³ container + €0.14/kg	92

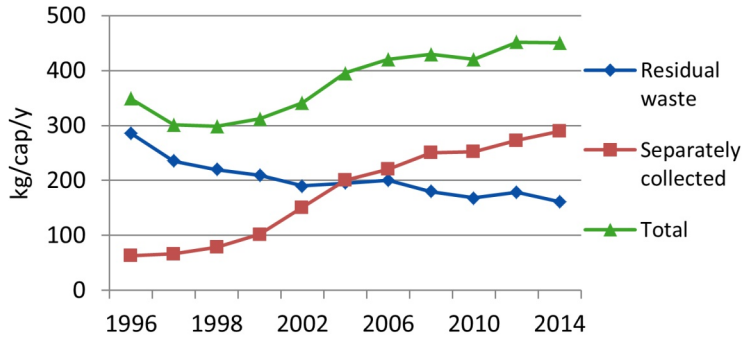
Selective collection scheme (continued)

	Container / bag	Recipient	Frequency	Variable charges in Euro	Kg/capita/y
Door-to-Door	Bio-waste	140L	Bimonthly Weekly	No bio-waste collection = extra fee on fixed charge calculated as follows: extra fee of €26/y for >40m2 unit and €13/y for <40 m² unit. So the total fixed fee if you do not separate biowaste is €32+26/y for >40 m² and €16+13/y for <40 m².	83
	Bulky waste & garden waste	Loose	On call	Fixed charge of €20.26 / pick up + €9.75 / m³	19

	Recycling yard	Recipient	Frequency	Costs	Kg/capita/y
Bring Bank	Glass, paper pack, plastics, metals, graphic paper & WEEE (80 BB stations)	Containers 1100L	Weekly emptying	–	94
Rec. yard	Recycling Yard (2 large and 5 small) 15 waste fractions	By car (with trailer)	No limits	–	169

The weight-based charge is applied on residual waste and for DtD collection of bulky & green waste while bio-waste DtD collection (not compulsory), bring banks and recycling yards are free of charge thus providing the residents with a strong incentive to separate all non-charged waste fractions. Besides bring banks (or recycling stations) apartments have garbage rooms for the collection of packaging waste. Food waste is also weighed, but not charged. Besides the weight aspect a differentiation in fees is made according to the volume of the bin, the distance to the towpath and the frequency of collection.

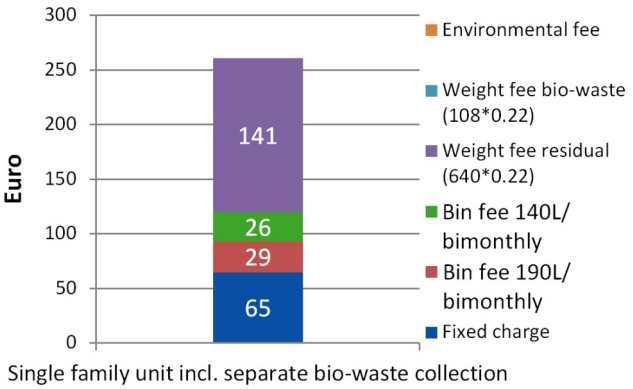
Evolution waste selectively collected (2014)



Year	RYs	DtD+BBs	DtD Resid.	Total
	Kg / cap / y			
1996	21	42	286	349
1998	32	47	220	299
2000	51	51	210	312
2004	132	68	195	395
2008	141	110	180	431
2012	145	182	179	451
2014	149	142	161	451

The PAYT system was introduced in 1996 and the separate collection of bio-waste in 2007. In 1998, two years after the introduction of the PAYT scheme, the residual waste collection had decreased by 23% and the separately collected waste increased by 25%. Overall in 2014, compared to 1996, the residual waste collection has decreased by 44% while the separately collected waste has increased by 360% and reached 64% in 2014 (70% = 2020 target), the total waste generated increased in the same period by 30%. Food waste collection started in 2007 and increased gradually reaching 27.1 kg/cap in 2014.

Costs (single family house)



Single family unit incl. separate bio-waste collection

Umeå applies a three step approach for the waste charges. A fixed charge of €65/y, a variable fee for the rent of bins (depending on the size) and a weight-based fee for residual waste that covers the treatment costs (incineration). The fixed charges pay for collection equipment & recycling centres. Bring banks are financed by the producers/ importers under the EPR schemes. An extra fee has to be paid if the resident opts for not separating the bio-waste. The figure presents a simulation of the fees paid for a family of four living in a single family house (€261/y) with the characteristics as presented in the legend.

More information: www.vakin.se
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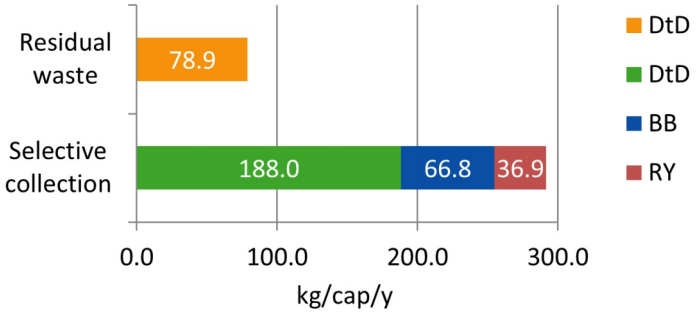
Zollernalbkreis / Zollernalbdistrict

Germany

General data

Population	184,611
Households	80,123
Surface	918 km²
Density	201 inhabitants/km²
Urbanisation class	C: 20%-29% multi-family houses
Year of introduction PAYT	1998/2001
PAYT system	1998: Frequency based charges 2001: Weight based charges for residual & biowaste

Municipal waste generation and collection (2014)



	Tonnes	Kg/cap/y
Municipal waste	69,069	370.6
Residual waste	14,705	78.9
Selectively collected waste	54,364	291.7
Door-to-Door (DtD)	35,039	188.0
BB (container & collection points)	12,443	66.8
Recycling yards (RY)	6,882	36.9

The 2012 national circular economy law (Kreislaufwirtschaftsgesetz) sets a quantitative target: 65% recycling of municipal waste by 2020 (§14). The Zollernalbdistrict introduced an integrated waste management system that combines Door-to-Door collection with Bring Banks (containers for glass and batteries + collection points for green waste) and Recycling Yards that receive up to 20 waste fractions and mainly target bulky waste and (car) batteries. The Zollernalbdistrict has almost reached the target already, with a recycling/biological treatment rate of 64.20% and a separate collection rate of 78.71%. No significant impurities.

Selective collection scheme (2014)

Door-to-Door

Container / bag	Recipient	Frequency	Variable cost	Kg/cap/y
Residual waste	80L, 240L or 1100L bins	Every 14 days	€0.21 / kg	78.91
Bio-waste (incl. small green waste)	80L or 240L bins	Every 14 days	€0.21 / kg	46.08
Paper / Cardboard	120L, 240L or 1100L bins + loose (collection through associations)	Every 4 weeks	For free	78.48
Lightweight packaging	90L bags	Every 4 weeks	For free	22.00 (estimation)
Bulky waste (incl. WEEE, scrap metal, old wood, other bulky waste)	Loose, max. 3m³ per type	1x per year (on request & registration), WEEE (11x per year)	For free	37.42
Green waste	Baled or paper bags	3x yearly	For free	4.04

Selective collection scheme (continued)

Bring Bank

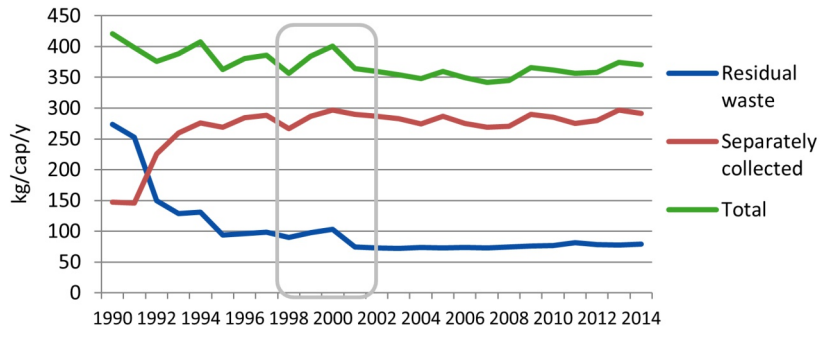
Container / bag	Recipient	Frequency	Variable cost	Kg/cap/y
Glass	Containers with capacity of 3.2m³ (per 600 inhabitants)	Weekly - every 2 weeks	For free	25.17
Batteries	Pocket for batteries in glass containers	Weekly	For free	Incl. in RY nr
Green waste	Collection points (29 in total)	Depending on municipality	For free until 2m²	41.60

Rec. yard

Recycling yard	Recipient	Frequency	Costs	Kg/capita/y
20 fractions, 10 recycling cntres. County landfill takes 38 waste fractions	By car or other means	No limits: max. 1m² per week	Minimum €15/delivery, Recyclables: €0 Other waste: depending on type of waste. Small amounts (<60-180kg) usually €15, afterwards €56-€225/t; biologically treatable waste: €15 for amounts below 180 kg, afterwards €79/t	36.93

A weight-based PAYT system was introduced in 2001. The variable part of the waste collection fee is applied to the DtD residual waste and biowaste collections as well as to the delivery of larger and heavier amounts to the landfill, and of other waste fractions to the recycling centres. DtD collection of lightweight packaging is conducted by EPR schemes and includes tinplate, aluminium, polystyrene, plastics, and tetrapak. While the emptying of glass containers is organised by dual systems, the collection of the batteries from the battery pockets is the responsibility of the county.

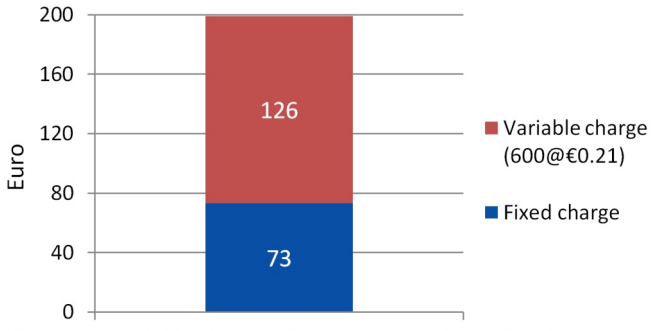
Evolution waste selectively collected (2014)



Year	Resid. waste	DtD	BB	RY	Total
	Kg / cap / y				
1990	274	147			421
1998	90	466			357
1999	98	178	98	27	401
2000	103	178	105	30	416
2001	75	167	107	31	380
2005	73	207	60	29	369
2010	77	200	57	32	366
2014	79	193	67	37	376

The introduction of the first, frequency-based version of the PAYT system in 1998 led to a drop in total waste generated in that year. It seems as if citizens held back parts of their recyclables as there was a substantial increase in the following two years. The introduction of the second (2001) and current weight-based PAYT system, had a direct impact on the generation of residual waste from the first year. It reduced the amount of residual waste generated per capita per year by around 30 kg.

Costs (single family house)



Fixed and variable charges for a 4 persons household

The costs per household are calculated by combining a fixed fee and a variable fee. The basic fee is calculated per building and on the basis of the number of people living on those premises. It is independent from the number and size of the bins. The variable fee is calculated on the basis of the weight of the annual amount of residual and organic waste and currently amounts to €0.21/kg. The simulation presented in the graph corresponds to the fixed and variable charges paid for by a family of 4 persons generating 600kg of residual and bio-waste.

More information: www.zollernalbkreis.de
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Guenter.Bames@Zollernalbkreis.de

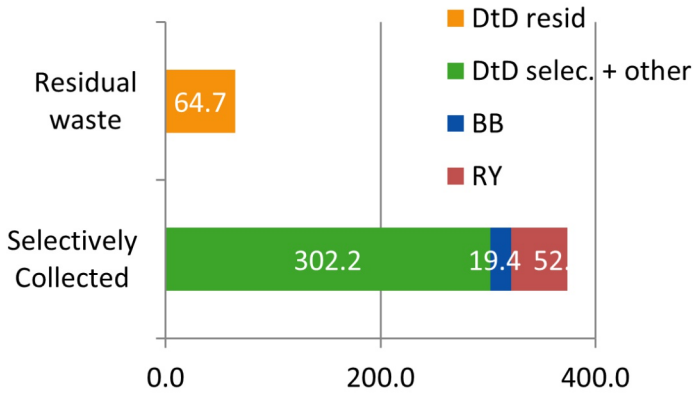
Treviso Municipality

Italy

General data

Population	83,652
Households	41,951
Surface	55.58 km²
Density	1,505.09 inhabitants/km²
Urbanisation class	A: 50% - 100% multi-family houses
Year of introduction PAYT	2014
PAYT system	Number of emptying of bin for residual waste

Municipal waste generation and collection (2014)



	Tonnes	Kg/cap/y
Municipal waste	36,722	438.9
Residual waste	5,414	64.7
Selectively collected waste	31,308	374.2
Door-to-Door (DtD)	22,758	272
Bring Banks (BB)	1,629	19.4
Recycling yards (RY)	4,389	52.4
"Other" recyclable waste	2,532	30.2

The Italian law 152/06, amended by law 205/10 regulates how the different waste fractions have to be (separately) collected and treated. It sets the target of 50% increase in separate collection by 2020. Since the end of 2013, Contarina, has introduced an integrated waste management system that combines Door-to-Door collection, for households, with Bring Banks and Recycling Yards. The Bring Bank system includes the services of Ecobus, Ecostop, for households, and fixed containers, only for non-households, which are removed on a call basis. 'Other' type of waste collection refers to additional waste collections such as waste from markets and demonstrations and from street sweeping. Treviso reached in 2015 an outstanding separate collection rate of 85.3%.

Selective collection scheme (2014)

	Container	Recipient	Recipient	Variable cost	Kg/cap/y
Door-to-Door	Residual waste	30L, 120L, 240L, 360L bins	1 to 2x / week	30L bin: €4.07; 120L bin: €16.29; 240L bin: €32.59; 360L bin: €48.88	19.06 + 7.8
	Paper/Cardboard & VPL glass, plastic, metal)	30L, 120L, 240L, 360L bins	1 to 3x / week	For free	125.43
	Green waste	120L, 240L bins	1/2 weeks	€9.07/€8.22 for 120L; €11.94/€10.82 for 240L depending on semester + emptying costs	33.68
	Bio-waste	25L, 120L, 240L bins	1 to 3x / week	For free	112.55
BB, Ecobus, Ecostop	Paper, VPL, green waste bio-waste	Bags collected at Eco information center	Ecobus 0.5h, Ecostop 1h	For free	6.02
	Residual waste	Same as above	Same as above	Same as DtD costs for residual	4.6

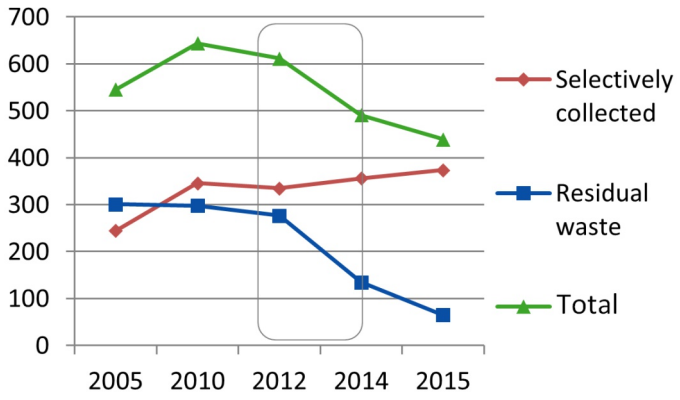
Selective collection scheme (2014)

	Container	Recipient	Frequency	Variable cost	Kg/cap/y
BB, Benne & Cassoni	1.Paper, 2. Glass, 3.VPL, 4. Bio-waste, 5. Green waste	Large containers	On call	€ / tonnes: 1. €0.00; 2. 51.97€; 3. €239.01; 4. €155.62; 5. €121.06	13.45
	Residual waste	Large containers	On call	Same as DtD costs for residual	21.35
Other	Recyclable waste	Street sweeping	–	–	30.26
	Residual waste	Street bins, clean-up	–	–	11.9
RY*	All recyclable materials: 18 waste fractions	By car (with trailer)	No limits	For free	52.47

Contarina introduced the services of Ecostop and Ecobus. Ecostop provides waste containers in set locations every hour, while Ecobus works as a bus with stops of the duration of 30m. The variable fee for households, calculated per emptying of a bin, is applied to residual waste and green waste. The collection of recyclable waste is included in the fixed fee. The variable fee covers the costs of collection and treatment, while the fixed fee covers general service costs, such as buildings, human resources, street cleaning, Eco information centers.

*including collection of pharmaceutics and batteries (0.42 kg/cap/y) and 7.8 kg/cap/y bulky waste considered as residual waste (loose and with no limits).

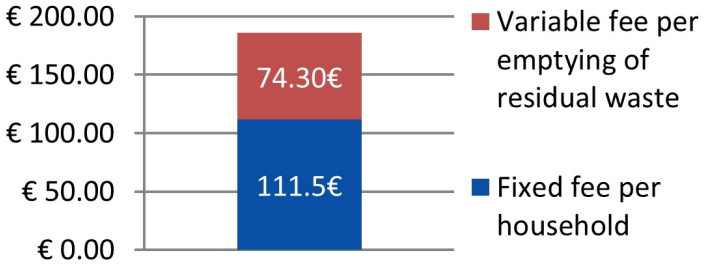
Evolution waste selectively collected (2015 data)



Year	Resid. waste	DtD	Benne + BB + other	RY	Total
	Kg / cap / y				
2005	301	_	227	18	546
2010	298	_	233	112	643
2012	277	_	246	89	612
2014	135	196	103	57	491
2015	65	272	50	52	439

The new PAYT system introduced in 2014 had visible and tangible consequences in the total amount of waste collected. The waste streams most affected has been the residual waste fraction which decreased by more than 80% (2012-2014). The separate collection rate increased only slightly after introducing the PAYT scheme.

Costs



The fixed fee is calculated per user and on the basis of the number of people living on that premise. It includes for some municipalities an additional fee which varies per municipality. The variable fee is calculated per emptying of the residual waste and is reduced by 30% for households which compost at home. The figure presents the fees (€185.76/year) paid by a family of 4 living in a single family house.

More information: www.contarina.it
comunicazione@contarina.it

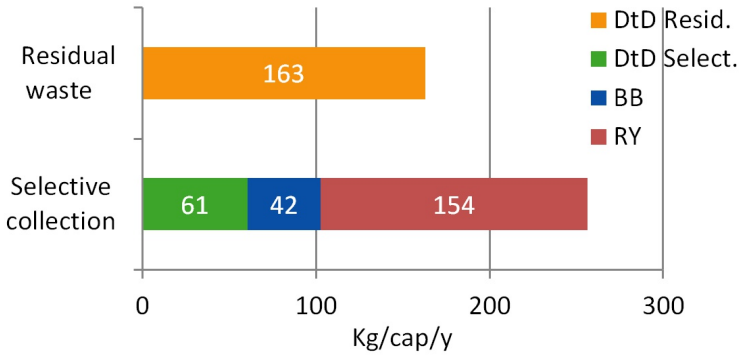
Besançon Municipality

France

General data

Population	176,339
Households	84,873
Surface	432 km²
Density	408 inhabitants/km²
Urbanisation class	A: 50% - 100% multi-family houses (58%)
Year of introduction PAYT	2012
PAYT system	Volume + Weight + Frequency

Municipal waste generation and collection (2014)



	Tonnes	Kg/cap/y
Municipal waste	73,929	419
Residual waste	28,730	163
Selectively collected waste	45,199	256
Door-to-Door (DtD)	10,674	60
Bring Banks (BB)	7,456	42
Recycling yards (RY)	27,069	154

The French national waste management plan set quantitative targets: 7% prevention by 2012, 45% recycling by 2015 and a decrease of 15% in waste incinerated and landfilled by 2012. Since 2007, Grand Besançon followed a proactive policy to reduce waste at the source by introducing incentive schemes to encourage good practices in the reduction, prevention and recovery of waste. Besançon reached the national targets: 16% less waste generated in 2014 compared to 2010, a recycling rate of 46% in 2014 despite a (much) higher separate collection rate (61%) and 24% less waste incinerated and 37% less waste landfilled. Impurities were merely found in the packaging DtD selective collection reaching 1,877 tonnes.

Selective collection scheme (2014)

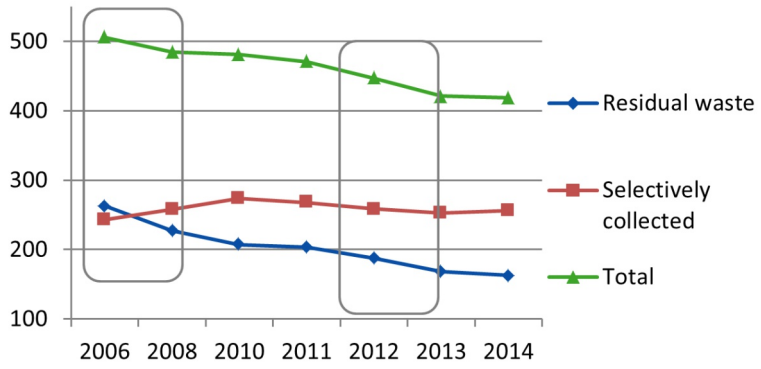
	Container / bag	Recipient	Frequency	Variable cost	Kg/cap/y
Door-to-Door	Residual waste	60L, 120/140L, 180L, 240L, 330L, 500L, 750L, 1100L	2x/week (City Center) Weekly (suburban) Weekly (periphery)	Fixed rate: €84 - €993/ bin (CC) €75 - €813/ bin (SU) €69 - €354/ bin (PE) Variable rate: €1.12–€4.15/emptying + €0.231/kg	163
Door-to-Door	Packaging waste / Paper & Cardboard	140L to 750L bins	Weekly (suburban) Bimonthly (periphery)	–	61
Bring Bank	Packaging waste / Paper & Cardboard	Container (on street or underground)	Weekly	–	6
Bring Bank	Glass	Container (on street or underground)	Weekly	–	33

Selective collection scheme (continued)

	Recycling yard	Recipient	Frequency	Costs	Kg/capita/y
Recycling yard	6 Recycling yards 21 waste fractions including wood, green waste, C&DW, WEEE, HHW…	By car (with trailer)	No limits	–	154

The PAYT, introduced in 2012, is a strong component of the 'Grand Besançon' integrated waste policy. The fees for collecting the residual waste (grey bins) are based on a fixed and variable rate. The fixed rate is based on the size and number of bins and the level of service provided in the corresponding geographical area, namely 2x/week in city centre and 1x/week in suburban and peripheric areas. The variable part of the waste fee is based on the weight of the grey bin and the number of emptyings. More than 40% of the residual waste (weight) is biowaste. Therefore the 'Grand Besançon + SYBERT' set up a comprehensive home & community composting plan to distribute home composters, community compost units and compost pavillions throughout the area. As such, more than 3,200 tonnes of bio-waste were diverted from the residual waste collection.

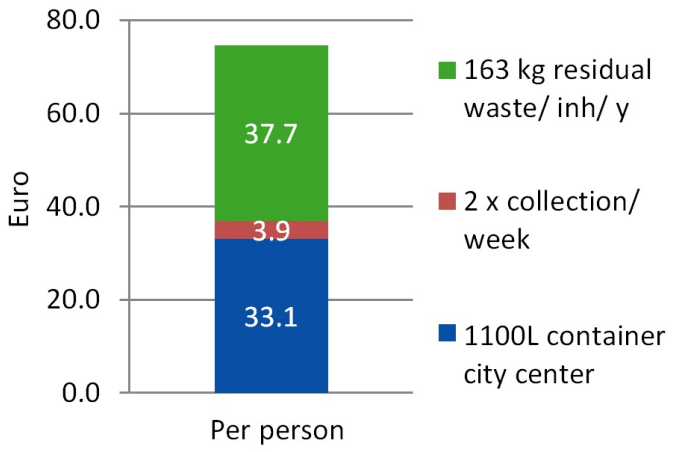
Evolution waste selectively collected (2014)



Year	RYs	DtD+BBs	DtD Resid.	Total
	Kg / cap / y			
2006	144	99	263	506
2008	162	96	227	485
2010	177	97	207	481
2011	169	99	203	471
2012	159	100	188	447
2013	153	100	168	421
2014	154	102	163	419

The PAYT system (DtD) was announced in 2008 and effectively implemented from 2012. The announcement only had an immediate effect on the waste generated and separately collected (RY mainly). Seen over the period 2006 to 2011, the residual waste collection decreased by 23% and the separate collection increased by +17% (RY mainly) for the same period. The real implementation of the PAYT system in 2012 brought a further decrease in the residual waste collection (13% in 2014), with the separate collection of recyclables remaining more or less stable. The separate collection rates are higher in the peripheric area compared to the city center.

Costs



The PAYT finances the collection and treatment of waste. The average cost per capita is €72.6 and is among the lowest in France. This cost has been calculated by dividing the full cost for collection and treatment for the city, by the number of inhabitants (€12,800,000/ 176,339 = €72.6). The average cost per capita has increased by 10% since 2008 (€65.9). The figure presents a simulation of the fees paid for a resident of an apartment block with 30 residents, and the characteristics are presented in the legend of the graph. The variable fee (weight) in this specific simulation represents 50%.

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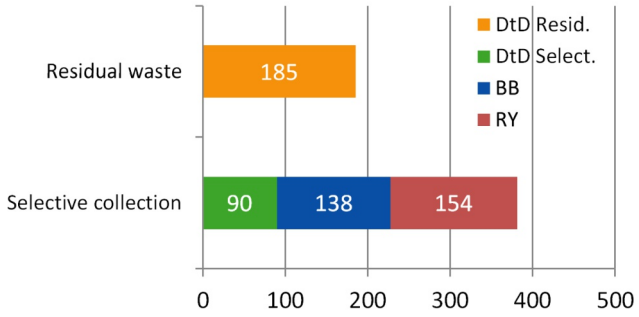
Innsbruck Municipality

Austria

General data

Population	127,944 (2014)
Households	60,234
Surface	104.91 km²
Density	1,140 inhabitants/km²
Urbanisation class	A: 50% - 100% multi-family houses
Year of introduction PAYT	1995
PAYT system	Volume based mainly

Municipal waste generation and collection (2014)



	Tonnes	Kg/cap/y
Municipal waste	72,427	566
Residual waste	23,710	185
Selectively collected waste	48,717	381
Door-to-Door (DtD)	11,506	90
Bring Banks (BB)	17,608	138
Recycling yards (RY)	19,683	154

The Austrian government regulates how the different waste fractions have to be (selectively) collected and treated. Innsbruck combines Door-to-Door collection for residual waste, bio-waste, bulky waste and hazardous household waste, with Bring Banks (141 collection points for recyclables collection) and 1 Recycling Yard receiving up to 19 waste fractions as well as a composting plant where citizens can deposit green waste. In 2014 the city of Innsbruck reached a separate collection rate of 67.3%. The residual waste is sent to a MBT centre for further extraction of recyclables (6%), with the remaining amount being sent to an incinerator. 95% of the selectively collected waste is effectively recycled. The largest amounts of impurities are merely found in the packaging selective collection (+/-18%).

Selective collection scheme (2014)

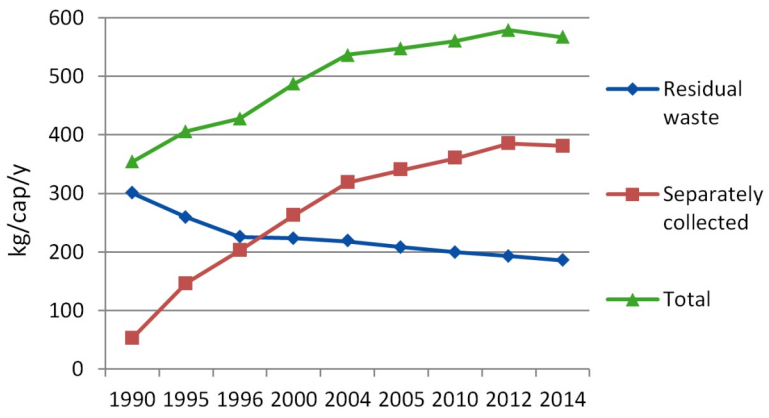
	Container / bag	Recipient	Frequency	Variable cost	Kg/cap/y
Door-to-Door	Residual waste	120L 240L, 660L, 770L, 800L, 1000L bins, 60L bags	At least once a week	0.0344/L €2.95	185.3
	Bio-waste	120L, 240L bins 60L bags	At least once a week	0.0344/L €2.95	75
	Bulky waste Hazardous Household waste	Loose	2x / year 3x / year	–	14.9
Bring Bank 141 collection points	Paper & Cardboard	240L, 770L, 1100L Containers	Daily to weekly	–	82.3
	Plastics	240L, 660L, 1100L Containers	Daily to weekly	–	24.0
	Metals	240L, 660L, 1100L Containers	Weekly	–	3.6
	Glass	3000L containers	Weekly	–	27.8

Selective collection scheme (continued)

	Recycling yard	Recipient	Frequency	Costs	Kg/capita/y
Recycling yard	1 Recycling Yard 19 waste fractions	By car (with trailer)	No limits	Commercial waste: ¼ m³: €16.30 Bulky waste: ¼ m³: €16.30 Wood: ¼ m³: €10.51 C&DW: ¼ m³: €16.30, €10.50 (pure) Scrap metals: ¼ m³: €10.51 Mixed waste weighed: €0.29/ kg Hazardous waste: varying €0.31/kg–€1.57/kg Green waste: 1000kg for free, as from 1000kg charge of €45.2/ tonne	153.08

The PAYT system was introduced in 1995. The variable part of the waste collection is applied to the DtD residual and biowaste collection (volume-based fee mainly) and the RY (volume- and weight-based) for different waste fractions. The fees are calculated per litre for the residual waste and bio-waste, the smallest volume being 15L per inhabitant per week (for those applying home composting). A request can be made to lower the minimal volume for residual waste to 8L. Citizens can also use priced bags, €2.95/60L bag (res. waste & bio-waste). Citizens applying home composting can request a refund for half of the costs pertaining to the purchase of the compost equipment with a maximum of €36.34. Some additional rules have been put in place related to the distance of the collection point to the road (more than 30m = pay more 20%) or close to the road with self-put back (discount 20%).

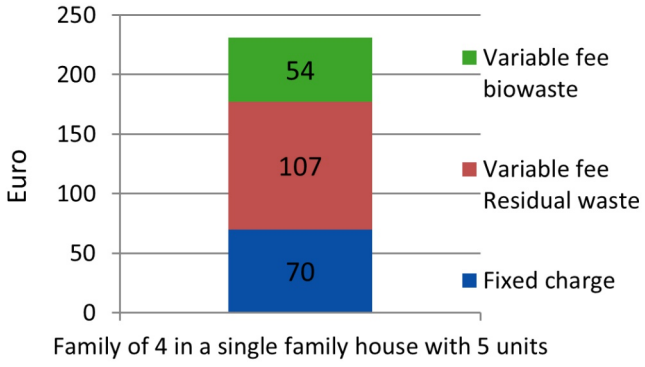
Evolution waste selectively collected (2014)



Year	DtD Resid. waste	DtD + BBs	RY	Total
	Kg / cap / y			
1990	301.1	51.6	1.1	354
1995	259.6	128.8	17.9	406
1996	225.7	183.9	18.8	428
2000	242.4	219.7	42.7	505
2004	269.3	266.1	52.8	588
2010	275.7	333.8	62.4	672
2012	193.5	229.0	156.6	579
2014	185.3	227.5	153.8	566

The introduction of the PAYT system (DtD + RYs) in 1995 resulted in a decrease of residual waste by 13% and an increase in the selective collection of recyclables by 38%, mainly through the increased DtD and BB selective collection. Since then, residual waste increased to 1995 (year of introduction of the PAYT system) levels in 2012, although a small decrease since 2010 was noted. The selective collection of recyclables has gradually increased throughout the years with a peak in 2004 whereby for the first time the green waste collected was included in the Innsbruck waste statistics.

Costs



Innsbruck applies a flat rate and a variable rate per household. The fixed charge (30% of total fees to be paid) is calculated based on the number of housing units of > 6m² and amounts to €0,225/housing unit/week. The variable part amounts to €0.0344/L for residual waste and for bio-waste collection. The figure presents the fees (€231/year) paid by a family of 4 living in a single family house with 5 housing units producing 60L of residual waste and 30L of bio-waste per week. The fees are meant to cover the waste management costs, not to make profit.

More information: www.innsbruck.gv.at

PART 3: CROSS-ANALYSIS PAYT CASES

3.1. Introduction

The number of cases studied is limited to 7 municipalities of around 100,000 inhabitants in 7 different European countries. The choice of the countries, corresponding to the studied municipalities, targets a number of countries where PAYT schemes are implemented for a long time and where it covers 100% of the municipalities (Belgium (Flanders), Germany and Austria), countries where only part of the municipalities implement PAYT for a rather long time (Sweden and the Netherlands) and finally countries with municipalities started implementing PAYT at a somewhat larger scale more recently (France, Italy). The detailed data collection per case study compensates the small amount of cases studied and allows for some meaningful key-findings. The cross-analysis is meant to provide the reader with some insights in the results and the different variables that affect those results.

At first the schemes are put into context considering EU, national and/or regional waste legislation, policies and compared against the strategies and results of the studied municipalities. Secondly the seven fact sheets are analysed in order to better understand the baseline situation including the general waste data, separate collection systems in place, choices of PAYT system (volume, frequency, weight), how the waste quantities overall and per collection system were influenced by the PAYT scheme in place as well as the cost structure making a distinction between the fixed and variable rate. Finally, few other findings regarding public acceptance, PAYT in multi-family units, special populations, illegal diversion and commercial waste are briefly discussed.

Fixed vs Variable charging

The charge is composed of a fixed part (which funds essential components of the waste management infrastructure), and a variable part which is determined by the quantity of waste generated, the standard of the service provided by the municipality and the costs of waste management.

3.2. Contextualizing waste prevention and recycling

3.2.1. Country waste prevention objectives, targets & performances

The different countries have established waste management strategies including, among other, economic instruments, targets and other measures, largely inspired by EU legislation. These strategies affect the way municipalities in those respective countries/regions implement concrete measures and actions regarding waste prevention.

Table 3 provides an overview of the country/region waste prevention objectives, targets, evolution between 2010 and 2013 and results. For the period 2010-2013 all countries achieved decoupling, some even absolute decoupling. So, overall a decoupling from waste generation as compared to GDP can be noticed but it is not clear if not to say unrealistic to couple these results to the implementation of waste prevention programmes.

Table 3: Overview of country/region waste prevention objectives/ targets and results

Country/ Region	Waste prevention objectives (1)	Quantitative waste prevention targets (1)	Waste prevention performance (2)	Evolution	Econ. Develop. (GDP) (2)	Decoupling (3)
Belgium (Flanders)	Decoupling	< 560kg/cap/y	2010: 525kg/cap/y 2013: 503kg/cap/y	- 4.2%	+ 2%	Absolute decoupling
Netherlands	-	-	2010: 571kg/cap/y 2013: 526kg/cap/y	- 7.9%	+ 0.1%	Absolute decoupling
Sweden	Absolute decoupling	Continuous reduction compared with 2010	2010: 439kg/cap/y 2013: 453kg/cap/y	+ 3.2%	+ 3.6%	Relative decoupling
Austria	Decoupling	-	2010: 562kg/cap/y 2013: 578kg/cap/y	+ 2.8%	+ 3.9%	Relative decoupling
Germany	Decoupling	-	2010: 602kg/cap/y 2013: 617kg/cap/y	+ 2.5%	+ 4.4%	Relative decoupling
France	Absolute decoupling	<7% in 2020 based on 2010 levels	2010: 533kg/cap/y 2013: 530kg/cap/y	- 0.6%	+ 3%	Absolute decoupling
Italy	Decoupling	<5% (ratio waste/GDP) in 2020 based on 2010 levels	2010: 547kg/cap/y 2013: 491kg/cap/y	- 10%	- 2.9%	Absolute decoupling

(1) European Environmental Agency

(2) Eurostat data 2013

(3) EEA (2014): Waste prevention in Europe — the status in 2013

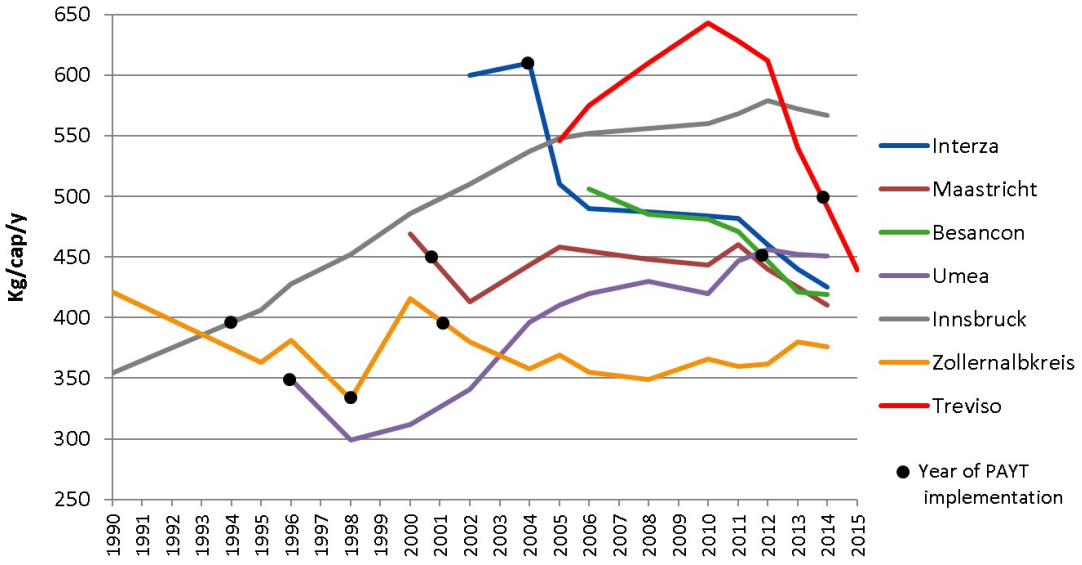
The observations are by no means an analysis of distance to targets but rather the evolution of the waste generated. Distance to target results would require an in depth examination of current management systems and practices; existing and planned infrastructure and facilities; overall development of relevant policies; and effectiveness of implementation measures and instruments, among other things.

However, this background information allows better understanding of, among other, the municipal initiatives taken and results achieved. As extensively described in literature, PAYT may have a positive influence on waste prevention, decreasing overall waste generation.

3.2.2. Municipal waste prevention performances

For the transition to PAYT, in terms of timeframe, 5 municipalities (Interza, Maastricht, Innsbruck, Umeå and Zollernalbkreis) have had the policy in place for over a decade, with the earliest implementation in 1995 (Innsbruck). The most dramatic changes, except for Innsbruck, in waste quantities appear to take place in the first two to three years after implementation (see coloured arrows). This can be seen in the graph in Figure 4 below, and was reported by the municipalities as the range for the biggest observed changes.

Figure 4: Influence of PAYT on overall waste generation



Some of the municipalities reported a levelling off of waste quantities over the next few years, followed by a slight increase (Maastricht and Zollernalbkreis). Interza is an exception as the waste quantities, at a high at the start of the implementation of the PAYT scheme, kept on decreasing until today to reach the same level as the other municipalities in 2014. The introduction of the PAYT scheme in Innsbruck on the other hand had no visible effect on the overall waste quantities[6].

The scale or size of the reductions, and whether the municipality is able to sustain stabilised waste level most likely depends on a multitude of factors, such as, accessibility of recycling infrastructure, or whether households have the possibility to home-compost. The level of waste reduction achieved appears to be strongly affected by whether garden waste was collected free of charge prior to the introduction of PAYT as is the case of Interza.

When considering the evolution of waste generated, in Figure 4, for the 2010-2013 period a similar trend can be observed with Table 3, showing for most countries a stabilisation or waste reduction over the last three years. Also, all municipalities had in 2014 lower overall waste generated as compared to the respective countries to which they belong.

3.2.3. Country separate collection/ recycling goals, targets & performances

Table 4 gives an indication of the separate collection and recycling targets, including the deadlines for achieving those targets as well as the results. All selected countries/regions, except Austria, have set separate collection or recycling targets equalling or exceeding the 50% recycling target 2020, set by the European Commission (EU Directive 2008/98/EC). The current separate collection/recycling performances differ largely between the countries/regions with Flanders, Germany and Austria being among the best performers (60% recycling and higher). France and Italy, despite considerable efforts done in the previous year, will have to speed up in order to

[6] However, separate collection of recyclables raised considerably by 43 %, while residual waste decreased by only 13 %.

achieve the required 50% recycling target by 2020. As the recycling performances for Flanders and Italy are compared against the 'separate collection targets' the differences that exist between the quantities separately collected and quantities recycled should be considered. The percentage of impurities found throughout the separate collection and first processing of the collected recyclables determine the 'destination to recycling' rate. Considering an estimated minimum percentage of 5%, Flanders may well reach its 'separate collection target'.

Table 4: Overview of waste recycling objectives and results[7]

Country/ Region	Waste generated in Kg/cap (1)	Separate collection targets (2)	Recycling targets (2)	Recycling performance (2)
Belgium (Flanders)	503	75% (2015)		70.6%
Netherlands	526		60% (2015)	49.5%
Sweden	453		50% (2010)	47.6%
Austria	578			59.2%
Germany	617		65% (2020)	64.5%
France	530		45% (2015) 50% (2020)	38.8%
Italy	491	65% (2012)		38.2%

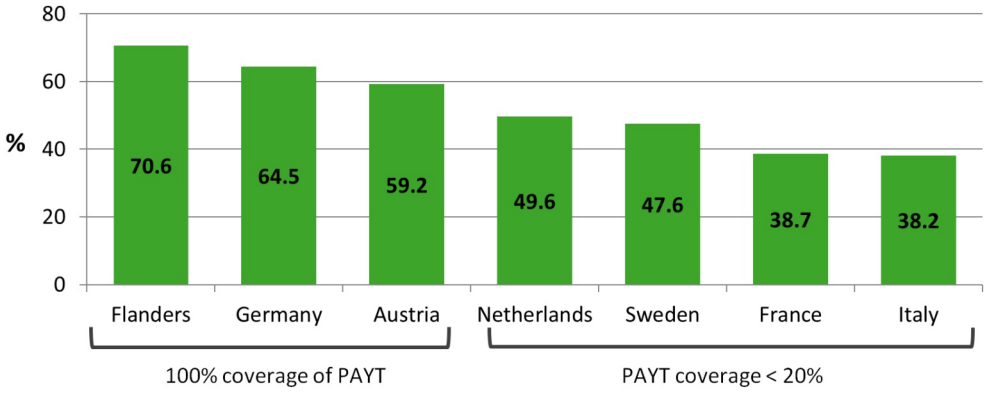
(1) Eurostat data 2013

(2) BIPRO, Assessment of separate collection schemes in the 28 capitals of the EU

When making a cross analysis of Table 2 (coverage of PAYT per country) with Table 4 (recycling objectives and results), it is evident deny that the best performance countries/ regions are those who achieved a 100% coverage of PAYT (see Figure 5). However, these good performances should not only be attributed to the implementation of PAYT only since the better performing countries/ regions have a long history in selective collection and recycling as well as a mix of additional economic, legal and other (educational) instruments put in place.

[7] Assessment of separate collection schemes in the 28 capital of the EU, national fact sheets, BIPRO, 2015.

Figure 5: Recycling performances linked to PAYT coverage per country/region

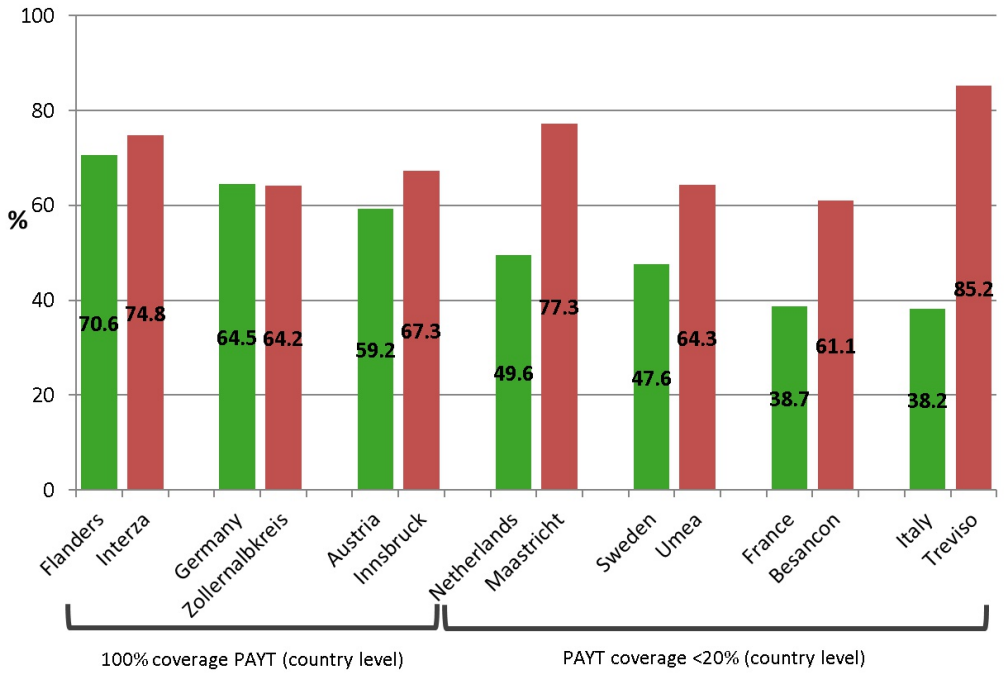


3.2.4. Municipalities separate collection performances against national/regional performances

The municipalities perform rather well regarding separate collection performances (Figure 6). The comparison of these performances may be distorted since the figures for the countries/ regions refer to recycling performances (Eurostat data) in contrast to the 'separate collection' data from the municipalities (except for Zollernalbkreis where the recycling rate is presented). Some municipalities provided partial data on impurities, but reporting was not accurate enough to calculate the real recycling rate.

Nevertheless, it comes as no surprise that the municipalities applying PAYT in countries/regions with a low national coverage of PAYT scheme perform much better (separate collection) than the respective national/regional average recycling performance as shown in figure 6. On the other hand the performances of the municipalities in countries where 100% of the municipalities are implementing PAYT (Interza, Zollernalbkreis and Innsbruck) correspond largely to the national averages considering that the separate collection rate is not equal to recycling rate, except for Zollernalbkreis.

Figure 6: Comparison of the separate collection performances of the municipalities against the respective national/regional recycling performances



Caution should be taken when attributing these separate collection/recycling performances solely to the implementation of the PAYT scheme.

The share of separately collected/recycled waste tends to increase under PAYT, but the extent of the increase will be largelly determined by the scope and convenience of the recycling infrastructure.

3.3. Findings collection schemes and PAYT systems

3.3.1. The separate collection schemes

Almost all municipalities apply Door-to-Door (DtD) collection, Bring Banks collection (BB) and provide the possibility to their citizens to bring waste to Recycling Yards (RYs). Interza is the only exception whereby collection is concentrated on DtD collection and RYs only.

Table 5 gives an overview of those collection schemes per municipality indicating what waste fractions are collected including the collection recipient as well as what waste fractions citizens have to pay fees for. All municipalities apply PAYT for the residual waste DtD collection. Maastricht (NL) allows residents to bring residual waste to the RYs but at a cost (same as for DtD collection). Interza, Zollernalbkreis and Innsbruck charge a fee for bio-waste DtD collection (Treviso for Green waste only), however, in the case of Interza, lower than the fee for residual waste collection. Innsbruck and Zollernalbkreis charge the same amount for DtD residual waste and bio-waste collection. The main reason (Innsbruck) for this is to avoid residents filling the bio-waste with residual waste if applying lower fees for bio waste. Interza (BE) is the only municipality charging a ‘low’ fee for the DtD separate collection of packaging waste. This fee is more or less 15% of the fee charged for the residual waste collection. The aim here is to strive towards waste reduction. Finally, five out of the seven municipalities charge fees at Recycling Yards.

Table 5: Collection schemes of municipalities including methods & application of PAYT

		Interza (BE)		Zollern-albkreis (DE)		Inns-bruck (AT)		Maastricht (NL)		Umeå (SE)		Besançon (FR)		Treviso (IT)	
		Collection applied	PAYT applied	Collection applied	PAYT applied	Collection applied	PAYT applied	Collection applied	PAYT applied	Collection applied	PAYT applied	Collection applied	PAYT applied	Collection applied	PAYT applied
Recycling yards (RYs)	Residual waste	S	√	B	√	S/B	√	S	√	B/C	√	B	√	B	√
	Biowaste	B	√	B	√	B	√	B		B				B	GW
	Packaging waste	S	√	S								B		B	
	P&C waste	L		B+L				L				B		B	
	Bulky waste	L		L		L		L	√	L	√			L	
Recycling yards (RYs)	Residual waste							UC	√					Ecobus & Ecostop	√
	P&C waste					C		UC		C		(U)C			
	Plastics					C		UC		C		(U)C			
	Metals					C		UC		C		(U)C			
	Glass			C		C		UC		C		(U)C			
	Green waste			L											
Recycling yards (RYs)		1 RY – 22 WF		10 – 32 WF		1 RY – 26 WF		4RYs – 22WF		2 Large + 5 small RY – 15WF		6RYs – 21 WF		1 RY – 18 WF	

B = Bin, **S** = Sac, **C** = container, **UC** = Underground containers, **L** = Loose, **WF** = Waste Fractions, **GW** = Green Waste only

In general the PAYT schemes as described above aim to include:

- The highest variable fee for residual waste (all municipalities)
- An equal or lower (but non-zero) fee for bio waste in order to encourage home composting and/ or the use of RYs (Interza, Zollernalbkreis and Innsbruck)
- A low or zero fee for collected dry recyclables (all municipalities)
- For those waste streams covered by producer responsibility: small charges on dry recyclables (at lower rates than for residual waste) can contribute to waste prevention (Interza)

3.3.2. How PAYT influences the residual waste collection

No PAYT system is alike as clearly shown in table 6. Different variables such as collection recipients, volumes, frequency, fees charged affect the costs for the residents as well as the residual waste quantities collected by the municipalities. Interza (BE) and Maastricht (NL) have similar variables, following a rather simple approach (priced sacks) and good performances. Umeå (SE) and Besançon (FR) put in place more complex schemes combining volume, frequency and weight. Besides a fixed rate corresponding to the size of the bin, a variable fee is charged per emptying (frequency) for Besançon and finally a fee per kg of residual waste collected. In Umeå an additional fee is charged if a resident requests a more frequent emptying.

Table 6: Analysis of the 'Door-to-Door' collection of residual waste per municipality

	Interza (BE)	Zollernalb-kreis (DE)	Innsbruck (AT)	Maastricht (NL)	Umeå (SE)	Besançon (FR)	Treviso (IT)
Year of implem. PAYT	2004	1998/ 2001	1995	2001	2007	2012	2013
Urbanisation	8%-19%	20%-29%	50%-100%	30%-49%	50%-100%	50%-100%	50%-100%
Recipient	Sack	Bins	Bins/ Sack	Sack	Bins	Bins	Bins
Volumes	60L	80L, 240L, 1100L	120L, 240L, 660L, 770L, 800L, 1000L 60l sack	50L 25L	140L, 190L, 370L, 660L	60L, 120L/140L, 180L,240L, 500L,750L, 1100L	30L, 120L 240L, 360L
Collection frequency	Weekly	Bimonthly	At least once a week	Bimonthly (50L) Weekly (25L)	Bimonthly (more = addit. Fee)	2x/week city centre Weekly in suburban	1 to 3x/week
Fees charged	€2/60L sack	€0.21/kg	€0.034/L or €2.95/60L sack (very few)	€0.71/50L €0.43/25L	Annual fee €36.8-€128/bin + €0.14-€0.22/kg	Annual fee €69-€993/bin + Variable rate €1.12-€4.15/empty + €0.231/kg	€4.07/ 30L €16.29/ 120L €32.59/ 240L €48.88/ 360L
PAYT system	Priced sack	Weight	Volume, priced sack	Priced sack	Volume, frequency, weight	Volume, frequency, weight	Frequency (emptying's)
Residual waste (kg/cap/y) (2014)	107	79	185	92	161	163	65
% of overall waste	25%	21%	41%	25%	36%	39%	15%

The table above shows that PAYT schemes are extraordinarily varied in their make-up. This, as well as the lack of a clear description of the systems, makes any cross-analysis extremely difficult to undertake. Any such attempt is further complicated by the fact that reported results of the schemes frequently fail to capture whether or not the charging systems is introduced alongside

changes in the collection system. Where both the charging system and the collection system are changed simultaneously, it becomes more difficult to apportion any behavioural change to one of these changes.

Some findings can be drawn from Table 6:

- Sack volumes vary from 25L to 60L while bin volumes vary from 60L to 1100L, larger bins quite obviously being more used in municipalities with a high share of multi-family units.

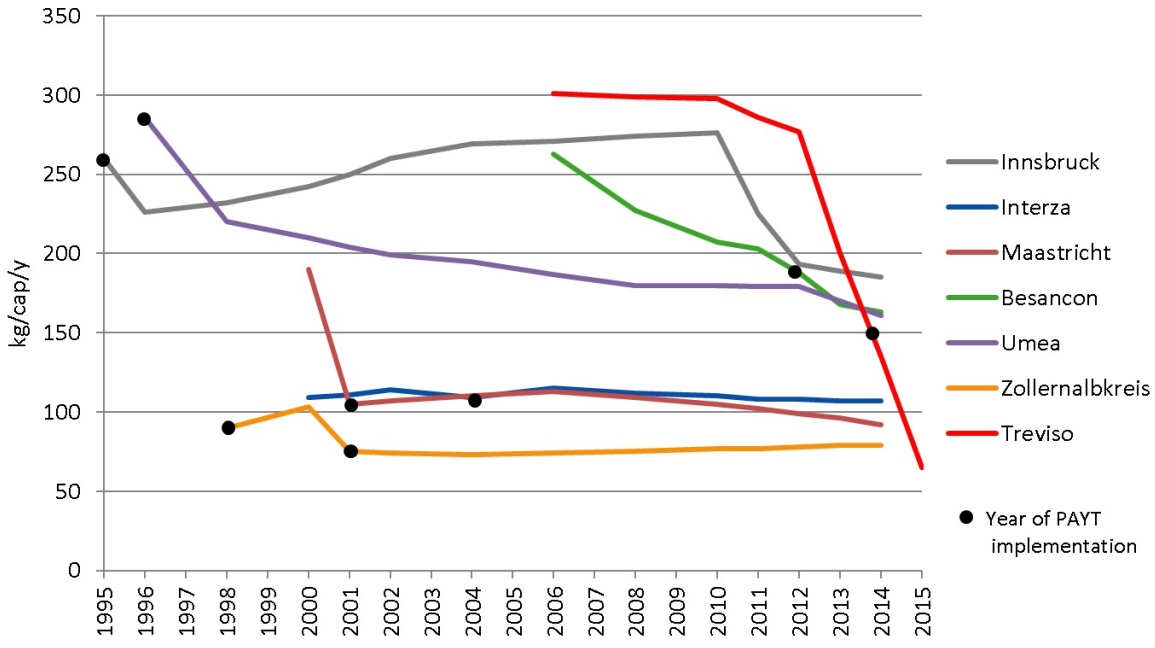
- Collection frequency goes from twice a week to bimonthly, the frequency being higher in municipalities with a higher share of multi-family units. In Umeå applying a bimonthly collection service, residents can choose to have extra pick-up at an additional fee.

- Fees are charged per sack (Interza, Maastricht and Innsbruck), per volume (Innsbruck), per emptying, per weight or a combination of those. In Besançon and Umeå an annual fee is charged depending on the size of the bin (variable thus) plus a fee based on number of emptying and/or weight.

- Despite all municipalities having implemented a PAYT scheme, large differences remain in the residual waste to be collected: from 50 Kg/cap/y (13% of all waste) in Treviso to 185 Kg/cap/y (41% of all waste) in Innsbruck.

The table above is only a snapshot of the residual waste collected, referring to 2014/2015 data. However, looking at the evolution of the residual waste collection in the time, the impact of introducing the PAYT scheme on residual waste collection can be well defined as well as the long term effects for those municipalities having implemented the scheme for a longer period as presented in Figure 7.

Figure 7: Performances of PAYT schemes per municipality related to (the evolution of) residual waste collection



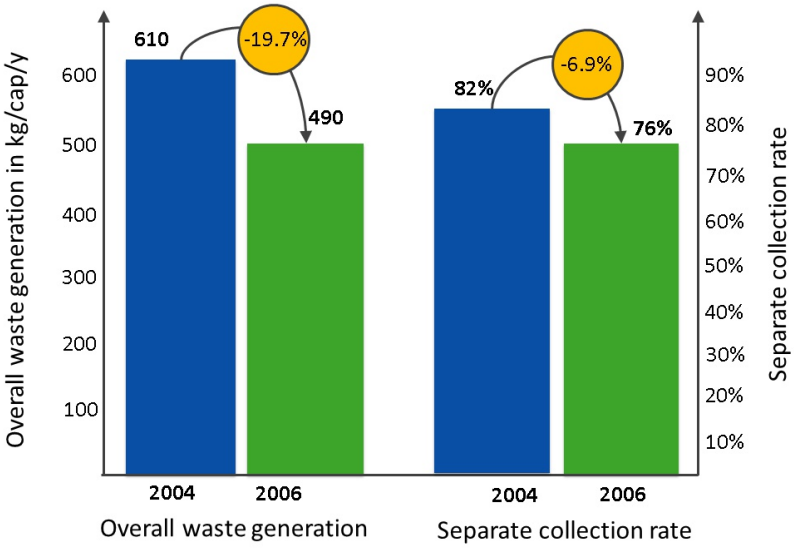
The figure shows for Interza, Maastricht and Zollernalbkreis a minimum amount of residual waste, namely decreasing the residual waste collection under the threshold of 80 to 100 Kg/cap/y. All three municipalities have nearly stabilized the quantities of residual waste collected since 2001. Umeå, Innsbruck and Besancon, generating overall higher levels of residual waste progressively decrease the amounts in time and may, depending on the flexibility and adaptation of the PAYT scheme as well as future investments in collection infrastructure reach similar levels as the others. The case of Treviso is in many ways remarkable. The amount of residual waste collected decreased in less than three years to 80% reaching 65 Kg/cap/y in 2015.

The municipalities with an urbanisation class of <50% multi-family units (Interza, Zollernalbkreis and Maastricht) show good performances (lower levels of collected residual waste). Home-composting and the high separate collection rate of bio-waste may play a role in this. However, high levels of bio-waste separate collection is not a privilege for smaller or less urbanised municipalities as shown by the case of Milan where close to 90 Kg/cap/y of mainly food waste is separately collected[8].

Detailed analysis of two cases

The introduction of a PAYT scheme does not always lead to the same results as shown in the two cases presented in Figures 8 and 9 hereunder, even though both cases show a positive trend. The first case (Interza) shows how PAYT had an impressive impact on waste prevention while the second case (Maastricht) shows the more likely results when introducing a PAYT scheme, namely reduction of the overall waste quantities and increase of selective collection/ recycling performances.

Figure 8: Residual waste collection and separate collection results at Interza

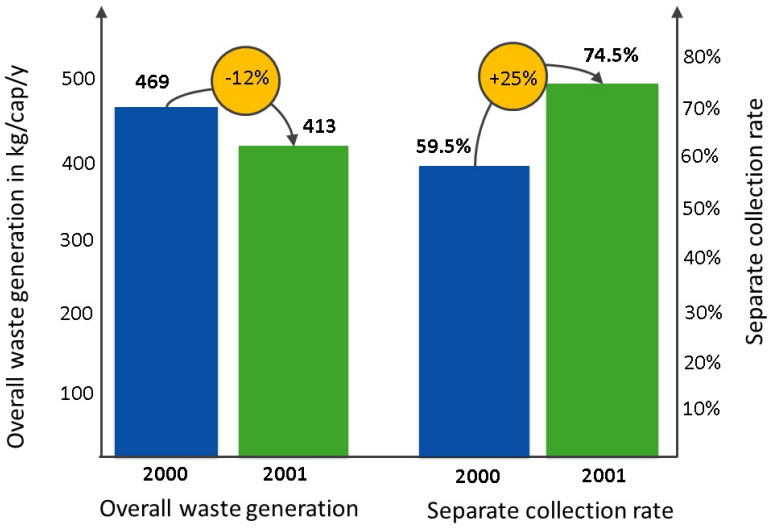


At the start of the introduction of the PAYT scheme, Interza had a separate collection rate of 82% but above average overall waste quantities. The PAYT targeted the transition towards more home-composting (subsidised) and a deterring fee for bulky waste at the recycling yard. The effect of this strategy was a decrease of the overall waste by 19.7% and of separately collected waste by 6.9% while still maintaining a high separate collection rate (76%). Since then the overall waste quantities steadily decreased as shown in figure 4.

[8] Regions for Recycling project (2014): Good practice Milan: Door-to-Door food waste collection for households, p.7.

Figure 9: Residual waste collection and separate collection results at Maastricht

The case of Maastricht presented in Figure 9 is more in line with expected results when introducing a PAYT scheme and confirmed when analysing the figure. The overall waste quantities, considerably lower than Interza at the start of the introduction of the PAYT scheme, reduced by 12% while the selective collection/ recycling performance increased by 25%, reaching the same level as Interza (76%). The level of overall waste quantities slightly increased in the following years levelling-off in 2014 to the same level as in 2001.



3.3.3. How PAYT influences the bio-waste collection

A variety of schemes have been put in place regarding bio-waste management and separate collection of this waste stream by the municipalities. These variations affect obviously the performances regarding bio-waste prevention and separate collection/recycling.

Bio-waste accounts on average for 30% to 40% of the overall municipal waste generated and considered therefore as an important waste stream for prevention[9] (decentralised composting: home composting, community composting, etc.) as well as for separate collection and recycling (centralised composting and/or anaerobic digestion). This is supported by recent EU communications promoting, among other measures, the reduction of the generation of food waste.

Bio-waste prevention is largely promoted by Interza (BE) and Besançon (FR). Interza cited even "to increase home-composting" as part of the reason for implementing PAYT. The decision to promote decentralised composting by the latter one however is surprising given the urbanisation class of Besançon (58%). In order to overcome this shortcoming Besançon promoted besides home composting also community composting allowing for multi-family houses with sufficient surrounding space to have access to multiple bins for composting their bio-waste[10]. Besançon diverts yearly more than 3000 tons of bio-waste from collection or +/- 5% of total

Decentralised composting

Home and community composting represent an important opportunity for cutting municipal waste streams and offers a host of advantages to municipalities such as less waste to be collected and treated and thus a considerable cost reduction. Home composting offers a direct way to lower the bill. The reality of the situation, however, is that not all households have the potential outdoor space to home compost, making this option limited in urban areas. However, some municipalities in Europe, including Besancon have successfully introduced community composting schemes in 'urban-like' environments.

[9] Home and community composting is considered as waste prevention as it doesn't enter the waste management system. Composting at a central composting plant after collection is considered as recycling.

[10] ACR+ (2014): Management options for 6 composting strategies Report (members only).

municipal waste generated. At Interza (BE) the introduction of the PAYT system was directly linked to a comprehensive home composting programme resulting in 2004 to 2006 in an overall decrease of total municipal waste (- 19.7%) partly due to less bio-waste collected.

Still, in these contexts, door-to-door collection remains the primary option for diverting this waste stream.

In separate collection of bio-waste often a division is made between food waste and green waste collection even though a combination may be possible. Interza (BE) and Maastricht (NL) promote the separate collection of VFG (Vegetables, Fruit and Garden waste) resulting in considerable variations in the collection quantities and frequency (more in summer and autumn due to higher availability of green waste).

The other municipalities (Zollernalbkreis, Innsbruck, Umeå and Treviso) keep it at separate collection of food waste only (or mainly) however in some cases supplemented with an occasional (seasonal) DtD collection for green waste. Besançon has no scheme for the separate collection of bio-waste. Finally, all municipalities provide on top of the separate collection the possibility for resident to bring green waste to the recycling yards.

In some cases national/ regional public authorities or even municipalities set specific prevention and/ or separate collection rates for bio-waste (food waste mainly). As an example, the Swedish government set a target of 35% diversion of this stream by 2010. However, this goal has proven difficult for municipalities to reach. The original aim was to have half of the Swedish population sorting their bio-waste, yet by 2005 only 1/6 reported to do so.

Table 7 provides a comparative overview of the main variables applied to the separate collection of food and green waste including costs and performances.

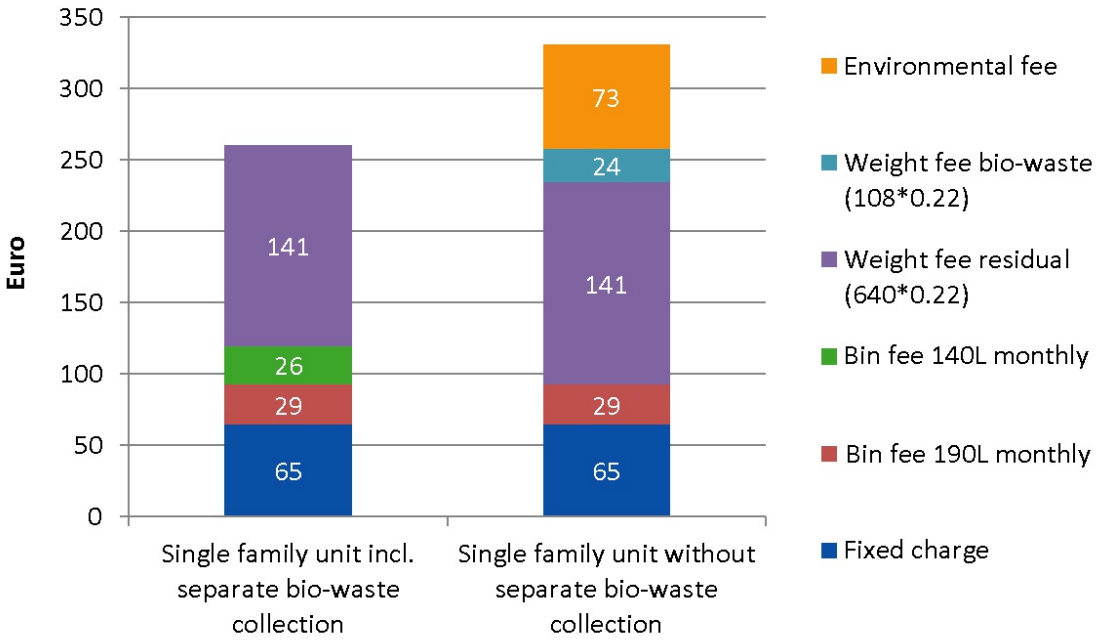
Table 7: Analysis of the separate collection of bio-waste per municipality

	Interza (BE)	Zollernalb-kreis (DE)	Innsbruck (AT)	Maastricht (NL)	Umeå (SE)	Besan-çon (FR)	Treviso (IT)
Bio-waste Door-to-Door collection							
Year of implem. PAYT	2004	1998/ 2001	1995	2001	2007	-	2013
Recipient	Bin	Bin	Bins/ Sacks	Bin	Bin	-	Bin
Bio-waste part	Food + green waste	Food waste + small green waste	Food waste	Food + green waste	Food waste	-	Food waste
Volumes	240L	80L, 240L	120L, 240L 60L	25L, 140L	140L	-	25L, 120L, 240L
Collection frequency	Weekly Bimonthly	Bimonthly	At least once a week	Bimonthly (140L) Weekly (25L)	Weekly	-	1 to 2x/week
Fees charged	30€/HH/y	-	€0.0344/L €2.95/sack	-	Extra fee on fixed charge if no participation in separate collection	-	-
Charge	Fixed rate	Weight	Volume, priced sack	-	-	-	Frequency
Performance (kg/cap/y)	130	46	75	83	27	-	125
Green waste Door-to-Door or Bring Banks collection							
Frequency	-	3x yearly	-	-	On call	-	1 to 3x/week
Charge	-	-	-	-	Fixed €20.26/pick up + €9.75/m3	-	€8.22 – €9.07/120L €10.8 – €11.9/120L
Performance (kg/cap/y)	-	4.04 + 41.6 (BBs)	-	-	6	-	34
Recycling yard - green waste collection							
Possibility	√	√	√	√	√	√	√
Charge	€0 to €10/m3	€15 < 180 kg	1 tonne free If > then €45/ tonne	€5 to €40/m3	-	-	-
Performance (kg/cap/y)	17	6	54.7	25	12	48	10

The analysis of above table shows some interesting findings as presented here below:

- all municipalities use waste bins (of varying sizes) for the DtD separate collection and only one municipality (Innsbruck) allows for sacks
- Interza and Maastricht offer a separate collection of food waste and small garden waste
- the collection frequency varies from twice weekly (Treviso) to weekly and/or bimonthly. Frequency can be related to seasonal aspects (Interza) and/or size of the bin (Maastricht).
- Fees are charged in 3 out of the 6 municipalities offering a DtD separate collection scheme for bio-waste. The fee for the bio-waste collection in Innsbruck and Zollernalbkreis are the same as for the collection of the residual waste. Umeå charges an additional part on the fixed charge for residents not participating in the separate collection scheme of bio-waste. Figure 10 shows clearly how this measure affects the fees paid for a single family unit.

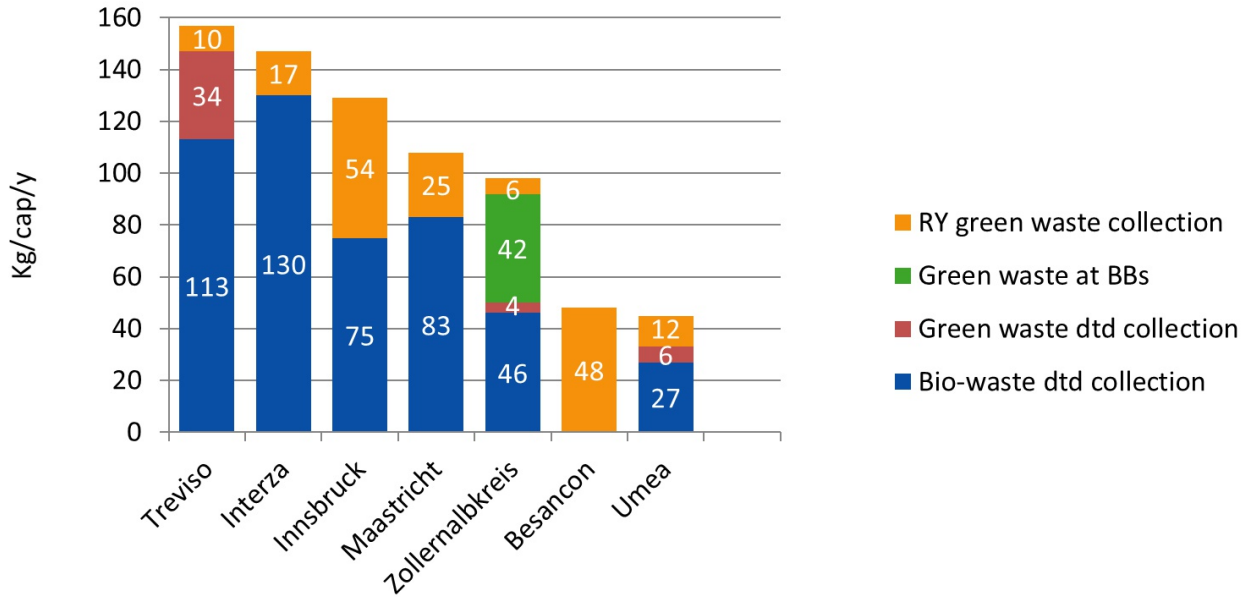
Figure 10: Umeå fixed and variable charges simulation comparing two options



- Green waste DtD collection is applied in 3 municipalities (Zollernalbkreis, Treviso and Umeå). All three municipalities charge for this service, which is most probably one of the reasons for quantities collected being rather low. However, this supplementary service can be of use for resident with a garden but no possibility to bring the green waste to the recycling yard.

- All municipalities offer the possibility to bring green waste to the recycling yard. Only 3 of the municipalities charge the residents: two on a volume basis (Interza, Maastricht) and one a weight basis (Innsbruck).

Figure 11: Bio-waste collection schemes per municipality and quantities collected



Bio-waste generation, making a distinction between food and green waste, differs between municipalities as shown in Figure 11 and can be linked to climatic conditions, urbanisation level, start of the bio-waste collection scheme and other variables (for example, socio-cultural aspects and consumption behaviour). The following findings can be drawn from this table:

- Separately collected quantities can be rather high via DtD collection (Interza, Treviso, Maastricht, Innsbruck) or RYs (Innsbruck and Besancon)

- If we consider a bio-waste percentage of between 30% to 40% of overall waste generation, Interza and Treviso come close to full collection of the bio-waste fraction. For most municipalities there is still potential for improvement, that is more separate collection

- Besançon is a particular case since no DtD collection of bio-waste is organised. However, the city of Besançon focused on home- and community composting and diverted more than 3,000 tonnes per year or close to 18 kg/cap/y

- There is no link between quantities collected and costs for collection. Only three cities apply PAYT on bio-waste : Interza (flat rate of €30/y), Innsbruck and Zollernalbkreis a fee similar to the fees to be paid for the residual waste collection

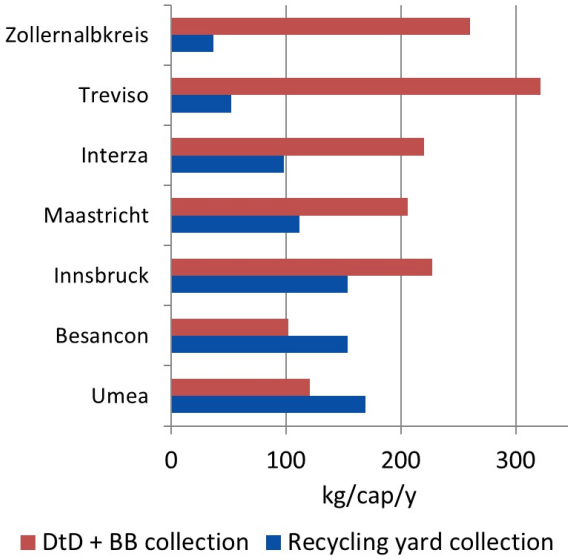
- The sample is too small to provide meaningful conclusions regarding ‘fees’ to be paid and bio-waste collection rates. However, charging fees for bio-waste is not seen as having a negative impact on the collection rate. Providing the right infrastructure and adequate bin sizes (and kitchen buckets with liners), optimising collection frequency and easing the access and user-friendliness of Recycling Yards are important incentives for residents to participate in bio-waste collection schemes

3.3.4. PAYT systems applied at recycling yards, or not?

All municipalities have recycling yards in which citizens can bring their waste on a voluntary basis. The number of waste fractions that can be deposited are between 15 and 22 and consist mainly of bulky and hazardous waste fractions even though some municipalities allow also for residual waste and recyclables.

Table 8 and Figure 12 Recycling yard fees and separate collection performances

Collection in kg/cap/y	Fees charged	Waste collected at RY	Recyclables collected DtD + BB
Interza	Yes	98	220
Zollernalbkreis	Yes	37	260
Innsbruck	Yes	154	228
Maastricht	Yes	112	206
Umeå	No	169	121
Besançon	No	154	102
Treviso	Yes	52	322



The quantities of waste collected at recycling yards differ considerably between municipalities and are lower in municipalities (Zollernalbkreis, Treviso, Interza, Maastricht and Innsbruck) where residents have to pay for the waste brought to the Recycling Yards. Table 8 and Figure 12 indicate the quantities collected at RYs are inversely proportional with the quantities of recyclables collected DtD or via BBs. Therefore the presence of charges at the RYs is deemed to have an impact upon the relative proportion of recyclables collected through the BBs and DtD collection schemes.

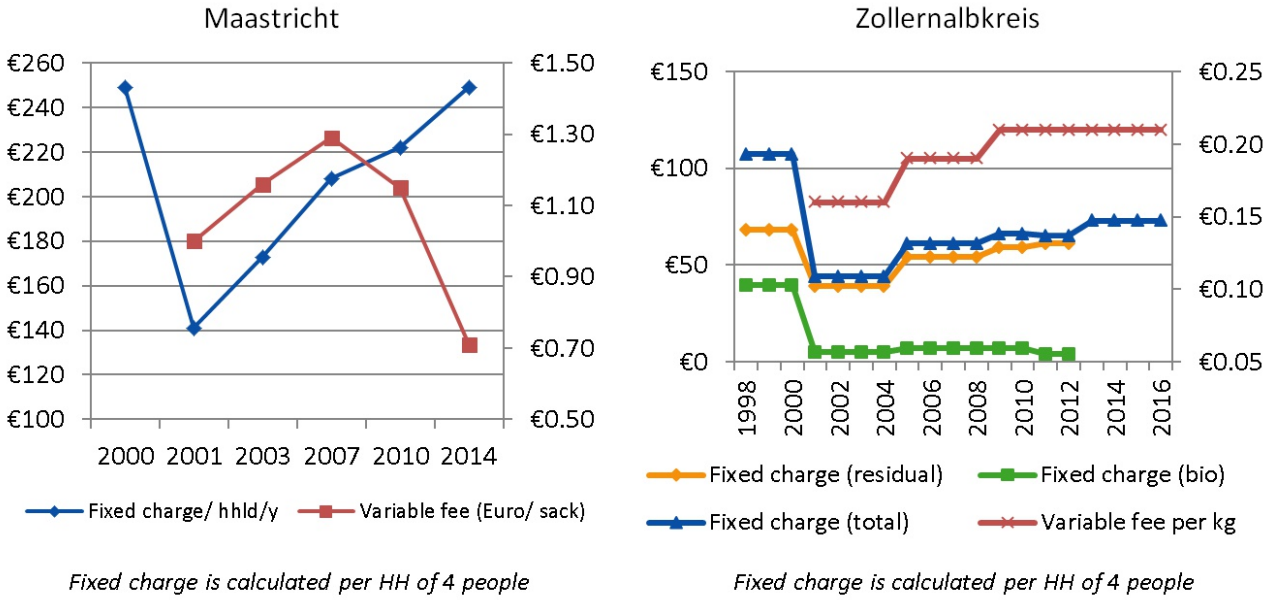
3.3.5. Comparison of and discussion on the fixed and variable fees applied by the municipalities

Our research revealed a broad range of fees applied by the 7 municipalities:

- Fixed annual fees per capita (as an element of a PAYT scheme) range from €17.5 (Innsbruck) to up to €136.7 (Maastricht)
- Fees for the purchase of mandatory priced bags for residual waste range from €0.71 for a 50 litre bag (Maastricht) to €2.95 for a 60L bag (Innsbruck)
- Fees per emptying of a bin range from €1.12 to €4.15/emptying in Besançon based on the size of the bin and the geographical area (city centre, sub-urban and periphery)
- Fees per kg range from €0.14 (Umeå) to €0.231 (Besançon)
- Fees at Recycling Yards are based on volume and/or weight and range from €5 for a car (Interza) to €40 for between 1½ - 2m³ (Maastricht). Fees based on weight at RYs are €0.29 for mixed waste (Innsbruck)

All municipalities reported to have changed the fee balance and pricing since first introducing PAYT. Most cases adjust the fixed and variable portions according to waste outcomes regularly as shown in the cases shown in Figure 13. Some municipalities did report increasing the fixed portion to protect against the costs needed for repairs and maintenance of waste related infrastructure. PAYT does, however, appear easily adjustable, as this can be done on a yearly basis, and given that the policy tends to offer high quality data, waste trends can be easily tracked.

Figure 13: Fluctuations of fixed charges and variable fees in the time for households in Maastricht & Zollernalbkreis



Fixed charge is calculated per HH of 4 people

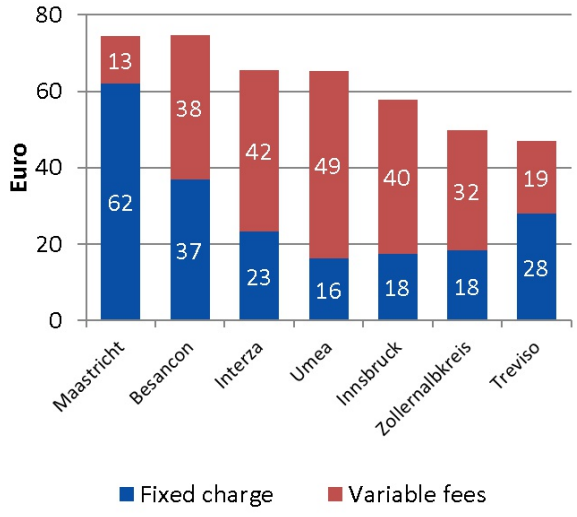
Fixed charge is calculated per HH of 4 people

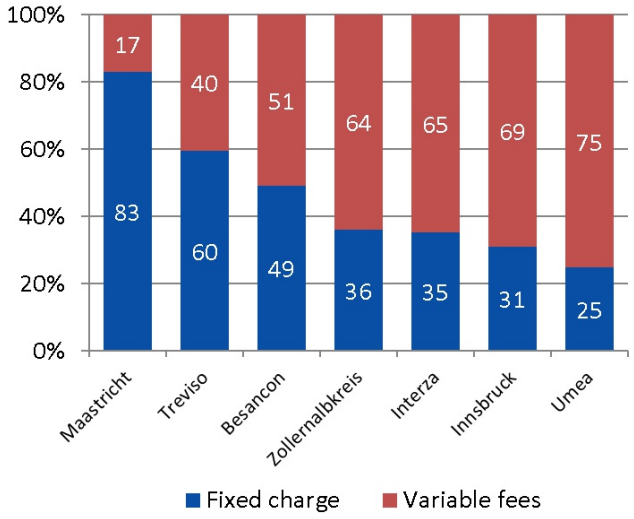
The fixed rate in Maastricht was €249/HH/y in 2000 and decreased to €141/HH/y in 2001 (year of introduction of PAYT). In 2014 the flat rate is again €249. The variable charge is estimated (average) at €40 (priced bags at €0.71/bag) and €10 (use of RY). On average households paid less than €50 per year for the variable fee. The variable rate reflects the real cost of the bag and the processing of its content. In 2001 a priced bag cost €1 and in 2014 €0.71 due to decreased treatment costs for the residual waste (€142/tonne in 2001 and €64/tonne in 2014).

The case of Zollernalbkreis shows a more logical approach whereby the fixed charges decreased at the introduction of the variables fees in 2001. However, throughout the years the fixed charges and variable fees increased gradually and as from 2012 only one fixed charge was charged.

Figure 14 and 15 present the fees charged per resident by the seven municipalities making a distinction between fixed and variable fees. Those fees are based on averages and simulations are made considering the fees applied per municipality. At first glance the differences stand out, not only with respect to the total fees to be paid but also considering the balance between fixed and variable fees. Maastricht is the clear exception with regard to the balance between fixed and variable charges. Besançon chooses for a close to 50:50 balance while the other municipalities favour lower fixed charges as shown in the graphs hereunder.

Figure 14 and 15: Distinction between fixed charges and variable fees for the 7 municipalities expressed in Euro and in percentages





Fixed charge is calculated per HH of 4 people

The design of the fee structure represents a critical component of PAYT, both for the need to connect the fixed portion of the fee correctly to cover the cost of waste services, but also to find the appropriate balance with the variable portion to incentivize waste prevention.

Nevertheless, municipalities have to cover basic costs, and some municipalities did report increasing the fixed portion of the fee to deal with economic uncertainties and to cover infrastructure repairs. Some of these adjustments are to be expected, given the increasing cost of waste treatment infrastructure. However, not giving the variable part of the bill adequate weight could undermine the impact of the incentive for households to reduce their waste generation. In this way, the goals of PAYT can be weakened if the bill cannot cover the basic infrastructure and repair costs of the municipality. Findings from this research do show that a number of municipalities reported adjusting the fee to meet waste infrastructure needs. Though this is an important reality of PAYT, the policy can also offer potential to address it: flexibility. As most municipalities reported having better waste data quality after implementing the new system, the local government can then use this data to make a decision each year on whether to adjust or change the fee. Thus, while PAYT may appear to initially cause uncertainty in revenue, and require some adjusting of the bill, the policy can provide the data needed to help make this decision and be easily adjusted each year.

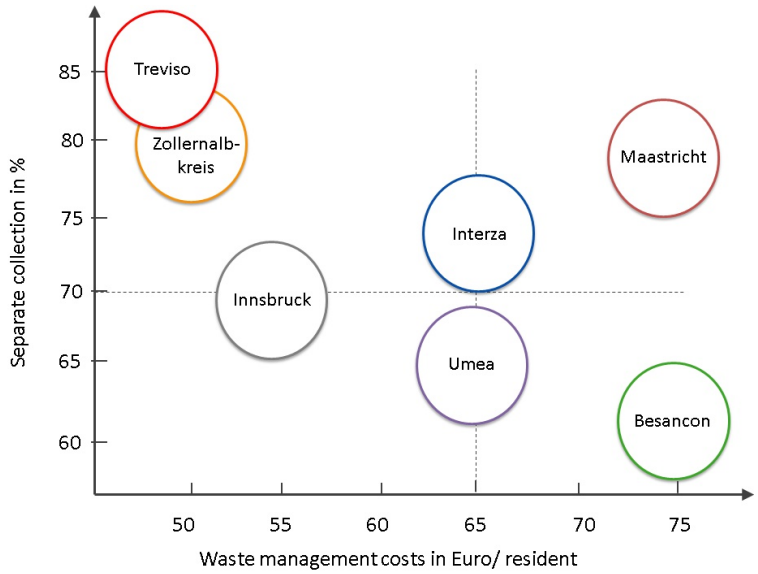
Acceptance PAYT

An important reality of the conventional flat fee is the fact that households feel as if they pay for the service of full container. Thus, to get the most for their money, customers may have the urge to throw out as much as possible each week to fill the container. PAYT takes away the possibility of this line of thinking, because more waste will always mean a higher bill. Of course, the size of the fee and the balance of the fixed and unit-based portions have to be accepted by users as well.

3.3.6. PAYT efficiency

The performances regarding environment and costs are presented in Figure 16. The dotted lines provide the averages of the indicators. The quadrant top left gives the municipalities with the best score regarding the share of separately collected waste and costs.

Figure 16: Performances against key variables



The municipalities can be found in all four quadrants. Overall the municipalities perform rather well achieving a more than 60% selective collection rate at reasonable costs (between €50/cap/y and €75/cap/y). Treviso is the best performing municipality achieving a separate collection rate of 85% at a low cost (€47/cap/y). Maastricht has a high separate collection rate too but at a higher cost than average (considering this sample of seven municipalities).

Regarding the cost of collection, a number of factors that derive from the great diversity of situations may explain the variability:

- Varying dispersion of the population in the municipality and density
- Provision of collection service at a supra-municipal level (inter-municipalities)
- Distance to waste treatment plants
- Collection frequency
- Collection system
- Type of containers/recipients
- Different bargaining power of municipalities at the time of pricing the contract
- Territorial differences in collective wage agreements governing service contracts

3.4. Benefits and problem-barriers

As a summary the following benefits and problem-barriers of PAYT systems as identified in this research can be highlighted:

Benefits

- Reinforcement of the waste management hierarchy
- Increase of citizens' participation in waste prevention and reduction efforts
- Establishment of a fairer waste charging-system for the citizens
- A perception of greater fairness where producers of large amounts of waste pay more
- Reduction of final disposal cost
- Increase of waste services' efficiency and effectiveness
- Higher transparency of service and thus promotion of a more reliable public image of waste services
- Higher capture of recyclables and increased revenues from selling them
- Improving/increasing/raising citizens' interest in environmental issues
- Reduction of negative impact of waste on the environment
- Better data concerning waste generation increase
- Transparency of costs

Problem-barriers

- Possible increase of illegal dumping
- Uncertain waste services' revenues because of uncertain waste generation with the consequences of rising charges
- Increased information, education and training costs
- Possible increased investment in equipment
- Possible increase in administration, managerial and operational costs
- Possible unfairness towards low-income citizens
- Implementation barriers in multi-family buildings
- Uncertain and perhaps uncontrollable citizens' response
- Political reservations or resistance

3.5. Concluding remarks

While PAYT does show potential as a waste prevention and recycling strategy it requires a proactive municipality willing to expand collection services, educate users, and deal with a large amount of data. The policy can represent an important step towards waste prevention but cannot tackle waste levels on its own. As observed in the report, there is a general recent trend of decreasing or stabilising overall waste quantities generated at national/regional and municipal level. The reasons for this are manifold, such as the consequences of the economic crisis and the implementation of waste prevention programmes.

PAYT does help to put municipal waste policy in line with the Polluter Pays Principle, and encourage the important environmental savings that come with prevention and recycling but it is not clear how fully effective the instrument is as a waste prevention tool in the long-term. Applying PAYT schemes can help reduce levels of residual waste below 150 kg/cap/y (and even below 100 kg/cap/y).

The instrument does, however, adapt well to local conditions and shows a high level of acceptance for stakeholders which gives it great potential to spread and make waste management systems more consistent with the Polluter Pays Principle and the goals set by the EU and national/regional governments.

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ANNEX: 'PAY-AS-YOU-THROW' VARIABLES TO CONSIDER

To successfully implement Pay-As-You-Throw, there are many considerations planners will need to perform, as described in the previous chapters. The following additional challenges expressed by the municipalities are important for municipalities wanting to introduce a PAYT scheme. However there is not such a thing as 'one fit for all' guideline to make a PAYT scheme work since no municipality is the same. Each municipality begins the process of implementing PAYT with unique issues and circumstances and therefore the implementation steps and prior considerations will vary considerably. Hereunder are described a number of factors to consider when implementing a PAYT scheme that can influence the success of such a scheme.

Public acceptance of the PAYT system

Though the municipalities did not report measuring public opinion right after the shift, general waste surveys by the municipalities show satisfaction with the system, and the waste planners reported that users have a perceived high level of acceptance for the waste services and billing system. This relates to the fact that PAYT is viewed as an extension of the same billing process used by other utility services, such as water and electricity, which also charge by unit. The general advantages for the policy listed by the municipalities are that it is "fair," offers a strong incentive for waste reductions and increased sorting, and that it delivers high quality waste data.

Education and awareness

Municipal awareness raising campaigns are probably an influential factor in prevention and recycling behaviour. Educational efforts early on can also insure that users know about the options available to sort waste or home compost to reduce the fee. During the take-off and acceleration phases, when the policy is first implemented, and users are adjusting to the fee, the municipality can work to stay in good contact through educational materials, and carefully monitor waste outcomes and revenue to adjust the fee accordingly. A brief look at the municipalities' internet home pages revealed a wide variation in waste information. However, information and communication activities were not investigated in this research, and the extent to which differences in the amount of waste were due to differences in information policy is unknown.

PAYT in multi-family units

One potential challenge facing communities implementing Pay-As-You-Throw is how to deal with residents in apartments/multi-family housing (buildings with five units or more). Since waste generated by these residents typically is combined in a central location to await collection, identifying the amounts of waste generated by individual residents in order to charge accordingly can be difficult.

Municipalities have developed many different strategies to deal with this issue, ranging from high-tech measuring equipment to exempting residents in large buildings. Multi-family buildings may not receive the same level of recycling and other complementary services as single-family housing units. These residents might therefore have fewer avenues for waste reduction.

Despite these potential difficulties, options are available to include residents of apartments/multi-family housing. Planners might work with building managers to offer a waste reduction incentive tailored for the building's residents. Under this approach, if residents generate less waste, some of the building manager's reduced waste disposal fees would be passed on to them in the form of lower rents or fees, or even a direct cash rebate. The incentive is somewhat diluted with this option, however, because the cost savings would be spread amongst all building residents-regardless of whether they threw away less trash.

Another approach is to modify buildings' waste collection systems. Containers could be altered to operate only with a magnetic card, waste token, etc. In addition, planners could try to have building codes for new and renovated buildings amended to require the installation of dedicated places for selective disposal.

Illegal Diversion

Three pathways for illegal dumping are identified: waste tourism, meaning, depositing waste in someone else's bin, burning waste at home, and disposal in nature. When municipalities first consider Pay-As-You-Throw, illegal diversion is one of the most frequently cited concerns. Residents, elected officials, and others often assume that charging a fee per container of waste will encourage some households to illegally dump or burn waste.

Most municipalities have found that illegal diversion has proven to be less of a concern than anticipated and that there are steps they can take to minimize its occurrence. Typically, municipalities report that illegal diversion can be an issue regardless of the way in which residents are charged for solid waste management. The municipalities that did report some problems were Maastricht and Innsbruck. In terms of the issue of waste tourism, while Innsbruck did report that some rest stops had seen an increase in waste, this situation was not viewed as a lasting problem.

Innsbruck experiences some waste tourism from neighbouring municipalities since they have to pay at the recycling yard for commercial and bulky waste contrary to the residents of Innsbruck. To tackle waste tourism, it is important to have similar systems in neighbouring municipalities (Flanders did so).

Also Innsbruck reported 700 tons yearly at the 141 Bring Banks stations in the municipality. Therefore Innsbruck decided to move to DtD collection for plastic waste and Paper and Cardboard as from 2016.

According to municipalities, the key to minimizing the potential for illegal diversion is to create a significant deterrent. Municipalities often implement fair but aggressive enforcement policies at the same time as the PAYT program. The most common step solid waste planners take is to pass ordinances (if they do not already exist) or take other legal steps that clearly establish illegal diversion as a violation. These measures often allow enforcement personnel to search abandoned waste for indications of its origins. Fines or other penalties also are usually included as part of these ordinances.

Municipalities often emphasize that one of the most effective deterrents is simply to ensure that residents have as many legal options for waste diversion as possible. Recycling, composting of

garden waste, and other complementary programs allow residents to significantly reduce waste disposal amounts and save money, making illegal diversion less likely.

In tandem with enforcement, municipalities typically report that public education and outreach can help to prevent illegal diversion from becoming a problem. Simply informing residents about the program and how they can participate will facilitate greater compliance with its rules and procedures. To help allay residents' concerns, municipalities also can include information in their outreach efforts about how they plan to use enforcement and penalties to control illegal diversion.

Special Populations

In most municipalities, there will be a percentage of residents for whom Pay-As-You-Throw may pose particular challenges. Resident who may need assistance or special attention include low-income residents, senior citizens, transient populations (for example, students and tourists), and multilingual residents (resident for whom the official language is not their first language).

The key for many solid waste planners is to incorporate flexibility into their program design. For example, while some residents may feel that PAYT poses a burden for those living on a low income, planners can structure their program to allow everyone to benefit. They can reduce the per-household waste collection charges for eligible residents by a set amount, offer a percentage discount, or provide a credit on the overall bill.

In addition, some municipalities offer a predetermined number of bags or stickers free of charge to low-income residents. In municipalities with a multi-tiered system, while everyone is charged equally for bags or tags, the base service charge is reduced for low-income households. These strategies allow low-income households to benefit from assistance while retaining some level of incentive to use source reduction, recycling, and composting.

Commercial waste

Commercial waste generators do not always require all services offered to households. So it may happen that the fee calculated for private households is higher than the “market price”, i.e. the price a company could be offered by a collector who has to account for the required service only. If a separate fee is calculated for companies concerning only the services the company requires, the fee will often be attractive compared with that offered by private collectors (focussing on commercial waste only), as the municipality operates over a larger area with close distances between collection points. By combining two types of waste generators (e.g. residential and commercial) a cost-efficient collection can be realised. Integrating the management of commercial waste into municipal waste management helps municipalities receive a contribution to the fixed costs. Consequently, the average cost can be shared, and reduced.

The Association of Cities and Regions for Recycling and sustainable Resource management (ACR+) is an international network of members who share the common aim of **promoting the sustainable consumption of resources and management of waste through prevention at source, reuse and recycling**. ACR+ currently has more than 90 members, mainly local and regional authorities as well as national networks of local authorities representing around 1100 municipalities. ACR+ also welcomes other key players in the sustainable resource-product-waste management, such as NGOs, academic institutions or private organisations, as partner members.

ACR+