Literature Review

Summary paper

Work Package 1 – V.1.3

INDEX

1 Background

1.1 Objectives

The objective is to conduct a relatively **comprehensive review of technical studies and publications made on the implementation, conditions and impacts on and from schemes of waste fee collection according to the pay-as-you-throw principle and to aggregate secondary source data and information**. The review considers legislative, economical, technical and urban structure conditions for variable rate pricing in the management of municipal solid waste in EU as well as experiences and results made with technical solutions and in pilot projects including town-planning constrains and challenges.

1.2 Methodology

1.2.1 Checklist of factors

The first task to be accomplished before starting the desk research is to develop an understanding, based on our current experience, of the main factors that affect design, implementation, monitoring and review of Pay-as-you-Throw (PAYT) systems. This will help both selecting relevant literature and investigating the observed influence that such factors have on PAYT.

One session of the kick-off meeting was devoted to a brainstorming discussion toward the production of a draft list of key factors. The factors selected are listed in Appendix (see Checklist of factors 5.1).

A precondition to the selection of factors is their classification into three broad areas of influence: the economic dimension, technical solutions and social/political context. These areas are consistent and mirror the scope of work package 1.

It is interesting to report that social/political factors are predominant as compared to economic and technical issues. We could already speculate, at least in the perspective of the project participants, that the social/political issues may play an important role and they should be investigated carefully.

1.2.2 The Template for data gathering

Having agreed the key factors for analysing PAYT systems, the next step is to operationalise the list into a "template" for data gathering (see appendix for the complete outline).

The objective of the template is to facilitate the collection and structuring of the information on waste related pay-as-you-throw systems. With a view of developing a literature review document on the state of the art of PAYT together with brief outline of data gaps and data needs.

The template is structured in six parts. It contains both free forms (e.g. abstract, additional note, etc.) and ticking boxes. Most of the questions can have multiple answers and boxes selected. In case of particular information that cannot fit into the different sections, the user is suggested to include it in the "additional box" section or directly in the abstract of the document reviewed.

1.2.3 The implementation into "Access" based information and collection systems

The paper version of the template is translated into a MS Access database. The data is entered remotely by each project partners and stored into a central database physically located into the servers of TU-Dreden.

The reasons for having an electronic database is two fold:

- The data can be processed and analysed quickly
- The data can be easily distributed or made available on line

The present document has taken into consideration literature inserted into the database up to the 20th of August. Further necessary revisions to this document will also include study been introduce meanwhile.

2 Definitions

First and essential step for our literature review is the definition of key terms. The fact we are confronted with a heterogeneous mix of literature with different profiles and focus (e.g. academic origin, purely technical, social and/or economic analysis) as well as different geographical origin had forced us to better clarify basic terms related to waste, PAYT, social and economic factors.

Moreover, this process will help us, at a later stage, to better compare and summarise results.

2.1 General aspects

1) *Nature of the information:* If the information can be shared outside of the project or is restricted to the group
2) *Type of information:*
    a. Technical: regarding questions about statistics of waste flow, technical reference to collection systems and technologies applied to. Determinants of charge rates (design). Urban and housing infrastructure;
    b. Economic: related to investments, costs and benefits and financing issues;
    c. Political: that covers policymaking and legal aspects
    d. Socio-cultural: that covers social factors like social meaning and public perception, social framework, socio-economic context and socio-cultural framework.

3) *Type of analysis:* there many different ways of analysing a problem, we can't mention all of them in this contest. But of course there are elements that are more relevant for our research than others. For example, the evaluation of impacts of PAYT related schemes are very important for the successful accomplishment of the project objective. It is commonly understood that the vast majority of secondary information source is of a descriptive nature (from the legal, technical or economic point of view). Documents focusing on evaluation of impact (before or after the implementation of the scheme) are less diffuse or known;
    a. *Ex-ante evaluation of impacts:* refers to evaluation of impacts that are prior to the introduction of the instrument/system under consideration;

   b. *Ex-post evaluation of impacts:* refers to evaluation of impacts that are performed after the introduction of the instrument/system under consideration.

4) *Type of data and factors considered*: The information gathered from this section will give and indication of the type of data and the factors considered in the secondary source under analysis. This information will support the work on the production function and trade-off analysis (WP 4) and the elaboration of the model;
5) *Type of waste:* Different technical solution, PAYT schemes or economic and social analysis are applied according to the waste considered. It is important so to gather information about the type of waste that the literature under reference is considering. The selection of the waste type is based on what commonly is found in municipal solid waste. "Municipal waste" means waste from households, as well as other waste which, because of its nature or composition, is similar to waste from households" (council directive 1999/31/EC on landfill of waste). Hazardous waste is also included in the list. Hazardous material is usually collected separately and treated in specialised disposal/recovery sites. However a small fraction can be found in the ordinary collection systems (e.g. paints, oils, etc.);

6) *Geographical zone targeted:* It does not refer to the origin of the paper under review but to the geographical focus and the content of the analysis;

7) *Type of focus:* characterising the level of implementation/analysis

2.2 Waste related definitions

This section focus is oriented more to collect key technical references related to the document under review. Some of the factors have, unavoidably; not just a technical orientation but also an economic, social and/or political one (e.g. charge design, house structure, etc.)

1) *Total amount of waste generated:* Usually refers to the generation of municipal solid waste that is derived from the production of waste on a weight basis at the point of production. In some references it may have the same meaning as the "total amount of waste collected" and this is particularly true for what concerns municipal/household waste
2) *Composition of waste:* also called waste characterisation it refers to the proportion (%) of different type of waste contained in waste bins (e.g. % paper, plastic, organic materials, etc.). The share of different materials is a factor that will influence collection, management and the related recovery options.
3) *Total Amount of recyclable:* The share (%) of waste potentially recyclable from the total amount of waste collected.
4) *Total Amount of recycled materials:* The percentage of materials that is actually recycled
5) *Total Amount of residual waste:* Corresponding to the amount of material potentially recyclable but not actually recycled. It may correspond to the waste that is finally disposed (total amount of waste going to landfill) together with other waste that cannot be recycled.

Collection Systems

This section tries to get more information on the management of waste at the level of collection including bin characteristics and payments systems.

1) *Presence of separate collection:* In most of the countries and also due to environmental related regulation (e.g. Packaging and packaging waste Directive) different private/public systems, on a mandatory or voluntary base are dealing with specific waste streams (e.g. packaging, metal cans, plastic, paper).

2) *Type of bin:* different types of solution have been applied for the design of the bins. Some examples were presented during the kick-off meeting of our project. Please check this box if the document under review give details about the type of bin used.
3) *System used:* If the document gives reference on systems used and/or the typology of vehicles used then please tick this box. You main find different terminology and definitions such as, for example:
    a. Blue Box: A collection system of recycling where mixed recyclables are collected from households and sorted at a centralised plant;
    b. Bring systems (=Drop-off): Require household to bring the waste to collection point or to specific containers;
    c. Dual-bin systems: requiring households separating their waste into two fractions, typically the wet fraction and the reminder;
    d. Kerbside collection (door to door): requiring local authorities to collect the waste already separated or mixed;
4) *Frequency of collection:* please tick this box if the paper gives indication about frequency of collection. Frequency of collection can have significant impacts on collection costs (operating, maintenance and labour costs) and on the rate of collection.
5) *Payment systems*: Tick this box if the document give indication of payment and/or billing systems (e.g. computerised billing)

Convenience

Key to success of collection and recovery systems is the convenience and accessibility of management sites or collection points. Short distance and easy access to waste collection bins can positively influence the rate of collection and reduce the tendency of illegal behaviour. However, it can also increase costs.

1) *Distance to bin:* give an indication of the distance from the waste "production" site to the waste collection site
2) *Transparent billing:* easy to understand charging system, facilitating the monitoring of waste flow

Physical Community Characteristics

Factors related to city infrastructure, building and housing patterns, etc. are (should be) always considered at the level of designing collection systems and frequency, type of bins, charge design and associated rates, etc. They are also central factors for the evaluation of the efficiency and effectiveness of PAYT schemes.

1) *House structure:* information related the size of house, size of garden, number of rooms, and type of heating system. All this factors can influence the amount and composition of waste;
2) *Urban structure:* it includes for example, the type and distribution of building

Charge Design

It is important to underline that there many different ways to define a tax. In some documents the term tax, charge, fee, levy is used with no distinction. Other sources, instead, distinguish between a tax and a fee according to the use of the revenue generated.

If the revenues are used for general budget purpose than the charge is "tax", if on the contrary, the revenues are used for the financing of a specific service (e.g. collection) then the charge is called "fee".

In the context of this project this differentiation is not central, what is important to know is if the tax, charge, fees of levy is related or not to waste production/generation. In other words, if the tax is in line with the "Pay-As-You-Throw" principle.

Charging according to the weight of the waste or according to volume is in line with the "pay-as-you-throw" principle. There could be also other factors been used as a proxy to waste productions (e.g. size of the house, income, etc.) even if sometimes their direct relationship with production can be questioned.

1) *Volume:* where the factor for determining the rate of the charge is the volume of the waste collected
2) *Weight:* where the factor for determining the rate of the charge is the weight of the waste collected
3) *Flat:* no relation with waste flow, the rate of the charge is fixed.

2.3 Specific economic, social and political aspects

Info on economic aspects

This section focus on the economic factors related to PAYT systems and to the management of waste materials, ranging from investments costs in new machinery to disposal costs.

1) *Disposal Costs:* Cost related to waste disposal including externalities (if evaluated) and cost related to waste incineration without energy recovery.
2) *Collection cost:* Costs related to the pick-up of the waste from waste bin/waste deposits to recovery/disposal sites
3) *Land-use:* Usually refers to the cost of land. In densely populated areas this cost may be high. It is also used to estimate externality related costs.
4) *Remediation costs:* Cost related to illegal dumping, clean-up of littering, cost of remediation of landfills or other waste management facilities post closure
5) *Maintenance of waste management facilities:* cost related to the proper running of waste management facilities such as vehicles and collection sites maintenance (sanitation, clean-up, upgrade, etc.). The costs of recovery/recycling facilities are not included here but in the "cost of recovery options" item.
6) *Information and education costs:* Costs related to education and information campaign usually targeted toward the citizens and households. It may be both related to guide of 'good practice' towards waste reduction or environmental awareness campaign.
7) *Treatment costs:* Usually costs related to waste treatment prior to landfill
8) *Costs of recovery options:* Costs associated to recovery of material from waste including chemical recycling, feedstock recycling, mechanical recycling and also incineration with energy recovery
9) *Emissions:* Externality costs often referring to emission from incineration or emission from the transport/transfer of waste material.
10) *Cost-Benefit:* Analysis targeted towards the measure of costs of a certain activity/action and its related benefits. It may include also an evaluation of environmental costs and benefits (e.g. reduction of emissions, recovery of resources, energy, etc.)

Waste Management Financing

An important aspect of waste management and one of the key bottlenecks for its successful uptake is the economic benefits (surplus) that derive from the recovery of wasted material. Apart from some waste streams (e.g. metals, glass, paper) that are able to survive only on economic bases, other waste streams such as municipal ones have a very critic economic dimension. Costs are usually higher than revenues. It is so of relevance to get basic information of financing measures and revenues generated by the recovery of these materials together with the potential markets associated to recycled products.

1) *Charge rates:* please tick this box if the document under review gives clear indication of charge rates.

2) *Use of revenue collected:* please tick this box if the document under review gives indication on the use of the revenues from the charge (e.g. general budget, recycling projects, environmental funds, non-profit organisation, etc.)
3) *Revenues from selling recycled products:* Please tick this box if the document under review makes reference to revenues originated from selling of recycled products.

Info on political aspects

This section covers the political and organisational aspects of PAYT schemes these are legal and policy framework and policy instruments.

Legal basis and policy framework

1) *Legal basis/legislation:* If the paper gives indication whether local authorities are empowered to impose taxes or fees for collection of household waste than tick this box. It is commonly accepted in all countries, but there are exceptions. For example, in the UK article 45 of the "Environment Act" state that "no charge shall be made for the collection of household waste, expect in cases prescribed in regulations made by Secretary of State".
2) *Framework policy:* Please tick this box if the document under review makes reference to programmes, plans, strategies and/or general waste related legislation in the country under consideration.
3) *Objectives of framework policy:* please tick this box in case the document reviewed make reference to specific waste related objectives (e.g. disposal, recovery and recycling targets)
4) *Charge related policy:* please tick this box if the document under review makes reference to specific policy on charges, fees, taxes, levies, etc.
5) *Objectives of the charge related policy:* please tick this box if the document refers to objectives of charge related policy (e.g. to cover the cost of collection, to provide incentives recycling, raise revenues, etc.)
6) *Involvement and influence of stakeholder:* to which extent the citizens and all stakeholder organisations are involved in the decision making process and/or in the implementation of waste related initiatives.
7) *Responsibility allocation:* to which extent is possible to recognise a clear allocation of responsibility along the chain of waste management including decisions taken at the level of design as well as at the level of implementation and monitoring and finally also at the level of non-fulfilment.

Policy instruments

Different policy instruments can be implemented in order to facilitate the achievement of a policy objective. They range from taxation instruments (including PAYT schemes) to command-and-control instruments (e.g. ordinance and prohibitions). A mix of policy instruments is also possible and desirable (economic instruments, command-and-control, voluntary approaches, information campaign, subsides, etc.).

Info on socio-cultural aspects

This section covers the social, cultural and socio-economic aspects of PAYT schemes these are social meaning/public perception, social and socio-economic context as well as cultural context

Impact of users' and public actors' perceptions, cognitions, attitudes

Social meaning of waste activities is another important element to consider when thinking about implementing a PAYT scheme. Confidences in public authorities, willingness to pay for an environmental improvements as well as attitudes towards other environmental issues are factors that should always be considered for a successful

uptake of policy measure or private initiatives. These factors are often linked to the socio-cultural and socio-economic context

1) *Attitudes towards/ acceptability of Waste separation/collection:* please tick this box if the paper under review makes reference to attitude/acceptability towards waste separation/collection from households and/or public authorities (this may include information about type of collection systems such as kerbside collection, drop-off points, recycling station, etc.)
2) *Attitudes towards/ acceptability of Polluter pays principle:* tick this box if the paper is referencing to attitudes towards the principle that the polluter should pay for its damage to the environment. The original definition from OECD state that: "The polluter should bear the cost of measures to reduce pollution to ensure that the environment is in an acceptable state"
3) *Attitudes towards/ acceptability of Charges (tax, fees, PAYT systems):* please tick this box if the document under review make reference to the attitudes/acceptability by households and/or public authorities towards pay-as-you-throw schemes.

Impact of social, socio-economic and cultural context factors

This section includes factors related to crime, income distribution, age, presence of association of neighbourhood, all factors that are influencing more of less indirectly the rate and the pace of activities associated to waste management and recovery.

1) *Socio-economic status:* i.e. income (per capita, per family, per household), level of education/ educational status, job status/ level of occupational qualification
2) *Age distribution:* Past analyses have highlighted a relationship between collection rate and age distribution. Please tick this box if the document makes reference to such relation.
3) *Purchase and disposal behaviour:* please tick this box if the paper make reference to the behaviour of households at the level of purchase (e.g. preference towards products with less packaging –'green purchasing') or at the level of disposal (e.g. proper/un-proper separation of the different materials into the waste bins)
4) *Social exchange and social norm*: Social structures that allow for social exchange and the establishment of social norms are better predictors for disposal and recycling behaviours than environmentally related attitudes.

3 Key findings (executive summary)

The key findings are grouped according to main areas of concern:

Political and legal framework

For all country surveyed it exist a legal framework for implementing charges on waste. The only country that prohibits this possibility is the United Kingdom.

Institutional and administrative framework

A dynamic (from the design to the monitoring of results) and clear allocation of responsibility together with a strong commitment by the institutions are the fundamental preconditions for the uptake of PAYT systems.

Characteristics of cities

This factor is reported to mainly influencing the technical solution for collection and allocation of costs. The multi-material collection points are indicated as the most feasible approach for highly dense populated areas.

Waste managements and collection systems

A variety of approaches and collection systems are described in the literature each of them with strengthens and weaknesses. Municipality tends to subcontract the collection and management of the household waste to private companies. This has somehow influenced the economics of management pushing towards compensation systems to cover costs (i.e. charges, PAYT systems).

Waste management costs, financing and charge system

The implementation of PAYT charges has doubtless contributed to an increased cost for waste management, ranging from the need of new infrastructure to separate systems for accounting. The cost ratio is directly correlated to the type of solution adopted. Controversial are the indication of the benefits, some refers to an offsetting of costs others to a "null" effect. Volume waste charges are the most widely applied system as compared to weight based charges. However, it is also highlighted that with 'volume design' is not always possible to clearly allocate costs according to PAYT principle.

Attitudes towards PAYT

They are generally well accepted by the households, many different factors can influence the attitudes towards PAYT. Households tend be more pro-active when a clear benefit can be identified such as implementing credit systems and discounts for successful separation and collection of recyclables.

According to the literature, the main strengths of PAYT can be summarised as follow:

- Fairer allocation of costs to the communities/users (depending on the design);
- Ensure transparency of waste management financing;
- Effective in reducing residual waste (15 to 90% reduction);
- Increase sorting and collection of recyclable;
- Encourages individual composting

On the other hand, literature has also highlighted the following weaknesses:

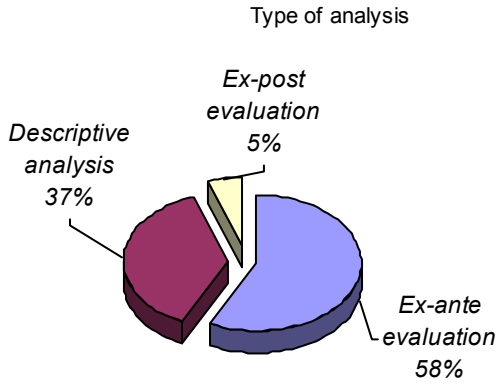
- Illegal dumping (waste burned or left in open grounds)
- Waste tourism (waste moved to nearby uncontrolled communities)
- Increased cost (both investment and operational costs);
- Increased amounts of contaminants into recyclable materials collected (Germany);

3.1 By geographical distribution

3.1.1 EU wide results

The large majority of literature been surveyed is either of a descriptive nature or based on an ex-ante analysis of impacts (see graph below). It is quite surprising that only 5% of the literature focus on the real effects of PAYT related systems. One the consequence of this result (if confirmed) is that it will be difficult to draw EU wide conclusions on the effectiveness of charging systems based on ex-post analysis. The stakeholder survey should play a role in validating or contradicting this tendency.

These results can be partially explained by the fact that even if the development at EU level is very dynamic and rapidly evolving the wide application of charging systems based on PAYT are so far limited to country like Germany, Sweden, Austria and Finland.



If we want to classify the EU countries according to the state of development of charging systems than we can divide them into three main groups:

- Mature state: Germany, Sweden, Austria, Finland, the Netherlands
- Rapid development: Denmark, France, Ireland, Italy
- Slow but consistent development: Czech Republic, Spain, Greece

Each group has common characteristics. For the first group (mature state) PAYT is a common reality, these systems are widely diffused and in stable increase. The literature for this first group focuses on optimisation of PAYT systems and reports of effectiveness both at technical and socio-economic level.

For the second group (rapid development) we have a clear move towards PAYT either due to policy development or because of different and diffused PAYT piloting schemes.

The last group (slow but consistent development) shows an interest and a commitment at different level of the decision making process but it manly concentrated on understanding the consequences of shifting from traditional management systems to PAYT based approaches. Large share of the literature for these countries is, in fact, focusing on assessing the real costs of an integrated waste management system.

3.1.2 Country results

This section explores in detail the results at country level.

3.1.2.1 Germany

A large share of the literature reviewed so far, describes and analyse experiences gained in pilot tests in Germany. The literature been identified mainly reviews the feasibility, the technicalities and the problems encountered in context of the implementation of Pay-As-You-Throw systems in densely populated building areas.

The main conclusion that can be drawn from this research is that the technical solutions tested, such as various kind of sluice *systems, worked well and led to decreasing amounts of residual waste by 50 to 90%* while the collected amounts of all other fractions (bulky waste, organic waste, Green Dot waste, etc.) increased.

Less conclusive and subject to controversy are statements concerning the decline in the total amount of collected waste and costs for residual waste treatment.

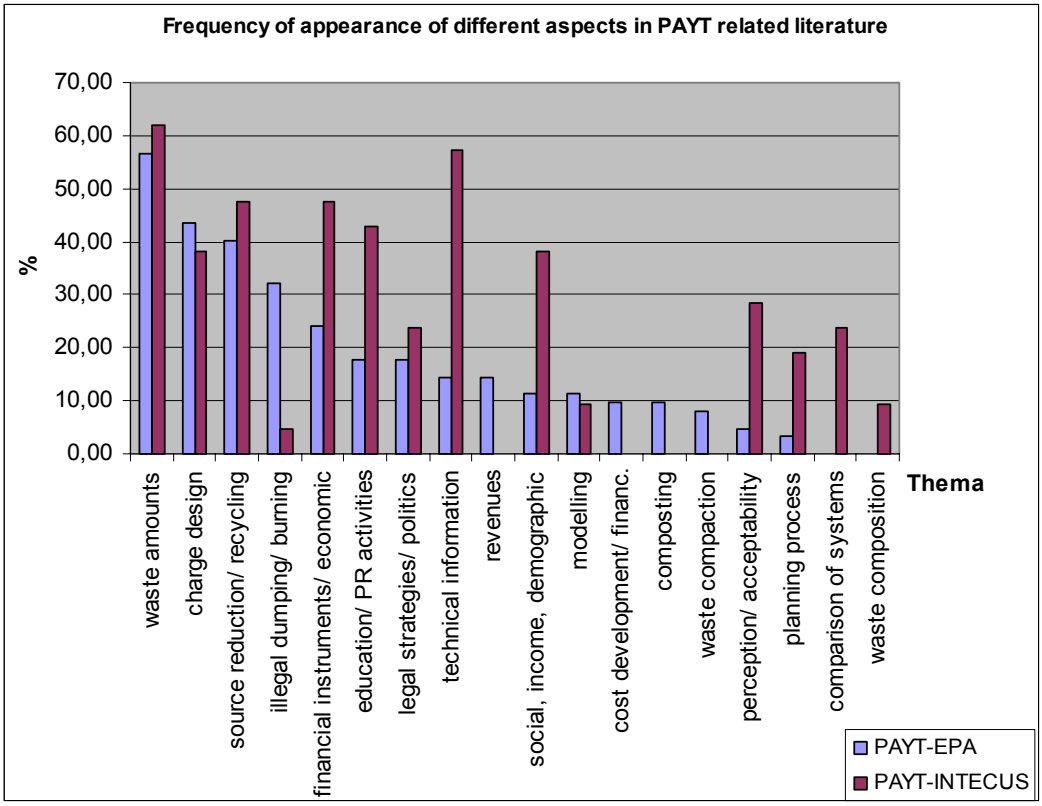
Generally highlighted is the *importance of a fixed minimum charge* and intensive public information and communication campaign parallel to the introduction of PAYT.

Certain problems such as *waste export* (i.e. illegal dumping into uncontrolled neighbourhood areas), growing pollution of other waste fractions collected, unforced and wilfully caused technical failures are repeatedly mentioned, sometimes in context with the rejection of the pay-as-you-throw systems.

Many pilot studies point out the need to review and adapt the local waste ruling in order to facilitate or allow the effective implementation of PAYT. Considering the whole spectrum of references, one has to conclude that the new federal states, especially the State of Saxony, have been frontrunners in testing PAYT systems whereas in the west of Germany its only now that the approach is getting more and more attention.

A comparison of German publications with the US, where PAYT and the corresponding publications mostly have single and semi detached dwellings and the bag and tag or single container system as reference, gave the following picture with regard of the different aspects involved:

Appearance of different aspects in American and German publications on PAYT



According to the literature, problems that need to be resolved for a wider implementation of variable pricing systems based on the PAYT-principle are:

- Illegal dumping (either right next to the provided containers or on public ground near the building)
- Export of waste in other regions of the city
- Increasing amounts of contaminants especially in the Green Dot fraction.

Regarding the economic aspects it is stated that although the costs incurred for the treatment of residual waste went down, the total waste management costs increased due to necessary investment and costs for the operation and maintenance of the technical systems, increasing administrative efforts, necessary changes in the collection logistics and tour planning, etc..

Local legal frameworks are reported as a principal barrier for implementing variable pricing systems on a wider scale. In fact, in most communities the statues on waste charges and waste ruling in general must be changed in order to provide the legal basis for the introduction of such systems.

3.1.2.2 France

The concept of waste management planning appeared for the first time into an act of the French legislation of 27 November 1969, when Prefects were asked to establish prefectorial schemes for household waste collection and transportation. The Directive 75-442/15 July 1975 of the European Economic Community (EEC) demanded from member-States to elaborate territorial plans for waste elimination. The French legislation incorporated this Directive into the Law 75-633 of 15 July 1975, demanding the

establishment of waste management plans in order to define the elimination conditions of certain categories of wastes, after a systematic public research and collaboration with the local authorities involved.

With the amended Directive 75-663 (by the Directive of 18 March 1991), the EC updated the concept of waste management plans aiming mainly to the promotion of material recycling-recovery and energy exploitation, as well as to the limitation of waste transportation and final waste disposal.

The French State then decided -in accordance with the Law 92-646 of 13 July 1992- to broadly define the elaboration conditions of the plans. Since then, prefectures are obliged to elaborate a waste management plan, which local authorities of waste management are forced to follow. The Law 92-646 sets the legal and political framework for local waste management. The national planning and policy for waste management is based on recycling, composting and, generally, the modernization of local waste management. This Law defines local communities as responsible for waste collection, transportation and treatment.

The following legislation, currently in force, defines precisely the contents of a plan:

- Law 75-633 as modified by the Law of 3 February 1995.
- Directive 94/62/CE (20.12.1994) about the valorization of packaging wastes.
- Decree 96-1008 of 18 November 1996, where the objectives of the Directive of 94/62/CE were embodied into the French legislation. The form and the procedure of the elaboration, publication and revision of Plans are determined in this decree.
- Circular of 28 April 1998:
    - Support on material and organic waste recycling, limitation of incineration and final waste disposal.
    - Introduction of a hierarchy on the methods of waste elimination.
    - Strict application of the legislation currently in force.
    - Control of waste management costs.
    - Periodical readjustment of the plans in collaboration with local actors.
    - Information and communication for citizens.

Waste reduction, waste avoidance and revision of the waste charging systems according to the current needs and demands are considered necessary.

The cost of waste management has increased in the last few years. Citizens demand more transparency on public activities together with a fairer confrontation regarding individual waste production. These were the reasons of the establishment of waste-charging systems based on polluter-pays principles. Two waste-charges are established in France:

- TEOM (Taxe d'Enlevement des Ordures Menageres=Tax for waste collection), a fixed waste tax based on flat-rate system (according to the size of the real estates).
- REOM (Redevance d'Enlevement des Ordures Menageres= Charge for waste collection), a special waste charge which corresponds to polluter-pays principle. Citizens pay proportionally to their individual waste production. In this way, citizens are invited to be actively mobilized towards waste reduction.

The setting-up of a special waste charge became obligatory by the Law of 13 July 1992, mainly for the management of non-household wastes within residential areas.

Several examples of PAYT schemes can be reported within France mostly based on the volume-based system (e.g. city of Besancon). A pre-paid system, not exactly based on PAYT, but following the broader polluter-pays principles, is considered as the most suitable system for the French local reality. Four of the most interesting PAYT-systems' implementation cases are the following:

- Union of Municipalities and Communities of "Pays de Mormal et Maroilles" (Region of Mormal and Maroilles) $\rightarrow$ charging by prepaid bags.

- "Ville de Besancon" (City of Besascon)→ charging by the volume of the used bin.
- Mixed syndicate of "Montaigu-Rocheserviere"→ charging by the volume of collected wastes.
- Union of Municipalities and Communities of "Porte d'Alsace et du Pays de Ribeauville" (Porte d'Alsace and Region of Ribeauville)→ charging by the weight of the collected wastes

The new waste-charging system ensures the transparency of the waste management financing and renders the entire system fairer for the citizens. Citizens are confronted with equity issues and pay in advance for individual waste generation.

On the contrary, the conventional, current waste-charging system often does not correspond to reality and discourages the citizens' active participation. The best example of a unit-pricing system is the one applied in the consumption of drinking-water. Citizens accepted the unit-pricing system on drinking-water consumption, as they felt more secure about the fairness of the imposed charges.

Beyond the benefits of polluter-pays systems, many defects also arise (e.g. difficulty on the measurement of the volume or weight of collected wastes and illegal dumping). Solutions to problems could be reached by continuous observation and adjustment of the system.

3.1.2.3 The Netherlands

The Environmental Management Act of 1993 sets the basic framework for waste management. According to this Act, Municipalities have the right to impose taxes or fees to cover the necessary costs of household waste disposal.

Art. 15.33 of the Environmental Management Act specify that:

> "...to cover the costs it incurs in connection with disposal of households waste, each municipality may institute a levy which may be imposed on persons..."

Waste charges

The use of flat-rate charges based on the rental value or the size of the dwelling is the most common approach in the Netherlands (approximately 78% of the municipalities).

The remaining 22% are implementing Volume/Weight/Frequency type of charges.

A study by the ministry of Environment reviews around 60 municipalities implementing variable rate charging.

The main conclusion from this analysis is that tariff differentiation cannot be viewed as an instrument of waste management that stands alone; rather the application of tariff differentiation always occurs as a part of or complement to a wider set of arrangements for the collection and processing of domestic waste, programs of information and enforcement activities.

Nevertheless, the report concludes, a clear independent impact to the achievement of environmental objectives can be attributed to forms of differentiation of charges. A important factor in this connection is that before or simultaneously with the introduction of such forms of tariff differentiation, *there must exist adequate facilities for waste separation, an effective system communication between the municipality and its citizens, and strict enforcement practice – all these as indispensable preconditions for the successful application of tariff differentiation.*

The independent contribution of tariff differentiation to the achievement of environmental objectives consists of:

- tariff differentiation for domestic waste increases the positive response of citizens to the system of selective collection (i.e. higher percentage of waste separation)

- there is a reduction of waste streams (often due to an increase in home composting)
- the principle of "polluter pays" can be put into practice

At the same time, tariff differentiation also serves as an extra "incentive" for various forms of "deviant behaviour", such as "waste tourism[1]". The extent of such behaviour depends on the intensity of the accompanying information campaigns and enforcement at the time of introduction of tariff differentiation (and subsequently).

The introduction of forms of tariff differentiation leads to structural increases in the cost of municipal waste removal. (How high these costs are depends on the form of tariff differentiation selected and the concrete form given to it.) At the same time, there are also a number of cost savings that can be realised as a result of tariff differentiation*. The research shows that, in most communities, added costs and savings balance each other out.*

Overall, the report presents a positive picture of the impact of tariff differentiation. It is not possible to make general recommendations regarding the best strategy to follow in introducing such a system, since local conditions differ greatly among municipalities. *Given that the municipalities examined in the research were predominantly small communities, the results of the study cannot necessarily be extrapolated to larger municipalities*, where there are problems resulting from the different housing structure (e.g. high-rise buildings) and the limited opportunities for home composting.

Moreover, the introduction of tariff differentiation (i.e., the choice of a particular model and the specific features of its organisation and operation) is, in the last analysis, a question of political consideration at the local level, whereby the ultimate decision will depend on the weight given to the different effects of tariff differentiation.

3.1.2.4 Italy

The legal framework for waste management is established by the Legislative Decree n.22 dated 22 February 1997.

This framework decree has been amended and revised several times up to nowadays (Law N.426, 448, Presidential decree 158, "circolare" n.25 dated February 2000). These revisions where mostly related to the implementation of the new waste charge systems and to detail practical aspects for estimating the new waste charge.

In fact, Art.49 of decree 22 abolishes the flat-rate tax (TARSU) and introduces the possibility for applying variable rate charge based on polluter pays principle (so called "from tax to tariff").

Starting from 1st January 2004 all municipalities will have to introduce this new system.

Municipalities will introduce a fee to cover the service costs of managing municipal and similar waste, as well as other waste located on public grounds. The charge has two parts:

- a fixed portion determined by the basic components of the service, particularly investments and depreciation;
- a variable portion linked to quantity of waste produced, service provided and management costs, in order to ensure full coverage of investments and operational costs

Based on the legislative decree some municipalities have started pilot testing of the "tariff".

[1] The uncontrolled movement of waste from one regulated community to another non-regulated

It is reported that around 219 municipalities are applying the new waste tariff, corresponding to approximately 2 million inhabitants. The larger municipality where the system is applied counts of more than 200.000 inhabitants. In the province of Bolzano a total of 113 municipalities apply the tariff (300.000 inhabitants).

Table 1. Implementation patterns from a sample of 43 Municipalities

	Implementation status (N. of Municipalities)			
	Operational	**Piloting**	**Ready to start**	*Charge Design (%)*
Volume based	12	1	7	*46%*
Weight based	3	5	2	*23%*
Other factors (e.g. collection frequency)	3	1		*9%*
"Bobby Box" systems (weight based)	6	1	2	*22%*
Impl. Status (%)	*56%*	*19%*	*25%*	*100%*

Data elaborated from ANPA (2000)

From the sample analysed in table 1, the majority of the experiences are tuning the tariff according to the volume of waste collected. A good proportion of municipalities are using centralised collection points (i.e. Bobby box systems) and finally a relative minor group use weight (only in 3 municipalities the system is fully operational).

There is no indication, from the literature we were able to collect, about the effects in terms of waste reduction and prevention. Some descriptive analysis reported a considerable increase of collection of recyclable materials.

A review of application of technical solution has been carried out for a sample of 15 municipalities. Data on waste generation and collection are listed together with information on the technical solutions adopted. As for the technical solutions, also the implementation at municipal level is assessed and short statements are given on strengths and weaknesses.

3.1.2.5 Spain

Main policy documents dealing with waste in Spain is the "Urban Waste National Plan". The article 5 of the Spanish Law 10/98, the general law governing waste management, establishes that the National Government will create different National Waste Plans by "the integration of the Plans elaborated by the different Autonomous Communities". These National Plans "will define the objectives of reduction, reuse, recycling and other types of valorisation and elimination".

Law 10/98 defines urban waste as "waste generated in private households, shops, offices and service businesses as well as waste similar to that produced in the above mentioned places or activities and that is not classified as dangerous". According to this definition the Environment Ministry elaborated a Urban Waste National Plan (2000-2006) that was published in January 2000.

The general objective of the Urban Waste National Plan (UWNP) is to prevent the production of waste, to establish systems of waste management and to promote its reduction, reuse, recycling and other types of valorisation.

The Plan refers to waste charges in two of its basic principles:

- *Polluter pays principle and producer's responsibility*: The possessor or the producer of waste has to assume the costs of its environmentally correct management. According to this principle, the plan considers that the service of collection, treatment and elimination of urban waste has to be financed through taxes or similar instruments managed by the Local Authorities or, in some cases, by the Autonomous Communities as well as through the economic resources coming from the Systems for the Integrated Management of Packaging Waste.
- Discouragement of urban waste production: The plan refers to the creation of suitable economic instruments to discourage urban waste production. Those economic instruments should increase the costs for producers to an extent more than proportional to the increase of the amount of waste generated.

In accordance with its basic principles, the UWNP includes several sectoral (specific) plans: the National Prevention Programme, the National Waste Recovery and Recycling Programme, the National Packaging and Packaging Waste Programme, the National Composting Programme, the National Energy Valorisation Programme and the National Waste Elimination Programme.

The National Prevention Programme establishes that the amount of urban waste generated per head[2] should be reduced by 6% so that in 2002 the total waste production is maintained at the levels of 1996 (year of reference). Some of the actions mentioned to achieve this goal are the following:

- Pilot studies for the quantitative application of the "polluter pays principle" (in the form of taxes based on the amount of waste generated).
- Establishment of procedures and economic systems that increase the cost for excessive production of waste. The plan states that before the 31/12/2001 a model for the calculation of that kind of taxes should be approved.
- Application of economic instruments (i.e. waste taxes). The plan gives especial emphasis to the fact that waste taxes should incorporate all the real costs of a suitable waste management including those derived from the closing and restoration of landfills (as it is established at the Landfill Directive).

The *National Waste Recovery and Recycling Programme* also mentions the need for local authorities to design progressive tax systems based on the quantitative application of the "polluter pays principle". It also establishes the need to apply measures that penalize economically, in a progressive way, the disposal of materials that can be reused or recycled.

Legal framework in the Catalonia Region

The Catalan law 6/93 establishes the framework for waste management in Catalonia. According to this law, the Autonomous Government of Catalonia elaborated the Municipal Waste Management Programme for Catalonia (1995-2000) so as to define the actions needed to accomplish the law.

Some of the main objectives of the programme were the following:

- To reduce the amount and dangerousness of waste at the source, reducing at the same time the use of dangerous materials both at production level and products.
- To increase reuse, recycling and valorisation of municipal waste.
- To limit waste disposal to those wastes that cannot be valorised.

As for the organisation of selective collection, the programme foresees a three-level system according to the fractions to be collected:

[2] According to the Plan the urban waste generation in Spain is 1,2 kg/day per head.

- Curbside Area (CA): In this type of area, containers are situated within a distance of 50 m. from households (1container/200 inhabitants in urban areas). There are basically two kinds of containers in this area: containers for organic matter and containers for non-recyclable waste, although a third container for light packaging waste can be added.
- Selective Collection Area (SCA): Containers are situated within a distance of 300 m. from households. There are three kinds of containers in this area for inorganic recycable materials:

    - Blue container: Paper and board.

    - Green container: Glass.

    - Yellow container: Light packaging waste (plastic, metal).
- Green Point: Centre for the reception and storage of municipal waste that is not collected through the ordinary collection system. The programme foresees the reception of the following types of waste:

    - Special waste (Domestic hazardous waste): Medicines beyond their expiration date, fluorescents, tyres, batteries, paint, fridges and other domestic appliances with CFCs, mineral oils from households.

    - Municipal waste: Paper and board, glass, plastics, metals, wood, textiles, white goods without dangerous substances.

    - Other waste: Construction waste, green waste, bulky items.

As for economic instruments, the programme proposes the creation of several taxes: tax on waste disposed in landfills, tax on packaging waste, tax on goods that become eventually domestic dangerous waste (*batteries, fluorescent lamps*, etc).

This programme is now being reviewed and there is already a draft proposal for a new programme (2001-2006) that cannot be consulted because it has still not been approved.

Metropolitan Municipal Waste Management Programme (1996-2006)

The Catalan Law 8/1987, law for municipal procedures in Catalonia, provides that all municipalities either independently or associated, have to provide the waste collection service. The municipalities with more than 5.000 inhabitants also have to render the waste treatment service.

Detailed reporting on waste framework together with established recovery and recycling targets are included in the annexes (country reports)

Waste tax

The available studies on waste taxes only reports on a limited sample of cities. Therefore, it is not possible to generalise about the situation in Spain as a whole. The studies reviewed, in fact, highlight the need for research on a broader sample of cities. However, when it comes to waste tax design, some of the approaches reported are:

- Córdoba, Loja: The city is divided into zones (streets) defined in function of the property value of each building, the waste tax fee is calculated accordingly (separating collection and treatment).
- Pamplona: The waste tax fee is composed of a fixed fee and variable fee, which is calculated according to the situation and value of each dwelling.
- Madrid: The waste tax is integrated in the property tax.
- Sevilla, Jérez: The waste fee is calculated according to water consumption.
- Santiago de Compostela, Alcoi: They have established a fixed fee.

In the Metropolitan Area of Barcelona (MAB), each municipality is responsible for the design of the waste collection tax whereas the MAB is responsible for the waste treatment tax. The waste treatment tax is determined according to water consumption since it was considered that both water consumption and waste generation depended on

similar variables such as the real use of the houses or the number of people living in them. In this sense, if we assume that water consumption is proportional to waste production, the tax may have some characteristics near to PAYT principles. However, we cannot state that the tax is in line with the PAYT principle in the strict sense, since there is no objective measure of the waste flow.

Most of the literature reviewed is focused on assessing the real cost for waste management (mainly collection costs) in different cities throughout Spain.

One study explores the potential for PAYT systems in Spain, concluding that:

- The adoption of some environmental principles, such as the Polluter-Pays-Principle, seems not to be compatible with the most important criteria taken into account in Spain when it comes to tax design. Social and economic criteria, but not environmental criteria, are taken into consideration in tax design. Spanish municipalities, thus, seem to keep on designing taxes according to the economic capability of the taxpayer.
- The application of "environmentally efficient" taxes, such as PAYT taxes, will be difficult in Spanish cities. An enhanced social environmental consciousness is needed as well as the upgrading of the waste management services (skills and technological options).

3.1.2.6 Portugal

Based on the Law n.42/98 of August 99, municipalities may impose fees for waste collection.

Most municipalities use the general budget to finance waste management. Waste ordinances from three Portuguese municipalities where reviewed (i.e. Braga, Almada and Viana.

According to those ordinances, local waste fees in Portugal cover domestic waste collection, transport and treatment and they are determined according to water consumption.

3.1.2.7 Denmark

The legal foundation of charging waste collection fees are especially levied in section 48 of the Danish Environmental Protection Act. It is a precondition of charging fees that the comprised waste system(s) and user groups is/are described thoroughly in the municipal regulations. The fixing of the waste fees is limited to the be-in-equilibrium principle meaning that the financial means received from user payment of waste handling may neither be more nor less than the municipal costs of the system (over some years).

Thus, *the payment for collection and treatment shall correspond fairly to the costs with which the user or a group of users are straining the system in question*.

Different models of taxation are applied in Denmark from flat rate to combination of different factors like volume, weight, property, collection of hazardous material, large household items, distance to bin, etc.

A typology of different design options can be summarised as follow:

- Fixed fees for waste disposal;
- Fee based on waste amount of the property;
- Fixed fee combined with fee based on waste amount;
- Differentiated fees (e.g. separate payments for covering extra costs due to lift use, unlocking of doors, long distance from the kerb, etc.)
- Separate charges for ad-hoc services for particular products categories (e.g. garden waste);

Many Danish municipalities charge the waste collection fee as a fixed annual fee per container/sack put at the disposal of the user. If it is possible to use various container sizes, the fee is graduated accordingly, but not necessarily linearly in proportion to the container volume. If emptying takes place several times a week, the fee is multiplied by the emptying frequency.

Typically, the waste collection fee is an overall fee that, apart from the compulsory systems for environmentally hazardous waste, paper and glass packing, also covers large household items, recycling site and possible collection of garden waste which is, however, equally often an additional choice at a separate fee.

It is also a common approach not differentiating the charge between different building types. Irrespective of the fact that both household waste and large household items etc. are more cost requiring in residential neighbourhoods than in blocks of flats.

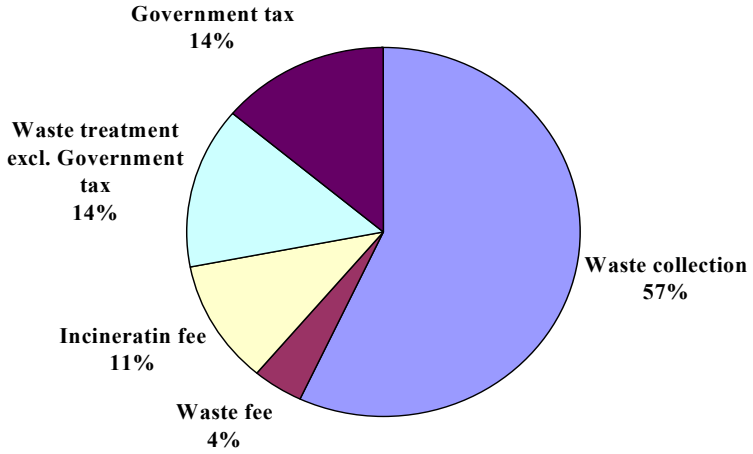
Fee charging according to weight of the collected household waste is only known of in few Danish municipalities, probably only in areas with one-family houses and farms.

<u>The charge systems in Copenhagen/Frederikshberg</u>

The aim of the building-up of R98's fee system through the years has been that the charge of any given property should reflect, as closely as possible, the costs incurred by servicing the property in question, both for collection of household waste and large household items and garden waste, recycling systems, recycling sites. *Additionally, the R98's system offers to the user the possibility of choosing themselves their own level of service.*

An overall fee is charged covering all systems that are only based, however, on the data concerning collection of household waste. By far the greater part – approx. 80% - of the fee charged is a volume fee based on the container volume at disposal for the household waste.

The total user payment of the waste and recycling systems comprises three types of fees of which the payment to R98 makes 85% (of which 14% is government taxes in connection with the waste treatment), the waste fee 4% and the incineration fee 11%.



3.1.2.8 Ireland

Policy Overview

The situation regarding waste management in Ireland has undergone significant changes in the past 10 years both in terms of policy and legislation / regulations. According to the Department of the Environment, Ireland is in a transition phase in relation to waste management moving relatively rapidly from an unsophisticated one-dimensional approach which is heavily reliant on landfill, to one which will better reflect and give effect to the waste hierarchy and polluter pays principle.

Prior to 1990 there was little legislation relating to waste management in the country, with the only significant piece of legislation being the Litter Act, 1982. Local Authorities were responsible for providing waste management services i.e. collection, transportation and disposal. Urban centres have had adequate collection systems for a number of years while rural areas have had organised collection only very recently. Disposal methods were almost exclusively to landfill. Local Authorities were responsible for issuing permits where applicable to private companies, however they were not subject to external regulation themselves.

After 1990, several factors combined to create a better waste management system in Ireland.

- The Environmental Action Programme (EAP) 1990 outlined the basic principles of waste management reforms. It advocated the preparation of waste recycling schemes by local authorities; it also supported packaging minimisation and the use of biodegradable packaging.
- The creation of the Environmental Protection Agency (EPA) in 1992 (by the EPA Act, 1992). This provided the infrastructure for the implementation of Integrated Pollution Control (IPC) Licensing, which addressed waste disposal and recovery in various industry sectors. It began to regulate and control the selection, management, operation and termination of landfill sites. Furthermore the creation of the EPA allowed for a National Waste Database to be set up.
- The National Recycling Strategy, which was published in 1994, established targets for diversion of municipal waste from landfill. This target was set at 20% of municipal waste by 1999. Significantly this document also advocated the principle of producer responsibility.
- The Waste Management Act, 1996, provided for more effective organisation of waste management infrastructure, by clearly defining roles for Local Authorities,

the EPA and the Minister for the Environment. It also provided a comprehensive regulatory framework for the application of higher environmental standards to waste management in Ireland and underpinned the principle of producer responsibility.

- Two further policy / strategy documents have had a significant bearing on waste management policies shaping a strategic framework since the Waste Management Act. These are *Sustainable Development: A Strategy for Ireland,* 1997 and *Changing Our Ways*, 1998, the policy statement published by the Minister for the Environment.

PAYT-Related Initiatives

In a review of literature based on the present waste management situation in Ireland, we identified that there are two other research projects underway in relation to PAYT principles. The first is a current project currently underway in the Economic and Social Research Institute (ESRI); based on the '*Effects of weight-based charges for solid waste services'* there is no indication as yet of when these results will be available. The second project is part funded under the EU Life Programme and is titled ANSWER – A New Solid Waste Environmental Response. The project is run by Kerry County Council and Killarney Urban District Council (UDC), and is focused on developing initiatives for environmentally sound solid waste management in Kerry. Examples of these initiatives include composting schemes, recycling schemes and an on-board weighing and identification system based in Killarney. A pilot project on this system is being initiated and chips are being fitted to bins. It will be some time before results and conclusions can be drawn from this project.

In addition to the projects described above, there are other examples of PAYT-related waste management practices. For example, "tag-a-bag" systems or other waste reduction incentive schemes, the introduction in 2001 of separate collection for recyclables in Dublin, the separate collection since 2000 of household hazardous wastes in Cork (city and county) and of compostable waste in Kerry are systems that would be useful were a PAYT scheme introduced. Again however, there are no written reports on the effectiveness of these schemes.

As stated in the OECD Environmental Performance Review of Ireland (OECD, 2000) many households pay relatively low waste charges or none at all, while charges levied on commercial generators of waste are often well below the true cost of managing their waste. Most of the documented evidence shows that charges / fees for waste collection and disposal are on a flat-fee-per-standard-volume-bin basis throughout most of the country, with little or no incentive to reduce waste (either volume and/or type) generated.

Overview of Literature Reviewed

The current waste management situation in Ireland is very dynamic and there are a number of reviews of the waste situation, policy documents, and proposals for future management strategies. Available literature relates to the situation prior to most of the PAYT-related schemes and projects quoted above. Therefore there is little documented evidence available as to the feasibility of beginning a PAYT scheme in Ireland.

Conclusion

Waste management in Ireland is going through a concerted and dynamic phase of legislative and policy development. To date there is no documented evidence of a fully elaborated PAYT (as defined by this project) in the Irish context, however, there are incremental changes that do have a bearing on the potential for PAYT system in the future. Evidence of these developments can be seen in research and at a local government pilot project level. Local Authorities have moved from not covering costs for the service provided to needing to cover costs themselves. This has led to an increased awareness among Government, Local Authority and environmental groups about the benefits of operating a PAYT system. The Polluter Pays Principle is still not evident in charging schemes operated at present. These are almost all flat rate charges per year regardless of volume or weight of waste produced. This indicates that there are changes

occurring in the country, which would increase the acceptability of a PAYT scheme, however, there are still substantial socio-cultural barriers present[3].

3.1.2.9 Greece

In Greece, solid waste charges are imposed by the flat-fee system. City councils decide and determine a fee for offered services to the public on an annual basis. Fee is charged on a square-meter basis of the serviced utilized area.

So far, Greek actors and scientists have not examined thoroughly the issues of waste avoidance and PAYT. Research is focused mainly in material recycling and recovery, packaging, calculation of waste quantities and composition, landfill siting and optimization of waste collection. Some local studies and research theses about administrative and financial management of the PCS's (which are responsible for waste collection and transportation, as well as the charging of these services) have been elaborated during the recent years.

Recently, a new area of interest in waste charges was developed. This interest was the result of new demands, as well as by the need for more transparency in public affairs, especially on MWM. Municipalities, organisations and scientists have slowly started to study PAYT and to adjust it to the Greek reality, so that its feasibility may be enhanced. The Aristotle University of Thessaloniki (AUTH) together with the Hellenic Solid Waste Management Association (HSWMA)[4] are the first actors who brought PAYT into the foreground. HSWMA is preparing the preliminary steps and activities for the further study and implementation of PAYT in Greece. Material recycling is a yet unsolved problem for Greek Municipalities. The efforts for the establishment of large-scale material recycling in Greece are unfortunately unsuccessful so far. These efforts resulted in limited effects, not because of the citizens' attitude towards recycling (which has been improved continuously during the recent years), but because of the partial inability of the actors engaged in material recycling to promote the idea and keep the program as a top public priority.

The legislative and political framework is sufficiently defined by the Greek State and the Prefectorial Self Governments (PSG). Both of them have already formulated the support basis of such programs as PAYT by setting the frame for promoting the idea of waste avoidance, material recycling and recovery. The Greek State compiled within a Common Ministerial Decision the "National Planning of Solid Waste Management", a framework which presents the general trends of solid waste management (SWM) policy and legally paves the way for the optimisation and modernisation of SWM in Greece. The PSG of Thessaloniki elaborated an analytical study on all levels of waste management within the Prefecture of Thessaloniki, which can be the guide and basis for the implementation of PAYT system. Further similar studies are performed and implemented in numerous other PSG's, all over Greece.

The Greek State, together with actors involved in environmental protection, have realised the importance of environmental education. For this reason, environmental education is provided in Greek schools within the Greek educational program, a fact that can facilitate the formulation and cultivation of recycling-oriented and PAYT-related behaviour.

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[3] Evidence for this can be seen in the responses to the first round of the stakeholder survey

[4] HSWMA, founded within the year 2000, is the national representative of Greece in the Solid Waste Management Association.

3.1.2.10Czech Republic

The main policy document establishing environmental objectives and sectoral targets is the State Environmental policy of Czech Republic (SEP CR).

The "SEP CR" is a basic, strategic, cross-sectoral document which forms the foundation for detailed programs for the individual components of the environment and for dealing with particular environmental issues. The individual programs are specific and provide details of targets, responsibilities and deadlines.

The orientation of the CR towards the European Union has increased attention on the revision of national environmental regulation at the level of objectives, ways of enforcement and investments needed. For the waste management the most important part of the strategy is strengthening investments (the ISPA Program).

The main problems associated to waste are detailed as follow:

- Unlicensed tips
- Increased waste production and disposal
- Low fraction of separated and reused waste

Among other environmental requirements on waste management, the following are of relevance in the context of PAYT systems:

- Preparing concepts of regional and national plans for waste management for consistent implementation in accordance with the requirements of the EU directives, where municipal waste is a special subgroup.
- Develop and enforce the implementation of economic instruments (payments, taxes, subsidies, etc.) to prevent waste generation and stimulate the return of waste to the production process (the "reduce-reuse-recycle" principle).
- While respecting the priorities of prevention of waste generation and re-use of packaging, ensure that system based on the obligation to take back packaging achieve concrete targets by the concrete date for example recovery of at least 35% of packaging waste, recycling of at least 15% by weight of all materials etc.

The experiences with PAYT systems are not too common and up to now very limited in scope and size. Efforts are mainly concentrated on remediation of contaminated sites, development of waste plans, cost accounting as well as organization of collection (logistics), treatment (technical solution) and safe disposal.

Awareness of the problem seems to grow amongst households; however, it is also reported that household do not participate enough to pilot programs. A pilot survey questionnaire target to a small group of households (VSE 2000), shows that economic instruments have as small influence on household behaviour.

One study reviewed in detail the experience of a variable rate charge in the city of Kladno. Two types of waste collection are used in Kladno. The *bring-to-point system* is used for recyclable materials and a *hol system (refuse collection)* is used for residual (mixed) waste.

The billing consists of two parts. The first one is fixed. This part incorporates collecting of large-scale waste, regular disposal of waste from public litters, collection of separated waste, disposal of dangerous waste. The second part is variable and it is used for collection and disposal of residual (mixed) municipal waste. The rate depends on the type of used bin and the frequency of collection. If the bin is rented, then the price is also included to the variable part.

The problems of the present (1999) system are as follows:

- Part of the citizens don't participate on the system

- The bins are also used by small companies
- Some bins are over crowded due to the lower number of paid bins
- Illegal dumping

Three possible alternative solutions within the present legal framework are mentioned. Those are payment for the bin, payment for the weight of the waste and a flat rate. The recommended one is the flat rate because it is the most advantageous for the municipality.

3.2 By PAYT related factors

3.2.1 Technical aspects

This part will concentrate mainly on technical solution to waste management and particularly on collection devices and systems; we can divide this into three main technical areas:

1) In-vehicles technologies
2) On-ground technologies
3) Identification technologies (both at in 1 and 2)

The data regarding the technologies and the related assessment of weakness and strengths are mainly based on literature from Germany and Italy.

1) In-vehicle technologies

There two main solutions for in-vehicle technologies:

- retrofitting existing vehicles;
- new vehicles with identification and weighing systems fully integrated

The main advantage for retrofitting solution is that it is possible to use existing infrastructure, however the level of the service and the potential of retrofitting technologies are strongly influenced by the type of vehicles in use. The majority of highly automated systems cannot be mounted on "aged" vehicles.

Conversely, the adoption of new vehicles with integrated weighing systems represents a significant costs in terms of investments and operational costs.

In both systems, the maintenance costs is increasing compared to traditional waste collection tracks.

The identification of the user/households is usually based on a transponder attached to the waste bin, some technical solution are using bar code labels or more sophisticated systems are using GPS.

The transponder is considered the most robust solution even if it has been reported that it can be damaged or removed by vandals. The identification of the bin through bar code labels is very sensitive to dust and scratches. Finally, the identification of the bin through GPS is complex to set-up and do not ensure a punctual identification of the user.

The advantage of the adoption of GPS systems is manly related to the possibility of real-time optimisation and adaptation of the route of the track. This system has however raised severe concerns by the workers association.

The systems using waste volume quantification are not always precise, and the some systems with weight-based quantification are very sensitive to vibration and gradient.

2) On-ground technologies

For on-ground technologies, we mean all technical solutions that are physically placed on the territory through mono or multi-material collection point.

These systems can be installed on-ground but also underground. The advantage of underground system is the relative limited or null visual impacts, but maintenance can be more complex and time consuming.

They are usually design as multi-material collection points and can manage up to 8 different materials. The user/household is identified by a magnetic card (or an electronic card with an integrated chip) that has to be inserted in the systems at the time of depositing the waste.

The waste is weighted (there are also systems based on volume of waste inserted) and the operation is recorder on the card for the accounting. Some systems also transmit the operation to a central database.

The system is usually very easy to use, it can be very highly automated and it allows an easy identification and accounting according to pay-as-you-throw.

Some of the reported weaknesses are the:

- dependency from external power systems;
- suitable only densely populated areas;
- Solution with solar cell may be damaged by vandals;
- Underground systems are very demanding in terms of work to be performed for installing and servicing

3) Identification technologies

The basic requirement for the implementation of pay-as-you-throw systems is the identification of the "polluter". There are three main technical solutions for identifying the user of the service:

- Magnetic cards
- Electronic cards (based on integrated chips)
- Bar codes

As we already mentioned each solution, have advantages and disadvantages. Bar code can be scratched, magnetic cards have limited capacity in terms of data stored and finally chip cards require proper technologies in order to be read.

The general trends are favouring the chip cards since they can store a larger amount of data. Therefore, Chip cards are suitable for "all-in-one" card solution (i.e. the same card can be used for different services at municipal or commercial level).

3.2.2 Political Aspects

All countries surveyed are explicitly mentioning the possibility (from the legal point of view) of applying pay-as-you-throw systems.

Only for the United Kingdom (that was not directly reviewed in this study), it has been reported that according to the Art.45 of the "Environmental Act" 1990 "…no charge shall be made for the collection of household waste…".

For Italy, Luxembourg and Switzerland the local authorities are obliged to collect waste.

In some countries (e.g. Denmark, France, Italy, Netherlands) national legislation is also detailing (or giving guidance) how to design and rate the level of the charge.

For the case of Germany and Belgium national legislation are complemented with regional or federal states specific regulation of waste management and procedures for application of charges.

For the latter case it is has been reported that some coordination problems have risen manly at local level.

An important factor that is often mentioned in the literature is the allocation of responsibility. A clear setting of responsibility at national and local level is required for a transparent and effective implementation of PAYT. Responsibility should also be clear at the level of monitoring, assessment and reviewing of implemented systems.

3.2.3 Economic Aspects

There are two main issues related to economic aspects that can be highlighted in the context of PAYT literature review:

Countries at an early stage of PAYT developments are mainly concerned to understand the real cost for managing waste in their communities. A large share of literature from countries like Czech Republic, Spain, Ireland, Greece are focused on assessing waste management cost and modelling systems accordingly. It also true that a precondition for a successful implementation of PAYT systems is to know the real cost for an integrated waste management.

For countries like Germany and somehow Italy, it is a matter of fact that PAYT systems implies increased costs (depending on the solution adopted) from the point of view of investments, operational costs as well as administrative costs (separate accounting systems).

However, literature has also testified that the benefits (increased share of recyclable over residual waste) seem, up to a certain level, offsetting the costs. Analyses have confirmed this tendency assuming that the cost of landfill will further increase in the near future. This is more evident in northern countries with higher landfill costs than southern countries where the costs are less incisive.

3.2.4 Social Aspects

A consistent share of literature is analysing the social dimension of waste management and Pay-as-you-throw systems. A good overview of social based investigations is provided by IOER (D).

It is commonly reported that a necessary precondition for successful up-take of PAYT systems is to provide to the user with extensive information about waste issues, PAYT systems, technical details, and specific guidance on "how to do it".

The reviewed literature revealed that several approaches were employed for promoting individual waste recycling. All approaches are aimed to affect individual recycling and disposal behaviour. Several actions were targeted to information campaigns, designing the waste bins, providing feedback, etc.

The likelihood of support for a recycling policy is significantly influenced by regular waste-recycling habits, political affiliation, family size, minority status, home ownership, and income.

In medium socio-economic residential areas, the participation at recycling programs and the quantity of collected recyclables are at the lowest level possible (Oskamp et al., 1996). High income, but not gender or age, was a good predictor of recycling behaviour (Schultz et al., 1995).

These scientific results are important but they do not allow an individual prognosis of recycling behaviour. However, they may have strong consequences for designing tailored PR-campaign and a tailored intervention programs.

A PR-campaign shall reflect the psychological knowledge about the relationships of a given information and an intended individual behaviour: (1) the information shall meet the attitudes and values and the needs of the target groups; the proposed behavioural setting shall provide (2) convenience, (3) feedback, (4) benefits and visible effects (like for example pay-as-you-throw) and (5) social exchange (Kossakowski, 1999).

All reviewed literature revealed that external conditions have direct effects on recycling behaviour. The design of the physical setting and technical solutions of the refuse disposal facilities are the key issue of every intervention program.

Schultz and colleagues (1995) have shown that situational variables like prompts, public commitment, normative influence, goal setting, removing barriers, providing rewards and feedback, produce significant increases in individual recycling behaviour.

Other authors stated that users can hardly be convinced to show better recycling behaviour. Neither awareness of consequences of recycling, nor perceived personal costs had a significant direct effect on recycling behaviour

Several studies have shown, that the design of the apartment buildings is a good predictor of better recycling behaviour. Additionally, the individual waste disposal behaviour at the collection site should be visible for others to allow social control.

The usual labelling of the bins with different colours coding the different types of waste doesn't provide a useful behavioural setting. Additional wording or illustration will be more useful. Another barrier in "soft factors" for recycling behaviour was identified in the design of the litter boxes for use in kitchen. The common design clashes with the individual need for life-style and/or cosiness.

4 Conclusions

4.1 Observed strengths and weaknesses of PAYT systems

The situation on pay-as-you-throw systems has evolved very much as compared to the beginning of the 80's. We have slowly moved from theoretical analysis on economic instruments advocating "a priori" advantages of market based instruments as compared to traditional instruments to empirical analysis detailing efficiency and effectiveness of such approaches.

For countries like Germany, Sweden, Austria, Finland, the Netherlands PAYT is a common reality, these systems are widely diffuse and in a stable increase.

In Countries like Italy, Belgium and Ireland, the application of PAYT systems is rapidly evolving also due to the revision national policy programs (i.e. Italy)

For countries like France, Spain, Greece and Czech Republic the situation is evolving at lower speed. Nevertheless, it is encouraging the fact that, in these countries, new policy programs and actions have been proposed or are planned in the near future.

According to the literature, the main strengths of PAYT can be summarised as follow:

- Fairer allocation of costs to the communities/users (depending on the design);
- Ensure transparency of waste management financing;
- Effective in reducing residual waste (15 to 90% reduction);
- Increase sorting and collection of recyclable;
- Encourages individual composting

On the other hand, literature has also highlighted the following weaknesses:

- Illegal dumping (waste burned or left in open grounds)
- Waste tourism (waste moved to nearby uncontrolled communities)
- Increased cost (both investment and operational costs);
- Increased amounts of contaminants into recyclable materials collected (Germany);

4.2 Data gaps and needs

- It is often reported that illegal dumping of waste and waste tourism are the main barriers to PAYT systems. However, empirical data proving the degree of significance of such behaviour is not definitive. For example, some studies have reported that only 3 to 10% of waste is re-routed illegally.
- Recent analysis of PAYT in the US (pioneers in the application of PAYT systems from the early 70's) have shown the potential of PAYT in reducing waste to landfill (16-17% decrease), to increase recycling (up to 50%) and also reduction at source (5-7%). Available data at European level is contradictory and less conclusive about the above-mentioned effects. Further elaboration to this point is needed.

- There are also contradictory results related to the degree of increased costs due to implementation of PAYT systems. Some studies reported that overall, the total waste management costs increased even if the costs of treatment of residual waste have been reduced. Other analyses demonstrate that benefits are offsetting and/or neutralising costs. Further elaboration on this point is need.
- No definitive relationship between societal factors (age, income, etc.) and attitudes towards recycling/PAYT can be extrapolated from the literature reviewed. Moreover, some of the literature seems contradicting others. These behavioural inconsistencies seem to suggest the need for a "case-by-case approach" when planning the introduction of variable rate pricing. Further analysis is needed.

4.3 Follow–up activities