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Exploring the public views concerning the introduction of “Pay-As-You-Throw” waste management systems in Greece

Maria Kevrekidou

SCHOOL OF ECONOMICS, BUSINESS ADMINISTRATION & LEGAL STUDIES

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Student Name: Maria Kevrekidou
SID: 1105130014
Supervisor: Dr. Iosif Botetzagias

I hereby declare that the work submitted is mine and that where I have made use of another's work, I have attributed the source(s) according to the Regulations set in the Student's Handbook.

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Thessaloniki - Greece

Abstract

This dissertation was written as part of the MSc in Sustainable Development at the International Hellenic University.

“Pay-As-You-Throw” waste management systems have long been implemented by various communities globally as a means to effectively inspire waste prevention and enhance waste diversion and recycling. While waste generation in Greece is constantly rising, the current legal framework, on the one hand, still requires the application of a flat-rate waste management system and, on the other hand, binds the country to specific quantitative targets and timeframes for the alternative management of municipal waste. The present thesis considers it’s timely to identify individuals’ perceptions as well as possible factors influencing public reception of three versions of the alternative waste management system prior to their implementation in Greece. Furthermore, the current study aims to investigate individuals’ opinion about the effective treatment of phenomena of illegal waste dumping, once a PAYT is in place. The PAYT alternatives included in the study were a) the volume-based bag program, b) the punch card weight-based system and c) the weight-based bin per property scheme. Study results reveal a wide public acceptance of the introduced waste management program but low levels of trust both towards municipalities for the effective implementation of any of the three PAYT versions and towards fellow citizens for adhering to the operating rules of the alternative waste management system. Several factors influencing individuals’ acceptance of “Pay-As-You-Throw” waste management systems have been identified and citizens’ views on how to effectively safeguard the operation of the introduced alternative system have been recorded, thus providing competent authorities with valuable information for a meticulous planning of the program prior to its actual implementation.

Keywords: Pay-As-You-Throw (PAYT), Sustainable waste management, Economic instrument, Public perception

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Contents

Abstract.....	- 2 -
Acknowledgments.....	- 3 -
Contents.....	- 4 -
List of Tables.....	- 5 -
List of Figures.....	- 5 -
Introduction.....	- 6 -
1 “Pay as you throw” schemes.....	- 12 -
1.1 PAYT scheme variations.....	- 13 -
1.2 PAYT assessment.....	- 14 -
1.3 PAYT strengths.....	- 18 -
1.4 PAYT weaknesses.....	- 19 -
1.5 Prerequisites and motivators for PAYT implementation.....	- 23 -
2 Methods.....	- 27 -
2.1 Description of research.....	- 27 -
2.2 Research design.....	- 28 -
3 Results.....	- 32 -
3.1 Perceptions regarding the proposed policy.....	- 32 -
3.2 Perceptions on municipal authorities’ effectiveness.....	- 33 -
3.3 Perceptions on the behavior of fellow citizens.....	- 35 -
3.4 Perceptions regarding interviewees’ own behavior.....	- 36 -
3.5 Correlations.....	- 37 -
3.6 Principal components analysis.....	- 41 -
3.7 Associations.....	- 46 -
Discussion and Conclusions.....	- 48 -
References.....	- 53 -
Appendix.....	- 61 -

List of Tables

Table 1 Spearman's rank-order correlation results and corresponding significance levels	- 38 -
Table 2 Spearman's rank-order correlation results and corresponding significance levels	- 39 -
Table 3 Spearman's rank-order correlation results and corresponding significance levels	- 40 -
Table 4 Spearman's rank-order correlation results and corresponding significance levels	- 41 -
Table 5 Rotated Component Matrix(a) for volume-based bag PAYT scheme	- 42 -
Table 6 Rotated Component Matrix(a) for punch-card weight-based PAYT scheme	- 43 -
Table 7 Rotated Component Matrix(a) on weight-based bin-per-property PAYT scheme.....	- 44 -
Table 8 Rotated Component Matrix(a) – Comparative presentation of PCA results	- 46 -
Table 9 Sample and general Greek population's demographic characteristics in percentages ...	- 61 -

List of Figures

Figure 1 Acceptance of "PAYT"	- 32 -
Figure 2 Agreement with "PAYT" implementation	- 32 -
Figure 3 Ranking of "PAYT" alternatives	- 33 -
Figure 4 Levels of trust towards municipality	- 34 -
Figure 5 Effective treatment of illegal waste dumping.....	- 35 -
Figure 6 Compliance of fellow citizens.....	- 36 -
Figure 7 Interviewees' own behavior vs system offenders.....	- 37 -

Introduction

Waste constitutes currently both a multidimensional challenge and a considerable opportunity for Europe. The environmental dimension of the problem relates to the issue of the unsustainable exploitation of natural resources as well as the pollution caused by waste itself and by applied waste management processes (Bilitewski, 2008; COMMISSION OF THE EUROPEAN COMMUNITIES, 2005). Substandard waste treatment has an adverse effect on the urban environment (Bilitewski, 2008) and the illegal exportation of waste to third countries poses a serious social issue (EUROPEAN COMMISSION, 2011a, 2012). The economic implications of waste are equally significant. Over the past decades, continuously growing waste volumes and a generalized tendency to internalize waste treatment-related externalities have led to increased waste management costs (COMMISSION OF THE EUROPEAN COMMUNITIES, 2005; Karagiannidis et al., 2008). At the same time, Europe has been successfully moving up the waste hierarchy when dealing with its escalating waste production. The resource recovery industry has created numerous business opportunities and has set the ground for the resource sufficiency of Europe's manufacturing industry (COMMISSION OF THE EUROPEAN COMMUNITIES, 2005).

According to Eurostat, between 1995 and 2014 the municipal waste generation and waste management processes and results differ remarkably among the EU member states (Eurostat, 2016b). Municipal waste generation within the EU-27 stood at 473kg/capita in 1995, increased to 513kg/capita in 2004 and decreased again to 475kg/capita in 2014. In 1995, 64% of the EU's produced municipal waste was landfilled (the rest being incinerated and recycled). By 2004 47% of municipal waste was landfilled, and this percentage dropped even further to 28% in 2014 (Ibid., p. 7). Nevertheless, if waste prevention efforts are not enhanced, total waste production within the European Union is estimated to grow by 7% from 2008 to 2020 (EUROPEAN COMMISSION, 2011a).

The European Community's Thematic Strategy on the Prevention and Recycling of Waste aspires to *"move the EU decisively onto the path of becoming an economically and environmentally efficient recycling society"* (COMMISSION OF THE EUROPEAN COMMUNITIES, 2005, p. 6) while, according to the European Commission (2011b), by 2020, waste should be treated as a resource. In order to reach these goals, member states are encouraged to adopt a series of measures and economic instruments (EIs) that promote waste prevention and enhance re-use, recycling and waste recovery (COMMISSION OF THE EUROPEAN COMMUNITIES, 2005). Numerous EIs, with different impacts on waste management outcomes, are currently being implemented by EU member states, including landfill and incineration taxes and fees as well as "Pay-as-you-throw" and "Producer responsibility" schemes (EUROPEAN COMMISSION, 2012).

Different waste treatment related challenges and policy objectives may lead municipalities to the adoption of unit-pricing waste management schemes, such as Pay-As-You-Throw (PAYT). PAYT programs support waste prevention, enhance recycling and assist communities in regulating issues of increased waste production, landfill saturation and growing final disposal costs. Their implementation also addresses the growing public demand for more effective waste treatment services and specific waste management requirements defined by local or national legislation (Miranda et al., 1996). By 2012, 17 European Union member states had introduced some version of unit-pricing programs for the management of their municipal waste (EUROPEAN COMMISSION, 2012).

Despite Greece's growing per capita municipal waste production (from 436kg/capita in 2004 to 506kg/capita in 2012) (Eurostat, 2016a), waste charges in the country are still based on a flat-rate system while, until recently, the legal framework actually prohibited the implementation of unit-pricing waste management schemes (Royal Degree 24-9/20-10-58; Mandatory Law 25/21-04-1975, Law 1828/3-01-89). Nevertheless, with relevant EU provisions transposed into Greek law, the recently ratified National Waste Management Plan and National Strategic Waste Prevention Plan underline the potential of economic instruments, PAYT schemes included, in enhancing the effectiveness of municipal waste management systems (Joint Ministerial Decision

51373/4684/15-FEK 2706/B/15-12-2015, Cabinet Act 49/15-12-2015 FEK 174/A/15-12-15).

Mandatory Law 25/1975 sets the framework for the calculation and collection of Greek municipal waste fees. According to its article 1, for every property equipped with an electricity supply meter, municipal waste fees are calculated by multiplying the property's surface with a coefficient which may vary annually following a decision of the local council. The City Council is allowed to define up to 7 coefficients, each corresponding to distinct service-consuming groups, which benefit from a different waste treatment service. Article 4 of Mandatory Law 25/1975, as amended by article 43 of Law 3979/11, states that waste fees are borne by the individual liable to pay the electricity bill of the particular property. Municipal waste fees and private electricity charges are collected as an indivisible sum by the electricity provider which hands over the former amount to the municipality after subtracting a two percent commission fee. The electricity provider proceeds with cutting the power supply if a customer denies paying the municipal fees - and notifies the municipality accordingly (article 6 of Mandatory Law 25/1975, as amended by article 43 of Law 3979/11). Properties lacking electricity installation had not been exempt from municipal waste and street lighting fees (article 3 of Mandatory Law 25/1975) until recently, when Law 3345/05 (article 5) postulated that, properties remaining unused, (as certified by their owners), and without electricity, (as certified by the electricity provider) will be exempted from waste charges.

The current legislative framework establishes a flat rate system for the calculation of Municipal Solid Waste Management charges and clearly prohibits the implementation of PAYT programs by Greek municipalities. Since waste-related fees are proportionate to the property surface area, there is obviously no connection between waste produced and charges attributed. The existing system is designed to financially sustain itself but has a low potential in addressing the challenges of constantly increasing waste production and raising waste management costs since it fails to provide any incentive to its users for waste reduction and diversion. In Greece, waste charges have depended on the level of service provided to citizens by their municipality and not on the level of service actually

consumed by every household. Nevertheless, latest legislation allows for municipalities to develop their own collecting mechanism for waste management fees which is an important prerequisite when adopting unit-pricing schemes.

In 2010, Law 3854/10 (FEK 94/A/23-6-2010) introduced some important changes as far as the tipping fees of municipal waste are concerned. As defined in article 9, annual tipping fees for every municipality, are proportionate to the corresponding amount of solid waste entering the landfill serving the particular Municipality, including residues from Recycling Facilities. Gate fees (€/tone) reflect the cost of service provided to municipalities. Temporary 2016 gate fees amount to 22,3042989€/ton of waste for the 66 member municipalities of the Solid Waste Management Organization of the Prefecture of Attica. Definitive 2016 rates will be defined after 31/12/16, once data on actual solid waste amounts entering the facilities of the Organization and real operating costs of the latter will be available (The Solid Waste Management Organization of the Prefecture of Attica, 2016). The Regional Association of Municipal Solid Waste Management Bodies of Central Macedonia has defined different tipping fees for its 38 member municipalities for the year 2016. Indicatively, rates for the municipalities of Thessaloniki and Kalamaria amount to 22€/ton of waste delivered to the Organization (The Regional Association of Municipal Solid Waste Management Bodies of Central Macedonia, 2015). The cost of these annual tipping fees is (to be) met by the revenue from municipal waste management charges, described earlier (article 9 of Law 3854/10, as amended by article 28 of Law 4315/14 – FEK 269/A/24-12-14). In order to compensate municipalities where landfill sites operate, and particularly to mitigate related environmental impacts, additional countervailing fees may be imposed to municipalities served by a particular landfill (article 9 of Law 3854/10, as amended by article 17 of Law 4164/13 – FEK 156/A/9-7-13). According to article 12 of Joint Ministerial Decision H.P./29407/3508/02 (FEK B/1572/16-12-02) tipping fees should incorporate construction, operation, decommissioning and reconstruction costs of landfill areas. Aftercare of reconstructed landfills should cover a time period of minimum 30 years. Article 43 of Law 4042/12 (FEK 24/A/13-2-2012), defines the categories of municipal waste that, if land-filled, without

prior being subjected to specific processing, determined by the same provisions, will be charged with an extra fee per ton for final disposal (equal to 35€/ton for the year 2014). The special land filling fee will rise annually by 5€ until it reaches the amount of 60€/ton. The implementation of the provisions of article 43 have been postponed until the 31/12/16 (paragraph 2 of article 77 of Law 4257/14, FEK 93/A/14-4-14 and article 7 of Legislative Act 24/24-12-15, FEK 182/A/24-12-15). Municipalities will also have to bear any penalties imposed to the Greek Republic as a result of inadequate implementation of European legal provisions regarding waste management, proportionately to their liability (Article 44 of Law 4042/12 - FEK 24/A/13-2-2012).

Law 3854/10, for the first time in Greece, links tipping fees to actual costs related to landfill operation and to actual amounts of waste brought by municipalities to landfills. These changes translate to an increase of municipal waste management costs for Greek municipalities and consequently to increased waste management fees for citizens. Municipalities need to consider ways to address the emerging reality and PAYT schemes constitute economic instruments with the potential to offset that reality by reducing waste production, increasing waste diversion and decreasing residues for final disposal.

The adoption of unit-pricing waste management schemes by municipalities around the globe has proven the effectiveness of the particular economic instrument towards waste prevention and enhanced waste diversion and recycling. Public acceptability of the program has been identified as one of the determinant factors of its successful implementation. Thus, now that Greece has introduced legislative changes which, on the one hand, set specific quantitative targets and timeframes for the alternative management of municipal waste within Greece and, on the other hand, push towards the realistic illustration of waste management costs in municipal waste charges, it seems timely to investigate the Greek public's reception of different PAYT systems.

This thesis is structured as follows. The first part provides a review of existing literature on unit-pricing waste management program implementation. The second part analyzes methodological issues regarding the research area, questionnaire design and distribution as well as sample selection. Data analysis and study results are presented in

the third part of the thesis while the fourth part discusses the findings and summarizes the main conclusions of the paper.

1 “Pay as you throw” schemes

“Pay as you throw” (PAYT) programs charge waste producers proportionately to the amount of waste treatment service they choose to consume. PAYT systems, also known as “user-pay”, “unit-pricing”, “variable-rate pricing” or “differentiated tariffs schemes”, provide households with the possibility to reduce their waste bills by controlling the amount of residues they set out for collection (Bilitewski, 2008; Skumatz, 2008). The shift from a flat rate to a unit pricing model constitutes a transition from a taxed-based to a service-based waste management system in which citizens contribute to system costs according to service consumption (Elia et al., 2015).

Unit-pricing waste management and charging schemes are structured around the Polluter Pays Principle (PPP), which is incorporated in the European waste policy. According to the PPP, the cost of waste disposal must be borne by the waste producer (Article 15, EEC directive 15/442/EEC. European Council, 1975, 1991, 1996, 2003). By ensuring revenues capable of covering waste management costs, fixed waste charges only manage to fulfill their fiscal role. User-pay systems on the other hand assume additional motivational and informative functions. Since PAYT programs link waste charges to waste production, households are given the motive to adapt their behavior. Moreover, fluctuating charges inform system users about the conditions surrounding the service provision. In the case of waste management, escalating fees may reflect limitations linked to landfill sites, incineration structures, administrative shortcomings (Slavik and Pavel, 2013) or the existence of external costs (OECD, 2004).

User-pay waste management schemes are implemented in various forms and combinations by different municipalities globally. Some of these PAYT alternatives are presented below.

1.1 PAYT scheme variations

There is no “one-fits all” unit-pricing waste management program (Sakai et al., 2008) and different versions of PAYT programs are currently implemented by numerous communities, particularly across Europe (Reichenbach, 2008) and North America (Skumatz, 2008). According to Skumatz and Freeman (2006), in 2006, almost 7.100 U.S. jurisdictions, with different population size and urban characteristics, applied unit-pricing waste management schemes, making the program available to one fourth of the country’s population. San Francisco has been implementing a user-pay waste management system since 1932 (The Cornell Waste Management Institute, 2001). In 2005, 193 Dutch municipalities (31% out of the total number) were implementing some form of user-pay waste management system (Dijkgraaf and Gradus, 2009), while Switzerland and Luxembourg have switched to PAYT schemes throughout their territory (Reichenbach, 2008).

PAYT scheme variations allow municipalities to adopt the type that best addresses local particularities, thus strengthening the possibility for a successful implementation of the program. In, so called, “*can programs*”, households subscribe for a certain number or volume of waste containers and in some cases also state the desired frequency of waste collection (e.g. once every week or every two weeks) (Dahlén and Lagerkvist, 2010; Skumatz, 2008). “Can programs” are not complex to manage and result in efficient waste collection, since households tend to put out only full bins (Le Bozec, 2008). On the other hand, “*bag programs*” oblige waste producers to purchase special bags and exclusively use those for waste disposal. The selling price of those bags may incorporate the total cost of waste treatment or just its variable part. “*Tag or sticker programs*” are a variation of bag programs where ordinary bags are marked with distinctive tags or stickers to signal that waste can be collected. “*Weight based*” systems require the identification of the polluter, the calculation of the produced waste and the attribution of waste treatment charges to the appropriate household. The process becomes feasible through the use of constantly evolving, reliable technologies. “*Hybrid*” systems may take two forms. In one instance, fixed bill systems are paired with some version of the PAYT system. A limited

only amount of service is provided for the fixed charge while excess service adheres to the rules of the particular user-pay program applied in the particular case. In the second instance, different PAYT types are applied simultaneously (Dahlén and Lagerkvist, 2010; Skumatz, 2008). “Chamber or punch card systems” restrict access to containers only to registered system users. In this case, waste is inserted through special feeding chutes that assess the waste’s weight or volume. The identification of system users and the attribution of the corresponding fee is enabled by the use of direct payment smart cards or transponder keys (Reichenbach, 2008; www.payt.gr).

1.2 PAYT assessment

PAYT implementation outcomes may be assessed against various criteria. Karagiannidis et al. (2008, p. 2802) refer to “the proportion of commingled waste to be recycled, the annual aggregate waste management cost (C_T), as well as the participation rate of citizens”. The presence of an integrated infrastructure for the collection of recyclables (van Beukering et al., 2009) and the operation of adequate and user friendly recycling programs (Reichenbach, 2008) will certainly positively influence the performance of the PAYT program. PAYT schemes, through the promotion of the waste management hierarchy (reduce, reuse, recycle and recover), are effective instruments towards the establishment of zero-waste communities (Sakai et al., 2008). The implementation of a unit-pricing waste management system is a balancing act between providing a stimulus that will trigger the desired behavioral change (i.e. waste reduction at source and waste diversion) and ensuring revenues that will cover service provision costs (Dunne et al., 2008). The lack of homogeneous and thus comparable data related to waste collection hinders the assessment of real PAYT outcomes. The development of consistent methodologies and key indicators to measure, report and compare waste production and composition will allow the realization of more refined and reliable PAYT assessments (Dahlén and Lagerkvist, 2010). Furthermore, accurate data are an essential component in effective policy design (Dunne et al., 2008). Like for all economic instruments used in environmental policy, well informed actors about pollution control alternatives and

related costs, as well as free market conditions constitute key prerequisites for the expected performance similarly for variable-rate charges in waste management. Economic waste management instruments should be assessed not only according to their impact on waste reduction and diversion but also by their influence on secondary policy objectives. PAYT schemes should ideally be applied simultaneously with other economic instruments towards the achievement of particular environmental goals (van Beukering et al., 2009).

The assessment of PAYT impacts becomes difficult since the scheme is never applied in isolation but parallel to other programs (e.g. recycling, green spots, composting) and initiatives (e.g. awareness campaigns, education projects) (Dahlén and Lagerkvist, 2010; Skumatz, 2008; Slavik and Pavel, 2013) and individual behavior is shaped by a variety of both monetary and non-monetary parameters (Slavik and Pavel, 2013).

It has been empirically proven that the implementation of variable-rate pricing schemes leads both to an increase of waste diversion and to an overall reduction of municipal solid waste generation (Reichenbach, 2008; Skumatz and Freeman, 2006). A series of studies performed by Skumatz (2008), involving a significant sample of US communities, indicate that PAYT programs divert circa 17% (in weight) of residential Municipal Solid Waste (MSW) from land filling due to increased recycling (5-6%), composting (4-5%) and enhanced source reduction initiatives(6%). Variable charges have proven their environmental effectiveness, especially when compared to fixed fees (Slavik and Pavel, 2013). Similarly, a survey among Czech municipalities proved that those implementing PAYT not only present lower amounts of waste for final disposal through a proportionate increase of waste separation but indeed limit total waste volume production compared to municipalities without PAYT. These differences are statistically significant but actually reflect small variations in total, separated and residue waste amounts among the two groups of surveyed municipalities. The same survey concluded that waste separation by Czech households was mostly influenced by technical and social conditions and barely by the applied waste charging system (Sauer et al., 2008). Reduced amounts of waste reaching landfills maybe due to changed consumer behavior, as individuals, due to PAYT schemes, make efforts to buy in bulk or choose goods with more

environmental friendly packaging (Dijkgraaf and Gradus, 2004; Dunne et al., 2008). Another research conducted among Swedish municipalities confirmed that in communities applying weight-based waste management systems individuals produced on average 20% *less* waste annually compared to individuals in any other municipality without weight-based PAYT. As the phenomenon could not be attributed to increased amounts of recyclables possible explanations could be the adoption of less waste producing life styles and the disposal of waste outside the official waste management system in those communities (Dahlén and Lagerkvist, 2010). During the short implementation of a bag-based unit-pricing system for residential waste in the small Spanish town of Torrelles de Llobregat, overall recycling increased impressively in quantity (from 41% to 83%) and quality, and waste prevention was estimated to represent 2% of total waste production (Puig-Ventosa, 2008). In a somewhat similar outcome, increased recycling and decreased residues production in Japan can be attributed to a combined implementation of different environmental policy instruments, PAYT and recycling programs being among them (Sakai et al., 2008).

Any research regarding unit-pricing system impacts has to isolate the effects of environmental activism on waste production and diversion. Environmental activism refers to environmentally friendly behaviors stimulated by systemic conditions (e.g. high municipal waste charges) (Dijkgraaf and Gradus, 2009). Already before the introduction of PAYT programs, “green” municipalities in the Netherlands presented lower levels of total waste production by 6% compared to less environmental friendly communities (Ibid., p. 16). As proven by Dijkgraaf and Gradus (2009), even after subtracting the environmental activism effect, weight and bag based user-pay schemes’ contribution to total waste reduction remains significant.

Because of low evidence for the presence of a learning effect on the one hand and of almost total lack of evidence for the existence of an awareness erosion effect on the other hand, Dijkgraaf and Gradus (2009) conclude that the PAYT impacts remain unaffected over time and this is extremely positive for the environment. Linderhof et al., (2001) studied the implementation of a weight-based unit pricing scheme in Oostzaan,

Netherlands. They found that, one year after its introduction, the PAYT program had led to a decrease of 30% in waste production per household while there was also an increase in recycled glass by 36% and in tin by 600%. More interestingly, long-run price elasticities for compostable and non-recyclable waste were found to be 30% higher than short-run elasticities, meaning that the effects brought about by the PAYT scheme are long lasting.

Van Beukering et al., (2009) have concluded that a wider implementation of variable-pricing programs among Dutch municipalities would result in further reductions in total and residue waste production. They also found that a more generalized application of PAYT schemes in the Netherlands would affect positively certain environmental impact indicators (e.g. human toxicity and smog formation) and negatively a number of others (e.g. primary energy resources and climate change, due to increased use of primary energy sources instead of waste as an energy source).

Changes in waste management costs attributable to the switch from a fixed-rate to a user-pay system have to be certainly estimated (Skumatz, 2008). Although PAYT systems may require administrative and personnel changes, machinery and equipment acquisition, research has shown that *“household costs for monthly garbage service were not significantly higher for PAYT communities compared to non-PAYT communities”* (Skumatz, 2008, p. 2782), probably also because municipalities are careful in choosing a PAYT type that takes full advantage of the existing waste management system rather than a type that requires radical changes (Skumatz, 2008). Linderhof et al., (2001) found that the implementation of a weight-based pricing system in Oostzaan did not result in higher net monetary costs compared to the previous flat-rate charging system. Higher collection, monitoring and administrative costs, resulting from the PAYT introduction, were balanced by lower waste treatment costs due to reduced total waste production. Economies of scale lower waste management costs in municipalities where household participation in waste collection systems is obligatory (Skumatz and Freeman, 2006) while it is also due to economies of scale that *“larger municipalities have lower per-capita administrative costs on average”* (Slavik and Pavel, 2013, p. 73). Weight-based systems present higher administrative costs compared to other PAYT versions (Dijkgraaf and Gradus, 2009) and

higher initial investment costs (Dunne et al., 2008). Single user weight-based systems are the most expensive ones (Elia et al., 2015). Collection cost comprises a significant part of total waste management cost due to high expenses related to waste-truck itineraries (The Cornell Waste Management Institute, 2001).

The subsection below highlights some of the advantages of user-pay waste management programs already documented during actual program implementation in various municipalities around the world.

1.3 PAYT strengths

PAYT programs have significant strengths. Particularly when compared to fixed rate systems, where small and large waste producers are treated in a standard manner, user-pay systems are perceived as more fair, since households are charged proportionately to the amount of waste they set out for collection. By linking waste charges to waste generation, PAYT programs create an economic incentive capable to alter behavior related to waste production (Batllell and Hanf, 2008; Le Bozec, 2008; Skumatz and Freeman, 2006; The Cornell Waste Management Institute, 2001). Furthermore, user-pay systems rationalize waste treatment service consumption by community members, reducing incidents of service overuse. Regardless of demographic and urban characteristics and no matter the current waste management system, communities can quickly switch to PAYT schemes. The latter do not only encourage recycling and composting but also reuse (Skumatz and Freeman, 2006) and source reduction, the most environmentally and financially beneficial waste management strategy (Skumatz, 2008). Recycling is encouraged more by the implementation of a PAYT program than by alterations to recycling programs themselves (e.g. adding recycling streams, increasing collection frequency, creating green spots) (Skumatz and Freeman, op. cit. p. 18). Communities may see a decrease in waste management costs in the long run due to increased diversion from landfills, effective use of existing structures and higher revenues from secondary markets of recyclables (Skumatz and Freeman, 2006). The positive effects on the environment due to reduced natural resources use, reuse of materials and increased

recycling, attributable to PAYT implementation, are not to be neglected (Skumatz and Freeman, 2006). Consequently user-pay schemes lead to energy conservation and to reduced greenhouse gases (GHG) emissions (Skumatz and Freeman, 2006; US EPA, 2002), thus contributing to global climate change mitigation efforts (The Cornell Waste Management Institute, 2001). PAYT programs ultimately stimulate the economy through job creation due to the increased need in labor intensive recycling treatment services (COMMISSION OF THE EUROPEAN COMMUNITIES, 2005; US EPA, 2002). Unit-pricing schemes have the capacity to enhance transparency regarding the financing sources of the waste management system (Puig-Ventosa, 2008). Weight-based waste management programs generate high quality waste production data, which may assist the design and implementation of relevant municipal efforts (Dunne et al., 2008).

Nevertheless, PAYT schemes have also certain drawbacks as presented in the following subsection.

1.4 PAYT weaknesses

Obviously PAYT systems are not unflawed and several concerns relate to their implementation. Numerous communities are reluctant to adopt user-pay systems in fear of a serious increase in illegal dumping incidents (Karagiannidis et al., 2008; Reichenbach, 2008; Skumatz, 2008). Research has proven that illegal dumping increased occasionally (Le Bozec, 2008; Reichenbach, 2008; Skumatz, 2008), only to subside shortly after the PAYT implementation (Le Bozec, 2008; Skumatz, 2008). The phenomenon can be dealt with efficiently with timely and transparent enforcement of relevant legislative provisions (Skumatz, 2008), though monitoring and enforcement needs will most probably generate additional costs (Karagiannidis et al., 2008; Skumatz and Freeman, 2006) which may occasionally exceed benefits linked to the particular economical instrument implementation (van Beukering et al., 2009). Increased awareness and availability of reporting mechanisms, which come along with a switch to a PAYT program, may lead to an increase of illegal dumping *reporting*, although the actual number of incidents may not necessarily have increased likewise (Dunne et al., 2008). Dijkgraaf and Gradus, (2004) have

concluded that, in the Netherlands, “waste tourism” (from municipalities implementing PAYT to communities without PAYT) is a weak phenomenon. Appropriate information campaigns are likely to contribute to limiting incidents of adverse system user conduct (Dunne et al., 2008; Reichenbach, 2008).

Waste management constitutes a long known challenge to local authorities, with numerous municipalities stating their reluctance to abandon old but tested management and charging schemes in favor of PAYT programs (The Cornell Waste Management Institute, 2001). According to Skumatz and Freeman (2006, p.16) *“getting PAYT programs approved is often harder than designing and running the actual system. City councils are sensitive to concerns about not fixing things that are not broken”*. Political concern over the impact of PAYT systems on low income households and large families is regularly voiced. PAYT systems are designed to reward waste reduction and its inherent economic incentive applies to all system participants, large families included. Furthermore the system can be adjusted to incorporate provisions for low income households and other vulnerable social groups (Skumatz, 2008). According to Dunne et al. (2008) the incorporation of waivers during a PAYT scheme application enhances user acceptability but at the same time increases the possibility of neighboring waste being improperly dropped off in cans belonging to households benefitting from this social measure.

Probably the most serious concern related to PAYT programs, particularly during the early phases of their implementation, is the rate setting (Reichenbach, 2008). Because waste production is expected to decrease, in an unknown way, once the program is adopted, rates have to be thoughtfully designed in order to cover fixed system costs (Le Bozec, 2008; Skumatz, 2008; The Cornell Waste Management Institute, 2001). Rate differentials must be high enough to stimulate waste reduction but not too aggressive since they may lead to revenue uncertainties (Skumatz, 2008; The Cornell Waste Management Institute, 2001). Research has shown that rate differentials of up to 80% for double the service induced the desired results (Skumatz, 2008). In early implementation stages, budgetary deficits can be attributed both to reduced collected waste fees due to

behavioral change that led to decreased waste production but also to a slower adoption of the system to lower expenditure needs (Le Bozec, 2008).

Bilitewski (2008) describes the different waste charging policies that may be adopted depending on the political and social agenda of competent authorities. Charging systems that bill each waste unit with the same price are characterized as linear (or neutral). These systems seem to be more comprehensible by citizens, are perceived as fairer, and thus more acceptable by the public, while they are also easier to administer. In digressive (or passive) charging systems every additional waste unit is charged with a price lower than the amount paid for the immediately preceding one. These systems reflect more realistically the marginal cost incurred by the waste management system for the treatment of each additional waste unit. On the contrary, progressive (or active) charging mechanisms tend to penalize large waste producers, since every additional unit of waste has an increased price compared to the previous unit (Ibid., p. 21).

The adoption of a fully variable charging system (one-component scheme) certainly leads to better results regarding total waste reduction and waste diversion but unfortunately increases the risk of individuals circumventing the PAYT system (e.g. illegal dumping, backyard incineration, waste stumping) (Puig-Ventosa, 2008; Reichenbach, 2008). On the other hand, a two-tiered charging system, comprising of a fixed and a variable part, although administratively more demanding, allows for cost differences, related to particularities during PAYT implementation in heterogeneous urban environments, to be taken into consideration (Batllell and Hanf, 2008). The fixed part of user pay charges guarantees certain revenue stability (Le Bozec, 2008; Puig-Ventosa, 2008; The Cornell Waste Management Institute, 2001) and smoothens the transition from a flat to a variable-pricing system (Puig-Ventosa, 2008). It has to be kept though at the minimum level in order not to negate citizens' incentive towards waste reduction and separation (Karagiannidis et al., 2008). Limit –based waste billing systems charge a standard amount for a predefined level of service. Any additional service provision has additional costs for the system user (Bilitewski, 2008).

In two-tiered charging systems the fixed part is unrelated to the amount of produced waste. It comprises of initial investment costs, administrative costs and expenses realized in order to educate and inform system users (Karagiannidis et al., 2008). The fixed fee component represents system installation costs and thus corresponds to the possibility of using the system and not necessarily to actual service provision. Thus owners of empty buildings are not to be exempt from fixed waste charges (Bilitewski, 2008). It may also reflect recycling and supervision expenses as well as landfill closure costs (The Cornell Waste Management Institute, 2001). It may apply uniformly to all system users or there may be different fixed fees for different groups of system users (Bilitewski, 2008). The variable part of the fee is linked to the amount of waste produced by each system participant. It entails collection, transportation, treatment and final waste disposal costs. Expenses for the procurement of bags and stickers, where relevant PAYT versions are applied, make up part of the variable charge (Karagiannidis et al., 2008). Research has shown that fixed costs represent about 60-80% of total waste management costs while the remaining 20-40% corresponds to variable costs. Complex billing systems may affect negatively the indented program purposes (Bilitewski, 2008). Multi-component charging systems comprise of a fixed and a variable part, as described above, and an additional part, applied in the case of special service provision or particular waste policy targets (e.g. collection of bulky waste or construction material, remote or difficult serviced area). Those supplementary components should only reflect a small portion of the basic parts of the fee so as not to distort the steering potentials of the latter within the waste charging mechanism (Bilitewski, 2008).

The impediments encountered during the introduction of a PAYT scheme and program outcomes certainly depend on the structure of the applied charging mechanism (Sakai et al., 2008). Reichenbach (2008, p. 2812) states that *“the closer the link of the waste charge to the residual waste generated and actual amount of residual waste services received, the higher becomes the tendency of the people to engage in source separation and recycling efforts”*. In that sense, weight and bag-based systems are more sophisticated and thus more efficient than frequency and volume based programs

(Dijkgraaf and Gradus, 2004; 2009). Interestingly, Dijkgraaf and Gradus, (2004) found that results brought about by the application of weight and bag-based programs in the Netherlands are comparable and thus bag-based programs present special interest due to significantly lower implementation costs.

Administrative changes will most probably be needed for the implementation of the program (Ecological Recycling Society, 2011) and additional staff is deemed necessary during the early implementation phase in part to deal with the increased need for public information. PAYT programs maximize their diversion possibilities when recycling and composting costs are incorporated in waste management fees (Skumatz, 2008). Charging for recycling and composting bins weakens citizens' incentive for waste separation (Dunne et al., 2008).

1.5 Prerequisites and motivators for PAYT implementation

The adoption of a PAYT scheme remains foremost a political decision and its successful implementation depends predominantly on continuously informing and educating system users (Skumatz, 2008; The Cornell Waste Management Institute, 2001). Communities have to invest both time and money in increasing public awareness around PAYT programs (Ecological Recycling Society, 2011; Puig-Ventosa, 2008; Skumatz and Freeman, 2006). Lack of political consensus, which gave rise to public opposition regarding certain aspects of the implemented PAYT scheme in the Spanish town of Torrelles de Llobregat, led to the abandonment of the program (Puig-Ventosa, 2008).

Several other issues relate to PAYT implementation. The involvement of all stakeholders in designing the system will contribute to its successful application. Running a pilot program prior to fully implementing PAYT is considered necessary (Ecological Recycling Society, 2011; Puig-Ventosa, 2008; Skumatz, 2008). In the case of Ireland, public acceptance of PAYT programs was higher in areas where the service was provided by private haulers than by municipalities, as citizens seem to justify more waste charges coming from private contractors than from public authorities. Resistance against PAYT

adoption in Ireland eased as the program went into implementation (Dunne et al., 2008). Elia et al., (2015) underline that transitioning from a flat rate to a unit-pricing scheme requires significant effort and the collaboration of different scientific disciplines.

Skumatz (2008) identified some of the parameters that motivated US communities towards the adoption of PAYT programs. In some cases municipalities switched to user-pay systems in order to cope with excessive landfill fees or to comply with state or local legislation. . Puig-Ventosa (2008, p. 2771) underlines that *“it is accepted that one of the main drivers behind the development of unit pricing is an adequate legal frame work requiring reductions in municipal waste”* while according to Karagiannidis et al. (2008) a political decision to readjust tipping fees has the potential to orient municipalities towards user-pay waste management systems. Communities may also be inspired by the successful implementation of a PAYT program in other municipalities (Skumatz, 2008). Other parameters that encourage the adoption of user-pay systems include the existence of recycling and diversion goals, the application of recycling programs and citizen accessibility to the latter (Puig-Ventosa, 2008; Skumatz and Freeman, 2006). Le Bozec, (2008) recognizes recycling programs for a vast spectrum of waste streams as a prerequisite for the implementation of a unit-pricing program while door-to-door waste collection does facilitate the introduction of PAYT schemes (Puig-Ventosa, 2008). Small and low density communities face fewer challenges when deciding to adopt a variable-price waste management program compared to large and densely populated municipalities (Ibid., p. 24). According to Linderhof et al., (2001, p. 370) *“practical problems limit the implementation of weight-based pricing to communities with a certain degree of social control and a relatively small number of apartment buildings”*.

Communities contemplating the possibility of applying a PAYT scheme ought to examine a series of parameters related to the area of implementation. Urban and demographic characteristics as well as current waste management structures provide significant information regarding the selection of the appropriate unit-pricing program (Ecological Recycling Society, 2011; Karagiannidis et al., 2008; Puig-Ventosa, 2008; Skumatz and Freeman, 2006; The Cornell Waste Management Institute, 2001) with

current technology practically enabling PAYT application nearly in all municipal environments (Reichenbach, 2008). An analysis of national and local legislation and of central and local governmental policies will reveal limitations and possibilities for PAYT implementation. Levels of public acceptance and well defined program targets will certainly influence the outcome of the program (Ecological Recycling Society, 2011; Karagiannidis et al., 2008; Puig-Ventosa, 2008; Skumatz and Freeman, 2006; The Cornell Waste Management Institute, 2001). Information and awareness campaigns prior and during PAYT implementation are deemed absolutely necessary (Ecological Recycling Society, 2011; Skumatz and Freeman, 2006). Prior to the application of any PAYT program, waste management costs have to be analyzed at the local and national level and fees for system users have to be determined accordingly. The required cost analysis will ensure the waste management systems' sustainability (Bilitewski, 2008; Reichenbach, 2008).

Dijkgraaf and Gradus (2004; 2009) have concluded that, when compared to municipalities with lower levels of environmental awareness, communities with environmental conscious citizens (environmental activism) tend to produce on average 6% less total waste (environmental activism effect) already before the introduction of any PAYT scheme. These "green" municipalities are also the first to implement unit-pricing waste management programs. Dijkgraaf and Gradus' (2004; 2009) findings concerning the presence of the previously described environmental activism affect in municipalities which first introduced unit-pricing waste management programs, speaks against the efficiency hypothesis effect, according to which it would be municipalities with higher levels of waste production and reduced environmental initiatives which would first implement unit-pricing systems due to the possibility of larger efficiencies in waste reduction and diversion.

Nevertheless, the successful implementation of a PAYT program is ultimately dependent on, and measured by, the level of citizen participation. Thus the system must not only present a sufficient level of economic attractiveness to system users but also incorporate attributes that amplify citizens' perception of its fairness. As a first step, the legislative framework ought to ensure that responsibility is allocated properly among

urban waste generation actors (i.e. producers, distributors, merchandisers, consumers). Secondly, the system must guarantee that waste generators are not charged repeatedly for the same amount of produced waste (i.e. once as product consumers and once as waste management system users). Thirdly, when designing a PAYT system authorities should incorporate three essential dimensions of fairness. These are i) the equality of cost per unit of produced waste, ii) the equality of opportunity in using the system in terms of accessibility to system structures and provided incentive for system participation and iii) the system equity in the sense that discreet treatment of PAYT users is allowed to correct for inequalities among system participants due to social, financial or health factors. Waste fee systems that penalizes big waste producers by charging progressively more for every additional unit of waste, or charge differently according to the environmental impact of produced waste, are perceived as more fair (Batllell and Hanf, 2008).

2 Methods

2.1 Description of research

Although existing literature on PAYT covers a broad spectrum of topics, research on public acceptability of the program prior to its implementation is limited both within Greece and abroad. Thus the current empirical study aims to address this under-researched topic by presenting respondents with three alternative PAYT schemes, identified by previous research as most suitable for implementing under existing conditions in Greek communities: a) the volume-based bag program (Ecological Recycling Society, 2011; Karagiannidis et al., 2008; Malamakis et al., 2009), b) the punch card weight-based system (Ecological Recycling Society, 2011; Jones et al., 2010; Karkanias et al., 14-18th of July 2015) and the c) weight-based bin scheme (Ecological Recycling Society, 2011; Karagiannidis et al., 2008; Malamakis et al., 2009). The scope of the study spans across three core fields. Initially the empirical study intends to reveal individuals' perceptions towards the proposed PAYT scheme versions comparatively to each other as well as to the currently implemented waste management system and waste charging mechanism. Moreover the study aspires to identify which social factors may influence public acceptance of the innovative scheme in Greece. Similarly possible relations between the demographic characteristics of the Greek population and perceptions towards unit-pricing waste management programs are investigated. Finally the study attempts to elicit individuals' opinion about the effective treatment of the dominant drawback of PAYT scheme implementation, namely illegal waste dumping, providing thus municipalities with valuable information for the adoption of effective mitigation policies.

In order to serve the purposes of the present study an electronic questionnaire was assembled with the help of the Google Forms application. Due to time and resource constrains but also because of the relative novelty of the research topic regarding Greece, convenience sampling was the technique applied for sample unit selection. The questionnaire was forwarded to the network of acquaintances of the authors of the study

with the use of electronic means (i.e. electronic mail), through the University of the Aegean's email lists as well as the latter's official Facebook page. The recipients of the questionnaire were also encouraged to forward the form to their own network of contacts. The survey was online from the 30th of May until the 29th of June 2016, and during this period 299 questionnaires were received anonymously. The above approach, which eventually formed the survey sample, means that our sample is not representative of the Greek population as a whole, as individuals that are not familiar with the use of electronic means had been a priori excluded from the survey. A comparison of our sample's demographics characteristics to that of the general Greek population, according to 2011 census data, is presented in the Appendix of the present thesis.

2.2 Research design

Because of the hypothetical nature of the subject under study interviewees are immediately presented with information regarding the current situation in the field of waste management and waste charges in Greece as well as the hypothetical scenario of the implementation of a PAYT scheme by their municipality. It is made known that the new system relies on the Polluter Pays Principle and thus waste charges will be proportionate to the amount of waste produced. Furthermore citizens are provided with the information that the unit-pricing program will be applied simultaneously to residue waste and recyclables entering the recycling system of packaging waste that is already running in Greek municipalities. Citizens will be charged 0,05€ for every kilogram of residue waste or recyclables entering the corresponding system, an amount which would reflect the real municipal waste management costs once Article 43 of Law 4042/12 (FEK 24/A/13-2-2012) becomes operational in 2017. The three alternative versions of the proposed policy instrument are presented in further detail. a) In the case of the bag program, households are obliged to make use of special bags for the disposal of residue waste and recyclables within the already installed and well known to citizens network of green (residue waste) and blue (recyclable packaging waste) bins respectively. These bags will be available for purchase at various selling points within the municipality. Only waste

placed within special bags will be collected by municipality staff. Waste within “regular” bags will not be collected. b) In the second PAYT scenario, the currently used green and blue cans will be replaced by “smart cans”. Access to the system will be possible with the use of pre-paid smart cards again available at different selling points within the municipality. Each time a citizen accesses the system the “smart can” weighs the disposed waste and deducts a proportionate amount from his/her pre-paid punch card. Only waste within “smart cans” will be collected by haulers. Any waste placed outside the cans will be left at the point of its disposal. c) The third alternative PAYT scheme is based on the installment of one can per detached house or multifamily building. The exclusive access of the tenants of a certain building to their waste bin is guaranteed by the use of a security lock. The bin is weight and corresponding waste charges are equally divided among households sharing its use. Again, municipality staff will only collect waste placed within the shared cans.

The questionnaire distributed to the sample consists of three main question groups. The vast majority of the questions included in the form stem from relevant literature and only a few of them arose intuitively. The first group of questions records citizens’ attitudes towards the proposed policy and the program alternatives included in the study (Ecological Recycling Society, 2011). Citizens’ recycling habits, previously linked to PAYT implementation outcomes (Blaine et al., 2005; Ecological Recycling Society, 2011; Everett, J.W., 1989; Puig-Ventosa, 2008; Sauer et al., 2008; Simmons and Widmar, 1989; Skumatz and Freeman, 2006; Van Houtven and Morris, 1999), are also investigated. A five-point Likert scale is used to measure individuals’ understanding of possible PAYT benefits (Batllell and Hanf, 2008; Dahlén and Lagerkvist, 2010; Dijkgraaf and Gradus, 2004, 2009; Dunne et al., 2008; Ecological Recycling Society, 2011; Karkanias et al., 14-18th 2015; Le Bozec, 2008; Linderhof et al., 2001; Puig-Ventosa, 2008; Sakai et al., 2008; Skumatz, 2008; Skumatz and Freeman, 2006; The Cornell Waste Management Institute, 2001; US EPA, 2002; Van Houtven and Morris, 1999) and drawbacks (Dijkgraaf and Gradus, 2009; Dunne et al., 2008; Ecological Recycling Society, 2011; Elia et al., 2015; Jones et al., 2009; Puig-Ventosa, 2008; Karagiannidis et al., 2008; Le Bozec, 2008; Linderhof et al., 2001;

Reichenbach, 2008; Skumatz, 2008; Skumatz and Freeman, 2006; Slavik and Pavel, 2013; van Beukering et al., 2009; Van Houtven and Morris, 1999) already documented during actual program implementation in various municipalities around the world.

The second group of questions intends to capture, again on a five-point Likert scale, citizens' perceptions regarding the: a) municipal effectiveness in case of PAYT scheme implementation, b) public conformity to the rules set out by an applied PAYT program (Dahlén and Lagerkvist, 2010; Dijkgraaf and Gradus, 2004; Dunne et al., 2008; Hage et al., 2009; Le Bozec, 2008; Sakai et al., 2008, 2008; The Cornell Waste Management Institute, 2001; TU Dresden et al., 2003), c) effective treatment alternatives of potential phenomena of illicit waste disposal by municipalities after program adoption (Dahlén and Lagerkvist, 2010; Dijkgraaf and Gradus, 2004; Dunne et al., 2008; Karagiannidis et al., 2008; Le Bozec, 2008; Linderhof et al., 2001; Puig-Ventosa, 2008; Reichenbach, 2008; Skumatz, 2008; The Cornell Waste Management Institute, 2001; TU Dresden et al., 2003) and d) individual reactions towards incidents of violation of the operating rules of the system by its users (Dahlén and Lagerkvist, 2010; TU Dresden et al., 2003).

The third part of the questionnaire records the participants' demographic characteristics [municipality of residence (Ecological Recycling Society, 2011; Dahlén and Lagerkvist, 2010; Hage et al., 2009; The European Values Study, 20th of May 2016), gender (Blaine et al., 2005; Ecological Recycling Society, 2011; Hage et al., 2009; Jin et al., 2006; Karkanias et al., 14-18th of July 2015; Linderhof et al., 2001; The European Values Study, 20th of 2016), age (Batllell and Hanf, 2008; Blaine et al., 2005; Ecological Recycling Society, 2011; Hage et al., 2009; Karkanias et al., 14-18th of July 2015; The European Values Study, 20th of May 2016), level of education (Batllell and Hanf, 2008; Hage et al., 2009; Jin et al., 2006; Skumatz and Freeman, 2006; The European Values Study, 20th of May 2016; Van Houtven and Morris, 1999), employment status (The European Values Study, 20th of May 2016; Van Houtven and Morris, 1999), personal income level (Batllell and Hanf, 2008; Blaine et al., 2005; Hage et al., 2009; Jin et al., 2006; Linderhof et al., 2001; Skumatz and Freeman, 2006; Skumatz, 2008; The European Values Study, 20th of May 2016; Van Houtven and Morris, 1999), number of household members

(Ecological Recycling Society, 2011; Karkanias et al., 14-18th of July 2015; Linderhof et al., 2001; Skumatz and Freeman, 2006; The European Values Study, 20th of May 2016; Van Houtven and Morris, 1999) and dwelling type (Ecological Recycling Society, 2011; Hage et al., 2009; Karkanias et al., 14-18th of July 2015; Linderhof et al., 2001)].

3 Results

3.1 Perceptions regarding the proposed policy

After being presented with the hypothetical scenario, interviewees were asked to state whether they would be against or in favor of the implementation of a PAYT alternative by their municipality of residence. According to the results of the study 47,2% of the sample stated being in “favor” of a PAYT program alternative, while only 5,0% stated being “against” the implementation of a PAYT version. The whole range of responses on the question is presented in Figure 1. Interestingly, those who “do not wish the implementation of any PAYT alternative in their municipality of residence”, amount to 11,4% of the sample as shown in Figure 2.

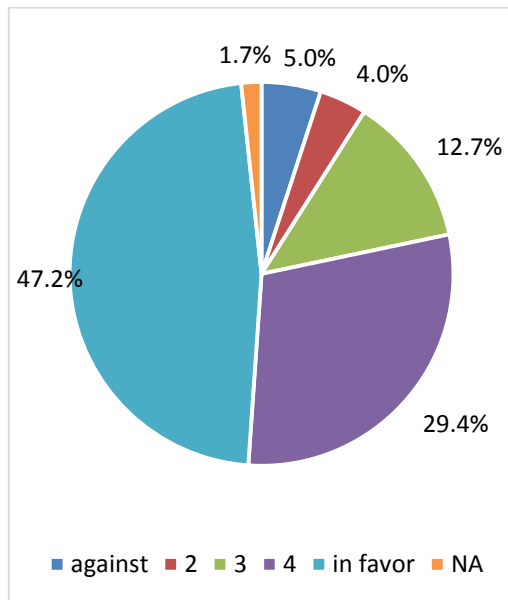


Figure 1 Acceptance of "PAYT"

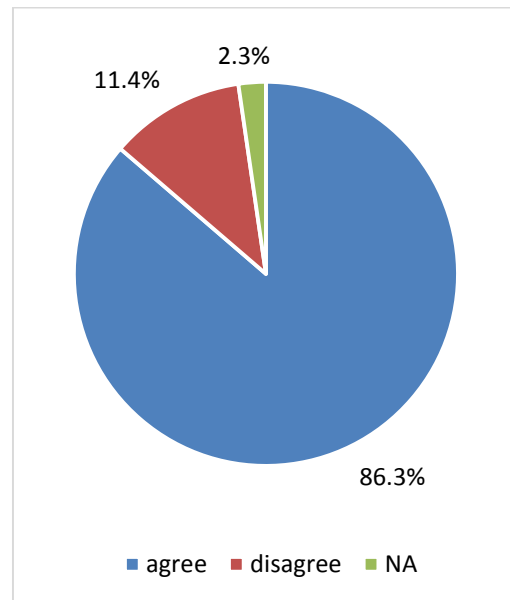


Figure 2 Agreement with "PAYT" implementation

When asked how they would rank the PAYT alternatives presented in the study if they had to choose between a) the volume-based bag program, b) the punch card weight-based system or c) the weight-based bin per property scheme for adoption by their municipality, 29,1% of the sample stated the volume-based bag program as their first priority, 35,5% of the interviewees put the punch card weight-based system in first place

and 33,1% of the citizens named the weight-based bin per property scheme as their first choice. Figure 3 illustrates the ranking of the different PAYT versions by interviewees.

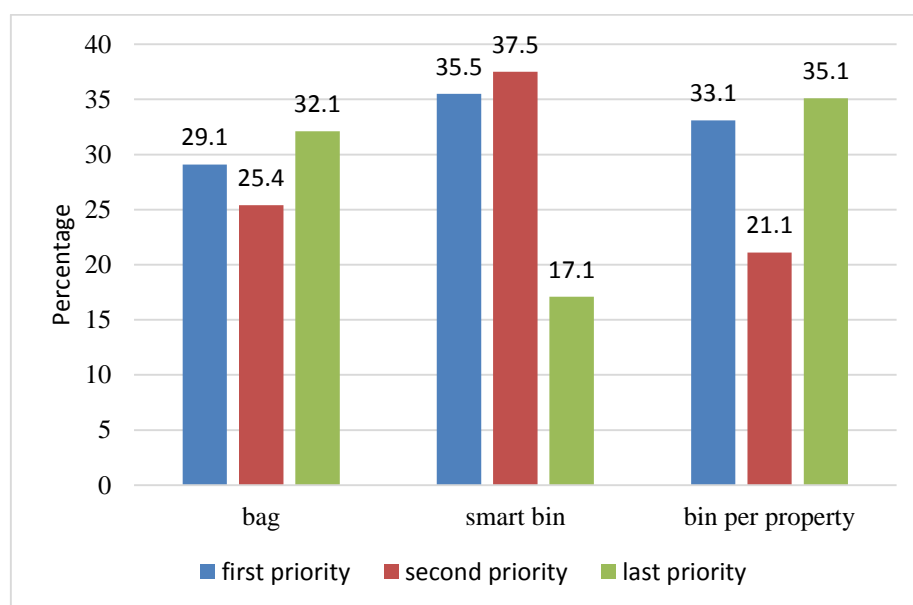


Figure 3 Ranking of "PAYT" alternatives

3.2 Perceptions on municipal authorities' effectiveness

The questionnaire intended to capture citizens' perceptions on the subject of municipal authorities' effectiveness in case of a PAYT alternative implementation. The survey results, presented in Figure 4, show that more than half of the interviewees do not exhibit enough trust towards their municipalities for the effective implementation of any of the three alternative programs included in the survey. An almost recurring pattern of answers is to be observed among respondents for all three PAYT versions, with the weight-based bin per property scheme presenting slightly higher percentages both for "very low levels of trust" (26,4%) and "very high levels of trust" (5,4%) of individuals towards their municipality for its implementation. These results may reflect an established public perception regarding the inefficiency of the public sector in Greece.

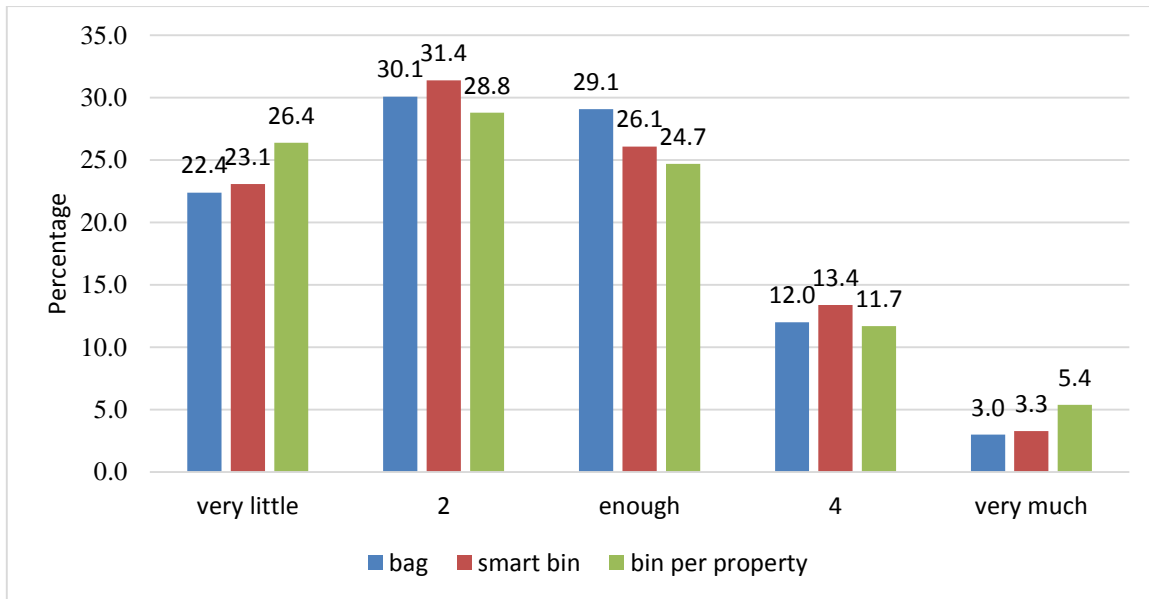


Figure 4 Levels of trust towards municipality

The study investigated a second issue related to municipal effectiveness. Citizens were asked to state their level of agreement with several proposed ways for municipalities to effectively treat the possible phenomena of illegal waste dumping once a PAYT program was in place. The majority of the interviewees (50,8%) strongly agree that an increase in information campaigns, by municipalities, highlighting PAYT financial and environmental benefits, is an effective means to combat illegal dumping. Almost half of the sample (45,2%) stated they “agree a lot” that strict warnings by municipalities to offenders can effectively limit the number of incidents of system misuse. Interviewees seem to have very divided opinions on whether municipalities should choose to publicize offenders’ names to effectively reduce phenomena of illegal dumping since all five points of the Likert scale used (disagree a lot, disagree, neither agree nor disagree, agree, agree a lot) collected similar percentages. This result may relate to an actual behavioral conflict among Greek citizens who, on the one hand, are convinced that misconduct ought to be penalized, but on the other hand, cannot ignore a commonly accepted informal social norm that disapproves the naming of the offender. There seems to be a consensus among interviewees that, both the fining of wrongdoers by municipalities and the reporting of offenders to competent authorities by citizens themselves are effective ways to eliminate

illegal dumping. Thus, with the exception of the publicizing of the offenders' names by municipalities, the proposed policies targeting illegal waste dumping are widely accepted as efficient by the Greek public. This information is valuable to competent authorities during policy design. All the answers on the subject of effective treatment of illegal waste dumping by municipalities are presented in Figure 5.

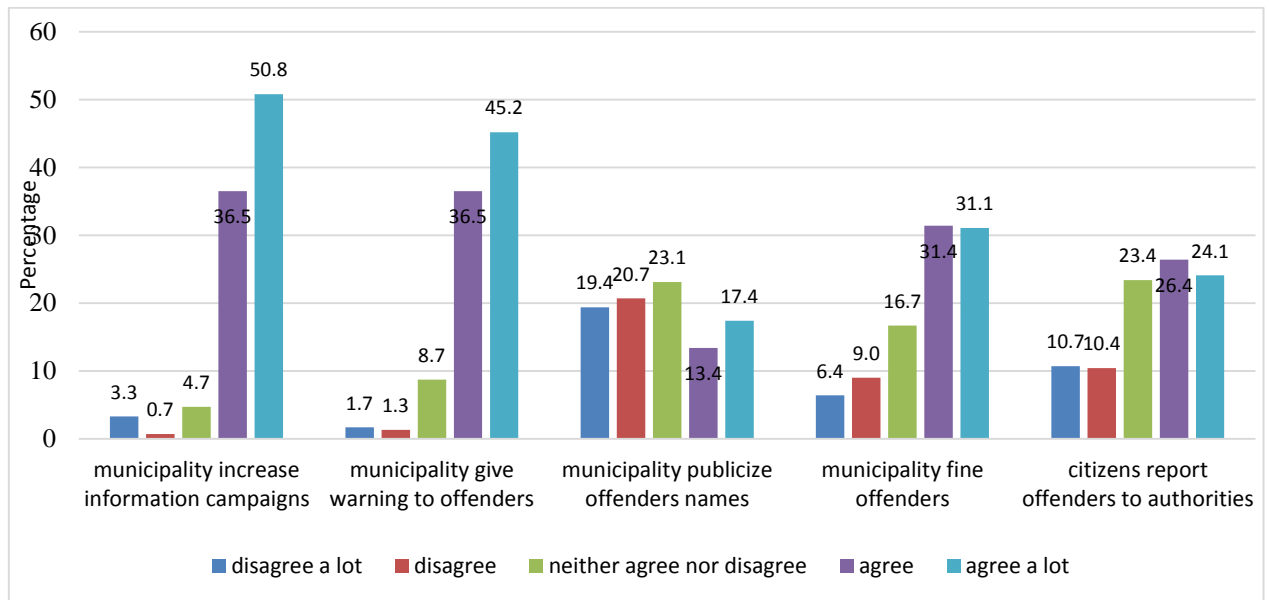


Figure 5 Effective treatment of illegal waste dumping

3.3 Perceptions on the behavior of fellow citizens

Survey results indicate that interviewees are rather skeptical on whether fellow citizens will respect the operating rules of the alternative waste management system especially if a volume-based bag program or a punch card weight-based system is to be implemented. Things look more optimistic in the case of a weight-based bin per property scheme adoption. Cumulatively 36,8% vs. 35,4% of the interviewees stated that “very few” and “few” people vs. “quite a lot” and “many” people respectively would comply with the operating rules of a weight-based bin per property scheme. Citizens’ perceptions on the subject are presented in Figure 6.

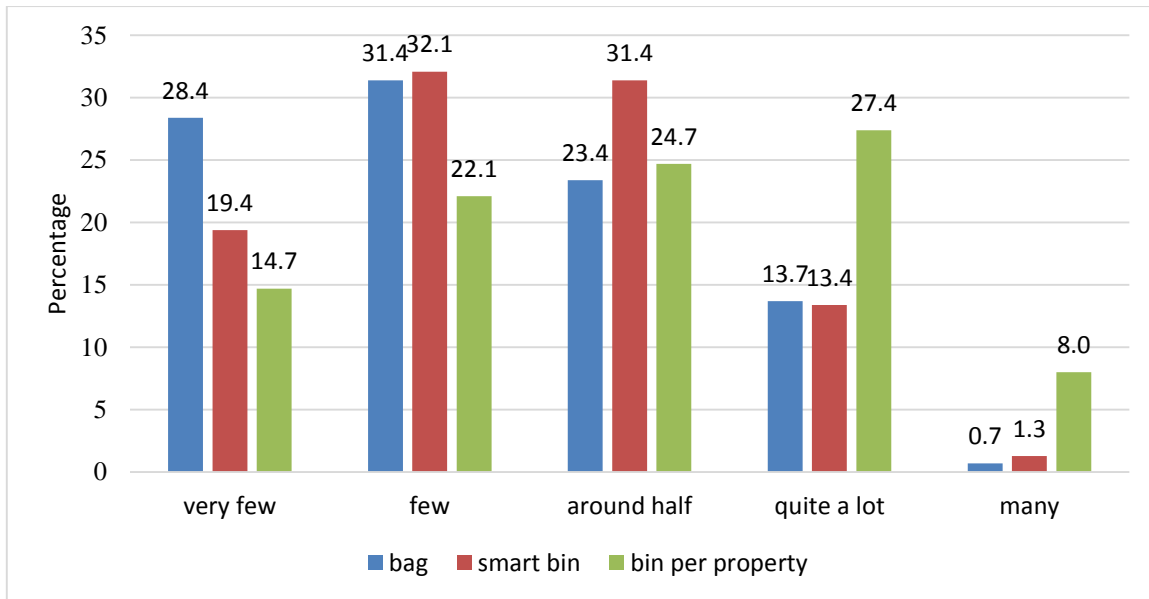


Figure 6 Compliance of fellow citizens

3.4 Perceptions regarding interviewees' own behavior

The survey also collected information on interviewees' perceptions regarding their own reactions towards incidents of violation (e.g. waste left outside the designated bins or the use of common instead of special bags for waste disposal) of PAYT system rules. An impressive 66,6% of the sample would rather not immediately report offenders to the police and similarly, 53,2% of respondents would rather *not* "report offenders to the competent authorities the day after the incident". On the contrary, the vast majority of interviewees (81,6%) seems ready to confront offenders for their misconduct on the spot. These results may, once more, reflect particular features of the Greek society which, on the one hand, regards the naming of offenders as an unjustifiable act and, on the other hand, justifies spontaneity of behavior by its members. Interviewees also seem ready to inform other neighbors and acquaintances about the offenders conduct. Relevant responses on "surely no"/"rather no" and on "rather yes"/"surely yes" amount to 32,4% and 54,5% of the sample respectively. It seems though that the vast majority of survey participants would choose to react, in one way or another, to phenomena of violation of PAYT system rules rather than stay indifferent. The statement "I will mind my own business and won't preoccupy myself with the offender" gathered 76,0% of answers on

“surely no”/“rather no” and only 10,7% of answers on “rather yes”/ “surely yes”. Figure 7 illustrates the range of answers regarding interviewees’ perceptions on their own behavior.

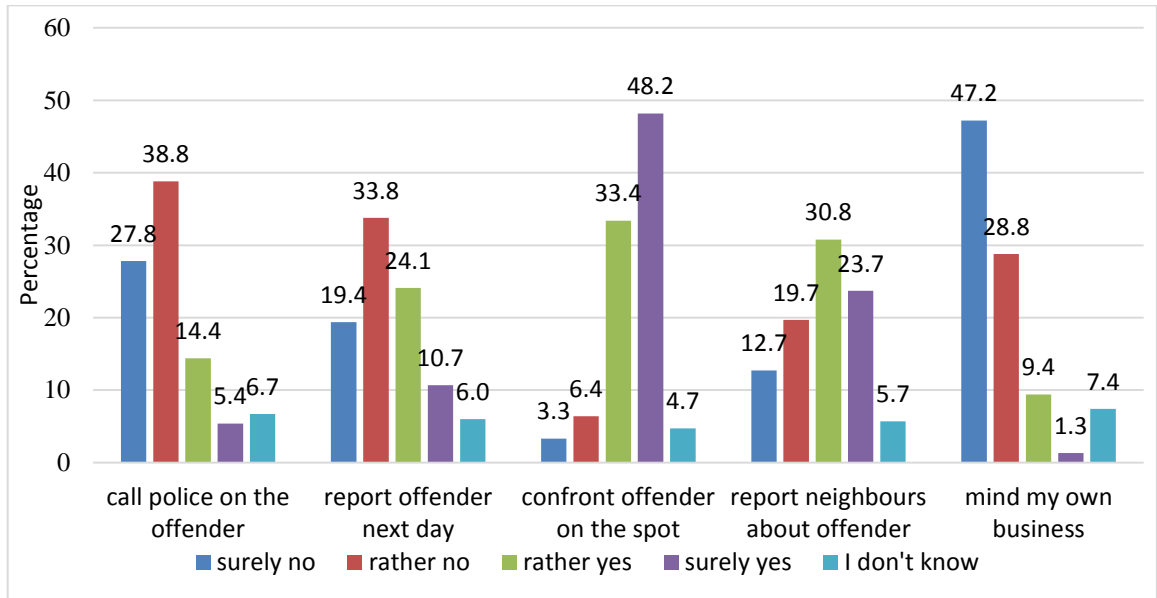


Figure 7 Interviewees' own behavior vs system offenders

3.5 Correlations

A Spearman's rank-order correlation was run to assess the relationship between citizens’ predisposition towards the possibility of their municipality of residence implementing a PAYT scheme version (a) a volume-based bag program, b) a punch card weight-based system or c) a weight-based bin per property scheme) and selected ten (10) variables included in the study.

As shown in Table 1, the analysis revealed a weak positive relationship between individuals’ predisposition towards the likelihood of the adoption of a PAYT program alternative by their municipality and citizens’ level of trust towards their municipality for an effective implementation of a volume-based bag program and of a punch card weight-based system. Interestingly, there is no correlation between citizens’ predisposition towards the possibility of their municipality implementing a PAYT scheme alternative and citizens’ level of trust towards their municipality for an effective implementation of a

weight-based bin per property scheme. This last result may reflect respondents' concerns regarding the perceived drawbacks of the weight-based bin per property scheme when compared to the currently applied waste management system (i.e. aesthetic degradation of their property and deterioration of malodors due to the proximity of the waste bin, sound pollution due to the proximity of waste collection itineraries).

Table 1 Spearman's rank-order correlation results and corresponding significance levels

Variable	Trusting municipality for effective implementation of bag program	Trusting municipality for effective implementation of smart-bin program	Trusting municipality for effective implementation of bin per property program
In favor of PAYT implementation	0,192**	0,212**	n.s.

Significance levels: * $p < 0,1$; ** $p < 0,01$; n.s. not statistically significant

Citizens' attitude regarding the possible implementation of a unit-pricing waste management program alternative by their municipality and their perception regarding public conformity to the rules set out by an applied volume-based bag program or by a punch card weight-based system are also positively but weakly correlated. Again there is no relationship between individuals' reception of a plausible PAYT version implementation and public conformity to the rules set out by an applied weight-based bin per property scheme. The above result may echo individuals' reservations regarding the implementation of the weight-based bin per property scheme in the case of multi-family buildings, where waste charges are equally divided among households. The particular PAYT alternative thus not only fails to reward waste minimization according to the individual effort but also allows for free riders to equally benefit from any reductions in waste charges. Relevant results are presented in Table 2.

Table 2 Spearman's rank-order correlation results and corresponding significance levels

Variable	Public will conform to bag program rules	Public will conform to smart-bin program rules	Public will conform to bin per property program rules
In favor of PAYT implementation	0,122**	0,213**	n.s.

Significance levels: * $p < 0,1$; ** $p < 0,01$; n.s. not statistically significant

According to our analysis, and as shown in Table 3, there is a weak positive relationship between citizens' predisposition towards the likelihood of the adoption of a PAYT program alternative by their municipality and individuals' willingness to react, in different ways, to incidents of violation of the operating rules of the system (e.g. waste left outside the designated bins or the use of common instead of special bags for waste disposal) by fellow citizens. The analysis revealed a weak negative relationship between individuals' attitude regarding the possible implementation of a unit-pricing waste management program alternative by their municipality and their willingness to remain indifferent towards system users' misconduct. The results can be regarded as anticipated since it is reasonable to expect that the expression of a personal preference (e.g. being in favor of a PAYT implementation) is coupled with some level of willingness to defend one's choice and, vice versa, any reaction to a violation of the operating rules of the PAYT system could be interpreted as an expression of the individual's positive predisposition towards the alternative waste management system.

Table 3 Spearman's rank-order correlation results and corresponding significance levels

Variable	Immediately report offence to police	Report offender to competent authorities the day after the incident	Confront offender on the spot	Inform neighbors/acquaintances about the offender's conduct	Remain indifferent towards offender's conduct
In favor of PAYT implementation	0,148**	0,190**	0,188**	0,129*	-0,197**

Significance levels: * $p < 0,1$; ** $p < 0,01$

Furthermore, the analysis showed that citizens' predisposition towards the possibility of their municipality adopting a PAYT scheme alternative correlates positively with individuals' attitudes regarding the implementation of different municipal policies targeting potential phenomena of illicit waste disposal, once a PAYT is in place. The relationships however are weak with slightly higher correlation coefficients between the former variable and individuals' attitudes towards the intensification of the municipality's information campaigns highlighting the financial and environmental benefits of PAYT programs to citizens and respondents' stance regarding the enforcement, by municipalities, of strict monetary penalties to system offenders. The interpretation of the findings in Table 4 could fall under the rationale discussed in the previous paragraph. Individuals in favor of a PAYT program would most likely want to see its operation being protected and, vice versa, peoples' desire for the implementation of PAYT protection policies relates to some level of positive predisposition towards the alternative waste management system.

Table 4 Spearman's rank-order correlation results and corresponding significance levels

Variable	Intensification of information campaigns by municipality	Strict recommendations to offenders by municipality	Publicizing of the identity of proven offenders by municipality	Strict monetary penalties to system offenders by municipality	Citizens' reporting the system's offenders
In favor of PAYT implementation	0,303**	0,283**	0,250**	0,298**	0,239**

Significance levels: * $p < 0,1$; ** $p < 0,01$

The test ran revealed no correlation between individuals' predisposition towards the likelihood of the adoption of a PAYT program alternative by their municipality and citizens' first preference regarding the applied program alternative (a) volume-based bag program, b) punch card weight-based system or c) weight-based bin per property scheme), individuals' recycling frequency, gender, age, level of education and personal income level.

3.6 Principal components analysis

A principal components analysis (PCA) was run on part of the questionnaire (a total of eleven questions) that measured individuals' understanding of possible PAYT implementation benefits and drawbacks on three groups of the total sample divided according to the PAYT alternative interviewees have ranked as their first preference. The aim of the PCA analysis was to establish the overall (positive and negative) perception of each PAYT alternative by the individuals who prioritize its adoption.

In the case of the individuals who ranked the volume-based bag program as their first choice (87 out of 299 interviewees), the PCA, following a Varimax orthogonal rotation with Kaiser Normalization, revealed three components with Eigenvalues greater than one and which explained 35,8%, 20,3% and 10,0% of the total variance, respectively. The three-component solution thus explained 66,1% of the total variance.

The interpretation of the data was consistent with the PAYT scheme attributes (comparatively to the existing waste management system) the questionnaire was designed to measure, with strong loadings of all PAYT benefit items on Component 1 and PAYT drawback items on Component 2. The only item with a strong loading on Component 3 is the variable measuring individuals' beliefs on whether the implementation of a PAYT program would lead to an increase of incidents of citizens circumventing the municipal waste management system. Component loadings of the rotated solution are presented in Table 5.

Table 5 Rotated Component Matrix(a) for volume-based bag PAYT scheme

	Component		
	1	2	3
Time consuming	-,087	,821	-,095
Harder to use	-,026	,872	-,021
More env friendly	,677	,157	-,377
Reduce waste	,667	,360	,025
Increase recyclables	,757	-,093	,181
Fairer distribution of costs	,749	-,214	,150
Improve cleanliness	,854	-,112	,098
Aesthetic improvement	,805	-,067	,189
Increase unlawful behav	,233	,064	,909
Be more costly	-,081	,744	,130
Rationalize waste mgmnt	,676	-,131	,005
Explained variance (%)	35,8%	20,3%	10,0%

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a Rotation converged in 4 iterations.

In the case of the individuals who ranked the punch card weight-based system as their first choice (106 out of 299 interviewees), the PCA once more revealed three components that had Eigenvalues greater than one and which explained 25,9%, 19,8% and 14,2% of the total variance, respectively. The three-component solution this time explained 59,8% of the total variance.

There are strong loadings of PAYT benefit items on Component 1 and PAYT drawback items on Component 2. It has to be noted though, that this time, not all variables measuring perceptions of PAYT benefits have loadings greater than 0,60 on Component 1. These are the variables measuring the systems' ability to improve city cleanness and aesthetics. Similarly to the case of the volume-based bag program, only the variable measuring individuals believes on whether the implementation of a PAYT program would lead to an increase of incidents of citizens circumventing the municipal waste management system has a strong loading on Component 3. Component loadings of the rotated solution are presented in Table 6.

Table 6 Rotated Component Matrix(a) for punch-card weight-based PAYT scheme

	Component		
	1	2	3
Time consuming	-,039	,806	-,252
Harder to use	-,062	,851	-,122
More env friendly	,616	-,021	,091
Reduce waste	,754	-,078	-,026
Increase recyclables	,780	-,064	-,105
Fairer distribution of costs	,633	,015	,362
Improve cleanliness	,517	-,417	,492
Aesthetic improvement	,333	-,382	,578
Increase unlawful behav	-,008	,064	,754
Be more costly	-,066	,667	,264
Rationalize waste mgmnt	,706	-,158	,338
Explained variance (%)	25,9	19,8	14,2

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a Rotation converged in 5 iterations.

In the case of the individuals who ranked the weight-based bin per property scheme as their first choice (99 out of 299 interviewees), the Varimax orthogonal rotation with Kaiser Normalization analysis again led to three components with Eigenvalues greater than one, able to interpret 36,5%, 17,4% and 15,0% of the total variance

respectively. The three component solution is now able to explain a total of 68,9% of the total variance.

The interpretation of the data was consistent with the PAYT scheme attributes (comparatively to the existing waste management system) the questionnaire was designed to measure with strong loadings of PAYT benefit items on Component 1 and PAYT drawback items on Component 2. Interestingly in the present case of the weight-based bin per property scheme ranked first, the variable measuring individuals perception on whether a PAYT implementation would increase the amount of recyclables entering the recycling system has a strong loading on Component 3, together with the variables on whether the implementation of a PAYT program would lead to an increase of incidents of citizens circumventing the municipal waste management system and on increased waste management costs. Component loadings of the rotated solution are presented in Table 7.

Table 7 Rotated Component Matrix(a) on weight-based bin-per-property PAYT scheme

	Component		
	1	2	3
Time consuming	-,074	,919	,084
Harder to use	-,090	,912	,163
More env friendly	,822	-,184	,144
Reduce waste	,686	-,138	,373
Increase recyclables	,378	-,171	,711
Fairer distribution of costs	,785	-,082	,169
Improve cleanliness	,874	-,103	,005
Aesthetic improvement	,804	,059	-,207
Increase unlawful behav	,189	,205	,652
Be more costly	-,194	,300	,632
Rationalize waste mgmnt	,784	,021	,233
Explained variance (%)	36,5	17,4	15,0

Extraction Method: Principal Component Analysis.
 Rotation Method: Varimax with Kaiser Normalization.
 a Rotation converged in 5 iterations.

As shown in Table 8, when comparing the PCA results for the three sample groups, it becomes evident that the three component solution is able to explain 66,1% of total variance in the case of individuals naming the volume-based bag program as their first choice, 59,8% of total variance for the group of respondents stating the punch card weight-based system as their first preference and 68,9% of total variance in the case of interviewees ranking the weight-based bin per property scheme first.

The interpretation of the data is fairly consistent with the PAYT scheme attributes (comparatively to the existing waste management system) the questionnaire was designed to measure for all three respondent groups, namely system advantages and disadvantages. In the case of the volume-based bag program being ranked first, there are strong loadings of all PAYT benefit items on Component 1 and three out of four PAYT drawback items on Component 2. The only item with a strong loading on Component 3 is the variable measuring respondents believes on whether a PAYT implementation would lead to an increase of incidents of illegal waste dumping. For the group of respondents who ranked the punch card weight-based system first, there are strong loadings of five out of seven PAYT benefit items on Component 1. This time, the items corresponding to the variables on the systems' ability to improve city cleanness and aesthetics present loadings lower than 0,60 on Component 1. The same PAYT drawback items as in the first group, present strong loadings on Components 2 and 3 respectively, in the case of the punch card weight-based system group as well. For individuals choosing the weight-based bin per property scheme as their first choice, it is interesting to note, that the item linked to the variable measuring the systems' ability to increase recycling, presents a strong loading on Component 3 (and not on Component 1 as was the case in the previous two groups) as do the PAYT drawback items corresponding to the variables on perceptions regarding increased illegal waste dumping and higher waste management costs due to PAYT implementation.

Furthermore, as shown in Table 8, Component 1 can explain an almost equivalent percentage of the total variance in the case of the volume-based bag program and the weight-based bin per property scheme being ranked first, namely 35,8% and 36,5%

respectively, but only 25,9% of total variance for the group of people naming the punch card weight-based system as their first choice. Also the explanatory power of Components 2 and 3 on the total variance for the group of people who placed the punch card weight-based system first becomes almost equal compared to the other two sample groups.

Table 8 Rotated Component Matrix(a) – Comparative presentation of PCA results

	Bag as 1 st choice. <i>Bag PAYT scheme will be...</i>			Smart can as 1 st choice. <i>Can PAYT scheme will be...</i>			Bin per property as 1 st choice. <i>Bin PAYT scheme will be...</i>		
	Components			Components			Components		
<i>Attribute of PAYT scheme</i>	1	2	3	1	2	3	1	2	3
Time consuming	-,087	,821	-,095	-,039	,806	-,252	-,074	,919	,084
Harder to use	-,026	,872	-,021	-,062	,851	-,122	-,090	,912	,163
More env friendly	,677	,157	-,377	,616	-,021	,091	,822	-,184	,144
Reduce waste	,667	,360	,025	,754	-,078	-,026	,686	-,138	,373
Increase recyclables	,757	-,093	,181	,780	-,064	-,105	,378	-,171	,711
Fairer distribution of costs	,749	-,214	,150	,633	,015	,362	,785	-,082	,169
Improve cleanliness	,854	-,112	,098	,517	-,417	,492	,874	-,103	,005
Aesthetic improvement	,805	-,067	,189	,333	-,382	,578	,804	,059	-,207
Increase unlawful behavior	,233	,064	,909	-,008	,064	,754	,189	,205	,652
Be more costly	-,081	,744	,130	-,066	,667	,264	-,194	,300	,632
Rationalize waste management	,676	-,131	,005	,706	-,158	,338	,784	,021	,233
Variance explained (%)	35,8	20,3	10,0	25,9	19,8	14,2	36,5	17,4	15,0

3.7 Associations

A chi-square test was conducted in order to conclude on the existence of association between dwelling type (detached house/duplex or apartment) and PAYT alternatives of (a) volume-based bag program, b) punch card weight-based system and c)

weight-based bin per property scheme). There was no statistically significant association between the dwelling type and the volume-based bag program ranked first ($p=0,683$). Similarly there is no statistical significant relationship between the dwelling type and the punch card weight-based system ($p=0,058$) stated as first choice. There was a statistically significant association between dwelling type and weight-based bin per property scheme ranked first ($p<0,05$). More specifically, there was a very weak negative association between the detached house/duplex and the weight-based bin per property scheme stated as first priority $\phi = - 0,142$, $p<0,05$. In effect, those living in single/semi-detached houses are less willing to have the weight-based bin per property scheme as their first priority compared to those living in a flat.

Discussion and Conclusions

The first aim of the present study was to investigate citizens' perceptions towards the proposed PAYT scheme versions comparatively to each other as well as to the currently implemented waste management system and waste charging mechanism. Survey results clearly show that the majority of respondents support the possibility of the adoption of one of the presented policy alternatives by their municipality of residence, thus indirectly stating their dissatisfaction with the status quo. The punch card weight-based system is the PAYT version most interviewees chose to name as their first priority, followed by the weight-based bin per property scheme and the volume-based bag program. It could be possible that the volume-based bag program is ranked last because the particular alternative demands a more obvious change in citizens' current habits regarding waste disposal, namely the purchase of special waste disposal bags. Furthermore, particularly in the case of multi-family buildings, the punch card weight-based system may be regarded as more fair compared to the weight-based bin per property scheme, since individual waste minimization efforts will accurately be reflected in applied waste charges. Despite the increased popularity of the introduced waste management program, interviewees do not exhibit enough trust towards their municipalities for the effective implementation of any of the three alternative programs included in the survey and are rather skeptical on whether fellow citizens will respect the operating rules of the alternative waste management system, once in place. These results may echo established public perceptions regarding the inefficiency of the public sector in Greece and fellow citizens' lack of ability to comply with rules set out by official authorities.

The survey also aimed to identify factors influencing citizens' attitudes towards the proposed alternative waste management system. The data analysis revealed a weak positive relationship between respondents' predisposition towards the possibility of their municipality of residence implementing a PAYT scheme version and citizens' level of trust

towards their municipality for an effective implementation of a volume-based bag program and of a punch card weight-based system as well as citizens' perceptions regarding public conformity to the rules set out by the above mentioned PAYT alternatives. Interestingly, there is no correlation between citizens' attitude regarding the possible implementation of a unit-pricing waste management program alternative by their municipality and their level of trust towards their municipality for an effective implementation of a weight-based bin per property scheme as well as peoples' perceptions regarding public conformity to the rules set out by that same waste management program. Moreover, there is no relationship between the former variable and citizens' first preference regarding the applied program alternative. The findings concerning the weight -based bin per property scheme may reflect respondents' concerns related to particular characteristics of the alternative, as is the proximity of the waste bin to ones residence (perceived as an aesthetic degradation of one's property and a source of sound pollution due to waste collection itineraries) and, in the case of multi-family buildings, the systems' inability to accurately reward individual waste minimization efforts while simultaneously failing to discourage incidence of free-riding. Furthermore, survey results showed that people who favor the possibility of a PAYT alternative adoption by their municipality are not willing to stay indifferent in front of phenomena of illegal waste dumping but, on the contrary, are ready to react accordingly. They also want to see municipalities implementing policies that ensure the proper operation of the alternative waste management system.

A closer examination of the three sample groups deriving from the PAYT alternative respondents have named as their first preference, leads to the conclusion that all three sample groups roughly follow the same pattern of answers focusing on PAYT benefits and drawbacks. The group of people who named the volume-based bag program as their first choice had a similar approach both towards the advantages and most of the disadvantages of the particular PAYT version when compared to the existing waste management system. The only variable that differentiates the particular sample group is the one that measures citizens' perceptions on whether the implementation of a volume-

based bag program, compared to the status quo, would lead to an increase of incidences of illegal waste dumping. In the case of the punch card weight-based system being ranked first, individuals exhibited a common pattern of answers regarding the system's environmental friendliness, its ability to reduce waste, increase recycling as well as its contribution to a fairer distribution of system costs among its users and to a rationalization of the waste management system when compared to the status quo. A second pattern of answers related to the systems' drawbacks, namely it being more time consuming, harder to use and more costly than the currently implemented waste management system. Once more, the factor that differentiates the group of people who preferred to see the implementation of a punch card weight-based system first, is the variable on increased illegal waste dumping. The group of citizens who named the weight-based bin per property scheme as their first choice, answer in a common fashion questions that relate to PAYT benefits. The same applies to the questions on whether the particular alternative is more time consuming and harder to use than the currently applied waste management system. In this group individuals followed the same pattern when providing answers to the questions on whether the weight-based bin per property scheme would lead to an increase of recyclables, of phenomena of illegal waste dumping as well as of waste management costs comparatively to the status quo. Further data analysis revealed that people who live in single/semi-detached houses are less willing to have the weight-based bin per property scheme as their first priority compared to those living in apartments.

A third aim of the study was to elicit individuals' opinion on the effective treatment of the dominant drawback of PAYT scheme implementation, namely illegal waste dumping, providing thus municipalities with valuable information for the adoption of both effective and popular mitigation policies. There seems to be a consensus among respondents that an increase in information campaigns, by municipalities, highlighting PAYT financial and environmental benefits, strict warnings to and fining of wrongdoers by municipalities as well as the reporting of offenders to competent authorities by citizens themselves can effectively limit the number of incidents of system misuse. There seems to

be a pluralism of opinions though on whether municipalities should resort to the publicizing of the offenders' names as a means to combat illegal waste dumping. Citizen's readiness to react themselves to incidents of system users' misconduct is an additional aspect municipalities could consider when designing policies to safeguard the operation of the PAYT scheme.

With the current legislative framework defining clear quantitative targets and timeframes for the alternative management of municipal waste while also pointing towards a realistic illustration of waste management costs in municipal waste charges Greece is forced to find ways to cope with its escalating waste production. Numerous economic instruments, with different impacts on waste management outcomes have been adopted by various municipalities around the world and "Pay-As-You-Throw" schemes, in particular, have proven their effectiveness towards waste prevention and enhanced waste diversion and recycling. And although waste charges in Greece are still based on a flat-rate system, the present study considered it was timely to investigate the Greek public's reception of different PAYT systems. The wide acceptability, within Greek citizens, of the likelihood of the adoption of a PAYT scheme by their municipality indicates that there is ground for the implementation of the alternative waste management system in Greece. Furthermore, the identification of some of the factors influencing individuals' perceptions on the particular economic instrument, highlight the need for a meticulous planning by competent authorities before its actual implementation. Further research on aspects of public acceptability of the alternative waste management program, as a vital parameter of its successful implementation in Greece, is deemed necessary.

As a final note we would like to refer to the generalizability of our findings. As we have mentioned earlier, our sample is not representative of the Greek population as a whole, thus the *descriptive* statistics results (i.e. the percentage of people opting for one PAYT scheme over the other; the percentage of people reporting offenders; and so on) will not necessarily hold for the Greek population in general. Nevertheless, it is a different story concerning the *analytic* statistics results (i.e. the correlation and PCA results) which explore the relations between the respondents characteristics/views and the PAYT

schemes. The restricted variability of our (not-representative-of-the-Greek-population) sample would result in weakened correlations. Thus, the fact that we did find a number of statistically significant correlations suggests that, albeit acknowledging the limitations posed by the specific characteristics of our sample which should serve as a note of caution as far as the interpretation of our results is concerned, it is rather unlikely that the sample's composition substantially affected the analytic results obtained, which accordingly may be considered representative of the actual situation.

References

- Batllevell, M. and Hanf, K. (2008) 'The fairness of PAYT systems: some guidelines for decision-makers', *Waste management (New York, N.Y.)*, vol. 28, no. 12, pp. 2793–2800.
- Bilitewski, B. (2008) 'From traditional to modern fee systems', *Waste management (New York, N.Y.)*, vol. 28, no. 12, pp. 2760–2766.
- Blaine, T. W., Lichtkoppler, F. R., Jones, K. R. and Zondag, R. H. (2005) 'An assessment of household willingness to pay for curbside recycling: A comparison of payment card and referendum approaches', *Journal of Environmental Management*, vol. 76, no. 1, pp. 15–22.
- COMMISSION OF THE EUROPEAN COMMUNITIES (2005) *Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions, Taking sustainable use of resources forward: A Thematic Strategy on the Prevention and Recycling of waste* [Online]. Available at <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52005DC0666&from=EN> (Accessed 20th March 2016).
- Dahlén, L. and Lagerkvist, A. (2010) 'Pay as you throw: strengths and weaknesses of weight-based billing in household waste collection systems in Sweden', *Waste management (New York, N.Y.)*, vol. 30, no. 1, pp. 23–31.
- Dijkgraaf, E. and Gradus, R. (2004) 'Cost savings in unit-based pricing of household waste', *Resource and Energy Economics*, vol. 26, no. 4, pp. 353–371.
- Dijkgraaf, E. and Gradus, R. (2009) 'Environmental activism and dynamics of unit-based pricing systems', *Resource and Energy Economics*, vol. 31, no. 1, pp. 13–23.
- Dunne, L., Convery, F. J. and Gallagher, L. (2008) 'An investigation into waste charges in Ireland, with emphasis on public acceptability', *Waste management (New York, N.Y.)*, vol. 28, no. 12, pp. 2826–2834.

- Ecological Recycling Society (2011) *The implementation of PAYT systems in Greek municipalities* [Online], Athens. Available at <http://www.payt.gr/images/stories/pdf/Meleth%20PAYT%20final.pdf> (Accessed 4th November 2014).
- Elia, V., Gnoni, M. G. and Tornese, F. (2015) 'Designing Pay-As-You-Throw schemes in municipal waste management services: A holistic approach', *Waste management (New York, N.Y.)*, vol. 44, pp. 188–195.
- 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* [Online]. Available at <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0013&from=EN> (Accessed 20th March 2016).
- 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* [Online]. Available at <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0571&from=EN> (Accessed 20th March 2016).
- EUROPEAN COMMISSION (2012) *USE OF ECONOMIC INSTRUMENTS AND WASTE MANAGEMENT PERFORMANCES* [Online]. Available at http://ec.europa.eu/environment/waste/pdf/final_report_10042012.pdf (Accessed 25th March 2016).
- European Council (1975, 1991, 1996, 2003) *15/442/EEC*.
- Eurostat (2016) *Municipal waste generation and treatment, by type of treatment method* [Online]. Available at <http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tsdpc240> (Accessed 3rd May 2016).
- Eurostat (2016) *Municipal waste statistics* [Online]. Available at http://ec.europa.eu/eurostat/statistics-explained/index.php/Municipal_waste_statistics (Accessed 16th July 2016).

- Everett, J. W. (1989) 'RESIDENTIAL RECYCLING PROGRAMS:ENVIRONMENTAL, ECONOMIC AND DISPOSAL FACTORS', *Waste Management & Research*, vol. 7, pp. 143–152.
- Hage, O., Söderholm, P. and Berglund, C. (2009) 'Norms and economic motivation in household recycling: Empirical evidence from Sweden', *Resources, Conservation and Recycling*, vol. 53, no. 3, pp. 155–165.
- Hellenic Official Gazzete (1958) *Royal Degree 24-9/20-10-58 "Codification in a single text of existing legal provisions regarding municipal revenues"*. FEK 171/A/20-10-1958.
- Hellenic Official Gazzete (1975) *Mandatory Law 25/21-04-1975 "Regarding the calculation and collection of municipal waste and street lighting charges and the regulation of relevant issues"*. FEK 74/A/21-04-75.
- Hellenic Official Gazzete (1989) *Law 1828/3-01-89 "Amending provisions regarding income tax and other provisions"*. FEK 2/A/3-01-89.
- Hellenic Official Gazzete (2002) *Joint Ministerial Decision 29407/3508/10-12-02 "Measures and conditions for the landfill of waste"*. FEK 1572/B/16-12-02.
- Hellenic Official Gazzete (2005) *Law 3345/16-06-05 "Financial issues of Prefectures and regulation of administrative issues"*. FEK 138/A/16-06-2005.
- Hellenic Official Gazzete (2010) *Law 3854/21-06-10 "Amending the legislation regarding the alternative management of packaging and other products and the National Organization for the Alternative Management of Packaging and Other Waste and other provisions"*. FEK 94/A/23-06-10.
- Hellenic Official Gazzete (2011) *Law 3979/14-06-11 "Concerning electronic governing and other provisions"*. FEK 138/A/16-06-2011.
- Hellenic Official Gazzete (2012) *Law 4042/13-02-12 " Criminal Law for Protecting the Environment. Compliance with Directive 2008/99 / EC - Framework for waste production and management – Harmonization with Directive 2008/98 / EC - Regulating issues of the Ministry of Environment, Energy and Climate Change"*. FEK 24/A/13-02-12.
- Hellenic Official Gazzete (2013) *Law 4164/5-07-13 "Supplementing the provisions concerning the national land registry and other provisions"*. FEK 156/A/9-07-2013.

- Hellenic Official Gazette (2014) *Law 4257/11-04-14 "Urgent regulations of the responsibility of the Ministry of Interior"*. FEK 93/A/14-04-2014.
- Hellenic Official Gazette (2014) *Law 4315/24-12-14 "Contributions in land and capital - urban expropriations and other provisions"*. FEK 269/A/24-12-2014.
- Hellenic Official Gazette (2015) *Cabinet Act 49/15-12-15 "Modification and approval of the National Waste Management Plan and the National Strategic Waste Prevention Plan ratified by 51373/4684/11.25.2015 Joint Decision of the Minister of Internal Affairs and Administrative Reconstruction and the Minister of Environment and Energy in accordance with Article 31 of Law 4342/2015"*. FEK 174/A/15-12-15.
- Hellenic Official Gazette (2015) *Joint Ministerial Decision 51373/4684/15 "Ratification of the National Waste Management Plan and the National Strategic Waste Prevention Plan"*. FEK 2706/B/15-12-15.
- Hellenic Official Gazette (2015) *Legislative Act 24/24-12-15 "Regulation of urgent matters of the Ministries of of the Interior and Administrative Reconstruction, of Environment and Energy, of Shipping and Island Policy, of Justice, Transparency and Human Rights, of Labor, Social Insurance and Social Solidarity, of Health, of Agricultural Development and Food and of Finance"*. FEK 182/A/24-12-2015.
- Hellenic Statistical Authority (2016) [Online]. Available at <http://www.statistics.gr/en/home> (Accessed 1st August 2016).
- Jin, J., Wang, Z. and Ran, S. (2006) 'Estimating the public preferences for solid waste management programmes using choice experiments in Macao', *Waste Management & Research*, vol. 24, no. 4, pp. 301–309.
- Jones, N., Evangelinos, K., Halvadakis, C. P., Iosifides, T. and Sophoulis, C. M. (2010) 'Social factors influencing perceptions and willingness to pay for a market-based policy aiming on solid waste management', *Resources, Conservation and Recycling*, vol. 54, no. 9, pp. 533–540.

- Jones, N., Sophoulis, C. M., Iosifides, T., Botetzagias, I. and Evangelinos, K. (2009) 'The influence of social capital on environmental policy instruments', *Environmental Politics*, vol. 18, no. 4, pp. 595–611.
- Karagiannidis, A., Xirogiannopoulou, A. and Tchobanoglous, G. (2008) 'Full cost accounting as a tool for the financial assessment of Pay-As-You-Throw schemes: a case study for the Panorama municipality, Greece', *Waste management (New York, N.Y.)*, vol. 28, no. 12, pp. 2801–2808.
- Karkanias, C., Malamakis, A., Kontogianni, S., Somakos, L., Chatzistelios, G., Chasapidi, T., Tsalidis, S., Lykourantzou, C., Aravosis, K., Tatsiopoulou, S. and Moussiopoulos, N. (14-18th 2015) *Pay-As-You-Throw project: monitoring the aspects of implementation*, fifth International Conference on Environmental Management, Engineering, Planning and Economics (CEMEPE) and to the SECOTOX Conference [Online]. Available at http://aix.meng.auth.gr/~ckarkanias/PAYTwebpage%20files/CEMEPE_PAYT.pdf (Accessed 3rd March 2016).
- Le Bozec, A. (2008) 'The implementation of PAYT system under the condition of financial balance in France', *Waste management (New York, N.Y.)*, vol. 28, no. 12, pp. 2786–2792.
- Linderhof, V., Kooreman, P., Allers, M. and Wiersma, D. (2001) 'Weight-based pricing in the collection of household waste: the Oostzaan case', *Resource and Energy Economics*, vol. 23, no. 4, pp. 359–371.
- Malamakis, A., Karagiannidis, A. and Perkoulidis, G. (2009) *SIMULATION AND ASSESSMENT OF ALTERNATIVE PAY-AS-YOU-THROW SCENARIOS AIMING AT MAXIMIZING MUNICIPAL WASTE DIVERSION BY THE RESULTING DIRECT PROMOTION OF MINIMIZATION AND RECOVERY SCHEMES* [Online], Twelfth International Waste Management and Landfill Symposium. Available at https://www.researchgate.net/publication/200752595_Simulation_and_assessment_of_alternative_pay-as-you-throw_scenarios_aiming_at_maximizing_municipal_waste_diversion_by_the_resulting_direct_promotion_of_minimization_and_recovery_schemes (Accessed 6th January 2016).

- Miranda, M. L., Bauer, S. D. and Aldy, J. E. (1996) *Unit Pricing Programs for Residential Municipal Solid Waste: An Assessment of the Literature* [Online]. Available at [https://yosemite.epa.gov/ee/epa/erm.nsf/vwAN/EE-0305-1.pdf/\\$file/EE-0305-1.pdf](https://yosemite.epa.gov/ee/epa/erm.nsf/vwAN/EE-0305-1.pdf/$file/EE-0305-1.pdf) (Accessed 3rd May 2016).
- OECD, Organization for Economic Cooperation and Development (2004) *Addressing the Economics of Waste* [Online], Paris, OECD Publishing. Available at <http://ewaste.pbworks.com/f/Economics+of+waste.pdf> (Accessed 2nd January 2016).
- Puig-Ventosa, I. (2008) 'Charging systems and PAYT experiences for waste management in Spain', *Waste management (New York, N.Y.)*, vol. 28, no. 12, pp. 2767–2771.
- Reichenbach, J. (2008) 'Status and prospects of pay-as-you-throw in Europe - a review of pilot research and implementation studies', *Waste management (New York, N.Y.)*, vol. 28, no. 12, pp. 2809–2814.
- Sakai, S., Ikematsu, T., Hirai, Y. and Yoshida, H. (2008) 'Unit-charging programs for municipal solid waste in Japan', *Waste management (New York, N.Y.)*, vol. 28, no. 12, pp. 2815–2825.
- Sauer, P., Parízková, L. and Hadrabová, A. (2008) 'Charging systems for municipal solid waste: experience from the Czech Republic', *Waste management (New York, N.Y.)*, vol. 28, no. 12, pp. 2772–2777.
- Simmons, D. A. and Widmar, R. (1989) 'Participation in Household Solid Waste Reduction Activities: The Need for Public Education', *Journal of Environmental Systems*, vol. 19, no. 4, pp. 323–330.
- Skumatz, L. A. (2008) 'Pay as you throw in the US: implementation, impacts, and experience', *Waste management (New York, N.Y.)*, vol. 28, no. 12, pp. 2778–2785.
- Skumatz, L. A. and Freeman, D. J. (2006) *Pay as you Throw (PAYT) in the US: 2006 Update and Analyses* [Online] (Accessed 29th November 2015).
- Slavik, J. and Pavel, J. (2013) 'Do the variable charges really increase the effectiveness and economy of waste management? A case study of the Czech Republic', *Resources, Conservation and Recycling*, vol. 70, pp. 68–77.

The Cornell Waste Management Institute (2001) *Pay As You Throw For Large Municipalities* [Online]. Available at <http://cwmi.css.cornell.edu/PAYTreport.pdf> (Accessed 6th January 2016).

The European Values Study (20th of 2016) *The European Values Study* [Online]. Available at <http://www.europeanvaluesstudy.eu/>.

The Regional Association of Municipal Solid Waste Management Bodies of Central Macedonia (2015) *Decision 8/3rd/2015, Pricing policy for the year 2016 of the Regional Association of Municipal Solid Waste Management Bodies of Central Macedonia, ΑΔΑ ΒΖΘΜΟΞΧΝ-ΧΚΒ* [Online], Thessaloniki. Available at <https://diavgeia.gov.gr/decision/view/%CE%92%CE%96%CE%98%CE%9C%CE%9F%CE%9E%CE%A7%CE%9D-%CE%A7%CE%9A%CE%92> (Accessed 1st August 2016).

The Solid Waste Management Organization of the Prefecture of Attica (2016) *Determination of annual fees and total contributions of member Municipalities to the Organization for the year 2016, ΑΔΑ ΩΡΕΓΟΡ05-ΕΤΣ* [Online], Athens. Available at <https://diavgeia.gov.gr/decision/view/%CE%A9%CE%A1%CE%95%CE%93%CE%9F%CE%A105-%CE%95%CE%A4%CE%A3> (Accessed 1st August 2016).

(2003) *Variable Rate Pricing based on Pay-As-You-Throw as a Tool of Urban Waste Management*, TU Dresden, Institute for Waste and Site Mgt. [Online]. Available at http://web.tu-dresden.de/intecuspayt/results/WP8_PAYTdemonstration%20proposal.pdf (Accessed 5th March 2016).

US EPA (2002) *Resource Conservation Challenge, Campaigning Against Waste* [Online], Washington, DC. Available at <http://nepis.epa.gov/Exe/ZyNET.exe/10000KXG.txt?ZyActionD=ZyDocument&Client=EPA&Index=2000%20Thru%202005&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&UseQField=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5CZYFILES%5CINDEX%20DATA%5C00THRU05%5CTX%5C00000005%5C10000KXG.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/>

x150y150g16/

i425&Display=p%7Cf&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackD
esc=Results%20page&MaximumPages=1&ZyEntry=1 (Accessed 1st January 2016).

Van Beukering, Pieter J H, Bartelings, H., Linderhof, Vincent G M and Oosterhuis, F. H.
(2009) 'Effectiveness of unit-based pricing of waste in the Netherlands: applying a
general equilibrium model', *Waste management (New York, N.Y.)*, vol. 29, no. 11,
pp. 2892–2901.

Van Houtven, G. L. and Morris, G. E. (1999) 'Household Behavior under Alternative Pay-as-
You-Throw Systems for Solid Waste Disposal', *Land Economics*, vol. 75, no. 4, pp. 515–
537 [Online]. Available at <http://www.jstor.org/stable/3147063> (Accessed 3rd April
2016).

www.payt.gr *Chamber system* [Online]. Available at [http://www.payt.gr/
index.php?option=com_content&view=article&id=31&Itemid=75&lang=en](http://www.payt.gr/index.php?option=com_content&view=article&id=31&Itemid=75&lang=en)
(Accessed 5th January 2016).

Appendix

Table 9 Sample and general Greek population's demographic characteristics in percentages

	Sample	Population
Gender		
<i>Male</i>	43,8	49,0
<i>Female</i>	54,8	51,0
Average age	37,9	41,9
Employment status		
<i>Employed</i>	72,2	34,4
<i>Unemployed</i>	7,4	7,9
<i>Retired</i>	2,3	22,3
<i>Students</i>	12,4	16,1
<i>Stay-at-home individuals</i>	1,7	11,3
<i>Other</i>	0,7	8,0
Level of education		
<i>Ph.D.</i>	8,7	0,4
<i>Postgraduates</i>	37,1	1,4
<i>Tertiary education graduates</i>	36,8	19,5
<i>Secondary school graduates</i>	16,1	25,8
<i>High school graduates</i>	0,3	10,9

Source: 2011 census data (Hellenic Statistical Authority, 2016)