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Greening Household  
Behaviour and Waste

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ENVIRONMENT WORKING PAPER No. 76 - GREENING HOUSEHOLD BEHAVIOUR AND WASTE

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## ABSTRACT

This report focusses on the determinants of household waste generation, the separation of recyclables and waste prevention behaviours. It presents the econometric results of follow-up analysis of the 2011 OECD Survey on Environmental Policy and Individual Behaviour Change (EPIC). This report complements the overview of the survey data provided in the publication « *Greening Household Behaviour: Overview from the 2011 Survey - Revised edition* » (2014).

In general, the results suggest that the most effective policy approach is to combine a pay-as-you-throw (PAYT) waste charge with intensive materials separation services (with the most intensive class of service being door-to-door collection of all separated materials). Yet this policy package is also typically among the most expensive to implement. Results from the survey imply that households charged for waste collection services via PAYT generate between 16 and 20 per cent less mixed waste, compared to households charged through other means. When separation rates are studied in relation to the presence of PAYT systems, it is found that households subject to these unit-based charges separate more, suggesting that these charges indeed work in part by channelling more recyclable waste away from the mixed waste stream.

Findings regarding the links between socioeconomic factors and waste generation largely confirm previous studies. Income and household size are both positively related to waste generation. On the other hand, higher-income households are also more likely to separate recyclable materials (though evidently not enough on average to offset their greater waste generation). In addition, whilst larger households produce more waste, *per capita* generation declines with household size, with each additional person in a household associated with only a 30 per cent increase in waste generation on average. With regard to waste prevention, the single most important factor predicting waste prevention effort (e.g. composting, adoption of reusable shopping bags) is whether or not individuals belong to environmental organizations. Whether a household is charged for waste collection via a PAYT system is also a strong and independent predictor of whether individuals engage more frequently in waste prevention.

**JEL Classification:** C51, D11, D12, H23, Q53, Q58

**Keywords:** waste generation, recycling, waste prevention, pay-as-you-throw pricing, household survey

## RÉSUMÉ

Ce rapport est consacré aux déterminants de la production de déchets ménagers, du tri des déchets recyclables et des comportements de prévention de la production de déchets. Il présente les résultats de travaux d'analyse économétrique qui s'inscrivent dans le prolongement de l'enquête sur la politique de l'environnement et le comportement individuel (EPIC) réalisée par l'OCDE en 2011. Ce rapport complète la synthèse des données de l'enquête présentée dans l'ouvrage « *Vers des comportements plus environnementaux : Vue d'ensemble de l'enquête 2011* » (2014).

En général, les résultats tendent à indiquer que la stratégie la plus efficace consiste à associer une redevance PAYT à un service de ramassage des matériaux de grande ampleur (le ramassage porte-à-porte de l'ensemble des déchets recyclables étant le service le plus complet). Cependant, cette panoplie de mesures figure aussi généralement parmi les plus coûteuses à mettre en place. D'après les résultats de l'enquête, les ménages payant une redevance déterminée en fonction de la quantité de déchets produits, via un système PAYT, produisent entre 16 et 20 % de déchets mixtes en moins que ceux soumis à d'autres dispositifs. Si l'on examine les taux de tri en fonction de la présence de systèmes PAYT, on constate que les ménages soumis à ces redevances unitaires trient davantage leurs déchets, ce qui laisse supposer qu'elles permettent effectivement de réduire la part des matériaux recyclables qui finissent parmi les déchets mixtes.

Les conclusions concernant les liens entre les facteurs socio-économiques et la production de déchets confirment dans une large mesure celles d'études antérieures. Le revenu et la taille des ménages sont corrélés de manière positive à la production de déchets. Cela étant, les ménages à revenu élevé ont davantage tendance à trier leurs déchets (même si, à l'évidence, cela ne suffit généralement pas à compenser cette production plus importante). En outre, si les familles nombreuses génèrent davantage de déchets, plus le ménage est grand, plus la production par membre est faible, chaque personne supplémentaire entraînant une hausse moyenne du volume de déchets de 30 % seulement. Quant à la prévention de la production de déchets, c'est le fait d'appartenir à une association de défense de l'environnement qui est le principal élément déterminant les efforts entrepris en ce sens (compostage, recours à des sacs de courses réutilisables, etc.). Enfin, un autre facteur indépendant qui conditionne largement les efforts consentis par les ménages pour réduire leur volume de déchets est l'existence d'un système PAYT.

**Classification JEL :** C51, D11, D12, H23, Q53, Q58

**Mots-clés :** production de déchets, recyclage, prévention de la production de déchets, redevances unitaires incitatives (PAYT), enquête ménages.

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## INTRODUCTION

Solid waste generation is positively related to the level of income and urbanization, with higher income and more urbanized economies generating higher levels of solid wastes per capita. Various types of solid waste make up the household fraction of municipal waste, including biodegradable food and kitchen waste, recyclable materials, such as paper, glass, plastic bottles, other plastics, metals and aluminium cans. Composite wastes such as clothing and children's toys, and household waste containing hazardous materials such as medicines, paint, batteries, light bulbs, fertilizer and pesticide containers and e-waste like old computers, printers, and cellular phones are also present in the collected waste from households.

In 2012, approximately 1.3 billion tonnes of municipal solid waste (MSW) were generated worldwide, equivalent to 1.2 kg per capita per day, compared to 0.68 billion tonnes per year, 0.64 kg per capita per day, a decade ago. The OECD countries generate an average of 2.2 kg/capita/day, double that of other regions. For comparative purposes, Table 1 presents MSW generation by region. MSW generation is expected to increase to around 2.2 billion tonnes per year, 1.42 kg per capita per day by 2025 (World Bank, 2012). Much of this increase is due to population growth, but generation rates are also influenced by economic development, industrialization, public habits and local climate. Urbanization and income level are highly correlated, and increases in income and standards of living, lead to an increase in consumption of goods and related services. These in turn increase the amount of waste that is generated (World Bank, 2012).

Waste composition is influenced by many socio-economic factors, such as economic development, climate, level of education, religious and cultural beliefs, and social and public attitudes. As a country becomes urbanized, and populations become wealthier, the use of plastics, paper and aluminium increases and the organic fraction decreases. Low- and middle-income countries have a higher proportion of organic wastes (59%-64%) whereas in high-income countries this proportion is much lower (28%-54%). Instead, these countries have a higher proportion of paper, plastics, glass and metals (33%- 55%), compared to low to medium income countries (19%-26%) (World Bank, 2012).

**Table 1. MSW generation around the world**

Region	MSW generation (kg/capita/day)
OECD	2.2
Central and South Africa	0.65
East Asia and Pacific	0.95
Europe and Central Asia	1.1
Latin America and the Caribbean (includes Chile)	1.1
Middle East and North Africa (includes Israel <sup>1</sup> )	1.1
South Asia	0.45

Source: Based on World Bank, 2012

The handling of household waste has become a significant policy issue for governments and municipalities. Due to increasing environmental awareness of the effects of contamination at landfills, as well as increasing environmental pressures caused by waste generation, environmental impacts are of central importance in waste management. At the same time, the increasing scarcity of some raw materials has led to greater demand for recovering resources from waste streams. Litter resulting from the illegal disposal of waste remains an administrative and economic issue. In addition, waste containing hazardous materials (e.g. batteries, electronics, and chemicals) can pose threats to human health and the environment, and hence require not only specialized management systems, but also awareness and cooperation from the public. Increasing pressure, both from central governmental entities and from the concerned public, is being placed on municipalities to increase the separation and recycling of valuable resources, and to manage waste in ways which minimize environmental and health risks.

In addition, producers and municipalities are required to meet strict targets set out, for example, by European landfill and packaging directives, and international waste shipments agreements (DEFRA 2013). These directives aim to divert waste from landfills, by increasing the fraction of waste separated for recycling. This has financial implications for local municipalities, as these entities are typically responsible for waste management especially with regard to households. A common question for municipalities is how much the cost of additional waste collection services, such as increasing access to waste separation services (e.g. door-to-door collection of recyclables) and the use of unit-based billing for waste collection (so-called pay-as-you-throw pricing, or PAYT), can be offset by reduced landfill fees from a reduction in mixed waste generation. The cost-benefit calculus will vary across contexts. In some cases introducing collection schemes for separated materials is a more expensive option, especially when taking into consideration that the degree of municipal waste recycling is largely dependent on the market demand for secondary raw materials and various other factors (e.g. the price of primary raw materials) (Slavic and Patel, 2013).

A first step in assessing the net benefits of different policies is analysing how they are likely to affect waste prevention, generation and separation behaviours. This study aims to provide such information, in particular by analysing how different waste management policies interact with households' attitudes to affect key behaviours such as waste generation and separation. The data comes from an OECD survey

<sup>1</sup> The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.



(EPIC) of over 12,000 households, focusing on environmental behaviour.<sup>2</sup> This study employs this data to examine several specific policy questions pertaining to recycling behaviour and waste prevention:

- Do unit-based waste fees (PAYT) have a significant effect on waste generation, prevention and separation relative to “flat” (or no) fees?
- To what extent are household waste generation and separation affected by attributes of waste management services (e.g., location and frequency of waste collection services)?
- How does the impact of PAYT vary depending on the levels of concurrent separation services, ranging from a low-level of service (e.g. drop-off for only some types of materials) to a high-level of service (e.g. door-to-door for most types of materials)?
- How do general attitudes towards the environment (environmental awareness, membership in environmental organization...) influence waste generation, disposal prevention and separation of wastes?

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<sup>2</sup> The present analysis is based on the 2011 data, summarised in OECD (2014). OECD household survey in 2008 (OECD 2011) was performed in the following 10 countries: Australia, Canada, Czech Republic, France, Italy, Korea, Mexico, the Netherlands, Norway and Sweden.

## LITERATURE REVIEW

In the review of related literature, several socioeconomic parameters have been found to affect the generation of household waste. A number of studies have found that household waste generation increases with increased income level (Bandara et al., 2007; Fiorillo, 2011; Afroz et al., 2010; Gorecki et al., 2010; Mazzanti & Zoboli, 2009; Jenkins et al., 2003; Hong et al., 1993). Other studies have shown that this increase in income level also corresponds to increased separation and recycling (Fiorillo, 2011; Halvorsen, 2010; Ferrara & Missios, 2005; Palatnik et al., 2005; Jenkins et al., 2003; Hong & Adams, 1999; Callan & Thomas, 1997), although there are further studies that show the opposite to be the case (Ashenmiller, 2011; Sidique et al., 2010a; Ashenmiller, 2006).

Household size also has an effect on the quantity of waste generated. Unsurprisingly larger families are found to produce in total more waste than smaller families (Monavari et al., 2011; Afroz et al., 2010; Gorecki et al., 2010; Bandara et al., 2007). However, the effect decreases with household size – i.e. as the number of members in the household increases there is a reduction in the amount of waste generated per capita (Thanh et al., 2010; Mazzanti & Zoboli, 2009; Scott & Watson, 2006).

Age is also been found to affect the amount of waste separated and recycled, with the likelihood of separating waste increasing with age (Ashenmiller 2011; Sidique et al., 2010a; Saphores et al., 2006; Meneses & Palacio, 2005).

The gender of respondents also has an influence. Ashenmiller (2011) found that the impact of financial incentives for reduced waste generation is less for women than for men, while Forillo (2011) found that men were – in absolute terms – less likely to separate their waste. The previous OECD study undertaken in 2008 (OECD, 2011) found that men were more likely to separate metal wastes, but not other materials. In a study about the separation of electronic (e)-waste, Saphores et al., (2006) found that women were more likely to recycle their e-waste compared to men.

Different studies have found differing results regarding the effect of education levels on waste generation. Folz and Giles (2002) found that a higher level of education increased the amount of household waste generated, whereas Monavari et al., (2011) found the opposite to be true. Alongside this, studies also indicate an increase in separation and recycling as the number of years of education increases (Fiorillo, 2011; Sidique et al., 2010a; Saphores et al., 2006; Ferrara & Missios, 2005; Jenkins et al., 2003; Callan & Thomas, 1997; Reschovsky & Stone, 1994).

Numerous studies undertaken in various countries have shown that the implementation of variable waste charges reduces the amount of household waste generated (Allers & Hoeben, 2010; Dahlen et al., 2010; Gorecki et al., 2010; Curtis et al., 2009; O’Callaghan-Platt & Davies, 2007; Scott & Watson, 2006; Folz & Giles, 2002; Kinnaman & Fullerton, 2000; Skumatz, 2000; Miranda & LaPalme, 1997; Fullerton & Kinnaman, 1996; Kutzmark & Canterbury, 1996; Miranda et al., 1994). There is also evidence that these waste charges also increase the quantity of waste separated for recycling (Allers & Hoeben, 2010; Sidique et al., 2010a; O’Callaghan-Platt & Davies, 2007; Kipperberg, 2007; Folz & Giles, 2002; Kinnaman & Fullerton, 2000; Bauer & Miranda, 2006; Miranda & LaPalme, 1997; Fullerton & Kinnaman, 1996; Kutzmark & Canterbury, 1996; Miranda et al., 1994; Hong et al., 1993), although in one case allowing a set number of free units under a unit pricing scheme actually reduced the amount of waste separated (Ferrara & Missios, 2005).

Reward and incentive schemes such as deposit-refund schemes also contribute to motivation regarding waste reduction and separation (Walls, 2011), although women are less likely to separate or recycle for cash than men (Ashenmiller, 2011). Ashenmiller (2011) also found that married people and older people were more likely to separate waste for cash as were those with low incomes.

The availability of collection systems and the range of materials which are collected have a clear impact on the amount of waste that is separated. Householders are more likely to separate and recycle up to twice as much waste with the availability of door-to-door (curbside) collections compared to drop-off centres (Fiorillo, 2011; Beatty et al., 2007; Kipperberg, 2007; Saphores et al., 2006; EPA, 2005; Jenkins et al., 2003; Callan & Thomas, 1997; Fullerton & Kinnaman, 1996; Rechovsky & Stone, 1994; Hong et al., 1993). When curbside collection is offered in conjunction with the provision of drop-off centres for separated waste materials, further improvements in the recycling performance are seen (Sidique et al., 2010a; Hong & Adams, 1999). However, the operational costs of the provision of drop-off centres are lower compared to that of curbside collections as they are less labour-intensive and transfer the transportation cost to households. Therefore, they are considered easier and quicker to be implemented by the waste management authorities, particularly in low population density areas (Bohm et al., 2010; Saphores et al., 2006; Tiller et al., 1997).

Mandatory separation and recycling programmes have been found to increase the rate of recycling (Palatnik et al., 2005; Sidique et al., 2010a; Ferrara & Missios, 2005; Miranda & LaPalme, 1997). Broitman et al. (2012) found that source separation leads to high-quality and high-value recoverable waste streams with recycling rates expected to be higher than under other mandatory systems.

Knowledge and information can play an important role in increasing recycling participation and reducing the amount of waste generated, thus making the citizens more active and competent recyclers (Hong & Adams, 1999; Bauer & Miranda, 1996). According to Evison and Read (2001), education, publicity and promotion are fundamental for the success of any recycling scheme. The provision of quality promotional material on a regular basis is required, including regular leaflets to help maintain public awareness. In regard to this, Tucker & Speirs (2002) recommended three classes of educational materials: newsletters and media campaigns on pro-recycling attitudes and composting; specific information/awareness campaigns (reminding the public to put out bins on certain weeks); and personal letters (these reinforce the idea that every individual's action counts).

Studies investigating motivation have found that respondents' norms, both moral and social, are important drivers of recycling behaviour (Fiorillo, 2011; Halvorsen, 2012; Sidique et al., 2010b; Aadland & Caplan, 2005; Tonglet et al., 2004). These personal norms are an internal motivational factor and represent behaviour that is thought to be the right thing to do and represents the individual's values and moral obligations to act in a socially optimal manner. In the same way, a positive attitude towards environmental issues in general will convince households that their recycling efforts are important for improving environmental qualities (Prestin & Pearce, 2010; Halvorsen, 2012). Table 2 summarises parameters that are found to significantly affect households' waste generation and participation in source separation schemes in the cited literature, focusing on developed countries – the same as current study.

Table 2. Summary of the results in previous studies in developed countries.

(+ represents an increase, - represents a decrease, 0 represents no effect)

Independent Variable	Income	Household Size	Age	Gender (Male)	Education	Fee	Mandatory	Community Education	Promotion	Collection System	Country
<b>Amount of waste generated</b>											
Allers & Hoeben 2010						-					Netherlands
Bauer & Miranda 1996								-		-	US
Curtis et al. 2009						-				-	Ireland
Dahlen et al. 2010						-					Sweden
Fiorillo 2011	+										Italy
Folz & Kinnaman 1996					+	-					US
Fullerton & Kinnaman 1996	-					-					US
Gorecki et al. 2010	+	+				-					Ireland
Hong et al 1993	+					-					US
Jenkins et al. 2003	+										US
Kinnaman & Fullerton 2000						-					US
Kutzmark & Canterbury 1996						-					US
Mazzanti & Zoboli 2009	+	+									EU
Miranda et al. 1994						-					US
Miranda & LaPalme 1997						-	-				US
O'Callaghan-Platt & Davies 2007						-					Ireland
OECD 2011		-									10 OECD
Palatnik et al. 2005	+	+				-	-	-	-		Israel
Scott & Watson 2006		-				-					Ireland
Skumatz 2000						-					US
Slavik and Pavel, 2013						-					Czech Rep.
Summary	+	?			+	-	-	-	-	-	
<b>Volume of waste recycled / separated</b>											
Allers & Hoeben 2010						+					Netherlands
Ashenmiller 2006	-										US
Ashenmiller 2011	-		+	+							US
Bauer et al. 2005						+					US
Beatty et al. 2007										+	US
Callan & Thomas 1997	+				+	+				+	US
Dahlen et al. 2010						0					Sweden
EPA 2009										+	Ireland
Ferrara & Missios 2005	+				+		+			+	Canada

Independent Variable	Income	Household Size	Age	Gender (Male)	Education	Fee	Mandatory	Community Education	Promotion	Collection System	Country
Fiorillo 2011	+			+	+					+	Italy
Folz & Kinnaman 1996	0				0	+				0	US
Fullerton & Kinnaman 1996						+					US
Halvorsen 2012	+					-					Norway
Hong et al. 1993						+					US
Hong & Adams 1999								+		+	US
Jenkins et al 2003					+					+	US
Kinnaman & Fullerton 2000						+					US
Kipperberg 2007			+			+				+	Norway / US
Kutzmark & Canterbury 1996						+					US
Meneses & Palacio 2005			+								Spain
Miranda et al. 1994						+					US
Miranda & LaPalme 1997						+	+				US
O'Callaghan-Platt & Davies 2007						+					Ireland
OECD 2011	+	+	+	+	+	+	+				10 OECD
Reschovsky & Stone 1994					+	0					US
Saphores et al 2006	+			-	+					+	US
Šauer et al. 2008						+					Czech Rep.
Sidique et al 2010a	-		+		+	+				+	US
Slavik and Pavel, 2013						+					Czech Rep.
Walls 2011										+	US
<b>Summary</b>	?	+	+	?	+	?	+	+		+	
<b>Willingness to Pay for waste collections</b>											
Aadland & Caplan, 2005			+	+	+						US
Gillespie & Bennett 2011	+			-							Australia
Jamelske & Kipperberg 2006	+		-	-	+						US
Palatnik et al. 2005	+		+		+	-	+	+	+		Israel
<b>Summary</b>	+		+	-	+	-	+	+	+		
<b>Waste prevention</b>											
OECD 2011	-		-	-		+	+				10 OECD
Pham 2011	-		+								UK
<b>Summary</b>	-		?	-		+	+				

## DESCRIPTION OF SOCIO-ECONOMIC AND ATTITUDINAL VARIABLES USED IN THE ANALYSIS

Using the questionnaire employed in the survey (see OECD 2014), the following independent variables were constructed for inclusion in the empirical analyses of waste generation, waste separation, waste prevention and the use of recycling labels in the purchasing decision. A full description and definition of each of the variables used in the analysis can be found in Annex 1.

The **socio-demographic characteristics** assessed in relation to waste-related behaviours are the survey respondents' age, gender, education level (number of years in postsecondary education), and marital status (i.e. whether s/he is married or living as a couple). In addition, the size of the respondent's household, household income, residence type, area type and home tenure.

**Attitudinal characteristics** are analysed using the following variables. Respondents expressed satisfaction with their life, ranking of serious issues facing the world today and respondents' view of how serious waste generation issues are. Some other attitudinal characteristics investigated were participation in general election, and participation in an environmental organisation (participation=1). In addition, the regression analyses also includes attitudinal variables generated from a clustering procedure performed on a set of 7 attitudinal statements related to altruism, views towards environmental policy, and perceived importance of future generations. Respondents were asked for their levels of agreement with these statements, and their responses to the whole set were used as the basis of the clustering procedure (details can be found in Chapter 2 of OECD 2014).

The next part of the survey looked at the more waste-specific factors, including policy variables such as charging systems and service availability. The role of waste collection frequency was assessed, with other factors, in relation to how much mixed waste that respondents generated per week.

In terms of recycling service availability, respondents were asked to indicate what collection services were available for the five most-relevant materials (metal, plastic, paper, glass, and food and garden waste). Respondents that had a service available were also asked to estimate the percentage of each material that they separated for recycling. To summarize relative service availability across materials, three categories of service level were defined in the data: a household with access to a "high level" of service is defined as having door-to-door collection for glass, paper, plastic, and metal. A "medium level" of service is defined as having drop-off services for all of these materials, or a door-to-door service for at least one (but not all) materials. A "low level" of service is defined as having drop-off service available for some – but not all – materials, and no door-to-door collection of recyclables. Lastly, the "no service" category is defined as having no drop-off or door-to-door collection of glass, paper, plastic or metal recyclables.

A key area of focus in the analysis is the use of unit-based charging for the collection of mixed waste, i.e. PAYT charging schemes. However, there is considerable variation across countries with respect to the presence of PAYT schemes and - for those which have such schemes - their associated fee levels. Currently, the survey data shows only Canada, Japan, Korea, the Netherlands, Sweden and Switzerland as having non-negligible levels of weight/volume charging systems in place. In the other surveyed countries, flat fees are the most frequently reported billing system (these fees are usually set according to size of residence; see OECD 2014, Chapter 7 for descriptive statistics related to waste behaviours and policies, including billing systems).

A key area of importance for policy guidance relates to possible interaction effects both among policy instruments (e.g. the combined effect of PAYT with differential levels of separation services) and between the policy variables and socio-demographic or attitudinal characteristics.

To analyse the interaction effects between PAYT and recycling service availability and capture possible complementary effects among policies, the dummy between unit-pricing and recycling services for each type of material was constructed. A full breakdown of service availability by population percentages can be found in Annex 2.

General support of various government actions were also rated in the survey, and included in the regression analysis summarized below.

Sample weights were also applied in all regressions, to ensure that the results corresponded to representative samples within each country and accounted for the different population sizes between countries. The construction of these weights can be found in the general background documentation for the survey.

## EMPIRICAL RESULTS

Regression analysis was used to investigate the independent role of a range of factors in determining relevant outcomes measured in the survey. The regression results presented here correspond to an analysis of the data pooling all 11 countries together (including country-level fixed effects throughout), and present only factors which were found to be statistically significant determinants of the target outcomes (waste generation, separation, and prevention).<sup>3</sup>

A series of tables (available upon demand) provides the full regression results, including estimates for factors which were not found to be statistically significant. Matching country-level regressions were also performed; these are also contained in the Annex (available upon demand). In some cases, regressions are presented using data pooled only from a subset of the 11 countries; a rationale for the sample construction is provided in such cases.

Before turning to the regression results, it is informative to summarise some of the key outcomes of interest, as well as the prevalence of different waste management services and practices. As shown in the figures in Annex 2, an estimated 36% of households in the surveyed countries enjoy a high-level of recycling services, which – recall – is defined here as door-to-door collection of separated metal, glass, paper and plastic wastes. An additional 53% have a medium-level of service available, i.e. either drop-off service for all four of these materials or door-to-door collection of at least one (but not all) of them. Only 3% of households report having no access to recycling services.

Nearly a quarter of households in the surveyed countries pay for waste collection via pay-as-you-throw (PAYT) systems: these households are generally concentrated in Canada, Korea, Japan, the Netherlands, Sweden, and Switzerland (additional summary statistics by country are reported in OECD 2014). In general, PAYT are much likely to arise in areas with medium- or high-level recycling services: 30% of households with access to high-level of recycling services pay for waste collection via PAYT systems, whereas only 10% of households with access to only low-level recycling services pay for their waste via PAYT.

Figure 1 displays average waste generation volumes per household in each country. From this figure, it is seen that in general, those countries having some level of PAYT system in place do in fact generate less mixed waste than countries without this charging system in place (PAYT range 37.8 to 121.2 litres per week compared with 119.2 to 235.4 litres per week in countries without PAYT).

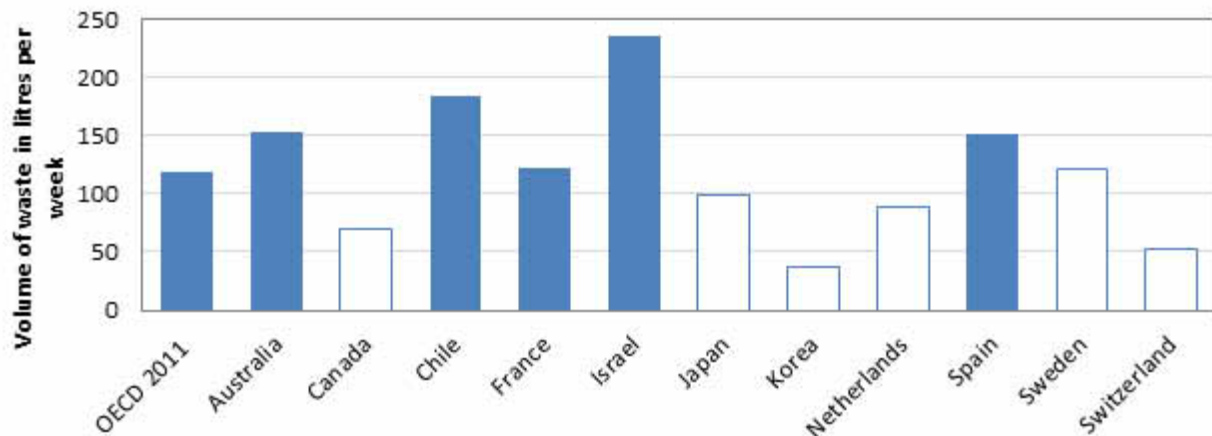
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<sup>3</sup> In some tables, the values are different from those in the appendices because insignificant values were removed one by one to improve the number of respondents and the R2 values. The marginal effects analyses were then run for some of these tables. These new analyses were used in the report but the full original analyses, including the insignificant variables, are available in the Annexes.



**Figure 1. Mixed waste volumes generated per household by country**

Unfilled bars correspond to countries with more than 5% prevalence of PAYT systems for billing waste collection.



## 1 Factors affecting waste generation

Table 3 summarizes the factors found to be significantly associated with mixed waste generation. An ordinary least squares (OLS) regression was performed using the natural logarithm of weekly waste generation volumes as the dependent variable, and a set of explanatory variables hypothesized – based on the literature – as being associated with household waste generation.

As expected socioeconomic factors are key determinants of waste generation, independent of other factors. A 10% increase in income is associated with a 1.2% increase in waste generation. In line with previous studies, larger households also generate more waste, although the relationship is less than proportional to household size. On average, a single-person household generates 5% *more* waste *per capita* than two-person households. For households with two or more persons, each additional household member is associated with between a 20% and 40% increase in total household mixed waste generation.

Respondents living in towns/villages or rural areas produce between 6% and 17% less waste on average than those in cities and suburban areas. It is important to note that this finding focuses on the independent effect of living in cities or suburbs, and controls for service availability and the incidence of PAYT systems (which tend to be greater in cities and suburbs, and which are found to reduce waste generation). Respondents' levels of post-secondary education appear to have a minimal association with household waste generation.

Table 3. Factors affecting the reported mixed waste volume generated for disposal (OLS)

Dependent variable: LOG (Vol. waste generated per week)		POOLED SAMPLE	Japan and Korea	Canada, Sweden, Switzerland, & the Netherlands
<i>Separation service*</i>	<i>Pay-as-you-throw?</i>			
Low-level service	No PAYT	0.03 (0.05)	0.49** (0.23)	0.04 (0.10)
	PAYT	-0.24 (0.20)	-0.29 (0.26)	0.12 (0.24)
Medium-level	No PAYT	-0.06 (0.05)	0.13 (0.10)	-0.05 (0.09)
	PAYT	-0.31*** (0.08)	-0.10 (0.11)	-0.27** (0.11)
High-level	No PAYT	-0.09* (0.05)	0.15 (0.10)	-0.31*** (0.10)
	PAYT	-0.31*** (0.07)	-0.10 (0.10)	-0.58*** (0.15)
Collection Frequency		0.04*** (0.01)	0.04*** (0.02)	0.06*** (0.02)
Log (household income)		0.12*** (0.03)	0.16*** (0.05)	0.12** (0.05)
Age (years)		-0.04*** (0.01)	-0.05*** (0.02)	-0.04*** (0.01)
Age <sup>2</sup>		0.00*** (0.00)	0.00*** (0.00)	0.00** (0.00)
<b>Household size (compared single-member households)</b>				
Two members		0.64*** (0.01)	0.77*** (0.10)	0.47*** (0.06)
Three members		0.93*** (0.06)	0.87*** (0.10)	0.93*** (0.07)
Four members		1.10*** (0.05)	1.06*** (0.10)	1.05*** (0.08)
Five or more members		1.41*** (0.06)	1.34*** (0.12)	1.22*** (0.11)
<b>Years Post-secondary Ed. (compared to no post-secondary education)</b>				
5 years		-0.13** (0.05)	-0.16 (0.14)	-0.06 (0.08)
8 or more years		-0.02 (0.07)	0.04 (0.10)	-0.20** (0.08)
<b>Location (compared to city dwellers)</b>				
Living in a suburban area		0.02 (0.04)	0.05 (0.06)	-0.04 (0.06)
Living in a small town or village		-0.07* (0.04)	-0.16** (0.08)	-0.02 (0.05)
Living in isolated dwellings		-0.18** (0.09)	-0.30 (0.22)	-0.09 (0.10)
Homemaker		-0.12* (0.07)	-0.14 (0.10)	-0.06 (0.12)
Seeking a job/unemployed		-0.02 (0.07)	0.12 (0.13)	-0.08 (0.11)
Student		-0.21*** (0.07)	-0.16 (0.13)	-0.25* (0.13)
Technological Optimists		-0.02 (0.04)	-0.04 (0.07)	0.13** (0.06)
Environmental Sceptics		0.06* (0.03)	0.05 (0.06)	0.20*** (0.05)
Recently voted in local elections		-0.06** (0.03)	0.06 (0.06)	-0.21*** (0.02)
No. of observations		<b>8881</b>	<b>1698</b>	<b>3095</b>
R-square		<b>0.3286</b>	<b>0.3729</b>	<b>0.2847</b>

Robust standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country level fixed effects and regression constant included in estimation but not shown in table, sampling weights used in estimation.

\* Separation service levels are defined in the analysis as follows: **Low-level** service is defined as drop-off services available for only some materials (plastic, paper, metal, or glass), **medium-level** service is defined as drop-off services available for all of these materials and/or some door-to-door collection of at least (but not all of these materials), a **high-level** of service is defined as a door-to-door collection service for all four materials.

Respondents expressing concern for the accumulation of waste generate a lower volume of waste both in the pooled sample, as well as in country-specific analyses of the sample for Australia, Japan, Sweden and Switzerland. The effect of environmental attitudes in the pooled sample is reflected in the positive and significant effect of the indicator for “environmental sceptics” (relative to extreme responders).

A binary variable PAYT was created, with a value=1 for those respondents stating that they have a waste charging scheme by weight/volume. This was interacted with variables reflecting the presence of different recyclable material collection systems. As noted, not all of the countries represented in this survey have a unit pricing scheme in place, so the country level effects of respondents having a waste charging scheme in place was restricted to those countries that have the scheme to a significant extent. This included Canada, Japan, Korea, the Netherlands, Sweden and Switzerland.

In the pooled sample, households who pay for waste collection via PAYT systems generate between 16% and 20% less mixed waste on average (controlling for other factors), although this effect is only statistically significant among those who also have access to a medium- or high-level recycling service.

Other than through the interaction with PAYT systems, there appears to be only a mild direct association in the pooled sample between waste generation and access to recycling services. However, when focusing on certain subsets of countries, the effect of recycling service access is much more pronounced: In Canada, the Netherlands, Sweden and Switzerland (all countries with more than 5% of households charged via PAYT), increasing recycling service from a medium to a high level (essentially, shifting from a drop-off to a door-to-door system) is associated with between a 26% and 31% decrease in mixed waste generation, depending on whether or not PAYT is also present. In the sample for Korea and Japan, among those who are not subject to PAYT and who have relatively inconvenient recyclables collection services waste generation rates are considerably higher. The conclusion at the end of this report discusses the potential reasons for these country-level differences in the estimated effects of PAYT and recycling service provision.

Finally, Table 3 regression results also imply that lower mixed waste collection frequencies are associated with less waste generation. Each additional collection that is regularly made on an average week is associated with a 4% increase in mixed waste generation. This is also seen in the country-specific models for Australia, France, Japan, Korea, Sweden and Switzerland.

## **2 Factors affecting waste separation**

The decision to separate waste is subject to country specific cultural and economic decisions that affect all aspects of household waste behaviour. Binary variables were constructed for each of the four materials (glass, metal, paper and plastic) taking on a value of 1 if the respondent indicated that it was separated at all. Food is not presented in this report. Waste separation rates by type of material at a country level are presented in Annex 3. It is important to note that the decision to separate each waste type is dependent upon the availability of collection services for each material type.

Probit regression analysis was run with a wider range of explanatory variables to capture expected effects as seen in the literature, and can be found in the separate Annex in tables A through D, along with the country-by-country breakdown. A summary of the statistically significant results for the pooled sample are presented in Table 4.<sup>4</sup>

The analysis indicates that there is a statistically significant and positive relationship between the likelihood of separating glass, metal and paper wastes and yearly household income. Similar trends were also seen in some of the countries, but not all. The variables for home tenure and home ownership were also investigated but the coefficients are not statistically significant. Households living in isolated areas separate more glass and metal waste in percentage terms than their urban and suburban counterparts. Married couples are more likely to separate their waste, in line with the previous survey (OECD, 2011).

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<sup>4</sup> This table presents the results after removing the insignificant variables one by one, compared to the Annexes where all the variables are included. This explains existing differences.

In terms of policy-related variables, analysis of the pooled sample indicates that respondents having a door-to-door collection scheme in place are more likely to separate their wastes. This is true of the country-specific models as well, with very few exceptions by material and country. The magnitude of impacts is greatest for metal, followed by glass, paper and finally plastics. Surprisingly, respondents with drop-off centre schemes available have almost the same probability of separating wastes. The only exception to the finding that drop-off centres have a positive and significant impact is the case of paper in Korea.

Respondents who feel they are satisfactorily informed about the availability of recycled materials collection schemes are more likely to separate their metal, paper and plastic wastes in the pooled sample. On a country level, respondents in Canada, Israel, Korea and Sweden are more likely to separate their glass wastes when they are informed about the availability of services in their neighbourhood. This is also found to be the case in France and Japan for metal wastes; Australia, Spain and Switzerland for paper wastes; and, Canada and Spain for plastic wastes.

**Table 4. Participation in separation of waste – Probit (marginal effects)**

	GLASS WASTE SEPARATION	METAL WASTE SEPARATIONS	PAPER WASTE SEPARATION	PLASTIC WASTE SEPARATION
Married Indicator	0.00 (0.01)	0.01* (0.01)	0.01** (0.01)	0.01 (0.01)
Years post high school education	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Yearly household income	0.03*** (0.01)	0.02*** (0.01)	0.01*** (0.01)	0.01 (0.01)
Major Town / City dwelling	-0.02* (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.02 (0.01)
Suburban dwelling	-0.02* (0.01)	-0.02* (0.01)	0.00 (0.01)	0.00 (0.01)
Collection frequency	-0.01* (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Availability of door to door collection for separated material	0.25*** (0.03)	0.36*** (0.02)	0.23*** (0.02)	0.15*** (0.01)
Availability of drop off centres for separated material	0.25*** (0.02)	0.35*** (0.02)	0.22*** (0.02)	0.16*** (0.02)
Availability of bring back scheme no refund for separated material	0.23*** (0.03)	0.37*** (0.03)	0.20*** (0.02)	omitted
Availability of bring back scheme with refund for separated material	0.16*** (0.06)	0.35*** (0.02)	0.20*** (0.03)	0.11*** (0.02)
Motivated by Civic Duty	0.01*** (0.00)	0.00 (0.00)	0.00 (0.00)	0.00* (0.00)
Motivated by Environmental Benefits	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Motivated by reducing waste charge	0.00 (0.00)	0.00 (0.00)	0.00*** (0.00)	0.00 (0.00)
Motivated by being seen as responsible citizen	0.00 (0.00)	0.00** (0.00)	0.00*** (0.00)	0.00** (0.00)
Informed about Recycling	0.01 (0.01)	0.01** (0.01)	0.02*** (0.01)	0.02*** (0.01)
Charged by weight / volume (PAYT)	0.04** (0.02)	0.00 (0.01)	0.00 (0.01)	0.02 (0.01)

Robust standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Country level fixed effects and regression constant included in estimation but not shown in table, sampling weights used in estimation.

The effects of deposit-refund schemes were also assessed. This is primarily relevant for glass and metal wastes, which are significant and positive in the pooled sample. At the country-specific level there is a positive effect across all the countries for glass waste with the exception of Japan, the Netherlands and Switzerland. For metal waste, all countries except Japan once more show a positive correlation. The

availability of a bring back to retailer / manufacturer scheme, without a refund, has a positive effect on the likelihood of separating glass, metal and paper waste in the probit regression results for the pooled sample.

In the pooled sample respondents subject to a PAYT charging scheme are more likely to separate glass in their waste. For the other materials the coefficient is not statistically significant. In the country-specific samples there is much variation in the materials for which PAYT has a statistically significant effect on separation (see Tables A through D).

The analysis was restricted to those countries having a significant number of respondents reporting the presence of a waste charging scheme: Canada, Japan, Korea, the Netherlands, Sweden and Switzerland. The Netherlands and Switzerland show a positive relationship between unit pricing and metal waste separation. Respondents in the Netherlands are also more likely to participate in waste separation with a unit pricing scheme in place for paper wastes, and respondents in Canada and Japan are more likely to separate their plastic wastes.

Collection frequency for mixed wastes has an effect on the amount of glass waste separated: the less often mixed waste is collected, the more likely respondents are to separate their waste. This effect probably arises since separation reduces the inconvenience associated with overflowing mixed waste bins. The pooled sample of respondents indicated no significant effect of the collection frequency of mixed solid waste on the respondents' participation in separating their metal, paper, and plastics waste.

Individual motivation is clearly another key factor in the decision to separate waste. Respondents that are motivated by civic duty are more likely to separate their wastes than other respondents, although those that would like to be seen as a "responsible citizen" also show some significance for participation in waste separation.

## **2.1 Intensity of waste separation**

After identifying the factors that influence a household's participation in source separation of recyclable materials, linear regression was undertaken to investigate the actual amount of wastes that are separated and the factors affecting it. Regression was run on the pooled sample for each of the materials and a summary of the results for the pooled sample are presented in Table 5. The country level breakdown including the insignificant variables can be found in Tables E through H.

Analysis of the pooled sample indicates that the following characteristics induce waste separation effort: gender (males separate more metal wastes), marital status (married respondent separate more of all materials except paper), age (older respondents separate more metal and paper), years in post-secondary education (all materials). Living in a suburban area decreases the amount of metal waste separated relative to respondents living in rural and isolated areas (i.e. "others" the reference group). Home tenure and home ownership were included in the analysis, but were found to be insignificant, as was a variable reflecting whether people live in a major city or town.

The country-specific models show some differences. For example, significant effects are found the gender indicator (male = 1) for all four materials in France and Switzerland. Married respondents in Spain separated more glass, paper and plastic wastes, whereas respondents in Sweden separated less glass metal and plastic materials.

The availability of drop-off centres and door-to-door collection both have a positive impact for all wastes. However, the differences in the coefficients are very small. On a country level, when there is a presence of door-to-door collection for recyclable materials, more glass is separated in Australia, Canada, Israel, and Sweden; more metal wastes are separated in Canada, France and the Netherlands; more paper in Australia, France, Israel, Sweden and Switzerland; and more plastic wastes in Australia, France, Korea, and Sweden. In the case of paper, the signs for Switzerland and Spain are counter-intuitive. At the country level drop-off centres have a significant effect on metal wastes in Korea and the Netherlands. For paper waste the effect is positive and significant in Israel, Sweden and Switzerland. And finally, in Australia, Chile and Sweden more plastic wastes are separated in the presence of drop-off schemes.

Availability of a bring-back scheme with refund was found to have no significant impact on volume of wastes separated in the pooled sample. However, respondents in Israel separate more of their glass. Respondents in Canada and Sweden separate more metal waste with the availability of a deposit-refund scheme. The availability of a bring-back scheme with no refund has a positive effect on the quantity of metal waste separated in the Netherlands. The sign is counter-intuitive for Spain. The amount of plastic waste separated increases in Chile in the presence of such a scheme, although it is likely that respondents confused the bring-back scheme with a deposit-refund scheme.

Awareness of services availability is important. Respondents who feel that they are informed about the recyclable materials collections in their area separate more of their glass wastes, paper wastes and plastic wastes in the pooled sample, confirming the importance of educating the public on the availability of services available in their area.

In the pooled sample, as the frequency of mixed waste collection decreases, there is an increase in the quantity of glass, metal, paper and plastic waste separated. At the country level, respondents in Canada and Sweden separate more glass; respondents in Canada and France separate more metal and plastic wastes; and respondents in Canada and Korea separate more paper wastes.

The results of pooled sample indicate that both civic duty and environmental benefits are motivating factors for separation of all materials. The coefficient for environmental benefits is greater than that for civic duty only for plastics. There is wide variation across materials and countries.

Table 5. Intensity of Waste Separation for recyclable materials - OLS

INDEPENDENT VARIABLES	GLASS	METAL	PAPER	PLASTIC
Male indicator	1.47 (0.96)	2.16** (0.98)	0.63 (0.89)	-0.18 (0.92)
Married Indicator	1.72* (1.05)	2.02* (1.15)	1.51 (1.06)	2.06* (1.08)
Age of respondent	0.05 (0.04)	0.15*** (0.04)	0.16*** (0.04)	-0.00 (0.04)
Household size	0.69* (0.39)	1.21*** (0.41)	1.05*** (0.37)	0.69* (0.37)
Years post high school education	0.39*** (0.15)	0.31** (0.17)	0.60*** (0.17)	0.42*** (0.16)
Log of yearly household income	3.19*** (0.89)	1.53 (0.94)	0.98 (0.88)	2.21** (0.90)
Living in a suburban area	-1.59 (1.07)	-2.18* (1.16)	-0.19 (1.07)	-0.90 (1.08)
Technological optimists	-2.02 (1.25)	-1.54 (1.20)	-0.88 (1.16)	-1.54 (1.15)
Availability of door to door collection for separated material	15.28*** (1.52)	32.99*** (1.69)	21.65*** (1.76)	17.47*** (1.48)
Availability of drop off centres for separated material	15.51*** (1.48)	30.81*** (1.61)	18.42*** (1.76)	14.12*** (1.40)
Motivated by civic duty	1.44*** (0.31)	1.41*** (0.33)	1.47*** (0.30)	1.11*** (0.30)
Motivated by environmental benefits	1.22*** (0.35)	1.16*** (0.36)	1.35*** (0.35)	1.65*** (0.35)
Informed about recycling	2.68*** (0.93)	1.42 (1.00)	2.57*** (0.92)	3.00*** (0.95)
Collection frequency	0.98** (0.49)	1.08** (0.49)	1.61*** (0.44)	1.50*** (0.47)
Constant	-33.59** (8.36)	-19.76 (8.97)	2.11 (8.55)	-31.90*** (8.41)
No of Observations	8564	8573	8744	8687
Adj R Squared	0.4189	0.4244	0.4538	0.3870

Robust standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Country level fixed effects and regression constant included in estimation but not shown in table, sampling weights used in estimation.

Surprisingly, there was no homogeneity in the way unit fees affect waste separation. Indeed there are a large number of counter-intuitive results with the presence of PAYT having a negative effect on separation. The variables reflecting underlying environmental attitudes also play an insignificant role.

### 3 Factors affecting waste prevention

Analysis of the determinants of waste prevention was also undertaken. A set of models were estimated including: the effect of the recycling logo on the purchasing decision; the choice of whether to compost food waste, the effects of choosing products with less packaging, and the use of reusable shopping bags.

#### 3.1 Effects of product recycling logos on purchasing decisions

A range of labels were shown to respondents in all the countries. The label of interest for this analysis was the recycling logo, and respondents were requested to indicate if they used it in their purchasing decisions. The analysis was only undertaken for Chile, Israel, Japan and Korea, as these were the only countries that were asked about the recycling logo. Probit models were estimated. Table 6 presents the results. A full country level table including all the analysed variables can be found in **Table I** in separate Annexes.<sup>5</sup>

<sup>5</sup> Available upon request.

**Table 6. Factors influencing the use of the recycling logo in the purchasing decision – Probit (marginal effects)**

INDEPENDENT VARIABLES	OECD 2011 (pooled sample)	OECD 2011 (pooled sample)
	Binary Probit	Marginal Effects
Household Size	0.10*** (0.03)	0.03*** (0.01)
Affiliation with an environmental association	0.54*** (0.19)	0.18** (0.06)
Motivated by Environmental Benefits	0.10*** (0.03)	0.03*** (0.01)
Motivated by being seen as responsible citizen	0.05*** (0.02)	0.02*** (0.01)
Constant	-2.06*** (0.27)	
No of Observations	2967	
Pseudo R2	0.0937	

Robust standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Country level fixed effects and regression constant included in estimation but not shown in table, sampling weights used in estimation.

There is a negative relationship between the volume of waste generated and the use of the recycling logo for respondents in Korea, but not for the other countries or the pooled sample. In the pooled sample, the respondent is more likely to use the recycling logo in purchasing decisions as household size increases. This is also the case for Japan. However, there was no statistically significant relationship between gender and the use of the recycling label in purchasing decisions in the pooled sample or in the country level breakdown. This is also true of marital status, age, education level, and income.

Being affiliated with an environmental organization increases the probability that the respondent indicates that the recycling logo influences their purchasing decisions. This is also seen in the models for Chile and Japan. A respondents' motivation plays some part in the decision to use the recycling logo in their purchasing decisions. In particular, motivations related to environmental benefits, and being seen as a responsible citizen, have a significant effect.

### 3.2 *Factors influencing households' decision to compost*

Respondents were also asked whether their household usually composts their food waste. 31.5% of the total sample answered that they did (range 13.7% in Israel to 60.2% in Switzerland). Probit models were used to assess the factors that influence household composting. Respondents that live in an apartment (without a garden) were dropped from the assessment. Table 7 presents the results of the Probit regression. A full country level table of results including all the analysed variables can be found in Table J [see separate Annex].

The results indicate that there was no statistically significant relationship between gender and household composting in the pooled sample. On a country level males in Korea are more likely to compost food waste, whereas male respondents in Spain are less likely to do so. There was no statistically significant correlation between marital status in the pooled sample, but on a country level, married respondents in Canada are more likely to compost their food waste, but less likely to do so in Spain.

The likelihood of composting increases with age. Household size, education levels and income generally have no effect, except for selected country samples. Not surprisingly rural residents are more likely to compost their organic waste.

Respondents who indicated a high level of concern for waste generation are more likely to compost their food waste in the pooled sample than respondents showing little or no concern. This is also true of the country-specific models for Australia, Canada and Japan. When it comes to affiliation with an environmental organization, the binary regression for the pooled sample shows that these respondents are



more likely to compost their food waste than unaffiliated respondents. Voters are also more likely to compost food waste.

**Table 7. Factors influencing the decision to compost food waste - Probit (marginal effects)**

INDEPENDENT VARIABLES	OECD 2011 (pooled sample)	
	Binary Probit	Marginal Effects
Age of Respondent	0.00** (0.00)	0.00** (0.00)
Living in a major city/town	-0.27*** (0.08)	-0.09*** (0.03)
Living in a suburban area	-0.01 (0.07)	0.00 (0.02)
Environmental concern for waste	0.20*** (0.07)	0.07*** (0.02)
Respondents that Vote	0.24*** (0.07)	0.08*** (0.03)
Affiliation with an environmental association	0.43*** (0.09)	0.14*** (0.03)
Collection Frequency	0.06** (0.03)	0.02** (0.01)
Volume of Waste (per 100l)	-0.05*** (0.02)	-0.02*** (0.01)
Charged by weight / volume (PAYT)	0.25** (0.10)	0.08** (0.03)
Constant	-0.73*** (0.19)	
No of Observations	6112	
Pseudo R2	0.0909	

Robust standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Country level fixed effects and regression constant included in estimation but not shown in the table of margins, sampling weights are used in estimation.

The indicator variables representing different groups of respondents clustered by their attitudes towards the environment were not significant in the pooled sample. On a country level, the environmentally motivated respondents in Israel are more likely to compost their waste than respondents in the sceptic cluster, as are technological optimists in Spain. In Chile, technological optimists are less likely to compost their food waste.

The frequency of mixed waste collection services has an effect on whether respondents compost their food waste. As collection frequency decreases, respondents are more likely to compost in the pooled sample. However, for the country-specific models it is only significant for France

There is a positive and significant relationship between being charged by a weight / volume charging system and the probability of composting food waste in the pooled sample. At the country level, this relationship holds for Canada, Japan and the Netherlands. The relationship is counter-intuitive for Korea.

### 3.3 *Factors influencing the use of reusable shopping bags*

Respondents were asked whether their household usually uses reusable shopping bags for food shopping. 81.7% of respondents in the sample answered that they did, with a range from 52.1% in Israel to 95.6% in France. Probit models were implemented to assess the effect of different factors on the use of reusable shopping bags. Table 8 shows the results for the pooled sample, and a full country level table including all the analysed variables can be found in Table K.

**Table 8. Factors influencing the use of reusable shopping bags – Probit (marginal effects)**

INDEPENDENT VARIABLES	OECD 2011 (pooled sample)	OECD 2011 (pooled sample)
	Binary Probit	Marginal Effects
Male Indicator	-0.35*** (0.05)	-0.08*** (0.01)
Age of Respondent	0.01*** (0.00)	0.00*** (0.00)
Household Size	0.04** (0.02)	0.01** (0.00)
Environmental concern for waste	0.35*** (0.06)	0.08*** (0.01)
Respondents that Vote	0.20*** (0.07)	0.04*** (0.02)
Affiliation with an environmental association	0.17** (0.08)	0.04** (0.02)
Environmentally Motivated	0.24*** (0.06)	0.06*** (0.01)
Technological Optimists	0.23*** (0.07)	0.05*** (0.02)
Extreme Response	-0.34** (0.15)	-0.08** (0.03)
Collection Frequency	-0.06** (0.02)	-0.01** (0.01)
Volume of Waste (per 100l)	-0.08*** (0.01)	-0.02*** (0.00)
Constant	-0.02 (0.40)	
No of Observations	11430	
Pseudo R2	0.1404	

Robust standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Country level fixed effects and regression constant included in estimation but not shown in table, sampling weights used in estimation.

The results indicate that males in the pooled sample are less likely than females to use reusable bags for their food shopping. On a country level, males are less likely to use reusable bags in Australia, Canada, France, Israel, Japan, the Netherlands and Switzerland. As respondent's age increases, there is more likelihood of respondents using reusable bags for the pooled sample and most country-specific models.

The relationship between marital status and the use of reusable bags in the pooled sample is statistically insignificant, but on a country level, married respondents in France and Korea are more likely to use them. As household size increases, the respondent is more likely to use reusable bags for their food shopping in the pooled sample, and for Australia and Japan.

Both level of education and household income are statistically insignificant in the pooled sample. However for some of the country samples there is a significant impact for both education (Canada, Korea and Sweden) and income (Australia and Chile).

Respondents indicating concern for waste generation are more likely to use reusable bags in the pooled sample than respondents indicating little or no concern for waste generation. This is also the case for the models with the samples from Australia, Canada, France, Israel, Japan and Switzerland.

Affiliation with an environmental organization also has a positive influence in the pooled sample, Canada, Israel and Spain. A counter-intuitive negative coefficient is found for the samples from the Netherlands and Switzerland. Respondents clustered as environmentally motivated are more likely to use reusable bags in the pooled sample than the sceptics cluster (the reference), as are technological optimists.

The frequency of collection services for mixed waste has a negative effect on whether respondents use reusable bags for their food shopping. As the volume of waste generated for disposal increases, the likelihood of using reusable bags (in the pooled sample regression results) decreases. And finally, respondents that are charged according to a weight / volume charging system are more likely to use reusable bags in Switzerland, but not in the pooled sample or other country samples.

### **3.4 *Factors influencing the choice of food items with less packaging***

Respondents were asked whether their household chooses food items with less packaging. About 61% of respondents in the sample answered that they did (range 40.3% in Israel to 70.8% in Korea). Probit models were estimated and marginal effects were used to assess the factors that influence respondents' decision to choose food items with less packaging. Table 9 shows the results of the binary regression. A full country level table including all the analysed variables can be found in Table L. However, when interpreting the results it is important to bear in mind that the ability to choose items with less packaging is conditional upon shopping habits. For example, those doing most of their food shopping in a supermarket may be more constrained with respect to their capacity to choose items with less packaging. Further work could examine the relationship between these two decisions in greater detail.

In the pooled sample males are less likely than females to choose food items with less packaging. This is true of the country-level models for Australia, France, Japan, Korea, the Netherlands, Spain and Sweden. The relationship between marital status and less packaging is not statistically significant in the pooled sample. For the country samples, married respondents in Korea and Spain are less likely to choose food with less packaging.

As age increases there is also an increase in the likelihood that the respondent will choose food items with less packaging for respondents in the pooled sample, as well as in all of the country-specific models. As household size increases, the respondent is more likely to choose food items with less packaging in the pooled sample, and in the models for Australia and Japan.

The relationship between the number of years of post-secondary education and the reduction of packaging is not significant in the pooled sample, but an increase in education shows a positive and significant effect in Australia and Spain. Respondents are less likely to consider food packaging in Chile as education increases. As the yearly household income increases, there is a decrease in likelihood that the respondents choose food items with less packaging.

**Table 9. Factors influencing the choice of food items with less packaging – Probit (marginal effects)**

INDEPENDENT VARIABLES	OECD 2011 (pooled sample)	
	Binary Probit	Marginal Effects
Male Indicator	-0.26*** (0.04)	-0.09*** (0.01)
Age of Respondent	0.02*** (0.00)	0.01*** (0.00)
Household Size	0.05*** (0.02)	0.02*** (0.01)
Log of yearly household income	-0.10** (0.04)	-0.03** (0.01)
Environmental concern for waste	0.39*** (0.05)	0.13*** (0.02)
Respondents that Vote	0.19*** (0.06)	0.07*** (0.02)
Affiliation with an environmental association	0.58*** (0.07)	0.20*** (0.02)
Environmentally Motivated	0.16*** (0.05)	0.05*** (0.02)
Technological Optimists	0.16*** (0.06)	0.05*** (0.02)
Collection Frequency	-0.03* (0.02)	-0.01* (0.01)
Volume of Waste (per 100l)	-0.06*** (0.01)	-0.02*** (0.00)
Charged by weight / volume (PAYT)	0.15** (0.07)	0.05** (0.02)
Constant	-0.02 (0.40)	
No of Observations	9473	
Pseudo R2	0.0903	

Robust standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Country level fixed effects and regression constant are included in the estimation but not shown in the table of margins, sampling weights are used in estimation.

Respondents indicating concern for waste generation are more likely to choose items with less packaging in all countries, with the exception of Korea. Affiliation with an environmental organization has an influence in the pooled sample. There is also a positive and significant effect for all country samples, with the exception of Korea once again where no statistically significant effect is seen. The environmentally motivated in the pooled sample are more likely to choose packaging than sceptics in the pooled sample, as are technological optimists.

The frequency of mixed waste collection services frequency of mixed waste for disposal has a negative effect on whether respondents choose food items with less packaging in the pooled sample. Respondents that are charged by a weight / volume charging system are more likely to choose food items with less packaging in the pooled sample when compared to respondents without a unit based waste charging system.

### 3.5 *Summary of factors influencing waste prevention*

Summarising the main results for the different waste prevention models, the most significant predictive factor in determining these waste prevention behaviours is whether a respondent reported affiliation with an environmental organization (either through monetary donations or volunteering). This discrete factor was the single most powerful predictor for whether respondents utilised reusable shopping bags (17% more likely), whether they composted food waste (14% more likely), and whether they tried in general to

purchase food items with less packing (20% more likely). This factor was also a significant predictor of whether respondents reportedly utilised reusable shopping bags on a regular basis.

**Table 10. Summary of factors predicting waste prevention behaviours**

<i>Factor</i>	Use recycling labels in purchases	Compost food waste	Utilise reusable shopping bags	Purchase food items with less packaging
Member of env. org.	+	+	+	+
Age		+	+	+
Male			—	—
Voter		+	+	+
Household size	+			+
Income				—
Waste generation		—	—	—
Concern for waste		+	+	+
<i>Attitudinal class:</i>				
Env. motivated			+	+
Env. sceptics			—	—
Tech. optimists			+	+
<i>Motiv. to recycle:</i>				
Env. benefits	+			
Responsible citizen	+			
<i>Household location</i>				
City		—		
Subject to PAYT		+		+
Collection frequency		+	—	—

+ = Significantly positive predictor of behaviour

— = Significantly negative predictor of behaviour

\* = Most significant discrete factor found in the regression

Other significant predictors of waste prevention behaviours included respondent age and gender, household size and income, household waste generation, stated attitudes towards environmental issues, and whether or not households were subject to PAYT charges. Predictably, older respondents engaged in more waste prevention activities, according to every measure in the survey. Yet in contrast to the above results on waste generation, men reported significantly less frequent practice of some key behaviour (reusable shopping bags and purchasing food with less packaging). Respondents in larger households were significantly more likely to practice waste prevention behaviours, according to all measures in the survey. Income was only a significant predictor of waste prevention with respect to purchasing food with less packaging (with lower income respondents practicing this behaviour more). The only policy-related variable that was found to be a significant factor in the waste prevention regressions was households' exposure to PAYT charges: respondents subject to PAYT charges were 8% more likely to compost their food waste and 5% more likely to regularly purchase food items with less packaging, controlling for correlated factors.

**Table 11. Factors predicting improper disposal of waste containing hazardous materials – Probit (marginal effects)**

Independent variables	Improper disposal of old electronic equipment (pooled sample)	Improper disposal of old and unused medicines (pooled sample)
Male Indicator	0.19*** (0.06)	-0.02 (0.05)
Married Indicator	0.05 (0.06)	0.16*** (0.05)
Age of Respondent	-0.01*** (0.00)	-0.01*** (0.00)
Log of yearly household income	0.01 (0.05)	0.15*** (0.04)
Environmentally motivated	-0.14** (0.06)	-0.02 (0.05)
Technological optimists	-0.22*** (0.08)	-0.01 (0.07)
Volume of Waste (per 100l)	0.04*** (0.01)	0.00*** (0.00)
Charged by weight / volume (PAYT)	0.14 (0.10)	0.17* (0.07)
Constant	1.38*** (0.53)	-2.48 (0.45)
No of Observations	9811	9811
Pseudo R2	0.0951	0.1238

Robust standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Country level fixed effects and regression constant included in estimation but not shown in table, sampling weights used in estimation.

#### 4. Factors affecting the disposal of waste containing hazardous materials

Hazardous wastes have the potential to cause substantial damage to the environment. This study considered two common types of waste containing hazardous materials – old and unused medicine wastes and old electronic equipment. Medicines contain a wide range of chemicals that can be hazardous both to people as well as to the environment, and should be disposed of correctly. Old electronic equipment may contain high levels of heavy metals such as lead and cadmium which again are toxic to both the environment and to people.

The final analytical part in this study aimed to identify factors affecting the inappropriate disposal of waste containing hazardous materials (i.e. old medicines and electronic waste). Probit models were estimated and the results are presented in Table 11 (above); country-level regression results can be found in Table M. Men are more likely to dispose of electronics improperly. Married respondents, and those in high-income households, are more likely to dispose of medicines improperly. Older respondents are less likely to improperly dispose of either electronics or old medicines. Respondents classified as either “environmentally motivated” or “technological optimists” are less likely to improperly dispose of electronics. Lastly, being subject to a PAYT charge decreases the likelihood that respondents improperly dispose of used medicines.

## POLICY IMPLICATIONS

The econometric analysis presented above has implications for policy design in two ways. The first and most direct way is the econometric analysis of how (much) specific policies appear to impact household behaviours. Another way that these results inform policy is by identifying how relevant behaviours vary according to household characteristics, and how these behavioural patterns might be considered in policy design.

The specific policies considered here relate mainly to the type of waste charge in place, and to varying availabilities of separation and collection services for different types of waste materials. The most relevant behaviours analysed here are household mixed waste generation and materials separation rates. Other relevant behaviours include waste prevention efforts, and the disposal of waste containing hazardous materials (electronics and medicines). In general, the results – at least for waste containing packaging materials - indicate that the most effective approach is to combine a PAYT waste charge with intensive materials separation services (with the most intensive class of service being door-to-door collection of all separated materials).

An approximate reduction of between 16% and 20% in mixed waste generation can be expected as a result of PAYT implementation in a situation where a “medium-level” of recycling service already exists (i.e. some level of collection for all separated materials, or a door-to-door service for at least one – but not all – materials).

In some countries, there are complementarities between the effect of PAYT charging and expansion of recycling services. This was found to be the case in Canada, the Netherlands, Sweden, and Switzerland. In these countries, the combination of PAYT charges with door-to-door recycling service for all major non-food materials is associated with a 40% reduction in mixed waste generation, relative to a setting with only drop-off or limited door-to-door recycling service and no PAYT charges.

Analysis of waste separation rates confirms that the mixed waste reductions from expanded separation services are achieved due to households in fact separating more recyclable materials from their mixed waste stream. Meanwhile, the analysis here confirms that PAYT charges seem to reduce mixed waste volumes by increasing the separation of recyclables from mixed waste, and potentially by increasing the waste prevention efforts: Being subject to a PAYT charge is significantly associated with a greater frequency of composting, and exhibiting a preference for items with less packaging in grocery purchases.

The analysis also raises some caveats for the above recommendations, particularly regarding the cross-country differences in the estimated impact of PAYT charges. Statistically, there appears to be two groups of PAYT-adopting countries in the data: In the first group, which includes Canada, the Netherlands, Sweden and Switzerland, PAYT charges are unambiguously linked to less mixed waste generation, as discussed above. In the second group, which includes Japan and Korea, the analysis above finds no statistical evidence of any impact from PAYT.

The reasons for this null finding need to be investigated further, with additional data, before any conclusions can be drawn about the differential impacts of PAYT between these two groups of countries. Problems with measuring PAYT exposure in the survey (e.g. respondent confusion about the meaning of a PAYT charge, or related issues in questionnaire translation) could lead to inaccurate and imprecise statistical estimates. Furthermore, there may be real differences in the designs and implementation of PAYT policies that lead to different impacts. An obvious potential difference is variation in the level of the per-litre or per-kg charge used across countries: Basic economics dictates that a higher unit charge should lead to lower mixed waste generation, all other factors being equal. But there may also be differences in the way that households are informed about the relationship between their waste collection bill and their level of mixed waste generation. More information on the nature of the PAYT systems in place, which might be

more accurately collected through surveys of municipal waste management authorities (WMAs) in parallel with the households, could help clarify why these cross-country differences arise.

Obviously, the class of service found to be most effective – PAYT charging in combination with door-to-door collection of all recyclable materials – is among the most expensive to implement: PAYT waste charges require systems to measure each household’s volume of waste generation. Such systems are in general more costly than collecting revenues via flat fees or through property taxes. Meanwhile, providing door-to-door collection is often effective precisely because it transfers the cost of transporting separated materials from the household to Waste Management Authorities (WMAs), whose expenditures increase as a consequence. WMAs considering the balance between PAYT schemes and the quality of collection services must take budgetary implications into account. Where local WMAs are unable to finance collection services out of landfill fees, regional or national environmental authorities may consider assessing the regional structure of waste management, e.g. whether the true landfill costs are passed on to municipalities through existing fee structures.

In addition to the question of how waste management policies directly affect household behaviours, there is also policy relevance in analysis of how behaviours vary according to household characteristics, including demographic, socioeconomic and attitudinal factors. This line of inquiry is relevant for policy in two ways. First, when certain socioeconomic subgroups engage more or less frequently in a given behaviour, then some policies, such as “awareness” campaigns, may increase their impact by engaging more with these subgroups. For example, analysis of these data suggests that age is significantly correlated with waste separation and prevention, and the proper disposal of hazardous materials, a pattern which is also found in other research. Measurement issues notwithstanding, there are policy relevant reasons to better understand the relationship between age and recycling/reuse behaviours. Can we expect that as younger individuals grow older that they will ‘automatically’ shift their behaviour to more frequent separation and waste prevention? Or are there institutional or infrastructural constraints that increase the relative inconvenience of engaging in these behaviours among younger populations? For example, younger individuals in OECD countries tend to move more frequently and may therefore be less aware of local waste collection services, policies, and billing. Or is the correlation found in the data simply due to fixed, generational differences and norms, with older generations being more conservation-minded than younger generations?

Furthermore, income and household size are found to be significant factors in waste generation and separation rates, in line with previous literature. Predictably, mixed waste generation increases with both household income and household size. Across all surveyed countries, a 1% increase in household income is associated with an average 0.12% increase in mixed waste generation volumes, holding other factors constant. While household size is understandably a strong determinant of waste generation, the effect is less than proportional: Each additional household member is associated with approximately a 30% increase in total mixed waste generation, on average. Countervailing effects are found with respect to waste separation: larger, higher-income households tend to separate larger percentages of their total waste generation, though this effect is evidently not enough to fully offset their higher waste generation rates, as evidenced by the above. Bearing in mind potential issues with projecting the future based on cross-sectional survey data, these results suggest that increasing household incomes are likely to be associated with more mixed waste generation, but one small consolation is that these higher incomes may also lead to more separation (though the mechanism for this latter effect remains unclear, and requires further investigation). Policies seeking to address likely increases in waste generation may therefore seek to leverage the evident receptivity of higher-income households to engage in waste separation, an effect which is independent of any effect of formal education levels (which tend to positively correlate with income). It is also clear from this analysis that, at least in terms of waste generation, households with fewer persons have a greater ecological footprint in *per capita* terms.



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## ANNEX 1: VARIABLE DESCRIPTIONS

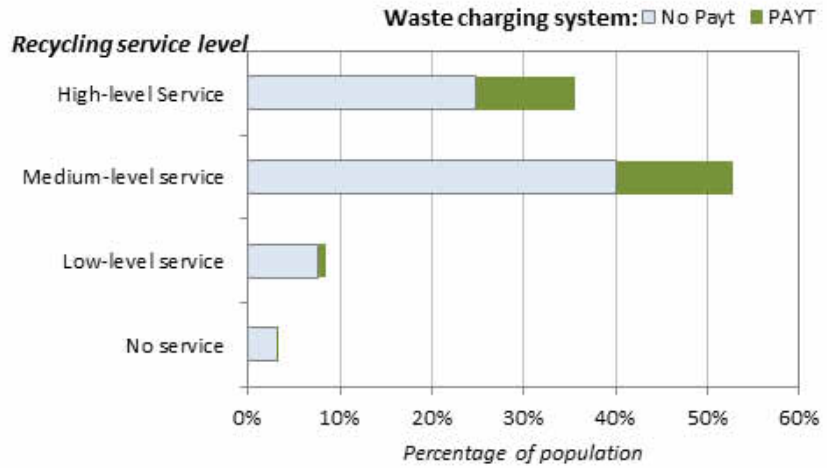
<b>Socio-demographic characteristics</b>	
<b>Gender</b>	Male = 1
<b>Married or living as a couple indicator</b>	Married = 1
<b>Household size</b>	number of people that live in the household, but using imputed values to take into consideration the households that have 5+ members
<b>Number of years education</b>	the number of years in education post high school, imputed to take into consideration respondents having over 8 years
<b>Household income</b>	log of imputed value of income
<b>Residence type</b>	Detached house and semi-detached / terraced house grouped together as "house"
<b>Area type</b>	Major town/city, Suburban, small town/village, isolated dwelling
<b>Home Tenure</b>	number of years living in residence
<b>Attitudinal characteristics</b>	
<b>Respondents satisfaction with their life</b>	On a scale of 0 (not satisfied) to 10 (very satisfied). For the purpose of the analysis a new variable was created for respondents who were satisfied with their life (those rating 7 or above).
<b>Ranking of serious issues facing the world today</b>	These were international tensions (such as war and terrorism), economic concerns (such as unemployment, inflation and financial crisis), environmental concerns (such as pollution, waste & climate change), health concerns (such as cancer & infectious disease), social issues (such as poverty and discrimination) and personal safety (such as crime and theft). Respondents ranking environmental concerns as being 1, 2 or 3 (compared to 4, 5 or 6) were grouped together
<b>How serious is waste generation</b>	This was rated on a scale of 0 (not at all serious) to 10 (extremely serious), and for the purpose of the analysis a new variable was created for respondents that rated waste generation as serious (those rating 7 or above).
<b>Participation in local and general elections</b>	Voters = 1
<b>Participation in an environmental organisation</b>	Participation = 1
<b>satisfaction with the level of litter and rubbish in their local area</b>	Rated using a five point Likert scale from very dissatisfied to very satisfied. Satisfied & very satisfied=1, the rest were 0
<b>Respondents agreement with statements relating to the environment</b>	Using latent class analysis (LCA) to determine the most appropriate underlying attitudinal classes, four clusters of respondents were created: The environmentally motivated (believe that environmental problems are real and express a willingness to make compromises in their lifestyle to solve these problems), Sceptics (believe that environmental issues are over stated and do not wish to pay for government environmental policies, but are willing to make a few compromises for the environment), Technological optimists (also believe that environmental problems are real and are also willing to make compromises for the environment, but have greater belief that technological processes will solve environmental problems) and the Extremists (that disagreed with every statement). These clusters of respondents were used in each of the analyses.
<b>Waste-specific attributes</b>	
<b>Waste collection frequency</b>	Variables grouped - more than once per week, once per week and less than once per week).
<b>Amount of mixed waste generated per week excluding wastes separated for recycling and composting</b>	To ease on the respondent to retrieve an answer, he was shown a diagram depicting various sizes of bags as a guide. The indicated size of the bag was then multiplied by the number of bags generated per week to obtain the volume of waste generated. This volume does not take into consideration how the householders pack the bags, so the volume of waste generated is only an approximation.
<b>Availability of collection services for each of the five recyclable materials</b>	The options provided were door-to-door collection (curbside collection), drop-off centres/containers, bring back with refund (to the retailer/manufacturer), bring back no refund (to the retailer/manufacturer), no collection service for separated materials and don't know.
<b>Accessibility to a door-to-door collection OR a drop-off centre</b>	An "aggregated separation variable" was generated incorporating the count of materials that there was either a drop-off or a door-to-door recyclable material collection service. Respondents that confirmed that they separate at least one of the recyclable materials were then asked about various factors that motivate them to separate their wastes.

<b>Percentage of materials separated for each of the recyclable materials</b>	Respondents that had a service available were also asked to estimate the percentage of each material that they separated for recycling.
<b>What motivates respondent to separate their waste</b>	They were rated on a scale of 0 (not important) to 10 (very important), and for the purpose of the analyses a new variable was created for respondents that rated the motivation factor as important (those rating 7 or above). The motivation factors assessed were; that it is beneficial for the environment, to reduce waste charges or collect refunds, because it was their civic duty, and that they want to be seen as a responsible citizen.
<b>Waste charging</b>	Those respondents having some form of unit pricing (PAYT=1, the others = 0) were assessed against those respondents that did not. At this point it is worth noting that PAYT schemes are fully implemented in Korea and yet only 43.3% of respondents thought that they pay per volume for their waste. For reference, 14.2% thought they had a flat fee charge, 9.1% according to size of property, 8.8% were not charged and 23.2% did not know how they were charged. Korea has been left in for the analyses as their responses will relate to how they think that they pay, rather than how they actually do pay.
<b>linkages between unit pricing and recycling services,</b>	This was calculated by using the PAYT=1 indicator and multiplying it by the indicator for availability of each collection service type for each recyclable material.
<b>Interaction indicators for the availability of a particular collection scheme for separated materials</b>	In this case, an overall indicator was created for the availability of a door-to-door collection service for one or more of the recyclable materials, an indicator for the availability of a drop-off service for one or more of the materials, indicators for the availability of bring back schemes with refund and without refund for the materials as well as an indicator for no available service for any of the materials. For example; the overall availability of door-to-door collections for any of the materials was calculated by adding the indicator for door-to-door for food& garden plus that for glass waste plus metal waste plus plastic waste plus paper waste. A new indicator for the overall availability for door-to-door collection was created where values were greater than or equal to 1.
<b>Support of various government actions</b>	Rated on a scale of 0 (don't support) to 10 (strongly support), and for the purpose of the analyses a new variable was created for respondents that rating their support as important (those rating 7 or above).

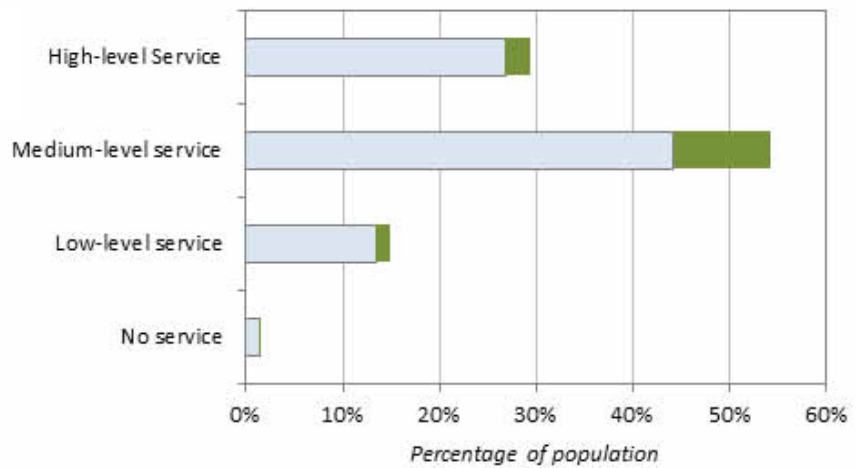


**ANNEX 2: RECYCLING SERVICE AVAILABILITY AND USE OF PAY-AS-YOU-THROW WASTE CHARGES, POPULATION DISTRIBUTIONS**

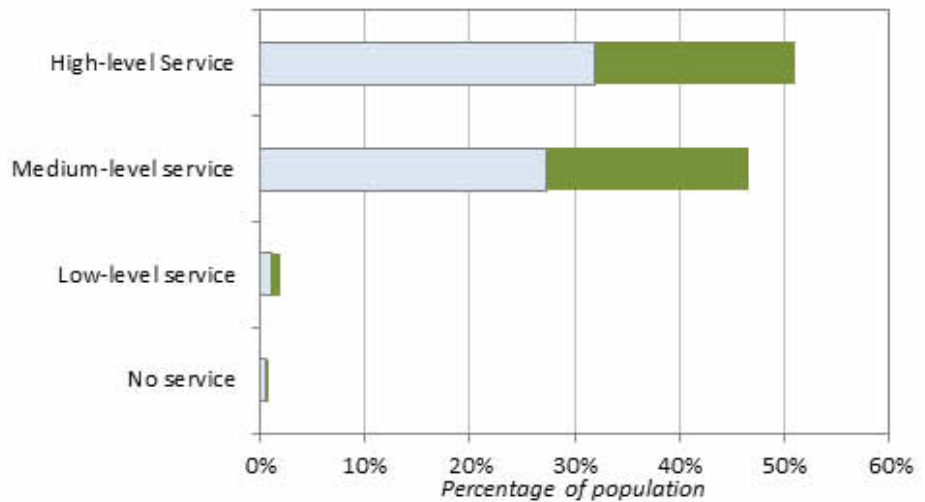
**Pooled sample**  
*(weighted)*



**Canada, Netherlands, Sweden and Switzerland**



**Korea and Japan**



**ANNEX 3: WASTE SEPARATION FREQUENCY BY COUNTRY (IN PERCENTAGES)**

	FOOD		GLASS		METAL		PAPER		PLASTIC	
	SEPARATE	DON'T SEPARATE	SEPARATE	DON'T SEPARATE	SEPARATE	DON'T SEPARATE	SEPARATE	DON'T SEPARATE	SEPARATE	DON'T SEPARATE
OVERALL	61%	39%	79%	21%	71%	29%	81%	19%	80%	20%
AUSTRALIA	51%	49%	77%	23%	78%	22%	78%	22%	78%	22%
CANADA	43%	57%	86%	14%	84%	16%	85%	15%	88%	12%
CHILE	11%	86%	30%	70%	15%	85%	24%	76%	21%	79%
FRANCE	58%	42%	82%	18%	67%	33%	84%	16%	83%	17%
ISRAEL	27%	73%	61%	39%	35%	65%	69%	31%	81%	19%
JAPAN	70%	30%	78%	22%	82%	18%	80%	20%	81%	19%
KOREA	81%	19%	88%	12%	80%	20%	93%	8%	91%	9%
NETHERLANDS	70%	30%	82%	18%	19%	81%	86%	14%	74%	26%
SPAIN	59%	41%	82%	18%	62%	38%	83%	17%	80%	20%
SWEDEN	53%	47%	83%	17%	83%	17%	86%	14%	85%	15%
SWITZERLAND	67%	33%	89%	11%	83%	17%	91%	9%	88%	12%



**ANNEX 4: MIXED WASTE: COLLECTION FREQUENCY BY COUNTRY  
(IN PERCENTAGES)**

Country	More than once per Week	Once per Week
Australia	6.5	81.6
Canada	14.8	62.4
Chile	90.2	5.2
France	51.3	37.9
Israel	80.0	8.8
Japan	88.2	6.8
Korea	60.7	27.2
Netherlands	12.3	34.5
Spain	86.5	4.5
Sweden	12.5	32.6
Switzerland	31.2	59.3
Overall	48.3	32.6

## ANNEX 5: DATA SOURCES AND LIMITATIONS

Based on a sample of more than 12 000 respondents in eleven countries,<sup>6</sup> this thematic report summarises main results on energy from the 2011 OECD periodic surveys on Environmental Policy and Individual Behaviour Change (EPIC) and draws evidence-based policy recommendations.<sup>7</sup> It builds on earlier work and supplements the overview of the 2011 survey data presented in OECD (2014).<sup>8</sup>

As in all studies involving primary data collection, there can be a sample bias when implementing a survey. Rigorous efforts were made at stratification and quota sampling. The sampling strategy involved stratification across region, gender, age and socio-economic status. The degree to which the country-level samples are representative of the national population is presented for a number of key variables in OECD (2014) in Annex B. However, in some countries (e.g. Chile and Switzerland) not all of these parameters could be included. Nonetheless, as Annex B in OECD (2014) shows, deviations in excess of 20 per cent from representativity across these variables, for which quotas were set, were very limited. Response bias can be a second concern. It should be noted that such a bias is not specific to using internet panel-based surveys and responses can be biased by the interviewer in face-to-face interviews and telephone surveys. Given that the subject matter of the OECD survey is not related to information technologies or Internet, except for a very small number of questions (i.e. investment in “smart” meters), there is little reason to believe that this would result in a systematic bias.

It is also important for the reader to bear in mind the fact that all of the data used in the analyses reported here are based upon survey responses. This survey elicited respondents’ stated preferences and perceptions. Therefore statistics reported here which relate to objective, verifiable indicators should be interpreted with caution and in some cases there may be ‘measurement error’. On the one hand, this may relate to the dependent variable used in the studies. For example, estimates of waste generation and recycling rates may be inexact for some respondents. Similarly, estimates of the percentage of fresh fruit and vegetables consumed which is organic may also be inexact. On the other hand, some respondents may be mistaken about the precise nature of the policy measures to which they are subject. For example, it is possible that some respondents may not be aware that a given policy exists in their country. Similarly, some respondents may mistakenly believe that a policy exists in their country, when in fact it does not. However, it is important to note that for all questions in which there was significant potential for such “measurement error”, respondents were given the option to respond that they “did not know” if such a policy was in place. This may relate to both “carrot” (i.e. grants for investment in energy-efficient devices, scrappage bounties for motor vehicles) and “stick” approaches (i.e. price-based measures). Given the large sample size, such observations should not affect the results in an important way. However, in order to ensure robustness of the results, a large number of models were estimated, including models with different country samples. Attention is drawn to important differences.

In general, readers should view these data as exactly what they are: the self-reported behaviours, attitudes and perceptions of representative samples of households from eleven OECD countries. Bearing the limits of such data in mind, it is important to recognise their advantages: information on households’ knowledge and perceptions about environmental issues – increasingly recognised as a crucial factor for better understanding behavioural responses to environmental policies – is rarely analysed at such level of detail. Moreover, for many variables such as discrete choices about whether or not a given purchase has been made, there is likely to be very little deviation from a more formal household consumer survey.

<sup>6</sup> Australia, Canada, Chile, France, Israel, Japan, Korea, the Netherlands, Spain, Sweden and Switzerland. Approximately 1 000 households were surveyed in each country.

<sup>7</sup> The first survey was carried out in 2008 in ten countries with a sample of more than 11 000 respondents and the main results were presented in the OECD (2011).

<sup>8</sup> The full 2011 EPIC Survey questionnaire in English is provided in OECD (2014) in Annex A.