Analysis of household waste composition and factors driving waste increases

Article

1 author:

Julian Parfitt
Anthesis

Analysis of household waste composition and factors driving waste increases

Dr Julian Parfitt

Principal Analyst, WRAP

December 2002

Contents

1.0 Introduction

There is much confusion over the meaning and validity of household waste compositional statistics in the UK. Since the National Household Waste Analysis Programme has not been active for a decade, no recent estimates are available and data from ‘dustbin’ analyses are often misconstrued as representing the composition of all municipal waste arisings. Furthermore, an increasing number of local authorities have commissioned their own compositional research, but no general guidelines exist on the essential methodological requirements for such studies. At a national level, the lack of credible national estimates has important implications for the development of waste policies. For example, the assumptions made about the biodegradable content of municipal waste for the 1995 baseline year under the Landfill Directive will have important implications for performance against biowaste landfill reduction targets in the UK.

The first part of this paper focuses on current household waste compositional data with the objective of obtaining the best current estimates. Results of this review have been fed into the Strategy Unit municipal waste modelling exercise.

The second part of the paper focuses on the factors that influence the quantities of household waste arisings, building on the conclusions from the compositional analysis. Household waste arisings have been increasing in the UK, yet no systematic review of the drivers behind these increases has been conducted. The statistical analysis of waste increases undertaken for the Strategy Unit is intended as an initial step in a more systematic analysis. In particular it explores the influence of weight-based recycling targets, which are not material-specific, on variations in district household waste arisings across England.

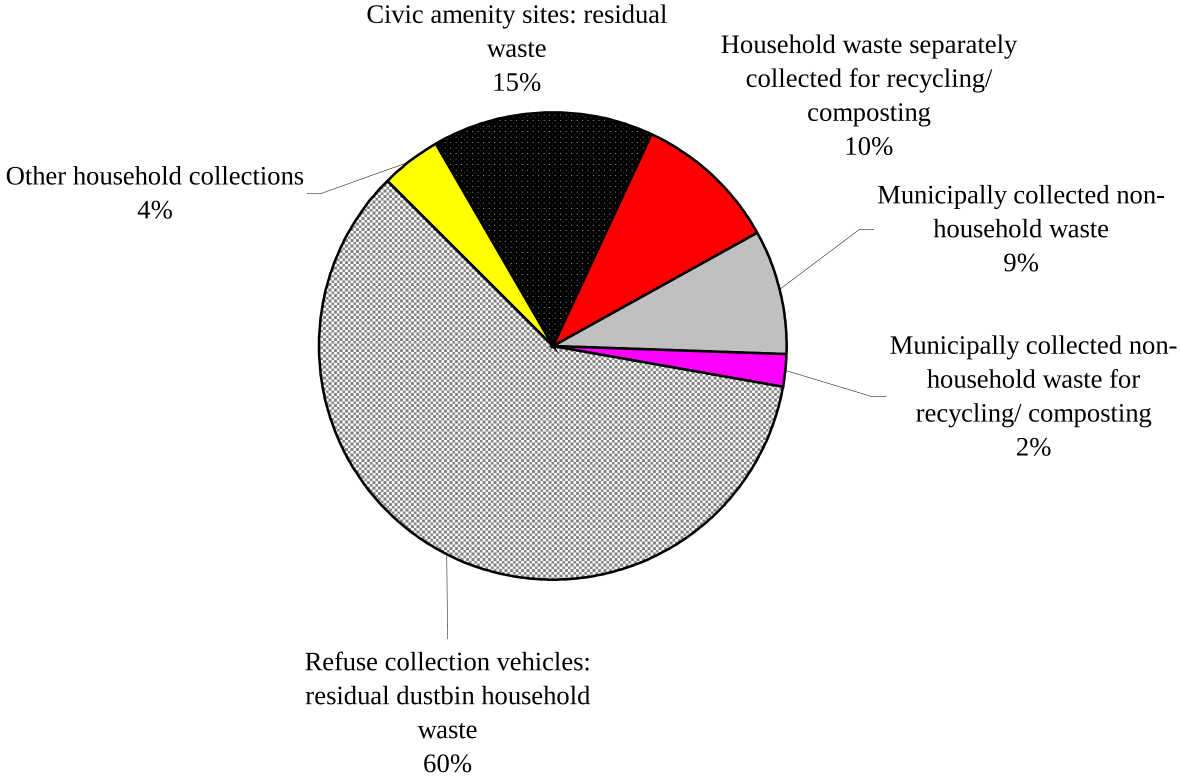
Most of the analyses in both parts of this working paper relate to England as more compositional analyses were available than from elsewhere in the UK and these could be linked to a well-established series of operational statistics in the form of DEFRA's Municipal Waste Management Survey.

Definitional issues

As **Figure 1** demonstrates, municipal waste in England consists of more than just ‘dustbin’ waste (that collected, usually from the kerbside, by regular refuse collection vehicles). Unfortunately, compositional studies in the UK have focused almost exclusively on establishing the composition of residual ‘dustbin’ waste and few studies have collected any data on civic amenity site waste composition, street litter or non-household municipal collections.

The definitions of household and non-household waste applied throughout this paper are compatible with those used to compile the annual DEFRA statistics from the Municipal Waste Management Survey. Integration of compositional data from local authority analyses with national DEFRA statistics forms an important component of the analysis presented here.

Figure 1: Municipal waste arisings in England 2000/01



[Source: DEFRA Municipal Waste Management Survey 2000/01]

Household waste, which constitutes about 90% of total municipal waste in England, is the main subject of this paper. It includes 'dustbin' waste from household collection vehicles (60% of total weight) and waste from other household collection services (4%) ~ such as litter, street sweeping and bulky waste collection services. Beyond these categories, household wastes also comprise residual materials taken by householders to civic amenity sites (15% of municipal waste) and waste from household sources separately collected for recycling or composting through bring sites, CA sites and kerbside recycling schemes.

An anomaly within the household waste definition used is that building rubble taken to CA sites for recycling has been excluded. This is partly because for some authorities the quantities collected exceed all other recycling and composting collections combined and it is likely that much originates from semi-commercial sources. Abandoned vehicles and waste from fly-tipping incidents have also been excluded from the household waste definition. All of these exclusions contribute to non-household municipal wastes along with any other materials that local authorities collect, or arrange to collect, from commercial and industrial sources.

2.0 Household waste compositional analysis

2.1 Objectives of analysis

- Collect together recent data from household 'dustbin' waste compositional studies
- Assess data quality and degree of compatibility between waste categorisation systems
- Develop criteria for selecting the best-selection of 'dustbin' data in terms of data validity and national coverage
- Compile an integrated data set from combining 'dustbin' compositional data, CA data and DEFRA weight data
- Compare results with compositional estimates used for in the England and Wales Waste Strategy 2000 (DETR 2000) and other data sets

2.2 Methodology

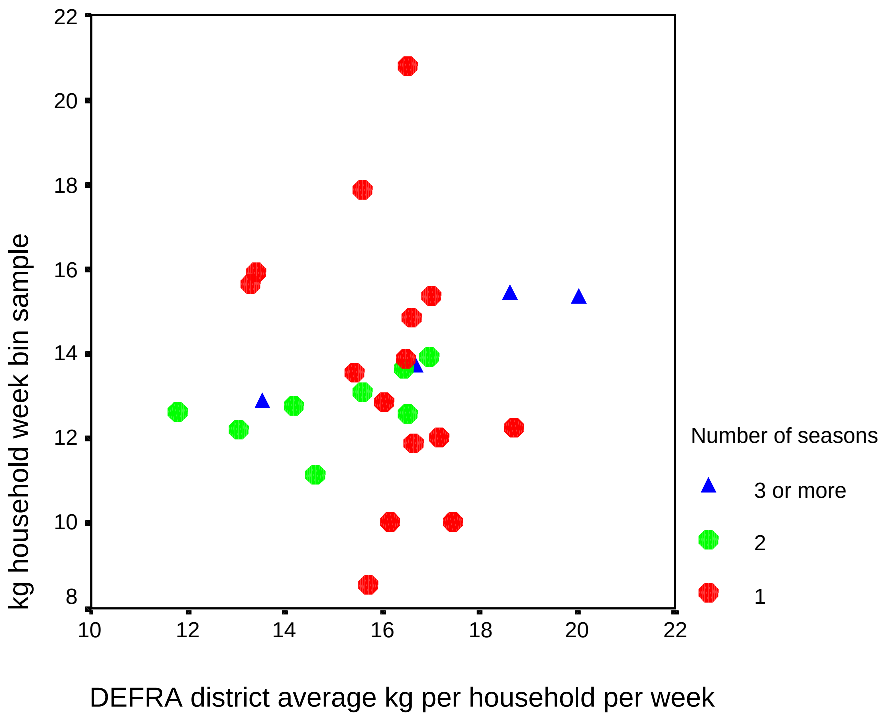
2.2.1 'Best selection' of 'dustbin' data

In total 70 compositional data sets were obtained from studies commissioned between 1999 and 2002 across England and Wales. No two studies employed the same methodology ~ most used bulk sampling of 'dustbin' waste from selected street blocks of houses (between 25 and 60 households) and there was much variation in the number of different neighbourhood types sampled and in seasonal coverage.

Methodological differences were found to be one of the main factors behind the wide variation in the quantities of different materials measured in the compositional analyses. It was therefore decided to develop criteria to select local authorities with compositional 'dustbin' samples likely to be most representative of district composition.

Seasonal coverage of district samples was found to be the main factor that influenced how representative the compositional samples were likely to be of their districts, although the total number of different neighbourhood types represented within each local authority study was also important. Comparisons were made between the district average weight of bin per household from the compositional data sets and corresponding district mean values from annual DEFRA statistics (DEFRA 2002). Although this test did not represent a direct measure of how representative of a district each set of compositional samples were likely to be, it did provide indicative evidence that single season studies were likely to be a poor guide to overall annual waste composition. **Figure 2** shows the relationship between the average weight of 'dustbin' waste per household from compositional studies correlated with corresponding DEFRA mean values. Single season studies produced mean weights that did not correlate well with DEFRA statistics, with spring/summer samples usually above DEFRA mean values and autumn/winter samples below average. Single-seasonal studies were therefore discarded, as there is no viable method for estimating seasonally adjusted composition from such studies. A further set of studies was rejected because their categorisation systems were too incompatible or the data did not distinguish residual bin waste from material collected by kerbside recycling schemes. After removing datasets based on these criteria only 27 of 70 local authorities remained in the study for further analysis.

Figure 2: Correlation between district average weight of 'dustbin' waste/ household (DEFRA Municipal Waste Management Survey) and average weight for each district obtained from compositional studies: analysis by number of seasons covered by compositional analysis



2.2.2 Use of Local Authority classification to group compositional data

The remaining 27 local authorities were grouped according to a classification developed for DEFRA, based on local authority collection and recycling strategies. Details of this classification are described elsewhere (Parfitt *et al.*, 2001). The classification permits the influence of two key factors to be incorporated into national compositional estimates:

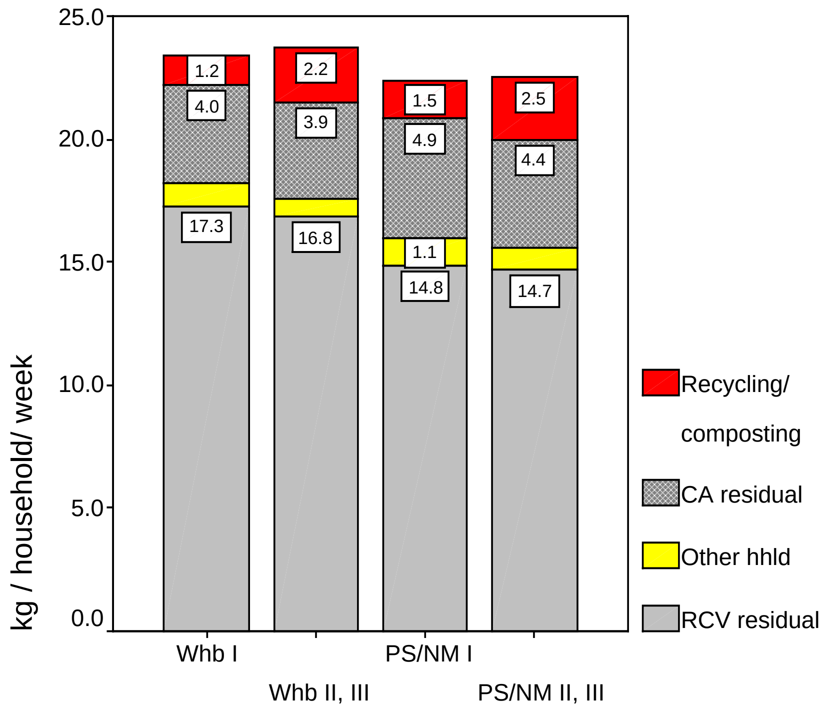
- methods of refuse waste containment (wheeled bins, plastic sacks and authorities that do not provide householders with a method of waste containment)
- levels of recycling infra-structure provided within the district (I = low, II = medium, III = high)

Each element of the classification is a combination of method of waste containment (that provided to more than 50% of households within district) and level of recycling/ composting infrastructure provided. The latter dimension was included in the classification by means of two variables: '% of households within a district serviced by a kerbside recycling collection' and 'number of bring/ CA sites per 1000 households'. The most similar elements in the original classification ('no method' and 'plastic sack' authorities) have been combined to produce a four-element classification used for grouping the local authorities remaining in the compositional analysis.

Characterisation of each of the four main groups by DEFRA average waste arisings (kg per household per week) is shown in **Figure 3**. The stacked bars compare average values for household waste collected through different outlets (‘dustbin’, other collections, CA residual and recycling/ composting collections). In general, householders in wheeled bin areas take less waste to CA sites due to the extra bin capacity at their disposal provided by 240 litre bins (lower capacity wheeled bins are also used by some authorities ~ this issue is discussed in more detail in Part II). By implication refuse collections in wheeled bin areas will contain more ‘CA type’ waste than is the case in plastic sack areas (for example garden waste, corrugated card and small household items). This is therefore an important aspect to control for when estimating total composition of residual wastes on a national basis.

Comparison of the national profile of each main cluster by the percentage use of different household waste outlets (**Figure 4**) with that of the grouped data from the authorities in the compositional study (**Figure 5**) shows that the profile generated by the sub-sample closely matches the national profile of each cluster.

Figure 3: Variation in average weight of household waste (kg per household per week) collected through different outlets for the main groupings of local authority clusters



KEY

Whb I = Authorities with more than 50% of households provided with wheeled bins for refuse: low levels of bring sites & kerbside recycling

Whb II, III = Authorities with more than 50% of households provided with wheeled bins for refuse: medium/high levels of bring sites & kerbside recycling

PS/NM I = Authorities with more than 50% of households provided with plastic sack collections for refuse, or not provided with any method of containment by local authority: low levels of bring sites & kerbside recycling

PS/NM II, III = Authorities with more than 50% of households provided with plastic sack collections for refuse, or not provided with any method of containment by local authority: medium/high levels of bring sites & kerbside recycling

Figure 4: Comparison of % total household waste in each outlet for main groupings of local authority clusters: English WCAs/ UAs, DEFRA 2000/01

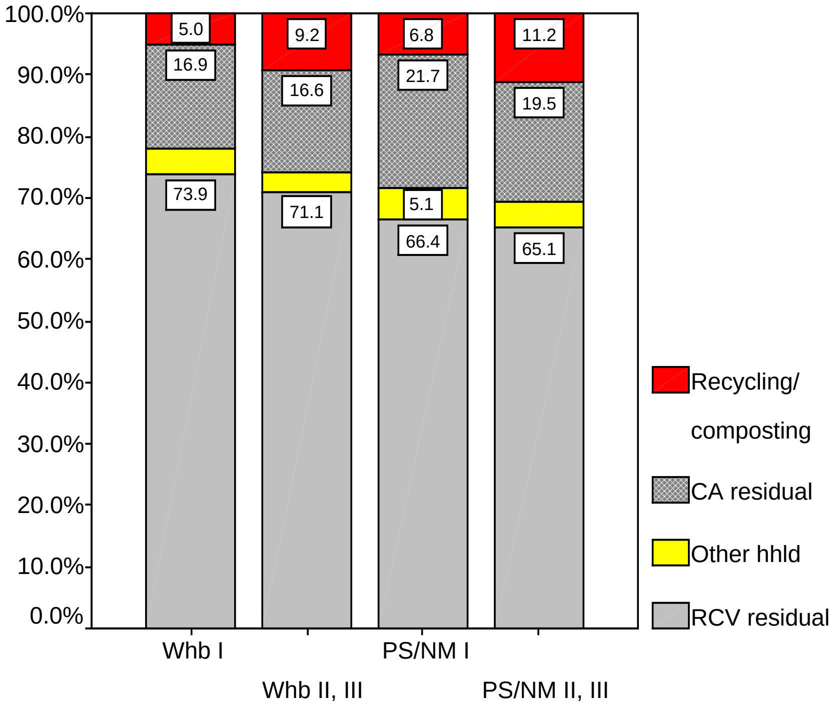


Figure 5: Comparison of % total household waste in each outlet for main groupings of local authority clusters: 27 English authorities in SU compositional analysis

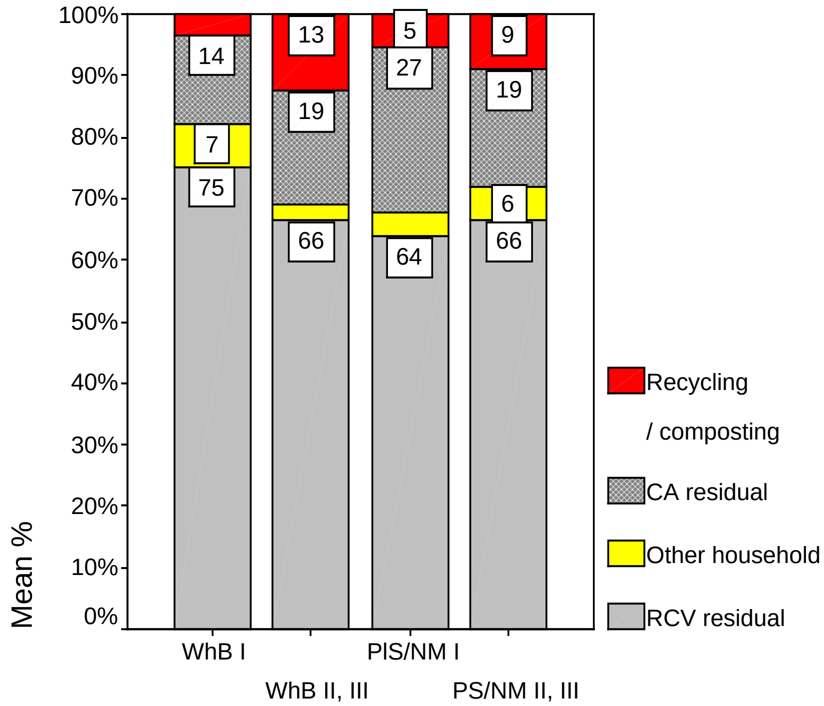


Figure 6: Distribution of deprivation scores for 27 local authorities in final compositional analysis

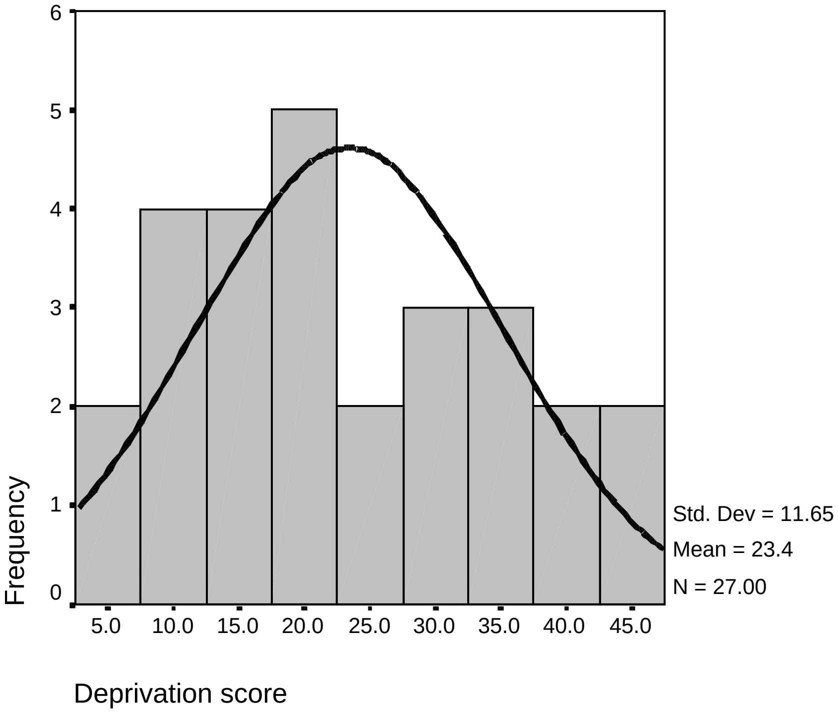
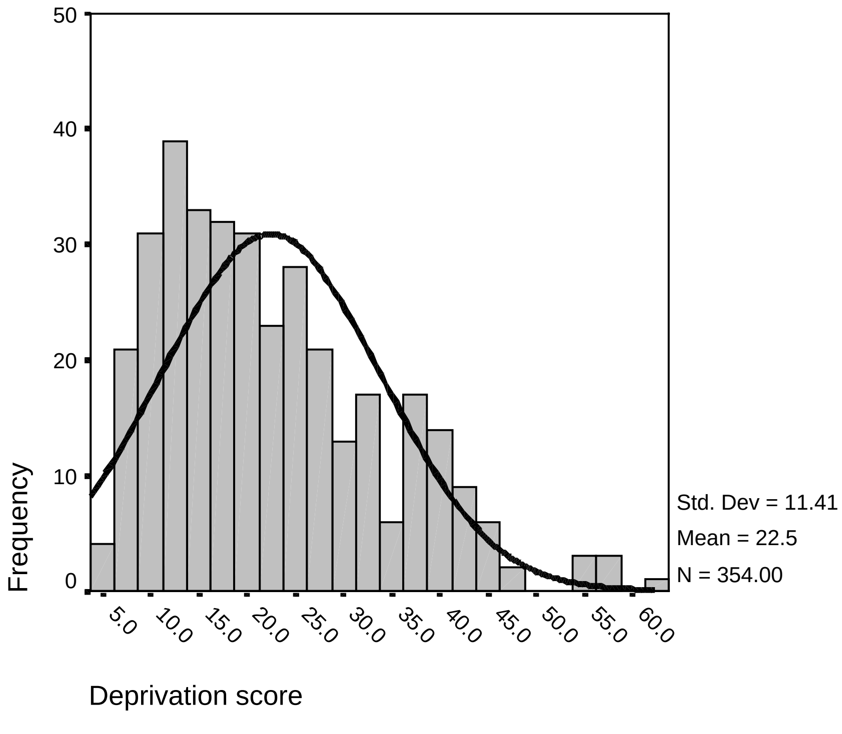


Figure 7: Distribution of deprivation scores for local authorities in England



The local authority cluster membership is highly associated with socio-economic factors: local authorities with lower levels of recycling infra-structure (e.g. WhB I) tending to be areas of higher socio-economic deprivation than those with higher levels of recycling collection service provision (e.g. WhB II & III). A further comparison of the 27 authorities against national socio-economic characteristics was carried out using local authority deprivation scores (DETR 2000a). **Figure 6** indicates the overall range of authority deprivation scores encompassed by the 27 districts in the final compositional analysis. Comparison with **Figure 7** shows that this sub-set of authorities broadly covers the range of deprivation scores (5-45) found across England (mean score 23.4 v mean score of 22.5 for local authorities responding to DEFRA survey).

2.2.3 Stages in data compilation

The overall objective was to integrate DEFRA tonnage data with estimates of dustbin waste composition generated by the compositional studies. The required output for Strategy Unit modelling purposes was to include estimates of total arisings by compositional category and by the following sub-divisions:

Total household waste ('dustbin' waste + CA + recycling/composting)
Total bin waste ('dustbin' waste + non CA bring + kerbside recycling)
Total CA waste (CA waste + CA recycling /composting)
Total recycling (non CA bring, bring and kerbside)

The main stages of this data integration process were:

1. Generation of 'dustbin' waste and CA residual waste values for each cluster: Mean values for primary compositional categories (kg/household/week) for residual 'dustbin' waste and CA residual waste were compiled for each of the four main clusters. Due to the paucity of CA data, CA residual waste composition was derived from polling all available CA compositional data sets to produce a single set of compositional values for all clusters. Adjustment factors were applied such that each set of compositional values produced a total arisings value for 'dustbin'/ CA residual waste identical to the national value for each cluster in the DEFRA statistics.

   The primary categories were:

1	Paper and board
2	Plastics
3	Textiles
4	Glass
5	Wood & other combustibles
6	Miscellaneous non-combustible
7	Metal cans & foil
8	Other non-ferrous
9	Other ferrous/ white goods
10	Garden waste
11	Kitchen waste
12	Soil & other organic waste
13	Fines

2. Derivation of recycling/ composting values for each cluster: Within each cluster DEFRA statistics (2000 01) were used to calculate mean values for quantities of each material (kg/hhld/week) collected from bring, CA and kerbside recycling schemes. A standard formula was used to assign weights of kerbside collected co-mingled materials back to individual materials (based on unpublished research conducted by the University of East Anglia for the Peterborough Regional Recycling Cell and data from Project Integra, Hampshire).
3. National estimates for the primary compositional groups were then calculated by multiplying each factor by the total number of households within each cluster.

2.3 Data limitations ~ caveats associated with national estimates obtained:

The primary level of compositional estimates provides a more robust set of estimates than those at the secondary level as the latter were more susceptible to sampling errors and differences between detailed classifications employed by the 27 compositional studies.

The CA compositional samples available to this analysis were too limited to reflect the full range of CA sites operating across WDAs and UAs in England (particularly the variation in site inputs from non-household sources and the variation in garden waste inputs from different site catchment areas). Furthermore, the compositional data related to site inputs and therefore did not contain information about segregation efficiencies at the sites sampled. It was therefore difficult to estimate which of the input materials from the analyses were actually residuals and which were diverted from disposal into recycling or composting systems.

2.4 Results

Detailed results of the compositional analysis are shown in **Appendix 1**. This section discusses the overall findings in relation to previous national estimates.

The main findings are that the proportions of household waste classified as 'biodegradable' (68%) and as 'recyclable/ compostable' (68%) were found to be significantly higher than estimates contained in Waste Strategy 2000. Furthermore, the 68% biodegradable fraction was higher than the 62% used for calculation of the UK's obligations under the Landfill Directive 1995 baseline year. Although the fractions used in **Tables 1** and **2** to calculate the 'biodegradability' or 'recyclability" within each of the main waste categories appear to be quite crude (e.g. 33% plastics classified as recyclable), these have been fixed by those factors used in Waste 2000 in order to achieve consistency.

Table 1: Estimates of overall proportion of household waste biodegradable or recyclable/ compostable: England & Wales Waste Strategy 2000

	Waste 2000	Biodeg.	% recyclable	Biodeg.	Recyclable
Paper/card	32%	100%	65%	32%	21%
Putrescible	21%	100%	90%	21%	19%
Textiles	2%	50%	95%	1%	2%
Fines	7%	50%	0%	4%	0%
Misc. combust	8%	50%	0%	4%	0%
Misc. non-com	2%	0%	0%	0%	0%
Metals	8%	0%	95%	0%	8%
Glass	9%	0%	90%	0%	8%
Plastics	11%	0%	33%	0%	4%
	100%			62%	61%

Table 2: Estimates of overall proportion of household waste biodegradable or recyclable/ compostable: Strategy Unit study

	SU	Biodeg.	% recyclable	Biodeg.	Recyclable
Paper/card	19%	100%	65%	19%	12%
Putrescible	42%	100%	90%	42%	38%
Textiles	3%	50%	95%	2%	3%
Fines	3%	50%	0%	2%	0%
Misc. combustil	8%	50%	0%	4%	0%
Misc. non-comb	4%	0%	0%	0%	0%
Metals	7%	0%	95%	0%	7%
Glass	7%	0%	90%	0%	6%
Plastics	7%	0%	33%	0%	2%
	100%			68%	68%

Figure 10 compares bin waste results from Waste 2000, Environment Agency 1997 with the current study. Waste 2000 statistics were based on data collected in 1993/94 by the National Household Waste Analysis Programme. This programme was criticised for failing to adequately cover seasonal variations and for insufficient sampling of wheeled bin households (Parfitt & Flowerdew 1997).

Results of the current study are similar to those obtained by the Environment Agency study in 1997. This study included a similar number of local authorities to the current one and controlled the balance of wheeled bin and non-wheeled bin households in the final analysis (Parfitt, 2000). The higher proportion of garden waste found in the Environment Agency study was due to it being a single season study carried during fine weather in spring.

In **Figure 11** comparisons are made between average household waste composition across the EU (ESTO 2002) and the results of the bin element of the current analysis. Again, results are very similar: adding further weight to the conclusion that the estimates from the current study are likely to be more accurate than those used in the England and Wales Waste Strategy 2000.

Figure 8: Total household waste composition

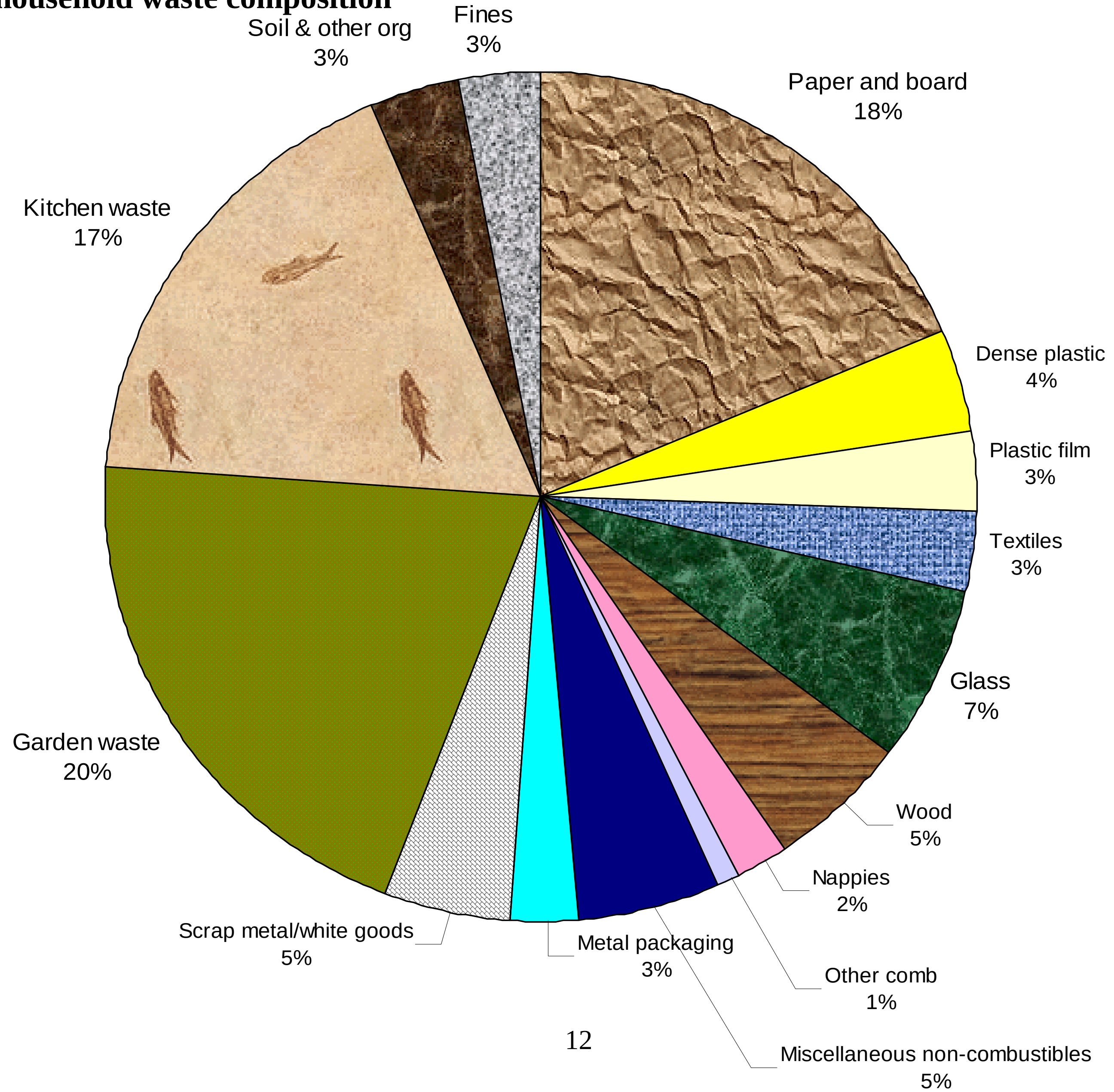


Figure 9: Main findings ~ comparison of bin and CA waste composition by % weight

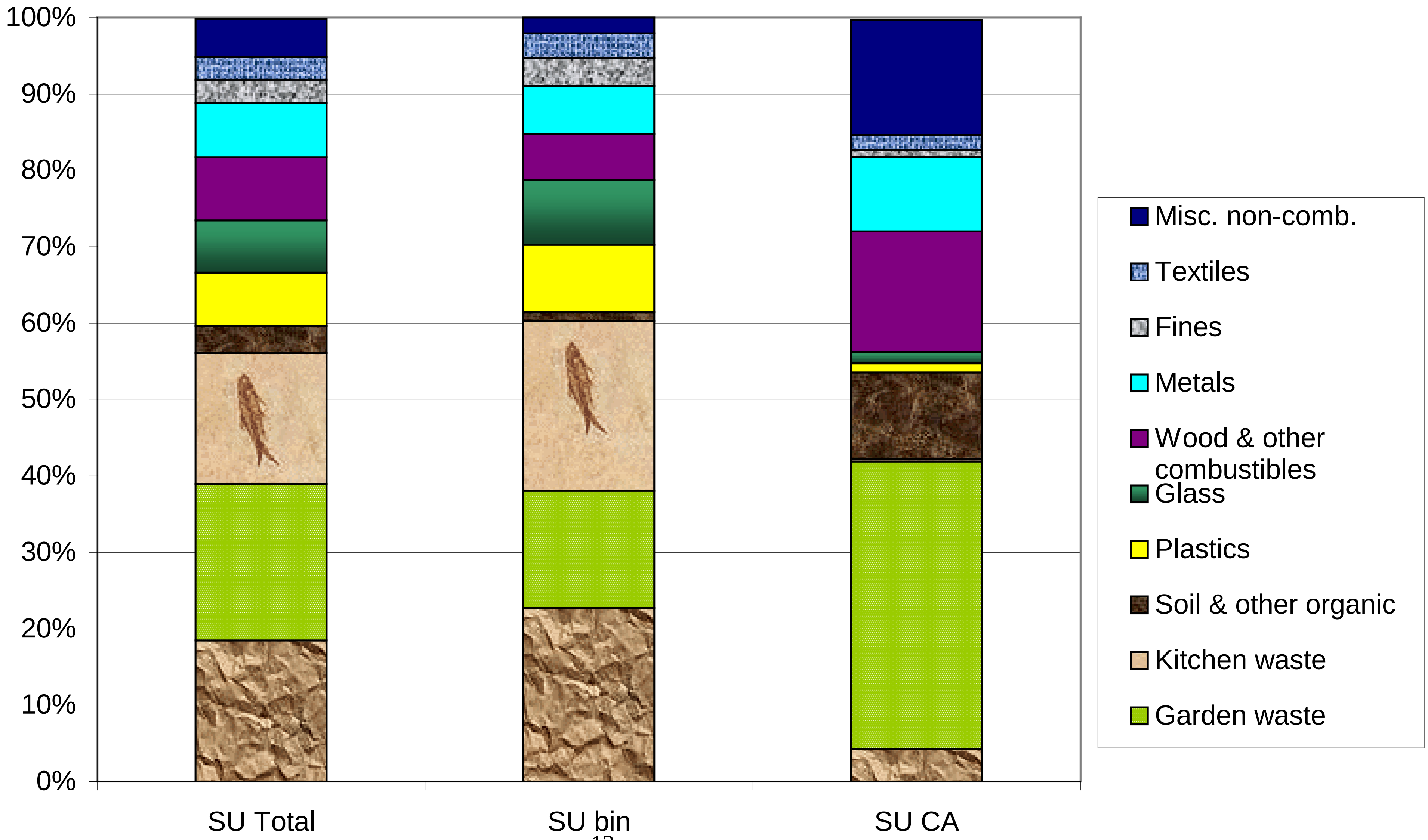


Figure 10: Comparison between Waste 2000, this study and Environment Agency 1997 ~ % weight

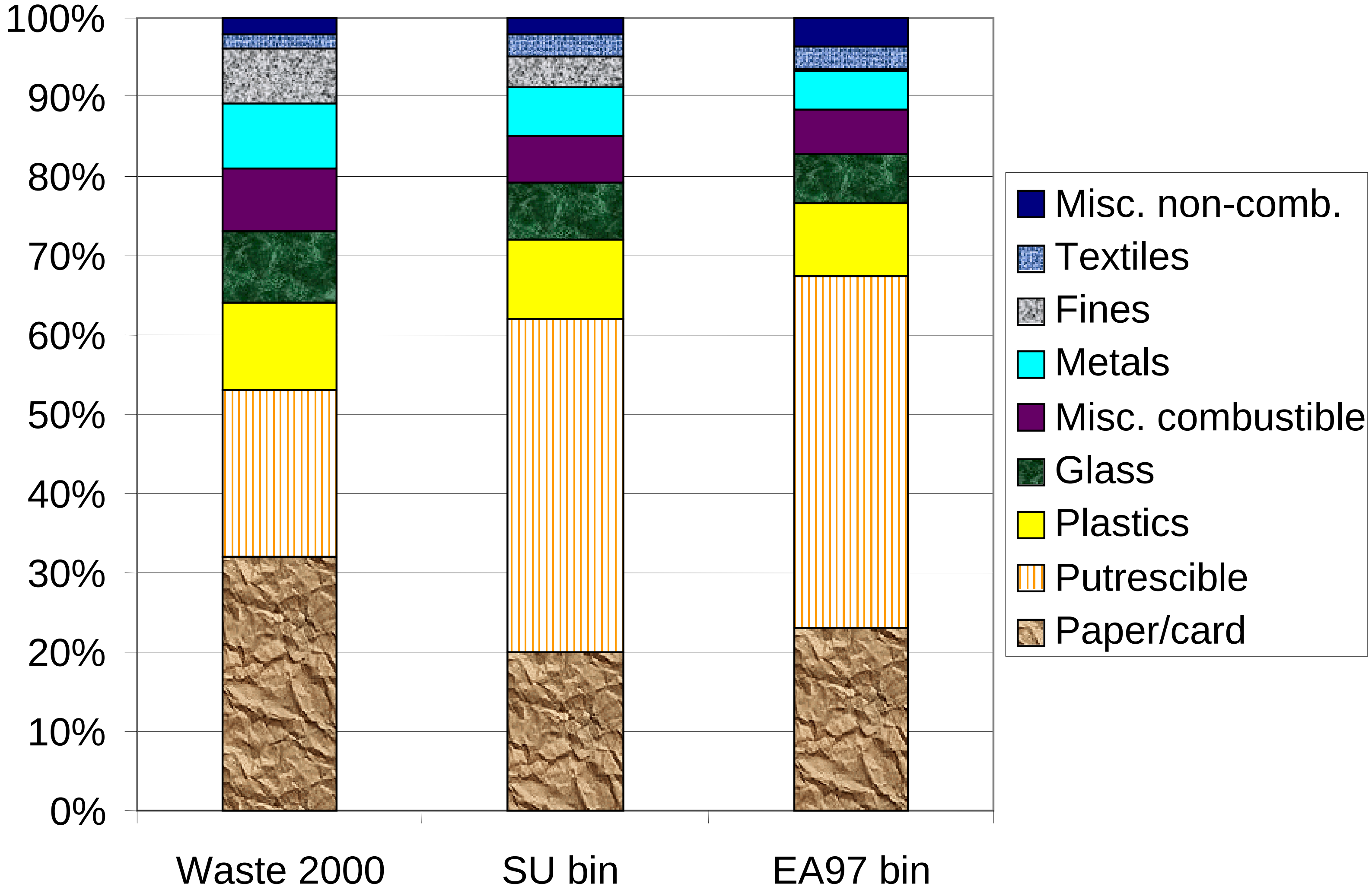
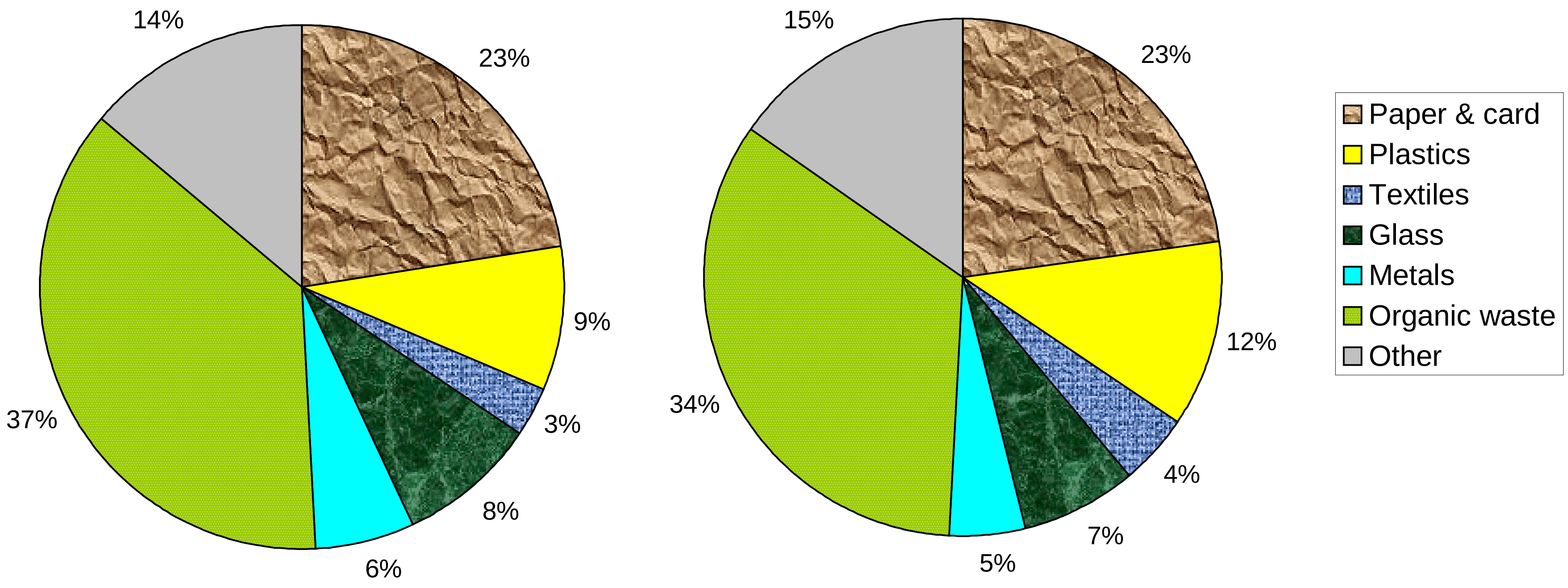


Figure 11: Comparison between bin waste analysis from this study (left) and average composition across the EU (ESTO 2002)



3.0 Factors driving household waste increases

3.1 Introduction

In recent years annual household waste arisings in the UK have been growing at a rate above the annual rate of growth in GDP. These increases have meant that, even though the national household waste recycling rate has continued to increase, so too has the absolute tonnage of materials sent for disposal. A number of factors drive these increases, many of which are inter-related, these include:

1. Demographic (particularly the declining average household size and the growth in the rate of new household formation).
2. Increased consumer spending leading to more goods consumed and more waste created.
3. Behavioural change in relation to waste producing activities (food wastage, attitudes towards garden waste, DIY activity etc.,).
4. Transfers of waste from other sectors, rather than true increases: for example, the transfer of material from commercial sources following the introduction of the Landfill Tax in 1996 (this is mostly associated with trade waste arising at CA sites, but may also involve wastes from small businesses deposited in the household waste stream).
5. Changes to waste management services, such as the provision by local authorities of 240 litre wheeled bins to householders in place of plastic sack and standard dustbin collections.
6. The introduction of statutory weight-based recycling targets that are not material-specific (for example, a tonne of aluminium cans sent for reprocessing and a tonne of compost used as landfill cover material represent an equal achievement).

The purpose of the analysis in the following sections is to consider the last two factors in detail, as they are more amenable to statistical analysis than some of the other factors. In the final section a regression model is constructed to explain variation in household (bin and CA) waste arisings.

3.2 Method of waste containment and household waste increases

Since the late 1980s continental style ‘wheeled bins’ have been introduced on many collection rounds, replacing standard dustbins and plastic sack collections. Initially these bins were of 240 litre capacity, but in recent years lower capacity bins (e.g. 140 litre) have been introduced by some authorities in an attempt to contain collection round waste growth induced by the extra disposal capacity provided by 240 lire bins. Reduced residual waste bin capacity is also sometimes considered when kerbside recycling/ composting schemes are introduced.

The proportion of households in England with wheeled bin provision has now reached 50% (**Figure 12**). Of these 90% are of 240 litre capacity; most of the rest are 140 litre bins.

Although it is true that households with 240 litre wheeled bins put more waste out for collection than other households, it is over-simplistic to argue that these households are more wasteful than others. This is because:

- Wheeled bin households tend to take less material to CA sites (**Figure 13**), which may represent a net environmental benefit in terms of private vehicle emissions avoided
- 240 litre wheeled bins tend to occur in areas with a higher proportion of detached and semi-detached housing than other options, such as plastic sack collections: larger households naturally produce more waste per household (but less waste per capita).

Taking into account these influences, it is still the case that 240 litre wheeled bin households produce more waste than others households, even allowing for reduced CA site use. This may be due to behavioural factors whereby householders tend to 'top-up' their bins with material that other households might have left *in situ* (this would particularly apply to garden waste). The extra capacity might also attract greater quantities of non-household waste from small businesses, perhaps taken home by householders.

Householders in 240 litre wheeled bin areas with adequate kerbside recycling facilities recycle as much as other households (see **Figures 3** and **4** in Part I). However, in 240 litre wheeled bin areas with poor recycling infra-structure, recycling rates tend to be lower than in non-wheeled bin areas as householders have more bin capacity available and are less likely to seek out bring sites for recyclables.

3.3 Conclusion

Provision of 240 litre wheeled bins can lead to greater quantities of collection round waste, but this is offset by reduced quantities of waste taken to CA sites. Despite this trade-off, provision of 240 litre bins can be a driver for waste increases.

Figure 12: Trend in local authority provision of 'dustbins' in England 1996/97-2000/01

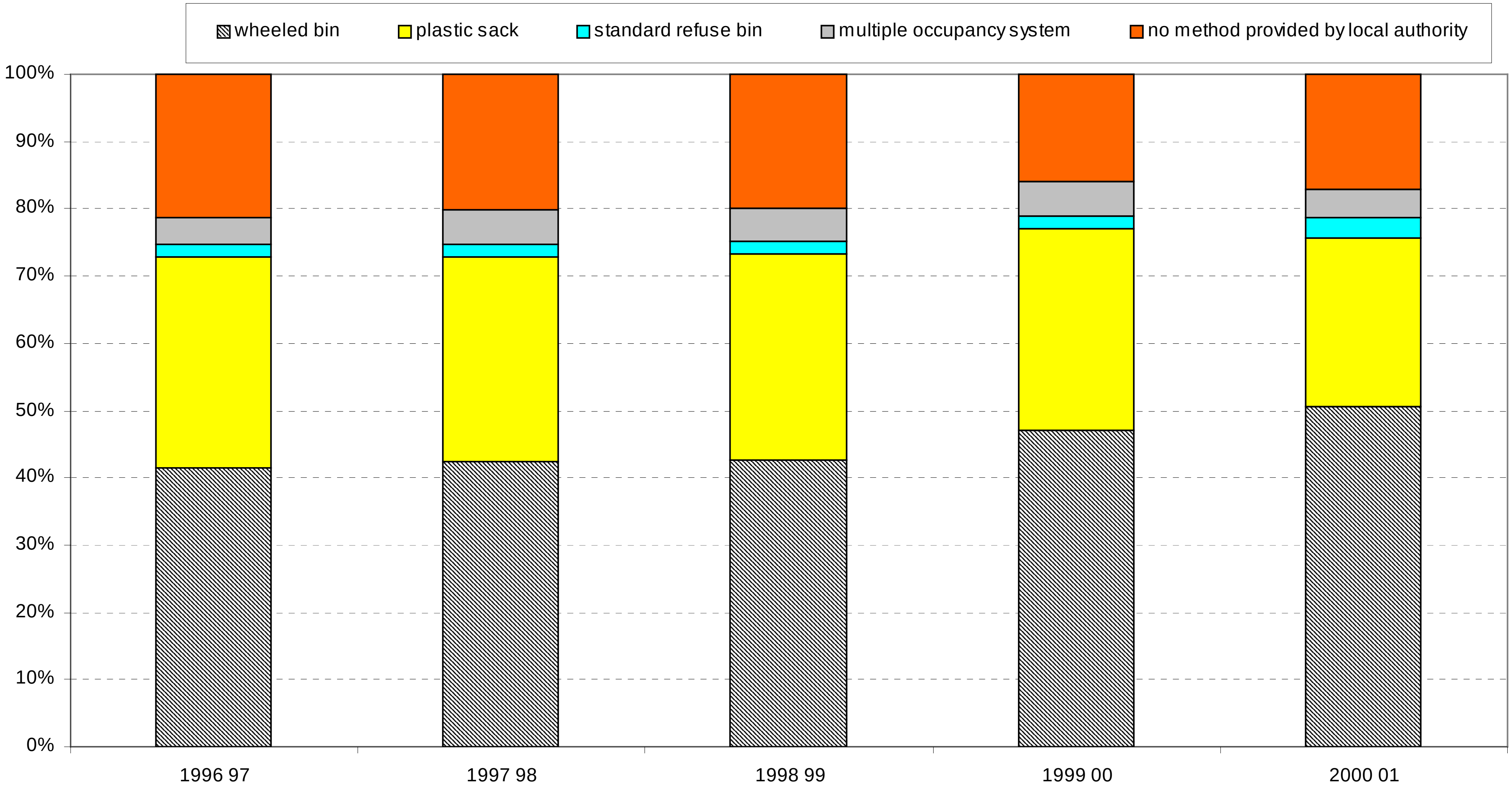
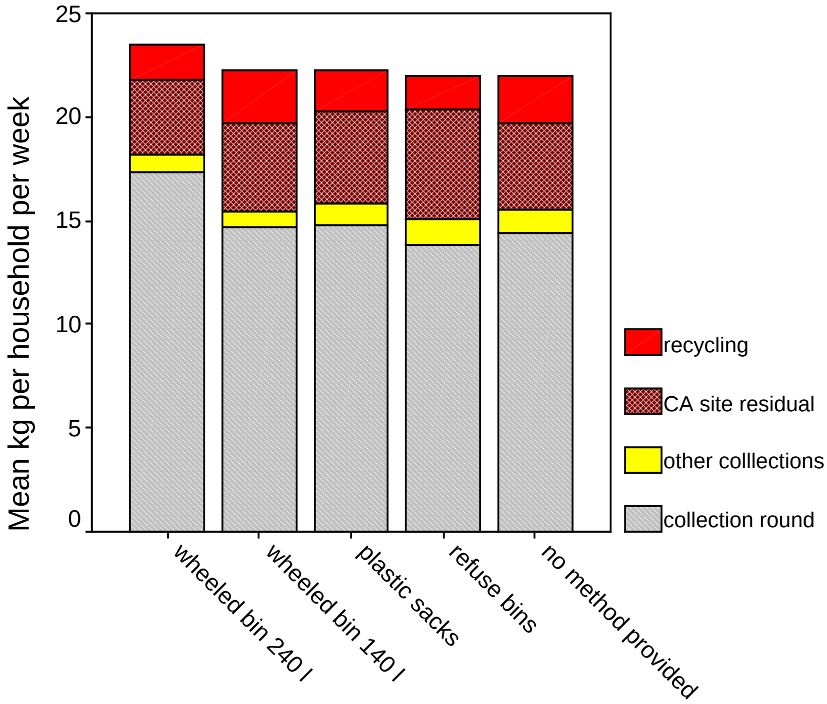


Figure 13: Mean quantities of household waste collected through different outlets: analysis by method of waste containment provided to householders



3.4 Weight-based recycling targets and waste increases

One of the possible consequences of weight-based recycling targets is that in order to meet those targets greatest priority is given to capturing the heaviest materials. A case in point is the segregation of garden waste for centralised composting at CA sites or through kerbside collections. A proportion of the garden waste collected is likely to be material that would otherwise have been dealt with outside the municipal system through:

- **Home composting**
- **Bonfires (not such a good environmental option)**
- **Being left by householders *in situ***
- **Major garden prunings being disposed of by private skip-hire companies**

The evidence for this influence on waste arisings does not take the form of 'before and after' studies, but results from comparison of current arisings data between authorities following divergent waste strategies. Similar experiences have been reported elsewhere in Europe, with waste arisings rising sharply following the introduction of garden waste kerbside collections in parts of Germany (von Sothen *et al*, 2002).

Comparison of waste arisings: with and without garden waste collection for composting

Nearly all of the top-performing local authorities target garden waste as part of their recycling strategy. However, the nature of two-tier local authorities distorts performance data as materials collected at WDA-run CA sites do not feature in WCA arisings and recycling/composting data. In this analysis CA data have been integrated with WCA data to produce an undistorted picture of the impacts of different policies on overall waste arisings.

Figures 14 displays local authority recycling performance (including material collected at CA sites) ranked in ascending order. For each authority overall household waste arisings are also shown in the scatterplot. Total arisings per household (kg per week) are significantly positively correlated (r=0.22) with district recycling rate, however this trend is partly obscured by the overall variability of waste arisings data (influenced by the factors described above).

The importance of garden waste segregation to district recycling performance is demonstrated in **Figure 15**. The maximum recycling rate amongst the smaller group of authorities (and their associated WDAs) that did not target garden waste for composting in 200/01 is less than 20%. The best performing authorities target garden waste either through kerbside collections or at CA sites to achieve over 35% recycling. In doing so, they are also likely to have the highest total arisings of household waste. Out of the 30 authorities recording the highest waste arisings (in the region of 30 kg per household per week) only 1 has not targeted garden waste. Conversely, of the 30 authorities with the lowest arisings (less than 18.5 kg per household per week), over half were authorities that did not target garden waste.

As noted earlier: socio-economic conditions and residual bin capacity are also influences on total waste arisings and these need to be considered when looking at the influence of targeting garden waste. **Figures 16** and **17** compare average household waste arisings and recycling rates by bin types and social deprivation indicators for authorities with and without garden waste segregation for composting. The analysis in **Figure 16** indicates that social deprivation appears to be less of an influence on total waste arisings than whether or not garden waste is targeted. As stated earlier, wheeled bin authorities have higher arisings than non-wheeled bin authorities: the highest arisings are therefore associated with wheeled-bin authorities that also target garden waste (**Figure 17**). The first two anomalous bars in **Figure 17** can be explained by the fact that the highest levels of home composting bin distribution by local authorities are found in affluent rural 'plastic sack' authorities that also target garden waste for centralised composting (average 20 bins per 1000 households). In the comparable plastic sack areas that do not target garden waste for centralised composting, the level of home composting distribution is approximately half.

Figure 14: Ascending rank of local authority recycling rates (line) and total household waste arisings (scatter plot)

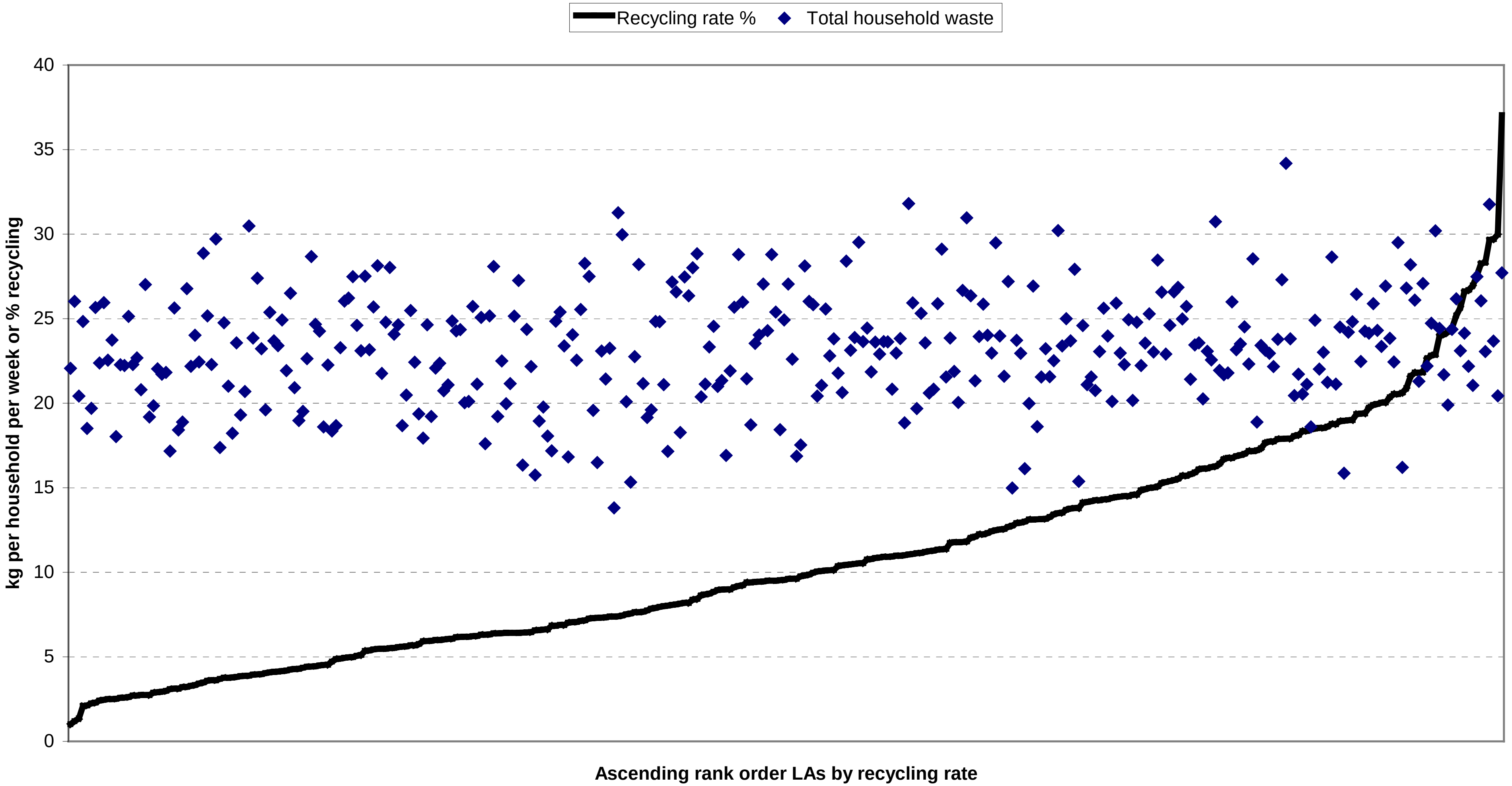


Figure 15: Ascending rank of local authority recycling rates (lines) v total household waste arisings (scatter plot), sorted by garden waste policy

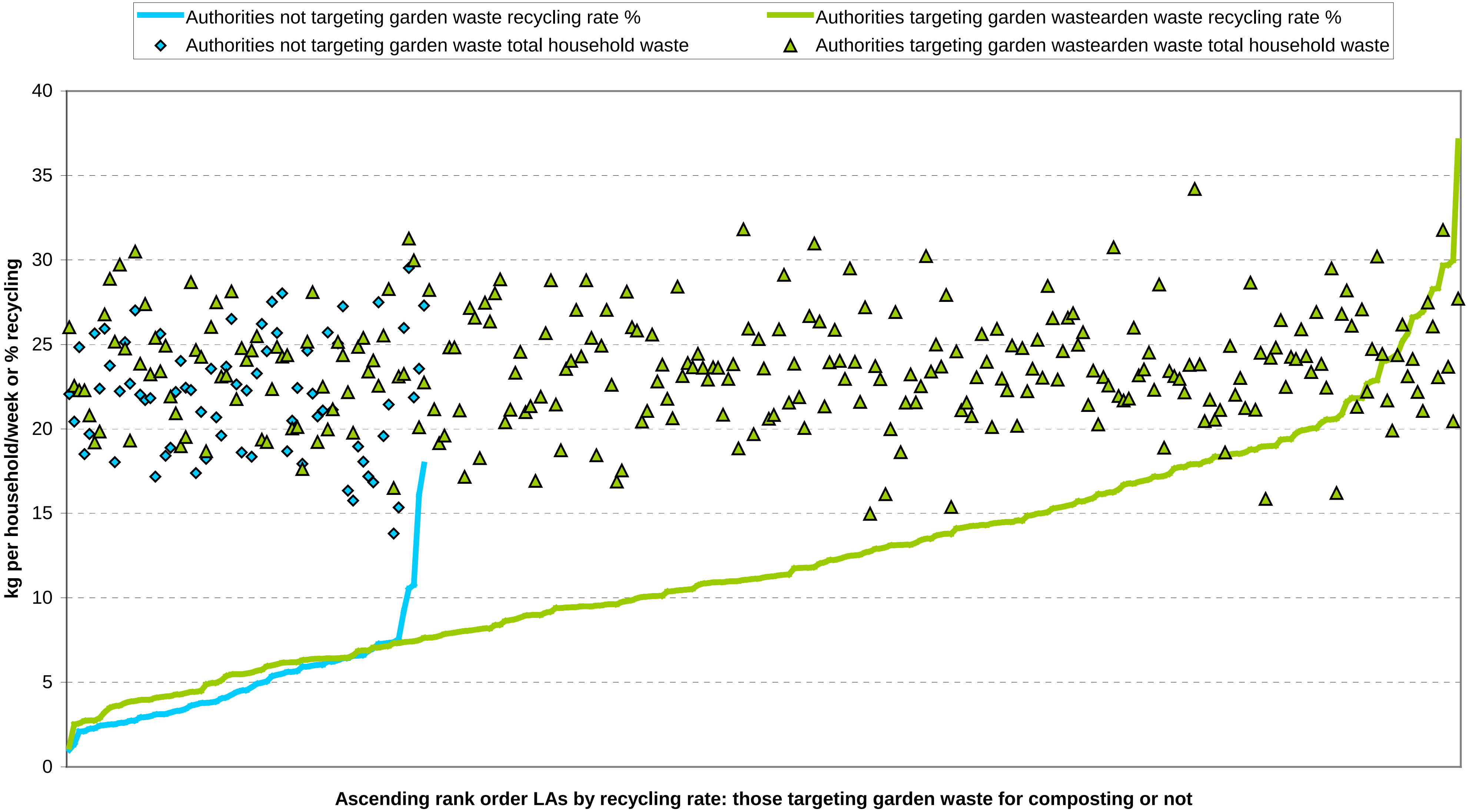


Figure 16: Comparison of average household waste arisings in districts with and without garden waste segregation schemes

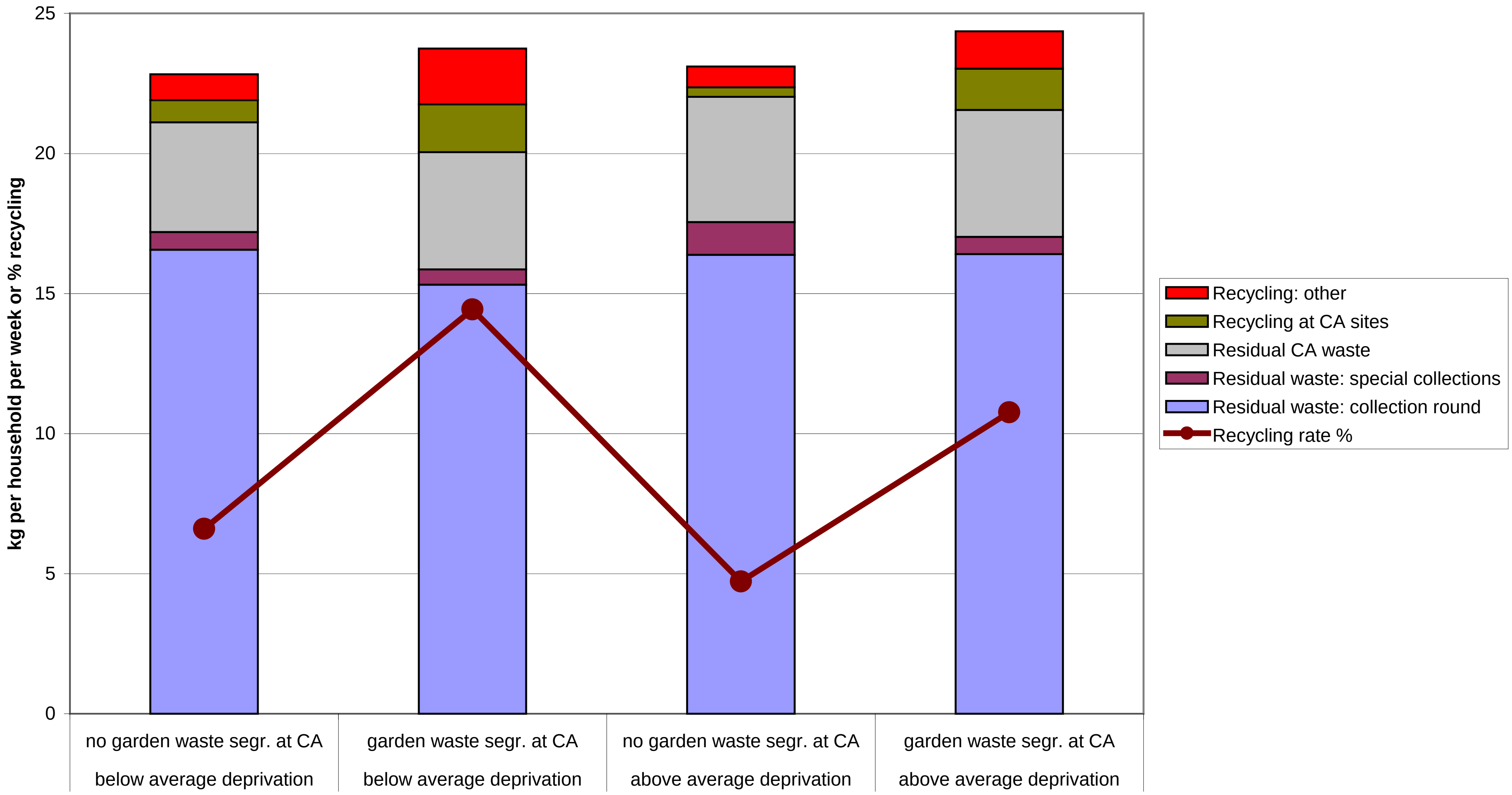
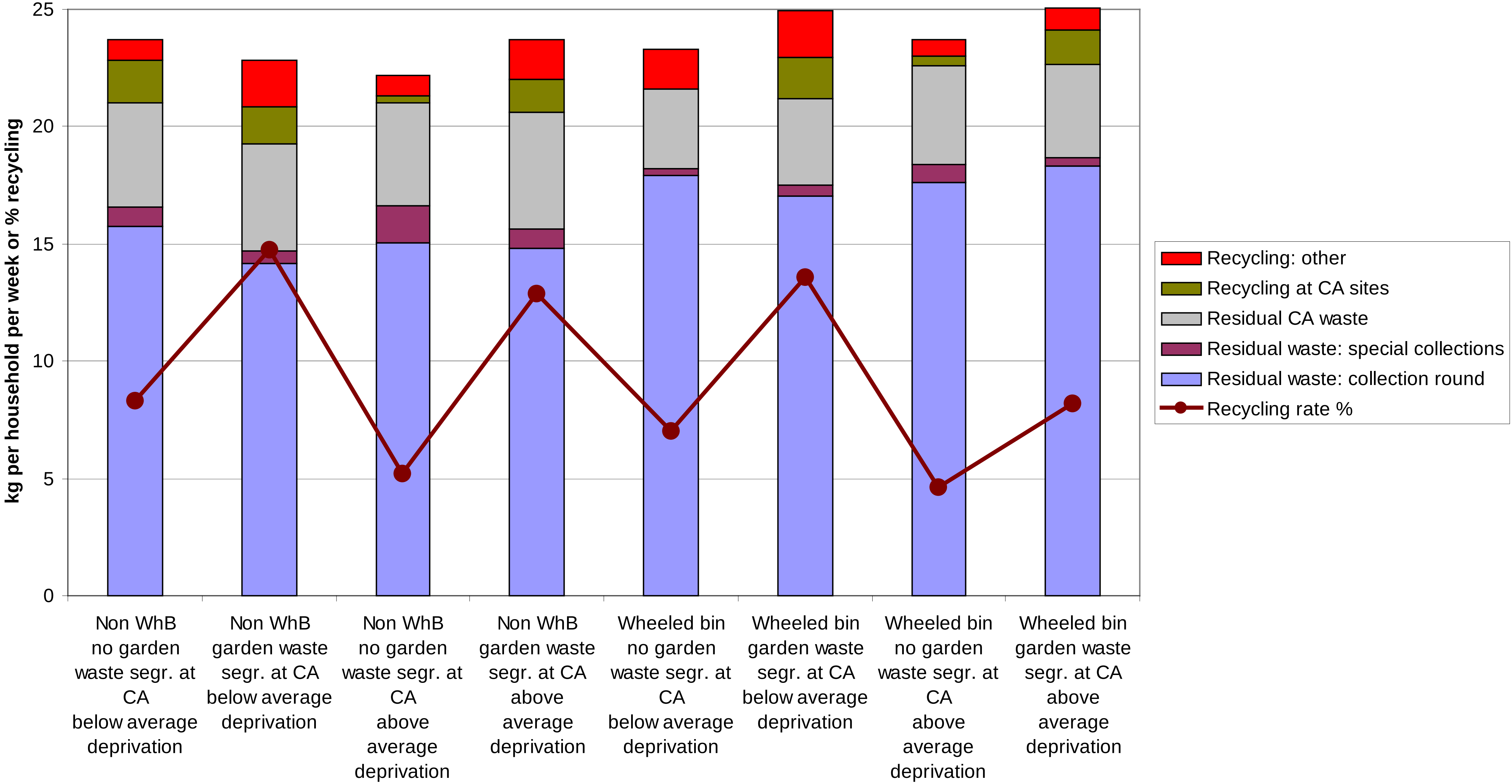


Figure 17: Comparison of average household waste arisings in districts with and without garden waste segregation schemes



3.5 Results of regression model

The final section presents the results of a regression analysis with overall household waste arisings (kg per household per week) as the dependent variable. This attempts to draw together some of the significant waste management drivers into a single model to explain district-level variations in household (bin and CA) waste arisings.

The model demonstrates three key factors that influence overall household waste arisings. It is based on 2000/01 DEFRA waste management statistics from local authorities in England and Wales. Socio-economic variables, such as social deprivation indicators, were also introduced into the model, but these tend to be highly inter-correlated with local waste policies and do not result in an improvement in the explanatory power of the model.

The final model contains three variables, all with significant coefficients, with 'wheeled-bin' and 'garden waste for composting' associated with areas producing more household waste and areas with higher levels of home composting bin distribution with lower arisings:

1. Proportion of households within district with **240 litre wheeled bins** for residual collection round waste collected (WCA data). As described earlier, 240 litre wheeled bin provision is linked to increases in the amount of household waste arising per household.
2. **Garden waste collection for centralised composting**: a dichotomous variable describing garden waste policy, where '1' = garden waste segregated for composting at civic amenity sites or collected at kerbside (and in some cases both), '0' = no collection of garden waste for composting. Provision of garden waste segregation for composting has a positive influence on overall household waste arisings.
3. The number of **home composting bins distributed** by WCA per 1000 households (WCA data). This is the only factor in the model that is linked to waste reductions. Local authority distributed bins represent only about 20% of home composting bins/heaps operated by households ~ so this variable is likely to be only indicative of overall home composting activity within each WCA.

All three variables contribute statistically significant coefficients in the final model ~ details of which are given in **Appendix 2**.

Although the R-square adjusted value is not particularly high (18%), there are a number of factors that reduce the robustness of the final regression model.

In two-tier local authorities CA site data is collected by the WDA. It was necessary to apportion CA residual waste and materials segregated for composting/recycling between constituent WCAs. The apportionment was based on CA weight data supplied by each WDAs to the 2000/01 DEFRA municipal waste management survey and is therefore not based on population figures. However, there is less of a direct relationship between individual WCA policies (collection round bin types, policy on home composting) and within-district CA site policy (such as garden waste segregation) due to CA site catchment areas commonly spilling across district boundaries.

Other factors that reduce the explanatory power of the model include:

- waste tonnage derived from estimation rather than weights from weighbridge tickets (authorities that don't weigh waste usually over-estimate the quantities arising)
- data omissions: such as missing recycling data and missing home composting bin data
- data transcription errors and reporting errors
- variation between districts in key waste drivers not included in the model, such as trade waste inputs to CA sites and collection rounds and policy on garden waste collections as part of residual refuse collections.

3.6 Conclusions

The targeting of garden waste for centralised composting schemes and the further encroachment of 240 litre wheeled bins across the country are both significant contributory factors to the year-on-year household waste increases. As a counter measure, this analysis suggests that home composting activity can have a significant measurable impact through waste reduction. Although this may be intuitively obvious, before now statistical evidence has been lacking, due to the practical difficulties of measurement of home composting diversion on the ground.

The evidence presented in Part I suggests that the proportion of organic waste in the household waste stream is much higher than previously estimated. With the future Landfill Directive targets in mind, it is clear that greater effort will be required in the immediate future to devise better integrated policies towards organic household wastes in particular, so as to avoid some of the perverse consequences of the current situation.

4.0 References

Department for Environment, Food and Rural Affairs (2002) Municipal Waste Management Survey 2000/01

Department of Environment, Transport and the Regions (2000) *Indices of Deprivation 2000*.

Department of Environment, Transport and the Regions (2000) Waste Strategy 2000 for England and Wales

ESTO (2002) Analysis of techno-economic potentials to de-couple waste generation from economic growth - the case of municipal waste. Paper presented at project workshop, ESTO Brussels, September 2002.

Parfitt, J.P., Lovett A.A. and Sunnenburg, G. (2001) A classification of local authority waste collection and recycling strategies in England and Wales. Resources, Conservation and Recycling Vol 32/ 3-4 pp 239-257.

Parfitt, J.P. (2000) 'A study of the composition of collected household waste in the UK ~ with particular reference to packaging waste'. Final report, prepared under contract No. EPG 7/10/21P1-201, Technical Report P347, Environment Agency ISBN: 1 85705 267 6.

Parfitt, J.P., Flowerdew, R. and Pocock, R. (1999) ‘A Review of the United Kingdom Household Waste Arisings and Compositional Data’. Final report, prepared under contract No. EPG 7/10/21 CLO 0201 for the Department of the Environment, Wastes Technical Division, published by Environment Agency.

Parfitt, J.P. and Flowerdew, R. (1997) ‘Methodological problems in the generation of household waste statistics: an analysis of the United Kingdom’s National Household Waste Analysis Programme. Applied Geography. April 1997

von Sothen, F., Salhofer, S. and Parfitt, J. ‘A Comparison Of Municipal Waste Recycling Strategies In Germany, Austria And The United Kingdom’, Waste 2002

APPENDIX 1: Detailed results of compositional analysis: England 2000/01

	'BIN WASTE' 'dustbin' residuals + kerbside recycling & non CA bring recycling			CIVIC AMENITY SITE WASTE Total CA residuals + Recycling Excluded: building rubble		
Category	**000's tonnes**	**Kg/Hhld/yr**	**% wt**	**000's tonnes**	**Kg/Hhld/yr**	**% wt**
Newspapers & Magazines	1,501	71	8.1%	71	3	1.3%
Other recyclable paper	1,073	51	5.8%	52	2	0.9%
Liquid cartons	77	4	0.4%	1	0	0.0%
Board packaging	228	11	1.2%	90	4	1.6%
Card and paper packaging	646	31	3.5%	2	0	0.0%
Other card	29	1	0.2%	5	0	0.1%
Non-recyclable paper	638	30	3.5%	14	1	0.3%
Plastic Bottles	388	18	2.1%	7	0	0.1%
Other dense plastic packaging	395	19	2.1%	10	0	0.2%
Other dense plastic	114	5	0.6%	33	2	0.6%
Plastic film	733	35	4.0%	18	1	0.3%
Textiles	589	28	3.2%	111	5	2.0%
Glass bottles and jars	1,463	69	7.9%	69	3	1.2%
Other glass	95	4	0.5%	13	1	0.2%
Wood	507	24	2.7%	488	23	8.8%
Furniture	49	2	0.3%	255	12	4.6%
Disposable nappies	444	21	2.4%	0	0	0.0%
Other Miscellaneous combustibles	111	5	0.6%	127	6	2.3%
Miscellaneous non-combustibles	382	18	2.1%	827	39	15.0%
Metal cans & foil	622	29	3.4%	1	0	0.0%
Other non-ferrous metals	0	0	0.0%	5	0	0.1%
Scrap metal/white goods	544	26	2.9%	535	25	9.7%
Batteries	0	0	0.0%	12	1	0.2%
Engine oil	0	0	0.0%	7	0	0.1%
Garden waste	2,824	134	15.3%	2,078	98	37.6%
Soil & other organic waste	211	10	1.1%	624	30	11.3%
Kitchen waste	2,234	106	12.1%	17	1	0.3%
Non-home compostable kitchen waste	1,865	88	10.1%	0	0	0.0%
Fines	682	32	3.7%	50	2	0.9%
TOTAL	**18,441**	**872**	**100.0%**	**5,521**	**261**	**100.0%**

APPENDIX 2: Regression Model: total household waste (bin & CA)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.427[a]	.182	.172	3.39161

a. Predictors: (Constant), home composting bin distribution /1000 households, % households with 240 l wheeled bins, collect green waste for composting at CA or kerbside

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	650.519	3	216.840	18.851	.000[a]
	Residual	2921.765	254	11.503		
	Total	3572.284	257			

a. Predictors: (Constant), home composting bin distribution /1000 households, % households with 240 l wheeled bins, collect green waste for composting at CA or kerbside

b. Dependent Variable: total household waste

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	20.074	.557		36.048	.000
	% households with 240 l wheeled bins	2.282E-02	.005	.282	4.955	.000
	collect green waste for composting at CA or kerbside	2.682	.559	.274	4.800	.000
	home composting bin distribution /1000 households	-2.79E-02	.008	-.197	-3.460	.001

a. Dependent Variable: total household waste